University of Agronomic Sciences
and Veterinary Medicine of Bucharest
Faculty of Horticulture

SCIENTIFIC PAPERS
SERIES B. HORTICULTURE

Volume LVI

2012
Bucharest

SCIENTIFIC PAPERS
SERIES B. HORTICULTURE
VOLUME LVI, 2012

University of Agronomic Sciences
and Veterinary Medicine of Bucharest
Faculty of Horticulture

SCIENTIFIC PAPERS
SERIES B. HORTICULTURE

Volume LVI

2012
Bucharest

PUBLISHER:
University of Agronomic Sciences and Veterinary Medicine of Bucharest - Faculty of Horticulture
Address: 59 Marasti, District 1, 011464 Bucharest, Romania
Phone: + 40 213 183 636, Fax: +40 213 183 636, Webpage: www.horticultura-bucuresti.ro

To be cited: Scientific Papers. Series B. Horticulture, Vol. LVI, 2012

CD-ROM ISSN 2285-5661, ISSN-L 2285-5653

SUMMARY

SUSTAINABLE PRODUCTS AND TECHNOLOGIES IN HORTICULTURE

HORTICULTURAL BIODIVERSITY AND GENETIC RESOURCES

PLANT PRODUCTION SYSTEMS

ORNAMENTAL PLANTS, DESIGN AND LANDSCAPE ARCHITECTURE

MISCELLANEOUS


EX·TERRA·AVRVM

SUSTAINABLE PRODUCTS AND TECHNOLOGIES IN HORTICULTURE


EX·TERRA·AVRVM

Scientific Papers, Series B, Horticulture, Vol. LVI, 2012
CD-ROM ISSN 2285-5661, ISSN-L 2285-5653

RESEARCHES ON THE INFLUENCE OF TECHNOLOGICAL PRODUCTION AND VALORIZATION FACTORS ON THE COMMERCIAL QUALITY OF CARDINAL PEACHES CULTIVAR

Constanța ALEXE[1], M. VINTILĂ[1], Simona POPESCU[1], Liana-Melania DUMITRU[2], Gh. LAMURANU[2], Lenuța CHIRA[3]

[1]Research and Development Institute for Processing and Marketing of the Horticultural Products - Bucharest, No. 1A, Intrarea Binelui street, District 4, 042159, Bucharest, Romania, Phone 40214610706, fax 0214600725, E-mail: tantialexe@yahoo.com
[2]Research Station for Fruit Growing Constanta, No.1, Pepinierei Street, 907300, Commune Valu lui Traian, Romania, Phone/Fax.+4024123187, E-mail: scpp_constanta@hotmail.com
[3]University of Agricultural Sciences and Veterinary Medicine Bucharest, No. 59, Mărăști Blvd, District 1, 011464, Bucharest, Romania Phone: +40 21 318 25 64/232, Fax: + 40 21318 28 88 E-mail: lenutachira@yahoo.com

Corresponding author email: tantialexe@yahoo.com

Abstract

Peaches are perishable fruits, with a high level of water, which present a pronounced sensitivity both to the action of environmental factors in orchard as well as after harvesting, at handling and storage. They may not be preserved for more then 3-4 weeks, according to the culture technology, cultivar, preserving conditions, because the quality may be affected . The quality represents one of the most important aspects of the produce, both during trading and on reaching the consumer or final buyer. Starting from this aspects, this paper will analyse the influence of some production (fertiliser regime) and valorisation (preserving conditions) factors upon the quality and its maintaining capacity during the preserving of peaches. The fruits' firmness, organoleptic appreciation, biochemical composition, quantitative and qualitative losses were determinated. The peaches - Cardinal cultivar (American cultivar, created in 1941, introduced in our country in 1962, appreciated throughout the world up to now) provided from experimental plots of the Research Station for Fruit Growing Constanta, fertilized in different manners, with organic and chemical fertilizers, applied on soil and foliar. The peaches were stored at ICDIMPH-Bucharest in three variants: in the ambient temperature (26-28^{0}C), in cold conditions (T = 2-4°C) and cold + modified atmosphere conditions, for 7; 28 and 35 days, respectively. The best results were obtained in the case of the fertilisation with chemical fertilisers applied on soil + foliar, which induce the best quality and their maintaining during storage. The results also indicate the superiority of fruit storage in modified atmosphere conditions in comparison with the others methods.

Keywords: *chemical analysis, fertilizer, firmness, storage*

INTRODUCTION

Due to their special characteristics in terms of taste, appearance and flavour and their importance in nutrition, peaches play an important role in consumption, both fresh and processed. Their superior dietary qualities are determined by their content of vitamins, minerals, cellulose, acids and peptic substances. Peaches have the following properties: they are energizing, seizures, diuretic, slightly laxative, being indicated in treating dyspepsia, haematuria, urinary lithiasis [7].

Achieving and maintaining fruit quality depends on a complex of factors occurring in all the links of the culture and valorisation technology, from the choice of cultivar, crop maintenance, until harvesting, conditioning and shipping [4].

Since peaches are highly perishable fruit, maintaining their quality after harvesting is an important issue for their valorisation sector, given their importance within all fruit species.

Storage capacity depends on the quality of the raw material for preserving and on the conditions of storage. The chemical composition of peaches, which determines the biochemical processes during storage and thus, the storage capacity, is strongly influenced by the fertilization regime. Based on research results, it was proven that the dosage in which organic or mineral fertilizers are applied affects

the chemical composition of fruit, with effect on the storage capacity [5, 9].
The manner in which technology factors manifest themselves during storage (temperature, humidity, air composition, etc.) exerts a great influence on the storage life of peaches and the recorded losses [4].
The intensity of the metabolic processes, as well as the intensity of respiration are the most important factors determining the maintenance quality of horticultural products during post-harvest [3].
Peach varieties have different particularities regarding their preservation and recovery during a longer period of time. Extra early and early varieties with white pulp have the shortest duration of storage of only a few days. In contrast, cultivars with yellow pulp, which become ripen in the middle and late age, better withstand cold storage, thus allowing a recovery when market demands require it [7].
The valorisation technologies recommend storage application of technological processes (low temperatures, changing the gaseous composition of air, etc.) to determine the inhibition of physiological and biochemical processes of the fruit, leading to the maintaining of their commercial value for a longer period [1,2,8].
The purpose of this paper is to evaluate the achieving and maintaining of the quality of the Cardinal cultivar (American cultivar created in 1941, introduced in our country in 1962, appreciated throughout the world even today), depending on the fertility regime of the culture and the storage conditions after harvest.

MATERIAL AND METHOD

The peaches of the Cardinal cultivar were harvested from the experimental culture of SCDP Constanta and the research was conducted between 2008 and 2010. In specialized literature [6] this cultivar is described as follows: Cardinal (Photo 1) - early, with the period of maturation in the first and the 2nd decade of July, has medium to large fruit, weighting 120-160g, globular shape, flattened at the top and the bottom, slightly asymmetrical. The epidermis is thin, finely pubescent, yellow, 70-90% of surface covered in bright red, "Cardinal" in the form of patches and strips of varying sizes. The pulp is golden yellow, with fine iridescent red, medium hard, consistency, fondant, sweet, nice acid and aromatic, adherence to stone.

Photo 1. Cardinal cultivar

Stone is medium in size, oval, with sharp tip, asymmetric, gray-opened and features carvings in the form of recesses and grooves.
The Cardinal cultivar is early and yields economically beginning with the third year after cultivation. Its production is medium-large (about 28-32 kg / tree). Fruits are suitable for both fresh consumption and for processing (jam, stewed fruit, nectar, etc.)
For this experiment, fruits were harvested when they reached the mature stage - "first fruits".
Trees have benefited, in culture, from four different variants of fertilization:
V1 - control (unfertilized)
V2 - organic fertilization (fermented manure)
V3 - ground chemical fertilization (NPK complex fertilizers in relation to: 15:15:15.)
V4 - ground + foliar chemical fertilization (ground with NPK complex fertilizers 15:15:15 and foliar feeding with Murtonik 20:20:20 + micronutrients: Mn, Fe, Cu, Zn, Bo, in the form of chelation).
At the Research and Development Institute for Processing and Marketing of the Horticultural Products, fruits were stored in three storage options:

- ambient temperature (T = 26-28^{o}C, RH = 65-70%) in 1 kg packages - *keep warm*;
- refrigeration room (T = 2-4°C, RH = 83-87%), in packs of 1 kg covered with perforated polyethylene film - *cold storage*;
- refrigeration room (T = 2-4°C, RH = 92-96%), in 1 kg hermetic packages, so that the composition of the atmosphere inside has

modified, by the reducing of the O_2 content and the increasing the CO_2 content and also of air relative humidity - storage in modified atmosphere - *MA*.

The storage period (days) varied depending on the variant of storage technology, as follows:

- warm conditions: 7
- cold conditions: 28
- AM conditions: 35

Immediately after harvest, before placing in storage and at the end of storage, observations were made concerning fruit firmness, as well as organoleptic measurements and biochemical analyses of the main components (soluble dry matter, soluble carbohydrates, titratable acidity). Also, weight losses (quantitative) and depreciation (qualitative) suffered by the fruit during storage were quantified.

The determination of the fruit firmness was performed by means of a mass penetrometer OFD, the measurement being in penetrometer units (1UP = 0.1 mm) of the depth of the conical needle penetration (length = 24mm, diameter at base = 4 mm) in the pulp. Measurements were performed on a total of 25 fruit / variant, each fruit being penetrated in four points in the equatorial zone.

Organoleptic quality assessment was done by performing a sensory testing, by means of a method of assessing the fruit with a scoring scale of 1 to 100. Tasting ships were used which comprise three criteria for the assessment (appearance, texture, taste). Each of the three criteria of evaluation has a different weight in the general scoring, according to their importance: "aspect" is 15%, "texture" 35% and "taste" 50%. Depending on the obtained score, there are five different classes, as follows:

Grade(quality level)	**Score**
Very Good	80-100
Good	60-79
Acceptable	40-59
Mediocre	20-39
Unsuitable	0-19

The methods for determining biochemical components were:

- refractometry, using an ABBE refractometer to determine the soluble substance;
- the Bertrand titrimetric method for determination of soluble carbohydrates;
- the titrimetric method for the determination of the titratable acidity;

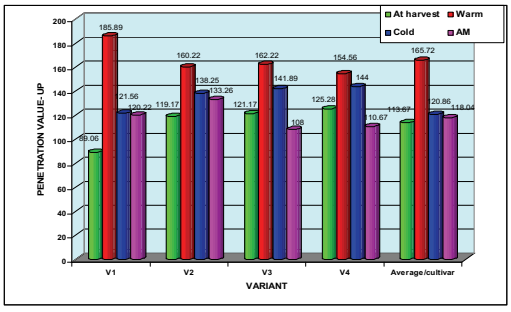
During preservation, the thermo-hydric factors in the cold room were checked daily, in order to ensure the compliance of the optimal conditions for maintaining quality. Also, the ability to maintain fruit quality was assessed, including the emergence and development of deposits of various diseases.

RESULTS AND DISCUSSIONS

1. Firmness

Firmness values at harvesting vary between 89.06 and 125.28 UP, the fruit in variant V1 having the highest firmness (Fig. 1). During preservation in warm conditions peaches easily lose their firmness through rapid ripening. When the fruits are stored in cold conditions, the intensity of the maturity processes reduce and so the structural and textural firmness is maintained for a longer period of time (28 days). By enriching the atmosphere in the space of storage in carbon dioxide, the metabolic processes are slower and the firmness of the peaches is preserved longer (35 days).

Fig. 1. Peach firmness at harvest and after storage



Firmness loss occurs in different rhythm during storage, depending on the variant of fertilization and storage conditions (Table 1).

Table 1. Firmness evolution of peaches during storage

Variant	**Extent of reduction in fruit firmness in storage-%**		
	warm	**cold**	**AM**
V1	208.72	136.49	134.98
V2	134.44	116.01	111.82
V3	133.87	117.09	89.13
V4	123.45	114.94	88.33
Average/ cultivar	**150.12**	**121.13**	**106.06**

It was noticed that, although at harvest peaches in variant V1 were the firmest, during storage

the intensity of its reduction is the most pronounced. The peaches in the V4 variant are best at retaining their firmness during storage in various conditions.

2. Organoleptic quality

The results of the organoleptic testing (Table 2) reveals that, in the moment of the harvest, peaches got high marks because of their attractive appearance, firmness and taste which are “good” (93.20 points) and "very good" qualifying.

Table 2. Organoleptic assessment of peaches at harvest and after storage

Time determination - the indicator	Organoleptic assessment - score
At harvest: - Total	93.20
- Aspect	14.25
- Firmness	33.95
- Taste	45.00
- Qualifying	very good
After warm storage - Total	85.00
- Aspect	10.50
- Firmness	29.50
- Taste	45.00
- Qualifying	very good
Alter cold storage - Total	83.37
- Aspect	14.25
- Firmness	30.00
- Taste	39.12
- Qualifying	very good
Alter AM storage - Total	78.75
- Aspect	11.20
- Firmness	30.55
- Taste	37.00
- Qualifying	good

After storing peaches in warm conditions for seven days, the total score obtained in organoleptic test dropped to 85.00, which is still quite high and is due to the taste that has remained unchanged (45 points), so the qualifying remained "very good".

Storage in refrigerated conditions for 28 days also allowed for the maintaining of a high enough score and a "very good" qualifying. It should be taken into account that the fruit preserved a beautiful aspect. Because of the maturation during storage, they achieved the colour specific to the cultivar, but, at the same time, there was a decrease in the taste and firmness structural values.

After storage in modified atmosphere conditions for 35 days peaches were damaged in terms of appearance and especially in terms of taste and obtained a "good" qualifying. In some cases, the skin of the peaches began peeling off.

3. Biochemical composition

The data presented in Table 3 reveals the fact that the values of the biochemical indicators of the fruit vary according to the fertilization method used in the peach culture. Thus, the content of soluble dry matter ranges between 9.65°R in variant V1 (control) and 11.12°R in variant V4 (root and foliar chemical fertilizer). Variant V2 (organic fertilization) ranks second in terms of the content of soluble dry matter of the fruit, this being the only difference from variant 0.14°R V4, which ranked first. The third place was occupied by variant V3 (root chemical fertilization), with a content of soluble dry matter of 10.62°R.

The V1 variant also ranks last in terms of soluble carbohydrate content (6.80%), there being a big difference from other versions, whose contents have very similar values: 8.42% - V2 (the 1st place), 8.01% -V3 and 8.17% - V4. The content of organic acids has values between 1.03% to variant V1 (the 1st place) and 0.78% for variants V3 and V4.

During storage in warm conditions for 7 days, soluble dry matter content of peaches increased, while soluble carbohydrate content and malic acid decreased, a process observed in all four variants of fertilization.

Table 3. The main chemical components of peaches at harvest and after storage

Biochemical indicator	Variant				
	V1	V2	V3	V4	Avera-ge
At harvest: - soluble dry matter (°R)	9.65	0.98	10.62	1.12	10.59
-soluble carbohydrates (%)	6.80	8.42	8.01	8.17	7.85
- acidity (malic acid /100g)	1.03	0.78	0.81	0.78	0.85
After warm storage: -soluble dry matter (°R)	12.27	12.61	11.41	12.07	12.09
-soluble carbohydrates (%)	5.55	6.41	6,94	6.66	6.39
- acidity (malic acid /100g)	0.89	0.73	0.76	0.74	0.78
Alter cold storage: -soluble dry matter (°R)	11.60	11.37	11.26	11.30	11.38
-soluble carbohydrates (%)	6.52	8.10	7.86	7.96	7.61
- acidity (malic acid /100g)	0.98	0.76	0.79	0.72	0.81
- **Alter AM storage:** soluble dry matter (°R)	10.96	11.13	10.95	10.87	10.97
-soluble carbohydrates (%)	6.36	7.93	7.81	7.66	7.44
- acidity (malic acid /100g)	0.97	0.77	0.77	0.72	0.81

During cold preservation for 28 days, the value of the indicator soluble dry matter also increased, whereas the values of soluble carbohydrate content and titratable acidity were lower, but with a lower intensity.
Putting fruits in the modified atmosphere reduced the intensity of biochemical transformations, which, however, took place in the same direction, meaning in the increasing of the content of soluble dry matter and the reducing of soluble carbohydrate content and malic acid.

4. Quantitative and qualitative losses

The research shows that the fertilization variant of the peach crop – Cardinal cultivar, with the best results in terms of losses during storage, in all 3 technological methods is V4, followed by V2 variant, while the poor results were obtained by the variant V1 (Fig. 2).

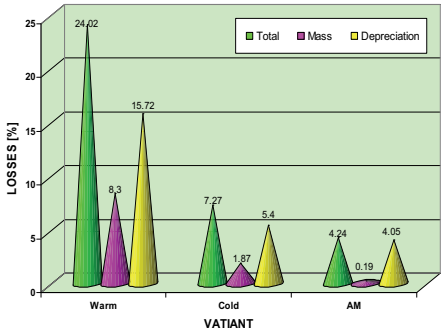


Fig. 2. Losses occurred during the preservation of peaches in different technological conditions

The impairment of the fruit is due to late infections caused by fungi Monilinia laxa and M. fructigena before harvesting, when they are barely visible. After harvesting, during transport and storage, their attack is rapidly evolving (depending on temperature) and the entire fruit rots. Moreover, during storage, it can lead to the rotting of the healthy, surrounding fruit, the mycelium penetrating directly or through almost invisible lesions. Also, fruit can be infected through wounds, blows or compression produced during harvesting and handling, by the molds Botrytis cinerea and Rhizopus stolonifera.
Of the three methods of storage (at ambient temperature, the cold room and the cold room + modified atmosphere), the best results were obtained in the case of the third method, because these fruit recorded the lowest losses during storage. Very good results were obtained through the option of cold storage, in which case losses during preservation for 28 days were much lower compared to storage at room temperature for 7 days.

CONCLUSIONS

In terms of firmness, the best results were obtained by peaches from cultures fertilized with foliar fertilizers. It was found that the rate of the metabolising of pectic substances in peaches and the reducing of their firmness differs according to the fertilization regime and especially to the temperature of the air and the composition of the storage space. In cold conditions and By enriching the atmosphere in the space of storage in carbon dioxide, the metabolic processes become slower and the firmness of the peaches is preserved for a longer period (35 days).
The peaches of the Cardinal are appreciated from an organoleptic point of view. The evolution of the quality during preservation depends on the environmental conditions of storage and especially on the temperature and gas composition. The storage method that gave the best results in terms of organoleptic assessment is the cold storage, taking into account the storage period and the score obtained at the end of it.
The content of main biochemical indicators (soluble dry matter, soluble carbohydrate, organic acids) varies depending on the fertilization system of the culture. From a biochemical point of view, the peaches from the culture fertilized with organic fertilizers and those from the culture fertilized with fertilizer incorporated into the soil plus foliar fertilization gave the best results.
The ability to maintain the fruit quality of the peaches varies according to the fertilization system and the storage conditions of the environment and especially to the temperature and gas composition of the air. Among the variants of fertilization, variant V4 (ground + foliar chemical fertilization) induces the best storage capacity. Foliar fertilizers provide, in addition to an intake of macro-and micronutrients and other organic substances

that stimulate the metabolism of chlorophyll assimilation, energy efficiency and, finally, the quality of the fruit Organic fertilizers contribute through their presence to the supplying of the plants with all the necessary minerals, ensuring the achievement of high quality fruit production and a high storage capacity.

Of the three methods of storage (at ambient temperature, the cold room and the cold room + modified atmosphere), the best results were obtained in the case of the third method, in which case the lowest losses during storage were recorded. Cold storage can be used successfully if there is not the possibility of changing the gaseous composition of the air in the storage space.

Low temperatures inhibit or slow down the growth of fungi and molds specific to each species of fruit and reduce the pace of the biochemical processes during their storage, so that impairment losses are greatly reduced.

REFERENCES

[1] Burzo I., 1986. *Physiology and technology of preserving horticultural products*. Technical Publishing House, Bucharest, p. 35-43,151-162

[2] Burzo I., Elena Delian, Hoza D., 2005. *Physiology of crop plants*. Vol. IV: Physiology of fruit trees, shrubs and grssies plant. Elisavaros Publishing House Bucuresti, p. 386-394

[3] Lenuţa Chira, Chira A., Elena Delian, Liliana Bădulescu, Elena Săvulescu, 2010. *Research regarding the dynamics of some physiological processes during nectarine and peach fruits storage*. Scientific papers B, LIV, Bucureşti, p. 412 –416.

[4] Gherghi A. si colab.,1977. *Metods for maintain quality and reduce losses during storage of fruits and vegetables*. Scientific papers ICVLF, vol VIII, București, p. 27-31

[5] Ion V., 2004. *Biological agriculture*. Alma Mater Publishing House, Bucuresti, p. 76-89

[6] Ivascu Antonia, Hoza D.,2003., *Catalog of the peach cultivars*. Medro Publishing House, Bucureşti, p. 8

[7] Jamba A., Carabulea B., 2002. *Technology of preservation and industrialization horticultural products*. Chisinau, Cartea Moldovei Publishing House, p. 308-317

[8] Lill R.E., King G.A., 1999. *Postharvest physiology of peach and nectarines*. Hort. Rev. 11:413-452

[9] Salunke D.K., 1974. *Storage, processing and nutritional quality of fruits and vegetables*. CR Press, Utah

Scientific Papers, Series B, Horticulture, Vol. LVI, 2012
CD-ROM ISSN 2285-5661, ISSN-L 2285-5653

EFFECTS OF *GLOMUS MOSSEAE* ON LETTUCE

Ina ALSINA[1], Laila DUBOVA[1], Ligita LIEPINA[2]

[1]*Latvia University of Agriculture, Jelgava, LV-3001, Latvia, Phone+371 63010612, Fax. +371 6305685,* E-mail: ina.alsina@llu.lv
[2] *University of, Latvia, Institute of Biology, Salaspils, 3 Miera street, Latvia,* E-mail: ligita.liepina@lu.lv

Corresponding author email: ina.alsina@llu.lv

Abstract

The aim of study is to access the influence of arbuscular mycorrhizal fungi Glomus mosseae (BEG isolate) on the growth, yield and its quality of lettuce. Tree cultivars of lettuce cv. 'Arktika', 'Lollo Bionda' and 'Crimson' were grown from seeds. Fungus preparation was added under seeds during sowing. Control - without fungus. At the 3rd true leaf stage seedlings were planted in 1 L vegetation pots with peat substratum. Fresh weight of seedlings before transplantation, fresh and dry weight was detected. Results showed that Glomus mosseae stimulated seedling growth. Plant fresh and dry weight increased as result of fungi treatment. Glomus mosseae effect on the yield of lettuce depended on cultivar.

***Key words*:** arbuscular mycorrhiza*, Glomus mosseae,* lettuce

INTRODUCTION

Mycorrhizae is the mutually beneficial relationship between the plant and root fungus. These specialized fungi colonize plant roots and extend far into the soil. Mycorrhizal fungal filaments in the soil are truly extensions of root systems and are more effective in nutrient and water absorption than the roots themselves. Arbuscular-mycorrhizal (AM) fungi are important in agriculture because they improve plant water relations, increase mineral uptake, which reduces the use of fertilizers, increase the drought resistance of host plants and improve disease control. Endomycorrhizal associations often result in greater yields of crop plants such as rice tomato and onion and bell pepper [10, 11].

Vesicular-arbuscular mycorrhizal (VAM) fungi are beneficial plant symbionts that form a mutualistic relationship with the roots of most crop plants. VAM fungi enhance the uptake of nutrients of low mobility in the soil solution such as P, Zn, and Cu, but they have many other impacts on crop productivity. Mycorrhizal associations play important roles in this nutrient cycling through their microbial activity and their involvement in plant nutrient acquisition [4, 12]. VAM fungi can also reduce the impact of environmental stresses such as drought [13] and salinity [11, 6]. Inoculated plants under salt stress reach levels of photosynthetic capacity (estimated by the chlorophyll content) even superior to those of non-stressed plants, showing that in this respect mycorrhization is capable to fully counterbalance salt stress [14, 7, 11].

It is known that the development of mycorrhizal colonization and its effectiveness on plant growth is enhanced in poor soils AM root colonization is increased at low and medium nutrient levels but reduced at high levels [8].

The concept of effectiveness is defined as the ability of an AM inoculum to increase plant nutrient uptake and plant growth. Thus, the effective use of AM inocula and resulting colonization would results in similar plant growth. However, in order to optimize management of AM fungi/host plants under field conditions, more knowledge on the effect of agricultural practices is required [1, 2, 3, 5].

The aim of study is to clarify the influence of arbuscular mycorrhizal fungi *Glomus mosseae* (BEG isolate) on the growth, yield and quality of lettuce.

MATERIAL AND METHOD

Investigations were carried out at the Latvia University of Agriculture, Institute of Soil and Plant Sciences.

Three cultivars of lettuce cv. 'Lollo Bionda' 'Crimson' and iceberg lettuce 'Arktika' was grown from seeds. Arbuscular mycorrhizal fungi *Glomus mosseae* (BEG isolate) preparation was added under seeds during sowing. Control - without fungus.

Seedlings were grown in 2 L pots with peat substratum (content of mineral elements in 1M HCl, mg L^{-1}: N 17, P 76, K 415, Ca 3410, Mg 415, S 4.4, Fe 285, Mn 26, Zn 33, Cu 35, Mo 0.14, B 0.8, pH 5.2) in the heated polycarbonate greenhouse without artificial illumination. Temperature in green house was maintained between 8 ºC (min at night) and 30 ºC (max at day time). Lettuce was sown at January 26, transplanted at the stage of 3rd true leaf (February 23) and finished month transplantation (March 23).

At the 3rd true leaf stage seedlings were planted in 1 L pots with the same peat substratum. Fresh weight of seedlings before transplantation, fresh and dry weight, and leaf pigment content after vegetation was detected. Content of chlorophylls and carotenoides was determined spectrophotometrically in the ethanol extract of crushed fresh plant leaves. [9]. Experiments were done in 10 replicas and obtained data was elaborated by ANOVA.

RESULTS AND DISCUSSIONS

Obtained results showed that even at the early stages of lettuce development mycorrhizae had a positive effect on the plant growth. In average the seedling shoot weight increased by 12.4% in comparison with control. The largest increase was observed for cv. 'Crimson'. In this variant statistically significant difference was detected in comparison with control. (Fig.1). Similar results were obtained with root of lettuce seedlings. Ratio between lettuce shoot and root was close to 1. The largest differences as result of arbuscular mycorrhizal fungi treatment was observed for cv. 'Crimson', but data statistical elaboration didn't approve the significance of these data. (Fig.2.)

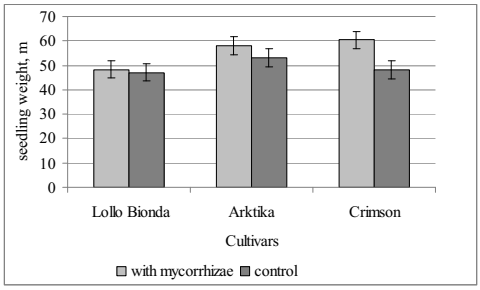


Fig.1.Lettuce seedling shoot weight (mg) at the age of 3rd true leaf.

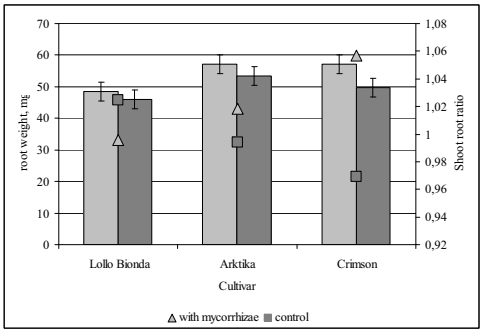


Fig. 2. Lettuce seedling root weight (mg) and shoot and root ratio (%) at the age of 3rd true leaf.

Almost the same fresh matter weight increase (in average 13.1%) was obtained after month of lettuce cultivation as result of AM fungi tratment. All cultivars showed stimulation effect of *Glomus mosseae,* but the largest effect was observed for cv. 'Lollo Bionda' where the fresh weight of lettuce increased by 35.1%, and it was significantly higher than control. For other two cultivars the significance of effect was not statistically approved. (Fig.3). Plant weight depended on cultivar. Naturally that the highest plant weight was observed for iceberg lettuce 'Arktika' in comparison with curly varieties 'Lollo Bionda' and red curly variety 'Crimson'.

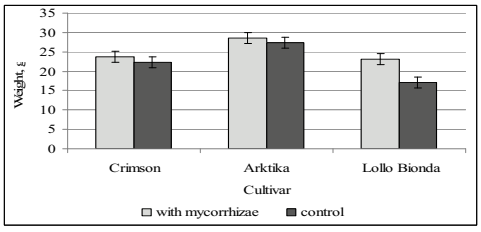


Fig. 3. Weight of lettuce (g) at the end of experiment.

During plant growth the ratio between lettuce shoot and root increases. In average shoot is 1.67 times larger in comparison with root. The differences between cultivars were found. In average proportion of leaves in whole plant is larger for iceberg lettuce. The use of arbuscular fungi decreases the ratio in comparison with control. Reverse regularity was founded for curly varieties. There plant treatment with *Glomus mosseae* increased shoot proportion. (Fig.4). Data statistical elaboration approves significance of ratio for cultivar 'Lollo Bionda'.

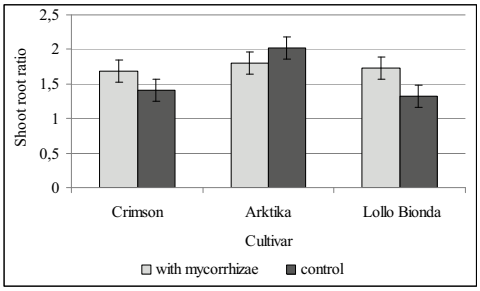


Fig. 4. Lettuce plant shoot and root ratio (%) at the end of experiment

Significant differences were found also in dry matter content between cultivars. Iceberg lettuce ,Arktika' contained the lowest dry matter content from tested varieties. No effect of mycorrhizal fungi was found. Both curly varieties were responsive to *Glomus mosseae* treatment and in average the increase of dry mater content by 24% was observed. Cultivar 'Crimson' was more sensitive and differences between variants with fungi and control is statistically significant (Fig. 5).

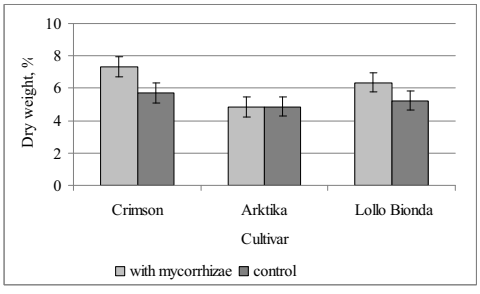


Fig.5 .Dry matter content (%) of lettuce plant at the end of experiment

Content of lettuce leaf pigments depended on cultivar. (Data not shown). In average leaves of cv. 'Arktika' contained 34.7% more chlorophyll and 31.6% more carotenoides in comparison with curly varieties. No significant effect of arbuscular micorhizae fungi treatment was observed. It is opposite literature data, were effect was found [14]. Differences should be explained with different growing conditions. Amelioration of chlorophyll content was found under salinity stress.

Obtained data reaffirm literature data that arbuscular mycorrhizae is beneficial for plants and *Glomus mosseae* (BEG isolate) should be used for improvement of lettuce growth.

CONCLUSIONS

1.The increase of fresh weight by 12-13 % during vegetative cultivation of lettuce as result of *Glomus mosseae* (BEG isolate) presowing treatment was found.

2.Presowing treatment with *Glomus mosseae* increased shoot proportion in the lettuce shoot root ratio for curly varieties.

3.Arbuscular mycorrhizae stimulate accumulation of dry matter in the leaves of curly lettuce varieties.

4.Content of leaf pigments depended on cultivar. No significant effect of arbuscular micorhizae fungi treatment on the content of chlorophylls and carotenoides in the lettuce leaves was found.

5.Glomus mosseae (BEG isolate) should be recommended for improvement of lettuce growth.

REFERENCES

[1] Adesemoye, A.O.,Kloepper, J.W. 2009, Plant-microbes interactions in enhanced fertilizer-use efficiency, Applied Microbiology and Biotechnology, 85 (1), p. 1-12.

[2] Aroca, R., Vernieri, P., Ruiz-Lozano, J.M. 2008, Mycorrhizal and non-mycorrhizal Lactuca sativa plants exhibit contrasting responses to exogenous ABA during drought stress and recovery, Journal of Experimental Botany 59 (8) , p. 2029-2041

[3] Barea J.M. 1991, Vesicular–arbuscular mycorrhizae as modifiers of soil fertility. B.A. Stewart (Ed.), Advances in Soil Science, Springer, New York, p.1–40

[4] Bethlenfalvay G J 1992 Mycorrhizae and crop productivity. *In* Mycorrhizae in Sustainable Agriculture.

Eds. G J Bethlenfalvay and R G Linderman. Am. Soc. Agron. Special Publ. No. 54, p 1–27.
[5] Bethlenfalvay,G.J., Schüepp H. 1994, Arbuscular mycorrhizas and agrosystem stability S. In: Gianinazzi, H. Schüepp (Eds.), Impact of Arbuscular Mycorrhizas on Sustainable Agriculture and Natural Ecosystems, Birkhäuser, Basel ,p. 117–131
[6] Cantrell I.C. and Linderman R. G. 2001, Preinoculation of lettuce and onion with VA mycorrhizal fungi reduces deleterious effects of soil salinity Plant and Soil V.233, (2) ,p. 269-281.
[7] Dodd, I.C., Ruiz-Lozano, J.M. 2012, Microbial enhancement of crop resource use efficiency Current Opinion in Biotechnology 23 (2) , p. 236-242
[8] Jahromi, F., Aroca, R., Porcel, R., Ruiz-Lozano, J.M. 2008, Influence of salinity on the in vitro development of Glomus intraradices and on the in vivo physiological and molecular responses of mycorrhizal lettuce plants**.** Microbial Ecology 55 (1) , p. 45-53
[9] Lichtenthaler, H.K. and Buschmann, C. 2001. Current Protocols in Food Analytical Chemistry. John Wiley and Sons, Inc., Hoboken, New Jersey. published on line.
[10] Poss J A, Pond E, Menge J A and Jarrell W M 1985 Effect of salinity on mycorrhizal onion and tomato in soil with and without additional phosphate. Plant Soil 88, 307–319.
11] Ruiz-Lozano J M, Azcon R and Gomez M 1996 Alleviation of salt stress by arbuscular- mycorrhizal *Glomus* species in *Lactuca sativa* plants. Physiol. Plant. 98, p. 767–772.
[12]Smith SE, Smith FA, Jakobsen I. 2004**.** Functional diversity in arbuscular mycorrhizal (AM) symbioses: the contribution of the mycorrhizal P uptake pathway is not correlated with mycorrhizal responses in growth or total P uptake. *New Phytologist* 162: p. 511–524.
[13]Sylvia D M and Williams S E 1992 Vesicular-arbuscular mycorrhizae and environmental stress. *In* Mycorrhizae in Sustainable Agriculture. Eds. G J Bethlenfalvay and R G Linderman. American Society of Agronomy Special Publ. No. 54. p 101–124.
[14] Zuccarini P. 2007. Mycorrhizal infection ameliorates chlorophyll content and nutrient uptake of lettuce exposed to saline irrigation. Plant soil environ., *53*, (7): p. 283–289

Scientific Papers, Series B, Horticulture, Vol. LVI, 2012
CD-ROM ISSN 2285-5661, ISSN-L 2285-5653

EVALUATION OF SOME SWEET CHERRY CULTIVARS TO WINTER FREEZE IN DIFFERENT AREAS OF ROMANIA

Adrian ASĂNICĂ, Dorel HOZA, Valerica TUDOR, Georgeta TEMOCICO

University of Agricultural Sciences and Veterinary Medicine, Bucharest, 59 Marasti, District 1, 011464, Bucharest, Romania, Phone, Fax: +40 21 318 36 36, E-mail: asanica@gmail.com

Corresponding author email: asanica@gmail.com

Abstract

A very large number of sweet cherry cultivars grafted on different rootstocks was tested for freeze injuries in the winter of 2011/2012. The cultivars evaluated were Van, Celeste, Lapins, Kordia, Giant Red, Ferrovia, Early Red, Firm Red, Skeena, New Star, Regina grafted on PHLC rootstock in Istrita Nursery Station; Van and Stella on Prunus mahaleb L. in Moara Domneasca Didactic Farm; Ferrovia, Lapins, Celeste, Vega, Skeena, Early Red, New Star, Kordia, Mora di Vignola, Firm Red, Giant Red, Katalin, Ulster, Sam, B. Burlat, Boambe de Cotnari, Hedelfinger, Germersdorf, Van, Rivan, Regina, Giorgia grafted on PHLC, Colt, CAB6P, CAB11E and Prunus mahaleb L. in USAMV Bucharest Experimental Field. The wood hardness of the cultivars was assessed considering the branch types and the position in the crown. Frost hardiness results indicate a wide spectrum of cultivar resistance in terms of winter damages between 9.98% to 63.92% in Istrita region, 1.96% to 48.25% in Bucharest and Moara Domneasca area. The most affected by frost was Skeena at Istrita and Germersdorf in Bucharest.

Keywords**:** *sweet cherry, frost injuries, hardiness evaluation*

INTRODUCTION

The benefits of the sweet cherry (*Prunus avium* L.) consumption and fruit growing are well known worldwide [4]. Because of his importance, many producers are trying to adapt the new release cultivars [9] and rootstocks [1] in different regions in order to maximize the quality and yield of fruits [5].

A lot of remarkable sweet cherries varieties recently introduced coming from different breeding conditions [9] have abroad origin. In the new concept of european market and globalization, sweet cherry productions should come from cultivars more homogenous [2] with standard required quality.

Due to a lack of data regarding their performance in the traditional and non traditional Romanian cultivation area of sweet cherry, many of these cultivars could be affected by winter frosts and may register serious production losses in the unfavourable years. The climate changes problems should not be ignored in this case and might be a subject for further researches.

The temperature fluctuations in winter and the sudden amplitudes are the main cause for frost injuries [7] in the south-eastern part of Europe where the absolute minimum temperature is not the major factor involved for cherry. The effect of low temperatures is also expressed by cultivars according to genetic heritage [2] and rootstock used. For instance, Gisela 5 one of the most recommended and used dwarf rootstock for cherry is mentioned by some authors [8, 10] as hardier than Mazzard. Other authors [7] found that 'Burlat' grafted on Gisela 5 recorded much severe frost injuries than *P. mahaleb* L. seedlings or Weiroot rootstock series.

A research conducted on many sweet cherry cultivars from Fruit Genebank Dresden-Pilnitz show no correlation between frost and diseases resistance of the cultivars, so this issue must be approached separately [3].

MATERIAL AND METHOD

In order to evaluate the hardiness of some sweet cherry cultivars grafted on different rootstocks in the condition of 2011/2012 winter, three locations were choosed for test. The cultivars evaluated were Van, Celeste, Lapins, Kordia, Giant Red, Ferrovia, Early Red,

Firm Red, Skeena, New Star, Regina grafted on PHLC rootstock in Istrita Nursery Station; Van and Stella on *Prunus mahaleb* L. in Moara Domneasca Didactic Farm; Ferrovia, Lapins, Celeste, Vega, Skeena, Early Red, New Star, Kordia, Mora di Vignola, Firm Red, Giant Red, Katalin, Ulster, Sam, B. Burlat, Boambe de Cotnari, Hedelfinger, Germersdorf, Van, Rivan, Regina, Giorgia grafted on PHLC, Colt, CAB6P, CAB11E and *Prunus mahaleb* L. in USAMV Bucharest Experimental Field (photo 4).

The wood hardiness of the cultivars was assessed considering the branch types and the position in the crown. From each cultivar it were collected spur, medium and long branches, detached from first level and upper half of the crown (second level). At the end of January and in the first decade of February, it were analyzed 100 floral buds on each variant and it was calculated the percentages of losses. As statistical method it was used Duncan's multiple range test *($P \leq 0.05$)* where means followed by the same letter in the same column are not significantly different.

RESULTS AND DISCUSSIONS

In the last time, in Romania as in other European countries, the climate changes are more often mentioned when pay attention to very low temperatures in winter or very hot summers with long periods of dryness.

The winter of 2011/2012 is one of the hard winter examples, when low temperatures have persisted for many days and the wind blew harder.

In the Istrita condition (table 1), the highest degree of frozen flower buds was recorded by Skeena (63,92%). The biggest losses were counted in the bazal part of the crown and the most affected type of branch was the medium one (90,91%). In the upper part of the tree, the percentages of damages were under 50% for the medium and long branches.

Not all of cultivars react like Skeena. For instance, Kordia tolerate quite well the low temperatures and has numbered only 9,98% frost buds/tree.

Table 1. Floral buds losses due to 2011/2012 winter frost at some sweet cherry cultivars grown in Istrita, Buzau (%)

Cultivar	*I level (below)*				*II level (upper)*				*Mean per tree*
	Spurs	*Medium branches*	*Long branches*	*Average I level*	*Spurs*	*Medium branches*	*Long branches*	*Average II level*	
Van	68.29a	60.00d	57.30b	***61.87b***	22.95f	20.29de	44.93a	***29.39d***	***45.63b***
Celeste	7.73h	53.33e	14.04g	***25.03g***	1.56h	0	0.00	***0.52h***	***12.78g***
Lapins	42.18c	37.25g	32.31d	***37.25e***	6.21h	8f	10.09f	***8.10gh***	***22.67f***
Kordia	13.76g	9.92j	2.38i	***8.68j***	12.58g	7.31f	13.92e	***11.27g***	***9.98h***
Giant Red	28.92d	61.36c	28.33ef	***39.54d***	38.02c	18.46e	5.61g	***20.70f***	***30.12e***
Ferovia	20.83f	7.37j	11.43h	***13.21i***	27.78e	25.53c	43.30b	***32.20c***	***22.71f***
Early Red	28.48d	67.21b	29.79e	***41.83c***	3.85h	9.09f	10.37f	***7.77gh***	***24.80f***
Firm Red	43.33c	35.53h	27.42f	***35.43f***	43.33b	35.52b	27.42c	***35.43b***	***35.43c***
Skeena	65.52b	90.91a	77.55a	***77.99a***	58.57a	45.45a	45.52a	***49.85a***	***63.92a***
New Star	42.51c	40.58f	45.16c	***42.75c***	31.21d	21.84d	19.44d	***24.17e***	***33.46d***
Regina	26.72e	26.72i	15.38g	***22.94h***	6.77h	4.80f	7.89fg	***6.49h***	***14.72g***
Media	***35.30***	***44.56***	***31.01***	***36.96***	***22.98***	***17.84***	***20.77***	***20.54***	***28.75***

* means followed by the same letter in the same column are not significantly different.

With no significant differences, Lapins, Ferrovia and Early Red positioned in the "*under 30%*" group. According to Kolesnikov [6], cited by Budan S. [2], the sweet cherry production started to decrease only when the flowering buds were lost in a higher percentage than 30%. Other cultivars with a good resistance that recorded under 35% losses are Celeste, Regina, New Star and Giant Red.

The analyze of the frost injuries depending on branch type (fig. 1) is revealing the fact that the losses are linked with genetic information of the cultivar and with flowering bud formation on the fruit branches.

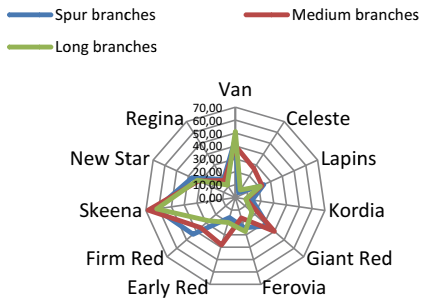


Fig. 1. The flower buds losses at some sweet cherry cultivars depending on branch type (Istrita, %)

Position in the crown of the flowering buds is another element involved in the total percentage of bud losses. As it could be observed in the figure 2, the first level (from the ground to half of the tree height) is much affected by cold temperatures.

For Celeste, even the total injuries are minor, the higher share of the frozen flower buds was remarked in the first level of the crown.

As a general comment, we observed that the cultivars appreciated together (mean values) indicate the inferior part of the crown with susceptibility to the cold injuries.

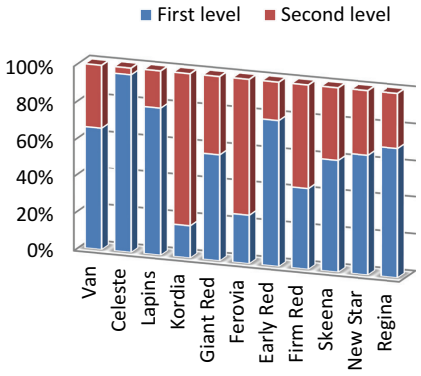


Fig. 2. The flowering bud losses degree at some sweet cherry cultivars depending on the position in the crown (Istrita, %)

In the experimental plot of USAMV Bucharest, the total frost buds percentage at cherry was smaller than in the Istrita Station field.

Excepting Germersdorf (48,25%), Giant Red (45,74%), Skeena (34,4%) and Lapins (35,07%), all the sweet cherry cultivars proved a good tolerance to cold winter temperatures.

The smallest percentages of flower buds destroyed by frost were noticed for Giorgia, Regina, Ulster, Rivan, Van, Mora di Vignola, Vega (table 2). The values did not exceed 10%.

Table 2. The flower buds losses by cold temperatures in the 2011/2012 winter of some sweet cherry cultivars in the experimental field of USAMV Bucharest (%)

Cultivar	*Spur*	*Medium branch*	*Long branch*	*Mean (tree)*
Ferrovia	26.92g	9.52ghij	16.67gh	***17.70h***
Lapins	43.55d	18.18f	43.48b	***35.07d***
Celeste	72.41b	7.69hij	15.00hi	***31.70e***
Vega	10.71i	12.50g	0.00	***7.74j***
Skeena	35.90f	61.11a	18.18fg	***38.40c***
Early Red	55.56c	12.82g	34.78c	***34.39d***
New Star	13.56i	20.51ef	4.17k	***12.75i***
Kordia	36.00f	10.81gh	25.00d	***23.94f***
Mora di Vignola	12.50i	10.00ghi	0.00	***7.50j***
Firm Red	39.13e	18.87f	2.38k	***20.13g***
Giant Red	87.50a	36.67b	13.04ij	***45.74b***
Katalin	8.89i	35.06c	31.03d	***25.00f***
Ulster	6.38i	0.00	7.14k	***4.51j***
Sam	19.81h	19.44f	11.11j	***16.79h***
Burlat	4.35i	4.76ij	20.00f	***9.70ij***
B de Cotnari	14.47i	24.53d	19.05fg	***19.35gh***
Hedelfinger	6.02i	22.22e	0.00	***9.42ij***
Germersdorf	12.99i	61.76a	70.00a	***48.25a***
Van	3.37i	17.65f	0.00	***7.01j***
Rivan	1.41i	5.41ij	11.54j	***6.12j***
Regina	2.70i	3.64j	0.00	***2.11j***
Giorgia	5.88i	0.00	0.00	***1.96j***
Media	***23.64***	***18.78***	***15.57***	***19,33***

** Duncan's multiple range test ($P \leq 0.05$)*

As in the Istrita case, the branch type influenced the number of frozen floral buds at the cherry trees in Bucharest. Bigger damages were observed for floral buds on the spur branches at Celeste, Early Red, Giant Red, Ferrovia and Kordia; on medium branches at Skeena, Vega, New Star, Katalin, Hedelfinger, Boambe de Cotnari and Van); on long branches at Ulster, Burlat, Germersdorf and Rivan (fig. 3).

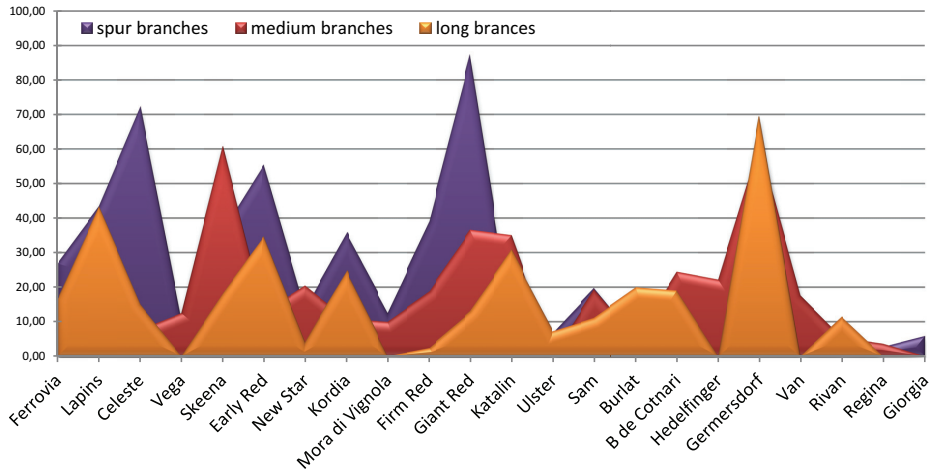


Fig. 3. Flower bud losses of some different sweet cherry cultivars in the USAMV Bucharest experimental field depending on branch type (%)

It is important to say that the age of the tree, genetic distribution and share of the branch type in the crown as well as the physiological and biochemical balance of the tree in the previous year, could lean towards a higher or lower percentage of buds lost due to low temperatures in the winter.

In the Didactic Farm of Moara Domneasca, the main cultivars have been affected by cold temperatures in the 2011/2012 winter too, but the bud losses did not overcome significantly the limit accepted as regular. Stella and Van recorded superior values of frozen flower buds on medium branches (table 3).

Table 3. The frost injuries degree of the flower buds in the winter of 2011/2012 at main sweet cherry cultivars in the Didactic Farm of Moara Domneasca (%)

Cultivar	*Spurs*	*Medium branch*	*Mean*
Stella	5.80a	12.00b	***8.90b***
Van	27.38b	34.25a	***30.81a***
Media	***16,59***	***23,12***	***19,86***

** Duncan's multiple range test ($P \leq 0.05$)*

Ensembling the average data regarding the floral buds losses due to the cold temperatures during the last winter in each of the studied areas (figure 4), we found that percentages of the cherry injuries are unable to compromise the yield of this year.

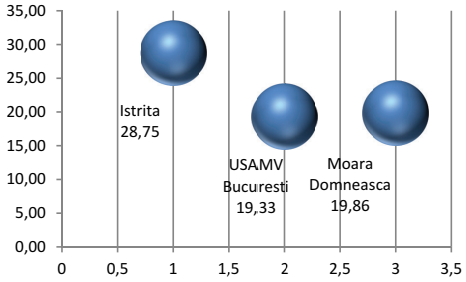


Fig. 4. The average percentages of affected flower buds in the three experimental centers: |Istrita Buza, USAMV Bucharest and Didactic Farm Moara Domneasca

Unfortunately, later in the Spring, the temperatures oscillations after bud burst and especially the lower temperature registered in the morning of April, 10 in Istrita Buzau region (-6^0C) destroyed all the flowers (photo 1,2,3) and fully compromise the cherry production in this year.

The other two centers haven't reported additional losses caused by the late spring frosts.

Photo 1. Browning of the floral organs due to negative temperatures occured in the morning of April, 10 in Istrita Buzau

Photo 2. Transversal sections reveal floral organ damage by frost (Moara Domneasca, 2012)

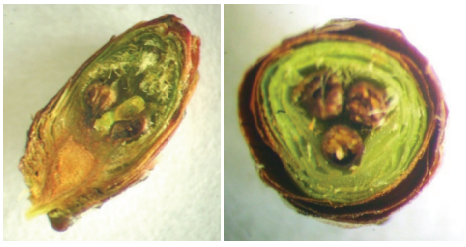


Photo 3. Frost damage at sweet chery fruiting buds - transversal and longitudinal section view

Photo 4. Sweet cherry experimental plot in high density system at USAMV Bucharest (2012)

CONCLUSIONS

The lasting low temperatures in the 2011/2012 winter produced frost damages at the floral buds of sweet cherry cultivars grown in Istrita, Bucharest and Moara Domneasca regions differentially.

9.98% to 63.92% of floral buds affected by frost was recorded in Istrita region and 1.96% to 48.25% in Bucharest and Moara Domneasca area.

The most affected by winter frost was Skeena (63,92%) at Istrita and Germersdorf (48,25%) in Bucharest.

Lower part of the crown was much exposed to the low temperatures and registered a higher percentage of floral buds losses, respectively with 28,5% more than the upper half of the crown.

Frost injuries depend on branch type. Floral bud losses are linked also with genetical heritage of the cultivar.

ACKNOWLEDGEMENTS

This work was supported by UEFISCDI, Project PD-85 193/2010.

REFERENCES

[1] Blažková, J., Hlušičková, I., 2002. *Testing of wood hardiness to winter freezes in selections from progenies of* Cerapadus × Prunus avium *L. crosses.* Hort. Sci. (Prague), 29 (2002): 133-142

[2] Budan, S., Butac M., Chitu E., 2005. *Evaluation of the winter hardiness of some cherry and plum varieties under 2004/2005 climatic conditions*. Lucrari ştiintifice ale USAMV „Ion Ionescu de la Brad", Iaşi, Vol. 1(48), CD, I.S.S.N. 1454-7376: 83-88.

[3] Fischer, M. and Hohlfeld, B. 1998. *Resistance Tests In Sweet Cherries*. Acta Hort. (ISHS) 468:87-96

[4] Jänes H., P. Ardel, K. Kahu, K. Kelt and A. Kikas, 2010. *Some biological properties and fruit quality parameters of new sweet cherry cultivars and perspective selections*, Agronomy Research 8 (Special Issue III), 583–588.

[5] Kappel, F., Fisher-Fleming, B. & Hogue, E. 1996. *Fruit characteristics and sensory attributes of an ideal sweet cherry*. HortScience 31 (3), 443–446

[6] Kolesnikov, M.A., Kirichek, I.M., 1975. *Effect of meteorological factors on yielding capacity of sour and sweet cherry in the central part of Kuban*. Izd. Urojai, Kiev.

[7] Lichev V. and PapachatzisA., 2006. *Influence of ten rootstocks on cold hardiness of flowers of cherry cultivar 'Bigarreau Burlat'*. Sceintific Works of the Lithuanian Institute of Horticulture and Lithuanian University of Agriculture. Sodininkyste IR Darzininkyste. 25(3). 296-301.
[8] Lynn E. Long and Clive Kaiser. 2010. *Sweet cherry rootstocks for the Pacific Northwest*. A Pacific Northwest Publication, PNW 619, September 2010.
[9] Sansavini, S. and Lugli, S., 2008. *Sweet Cherry Breeding Programs In Europe And Asia*. Acta Hort. (ISHS) 795:41-58.
[10] Sitarek, M., Z. Grzyb, 1998. *Frost injuries of sweet cherry and plum after winter 1996/97*. - Journal of Fruit and Ornamental Plant Research, 6:1, 15-22.

Scientific Papers, Series B, Horticulture, Vol. LVI, 2012
CD-ROM ISSN 2285-5661, ISSN-L 2285-5653

THE IMPACT OF SOME MODERNIZED TECHNOLOGICAL OPERATIONS UPON THE PRODUCTIVE POTENTIAL OF SOME CUCURBITA PEPO L., CONVAR. GIROMONTIA HYBRIDS, CULTIVATED IN COLD SOLARIUMS

Alexandra BECHERESCU[1], HORGOŞ A.[1], POPA D.[1], Anca DRĂGUNESCU[1], Anişoara IENCIU[1], Roxana STEPAN[2]

[1]Banat's university of Agricultural Sciences and Veterinary Medicine, Faculty of Horticulture and Forestry, Fruit Culture, Calea Aradului 119, 300645, Timisoara, Romania, Phone: 0256 277006, fax: 0256 277263
[2]Family association

Corresponding author email: alexandra_becherescu@yahoo.com

Abstract

The importance of courgette in alimentation is duet o its alimentary value given by the high content of Carbone hydrates, proteins, Ca, P and Iron salts, vitamins A and C with their favorable role in metabolism. Obtaining efficient quantitative productions is very important for vegetable growers, who hope to introduce this vegetable, in the near future, more and more in alimentation. This can happen only by applying in culture a modern technology. In this purpose we experienced two courgette hybrids Cavili F_1 and Ambasador F_1, cultivated in two types of culture systems – one with modeled field and mulching with white polyethylene (PE) foil and drip irrigation (b1) and one with no modeled field, no mulching and with drip irrigation (b2) – and by applying as fertirrigation three types of completely soluble chemical fertilizers – Agriplant, Haifa Chemicals and Kemira. The results showed that the field has to be modelled with raised layers of 104 cm width, on which to apply white PE foil as mulch. It is recommended to use the two completely soluble fertilizers Haifa Chemicals and Kemira, applied by fertirrigation, which determined high yields for both hybrids. The biological value of the two hybrids, considering their quantitative productive potential is very close, the differences between the hybrids being not significant, so that from Cavili F1 we obtained 27.1 t/ha (100%) and from Ambasador F1 we obtained 26.3 t/ha (97%), the difference expressed in physical units being of 0.8 t/ha, and in percentage units of 3%.

Keywords: *technology, production, alimentation, grower*

INTRODUCTION

Courgette is vegetable species from *Cucurbitaceae* family, which was not given too much attention if we consider other species like cucumbers (long, semi-long and cornichon) or yellow and green melons, all these species having improved technologies in the past years, some of them considered as being modernized compared to the classic ones. Obtaining early or very early productions, as an effect of some culture protecting systems by using some plastic shelters with new features, obtaining quantitative productions close to the theoretical potential of the cultivars and the organoleptic features of the new varieties and hybrids, meaning the taste, core's color and smell and, the lack of seeds (eg. yellow melons), the use of drip irrigation and fertirrigation, all these are technological elements which form the modern technology.

The alimentary values of courgette (ignored till now), meaning the high content of carbon hydrates, proteins, calcium salts, phosphorus and iron, vitamins A and C (with their extremely favorable role in human metabolism), will get their well-deserved place in human alimentation as the natural remedies and the alternative alimentation conceptions are more and more used and nutritionists give higher attention to researches in this domain. Obtaining high productions, which can satisfy consumers' requests for this vegetable along the spring-summer period, are aimed by specialized and common vegetables' growers, so that they can improve and modernize the culture technology of this species. Cultivating courgette in protected spaces and modernizing

a technological link are the aims of our experimental research.

MATERIAL AND METHOD

This research took place in a family association from Iermata locality, Seleuş district, near Ineu city, in Arad County, where there is a tradition in cultivating vegetables on large surfaces in a protected system by private growers. The family association has a large surface with cold solariums of almost 0.5 ha. The culture was established in 10-15 April 2010 and 2011 in cold solariums, at a density of 12500 pl/ha and seedlings' age was of 45-50 days. ***The goal*** of the research was to study the productive potential behavior of two courgette hybrids (Cavili F1 and Ambasador F1) in conditions of modernizing the culture technology in cold solariums, meaning the culture system (modeled and mulched field and not modeled and not mulched field in conditions of drip irrigation and fertilization done through drip irrigation installation) and the use during vegetation period of some modern completely soluble fertilizers such as Agriplant, Kemira and Haifa-Chemicals. The flowers of this species, and all other species in this botanical family, which are not pollinated or incompletely pollinated, usually don't bind, falling down of the plant (abortion) mainly in early season because of low temperatures during night and the high differences between day and night temperatures and because of insufficient sun light, conditions which are not favorable for pollination.

The objectives of this research, considering the hybrids under the impact of the other two factors, were:

- the behavior of the two hybrids cultivated in cold solariums in conditions of soil mulching and fertilization with modern completely soluble chemical fertilizers;
- to determine the productive potential of the two hybrids per plant and per surface (m^2 or ha);

In order to obtain the objectives there were done the following determinations:

- number of flowers per plant;
- percentage of bind fruits;
- fruits' weight.

In this purpose there was settled a polyfactorial experiment with the fallowing experimental factors:

Factor A – The hybrid

a_1 – Cavili F_1; a_2 – Ambasador F_1

Factor B – Irrigation and field modeling system for establishing the culture (culture system)

b_1 Modeled field with raised layer width 104 cm and mulching with white polyethylene foil (PE)+drip irrigation; b_2 not modeled and not mulched field + drip irrigation

Factor C – Types of modern completely soluble chemical fertilizers used for fertirrigation

c_1 – Agriplant (Agriplant 1-4);

c_2 – Haifa-Chemicals (*Agro-Feed Multicote 4; Agro-Feed – Magnesium nitrate; Agro-Feed – Complex soluble fertilizers N-P-K; Agro-Feed – Potassium nitrate – KNO_3;*

c_3 – Kemira (Cropcare and Ferticare);

In order to have a complete image of the two courgette hybrids' behavior Cavili F_1 and Ambasador F_1, under the impact of the experimental factors (culture systems and fertilizers) there were done the following observations:

- production quality index for establishing the consume on the market;
- average weight of fruits and average production obtained on the surface unit;
- fruits' dimensions for determining the size units;
- productions obtained per plant and per surface unit under the unilateral and factors' interaction impact.

RESULTS AND DISCUSSION

By analyzing table 1 and figure 1 one can see the features specific for this species culture under the impact of the two experimental factors considering the feontipic behavior:

- the total number of flowers per plant varies from 14.2 to 14.8 for Cavili F_1 and from 13.5 to16.0 for Ambasador F_1, the variation limits being conditioned by the bifactorial combinations of factors B and C.;
- the total number of bind fruits per plant is not in directly proportional relation with the

number of flowers on the same plant, the binding degree varying from 46.3 % and 50.7 % under the impact of factor b_1 (modeled field, mulching and drip irrigation) for both hybrids and between 40.1% and 46.5% under the impact of b_2 (not modeled or mulched field, drip irrigation).

- fruits' length at consume or technical maturity (courgettes in flower) is not higher or lower correlated to factor B (b_1 and b_2), but more to factor C;
- for c_1 - Agriplant combined with b_1 and b_2 fruits length at consume maturity is lower compared with c_2 (Haifa Chemicals) and c_3 (Kemira), which shows a favorable effect of using the two completely soluble chemical fertilizers;
- fruits' weight at consume maturity is higher for Cavili F_1 compared with Ambasador F_1 but only under the impact of b_1 (modeled field + mulch); while under the impact of b_2 (level field) the situation is opposite, the higher weight values being obtained from Ambasador F_1.
- the average production per plant varies from 1.776-2.570 kg/plant for Cavili F_1 and from 1.688-2.480 kg/plant for Ambasador F_1 in the phase of consume maturity;
- the average productions per hectare are very different, the extreme limits being of 17.3-30.2 t/ha.

Table 1. Experimental results concerning the behavior of some courgette hybrids cultivated in cold solariums on modeled and level field by using in vegetation foliar fertilizers in cycle I 2010-2011*

Experimental factors			No.of flowers/ plant	Bind fruits/plant		Fruit's length (cm)	Average weight (g/piece)	Average production		
A (Hybrid)	B (culture system)	C (chemical fertilizer)		piece	%			Kg/plant	t/ha	% than Mt not fertilized
a_1– Cavili F_1	b_1 –modeled field + mulch + drip irrigation	c_1 – Agriplant	14,5	7,2	49,7	24,0	326,3	2,344	29,4	100,0
		c_2 – Haifa-Chemicals	14,8	7,5	50,7	26,4	342,7	2,570	31,0	126,9
		c_3 – Kemira	14,7	7,4	50,3	25,7	335,1	2,480	24,6	122,5
	b_2 – level field not mulched + drip irrigation	c_1 – Agriplant	14,8	6,3	42,5	22,9	281,9	1,776	28,5	100,0
		c_2 – Haifa-Chemicals	14,2	6,5	45,7	26,1	302,8	1,968	30,3	121,8
		c_3 – Kemira	14,2	6,6	46,5	25,2	281,2	1,856	23,8	114,9
a_2 – Ambasador F_1	b_1 –modeled field + mulch + drip irrigation	c_1 – Agriplant	14,9	7,2	48,3	22,9	316,7	2,280	29,0	100,0
		c_2 – Haifa-Chemicals	16,0	7,4	46,3	25,9	335,1	2,480	30,7	126,5
		c_3 – Kemira	15,7	7,6	48,4	24,1	318,9	2,424	24,2	123,7
	b_2 – level field not mulched + drip irrigation	c_1 – Agriplant	13,5	5,8	40,1	21,9	291,0	1,688	100,0	100,0
		c_2 – Haifa-Chemicals	14,8	6,1	41,2	25,1	312,1	1,904	122,5	124,6
		c_3 – Kemira	15,3	6,3	41,1	24,2	293,3	1,848	121,8	120,9
a_3 –Average (Mx)	b_1 –modeled field + mulch + drip irrigation	c_1 – Agriplant	14,7	7,2	49,0	23,5	321,5	2,307	100,0	100,0
		c_2 – Haifa-Chemicals	15,4	7,5	48,7	26,2	338,9	2,525	123,7	109,0
		c_3 – Kemira	15,2	7,5	49,3	24,9	335,0	2,452	124,6	105,9
	b_2 – level field not mulched + drip irrigation	c_1 – Agriplant	14,2	6,1	42,9	22,4	286,5	1,732	100,0	100,0
		c_2 – Haifa-Chemicals	14,5	6,3	43,4	25,6	307,5	1,936	105,9	111,5
		c_3 – Kemira	14,8	6,5	43,9	24,7	287,3	1,852	111,5	106,9

* fruits harvesting was done at consume maturity (courgette in flower)

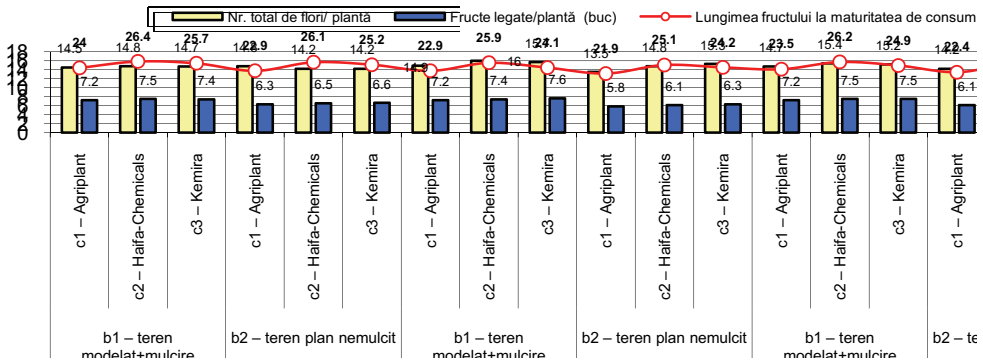


Fig.1. Experimental results concerning the behavior of some courgette hybrids cultivated in cold solariums on modeled and level field by using in vegetation foliar fertilizers in cycle I 2010-2011

In Table 2 and Fig. 2 there is presented the synthesis of experimental results under the unilateral impact of the experimental factors.

Table 2. Synthesis of production results for courgette hybrids cultivated in cold solariums in cycle I 2010-2011 (production obtained at consume maturity)

Experimental factors			Average production per plant and per hectare for:										
A	A	A	Factor C				Factor B				Factor A		
(Hybrid)	(Hybrid)	(Hybrid)	g/buc	kg/pl.	t/ha	%	g/buc	kg/pl.	t/ha	%	/buc	t/ha	%
a_1– Cavili F_1	b_1 –modeled field + mulch + drip irrigation	c_1 – Agriplant	326,3	2,344	29,4	100,0	334,7	2,464	30,8	100,0	311,7	27,1	101,5
		c_2 – Haifa-Chemicals	342,7	2,570	32,1	109,2							
		c_3 – Kemira	335,1	2,480	31,0	105,4							
	b_2 – level field not mulched + drip irrigation	c_1 – Agriplant	281,9	1,776	22,2	100,0	288,6	1,866	23,3	75,6			
		c_2 – Haifa-Chemicals	302,8	1,968	24,6	110,8							
		c_3 – Kemira	281,2	1,856	23,2	104,5							
a_2 – Ambasador F_1	b_1 –modeled field + mulch + drip irrigation	c_1 – Agriplant	316,7	2,280	28,5	100,0	323,6	2,395	29,9	100,0	311,2	26,3	98,5
		c_2 – Haifa-Chemicals	335,1	2,480	31,0	108,8							
		c_3 – Kemira	318,9	2,424	30,3	106,3							
	b_2 – level field not mulched + drip irrigation	c_1 – Agriplant	291,0	1,688	21,1	100,0	298,8	1,813	22,7	75,9			
		c_2 – Haifa-Chemicals	312,1	1,904	23,8	112,8							
		c_3 – Kemira	293,3	1,848	23,1	109,5							
a_3 –Average (Mx)	b_1 –modeled field + mulch + drip irrigation	c_1 – Agriplant	321,5	2,307	29,0	100,0	329,2	2,430	30,4	100,0	311,5	26,7	100,0
		c_2 – Haifa-Chemicals	338,9	2,525	31,6	109,0							
		c_3 – Kemira	327,0	2,452	30,7	105,7							
	b_2 – level field not mulched + drip irrigation	c_1 – Agriplant	286,5	1,732	21,7	100,0	293,7	1,840	23,0	75,7			
		c_2 – Haifa-Chemicals	307,5	1,936	24,2	111,5							
		c_3 – Kemira	287,3	1,852	23,2	106,9							

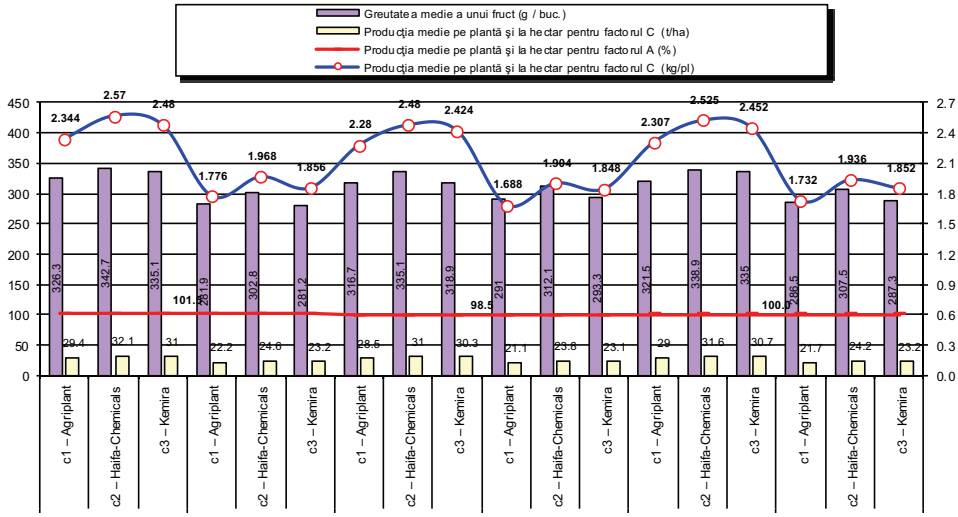


Fig.2. Synthesis of production results for courgette hybrids cultivated in cold solariums in cycle I 2010-2011 (production obtained at consume maturity)

By analyzing the impact of factor B (culture system) with its two graduations - b_1 (modeled field + mulch) and b_2 (level field, not mulched) – we see production variation limits for each hybrid and for the average value of the experiment (Mx –a_3). These limits are more emphasized for factor A (the hybrid) and less emphasized for factor C (the fertilizers). They vary from 22.7 t/ha (a_2b_2) to 30.8 t/ha (a_1b_1), a difference of +8.1 t/ha, meaning +24.1%, the average being of 23.0 (b_2) – 30.4 (b_1) t/ha, meaning 24.3%. The percentage differences for hybrids vary between – 24.4 and – 24.1%, showing the high impact of filed modeling and mulching with PE upon the production. Graduations of factor C (the fertilizers) show the highest variation of production at the same time for consume maturity and physiological maturity. The extreme limits are of 104.5% ($a_1b_2c_3$) and 112.8% ($a_2b_2c_2$), evident from Agriplant fertilizer. The average value (Mx – a_3) has limits of 21.7 t/ha – 100.0% ($a_3b_2c_1$) and 31.6 t/ha – 109.0% ($a_3b_1c_2$). In table 3 there is presented the synthesis of production results as an effect of interactions between the experimental factors for each gradient.


Photo 1. Cougette culture in cold solariums in different stages of growing and development

Table 3. Synthesis of production results for courgette hybrids cultivated in cold solariums in cycle I 2010-2011, as an effect of interactions between the experimental factors (consume maturity)

Experimental factors			Average production per hectare (t/ha şi %) for:									
A	B	C	Factor C				Factor B		Factor A			Average exp. Mx
			c_1-c_3		b_{1-2} c_{1-3}	a_{1-2} c_{1-3}	$a_{1-3}b_{1-2}$	$a_{1-2}b_1$ şi $a_{1-2}b_2$	a_{1-3}	% faţă de a_1	%faţă de Mx	t/ha (%)
			t/ha	%								
a_1	b_1	c_1	29,4	100,0	$b_{1-2}c_1$ 25,8 (100,0%)	$a_{1-2}c_1$ 25,3 (100,0%)	30,8 (100,0%)	$a_{1-2}b_1$ 30,4 (100,0%)	27,1	100,0	101,5	26,7 (100,0%)
		c_2	32,1	109,2								
		c_3	31,0	105,4	$b_{1-2}c_2$ 28,4 (110,1%)							
	b_2	c_1	22,2	100,0			23,3 (75,6%)					
		c_2	24,6	110,8	$b_{1-2}c_3$ 227,1(105,0%)	$a_{1-2}c_2$ 27,9 (110,3%)						
		c_3	23,2	104,5								
a_2	b_1	c_1	28,5	100,0	$b_{1-2}c_1$ 24,8 (100,0%)		29,9 (100,0%)	$a_{1-2}b_2$ 23,0 (75,7%)	26,3	97,0	98,5	
		c_2	31,0	108,8								
		c_3	30,3	106,3	$b_{1-2}c_2$ 27,4 (110,5%)	$a_{1-2}c_3$ 26,9 (106,3%)						
	b_2	c_1	21,1	100,0			22,7 (75,9%)					
		c_2	23,8	112,8	$b_{1-2}c_3$ 26,7 (107,7%)							
		c_3	23,1	109,5								
a_3 (Mx)	b_1	c_1	29,0	100,0	$b_{1-2}c_1$ 25,3 (100,0%)	a_3c_1 25,3 (100,0%)	30,4 (100,0%)	a_3b_1 30,4 (100,0%)	26,7	98,5	100,0	
		c_2	31,6	109,0		a_3c_2 27,9 (110,3%)						
		c_3	30,7	105,7	$b_{1-2}c_2$ 27,9 (110,3%)							
	b_2	c_1	21,7	100,0		a_3c_3 26,9 (106,3%)	23,0 (75,7%)	a_3b_2 23,0 (75,7%)				
		c_2	24,2	111,5	$b_{1-2}c_3$ 26,9 (106,3%)							
		c_3	23,2	106,9								

Both the analyses done for each hybrid (a_1 – Cavili F_1 and a_2 – Ambasador F_1) correlated with the culture system (b_1 and b_2) and for the average value of the experiment (Mx – a_3) differentiated for b_1 and b_2 shows that the largest production increase other than c_1 – Agriplant, is obtained when using Haifa Chemicals (c_2) which gives a plus of 2.7 t/ha – 109.2% for Cavili F_1 (a_1) and of 2.5 t/ha – 108.8% for Ambasador F_1 (a_2). In average there is a plus of 2.6t/ha – 110.3%, being followed by Kemira (c_3) with +4.6 t/ha – 122.5%.

As a conclusion we can say that both Haifa Chemicals (c_2) and Kemira (c_3) fertilizers determine high increases of production by root administration than Agriplant fertilizer.

Factor B (culture system) by its two graduations (b_1 and b_2) give an emphasized production differentiation, in favor of b_1 (modeled field + mulch), of 30.4 t/ha (100.0%) compared to b_2 (level field, not mulched), 23.0 t/ha (75.7%). The production increase is of 7.4 t/ha, meaning +24.3%.

The natural conclusion that emerges is that for courgette's culture it's recommended to use modeled field with raised layer width 104 cm and mulching with white PE foil. Factor A (the hybrid) with its two graduations (a_1 Cavili F_1 and a_2 Ambasador F_1) doesn't determine high production increases, showing

the almost similar productive potential of the two hybrids. The difference of 0.8 t/ha (3,0%) between Cavili F_1 (a_1) and Ambasador F_1 (a_2) is not significant.

In table 4 there are presented the production differences' significations under the unilateral and experimental factors' interactions impact.

Table 4. Unilateral and experimental factors' interactions impact upon courgette's production at consume maturity in conditions of modernizing some technological culture's links

Variant	Average production (kg/ha)		Relative production (%)	Difference (± t/ha)	Significance
1. Unilateral impact of the hybrid upon the production					
a2-a1	26,30	27,08	97,11	-0,78	-
a3-a1	26,71	27,08	98,63	-0,37	-
a3-a2	26,71	26,30	101,56	0,41	-
DL 5%= 2,85		DL 1%= 4,32		DL 0,1%= 6,94	
2. Unilateral impact of the culture system upon the production					
b2-b1	23,01	30,39	75,71	-7,38	000
DL 5%= 1,74		DL 1%= 2,40		DL 0,1%= 3,30	
3. Unilateral impact of the modern completely soluble chemical fertilizers upon the production					
c2-c1	27,88	25,31	110,19	2,58	***
c3-c1	26,91	25,31	106,32	1,60	*
c3-c2	26,91	27,88	96,49	-0,98	-
DL 5%= 1,41		DL 1%= 1,91		DL 0,1%= 2,55	
4. The impact of interaction between the same hybrid and different culture systems upon the production					
a1b2- a1b1	23,33	30,83	75,68	-7,50	000
a2b2- a2b1	22,67	29,93	75,72	-7,27	000
a3b2- a3b1	23,02	30,40	75,73	-7,38	000
DL 5%= 3,01		DL 1%= 4,15		DL 0,1%= 5,71	
5. The impact of interaction between the same hybrid and different types of modern completely soluble chemical fertilizers upon the production					
a1c2- a1c1	28,35	25,80	109,88	2,55	*
a1c3- a1c1	27,10	25,80	105,04	1,30	-
a1c3- a1c2	27,10	28,35	95,59	-1,25	-
a2c2- a2c1	27,40	24,80	110,48	2,60	*
a2c3- a2c1	26,70	24,80	107,66	1,90	-
a2c3- a2c2	26,70	27,40	97,45	-0,70	-
a3c2- a3c1	27,90	25,32	110,20	2,58	*
a3c3- a3c1	26,92	25,32	106,32	1,60	-
a3c3- a3c2	26,92	27,90	96,48	-0,98	-
DL 5%= 2,44		DL 1%= 3,30		DL 0,1%= 4,41	
6. The impact of interaction between the same culture system and the same or different types of modern completely soluble chemical fertilizers upon the production					
b2c1- b1c1	21,66	28,96	74,79	-7,30	000
b2c2- b1c2	24,21	31,56	76,73	-7,34	000
b2c3- b1c3	23,16	30,66	75,53	-7,50	000
b2c2- b1c1	24,21	28,96	83,61	-4,74	000
DL 5%= 2,38		DL 1%= 3,25		DL 0,1%= 4,42	
7. The impact of interaction between the same hybrid and the same culture system and different types of modern completely soluble chemical fertilizers upon the production					
a1b1c2- a1b1c1	32,10	29,40	109,18	2,70	-
a1b1c3- a1b1c1	31,00	29,40	105,44	1,60	-
a1b1c3- a1b1c2	31,00	32,10	96,57	-1,10	-
a2b2c2- a2b2c1	23,80	21,10	112,80	2,70	-
a2b2c3- a2b2c1	23,10	21,10	109,48	2,00	-
a2b2c3- a2b2c2	23,10	23,80	97,06	-0,70	-
DL 5%= 3,45		DL 1%= 4,67		DL 0,1%= 6,24	
8. The impact of interaction between the same hybrid and different culture systems and the same type of modern completely soluble chemical fertilizers upon the production					
a1b2c1- a1b1c1	22,20	29,40	75,51	-7,20	000
a2b2c2- a2b1c2	23,80	31,00	76,77	-7,20	000
a3b2c3- a3b1c3	23,17	30,67	75,54	-7,50	000
DL 5%= 4,12		DL 1%= 5,63		DL 0,1%= 7,65	

From the Table 4 we conclude that:

- considering hybrids' impact upon the production there is no production differences' significance between Ambasador F_1 and Cavili F_1 or between the average value of the experiment and each hybrid, which shows the almost similar production value (point 1);

- the culture system (b_1 – modeled field + mulch and b_2 – level field, not mulched) has a very favorable impact upon the production, compared with b_2 the production difference' signification being very significant negative, and the relative production difference being - 24.29% than de b_1 - (point 2);

- considering the unilateral impact of fertilizers upon the production, the obtained values were statistically assured, the differences being very significant positive for c_2 (Haifa-Chemicals) – c_1 (Agriplant) and significant positive for c_3 – c_1 (Kemira - Agriplant); this shows the favorable effect of Haifa Chemicals and Kemira fertilizers upon the production compared with Agriplant fertilizer (point 3);
- the interactions' impact from points 4-8 shows the association superiority of c_2 and c_3 (Haifa Chemicals and Kemira fertilizers) used for root fertilization, with any of the culture systems and hybrids and also the lack of remarkable effects in case of the association between any culture systems and Agriplant fertilizer.

CONCLUSIONS

1. Courgette hybrids Cavili F_1 – recent hybrid and Ambasador F_1 – already known for growers, have some morphological features of fruits at consume (technical) maturity which recommends them for extension in solariums' culture;
2. The biological value of the two hybrids, considering their productive potential is very similar, the differences between them being not significant, so that Cavili F_1 has a production of 27.1 t/ha (100,0%), and Ambasador F_1 26.3 t/ha (97.0%), the difference being of 0.8 t/ha, meaning 3%;
3. The culture system has a great impact upon production, the physical units' differences being up to 7.4 t/ha, meaning 24.3%, as it follows:
- under the impact of b_1 (modeled filed, mulching with PE + drip irrigation) there was obtained a production of 30.4 t/ha (100.0%);
- under the impact of b_2 (level field – not modeled, no mulching + drip irrigation) there was obtained a production of 23.0 t/ha (75.7%);
4. Modern completely soluble chemical fertilizers, of types Agriplant, Haifa Chemicals and Kemira, being used in fertirrigation, have an extremely favorable impact upon the productive potential of the two hybrids (Cavili F_1 ans Ambasador F_1), no matter the culture system;
5. In both culture systems (b_1 and b_2) the best impact was noticed when using Haifa Chemicals and Kemira, but of them the best was Haifa Chemicals;
6. The average productions obtained under the impact of Haifa Chemicals (c_2) are on the first place and they vary from 24.2 t/ha–111.5% in b_2 to 31.6 t/ha–109.0% in b_1, while the productions obtained under the impact of Agriplant (c_1), which were of 21.7 t/ha (100.0%) in b_2 and of 29.0 t/ha (100.0%) in b_1;
7. On the second place there are the productions obtained under the impact of Kemira (Ferticare in vegetation period) (c_3), which had values between 23.2 t/ha – 106.9% in b_2 and 30.7 t/ha – 105.7% in b_1, compared to the same productions obtained in b_1 and b_2 under the impact of Agriplant;
8. The average productions value under the impact of Haifa Chemicals (c_2) and Kemira (c_3) are of 27.9 t/ha – 110.3% for c_2 and 26.9 t/ha – 106.3% for c_3, compare with those obtained under the impact of Agriplant (c_1), 25.3 t/ha - 100.0%;
9. It is recommended to use the two completely soluble fertilizers Este Haifa Chemicals and Kemira, which can be applied at the same time with irrigation water through the drip irrigation system cu, having as support for this recommendation the productions values of the two hybrids, Cavili F_1 and Ambasador F_1.

REFERENCES

[1] Becherescu Alexandra, Horgoş A., Popa D., Ţârau O., 2010. *The productive potential manifestation of some courgette hybrids under the impact of some culture technologies modernization in conditions of cold solariums*. Analele Universităţii din Craiova, vol. XV (XLXI), Universitaria PH.
[2] CIOFU Ruxandra, Stan N., Popescu V., Chilom Pelaghia, Apahidean S., Horgoş A., Berar V., Lauer K.F., Atanasiu N., 2003. *Tratat de legumicultură*. Ceres PH, Bucureşti.
[3] Horgoş A., 2003. *Legumicultură special*. Agroprint PH, Timişoara.


EX·TERRA·AVRVM

Scientific Papers, Series B, Horticulture, Vol. LVI, 2012
CD-ROM ISSN 2285-5661, ISSN-L 2285-5653

ASPECTS OF THE INTERSPECIFIC RELATIONSHIPS BETWEEN KLOECKERA APICULATA AND SACCHAROMYCES CEREVISIAE var. ELLIPSOIDEUS YEASTS

Georgeta BELENIUC[1], Constantin Băducă CÂMPEANU[2], Victoria LEUSTEAN[3]

[1] Universitatea Ovidius, Constanta, Constanta, Mamaia str., no.124,Romania.georgetabelen@yahoo.com;
[2] U.S.A.M.V. Craiova, Al.I. Cuza street, no. 13 Craiova, Romania, cbaduca@yahoo.com;
[3] SC DUVIGNEAU MURFATLAR SRL, Poarta Alba, Constanta, Romania

Corresponding author email: georgetabelen@yahoo.com

Abstract:

In this paper, we have studied during alcoholic fermentation, some aspects of the interspecific relationships between the apiculated yeasts belonging to the Kloeckera apiculata species and the elliptical yeasts belonging to Saccharomyces ellipsoideus species, isolated from Murfatlar vineyard, viticol centre Cernavoda. The two species yeasts were inoculated separately and mixedly, in sterile Pinot Gris must. At the mixted inoculation, an inhibition have been noticed, particulary for Saccharomyces ellipsoideus species. The inhibition was maximum, when the inoculation with Saccharomyces ellipsoideus species, is done when there is a maximum activity period of Kloeckera apiculata species. Mixed inoculation leads to the occuarence of two maximum in the fermentation process: the first maximum occurs due to the activity of the Kloeckera apiculata species and the second maximum occurs due to the activity of the Saccharomyces ellipsoideus species, after the passing of the inhibition period.

Key words: alcoholic fermentation; inhibition period; mixted inoculation.

INTRODUCTION

In the wine microbiology majority of the researches are orientated upon the relationships between microorganisme species and from inside of the same species. All the time were studied the yeasts attend in the fermentation process [Beleniuc G., 2006; Castelli T.,1973; Gandini -1966], the yeasts influence upon lactique bacterias and viceversa [Ribereau-Gayon and Peynaud-1960, 1961] the action of the acetic bacterias and moulds upon the yeasts and lactic bacterias [Ribereau-Gayon, 2000]. Were studied the relationships between
the mains yeasts groups, apiculate and elliptical [Domerq-1956]. Some authors, have seen the negative role of the apiculate yeasts in alcoholic fermentation process and therefore even recommend their elimination from the must [CoteaD.V., 1985]. The others authors, showed the main role of apiculate yeasts in the wine flavours formation. They showed that the famous wines, can not be obtained in exclusivity with elliptical yeasts, only by using the spontaneous microflora from the vineyard.

MATERIAL AND METHOD

Were studied some aspects of the relationships between apiculate yeasts, belonging to Kloeckera apiculata species and elliptical yeasts, belonging to Saccharomyces ellipsoideus, isolated in the viticol Centre Medgidia, from Murfatlar vineyard, and identified by „Yeasts A taxonomic study, 6-th Revised and Enlarged Edition"[Kurtzman, C.P., şi J.W. Fell, 2006]. The researches were made, using like fermentation medium, Pinot gris sterile must with the following characteristics: 230 g/l sugars and 6,24 g/l H_2SO_4 total acidity.
The experiments were made in seven variants, as following:
V_1 – inoculated only with Kloeckera apiculata species;
V_2 – inoculated only with Saccharomyces ellipsoideus species;
V_3 – inoculated simultaneous with Kloeckera apiculata and Saccharomyces ellipsoideus species;

V_4 – inoculated with Kloeckera apiculata species and after one day with Saccharomyces ellipsoideus species;
V_5 – inoculated with Kloeckera apiculata species and after 2 days with Saccharomyces ellipsoideus species;
V_6 – inoculated with Kloeckera apiculata species and after 4 days with Saccharomyces ellipsoideus species;
V_7 – inoculated with Kloeckera apiculata species and after 31 days with Saccharomyces ellipsoideus species. The samples were keep at 25^0C temperature and was followed the fermentation process by daily yeasts population evolution (daily counting–Thoma mount) and the lost in weight registration, by CO_2 lost (g%).
Finally, the wines obtained were analised from the chemical characteristics point of view, using the O.I.V methods and the Romanian standards in force.

RESULTS AND DISCUTIONS

The results are showed in the charts 1-7 and in the table 1.
Following the curves of the cells yeasts evolution and the lost in weight, for the sample inoculated with one yeasts species (V_1 and V_2), we can show (chart 1): Kloeckera apiculata yeasts has a big fermentative intensity in the first four-five days, and Saccharomyces ellipsoideus species in the first eight days. After these periods, the fermentation has a low intensity. In the power fermentation period (1-5, 1-8 days) the number of yeasts cells are increase and, after this period, was hardly to establish with accuracy a correlation between total yeasts cells number/mm^3 and the fermentation intensity.

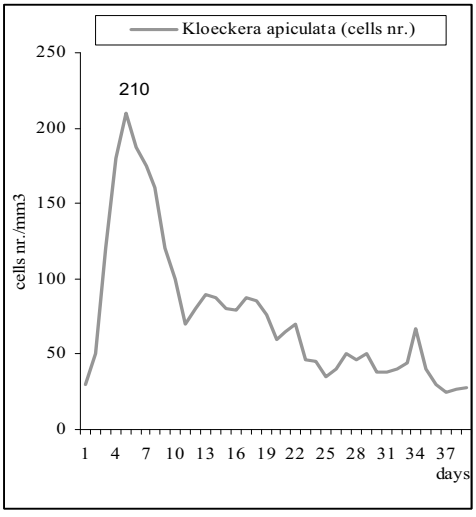


Chart 1. The cells number evolution at V1 (inoculated with Kloeckera apiculata)

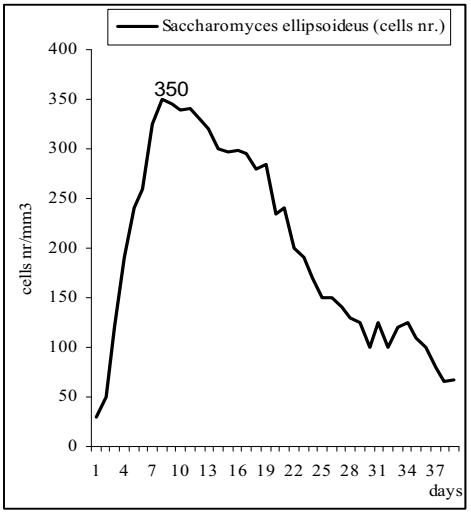


Chart 2. The cells number evolution at V2 (inoculated with Saccharomyces ellipsoideus)

When the samples were mixed inoculated (V_3-V_8), we have seen a mutual inhibition of two yeasts species, correlate with their inoculated moment. When the two yeasts species are simultaneous inoculated (V3, chart 3) was showed a mutual inhibition thus that, the Kloeckera apiculata species can not reach a big cells number like in V_1 (inoculated only with Kloeckera apiculata species). To the other mixed variants inoculated (V_4-V_7) due the lag of inoculation with Saccharomyces ellipsoideus, the yeasts Kloeckera apiculata, achieve a number of cells/mm^3, approached V_1 (inoculated only with Kloeckera apiculata species). Only at the V_7 variant the Kloeckera number of cells/ mm^3, is the same as in V_1 (chart 7).

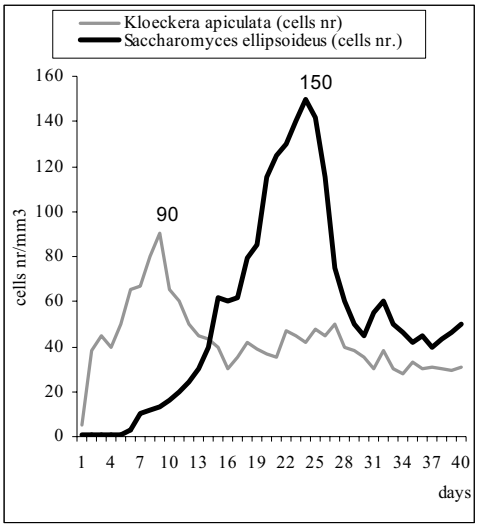


Chart 3 – The cells number evolution at V3 (simultaneous inoculated with Kloeckera apiculata and Saccharomyces ellipsoideus; almost 5 days inhibition for Saccharomyces ellipsoideus)

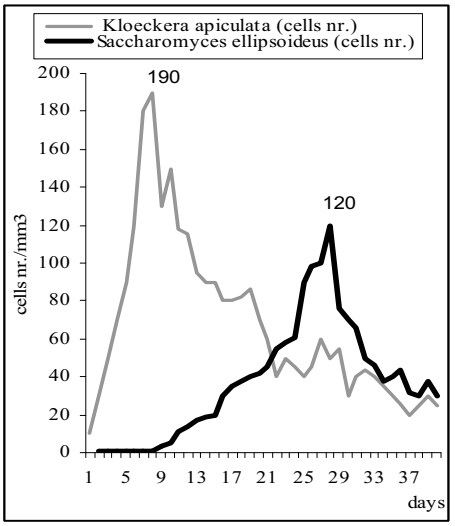


Chart 4 – The cells number evolution at V4 (inoculated with Kloeckera apiculata and after one day with Saccharomyces ellipsoideus; almost 7 days inhibition for Saccharomyces ellipsoideus)

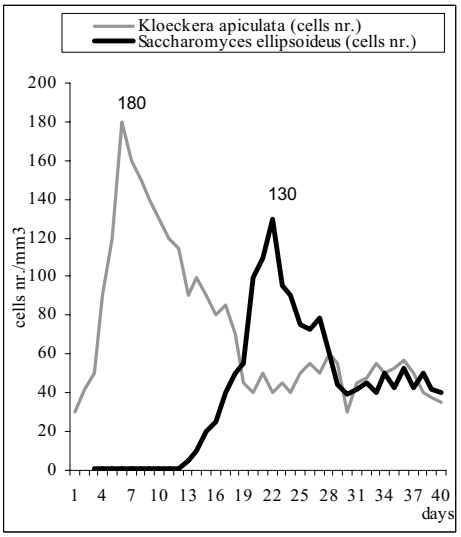


Chart 5 – The cells number evolution at V5 (inoculated with Kloeckera apiculata and after two day with Saccharomyces ellipsoideus; almost 10 days inhibition for Saccharomyces ellipsoideus)

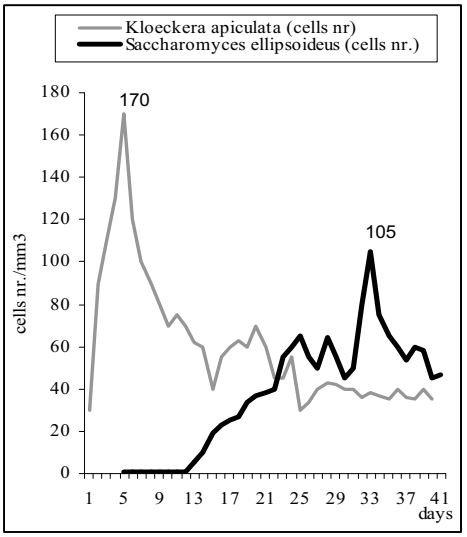


Chart 6 – The cells number evolution at V6 (inoculated with Kloeckera apiculata and after two day with Saccharomyces ellipsoideus; almost 8 days inhibition for Saccharomyces ellipsoideus)

As the strain of Saccharomyces ellipsoideus behavior in mixed inoculated variants (V_3-V_7), there is an inhibition of its multiplication by Kloeckera apiculata, for a number of days, correlated with the_lag time of both species yeast inoculation.

This inhibition is: -almost 5 days for V_3; - almost 7 days to V_4; - almost 10 days for V_5; - almost 8 days for V_6 and almost 5 days for V_7.

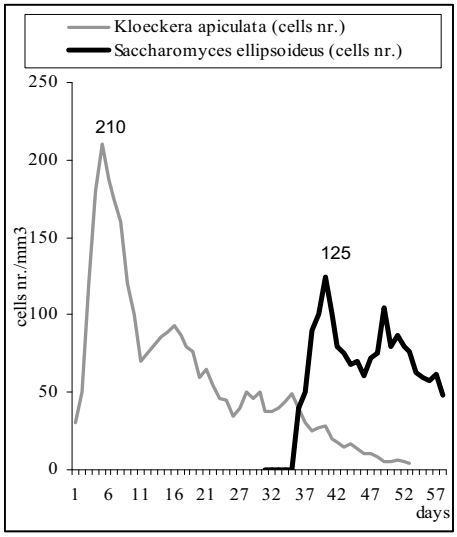


Chart 7 – The cells number evolution at V7 (inoculated with Kloeckera apiculata and after 31 day with Saccharomyces ellipsoideus; almost 5 days inhibition for Saccharomyces ellipsoideus)

The lost in weight curves are different for variants mixed inoculated (V_3-V_7), comparatively with variants inoculated with one species of yeast (V_1 and V_2). If to V_1 and V_2, fermentation curve (CO_2 % release) recorded a single maximum (chart 1 a and chart 2a), the V_3-V_7 variants, it has two maximum (chart 3a, chart 4a, chart 5a, chart 6a, and chart 7a):

- the I-st maximum, came up in the 6-7 day fermentation and is the most species Kloeckera apiculata fermentation product, due to its intense activity in the first days of fermentation;
- the II-nd maximum was in the 26-27 days (V_3), the 31day (V_4), the 27 day (V_5), the 33 day for V_6 and 46 day (V_7) and is generated by Saccharomyces ellipsoideus, after passed the period of inhibition produced by species Kloeckera apiculata.

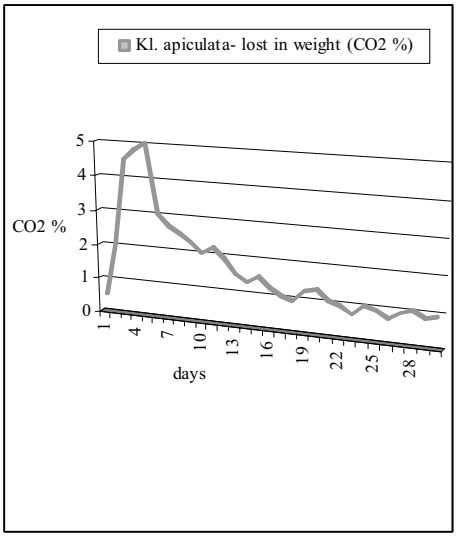


Chart 1a. - The lost in weight at V_1

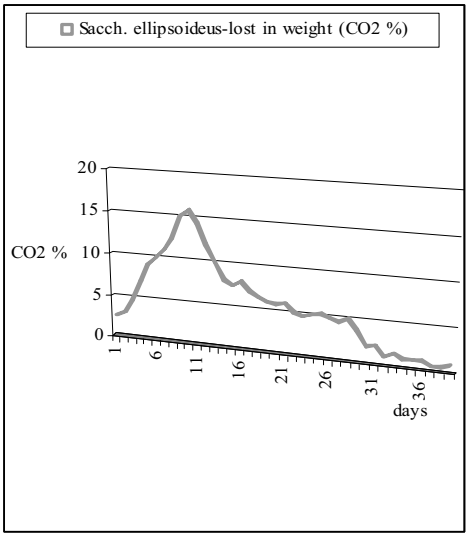


Chart 2a. - The lost in weight at V_2

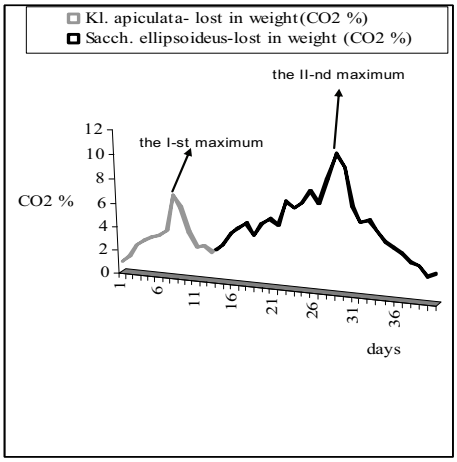


Chart 3a -The lost in weight at V_3

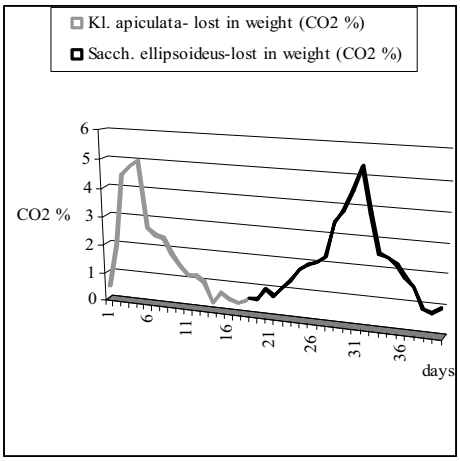


Chart 4a -The lost in weight at V_4

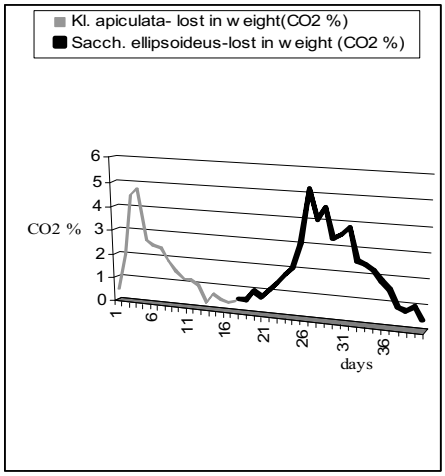


Chart 5a -The lost in weight at V_5

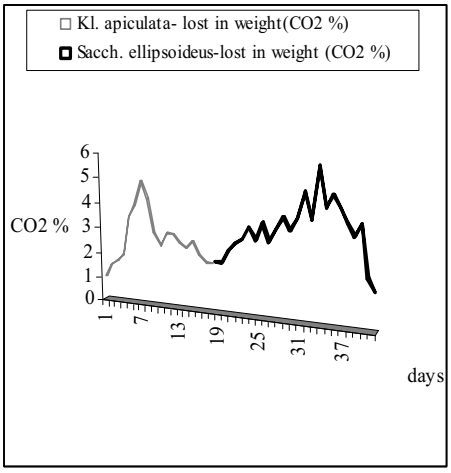


Chart 6a -The lost in weight at V_6

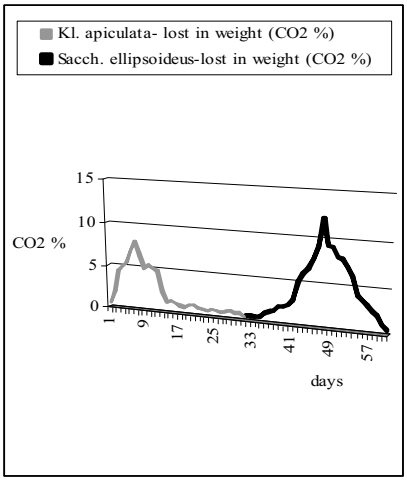


Chart 7a -The lost in weight at V_7

And the chemical analyses of the wines produced, show us the difference of activity between Kloeckera apiculata and Saccharomyces ellipsoideus yeasts species. So, at the variant inoculated with Kloeckera apiculata the alcohol content was 4,85 % vol only, while the variant inoculated with Saccharomyces ellipsoideus have had 11,0 % vol alcohol. The variants mixed inoculated have had an alcohol degree between 8,24-8,82 % vol, closer to V_2, as the time for inoculated of Kloeckera apiculata and Saccharomyces ellipsoideus is shorter (table 1).

The sugars content has a reverse variation comparatively with the alcohol content.

Referring to totale acidity, the low value has V_2, while V_1, has a biggest value.

Volatile acidity has different values for the two yeasts species. Thus, Saccharomyces ellipsoideus in pure culture produce a small quantity of volatile acids (0,43 g/l H_2SO_4-V_2) comparatively with Kloeckera apiculata which exceling by her content in volatile acidity (1,40 g/l H_2SO_4-V_1).

Table 1- The physico-chemical composition of the wines obtained

Sample	Sugar g/l	Alcohol % vol.	Total acidity g/l H_2SO_4	Volat. Acidity g/l H_2SO_4
Must	229,0	-	6,74	-
V_1	128,0	4,85	6,20	1,40
V_2	43,0	11,0	4,80	0,43
V_3	67,3	8,82	6,03	1,04
V_4	67,3	8,75	6,00	1,09
V_5	76,3	8,40	5,94	1,03
V_6	73,6	8,42	6,10	1,06
V_7	74,5	8,49	6,01	1,00
V_8	68,0	8,24	5,97	0,93

CONCLUSIONS

- The apiculate yeasts has the main role to the formation of wine flavours.
- The famous wines, can not be obtained in exclusivity with elliptical yeasts, but by using the spontaneous microflora from the vineyard.
- Kloeckera apiculata yeasts has a big fermentative intensity in the first four-five days, but Saccharomyces ellipsoideus species in the first eight days.
- In the power fermentation period (1-4, 1-8 days) the number of yeasts cells are increase and after this period was not possible to establish a correlation between total yeasts cells number /mm^3 and the fermentation intensity.
- When the samples were mixed inoculated (V_3-V_7), we have seen an mutual inhibition of two yeasts species, correlate with their inoculated moment.
- The lost in weight curves are different to the samples mixed inoculate (V_3-V_7) comparatively, with the samples inoculated with one yeasts species (V_1 and V_2).
- In conclusion, during alcoholic fermentation process, between the two species of yeasts have established negative relationship, of antagonism, which indicated that the Kloeckera apiculata species, by his activity of the metabolites produced in the fermentation medium, unfavorable to the Saccharomyces ellipsoideus species, inhibiting its development and activity for a specified number of days, correlated with their lag time of inoculation.

REFERENCES

[1] Castelli T., 1973- L'ecologie des levures. Vignes et vins, mars 1974, numero special, consacre du Coloque Internat. D'oenologie d'arc et senans-mai, 150-e anniv. De la nassance de Pasteur.

[2] Beleniuc Georgeta, 2006- Elemente de microbiologie, Ed. Cartea Universitară Bucureşti, p. 216-227.

[3] Cotea D. V., 1885. Oenologie, vol I. Ed did. Bucuresti. p. 261-320.

[4] Gandini A., 1966- Vinificatione di mosti piemontesi con lieviti in associazione controllata escalare, Ind. Agrar. Vol. IV, nr. 9/3-30

[5] Domerq S., 1956 - Etude et classification des levures de vin de la Gironde. These. Ingineur Docteur Bordeaux.

[6] Gandini A., 1966- Vinificatione di mosti piemontesi con lieviti in associazione controllata escalare, Ind. Agrar. Vol. IV, nr. 9/3-30.

[7] P. Ribéreau-Gayon, D. Duburdieu, B. Doneche, A. Lonvaud, 2000: Handbook of Enology, Vol. 1, The Microbiology of Wine and Vinifications, John Wiley & Sons, Ltd., New York. pp. 88–127.

Scientific Papers, Series B, Horticulture, Vol. LVI, 2012
CD-ROM ISSN 2285-5661, ISSN-L 2285-5653

RESEARCHES CONCERNING THE INFLUENCES OF CLIMATE CHANGES ON GRAPEVINE

Georgeta Mihaela BUCUR, L. DEJEU, G. CAZAN, Ana TĂNASE

[1]University of Agricultural Sciences and Veterinary Medicine, Bucharest, 59 Marasti, District 1, 011464, Bucharest, Romania, Phone: +40 21 318 25 64, Fax: + 40 21 318 28 88,
E-mail: mihaela_g_savu@yahoo.com; liviudejeu@gmail.com; ana.tanase@ymail.com.

Corresponding author email: mihaela_g_savu@yahoo.com

Abstract

Starting with the fundamental influence of climatic factors on the territorial repartition, on the quantity and quality of viniviticultural products, there were studied the effects of global warming on grapevine, in the last decade. The research concerned the variety Feteasca regală, clone 21 Bl, grafted on Kober 5 BB rootstock, on the experimental plantation of the University of Agronomical Sciences and Veterinary Medicine Bucharest, in 2000-2010. Following the evolution of climatic indicators in this period, as compared to the annual average, we can notice the frequence of the years with high temperature at maturation, which led to increased sugar accumulation in grapes, lowering the acidity of the must, together with the speed-up of the phonological stages and the extension of favorable areas for viticulture.

Key words**:** *climate change, viticulture, grapes*

INTRODUCTION

The global warming manifested during the last period of time affects the growth and the fructification of grapevine as other plants.
There were studied the consequences of climatic changes on viticulture, on grapes, on must and wines [1, 5, 7, 10], mechanism of genetic and physiological adaptation [2, 6, 9], as well as on new strategies for the adaptation of crop management and varieties to these new conditions [3, 4]. The latest researches in this field regard the grapevine adaptations to stress conditions changing climate effects on grapes productions, grapes composition, wine typicity, and pathogens behavior. Today, of the importance the topic is given also by the recently created OIV group of experts „Viticultural Environment and Climate Change" who have developed the OIV guidelines for studies on the effects of climate change in vitiviniculture and proposed adaptations [8, 11]. This study is aimed to determine the effects of the climate changes from last decade on the vegetative growth of grapevine, grape yield and quality for Feteasca regală variety.

MATERIAL AND METHOD

The studied vineyard was established in the year 1994 along the North - South direction in the University of Agricultural Sciences and Veterinary Medicine, Bucharest. The plant material used was the 21Bl Feteasca Regală clone on the Kober 5 BB rootstock, with distances of plantation of 2.2/1.2 m.
It has been studied the spur prunet cordon with three bud loads: 10, 15 and 20 buds/m².
The trial was conducted for 10 years (2001-2010) with 3 repeats in such a way that there would be 10 vine per parcel.
From the analysis of climate data, the following agroclimatic indices have been calculated: the average year temperature (°C); the average temperature during the growing period (°C); the average temperature of the hottest month (July or August) (°C); the length of the growing season (days); the active thermic balance ($\sum^{o}$ta); the useful thermic balance ($\sum^{o}$tu) (°C); the sum of the hours of real insolation ($\sum$ir); the sum of the annual precipitations (mm); the sum of the precipitations from the growing period (mm); the real heliotermic index (IHr); the hydrothermic coefficient (CH); the deficit of precipitations (DP-mm); the viticultural bioclimatic index (Ibcv) and the index of the oenoclimatic aptitude (IAOe).

The data collected during the study was: the eliminated pruning wood (kg/vine), the grape yield (kg/vine), the cluster weight (g), the weight of one hundred berries (g), the sugar content (g/l) and the titratable acidity (g/l H_2SO_4).

To calculate the dry matter, the quantity of annual wood eliminated at pruning and the grapes, yield have been increased with the coefficients 0.5 and 0.2 respectively. The dry matter of the leaves was calculated with the help of the formula „m² leaf surface x 65 g/m²".

RESULTS AND DISCUSSIONS

1. The climatic conditions. Following the average annual temperature in the period 1961-2010 (Fig. 1), it can be observed it's upward trend over the past 10 - 15 years.

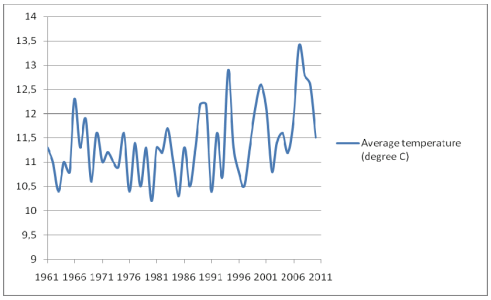


Fig. 1. Evolution of the average annually temperature (° C) for the period 1961-2010

The most pronounced increase is noticed in the hottest month of the year (July or August), when the values of the temperatures of this month during the experimental period, in 7 out 10 years, exceed the values of the average multiannual temperature (Table 1).

Following the evolution of the annual precipitation sum over the 1961-2010 period (Fig. 2), during the last decade, there have been established large variations from one year to another, because of the increasing annual sum, from 615 mm (the 50 years average sum of precipitations) to 659 mm (the average sum of precipitations between 2001 and 2010).

At the same time, the precipitation deficit from May to August, that interest the irrigated vines, has increased during the last decade: during the experimentation the average value was 135 mm, compared with the multiannual average of 99 mm. The enoclimatic aptitude index for producing red wines (IAOe) had a significant increase during the recent years, highlighting their favorability for red wine varieties.

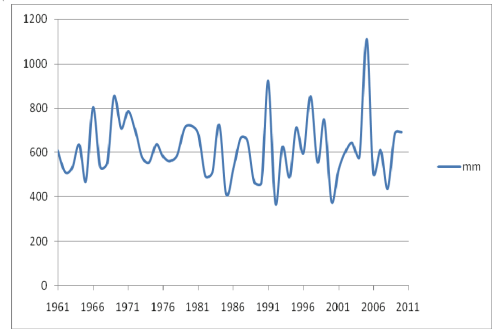


Fig. 2. Evolution of the sum of annually precipitations (mm) for the period 1961-2010

2. The influence of climate change on the vegetative growth parameters. As a consequence of the climatic variations from one year to another, the vegetative growths, the leaf surface and the accumulation of dry matter in the annual organs of the vine, registered high variations according to the hydric and the heliothermic regime (Table 2).

The annual quantity of wood remained at pruning at the end of the year 2002 was of only 0.295 kg/vine, while the values from the other years were 1.1-1.3 kg/vine, as a result of the accentuated deficit of precipitations from the growth period. The values of leaf surface were also reduced in same year only 1.73 m²/vine, compared with 3.5-4 m²/vine during the other years of culture. The dry matter accumulated in the annual organs of the vine (annual pruning wood, grapes, leaves) in the year 2002 totalized, in average 1.70 kg/vine, representing less than half from the values of a very favorable year for viticulture.

3. The influence of climate change on yield quantity and quality. The yield of grapes has varied in large limits (Table 3), according to the year of culture: from 2.596 kg/vine in an unfavorable year (2005) to 7.284 kg/vine in a very favorable year (2006). The accumulation of sugar was stimulated by the climatic warming an the hydric deficit in 2002, 2003, 2007 and 2008, arriving in average to 192.8 g/l (2002), 197.2 (2007), 203.7 (2007) and 196.8 (2008).

Due to the early maturation of the grapes during the high temperature periods, the titratable acidity of the must had lower values because of the combustion of the organic acids being more intense at high values of temperature.

Table 1. Climatic indicators

Climatic index	Average 1961-2010	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Average 2001-2010
Average year temperature (ºC)	11.3	10.80	10.8	9.9	11.6	11.2	11.1	13.4	12.8	12.6	11.5	11.6
Average temperature from the growing period (ºC)	18.6	18.10	18.5	19.4	17.6	17.8	18.2	19.1	17.9	19.1	19	18.5
Average temperature of the hottest month (VII-VIII) (ºC)	22.9	23.30	23.8	25.2	22.8	22.5	22.6	27.3	25.6	24.1	24.9	24.2
Length of the growing season (days)	201	190	180	181	211	200	202	199	207	203	192	196
Active thermic balance (∑ºta)	3738	3444	3328	3511	3721	3564	3675	3816	3709	3885	3649	3.630
Useful thermic balance (∑ºtu)	1728	1544	1528	1701	1611	1564	1655	1826	1649	1855	1729	1.666
Sum of the hours of real insolation (∑ir)	1157	1629	1413	1735	1483	1481	1568	1604	1694	1648	1409	1.566
Sum of the annual precipitatios (mm)	615	492.5	606.6	814.9	582	1109	562.3	610	435	686	692	677
Sum of the precipitatios from the growing period (mm)	361	283	353	429	378	840	340	248	298	391	397	395
Real heliothermic index (IH r)	2.44	2.51	2.15	2.95	2.38	2.31	2.59	2.93	2.79	3.05	2.43	2.6
Hydrothermic coefficient (CH)	1.00	0.82	1.06	1.22	1.01	2.35	0.92	0.65	0.8	1.35	1.08	1.1
Deficit of precipitatios (DP-mm)	99	129	122	301	104	-78.3	97	250	221	109	100	135
Viticultural bioclimatic index (Ibcv)	8.67	10.43	7.4	7.8	6.9	3.14	8.39	12.4	10.16	8.06	6.74	8.1
Index of the oenoclimatic aptitude (IAOe)	4694	4896	4685	5073	4569	4258	4803	5266	5092	5391	4859	4.889

Table 2. The vegetative elements of the vine according to the climatic conditions of the year of culture (Feteasca regală 2001-2010)

Specification	Bud load (bud /m²)	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Average 2001-2010
Pruning weight (kg/vine)	10	1.026	0.252	0.89	0.86	1.11	1.152	0.618	0.856	0.527	0.774	0.807
	15	1.11	0.258	1.014	1.33	1.306	1.188	0.632	0.896	0.519	0.956	0.921
	20	1.67	0.375	1.384	1.712	1.465	1.428	0.799	0.984	0.628	0.953	1.140
	Mean	1.269	0.295	1.096	1.301	1.294	1.256	0.683	0.912	0.558	0.894	0.956
Leaf area (m²/vine)	10	3.45	1.64	3.25	2.37	3.45	2.85	3.32	3.29	3.8	3.95	3.14
	15	4.06	1.66	3.35	2.53	3.67	4.17	4.07	4.03	4.07	4.32	3.59
	20	3.85	1.90	4.04	3.14	3.65	4.36	4.90	4.71	4.17	4.30	3.90
	Mean	3.79	1.73	3.55	2.68	3.59	3.79	4.10	4.01	4.01	4.19	3.54
Total dry matter accumulated in the annual organs (kg/vine)	10	1.35	0.83	2.25	1.38	1.26	2.17	1.11	1.66	1.45	1.24	1.47
	15	1.50	1.04	2.25	1.70	1.46	2.17	1.18	1.69	1.54	1.31	1.58
	20	1.73	1.34	2.02	1.89	1.47	2.66	1.53	1.82	1.83	1.26	1.76
	Mean	1.53	1.07	2.18	1.66	1.40	2.33	1.28	1.72	1.61	1.27	1,60

Table 3. Yield of grapes according to the quantitative and qualitative aspect depending on the climatic conditions of the year of culture (Feteasca regală 2001-2010)

Specification	Bud load (bud/m²)	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Average 2001-2010
Yield (kg/vine)	10	2.760	3.000	4.070	3.179	2.411	7.057	2.935	4.821	4.148	2.701	3.708
	15	3.280	4.040	5.140	3.236	2.852	6.500	3.018	5.030	4.470	2.528	4.009
	20	4.440	5.190	5.270	3.977	2.525	8.295	4.067	5.438	5.513	2.330	4.705
	Mean	3.493	4.077	4.827	3.464	2.596	7.284	3.340	5.096	4.710	2.520	4.141
Average weight of a grape (g)	10	47.8	64.8	89.1	63.1	71.5	144.2	88.6	109.5	104.3	118.2	90.1
	15	58.3	57.9	96.1	51.3	65.1	146.8	98.1	112.2	98.6	96.4	88.1
	20	52.4	56.3	82.9	49.5	56.5	151.7	83.6	110.5	104.5	108.5	85.6

	Mean	52.8	59.7	89.4	54.6	64.4	147.6	90.1	110.7	102.5	107.7	87.9
Weight of one hundred beries (g)	10	143.5	110.6	156.0	186.3	170.7	183.2	135.8	162.5	134.7	168.4	155.2
	15	147.0	128.6	173.1	173.5	161.8	177.1	131.6	162.9	132.2	171.1	155.9
	20	153.6	130.0	149.5	158.2	167.5	180.8	152.6	168.8	136.8	166.0	156.4
	Mean	148.0	123.1	159.5	172.7	166.7	180.4	140.0	164.7	134.6	168.5	155.8
Sugar (g/l)	10	171.1	192.2	193.7	164.2	176.3	188.8	203.7	196.3	174.8	211.8	187.3
	15	185.0	196.6	200.6	171.0	174.3	194.3	201.8	196.7	180.1	215.6	191.6
	20	178.8	189.5	197.3	162.8	169.8	196.3	206.0	197.3	185.8	218.1	190.2
	Mean	178.3	192.8	197.2	166.0	173.5	193.1	203.8	196.8	180.2	215.2	189.7
Acidity (g/l H_2SO_4)	10	4.01	3.48	3.52	6.14	6.29	4.86	3.99	4.14	5.09	4.39	4.59
	15	3.75	3.53	3.21	5.88	5.97	4.96	4.11	4.21	5.38	4.30	4.53
	20	3.92	3.43	3.28	5.83	5.88	4.91	3.95	4.18	5.13	4.37	4.49
	Mean	3.89	3.48	3.34	5.95	6.05	4.91	4.02	4.18	5.20	4.35	4.54

In Fig. 3, there is presented the correlation between the average temperature of the hottest month (July or August) and sugar accumulation, and in Fig. 4 there is shown the correlation between the useful thermic balance and sugar accumulation.

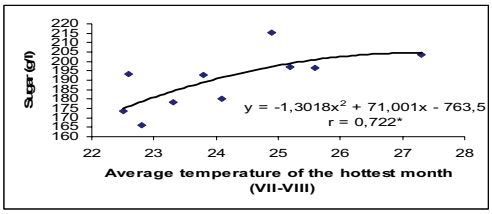


Fig. 3. Correlation between the average temperature (ºC) of the hottest month (VII-VIII) and sugar accumulation (g/l)

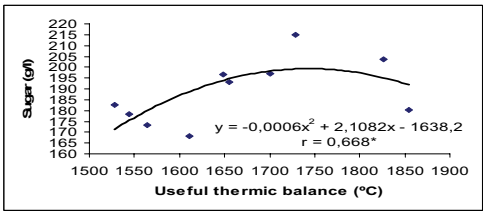


Fig. 4. Correlation between the useful thermic balance (ºC) and sugar accumulation (g/l)

CONCLUSIONS

The impact of high temperatures on grapevine and quality of grapes is to cause early ripening, increased sugar content and reduced acidity.

In order to diminish the impact of climate change it is necessary to adapt the cultural practices (the size of the bud load attributed of pruning, the application of some green operations, the water conservation from the soil, the irrigation etc) to the evolution of climate over time. Also the expansion of varieties adapted to the climate varming and the cultivation area of the red wine grape varieties are important.

REFERENCES

[1] Bonnefoy C., Quenol H, Planchon O., Barbeau G., 2010. *Températures et indices bioclimatiques dans le vignoble du Val de Loire dans un contexte de changement climatique*. EchoGéo, 14. http://echogeo.revues.org/12146 (8.06.2012).

[2] Burzo I., Dejeu L., Şerdinescu A., Bădulescu Liliana, 2005. *Fiziologia plantelor de cultură. Vol. III – Fiziologia viţei-de-vie*. Editura Elisavaros, Bucureşti, p. 300.

[3] Carbonneau A., Ojeda H., Escudier J.L., 2010. *Systèmes de production innovants en viticulture durable, face aux changements du climat et de la consommation.* Progrès Agricole et Viticole, 127 (13-14), 284-292.

[4] Carbonneau A., 2011. *Quelques idees de strategies viticoles face au changements climatique.* Progrès Agricole et Viticole, 128 (15/16), 301-305

[5] Duchêne E., Huard F., Dumas V., Schneider C., Merdinoglu D., 2010. *The challenge of adapting grapevine varieties to climate change*. Climate Research, 41, 193-204.

[6] Duchêne E., Butterlin G., Dumas V.,2012. *Toward the adaptation of grapevine varieties to climate change: QTL and candidate genes for developmental stages*. Theoretical and Applied Genetics, 124, 623-635.

[7] Holland T., Smit B., 2010. *Climate change and the wine industry: Current research themes and new directions*. Journal of Wine Research, 21 (2-3), 125-136.

[8] Quénol H. et al., 2012. *Variabilité Spatiale du Climat a l'echelle des terroirs viticoles dans un contexte de changement climatique: Programmes TERVICLIM et TERADCLIM.* Organisation Internationale de la Vigne et du Vin, Paris, le 13 mars 2012.

[9] Schultz H.R.,2010. *Climate change and viticulture: Research needs for facing the future.* Journal of Wine Research, 21 (2-3), 113-116.
[10] Tomasi D., Jones G.V., Giust M., Lovat L., Gaiotti F., 2011. *Grapevine Phenology and Climate Change: Relationship and Trends in the Veneto Region of Italy for 1964 to 2009*. American Journal of Enology and Viticulture, 62 (3), 329-339.
[11] *** - *OIV guidelines for studies on the effects of climate change in vitiviniculture and proposed adaptations.* Organisation Internationale de la Vigne et du Vin, Paris, le 13 mars 2012.


EX·TERRA·AVRVM

Scientific Papers, Series B, Horticulture, Vol. LVI, 2012
CD-ROM ISSN 2285-5661, ISSN-L 2285-5653

ORGANIC WEED CONTROL MEASURES APPLIED IN ORGANIC VEGETABLE

Elena CATANĂ[1,2], Gheorghe CÂMPEANU[2], Nicolae ATANASIU[2], Gabriela NEAȚĂ[2], Vasilica MANEA[2, 3], Valeria STUPCANU[2]

[1]Oficiul Județean de Consultanță Teleorman;
[2]Facultatea de Horticultură, USAMV, Bd. Mărăști, No. 59, Sect. 1, Bucharest, România;
[3]National Institute For Chemical - Pharmaceutical Research and Development – ICCF Bucharest.

Corresponding author email: elenacatana2009@yahoo.com*;* z18silvia@yahoo.com

Abstract

Plants that appear in cultures without interest are considered harmful for the production because of its infected potential. For removal the inconvenient of these plants the weeds are removed from the culture. Classical method of eliminating weeds is to dig culture. Also, weeds culture remains useful, without having a density that affects production. In order to improve productivity and product quality have used several methods to remove weeds from solanaceous crops. It is observed the efficiency of chicken associations with tomatoes and heat elimination of weeds.

Key words: *favorable associations, sustainable development, weeds*

INTRODUCTION

According to many scientists weeds are considered undesirable plant species found in soils worked and cultivated crops, which causes some damage expressed by reduction in production and quality. Weeds are considered important components in agrobiopedocenozez [4]. There are situations when weeds be controlled regardless of their weeding as the species commonly called "key weed" (weed Cuscuta, Orobanche), dangerous weeds (creeping wheatgrass, thistles, bindweed, wild mint) are perennial weeds that can fight hard with work of hoeing and hand removal of rhizomes. Beneficial weeds are thistles, clover, legumes spontaneous *Portulaca Oleraceea* [2]. If plants remove greenhouse pests are plants and trees that protect against disease. Action is a result of odor repellent plants, especially the fact that these plants belonging rotting plant debris from the trees and plant-health specific substances are absorbed by the root of the trees and enter into their flow. Therefore the action of these plants is not immediate but after 1-2 years [16]. Control weeds, pests and diseases must be made through preventive means, biological and mechanical. Possible will use the natural ability to inhibit proliferation crop weed [15]. In the years 1990-2000 were identified 706 species of weeds. In certain limits weeds are tolerated and considered partners of ecosystems [6]. Weeding was determined dynamically during critical crop to weed called herb critical period. Based on the number and mass of green weed threshold was considered a weed pest, extent and gravity of weeding number [4]. Preventive methods are the most important agro technical and chemical measures [13]. Only weeds are responsible for a reduction of nearly 34% of crop yield [3, 6, 7]. Processing intensive soil tended to decrease production of lettuce (*Lactuca sativa*) and broccoli (*Brassica oleracea*) in time. Weed density of shepherd's purse and nettle was lower in treatments with compost [12]. Use of herbicides represent one of the most effective weed control measures, but not replaces, nor exclude other maintenance of soil [14]. The same area, in addition to crop rotation is necessary and a rotation of herbicides with a different spectrum of anti [13]. Weed density of shepherd's purse and nettle was lower in treatments with compost [12]. Organic farming involves giving up the application of herbicides, balanced nutrition and correcting soil deficiencies that typically favor the occurrence of such weeds: sedges grow wet, dry ground plantain indicate, daisies grown in poor. The practice of

cultivating plants in the alternative "bio" is based on making the maximum economic and relative fertility of the soil. Without knowledge of qualities and deficiencies in culture took earth and improve the measures to be taken there can be no assurance of economic fertility, relative and constant [11, 17]. The most important works that contribute to weed control soil are: plowing, seedbed preparation, hoeing and weeding. Through a deep plowing perennial weed will be destroyed by cutting and burying them. Annual weed species and the perennial part will be destroyed by the mechanical work energy to destroy weeds - hoeing. To control perennial species take 3-4 mechanical weed [13].

MATERIAL AND METHOD

The land on which experiments were made of 0.40 ha is private property, of which 0.10 ha certified organic, located in southern Muntenia, County Teleorman. Existing weeds in the farm to the study were pig weed, veronica. Plants grown in the field are tomatoes, eggplant and peppers. Fertilizers for strengthening vegetables: Nettle dough (1 kg chopped fresh herb + 10 liters of water is kept in the shade to 4 days fermenting. Use the dilution of 1/20 for ground and 1/10 for spraying plants) and compost weeds (which is done in 4 weeks) [5, 8, 9, 10]. The experimental cultures existing weeds have been disproved by several methods as follows:

- Mowing or pulling weeds before seeds form and its use as a composting material;
- Organic fertilization with fermented compost, good compost has no weed seeds to sprout
- Use of green fertilizers, manual and mechanical works (combines, cultivator, weed whack, rotary brush machine;
- Compliance period optimal crop establishment (establishment date programming according to curve the flight of insects);
- Using weeds biodynamic methods (introduction in soil ash obtained by burning their seeds). It can be mixed with water in dilution of 1:10 or sand or soil to 9 parts of this material. This mixture is applied to prepare the ground on calm days with no wind. Effective treatment will apply for up to 4 years. If there are several species of weeds is recommended production of such preparations for each species. News cultivating sunflower was removed along the rows of vegetables outside the solar not;
- Alternation of winter crops, spring out weeds;
- False sowing (planting bed preparation with 3-4 weeks before setting up its culture and irrigation);
- Weeds that have sprung were removed using a thermal method using a cylinder assembled burner stove. To eliminate their need 6 bottles/ha [8];
- Introduction of successive crops - tomatoes + cucumber

Tomato + beans;

- Alelopatic Tratment, the biological method: + marigold tomatoes, peppers + basil, tomato + cabbage + onion [7].

Method of assessing soil biological activity is done in September to estimate the frequency frames into the soil, the model Balasca - 1993; [2]. There are 4 rectangles 50/10 cm dispersed using blocks and 4 variants, in different soils (conventional and organic). Each rectangle straw were placed 20 pieces 2-3 cm distance and waited 14 days. Then there were the straw moved. Method improvement in humus content was achieved by introducing the culture of leguminous plants (peas) by Badea et al., 2005 [1].

RESULTS AND DISCUSSIONS

Weed control in tomato crop by planting false on 100 sqm, with predominant weeds Veronica, news, *Portulaca Oleraceea* (Table 1).

Table 1. The tratment of weeds through false sowing at tomato culture

	Density of weeds/sqm	
	Experiment	Control
At the rising of control culture	18	26
At 14 days from the rising	29	48
At 30 days from the rising	34	69

At the emergence of control culture, experiences in the field are 18 weeds and control group have 26. At 14 days after culture emergence in the experimental field were 29 weeds and 48 weeds in the control area. At 30 days after emergence were observed 34 weeds in field experience and 69 weeds in control field. After 30 days of control culture springing in the experimental field consisted of 16 weed emergence, while the historical control of 43 weeds were counted in control area. The control of weeds by heat is used as a way to control weeds such pig weed, on an area of 100 sqm (Table 2).

Table 2. The tratment of weeds through heat control of them at tomato culture

	Density of weeds/sqm	
	Experiment	Control
At the rising of control culture	2	32
At 14 days from the rising	6	51
At 30 days from the rising	18	74

At the emergence of control culture in the experimental field was 2 weeds, while the areas of weed control were 32. At 14 days after emergence is observed that the experimental culture are six weeds and the weed control were 51. At 30 days after emergence, weeds were 18 in the experimental field and on the control 74. During the 30 days of experiment, the cultures have emerged weeds in experimental field 16 and 42 appeared to control weeds. Results of flame burning weeds in eggplant culture, area 1000 square meters, at a density of 0.70 cm, depending on the time of treatment in the Table 3.

Table 3. The elimination of weeds with flame burning

Variants	V1	V2	Control
	At 10 days from transplanting	At 20 days from transplanting	
Results	15 weeds/sqm	35 weeds/sqm	30 weeds/sqm

At variant v1 (Table 3) there were fewer weeds as he died some time after planting, germination of all existing weed seeds to light. At a time increased more weeds pop up in square. The variants v1 and v2 were totally destroyed by flame, while the control culture remained all weeds.

Table 4. Consumption of gas flame burning weeds in eggplant culture, area 1000 square meters, at a density of 0.70 cm between rows and 0.40 cm between plants in the row

	V1	V2	Control
Consumption of gas flame burning	15Liters	20 Liters	0
Results regarding the efficiency	91%	87%	0

After burning the weeds by flame (Table 4) was observed that maximum efficiency was achieved in 20 liter gas consumption in 1000 mp. The control was untreated, weeds are growing. Flame burning weeds in eggplant culture, area 1000 square meters, at a density of 0.70 cm, depending on the type of weed, weed type correlated with the existing culture.

Table 5. The elimination of weeds with flame burning at eggplant culture, in correlation with typs of weeds existed in culture

	V1	V2	Control
Weeds	Monocoty-ledonous weeds	Dicotyledonous weeds	Monocotyledonous and Dicotyledonous weeds
Results	78%	88%	0

The percentage of destruction was not 100%, because of the existence of perennial weeds culture. Monocotyledonous weeds were destroyed in the 2-3 leaf stage, because at that time are sensitive to heat (Table 5). Combustion was achieved a temperature of 70-80°C, so that protein coagulates and weeds die.

Table 6. Weed control by biodynamic methods, respectively ash ratio 1:9 with sand or dry soil

Specie of weeds eliminated	Byodinamic methods	Results, procent from total number of weeds existed in control culture
creeping wheatgrass (*Agnopyrom repens*)	Green manure (pea)	80%
gulf (*Convolvus arvensis*)	Monoculture of green beans	72%
veronica (*veronica*)	Sunflower culture	80%

Reproduction of new weeds is inhibited by the introduction into the soil of ash obtained by burning their own seeds (Table 6). This is repeated for 3-4 times in a row. The results show that the percentage of all existing weed

control cultures is reduced by 20% in case of application of green manure (pea) for creeping wheatgrass, 28% in monoculture beans for gulf and 20% sunflower cultivation for veronica. Weeds die only if in the soil is or introduce something that they do not want. Most weeds have medicinal value: plantain, Trast Shepherd. Beneficial weeds are dandelions, clover and other legumes [2].

Table 7. Weed control in tomato crop using association tomatoes with chicken, 200 sqm, with 100 offspring

	Density of weeds/sqm	
	Experiment	Control
At 10 days from the planting	2	154
At 30 days from the planting	3	314
Crop	3 kg/wire	2 kg/wire

At 10 days after planting shows that the field experience are just two weeds, while in control cultures are 154 weeds. At 30 days after planting, the experimental culture - two weeds, which represent 314 compared with control weeds. In 20 days of experiment, test shows that the culture has grown a weed, compared with 160 in the controls weeds. Output gap was a wire tomato kg. Chickens ate weeds, fertilized the culture with a fertilizer rapidly mineralized and mobilized soil around plants [8]. Effects of plant associations are: - better resistance against certain diseases and pests - shelter for useful auxiliary plants - effectively fight against weeds, - enrichment in organic nitrogen by leguminous crops, - enrichment in humus, - the use of groups which act mycosis

CONCLUSIONS

1. Control of weeds by planting false tomato culture reduces the number of weeds from 69 to 34.
2. Weed control by thermal emergence caused a reduction in the number of weeds from 74 to 18.
3. Removing weeds by burning flame is efficient to 10 days after planting. After burning flame weed at a density of 0.70 cm between rows and 0.40 cm between plants, in the row was observed that maximum efficiency was achieved in 20 liters gas consumption in 1000 mp. The percentage of destruction was not 100%, because of the existence of perennial weeds culture. Monocotyledonous weeds were destroyed in the 2-3 leaf stage, because at that time are sensitive to heat.
4. In the case of weed control by biodynamic methods, respectively ash ratio 1:9 with sand or dry soil the results show that the percentage of all existing weed control cultures is reduced by 20% in case of application of green manure (pea) for creeping wheatgrass, 28% in monoculture beans for gulf and 20% sunflower cultivation for veronica.
5. When it is used weed control in tomato crop by association tomatoes with chicken, 200 sqm, with 100 offspring the chickens ate weeds, were fertilized with a fertilizer culture rapidly mineralized and mobilized soil around plants.

ACKNOWLEDGEMENTS

Special thanks to Prof. dr. Gheorghe Campeanu and Prof. dr. Nicolae Atanasiu and to the Department of Chemistry, Faculty of Biotechnology of Veterinary Medicine.

REFERENCES

[1] Badea, Rodica Liana si colab., 2005. *Indrumar de practica traditionala si ecologic in legumicultura*. Ed. Estafalia, Bucuresti.
[2] Balascuta, N., 1993. *Protectia plantelor de gradina cu deosebire prin mijloace naturale.*, Ed. Tipocart, Brasov.
[3] Batish, D., Singh, H. P., Kohli, R. K., Kaur, S., 2008. *Eucalyptus essential oil as a natural pesticide*, Forest Ecology and Management, 256:2166–2174.
[4] Bucur, Gh., 2011. *Rolul culturii protectoare in controlul biologic al buruienilor la culturile prasitoare.* Ştiinţa agricolă, nr. 2/2011. ISSN 1857-0003, p. 10-13.
[5] Calin, Maria, 2005. *Ghidul recunoasterii si controlului daunatorilor plantelor legumicole cultivate in agricultura biologica*. Ed. Tipoactiv.
[6] Chirila, C., Ciocarlan, Berca, M., 2002. *Atlasul principalelor buruieni din Romanaia*. Ed. Ceres, Bucuresti.
[7] Chirila, C., 2001. *Biologia buruienilor*., Ed. Ceres, Bucuresti.
[8] Fitiu, A., 2003. *Ghidul legumicultorului in agricultura ecologica*. Ed. Risoprint, Cluj-Napoca.
[9] Fitiu, A si colab., 2003. *Controlul patogenilor plantelor in agricultura ecologica*. Ed. Risoprint, Cluj-Napoca.

[10] Fitiu, A., 2000. *Valorificarea in agricultura a compostului rezultat din compostarea deseurilor menajere*. Teza Doctorat, USAMV Cluj-Napoca.
[11] Florea, N., 2003. *Degradarea protectiei si ameliorarea solurilor si a terenurilor*. Ed. Ceres, Bucuresti.
[12] Jackson L. E., Ramirez, I., Yokota, R., Fennimore, S. A., Koike, S. T., Henderson, D. M., Chaney, W. E., Calderón, F. J., Klonsky, K., 2004. *On-farm assessment of organic matter and tillage management on vegetable yield, soil, weeds, pests, and economics in California*. Agriculture, Ecosystems and Environment, 103:443-463.
[13] Micu, L. M., 2008. *Protectia culturii la cartof.* Agroconsultim iulie-august, 2008.
[14] Moigrădean, D., 2010. *Cercetari privind influenta ingrasamintelor si erbicidelor asupra productiei si indicilor calitativi a unor soiuri de tomate*. Teza de doctorat, Universitatea de Ştiinte Agricole si Medicina Veterinara a Banatului, Timisoara.
[15] Ordinul MAPDR, nr. 1270/2005 şi MMGA, 1182/2005 din 30.11.2005 privind aprobarea Codului de bune practici agricole pentru protectia apelor împotriva poluarii cu nitrati din surse agricole Publicat în Monitorul Oficial, Partea I nr. 224 din 13.03.2006.
[16] paradisulmeu.wordpress.com, 2011b. *Plante sanitar pentru mentinerea sanatatii pomilor.* http://paradisulmeu.wordpress.com/category/agricultura-ecologica/
[17] Stoian, Lucian, 2005. *Ghid practic pentru cultura biologica a legumelor*. Ed. Tipoactiv.


EX·TERRA·AVRVM

Scientific Papers, Series B, Horticulture, Vol. LVI, 2012
CD-ROM ISSN 2285-5661, ISSN-L 2285-5653

THE INFLUENCE OF SOME FOLIAR FERTILIZERS APPLICATION ON THE SEED PRODUCTION OF FRENCH BEAN

Ana-Emilia CENUŞĂ

University of Agricultural Sciences and Veterinary Medicine, Bucharest, 59 Marasti, District 1, 011464, Bucharest, Romania, Phone: +40 21 318 25 64/232, Fax: + 40 21318 28 88, E-mail: ema_april@yahoo.com

Corresponding author email: ema_april@yahoo.com

Abstract

The paper presents the results concerning a study on the influence of some foliar fertilizers grown in a comparative crop in some dwarf French bean varieties used for seed production. The research works were carried out during the year 2011. Foliar fertilization, which is an environmental friendly method of applying nutrients, proved to be an important factor to achieve high yields. Biological material under trial was represented by two dwarf Romanian varieties having green pods (Fantastica, Delicioasă de Pasărea) and one dwarf Romanian varieties having yellow pods (Margareta). For the foliar fertilization, three products were used, Agroleaf Power Total 0,3%, Phyto's K 0,3%, MeForte 0,3% + CaForte 0,3% that were applied in all the physiological phases, at every ten days. The variants were grown in an experimental field according to the method of subdivided plots with three replications. The observations performed concerning the phenology and morphological traits of the plants (plant pod number, pod length and weight of one thousand seeds) allowed an accurate characterization of the varieties under investigation as well an optimum recommendation for the foliar fertilising scheme. The processing of the production data of the seed crop was made according to the variance analysis. The appliance of foliar fertilizers assures very significant seed production differences. By using Agroleaf Power Total 0,3% for fazial fertilization to dwarf french bean at ten days, has a very significant influence to seed production obtained on area unit. The paper presents data from the Ph. degree thesis in the frame POSDRU/107/1.5/S/76888, project financed from the European Social Fund through the Sectoral Operational Programme for Human Resources Development 2007-2013.

Keywords: *dwarf french bean, foliar fertilizers, seed production, variety.*

INTRODUCTION

Fertilizers are main means to get higher production in the most grown plants if they are correctly applied taking into account plant requirements, soil characteristics and weather conditions [4].

Research works emphasized that in the conditions of a normally supplied soil with nutritive elements, dwarf French bean crop has small requirements regarding the level of fertilization and does not require on organic fertilization in the year of culture [7].

Several authors presented in their works results concerning chemical fertilization in dwarf French bean crop [8,9].

Others authors recommended in dwarf French bean crop according to the results of soil analysis both chemical fertilization and 1-2 foliar fertilizations with Mg and microelements of Folimax 0.3% type [10].

Due to a good economical efficiency regarding mechanical works at application of foliar fertilizers as well their rapid effect on the plant production they are more and more used in the growing technology of different species [2].

Fertilization is a modern and efficient means both for higher crops and improvement of the production and on the other hand it offers possibilities for reduction of consumption of fertilizers and energy [5].

„Use of some alternately and nonconventional sources as unpolluant source of nutrients applied foliaceous and periodically in vegetation represents a necessary and important variance to get ecological products residually unpolluted. Foliar fertilization assure both macro and microelements share as well organic substances which stimulate the process of metabolism of chlorophyl assimilation and energetal output. Foliar fertilization does not

replace soil fertilization but it can make it complete and even substitute it" [12].
We consider necessary the improvement of growing technology for seed production in dwarf French bean according to the provision of the Law no. 266/2002 by introduction of the scientifical results obtained by our own research works on foliar fertilizers which can contribute at the growing of seed production and their quality.
Nowadays there are very many foliar fertilzers of chemical and biological nature but we must establish the type and doses of fertilizers as well the conditions of their use at a maximum efficiency.

MATERIAL AND METHOD

The research work were carried out during the year 2011 in a comparative crop with some dwarf French bean for the seed production.
At dimensioning of the plots, at carrieng out of the observations performed during the vegetative period and in the technique of the data recording, we observed the provisions imposed by the experimental technique.
Experiments were placed in the experimental field according to the method of subdivided plots having three factors with three replications. The surface of the experience covered 1,000 msq. and it had 36 variants. The Factor A consists in foliar fertilizers with four graduations (a1-untreated, a2- Agroleaf Power Total 0,3%, a3- Phyto's K 0,3%, a4- MeForte 0,3% + CaForte 0,3%). The Factor B consists in varieties of dwarf French bean with three graduations (b1, b2-varieties with green pod-Fantastica, Delicioasă de Pasărea, b3-variety with yellow pod-Margareta). The Factor C represents time of application with three graduations (c1-recommended by the producer, c2- six treatments at every 10 days, c3- three treatments when plants were of 15 cm height, at the beginning of the flower buds and pod setting). The check control was the variant without any treatments.
In order to establish of the level of soil provisioning with nutritive elements, soil samples were picked up before the crop setting using a probe. Taking into account the bulletin of soil analysis of the soil all the variants were chemical fertilized with 300 kg/ha complex fertilizer N.P.K. 15.15.15. The plots were shaped in wide furrows having 1.5m width.
On each furrow three rows were sown at 35 cm apart with 5 cm distance between plants. Herbicides were applied premergently with Dual Gold 1l/ha and postemergently with Basagran 2l/ha. Some chemical treatments were applied with Vondozeb 0.2% + Topsin 0.1%, Funguran 0.4%, Ridomil Gold 0.3%, Milbeknoch 0.075%, Confidor Energy 0.1%, Mospilan 0.022% to control diseases and pests.
For the location, field works, experience setting, agrotechnical works and biological purifications general standards for the seed green bean crop were observed. Biological purifications represent a specific work for the technology of seed production and were carried out by mass negative selection, removing unsuitable plants id est sick or untypical for the variety [6].
For the specific treatments of the experiment, pesticide pump graduated cylinder and electronical balance were used. Foliar fertilizers were applied in the shape of aqueous solutions using 200-500 l water/ha.
During the vegetative period observations were made as fallows:
- phenological observations regarding the most important phenophase: sowing-sprouting, sprouting-start of blooming, sprouting-appearance of the first pod, number of days to technical maturation of the pods and physiological maturity of the seeds.
- biometrical determinations concerning the height of the plants, pod width, pod length, number of pods per plant. After harvesting of the plants at the physiological maturity of the seeds, seeds were picked up, weighted using an electronic balance and registered. Biometrical determinations were made to establish weight of the grains per plant and weight of one thousand dried seeds.
Computing of the seed yield obtained per ha in varieties of dwarf French bean treated with foliar fertilizers was made after the recommendation of the researchers from the field of vegetable seed production [1].
-denseness of the crop (plants/ha) 400,000 recommended in the production technology (35 cm/35 cm/80*5 cm)

- decrease of denseness (46%), where: biological purification (6%), phytosanitary purification (35%), mechanical damages (5%)
- denseness of the harvested plants (220,000 pl/ha)
- amount of seeds per plant (gr. seeds/plant)
- gross weight of seeds (kg/ha)
- evaluation of the loses due to mechanical conditioning of the seeds-represent a minus of about 25%.

The production data were statistically processed in order to establish economical optimum amount of foliar fertilizers. The processing of the results was made by the method of variance analysis while testing of the results significance was assured by the aid of F test on the error for a global evaluation and by the method of limited difference (DL) to test the significance of every variant in proportion to the control [3,11].

RESULTS AND DISCUSSIONS

Influence of the variants of fertilization on plant phenology was evident in the phenophase of the varieties.

Yields of seeds obtained in comparative culture for orientation (CCO) are different depending on the variant of fertilization (Table 1).

It is remarkable positive influence of the foliar fertilizers irrespective of the variant, production gains by comparison with control being significant. The best production results (to seeds/ha) were recorded in the case of fertilization with Agroleaf Power Total where gain yield by comparison with control is also very significant (0.92 to/ha). The smallest seed yield was recorded at the control plot unfertilized with foliar fertilizer (1.65 to/ha). By the use of foliar fertilizers significant gain yield ranging between 33.73% and 55.42% were obtained.

By the analysis of the significance of the differences at total seed production by comparison with the untreated variant we found the following actions of the factors under investigation:

-foliar fertilizer Agroleaf Power Total assured the highest differences of production in all varieties under investigation (1.02 to/ha at Delicioasă de Pasărea, 0.48 to/ha at Margareta)

-variety Delicioasă de Pasărea recorded the highest yields of seeds in all the variants foliar fertilized by comparison with the control untreated (0.71 to/ha)

-irrespective of the foliar fertilizer used and variety the highest seed yields were obtained at variants treated by six times during the vegetative period at every ten days (2.40 to/ha)

-action of the foliar fertilizer Agroleaf Power Total and interactions Agroleaf Power Total and the variety Delicioasă de Pasărea are very significant

-the lowest production difference by comparison with control untreated was obtained in the case of interaction among factors foliar fertilizer Phyto's K x variety Fantastica x time of application being according the three phenophase of the plants (0.23 to/ha).

Table 1. Synthesis of the results from the comparative culture for orientation of some French bean seed varieties under investigation

Variant	Seed yield (to/ha)	Variant	Seed yield (to/ha)
14-a2b2c2	3.40	6-a1b2c3	2.09
32-a4b2c2	3.21	18-a2b3c3	2.04
13-a2b2c1	3.18	26-a3b3c2	1.96
31-a4b2c1	3.14	36-a4b3c3	1.91
15-a2b2c3	3.11	12-a2b1c3	1.85
23-a3b2c2	2.65	25-a3b3c1	1.77
22-a3b2c1	2.59	7-a1b3c1	1.75
11-a2b1c2	2.55	27-a3b3c3	1.67
17-a2b3c2	2.52	29-a4b1c2	1.55
35-a4b3c2	2.52	9-a1b3c3	1.49
33-a4b2c3	2.49	28-a4b1c1	1.46
34-a4b3c1	2.48	20-a3b1c2	1.26
24-a3b2c3	2.47	30-a4b1c3	1.21
16-a2b3c1	2.43	19-a3b1c1	1.15
4-a1b2c1	2.42	21-a3b1c3	1.14
5-a1b2c2	2.13	1-a1b1c1	1.11
8-a1b3c2	2.10	2-a1b1c2	0.83
10-a2b1c1	2.10	3-a1b1c3	0.80

DL 5% = 0.36 to/ha; DL1% = 0.50to/ha; DL0.1% = 0.68to/ha.

CONCLUSIONS

These contributions to the improvement of the technology give the individual producers of green bean seeds solutions of a durable utilization of the resources in agriculture, diminuish soil and subsoil water pollution using friendly products for vegetable plants (foliar fertilizers efficient at a low dose).

Application of this technology will cause a main decrease of the production costs and of

energetic consumptions because it is not necessary their incorporation in the soil and on the other hand, they can be mixed up with pesticides at their application.

The weight of the grains per plant and weight of one thousand dried grains are primarily characteristics of variety with a strong influence on the yield but they can be influenced also by technological measures. Foliar fertilizers applied in dwarf green bean crop for seed production influenced the production significantly.

The highest gain yield were obtained by application of the foliar fertilizers Agroleaf Power Total applied in the vegetative period in six treatments at every ten days in the variety with green pod Delicioasă de Pasărea. Use of foliar fertilizers applied periodically in the vegetative period in dwarf green bean crop for seed lead to important gains yield very significant by comparison with the control unfertilized foliar ranging between 33.73%-55.42%.

Quantity and quality of the seeds are evidently influenced by the three factors: foliar fertilizers, variety, time of application.

ACKNOWLEDGEMENTS

The paper presents data from the Ph. degree thesis in the frame POSDRU/107/1.5/S/76888, project financed from the European Social Fund through the Sectoral Operational Programme for Human Resources Development 2007-2013.

REFERENCES

[1]Badea Rodica, Voican V., Tudor M., 1996. *Research on some parameters of aubergine seed production (Solanum melongena L.)*. RIVFG Annals Vidra, Vol. XIV: 241-252

[2]Burzo I., Toma S., Dobrescu Aurelia, Ungurean Livia, Ştefan V., 1999. *Physiology of the growingplants,volume II, Physiology of the field crops*. Enteprise for publishing Science Publishing House, Chishinew, p. 180-207.

[3]Ceapoiu N., 1968. *Statistical methods applied in the agricultural and biological experimental works*. Agricultural and Forestry Publishing House, Bucharest, p. 137.

[4]Ciofu Ruxandra, Stan N., Popescu V., Chilom Pelaghia, Apahidean S., Horgos A., Berar V., Lauer K.F., Atanasiu N., 2003. *Vegetable growing monography*. Ceres Publishing House, Bucharest, p. 572-602, 865-873.

[5]Dana Daniela, 2005. *Special foliar fertilization applied on the mother selfbred in order to optimize the content of micronutrients in seeds*. Ph. degree thesis, UASVM Bucharest, p. 5-121.

[6]Drăghici Elena-Maria, 2006. *Seed and planting stock production in the vegetable species*. Atlas Press SRL Publishing House, Bucharest, p. 69-72, 212-219.

[7]Dumitrescu M., Scurtu I., Stoian L., 1999, Vegetable growing, Artprint Publishing House, Bucharest, p. 535-547

[8]Hălmăgean L., 2000. *Drawing up of the growing technology for seed crop in french beans in the frame of specific agroechological area Arad*. Ph. degree thesis, UASVM Banat, Timishwar, p. 80-97.

[9]Ifrim Aurelia, Bălaşa M., 2004. *Researches regarding fertilization of garden beans, Aura variety on the sandy soils conditions from Dabuleni*. RIVFG Annals Vidra, Vol. XVII: 403-412

[10]Lăcătuş V., Badea Rodica, 200. *Fertilization of the vegetable crops grown in open field*. Agris Publishing House, Bucharest, p. 24-25

[11]Săulescu N.A., Săulescu N.N., 1967. *Experimental field*. Agricultural and Forestry Publishing House, Bucharest, p. 262-270.

[12]Stan N., Stan T., Munteanu N., Stoleru V., Bircescu L., Dorneanu A., 2004. *Alternative sources for an unpolluted and nonconventional growing systems in the frame of an ecological vegetable growing*. RIVFG Annals Vidra, Vol. XVII: 413-418.

Scientific Papers, Series B, Horticulture, Vol. LVI, 2012
CD-ROM ISSN 2285-5661, ISSN-L 2285-5653

RESEARCH AND RESULTS ON THE IMPLEMENTATION OF MODERN TECHNOLOGICAL ELEMENTS IN TOMATOES GROWN IN OLD INDIVIDUAL GREENHOUSES

Mileva CHIRICĂ[1], Gheorghe CÂMPEANU[1], Felicia STAN[1], Nicolae ATANASIU[1], Gabriela NEAȚĂ[1]

[1]University of Agronomical Sciences and Veterinary Medicine Bucharest, Horticultural Faculty, Mărăşti, 59, Sect. 1, Bucharest, Romania

Corresponding author email: neatag@yahoo.com

Abstract

Efficient use of old greenhouses for growing vegetables in the current period is only possible by applying modern technology that unconventional fluid and mineral nutrition is achieved by fertirigation with nutrient solutions of growing media. For making tomato crops for fresh consumption, have carried out the reconfiguration of the interior heat greenhouses by installing the old parapets, reposition the heating registers and levelers, totally unsuitable for use as a substrate rooting for tomato plants. As the rooting medium was used peat bags installed in opaque foil UV additive, ensuring a rooting volume of 12L, which were planted two seedlings, resulting in a density of 3.12 plants/ m^2. Nutritive solution was prepared and given with automatic installation, connected to the installation of fertigation mounted in greenhouse. There were used soluble compound fertilizers produced by Scott´s and Yara. Tomato crops produced with this technology, according to a specific cultural calendar cycle extended tunnels, there was a production of over 15 kg/m^2, the laboratory results have confirmed a low level of biochemical components within the limits prescribed by legislation for the production of tomatoes in protected culture.

Keywords: *biochemical analysis, nutrient solution, soluble fertilizer, tomato*

INTRODUCTION

Use as a production base, for vegetable old greenhouses, is a priority for farmers in their possession. Conventional soil cultivation technologies are expensive and polluting less productive land and vegetable species with which they work [8, 9]. Now is an unconventional alternative crop on organic or inorganic substrates, the use of which requires the use of a material base and specific technologies, whose application does not raise special problems [1, 2, 5, 6, 7].

This paper shows how to work for the redevelopment of old greenhouses, in order to achieve the necessary conditions for implementation of the tomato crop on peat, with fluid and mineral nutrition fertilization provided by closed circuit.

Solutions applied based on the results obtained in previous years the experimental program conducted to achieve a doctoral thesis.

MATERIAL AND METHOD

The material consists of bodies rearranged individual greenhouses with width of 6.4 m, built over 60 years ago.

These greenhouses are equipped with internal parapets of brick and concrete, were originally intended to produce flowers.

The use that was not economic in recent years, establishing redevelopment objective and necessary equipment for unconventional vegetable crops.

Major changes and features made are:

- For redevelopment inside the greenhouse:

- Balustrade interior demolition, the floor of the greenhouse was maintained former technological paths and surfaces of which, covered with brick and leveled;
- Repositioning the heating-pipes;
- Redeploying existing ventilation windows on the sidewalls and roof pitches;
- Installation of a network of supply lines for solution dropper nutritional bags of peat culture substrate;

- To prepare and distribute nutrient solution:

- Purchase and installation of an automatic cooking stations for nutritive distribution solution, the concentration parameters (EC) and reaction (pH), the scheduled quantities;
- Connection Station to a permanent water source and pressure mains;
- Connecting the station to prepare the solution to the distribution of greenhouses

Provide UV treated polyethylene bags where is introduced culture substrate

• To achieve experimental variants, tomato cultivars [10] used were:

- Katerina F1 - Dutch origin;
- Amanda F1 - created in Israel. Key Elements specific technology used in the experiment were:
- Cycle culture system with delayed planting, but in early February and end of harvesting in late June;
- Seedlings produced in large pots with sides 10 cm in peat substrate Biolan were planted at the age of 65 days;
- Scheme of planting seedlings equidistant away from 160 cm. On these occasions were placed opaque polyethylene bags with drainage holes applied to 5-6 cm above the base of support.

The rooting substrate bags of peat 12 L were planted two plants. Distance between centers of two bags per row was 40 cm.

From planting scheme - 160/40cm bag x 2 plants resulting density of 1.56 bags/m^2 or 3.12 plants/m^2. Nutrient solution is distributed with one hose with flow 2L/hour spaghetti type for each plant. Nutrient solution distributed plants with nutrients was within the following limits: - Total - 180-225 ppm nitrogen, potassium: 225-300 ppm, calcium: 145-185 ppm, magnesium: 38-42 ppm, phosphorus: 40-50 ppm, SO_4 - 40-60 ppm, micronutrients: iron, manganese, boron, copper, zinc, molybdenum.

As sources of nutrients [11] were used Scott´s soluble compound fertilizers and the addition of calcium nitrate and magnesium sulphate. Electroconductivity was maintained at values of 2.6 mS/cm^2 - 3mS/cm^2 and the pH was 6.4. Consumption of nutrient solution was between 50-60 mL/plant/day immediately after planting and from 1.6 to 1.7 L/plant/day in June on plants located in eight-9 blossoms.

To avoid increasing the concentration at the bottom of the bag, was determined periodically electroconductivity, intervening by increasing the flow of nutrient solution or irrigation water for a short period, in this way was reduce the nutrient solution. To ensure complete pollination in greenhouses with mosquito nets to windows of ventilation were used bumble. The felt they pollination by increasing the average weight of fruit for the first five blossoms. Flowers of the last three blossoms were open pollinated, with negative consequences on the average weight and fruit number. Plants, palisades the trellis height of 2.20 m, total child, have been cropped to 8 flowers. Plants were the only problems created by repeated and virulent attacks by white midge (*Trialeurodes vaporariorum*) on the same site due to the existence of greenhouses with collections of perennial flower species. The experience was made observations and measurements from which results were obtained, of which most important are listed below.

RESULTS AND DISCUSSIONS

Tomato culture presented was characterized by vegetative growth and balance alerts, developing a very robust unit leaf. The substrate used - Biolan coarse peat – [3, 4] the optimum conditions of moisture and aeration for plant roots in culture. Plant physiological status and allowed normal growth and enjoyment to the installation of high temperatures, above 35-38ºC at the beginning of June, which could not be controlled by the particular construction of greenhouses.

As I have shown you, temperatures caused excessive loss bumble, with direct consequences on vegetative fructification on flowers 6.7 to 8.

Results on yields achieved are presented in Table 1.

Fruit quality, determined by chemical and biochemical analysis is presented in Table 2.

Nitrate compounds that influence consumer acceptance of tomatoes in both cultivars accumulated in high amounts indicating that fertilization culture was better ensuring

achievement of genetic potential of these tomatoes.

Table 1. Total production and its components. Tomatoes (cycle I) the organic substrate (peat)

Specification	Katerina F1	Amanda F1
Average number of fruits per inflorescences 1-5	5.2	5.4
Average number of fruits per inflorescences 6-8	4.1	4.6
Average weight of fruit on inflorescences 1-5, g	136	144
Average weight of fruit on inflorescences 6-8, g	93	96
Production per plant on flowers 1-5, kg	3.540	3.890
Production per plant on flowers 6-8, kg	1.144	1.325
Total production per plant, kg	4.684	5.215
Production kg/m^2	14.614	16.270

Table 2. Biochemical and agrochemical components of vegetables

Specification	Katerina F1	Amanda F1
Nitrate, ppm	215.3	225.7
Phosphates, ppm	287.3	245.2
Potassium, ppm	2150	1980
Soluble carbohydrates,%	2.35	3.10
Acidity,%	0.43	0.41
Vitamin C, mg/100 g fresh tomato	15.45	14.38

Comparing the contents accumulated maximum permitted level in our country that this compound 300 ppm N-NO3 can be said to meet quality tomatoes for consumption. Phosphates also accumulated in large quantities from 287.3 ppm Katerina F1 to 245.2 ppm in Amanda F1 indicating that fertilization culture was observed and is good quality tomatoes.

If potassium can say the same thing, namely its accumulation in tomato provides a good quality transport and good firmness of fruit. Biochemical characteristics are also obtained in normal tomatoes taste so good.

CONCLUSIONS

Converting old greenhouses to go to their cultivation of vegetables is possible using equipment and materials that can be purchased and our country.

The production made the 14.614 kg/m^2/year at Katerina F1 and 16.270 kg/m^2/year to Amanda F1 can be considered as very good for growing tomatoes in greenhouses for over 60 years old. Tomato fruit quality judged by the nutrient content is good quality can be compared with tomato fruit obtained in normal culture. Nitrate content is good and falls under CMA of the Ministry of Health Law No. 1 from 2002 year, value presented of 300 ppm.

REFERENCES

[1] Atanasiu, N., 2005. *Cultura legumelor în câmp şi solarii*. Ed. Atar, Bucureşti.

[2] Atanasiu, N., 2009. *Culturi horticole fără sol*. Ed.Verus, Bucureşti.

[3] Biolan, 2012. *http://www.biolan.fi/english/default4.asp?active_page_id=526*

[4] Biolan, 2012. *Raw materials and additives, http://www.biolan.fi/pro/english/image/biolan_en.pdf*

[5] Câmpeanu Gh., 1993. *Biochimie vegetală*. Ed. Ceres, Bucureşti.

[6] Popescu V., Atanasiu, N., 2001. *Legumicultura*. Vol. III, Editura Ceres.

[7] Popescu, V., Atanasiu, N., 2000. *Legumicultură*. Vol. II, Editura Ceres.

[8] Greenhouse Tomato Handbook, 2012. *http://www.hort.purdue.edu/fruitveg/rep_pres/gsgh/pub1828.pdf*

[9] Greer, Lane, Steve, 2000. *Diver, Organic Greenhouse, Vegetable Production*. Horticulture Systems Guide, NCAT Agriculture Specialists, January, *http://www.naturalhabitinc.com/content/documents/GreenHouse-Vegtables-Production.pdf*

[10] The Search Engine For Tomato Varieties, 2012. *http://tomodori.com/3culture/3culturecadres.htm*

[11] Universol, *Ingrăşământ solubil.* Scott´s International B.V.Holand.


EX·TERRA·AVRVM

Scientific Papers, Series B, Horticulture, Vol. LVI, 2012
CD-ROM ISSN 2285-5661, ISSN-L 2285-5653

THE BEHAVIOUR OF SOME APPLE TREE VARIETIES WITH GENETIC DISEASE-RESISTANCE IN THE HIGH DENSITY SYSTEM

Daniel COMĂNESCU, Gheorghe PETRE, Valeria PETRE
Research Station for Fruit Growing Voineşti

Corresponding author email: statiuneavoinesti@gmail.com

Abstract

The researches performed at the Research Station for Fruit Growing Voineşti, in the period 2007-2011, had as object the study of 13 disease-resistant apple tree varieties, cultivated in the high density system, grafted on the graft bearer M 9, respectively: Ariwa, Golden Lasa, Goldrush, Enterprise, Inedit, Iris, Luca, Real, Rebra, Redix, Remar, Saturn, Voinicel, comparative with the Jonathan variety, taken as witness. The trees were planted at a distance of 4 x 1m (2.500 trees/Ha), spindle crown form. With high production potential remarked themselves the disease-resistant apple tree varieties Ariwa, Inedit and Saturn, which in the year 4 and 5 after planting realized over 30 t/Ha. In the same conditions, the apple tree varieties Real, Golden Lasa, Voinicel, Goldrush, Luca, Remar and Iris realized between 24.05 t/Ha and 26.7 t/Ha. The promotion of the high density apple tree system, in which disease-resistant apple tree varieties are previewed, represents a modality for periodical and rapid replacement of the assortments, leading to the identification of new modern technologies in obtaining of productions adapted to the requirements of the European quality standards.

Keywords: *high density system, disease-resistant varieties, productivity, fruits quality*

INTRODUCTION

The modern apple tree culture systems [4], with rapid fruit bearing start and short exploitation duration, represent a modality for the periodical and rapid replacement of the assortments, through this being encouraged the introduction of modern technics and ideas in obtaining of productions adapted to the exigences of the European quality standards. On the European level, they generalized the use of the reduced vigour graft bearers (M9), with tree sustaining and irrigation system, covering the orchardsds with an anti-hail net [2]. In the high density fruit trees exploitaion in France, Italy, Germany, Spain, Switzerland etc., with densities of 2,500 – 3,000 trees/Ha, they obtain remarkable performances, concretized by productions of 40 – 60 t/Ha.
The rersearches performed at the Research Station for Fruit Growing Voineşti in the period 2007 – 2011, were aimed at the increase of the competity [3], corresponding to the principles of the enduring development and of the food security, concretized in the promotion of a high density apple tree culture system [1], in wich are previewed elements specific to the Romanian varieties, comparative with the foreign ones, wich will lead in short time to the increase of the productive performances and to the increase of the economical efficiency, as immediate profitability, simultaneously with the implementation at the private producers.

MATERIAL AND METHODS

The researches were organized at the Research Station for Fruit Growing Voineşti in the spring of the year 2007, by setting up a plantation, in which we followed up the promotion of a high density apple tree system, based on disease-resistant varieties and on the adaptation of specific solutions, which has as effect the early fruit bearing and the permanent fructification on young wood.
The researches, deployed in the perioad 2007 – 2011, had in view the establishing of an apple tree assortement, destined to the biological production, cultivated in the ecopedoclimatical conditions of the Voineşti zone, being studied 13 genetic disease-resistant apple tree varieties of local and foreign origin, respectively: Ariwa, Golden Lasa, Goldrush, Enterprise, Inedit, Iris, Luca, Real, Rebra, Redix, Remar, Saturn, Voinicel, comparative to the variety Ionathan, taken as a witness. All varieties were grafted on the graft bearer M9.

The trees were planted at the distance of de 4 x 1 m (2500 trees/Ha), spindle crown form.
The soil of the experimental lot was fallow on the interval and maintained clean of weeds on the tree row. It is brown eumezobazic, weakly preudogleizat, with clayish texture, with a weakly acid pH (5,7–5,9). The content in humus is medium at the surface (2,0–2,9%), medium supplied with nitrogen and weakly supplied with phosphorus and potassium.
For pest combat, 6–8 treatments were applied, only with insecticides. The other works were performed according to the technology specific to the high density apple tree orchards.
At the apple tree assortment used at setting up the orchard, we followed up the vegetative tree growth, the fruit bearing precocity, the production levels, the fruits quality and other culture aspects, which represent factors to be taken into account at the promotion in culture of the high density system apple tree orchards.

RESULTS AND DISCUSSIONS

The growing vigour in the age year 5 of the trees, cultivated in the high density system, when the growth potential is well differentiated, shows us that between the apple tree varieties appear significant differencies, regardig the trunk thickness growth, the height and the thickness of the fructiferous fence.
The trunk is one of the elements, which characterizes the tree vigour and it is always analyzed and correlated with a series of other biometrical processes and indices.
The values regarding the trunk thickness, registered in the year 5 from planting, are presented in table 1.
With values of over 50 mm are inscribed the varieties Golden Lasa (50.07 mm), Luca (50.68 mm), Enterprise (52.53 mm), being the most vigorous in the conditions of grafting on the graft bearer M9.
Values of the trunk thickness, comprised between 40 and 50 mm, registered the apple tree varieties: Inedit (42.35 mm), Iris (43.00 mm), Voinicel (45.30 mm), Rebra (46.88 mm), Redix (48.18 mm), Remar (48.75 mm).
Values lesser than 40 mm registered the varieties: Goldrush (34.57 mm), Saturn (37.70 mm), Real (39.20 mm), Ariwa (39.31 mm).
At the Ionathan variety, taken as witness, the trunk diameter in the year 5 from plantation had an increase of 39.57 mm, framing in the varieties group which had the trunk thickness growth under 40 mm.
The medium growth increase shows values comprised between 4.94 mm at the Goldrush variety and 11.58 mm at the Redix variety, both varieties grafted on the graft bearer M9.
The trunk vigour in the year 5 from planting, represented by the trunk section surface, registers extreme values, comprised between 9.38 cm^2 at the Goldrush variety and 21.66 cm^2 at the Enterprise variety.
The data, statistically processed as compared to the Ionathan variety, taken as witness, point out very significant positive differences at the varieties Golden Lasa, Enterprise, Luca, Rebra, Redix, Remar and Voinicel. Distinctive significant positive differences were assured by the Iris variety – and significant positive differences by the Inedit variety.
Distinctive significant negative differences, as compared to the Ionathan variety, taken as witness, registers the Goldrush variety.
Vigour with unsignificant differences, as compared to the level of the Ionathan variety, have the varieties Ariwa, Real şi Saturn.
The tree dimensions and the crown volume registered in the year 5 presents near values, comparative to those of the year 4 from the tree planting. Thus, the trees height registers 225 cm at the Voinicel variety, 235 cm at the Goldrush variety, 240 cm at the Ariwa and Saturn varieties. The greatest trees height values are registered at the Enterprise (280 cm), Redix (285 cm) varieties and at the Luca and Remar varieties, with 290 cm. The Ionathan variety had the height of 250 cm.
The fructiferous fence thickness was comprised between 130–150 cm at the Inedit, Goldrush, Golden Lasa, Voinicel, Real varieties and values of over 170 cm had the Ariwa, Luca and Enterprise varieties.
The crown volume per tree, in the year 5 from planting, oscillated between 2.73 cm/tree at the Voinicel variety and 4.50 cm/tree at the Enterprise variety, comparative to the Ionathan variety, at which 3.52 cm/tree were registred.
The crown volumue in the year 5 after planting begin to be uniform, following to the trees

cuttings for crown height and thickness limitation. As compared to the Ionathan variety, taken as witness, the differences are unsignificant at the majority of the varieties. The statistical calculation registers significant positive differences only at the Enterprise and Luca varieties, these being considered vigorous varieties, even if grafted on the graft bearer M9.

Calculated on the surface unit, the crown volume registers values from 6825 mc/Ha at the Voinicel variety – to 11250 mc/Ha at the Enterprise variety.

Lesser vaues of the crown volume were registered at the varieties: Goldrush (6925 mc/Ha), Inedit (7475 mc/Ha) and Saturn (7600 mc/Ha). At the other varieties, the crown volume, calculated on one Hectar, approaches the value of 8800 mc/Ha, registred at the Ionathan variety, taken as witness.

The productivity of the genetic disease-resistant apple trees, was pointed out by annual registering the apple production at variety level.

Among the appple tree varieties cultivated in the apple tree high density system, the Iris variety, grafted on the graft bearer M9, has the tendency to bear fruits already from the year 2 after planting.

From the year 3 after planting, the 13 apple tree varieties with genetic resistance to diseases and the Ionathan/ M9 variety realized satisfactory productions, having in view that we used at planting seedling material from the field II of the nursery, rods, without anticipations, as support of the fruit bearing buds differentiation – already from the planting year.

From the data presented in table 3, rezults that from the studied apple tree assortement, the Romanian varieties, those early and productive, were: Real (7.5 t/Ha), Inedit (6.5 t/Ha), Iris (6.3 t/Ha), Remar (3.8 t/Ha).

From the foreign varieties, we point out, with their productions in the year 3 after planting: Saturn (5.8 t/Ha), Ariwa (5.5 t/Ha), Golden Lasa (5.5 t/Ha), Goldrush (5.0 t/Ha).

At the Ionathan/ M9 variety, taken as witness, we obtained in the year 3 after planting 3.5 t/Ha.

In the year 2010, the year 4 from planting, the medium production of the studied apple tree varieties increased over 4 times, as compared to the last year. The productions registered at the apple tree varieties with genetic resistance to diseases, cultivated in the high density system, were comprised between 10.7 t/Ha at the Rebra variety and 21.9 t/Ha at the Ariwa variety.

Among the Romanian varieties, which produced over 18 t/Ha, we point out: Inedit (18.5 t/Ha), Real (18.8 t/Ha), Remar (19.8 t/Ha), Iris (20.4 t/Ha) - and among the foreign ones: Golden Lasa (19.8 t/Ha), Goldrush (20.8 t/Ha), Saturn (21.6 t/Ha) and Ariwa (21.9 t/Ha). The Ionathan variety, taken as witness, registered in the year 4 from planting a production of 15.8 t/Ha.

In the year 2011, the year 5 from planting, the production was almost double, as compared to the former year. In this year the biggest productions were obtained, reaching over 42 t/Ha at the varieties: Ariwa (42.0 t/Ha), Inedit (42.2 t/Ha), Saturn (42.5 t/Ha). At the other varieties, were registered productions comprised between 28.5 t/Ha and 35.3 t/Ha, comparative to the Ionathan variety, taken as witness, at which 24 t/Ha were registered in the year 5 from planting.

Analyzing the medium production of the years 4 and 5 from planting, we observe that from the 13 apple tree varieties with genetic resistance to diseases, cultivated in the high density system, the most productive are the apple tree varieties: Ariwa, Inedit and Saturn, at which we obtained over 30 t/Ha. Appreciated with high potential are also the apple tree varieties, which registred medium productions of over 24 t/Ha, like: Real (24.05 t/Ha), Golden Lasa (24.60 t/Ha), Voinicel (24.2 t/Ha), Goldrush (25.15 t/Ha), Luca (25.85 t/Ha), Remar (25.9 t/Ha), Iris (26.7 t/Ha). The Ionathan variety, taken as witness, registered as a 2 years average a production of 19.9 t/ha.

The statistically calculated data confirm very significant positive differences, as compared to the Ionathan variety, taken as witness, at the majority of the studied genetic disease-resistant apple tree varieties.

The fruits quality, expressed by size, shows us a rather great amplitude, from 150 g at the Ionathan variety, taken as witness, to 190 g at the Rebra and Remar varieties. The fruits of over 170 g were obtained at the majority of the varieties – and smaller ones at the Goldrush (154 g), Inedit (155 g) and Voinicel and Iris varieties with 155 g, the registered differences being due especially to the genetic factors, respectively to the varieties (table 4).

The medium value of the fruits weight at variety level, in the perioad 2009–2011, shows that the Golden Lasa, Enterprise, Luca, Real, Rebra, Redix, Remar and Saturn varieties have the potential to assure the suitable fruits size, which shall compete on the market, the fruits framing in the big fruits class – and the other varieties frame in the medium fruits group.

The tree assortments are in a permanent change, the place of the varieties, presenting inferior commercial qualities, being taken by the new homologated varieties, which correspond to a higher degree to the consumers' continuously increasing requirements.

The apple tree varieties, which were study objects, can cover a great part of the consumption season, besides some of the genetis disease-resistant varieties, muliplied in culture, already known and apreciated on the market by the consumers.

In the table 4, we present the genetic disease-resistant apple tree varieties, which were the study object in the period 2007 – 2011 and the modality how they frame in between the valuable varieties, with genetic resistance to diseases, of the present apple tree assortement.

The majority of the presented varieties are suitable to the cultivation in high density orchards, wich will represent the orchards of the future for the apple tree cultivators.

Depending on the fruits maturation and consumption period, the studied apple tree varieties, which remarked themselves by genetic resistance to diseases, productivity and quality of the fruits, frame in differently into the varietal conveyer for the Dâmboviţa tree growing region.

Table 1. Trunk thickness growth in the year 5 from planting, at the genetic disease-resistant apple tree varieties, cultivated in the high density system (year 2011)

Nr.	Variety/ Graft Bearer	Diameter in the year 5, 2011 (mm)	Medium growth inrease (mm)	Trunk section surface in the year 5, 2011 (cm^2)	Differences ± as to Wt (cm^2)	Significance
1	Ionathan/ M9 (Wt)	39.57	7.25	12.29	-	-
2	Ariwa/ M9	39.31	5.97	12.13	- 0.16	N
3	Golden Lasa/ M9	50.07	8.10	19.68	+ 7.39	***
4	Goldrush/ M9	34.57	4.94	9.38	- 2.91	00
5	Enterprise/ M9	52.53	9.10	21.66	+ 9.37	***
6	Inedit/ M9	42.35	6.50	14.08	+ 1.79	*
7	Iris/ M9	43.00	7.69	14.51	+ 2.22	**
8	Luca/ M9	50.68	9.00	20.16	+ 7.87	***
9	Real/ M9	39.20	6.80	12.06	- 0.23	N
10	Rebra/ M9	46.88	8.72	17.25	+ 4.96	***
11	Redix/ M9	48.18	11.58	18.22	+ 5.93	***
12	Remar/ M9	48.75	10.50	18.66	+ 6.37	***
13	Saturn/ M9	37.70	6.61	11.16	- 1.13	N
14	Voinicel/ M9	45.30	7.65	16.11	+ 3.82	***

DL 5% = 1.51 cm^2; DL 1% = 2.10 cm^2; DL 0.1% = 2.91 cm^2

Table 2. Tree crown dimensions and volume at the studied apple tree varieties in the year 5 from planting (2011)

Nr.	Variety/ Graft Bearer	Tree Dimensions (cm)		Crown Volume (cm)			
		Height	Fruits fence thickness	Per tree	Differences ± as to Wt	Signifi-cance	Per Ha
1	Ionathan/ M9 (Mt)	250	160	3.52	-	-	8800
2	Ariwa/ M9	240	170	3.57	+ 0.05	N	8925
3	Golden Lasa/ M9	270	140	3.36	- 0.16	N	8400
4	Goldrush/ M9	235	135	2.77	- 0.75	N	6925
5	Enterprise/ M9	280	180	4.50	+ 0.98	*	11250
6	Inedit/ M9	260	130	2.99	- 0.53	N	7475
7	Iris/ M9	255	160	3.60	+ 0.08	N	9000
8	Luca/ M9	290	170	4.42	+ 0.90	*	11050
9	Real/ M9	270	150	3.60	+ 0.08	N	9000
10	Rebra/ M9	295	160	4.24	+ 0.72	N	10600
11	Redix/ M9	285	150	3.82	+ 0.30	N	9550
12	Remar/ M9	290	155	4.03	+ 0.51	N	10075
13	Saturn/ M9	240	145	3.04	- 0.48	N	7600
14	Voinicel/ M9	225	140	2.73	- 0.79	N	6825

DL 5% = 0.85 mc; DL 1% = 1.18 mc; DL 0.1% = 1.64 mc

Table 3. Fruits production realized at the apple tree varieties with genetic rezistance to diseases, cultivated in the high density system (2500 trees/Ha)

Nr.	Variety/ Graft bearer	Production obtained in the year (t/Ha)			Average of the years 4 – 5 (t/Ha)	Differences ± as to Wt	Significance
		3 2009	4 2010	5 2011			
1	Ionathan/M9 (Mt)	3.5	15.8	24.0	19.90	-	
2	Ariwa/M9	5.5	21.9	42.0	31.95	+ 12.05	***
3	Golden Lasa/M9	5.5	19.4	29.8	24.60	+ 4.70	***
4	Goldrush/M9	5.0	20.8	29.5	25.15	+ 5.25	***
5	Enterprise/M9	1.3	12.5	28.5	20.50	+ 0.60	N
6	Inedit/M9	6.5	18.5	42.2	30.35	+ 10.45	***
7	Iris/M9	6.3	20.4	33.0	26.70	+ 6.80	***
8	Luca/M9	2.8	16.4	35.3	25.85	+ 5.95	***
9	Real/M9	7.5	18.8	29.3	24.05	+ 4.15	***
10	Rebra/M9	3.0	10.7	31.0	20.85	+ 0.95	N
11	Redix/M9	2.8	16.6	23.0	19.80	- 0.10	N
12	Remar/M9	3.8	19.8	32.0	25.90	+ 6.00	***
13	Saturn/M9	5.8	21.6	42.5	32.05	+ 12.15	***
14	Voinicel/M9	4.3	18.6	29.8	24.20	+ 4.30	***

DL 5% = 1.80 t/Ha; DL 1% = 2.50 t/Ha; DL 0.1% = 3.47 t/Ha

Table 4. Consumption period of the studied apple varieties, framed into the variety conveyor of the genetic disease-resistant apple tree varieties, cultivated in the influence zone of S.C.D.P. Voineşti

Variety	Month/ decade																										
	VII			VIII			IX			X			XI			XII			I			II			III		
	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
Romus1(Vf)		•	•																								
Romus3(Vf)				•	•																						
Romus4(Vf)						•	•																				
Irisem (Vf)						•	•																				
Real (Vf)							•	•	•	•	•	•															
Prima (Vf)							•	•	•	•	•	•															
Voinea (Vf)								•	•	•	•	•															
Saturn (Vf)								•	•	•	•	•															
Remar (Vf)								•	•	•	•	•															
Golden Lasa (Vf)								•	•	•	•	•															
Pionier (Vf)								•	•	•	•	•	•	•	•												

Voinicel (Vf)								•	•	•	•	•	•	•											
Iris (Vf)								•	•	•	•	•	•	•											
Ciprian (Vf)								•	•	•	•	•	•	•											
Ariwa (Vf)								•	•	•	•	•	•	•	•	•	•	•	•						
Luca (Vf)								•	•	•	•	•	•	•	•	•	•	•	•						
Rebra (Vf)								•	•	•	•	•	•	•	•	•	•	•	•	•	•	•			
Redix (Vf)								•	•	•	•	•	•	•	•	•	•	•	•	•	•	•			
Inedit (Vf)									•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Enterprise (Vf)									•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Florina (Vf)									•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Goldrush (Vf)									•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•

CONCLUSIONS

The values of the trunk diameter increase, registered in the year 5 from planting, are defining for the differentiation on vigour groups of the genetic disease-resistant apple tree varieties, grafted on the graft bearer M9, thus:

- vigorous varieties, with a trunk diameter of over 50 mm: Golden Lasa (50.07 mm), Luca (50.68 mm), Enterprise (52.53 mm);
- medium vigorous varieties, with a trunk diameter between 40 and 50 mm: Inedit (42.35 mm), Iris (43.00 mm), Voinicel (45.30 mm), Rebra (46.88 mm), Redix (48.18 mm), Remar (48.75 mm);
- weakly vigorous varieties, with a trunk diameter smaller than 40 mm: Goldrush (34.57mm), Saturn (37.70mm), Real (39.20mm), Ariwa (39.31mm).

The crown volume, calculated on the surface unit, follows up the same classification of the varieties vigour, the greatest being registered at the Enterprise variety (11.250 cm/Ha) and the smallest at the Voinicel and Goldrush varieties, with 6.825 cm/Ha, respectively 6.925 cm/Ha.

The highest production potential on the surface unit was realized in the years 4 and 5 from planting at the Ariwa, Inedit and Saturn apple tree varieties, with over 30 t/Ha, but also at the Real, Golden Lasa, Voinicel, Goldrush, Luca, Remar and Iris apple tree varieties, at which we realize between 24.05 t/Ha and 26.7 t/Ha. The bigger fruits, which shall resist the competitional pressures on the market, were obtained by the varieties: Golden Lasa, Enterprise, Luca, Real, Rebra, Redix, Remar and Saturn.

The apple tree varieties, recently homologated at S.C.D.P. Voineşti, and also other studied foreign varieties, cover a great part of the consumption season, besides some genetic disease-resistant varieties already known and appreciated on the market by the consumers – these framing in differently in the conveyor recommended for the Dâmboviţa tree growing region.

REFERENCES

[1] Comănescu D.N., 2012. *Researches regarding the apple tree high density system, with the purpose of obtaining productions adapted to the trading requirements*. Doctorate thesis USAMV Bucharest.

[2] Eremia P., 2007. *The Dutch Orchard at Lacul Rezii*. The Agricultural Profit Nr. 1-2 (Profitul agricol nr. 1-2).

[3] Petre Gheorghe, Petre Valeria, Comănescu Daniel Nicolae, 2009. *The Promotion of the Modern Apple Tree System in the Romanian Tree Growing.* The Romanian Farmer Review Nr. 9 (Revista Agricultorul român nr. 9), page. 18.

[4] Petre Gheorghe, Petre Valeria, Comănescu Daniel Nicolae, 2010. *The Influence of some Specific Technological Sequences in the Increase of the Apples Production and Quality*. The Romanian Farmer Review Nr. 5, (Revista Agricultorul român Nr. 5).

Scientific Papers, Series B, Horticulture, Vol. LVI, 2012
CD-ROM ISSN 2285-5661, ISSN-L 2285-5653

EVALUATING THE QUALITY OF THE TABLEGRAPE VARIETIES OBTAINED AND CULTIVATED IN THE VINEYARD ŞTEFĂNEŞTI - ARGEŞ

Adriana COSTESCU[1], Liviu DEJEU[1], Camelia POPA[2]

[1]University of Agricultural Sciences and Veterinary Medicine, Bucharest, 59 Marasti, District 1, 011464, Bucharest, Romania, Phone: +4021 3182564/232, Fax: +4021 3182888, E-mail: cosadriana@yahoo.com
[2]National Research & Development Institute for Biotechnology in Horticulture Stefanesti, Sos. Bucuresti - Pitesti, no. 37, CP 117715 Arges, Romania, Phone/fax: +40248 266 814, E-mail:cameliapopa8@gmail.com

Corresponding author email: cosadriana@yahoo.com

Abstract

Grapes as a food product can be evaluated qualitatively within the context of a complex system of physical, chemical, microbiological and sensory determinations. The tablegrapes are named according to the International Organisation of Vine and Wine, the fruit of the vine with the special destination to be consumed fresh, and which can be obtained from special varieties created for this purpose. The grapes destined to be consumed fresh are gathered at commercial maturity, when the quality is optimal and a good storage capacity can be ensured. At ripening, the ideal would be that production should represent a very high percentage from the total production. The qualitative properties are mostly dependent on the genetic characteristics of the respective variety. These characteristics can be influenced negatively or positively by the corresponding technological links.
This paper presents the results obtained in the vineyard Ştefăneşti-Argeş as regards the fertility, the productivity, the quality and the quantity of the tablegrape crop for the varieties: Argessis, Auriu of Ştefăneşti, Augusta, Muscat d'Adda and Victoria. During the period 2010-2011 these varieties registered at commercial maturity, a sugar content between 180-225g/l; the gathering period had been spaced out beginning with 15.08. until 25.10. The variety Argessis distinguished through the biggest production of 15t/ha and the most agreeable shape of the grapes.

Key words: *table grapes, consumer, quality, fertility, productivity*

INTRODUCTION

The latest years have recorded an important rise in the consumption of fresh grapes, due to a general tendency towards a healthy nutrition, rich in vegetal resources [2]. Grapes represent a medicine-fruit as they have high therapeutic qualities as well as the grapevine and the wine [4.9].

The confrontation of Romanian viticulture with the international one and mainly with the European one, is a current issue which obliges us achieve high quality products [3]. As the Romanian market contains few varieties with early maturation and pleasant commercial aspect, new varieties and clones meeting these requirements must be promoted. Such new varieties and clones have been already cultivated in some plantations in the area Ştefăneşti Argeş. These are newly homologated varieties such as : Argessis, Golden of Ştefăneşti and the clones Muscat de Adda 10 Şt., Perlette 22 Şt. The famous varieties cultivated in the area Augusta and Victoria can be added to the new cultivated varieities and clones.

MATERIAL AND METHOD

The consumers' requirements, especially children and old people, for seedless grapes determine the obligatory extension of the apirene and other varieties in the viticulture of the countries having a warm or continental climate like Romania [6]. The newly created varieties, homologated during the latest years, but known only in the units where they had been obtained, will be set into

culture in order to replace some older varieties which do not meet the continuously changing qualitative requirements of consumers [8].

Observations and determinations have been made on the experimental plot located in the viticultural area of Muntenia (Ştefăneşti Argeş), as regards the quality of the tablegrapes under the pedoclimatic conditions of the Argeş zone. The grapevine plantation has a distance of de 2,2/1 m, the applied cutting is the Guyot type on semistock.

The tablegrapes have been harvested when their maturation ensures a superior and efficient capitalization [3]. This has been set in general, according to the variety, when the grapes reached full maturity. The moment of full maturity for the tablegrapes has been established by approximation, through performing the following determinations: the weight of the berries, the sugar content of the must and the titrable acidity. These determinations have been made periodically, every 3-5 days, beginning with the ripening of the grapes.

RESULTS AND DISCUSSIONS

Description of varieties

ARGESSIS (photo 1.) – variety homologated in 2002 at SCDVV Stefănesti. The first tablegrape variety obtained under the pedoclimatic conditions specific to the vineyard Ştefăneşti-Argeş. Pleasant commercial aspect, large berry (7,5-8,0 g), ovoidal, bluish-black colour. Large, uniaxial grape(450-480 g). Good tolerance to cryptogamic diseases (mildew, blight, rot). High vigour vines, suitable for arbour cultue. Average production reaches 15 t/ht [7,8].

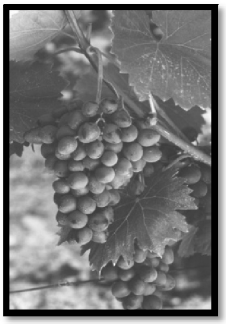


Photo 1. Variety Argessis

AURIU DE ŞTEFĂNEŞTI – the first grapevine variety for white tablegrapes, having a very early maturation,obtained under the pedoclimatic conditions specific to the vineyard Ştefăneşti-Argeş, homologated in 2007 at INCDBH Ştefăneşti. Pleasant commercial aspect, large berry (5,5-6,8 g), globular, golden-yellow colour. Large grape (400-450 g), winged. Good tolerance to cryptogamic diseases (mildew, blight, rot). The maturation of grapes in phase I (28.07-05.08). Suitable for ecological cultures. Extension in culture of the variety ensures an average production of 14 t/ha [7].

MUSCAT DE ADDA 22 ŞT. (photo 2.) – has been obtained through clone selection from the variety Muscat d'Adda at INCDBH Ştefăneşti and homologated in 2008; it is a variety destined for fresh consumption; the leaf is green; the grapes are medium sized, towards large (270-340 g); the berries are disposed equally on the cluster, being medium to large size; semicrisp pulp with specific taste and flavour; the skin is thick, black-aubergine coloured, highly bloomed; the vigour of the vines medium to large; it has good resistence to drought and diseases (mildew, blight and grey rot); the maturation of the grapes in September; a production of 4,9-5,3 kg/vine; it accumulates 187 g/l sugars and 3,9 g/l acidity; it has an increased resistence to handling, transport and storage [1].

Photo 2. Variety Muscat d'Adda

VICTORIA - a complex hybrid obtained by crossing over: Cardinal x (Alphonse Lavallee x Ahmeur bou Ahmeur) x Afuz ali white. The Hybridation were performed at Horticulture Research Institute (I.C.H.V.) Bucharest, by Victoria Lepadatu. Selection work continued at S.C.V. Dragasani, the variety being recognized in 1978. It is one of the most valuable Romanian variety of table grapes. Its strengths are early maturation but especially its beauty and the increased productivity. At debud the rosette and the young leaves are glared, shiny greencopper-colored. The adult leaf, medium sized (16-18 cm long) full, rarely trilobite, with a smooth gabby, and glared on both sides. The side sinuses are superficial and open, and the sinusoidal petiol is in the shape of a V. The Shoots of medium power, green colored, and the bark slightly striated. Fall chords, playing an amberbrown. Flower is monoecious normal guy May, variety is autofertil; 350-580 g grapes are large, conical or cylindrical-conical, with grains arranged in compact clusters. Large and very large grain (6,5 g), ovoid yellow-amber (amber) semicrisp pulp, balanced flavor, not flavored [5].

AUGUSTA (photo 3.) **-** It was obtained by controlled sexual hybridization Italy x Queen variety of vineyards, the Agronomic Institute in Bucharest. Variety approval was made in 1984. Required by timpurietate (II era of aging), size and look to the grapes. At the rosette is starting in vegetation glabra, green and brown shades, and young leaves are bronze. Adult leaf of medium size (16-18 cm long) and have fine grooves. Autumn chords acquires a brown color - brown. Monoecious flower normal guy May, variety is autofertil. Grapes are high (average 325g), conical and cylindrical-Lacs. Berries large, oval, yellow-green, semicrisp flesh with pleasant flavor [5].

Photo 3. Variety Augusta

Table 1. Qualitative characteristics of the studied tablegrape varieities (2010-2011)

Variety	Production Kg/but.	Sugars g/l	Acidity g/H_2SO_4	Weight of 100 grains (g)	Weight of grape (g)
Argessis	6,25	180	4,30	619	440
Auriu de Ştefăneşti	4,50	225	4,15	460	380
Augusta	5,50	186	4,25	550	320
Victoria	3,55	172	3,30	580	460
Muscat d'Adda 22 St.	5,15	165	4,14	546	425
Perlette 10 St.	4,25	170	3,80	480	400

CONCLUSIONS

1. Within the conditions of the viticultural system of the vineyard Stefănesti Arges, the obtained and cultivated tablegrapes varieties can compete in quality with many other varieties obtained at the world level (Muscat d'Adda, Perlette).

2. The variety Argessis can be noted through qualitative and quantitative productions as compared to the other varieties (15 t/ht, 180g/l sugars).

3. The variety Golden of Stefănesti is appreciated as an extra-early variety for the vineyard Stefănesti, and completes successfully the variation range of the area (maturation in epoch I).

4. The promotion in production of the tablegrape varieties having a high biological resistence to pests and diseases, the environment will be protected in the viticultural area.

5. The production of large quantities of tablegrapes will reduce the imports of our country in such products, which sometimes originate in autochthonous varieties, cultivated in other European countries (ex. Victoria).

ACKNOWLEDGEMENTS

Thanks POSDRU, Cod Contract: POSDRU/CPP107/DM11.5/S/76888 for financial support, to the University of Agricultural Science and Veterinary Medicine Bucharest who made this project and National Research&Development Institute for Biotechnology in Horticulture Stefanesti-Arges for the material provided and the possibility of conducting research.

REFERENCES

[1] Costescu Adriana, Popa Camelia, Vişoiu Emilia, Necula Cezarina, Iordache Ştefania, 2010 – The amelioration of the Muscat d'Adda variety through clone selection, Annals Foodsand Techology, University of Targoviste, p. 74-78.
[2] Dejeu L., 2011 – Wine and Health, Ceres Printing House, Bucuresti, 272 p;
[3] Dejeu L., 2010 - Viticulture, Ceres Printing House, Bucureşti, 480 p.
[4] Messegue M., 1998 - Grapes,Venus Printing House, Bucureşti.
[5] Necula Cezarina, Popa Camelia, Petrescu N., Marin Cr., 2010 - Valuable table grapes varieties from Stefanesti-Arges wineyard and their agrobiological attributes. USAMV Iaşi, Scientific papers – vol. 53, no .2, series Agronomy.
[6] Nicolaescu Gh., Apruda P., Perstniov N., Tereşcenco A., 2007 – Guide to table produces of grapes, Chişinău, 128 p.
[7] Popa Camelia., Necula C., Cichi D., Giugea N, 2009 - Argessis and Golden Stefanesti new varieties for table grapes with high biological strenght. Proceedings of the 32st World Congress of Vine and Wine, Verona, Italy.
[8] Popa Camelia, Necula Cezarina, 2003 - The new comes Variety Grapes for table Argessis. Annals of University of Craiova, vol VIII (XLIV), p. 235-239.
[9] Petrescu E., 2002 – The Therapy with Grapes and Medicinal Wines, Polirom, 152 p.

Scientific Papers, Series B, Horticulture, Vol. LVI, 2012
CD-ROM ISSN 2285-5661, ISSN-L 2285-5653

MINERAL CONTENT OF NECTARINES FRUITS IN RELATION TO SOME FERTILIZATION PRACTICES

Elena DELIAN[1], Lenuţa CHIRA[1], Liana DUMITRU[2], Liliana BĂDULESCU[1], Adrian CHIRA[1], Alexandra PETCUCI[1]

[1]University of Agronomic Sciences and Veterinary Medicine of Bucharest
59 Mărăşti Blvd., Sector 1, Postal Code 011464, Bucharest, Romania
[2]Research and Development Fruit Growing Station Constanţa, Romania
Str.Pepinierei Nr.1, 907300, Valu lui Traian, Constanţa county

Corresponding author email: delianelena@yahoo.com

Abstract

Fruits nutritional quality at the harvest moment and their storage capacity is directly or indirectly affected by multiple factors, including fertilization practices. The aim of this study was to evaluate soil organic and chemical fertilization, also foliar spray treatments on fruits mineral content of two nectarines [Prunus persica L. Batsch var. nectarina (Ait) Maxim] cultivars: Cora and Delta. The following fertilization treatments were applied: V1. Control: No fertilization; V2. Organic fertilizer in mid-May; V3 and V4 Chemical fertilizer in the first part of June; for variant 4 there were applied also two treatments with foliar fertilizer in the second part of May and early June. The experiment was carried out in 2008 at the Research and Development Fruit Growing Station Constanţa, Romania. Nectarine fruits were picked at commercial maturity stage from each tree of various replicates and mineral content was determined at the Plant Physiology Laboratory of the Faculty of Horticulture Bucharest, by using an Inductively Coupled Plasma Spectroscopy (ICP-AES IRIS INTREPID). The results were expressed in mg 100 g^{-1} fresh weight. Our preliminary results indicated a change in the fruits minerals composition in relation with the applied fertilizer, with significantly differences among the treatments. The organic fertilization and foliar sprays impact were found to be the most significant ones for all mineral elements studied in this work.

Key words**:** *fertilization, fruits, nectarine orchard, minerals*

INTRODUCTION

Peach and nectarine fruit [*Prunus persica* (L.) Batch] are the second most important fruit crop in the European Union after apple [18, 23].

Stone fruits contain significant levels of biologically active components with physiological and biochemical functions which benefit human health [30, 9, 17]. Generally, mineral compositions of plants show a lot of variation [8, 26], also the phytochemical content of fruit tissues is influenced by numerous pre-harvest factors (including genotype, rootstock, climatic conditions, agronomic practices and harvesting time), but also by post-harvest factors, including storage conditions and processing procedures [30]. Many studies through the world have focused on the beneficial effects of nutrient elements, especially calcium and boron on fruit quality.

So, mineral nutrients are essential for normal growth and development of plants [29]. During the time, there have made remarkable progress on the knowledge of mechanism of ions absorption, their physiological role at the cellular and molecular level, as well as those related to the fruits nutritional value [16, 26 etc.]. The relative health promoting potential is also very important, even if from the view point of bile acid binding on a dry mass basis nectarines are on the last place (bananas > peaches > pineapple > grapes > pears > apricots > nectarines) as indicated results obtained by Kahlon and Smith (2007). Recent studies are focused also on new investigation techniques, as for instance Ecological Footprint Analysis (EFA). This is an environmental accounting system, in physical unit, able to quantify the total amount of ecosystem resources required by a region or by a production process [10]. The authors presented a detailed application of EFA to an experimental trial in a commercial nectarine orchard in Piedmont (Italy). Related to different fertilization, in the manure fertilized

systems the fertilizer contribution goes from 0.9% to 1.2% of the total ecological footprint. In the mineral nutrition system the fertilizer contribution is 6.6% of the total ecological footprint. Results support the hypothesis that internal recycle and connections among different systems increasingly resulted in high system benefit and sustainability.

Fertilizer is an important tool used by the most farmers in order to boost crop yield, but the increasing of the public concern about environment aspects caused by over fertilization renew the interest on evaluating the adequate fertilization recommended on field to maintain productivity and fruit quality with less environment impact [13].

According to Olivos et al. (2012) low phosphorus and nitrogen fruit concentrations were associated with biochemical browning reactions in fruit flesh at harvest and with fruit browning during storage, signs of a shorter market life and lower consumer quality. Currently recommended leaf and fruit nutrient critical values are based only on production and do not addresses post harvest quality. In fact, recent results [27] include also proteomic analysis of peach fruit mesocarp softening and chilling injury using difference gel electrophoresis (DIGE). This technique allowed us to identify proteins that showed stage-specific changes in their accumulation pattern. Thus, comparative proteomics has proven to be a valuable tool for understanding fruit softening and post harvest behavior.

The conclusion of Kader (1999) that continue efforts aimed at developing of new genotypes with better flavor and nutritional quality in all major fruits is valuable in our country too. For nectarines, at Valu lui Traian there is The Peach National Collection, which contents 855 genotypes. Annually, the breeders selected the best genitors and made hibridations, self pollinations and clonal selections, in order to obtain new cultivars [14].

Taking into consideration the importance of trees mineral nutrition and fruit mineral level, both from the view point of nutritional quality and post harvest storage capacity, the aim of this study was to evaluate soil organic and chemical fertilization, also foliar spray treatments on fruits mineral content of two nectarines [*Prunus persica L.* Batsch var. *nectarina* (Ait) Maxim] cultivars: Cora and Delta, recommended as fresh consumption.

MATERIAL AND METHOD

The study was carried out on two nectarines [*Prunus persica* L. Batsch var. *nectarina* (Ait) Maxim] cultivars: Cora and Delta, grown in the fruit tree orchards located at Valu lui Traian, Constanţa, Romania (latitude 44°10 'longitude 28°40' and an altitude of 40-80 m). Mature trees (14-year old-) (grafted on seed propagated rootstock) spaced 4 and 3 m between and along the rows, respectively grown in semi arid conditions and irrigated regime, on calcaric chernozem (CZka), with a clay texture and a slightly alkaline pH (8.2) on the entire profile, have been used in the experiment.

To evaluate soil organic and chemical fertilization, also foliar spray treatments on fruits mineral content, the following fertilization treatments were applied: V1. Control: No fertilization; V2. Organic fertilizer/ manure (30 t ha^{-1}) in mid-May; V3 and V4 Chemical fertilizer (NPK- 15:15:15) – 0.6 kg pom^{-1}) in the first decade of June; for variant 4 there were applied also two treatments with foliar fertilizer (Murtonik – NPK- 20:20:20: and microelements) (2 kg Murtonik in 150 L water/treatment/] well bathe crown trees, in the second part of May and early June.

Fruits were harvested at commercial maturity stage at the end of June 2008. At least 30 nectarines fruits were harvested from at least four different trees for each cultivar. Samples were placed into polyethylene bags and stored at 4 °C until the analysis (analyzed after two days). Two replicates of each variety were selected and analyzed.

Dry matter content was determined in the entire nectarines fruits (peel and flesh) according to the AOAC 1990. Ash content of samples was determined at 550 C [1] After cooling the resulting white ash was dissolved in 1 mL HNO_3 conc., adjusted to a volume of 50 mL with ultra pure water obtained by using a Milli –Q system. Monoelemental containing stock solutions were used for preparing reference solution for the calibration curve, then the elemental analysis was carried out in an

inductively coupled with plasma (ICP-AES) IRIS INTREPID. All determinations were carried out in triplicate and expressed as mass on a fresh weight basis. Using Statgraphics software there were compared the obtained data.

RESULTS AND DISCUSSIONS

Dry matter content of the nectarines cultivars and studied variants varied from 8.42 % of the fresh weight (Delta V4 – including foliar fertilization) to 9.92 % (Delta V2 – organic fertilizer). This parameter was not significantly different between variants. Ash content ranged from 3.44 % of the dry matter (Cora – manure fertilization) to 8.52 % (Delta - manure fertilization), with statistically significantly differences between these variants (Figure 1). These data are slightly higher as compared with those synthesized by Kahlon and Smith (2007) (3.9 % of the dry matter). Cora and Delta were licensed as the earliest in the Romanian nectarine assortment [35]. Generally, accumulation of the dry matter is also reflected into the obtained yield. In a such context, according to the multiannual data obtained at the Fruit Growing Station Constanţa, there are no significantly differences between the two cultivars (Cora 21 t ha^{-1}; Delta 22.55 t ha^{-1}) [14].

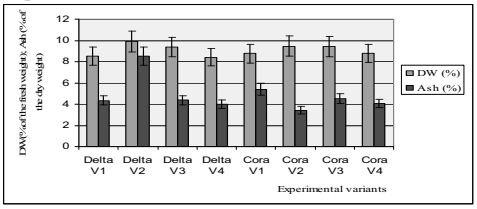


Fig. 1. Nectarines fruits dry matter and ash content

On the other hand, results obtained by Costea and Lăzureanu (2011) emphasized that the different fertilization measures (manure 40 t ha^{-1}; $N_{30}P_{30}K_{30}$; $N_{45}P_{45}K_{45}$; $N_{90}P_{45}K_{45}$) of Delta and Cora cultivars determined an improvement of the yield in the case of Cora (13.6 t ha^{-1} unfertilized; 20.55 t ha^{-1} for the $N_{90}P_{45}K_{45}$).

As Akin et al. (2008) mentioned in the case of apricots, dry matter content is one of the most important parameters that show fruits commercial value. Thus, varieties with high dry matter content are preferred for drying processes while the ones with low dry matter content are consumed freshly. The two studied nectarines cultivars are recommended to fresh consume, so low dry matter content determine fruits to be very sensitive to transportation and handling. Regarding the fruits mineral composition, as we can see in the followings figures (Figure 2, Figure 3 and Figure 4), there were registered significantly cultivars and variants differences.

Potassium, calcium, magnesium, levels were considerably higher and as it is known these are classified as macroelements [26]. On the other hand, natrium, boron, aluminum, iron, cupper have been determined in lower concentration and are classified as micronutrients [26]. So, at harvest the relative order of macronutrients concentration was: K> Ca>Mg (Fig. 2, Fig. 3, Fig. 4) and of micronutrients: Na> B>Al>Fe>Cu (Table 1). First of all it can be mentioned that the mineral content was expressed on the fresh weight, so, the obtained values depends also on fruits water content. This parameter was not so variable, ranging from 90.08 % (Delta V2), to 91.58 % (Delta V4). The highest value was registered for K (204.63 mg 100 g^{-1} F.W.) (Cora V3) and at the opposite pole was Cu 0.01 mg 100 g^{-1} F.W. (Cora V1) (Fig. 2; Table 1).

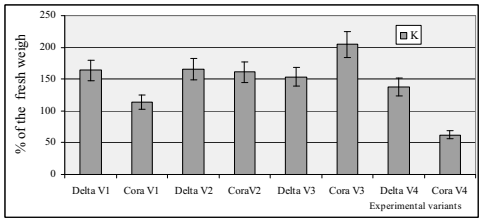


Fig. 2. Nectarines fruits potassium content

From the literature studied, there are no other scientific papers to describe Cora and Delta fruits mineral composition. Our data are close to those obtained by Val et al. (2010) in the case of 'Miraflores' peach trees sprayed at monthly intervals with different concentrations of Ca along the growing season. Mesocarp K^+ content was 128.6 mg 100g^{-1} F.W. and 179.9 mg 100 g^{-1} F.W. (control) as compared with skin level: 125.1 mg 100g^{-1} F.W., 170.7. mg 100 g^{-1} F.W. respectively (for 1 % Ca^{2+} application). In the case of calcium and magnesium, the mesocarp level was higher for

magnesium as compared with calcium (7.01 mg 100 g^{-1} F.W.; 2.66 mg 100 g^{-1} F.W. – control; 7.09; 2.23 in the case 1% Ca treatment).

In our experiment calcium level was higher as against magnesium for both cultivars, with higher values for Delta cv. For Delta cv. organic fertilization fruit calcium level was 17.60 mg 100g^{-1} F.W, as compared with 12.09 mg 100g^{-1} F.W. Cora cv., the same treatment, as compared with Mg level: 12.92 mg 100g^{-1} F.W, 11.94 mg 100g^{-1} F.W., respectively. The lowest level was noticed in the case of V4. Chemical fertilizers determined higher fruit Ca^{2+} and K^{+} accumulation in Cora cv. (Figure 3, Figure 4). According to Başar (2006) results, in the case of Redhaven cv., in the fruits flesh samples the highest levels was occupied by K^{+} (1.34 %), followed by Mg^{2+} (0.064 %), Ca^{2+} (0.032%) and microelements values decreased from Fe to, Zn, Cu and Mn (13.46; 8.41; 6.28; 3.23 mg kg^{-1}). The author mentioned that elemental analysis of fruit is not a common practice to estimate sufficiency of a fertilization program and nutritive value of a fruit. Our opinion is that the second part of his affirmation is still disputable.

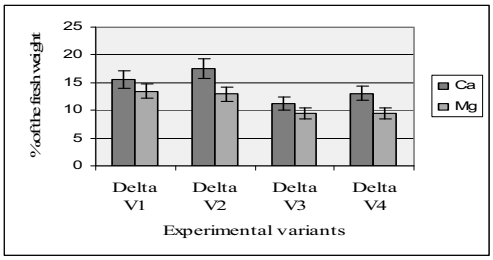


Fig. 3. Delta cv. calcium and magnesium level

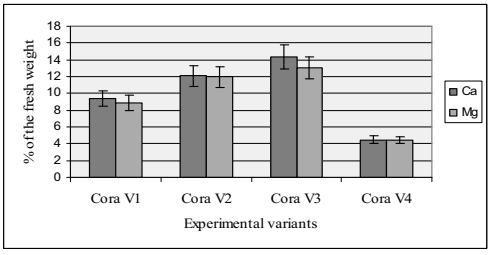


Fig. 4. Cora cv. calcium and magnesium level

These remarkable differences in minerals are most likely due to differences in fertilizer use and soil quality. So, differences in the soil fertility management affect soil dynamics and plant metabolism. The induced results are emphasized in differences in plant composition and nutritional quality [38]. Technological advances in genomics, plant breeding, bioengineering, and biotechnology now make it possible to create foods which will have maximal nutritional content, by manipulating field growing conditions [37].

For instance, although K^{+} not enter into the composition of organic molecules and is not an element of a mineral structure, it is involved in many physiological and biochemical processes essential for plant growth, to achieve a quality crop and plant response to stress factors etc. [24]. As regard as organic fertilization, Bravo et al. (2012) studied the effect of organic fertilization on carbon dioxide fixation, carbon partitioning and growth of potted nectarine trees (*Prunus persica* L. Batsch), cv. 'Orion'. The addition of compost at the highest rate was effective in increasing CO_2 fixation, promoting root and shoot growth, with no effect on fruit biomass, compared to the unamended control. Also, Baldi et al. (2010) noticed that organic fertilization practices can have strong influences on root production. This work helps to clarify the complex ways the shifts in fertilization practices may affect fruit tree root function and dynamics.

If we refer to calcium foliar application, as Crisosto et al. (2000) noticed, the lack of Ca^{2+} uptake in the fruit flash suggest that the calcium mobility is extremely limited in peach and nectarine fruit tissue under California orchard condition. In fact, generally, Ca^{2+} is an element that differs from others by being imported into fleshy fruit only in small amounts, much less than into leaves. Although Ca^{2+} is sufficiently available in the soil of most orchards, localized Ca^{2+} deficiency may become a problem in several fruits and vegetable crops, with the risk of large economic losses [31].

Excess Ca^{2+} in the growth medium induces premature shedding of fruit and buds. Also, excess Ca^{2+} interferes with Mg^{2+} absorption. Possibly in our experiment, with a slightly alkaline pH, there was induced a precipitation of many micronutrients, and in turn these were undisponible to the plant. After Marschner (2012), the high concentration of Ca^{2+} in the peel and the low concentration in the pulp can be attributed to the low mobility of Ca^{2+} in

phloem. Calcium sprays to peach fruits as an aqueous solution had no effects on the fruit quality parameters and on ion content in the peach skin or mesocarp. On the contrary, the treatment of $CaCl_2$ incorporated in Tara gum to the fruits and these bagged following the application resulted in a great increase in the absorption of Ca^{2+}: up to a 261% in the mesocarp and 247% in the skin for the greatest concentration of Ca^{2+} applied. However, the 1% level determined a great increase in pre-harvest fruit drop [36].

Table 1. Some microelements content in nectarines fruits (mg 100 g fresh weight $^{-1}$)

Experimental variant	Na	B	Al	Fe	Cu
Delta V1	0.88	**0.41**	0.16	0.16	0.02
Delta V2	**3.03**	0.22	0.17	0.17	0.02
Delta V3	2.08	0.26	**0.24**	**0.24**	**0.06**
Delta V4	2.72	0.13	0.16	0.16	ND
Cora V1	1.48	0.14	0.11	0.11	0.01
Cora V2	3.94	0.17	0.19	0.19	0.05
Cora V3	**4.75**	**0.19**	0.19	0.19	0.03
Cora V4	0.14	0.10	0.10	0.08	ND

[1] V1 – Control
[2] ND = not detectable

Iron is a transitional element, and its absorption is regulated to ensure sufficient quantities for optimal growth and ensure prevention of excessive accumulation [22]. Boron is an important microelement that prevents fruits physiological disorders and disease incidence. As we can see in Table 1, the highest level was registered for Delta – unfertilized (0.41 mg 100 g fresh weight $^{-1}$), of about three times higher as compared with Cora cv. (the same variant). As regard as Al, Fe and Cu, the highest levels were noticed in the case of chemical fertilization, also for Delta cv. Field experiment showed that the incidence of peach infections by *Monilinia laxa* was negatively correlated with the content of boron in the leaves [34]. Copper as a transition element and also a heavy metal has been accumulated in small amounts and in the case of foliar fertilization this element was not detected.

It can be mention that our data are agreed with those presented by Mayer (1997) in a synthesis regarding the mineral composition changes during the time (1930s and the 1980s). In the case of nectarines fruits (mg 100g $^{-1}$ F.W.) these data are as followings: Ca old 3.9; Ca new 7.0; Mg old 12.6; Mg new 10.0; Fe old 0.46; Fe new 0.4; Cu old 0.06; Cu new 0.06; Na 9.1 old; Na new 1.0; K old 268.0; K new 170.0; Dry matter old 19.8; Dry matter new 11.1.

Results obtained by Cerutti et al. (2011) support the hypothesis that internal recycle and connections among different fertilization systems increasingly resulted in high system benefit and sustainability. Also, as Olivos et al. (2012) noticed, further research is needed to determine new recommended leaf and fruit nutrient values suitable for both production and maintaining fruit quality during storage. The conclusion of El-Jendoubi et al. (2011) was that it should be always taken into account that the effectiveness of a given Fe-fertilizer will depend on the specific conditions imposed in the particular study. In many cases, a positive result will not grant efficiency in other scenarios or can be valuable for other fertilizers too. Increasing productivity of horticultural production has primarily focused on intensification of fertilizers and water, resulting in high environmental costs. That is why Stefanelli et al. (2010) reviews the link between the nutritional quality of horticultural crops and the environmental and social sustainability of reducing nitrogen and water.

From the view point of nectarines quality, Iordănescu et al. (2010) noticed that the sugars content over passed 10% only for Cora nectarines, while all the other studied varieties had a sugars content value between 6.20% and 8.98%. Also, the highest gluco-acidimetric index (15.60) was registered at Cora even if most of the varieties had similar acidity content. fact, ten years ago, Tagliavini and Marangoni (2002) noticed that about 60% of peach and nectarine orchard in Emilia Romagna (north Italy) follow the guidelines of integrated fruit production. They mentioned that the period trend was for restriction in the amounts of mineral nutrients to be applied in orchards as a consequence of regulation at the European Union.

In addition, recent results indicate that supplementation of food with 4% nectarine is sufficient to promote life span and health span in the *Drosophila melanogaster.* This study

carried out by Boyd et al. (2011) is the first to show life span extension by nectarine in an animal model. As the authors mentioned, these results provide a foundation for future research and development of nectarine as an effective intervention to promote life span and health span in mammals, including humans.
The ongoing *Prunus persica* genome sequencing project, together with the development of deep-sequencing technologies (e.g., RNA-Seq), will represent formidable advancements and powerful tools to identify and characterize peach genes and track gene expression changes during the last phase of development and in relation to different postharvest conditions [4].

CONCLUSIONS

Our preliminary results indicated a change in the nectarines fruits minerals composition in relation with the applied fertilizer, with significantly differences among the treatments.
The organic fertilization and chemical fertilization associated with foliar sprays impact was found to be the most significant ones for all mineral elements studied in this work

ACKNOWLEDGEMENTS

This research work was carried out with the support of ANCS, PNCDI II Partnership No. 51022/2007.

REFERENCES

[1] AOAC. 1990. *Official Methods of Analysis.15th Ed. Association of Official* Analytical Chemists, Inc.,Virginia, USA, p.770-771.
[2] Akin, E.B., Karabulut, I., Topcu, A. 2008. *Some compositional properties of main Malatya apricot (Prunus armeniaca L.) varieties.* Food Chemistry, Vol. 107, p. 939–948.
[3] Baldi, E., Toselli, M., Eissensta, D.M., Marangoni, B. 2010. *Organic fertilization leads to increased peach root production and lifespan.* Tree Physiology, Vol. 30, p. 1373–1382.
[4] Bonghi, C., Begheldo, M., Ziliotto, F., Raso, A., Tosetti, R., Tonutti, P.2010. *Transcriptome analyses and postharvest physiology of peaches and nectarines*. Acta Horticulturae, Vol. 877, p. 69- 74.
[5] Başar, H. 2006. *Elemental composition of various peach cultivars*. Scientia Horticulturae, Vol. 107, p. 259-263.
[6] Boyd, O., Weng, P., Sun, X., Alberico, T., Laslo, M., Obenland, D.M., Kern, B., Zou, S. 2011. *Nectarine promotes longevity in Drosophila melanogaster*. Free Radical Biology and Medicine, Vol. 50, p.1669–1678.
[7] Bravo, K., Toselli, M., Baldi, E., Marcolini, G., Sorrenti, G., Quartieri, M., Marangoni, B. 2012. *Effect of organic fertilization on carbon assimilation and partitioning in bearing nectarine trees*. Scientia Horticulturae, Volume 137, p.100-106.
[8] Brown, P.H., Welch, R.M., Cary, E.E. 1987, Nickel: a micronutrient essential for higher plants. Plant Physiology, Vol.85, p. 801-803.
[9] Byrne, D.H., Noratto, G., Cisneros-Zevallos, L., Porter, W., Vizzotto, M. 2009. *Health benefits of peach, nectarines and plums.* Acta Horti. (ISHS), Vol. 841, p.267-274.
[10] Cerutti, A.K., Bagliani, M., Beccaro, G.L., Gioelli, F., Balsari, P., Bounous, G. 2011. *Evaluation of the sustainability of swine manure fertilization in orchard through Ecological Footprint Analysis: results from a case study in Italy*. Journal of Cleaner Production, Vol.19, p. 318-324.
[11] Costea, B., Lăzureanu, A. 2011. *Influence of fertilization on peach production (Redheaven, Sunhaven and Redglobe varieties) and nectarine (Cora, Delta and Romamer varieties)*. Journal of Horticulture, Forestry and Biotechnology Vol. 15, p. 49- 52.
[12] Crisosto, C.H., Day, K.R., Johnson, R.S., Garner, D. 2000. *Influence of in season foliar calcium sprays on fruit quality and surface discoloration incidence of peach and nectarines.* Journal of American Pomological Society, Vol.53, p. 118-122.
[13] Cuquel, F.L., Motta, A.C.V., Tutida, I., De Mio, L.L.M. 2011. *Nitrogen and potassium fertilization affecting the plum postharvest quality. Revista Brasiliera de Fruticultura*, Jaboticabal Oct.
http://dx.doi.org/10.1590/S0100-29452011000500041
[14] Liana Melania Dumitru. 2008. *New peach and nectarine cultivars obtained at Research Station for Fruit Growing Constanţa*. Lucrări Ştiinţifice, Seria Horticultură, Vol. LI, p. 701-704.
[15] El-Jendoubi, H., Melgar, J.C., Álvarez-Fernández, A., Sanz, M., Abadía, A., Abadía, J. 2011. *Setting good practices to assess the efficiency of iron fertilizers.* Plant Physiology, Vol. 34, p.778-791.
[16] Epstein, E. 1972. *Mineral Nutrition pf Plants: principles and Perspectives*. New York: John Wiley, p.412.
[17] Ghasemi, Y., Ghasemnezhad, A., Atashi, S., Mashayekhi, K., Ghorbani, M. 2011. *Variations in antioxidant capacity of nectarine fruits (Prunus persica cv. red-gold) affected by harvest date*. International Journal of Plant Production , Vol.5, p. 311- 318.
[18] Iglesias, I., Echeverría, G. 2009. *Differential effect of cultivar and harvest date on nectarine colour, quality and consumer acceptance*. Scientia Horticulturae, Vol.120, p.41-50.
[19] Iordănescu, O.A., Micu, R.E., Blidariu, A. 2010. *Researches concerning the fruit binding degree and fruits' qualities of some nectarine varieties in conditions of Timişoara*. Journal of Horticulture, Forestry and Biotechnology, Vol.2, p. 113-117.

[20] Kader, A.A. 1999. *Fruit maturity, ripening, and quality relationships*. Acta Horticulturae,Vol.485, p.203-208.
[21] Kahlon, T.S., Smith, G.E. 2007. *In vitro binding of bile acids by bananas, peaches, pineapple, grapes, pears, apricots and nectarines*. Food Chemistry, Vol.101, p. 1046-1051.
[22] Kim, S.A., Guerinot, M.L. 2007. *Mining iron: Iron uptake and transport in plants*. FEBS Letters, Vol. 581, p. 2273–2280.
[23] Legua, L., Pinochet, J., Moreno, M.A., Martínez, J.J., Hernández, F., 2012. *Prunus hybrids rootstocks for flat peach*. Scientia Agricola, Vol.69.
http://dx.doi.org/10.1590/S0103-90162012000100003
[24] Lester, G.E., Jifon, J.L., Makus, D.J. 2010. *Impact of potassium nutrition on food quality of fruit and vegetables: a condensed and concise review of literature.* Better Crops, Vol. 94, p.18-21.
[25] Mayer, A.M. 1997. *Historical changes in the mineral content of fruits and vegetables*. British Food Journal, Vol. 99, p. 207–211.
[26] Marschner, P. 2012. *Mineral nutrition of higher plants*. Third Edition. Academic Press.
[27] Nilo, R., Saffie, C., Lilley, K., Baeza-Yates, R., Cambiazo, V., Campos-Vargas, R., González, M., Meisel, L.A., Retamales, J., Silva, H., Orellana, A. 2010. *Proteomic analysis of peach fruit mesocarp softening and chilling injury using difference gel electrophoresis (DIGE).* BMC Genomics, Vol. 11:43.
[28] Olivos, A., Johnson, S., Xiaoqiong, Q., Crisosto, C.H. 2012. *Fruit phosphorous and nitrogen deficiences affect Grand Pearl nectarine flesh browning*. HORTSCINCE, Vol. 47, p. 391-394.
[29] Reddy, K.J. 2006. *Nutrient stress. In Physiology and Molecular Biology of Stress Tolerance in Plants*. p. 186-217.
[30] Remorini, D., Tavarini, S., Degl'Innocenti, E., Loreti, F., Massai, R., Guidi, K., 2008. *Effect of rootstocks and harvesting time on the nutritional quality of peel and flesh of peach fruits*. Food Chemistry, Vol. 110, p. 361–367.
[31] Saure, M.C. 2005. *Calcium translocation to fleshy fruit: its mechanism and endogenous control*. Scientia Horticulturae, Vol.105, p.65-89.
[32] Stefanelli, D., Goodwin, I., Jones, R. 2010. *Minimal nitrogen and water use in horticulture: Effects on quality and content of selected nutrients*. Food Research International, Vol. 43, p.1833-1843.
[33] Tagliavini, M., Marangoni, B. 2002. *Major nutritional issues in deciduous fruit orchard of northern Italy*. HorTechnology, Vol.12, p.26-31.
[34] Thomidis, T., Rossi, V., Exadaktylou, E. 2010. *Evaluation of a disease forecast model for peach leaf curl in the Prefecture of Imathia*. Greece. Crop Protection, Vol.29, p.1460-1465.
[35] Topor, E., Dumitru L.M., Trandafirescu, M. 2006. *New nectarine cultivars with very early ripening period obtained in Romania s conditions*. Acta Horti (ISHS), Vol.713, p.149-150.
[36] Val., J., Monge, E., Blanco, A., Espada, J.L. 2010. *The Effects of Ca applications on peach fruit mineral content and quality*. Acta Horticulturae,Vol.868, p.405-408
[37] Wang, S.Y. 2006. *Effect of pre-harvest conditions on antioxidant capacity in fruits*. Acta Hoti (ISHS), Vol. 712, p. 299-306.
[38] Worthington V. 200. *Nutritional quality of organic versus conventional fruits, vegetables, and grains*. Journal of Alternative and Complementary Medicine, Vol. 7, p.161-173.


EX·TERRA·AVRVM

Scientific Papers, Series B, Horticulture, Vol. LVI, 2012
CD-ROM ISSN 2285-5661, ISSN-L 2285-5653

EFFICACY OF SOME BACTERIAL BIOPRODUCTS AGAINST *SCLEROTIUM CEPIVORUM*

Sorina DINU[1], Oana-Alina SICUIA[1], Florica CONSTANTINESCU[1], Cătălin LĂZUREANU[1], Florin OANCEA[1,2]

[1]Research and Development Institute for Plant Protection, 8 Ion Ionescu de la Brad Blvd., 013813 Bucharest, Romania, tel. 004-021-2693231, 33, 34, 36, fax. 004-021-2693239, e-mails: sori.dinu@yahoo.com; sicuia_oana@yahoo.com; cflori@yahoo; catalinlazureanu@gmail.com
[2]The National Institute for Research and Development in Chemistry and Petrochemistry, 202 Spl. Independentei 060021, Bucharest, Romania, tel. 021-315.32.99, fax: 021-312.34.93, e-mail: florino@ping.ro

Corresponding author email: cflori@yahoo.com

Abstract

The aim of this paper was to determine the efficacy of some bioproducts based on useful bacteria from the genus Bacillus and Pseudomonas against the phytopathogenic Sclerotium cepivorum fungus wich causes white rot in onion crop.The selected bacterial strains for this study were: Bacillus subtilis Us.a2, isolated from rhizosphere of green garlic, with deposited DSMZ number 23654; Pseudomonas chlororaphis Sal.c2, isolated from rhizosphere of lettuce; Bacillus pumilus OS.15 and Bacillus amyloliquefaciens OS.17 strains isolated from rhizosphere of onion and Bacillus subtilis 98a isolated from wheat straw. The five strains, besides other important biological features such as lithic enzyme production, mobility, action to stimulate plant growth, showed in vitro antagonistic ability against Sclerotium cepivorum. In order to be tested in vivo, the strains were formulated as microemulsion (which can be applied as seed treatment) and alginate beads (which can be distributed in rows along with the seeds). The tests were performed in growth chamber conditions by using artificially infected soil.Results showed a moderate or similar efficacy of bioproducts compared with the chemical control Topsin 500 SC.

Key words: *bacterial bioproducts, biocontrol efficacy, Sclerotium cepivorum*

INTRODUCTION

Biological means of useful crop plant microorganisms is one of the directions for reducing the dependence of chemicals products. Biopesticides are widely used in farming because of their advantages: (i) equal or higer efficacy than conventional products when used in integrated control systems; (ii) high applicability hence the use of unqualified staff; (iii) are biodegradable, important feature for the groundwater and surface; (iv) can be successfully used alone or in combination with some pesticides having a synergistic effect; (v) microbial biopesticides are obtained by fermentation and often used as conditioning substrate materials/ agricultural bioproducts.

In our country, the first bioproduct was conducted by N. Zinca in 1970 based on avirulent *Agrobacterium vitis* bacteria designed to control the crown-gall of vines. Subsequently were obtained a series of bioproducts for important soilborne pathogens (*Pythium*, *Rhizoctonia*, *Fusarium*) such as: **Vamfix** (based on spores of mycorrhizal *Glomus* fungi), **Bacillin** (based on *Bacillus subtilis* strains), **Trichosemin** (*Trichoderma viride*), or based on plant growth promoting rhizobacteria such as: **Azostim** (based on *Azospirillum* bacteria), **Nitrostim** (*Bradyrhizobium*), **Nitrofix** (*Rhizobium*).

On the plant protection market in USA there are several bioproducts including bacteria and fungi of genera *Agrobacterium, Bacillus, Pseudomonas, Streptomyces* and *Trichoderma, Candida* and *Coniothyrium*. In the last years, there was a slight increase (2.5%) compared to the chemicals products, the highest use (55%) being in the horticulture sector.

The European Union is focused on developing organic farming systems in order to reduce negative side effects that may occur from the use of chemical fertilizers. Some of these bioproducts

are: **Kodiak, Companion (***Bacillus subtilis*), **Actinovate (***Streptomyces lydicus*), **Mycostop** (*Streptomyces griseoviridis*), **PlantShield** (*Trichoderma harzianum*).
One of the most important soil phyto-pathogen is *Sclerotium cepivorum* Berk fungus, causing white rot of *Allium* species, being a major limitation factor of onion crop production and the incidence disease in favourable conditions being over 65% [2]. The fungus penetrates the root epidermis and then invades the cortical parenchyma [5] so that, infected plants suffer from water stress and often die before harvesting or of rotting in warehouses. The pathogen persists in soil in the absence of host plants as sclerotia and can survive in this form more than 20 years [1]. Sclerotia remain dormant in soil for 1-3 months and can only germinate in the presence of host plants. The stimulus for germination is the exudates of alkyl-cysteine-sulphoxides which are metabolized by the soil microflora to produce volatile thiols and sulphoxides that trigger dormant sclerotia germination [1, 6]. Biological control of the disease can also be done directly, by adding antagonists or indirectly by changing environmental conditions in favour of selective antagonists [3]. Among antifungal microorganisms active against this pathogen are *Trichoderma viride* and *Coniothyrium minitans* that have proven an over 60% efficacy in reducing the onion bulbs attack. Also, the bacteria from the genus *Bacillus* and *Pseudomonas* were found to have a strongly antagonism against this pathogen [4].
The aim of this work was to test the efficacy of some bioproducts based on *Bacillus* and *Pseudomonas* useful bacteria formulated as microemulsion and as sodium alginate beads on the growth of *Sclerotium cepivorum* fungal phytopathogen, under controlled conditions.

MATERIAL AND METHOD

Microorganisms

Bacterial strains used in this study were: *Bacillus subtilis* Us.a2 isolated from rhizosphere of green garlic, with deposit number DSM 23654, *Pseudomonas chlororaphis* Sal.c2 isolated from rhizosphere of lettuce, *Bacillus pumilus* OS.15 and *Bacillus amyloliquefaciens* OS.17 strains isolated from onion rhizosphere and *Bacillus subtilis* 98a isolated from wheat straw, identified by biochemical and molecular tests (Biolog GEN III, ARDRA technique or sequencing analysis of 16S rRNA gene). Bacteria were grown in Luria Bertani broth medium (LB) (bactotryptone – 10g; yeast extract – 5g; distilled water up to 1000 ml; pH adjusted to 7.4 with NaOH 5M or HCl 1M solutions) with a starting inoculum of a 10% aqueous suspension of $1x10^8$ cfu/ml, in Erlenmeyer flasks on a rotary shaker (150rpm) at 28°C for 48 h. Biomass was harvested by centrifugation at 3000 rpm for 20 minutes.

Fungal inoculum was the strain DSM 63024 of *Sclerotium cepivorum* which was previously cultivated on PDA medium (decoction from 200g potato, 20 g dextrose, 20 g agar-agar and 1000 ml distilled water, pH 7.0) which was inoculated in Roux plates on barley seeds substrate and incubated 20 days at 20°C. The fungal inoculum was mixed with the soil (previously sterilized by gamma radiation) at a rate of 2% of soil weight (18 g / tray).

In vitro selection of bacterial strains was carried out by testing the antagonistic activity towards different phytopathogenic fungi: (*Botrytis cinerea*, *Fusarium oxysporum* f.sp. *radicis lycopersici* ZUM 2407, *Fusarium graminearum* DSM 4527, *Sclerotium bataticola, Sclerotium cepivorum* DSM 63024. Bacterial strains (24 h fresh culture) were inoculated on PDA medium by streaking a straight line at 3cm distance towards the calibrate mycelium disk (5mm diameter). Inoculated Petri dishes were incubated at 28°C and analyzed after 48-72 h regarding the inhibition zone (mm). The experiment was repeated three times.

The bacterial strains *conditioning procedure* was developed in two forms:
1. microemulsion consisted in: biomass of sporulated or nonsporulated bacteria as active ingredient – 10 g; sucrose as suspending agent – 5 g; soprofor FL as anionic surface surfactant and dispersant agent – 9.6 g; emulsifier CL3 as non-ionic surface surfactant agent – 2.4 g ; PEG 400 as antifreeze agent – 3.0 g; 5% carboxy-methyl-

celullose solution as thickening agent – 5.0 g; sodium benzoate as stabilizer – 0.2 g; organic solvent – methyl esters of fatty acids in canola or sunflower oil – 30.0 g; distilled water – up to 100 ml.

Preparation of organic phase

In a conditioning recipient with stirring were introduced 30 g solvent, 9.6 g soprofor FL and 2.4 g emulsifier CL3. The mixture was maintained under stirring until obtaining a homogenous solution. Resulted 42 g of emulsifier solution.

Preparation of the aqueous phase

In a 250 ml conditioning gradually recipient with stirring and dropping funnel 10 g biomass, 5 g sucrose, 0.2 g sodium benzoate, 3 g PEG, 5 g carboxy-methyl-celullose of 5% solution and about 80% of the amount of water needed (~ 27 ml) were placed. The mixture was homogenized under stirring for 10 minutes.

Preparation of microemulsion

Over the aqueous phase the organic phase was added under stirring. After adding the organic phase, stirring continued for another 15 minutes. 100 ml of bioproduct resulted as homogenous microemulsion.

2. Alginate beads

Bacteria were cultured in LB liquid medium in a rotary shaker (150 rpm) incubated at 28°C for 48 h up to a final concentration of 10^8 cfu/ml. Entrapment of bacteria within the alginate beads was carried out under sterile conditions in a laminar flow hood; 20 ml of bacterial culture with 80 ml of 2% (w/v) sodium alginate was aseptically mixed. The mixture was homogenised by stirring gently for 1 h at room temperature and then it was added drop wise with the aid of a 10-ml sterile syringe in $CaCl_2$ 2% (w/v) solution. The resulting alginate beads (with 3mm diameter) were maintained in the solution at room temperature for 1 h in order to obtain regular solid beads. Afterwards the beads were washed twice with 0.4% sterile NaCl and then stored at 4±1°C up to use.

Test of the antagonistic capacity preservation was achieved *in vitro* on PDA medium by inoculating phytopathogenic fungus (disk of 5 mm diameter, from a five-old days culture on PDA incubated at 22°C) and bioproducts in the same Petri dish (9 mm diameter). After 5 days of incubation at 28°C, linear growth of tested pathogen was recorded. The percent of growth inhibition was calculated using the following formula:

$$\%IG = \frac{GC - GT}{GC} \times 100$$

where: IG = inhibition of growth; GC = growth in control and GT = growth in treatment

The preservation of the biological qualities of bioproducts was tested *in vivo* under controlled conditions on the efficacy against *Sclerotium cepivorum* phytopathogen which attacks mostly the seedlings, causing severe damages. The experiment was carried out in growth chamber on seeds of onion (*Allium cepa*) cultivar RIJNSBURGER, disinfected in a first stage with 70% ethanol and in the second stage with 4% sodium hypochlorite solution. 30 seeds/variant were planted in soil previously sterilized by gamma ionizing radiation, and artificially infected with *Sclerotium cepivorum* phytopathogenic fungus at a rate of 18 g inoculum/tray. The alginate beads bioproducts were applied in rows along with the seeds (6 beads / row, 18 beads / tray) and those conditioned as microemulsion were applied as seed treatment by immersion for 20 minutes. Chemical treatment was performed using soil TOPSIN®500 SC at a dose of 0.25% and row sowing application (5 ml / row, 15 ml / tray).

Experimental variants were: V1 – *Pseudomonas chlororaphis* Sal.c2 vs. *Sclerotium cepivorum*; V2 – *Bacillus subtilis* Us.a2 vs. *S. cepivorum*; V3 – *B. subtilis* 98a vs. *S. cepivorum*; V4 – *Bacillus pumilus* OS.15 vs. *S. cepivorum*; V5 – *Bacillus amyloliquefaciens* OS.17 vs. *S. cepivorum*; V6 – Chemical control TOPSIN 500 SC vs. *Sclerotium cepivorum*; V7 – Negative control with *Sclerotium cepivorum*; V8 – Positive control – sterilized soil.

After four weeks, the plants were analyzed in terms of specific symptoms of disease like yellowing and wilting of the leaves, particularly browning and growth of white fluffy mycelium at the base of the stem. Roots that showed no characteristic symptom of the disease were considered healthy (photo 4).

Efficacy data were calculated according to Abbot's formula and represent the mean of three replicates.

RESULTS AND DISCUSSIONS

Selection of the bacterial strains

Table 1 shows the activity of bacterial strains *in vitro* their antagonistic activity on the growth of phytopathogenic mycelium fungi studied (observations at three days of incubation at 28°C for *Botrytis cinerea*, *Fusarium graminearum, Fusarium oxysporum* f. sp. *radicis lycopersici* and *Sclerotium bataticola* fungi, five days of incubation at 22°C for *Sclerotium cepivorum* fungus respectively, according to Manka & Manka method [7] (Photo 1).

Table 1. *In vitro* antagonistic activity of tested bacterial strains against to different phytopathogenic fungi (3-5 days of incubation at 22-28°C)

Bacterial strains	***Botrytis cinerea***	***Fusarium graminearum***	***Fusarium oxysporum* f. sp. *radicis lycopersici***	***Sclerotium bataticola***	***Sclerotium cepivorum***
Bacillus pumilus OS.15	+++	++++	+++	+++	+++
Bacillus amyloliquefaciens OS.17	++++	+++	++++	++++	+++
Bacillus subtilis Us.a2	+++	+++	+++	+++	++++
Pseudomonas chlororaphis Sal.c2	+++	+++	+++	+++	++++
Bacillus subtilis 98a	+++	+++	+++	+++	++++

Legend: ++++ = very strong inhibition of mycelium growth and formation of propagation organs; + + + = strong inhibition of mycelium growth; ++ = moderate inhibition of mycelium growth

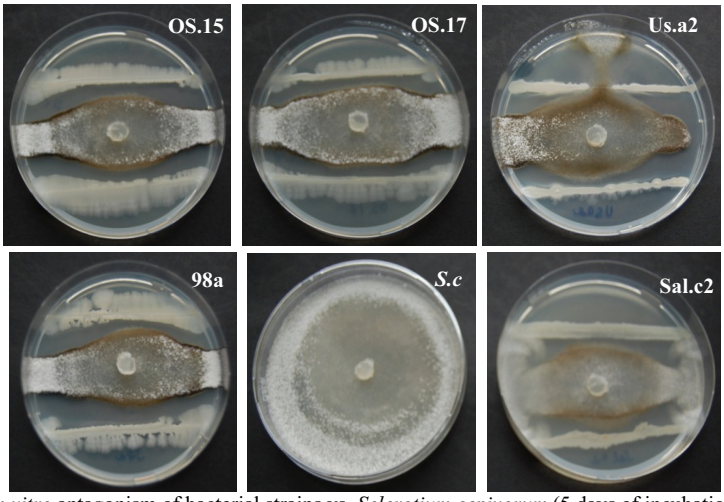


Photo 1. *In vitro* antagonism of bacterial strains vs. *Sclerotium cepivorum* (5 days of incubation at 22°C)

The bacterial strains, tested *in vitro* regarding their antagonistic activity produced a series of antifungal metabolites which inhibited the growth of the phytopathogens studied, causing large aria of inhibition (>5mm equivalent to ++++; >3mm equivalent to +++).

The conditioning of the selected bacterial strains was performed in order to obtain bioproducts (Photos 2), which were afterwards tested, both *in vitro* and *in vivo* for establishing the biological control agent qualities.

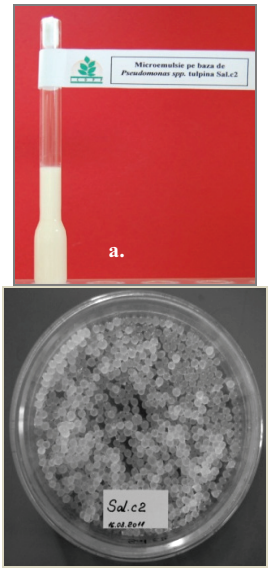


Photo 2. Bacterial bioproducts: a. Microemulsion formulation, b. Alginate beads formulation

Verification of preserving bio-antagonistic capacity

The results presented in table 2, indicated that both types of bioproducts based on the bacterial strains previously selected showed a strong inhibitor effect against *Sclerotium cepivorum* pathogen growth *in vitro*. Thus, bioproducts like alginate beads based on *Bacillus pumilus* OS.15 and *Bacillus subtilis* 98a strains showed the greatest percentage of inhibition (95%) to the growth of the pathogen followed by *Bacillus amyloliquefaciens* OS.17 bioproduct which had an inhibitory effect on percentage of 87.5% (Photo 3).

Microemulsion form of conditioned strains has also preserved the biological qualities of antagonists, showing inhibitory effect on fungus growth with 85% (*Bacillus subtilis* 98a) and 70-75%, respectively (Photo 4).

Table 2. *In vitro* antagonistic effect exerted by the bioproducts on *Sclerotium cepivorum* growth (5 days of incubation at 22°C)

Bioproducts vs *Sclerotium cepivorum*			
Alginate beads	**inhibition (%)**	**Microemulsion**	**inhibition (%)**
Bacillus pumilus OS.15	95	*Bacillus pumilus* OS.15	75
Bacillus amyloliquefaciens OS.17	87.5	*Bacillus amyloliquefaciens* OS.17	75
Bacillus subtilis Us.a2	75	*Bacillus subtilis* Us.a2	70
Pseudomonas chlororaphis Sal.c2	75	*Pseudomonas chlororaphis* Sal.c2	70
Bacillus subtilis 98a	95	*Bacillus subtilis* 98a	85

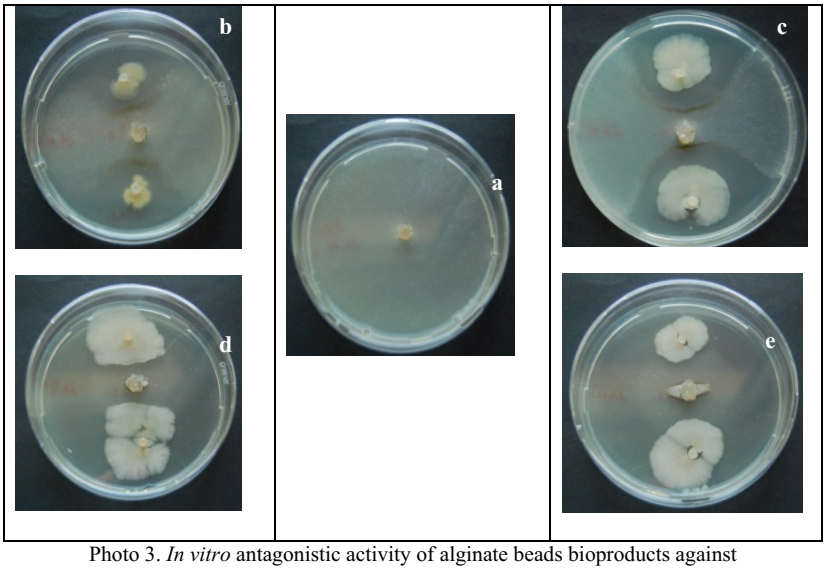


Photo 3. *In vitro* antagonistic activity of alginate beads bioproducts against *Sclerotium cepivorum* pathogen (5 days incubation at 22°C): **a** – fungal control; **b** – *Bacillus subtilis* Us.a2; **c** – *Bacillus amyloliquefaciens* OS.17; **d** – *Bacillus subtilis* 98a; **e** - *Bacillus pumilus* OS.15)

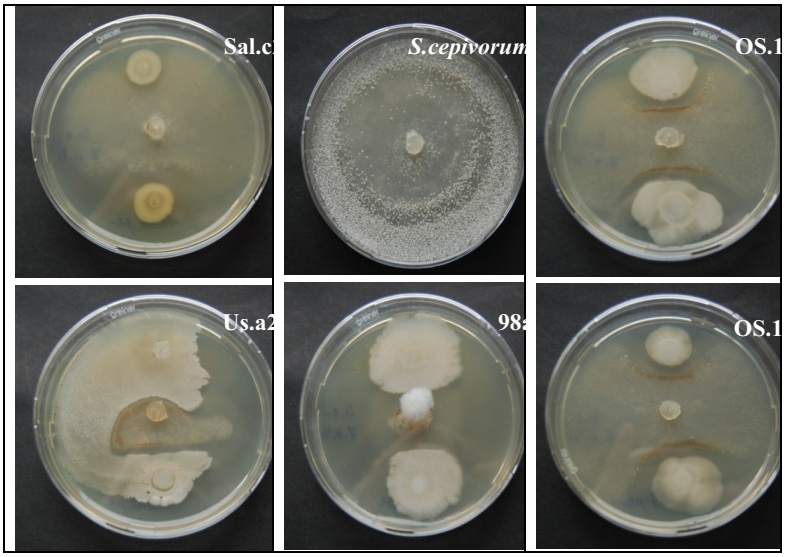


Photo 4. *In vitro* antagonistic activity of microemulsion bioproducts vs. *Sclerotium cepivorum* pathogen (4 days of incubation at 22°C)

In vivo preservation of the biological qualities of the bacterial bioproducts

The efficacy of the bioproducts against *Sclerotium cepivorum* in onion seedlings is represented graphically (figures 2, 3).

Among the microemulsion bioproducts applied as seed treatment the best efficacy was recorded in OS.15, 98a and OS.17 treatment variants (80-90%) with similar or very close values to the chemical control (90%). Also, Us.a2 and Sal.c2 bioproducts showed a protective but moderate effect on seedlings (40-50%) compared to chemical control (figure 2).

Administration of alginate beads showed reduced efficacy compared to the chemical control, mean values being recorded in OS.17, 98a and Us.a2 treatment variants (50-60%). Disease characteristic symptoms were noticed only in Salc2 treated variant which showed the lowest efficacy (10%) (figure 3).

The differences between efficacy values recorded for the two types of formulation of bioproducts mentioned above were significant because of the conditioning form. Thus, conditioning the bacterial strains as alginate beads allowed a slow release of microorganisms in soil, which led to a weaker colonization of seedling roots and, consequently, a lower protective effect from chemical control.

In the case of microemulsion, the bacteria were applied directly, as seed treatment causing a better colonization of plant roots and significant protection against *Sclerotium cepivorum* attack.

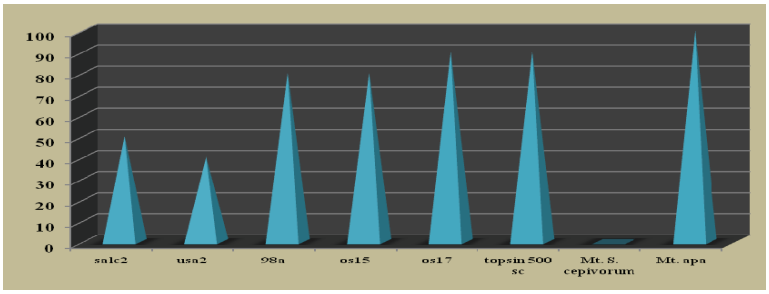


Fig. 2. The efficacy of microemulsion bioproducts in controlling *Sclerotium cepivorum* fungus on onion crop (24°C, 70% humidity)

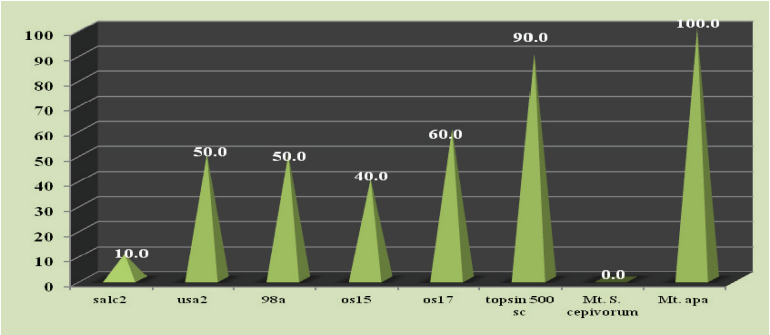


Fig. 3. The efficacy of alginate beads bioproducts in controlling *Sclerotium cepivorum* fungus on onion crop (24°C, 70% humidity)

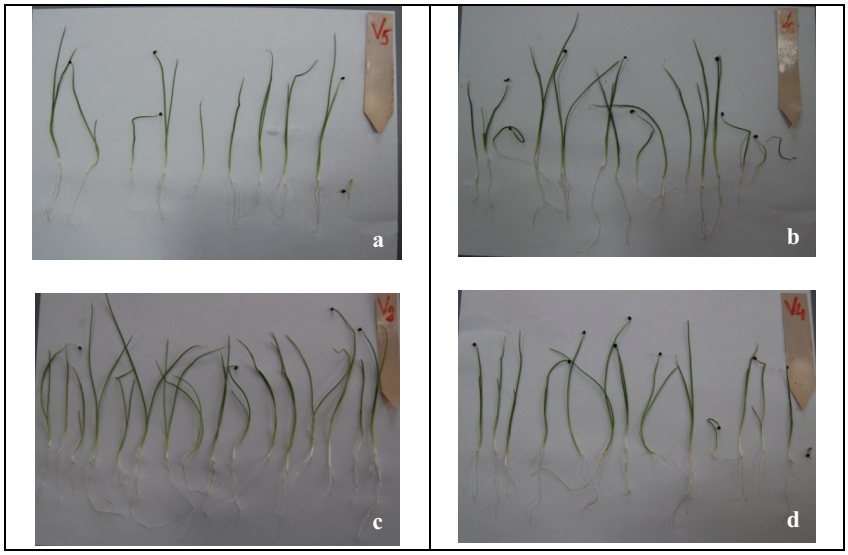


Fig. 4. The influence of the biological treatments on onion seedlings in growth chamber conditions: **a** - *Bacillus amyloliquefaciens* OS.17; **b** – Chemical control TOPSIN 500 SC; **c** – positive control; **d** – *Bacillus pumilus* OS.15

CONCLUSIONS

Five bacterial strains with high antagonistic activity *in vitro* against various phytopathogenic fungi were selected and formulated as microemulsion and sodium alginate beads.

In vitro bioassay showed that our bacterial bioproducts preserved antagonistic capacity against *Sclerotium cepivorum* fungus.

Conditioning methods used, allowed the development of high quality bioproducts which showed the property to preserve very well the biological qualities of the microorganisms.

In vivo results have shown the beneficial effects of the microorganisms formulated and the high efficacy in seedlings protection against the *Sclerotium cepivorum* attack.

REFERENCES

[1] Coley-Smith, J.R. and King, J.E., 1969. *The production by species of Allium of alkyl sulphides and their effect on germination of sclerotia of Sclerotium cepivorum.* Berk. Ann. Appl. Biol. 64: 289-301.

[2] Jesus Ricardo Sanchez Pale, Emma Zavaleta Mejia, Gustavo Mora Aguilera, Luis Perez Moreno, 2000. *Viability of four mexican isolates of Sclerotium cepivorum*, Berk. Revista Mexicana de Fitopatologia, 18(002):103-110.

[3] Leggett M., 1982. *Potential for biological control of onion white rot in the Fraser Valley, Proceedings of*

the 29th annual meeting, Canadian Pest Management Society; 12 – 15, July, 1982. Vancouver, British Columbia, (C.F. CAB abstracts 1984 – 1986).
[4] Mahomed I. A. Ali, Ismail M.K. Ismail, Abdel - Aziz M.Salama, Salama A. Ouf, 1990. *Effect of O-Cresol on Microbial Compozition in Soil and Rhizosphere of Onion Plants*. Cultivated in Mclean K.L. and Stewart A., 2000. *Infection sites of Sclerotium cepivorumon onion roots*, New Zealand Plant Protection 53:118-121 presence of *Sclerotium cepivorum*, Science, 3(1):5-21 (1411. 1991).
[5] Mclean K.L. and Stewart A., 2000, *Infection sites of sclerotium cepivorumon onion roots.* New Zealand Plant Protection 53:118-121.
[6] Ozkan M, Dilek F.B., Yetis U., Ozcengiz G., 2003. *Nutritional and cultural parameters influencing antidipteran delta-endotoxin production*. Res. Microbiol.;154(1):49-53
[7] Manka K, Manka M, 1992. *A new method for evaluating interaction between soil inhabiting fungi and plant pathogens. New approaches in biological control of soil-borne diseases*. Buletin OILB/SORP. XV, 1: 73-75.

Scientific Papers, Series B, Horticulture, Vol. LVI, 2012
CD-ROM ISSN 2285-5661, ISSN-L 2285-5653

EVALUATION OF POTENTIAL BIODEGRADATION OF MATERIALS BASED ON PEAT AND WASTE OF CELLULOSE FIBRES FOR USE IN SEEDLING PRODUCTION

Elena DOBRIN[1], Mihaela ROȘU[1], Elena DRAGHICI[1], Petronela NECHITA[2]

[1]Faculty of Horticulture, University of Agricultural Sciences and Veterinary Medicine from Bucharest, Marasti 59, District 1 011464, Bucharest, Romania,
E-mail: edobrin_usamv@yahoo.com
[2]Ceprohart S.A., Braila, Al. I. Cuza, Email: petronela.nechita@ceprohart.ro

Corresponding author email: edobrin_usamv@yahoo.com

Abstract

In order to develop a flexible production technologies nutritive biodegradable pots that easily adapt to culture plant requirements and the environmental protection have been tested in terms of biodegradation capacity following types of fibrous materials: natural wood cellulose, cellulose bleached softwood, softwood mechanical pulp, waste, corrugated cardboard, waste paper from newspapers and magazines mixed, with variations of compositions consisting of mixtures of cellulose waste and peat. Research developed in a PNCDI 2 researches program has revealed that the biodegradation potential of the tested samples is very different, from 20% in softwood mechanical pulp to 57% to natural wood pulp. Using the peat in the composition samples resulting slowing their biodegradation in soil. In terms of ability to develop an environment for root growth and development, of all samples can be recommended for introduction into the test as biodegradable pots, between the degree of cellulose degradation and the intensity of specific microflora respiration there is a direct positive correlation very significant.

Keywords**:** *biodegradation, cellulose waste, peat, pots, seedling*

INTRODUCTION

Cellulose is a major constituent of plant materials and the most abundant organic material present in nature, the main source of carbon and energy for soil microflora and is degraded only by microorganisms capable of producing cellulases [5]. In general, organic substances of plant origin have a high resistance to biological degradation. It develops slowly and usually requires intervention of a large number of microorganisms, so that there are over 200 species of microorganisms that produce cellulases and their ability to degrade cellulose. Therefore, in recent years, cellulose was introduced as a prop for carrying out different types of biodegradable pots used in the production plant production of container plant material. Develop new biodegradable products based on peat, cellulose and other supplements protective and stimulating Romanian design, for use for making pots to support crop production, in general, and horticultural production, particularly is a priority for research. Solving this problem would allow development an alternative technology, bio, for containerized seedlings for horticultural production. The purpose of this research was to characterize different materials based biocomposites peat and waste cellulose and identifies the most suitable recipes, in terms of their ability to develop an appropriate culture medium of microorganisms respectively, plants. The research was part of a comprehensive research program PNCDI-2, contact BIOSUN 51-090.

MATERIAL AND METHOD

Research has been conducted in the laboratories of the Faculty of Horticulture - University of Agricultural Sciences and Veterinary Medicine, Bucharest. Have been studied several types of waste cellulose, singly or in combination with peat KEKKILÄ - BP. Results of previous research recommends this type of peat as a good material for making nutritive biocomposites pots [1].

Variants of samples studied were as follows:
1. softwood mechanical pulp (PM);
2. 25% cellulose bleached softwood (R) + 75% KEKKILÄ – BP peat (T75);
3. 50% cellulose bleached softwood (R) + 50% KEKKILÄ – BP peat (T50);
4. waste paper from newspapers and magazines (MZ);
5. waste from corrugated cardboard (MO);
6. cellulose bleached softwood (R);
7. natural wood cellulose (N);

These samples were tested in terms of biodegradation potential by determining the cellulose decomposition - adapted from the method for determining cellulozolytic activity in soil [4, 5, 1, 2, 3] and in terms of ability to develop a favorable environment for the installation of the microflora specific to the soil and growing substrate by determining the intensity of respiration microflora involved in the cellulozolytic material decomposition - Ştefanic method adapted from Unger - quoted Szegi [4, 5, 6]. Adaptation of the two methods work consisted in the fact that different variants of working, with equal areas and weights determined were placed in a nutrient substrate, suitable for producing seedlings, placed in plastic pots of 0.5 l capacity. In advance samples were weighed and dressed in a plastic lycra bag of the known weight with the role of preservation of organic matter biodegraded [1, 2, 3]. Samples thus prepared were kept in a small home of vegetation at 24-26^{o}C, a constant humidity of 60-70% of the substrate, for 14 days. After this period was done as follows: bag of pot was removed, washed in running water, then was dried in an oven for 4 hours at 105^{o}C and weighed.

The degree of cellulose degradation was calculated as:

$$\% \text{ cellulose material decomposed} = \frac{Gi - Gf}{Gi - Gs} x100$$

Gi - sample weight + weight bag before they enter into the pot

Gf - sample weight + weight bag after being removed from the pot

Gs - bag weight

RESULTS AND DISCUSSIONS

Cellulosic materials studied have varying degrees of decomposition (Table 1). Although cellulose is an organic compound with a slow decay in nature, in our case the materials used were degraded at a rate of 20.37% -57.2% after only 14 days, during which they were kept in optimal conditions for growth and development of cellulozolytic microorganisms (humidity, temperature, and nutrient substrate - peat). We should mention here that in the assessment of the degree of decomposition of cellulose substrate is used as a pure substance or in our study worked but not with cellulose cellulosic substances with other organic compounds which printed different characteristics of studied materials specific to practical purpose use, namely making of pots used in the production of vegetable seedlings.

Table 1. Biodegradation potential of biocomposites materials

No.crt.	Cellulosic material	Biodegradation potential (%)	Observation
1	PM	20,37	The material hadn't been disintegrated
2	T75	27,09	The material hadn't been disintegrated, but some small pieces had detached
3	T50	45,53	The material had been disintegrated in cca. 50%
4	MZ	40,32	The material had been disintegrated in big and small pieces
5	MO	41,71	The material hadn't been disintegrated but some small pieces had detached
6	R	54,78	The material had been disintegrated
7	N	57,20	The material had been disintegrated, but not all

Breathing activity is an indicator which highlights global biological activity of the substrate. Unlike natural habitats where many species are represented by a relatively small number of individuals in habitats where they are introduced substances or substrate,

proliferation is favored species able to use it as energy source. Therefore in this study presumably cellulozolytic microflora is stimulated, one equipped with complex enzyme capable of degrading cellulose substances introduced as a substrate in the form of cellulosic materials. According to the results presented in Table 2 can be seen that the introduction of cellulosic materials has led to increased activity of the microflora breathing between 21.51 to 151.10 mg g CO2/100 substrate, which means an increase of 0.5 to 4.75 times higher than the simple peat, which was the work of breathing characteristic of this habitat. The largest increase in respiration activity was recorded in bleached softwood pulp natural (191.35 mg CO2/100 g substrate). This is followed by bleached softwood pulp (189.42 mg CO2/100 g peat). In samples where bleached softwood pulp was mixed with peat potential biodegradation decreased with increasing percentage of peat, something reflected in the breathing of the microflora. The lowest stimulating breathing activity was determined by the pine wood mechanical pulp (PM).

Table 2. Microflora breath involved in the breakdown of the cellulosic material

No.crt.	Variant	mg CO_2/100 g substrate	Differences from control	
			mg	%
1	PM	61,76	21,51	153,44
2	T75	99,26	59,01	246,60
3	T50	126,28	86,03	313,73
4	MZ	100,91	60,66	250,70
5	MO	126,83	86,58	315,10
6	R	189,42	149,17	470,60
7	N	191,35	151,10	475,40
8	control	40,25	Mt	100

From Fig. 1 we can see very strong relationship between the degree of decomposition of various cellulosic materials studied and the breathing of the microflora of the habitats where they were introduced as energy substrates.

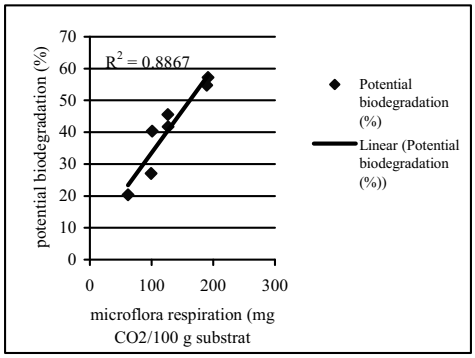


Fig. 1 Influence of sample composition on the degree of biodegradation and the specific microflora respiration

CONCLUSIONS

Biocomposites materials studied had extremely different biodegradation potential.

Lowest biodegradation potential was recorded in softwood mechanical pulp (PM) - 20.37%, while the natural wood cellulose (N), biodegradation was intense, more than 57%.

Waste paper from newspapers and magazines (MZ) and waste from corrugated cardboard (MO), can be categorized as having medium potential for biodegradation (40-42%).

Addition of peat in the bleached softwood pulp leads to lower degree of decomposition, with implications for physical integrity of the material studied for a long period of time.

Between the degree of cellulose decomposition and involved microflora respiration intensity level in the breakdown cellulosic material is a positive correlation direct, highly significant.

REFERENCES

[1] Nechita Petronela, Elena Dobrin et all., 2007. *Biocomposites from renewable resources – biodegradable nutritiv supports for containerized seedling manufacturing*. National Research Programme, BIOSUN, contract no. 51-090, stage 1/2007

[2] Nechita Petronela, Elena Dobrin et all., 2010. *Biodegradable pots for planting*. BioResources 5(2), p. 1102-1113, www.bioresources.com

[3] Stanciu Florentina, 2011. *Cercetări privind noi sisteme de producere a răsadurilor de legume*. Teză de Doctorat, USAMV Bucureşti, Bucureşti, p. 194-245

[4] Ştefanic G., 1999. *Probleme de agrofitotehnie teoretică şi aplicată*. Vol XXVIII, supliment, p. 45-50

[5] Ştefanic G., Săndoiu D.I., Gheorghiţă Niculina, 2006. *Biologia solurilor agricole*. Ed. Elisavaros, Bucureşti

[6] Szegi J., 1988. *Cellulose decomposition and soil fertility*. Akademiai Kiado, Budapest, p. 65-68


EX·TERRA·AVRVM

Scientific Papers, Series B, Horticulture, Vol. LVI, 2012
CD-ROM ISSN 2285-5661, ISSN-L 2285-5653

RESEARCH REGARDING THE BEHAVIOR OF SOME BLUEBERRY PLANT VARIETIES IN THE CONDITIONS FROM THE BUCHAREST AREA

Tudora NEAGU, Dorel HOZA, Ligia ION
University of Agronomic Sciences and Veterinary Medicine of Bucharest, 59, Marasti Street, 011464, Bucharest, Romania, tel.: 0213182564, fax: 0213182888, dorina_neagu@yahoo.com, dorel.hoza@gmail.com, ionnagyligia@yahoo.fr

Corresponding autor email: dorina_neagu@yahoo.com

Abstract

For the success of the blueberry culture, certain conditions are necessary to be fulfilled, especially the soil reaction which must be acid (pH=4,5-5,5), the soil must be properly drained, having a high content in organic material. In order to test the reaction of certain blueberry varieties to the Bucharest area conditions, where the soil is not totally suitable for this culture, an experiment was conducted with 6 varieties and 4 different methods of working the soil on the rows (bark, sawdust, agrotextile and grass) to ensure conditions as good as possible for the growth of the plants. For the planting, 10 liters of acid peat were used to correct the acidity of the soil. The biometric parameters analyzed for the plants highlighted, on one hand, differences among varieties, and on the other hand, differences among the soil maintenance variants. The varieties Pemberton and Bluecrop were more vigorous, while the varieties Delicia and Simultan proved to have a lower vigor. Also the fruit quality varied depending on the soil maintenance variants.

Key words*: blueberry plant, mulching, biometric parameters, production*

INTRODUCTION

In Romania, blueberry culture is not so spread, on one hand due to the lack of knowledge of the small fruit producers regarding the culture particularities and on the other hand due to difficulties in producing seedling material, which is obtained using special systems, on acid substrate [2].

Blueberry culture can represent an alternative for the small fruit producers and not only, being one of the shrub species that is very appreciated by the consumers, both for fresh fruit consumption and for the wide range of products resulting from processed fruit [3, 4]. Even though blueberry culture does not pose difficulties from a technological point of view, suitable regions for this species are limited due to the fact that the species is very pretentious regarding the reaction of the soil, which must be acid [1]. Extending the area of culture and capitalizing certain regions that are climatically favorable, but with some deviations for the soil reaction compared to the requirements of the species, can be done only after the reaction of the soil has been corrected with materials that acidify the soil or the culture can be created in containers.

For the purpose of extending the blueberry culture in Bucharest area, an experiment was organized to test the adaptation capacity of some blueberry varieties to the climatic and soil conditions from the respective area. Bucharest area would be a very good area from the point of view of capitalization due to the large population and its taste diversity.

MATERIAL AND METHOD

The experiment was conducted during 2009-2012, in the Teaching Field of the Faculty of Horticulture, in a culture founded in 2009, with six blueberry varieties: Augusta, Simultan, Delicia, Weymouth, Bluecrop and Pemberton, planted at the distance of 3 m between the rows and 1,5 m on the rows. At planting, 10 liters of acid peat were used for each plant in order to correct the reaction of the soil. The soil was maintained worked between the rows and with mulch on the rows,

with 3 materials that represented the experimental variants:
V1 – resinous sawdust;
V2 – pine bark;
V3 – black agrotextil
The plantation was provided with localized irrigation system, and the specific maintenance works for the shrub plantations were performed.
Biometric measurements were made related to the growth capacity, foliar surface, production capacity and production, quality through specific analyses using the HPLC device.

RESULTS AND DISCUSSIONS

The growth capacity of the analyzed varieties differed among varieties on one hand due to the biological characteristics and on the other hand due to soil maintenance variants. Thus, the ramification capacity of the strains was different, the average number of ramifications during 2009-2012 was between 15.59/plant for the Weimouth variety in case of mulching with sawdust and 23.78/plant for the Pemberton variety in case of mulching with agrotextil (table 1). The highest ramification capacity was recorded for the variety Pemberton, with an average of more than 21 ramifications per plant, followed by Bluecrop with 19.3 ramifications per plant. A lower ramification capacity was recorded for the varieties Weimouth with 15.8 ramifications per plant and Delicia with 16.76 ramifications per plant (table 1).

Table 1. Ramification capacity of some blueberry varieties (ramifications/plant, 2009-2012, Bucharest)

Variety	Mulching variant			Average
	Sawdust	Pine Bark	Agrotexil	
Augusta	17,16	19,42	20,06	18,88
Simultan	16,50	17,55	20,97	18,34
Delicia	14,98	18,12	17,17	16,76
Weymouth	15,59	15,61	16,20	15,80
Bluecrop	18,55	19,31	20,17	19,34
Pemberton	20,04	21,62	23,78	21,81
Average	17,14	18,61	19,73	18,49

The foliar surface of the plants is important through its size and heath degree in order to synthesize the organic substances necessary for the nutrition of the plant as a whole and in order to ensure a proper fructification. For the analyzed varieties, the foliar surface differed according to the variety and mulching material, the values obtained varying between 2561 cm^2/plant for the Weimouth variety in case of mulching with sawdust and 7679 cm^2/plant for the Pemberton variety in case of mulching with agrotextil (table 2). The values per mulching material were lower in case of plants mulched with sawdust and higher in case of plants mulched with agrotextil. Mong varieties, the average values for the three mulching materials showed higher values for the foliar surface for Pemberton variety, which exceeds the average by 49%, followed by Bluecrop, which exceeds the average by 12%, the remaining four varieties recording values under the average. These two varieties were more vigorous also from the point of view of the ramification capacity.

Table 2. Foliar surface for some blueberry varieties (cm^2/plant, 2009-2012, Bucharest)

Variety	Mulching variant			Average
	Sawdust	Pine Bark	Agrotextil	
Augusta	3438,00	4107,67	4397,25	3980,97
Simultan	3480,23	3819,81	4991,58	4097,21
Delicia	2586,97	3623,31	4071,30	3427,19
Weimouth	2561,98	3428,73	3852,64	3281,12
Bluecrop	3685,17	5170,89	5757,50	4871,19
Pemberton	5133,07	6802,70	7679,32	6538,36
Average	3480,90	4492,19	5124,93	4366,01

The fructification potential of the blueberry is lower in the first years of life of the plants due to the low growth capacity, and the formation of the inflorescences begins in the first two-three years from planting. During the experiment conducted, the first inflorescences appeared during the first year since planting because the plants were fortified and planted with bales of peat, but the production was insignificant; during the following three years, the production recorded a slight increase. The average production for the four years was relatively low, due to the slow growth of the plants, and recorded values between 813 g/plant for the Simultan variety mulched with sawdust and 2384 g/plant for the Bluecrop variety mulched with agrotextil (table 3).

If the production per mulching material was analyzed, it would be noticed that the agrotextil stimulated a better fructification than the organic materials, for which the production was relatively equal. Among varieties, Bluecrop proved to be more productive, with an average of 2099 g/plant, followed by Pemberton with 1695 g/plant. The smallest production was obtained from the Simultan variety, with approximately 750 g/plant.

Table .3Production capacity of some blueberry varieties (g/plant, 2009-2012, Bucharest)

Variety	Mulching variant			Average
	Sawdust	Pine Bark	Agrotextil	
Augusta	1009,23	1139,90	1228,37	1125,83
Simultan	813,31	694,70	734,72	747,58
Delicia	1658,94	1235,33	1318,58	1404,28
Weimouth	1062,55	1112,80	1307,47	1160,94
Bluecrop	1863,51	2051,40	2383,71	2099,54
Pemberton	1442,69	1723,94	1919,40	1695,34
Average	1308,37	1326,35	1482,04	1372,25

Fruit quality is very important both for a better capitalization of the production and for the role played by the fruit in the rational nutrition of humans. From this point of view, measurements were made regarding the content in dry substance and vitamin C. among varieties, differences were recorded, but without the possibility to identify any direct relationship with the mulching material, the values obtained probably being the result of the interaction between the varieties and the respective mulching materials.

The total content in dry substance was higher for the Simultan variety, 30,41%, for which the production was the lowest one, while the lowest content was recorded for the Bluecrop variety, 16,58%, for which the production was the largest, thus confirming once more the negative correlation between quantity and quality. The mulching materials did not uniformly influence all the varieties, reason for which no direct relationship between these two indicators can be found (table 4).

The soluble dry substance was slightly influenced by the mulching material in case of four out of six varieties; the values for the fruit produced by plants mulched with agrotextil were higher for this parameter. The variation limits for the values recorded among varieties were 11,70% for the Delicia variety and 13,1% for the Pemberton variety. The content in vitamin C was generally higher for the plants mulched with agrotextil. Among varieties, the values recorded differed, the variation limits being 12,53 mg/100 for the Delicia variety and 16,13 mg/100 for the Weymouth variety (Table 4).

Table 4. Some fruit quality indicators for blueberry (Bucharest)

Parameter	Mulching material	Augusta	Simultan	Delicia	Weymouth	Bluecrop	Pemberton
Water %	Sawdust	76,43	68,77	82,8	73,05	83,36	71,35
	Pine Bark	75,05	69,49	82,52	74,92	83,42	72,25
	Agrotextil	73,60	70,50	78,31	75,37	83,49	74,18
	Media	75,03	69,59	81,21	74,45	83,42	72,59
Total dry substance %	Sawdust	23,57	31,23	17,20	26,95	16,64	28,65
	Pine Bark	24,95	30,51	17,48	25,08	16,58	27,75
	Agrotextil	26,4	29,5	21,69	24,63	16,51	25,82
	Media	24,97	30,41	18,79	25,55	16,58	27,41
Soluble dry substance %	Sawdust	12,08	12,28	11,37	13,01	12,02	12,66
	Pine Bark	11,87	11,66	11,80	12,89	11,90	13,10
	Agrotextil	12,31	12,12	11,92	12,79	12,65	13,28
	Media	12,09	12,02	11,70	12,90	12,19	13,01
Vitamin C mg/100 g	Sawdust	14,92	14,43	11,78	16,33	13,45	14,72
	Pine Bark	14,51	14,18	12,60	15,74	13,73	15,22
	Agrotextil	15,37	14,58	13,21	16,31	15,35	15,48
	Media	14,93	14,40	12,53	16,13	14,18	15,14

CONCLUSIONS

From the present study the following conclusions can be drawn:

- The growth of the blueberry plants in the Bucharest area is rather slow; after four years, the plants failed in reaching a proper size of the bush according to the potential of the species;
- The behavior of the six varieties was different from the point of view of the vigor and fructification capacity;
- The varieties Pemberton and Bluecrop proved to be more vigorous, while the varieties Weymouth, Delicia and Simultan were less vigorous;
- The foliar surface was higher for Pemberton, a vigorous variety, and smaller for the Weymouth variety;
- The varieties Bluecrop and Perberton were more productive, while the varieties Simultan and Augusta recorded lower production values;

Due to the fact the plants are young, the research must continue in order to obtain precise data regarding the adaptation capacity of the blueberry plant to the conditions from Bucharest area.

REFERENCES

[1].Bădescu C., Petre, G.H., Cristina Bădescu, Delian, E. and Bădescu, A. 2009. *Soil and climatic limitations to blueberry culture in Romania submontane areas*. Acta Hort. (ISHS) 810:765-770.

[2].Hoza D., 2000. *Cultura căpşunului, semiarbuştilor şi arbuştilor fructiferi*. Ed Elisavaros, Bucureşti, pag. 215-222.

[3] Mladin Gh., Mladin Paulina, Rădulescu Maria, 1995, Agronomical and biochemical value of some minor small fruits. Lucrări ştiinţifice ale ICDP Piteşti-Mărăcineni, vol. XVIII, pg. 79-85.

[4] Mladin Paulina, 2001, New highbush blueberry cultivars, Eucarpia fruit breeding section newsletter Nr. 5: 18-1.

Scientific Papers, Series B, Horticulture, Vol. LVI, 2012
CD-ROM ISSN 2285-5661, ISSN-L 2285-5653

STUDY REGARDING THE INFLUENCE OF THE BIO STIMULATOR BIOSEED ON BELL PEPPER SEED GERMINATION

Elena Maria DRĂGHICI [1], Andy BRATOSIN[2], Elena DOBRIN [1], Maria PELE[1]

[1]University of Agronomic Sciences and Veterinary Medicine of Bucharest, Mărăşti Blvd., District 1, 011464, Bucharest, Romania, elena.draghici@horticultura-bucuresti.ro, edobrin_usamv@yahoo.com, mpele@yahoo.com
[2]SC.Ecoindustries Trading Group SRL Bucharest

Corresponding author email: elena.draghici@horticultura-bucuresti.ro

Abstract

The study was conducted in Hortiviticol Systems Bioengineering Department, University of Agronomic Sciences and Veterinary Medicine - Bucharest. The purpose of this study was to test the product BioSeed 3 + and to recommended the best concentration for shortening and economic pepper seed germination. Research results have shown that the wetting of pepper seeds for 60 minutes before sowing in solutions of different concentrations BioSeed 3+ resulted in a shorter period of germination. The forming and growth rhythm of the roots was accelerated for all treated variants. This is a relevant aspect as the development of a vigorous radicular system leads to obtaining an appropriate sapling. Germination time for all treated variants of the pepper seeds was shortened which helps obtain quality seedlings earlier. Keeping in mind the species specific requirements regarding the germination temperature and timeframe, this provides an advantage as it saves on the energy required for heating the environment where the seedlings are produced.

Key words: germination, organic product, pepper seeds.

INTRODUCTION

Farming is one of the most important branches of agriculture and the most parts the cultures started by seedling.
Using some organic products for speeding germination of seeds is a goal pursued by most growers. If sweet pepper seeds are planted without simulating they take a very long time to germinate. We know many techniques to simulate the sweet pepper seed [1,2]. So, sweet pepper seed pre-treated by far germinated quicker than untreated seeds [4].
Reduction of producing seedlings, especially for greenhouse crops, help to reduce of energy costs.
For sustainable agriculture are searching after numerous ways to ensure a quality seedling using organic products [5].

MATERIAL AND METHOD

The study was made at the Horticulture Faculty Bucharest at the Hortiviticol Systems Bioengineering Department. We used seeds of pepper, Opal cultivar to testing the germination, in controlled condition, in germinator.
Product tested: BioSeed 3+, in three different concentrations defined here in as C1, C2 and C3.
BioSeed 3+ is a new product, wholly plant derived, made from 100 % natural plant-fruit extracts and oils, designed for use in horticulture.
All starting materials come from a closed ecological cycle produced without synthetic or chemical agents or fertilisers.
Producer: Wise Use International BV Holland. The BioSeed 3+ composition: Ca: 9,6 – 19,2 mg/l; Co: 19,2 – 24 mg/l; Cu: 0,048 - 0,01mg/l; Fe: 0,56 – 0,8mg/l; Mg: 1,6 - 2,4mg/l; K: 88 – 120 mg/l; S: 16 – 32 mg/l; Urea: 0,8 – 1 mg/l; Essential Oils - 28 mg/l; Acid Oils: 0,02 – 1,2 %; Ph: 9,4; Density: 1,05kg/l.
Experiment: Humectation with BioSeed 3+ for 60 minutes.

The experimental variants were: V1 – Control Group – seeds dampened in distilled water; V2 – Seeds dampened in C1 concentration; V3 - Seeds dampened in C2 concentration; V4 - Seeds dampened in C3 concentration;
The germination was tested in a germinator at 30 ^{o}C during the daytime and 20 ^{o}C during the night-time, in conformity with the germination determination standard for pepper seeds. Data was retrieved after 5 days for the registration of the germination energy and for the final data after 10 days.
The following was determined:

- The number of germinated seeds after 3, 5, 8 and 10 days;
- The length of the roots;
- The height of the stems;
- The growth rhythm of the roots and stems
- The statistical interpretation of the results using the variance analysis.

RESULTS AND DISCUSSIONS

Experiment I - The testing of bell pepper seed germination on a substratum of filtering paper. Based on the data retrieved the following was determined after three days of sowing, the lowest number of germinated bell pepper seeds was found for the 4th Variant – the C3 Biorootz solution. The highest percentage of germinated bell seeds (22%) was found for the 2nd Variant – C1, table 1.

Table 1.Number of germinated pepper seeds and percent of germination

Variant	No. of germinated seeds	Germination percent	No. of germinated seeds	Germination percent	No. of germinated seeds	Germination percent	No. of germinated seeds	Germination percent
	After tree days		After five days		After eight days		After ten days	
	No.	%	No.	%	No.	%	No.	%
V_1Ctrl G	7,33	15	14	28	21	42	41	82
V_2 - C1	11,0	22	27	54	43	86	46	92
V_3- C2	7,67	15	26	52	46	92	47	94
V_4 - C3	5,33	11	31	62	47	94	47	94

After six days, the highest germination percentage was registered by V4.
The percentage of seed germination was also maintained after eight days from sowing.

Also, from a statistical point of view, a considerable difference was notable between the germination and the control Variant (V1).

Table 2.The percentage of germinated seeds as opposed to the control group after three days treatment

Variant	Germination percent as opposed to V_1 %	Difference		Significance
		Percent of germination	% as opposed to V1	
V_1 Ctrl	14.67	0.00	100.00	Ctrl
V_2 - C1	22.00	3.67	150.00	*
V_3 - C2	15.34	0.33	104.55	N
V_4 - C3	10.66	-2.00	72.73	N
	DL5% = 2.710		DL5% in % = 36.9545	
	DL1% = 4.100		DL1% in % = 55.9091	
	DL01% = 6.530		DL01% in %= 89.0455	

Six days after sowing the differences are distinct as opposed to the control group, the germinated seeds with V3-C1 being at 85,71% and the V4-C3 ones at 121,43% (see table 3).

Table 3. The summary of the results for the germinated seeds percentage on 6 days after sowing

Variant	Germination percent as opposed to V_1 %	Difference		Significance
		Percent of germination	% as opposed to V1	
V_1 Ctrl	28	0.00	100.00	Ctrl
V_2 - C1	54	26.00	192.86	***
V_3 - C2	52	24.00	185.71	***
V_4 - C3	62	34.00	221.43	***
	DL5% = 1.130		DL5% in % = 4.0357	
	DL1% = 1.720		DL1% in % = 6.1429	
	DL01% = 2.740		DL01% in %= 9.7857	

At the eight days after sowing, the percentage of germinated seeds was 94% for V4, a difference of 123,81% over the control group (V1).
All the treated variants showed higher germination values than V1, with percentages of over 104% (see table 4).

Table 4.The summary of the results for the germinated seeds percentage after eight days from sowing

VARIANT	Germination Percentage (%)	DIFFERENCE (% sem.)	(%)	SIGNIF
V(0) average	78.50	36.50	186.90	***
V(1)	42.00	0.00	100.00	Ctrl
V(2)	86.00	44.00	204.76	***
V(3)	92.00	50.00	219.05	***
V(4)	94.00	52.00	223.81	***
DL5% =	1.700	DL5% in % =	4.0476	
DL 1% =	2.580	DL 1% in % =	6.1429	
DL 01% =	4.110	DL01% in %=	9.7857	

Ten days after sowing the differences were up to 14, 63% compared to the control group V1, which shows that the bell pepper seeds germinated in a shorter timeframe in the treated variants. The control group germinated in a longer timeframe compared to the rest of the treated variants.

Table 5. The summary of the results for the germinated seeds percentage after ten days from sowing

VARIANT	Germination Percentage (%)	DIFFERENCE (%)	(%)	SEMF
V(0) average	90.50	8.50	110.37	***
V(1)	82.00	0.00	100.00	Ctrl
V(2)	92.00	10.00	112.20	***
V(3)	94.00	12.00	114.63	***
V(4)	94.00	12.00	114.63	***
DL5% =	0.980	DL5% in % =		1.1951
DL1% =	1.490	DL1% in % =		1.8171
DL01% =	2.370	DL01% in %=		2.8902

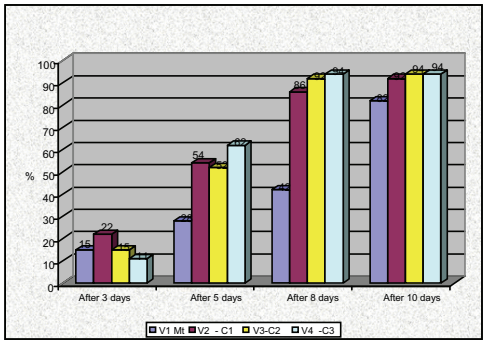


Fig. 1. Percentage of germinated bell pepper seeds

Bell pepper seedlings presented differences even after only 5 days from sowing. The highest was registered at V4.

Table 6. Average height of seedlings – mm

Variant	Average height of seedlings:		
	After 5 days	After 8 days	After 10 days
V_1 Ctrl	0.0	4.11	6.25
V_2 - C1	1.0	8.33	11.5
V_3 - C2	2.0	6.00	10.8
V_4 - C3	2.0	6.33	21.2

After 10 days from sowing the growth of the seedling was of 21,2 mm, and from a statistical point of view the differences were significant as per V1 (see Table 7).

Table 7. The meaning regarding the height of bell pepper seedlings after 10 days

Variant	Medium height of seedlings (mm) after 10 days	Difference		Significance
	mm	mm	%	
V_1 Ctrl Gr	6.25	0.00	100.00	Ctrl Gr
V_2 - C1	11.50	5.25	184.00	***
V_3 - C2	10.80	4.55	172.80	***
V_4 - C3	21.20	14.95	339.20	***
	DL5% = 1.700	DL5% in % =		27.2000
	DL1% = 2.580	DL1% in % =		41.2800
	DL01% = 4.110	DL01% in %=		65.7600

The medium growth rhythm of the seedlings was higher for the treated variants (see table 8).

Table 8. The medium growth rhythm of the seedlings

Variant	From 3 to 5 days mm/day	From 5 to 10 days mm/day	Medium growth rhythm mm/day
V_1 Ctrl	1.37	0.31	0.69
V_2 - C1	2.44	0.45	1.28
V_3 - C2	1.33	0.69	1.20
V_4 - C3	1.44	2.12	2.36

All of the treated variants presented cotyledonous leaves bigger than the ones from V1, of 22,5 mm for V4 and 5,85 mm for V2 (see table 9, fig. 2).

Table 9. Size of cotyledon leaves - mm

Variant	**Length of the cotyledon leaves - mm**	
	After 8 days	**After 10 days**
V1 Ctrl	3.25	5.85
V2 - C1	5.00	12.00
V3 - C2	4.87	12.5
V4 - C3	5.00	22.5

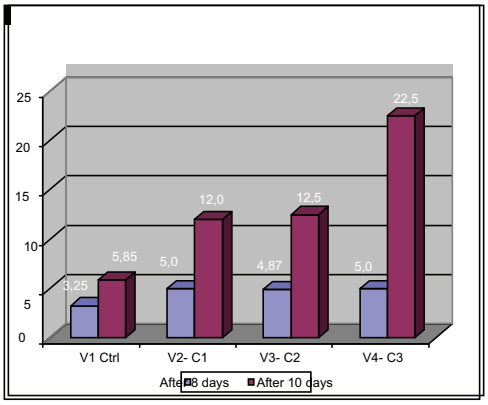


Fig. 2. Length of the cotyledonous leaves – mm

From tables 9 and 10 we notice that the root of the sapling was bigger for all the treated

variants: between 2 mm for V2 and 5 mm for V3 (after 6 days).

Table 10. Size of cotyledon leaves for bell pepper seedlings after 8 days from sowing

Variant	Size of cotyledonous leaves	Difference		Significance
	mm	(mm)	(%)	
V1 Ctrl	3.25	0.00	100.00	Ctrl
V2 - C1	6.33	3.08	194.77	***
V3 - C2	4.87	1.62	149.85	**
V4 - C3	5.00	1.75	153.85	**
	DL5% = 0,440 DL5% in % = 13,5385 DL1% = 0,820 DL1% in % = 25,2308 DL01% = 1,820 DL01% in %= 56,0000			

After 10 days for V3 and V4 the length was 32,5 mm and 36,8 mm respectively, table 11.

Table 11. Length of the root

Variant	**Length of the root - mm**		
	After 5 days	**After 8 days**	**After 10 days**
V1 Ctrl	1	12.66	24.33
V2 - C1	2	24.7	28.11
V3 - C2	5.0	25.6	32.5
V4 - C3	2.1	26.5	36.8

The control (V1) presented the lowest growth in height, the differences between the variants as opposed to the control group being very significantly (for V3 and V4) and significantly (for V2) - table 12.

Table 12. The summary of results regarding the length of the root on bell pepper seedlings

VARIANT	LENGTH OF THE ROOT (mm)	DIFFERENCE (mm)	(%)	SIGNIF
V(0) average	30.51	5.88	123.86	***
V(1)	24.63	0.00	100.00	Ctrl
V(2)	28.11	3.48	114.11	**
V(3)	32.50	7.87	131.94	***
V(4)	36.80	12.17	149.39	***
DL5% =	1.500	DL5% in % =	6.0893	
DL 1% =	2.270	DL 1% in % =	9.2152	
DL 01% =	3.620	DL 01% in %=	14.6955	

CONCLUSIONS

The percent of seeds germinated was 22% (V2) comparatively with control (V1) which only germinated 15%.

After 8 days the germination percentage for the treated variants was very close to the maximum germination percentage of the seeds after 10 days. The control group V1 was almost 50% smaller compared to the rest of the variants.

Early seed germination is preferred in order to obtain seedling in a shorter timeframe. Economically speaking, obtaining a seedling earlier also reduces costs.

Based on the obtained results the following data was extracted:

- Treated seeds presented a higher germination percentage in a shorter time period compared to the control group one – without any treatment.
- All the variants on which the treatment with Bioseed was applied to for 60 minutes had a superior seedling height than that of the control but the best results were obtained by V2 on which we applied the solution with a C1 concentration;
- Although remarkable differences can be observed for all the treated variants, we can appreciate that for pepper only using the V2 variant is practical.

ACKNOWLEDGEMENTS

This work was supported by a grant of the Romanian National Authority for Scientific Research, CNDI – UEFISCDI, financed from project number PN-II-PT-PCCA-2011-3.2-1351 - Contract No.68/2012.

REFERENCES

[1] Drăghici Elena Maria, Gheorghita Hoza, 2008, *The influence of lettuce transplants quality on yield,* Bulletin UASVM, Horticulture 65(1) PISSN 1843-5254; EISSN 1843-5394.

[2] Jules Janick, Anwar A. Khan, 2010 *Preplant Physiological Seed Conditioning*, Horticultural Reviews, Volume 13.

[3] Jules Janick, Carlos A. Parera, Daniel J. Cantliffe, 2010, *Presowing Seed Priming,* Horticultural Reviews, Volume 16, University of Florida Journal Series no. R-03271.

[4] Stoian, L., 2005 – Ghid practic pentru cultura biologică a legumelor. Editura Tipoactiv, Bacău.

Scientific Papers, Series B, Horticulture, Vol. LVI, 2012
CD-ROM ISSN 2285-5661, ISSN-L 2285-5653

COMPARISON OF TRICHODERMA SP. USE EFFICIENCY ON CUCUMBERS AND LETTUCE

Laila DUBOVA, Ina ALSIŅA, Vilhelmine ŠTEINBERGA

Latvia University of Agriculture, Liela iela 2, Jelgava LV 3001, Latvia, Phone: +371 63010612,
E- mail: laila.dubova@llu.lv

Corresponding author email: laila.dubova@llu.lv

Abstract

The effect of additional soil microorganisms' preparations (Trichoderma viride, Trichoderma lignorum) on cucumber cv. 'Pioneer' and lettuce cv. 'Grand Rapids' growth and quality as well as peat substratum biological activity was studied. Trichoderma sp. added as liquid culture in concentration 20 and 100 mL m^{-2}. Substratum was treated 3 days before plants were potted. Plant growth parameters and yield was analyzed. Soil respiration intensity was measured by changes of carbon dioxide, soil enzymatic activity assessed by dehydrogenase and fluorescein diacetate (FDA) hydrolysis activity. Trichoderma viride stimulated plant vegetative growth. Both preparations increased plant fresh weight in comparison with control. The increased level of chlorophylls was observed in cucumber leaves as effect of Trichoderma lignorum. Plant species had different sensitivity to additional microorganisms. Effect of preparation depended on plant development stage. Microorganisms' preparations differently affect soil enzymes activity. Peat substratum without plants showed decreased soil respiration intensity, but increased dehydrogenases activity.

Key words**:** *Trichoderma viride, Trichoderma lignorum, cucumber, lettuce, enzymes*

INTRODUCTION

Free-living fungi *Trichoderma* spp. are highly interactive in root, soil and foliar environments. Beneficial microorganisms enhance plant growth through numerous mechanisms and can also compete with other microorganisms for nutrients and/or space [4]. Experiments carried out in different locations have demonstrated that under certain environmental and soil and growing media conditions inoculation with microorganisms has beneficial effects on plant yield. It is reported that *Trichoderma spp.* promoted growth and development of seedlings of vegetable, namely cabbage, cucumber, tomatoes and lettuce [2, 8, 10, 4]. Cucumber, bell pepper and strawberry yields were increased significantly following the application of *Trichoderma spp.* [1, 3, 12]. Many species of *Trichoderma* can enhance growth, development and yield on different plants: *T. harzianum* and *T. viride* in cucumber and bell peppers [8, 3], *T. longipile, T. tomentosum* and *T. virens* in cabbage [11]. Some of the *Trichoderma* species may interact better with certain plant species. In other words so called "affinity" of some of the *Trichoderma* species is high only with some plant species that is root exudates of some plants may induce or inhibit mycelial growth of certain *Trichoderma* species only. Pea and maize root exudates strongly induced the mycelial growth of *T. longibrachiatum, T. harzianum* and *T. viride*. However, the increasing effect on the mycelial growth by the lettuce root exudates was only slight for the above mentioned *Trichoderma* species. The mycelial growth was completely inhibited by the exudates of onion and cabbage for the *Trichoderma* species above. [3, 13].

Lettuce (*Lactuca sativa*) and cucumber (*Cucumis sativus)* is grown widely around the World and those are popular vegetables in Latvia. Therefore the aim of this study was compared the effect of *Trichoderma viride, Trichoderma lignorum* on the growth, yield formation and quality of lettuce and cucumber and soil biological parameters were plants were grown.

MATERIAL AND METHOD

Experiments were carried out in the greenhouse of Institute of Soil and Plant Science, Faculty of Agriculture, Latvia University of Agriculture.
Lettuce (*Lactuca sativa*) cv.'*Grand Rapids'* and cucumber (Cucumis sativus) cv. *'Pioneer'* were grown in 1L vegetation pots. After three weeks cucumbers were transplanted into 10 L vegetation pots. Vegetation pots were filled with peat substratum and one plant per pot planted. Three days before planting, commercial peat substratum (pH_{KCl} 5.5 ± 0.5, N 100 - 140 mg L^{-1}, P_2O_5 110 - 170 mg L^{-1}, K_2O 190 - 290 mg L^{-1} with Ca, Mg, S and microelements: Fe, Mn, Mo, Zn, Cu and B) was mixed with microorganisms *Trichoderma viride, Trichoderma lignorum* given by the Institute of Microbiology and Biotechnology, Latvia University. Control - without additional microorganisms. *Trichoderma viride, Trichoderma lignorum* was added as liquid culture in concentration 20 and 100 mL per square meter and labelled TV20, TV100, TL 20, TL100. Used concentrations were recommended by producers.
After 20 and 40 days of experiment plant fresh and dry weight, content of dry matter, pigment and ascorbic acid content in leaves, antiradical activity of plants was determined. Pigment content was determined spectrophotometricaly in ethanol extract [6].
Soil enzymatic activity (catalase, dehydrogenase) was detected spectrophotometricaly, soil respiration activity with Gas Analyser ADC 2250 at the end of experiment. Dehydrogenase activity was determined by reduction of 2-*p*-iodo-3-nitrophenyl-5-phenyltetrazolium chloride to iodonitrophenylformazan at 30 °C. [5; 12]. Activity of catalase was determined by measurement of produced oxygen in enzymatic decomposition of hydrogen peroxide to water and oxygen [7; 12]. Intensity of soil respiration was determined by measurement of emissioned carbon dioxide [7; 12].
Analyses of variance (ANOVA) and correlation were performed.

RESULTS AND DISCUSSIONS

Trichoderma lignorum stimulated vegetative growth of lettuce plants. Both preparations dose 100 mL m^{-2} increased plant fresh weight in comparison with control (Fig.1). The highest dry matter content in lettuce leaves was observed in variant with *T.viride* in larger concentration.

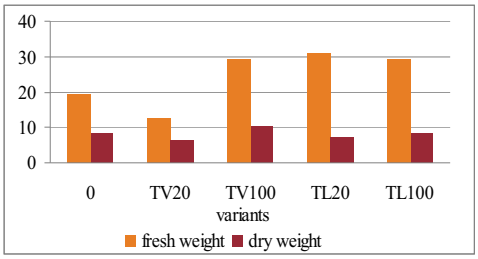


Fig. 1. Fresh weight (g) and dry weight (%) of lettuce leaf in the end of experiments

The increased level of chlorophylls was observed in cucumber leaves as effect of *Trichoderma lignorum* (Fig.2). However, lettuce leaves show different effect. Level of chlorophylls decrease in the variants with higher microorganisms dose (Fig.3).

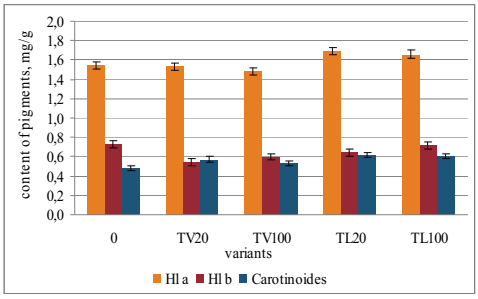


Fig. 2. Content of pigments in the cucumber leaves

Decreased level of chlorophyll b was observed in the lettuce leaves as result of microorganisms preparation use and it causes changes in the chlorophyll a and b ratio. The lowest ratio was observed in control (2.12 for cucumber leaves and 2.87 for lettuce leaves. Plant species had different sensitivity to additional microorganisms.

Effect of preparation depended on plant development stage. Data statistical analyses didn't approve the significant effect of additional microorganisms on dry matter content in lettuce leaves.

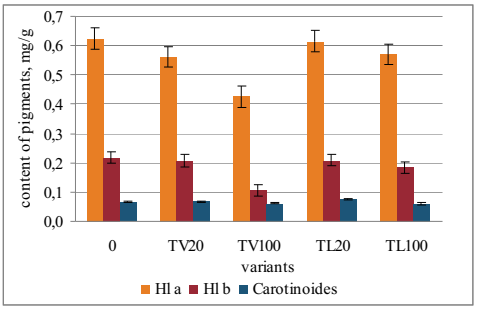


Fig. 3. Content of pigments in the lettuce leaves

Peat substratum without plants showed decreased soil respiration intensity (Fig.4.), but increased dehydrogenase activity. During experiment was determined different interaction between plant and microorganisms. Higher respiration intensity of peat substratum of lettuce was determined in variants with additions *T. viride*, but in the experiment with cucumber in the variants with *T. lignorum* (TL100) (Fig.4.).

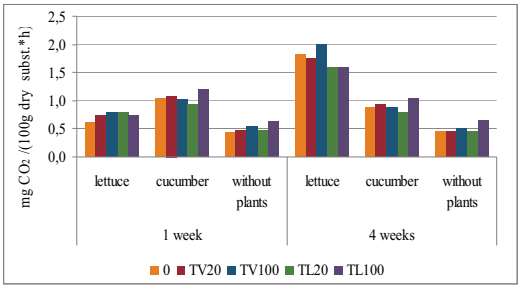


Fig. 4. Respiration intensity of peat substratum

Soil respiration intensity changed also during plant vegetation. At the beginning of experiment substratum were cucumbers grow showed larger activity, but after 4 weeks of cultivation "lettuce" soil became more active (Fig.4).

Microorganisms' preparations differently affect soil enzymes activity (Fig.5. and Fig.6.).

Dehidrogenase activity was affected more significantly than fluoresceine diacetate (FDA) hydrolysis intensity. Addition of *Trichoderma* essentially decreases activity of dehydrogenase, except higher dose of *T.lignorum*. Fluorescein diacetate (FDA) hydrolisys intensity have trend to increase in variants with higher dose of additional microorganisms.

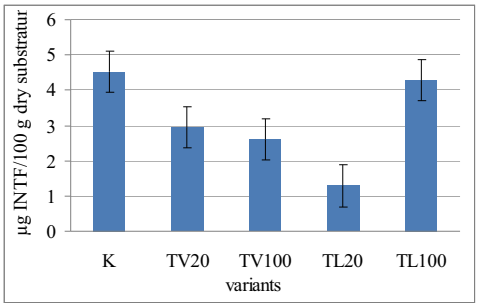


Fig. 5. Dehidrogenase (DH) activity of cucumber peat substratum at the end of experiment

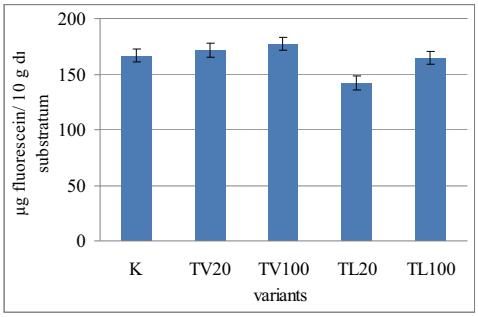


Fig. 6. Fluorescein diacetate (FDA) hydrolisys intensity of cucumber peat substratum at the end of experint

Strong negative correlation was observed between used microorganisms' dose and chlorophyll concentration in lettuce leaves, but for cucumber leaves that correlation was insignificant. Positive correlation was observed between plant dry matter and soil respiration intensity and chlorophyll b content in plants and soil enzymatic activity.

In average *T.lignorum* was more suitable for lettuce and cucumber cultivation and should be recommended for growers.

CONCLUSIONS

1. Significant increase of lettuce fresh weight was observed with addition of *Trichoderma lignorum* dose 20 g m^{-2} in peat substratum before lettuce planting.
2. The increased level of chlorophylls was observed in cucumber leaves as effect of *Trichoderma lignorum.*
3. Plant species had different sensitivity to additional microorganisms. Effect of preparation depended on plant development stage.
4. Increase of substratum respiration intensity as result of addition of microorganisms was observed.

REFERENCES

[1] Altintas, S. and Bal, U. 2005. *Application of Trichoderma harzianum increases yield in cucumber (Cucumis sativus) grown in an unheated glasshouse.* J. Appl. Horticulture 7: 25-28.

[2] Bal, U.and Altintas, S., 2006*. A positive side effect from Trichoderma harzianum, the biological control agent: Increased yield in vegetable crops*. Journal of Environmental Protection and Ecology 7: 383-387.

[3] Bal, U.and Altintas, S., 2008. *Effects of Trichoderma harzianum on lettuce in protected cultivation*. J.Central Europian Agriculture. 9:63-70

[4] Gravel, V., Antoun, H. and Tweddell, R. J. 2007. *Growth stimulation and fruit yield improvement of greenhouse tomato plants by inoculation with Pseudomonas putida or Trichoderma atroviride: Possible role of indole acetic acid (IAA).* Soil Biology &Biochemistry. 39:1968-1977.

[5] Kaimi, E., Mukaidami, T. and Tamaki, M.. 2007. *Screening of Twelf Plant Species for Phytoremediation of Petroleum Hydrocarbon-Contaminated Soil*. Plant Prod. Sci., 10: 11-218.

[6] Lichtenthaler, H.,K. and Buschmann, C. 2001 *Current Protocols in Food Analytical Chemistry* F4.3.1-F4.3.8 John Wiley & Sons,

[7] Pell, M., Stenström, J., Granhall, U. 2005. *Soil respiration. p. 117-126. In: J. Bloem, W.D Hopkins and A. Benedetti (eds.), Microbiological Methods for Assessing Soil Quality*. CABI Publishing, Wallingford, Oxordsire,GRB.

[8] Põldma, P., Jaakson, K., Merivee, A. and Albrecht A. 2000. *Trichoderma viride promotes growth of cucumber plants*. Proceedings of the International Conference: Development of environmentally friendly plant protection in the Baltic Region, Tartu, Estonia, September 28-29.p 162-164.

[9] Põldma, P., Albrecht, A. and Merivee, A., 2002 *Influence of fungus Trichoderma viride on the yield of cucumber in greenhouse conditions*. Proc. Conference on Scientific Aspects of Organic Farming. Jelgava, Latvia 21-22 March. p. 176-180.

[10] Põldma, P., Vabrit, S., Merivee, A. and Suigusaar, K. 2008. *Influence of Trichoderma viride –inoculated growing substrate on the growth and yield of lettuce (Lactuca sativa)*. Acta Hort. 779:85-90.

[11] Rabeendran, N., Moot, D.J., Jones, E.E.and Stewart A. 2000. *Inconsistent growth promotion of cabbage and lettuce from Trichoderma isolates*. N.Z. Plant Prot. 53: 143-146.

[12] Tate III, R.L.1995. *Soil Microbiology*. John Wiley & Sons Incorporation, New York.

[13] Zariņa, Dz., Bērziņš, A., Dubova, L., Viesturs, U., Bērziņa, G., Lisovska, A., Strikauska, S., Šteinberga, V. and Tūla, A. 1999. *Mikrobioloģiskie preparāti-trihodermīns un azotobakterīns un to loma nepiesārņotas augkopības produkcijas ieguvē. (Microbiological preparations- Trichodermin and Azotobacterin and its part in the output of uncontaminated cultivation of plants*. p.7.31-7.44 (in Latvian)

Scientific Papers, Series B, Horticulture, Vol. LVI, 2012
CD-ROM ISSN 2285-5661, ISSN-L 2285-5653

THE CONTENT OF PLANT PIGMENTS IN RED AND YELLOW BELL PEPPERS

Mara DUMA, Ina ALSINA[1]

[1]*Latvia University of Agriculture, Jelgava, LV-3001, Latvia*
Phone+371 63005662,Fax. +371 6305685, E-mail: Mara.Duma@llu.lv; Ina.Alsina@llu.lv

Corresponding author email: mara.duma@llu.lv

Abstract

Carotenoids are plant pigments that are widespread in vegetable and fruit and have many important functions, especially in relation to human health and their role as biological antioxidants. Bell peppers are very low in saturated fat, cholesterol and sodium. It is also a good source of vitamin K, thiamin, riboflavin, niacin, potassium and manganese, and a very good source of dietary fiber, vitamin A, vitamin C, vitamin E (alpha tocopherol), vitamin B6 and folate.The aim of this research was to determine the content of β-carotene and lutein in red and yellow peppers, using different solvents - acetone, hexane, petroleum ether (PE), tetrahydrofuran (THF) for carotenoids extraction. The amount of carotenoids was established spectrophotometrically.The acquired results of current research demonstrate that total content of carotenoids is in average two times higher from yellow peppers comparing with red peppers. The highest total content of carotenoids 5.81±0.02 mg g^{-1} was obtained from yellow peppers using THF as solvent. The relation between β-carotene and lutein is higher in red peppers, in average 0.13 mg g^{-1} compared with 0.075 mg g^{-1} in yellow peppers.

Key words: β-carotene, lutein, red peppers, solvents, yellow peppers, *Capsicum annuum*.

INTRODUCTION

Pigments are chemical compounds which reflect only certain wavelengths of visible light. The light that is absorbed may be used by the plant to power chemical reactions, while the reflected wavelengths of light determine the color the pigment will appear to the eye. There are many different plant pigments, and they are found in different classes of organic compounds. Plant pigments give color to vegetables and fruits, its leaves and flower and are also important in processes of photosynthesis, growth and development. Carotenoids are plant pigments that are widespread in vegetable and fruit and have many important functions, especially in relation to human health and their role as biological antioxidants. They are essentially C40 terpenoid compounds formed by the condensation of eight isoprene units. There are two general classes of carotenoids – carotenes and xantophylls. Carotenes consist only of carbon and hydrogen atoms, while xantophylls have one or more oxygen atoms.

Sweet bell peppers (*Capsicum annuum* L.) are very low in saturated fat, cholesterol, sodium and also a fineness source of ascorbic acid and carotenoids. Bell pepper is not only an excellent source of carotenoids, it contains more than 30 different carotenoids, including concentrated amounts of beta-carotene and zeaxanthin. Both of these carotenoids provide antioxidant and anti-inflammatory health benefits. More over peppers are rich in flavonoids [6] and other phytochemicals [2]. A recent study about vitamin C, vitamin E, and six of carotenoids (alpha-carotene, beta-carotene, lycopene, lutein, cryptoxanthin and zeaxanthin) content in commonly eaten foods found that only two vegetables contained at least two-thirds of all the listed nutrients. One of these foods was tomato, and the other was sweet bell pepper. Bell pepper alone provided 12% of the total zeaxanthin found in the participants' diets. Bell pepper also provided 7% of the participants' total vitamin C intake [3].

Most extraction methods of carotenoids from plant samples use different polar and non-polar

organic solvents such as hexane, ethanol, methanol, acetone, tetrahydrofuran, benzene and petroleum ether. Additionally, mixtures of hexane with acetone, ethanol or methanol are often used [7], [11].
Carotenoid analysis in plant samples may be carried out by different analytical methods. Although HPLC is the very often used for separation and quantification of β-carotene, it requires exhaustive sample purification steps and complicates equipment. Therefore spectrofotometric methods are popular, reliable and low cost.
In the present work, the content of β-carotene and lutein in red and yellow peppers was determined, using different solvents - acetone, hexane, petroleum ether (PE), tetrahydrofuran (THF) for carotenoids extraction.

MATERIAL AND METHOD

Investigations were carried out at the Latvia University of Agriculture, Institute of Soil and Plant Sciences.
The objects of the research were red and yellow bell peppers *Capsicum annuum* cv 'California Wonder' red, and cv 'California Wonder' yellow.
All the reagents used were of analytical grade. A UV Visible spectrophotometer with 1 cm quartz cell was used for the absorbance measurements.
Plant pigments were extracted using different organic polar and non polar solvents: acetone, hexane, petroleum ether (PE) and tetrahydrofuran (THF). For extraction a representative portion of sample (0.5 g) was accurately weighted in a glass test tube. Then 5 mL of each solvent was added to it and the test tubes were held for 15 min with occasional shaking at room temperature and finally centrifuged.
The carotenoids content were analyzed spectrophotometrically by absorption measurements at 350 to 700 nm with 1 nm interval and calculated in accordance with Nagata and Yamashita [8] and Seow-Mun Hue at all [10].
Investigations were carried out in three replications. The data was processed using MS EXCEL.

RESULTS AND DISCUSSIONS

The absorption spectra of extracts from red and yellow peppers in different organic polar and non polar solvents - acetone, hexane, petroleum ether and tetrahydrofuran were analyzed. The obtained results are showed in Fig. 1. and Fig. 2.

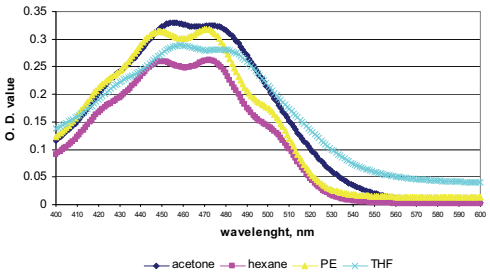


Fig.1. Absorption spectra of extracted carotenoids using different solvents in red peppers

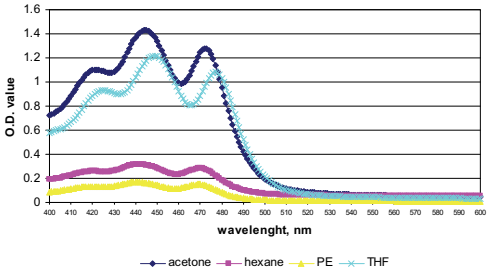


Fig.2. Absorption spectra of extracted carotenoids using different solvents in yellow peppers

Comparison of absorption spectra of extracts obtained from red peppers (Fig.1.) has shown that all investigated organic solvents give the similar characteristic bands in 400- 500 nm region. The higher absorption (O.D.) values were obtained using acetone, the less O.D. values gives extracts with hexane, but these differences are not significant ($p>0.05$). Therefore the conclusion can be drawn that all investigated organic solvents are corresponding for carotenoids extraction in red peppers.
The obtained results in yellow pepper were different (Fig.2.). The absorption spectra of carotenoids in acetone and THF differed from the spectrum of these pigments in hexane and PE and these differences are significant ($p<0.05$). Analyzing acetone and THF extracts of carotenoids the obtained absorption were 4-5 times higher. Considering these results the

use of acetone and THF can be recommended for carotenoids extraction from yellow pepper.

Further the amount of β-carotene and lutein were calculated in red and yellow bell peppers and the contribution of different organic solvents to the extraction of these compounds was examined comparatively.

Table 1 shows the content of β-carotene (C), lutein (X), as well as the total content of extracted carotenoids and ratio between β-carotene and lutein (C/X) in red and yellow peppers.

Table 1. Content of carotenoids in extracts from peppers

Sample	Solvent	Carotenoids, mg g^{-1} ± SD			C/X
		lutein (X)	β-carotene (C)	total	
Red pepper	acetone	2.33 ± 0.16	0.26 ± 0.01	2.59 ± 0.08	0.11
	hexane	1.19 ± 0.09	0.17 ± 0.01	1.36 ± 0.04	0.14
	PE	2.07 ± 0.11	0.27 ± 0.01	2.34 ± 0.07	0.13
	THF	3.39 ± 0.10	0.44 ± 0.02	3.83 ± 0.11	0.13
Yellow pepper	acetone	3.73 ± 0.13	0.52 ± 0.02	4.25 ± 0.14	0.14
	hexane	2.24 ± 0.06	0.11 ± 0.004	2.35 ± 0.06	0.049
	PE	3.44 ± 0.10	0.098 ± 0.002	3.54 ± 0.10	0.028
	THF	5.37 ± 0.16	0.44 ± 0.02	5.81 ± 0.02	0.082

The calculated amount of lutein in red peppers differs from 1.19 mg g^{-1} (as solvent using hexane) till 3.39 mg g^{-1} in the case of THF. Thereby the THF is in average 2.8 times more efficient than hexane for lutein extraction. In the case of other examined solvents acetone and PE the level of lutein was practically similar – it was determined in average 2.2 mg g^{-1}. The similar results we observed analyzing the content of β-carotene. THF is the most corresponding solvent for β-carotene extraction in red pepper.

This study has also demonstrated that the content of lutein from yellow peppers is 1.6 times higher than from red pepper compared together applying solvents. The examined solvents can be arranged following lutein extraction efficiency: THF > acetone > PE > hexane.

Literature data for lutein and β-carotene content differs, probably due to influence of variety, weather conditions, ripening stage or other factors [1], [4], [5], [9].

The acquired results of current research demonstrate that total content of carotenoids is in average two times higher from yellow peppers comparing with red peppers. The highest total content of carotenoids 5.81±0.02 mg g^{-1} was obtained from yellow peppers using THF as solvents. The calculated relation between the content of β-carotene and lutein is higher in red peppers, in average 0.13 mg g^{-1} compared with 0.075 mg g^{-1} in yellow peppers.

CONCLUSIONS

Results showed that all investigated organic solvents are corresponding for carotenoids extraction in red peppers, but acetone and THF are the most corresponding solvents for carotenoids extraction in yellow pepper. These solvents are in average 2.5 times more efficient than PE and hexane. The acquired results demonstrate that yellow peppers are richer of total carotenoids comparing with red peppers. The highest total content of carotenoids 5.81±0.02 mg g^{-1} was obtained from yellow peppers using THF as solvent. The relation between the content of β-carotene and lutein is in average two times higher in red peppers.

ACKNOWLEDGEMENTS

This work was supported by the Latvian Council of Science, project 09.1456.

REFERENCES

[1] Damaso Hornero-Mendez, Ricardo Gomez-Ladron de Guevara, M.Isabel Minguez-Mosquera, 2000. *Carotenoid biosynthesis changes in five red pepper (Capsicum annuum L.) cultivars during ripening. Cultivar selection for breeding*. *Journal of Agricultural and Food Chemistry*, 48 :3857-3864.

[2] Duke, J. A., 1992. *Biologically Active Phytochemicals and Their Activities*. CRC Press, Boca Raton, FL

[3] Garcia-Closas, R., Berenquer, A., Sanchez, M.J. , 2004. *Dietary sources of vitamin C, vitamin E and specific carotenoids in Spain*. The British Yournal of Nutrition. Cambridge, 91 (6): 1005-1011.

[4] Hallmann, E., Rembialkowska, E., 2008. *The content of slected antioxidant compounds in bell pepper varieties from organic and conventional cultivation before and after freezing process*. 16th IFOAM Organic Congress materials, Modena, Italy, June 16-20, 2008. Archived at http://orgprints.org/12516.

[5] Howard, L.R., Talcott, S.T., Brenes, C.H., Villalon, B., 2000. *Changes in phytochemical and antioxidant activity of selected pepper cultivars (Capsicum species) as influenced by maturity*. Journal of Agricultural and Food Chemistry, 48: 1713-1720.

[6] Lee, Y., Howard, L. R., and Villalon, B.,1995. *Flavonoid and ascorbic acid content and antioxidant activity of fresh pepper (Capsicum annuum) cultivars*. IFT Abstract: 55, 79.

[7] Lin, C.H., Chen, B.H., 2003. *Determination of carotenoids in tomato juice by liquid chromatography*. Journal of Chromatography, 1012: 103-109.

[8] Nagata, M., Yamashita, I., 1992. *Simple method for simultaneous determination of chlorophyll and carotenoids in tomato fruit*. Journal of Japan Food Science and Technology, 39: 925-928.

[9] Perry, A., Rasmussen, H., Johnson, E.J., 2009. *Xantophyll (lutein, zeaxanthin) content in fruits, vegetables and corn and egg products*. Journal of Food Composition and Analysis, 22: 9-15.

[10] Seow-Mun Hue, Amru Nasrulhag Boyce, Chandran Somasundram, 2011. *Influence of growth stage and variety on the pigment levels in Ipomoea batatas (sweet potato) leaves*. African Journal of Agricultural Research, Vol. 6(10): 2379-2385

[11] Van den Breg, H., Faulks, R., Fernando, H., Hirschberg, J., Olmedilla, B., Sandmann, G. et al, 2000. *The potential fot the improvement of carotenoids levels in foods and the likely systemic effects*. Journal of the Science of food and Agriculture, 80,: 880-912.

Scientific Papers, Series B, Horticulture, Vol. LVI, 2012
CD-ROM ISSN 2285-5661, ISSN-L 2285-5653

MANIFEST OF THE PRODUCTIVE POTENTIAL OF SOME TOMATO HYBRIDS WITH DETERMINED GROWTH CULTIVATED IN COLD SOLARIUMS UNDER THE IMPACT OF FLOWER STIMULATION AND FECUNDATION METHODS AND OF DIFFERENT MODERN FERTILIZERS

A. HORGOS [1], Alexandra BECHERESCU[1], D. POPA[1], Anişoara IENCIU[1], Anca DRĂGUNESCU[1], L. RUSU[2]

[1]Banat's University of Agricultural Sciences and Veterinary Medicine, Faculty of Horticulture and Forestry, Fruit Culture, Calea Aradului 119, 300645, Timisoara, Romania, Phone: 0256 277006, fax: 0256 277263
[2]Family association

Corresponding author email: horgos_a@yahoo.com

Abstract

In the past years, as a result of fuel price increase, there was registered a regression of surfaces cultivated with vegetables in greenhouses or solariums. Private growers started to cultivate vegetables in cold solariums, reducing by this the costs of obtaining productions, meaning heating costs. But there were necessary some other operations in order to maintain the productions that they would have obtained in conditions of heat and to compensate the decrease of early productions and the income costs. In this article we present the impact of some modern technology operations, which can determine high yields of two tomato hybrids with determined growth Magnus F1 and Maximus F1, known as being very good cultivated in cold solariums. Stimulation was done with Tomato-Stim, by natural pollination with bumble-bees (Natupol) and with Bionex (foliar fertilizer with plant extracts) all compared to a control variant where it occurred natural pollination. At the same time, there were applied two types of fertilizers – Agriplant and Kemira. Tomato-Stim gave good quantitative yields, while Natupol gave good qualitative yields. The productions obtained after applying Kemira fertilizer were with 15.5% till 15.9% higher than those obtained after applying Agriplant fertilizer. Both hybrids, Magnus F1 and Maximus F1 are valuable considering the quantity, but also the Extra and Ist quality productions, but Maximus F1 gave higher productions than Magnus F1 tomato hybrid.

Keywords: *growers, solariums, production, tomato, hybrids.*

INTRODUCTION

Price increase of fuel and of any kind of energy in general, led to the impossibility of growing vegetables in heated protected spaces by the vast majority of private farmers. There have been and continue to be affected small producers, especially those who ventured to cultivate vegetables as starters in the profession and not always have enough financial capital to ensure their start.

For this reason many farmers have shifted to growing vegetables in unheated rooms, solariums is most handy. But to increase the profitability of vegetable crop in case of tomatoes removing the heating costs is not enough, but also improving those technology links that offset the influence of lack of heating, which led to a big decrease in early production, but also of its quality of the first part of the harvest period.

"Modernization" of a technology culture, be it vegetable cultivation under shelter, meaning that some basic technological links (stimulation fertilization of flowers, modern types of fertilizers and hybrid performance), require improved of their depth, so that the effect produced to determine the profitability of the production as the defining elements, namely the productivity, quality and economic efficiency.

Hybrid, by its characteristics, nearby with the vegetation management system by changing or not axial system architecture of the plant and improving irrigation system and fertilization applied, can help achieve the goal of this profitable crop of tomatoes in the new conditions.

The contribution of the factors listed above that are competing to elucidating the problem taken in the survey in interpreting the complex relationships created between them, was studied in terms of their impact on improving production quantity and quality – superior, extra and Ist quality.

MATERIAL AND METHOD

This study upon tomato culture's profitability developed in Agrişu Mare locality, Târnova district, Arad County, an area where vegetables started to be cultivated on larger and larger surfaces, especially tomatoes and peppers, but also cabbage and cauliflower, by beginner private growers, who have a certain professional experience. The family association has almost 0.25 ha of cold solariums. The experiment had two tomato hybrids, relatively new in culture, which are Magnus F_1 from Sluis & Groot Novartis Company, Netherlands, and Maximus F_1 from De Ruiter Seeds (Siminis Company, Netherlands), both hybrids being sort of known by growers because of their qualities. Both hybrids were studied in terms of their productive potential and quality manifestation under the influence of application of two fertigation systems (modern chemical fertilizers Agriplant and Kemira) and the use of various methods to stimulate the fertilization of flowers.

The culture was established in the period 20-25th March 2011 in cold solariums, using 65 days seedlings at a 3.2 plants/m^2 density. In this purpose, there was organized a polifactorial experiment, in which the experimental factors were:

Factor A – Method of stimulating flower fecundation

a_1 – Mt – control, natural pollination (use of mechanical methods)

a_2 – Biostimulation with synthetic stimulants – Tomato-Stim

a_3 – Natural pollination with bumble-bees (Natupol)

a_4 – Biostimulation with Bionex (foliar fertilizer with plants extract)

Factor B – Fertilization system

b_1 – Modern fertilization with chemical fertilizer Agriplant (basic fertilization with rich soil and Agriplant 1-4 in vegetation period)

b_2 – Modern fertilization with chemical fertilizer Kemira (basic fertilization with Cropcare and Ferticare in vegetation period)

Factor C – the hybrid

c_1 - Magnus F_1

c_2 - Maximus F_1

The culture technology consisted in:

- drip irrigation through Netafim irrigation system (Israel);
- fertilization through drip irrigation system (fertirrigation) using Agriplant and Kemira (complex modern fertilizers for basic, starter and phasial fertilizations, with microelements for fertilizing irrigation and foliar fertirrigation).

This study had as goal to determine the profitability possibilities for tomatoes culture in cold solariums in the new competitive market, using as biological material the newest hybrids with determined growth that started to be cultivated in forced and protected spaces. At the same time there was observed their behavior as productive potential and production's quality, using extra-root fertilizers for completing root nutrition assured by completely soluble modern fertilizers Agriplant and Kemira.

RESULTS AND DISCUSSION

Tables 1 and 2 and figure 1 show the quantitative and qualitative obtained productions, and the share of extra and Ist quality productions under the impact of factor A (method of stimulating flower fecundation) and factor B (b_1 and b_2), fertilization with Agriplant and Kemira. The average number of fruits/plant is higher for both hybrids in case of b_2, being with almost 1.2-2.3 fruits higher than in b_1. At the same time, the average weight/fruit is higher in case of Kemira fertilization (b_2) with 11.7-13.6g/piece.

Table 1. Experimental results concerning tomato hybrids
with determined growth culture in cold solariums, cycle I – 2011

Factor A (method of stimulating flower fecundation)	Factor B (fertirrigation system)	Factor C (the hybrid)	Average no.of fruits/plant	Average weight/fruit (g/piece)	Average production				
					Kg/plant	t/ha	% than c_1	of which extra and Ist quality production	
								t/ha	%
a_1- Control with natural pollination (mechanical methods)	b_1-Agriplant	c_1 - Magnus F_1	19,2	125,1	2,403	76,9	100,0	61,6	80,1
		c_2 - Maximus F_1	20,3	123,9	2,516	80,5	104,7	66,2	82,2
		Average c for a_1xb_1	*19,8*	*124,2*	*2,459*	*78,7*	*102,3*	*63,9*	*81,2*
	b_2-Kemira	c_1 - Magnus F_1	20,1	139,5	2,803	89,7	100,0	75,2	83,8
		c_2 - Maximus F_1	21,8	136,6	2,978	95,3	106,2	83,2	87,3
		Average c for a_1xb_2	*21,0*	*137,7*	*2,891*	*92,5*	*103,1*	*79,2*	*85,6*
	Average of factor B for factor a_1		***20,4***	***131,1***	***2,675***	***85,6***	*	***71,6***	***83,6***
a_2- Tomato-Stim	b_1-Agriplant	c_1 - Magnus F_1	31,6	120,3	3,803	121,7	100,0	85,8	70,5
		c_2 - Maximus F_1	33,4	118,9	3,972	127,1	104,4	95,0	74,7
		Average c for a_2xb_1	*34,5*	*119,6*	*3,888*	*124,4*	*102,2*	*90,4*	*72,7*
	b_2-Kemira	c_1 - Magnus F_1	31,9	134,9	4,303	137,7	100,0	97,9	71,1
		c_2 - Maximus F_1	34,0	131,9	4,484	143,5	104,2	108,5	75,6
		Average c for a_2xb_2	*33,0*	*133,2*	*4,394*	*140,6*	*102,1*	*103,2*	*73,4*
	Average of factor B for factor a_2		***32,7***	***126,6***	***4,141***	***132,5***	*	***96,8***	***73,1***
a_3- Natural pollination with bumble-bees (Natupol)	b_1-Agriplant	c_1 - Magnus F_1	27,4	128,3	3,516	112,5	100,0	91,9	81,7
		c_2 - Maximus F_1	28,2	130,0	3,666	117,3	104,3	97,7	83,3
		Average c for a_3xb_1	*27,8*	*129,2*	*3,591*	*114,9*	*102,1*	*94,8*	*82,5*
	b_2-Kemira	c_1 - Magnus F_1	29,5	140,4	4,141	132,5	100,0	114,2	86,2
		c_2 - Maximus F_1	30,7	141,4	4,341	138,9	104,8	122,8	88,4
		Average c for a_3xb_2	*30,1*	*140,9*	*4,241*	*135,7*	*102,4*	*118,5*	*87,3*
	Average of factor B for factor a_3		***29,0***	***135,0***	***3,916***	***125,3***	*	***106,7***	***85,2***
a_4- Bionex	b_1-Agriplant	c_1 - Magnus F_1	25,9	124,2	3,222	103,1	100,0	74,1	71,9
		c_2 - Maximus F_1	26,3	125,8	3,309	105,9	102,7	78,7	74,3
		Average c for a_4xb_1	*26,1*	*125,1*	*3,266*	*104,5*	*101,4*	*76,4*	*73,1*
	b_2-Kemira	c_1 - Magnus F_1	27,3	137,3	3,753	120,1	100,0	86,5	72,0
		c_2 - Maximus F_1	27,2	139,8	3,803	121,7	101,3	94,1	77,3
		Average c for a_4xb_2	*27,3*	*138,4*	*3,778*	*120,9*	*100,7*	*90,3*	*74,7*
	Average of factor B for factor a_4		***26,7***	***131,9***	***3,522***	***112,7***	*	***83,4***	***74,0***

Culture density: 32.000 plants/ha

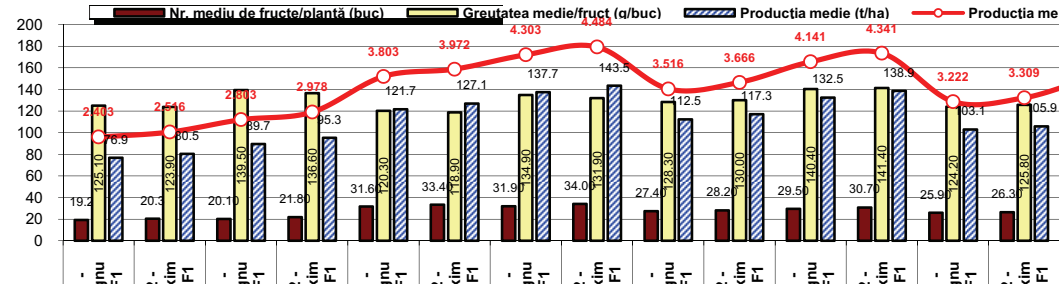


Fig.1. Experimental results concerning tomato hybrids with determined growth culture in cold solariums, cycle I – 2011

The average production/ha obtained under the impact of b_2 (Kemira) of 122.4 t/ha is vastly superior to the influence of b_1 – 105.6 t/ha, with 15.9 % higher. This if the calculation was made for the average experience Mx_1, where it was also the control - natural pollination (a_1). For Mx_2, eliminating from the calculation values Mt – natural pollination (a_1), the values for b_1 (Agriplant) and b_2 (Kemira) increase to 114.6 t/ha (100%) for b_1 and 132.4t/ha (115.5%) for b_2.

Considering extra and Ist quality productions under the impact of b_2 it was of 79.9 %, with 2.8 % more than in b_1, of 77.1 %.

As a conclusion, we can say that Kemira fertilizer had a great impact, its benefits being observed both upon obtained quantitative and qualitative productions, and also the weight and the number of fruits/plant.

Considering table 2 and figure 1 we can see that by interacting factor A with factor we obtain the same effects upon the production and its quality by fertilization with Kemira for both hybrids, of these two Maximus F1 being superior as obtained production – 125.7 t/ha and quality – 79.2% Extra + Ist quality production (101.8 t/ha).

Table 2. Synthesis of experimental results concerning tomato hybrids with determined growth culture in cold solariums in conditions of using some modernized technological links

Experimental factor			Average production for:																		
			Factor C				Factor B							Factor A							
A	B	C	t/ha	% than a_{1-5}	Of which E+I prod.		t/ha	% than $a_{1-5}b_1$	% $a_{1-5}b_{1-2}$ than Mx_1b_{1-2}	Of which E+I prod.				t/ha	% than a_1	%a_{1-5} than Mx_1	Of which E+I prod.				
					t/ha	%				t/ha	%	% than b_1	% than a_1b_{1-2}				t/ha	%	% than a_1	% than Mx_1	% than Mx_2
a_1	b_1	c_1	76,9	89,8	61,6	80,1	78,7	100,0	74,5	63,9	81,2	100,0	100,0	85,6	100,0	75,1	71,6	83,6	100,0	79,9	74,9
		c_2	80,5	94,0	66,2	82,2															
		a_1xb_1	78,7	91,9	63,9	81,2															
	b_2	c_1	89,7	104,8	75,2	83,8	92,5	117,5	75,6	79,2	85,6	123,9	100,0								
		c_2	95,3	111,3	83,2	87,3															
		a_1xb_2	92,5	108,1	79,2	85,6															
Average B for a_1			***85,6***	***100,0***	***71,6***	***83,6***	***85,6***	***108,8***	***75,1***	***71,6***	***83,6***	***112,0***	***100,0***								
a_2	b_1	c_1	121,7	91,8	85,8	70,5	124,4	100,0	117,8	90,4	72,7	100,0	141,5	132,5	154,8	116,2	96,8	73,1	135,2	108,0	101,3
		c_2	127,1	95,9	95,0	74,7															
		a_2xb_1	124,4	93,9	90,4	72,7															
	b_2	c_1	137,7	103,9	97,9	71,1	140,6	113,0	114,9	103,2	73,4	114,2	130,3								
		c_2	143,5	108,3	108,5	75,6															
		a_2xb_2	140,6	106,1	103,2	73,4															
Average B for a_2			***132,5***	***100,0***	***96,8***	***73,1***	***132,5***	***106,5***	***116,2***	***96,8***	***73,1***	***107,1***	***135,9***								
a_3	b_1	c_1	112,5	89,8	91,9	81,7	114,9	100,0	108,8	94,8	82,5	100,0	148,4	125,3	146,4	109,9	106,7	85,2	149,0	119,1	111,6
		c_2	117,3	93,6	97,7	83,3															
		a_3xb_1	114,9	91,7	94,8	82,5															
	b_2	c_1	132,5	105,7	114,2	86,2	135,7	118,1	110,9	118,5	87,3	125,0	149,6								
		c_2	138,9	110,9	122,8	88,4															
		. a_3xb_2	135,7	108,3	118,5	87,3															
Average B for a_3			***125,3***	***100,0***	***106,7***	***85,2***	***125,3***	***109,1***	***109,9***	***106,7***	***85,2***	***112,5***	***149,0***								
a_4	b_1	c_1	103,1	91,5	74,1	71,9	104,5	100,0	99,0	76,4	73,1	100,0	119,6	112,7	131,7	98,9	83,4	74,0	116,5	93,1	87,2
		c_2	105,9	94,0	78,7	74,3															
		a_4xb_1	104,5	92,7	76,4	73,1															
	b_2	c_1	120,1	106,6	86,5	72,0	120,9	115,7	98,8	90,3	74,7	118,2	114,0								
		c_2	121,7	108,0	94,1	77,3															
		a_4xb_2	120,9	107,3	90,3	74,7															
Average B for a_4			***112,7***	***100,0***	***83,4***	***74,0***	***112,7***	***107,8***	***98,9***	***83,4***	***74,9***	***109,1***	***116,5***								
a_5 (Mx1)	***b_1***	c_1	103,6	98,0	78,4	75,6	105,6	100,0	92,6	81,4	77,1	100,0	127,4	114,0	133,2	100,0	89,6	78,6	125,1	100,0	93,7
		c_2	107,7	101,9	84,4	78,4															
	b_1		105,6	100,0	81,4	77,1															
	b_2	c_1	120,0	97,9	93,5	77,9	122,4	115,9	107,4	97,8	79,9	120,1	123,5								
		c_2	124,9	102,0	102,2	81,8															
	b_2		122,4	100,0	97,8	79,9															
	c_1		111,8	98,0	86,0	76,9	*	*	*	*	*	*	*								
	c_2		116,3	101,9	93,3	80,2	*	*	*	*	*	*	*								
Mx_1			***114,1***	***100,0***	***89,6***	***78,6***	114,0	108,0	100,0	86,6	78,6	110,1	*								
a_6 (Mx2)	***b_1***	*	*	*	*	*	*	114,6	100,0	92,8	87,2	76,1	100,0	136,5	123,5	144,3	108,3	95,6	77,4	133,5	133,5	100,0
	b_2	*	*	*	*	*	*	132,4	115,5	107,2	104,0	78,5	119,3	131,3							
	*	c_1	121,3	98,2	91,7	75,6	*	*	*	*	*	*	*								
		c_2	125,7	101,8	99,5	79,2	*	*	*	*	*	*	*								
Mx_2			***123,5***	***100,0***	***95,6***	***77,4***	123,5	107,8	100,0	95,6	77,4	109,6	*								

Out of this table we conclude that:

- in case of all graduations from factor A (method of stimulating flower fecundation) the obtained production under the impact of b_2 – Kemira is with 13.0% (a_2 – Tomato-Stim) up to 18.1% (a_3 – bumble-bees natural pollination - Natupol) higher tha under the impact of factor b_1 –Agriplant, which determined a maximum production of 140.6 t/ha (a_2 – Tomato - Stim);
- comparing the productions with Mx_1 (114.1 t/ha -100.0%), for b_1 (Agriplant) is of 105.6 t/ha – 92.6 %, while the production in b_2 (Kemira)

is of 122.4 t/ha – 107.4% and compared with b_1 (Agriplant) is of 115.9%;

- comparing the productions with Mx_2 the situation is normally different, the production in b_2 (Kemira) being of 132.4 t/ha (115.5%) higher than in b_1 (Agriplant) – 114.6 t/ha (100.0%). Comparing the productions in b_1 (Agriplant) and b_2 (Kemira) with Mx_2 – 123.5t/ha (100.0%) they are of 92.8% in b_1 and 107.2 % in b_2;
- under the impact of factor A (method of stimulating flower fecundation) productions obtained widely differ of both Mx_1-114.0 t/ha and Mx_2-123.5 t/ha;
- the highest production was obtained under the impact of a_2-Tomato – Stim, of 132.5 t/ha (154.8% than a_1- natural pollination, 116.2% compared with Mx_1 and 107.3% compared with Mx_2);
- productions quality under the impact of a_2 (Tomato-Stim) is the lowest 73.1% E+Ist quality production (96,8 t/ha E+I of the total 132,5 t/ha) compared with the best production in a_3 (Natupol), of 85.2%, meaning 106.7 t/ha E+Ist quality production of the total 125.3 t/ha;
- concluding, tomato production quality achieved, extra and Ist quality, is in inverse relationship to the amount realized production per hectare;
- of the four methods of stimulating flower fertilization, in terms of production quantity, the safest ranked first proved to be the method of biostimulation with Tomato-Stim (a_2), but it was on the last place in terms of production quality;
- in terms of production quality, the first place is the natural pollination with bumble-bees – Natupol (a_3), with 85.2% E+Ist quality (106.7 t/ha E+Ist quality of the total 125.3 t/ha), and the second of four methods, in terms of its quantitative production (109.9% than Mx_1);
- the method of stimulating flower fertilization a_4 (Bionex) is on the third place, both in terms of production quantity (112.7 t/ha – 98.9% than Mx_1), and production quality (74.0% → 83.4 t/ha of the total 112.7 t/ha).

In table 3 there are presented the results of the statistical calculation, and the production differences significances as a result of the interaction between the experimental factors.

Table 3. Unilateral and experimental factors' interactions impact upon determined growth tomato hybrids culture in cold solariums

Variant	Average production (kg/ha)		Relative production (%)	Difference (± t/ha)	Significance
1. Unilateral impact of the method of stimulating flower fecundation upon the production					
a2-a1	132,50	85,60	154,79	46,90	***
a3-a1	125,30	85,60	146,38	39,70	***
a4-a1	112,70	85,60	131,66	27,10	***
a3-a2	125,30	132,50	94,57	-7,20	000
a4-a2	112,70	132,50	85,06	-19,80	000
a4-a3	112,70	125,30	89,94	-12,60	000
DL 5%= 2,18 DL 1%= 3,30 DL 0,1%= 5,30					
2. Unilateral impact of the fertilization system upon the production					
b2-b1	122,43	105,63	115,91	16,80	***
DL 5%= 1,34 DL 1%= 1,84 DL 0,1% = 2,53					
3. Unilateral impact of the hybrid upon the production					
c2-c1	116,28	111,78	104,03	4,50	***
DL 5%= 1,54 DL 1%= 2,08 DL 0,1% = 2,78					
4. The impact of interaction between different methods of stimulating flower fecundation and the same or different fertilization systems upon the production					
a2b1-a1b1	124,40	78,70	158,07	45,70	***
a3b1-a1b1	114,90	78,70	146,00	36,20	***
a4b1-a1b1	104,50	78,70	132,78	25,80	***
a3b1-a2b1	114,90	124,40	92,36	-9,50	000
a4b1-a2b1	104,50	124,40	84,00	-19,90	000
a4b1-a3b1	104,50	114,90	90,95	-10,40	000
a2b2-a1b2	140,60	92,50	152,00	48,10	***
a3b2-a1b2	135,70	92,50	146,70	43,20	***
a4b2-a1b2	120,90	92,50	130,70	28,40	***
a3b2-a2b2	135,70	140,60	96,51	-4,90	00

a4b2-a2b2	120,90	140,60	85,99	-19,70	000
a4b2-a3b2	120,90	135,70	89,09	-14,80	000
a2b2-a1b1	140,60	78,70	178,65	61,90	***
DL 5% = 2,88 DL 1% = 4,17 DL 0,1% = 6,28					
5. The impact of interaction between the same method of stimulating flower fecundation and different fertilization systems upon the production					
a1b2- a1b1	92,50	78,70	117,53	13,80	***
a2b2- a2b1	140,60	124,40	113,02	16,20	***
a3b2- a3b1	135,70	114,90	118,10	20,80	***
a4b2- a4b1	120,90	104,50	115,69	16,40	***
DL 5% = 3,07 DL 1% = 4,16 DL 0,1% = 5,57					
6. The impact of interaction between the same method of stimulating flower fecundation and different hybrids upon the production					
a1c2- a1c1	87,90	83,30	105,52	4,60	***
a2c2- a2c1	135,30	129,70	104,32	5,60	***
a3c2- a3c1	128,10	122,50	104,57	5,60	***
a4c2- a4c1	113,80	111,60	101,97	2,20	*
DL 5% = 3,07 DL 1% = 4,16 DL 0,1% = 5,57					
7. The impact of interaction between the same fertilization system and different hybrids upon the production					
b1c2- b1c1	107,70	103,55	104,01	4,15	***
b2c2- b2c1	124,85	120,00	104,04	4,85	***
DL 5% = 2,17 DL 1% = 2,94 DL 0,1% = 3,94					
8. The impact of interaction between different fertilization systems and the same hybrid upon the production					
b2c1- b1c1	120,00	103,55	115,89	16,45	***
b2c2- b1c2	124,85	107,70	115,92	17,15	***
b2c2- b1c1	124,85	103,55	120,57	21,30	***
DL 5% = 2,04 DL 1% = 2,78 DL 0,1% = 3,76					
9. The impact of interaction between the same method of stimulating flower fecundation and the same fertilization system and different hybrids upon the production					
a1b1c2- a1b1c1	80,50	76,90	104,68	3,60	-
a2b2c2- a2b2c1	143,50	137,70	104,21	5,80	*
DL 5% = 4,35 DL 1% = 5,89 DL 0,1% = 7,87					
10. The impact of interaction between different methods of stimulating flower fecundation and the same fertilization system and the same hybrid upon the production					
a1b2c1- a1b1c1	89,70	76,90	116,64	12,80	***
a2b2c2- a2b1c2	143,50	127,10	112,90	16,40	***
DL 5% = 4,07 DL 1% = 5,56 DL 0,1% = 7,52					

From the analysis of point 1 – unilateral impact of stimulating flower fecundation method, it results that the productions determined by a_2 – Tomato-Stim, a_3 –Natupol, a_4 –Bionex, are statistically assured, the differences being significant positive and very significant negative in case of a_3 – Natupol than a_2 – Tomato-Stim, a_4 –Bionex than a_2 –Tomato-Stim and a_4 –Bionex than a_3 – Natupol).

Point 2, unilateral impact of fertilization systems upon the production, shows that the production determined by b_2 (Kemira) is statistically assured, the differences being very significant positive, with an increase of 15.9%.

From point 3 – unilateral impact of the hybrid upon the production – it results that the productions obtained from the two hybrids are statistically assured, the difference significance between c_2 – Maximus F1 and c_1 – Magnus F1 being very significant positive, showing that Maximus F1 (c_1) has superior quantitative features (125.7 t/ha than 121.3t/ha for c_1 – Magnus F1 compared to Mx_2; 116.3 t/ha than 111.8 t/ha compared to Mx_1), but also qualitative, things that also resulted from table 1 and figure 1.

From points 4-10 in table 3 it results that according to bi or trifactorial combinations, the production differences' significances are very diversified, covering the full range of appraisal (very significant positive or negative, distinct significant positive or negative and significant positive or negative), which shows the intensity of experimental factors' interactions upon the

obtained quantitative and qualitative productions.

CONCLUSIONS

1. The application to our experiment of multiple methods to stimulate flowers' fertilization, some of which have been considered support and increased performance of pollination, natural fertilization of the flowers, and others to replace them by outside plant intake of artificial substances, resulted in the production of differentiated unilateral or combined influence of other experimental factors (fertilization system with different types of modern fertilizers and the hybrid)

2. A unilateral decisive influence factor (method of stimulating flower fertilization) on tomato production quantitatively and qualitatively, was not carried out only by a single graduation, so graduation a_2 (Tomato-Stim stimulation) expressed its effect on the level of production quantity and graduation a_3 (natural pollination by bumble-bees - Natupol) on its quality level.

3. Under the impact of a_2 (Tomato-Stim) we obtained the highest tomato production in the experiment, of 132.5 t/ha (154.8% than a_1 – natural pollination), on the second place being the production determined by a_3 (natural pollination by bumble-bees – Natupol), of 125.3 t/ha (146.4% than a_1 – natural pollination), being followed by the productions in a_4 (biostimulation with Bionex) and last a_1 (natural pollination).

4. Considering the quality of obtained productions we can an occurrence of the inverse effect, the largest productions under the influence of a_2 (Tomato-Stim), of 132.5 t/ha, corresponds to the lowest rate of production of extra and Ist quality, of 73.1% of the total production (108.0% and 101 .3% compared to Mx_1 respectively Mx_2).

5. The largest share of production of extra and Ist quality is recorded under the impact of graduation a_3 (Natupol), of 85.2% - 106.7 t/ha of the total 125.3 t /ha (119.1% and 111.6% compared to Mx_1 respectively Mx_2), being followed by 83.6% - 71.6 t/ha in a_1 (natural pollination) and 74.0% - 83.4 t/ha in a_4 (biostimulation with Bionex).

6. Hierarchy of production levels achieved in terms of quality with top filling (I and II) under the impact of a_3 (natural pollination by bumble-bees - Natupol) and a_1 (natural pollination), fertilization stimulation involving the naturally pollinated flowers, is explained by the influence exerted by the aforementioned phenomenon of fruit quality in terms of physical characteristics (size, weight, color, etc.) and the chemical and organoleptic features (taste, smell, etc.).

7. The productions obtained after using Kemira fertilization system (b_2) are with 15.5% up to 15.9% higher than those obtained after using Agriplant fertilization system (b_1):

- the average production Mx_1b_2 is of 122.4 t/ha, meaning 115.9% than Mx_1b_1 and of 115.5% than Mx_2b_1, while Mx_1b_1 is of 105.6 t/ha, meaning 92.6% than Mx_1 and of 114.6 t/ha , meaning 92.8 %, than Mx_2.
- The average production Mx_2b_2 is of 132.4 t/ha, meaning 107.2% than Mx_2, and Mx_2b_1 is of 114.6 t/ha, meaning 92.8% than Mx_2.

8. Both hybrids, Magnus F1 and Maximus F1 proved to be valuable both in terms of quantity production level achieved and the Extra and Ist quality percentage of the average yield achieved, the quality of the productions made by the two hybrids compared to the two average values of the experiment vary in the following intervals:

- Magnus F_1 (c_1) – 111.8 -121.3 t/ha, of which 86.0-91.7 t/ha E+I quality production, meaning 76.9-75.6 %;
- Maximus F_1 (c_2) – 116.3-125.7 t/ha, of which 93.3-99.5 t/ha E+I quality production, meaning 80.2-79.2%.

9. We recommend further research to strengthen the conclusions of the experiment.

REFERENCES

[1]. Horgoş, A., Oglejan, Doina., Kondor, F., Becherescu, Alexandra, 2002. *On the influence of kemira-type fertilising on the quantitative and qualitative levels of tomato yields in unheated solaria,* Vol. Lucrări Ştiinţifice seria B (XLV) 2002, ISSN1222-5312, Bucureşti.

[2]. Horgoş A., Oglejan Doina, Bulboacă T., 2001. *Studies on unheated solarium tomato yield efficientialisation.* Vol. Lucrări Ştiinţifice seria B (XLIV) 2001, ISSN 1222-5312, Bucureşti.


EX·TERRA·AVRVM

Scientific Papers, Series B, Horticulture, Vol. LVI, 2012
CD-ROM ISSN 2285-5661, ISSN-L 2285-5653

THE INFLUENCE OF THE PLANT MANAGEMENT SYSTEM OVER CERTAIN PHYSICAL AND PHYSIOLOGICAL PARAMETERS FOR APPLE TREES

Dorel HOZA[1], Ligia ION[1], Andrei Ionescu[1]

[1]University of Agronomic Sciences and Veterinary Medicine of Bucharest, 59, Marasti Street, 011464, Bucharest, Romania, tel.: 0213182564, fax:0213182888, dorel.hoza@gmail.com, ionnagyligia@yahoo.fr, ionescuandrei@yahoo.com

Corresponding author email: dorel.hoza@gmail.com

Abstract

Crown shape plays a very important role in ensuring proper lightning conditions for the branches and fruit; it ensures different exposure conditions for the leaves and influences their synthesis capacity, while also permitting the formation of the fruit branches and support of the production. Depending on the plant management system, the planting distances vary for the same vigor of the variety – rootstock combination. The plant management system with five crown shapes determined differences in what regards the biometric parameters of the trees, the quantity of wood removed when pruning, fruit production, degree of illumination of the branches, intensity of the photosynthesis and respiration and fruit quality. Tree crowns which recorded better productivity values were managed as interrupted pyramid and fruit cylinder, while regarding the quality values the vessel bush and interrupted pyramid proved better choices. The best leaf exposure was recorded for the trees managed as vessel bush.

Key words*: crown shapes, physiological indicators, morphological parameters*

INTRODUCTION

Apple culture in Romania is located on the first place considering the weight and area of fruit growing plantations, fact due to which many researchers are interested in modernizing the plantations, increasing the yield per unit of area and increasing the fruit quality. The manner in which plant management systems are applied has direct implications over the planting density, the degree of fruit exposure and quality [4]. By selecting a certain crown shape, a greater or lower illumination degree [1, 8] is ensured for the elements of the crown and for the leaves, with direct influence on their synthesis capacity and on the nutrition of the apple tree as a whole [2, 5, 9]. The chosen crown shape influences the distribution of the branches both vertically and horizontally; as the crown become more voluminous, the percentage of fruit bearing branches decreases [3, 6, 7]. Small sized crowns allow the fruit grower to perform the main manual works from the ground, with greater yield and lower percentage of the manual works in the production costs.

MATERIAL AND METHOD

The objectives of this study were:
- establishing the most economic plant management and maintenance systems for the crown for the trees of Florina variety, in order to obtain colorful, high quality fruit that better resist to storage conditions;
- studying the behavior of Florina apple trees when pruning is applied for fitting within predetermined crown shapes;
- studying the intensity of the processes of photosynthesis and transpiration, correlated with the type of crown;

The experiment was conducted during 2009-2010, at the Fruit Growing Research Center Voineşti, Dâmboviţa, in an apple tree plantation founded in 2000, with a planting distance of 4/3 m, with Florina variety grafted on M 106 rootstock. The trees were initially managed as slender spindle, but in 2004 five crown shapes were established, as follows:
-Variant 1 – control - Voineşti type of crown
- Variant 2 – Slender Spindle
- Variant 3 – Bush-vessel
- Variant 4 – Fruit bearing cylinder
- Variant 5 – Interrupted pyramid

The regular maintenance works, specific to fruit bearing plantations, were applied within the plantation. Measurements and observations were made regarding the dimensions of the trees, amount of wood removed at pruning, intensity of photosynthesis and transpiration, production capacity and fruit quality.

RESULTS AND DISCUSSIONS

The manner in which the trees reacted to the different plant management systems varied, the results regarding the trees' dimensions fitting within the normal limits for the respective age of the trees, but with differences according to the specific characteristics of each crown shape. Thus, the trees were slightly taller in case of crown shapes with axes (V1, V2 and V4) and shorter for the variant with bush-vessel crown (V3). The diameter of the crown after the spring pruning was maintained within the limits of the space ensured by the pruning distance in order to ensure a proper penetration of the light; the diameter recorded values between 235 cm for V3 and 210 cm for V4 (table 1).

The productive crown volume, a very important element the production capacity of the trees depends on, was greater for the trees with crown shapes with ax and lower for the trees without ax. The crown volume per unit of area had values varying between 7173 m^3 for V3 and 9217 m^3 for V1.

Table 1. Average values of the crown dimensions and volume according to the plant management system (Average data 2009-2010)

Variant	Tree height (cm)		Crown diameter (cm)		Productive crown volume after pruning		
	Before pruning	After pruning	Before pruning	After pruning	m^3/tree	Difference from control variant, ±	m^3/ha
V1(control))	399,00	367,50	265,00	220,38	11,07	-	9217,64
V2	404,25	367,50	265,00	215,25	10,41	0,66	8671,86
V3	304,50	273,00	280,90	235,75	8,61	2,45	7173,13
V4	399,00	357,00	275,60	210,13	9,69	1,37	8074,10
V5	378,00	346,50	280,90	225,50	10,67	-0,40	8888,44

Tree vigor and their growth capacity can be expressed through the amount of wood removed at pruning. From this point of view, large differences were recorded among varieties, the values per tree varying between 2,18 kg for V4 and 5,60 kg for V5, an increase of more than 156% (table 2). If a comparison would be done with the values obtained for the first variant, the plant management system specific to the region, the deviations were approximately ± 50%, the control variant being situated at the middle of the variation interval for the recorded values.

The degree of leaf exposure influenced the intensity of the main physiological indicators: photosynthesis and transpiration. By comparing the measurements made for the external, properly illuminated leaves and for the internal leaves with a lower illumination degree, large differences were observed among the recorded values, thus confirming the data from the specialized literature. As a result, the intensity of the photosynthesis for the external leaves was greater for the variants V4 and V2, more than 6,75 mg $CO_2/dm^2/h$, due to slender crowns that expose very well the trees, while the variants V1 and V5 had lower values, less than 4,8 mg $CO_2/dm^2/h$, due to crowns that have a more crowded structure. These values confirmed the data from the specialized literature (Burzo şi colab., 1999). For the internal leaves, the photosynthesis was less intense in case of crowns with a denser structure, the values being less than 4,2 mg $CO_2/dm^2/h$ for V3 – bush-vessel, as maximum value, and only 1,04 mg $CO_2/dm^2/h$ for V4 – fruit bearing cylinder. The intensity of the photosynthesis was directly influenced by the intensity of the light; it was probably influenced also by the structure of the leaves, due to the fact that no good correlation was found between the two parameters (Table 3).

Table 2. The weight of branches removed at pruning, for fitting within the specific types of crown (2009-2010)

Variant	Weight of branches removed at pruning							
	Total				Out of which annual branches			
	per tree (kg)	% compared to the control	Dif. compared to the control	per ha (kg)	per tree (kg)	% compared to the control	Dif. compared to the control	per ha (kg)
V1 (control)	3,94	100,00	-	3282,52	2,55	100,00	-	2126,23
V2	4,98	126,32	1,04	4146,34	3,68	144,00	1,12	3061,77
V3	4,25	107,89	0,31	3541,67	3,27	128,00	0,71	2721,58
V4	2,18	-55,26	-1,76	1814,02	1,74	68,00	-0,82	1445,84
V5	5,60	142,11	1,66	4664,63	3,68	144,00	1,12	3061,77

The intensity of the transpiration was within the normal limits for the exposed leaves (Burzo şi colab., 1999), the recorded values varying between 0,14 $mgH_2O/ dm^2/h$ for V4 and 0,63 $mgH_2O/ dm^2/h$ for V3, with no direct correlation with the intensity of the photosynthesis.

For the leaves with a lower illumination degree, the intensity of the transpiration was lower, the values obtained being between 0,06 $mgH_2O/ dm^2/h$ for V1and 0,31 $mgH_2O/ dm^2/h$ for V2.

Table 3. Intensity of photosynthesis and transpiration, according to each crown shape

Variant	External leaf (directly exposed to sunlight)			Internal leaf		
	Photo-synthesis *mg CO_2 / dm^2/h*	Transpiration *$mgH_2O/ dm^2/h$*	Intensity of light *$\mu moles/m^2$ /sec*	Photo-synthesis *mg CO_2 / dm^2/h*	Transpiration *$mgH_2O/ dm^2/h$*	Intensity of light *$\mu moles/m^2$ /sec*
V1 (control)	4,83	0,34	1287	2,33	0,06	345
V2	6,75	0,24	1612	3,52	0,31	1190
V3	6,32	0,63	1728	4,22	0,23	1140
V4	6,89	0,14	1387	1,04	0,13	239
V5	4,58	0,21	1520	3,75	0,28	1250
Average	*5,43*	*0,3*	*1621*	*1,6*	*0,09*	*190,5*

The production capacity of the trees was a proper one for this type of plantation (intensive with average density), but with differences among variants. The largest production was obtained for the variants V3 and V4, with more than 28 t/ha, as average production for the two years, while the smallest production was obtained for the control variant (table 4). It was interesting to observe that the third variant, with low crown volume, recorded the second largest production which showed that a better exposure degree of the branches also ensures a better fruit bud differentiation and finally a larger production. The production differences between the variants V2 and V4, both having crowns with ax and being relatively equal in volume, can be justified by a better cylinder structure from the point of view of the support branches for the ax. If it were to analyze the production from a statistical point of view, the variants V3, V4 and V5 were statistically ensured as very significant compared to V1, while V2 was not statistically ensured.

Table 4. The production capacity of Florina variety, grafted on M106, for each crown shape (t/ha)

Variant	2009	2010	Average	Difference	Significance
V1(control)	18,70	19,82	19,26	-	Mt
V2	19,20	20,35	19,78	102,67	N
V3	27,50	29,15	28,33	147,06	***
V4	30,00	31,80	30,90	160,43	***
V5	*25,50*	27,03	26,27	136,36	***

DL 5% - 0,59 t
DL 1% - 0,98 t
DL 0,5% - 1,84 t

From the point of view of fruit quality, small differences were recorded among the analyzed variants. Thus, the total dry substance varied between 13,86% for V4, variant with the largest production, and 15,33% for V3 and V5, variants without ax. The total mineral elements (ash) recorded values between 0,31% for V2 and 0,42% for V3 and were correlated with the content in total dry substance. The soluble dry substance had the lowest recorded value for V4 – 12,0%, variant that produce the most, and a higher value of 14,4% for V5 (table 5).

Table 5. Biochemical composition of fruit for Florina apple-tree variety, grafted on M106 rootstock, according to each crown shape

Variant	Total dry substance (%)	Ash (%)	Soluble dry substance (%)	Vitamin C mg / 100 g	Titrable acidity % malic acid	Total sugar mg/ 100 g
V1(control)	14,51	0,33	12,4	6,25	0,47	9,79
V2	14,72	0,31	12,5	10,38	0,48	8,45
V3	15,33	0,42	13,5	11,01	0,54	10,36
V4	13,86	0,35	12,0	11,07	0,48	9,19
V5	15,34	0,41	14,4	8,62	0,51	9,20
Average	14,75	0,36	12,96	9,47	0,50	9,40

The vitamin C content was greatly influenced by the crown management system; the control variant recorded a content in vitamin C of only 6,25 mg/100, the variants V3 and V4 recorded values of more than 11 mg/100, while the remaining variants had intermediary values. The titrable acidity recorded similar value among the variants, the variation limits being 0,47 for V1 and 53 la V3, while the total sugar content had values between 8,45 mg/100 g for V2 and 10,36 mg/100 g for V3.

CONCLUSIONS

From the present study, the following conclusions can be drawn:

- The growth capacity of the trees had normal values for all variants, according to the age of the trees, the small differences being due to the specific characteristics of each crown shape;
- The amount of wood removed at pruning was greater for the trees with interrupted pyramid shaped crown (5,6 kg/tree) and lower for the trees managed as fruit bearing cylinder (2,18 kg/tree);
- The intensity of the photosynthesis and transpiration was directly influenced by the intensity of the light; the leaves external to the crown recorded higher values, while the leaves from inside the crown had lower values;
- The production capacity was good for the trees managed as fruit bearing cylinder, bush-vessel and interrupted pyramid and not so good for the trees managed as slender spindle and Voineşti type crown;
- The quality of the production was influenced by the production quantity; for the variants with large production, the quality was lower.

REFERENCES

[1] Babuc V., Croitor A., 2007. *Suprafaţa foliară şi productivitatea pomilor de măr în funcţie de modul formării coroanei fus zvelt.* Lucrări ştiinţifice, Universitatea Agrară de Stat din Moldova, vol. 15, pg. 221-225;

[2] Burzo*.,* şi colab., 1999. *Fiziologia plantelor de cultură, vol. 3-Fiziologia pomilor fructiferi şi a vitei de vie*. Editura Ştiinţa, Chişinău, pag. 65-69.

[3] Callesen O., 1993, Influence of apple tree height on yield and fruit quality, Acta Horticulturae,(ISHS) nr.349, pg. 111-116;

[4] Căpraru F., Grădinariu G., 2009. *Cercetări privind productivitatea unor soiuri de măr, în secvenţe tehnologice diferite în condiţiile pedoclimatice de la Bistriţa*. Lucrări ştiinţifice, anul LII-vol. 52, seria Horticultură, Ed. Ion Ionescu de la Brad, Iaşi, pg. 545-550;

[5] Cepoiu N. şi colab., 1990. *Contribuţii la conducerea şi întreţinerea coroanei fus subţire la măr, în plantaţii cu densitate mare*. Lucrări ştiinţifice IANB Bucureşti,vol XXXIII, 45-54 ;

[6] Dumitrache I., 1983. *Influenţa unor forme de coroană asupra creşterii şi rodirii mărului în livezile superintensive*. Lucrări ştiinţifice ICCP Piteşti, vol X, pag.31-37;

[7] Hoza D., 2005. *Înfiinţarea unei plantaţii pomicole de măr la standarde europene.* Revista Horticultura, 10, pag. 18-19;

[8] Hoza D.,2000. *Ecofiziologia speciilor pomicole.* Editura Elisavaros, Bucureşti, pag. 38-46.

[9] Petre Gh., Petre Valeria, Neagu I.O., 2005. *Particularităţi de creştere şi rodire şi efecte ale unor secvenţe tehnologice specifice soiurilor de măr cu rezistenţă genetică la boli*. Lucrări ştiinţifice ale ICPP Piteşti Mărăcineni, vol. XXII, Ed. Pământul, Piteşti, pag.157-163;


EX·TERRA·AVRVM

Scientific Papers, Series B, Horticulture, Vol. LVI, 2012
CD-ROM ISSN 2285-5661, ISSN-L 2285-5653

RESEARCHES ON THE IMPACT OF CHEMICAL FRUIT THINNING WITH ETHREL UPON FRUITS' QUALITY OF SOME PEACH AND NECTARINE VARIETIES CULTIVATED IN THE WESTERN PART OF ROMANIA

Olimpia IORDĂNESCU, Beatrice SARKADI (MĂGURAN)

Banat's University of Agricultural Sciences and Veterinary Medicine, Faculty of Horticulture and Forestry, Fruit Culture Department Calea Aradului 119, 300645, Timisoara, Romania, Phone: 0256 277006, fax: 0256 277263, Email: olimpia.iordanescu@yahoo.com, bmaguran@yahoo.com

Corresponding author email: olimpia.iordanescu@yahoo.com

Abstract

The peach tree is one of the most appreciated fruit species cultivated in the temperate climate because of the special qualities of its fruits and also because of tree's particularities. In this article we present the impact of chemical thinning with Ethrel in different concentrations upon the content of soluble dry substance, rephractometrical determined, sugars, determined by soluble dry substance method, total acidity, determined by juice extraction and titration with NaOH, and gluco-acidimetric index. The data were collected in 2006 from 2 varieties of peach – Spring Lady and Maja, and 2 nectarine varieties – Caldesi 2000 and Nectaross cultivated in conditions of Periam, Timis County. The trees were planted at a distance of 4.0 x 2.5 m, having a density of 1000 trees/ha and the crown system is Palm Spindelbusch. The soil was maintained clean by mechanical hoes and Roundup 360 SL herbicide. Chemical thinning was done at 25 days after fruit binding, moment when the ovule (the future stone seed) had 10-12 mm, being done in four different concentrations: 125 ppm, 250 ppm, 350 ppm and 500 ppm. The results obtained showed that sugars increase in those variants where thinning was more severe (500 ppm and 350 ppm), than in those with slightly thinning (125 ppm and 250 ppm), while in the control variant the values obtained were the smallest. Total acidity had higher values in the control variant and smaller when using 500 ppm Ethrel. The differences between the varieties are given by their genetic nature and by some phenological differences at the moment of treatment. Severe chemical thinning is not recommended in commercial orchards because it reduces very much the number of fruits remained on the trees, even though they will have better physical-chemical features, having a bad impact upon the production obtained. We recommend moderate chemical thinning done with Ethrel in concentrations of 250-350 ppm, which have a good impact at the same time upon the qualitative and quantitative productions.

Key words: *acidity, chemical thinning, nectarine, peach, sugars.*

INTRODUCTION

Peach tree is one of the most appreciated fruit species cultivated in the temperate climate because of the special qualities of its fruits and also because of tree's particularities.

Peaches, as flavour, are placed after grapes, oranges and apples, having a complex chemical composition and can be eaten both fresh and processed into syrup, jam, juice, nectar, distilled etc. [2].

Standardization of production technology is a major operation and is achieved by: fructification pruning, chemical standardization of flowers and fruits; manual or mechanized fruit thinning. Fructification pruning is the main rate-setting operation of a load of fruit, but for peach tree this operation does not fully solve the problem because the species is auto-fertile, the percentage of binding being up to 94% of all flowers. Physiological fall of fruits does not resolve entirely the thinning process, as it occurs later in time and its effect upon fruits' size and quality is minor [3, 5].

Chemical thinning can be done with Ethrel 350-500 ppm, depending on the variety, applied at 15-30 days after flowering. The effect is satisfying after 2-3 weeks [8].

Thinning determines modifications of fruits' size, their weight and proportion between main

components, respectively pulp and stone. For small fruits there is an insufficient pulp development, and the skin is thin and very pubescent [4, 7].

MATERIAL AND METHOD

The experiment done on chemical thinning with Ethrel was placed in 2006 in a private orchard in Periam locality, an area in the western part of Romania, well-known for its tradition in cultivating peach trees.

The biological material consists in 2 varieties of peach trees: *Spring Lady* and *Maja* and two varieties of nectarine trees: *Nectaross* and *Caldesi 2000*, which were planted at a distance of 4m between the tree rows and 2.5 m between the trees on a row, giving a density of 1000 trees/ha. These trees have the same crown system: simple palmet, the same orchard floor management (ploughing on the interval and disc tillage and weed control with Roundup 3-4 l/ha on the tree rows), the same fertilization system (approximate doses of 90-100 kg/ha N, 60-80 kg/ha P_2O_5 and 100-120 kg/ha K_2O), the same treatment scheme (done according to the prognosis for pests and diseases, being done 8-12 treatments/year) and the same irrigation method (water is applied according to the needs by applying 2-4 watering).

In this article we present chemical thinning done with Ethrel (ethephon) on all four peach varieties, using four concentrations, which determined the experimental variants:

V1 – 125ppm
V2 – 250ppm
V3 – 350ppm
V4 – 500ppm
V5 – Not thinned, control variant

Chemical thinning was done at 25 days after fruit binding, moment when the ovule (the future stone seed) had 10-12 mm.

The main chemical substances in peaches' composition are sugars, organic acids, pectic substances, tannins, vitamins and minerals [6].

The content of dry soluble substance was determined with the digital rephractometer, sugars content was determined by calculation according to the soluble dry substance (4 x s.d.s. / 100 – 4,25), and total acidity was determined by juice extraction and titration with NaOH, expressed in malic acid [1].

At the same time there was calculated the sugars-acidity index, which expresses the taste quality of fruits, so that for high values of this index fruits have a low acidity and they don't quench thirst, and for higher values of this index the fruits are too sour, they quench thirst, but the taste is too strong, especially when and if there is a large quantity of tannins.

The data were collected in 2006 from all the varieties, for each experimental variant, they were calculated and interpreted as shown below.

RESULTS AND DISCUSSIONS

In 2006, for *Spring Lady* variety the soluble dry substance ranged from 8.8% in variant 1 up to 9.5% in variant 3, determining a total sugars content from 6.85% in variant 1 to 7.59% in variant 3 (350 ppm). Total acidity had the highest value of 0.54% in the control variant and the smallest value of 0.45% in variant 4. We can observe that in those variants with a more severe thinning the acidity is more intensively metabolised. In conclusion, the sugars-acidity index had a value of 12.88 in the control variant and of 16.64 in variant 4 (Table 1).

For *Maja* variety, there was determined a higher content of sugars, than in the fruits of the previous peach variety and a smaller content of acidity, which shows that this variety has a better quality. The soluble dry substance ranged from 12.00% in variant 5 – the control up to 13.30% in variants 3 and 4, determining a total sugars content from 10.25% in variant 5 – the control to 11.63% in variants 3 (350 ppm) and 4 (500 ppm). Total acidity had the highest value of 0.42% in variant 1 and the smallest value of 0.38% in variant 4, so that the sugars-acidity index had a value of 25.00 in the control variant and of 30.61 in variant 4 (Table 2).

Table 1. Fruits' chemical composition for Spring Lady variety

Variant	Soluble dry substance (%)	Total sugars (%)	Acidity (malic acid %)	Sugars-acidity index
V1-125ppm	8.8	6.85	0.49	13.98
V2-250ppm	9.2	7.28	0.47	15.48
V3-350ppm	9.5	7.59	0.47	16.16
V4-500ppm	9.4	7.49	0.45	16.64
V5-Not thinned	8.9	6.96	0.54	12.88

Table 2. Fruits' chemical composition for Maja variety

Variant	Soluble dry substance (%)	Total sugars (%)	Acidity (malic acid %)	Sugars-acidity index
V1-125ppm	12.40	10.68	0.42	25.42
V2-250ppm	12.90	11.21	0.39	28.73
V3-350ppm	13.30	11.63	0.39	29.82
V4-500ppm	13.30	11.63	0.38	30.61
V5-Not thinned	12.00	10.25	0.41	25.00

Nectaross nectarine variety gave better results than *Caldesi 2000* variety considering the chemical compositions, so that the soluble dry substance ranged from 11.7% variant 5 – the control up to 12.30% in variant 4, determining a total sugars content from 9.93% in variant 5 – the control and 10.57% in variant 4 (500 ppm). Total acidity had the highest value of 0.45% in the control – not thinned variant and the smallest value of 0.41% in variant 4, so that the sugars-acidity index had a value of 22.07 in the control variant and of 25.78 in variant 4 (Table 3).

For *Caldesi 2000* variety, the soluble dry substance ranged from 10.30% in variant 5 – the control up to 11.40% in variant 4, determining a total sugars content of 8.44% in variant 5 – not thinned and 9.61% in variant 4 (500 ppm), while total acidity had the highest value of 0.36% in the control – not thinned variant and in variant 1 and the smallest value of 0.35% in all the other thinned variants (V2, V3 and V4). According to this, sugars-acidity index had a value of 23.45 in the control variant and of 27.46 in variant 4 (Table 4).

Table 3. Fruits' chemical composition for Nectaross variety

Variant	Soluble dry substance (%)	Total sugars (%)	Acidity (malic acid %)	Sugars-acidity index
V1-125ppm	11.8	10.04	0.44	22.81
V2-250ppm	11.9	10.14	0.42	24.15
V3-350ppm	12.1	10.36	0.42	24.66
V4-500ppm	12.3	10.57	0.41	25.78
V5-Not thinned	11.7	9.93	0.45	22.07

Table 4. Fruits' chemical composition for Caldesi 2000 variety

Variant	Soluble dry substance (%)	Total sugars (%)	Acidity (malic acid %)	Sugars-acidity index
V1-125ppm	10.7	8.87	0.36	24.64
V2-250ppm	10.8	8.98	0.35	25.64
V3-350ppm	11.2	9.40	0.35	26.86
V4-500ppm	11.4	9.61	0.35	27.46
V5-Not thinned	10.3	8.44	0.36	23.45

Considering the most important chemical features – sugars and acidity, there was done a comparison between the four varieties. We can see that sugars content for all variants was higher for Maja variety from the peaches' group and for Nectaross variety from nectarines' group. The values increase accordingly to the concentration use, so that in the not thinned variants and the ones thinned with Ethrel in concentration of 150 ppm the values were smaller and they increase in variants 2 (250 ppm), 3 (350 ppm) and 4 (500 ppm). We can notice that for Spring Lady variety in variant 1 there was determined the smallest content of sugars – 6.85%, this value being surpassed even by the fruits in the not thinned variant – 6.96%. For Maja variety there was obtained the highest content of sugars, and this value was the same in variant 3 and variant 4 – 11.63%, this being the best peach variety considering this quality element (Fig. 1).

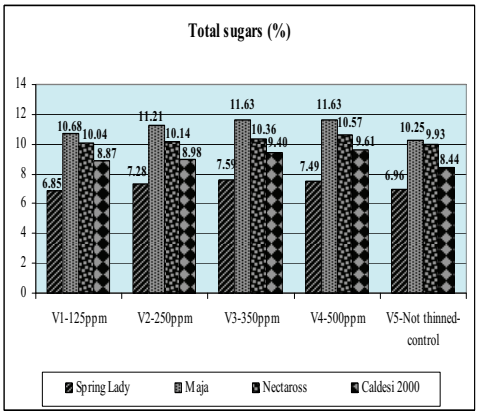


Fig. 1. Sugars content of peaches and nectarines

By analysing the acidity and the values obtained from the fruits of the four varieties in each variant, we can observe that for most of the varieties this element had the highest values in variant 5 – not thinned, especially for Spring Lady variety – 0.54%. Very close values to the ones obtained in the control variant were obtained in variant 1, for Maja variety being even higher with 0.01%. In fruits it is important that there is a good balance between the acidity and the sugars content, so that the fruits' would have a good taste. For this element, we remark the smallest values obtained from all the variants in variant 4, followed at equal values by variants 3 and 2 (Fig. 2).

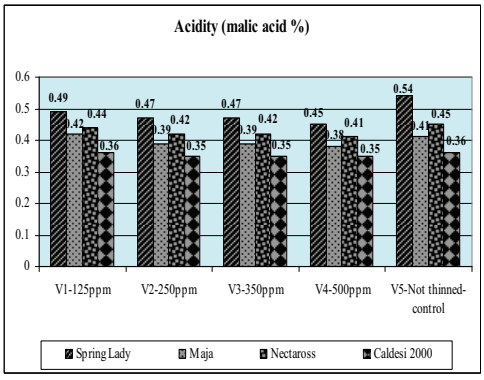


Fig. 2. Acidity content of peaches and nectarines

CONCLUSIONS

For all the elements determined we can say that the differences between the varieties are due to their genetical nature, and sometimes due to some phenological differences.

Sugars and acidity content in fruits are determined by the technological links applied in culture, but mainly by the genetical structure of the varieties and their behaviour in the culture area.

For all four varieties there was noticed a smaller content of sugars and soluble dry substance in the control – not thinned variant and higher values in variant 4 – 500 ppm Ethrel. His can be explained as the trees feed a smaller number of fruits, which grow better and have a better quality.

In reverse, total acidity had higher values in the control – not thinned variant and smaller values in variant 4 – 500 ppm Ethrel.

We recommend moderate chemical thinning done with Ethrel in concentrations of 250-350 ppm, which have a good impact at the same time upon the qualitative and quantitative (not presented in this article) productions.

Among the peach varieties, *Maja* variety remarked by the high quantities of sugars and small amounts of acidity in fruits, which was also observed for *Nectaross* nectarine variety.

ACKNOWLEDGEMENTS

This research work was carried out for the PhD Thesis entitled: *Researches on Fruits' Load Standardization of some Peach and Nectarine Varieties in Periam Culture Area*.

REFERENCES

[1] Alexa Ersilia, 2003. *Contaminants in vegetal products*. Eurobit PH, Timişoara, Romania.
[2] Botu I., Botu M., 2003. *Modern and Durable Fruit Culture*. Conphys PH, Râmnicu Vâlcea.
[3] Burzo, I., Toma, S., Olteanu, I., Dejeu, L., Delian Elena, Hoza, D., 1999. *Culture Plants' Physiology*. Vol. 3, Fruit Trees and Vine's Physiology. Ştiinţa PH, Chişinău.
[4] Cociu V., 1993. *Peach Culture*. Ceres PH, Bucureşti.
[5] Drăgănescu E., Mihuţ E., 2005. *Fruit Species' Culture*, Ferma Magazine, Waldpress PH, Timisoara.
[6] Ghena N., Branişte N., 2003. *Fruit Trees Special Culture*, MatrixRom PH, Bucureşti.
[7] Iordănescu Olimpia Alina, 2008. *Fruit Culture*, Eurobit PH, Timişoara, Romania.
[8] Stănică Fl., Branişte N., 2011. *Guide for Fruit Growers*, Ceres PH, Bucharest, Romania.

Scientific Papers, Series B, Horticulture, Vol. LVI, 2012
CD-ROM ISSN 2285-5661, ISSN-L 2285-5653

QUALITY EVALUATION OF SOME CLINGSTONE CULTIVARS PROCESSED INTO STEWED FRUIT

Gh. LAMUREANU[1], Constanta ALEXE[2], Simona POPESCU[2]

[1]Research Station for Fruit Growing Constanta, No.1, Pepinierei Street, 907300, Commune Valu lui Traian, Romania, Phone/Fax.+4024123187, E-mail scpp_constanta@hotmail.com
[2]Research and Development Institute for Processing and Marketing of the Horticultural Products - Bucharest, No. 1A, Intrarea Binelui street, District 4, 042159, Bucharest, Romania, Phone 40214610706, fax 0214600725, E-mail: tantialexe@yahoo.com

Corresponding author email: tantialexe@yahoo.com

Abstract

The peach tree is among one of the most valuable species cultivated both in Romania and abroad, being very much appreciated for the quality of its fruit. Being represented in crops through many varieties, with different periods of ripening, the peach tree provides fresh fruit beginning with the second half of the month of June and ending with the first decade of the month of November. This distribution of the production also allows for a rhythmical and prolonged supply with fresh fruit of the factories that process fruits. The cultivation of peach trees for industrial usage (clingstones) is of specific importance in the context of cultivating peach trees in general, due to the fact that lately it has become much more essential, having a wide and complex problematic as compared to the traditional crops for fresh consumption. This paper has as purpose the establishing of the viability for processing into stewed fruit of 7 clingstone cultivars: NJC 108, C 81, NJC 85, Shasta, Catherine, Fortuna and Loadel. The peaches, provided from experimental plots of Research Station for Fruit Growing Constanta, were processed into stewed fruit in micro production laboratory of Research and Development Institute for Processing and Marketing of the Horticultural Products, Bucharest. The sensorial analysis of the product was carried out according to the STAS 12656-88, which establishes the analysis methods with unitary scales of points (method A), methods used in the evaluation of the organoleptic characteristics of alimentary products. These methods are applied in order to appreciate a set of organoleptic properties: aspect, colour, taste, texture or, should it be the case, consistence. The best results were obtained by the Catherine cultivar, which received the maximum score (20.00) for its aspect, colour and taste and a total average score of 19.52. This cultivar, together with Fortuna (18.48 points) and C 81 (18.24 points) were labelled with the "very good" grade.

Key words**:** *aspect, colour, cultivar, taste, texture*

INTRODUCTION

The peach tree is among the most valuable species cultivated both in Romania and abroad and it is very appreciated for the quality of its fruit. These are generally large, beautifully coloured, with a relatively high content of vitamins and sugar and with a fresh, pleasant taste. Being represented in crops by numerous cultivars with different ripening periods, the peach tree ensures fresh fruit beginning with the second half of the month of June and ending in the first decade of the month of November. This distribution of the production also allows for a rhythmical and continuous supply of fresh fruit for the fruit processing factories.

Stewed fruits are tins containing fruit and sugar syrup which are packed in hermetic and thermally sterilised recipients. According to the species, they have a minimum content of over 45% fruit [1, 2]. The short processing process (65 minutes) allows for maintaining within the finite product of the maximum quantity of nutrients, as well as the taste characteristics, the colours and the flavour [3]. These are the products with the highest requirements concerning the quality of the raw material, which is why the chosen cultivars are those that have certain technological properties and chemical composition, with different ripening periods – from extra early to late – in order to prolong the processing season. The fruit are harvested little before they are ripen for

consumption, when the pulp is firm and the flavour is already pronounced [4].
The quality of the stewed fruit depends on the characteristics of the cultivar, whose fruit must be uniform, with an attractive colour, good firmness and good resistance for the sterilisation process [6]. Fruit assessment performed directly by the consumer is often used when seeking to popularise a new cultivar or to compare the quality of several cultivars or products obtained through processing of the fruit [5].
The purpose of this paper is to evaluate the suitability for processing into stewed fruit of certain clingstone varieties which were cultivated in the experimental field from SCDP Constanţa.

MATERIAL AND METHOD

The research was carrier out in 2010, with 7 clingstone cultivars: NJC 108, C 81, NJC 85, Shasta, Catherine Sel.1, Fortuna and Loadel which come from the experimental crop at SCDP Constanţa. Given the fact that the quality of the production is an essential factor in choosing the cultivars fit for processing into stewed fruit, analyses were carried out before processing, as well as measurements and determinations concerning the studied cultivars. Immediately after harvesting, the fruit were examined from an organoleptic point of view, the examination being focused on size, shape, colour, size of the stone and their adherence. Also, measurements were performed concerning the content of soluble dry substance (refractometric) and the acidity (titrimetric).
The fruit were processed into stewed fruit (slices) at the Research and Development Institute for Processing and Marketing of the Horticultural Products, Bucharest, in the microproduction laboratory. The sensorial analysis of the product was carried out according to the STAS 12656-88, which establishes the analysis methods with unitary scale points (method A), used in the evaluation of the organoleptic characteristics of alimentary products. This method is applied in order to determine an ensemble of organoleptic traits: aspect, colour, taste, texture and sometimes, consistency.
The evaluation of each organoleptic characteristic was performed by comparison with point scales from 0 to 5 points, thus obtaining an average total of points given by the tasters, based upon the individual files for recording the obtained points. Weighted averages of the points were calculated and they were, in their turn, added up in order to obtain a total average score. Also, the organoleptic qualities of the products were established based upon the average total principle, by comparison with a point scale from 0 to 20 points. Finally, each cultivar received a grade.
Within the general scores obtained by the various analysed products, there are 5 distinct quality classes:

Grade	Score
very good	18.10 – 20.00
good	15.10 – 18.00
satisfying	11.10 – 15.00
unsatisfying	7.10 – 11.00
unsuitable	0.0 - 7.10

The sensorial analysis of the tinned products was performed after a period of minimum 21 days after processing (in which time it is considered that the product become stable). After this period, other analyses involved the establishing of the content of soluble dry substance (the refractometric method), of soluble carbohydrates (the Bertrand titrimetric method) and of titrable acidity (the titrimetric method).

RESULTS AND DISCUTIONS

The fruit of the NJC 108 hybrid, which is extraearly, are spherical-ovoid, yellow with red on approximately 20-25% of their surface. The pulp is yellow and tasty. The size of the fruit is medium (80g). The ripening stage occurs in the last decade of June and the first two decades of July, making this hybrid the earliest clingstone in the Romania assortment (Photo1).
C-81 (Photo 2) is a hybrid with a low vigour, with fruit that are medium in size, of an ovoid shape and yellow-greenish with red on approximately 30% of the surface. The pulp is yellow-orange, with a good taste and high firmness. The ripening stage occurs in the last decade of July and the first decade of August.

Photo 1. Clingstones from the NJC 108 hybrid

Photo 2. Clingstones from the C 81 hybrid

The NJC 85 hybrid displays a greater vigour, the fruit being slightly ovoid, yellow with red on the sunny side, presenting slight pubescence (Photo 3). The pulp is yellow-orange and the average size of the fruit is that of 125 g. The ripening of the fruit occurs at the end of July and in the first half of August.

Shasta, a cultivar with medium to high vigour has spherical fruit, average-sized (75-80 g), the main colour being yellow, while the covering one, on the sunny side, is red (Photo 4). The pulp is yellow, firm and adherent to the core.

Photo 3. Clingstones from the NJC 85 hybrid

Photo 4. Clingstones from the Shasta variety

The Catherine Sel.1 cultivar (Photo 5) is a Romanian cultivar, unlike the other 6 studies cultivars which are of American origin. It is obtained at the SCDP Constanţa by means of auto pollination of the American cultivar Catherine, followed by a selection into hybrid lineage. The vigour of the tree is medium to high while the fruit are spherical, slightly flattened, with an average weight or 120 g. Their colour is an intense orange, with reddish shades on the sunny side. The pulp is yellow-orange, firm, rubbery, without red fibres and infiltrations and with a pleasant taste and string flavour. The ripening takes place in the second decade of July and the first decade of August.

Fortuna is a cultivar with a high vigour and fruit that are almost spherical, symmetrical, mainly yellow with red on the sunny side (Photo 6). The pulp is yellow, firm, flavoured and very adherent to the stone. The average weight of the fruit is of approximately 110 g. The ripening begins in the third decade of July and ends at the beginning of the second decade of August.

Photo 5. Clingstones from the Catherine Sel.1 variety

Photo 6. Clingstones from the Fortuna variety

Photo 7. Clingstones from the Loadel variety

The Loadel variety's vigour is medium to high and its fruit are big (over 130 g), round, the main colour being yellow, while the covering one is red, on approximately 25-30% of the surface. The pulp is yellow, very firm, tasty and adherent to the stone (Photo 7). The ripening begins with the last decade of July and lasts until the third decade of August, depending on the climatic conditions of that specific year.

The data referring to the size of the fruit (weight and dimensions) and the stone, as well as the content of dry substance and acidity can be seen in Table 1.

Table 1. The main physical and chemical characteristics of fresh fruit

Specification	U.M.	Cultivar						
		NJC 108	C 81	NJC 85	Shasta	Catherine	Fortuna	Loadel
Dmensions of the fruit - large diametre - small diametre - height	mm mm mm	54.0 51,2 49.5	52.9 47.3 42.0	55.8 52.8 53.5	54.9 53.8 51.5	57.0 52.1 48.6	55.2 43.7 48.2	53.7 48.3 52.7
Weight of the fruit	g	80.2	76.9	123.0	77.2	116.9	107.3	131.8
Weight of the stone	g	9.8	9.0	11.4	8.0	8.1	5.8	4.1
Weight of the stone as percentage of the weight of the fruit	%	12.2	11.8	9.3	10.4	6.8	5.5	3.1
Soluble dry substance	%	8.8	8.7	10.3	10.6	11.0	9.4	10.
Total acidity (malic acid)	mg/ 100g	0.54	0.55	0.38	0.60	0.50	0.41	0.44

The average weight of the fruit varies between 131.8 g (Loadel) and 77.2 g (Shasta), there being 4 varieties with fruit weighing over 100 g: NJC 85 (123.0 g), Catherine Sel.1 (116.9 g) and Fortuna (107.3 g). Generally, the dimensions of the fruit are in accordance to their weight.

The size of the stone and especially the relationship between the weight of the fruit and the weight of the stone is very important, particularly for cultivars meant for industrialisation, in order to obtain a good efficiency processing. Concerning the studied varieties, the average weight of the stone ranges from 11.4 g (9.3% of the fruit) at the NJC 85 and 4.1 g (3.1% of the fruit) at the Loadel cultivar.

By analysing the data in table 1 we can observe that the average value of the content of dry substance in the conditions of the year 2010 is quite low, varying between 11.0% at Catherine Sel.1 and 8.7% at the C 81 hybrid. Among all the studied cultivars, 3 of them present a ration of dry substance under 10%: C 81 (8.7%), NJC 108 (8.8%) and Fortuna (9.4%). The acidity in the fruit is the indicator which ensures balance of their taste. By analysing the table, we notice that the value of the acidity ranges from 0.38mg/100g at NJC 85 to 0.60mg/100g at Shasta.

The observations performed on the product stewed fruit reveals great differences between cultivars as concerns the biochemical composition (table 2).

Table 2. The main chemical characteristics of stewed clingstones

Cultivar	Specification			
	Soluble dry substance (°Bx)	Soluble carbohydrates (%)	Titrable acidity (malic acid mg/100g)	Ratio carbohydrates/acidity
NJC108	12.07	10.18	0.41	24.82
C 81	14.19	12.21	0.49	24.91
NJC 85	12.70	8.98	0.35	25.65
Shasta	12..88	10.20	0.42	24.28
Catherine	15.27	13.11	0.47	27.89
Fortuna	12.46	10.59	0.41	25.82
Loadel	12.52	9.73	0.43	22.62

The content of soluble dry substance varies between 12.07°Bx at the NJC 108 hybrid and 15.27°Bx at the Chaterine Sel.1 cultivar. The largest quantity of soluble carbohydrates is contained by the stewed fruit of the Catherine cultivar (13.11%), while the smallest belongs to the clingstones of the NJC 85 hybrid (9.98%). The titrable acidity has values that range from 0.49mg/100g at the C 81 cultivar to 0.35mg/100g at the NJC 85 hybrid. Due to these values, the ration soluble carbohydrates/titrable acidity is the highest at the Chaterine hybrid (27.89), whereas the Loadel cultivar presents the lowest values for this indicator (22.62).

An ensemble image of the jars containing stewed fruit from the 7 analysed cultivars is presented in Photo 8.

Photo 8. Stewed clingstones

The results of the sensorial analysis of the product "Stewed peaches" are presented in table 3. It can be noticed that the best values were obtained by the Catherine Sel.1 cultivar, which received maximum points for aspect, colour and taste and an average total score of 19.52. This cultivar, together with Fortuna (18.48 points) and C 81 (18.24 points) received the grade "very good".

Table 3. The sensorial analysis of the product "Stewed peaches"

Specification	Cultivar						
	NJC 108	C 81	NJC 85	Shasta	Catherine	Fortuna	Loadel
Aspect	5.52	5.12	4.08	4.56	6.00	5.36	5.04
Colour	3.04	3.68	3.04	2.56	4.00	3.84	2.88
Taste	5.04	5.76	4.08	5.04	6.00	5.76	5.04
Texture	3.20	3.68	3.04	3.36	3.52	3.52	2.56
Average total score	16..80	18.24	14.24	15.52	19.52	18.48	15.52
Grade	Good	Very good	Satisfying	Good	Very good	Very good	good

The NJC 108 hybrid (16.80 points) and the Shasta (15.52 points) cultivars obtained the grade "good". The last place, with only 14.24 points was occupied by the NJC 85 hybrid, which received the grade "satisfying".

CONCLUSIONS

The Romanian cultivar Catherine Sel.1, created at the SCDP Constanţa, proves to be utterly suitable to the processing of its fruit into stewed fruit, the resulting product having remarkable sensorial qualities. In the same category, highly suitable are the C 81 and Fortuna hybrids as well.

The peaches of the NJC 108 hybrid and the Shasta and Loadel cultivars can be processed into stewed fruit, given the fact that the tasters awarded them with the grade "good".

The NJC 85 hybrid is less suitable for processing into stewed fruit. The grade it obtained following the sensorial analysis was "satisfying", due to its less pleasant aspect, weak texture and low acidity, which resulted in the product having a less balanced taste.

For the cultivars having less satisfying results when processed into stewed fruit, the recommendation is that processing into other forms be tried (comfiture, jam, nectar, etc.)

REFERENCES

[1] Berceanu D., 2009. *Tehnologia prelucrarii legumelor si fructelor*. Iasi, Edit. Ion Ionescu de la Brad, p 254.

[2] Berceanu D., 2003. *Tehnologia produselor horticole*. Bucuresti, Edit. Economica, p 527.

[3] Jamba A., Carabulea B., 2002. *Tehnologia pastrarii si industrializarii produselor horticole*. Chisinau, Edit. Cartea Moldovei, 493:429-434

[4] Gherghi A., 1999., *Prelucrarea si industrializarea produselor horticole*. Bucuresti, Edit. Olimp, p. 46-51.

[5] Turner J., Seavert C., Collona A., Long L. E., 2008. *Consummer Senzory Evaluation of Sweet cherry Cultivars in Oregon.* USA, Acta Hort. (ISHS)795: 781-786.

[6] Webster A. D., Looney N. E., 1996. *Cherries: Crop Physiology, Production and Uses*. CAB International, Wallingford, Oxon, U.K., p 513.

[7] STAS 12656-88 Standard de Stat, Editie oficiala.

Scientific Papers, Series B, Horticulture, Vol. LVI, 2012
CD-ROM ISSN 2285-5661, ISSN-L 2285-5653

THE INFLUENCE OF CULTIVAR ON GROWTH AND PRODUCTIVE POTENTIAL OF TOMATOES GROWN IN SOLARIUMS PROTECTED WITH SELECTIVE PHOTO FILMS

Mali-Sanda MANOLE

University of Agronomic Sciences and Veterinary Medicine of Bucharest, Faculty of Agriculture, 59 Mărăşti Blvd., 011464, Bucharest, Romania, +40072357080, malismanole@yahoo.com

Corresponding author email: malismanole@yahoo.com

Abstract

Taking into account the importance of tomatoes in human diet the modern technologies aim is to implement the elements that provide quality products, staggered throughout the year. From these, the growing of vegetables in protected areas and diversification of varieties and hybrids are important to the producers. The paper presents the results regarding tomato culture in greenhouses, that are covered with selective photo foils anti condensation, additivated UV and IR films produced in Romania, and a biofond represented by two different botanical varieties: var. esculentum - hybrid Cindel and var. cerasiforme - Cerise hybrid. It was found that in general, light quality changes influenced the plant growth. In comparison with transparent and untreated films, those of different colors lead decrease the total plant height in both hybrids, with larger differences in Cindel F1. The red films had the strongest inhibiting effect. The height of formation of the first inflorescence was lower for hybrid Cerise and both hybrids were favorably influenced by the transparent film with additives. The photo selective films have influenced the growth of plants, number and average fruit weight. During 2009, the hybrid Cindel present increased yields in comparison with control, as it follows: in green foil (51.6%), transparent UV treated (21%) and yellow (9%). Cerise hybrid yield was strongly influenced, differences to control using the same kinds of films was 61%, 38% and 42%. It was observed that while red film reduced yield for Cindel F1 hybrid, in the case of Cerise had a favorable effect, causing an increase of 39% compared with the control. Using photo selective film of different colours, we can increase yield of tomatoes grown in greenhouses from 34.2 t / ha up to 51.2 t / ha in the case of Cindel F1, and from 23.6 t / ha up to 37.9 t / ha for Cerise.

Keywords**:** *photo selective films; greenhouses; Solanum esculentum; var. esculentum, var. cerasiforme*

INTRODUCTION

Although growing and tilling plants in glasshouses is more expensive then care crops on fields, it proves its economical efficiency and viability through the fact that it can offer means through which it exceeds the drawbacks related to the climatic and biological abridgements of the production [1]. The additional costs which tilling plants in glasshouses dictates are usually vindicated, if the price obtained on the product unit is high [3]. This appears when the production is of better quality, and when the production costs are compensated by the growth of the harvests. The experiment was developed during 2009, in the didactic sector and the experimental, of the University of Agricultural Sciences and Veterinary Medicine – Bucharest, Department of Vegetable Crops, in the greenhouse. In the paper, there are presented results obtained studied the behavior of two different varieties of tomatoes, in favorable conditions for protecting crops with different photo selective soils.

MATERIAL AND METHOD

The experiment was made in tunnel type solars, of high type tunnel. We used the liniar arrangement of blocks method, which was formed of two factors**:**

Factor a- two gradations; it was represented by the cultivars

a_1= *Lycopersicum esculentum* var. *esculentum*: *Cindel(F1)*

a_2= *Lycopersicum esculentum* var. c*erasiforme*: *Cerise*

Factor b - five gradations;

– photo selective films:

b1= red; b2=yellow; b3=green; b4= treated U.V. white; b5=not treated white- version control. By combining the two factors, *10 variants* resulted, and they are presented in Table 1.

Table 1 Tested variants

V1= a_1b_1	V2= a_1b_2	V3= a_1b_3	V4= a_1b_4	V5= a_1b_5
V6= a_2b_1	V7= a_2b_2	V8= a_2b_3	V9= a_2b_4	V10= a_2b_5

Seedlings were produced in heated nurseries, according to known technologies [2]. Seedlings were planted in photo selective covered greenhouses, as soon as the soil temperature was 10-12^{0}C. The establishment of crops, by tilling seedlings, was made on 08 April 2009, by the 70/35 cm scheme, resulting a number of 4 plants / mp (Fig.1).

Fig. 1. Care treatments for tomato

Care of crops was made according to classic technology, and the plant treatments application was excluded, in order to follow the influence of the protection with photo selective foils upon growth and fructification.

RESULTS AND DISCUSSIONS

This year, we studied the influence of foil photoselective protect the plant height, and comparative behaviour of the two hybrids grown under these conditions. Results were recorded at 6 weeks after planting, are presented in Table 2. Data analysis shows that, in hybrid *Cindel*, average plant height was 102.6 cm, recording values for variants grown under film photoselective (V1 - V4), ranging between 85.5 cm and 106.1 cm. Note that these values were much lower than those of the witness (V5), the total plant height was 115.5 cm. Variant 3 green sheet was covered with the highest values (106.1 cm), but lower than the control.

The lower heights were noted in option 1, covered with red foil (85.5 cm). As the height of formation of the first blossoms on the tree as an indicator of the earlier fructification, *Cindel* hybrid media was 27.22 cm and record values for variants grown under film photoselective (V1 - V3) were roughly equal, ranging between 27.40 and 28.9 cm, lower than the untreated control (26.1 cm) - V5 and the average hybrid (27.2 cm). Compared photoselective films of different colours and shades, as witness the film, transparent and UV untreated (V5), as well as UV treated white film (V4), was a much lower value than representing the average hybrid. *Cerise* hybrid of table 2 can be observed that, to witness the untreated film UV (V5) who had plant height of 102.8 cm, superior to all variants grown under colour sheets and hybrid media (93, 70cm). Covered with red foil variants (V1) and yellow foil (V2) had the lowest (83.9 cm and 85.9 cm respectively). The version covered with green foil (V3) there is a value close to that of the control represented by untreated white film (V5), the height is only 1cm lower. If this hybrid formation height of the first inflorescence was on average 22.94 cm. Same value was exceeded by the witness represented by untreated UV transparent film (21.6 cm), as well as variants V2, V3 and V4 in the greenhouses were cover foil yellow, green and white UV treated Under red foil (V1) formed the first inflorescence plants at a height lower than the average hybrid *Cerise*, approximately the size of the witness (V5).

Data analysis shows that six weeks after planting, hybrid *Cindel* had a higher growth than hybrid *Cerise* waist plant, average plant height difference is 8.9 cm. Versions covered with foil on both green photoselective hybrid showed the largest increases from red foil variant V1, V2 and V4-yellow-white film UV treated, recording values of 106.1 cm and 101.8 cm. Witness versions(V5) covered with white sheet untreated, registered in both hybrids, increases both the variants covered with colour sheets and media from hybrids.

Cindel hybrid (fig. 2) at 6 weeks, the number of inflorescences ranged from minimum registered foil variant V4 UV treated white maximum of 6.79 and 7.95 for the variant V3-foil flowers green. Hybrid media was 7.29, a value was below the number of inflorescences formed version control (V5). At 8 weeks, and values ranged from 6.95 to version 6.10 to version V2 and V4-white film UV treated. Average realized in this time of 6.56 inflorescences is equal to version control (V5). At 10 weeks,

version control stands (V5) and V1 variant with values lower than the average variations. Covered with green foil version (V3), and at 6 weeks, had the highest number of flowers formed by the variants. *Cerise* hybrid, in the three readings, no differences was noted to order variations, so the highest values were green film version (V3). Version control (V5) was close to the foil covering of the red version, both versions being below average. Data on the number of fruit per plant shows that the hybrid *Cindel* difference between the highest and lowest number of fruits formed per plant, is 52.46% and 55.37 Cerise differences is the% (Fig.3). Production of tomatoes per plant is influenced by the number of fruit and fruit weight (Table 3). Analyzing the data presented in Table 3, the average number of fruit produced per plant and average fruit weight in tomato hybrids *Cindel* and *Cerise*, shows the following: *Cindel* hybrid, the average number of fruits formed on a plant is between 18.6 and 12.2. Version control, represented by untreated white sheet, with a number of fruit per plant 17.10, exceeding the average variations (16.02) and red foil-protected variants (V1) and yellow (V2). The variants V3 and V4 are an increase in the number of fruit per plant of fruit from 1.1 to 1.5. The average fruit weight is between 69.7 g (V3) and 50.1 g (V5). All variants colour sheets and white version with UV treatment have obtained larger fruit than the control variant. In general, all variants were above the average hybrid, except version V4-white film UV cured, weight of 56.9 g.

Table 2. The influence of protection foil photoselective the total height of the plant and formation of the first inflorescence

Variant	*Cindel*		*Cerise*	
	Total height plant(cm)	Height to first inflorescence(cm)	Total height plant (cm)	Height tofirst inflorescence(cm)
V1: red foil	85,5	28,9	83,9	21,8
V2: yellow foil	101,8	28,3	85,9	22,9
V3: green foil	106,1	27,4	101,8	24,9
V4: white foil treated U.V.	104,8	25,4	94,1	23,5
V5: white not treated - version control.	115,5	26,1	102,8	21,6
Average	102,6	27,22	93,70	22,94

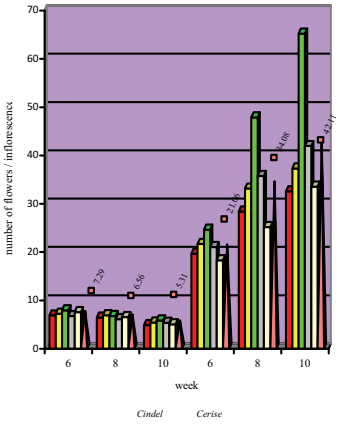


Fig. 2. Dynamics of the number of flowers

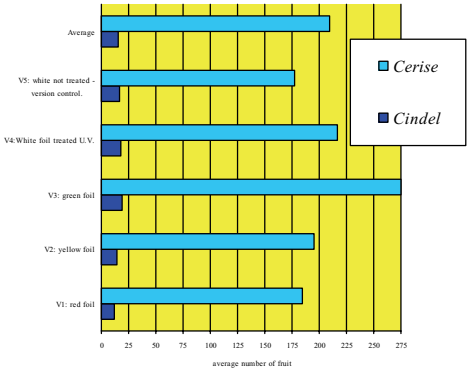


Fig. 3. The influence of photoselective protection foil on the number of fruits formed tomato hybrids *Cindel* and *Cerise*

Table 3. The influence of on the total number of foils photoselective fruit / plant and fruit weight of tomatoes in 2009

Hybrid / Version experimental	*Cindel*		*Cerise*	
	number of fruit / plant	Weight fruit (g)	number of fruit / plant	Weight fruit (g)
V1: red foil	12,2	61,4	185	4,42
V2: yellow foil	14,0	66,7	195	4,28
V3: green foil	18,6	69,7	275	3,45
V4:white foil treated U.V.	18,2	56,9	217	3,75
V5:white not treated - version control.	17,10	50,1	177	3,33
Average	16,02	60,96	209,8	3,85

Table 4. The influence of on the production of tomato photoselective films in 2009

Hybrid / Version experimental	*Cindel*				*Cerise*			
	Producția pe plantă (gr)	Total production (t / ha)	The difference towards witness		Producția pe plantă (gr)	Total production (t / ha)	The difference towards witness	
			(t/ha)	(%)			(t/ha)	(%)
V1: red foil	749,1	29,90	-4,3	87,43	817,07	32,68	9,12	138,71
V2: yellow foil	932,0	37,30	3,10	109,06	834,54	33,38	9,82	141,68
V3: green foil	1297,0	51,84	17,64	151,58	948,20	37,93	14,37	160,99
V4: white foil treated U.V.	1036,1	41,40	7,20	121,05	812,80	32,51	8,95	137,99
V5: white not treated - version control.	856,9	34,20	-	100	589,00	23,56	-	100
Average	974,22	38,93	4,73	113,83	800,32	32,01	8,45	135,87

Photo 1. Inflorescens of tomatoes *Cindel* and *Cerise* (original)

Hybrid Cerise, the average number of fruits formed on a plant is between 275 (V3-green foil) and 185 (V1-red foil). Version control with a mean number of fruits harvested per plant of 177 was below the average hybrid. Data on fruit weight, colour films shows influences of the average fruit weight, ranging from 4.42 g in red foil, from 3.75 g UV treated film. In general, all variants have resulted in increases to the version control fruit weight (3.33 g) and the average hybrid (3.85 g). *Cindel* hybrid largest production plant was made in the film version protected green (1297.0 g), and the lowest production was performed in protected version of red (749.1 g). Version control achieved a production of 856.9 g / plant, just beyond red foil variant (V1). To version control, production increases have been made for variants V3, V4 and V2 of 51.58% (17.64 t / ha), 21.05% (7.20 t / ha) or 9.06% (3.10 t/ha). Version control, represented by untreated white sheet that total production per hectare was 34.20 t, protected version of the film exceeded the red, reducing the production of 12.57%.

At *Cerise*, the average hybrid, which were obtained 32.01 t/ha, other variants have achieved yields ranging from 32.51 to 37.93

t/ha. Both versions covered with foil and colour photoselective the white sheet covered with UV treated exceeded the control variant, the production differences between 14.37 t / ha and 8.95 t/ha. Comparing the yields of both hybrids (tab.4), the largest production in both hybrids was harvested from the film version photoselective protected green. Witness untreated white sheet covered the production was lower than all alternatives, if *Cerise* hybrid and hybrid *Cindel* exceeded the harvested production of red film version. Hybrids exceeded the average in both version controls.

Photo 2. Fruits of hybrids tomatoes (original)

CONCLUSIONS

Cindel tomato hybrids and *Cerise*, botanical varieties belonging *cerasiforme esculentum* respectively, are distinguished by peculiarities of growth and fruiting, and the level of production.

Use sheets of different colors photoselective and UV treated to cover solariums, tomato influence plant growth and their productive potential.

Generally, films and treated photoselective decreasing plant height compared with control represented by untreated white film, the highest values are found in green foil and the lower one red.

Whatever type of film, *Cindel* hybrid was characterized by the waist with higher plants than *Cerise*, a much smaller number of fruits (12 to 19 fruit / plant from 177 to 275 fruits / plant) and their average mass, top (61g / fruit to 4 g / fruit). At both hybrids, productivity parameters reflect the level of production achieved in greenhouses, which reached 34.2 to 51.2 t / ha *Cindel* -37.9 and 23.6 t/ha in *Cerise*, representing increases from the control up to 51.6% and 61% for coverage solariums photoselectives green foil.

ACKNOWLEDGEMENTS

This research work was carried out with the support of Department of Vegetable Crops-Faculty of Horticulture, prof. univ. Ciofu Ruxandra.

REFERENCES

[1] Ciofu Ruxandra, Elena Dobrin, Mihaela Roşu, Tudoreanu, Liliana, 2006. *Improving the Productivity and Qality of Horticultural Plants by Growth under Romanian Photoselective* Films. Abstracts, 27th International Horticultural Congress & Exibition, COEX, IHC, Seoul, Korea, p. 368

[2] Ciofu Ruxandra and colab., 2003. *Tratat de legumicultura*. Ceres, Bucharest, p.634-637

[3] Dobrin Elena, Roşu Mihaela, Ciofu Ruxandra, Tudoreanu Liliana, 2005. *Modificări ale climatului în solariile acoperite cu folii fotoselective*. Scientifical Papers, USAMVB, Seria B, Vol. XLVIII, Bucuresti, p.50-55.


EX·TERRA·AVRVM

Scientific Papers, Series B, Horticulture, Vol. LVI, 2012
CD-ROM ISSN 2285-5661, ISSN-L 2285-5653

MICROPROPAGATION OF BABY KIWI (ACTINIDIA ARGUTA) USING MATURE STEM SEGMENTS

Adrian PETICILA[1], Florin STANICA[1], Roxana MADJAR[2], Oana VENAT-DUMITRIU[1]

[1]University of Agronomical Sciences and Veterinary Medicine of Bucharest, Faculty of Horticulture, Horticulture Bioengineering Resources Department, 59 Marasti Blvd., 011464 Bucharest, Romania; apeticila@yahoo.com;
[2]University of Agronomical Sciences and Veterinary Medicine of Bucharest, Faculty of Agriculture, Soil Sciences Department, 59 Marasti Blvd., 011464 Bucharest, Romania; rmadjar@yahoo.com;

Corresponding author email: apeticila@yahoo.com

Abstract

An effective in vitro culture system for mature stem segments of Actinidia arguta was established. The 1.2 cm nodal segments, cut from young shoots, was sterilized and established in vitro. The successfully induced culture was achieved on three types of growing media standing for three experimental variants were prepared according to the reference bibliography. The first culture medium variant is the classic MS with unchanged components, the second is the modified MS medium with a double quantity of ammonium nitrate (2N) and the third variant is the modified MS medium with a triple quantity of ammonium nitrate (3N) in the composition of macroelement salt solutions. These changes result from the study of reference literature where the ammonium nitrate was modified in order to boost the vegetative growth of explants. This experimental scheme was applied for the male and female genitor of Actinidia arguta. The shoots of micro cuttings were rooted in ½ MS supplemented with 0.5mg/l IBA, 12.5g/l sucrose. Regenerated shoots successfully acclimatized to vegetation house.

Key words*: Actinidia arguta, baby kiwi, micropropagation, European funds*

INTRODUCTION

Actinidia arguta is native to Northern China, Korea, Russian Siberia and possibly Japan. In forests from which it originates, it grows as a vine exceeding at times 50 cm height when climbing in tree crowns. It is most cultivated in European countries such as Italy, Greece, Portugal and Spain, in Asian countries – Turkey, South Korea and Japan - and in the U.S. as well, namely in California.

Actinidia family includes 55 species and about 76 taxa native to Central China and geographically-spread all over China and South-East Asia. Paleobiological research studies roughly date this genus back to some 20-26 million years ago.

As any other vine, the stem has no support tissue, is voluble and wraps around the supporting system of any other branches it may come in contact with. *A. arguta* looks more delicate than *A. deliciosa*: it has hairless oval or ovoid leaves 5 to 8 cm long, showing the specific leaf green glaze in its upper part, and red leafstalk with serrated border. Odor-feint flowers are about 3 cm in diameter, their color varies from white to cream and grow at leaf axils, no more than three in a bunch. The plant is dioceous and needs cultivated male plants to produce fruit. *Actinidia arguta* cv. Issai ist he unique cultivar known to have the perfect bloom. The fruit is a green smooth berry, 2 to 3 cm long and of oval, ovoid or oblong shape according to type. Its fruits are generally sweeter than those of *A. deliciosa* and their sugar content ranges between 14 and 29%. The *Actinidia arguta* species needs a longer vegetation time (about 150 frost-free days). While dormant, this species may face temperatures up to -30^{o}C. However, it needs gradual climate adaptation as any dramatic temperature fall may cause the splitting of the stem and further damages. It tolerates half-light, but it grows better on sunny fields. The support system is mandatory on commercial plantations.

A. arguta loves water and needs plenty of it throughout the vegetation period. However, it

shall be necessarily watered during summer. Dry cutback is needed if higher output is sought for. Cutback systems rely on the replacement of bearing canes. As far as diseases and vermin are concerned, the species poses no problem, possible due to the fact that it has not been intensively cultivated on large areas.

Although the genetic diversity of the genus *Actinidia* provides an outstanding potential for cultivar improvement, it shows features (including the genuine greenness of the vine, the juvenile period of up to 5 years, the dioceous nature and the poliploid netlike structure) that make this genus to be less flexible for particular reproduction targets over other agronomic cultures. Tissue culture, *in vitro* handling of cells, tissues and organs of the plant, is a major bio-technological technique from which may methods have been used to overcome some of the limitations shown by *Actinidia* in relation to traditional reproduction.

The first micropropagation protocol for *Actinidia* was suggested by Harada (1975) [1] and las afterwards improved. Standardi, 1983[2]; Wessels *et al,* 1984[3]; Monette, 1986[4]. The Murashige & Skoog (MS) method is the most used to prepare culture medium and is beneficial to regeneration and callusing. Other media like Gamborg B_5 and N_6 have been successful as well.

The stimulation of axillary buds is subject to a relatively high concentration of cytokinin which inhibits apical dominance and allows buds to grow (Pierik, 1987)[5]. A large number of even shoots may be obtained from a single explant in short time because this method is simpler than other micropropagation methods ad genetic stability is usually maintained. For *Actinidia* sp., this technique is the most viable propagation method for large-scale plant growth (Zuccherelli, 1994)[6] due to use of nodal segments (Velayandom et al., 1985)[7] and/or shoot ends (Monette, 1986a, b)[4]. However, much attention must be paid to prevent the propagation of shoots regenerated from basal callus because *Actinidia* sp. regenerates easily from undifferentiated cells and show high appetite for somatic variation.

The root induction methods vary; most of them include IBA as potent root-inducer: the immersion of the basal part of the shoot in solutions with high content of IBA (50mg/l) for a few seconds Standardi, 1981[8], 1983[2]; Wessels *et al.,* 1983 [3]. One alternative includes overnight immersion of shoot's basal part in solutions with low content of IBA (0.3, 1, 2 mg/l), which results in high rooting output.

OBJECTIVES

The research studies aim at defining the work protocol to obtain plants by micropropagation or *in vitro* growth from plants already adapted to existing conditions in the fruit garden of the Faculty of Horticulture within USAMV Bucharest.

MATERIAL AND METHOD

Micropropagation is the quickest way to obtain kiwi plants. In vitro proliferation studies aim to adapt abovementioned technologies to micropropagation conditions in the laboratory of the Faculty of Horticulture, USAMV Bucharest, where experiments are conducted under the research scheme below: din two plants, one female plant and one male plant that turned in time to be fruitful and well-adapted to climate conditions of our country, have been selected from the collection of *Actinidia arguta.*

The vegetal material required to set up the culture consists in shoots grown from the vegetative buds.

The vegetal material used consisted in plant R10P14 belonging to the species *Actinidia arguta* (male) and plant R10P2 of *Actinidia arguta* (female).

Three types of growing media standing for three experimental variants were prepared according to the reference bibliography. The first culture medium variant is the classic MS with unchanged components, the second is the modified MS medium with a double quantity of ammonium nitrate (2N) and the third variant is the modified MS medium with a triple quantity of ammonium nitrate (3N) in the composition of macroelement salt solutions. These changes result from the study of reference literature where the ammonium nitrate was modified in order to boost the vegetative growth of explants.

We therefore have for *Actinidia arguta* male plant the V 1- classic induction MS variant, V2- the MS 2N induction variant and V3 – the MS 3N induction variant. After 2-3 months of induction phase monitoring, the shift is made to V4- classic multiplication MS, V5- the multiplication MS 2N variant and V6- the multiplication MS3N variant for a period of 6 months of observation and measurements. These are followed by the V7 MS classic rooting variant, the V8 MS 2N rooting variant and the V9 MS 3N rooting variant for 2 months and afterwards by the acclimatization period of in vitro plants. This experimental scheme shall also be applied for *Actinidia arguta* female and male plants. The experiment started in January 2012 with the induced growth of section of plant shoots according to the research scheme above.

RESULTS AND DISCUSSIONS

Results obtained from the induction of *in vitro Actinidia arguta* cultures

	CUL-TURE MEDIUM	21.03	26.03		3.04		17.04		1.05	
		INITIAL NUMBER	No.	%	No.	%	No.	%	No.	%
R10P14	V1	15	15	100	12	80	9	60	9	60
	V2	15	14	93.3	13	86.6	13	86.6	13	86.6
	V3	15	10	66.6	9	60	7	46.6	7	46.6
R10P2	V1	12	10	83.3	8	66.6	8	66.6	8	66.6
	V2	12	10	83.3	8	66.6	8	66.6	8	66.6
	V3	12	10	83.3	10	83.3	4	33.6	4	33.6

The review of tabular data above shows that the best medium to initiate the *Actinidia arguta* culture for the male plant (86.6%) and for the female plant (66.6%) was the variant V2 (V2- MS 2N induction variant) and variants V1 (V 1- classic MS) and V2 (V2- MS 2N induction variant) respectively.

As far as the multiplication phase for the two baby kiwi varieties, the results are given in the table below with explanations for the impact of the growing medium on the multiplication rate, for average growth and differences recorded between male plants and female plants.

Table 1. Two-factor experimental scheme, a = variety, b = growing medium

Factor a = variety	Factor b = fertilization type
a1 = R10P14-Male a2 = R10P2-Female	b1 = MS+ b2= MS+2N b3= MS+3N

Table 2. Impact of variety (factor a) and of growing medium (factor b) over Actinidia arguta growth

a/b	b1 = MS+	b2= MS+2N	b3= MS+3N
a1 = R10P14-Male	a1.07a	b0.52b	b0.30b
a2 = R10P2-Female	a1.46b	a1.89a	a1.13b
B constant A variable: Dl 5%=0.51*cm; Dl 1%=1.01 cm; Dl 0.1%=2.73cm A constant B variable: Dl 5%=0.37* cm; Dl 1%=0.55 cm; Dl 0.1%=0.82 cm			

The analysis of the variant highlights major differences given by the growing medium for MS+2N and MS+3N, the highest values being recorded in centimeters for R10P2 female of 1.89 cm on the culture medium MS+2N. No major differences given by the growing medium have been found for the growing medium MS+.

The analysis of the variant shows major differences for the same R10P14 male variety between the growing medium MS+ and the other two media MS+2N used, namely MS+3N, with the highest values reached at MS+ of 1.07cm. As for the R10P2 female variety, the highest growth rate was noticed on the growing medium MS+2N of 1.89cm, with significant differences over MS+ and MS3+3N.

Conclusion: The best experimental variant for the growth of *Actinidia arguta* explants on various multiplication media is the variety R10P2-female on the MS+2N medium of 1.89 cm.

Table 3. Impact of variety (factor a) and of growing medium (factor b) over the multiplication rate of Actinidia arguta

a/b	b1 = MS+	b2= MS+2N	b3= MS+3N
a1 = R10P14-Male	a1.69a	a1.78a	a1.53a
a2 = R10P2-Female	a1.65a	a2.47a	a1.77a
B constant A variable: Dl 5%=1.11*; Dl 1%=2.17; Dl 0.1%=5.76 A constant B variable: Dl 5%=0.85*; Dl 1%=1.24; Dl 0.1%=1.86			

The variant analysis shows no major differences generated by the variety and the growing medium with impact on the multiplication rate of *Actinidia arguta.* The highest multiplication rate, i.e. of 2.74, was obtained for the variety R10P2- female on the growing medium MS+2N.

Table 4. Impact of the culture medium on the spring of roots and on their size

	CULTURE MEDIUM	30.04	3.08		3.08	
		INITIAL NUMBER EXPLANTS	No. of rooted explants	%	Average number of roots	Average length of roots in cm
R10 P14	V7	12	2	16.6	1.2	0.56
	V8	12	8	66.6	2.4	2.86
	V9	12	3	25	1.9	1.2
R10 P2	V7	12	12	100	3.2	2.92
	V8	12	4	33.3	2.1	1.4
	V9	12	6	50	1.9	2.5

The review of tab.4 data shows that the v8 culture medium for r10p14 influenced the growth of many rooted explants (66.6%) with the optimum average length, while the v7 culture medium for r 10p2 resulted in 100% rooted explants of 2.92cm average root **LENGTH.**

CONCLUSIONS

To initiate the culture of *Actinidia arguta,* the most successful medium for the male plant (86.6%) was V2 (V2- MS 2N induction variant) and the media in variants V1 (V 1- classic MS) and V2 (V2- MS 2N induction variant) for the female plant (66.6%).
The best experimental variant for growth of *Actinidia arguta* explants on different multiplication media is the variety R10P2- female on the medium MS+2N, with 1.89 cm.
The best rooting was achieved in medium MS2N+ (V8) for R10P14 and in
MS+ (V7) for R10P2.

ACKNOWLEDGEMENTS

This work was co-financed from the European Social Fund under the Sectoral Operational Programme Human Resources Development 2007-2013, project number POSDRU/ 89/ 1.5/ S/ 63258 ”Postdoctoral school for zootechnical biodiversity and food biotechnology based on the eco-economy and the bio-economy required by eco-san-genesys”.

REFERENCES

[1]Harada, H., 1975. *In vitro organ culture of Actinidia chinensis Pl. as a technique for vegetative multiplication*. J. Hort. Sci., 50:
[2]Standardi, A., 1983. *La ‘Micropropagazione’ nella moltiplicazione dell actinidia. Frutticoltura,* 45.
[3]Wessels, E., D.D. Nel and D.F.A. Von Staden, 1984. *In vitro Propagation of Actinidia chinensis PI. cultivar Hayward*. Deciduous Fruit Grower, 34: 453–7, 1984
[4]Monette, P.L., 1986. *Micropropagation of kiwifruit using non-axenic shoot tips*. Pl. Cell Tissue Organ Culture, 6
[5]Pierik, 1987. *In vitro culture of higher plants.*, M. Nijhoff (Dordrecht and Boston and Hingham, MA)
[6]Zucherelli, G., 1994. *Actinidia, the new kiwi (in Italian)*. Edagricole, Bologna.
[7]Velayandom, L., A.M. Hirsch and D. Fortune, 1985. *Tissue culture of nodal stem segments of Actinidia chinensis (L.) Planchon, as a method of micropropagation*. Comptes Rendus de I’Academie des Sciences IIISciences de la Vie-Life Sciences, 301: 598–600
[8]Standardi, A., 1981. *Micropropagazione dell’ Actinidia chinensis Planch Mediante coltura ‘in vitro’ di apici meristematic*i. Frutticoltura, 43: 23–7.

Scientific Papers, Series B, Horticulture, Vol. LVI, 2012
CD-ROM ISSN 2285-5661, ISSN-L 2285-5653

THE INFLUENCE OF THE CLIMATIC FACTORS ON THE DEVELOPMENT AND YIELD CAPACITY OF SOME APPLE VARIETIES CULTIVATED IN HIGH DENSITY ORCHARD SYSTEM

Ioan PLATON, Zsolt JAKAB-ILYEFALVI

[1]Fruit Research and Development Station Bistrita, No. 3, Drumul Dumitrei Nou street, 400127, Bistrita, Bistrita-Nasaud, Romania, Tel: 0263-217895, Fax: 0263-214752; scdpbn@yahoo.com, zsolt.jakab@yahoo.com

Corresponding author email: *zsolt.jakab@yahoo.com*

Abstract

Researches have been effectuated in a high density apple orchard (2500 trees/ha) established in the year 2001 with apple varieties resistant or tolerant to scab (Venturia inaequalis), Florina, Generos, Auriu de Bistrita grafted on rootstocks M9 and M 26.Growth and yield capacity of trees was influenced in the period 2001 and 2011 beside the fruit growing technology also by the evolution of climatic factors. The effects of drought has influenced the fruit production quantitatively and qualitatively through an increase of medium and little sized fruits in the years 2002 (118.5 mm rainfall deficit when compared with 677 mm/ year normal atmospheric precipitation quantity), 2003 (rainfall deficit 244.2 mm) and 2011 rainfall deficit 181.5 mm). In the 11 years of studies there have been registered hail droppings, in the year 2004, phenomena which has contributed to the quality depreciation of the fruit production. Also in the year 2007 in the period of blossom there have been registered low temperatures (-2.8˚C) which have been contributed to the reduction of the fruit production. The growth and yield capacity of the fruits in the eleven years have been influenced by the age of fruit trees, by the rootstock-scion combination, training system and not least by the evolution of the climatic factors.

Key words: *apple, climate, drought, hail, temperatures*

INTRODUCTION

In the scientific world it is well known the fact that the climatic changes are the effect of global warming. According to the estimations of the weather forecasts, there have been presented in the frame of the 4th report of the International Committee for Climatic Changes in the year 2007, the whole Europe and implicit Romania will be confronted in future with a process of global warming, characterized by increasing of temperatures with -0.5 - 1.5 ^{o}C for the period 2020 – 2029 and with -2 – 5 ^{o}C for the period 2029 – 2099. In the period 2090-2099 Romania will confront with pronounced drought during the time of summer.

Researches from many countries, in the frame of climatic research methodology have the approached aspects regarding climatic changes effects on growth and development of some fruit tree species (Chmielewski and Rotzer et al., 2002; Olensen 2002;Sunley et al.2006, Chitu et al., 2010; Sumedrea et al, 2009). Climatic changes occurred also in Romania, they have determined meteorological phenomena, which are manifesting with augmented amplitude and intense frequency (severe drought, intense flooding, tornados, hail). Researchers are well aware of the danger which are produced by the climatic changes and the effect of these on agriculture products and even on the existence of populations with high impact risk (flooding, drought). The scientific world at global level and implicitly in our country is asking if there is something to do to temper or stop the negative effects of climatic changes. In this situation the acute question is: what helps more, the planting of trees or the adopting of modern innovative technologies in the fight against the negative effects of the global changes. The answer is just one. Both of the directions can contribute to the obtaining of viable solutions which could be used toward the negative effect of climatic changes. In this

context the fruit growing from Romania in the last 10 years has been confronted with fluctuations in the realization of the targeted fruit productions, due to the effect of negative climatic factors. The problem is that if fruit growers need to adapt the fruit growing technologies to the different climatic conditions of present days it is a challenge how to realize this and face this situation. It is about problems of great economical effects, because the fruit growing activity represents an important sector of the agriculture and the effects of drought are reflected directly on the dimensions of fruits, on the quality of fruits, contributing in a great deal to the destination of the fruit processing industry where acquisition prices are of low level.

The meteorological forecasts for the next years are indicating an increase of the frequency of drought years for which we are asking: the climatic factors what impact will have on fruit yielding, especially effects of drought in Romania on quantitative and qualitative level in the conditions in which fruit orchards with localized drip irrigation are less and are representing low surfaces. In this situation the technologies need to be reorganized and adapted to the cultivation of fruit trees from Romania in the context of appearing of the negative climatic changes, denoting the proper rootstock- scion combination, mechanical soil cultivation techniques which need to contribute to the maintaining of water in soil and the promotion of these systems capable to face the effects of negative climatic changes.

MATERIALS AND METHODS

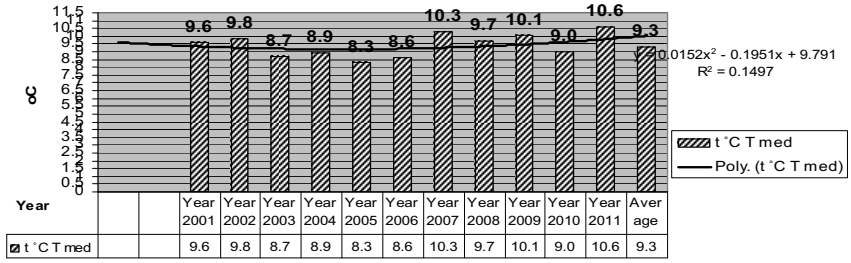
In the multi-annual experience during 2001-2011 there have been taken into study th following apple varieties Florina, Generos, Auriu de Bistrita resistant or tolerant to scab (Venturia inaequalis), and grafted on rootstocks M9 and MM 106. Main climatic indicators have been registered at the agrometeorological weather station "Agroexpert" localized at the Fruit Research and Development Station Bistrita during the time period 2001-2011.

The analyzing of climatic data targeted the scientific indicators, durable and relevant criteria for the characterization of the area in perspective of climatic global changes. The climatic factors are influencing and directly conditioning the vegetative and fruiting phenophases of the fruit species. The determinant factor for the apple culture is the thermal resource for the development if vegetative and fruiting organs. The main analyzed factors were annual average temperature of air, maximum and minimum temperatures of air, rainfall and relative humidity. There have been effectuated a series of biometrical analyses regarding the yield obtained per tree, per hectare. The finality of the researches was concretized in the elaboration of a real technical-economical report between the reference resources which have a direct consequence on the production and fruit quality.

RESULTS AND DISCUSSIONS

In the Table 1 and Fig. 1 it is presented the average climatic descriptors in the last 10 years during 2001-2011. From the analyses of these factors results that the average annual temperature on 10 years was 9.4 ^{o}C being observed an increasing of the temperature level by 1.5 ^{o}C when comparing with multi-annual average of 7.9 ^{o}C for Bistrita region calculated for the time span of 1961-1990 (Table 1).

Fig 1. Annual average temperature registered at the agrometeorological weather station at SCDP Bistrita during the period 2001 – 2011



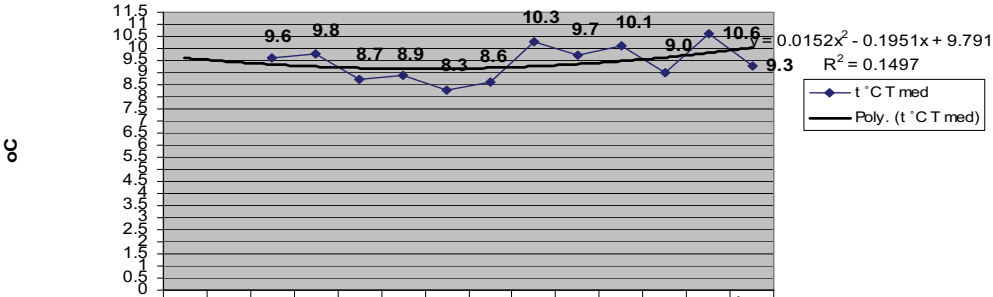
Year			Year 2001	Year 2002	Year 2003	Year 2004	Year 2005	Year 2006	Year 2007	Year 2008	Year 2009	Year 2010	Year 2011	Aver age
t °C T med			9.6	9.8	8.7	8.9	8.3	8.6	10.3	9.7	10.1	9.0	10.6	9.3

In the analyzed period during 2001-2011 the average annual temperature on 10 years had an increasing tendency with high temperatures values in 2007 (10.3 ^{o}C) and 2009 (10.1 ^{o}C) (Fig. 1). The first period of the analyzed time span presented values between 8.3-9.8 ^{o}C (2001-2007) and there was observed a relatively constant warming in the beginning (9.6 -9,8 ^{o}C) with an inflection of could effect in 2005 (8.3 ^{o}C) (Fig 2).

Analyzing Fig. 2 it is shown that the dynamics of warming process has an intense increase tendency starting with 2007 (10.3 ^{o}C), 2008 (9.7 ^{o}C), 2009 (10.1 ^{o}C), 2010 (9.0 ^{o}C), 2011 (10.6 $^{\circ}$C) , in conclusion four years of severe warm effect being observable.

Maximum temperatures influence shows a clear tendency of temperature increasing process especially in the final time periof of 2001-2011, years in which the maximum air temperature registered values over 13.9 $^{\circ}$C the calculated average maximum temperature for time period 1961-1990 were 2001, 2002, 2003, 2007, 2008, 2009, 2010 (Fig. 3). Unusual high absolute maximum temperatures were recorded as well in years 2007 (36.0 ^{o}C), 2009 (34.3 ^{o}C), 2010 (33.8 ^{o}C) (Fig. 4). Dynamics of absolute maximum temperatures is shown in Fig. 5.

Fig 2. Dynamics of the average temperatures registered at the agrometeorological weather station at SCDP Bistrita during the period 2001 – 2011



Anul			Year 2001	Year 2002	Year 2003	Year 2004	Year 2005	Year 2006	Year 2007	Year 2008	Year 2009	Year 2010	Year 2011	Aver age temp
t °C T med			9.6	9.8	8.7	8.9	8.3	8.6	10.3	9.7	10.1	9.0	10.6	9.3

Table 1. Climatic factors registered at the agrometeorological weather station at Fruit Research Development Station Bistrita in the period 2001-2011

Year	Average temperature of air [°C]		Temperature Difference [°C]	Maimum temperature of air [°C]		Temperature Difference [°C]	Minimum temperature of air [°C]		Temperatur e Difference [°C]	Sum of rainfall amount [mm]		Temperature Difference [mm]
	Value of the analysed year	Reference value	Value of the analysed year – Reference value	Value of the analysed year	Reference value	Value of the analysed year – Reference value	Value of the ana-lysed year	Refe-rence value	Value of the analysed year – Reference value	Value of the analysed year	Refere nce value	Value of the analysed year – Reference value
Year 2001	9.6	7.9	1.7	14.4	13.9	0.5	5.3	2.8	2.5	826.1	677	149.1
Year 2002	9.8	7.9	1.9	14.6	13.9	0.7	5.5	2.8	2.7	558.5	677	-118.5
Year 2003	8.7	7.9	0.8	14.4	13.9	0.5	3.9	2.8	1.1	432.8	677	-244.2
Year 2004	8.9	7.9	1	13.4	13.9	-0.5	3.9	2.8	1.1	690.7	677	13.7
Year 2005	8.3	7.9	0.4	13.4	13.9	-0.5	3.7	2.8	0.9	909.9	677	232.9
Year 2006	8.6	7.9	0.7	13.6	13.9	-0.3	4.1	2.8	1.3	914.4	677	237.4
Year 2007	10.3	7.9	2.4	15.2	13.9	1.3	5	2.8	2.2	1044.2	677	367.2
Year 2008	9.7	7.9	1.8	15	13.9	1.1	4.8	2.8	2	809	677	132
Year 2009	10.1	7.9	2.2	15.9	13.9	2	4.8	2.8	2	706.7	677	29.7
Year 2010	9.0	7.9	1.1	15.7	13.9	1.8	2.3	2.8	-0.5	954.2	677	277.2
Year 2011	10.6	7.9	2.7	16	13.9	2.1	4	2.8	1.2	495.5	677	-181.5
Average values	9.4	7.9	1.5	14.7	13.9	0.8	4.3	2.8	1.5	758.4	677.0	81.4

Fig 3. Annual maximum temperature registered at the agrometeorological weather station at SCDP Bistrita during the period 2001 – 2011

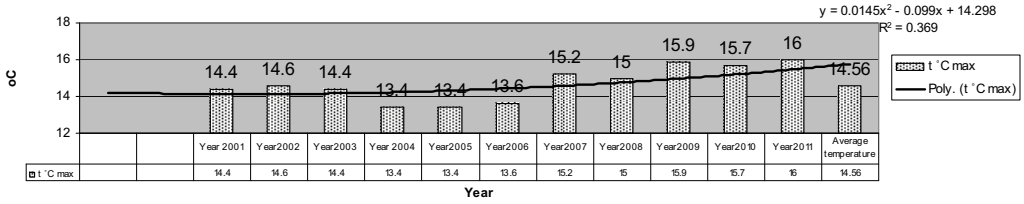


Fig 4. Annual absolute maximum temperature registered at the agrometeorological weather station at SCDP Bistrita during the period 2001 – 2011

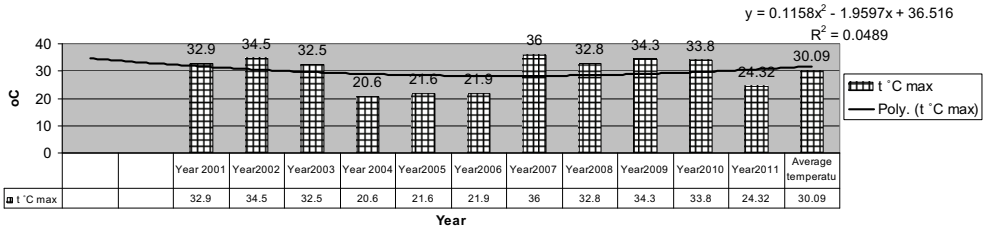


Fig 5. Dynamics of annual absolute minimum temperature registered at the agrometeorological weather station at SCDP Bistrita during the perioad 2001 – 2011

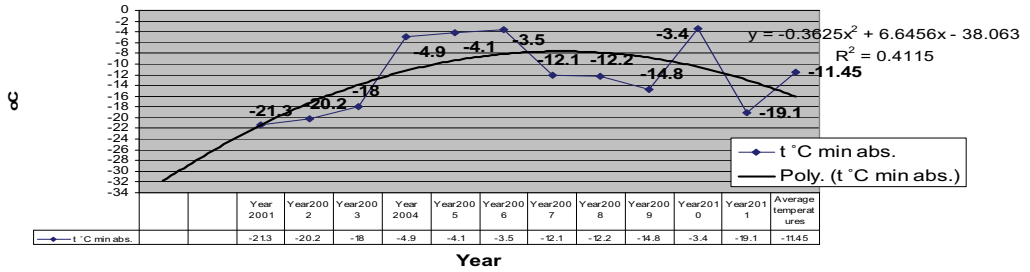
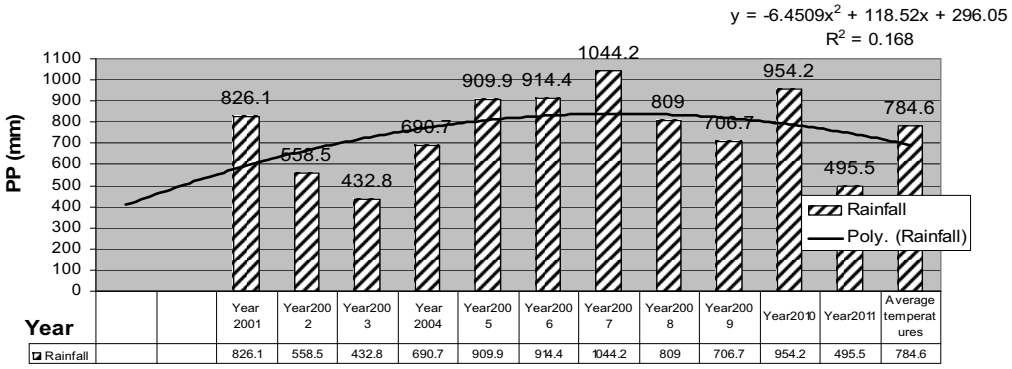


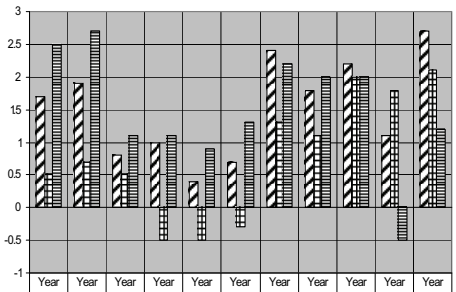
Fig 6 . Rainfall recorded at the agrometeorological weather station at SCDP Bistrita during the period 2001 – 2011



In the analyzed time period average minimum temperatures have increased, the recorded minimum temperature 4.3 ˚C increased when compared with the multiannual value of 2.8 ^{o}C calculated for the reference period 1961-1990, the difference being 1.5 ^{o}C. In the 10 years studied the winter periods were generally mild , with low level snow fall.

Rainfall level analysis (Fig 6) during the time period 2001-2011 revealed the fact that the amount of rainfall was in the frame of 432.8 mm-1044 mm, with a minimum in 2003 and a maximum in 2007. Analyzing Fig. 9 it is shown that there were several years with serious water deficits especially in the years 2002 (-118.5 mm), 2003 (-244.2) and 2011 (-181.5) (Fig. 8, 9). The tendency of water deficit is accentuated in the first and last part of the time period 2001-2011, rainfall graph line shows an increased deficit in 2002, 2003 and 2009.

Fig. 7 Temperature differences between the refrence values and the recorded value



	Year 2001	Year 2002	Year 2003	Year 2004	Year 2005	Year 2006	Year 2007	Year 2008	Year 2009	Year 2010	Year 2011
Average temperature of air oC Differences Recorded value-Refrence value	1.7	1.9	0.8	1	0.4	0.7	2.4	1.8	2.2	1.1	2.7
Maximum temperature of air oC Differences Recorded value-Refrence value	0.5	0.7	0.5	-0.5	-0.5	-0.3	1.3	1.1	2	1.8	2.1
Minimum temperature of air oC Differences Recorded value-Refrence value	2.5	2.7	1.1	1.1	0.9	1.3	2.2	2	2	-0.5	1.2

Average temperature of air oC Differences Recorded value-Refrence value
Maximum temperature of air oC Differences Recorded value-Refrence value
Minimum temperature of air oC Differences Recorded value-Refrence value

Fig 8. Differences between the refrence value and the recorded rainfall level at SCDP Bistrita

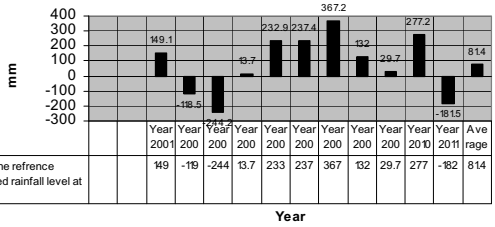
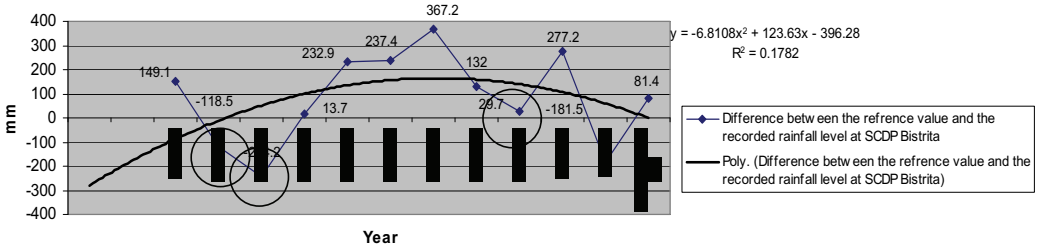


Fig 9 - Rainfall difference between the refrence value and the recorded rainfall level at SCDP Bistrita

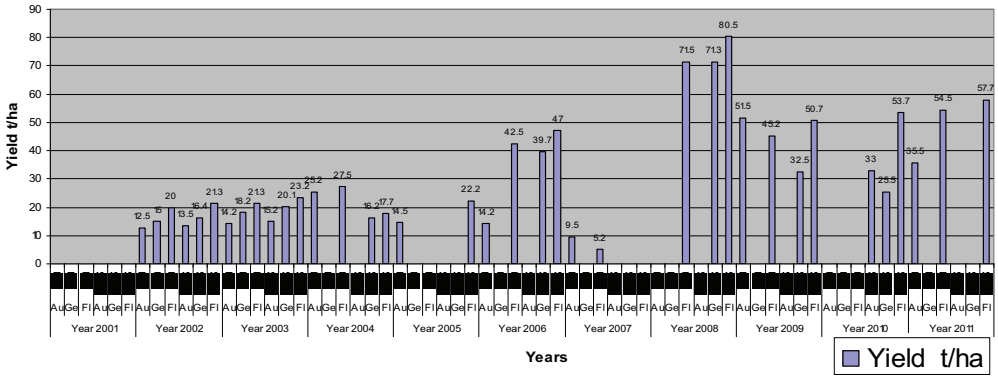


Increased air temperatures recorded during 2002, 2003, 2009 have influenced the phenomena of increased evapotranspiration from soil, which negatively influenced the normal physiological processes of the fruit tree metabolism. The accentuated drought was characterized during the summer period June-August which negatively influenced the development of fruits with direct effect on the quantitative and quality characteristics.

Technologies recommended in the drought period were localized drip irrigation where it could be effectuated (high density apple orchard of 2.0 ha), fruit tree nursery (rootstock seedlings plot and second year grafted seedlings plots). In other orchard plots

there have been recommended effectuation of soil cultivation techniques (ploughing along the fruit tree rows) for the interruption of water capillarity in the soil in order to maintain the water in the soil.

Fig.10 Yield capacity of some aple varieties cultivated in high density system during 2001-2011 at SCDP Bistrita



Fruit productions at the rootstock combinations taken into study in the 10 experimental years have fluctuated according to age of trees, bearing capacity kg / tree, training system and not ultimately de variation of climatic factors. Data presented in Fig.11 shows that the yields have increased year by year, with the exception of 2007 when in the first period of the month may in the period of blooming there have been registered -2.8 oC and the flowers were affected by frost. Improved yield capacity have been registered at the beginning of the 6th year after planting when there have been obtained at a density of 2500 tress/ha 42.5 to/ha at cultivar Florina grafted on M29 and 47 to/ha at the same variety grafted on M26.After the 7th year of planting until the 10th year after planting the recorded fruit yields have increased. There have been observed high rated capacities at Florina/M26 (80.5 t/ha) and Florina/M9 (71.5 t/ha). In the years with high yield capacity the climatic factors were favorable from the point of view of thermal and rainfall meteorological indicators (Fig. 2). At other rootstock-variety combinations Generos and Auriu de Bistrita grafted on rootstocks M9 and M26 the fruit yields had a fluctuation tendency. In the favorable years the fruit productions have achieved the values of 33.0 to/ha-51,5 to/ha at Auriu de Bistrita and 25.5 to/ha (2010) and 71.3 to/ha (2008) at cultivar Generos.

CONCLUSIONS

Growth and yield capacity of trees was influenced in the period 2001 and 2011 beside the fruit growing technology also by the evolution of climatic factors. The effects of drought has influenced the fruit production quantitatively and qualitatively through an increase of medium and little sized fruits in the years 2002 (118.5 mm rainfall deficit when compared with 677 mm/ year normal rainfall quantity), 2003 (rainfall deficit 244.2 mm) and 2011 (atmospheric rainfall deficit 181.5 mm). In the 11 years of studies there have been registered hail droppings, in the year 2004, phenomena which has contributed to the quality depreciation of the fruit production. Also in the year 2007 in the period of blossom there have been registered low temperatures (-2.8 ^{o}C) which have been contributed to the reduction of the fruit production. The growth and yield capacity of the fruits in the eleven years have been influenced by the age of fruit trees, by the rootstock-scion combination, training system and not least by the evolution of the climatic factors.

REFERENCES

[1] Chiţu, E., Elena Mateescu, Andreea Petcu, Ioan Surdu, Dorin Sumedrea, Tănăsescu Nicolae, Cristian Păltineanu, Viorica Chiţu, Paulina Mladin, Mihail Coman, Mădălina Butac, Victor Gubandru, 2010. *Metode de estimare a favorabilităţii climatice pentru cultura pomilor în România*. Editura INVEL Multimedia, CNCSIS accredited, ISBN 978-973-1886-52-7.

[2] Chmielewski, F.M., Rotzer, T., 2002. *Annual and spatial variability of the beginning of growing season in Europe in relation to air temperature changes*. Climate Research, Vol.19:257-264.

[3] Olensen, J.O., Bindi, M., 2002. *Consequences of climate change for European agricultural productivity, land use and policy*. European Journal of Agronomy, 16, 239–262.

[4] Sunley R.J., Jones H.G., Atkinson C.J. and Brennan R.M., 2006. *Phenology and yield modelling: the impacts of climate change on UK blackcurrant varieties*. Journal of Horticultural Science and Biotechnology 81: 949-95.

[5] Sumedrea D., Tănăsescu N., Chiţu E., Moiceanu D., Marin Fl., Cr., 2009. *Present and perspectives in Romanian fruit growing technologies under actual global climatic changes*. Scientific Papers of the Research Institute for Fruit Growing Pitesti, Vol. XXV, ISSN 1584-2231, Editura INVEL Multimedia, Bucureşti: 51-86.

Scientific Papers, Series B, Horticulture, Vol. LVI, 2012
CD-ROM ISSN 2285-5661, ISSN-L 2285-5653

INFLUENCE OF BUD LOAD FOR TWO ROMANIAN TABLE GRAPES CULTIVARS IN THE CLIMATIC CONDITIONS OF STEFANESTI VINEYARD

Cristian POPESCU

University of Pitesti, 1 Targu din Vale, 10040, Pitesti, Romania, Phone: +40 348-453100, Fax**:** +40 348-453123,

Corresponding author email: christian_popescu2000@yahoo.com

Abstract

The cultivated grapevine (Vitis vinifera L.) is a fruit crop of enormous economic importance with over eight million hectares planted in vineyards worldwide. Table grapes and wines represent a considerable share of the economy in many grape and wine-producing countries. The purpose of this study is to evaluate the effect of bud load on qualitative and quantitative table grapevine parameters. We study the influence of bud load by implementation of three experimental variants: 22 buds/vine, 26 buds/vine and 30 buds/vine. The experimental plant material consisted of table grapes Romanian cultivars of the Victoria and Coarna Neagra. We analyzing the influence of bud load on coefficients of fertility, productivity indices, sugars accumulation in berries grape, titratable acidity of must (g L^{-1} H_2SO_4), gluco-acidimetric index, cluster weight (g), yield per plant (kg vine $^{-1}$). Content of sugars was determined by refractometer. Titratable acidity (g L^{-1} sulphuric acid) was determined by titrating 0.1 N NaOH. Data is analyzed using analysis of variance (Duncan) by SPSS 16.0 for Windows programme. Differences are considered significant a 5% level of probability. The statistical analysis will be performed separately for each parameter. Regarding the results achieved for sugars accumulation at Victoria cultivars the best influence was represented by experimental variant with 22 buds/vine (149 g L^{-1}). In all variants the value of sugars was lower for Coarna Neagra than Victoria cultivar. Total acidity had a higher value for both cultivars under the influence of 30 buds/vine.

Key words**:** *acidity, bud load, sugars, table grapes, yield*

INTRODUCTION

The grapevine *(Vitis vinifera* L.*)* belongs to the family Vitaceae, which comprises about 60 inter-fertile wild Vitis species distributed in Asia, North America and Europe under subtropical, Mediterranean and continental–temperate climatic conditions [1]. The cultivated grapevine *(Vitis vinifera L.)* is a fruit crop of enormous economic importance with over eight million hectares planted in vineyards worldwide. Table grapes and wines represent a considerable share of the economy in many grape and wine-producing countries. Fruit quality is determined by the genotypic component of the cultivar as well as environmental and cultural management conditions.

Berry size at harvest depends on many factors which modify berry growth at any stage of development, mainly environmental conditions [2], mineral nutrition [3], fruit load [4], leaf area [5] and water status [6]. Sugar accumulation depends on many factors such as light [7], temperature, mineral nutrition [3], carbohydrate level in the permanent structures of the plant [8], leaf area [5], fruit load [4].

The aim of this work is to evaluate the effects of bud load on the vegetative growth, yield, sugars concentration in berries grapes, titratable acidity of must, grape quality in order to optimize the quality and quantity of grape yield in two Romanian cultivars, cv. Victoria and cv. Coarna Neagra grown under Stefanesti vineyard conditions.

MATERIAL AND METHOD

The purpose of this study is to evaluate the effect of bud load on qualitative and quantitative table grapevine parameters. We study the influence of bud load by implementation of three experimental variants: 22 buds/vine (V1), 26 buds/vine (V2) and 30 buds/vine (V3).

The experimental plant material consisted of table grapes Romanian cultivars of the Victoria and Coarna Neagra.

We analyzing the influence of bud load on coefficients of fertility, productivity indices, sugars accumulation in berries grape, titratable acidity of must (g L^{-1} H_2SO_4), *gluco-acidimetric index*, cluster weight (g), yield per plant (kg vine $^{-1}$). Content of sugars was determined by refractometer. Titratable acidity (g L^{-1} sulphuric acid) was determined by titrating 0.1 N NaOH. Data is analyzed using analysis of variance (Duncan) by SPSS 16.0 for Windows programme. Differences are considered significant a 5% level of probability. The statistical analysis will be performed separately for each parameter.

RESULTS AND DISCUSSIONS

The coefficient of absolute fertility had a higher value for both cultivars under the influence of 30 buds/vine (fig. 1). This indicator decreased while the bud load value increased.

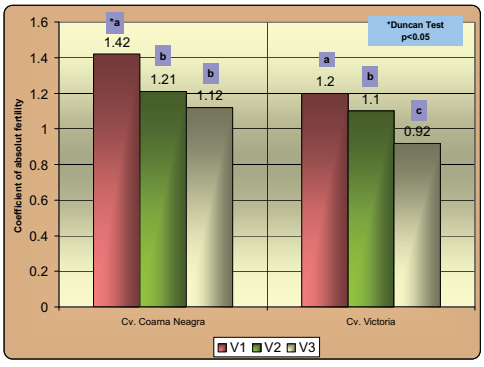


Fig. 1. Coefficient of absolute fertility

The coefficient of relative fertility had values between 0,55 and 0,64 in cv. Coarna Neagra and between 0,78 and 1,1 in cv. Victoria (Fig. 2). Statistical analyses showed that between values registered for Cv. Victoria exist significant differences ($p<0.05$) (Fig. 2).

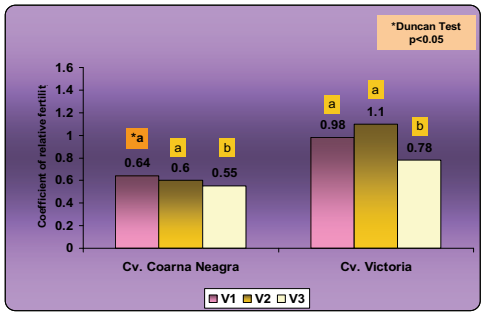


Fig. 2. Coefficient of relative fertility

Index of relative productivity decreased while the bud load value increased, the higher value being obtaining under the influence of 22 buds/vine (Fig. 3). Cv. Victoria had the higher value in case of load with 26 buds.

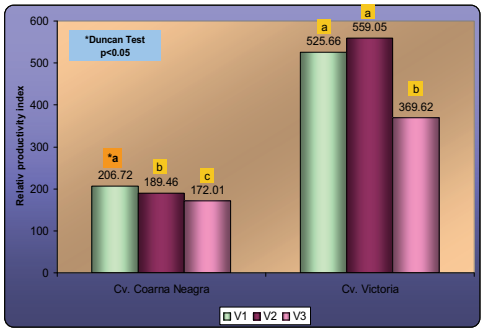


Fig. 3. Relative productivity index

The best value of absolute productivity index was registered in Cv. Victoria (663,66) for a load with 22 buds per vine (Fig. 4).

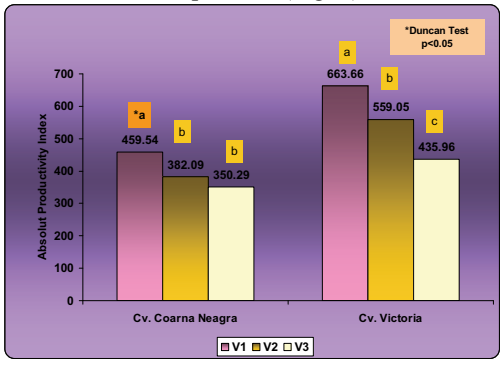


Fig. 4. Absolute productivity index

The average of cluster weight for Cv. Coarna Neagra had values between 312,76 g and 323,62 g and the statistic interpretation don't show significant differences under the influence of 26 and 30 buds per vine (Fig. 5). The average of cluster weight in. cv. Victoria decreased meanwhile the load buds increased.

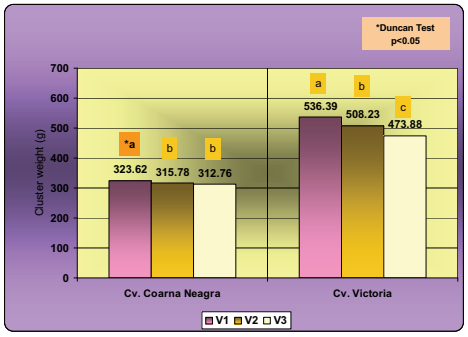


Fig. 5. Average cluster weight (g)

Yield grapes per plant (kg vine^{-1}) increased from the lower load buds to higher load buds experimental variant and the results achieved had significant differences using statistic analyse (Fig. 6). This situation was observed for both cultivars.

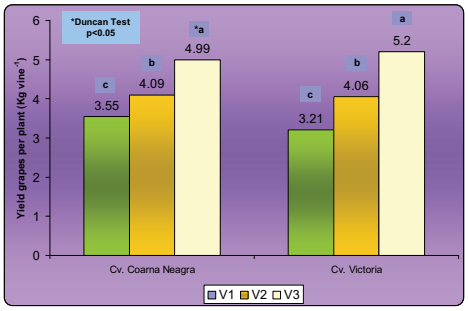


Fig. 6. Average yield grapes (kg vine -1)

Total titratable acidity had a higher value for both cultivars under the influence of 30 buds/vine (Fig. 7). This indicator which is responsible for quality of grape yield was increased meanwhile number of buds per plant increasing.

In all variants the value of titratable acidity was higher for cv. Coarna Neagra than cv. Victoria.

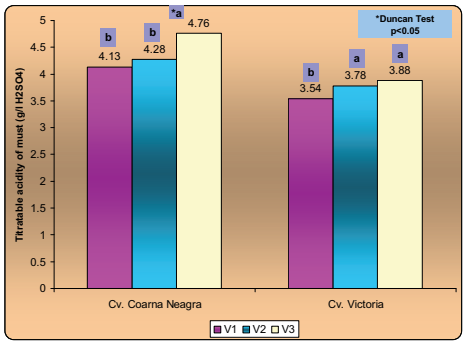


Fig. 7. Titratable acidity

The quality of grapes is influenced by the sugars concentration in berries grapes. Regarding the results achieved for sugars accumulation at Victoria cultivar the best influence was represented by experimental variant with 22 buds/vine (149 g L^{-1}) (Fig. 8).

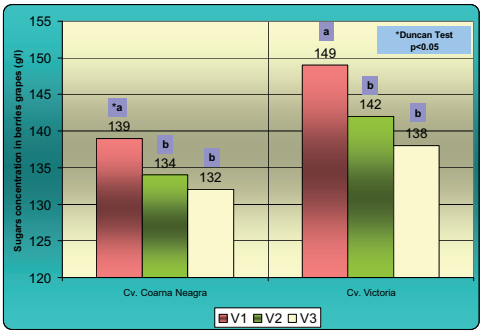


Fig. 8. Sugars concentration

Gluco – acidimetric index is given by the ratio of concentration in sugars and total acidity. This indicator has recorded the best results under the influence of experimental variant with the lowest number of buds. Increasing the number of buds led to decreased gluco-acidimetric index. Cv. Victoria recorded higher values than cv. Coarna Neagra (Fig. 9).

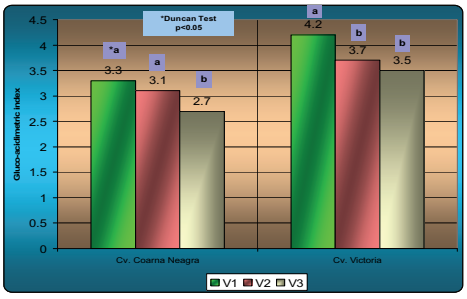


Fig. 9. Gluco – acidimetric index

CONCLUSIONS

The coefficient of absolute fertility had a higher value for both cultivars under the influence of 30 buds/vine.

Yield grapes per plant (kg vine^{-1}) increased from the lower load buds to higher load buds experimental variant and the results achieved had significant differences using statistic analyse.

Total titratable acidity had a higher value for both cultivars under the influence of 30 buds/vine.

Regarding the results achieved for sugars accumulation at Victoria cultivar the best influence was represented by experimental variant with 22 buds/vine (149 g L^{-1}).

REFERENCES

[1] Terral, F.J., Tabard, E., Bouby, L., Ivorra1, S., Pastor, T., Figueiral, I., Picq, S., Chevance, J.B., Jung, C., Fabre, L., Tardy, C., Compan, M., Bacilieri, R., Lacombe, T., This, P., 2010, Evolution and history of grapevine (Vitis vinifera) under domestication: new morphometric perspectives to understand seed domestication syndrome and reveal origins of ancient European cultivars. Annals of Botany 105, p. 443–455.

[2] Dokoozlian, N.K., Kliewer, W.M., 1996, Influence of light on grape berry growth and composition varies during fruit development. J. Am. Soc. Hort. Sci. 121, p. 869–874.

[3] Ussahatanonta, S., Jackson, D.I., Rowe, R.N., 1996, Effects of nutrient and water stress on vegetative and reproductive growth in Vitis vinifera L. Aust. J. Grape Wine Res. 2, p. 64–69.

[4] Dokoozlian, N.K., Hirschfelt, D.J., 1995, The influence of cluster thinning at various stages of fruit development on flame seedless table grapes. Am. J. Enol. Viticult. 46, p. 429–436.

[5] Candolfi-Vasconcellos, M.C., Koblet, W., 1990, Yield, fruit quality, bud fertility and starch reserves as a function of leaf removal in Vitis vinifera—evidence of compensation and stress recovering. Vitis 29, p. 199–221.

[6] Medrano, H., Escalona, J.M., Cifre, J., Bota, J., Flexas, J., 2003, A ten-year study on the physiology of two Spanish grapevine cultivars under field conditions: effects of water availability from leaf photosynthesis to grape yield and quality. Funct. Plant Biol. 30, p. 607–619.

[7] Dokoozlian, N.K., Kliewer, W.M., 1995, The light environment within grapevine canopies. II. Influence of leaf area density on fruit zone light environment and some canopy assessment parameters. Am. J. Enol. Viticult. 46, p. 219–226.

[8] Sommer, K.J., Clingeleffer, P.R., 1995, Vine canopy development and carbohydrate partitioning is influenced by pruning. In: Proceedings of the Ninth Australian Wine Industry Technical Conference, Winetitles, p.123–127.

Scientific Papers, Series B, Horticulture, Vol. LVI, 2012
CD-ROM ISSN 2285-5661, ISSN-L 2285-5653

EVOLUTION RESEARCH ON THE INFLUENCE OF MICORRHIZA ON CULTURE OF WATERMELONS WITH PLANTS GRAFTED ON SANDY SOILS FROM SOUTHERN OLTENIA

Iulian RĂȚOI[1], Vasile TOMA[1], Mihaela CROITORU[1], Nicolae LASCU[2], Valerian HĂNESCU[2], Emanuela Cristina VLADU[2]

[1]Research–Development Centre for Agricultural Plants on Sands – Dăbuleni, Street Victoriei, 130, Code 207220, Dăbuleni, County Dolj, Romania. Tel. 040 251 334 402, e-mail: ccdcpndabuleni@yahoo.com
[2]Faculty of Agriculture and Horticulture, Craiova

Corresponding author email: iulianratoi@yahoo.com

Abstract

Treatment of the soil with micorrhizal fungi on plants directly from the experimental field not led to higher levels of production instead when the inoculation is done directly in the hotbed there have been large increases in production. The production was dependent of the dose of inoculum, 33.1% in the case of inoculation with 50 micorrhizal spores to 10 grams of soil, and 73,1% in the case of inoculation with 100 micorrhizal spores to 10 grams of soil. Inoculation with fungi micorrhizal has proved to be beneficial and of average weight fruit. The spore of weight of fruit from the treated variants comparative untreated variant is the effect of arbusculare micorrhiza, which enhancing the ability of absorption, but also the quantity of nutrients, led to an acceleration of the photosyntetic process and default to shorten the length of maturity of the fruit. The rate of colonization in the case of variants with the inoculation of micorrhizal fungi was associated with organic fertilisation and was much reduced comparative to the untreated variant.

Key words**:** *grafting, micorrhiza, sandy soils, watermelons.*

INTRODUCTION

The role of arbusculare micorrhiza in the life of plants grown was the attention of many researchers **[**Abbott LK, Robson, 1982 AD.].
Research on the use of arbusculare micorrhiza in organic cultivation technology of watermelons on sandy soil could not effectuated in our country. The results of the world had other objectives and focused on other species and other conditions ecopedoclimatical **[**N.C. Schenck, 1984; N. C. Schenck, Yvonne Perez, 1988].
From previous research has shown that organic substance in the soil, which is more than 1% concentration, influenced negative the effect of arbusculare micorrhiza **[**Aliasgharzadeh et al., 2001; Mohammad et al., 2003; Mathur et al., 2007] and large concentrations of potassium from manure, slowing translocation carbohidrates in plants **[**Saint-Étienne et al., 2006].
Cavagnaro Tr., et. al., 2003; Javot h., 2007, were occupied by the study of the relationship between micorrhiza and nutrients from the soil and have reported the existence of negative correlations induced on the relationship of phosphorus and nitrogen micorizale mobile in organic and mineral fertilisers but whose strength is over 10-15% from phosphorus and nitrogen in soil naturally existing, and Daniela Popa et al., 2007, studied the rate of colonization of micorrhiza species *Glomus intraradices*. Also, Daniela Popa et al., 2008, tried to stabilise the heaps of slag and ashes by using micorrhizal fungi.

MATERIAL AND METHOD

Research has effectuated in the period 2009-2011. In 2009 the inoculation of spores was made directly to the experimental field, at 30 days from planting. The results obtained in the first year of experimentation determined the modification of experimental variants. Thus, in the years 2010 and 2011 inoculation made at seedling, after grafting and before the planting in the field.

Experimental variants in 2009

V1-unfertilized, untreated control;
V2-micorrhizal treatment;
V3-30 t/ha of manure treatment + micorrhizal treatment;
V4-60 t/ha of manure treatment + micorrhizal treatment;
V5-ground treatment with Maxiroot 10 l/ha;
V6- micorrhizal treatment + treatment by Maxiroot 10 l/ha.

Experimental variants in 2010 and 2011

V1-unfertilized, untreated control;
V2-unfertilized, + 1 * dose treatment;
V3-unfertilized + 2 dose treatment ;
V4. 30 t/ha of manure + treatment + 1 dose;
V5. 30 t/ha of manure + treatment dose 2 dose.
* 1 Dose has a concentration of inoculum with 50 micorrhizal spores to 10 grams of soil, and 2 doses has a concentration of inoculum with 100 micorrhizal spores to 10 grams of soil. Species of micorrhizal fungi was *Glomus intraradices*.
Experience has been placed by the method of randomized blocks, in 4 repetitions. Experimental plot area is 18 m^2. Hybrids of watermelons were *Montana F1* in year 2009 and *Lady F1* in the 2010 and 2011 years. Grafting is done in splinter on the rootstock *Macis F1*.
Planting grafted seedlings was age 35 days and the number of plants/ha was 5555, distances between rows was 1.8 m and 1 m between plants. For the prevention and control of major diseases were made 4 treatments with Cu SO_4, 0.5% and has been applied to a number of 8 irrigation in the 2009 and 2010 years and 4 irrigation in 2011 year, with rules of watering 300 m^3/ha.

REZULTS AND DISCUSSIONS

In the experimental conditions of 2009, soil treatment with micorrhizal fungi on plants directly from the experimental field has not increased production level, aspect highlighted by comparing the production obtained in untreated variant and treated variant with micorrhiza, dealt with loss of production as a result of treatment with micorrhiza was 4.9 t/ha but in comparison to treated variants with *Maxiroot* and *Maxiroot + micorrhizal fungi*, in which their application has led to a loss of production of 2 .5 t/ha (table 1).

Table 1.Production of watermelons with grafted plants function of fertilized and treatments with micorrhizal fungi (2009 Year)

Variant	Production		Difference	Signification
	t/ha	%	t/ha	
Unfertilized, untreated (Wt.)	32,0	100,0	Mt.	Mt.
Treatment with micorrhizal fungi	27,1	84,7	-4,9	-
30 t/ha manure + micorrhizal fungi	52,5	164,1	+20,5	***
60 t/ha manure + micorrhizal fungi	60,2	188,1	+28,2	***
Treatment with Maxiroot at soil, 10 l/ha	38,0	118,7	+6,0	-
Micorrhizal fungi + treatment with Maxiroot at soil, 10 l/ha	35,5	110,9	+3,5	-

Dl 5% 8,8 Dl 1% 12,6 Dl 0,1% 18,6

Productions were made dependent on the level of organic fertilization and they confirmed the results obtained from the experience on organic fertilization. The largest production (60.2 tonnes/ha) was obtained from the hybrid *Montana F1* by the 60 t/ha of manure, spore of production compared to the untreated, control variant of 28.2 t/ha and 7.7 t/ha compared to organic fertilized variant with 30 t/ha manure.
Results for the 2010 and 2011 years production and years average (tables 2, 3 and 4) were encouraging in that regard the use of micorrhiza to watermelons culture be grafted but also contradictory concerning to the organic fertilization. By inoculation with micorrhizal fungi at seedlings in the 2010 year, the year with the least favourable climatical conditions for plants of watermelons, recorded increases of production compared to untreated and unfertilized variant. The production rise was dependent upon the dose of inoculum, 33.1% being for 1 dose and 73.1% for dose 2. Beneficial effect of micorrhiza disappears or is greatly diminished when injecting is associated with fertilization. Inoculation of the root system at seedling stage proved to be the best in comparison with inoculation in the field.
The treatment of micorrhizal fungi has reduced the effect of 30 t/ha of manure, aspect found in 2011. In the second year of experimentation because to climatical conditions, level of production was higher than that of the 2010 year.

Table 2. Production of watermelons with grafted plants function of fertilized and treatments with micorrhizal fungi (2010 Year)

	Production		Difference t/ha	Signification
	t/ha	%		
Unfertilized, untreated (Wt.)	17,1	100,0	Mt.	Mt.
Unfertilized+treatment with 1 dose	22,9	133,9	+5,8	-
Unfertilized+treatment with 2 dose	29,6	173,1	+12,5	**
30 t/ha manure+ treatment with 1 dose	17,1	100,0	-	-
30 t/ha manure+ treatment with 2 dose	20,6	120,4	+3,5	-

Dl 5% 8.6 Dl 1% 12.0 Dl 0,1% 16.7

Table 3. Production of watermelons with grafted plants function of fertilized and treatments with micorrhizal fungi (2011 Year)

Variant	Production		Difference t/ha	Signification
	t/ha	%		
Unfertilized, untreated(Wt.)	50,7	100,0	Wt.	Wt.
Unfertilized+treatment with micorrhiza 1 dose	47,1	92,8	-3,6	-
Unfertilized+treatment with micorrhiza 2 dose	60,5	119,3	+9,8	-
30 t/ha manure+ treatment with 1 dose	51,5	101,5	+0,8	-
30 t/ha manure+ treatment with 2 dose	52,6	103,7	+1,9	-

DL 5% 12,8

One dose of inoculum was not sufficient to increase production, but by doubling the dose has been reported an increase in production by 9.8 tonnes/ha (19.3%) as compared to untreated variant. It is found and this time that treatment with spores of the genus *Glomus intraradices* micorhrizal in seedling stage with organic fertilization associated with 30 t/ha of manure does not have the effect of increasing the level of production. The results of two years of experimentation to support growth of watermelons production using the micorrhiza to grafted plants. Inoculation in seedling stage with larger doses of inoculum (2 dose) determined a spore of production by 33.0% (11.2 tonnes/ha), compared with untreated and unfertilized variant.

Table 4.Production of watermelons with grafted plants function of fertilized and treatments with micorrhizal fungi (Average years 2010-2011)

Variant	Production		Difference t/ha	Signification
	t/ha	%		
Unfertilized, untreated(Wt.)	33,9	100,0	Wt.	Wt.
Unfertilized+treatment with micorrhiza 1 dose	35,0	103,2	+1,9	-
Unfertilized+treatment with micorrhiza 2 dose	45,1	133,0	+11,2	-
30 t/ha manure+ treatment with 1 dose	34,3	101,1	+0,4	-
30 t/ha manure+ treatment with 2 dose	36,6	107,9	+2,7	-

Dl 5% 10,7 Dl 1% 14,4

Inoculation with micorrhizal fungi has proved to be beneficial and of average weight of fruit, in all experimental variants (Table 5).

All these results we consider particularly valuable and will form new points of departure for increasing the rate of inoculation, the best moments and association with different doses of fertilizer. Weight rises made by fruit of the following treaties to control them and explaining variant as arbusculare micorrhiza which effects, enhancing the ability of absorption, but also the quantity of nutrients, led to an acceleration of the process photosynthetic and default to shorten the length of maturity of the fruit. The results of chemical analysis carried out on samples average fruits of watermelons in all experimental variants are given in table 6 and relations of interdependence between variations of these chemical compounds are highlighted the significance of simple correlation coefficients in table 7.

In principle, the relations of the correlation coefficients exposed are those expected, so variations in concentrations of total soluble substance (Brix) are heavily influenced by the variation of dry and grey and the default variations that influence calcium accumulation and significant positive changes in the levels of ash in the ratio of 94,09% (r = 0,97). Also, significant positive influences are variations of calcium (r = 0.75) and high (r = 0.67) over acidity changes.

Table 5. The weight average fruit of watermelons with grafted plants function of fertilization and treatments with micorrhizal fungi (Years 2010-2011)

Variant	Fruit average weight	
	(Kg)	**(%)**
Unfertilized, untreated (Wt.)	5,816	100,0
Unfertilized+treatment with 1 dose	6,106	104,9
Unfertilized+treatment with 2 dose	6,490	111,5
30 t/ha manure+ treatment with 1 dose	6,272	107,8
30 t/ha manure+ treatment with 2 dose	5,896	101,3

Table 6. The results of chemical analysis effectuated at edible part of fruit at watermelons in harvesting moment

V*	Brix Brix	Dry substance (g%g fresh substanc)	Cinders	Ca	Acidity **	K
			(mg %g fresh substance)			
1	6,52	7,67	52,75	5,94	56,42	8,44
2	7,43	8,34	59,6	7,4	58,22	9,6
3	8,57	9,53	62,6	7,71	58,3	10,48
4	6,66	8,12	57,82	7,14	59,21	11,37
5	6,63	8,18	58,37	7,21	59,02	11,46

* Variant

**Acidity is expression in mg citric acid/100 g fresh substance

Based on correlation coefficients, the most significant, were considered regression curves of these interdependence. Thus, in the case of total soluble solids in relations with independent total dry matter, the values of experimental data obtained in repetition of variants V2 and V3 (micorrhizated with doses of 50 and 100 spores to grow 10 g soil) are distributed on the upper slope of regression curves (Fig. 1).Experimental data values recorded variations micorrhizated and organic fertilized, V4 and V5, it is situated on the inferior slope of the regression curves, in the immediate vicinity of the cloud of points representing the values of version control.

The rate of colonization in the case of variants with the inoculation of micorrhizal fungi was associated with organic fertilisation was much reduced compared to the unfertilized variant. As a result of the lack of performance in the case of variant production may be fertilized on account of adverse effects induced by some elements of the manure on the rate of colonization and the symbiotic process by reducing the rate of multiplication of micorrhizal spore grains.

Table 7. Coefficients to simple correlation between chemical compounds chemical analysated in fruits of watermelons

	Brix	Dry substance	Cinders	Ca	Acidity	K
Brix	1,00					
Dry substance	0,95	1,00				
Cinders	0,80	0,89	1,00			
Ca	0,65	0,76	0,97	1,00		
Acidity	0,12	0,30	0,61	0,75	1,00	
K	0,04	0,31	0,53	0,62	0,67	1

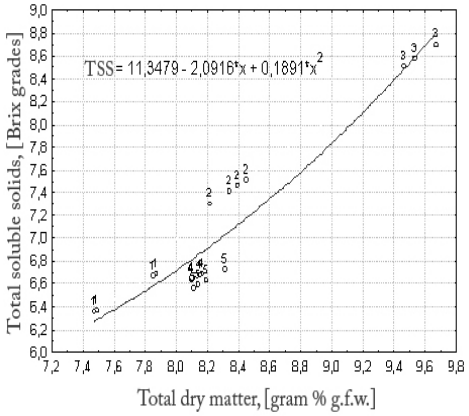


Fig. 1. Function and curve regression interlinkages Brix-SU

The same researchers have reported the existence of negative correlations induced on the micorrhizal relationship of phosphorus and mobile nitrogen from organic and mineral fertilisers where the concentration exceed 10-15% from phosphorus and nitrogen in soil. From the economic point of view, by reducing costs due to the supply and implementation of fertilizers, these issues seem to be encouraging as regards the use of micorrhizal fungi in biological culture of watermelons.

Calcium is extremely important for maintaining of shoots vigour, stalks and stems of plants and the same time reconciled nutrient absorption through membrane by the cellular plasma (Bennett, W.F., 1996). Contribute to the development and cell division and, most importantly, there is a positive nitrogen metabolism and translocation of carbohidrates processes, solving such requirements and default processes photosynthetic micorrhizal

fungi growth needs in glucose metabolism. Calcium can be considered as part of the cell wall that connects through a process of making from carburising steels a significant factor of vigour and increase the storage period of the fruit of watermelons. At least in the case of watermelons, the viability of plants is closely linked to their concentration in calcium.

CONCLUSIONS

1. Vesiculare-arbusculare micorrhiza has positive effects in the intensification of processes of plant growth and development of watermelons.
2. The most difficult but also the most important inoculation process is the optimal timing of inoculation, which has implications for the speed and degree of colonization of roots. This ecotechnology has never been tested (in the world) on watermelons, the results of these experiments are essential in determining stages of technological process. This research has established that inoculation of seedlings before planting with increased doses (100 spores to 10 g soil), determine the best rate of colonization with favourable implications on production of watermelons.
3. The species *Glomus intraradices* fungal used in this study convinced the vasculare effects of arbusculare micorrhiza on intensification metabolic processes of plants colonized harsh conditions, particularly in sandy land. As a result, micorrhiza has resulted in getting production increases of 33% compared to version unfertilized and untreate
4. Micorrhiza can be applied in the field of culture and be as generally of all horticultural plants with all the benefits that brings with it. Applicability of this colony does not refer strictly to the horticultural production but in its quality, protection of plants and even to maintain the health of the soil, these are a few aspects to which micorrhiza, can be raised to the rank of eco-technology.

This research emphasized the need to decrease the dosage of organic fertilization when used associate the micorrhiza with organic fertilizers. Results from the need to retain the control of calcium/potassium ratio in favour of calcium, which favours the maximum levels of carbohydrates collections, collections with major implications for the quality of water-melons but very favorable and sustainability colony of micorrhiza.

REFERENCES

[1] Abbott LK, Robson AD., 1982 - *The role of vesicular arbuscular mycorrhizal fungi in agriculture and the selection of fungi for inoculation*. Aust J Agric Res 33:pp.389–408.

[2] Aliasgharzadeh N., Saleh Rastin N., Towfighi H., Alizadeh A., 2001 – Occurence of arbuscular mycorrhizal fungi in saline soils of the Tabriz plain of Iran in relation to some physical and chemical properties of soil. Mycorrhiza 11:pp. 119-122.

[3] Cavagnaro TR, Smith FA, Ayling SM, Smith SE., 2003 - *Growth and phosphorus nutrition of a Paris-type arbuscular mycorrhizal symbiosis*. New Phytol 157(1):pp.127–134.

[4] Javot H, Pumplin N, Harrison MJ, 2007 - *Phosphate in the arbuscular mycorrhizal symbiosis: Transport properties and regulatory roles*. Plant Cell Environ 30(3):pp.310–322

[5] Mathur N., Singh J., Bohra S., Vyas A., 2007 – Arbuscular mycorrhizal status of medicinal halophytes in saline areas of Indian Thar Desert. International Journal of Soils Sciense 2, pp. 119-127.

[6] Mohammad MJ., Hamad SR., Malkani HI., 2003 – Population of arbuscular mycorrhizal fungi in semi-arid environment of Jordan as influenced by biotic and abiotic factors. Journal of Arid Environments 53 : pp. 409-417.

[7] Popa Daniela, V.Hănescu, M. Coyne, 2007 - *Study of the colonization rate with Glomus intraradices to the plants of Phaseolus vulgaris, cultivated on the ashes dumps.* Analele Universităţii din Craiova, vol.XXXVII/A, pp. 322-325.

[8] Popa Daniela, Hănescu V., Grebenişan Irina, Câmpeanu Carmen, Constantin Carolina, Apostol Tiberiu, 2008 - *Aplicaţii ale proceselor micorizale în stabilizarea haldelor de zgură şi cenuşă*, Editura Universităţii din Craiova

[9] Saint-Etienne L., Paul S., Imbert D., 2006 – Arbuscular mycorrhizal soil infectivity in a stand of the wetland tree Pterocarpus officinalis along a salinity gradient. Forest Ecology and Management 232: pp. 86-89.

[10] Schenck N. C., 1984 – Methods and Principles of Mycorrhizal Research. Published by The American Phytopathological Society, 3340 pilot knob Road, Sf. Paul, Minnesota 55121, USA.

[11] Schenck N. C., Yvonne Perez, 1988 – Manual for identification of VA mycorrhizal fungi. Second edition. INVAM 1453 Field Hall, University of Florida, Gainnesville, Florida 32611.


EX·TERRA·AVRVM

Scientific Papers, Series B, Horticulture, Vol. LVI, 2012
CD-ROM ISSN 2285-5661, ISSN-L 2285-5653

RESEARCHES ON THE IMPACT OF CHEMICAL FRUIT THINNING WITH ETHREL UPON MINERALS' CONTENT IN FRUITS OF SOME PEACH AND NECTARINE VARIETIES CULTIVATED IN PERIAM, TIMIS COUNTY

Beatrice SARKADI (MĂGURAN), Olimpia IORDĂNESCU

[1]Banat's university of Agricultural Sciences and Veterinary Medicine, Faculty of Horticulture and Forestry, Fruit Culture Department, Calea Aradului 119, 300645, Timisoara, Romania,
Phone: 0256 277006, fax: 0256 277263, bmaguran@yahoo.com, olimpia.iordanescu@yahoo.com

Corresponding author email: bmaguran@yahoo.com

Abstract

Peaches have a complex chemical composition, among all known components they contain 0.30-0.65 g total minerals, of which magnesium, calcium and iron being predominant, but also manganese, copper and zinc. The high content of vitamins, organic acids, manganese and potassium salts, which help in cardiac, vascular and renal diseases, and the richness of monosugars, compounds of copper, cobalt and calcium, which help in anaemia, liver diseases and obesity, all these make peaches and nectarines very important and special fruits. This article deals with the impact of chemical thinning with Ethrel in different concentrations upon the content of minerals in fruits, meaning: magnesium, iron, cobalt, manganese, copper and zinc. Data were collected in 2006 from an orchard in Periam locality, Timis County, where there are cultivated 2 varieties of peach – Spring Lady and Maja, and 2 nectarine varieties – Caldesi 2000 and Nectaross. The trees were planted at a distance of 4.0 x 2.5 m, having a density of 1000 trees/ha and the crown system is Palm Spindelbusch. The soil was maintained clean by mechanical hoes and Roundup 360 SL herbicide. Chemical thinning with Ethrel was done at 25 days after fruit binding, moment when the ovule (the future stone) had 10-12 mm, being done in four different concentrations: 125 ppm, 250 ppm, 350 ppm and 500 ppm. The results obtained showed that the content of metals in fruits varied from one variant to another, but the values did not surpass the maximum limits. The best results for each variety were obtained in those variants where thinning was done in concentrations of 250 ppm, 350 ppm and 500 ppm, but these values correlated with other physical-chemical features and the productions obtained, determine us to recommend for chemical thinning the use of Ethrel in concentrations of 250 ppm or 350 ppm.

Key words**:** *chemical thinning, chemical composition, metals, nectarine, peach*

INTRODUCTION

Peaches have a complex chemical composition, among all known components they contain 0.30-0.65 g total minerals, of which magnesium, calcium and iron being predominant, but also manganese, copper and zinc. The high content of vitamins, organic acids, manganese and potassium salts, which help in cardiac, vascular and renal diseases, and the richness of monosugars, compounds of copper, cobalt and calcium, which help in anaemia, liver diseases and obesity, all these make peaches and nectarines very important and special fruits [2].

In the category of minerals, or metals, there take part several elements, which by over passing the maximum admissible limits can be very toxic to organisms. Under this limit, minor minerals like copper, cobalt, iron, zincous, manganese or magnesium, which can be found in aliments, fruits and vegetables are essential components of some proteins involved in metabolism, having a favourable impact upon human organism. Otherwise, one can suffer of nutritional deficiencies [4].

Fruit thinning, as mentioned before, is necessary to obtain superior quality fruits, which are uniform as size and well coloured [3]. This operation is done after 15-30 days from fruits binding with the substance Ethrel (ethephon) 120-180 mg/l or 250-500 ppm completed by manual thinning before stone's strengthening, the effect being satisfying after 2-3 weeks. Thinning's intensity depends on the

fruit load, the planting system, the variety and fruits' size [6].

MATERIAL AND METHOD

This experiment was placed in a private orchard at about 60 km far from Timisoara, in Periam locality, Timis County. This area is very know in the western part of Romania as being favourable for peach culture and it has a long tradition in this culture. So, we can affirm that the culture area is favourable for this species considering its' climatic and soil's features.

The biological material consisted of two peach varieties: *Spring Lady* and *Maja* and two nectarine varieties: *Caldesi 2000* and *Nectaross*, planted at the distance of 4 x 2.05 m, giving a density of 1000 trees/ha. The crown system adopted for these trees was simple palmet, which has the spindle easily inclined on the tree row direction and garnished with middle branches and fructification branches. This crown system also has two main branches directed on the tree row, also garnished with middle branches and fructification branches.

In the orchard the soil was maintained clean by ploughing in autumn or early spring at 18-22 cm depth between the tree rows, and in the vegetation period there were done 3-4 disc tillages. On the tree row the soil was kept clean of weeds with Roundup (3-4 l/ha) and fertilised with chemical fertilizers in approximate doses of: 90-100 kg/ha N, 60-80 kg/ha P_2O_5 and 100-120 kg/ha K_2O. Water supply was assured by 2-4 watering, according to the rainfall quantities and the phytosanitary treatments were done according to the prognosis of pests and diseases attacks, normally being done 8-12 treatments/year.

In this article we present the chemical thinning with Ethrel done in 2006 for all four varieties using four concentrations:

V1 – 125ppm
V2 – 250ppm
V3 – 350ppm
V4 – 500ppm
V5 – Not thinned, control variant

The treatment was done 25 days after fruit binding, when the ovule (next stone) had 10-12 mm.

Fruits' quality was determined under two aspects: the physical features (big diameter – D, small diameter – d, height – H, size index – Is and weight of peaches) and the chemical features (dry soluble substance, sugars content, acidity and sugar-acidity index, metals' content).

Minerals were determined by calcinations of 3g of pulp at 600^{o}C, the ash being cooled afterwards at room temperature, and then treated with HCl 10% [1].

By spectrophotometry there were determined: cobalt, manganese, copper, zinc, magnesium and iron.

RESULTS AND DISCUSSIONS

Iron and copper have a beneficial role for the human body, in participating in the synthesis of normal blood cells roandi. Iron is an essential nutrient for living organisms, needed to make hemoglobin, the myoglobin, and enzymes. Copper, cobalt, manganese and vitamin C are necessary for iron to be assimilated in plant products (fruits, vegetables, grains), because this metal is essential for the metabolism of vitamin B. Copper is the basic component of the exterior of epithelial nerve fibers, collagen, the most important element of protein structure greatly influences the body and skin pigment production.

Zinc helps in stimulation of nerve and muscle, but and the immune system. Has the particularity to participate in the formation of over 200 different types of enzymes. Zinc vegetable protein can be used properly by the body compared to that of animal protein.

Manganese participates in many functions in human body. In the first phase acts as a coenzyme, and this facilitates many metabolic processes in the body. Benefits of manganese in the body are numerous. It is involved in bone formation, participates in thyroid functions in connective tissue formation, and is involved in the functions of sex hormones in calcium absorption, in normalizing blood sugar levels in immune function and the metabolism of fat and carbohydrates [5].

In 2006, for Spring Lady variety, metals' content for each mineral did not surpass the maximum admissible limit. For manganese, this

mineral ranged from 0.005% in the control variant and V1 up to 0.008% in variant 4. Iron varied from 4.00 ppm (V5- control variant) to 4.80 ppm (variant 4), while the content of cobalt was of 0.09 ppm in the control variant and of 0.14 ppm in variant 4 (Table 1 and Fig. 1).

Table 1. Fruits' metals content (ppm) for Spring Lady variety

Variant	Mg %	Fe ppm	Co ppm	Mn ppm	Cu ppm	Zn ppm
V1-125ppm	0.005	4.20	0.10	0.27	0.18	0.10
V2-250ppm	0.006	4.50	0.11	0.29	0.22	0.12
V3-350ppm	0.006	4.60	0.12	0.33	0.23	0.13
V4-500ppm	0.008	4.80	0.14	0.35	0.21	0.12
V5-Not thinned - control	0.005	4.00	0.09	0.18	0.19	0.10

Manganese ranged from 0.18 ppm (variant 5 – not thinned) and 0.35 ppm (variant 4) and copper from 0.18 ppm (variant 1) up to 0.23 ppm in variant 3. Zinc's content in Spring Lady peaches varied from 0.10 ppm (variants 1 and 5 – control) and 0.13 ppm (variant 3) (Table 1 and Fig. 1).

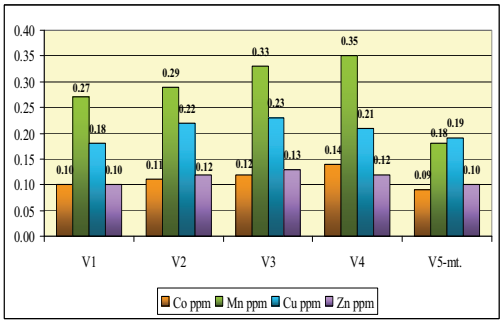


Fig.1. Fruits' metals content (ppm) for Spring Lady variety

For Maja peach variety, the same as for Spring Lady, metals' content for each mineral did not surpass the maximum admissible limit. For manganese, the values ranged from 0.003% in variant 1 up to 0.007% in variants 2 and 4. Iron varied from 4.10 ppm (V5- control variant) to 4.61 ppm (variant 4), while the content of cobalt was of 0.10 ppm in the control variant and of 0.14 ppm in variant 4 (Table 2 and Fig. 2).

Table 2. Fruits' metals content (ppm) for Maja variety

Variant	Mg %	Fe ppm	Co ppm	Mn ppm	Cu ppm	Zn ppm
V1-125ppm	0.003	4.22	0.12	0.24	0.19	0.11
V2-250ppm	0.007	4.40	0.11	0.26	0.20	0.13
V3-350ppm	0.006	4.61	0.13	0.29	0.20	0.12
V4-500ppm	0.007	4.60	0.14	0.33	0.22	0.12
V5-Not thinned - control	0.004	4.10	0.10	0.20	0.19	0.09

Manganese ranged from 0.20 ppm (variant 5 – not thinned) and 0.29 ppm (variant 3) and copper from 0.19 ppm (variant 1 and control variant) up to 0.22 ppm in variant 4. Zinc's content in Maja peaches varied from 0.09 ppm in variant 5 – control and 0.13 ppm in variant 2 (table 2 and Fig. 2).

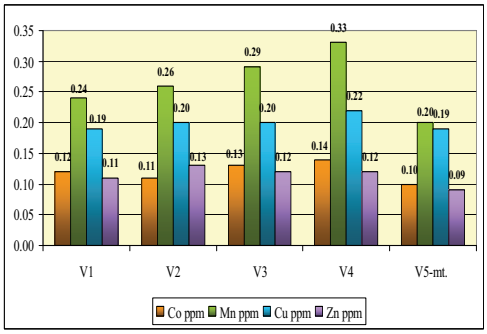


Fig.2. Fruits' metals content (ppm) for Maja variety

Considering minerals' content in nectarines, we can also affirm that for Nectaross variety, the same as for the other two peaches varieties, for each mineral the values did not surpass the maximum admissible limit. The content of manganese ranged from 0.004% in variant 5 up to 0.008% in variant 2, iron varied from 4.10 ppm (variant 1) to 4.40 ppm (variant 3), while the content of cobalt was of 0.11 ppm in the control variant and of 0.13 ppm in variant 4 and variant 1. Manganese ranged from 0.22 ppm (variant 5 – not thinned) and 0.29 ppm (variant 4) and copper from 0.19 ppm (control variant) up to 0.22 ppm in variant 4. Zinc's content in Nectaross nectarines varied from 0.10 ppm in variant 5 – control and in variant 3 and 0.12 ppm in variant 2 (Table 3 and Fig. 3).

Table 3. Fruits' metals content (ppm) for Nectaross variety

Variant	Mg %	Fe ppm	Co ppm	Mn ppm	Cu ppm	Zn ppm
V1-125ppm	0.005	4.10	0.13	0.23	0.20	0.11
V2-250ppm	0.008	4.30	0.12	0.26	0.21	0.12
V3-350ppm	0.006	4.40	0.12	0.28	0.20	0.10
V4-500ppm	0.007	4.30	0.13	0.29	0.22	0.11
V5-Not thinned - control	0.004	4.10	0.11	0.22	0.19	0.10

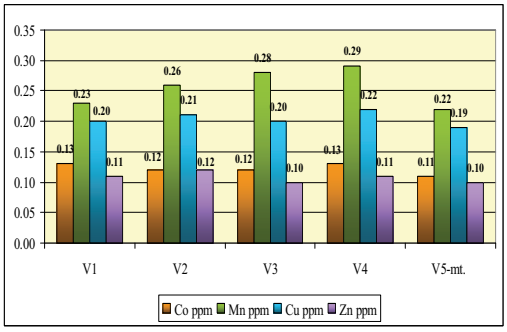


Fig.3. Fruits' metals content (ppm) for Nectaross variety

Metal's content was similar for Caldesi 2000 variety, in the sense that for each mineral the values did not surpass the maximum admissible limit. So, the content of manganese ranged from 0.004% in variant 5 up to 0.006% in variants 2 and 3, iron varied from 4.20 ppm (variant 5) to 4.40 ppm (variant 3), while the content of cobalt was of 0.12 ppm in the control variant and in variant 2 and of 0.14 ppm in variants 3 and 4. Manganese ranged from 0.22 ppm (variant 5 – not thinned) and 0.27 ppm (variants 3 and 4) and copper from 0.19 ppm (control variant) up to 0.21 ppm in variants 1, 2 and 4. Zinc's content varied from 0.09 ppm in variants 1 and 5 – control and 0.11 ppm in variant 4 (table 4 and figure 4).

Table 4. Fruits' metals content (ppm) for Caldesi 2000 variety

Variant	Mg %	Fe ppm	Co ppm	Mn ppm	Cu ppm	Zn ppm
V1-125ppm	0.005	4.30	0.13	0.24	0.21	0.09
V2-250ppm	0.006	4.30	0.12	0.26	0.21	0.10
V3-350ppm	0.006	4.40	0.14	0.27	0.20	0.10
V4-500ppm	0.005	4.30	0.14	0.27	0.21	0.11
V5-Not thinned - control	0.004	4.20	0.12	0.22	0.19	0.09

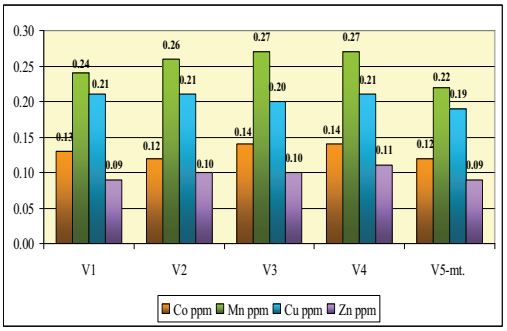


Fig.4. Fruits' metals content (ppm) for Caldesi 2000 variety

The results obtained showed that the content of metals in fruits varied from one variant to another, but the values did not surpass the maximum limits. The best results for each variety were obtained in those variants where thinning was done in concentrations of 250 ppm, 350 ppm and 500 ppm, but these values correlated with other physical-chemical features and the productions obtained – not presented in this article, determine us to recommend for chemical thinning the use of Ethrel in concentrations of 250 ppm or 350 ppm.

CONCLUSIONS

The differences between the four varieties are due to their genetical nature and maybe due to some phonological differences insufficiently approximated, while applying the thinning treatments.

Minerals content in peaches belonging to *Spring Lady* and *Maja* varieties and in nectarines of *Nectaross and Caldesi 2000* varieties did not over pass the maximum admissible limits, so that they are good and recommendable for organism.

By observing the two varieties of peach we can affirm that both of them are valuable for peaches cultivation, but in conditions of the culture area *Maja* variety remarked with higher contents of minerals (even though the values were close) than *Spring Lady*, while among nectarine varieties, the values obtained for each mineral was almost the same for *Nectaross* and *Caldesi 2000*, the differences being very small

Developing a research upon chemical thinning with Ethrel (ethephon) in different concentrations, determined us to recommend for commercial orchards the use of this substance in concentrations of 250 ppm (variant 2 in our experiment) or 350 ppm (variant 3 in our experiment).

This recommendation is done basing on the fact that using a lower concentration for chemical thinning the values obtained are almost similar to the ones from the not thinned fruits, even if the fruit load is smaller than in the not thinned trees – there is maintained a good balance in the tree so that it doesn't deplete and it is able to produce and carry fruit loads in the coming years. The sever thinning with 500 ppm ethephon is not recommended in commercial orchards because, even though the fruits are of superior quality, the productions are very damaged, being smaller with 2-3 times than the ones obtained in the not thinned variant.

ACKNOWLEDGEMENTS

This research work was carried out for the PhD Thesis entitled: *Researches on Fruits' Load Standardization of some Peach and Nectarine Varieties in Peariam Culture Area*.

REFERENCES

[1] Alexa Ersilia, 2003. *Contaminants in vegetal products*. Eurobit PH, Timişoara, Romania

[2] Drăgănescu Emil, 2006. *Fructele Terrei: alimente, medicamente, cosmetice*. Mirton PH, Timisoara

[3] Iordănescu Olimpia Alina, 2008. *Pomicultură*. Eurobit PH, Timişoara, Romania

[4] Lee Susan, 1990. *Metals in foods. A literature survey*. No.12. The British Food Manufacturing Industries Research Association. Surrey. United Kingdom

[5] Mayer Anne-Marie, 1997. *Historical changes in the mineral content of fruits and vegetables*. British Food Journal, 99/6: 207–211

[6] Stănică Fl., Branişte N., 2011. *Guide for Fruit Growers*. Ceres PH, Bucharest, Romania


EX·TERRA·AVRVM

Scientific Papers, Series B, Horticulture, Vol. LVI, 2012
CD-ROM ISSN 2285-5661, ISSN-L 2285-5653

GROWING TECHNOLOGY IMPLEMENTATION OF BLACK CURRANT VARIETIES FOR BERRIES PRODUCTION IN DISTRICT SOROCA, REPUBLIC OF MOLDOVA

Parascovia SAVA[1], Gh. BODIU[2]

[1] IP Scientific and Practical Institute of Horticulture and Food Technologies, Chisinau, 14, str. Costiujeni, MD-2019, Republic of Moldova, tel. + 373 69801776, psava2110@rambler.ru.
[2] Director of Agriculture Production Cooperative "Sagetatorul", Soroca, Republic of Moldova Phone: + 373 69326985

Corresponding author email: psava2110@rambler.ru

Abstract

The paper presents data on the implementation technology of black currant fruit Soroca, c. Niorcani, and cultivated varieties, which are good for mechanical and hand harvesting: Chentaur, Titania, Ben Alder. Parameters were established bushes and characteristic features of varieties for mechanical harvesting. The mechanical harvesting, with black currant harvester with the capacity to harvest a high productivity of 7-9 t / day of fruit and is served only three workers. The manual harvesting, each 85-100 workers are trained daily, which can harvest each 3.5 to 4.5 t/day of black currant fruit. The average yield obtained from varieties cultivated black currant reached at: Ben Alder -1.1 t/ha, Chentaur-2.6 t/ha, Titania - 1.9 t/ha.

Key words*: technology, black currents, variety, harvesting.*

INTRODUCTION

Black currant Ribes nigrum L. is a shrub with a height of 0.8 to 1.8 multi m starting to capitalize on the 2nd after planting. Time of ripening berries of black currant is the second half of June, depending on variety fructification length is average from14 to 20 days. Yield of studied varieties ranged from 0.96 t / ha (Iubileinaia) -6.72 t / ha (Kliymex). Fruit mass ranged 0.67 g (Iubileinaia) - 1.1 g (Compactnaia) [1].

Recommended planting distances of 0.8 to 1.2 m are in turn and 2.5 - 3 m between rows (3000-3300 plants / ha), the recommended plant species in plot 2-3 for a complete pollination. The governance bush plant, which is formed in 2-3 years after planting. Plant management is possible with trunk 20-40 cm, with a crown composed of 6-8 branches of skeleton, which support the trellis wires and installed at 40 cm from the ground. Productions are of 5-8 t / ha black currant, and duration of plantations reach 12-14 years [2].

If harvesting is done 5-7 days before the ideal point is determined differently for each variety, 30-36% of production is lost, don t get grains size characteristic of the variety. If the optimal maturity is exceeded, decrease the content of vitamin C and acids, and grains begin to fall or impaired [3].

Labour productivity depends on the crop harvesting and currant fruit maturation simultaneous. Manual harvesting allows for 7 hours harvesting 25 kg from a high to a low yield -10 kg. Table fruit is fully mature to their maximum. Harvesting is carried out in dry properly in the outer destination. Mechanized harvesting is possible with MPIA-1 in plantations combine with compact varieties, mechanical harvesting for the interval between rows of 2.5 to 3.0 m with an inclination of up to 5 degrees. Labour productivity is 0.53 ha / hour harvested 1.2 t / hour. Combine to serve 3 people. In comparison with mechanical harvesting the productivity increase of 73 times, by car ĂIAM-200-8 only 26 times. The term redemption of blueberry harvesting machine is 3.5 years. Full harvest is at 94-97% [4].

Densely plantations of black currant in the 0.6 to 1.0 m plant height ranged from 116-128 cm Lia plodorodnaia varieties, Pobeda. Width varies from 140-166 cm. La bush varieties

often located in all parameters were restricted and fan between the rows. The development located less had a more uniform crown [5].
Manual harvesting allows obtaining qualitative fruits, collected selectively in containers that can be marketed for fresh use, and the mechanized harvest is packed in boxes of 4-5 kg. Need on the manual labor force and high harvesting costs favored the development of mechanized method of harvesting. Mechanized harvesting of gooseberry fruits is based on the vibratory shake by suction in vacuum [6].

MATERIALS AND METHODS

Investigations on growth and productivity of black currant varieties under cultivation in the new production of fruit plantation which was established in 2002 in the North of Moldova were made in Soroca, c.Niorcani. In terms of production were studied three varieties of black currant: Chentaur (early variety), Titania, Ben Alder with a compact bush form that allows the practical application of mechanized harvesting and partly depending on conditions - manual. Planting Distance - 3.0 x 0.5 m. Cooperative Sagittarius - s.Niorcani, Soroca, established in 2002 a plantation of black currant on a surface of 50 ha with three varieties propductive: Titania-35 ha ha Centaur-10, Ben Alder-5 ha

RESULTS AND DISCUSSIONS

Conditions for the development of black currant in the North of Moldova is favorable due to the fact that rainfall is more common, amount that falls starts at falling from 550 mm to the northwest, and summer temperatures are lower by several degrees compared to area South of the country mean July temperature are 19.5 ° C (Briceni).
To establish a plantation of black currant fruit with the possibility of mechanized harvesting is necessary to choose the best varieties to meet the requirements for mechanical harvesting. Very important is that after the structure and volume bush varieties are compact, not scattered but erect, fruit clusters easy to break, tear be dry and be simultaneously baking, do not fall down to reach fruit maturity etc.

Fruits production obtained from black currant plantation on grown varieties are exposed in Table 1.

Table 1. Peculiarities of black currant varieties for mechanical harvesting, planting year 2002

Varietyplanting distance	Parametrii tufei bush parameters				degree of separation length	fall of the fruits	cluster length, cm
	h, m	l, m	L, m	bush volume,r			
3,0 x 0,7 m Centaur	1.10 1.11 1.13	0.65 1.04 0.83	1.30 1.07 1.05	0.93 0.97 0.98	medium	medium	5-6,high
average	1.11	0.84	1.14	0.96			
Ben Alder	0.87 0.79 0.76	0.65 0.64 0.82	0.91 0.81 0.73	0.51 0.41 0.45	medium	small	3, short
average	0.81	0.70	0.82	0.46			
Titania	1.51 1.51 1.46	0.85 0.86 1.15	1.80 1.49 1.60	2.31 1.93 2.69	medium	medium	4,medium
average	1.49	0.95	1.63	2.31			
Limit of variation	0.81-1.49	0.7-0.95	0.82-1.63	0.46-2.31			

According to data presented in Table 1 Height of black currant bushes ranging from 0.81 to 1.49 m within the parameters length varied between 0.7-0.95 m, width ranged from 0.82 to 1.63 m, bush volume ranged between values 0.46 to 2.31 m³. In studying the degree of detachment of the fruit clusters was found that the separation of studied variety Chentaur, Titania and Ben Alder are medium. Fruit fall to the variety Ben Alder is small, on the variety Chentaur and Titania are medium. The largest cluster of 5-6 cm length is on early variety Chentaur, the shorter is on the variety Ben Alder and on Titania is medium.
Harvesting of black currant is carried out by two methods: manual and mechanized.
For mechanical harvesting used several types of machines to each half of the entire row or each entire row.
Mechanized harvesting of black currant berries, is carried out by car type Polish, Jagoda, Jarek 5, which collects each bush half row (Fig. 1).

Fig. 1. Mechanized harvesting of black currant berries, is carried out by Polish type car

In cooperative mechanized harvesting Sagittarius black currant variety Titania is carried out by car type MKX English currant harvester that can harvest 3-4 hectares per day. Mechanized harvesting of berries of black currant variety Titania drive type English in Soroca, s. Niorcani, which collects each entire row (Fig. 2).

Fig. 2. Mechanized harvesting of berries of black currant variety Titania drive English type car, Soroca, s. Niorcani

Mechanized harvesting of black currant, variety Titania, is carried out by car type harvesters English currant MKX, which can harvest 3-4 hectares per day. Productivity harvesters of black currant berries can reach 7-9 t / day where only three workers involved in work. In the absence of labor in the plantations on large areas harvester has a unquestionable advantage. In a plantation of black currant berries with a yield of 3 t / ha recover investments made in purchasing harvesters can be done for 3-4 years. Simultaneously in plantation harvesting is carried out manually and black currant.

Manual harvesting is applied in variety Chentaur. Are involved in each daily harvest 85-100 workers, who can harvest each 3.5 to 4.5 t / day.

Price for 1 kg berries harvest ranges from 1.5 to 3.0 lei depending on the quality of harvesting and planting productivitaea. Labour productivity of a worker harvesting of black currant berries is 40-50 kg / day.

Productivity of black currant plantation depends on several factors that influence directly or indirectly. First is the significant influence of technological elements applicable maintenance capacities varieties used in plantations, pedo-climatic conditions, plant age, crop etc full record.

Planting varieties that are created or adapted to new conditions and expressed differently by crop cultivation has been obtained.

On the 2007-2009 years were drought years with high temperatures in summer and very rainy year 2010 was during the ripening of fruits which compromised the harvest of black currant. Fruits production obtained from black currant plantation on grown varieties are exposed in Table 2.

The highest harvest was obtained from variety Chentaur 3.2 t /ha in 8 th year after planting, with a decrease in the following year.

This is an early variety, and benefits for the marketing fresh. Titania is a good variety to variety mechanized harvesting, the harvest of lower (up to 2.5 t / ha in the 8th year after planting), but harvesting costs are considerably lower.

Table 2. The amount of fruits production in different black currants varieties, t/ha, 2004-2010

Variety	Year after planting							Ave-rage
	3	4	5	6	7	8	9	
Chentaur (timpuriu)	2.5	2.7	2.7	3.0	2.7	3.2	1.2	2.6
Titania	1.7	2.0	2.2	2.2	2.0	2.5	1.0	1.9
Ben Alder	1.0	1.2	1.2	1.3	1.0	1.2	0.5	1.1

Variety Ben Alder is a compact bush variety with a volume smaller than the other two varieties, harvested accordingly has a small (not exceeding 1, 3 t / ha in the 6 th year after planting), but can still be harvested mechanically.

CONCLUSIONS

In conclusion we can say that:
- Height of black currant bushes ranging from 0.81 to 1.49 m within the parameters length varied between 0.7-0.95 m, width ranged from 0.82 to 1.63 m, bush volume ranged between values 0.46 to 2.31 m³.
- Detachment degree of the fruit clusters was found that the separation of berry is medium on all studied variety.
- Fruit fall to the variety Ben Alder is small, on the variety Chentaur and Titania is medium.
- The largest cluster of 5-6 cm length is on early variety Chentaur, the shorter on the variety Ben Alder and Titania is medium.
- The implementation technology of black currant fruit in Soroca, Niorcani in terms of production allowed combining manual and mechanical methods of harvesting the cultivated varieties - Chentaur, Titania, Ben Alder.

-Mechanical harvesting, with black currant harvester, which has a harvest yield of 7-9 t / day of fruit and is served only three workers.
-Manual harvesting, each 85-100 workers are trained daily, which can yield many 3.5 to 4.5 t / day of black currant fruit - black currant average yield obtained from cultivated varieties: Ben Alder - 1.1 t / ha, Chentaur -2.6 t / ha, Titania - 1.9 t / ha.

REFERENCES

[1] Policarpov, Lilia., 1989. *Tehnologia cultivării arbuştilor fructiferi*. Chişinău, p. 34-44.
[2] Branişte, N., 2000. *Ghid pentru pomicultori. Cultura speciilor pomicole a arbuştilor fructiferi şi căpşunului în România.* Bucureşti, p.110-114.
[3] Chira Lenuța., 2000. *Cultura arbuştilor fructiferi*. Ed.IV, edit.M.A..T., Bucureşti, p.52-62.
[4] Glebova E., Mandrikina, 1984. Smorodina. Rosselizdat, s. 68-70.
[5] Pozdniacov A., 1985. *Smorodina*. Agropromizdat, s. 7-14.
[6] Trushecikin V., 1971. *Iagodnie custarnichi*. Izdat. Colos, Moscva, s. 55-57.

Scientific Papers, Series B, Horticulture, Vol. LVI, 2012
CD-ROM ISSN 2285-5661, ISSN-L 2285-5653

STUDY OF GOOSEBERRY VARIETIES IN DIFFERENT CULTIVATE CONDITIONS

Parascovia SAVA

IP Scientific and Practical Institute of Horticulture and Food Technologies, Chisinau, 14, str. Costiujeni, MD-2019, Republic of Moldova, tel. 00 373 69801776, psava2110@rambler.ru.

***Corresponding author email**:* psava2110@rambler.ru

Abstract

The paper The paper reflected the results of scientific investigations on productivity of gooseberry varieties Kolobok, Captivator, Grushenka, Sadko, Smena, Severni captan in different growing conditions in field during the years 2003-2006 on not irrigated field and 2007-2010 on irrigated field. Studied varieties have a few thorns, resistant on American powdery mildew, less resistant to bean and septoria, resistant to high and low temperatures, except less resistant varieties Grushenka and Smena on large heat. The average weight of gooseberry fruits, of studied varieties on non irrigated field ranged from 2.0 to 3.2 g, and on irrigated field ranged from 2.1 to 3.9 g. The average yield of studied gooseberry varieties - non irrigated field ranged from 1.2 to 14.6 t / ha and average yield on irrigated field ranged from 7.4 to 19.5 t / ha.

***Keywords*:** gooseberry, variety, fruits weight, yield, resistance, thorny.

INTRODUCTION

Culture of gooseberry is prized for entering early bearing, regular higher productivity, food quality and high herbal, fruits universal use. The content of pectin substances in fruit allows the list to include barberry ant radiate cultures. Productivity of the barberry plant is 1.5-2 kg in the 4-5 year after planting, 3-6 kg / bush - in the years when you can get 5-8 t / ha of fruit, and sometimes depending on the variety and respecting the maintenance of plant production technology of fruit produced can reach 12-15-20 t /ha [1, 2, 3, 4].

Gooseberry culture is profitable than the fruit yield more than 2.0 t / ha. Gooseberry varieties are classified into three groups: productive - with a crop of 4.0 to 6.0 t / ha, productive environment - with 2.0 to 4.0 t/ha and low productivity - under 2.0 t/ha [5].

Gooseberry fruit size although it is a trait characteristic of the variety, vary greatly depending on the year and largely depends on age, condition of plants and climatic factors of vegetation period [6].

Planting distances range gooseberry is 2.5 to 3 m between rows and 1.2 to 1.5 m at a time - for commercial plantations, and where no mechanical working range of lines can be used for shorter distances 1.5 m between rows and 0.7 to 1.0 m at a time - for gardens attached to houses but intensive plantations should be taken into account the fact that although the intensity of illumination in these cases is lower, the leaf surface small changes and plant yields are high [7, 8, 9].

MATERIAL AND METHODS

Investigations on the influence of growing conditions on plant development, production and fruits quality of introduced gooseberry varieties: Kolobok, Captivator, Grushenka, Sadko, Smena, Severni captain were made in plantations established in the experimental field of the Institute of Horticulture in the period 2003 - 2006 on land irrigated with planting distance 2.5 x 1.00 m and the distance from 2007 to 2010 on irrigated land 1.5 x 1.00 m planting The investigations were carried out according to established methods for studying the shrubs.

RESULTS AND DISCUSSIONS

Placing the responsive gooseberry variety to different conditions can cause a deviation of the degree of damage to plant diseases. If the favourable conditions for placing this kind can exist in the resistant varieties or disease that affects very little. The American origin varieties are resistant to mildew, while European origin varieties are strongly affects [1]. Study gooseberry varieties introduced during the years 2003-2010, allowed their determination as disease resistance, high temperature and low spiny and results are presented in Table 1.

Table 1. Adaptive qualities of studied gooseberry

Varieties	Resistance to disease		Resistance to high tempera-tures	Cold resis-tance	Thornes
	Powdery mildew disease	Bean, Septoria			
1.Kolobok	high	low	high	middle	low
2.Captivator	high	high	high	high	low
3.Grushenka	high	middle	low	middle	low
4.Smena	high	low	low	middle	low
5.Sadko	high	middle	middle	high	low
6. Severni capitan	high	high	high	high	low

According to the results obtained and presented in Table 1 the studied gooseberry varieties are appreciated by American mildew resistance with the highest grade, that are resistant. Resistance to bean and septoria is weakest on varieties Smena and Kolobok. Cold tolerance is good in all varieties. All studied varieties are with few thorns, allowing harvesting fruit without problems, thanks very small number of thorns on the branches.

Gooseberry culture is resistant to drought, but in exceptional cases to reduce the influence of high temperatures and lack of rainfall on fruit production is necessary to apply irrigation on plantation development in critical moments - intensive plant growth and fruit maturation, submission buds fruits.

Fruit weight varies under the influence of several factors: the ability of the variety, planting conditions for maintenance, weather conditions, which every year is different - with different amounts of rainfall and temperature values during the formation of fruit, plantation age etc.

Rainfall characteristic for period of research, years 2003-2010, is displayed in Table 2.

Table 2. Climatic conditions, rainfall (mm) in Republic of Moldova

month	2003	2004	2005	2006	2007	2008	2009	2010
I	56,1	87,8	37,9	38,6	44,3	25,8	24,7	86,3
II	22,6	97,9	111,4	18,4	62,2	5,8	35,5	61,5
III	12,4	31,0	14,8	89,1	33,7	35,6	70,8	29,0
IV	34,9	28,0	49,5	36,6	36,5	43,2	2,7	45,1
V	20,6	75,0	75,8	97,1	19,0	42,6	33,3	69,2
VI	21,6	11,0	104,8	81,6	23,7	62,8	39,0	85,0
VII	17,4	101,0	17,6	53,0	3,6	50,2	67,2	67,2
VIII	27,4	25,6	150,9	67,7	33,8	30,8	32,6	53,0
IX	52,7	69,6	4,9	57,8	24,8	77,7	21,7	46,7
X	62,1	33,4	11,0	13,6	71,0	16,0	29,6	68,9
XI	9,9	72,3	48,1	9,7	59,7	15,7	8,4	40,4
XII	38,7	19,3	33,6	1,0	62,1	54,3	89,1	82,9
Sum/ year	376,4	651,9	660.3	560	474,4	460,5	454,6	735,2

As shown in Table 2 during the research period (2003-2010) the driest year was 2003 with 376.4 mm precipitation and the wettest - in 2010 with 735.2 mm precipitation. Distribution of rainfall during the vegetation is not uniform. The largest amount of precipitation fell during the research in June (2005) value of 104.8 mm in July (2004) with 101 mm, August (2005) to 150.9 mm, in September (year 2008) to 77.7mm.

Some gooseberry varieties studied under cultivation without irrigation and with irrigation on intensive or rare plantations were influenced differently.

On fruits mass the studied gooseberry varieties are fall in three groups: large fruits - more than 4g, medium fruits -2.5 to 4.0 g, small fruits, up to 2.5 g [10].

Research conducted on assessing the average weight of fruit from studied gooseberry varieties during the 2003-2006 years on non irrigated field and in 2007-2010 years on irrigated field allowed to assess the impact of irrigation on fruit size, and the results were included in the table 3.

As shown in Table 3, gooseberry cultivars studied were assessed by the average weight of fruit produced on irrigated land ranged between 2.0 g and 3.2 g variety Severni captain to

variety Smena and maximum mass of 2, 3 g variety Grushenka and variety Smena 4.1 g.

Table 3. Fruit weight of studied gooseberry varieties on diferrent cultivate conditions,g

Varieties	Mean, non irigate field	Maxi-mum	Mean, irigate field	Maxi-mum	Comparative growth of fruit mass on irrigated land	
					average	maxi-mum
1.Kolobok	2,2	2,5	2,8	3,7	+0,6	+ 1,2
2.Capti-vator	2,4	2,8	3,9	4,2	+1,5	+1,4
3.Gru-shenka	2,1	2,3	2,1	2,2	0	+0,1
4.Smena	3,2	4,1	3,6	4,3	+0,4	+0,2
5.Sadko	2,9	3,5	3,3	4,4	+0,4	+0,9

The average weight of fruit, gooseberry bush varieties studied obtained irrigated land values ranged from -3.9 g 2.1 g and maximum fruit weight ranged from 2.2 g to 4.4 g. up. Based on the results obtained in studying varieties of gooseberry has been established that fruit can be classified according to weight into three groups with: large fruits - Captivator (3.9 g), Smena (3.6 g), Sadko (3.3 g), medium fruits - Kolobok (2.8 g), small fruits - Grushenka, Severni captain (2.1 g). Comparative growth of the fruits weight on non irrigated land in comparison with irrigated land, the varieties Grushenca, Severni captain did not deviate essentially only from 0 to 0.1 g and the weight on the other varieties increased from + 0.4 g and 1.5 g.

Gooseberry fruits harvest is influenced by several factors that have a role. In gooseberry intensive plantations plants per hectare increase allows the harvesting of plantations increased compared to normal, where coefficient use of land is much higher. Age size of plantation key influences the yield. Plant maintenance conditions plays an important role, which significantly influences the quantity and quality of the harvest obtained. Research on the maintenance of varieties in different conditions allowed us to obtain the results included in Table 4.

Table 4. Yield of studied gooseberry varieties on diferrent cultivate conditions, t / ha

Variety	Mean, non irigate field	Max-imum	Mean, irigate field	Maxi-mum	Comparative growth of fruit mass on irrigated field	
					average	maximum
1.Kolobok	**7,4**	9,6	**13,8**	24,0	**+6,4**	+14,4
2.Captivator	**5,5**	8,8	**19,5**	32,7	**+14,0**	+23,9
3.Grushenka	**1,4**	2,0	**7,4**	8,0	**+6,0**	+6,0
4.Smena	**5,2**	6,5	**9,3**	10,0	**+ 4,1**	+ 3,5
5.Sadko	**5,3**	7,2	**9,5**	19,3	**+4,2**	+12,1
6.Severni capitan	**13,2**	20,8	**18,6**	25,3	**+5,4**	+4,5

Gooseberry varieties studied on irrigated land, according to the results presented in Table 4, can be classified into three categories of productivity: low productivity, productive and highly productive. The first category refers to variety Grushenca that does not support moisture deficit and high temperatures fall low on water and fruit affected by heat. Average yield obtained from this variety is - 1.4 t / ha. Productive varieties, which gave a fruits harvest from 4.2 t / ha up to 5.5 t / ha are Captivate (5.5 t / ha), Sadko (5.3 t / ha), Smena (5,2 t / ha).Highly productive varieties with the fruit production more than 6 t / ha are Severni captan (13.2 t / ha), Kolobok (7.4 t / ha). Maximum obtained yield of fruit production varied from 2.0 t / ha (variety Grushenka) up to 20.8 t / ha (variety Severni captan).

According to research conducted established that the average yield of gooseberry studied varieties in irrigated field ranged from 7.4 to 19.5 years 2007-2010 t / ha and maximum yield from 8.0 to 32.7 t / ha.

On smaller areas is possible the gooseberry planting scheme rather chunky, where the distance between rows of plants can be reduced up to 1.5 m and between plants in turn, depending on the vigour of growth, characteristic of the variety. Drought resistance of gooseberry crops permit to obtain good and without irrigation, but if it is irrigated, crop increased considerably.

The most productive among the varieties studied are: Captivator, Severni capitan, Kolobok, corresponding on average yield reached to 19.5 t/ha, 18.6 t/ha, 13.8 t/ ha. Limit of the variation on the average yield of produced fruits was established between 7.4 t/ha and 19.5 t/ha. Among the studied varieties under cultivation without irrigation and with

irrigation, in intensive plantations or not the studied varieties were affected differently.
Average fruits yield of the studied varieties under irrigation deviated essentially. Harvest increased in all varieties, starting with + 4.1 t/ha on variety Smena and ending with 14.0 t/ha on variety Captivator. Maximum fruits production ranged from 3.5 up to 23.9 t/ha.

CONCLUSIONS

1. As a result of research conducted to study varieties Kolobok, Captivator, Grushenka, Smena, Sadko, Severni captan agreed that: 1. The varieties included in the study are weak barbed, are resistant on main disease affecting the gooseberry - American mildew, less resistant to bean and septoria, resistant to low temperature, to high temperatures are resistant, except varieties Grushenka and Smena that are more weaker.
2. Weight average of gooseberry fruits of studied varieties – in the non irrigated land ranged from 2.0 to 3.2 g and maximum mass from 1.5 g up to 4.1 g. On irrigated land ranged from 2.1 to 3.9 g and maximum weight ranged from 2.7 g to 4.4 g up.
The average weight of fruit in non irrigation conditions compared to irrigated land, only the varieties and Severni captan, Grushenka has deviated from 0 to +0.1 g only, whereas the other varieties studied the average weight increased from + 0.4 g up to +1.5 g.
3. The average yield of studied gooseberry varieties - in the non-irrigated field ranged from 1.2 to 14.6 t/ha and maximum yield from 3.4 to 20.8 t/ha – average yield on irrigated field ranged between 7.4 to 19, 5 t/ha and maximum yield from 8.0 to 32.7 t/ha;
Average fruit production under irrigation compared with irrigated land has increased in all studied varieties, starting with + 4.1 t/ha on variety Smena and ending with +14.4 t/ha on variety Captivator, and maximum between + 3.5 t/ha and +23.9 t/ha.

REFERENCES

[1] Sergheeva, C., 1989. *Crîjovnic.BO"Agropromizdat.* Moscкva, 1989,s. 37-39; s.58-66.
[2] Mladin, Gh., Mladin P. 1992. *Cultura arbuştilor fructiferi pe spaţii restrânse*. Bucureşti, p.135-149.
[3] Mihăiescu, G. 1977. *Pomicultura specială*. Bucureşti, p.326-328.
[4] Zazulina N., 2004. *Ishodnîi material dlia selecţii novîh sortov crîjovnica. Plodovodstvo. Iagodovodstvo na covremehhom etape. Плодоводство, Ягодоводство на современном этапе.* Naucn.trudî, т.15, Institut Plodovodstva NAN Belorusi, Samohvalovici, p.103-106.
[5] Zaletilo, A.1975. *Sortoizucenie crîjovnica v Severo-Kazahstanscoi oblasti*, VNIIS im. I.V. Miciurina, sb.n.r., vîp. 21, Miciurinsc, s. 43-47.
[6] Strelinicova V., 1971. *Pectinovîe veşcestva crîjovnica*. VNIIS im. I.V. Miciurina, sb.n.r., vîp. 15, Miciurinsc, s.181-186.
[7] Chira, Lenuţa. 2000. *Cultura arbuştilor fructiferi*. Editura M.A.S.T., Bucureşti, p. 72-79
[8] Hoza, D. 2000. *Cultura căpşunului, semi-arbuştilor şi arbuştilor fructiferi*. Bucureşti, p.184-224.
[9] Policarpov, L. 1989, *Tehnologia cultivării arbuştilor fructiferi*, Cartea moldovenească Chişinău, p. 126-131.
[10] Andruşchevici T., Dmitieva A. 2009. *Rezulitatî collecţionogo izucenia sortov crîjovnica*. 2006-2008. *Plodovodstvo i iagodovodstvo Rossii*. sb. n. r., tom 22, ciasti 1. Izdatelischii Dom MSP. GNU ISTISP. Moscva, s.200-205.

Scientific Papers, Series B, Horticulture, Vol. LVI, 2012
CD-ROM ISSN 2285-5661, ISSN-L 2285-5653

BACTERIAL BIOCONTROL STRAINS THAT REDUCE RHIZOCTONIA DAMPING-OFF IN TOMATO SEEDLINGS

Oana-Alina SICUIA, Florica CONSTANTINESCU, Sorina DINU

Research and Development Institute for Plant Protection, 8 Ion Ionescu de la Brad Blvd., 013813 Bucharest, Romania, tel. 004-021-2693231, 33, 34, 36, fax. 004-021-2693239,
e-mails: sicuia_oana@yahoo.com; cflori@yahoo.com; sori.dinu@yahoo.com.

Corresponding author email: cflori@yahoo.com

Abstract

To suppress the Rhizoctonia damping-off in tomato seedlings we used several antagonistic bacterial strains of Bacillus subtilis, B. amyloliquefaciens, B. pumilus and Mycobacterium alvei. These bacterial strains were previously selected for their in vitro ability to control Rhizoctonia solani and were formulated as alginate pellets. The experiment was performed in a growth chamber on tomato cultivar HEINZ 2274. To compare our results with a standardized fungicide we used a chemical treatment with thiophanate-methil, together with other two experimental controls, a negative one, without treatment and a positive one, uninfected. Results showed that the selected strains of B. amyloliquefaciens, B. pumilus and Mycobacterium alvei expressed a biocontrol activity with 37,5% efficacy in reducing the Rhizoctonia damping-off in tomato seedlings, equivalent to the chemical treatment. However, the 98a strain of Bacillus subtilis expressed 50% efficacy in Rhizoctonia biocontrol.

Keywords: *biocontrol, Rhizoctonia damping-off, tomato*

INTRODUCTION

Worldwide as well as in our country, tomato crop has a high share in the solarium surfaces that produce vegetables, approximately 70-75% of the total surface of solariums for vegetables production [2].

Among the soilborne fungal diseases that attack tomatoes cultivated under greenhouse conditions *Rhizoctonia solani* is one of the phytopathogens causing root and crown rot [8]. *Rhizoctonia*, along with other species such as *Fusarium*, *Pythium* and *Verticillium* can induce damping-off of seedlings and wilt of adult plants [7].

As biocontrol agents *Trichoderma*, *Gliocadium*, *Pseudomonas*, *Paenibacillus* and *Bacillus* genera have already been successfully used for *Rhizoctonia* suppression [4, 5, 9, 12, 13, 14, 15], some of them were formulated in different ways, such as alginate pellets [12].

MATERIALS AND METHODS

Bacterial biocontrol strains

Six bacterial strains were previously selected for their beneficial characteristic in plant protection [3, 16] and used to perform *in vivo* biocontrol of *Rhizoctonia solani* infection in tomatoes. Bacterial strains used in this study were Romanian isolates of *Bacillus subtilis* Us.a2 and 98a strains, *Bacillus amyloliquefaciens* OS.17 and Bw strains, *Bacillus pumilus* OS.15 strain and *Mycobacterium alvei* 82.1s strain. The origin of this strain is presented in table 1. All of these strains were identified using Biolog GEN III, and some of them were also identified through molecular tests like ITS-PCR (OS.15, OS.17, Bw strains), ARDRA technique (Bw strain), sequencing analysis of 16S rRNA gene (Us.a2 strain). Routinely, these strains were grown on LB agar medium at 28°C and formulated as bio-products into sodium alginate beads (photo 1) using Minaxi and Saxena method [11]. Resulted granules had a microbial load of 2×10^7ufc/g bioproduct.

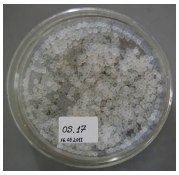


Photo 1. Granular bio-products of bacterial sodium alginate beads

Table 1. Biocontrol bacterial strains used in the experiments

Strain	Source	Provenience
Mycobacterium alvei 82.1s	Isolated from soil, South of Bărărgan area	RDIPP - Bucharest collection
Bacillus subtilis Us.a2	Isolated from garlic rhizosphere, Dolj county	RDIPP - Bucharest collection (DSM 23 654)
Bacillus subtilis 98a	Isolated from wheat straw, South of Romania	RDIPP - Bucharest collection
Bacillus pumilus OS15	Isolated from onion rhizosphere	RDIPP - Bucharest collection
Bacillus amyloliquefaciens OS17	Isolated from onion rhizosphere	RDIPP - Bucharest collection
Bacillus amyloliquefaciens BW	Isolated from soil	Faculty of Biotechnology Bucharest collection

Fungal inoculum

Rhizoctonia solani DSM 63002 strain was routinely grown on Potato-Dextrose-Agar (PDA) for maintenance and *in vitro* tests.

For *in vivo* tests the pathogen was previously cultivated on PDA medium and then multiplied in Roux plates on barley seeds substrate at 25°C for two weeks.

***In vitro* antagonistic tests**

The antagonistic activity of the isolates was revealed on PDA medium, using the dual culture technique. To see if the antifungal activity is maintained after formulation as sodium alginate beads, the bioproducts were *in vitro* tested against *Rhizoctonia solani* using the mentioned method. The test was performed in Petri dish where the fungal inoculum (plugs of 5 mm diameter) was placed in the middle of the plate and the bacterial inoculum was either streaked with fresh culture or, in case of granules, placed at 2 cm from the fungal colony, on both sides.

Fungal growth inhibition was visually appreciated according to Manka and Manka method [10]. Antagonistic activity was biometrically evaluated using a modified version of Islam *et al.* [6] calculation, through which they determined the percentage of inhibition efficacy:

$$E\% = \frac{RC - RI}{RC} \times 100$$

where: E (%) = antagonistic efficacy or pathogenic inhibition of growth; RC = radius of mycelia in the control (mm), RI = radius of the mycelia growth towards the interaction zone with the antagonism (mm).

***In vivo* growth chamber experiment**

The test was performed on tomato seedlings (*Lycopersicon esculentum* Mill.) cv. Heintz 2274 sensitive to *Rhizoctonia solani* attack. Tomato seeds were disinfected in two steps, first with 70% ethanol and then with 4% sodium hypochlorite.

The soil used was "FLORIMO" universal peat containing: Shagnum peat, black peat, earthworm humus, clay, river sand at pH 6,5-7. This was previously sterilized by gamma irradiation (25kGy).

The soil infection was done by mixing the fresh culture of *Rhizoctonia solani* at 2% rate (w/w) with the sterilized soil. The test was performed in plastic trays of 30cm/19cm/7cm. Thirty tomato seeds were sown per tray.

The alginate beads bioproducts were applied at the same time with sowing, near the seed, six pellets to 10 seeds.

For the chemical control variant we used Topsin 500SC fungicide based on thiophanate methyl, in 0,14% concentration and dose of 100µl/seed. As a negative control we used untreated plants grown in infested soil. Plants grown in gamma sterilized soil, without treatments or artificial infection, served as positive control.

Experimental variants are presented in table 2. Each variant had three repetitions and each repetition 10 plants.

Table 2. Experimental variants from the *in vivo* test on *Rhizoctonia solani* suppression in tomato seedlings

Experimental variants		Treatment characteristics
V1	*Mycobacterium alvei* 82.1s	Biological treatments with bacterial products and *Rhizoctonia solani* infected soil
V2	*Bacillus subtilis* Us.a2	
V3	*Bacillus subtilis* 98a	
V4	*Bacillus amyloliquefaciens* Bw	
V5	*Bacillus pumilus* OS.15	
V6	*Bacillus amyloliquefaciens* OS.17	
V7	Positive control	Uninfected soil
V8	Negative control	*Rhizoctonia solani* infected soil
V9	Chemical control	Chemical treatment with thiophanate methyl and *R.solani* infected soil

The experiment was performed in a growth chamber (Sanyo MLR-351H) with 16 hours photoperiod, at 24ºC/light, 16ºC/dark, 16000 lx luminance and 70% RH. During the experiment soil was moistened with tap water, every two days.

After 3 weeks of growth, plants were analyzed for *Rhizoctonia* infection symptoms (photo 4). Results were statistically analyzed and

treatments efficacy (%) was calculated with ABBOT formula.

RESULTS AND DISCUSSION

In vitro antagonistic activity against *Rhizoctonia solani*

Tested bacterial strains showed an antagonistic efficacy of 59 to 80% against *Rhizoctonia solani.* Results from the fungal inhibition after 5 days of interaction at 25°C are presented in table 3.

Table 3. *In vitro* evaluation of the bacterial strains antagonistic activity against *Rhizoctonia solani* (after 5 days of incubation at 25°C)

Bacterial strains	*Rhizoctonia solani* inhibition with bacterial biomass	
	Growth inhibition (according to Manka and Manka, 1992)	Antagonistic efficacy (according to Islam *et al.*, 2009)
Mycobacterium alvei 82.1s	+ + +	70%
Bacillus subtilis Us.a2	+	59%
Bacillus subtilis 98a	+ + + +	80%
Bacillus amyloliquefaciens Bw	+ + + +	77%
Bacillus pumilus OS.15	+ + +	71%
Bacillus amyloliquefaciens OS.17	+ + +	69%

Legend: + + + + = very strong inhibition of the fungal growth; + + + = strong inhibition of the fungal growth; + + = moderate inhibition of the fungal growth; + = slight inhibition of the fungal growth; − = no inhibition of the fungal growth.

Photo 2. *In vitro* antagonistic activity of bacterial strains vs. *Rhizoctonia solani* (5 days of incubation at 25°C)
a – *Bacillus pumilus* OS.15; **b** – *R.solani* control; **c** *Bacillus amyloliquefaciens* OS.17.

In vitro evaluation of the bio-products antagonistic activity revealed that sodium alginate beads formulation maintains the bacterial antifungal properties. Results with the bio-products antagonistic activity are listed in table 4. Sodium alginate beads formulation of our selected bacterial strains showed an antagonistic efficacy of 58 to 77,3% against *Rhizoctonia solani* fungal growth. Results from the *in vitro* test revealed that our selected bacterial strains maintained their antagonistic activity and showed a strong inhibitory effect against *Rhizoctonia solani* growth (photo 3).

Table 4. *In vitro* evaluation of the bacterial bio-products antagonistic activity against *Rhizoctonia solani* (after 5 days of incubation at 25°C)

Bacterial bio-products	*Rhizoctonia solani* inhibition with bacterial bio-products	
	Growth inhibition (according to Manka and Manka, 1992)	Antagonistic efficacy (according to Islam *et al.*, 2009)
Mycobacterium alvei 82.1s	+ +	64,8%
Bacillus subtilis Us.a2	+	58%
Bacillus subtilis 98a	+ + + +	77,3%
Bacillus amyloliquefaciens Bw	+ + +	74,5%
Bacillus pumilus OS.15	+ + +	68%
Bacillus amyloliquefaciens OS.17	+ + +	67,5%

Legend: + + + + = very strong inhibition of the fungal growth; + + + = strong inhibition of the fungal growth; + + = moderate inhibition of the fungal growth; + = slight inhibition of the fungal growth; − = no inhibition of the fungal growth.

Photo 3. *In vitro* antagonistic activity against *Rhizoctonia solani* by the selected bacterial strains after formulation as sodium alginate beads:
a – *Bacillus pumilus* OS.15; **b** – *R.solani* control; **c** *Bacillus amyloliquefaciens* OS.17.

In vivo* biological control of *Rhizoctonia

Symptoms: *Rhizoctonia* seedlings damping-off may occur before and/or after emergence. In pre-emergence damping off, the seeds fail to emerge after sowing; they became mushy, turn brown, and decompose as a consequence of seed infection. On seedlings stage, infection occurs on roots, hypocotyls and plant's crown. Infected seedlings form small lesions, pale brown and soft (photo 4). In time, root and crown lesions fuse and form large areas. Plants became stunted comparing with non-affected ones. In severe attack, plants collapse and the entire root is rotted. Tested bacterial strains showed an antagonistic efficacy of 59 to 80% against *Rhizoctonia solani.*

The highest disease incidence was recorded in the negative control, where plants were grown without treatment in the artificial infected soil and where *Rhizoctonia* infection was evaluated with a frequency of 36,4%. According to Abbot's algorithm, for efficacy evaluation of the treatments, results regarding the attack level in the negative control revealed the maximum disease incidence. Using this algorithm we found that thiophanate methyl treatment used as chemical control for *Rhizoctonia* suppression revealed a 37,5% efficacy protection. Similar defense capacity against the pathogenic infection was found when using biological treatments with *B. pumilus* OS.15, *B. amyloliquefaciens* OS.17 and Bw, and *Mycobacterium alvei* 82.1s. However, the highest efficacy protection (50%) was found in *B. subtilis* 98a treatment. Biological treatment with *B. subtilis* Us.a2 strain showed the lowest biocontrol activity, in this experimental variant treatment was evaluated at 12,5% efficacy. Tomato seedlings from the control trays and biological treatments are illustrated in photo 5 and 6 respectively. Treatments efficacy is illustrated in figure 1.

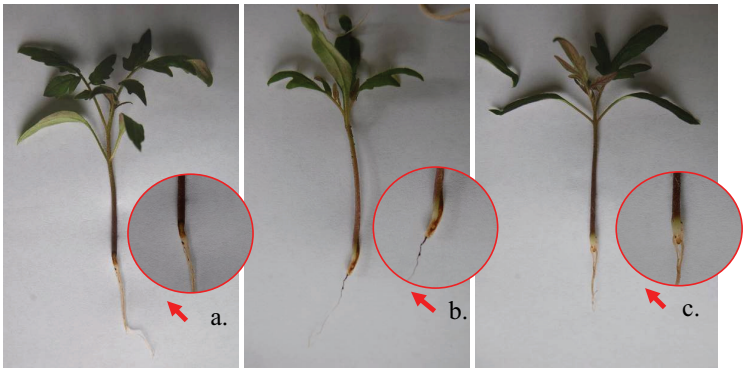


Photo 4. *Rhizoctonia* disease symptoms on tomato seedlings: a. browned hypocotyls; b. root and crown lesions; c. rotten root broken down from the plant

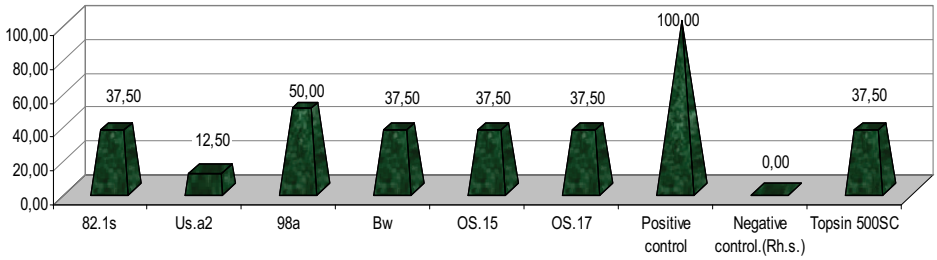


Fig. 1. Treatments efficacy in reducing *Rhizoctonia* damping-off in tomato seedlings

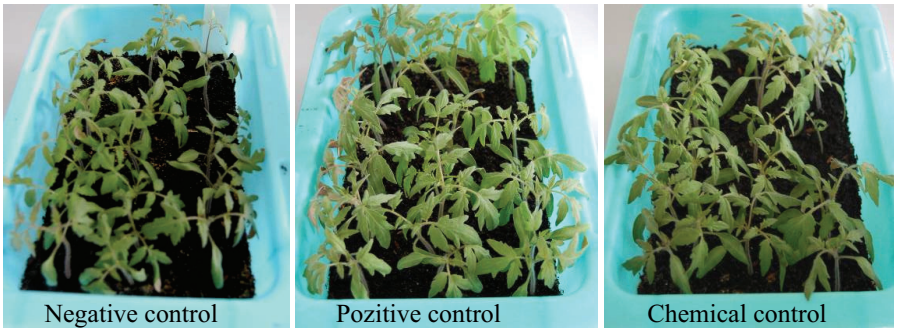


Photo 5. The experimental trays of the three controls with tomato seedlings obtained in growth chamber conditions

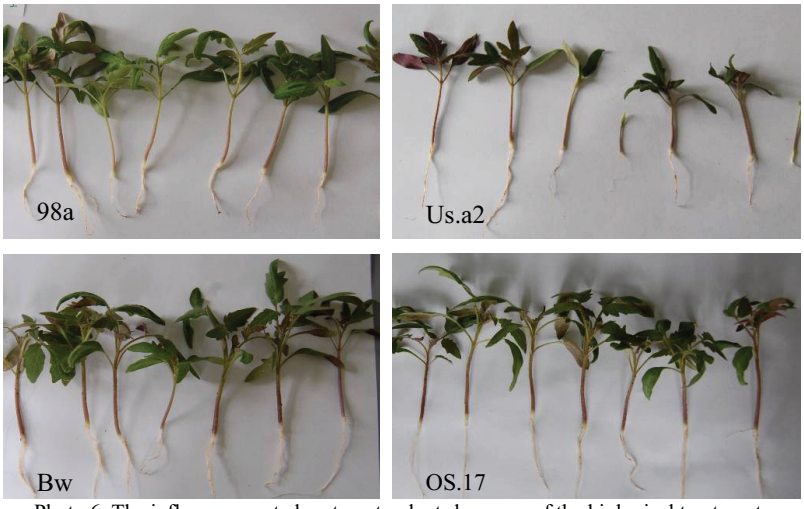


Photo 6. The influence exerted on tomato plants by some of the biological treatments after three weeks from seeding

CONCLUSIONS

Six bacterial strains with high antagonistic activity *in vitro* against various phytopathogenic fungi including *Rhizoctonia solani* were selected and formulated as granular bio-products.

In vitro bioassay showed that selected bacterial strains preserved their antagonistic properties against *Rhizoctonia solani* when formulated as sodium alginate beads.

In vivo evaluation of *Rhizoctonia* attack suppression revealed that biological treatments with some of the tested bacterial strains (82.1s;

OS.15; OS.17; Bw) are comparable with standard chemical treatment of thiophanate methyl.

Growth chamber experiments showed that biological treatment with *Bacillus subtilis* 98a strain can reduce the attack level of *Rhizoctonia solani* infection by half in tomato seedlings.

In vivo tests on tomato seedlings revealed five bacterial strains with good biocontrol activity in reducing *Rhizoctonia* damping-off.

REFERENCES

[1] Abbot W.S., 1925. *A method for computing the effectiveness of an insecticide*. Jour Econ. Entemol., 18: 265-267.

[2] Atanasiu N.E., 2005. *Cultura tomatelor timpurii în solaria*. Editura Atar, Bucureşti.

[3] Constantinescu Florica, Sicuia Oana-Alina, Zamfiropol Roxana, Dinu Sorina, Oancea Florin, 2010. *Beneficial characteristics of some bacterial strains isolated from rhizosphere for crops*. Romanian Journal for Plant Protection, 3: 6-11.

[4] Guo J.H., Qi H.Y., Guo Y.H., Ge H.L., Gong L.Y., Zhang L.X., Sun P.H., 2004. *Biocontrol of tomato wilt by plant growth-promoting rhizobacteria*. Biological Control, 29(1): 66-72.

[5] Huang C.J., Wang T.K., Chung S.C., Chen C.Y., 2005. *Identification of an antifungal chitinase from a potential biocontrol agent, Bacillus cereus 28-9*. Journal of Biochemistry and Molecular Biology, 38(1): 82-88.

[6] Islam R., Jeong Y.T., Ryu Y.J., Song C.H., Lee Y.S., 2009. *Isolation, identification and optimal culture conditions of Streptomyces albidoflavus C247 producing antifungal agents against Rhizoctonia solani AG2-2*. Mycobiology, 37(2): 114-120.

[7] Jiskani M.M., Pathan M.A., Wagan K.H., Imran M., Abro H., 2007. *Studies on the control of tomato damping-off disease caused by Rhizoctonia solani Kuhn*. Pak. J. Bot., 39(7): 2749-2754.

[8] Latorre Bernardo, 2004. *Enfermedades de las plantas cultivadas*. Santiago; Ediciones Universidad Católica de Chile. p.638

[9] Lewis J.A., Larkin R.P., Rogers D.L., 1998. *A formulation of Trichoderma and Gliocladium to reduce damping-off caused by Rhizoctonia solani and saprophytic growth of the pathogen in soilless mix*. Plant Dis. 82: 501–506.

[10] Manka K, Manka M, 1992. *A new method for evaluating interaction between soil inhabiting fungi and plant pathogens. New approaches in biological control of soil-borne diseases,* Buletin OILB/SORP. XV, 1: 73-75.

[11] Minaxi, Jyoti Saxena, 2011. *Efficacy of rhizobacterial strains encapsulated in nontoxic biodegradable gel matrices to promote growth and yield of wheat plants.* Applied Soil Ecology 48(3): 301– 308

[12] Montealegre J.R., Herrera R., Velásquez J.C., Silva P., Besoaín X., Pérez L.M., 2005. *Biocontrol of root and crown rot in tomatoes under greenhouse conditions using Trichoderma harzianum and Paenibacillus lentimorbus. Additional effect of solarization.* Electronic Journal of Biotechnology, 8 (3).

[13] Montealegre J., Valderrama L., Sánchez S., Herrera R., Besoain X., Pérez L.M., 2010. *Biological control of Rhizoctonia solani in tomatoes with Trichoderma harzianum mutants*. Electronic Journal of Biotechnology, 13 (2).

[14] Pal K.K., Tilak K.V.B.R., Saxena A.K., Dey R., Singh C.S., 2000. *Antifungal characteristics of a fluorescent Pseudomonas strain involved in the biological control of Rhizoctonia solani*. Microbiol. Res. 155: 233–242.

[15] Sabaratnam S., Traquair J.A., 2002. *Formulation of a Streptomyces biocontrol agent for the suppression of Rhizoctonia damping-off in tomato transplants*. Biol. Control 23, 245–253.

[16] Sicuia Oana-Alina, Olteanu Violeta, Ciucă Matilda, Cîrstea Doina Maria, Cornea Călina Petruţa, 2011. *Characterization of new Bacillus spp. isolates for antifungal properties and biosynthesis of lipopeptides*. Scientific Papers, USAMV Bucharest, Series A, 54: 482-491

Scientific Papers, Series B, Horticulture, Vol. LVI, 2012
CD-ROM ISSN 2285-5661, ISSN-L 2285-5653

STUDY REGARDING THE INFLUENCE OF LOW WINTER TEMPERATURES BETWEEN 2011-2012 ON THE VIABILITY OF WINTER BUDS OF SOME TABLE GRAPE VARIETIES IN THE CONDITIONS OF THE DIDACTIC EXPERIEMENTAL FIELD IN BUCHAREST

Marinela Vicuta STROE, Georgeta Mihaela BUCUR

University of Agricultural Sciences and Veterinary Medicine, Bucharest, 59 Marasti, 011464, Bucharest, Romania, Phone: +40 21 318 36 36/216, E-mail: marinelastroe@yahoo.com

Corresponding author email: marinelastroe@yahoo.com

Abstract

In general, new table grape varieties in Romania are obtained through intraspecific hybridization, which represents a method of improvement of grapevine varieties, with multiple possibilities, far from being completed. This method has as target the hybridization of two or more varieties, so that the new variety will contain new, superior characters and features in comparison with the one found in the genitors (parents). Thus, in the present paper frost resistance of some table grape varieties obtained in Romania with genitors from the Cardinal and Afuz ali genitors, as mother or father, has been analyzed, taking as witnesses these two varieties due to the fact that they are well-known in the wine-growing practice as being the most sensible-to-frost varieties from the table grape varieties group (Cardinal: - -15^0-18^{0}C, Afuz Ali: - 16^0- 18^{0}C). The obtained results highlight the fact that the dimension of the hereditary transmission of the frost resistance to the descendants depends highly on the genitor varieties resistance to this factor, as well as the period and the level of the destructive temperatures recorded in the rest of the vine.

Keywords: *intraspecific hybridization, table grapes, genitors, frost resistance, sensibility*

INTRODUCTION

In the wine-growing practice on one hand and the grapevine varieties amelioration operations on the other hand, it has been observed that, the heredity of the characters and features of new varieties obtained by sexual hybridization are more obvious (sometimes they even manifest the heterosis phenomenon for one or more characters), as the genitors are genetically further and have distant origins (*Proles pontica x Proles orientalis, Proles occidentalis x Proles orientalis*). In these situations, as a general rule, the characters of the first variety prevails [1, 2, 3].

Following the manifestation and the degree of hereditary variability for one or more characters, in the wine-growing practice, the research analyzes a series of characters including: the growing force, the number of grapes on a grapevine, the production per grapevine, the sugar quantity, the acidity of the grape must, various maturation age, grapes dimension, the resistance to diseases and pests, the resistance to drought and frost, etc. [2, 3].

In the present paper there have been tested four varieties of table grapes with different maturation ages under the aspect of their resistance to the low temperatures in the winter 2011-2012.

MATERIAL AND METHOD

For this reason, a frost resistance analysis of some table grapes varieties obtained in Romania has been made.

There were taken into account varieties with common genitors Cardinal and Afuz ali, as a motherly or fatherly form, taking as witnesses for being known as the most sensible to frost in their group (Cardinal - -15^0-18^{0}C, Afuz Ali - 16^0- 18^{0}C).

The research has been made on one hand in order to study the transmission of the frost sensibility to the descendants and on the other hand to observe the destructive effect of the frosts recorded in the winter of 2011-2012 on these grapevine varieties.

The varieties are grown in the experimental field from the Ampelographic Collection of the University of Agronomic Sciences and Veterinary Medicine – Bucharest, and they are conducted on a semi-high form, mixed cutting system (Guyot on a semi-stem cutting type, with a load of buds of 36 buds/vine).
The chords of the analyzed varieties have been collected from a medium number of 6 grapevines for each experimental version, and the length of the chords was established to 20 buds/chord.
The moment of collecting the chords was 19th of March 2012, practically before performing the cuts in dry of the grapevine.
After the collection, they have been introduced with the base in water to stimulate the rehydration of the tissues, and after this the determination of the winter buds viability was made (the method used: longitudinal cutting the winter bud, examining the bud complex under the magnifier, determining this way the viability of the bud complex).

Experimental variants
Victoria – Obtained at S.C.V.V. Dragasani through sexual hybridization of the varieties Cardinal and Afuz Ali and approved in 1978 (Victoria Lepadatu and Gh. Condei).
The variety stands out through a good frost resistance (-20 ^{0}C).
Azur – Obtained at S.C.V.V. Dragasani from the hybridization of the varieties Coarna neagra and Cardinal, approved in 1984 (Victoria Lepădatu, Gh. Condei).
The variety stands out through a good frost resistance (-20 ^{0}C).
Transilvania – Obtained at S.C.P.P. Cluj Napoca, through sexual hybridization between the varieties Black rose and Cardinal, approved in 1984.
The variety stands out through its sensibility to frost (-18^{0}C).
Greaca – Obtained at S.C.V.V. Greaca, through sexual hybridization of Bicane and Afuz Ali varieties and it was approved in 1979 (Gr. Gorodea).
The variety stands out through its tolerance to frost (-20 ^{0}C).
Cardinal (witness) – Obtained through the hybridization of Ahmeur bou Ahmeur and Alphonse Lavallee.
The variety stands out through frost sensibility (-15^0-18^{0}C).
Afuz Ali (witness) – Native from Asia Minor, it is supposed to be a selection of the assortment group Rozaki.
The variety stands out through its sensibility to frost (-16^0 – - 18^{0}C).

RESULTS AND DISCUSSIONS

Under the climatic aspect, the experimental field territory is situated in the second zone, moderately warm, an area with second degree of favourability regarding the culture of the grapevine.
The wine year 2010-2011 has been characterized through high temperatures during summer (38,^{0}C - 10.07.), less rain, marking the unfavourable climate conditions in June-July which determined a rush of the aging process, thus negatively favouring the quality of the production.
It was followed by a long and drought autumn, practically a period of 4 months of no rain or unimportant rain quantities.
Due to the rain deficit, the minimum destructive temperatures recorded at the end of January (Table 1), between -16,2 ^{0}C and -22,4^{0}C, as well as the temperatures in the first decade of February, -16,9^{0}C and -24,2^{0}C, have produced important damages to the viability of grapevine winter buds in general, and to the analyzed varieties in particular.
In the information of the same table, it is shown that the number of days with destructive temperatures for the grapevine surpassed ten, six of them being consecutive.
Analyzing the bud losses (table 2), it is shown that Victoria and Greaca varieties, for which one of the genitors is Afuz Ali, have recorded the most important losses percentages, from 3,5% (Greaca) to 13,46% (Victoria).
This results really to those registered by the Afuz Ali variety (6,66%) and even under his values in Greaca variety case.
For the varieties for having Cardinal variety as one of the genitors, the situation is slightly different, as follows: Transilvania variety

records losses of 26,41% and Azur variety records losses of 43,10%, in comparison with the witness variety 27,58%.

Table 1. The synthesis of climatic elements

Day number	DECEMBER			JANUARY			FEBRUARY		
	Air temperature			Air temperature			Air temperature		
	medium	maximum	minimum	medium	maximum	minimum	medium	maximum	minimum
01	-0,3	9,9	-7,6	-0,5	6,0	-3,7	-16,6	-8,6	-23,1
02	-1,0	8,7	-7,9	0,3	6,9	-4,4	-13,9	-10,7	-16,9
03	2,5	11,7	-2,1	4,0	11,7	-1,8	-10,6	-8,1	-12,1
04	6,3	15,9	-0,7	1,0	8,7	-4,9	-4,3	-2,3	-8,1
05	7,3	15,3	0,7	4,4	10,0	-0,6	-1,9	-0,3	-5,4
06	7,8	11,3	5,4	4,9	6,8	3,1	-6,8	-5,2	-7,3
07	4,3	6,8	1,3	4,1	6,7	2,4	-9,0	-7,3	-10,4
08	0,9	4,2	-2,2	2,1	4,3	-0,5	-11,6	-7,3	-13,6
09	1,8	8,3	-4,3	0,0	4,8	-4,2	-17,3	-7,7	-24,2
10	3,9	8,5	-0,3	1,9	7,0	-0,6	-13,9	-7,4	-18,7
11	6,5	11,5	3,8	-0,2	4,5	-5,0	-14,8	-11,2	-20,8
12	5,4	6,7	3,0	1,1	8,7	-3,7	-9,9	-8,2	-11,8
13	6,5	7,2	5,9	2,9	9,0	-0,9	-6,3	-3,2	-8,9
14	4,6	5,9	4,0	2,5	6,4	0,2	-6,5	-3,3	-8,5
15	3,4	5,0	1,9	-0,8	4,6	-4,3	-11,0	-5,7	-17,4
16	4,5	10,1	1,9	-1,9	2,9	-6,2	-3,2	1,3	-8,1
17	4,5	7,3	1,6	-2,5	2,0	-6,9	-5,2	-0,7	-12,7
18	4,2	8,5	1,7	-3,2	-0,4	-5,8	-7,6	1,0	-14,1
19	-1,0	2,3	-6,1	-3,2	1,1	-8,3	-8,0	3,0	-16,9
20	4,0	4,7	2,0	2,7	6,6	-3,9	-2,7	6,5	-10,1
21	1,5	4,2	0,1	1,6	4,7	0,2	-1,4	3,8	-7,4
22	0,6	2,8	-2,1	-2,3	2,0	-5,6	-3,0	3,4	-8,7
23	1,1	3,5	-0,7	3,2	8,7	-1,3	-4,7	-1,7	-7,4
24	-2,4	0,7	-5,4	0,5	6,2	-3,7	0,3	5,3	-4,4
25	-1,6	2,4	-6,6	-0,5	2,3	-1,9	4,4	11,5	-0,7
26	1,5	5,3	-0,6	-6,2	-1,8	-8,1	1,4	8,4	-4,1
27	-1,0	3,5	-3,7	-8,7	-6,0	-9,7	1,1	4,2	-2,3
28	2,0	6,2	-1,3	-11,8	-6,9	-16,2	-3,0	2,4	-9,2
29	4,5	8,2	2,6	-16,0	-7,4	-22,4	-2,9	2,3	-9,3
30	0,5	4,3	-1,7	-12,7	-8,0	-18,3			
31	-1,0	0,6	-4,5	-15,1	-7,4	-21,9			
AVERAGE	**2,6**	**6,8**	**-0,7**	**-1,6**	**3,4**	**-5,4**	**-6,5**	**-1,6**	**-11,1**

A significantly lower loss has been recorded at the table grape varieties Azur and Transilvania, having Cardinal and frost resistant varieties as genitors: Coarna neagra (-22^{0}C) and Black rose (-20^{0}C).

Considering the recorded losses, we tried to establish an estimated grape production for the wine year 2012: the highest percentage of the effective production potential of each variety has been recorded by Azur (40-45%), Transilvania (25-30%) and Cardinal (25-30%), practically the ones that have as genitor, the Cardinal variety.

The estimated grape production percentages recorded by the other varieties included in the study, where one of the genitors is Afuz ali variety, are very low, being situated between 0-15%.

Table 2. Synthesis regarding bud losses on the varieties including in the study

Studied varieties	Main buds		Estimated grape production %
	Viable %	*Dead%*	
Victoria Cardinal *and* ***Afuz Ali***	13,46	86,54	10-15
Azur *Coarnă neagră and* ***Cardinal***	43,10	56,89	40-45
Transilvania *Black rose and* ***Cardinal***	26,41	73,58	25-30
Greaca *Bicane and* ***Afuz ali***	3,5	96,49	0-5
Cardinal *(witness)*	27,58	72,42	25-30
Afuz ali *(witness)*	6,66	93,34	5-10

CONCLUSIONS

Destructive temperatures, low temperature limits, the alternation and the duration of this low temperatures, produced important damages to grapevine in general and the table grape varieties in particular.

Hence, we conclude that the degree of hereditary transmission to frost resistance to the descendants depends highly on the resistance of the genitor varieties to this factor.

In the case of the Victoria variety, where both varieties are genitors, it hasn't been highlighted through high percentages of viable buds compared to the varieties in which genetical structure includes only one of them; on the contrary in this case, the variety is even more sensible than the genitors.

Azur variety takes over from Coarna Neagra the highest frost resistance (in this case, prevailing the features of the first genitor). Although the Cardinal variety is known as being one of the most sensible to extreme climate conditions, for the year 2011-2012 Afuz ali variety and the varieties that have it as a genitor proved to be more sensible.

REFERENCES

[1] Ionescu A., 1998. *Comportarea unor hibrizi intraspecifici noi pentru vin obţinuţi în podgoria Murfatlar*. Teză de doctorat, U.S.A.M.V., Bucureşti.

[2] Stroe Marinela Vicuţa, Veliu Raluca, 2010. *The agrobiological and technological evaluation of some table grape variety with different maturation periods in vineyard Ostrov*. Sesiunea Ştiinţifică anuală „Horticultură - Ştiinţă, Calitate, Diversitate şi Armonie", U.S.A.M.V. „Ion Ionescu de la Brad" Iaşi, Facultatea de Horticultura, Anul LII, Vol 53, Seria Horticultură, CD ROM ISSN 2069-847X, pag. 437-443.

[3] Ţîrdea C., Mustea M., Ţârdea Angela, 2005. *Comportarea soiurilor de viţă-de-vie pentru vinuri de calitate superioară la temperaturile scăzute din iarna 1993-1994 în zona de nord est a Moldovei*. Lucr. Şt. Vol. 38, seria Hortic. Iaşi.

Scientific Papers, Series B, Horticulture, Vol. LVI, 2012
CD-ROM ISSN 2285-5661, ISSN-L 2285-5653

FRUIT GROWING TECHNOLOGIES TO MITIGATE THE NEGATIVE IMPACT OF CLIMATIC CHANGES FROM THE SOUTHERN PART OF ROMANIA

Dorin SUMEDREA, Emil CHITU, Viorica CHITU, Mihaela SUMEDREA, Florin Cristian MARIN, Nicolae TĂNĂSESCU

Research Institute for Fruit Growing Pitesti, Romania, Marului Str, Maracineni, Arges, cod 117450, OP 1, CP 73, *Tel: +40-248-278066; Fax: +40-248-278477;* office@icdp-pitesti.ro

Corresponding author email: dsumedrea@yahoo.com

Abstract

The actual relief and pedo-climatic diversity of Romania offer favorable conditions to grow a large panel of fruit species, but the climatic changes bring into the actuality new criteria for durable zoning of fruit species and adequate fruit growing technologies as well. With the large increase in air temperature, in number of hours of sunshine and lower rainfall in the summer months, irrigation techniques will have to evolve within the meaning of efficient exploitation of water resources. This work goal is to present the influence of fertigation on growth and fruit yield from a high density apple orchards, in the fourth year from orchard establishment. The fruit productions obtained in the third year from orchard establishment ranging between 34.3 - 44.4 t ha^{-1}*, depending on the cultivars. The decrease order of vigour of the studied cultivars, estimated by the average increase of trunk cross-section area (TCSA), was: Jonagored (4.39 cm^2 of TCSA), Fuji Kiku 8 (3.43 cm^2 of TCSA), Golden clona B (3.09 cm^2 of TCSA).*

Key words: *fertigation, climatic changes, high density apple orchard.*

INTRODUCTION

The effects of the Global Climate Changes, the increased frequency of the dry years and not very uniform distribution of the precipitations during the vegetation period, lead to the increasing of the semiaridity climatic character and its extent also in the hilly zones of the Southern part of Romania. Mateescu *et al.,* 2009, estimated that, in Pitesti, Romania, according to projections made by regional climate model RegCM3/SRES A1B, annual average air temperature will increase by 1.5°C from 2020 to 2050 compared to the current conditions. The biggest increases are expected in the warm period of the year respectively during April-August period (1.6°C in May, 2.6°C in June, 2.8°C in July and 1.0°C in August). Annual amounts of rainfalls will decrease by an average of 91.1 mm, the largest decreases being projected, again, in the summer period. In the Maracineni area, between 1969 and 2010, there was a statistically assured trend of weather warming, of sunshine hours and rainfalls deficit increasing and of the annual rainfalls decreasing [2]. The months having the highest abnormal weather were June, July and August. The largest slope of temperature and Penman-Monteith potential evapo-transpiration increase has been registered, however, in August. Under these conditions, even if in climatic areas favorable for growing fruit trees, the rainfall deficit in summer months is increasing, growing fruit trees in high density

systems require more efficient methods of irrigation and fertilization [1].

Many authors have argued that a highly accurate application, both for water and fertilizers, can be achieved by simultaneous administration by fertigation. Thus we obtain the advantage of simultaneous supply of mineral elements in accordance with the trees needs [5, 7]. The foliar application of fertilizer associated with fert-irrigations, insure in great measure the fruit trees needs for supplies, the soil fertilization is reducing and the fertilizers consumption as well [3].

The great densities of fruit trees on the surface unit, using low vigor vegetative rootstocks, determines the diminution of the

soil volume available for each fruit tree and determine the accentuation of the competition for nutrients and water, an exhaust of the soil explored by the roots and a higher trees dependence of the external supply with nutrients [6]. On the other hand, if is applied constantly, the localized irrigation provide into the plants a sustained sap circuit, with the capacities to uptake the minerals especially by the roots developed in the soil volume supplied with water by irrigation. Present paper goal is to present some essential elements of apple fertigation fruit growing systems, and to support by the our researches results, the necessity to guide the Romanian fruit growers toward these technologies and orchard types which join in a happy manner the economical efficiency with the environment protection.

MATERIAL AND METHOD

The researches were carried out in a high density apple orchard, established at RIFG Pitesti - Romania in the spring of 2007. The trial with the trees planted at 3.25 x 1.00 m (3,077 trees ha^{-1}), was a bifactorial one and included 18 treatments (3 x 6) with 5 trees in repetition plot, following the subdivided plots design. The experimental factors taking into the study included: A factor, the cultivar: 'Jonagored', 'Fuji Kiku' Cl. 8 and 'Golden Delicious' clone B cultivars, grafted on M9 T 337 rootstock; B factor, the nutrients doses applied together with irrigation water, with six graduations: b1 - untreated control, and treated with the following annual fertilizer rates (kg ha^{-1}): b2 - $N_{(20)}:P_2O_{5-(10)}:K_2O_{(30)}:MgO_{(10)}$, b3 -$N_{(40)}:P_2O_{5-(20)}:K_2O_{(60)}:MgO_{(20)}$, b4 - $N_{(60)}:P_2O_{5-(30)}:K_2O_{(90)}:MgO_{(30)}$, b5 - $N_{(80)}:P_2O_{5-(40)}:K_2O_{(120)}:MgO_{(40)}$, b6 - $N_{(100)}:P_2O_{5-(50)}:K_2O_{(150)}:MgO_{(50)}$.

The experimental plot was placed on a plane terrain, located on the second terrace of the Arges River, the soil being brown eumesobasic, slightly podzolic şi pseudogleic one. As regards the texture, in the experimental plot soil was a sandy loam one, with a good aeration and water holding capacity. The soil reaction was slight acid (pH=5.8 - 6.8). Generally, the humus content was under 3%, indicating a low supply in nitrogen of the soil. The mobile phosphorus ranged between 8-10 ppm, showing a medium supplied soil. Analysis of the soil degree of bases saturation indicated that the soil had a low to medium natural fertility. The nitrogen index value was under 2%, revealing a low supplied soil with nitrogen. The orchard soil training system was a combination of grasses cover between the trees rows and herbicides in stripes of 1.0-1.2 m wide, along the trees rows.

The influence of the experimental factors was quantified using the following set of biological indicators registered in the fourth year from orchard establishment: trunk cross section area (TCSA, cm^2), annual increase of TCSA, mean number of flower buds per tree, mean number of harvested fruits per tree, fruits mean weight at harvest time (g), and fruits mean yield (t ha^{-1}). The high amount of the experimental data was stored and processed by the analysis of variance, using the specialized program SPSS 14.0 with its bifactorial ANOVA calculation model and by correlations method (Pearson's coefficients).

RESULTS AND DISCUSSIONS

1. Meteorological parameters evolution during the last 42 years and their influence on fruit growing We are going to present some tendencies of the climate in 1969-2011 period, with consequences on the fruit growing activity. The polynomial curves of fifth degree trends, allow us to affirm that in this period a clear tendency (statistically insured) was directed toward weather warming (figure 1). All determination coefficients (r^2) for the regression curves are statistically insured, from 1998 to present the temperature probabilities being almost in all cases greater than 50%.

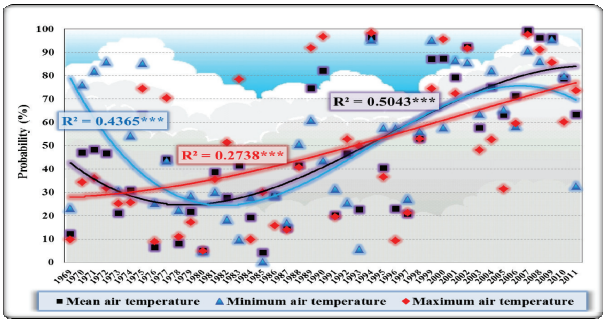


Fig. 1. Probability to register annual average values of the mean, maximum and minimum temperatures, equals or lower than the ones accomplished during 1969 - 2011 at Maracineni-Arges.

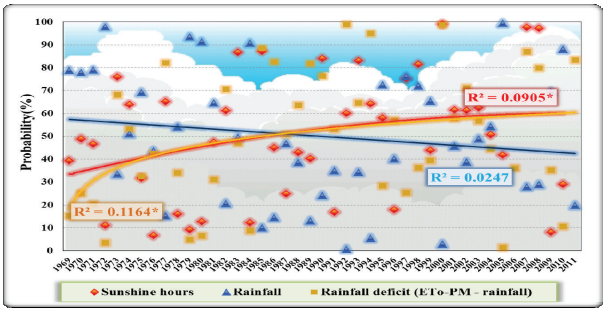


Fig. 2. Probabilities to register during 1969 - 2011 the annual sums of sunshine hours, rainfall amounts and rainfall deficit, equals or lower than the ones registered during the study period.

The same tendency of increasing the annual sums according the time was evidenced also in the case of sunshine hours (figure 2, R^2=0.0905*) and in the case of the rainfall deficit (R^2=0.1164*), but for the precipitations, the general tendency was to decrease (R^2=0.0247). As regard the intensity of correlation, between the monthly mean values of meteorological parameters and time included in the study (simples correlation coefficients - r, 1969-2009), the table 1 reveal that among the year months that influence the trees entrance into vegetation, February was the month with the most significant changes; the higher temperature, day-night amplitude and sunshine length period, manifested a rise up tendency, which can determine in the future an earlier onset of vegetation of the fruit trees [2].

Table 1. Correlations intensity between the monthly mean values of some meteorological parameters and time (simples r correlations coefficients, 1969-2009) Chitu et al., 2010

Month	Mean air temperature	Maximum air temperature	Minimum air temperature	Mean diurnal thermic amplitude	Sunshine length period	Atmospheric precipitations
I					0.332*	
II		0.331*		0.426**	0.464**	
III				0.331*		0.303*
VI	0.436**	0.396**	0.307*		0.319*	
VII	0.607***	0.586***	0.373*	0.301*		
VIII	0.559***	0.398**	0.520***			
IX					-0.351*	
X	0.545***		0.473**			

The results regarding the fruit yield obtained in the experimental intensive apple orchard, in relation with the experimental factors, in the second and third year after orchard establishment are presented from now on.

2. Effect of the experimental treatments on the growth and fructification processes in the fourth year after orchard establishment

Increase of trunk cross section area (*TCSA*)

In the fourth year of application, on average of the 6 levels of fertilization, induced a descendent of the vigor on the cultivars taken in the study, revealed in the trunk cross section area (TCSA) increase (Fig. 3), with different values from each cultivar for a statistical insurance of 5%: 'Jonagored' (4.39 cm^2 TCSA increase), 'Fuji Kiku Clone 8' (3.43 cm^2 TCSA increase T), 'Golden Delicious Clona B' (3.09 cm^2 TCSA increase). In general, at all graduations of fertilization level, the 'Jonagored' cultivar had the highest vigor and 'Golden Delicious Clone B', had the lowest vigor (Fig 3).

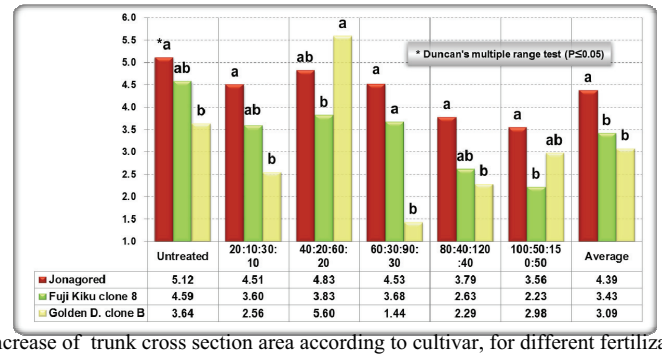


Fig. 3. Increase of trunk cross section area according to cultivar, for different fertilization levels

Assessment the influence of fertilization variants on the trunk cross section area (TCSA) annual increase (Fig. 4), reveal that, on cultivars average, the highest vigor and statistically assured was surprising registered in the untreated control variant and in the variant N:P2O5:K20:MgO with the elements ratio 40:20:60:20 (4.45 cm^2 and respectively 4.75 cm^2 TCSA increase), compared with the other fertilization variants with TCSA increase of 2.9-3.56 cm^2.

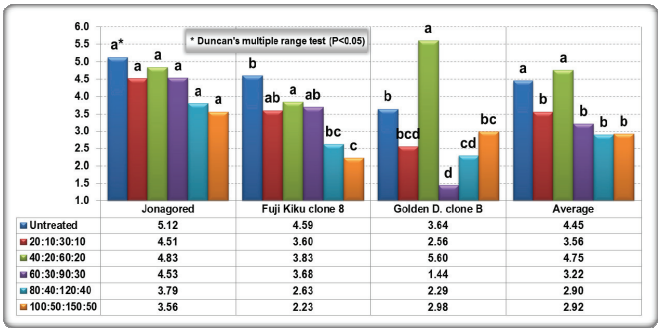


Fig. 4. Increase of trunk cross section area according to fertilization level, for different cultivars

Number of flower buds per tree

Although inside each fertilization variant there are statistically assured differences regarding the number of the flower buds per tree, on the average of the graduations of fertilization variants, the cultivars did not induced statistically assured differences (Fig. 5). In this sense, there are small differences regarding the flower buds number among the cultivars, the sorted descendent order being: 'Golden Delicious Clone B', with 57.9 flower buds, 'Fuji Kiku Clone 8' with 57.9 flower buds, and 46.5 flower buds at 'Jonagored' cultivar.

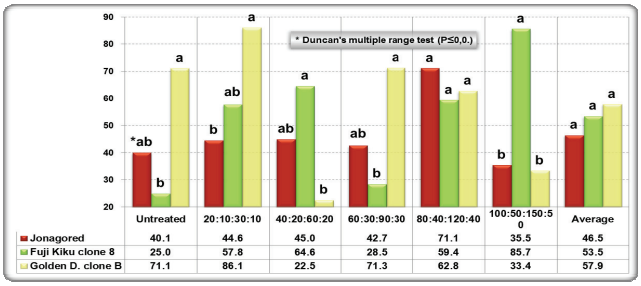


Fig. 5. Number of flower buds per tree according to cultivar, for different fertilization levels

On the cultivar average, the fertilization treatments did not induced statistically assured differences regarding the number of flower buds per tree (Fig. 6), their number ranging between 44.1 and 64.4 flower buds per tree.

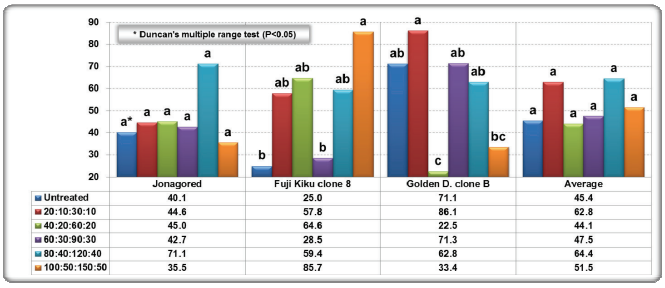


Fig. 6. Number of flower buds per tree according to fertilization level, for different cultivars

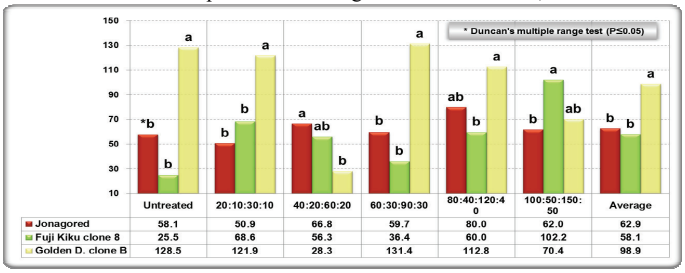


Fig. 7. Number of fruits per tree according to cultivar, for different fertilization levels

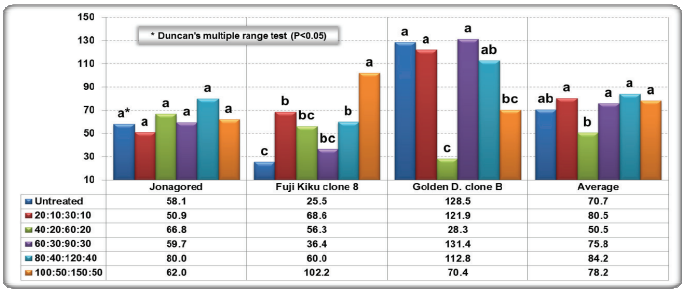


Fig. 8. Number of fruits according to fertilization level, for different cultivars

Number of fruits per tree

With small exceptions inside each fertilization level, the cultivar with the highest number of fruits per tree was 'Golden Delicious clone B', which presented 28.3-131.4 fruits / tree according the fertilization variant (Fig. 7).

On average of the fertilization levels 'Golden Delicious Clone B' cultivar presented the highest fruit number (98.9 fruits /tree), value which differ significantly from the statistically point of view from 'Jonagored' and 'Fuji Kiku' which produced 62.9 and respectively 58.1 fruits /tree (Fig. 7).

The fertilization variants with the highest nitrogen amounts (V4-V6) induced the highest fruits number per tree (Fig. 8), on the cultivars average being registered 75.8 - 84.2 fruits /tree, similar values being observed also in the variant 20:10:30:10, with the lowest nitrogen amount (80.5 fruits/tree).

Fruit yield

In the fourth year of fertilization, on the average of fertilization treatments level, the cultivar 'Golden Delicious Clone B presented the highest production (44.4 t/ha), which significantly differ from the one obtained at the cultivars 'Fuji Kiku Clone 8' and 'Jonagored' (34.3 and 35.2 t/ha respectively).

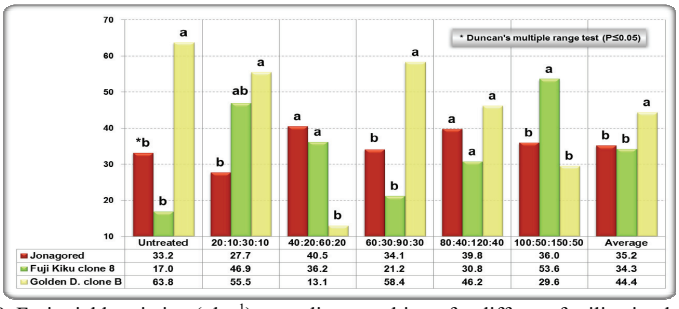


Fig. 9. Fruit yield variation (t ha^{-1}) according to cultivar, for different fertilization levels

It can be observed a light production increase tendency together with the fertilizers amounts increase, especially nitrogen and potassium (the proportion among these elements is increasing much more than phosphorus and magnesium in variants V4-V6), the obtained productions ranging between 37.9-39.7 t/ha, except the fertilization variant 20:10:30:10 in which was obtained the highest production 43.4 t/ha (Fig. 10).

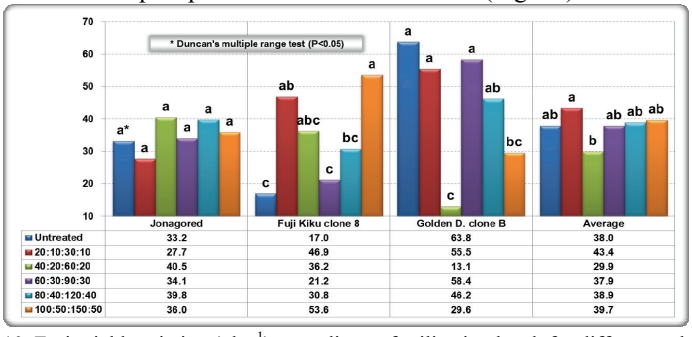


Fig. 10. Fruit yield variation (t ha^{-1}) according to fertilization level, for different cultivars

Fruit weight

In the fourth year of experimentation, on the average of the fertilization level, the cultivar 'Golden Delicious Clone B' formed the highest number of fruits per tree and in consequence the lowest fruit weight (151 g), the value which differ significantly from the statistically point of view to the cultivars 'Jonagored' and 'Fuji Kiku' wich registered average fruit weights of 201 g and respectively 206 g (Fig. 11). In general, the average fruit weight is inverse proportional

with the number of fruits per tree: 'Fuji Kiku Clone 8' 206 g, 'Jonagored' 201 g, respectively 151 g and 'Golden Delicious Clone B'.

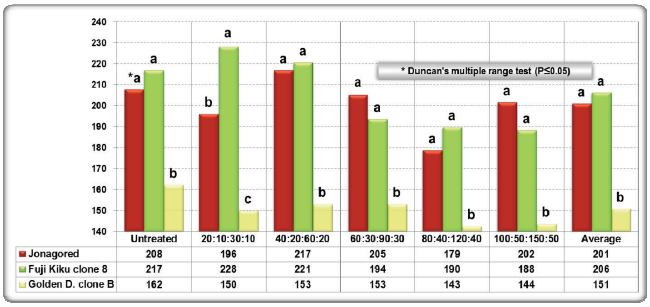


Fig. 11. Average fruit weight according to cultivar, for different fertilization levels

The fertilization level did not induced great differences regarding the average fruit weight. On cultivars average, no tendencies were registered which drive us to strong conclusions, this indicator variations being in relatively small limits 170.0 - 197.0 g, pretty similar to the ones registered in the previous year (Fig. 12).

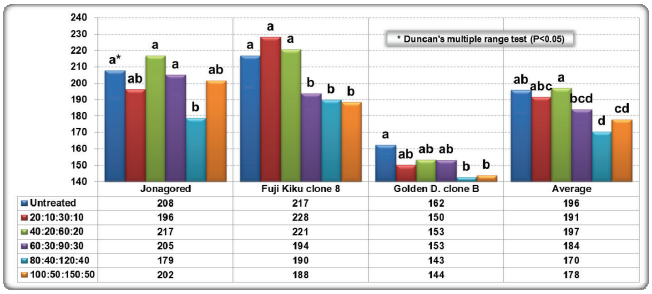


Fig. 12. Average fruit weight according to fertilization level, for different cultivars

CONCLUSIONS

From the climatic point of view, under the local conditions from Pitesti-Maracineni, a clear tendency of weather warming was noticed, with an increase of sunshine hours and an evident rainfall deficit than 10 years ago, compared with the multiannual values registered at the local weather station.

In the fourth year of experimental factors application, on the 6 level of fertilization average, the cultivars induced a descendent growing vigor expresses by the increase of trunk cross section area (TCSA increase): 'Jonagored' (4.39 cm^2), Fuji Kiku 8 (3.43 cm^2), Golden Delicious Clone B 3.09 cm^2).

Although inside each fertilization variant exist statistically assured differences regarding the number of flower buds per trees, on the average of fertilization variants graduations, the cultivar did not produced statistically assured differences.

On the fertilization level average, the 'Golden Delicious Clone B' cultivar presented the highest fruit number per tree (98.9 fruits / tree), the value being significantly different from the statistical point of view from 'Jonagored' and 'Fuji Kiku Clone 8' which registered 62.9 and respectively 58.1 fruits / tree.

In the fourth year of experimentation, on the fertilization variants average, Golden Delicious Clone B cultivar induced the highest production (44.4 t/ha), which differ significantly to the one formed by the cultivars 'Fuji Kiku' and 'Jonagored' (34.3 and respectively 35.2 t/ha).

On the cultivars average, the yield tends to be higher by increasing the quantity of fertilizers, the fruits productions ranging between 29.9 - 43.4 t / ha.

The average fruit weight was inversely with the fruit number per tree: 206 g on 'Fuji Kiku Clone 8'; 201 g on 'Jonagored' and respectively 151 g on 'Golden Delicious Clone B'.

REFERENCES

[1]. Chiţu E., Sumedrea D., Budan S., Butac M., Militaru M., 2009. *Fenomenele climatice extreme ale ultimilor ani şi impactul acestora asupra culturii pomilor în judeţul Argeş. Mediul şi Agricultura în regiunile aride*. Ed. Estfalia, ISBN 978-973-7681-68-3: 75-82;

[2]. Chiţu E., Sumedrea D., Tănăsescu N., Marin F. C., 2010. *Influence of fertigation on fruit yield in high density apple orchards, under global climatic changes.* Lucrări Ştiinţifice Seria Horticultura, Editura, Ion Ionescu de la Brad, ISSN 1545-7376, p 323-328;

[3]. Marangoni B., Toselli M., Zavolloni C., Flore J., 2001. *Nitrogen accumulation and gas exchange in apple trees grafted on M-26 EMLA, M-9 EMLA and Mark rootstocks under low soil temperature and drought stress*. Acta Hort. 564: 193-200;

[4]. Mateescu E., Adriana M., Alexandru D., 2009. *Climate Change Impact on Fruit Growing Production*. Lucr. Şt. ale ICDP, Vol. XXV, Ed. INVEL, Bucureşti: 87-100;

[5]. Neilsen, D., P. Millard, L.C. Herbert, G.H. Neilsen, E.J. Hogue, P. Parchomchuk, and B..I. Zebarth, 2001. *Remobilization and uptake of N by newly planted apple (Malus domestica) trees in response to irrigation method and timing of N application*. Tree Physiology 21:513-521;

[6]. Sumedrea Dorin, Mihaela Sumedrea, 2003. *Pomicultură*. Editura Academiei de Înalte Studii Militare Bucureşti. România: 189 pagini; ISBN 973-663-004-8;

[7]. Weinbaum, S.A., R.S. Johnson, and D.M. De Jong, 1992. *Causes and consequences of over fertilization in orchards*. HortTechnology 2:112-121.

Scientific Papers, Series B, Horticulture, Vol. LVI, 2012
CD-ROM ISSN 2285-5661, ISSN-L 2285-5653

RESEARCH ON INFLUENCE OF TOP SHOOTS PINCHING ON PLANT GROWTH AND BLOSSOMING OF SOME NEW VARIETIES OF PETUNIA

Florin TOMA, Sorina PETRA, Diana Zamfir-Vasca, Thomas VASILESCU

University of Agronomical Sciences and Veterinary Medicine Bucharest, Marasti 59 Street, zip code 011464, Bucharest, Romania, Phone: 040.21.318.22.66/040.21.318.25.64, Fax: 040.21.318.28.88.

Corresponding author email: florintoma@hotmail.com

Abstract

According to statistics, Petunia became the most used flower specie for summer and autumnal decor of parks and gardens. The degree of branching of the plant is a characteristic of variety but as well branching plant is influenced by the number of applied top pinching shoots. Our experiments were focused on study of reaction of four new varieties of Petunia ('Veranda Scarlet', 'Picotte Purple', 'Surfinia Blue', 'Shishi Purple') to pinching shoots. We used rooted cuttings of each variety that off the top over the 4-8 leaf growth (from 2.5 to 4 cm). Shoots arising from these were pinching pinch in the same way (every month) and repeated pinching and secondary shoots. The effect of pinching to quantify the observations, measurements and determination of the main indicators of growth and flowering plants: the number and length of shoots on the degree of branching, leaf number, plant height and diameter, number of buds and flowers. In terms of vegetative growths responded best plants of the varieties 'Picotte Purple' and 'Blue Surfinia' who had higher values of the indicators of growth right from the first pinch. In quality flowering best results were obtained from varieties 'Picotte Purple' and 'Veranda Scarlet'. These results attest to the fact that pinching of the shoots often has a positive impact on the formation, growth and flowering of petunia plants, plant response to these works is different depending on variety.

Keywords: *blossoming, branching, growing, petunia, pinching*

INTRODUCTION

Petunia is undoubtedly one of the most popular flower species for summer decoration of parks, gardens, balconies and terraces [4, 6]. Most often the plants are produced from seeds [1, 2, 5]. Recent researches have shown that some varieties behave very well to multiplication by cuttings [7].

Plants shoots good capacity allows to obtain a satisfactory number of seedlings in a short Period of time and the mother plants from cuttings which were can be used for decoration collected, after the cutting [3].

Branching plant capacity is superior to plants obtained from cuttings, degree of branching is influenced by variety and number of pinching applied [7].

MATHERIAL AND METHOD

The experiments were initiated from rooted cuttings of four new varieties of *Petunia* - *'Veranda Scarlet', 'Picotte Purple', 'Surfinia Blue'* and *'Shihi Purple'*.

Seedlings planted in pots were tissue with a diameter of 10 cm in peat substrate (90%) + perlite (10%), on 7/12/2010.

At 10 days after planting rooted cuttings in pots we pinching, eliminating the strict branching tip growth.

The following pinching, in number two, were made at intervals of one month each, the shoots emerged after previous pinching above the 4-6 leaves at the base.

After each pinch biometric measurements were made on the number and length of shoots emerged after pinching, number of leaves on the vine, plant height.

Starting with what the second month after the last pinch was recording and plant diameter, number of flowers and flower buds per plant.

The results were interpreted through the prism of the correlation between different elements of growth and flowering plants.

RESULTS AND DISCUSSIONS

The results of our research shows that the studied varieties react differently to pinching shoots that growth stimulation surgery degree of branching plant.

The data in Table 1 show that when first picking (done at 10 days after planting rooted cuttings in pots), plants had an average height 2.60 cm between the variety *'Shihi Purple'* and 3.40 cm from the variety *'Surfinia Blue '*.

Table 1. The growing of the plants at the first pinching

Variety	Plant height (cm)	Leaves number
'Veranda Scarlet'	3,25	3,5
'Picotte Purple'	2,75	7,5
'Surfinia Blue'	3,40	6,5
'Shihi Purple'	2,60	4,5

In the number of leaves, ranging from 3.5 to variety *'Veranda Scarlet'* and 7.5 cultivar *'Picotte Purple'*.

When the second picking, performed one month after the first pinching, number of shoots per plant vary between 4.5 shoots the variety *'Veranda Scarlet'* and 7.0 shoots the varieties *'Surfinia Blue'* and *'Shihi Purple'* (Table 2).

Table 2. The growing of the plants at the second pinching

Variety	Plant height (cm)	Shoots number	Leaves number/shoot
'Veranda Scarlet'	3,4	4,5	4,5
'Picotte Purple'	3,6	5,5	8
'Surfinia Blue'	2,8	7	4,5
'Shihi Purple'	3	7	5

In the number of leaves per shoot, it ranged from 4.5 to varieties *'Scarlet Veranda'* and *'Surfinia Blue'* and 8.0 cultivar *'Picotte Purple'* (photo 1 and 2).

Photo 1. The growing of the plant of *'Surfinia Blue '* variety at the second pinching

Photo 2. The growing of the plant of *'Veranda Scarlet'* variety at the second pinching

What the third pinch performed on shoots emerged after the second pinching, there is a significant increase in the number of shoots per plant, this variety oscillating between 10.5 *'Veranda Scarlet'* and 16, 5 the variety *'Surfinia Blue'* (Table 3).

Table 3. The growing of the plants at the third pinching

Variety	Plant height (cm)	Shoots number	Leaves number /shoot
'Veranda Scarlet'	3,6	10,5	5,5
'Picotte Purple'	3,8	12,5	8,5
'Surfinia Blue'	3,0	16,5	7,5
'Shihi Purple'	3,2	16,0	6,5

After the third pinch longer required about 2 months for the plants to reach quality standard to be recovered, expressed by the onset of flowering (Photo 3-6).

Photo 3. The plant of *'Veranda Scarlet'* after two months from third pinching

Photo 4. The plant of *'Shihi Purple'* after two months from third pinching

Photo 5. The plant of *'Surfinia Blue'* after two months from third pinching

From this point, it is found that growth rate and number of flowers per plant grow very rapidly, resulting in achieving maximum potential ornamental plant in about three months since the last pinching.

Photo 6. The plant of *'Picotte Purple'* after two months from third pinching

Even if they receive the same number of pinching, differences between varieties are significant for all the growth and flowering. Thus, in Table 4, it is found that the final determination, made in late May, the variety *'Purple Picotte'* presents the highest values increases both in terms of vegetative and flowering elements while variety *'Surfinia Blue'* presents the lowest values of these elements (Photo 7-10).

Photo 7. The plant of *'Veranda Scarlet'* after three months from the last pinching

Photo 8. The plant of *'Shihi Purple'* after three months from the last pinching

Photo 9. The plant of *'Surfinia Blue'* after three months from the last pinching

Photo 10. The plant of *'Picotte Purple'* after three months from the last pinching

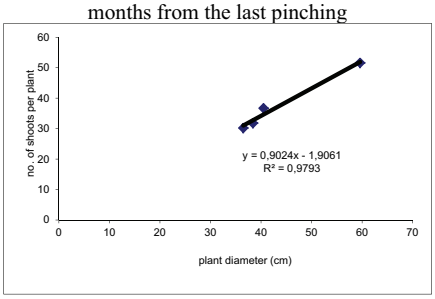


Fig. 1. The correlation between the diameter of plant and the number of shoots per plant

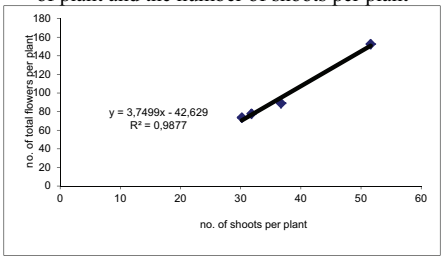


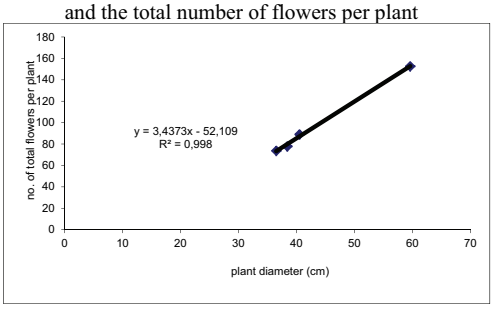
Fig. 2. The correlation between the number of shoots per plant and the total number of flowers per plant

Table 4. The growing and the blossoming of the plants at the third months of the last pinching

Variety	Plant height (cm)	Plant diameter (cm)	Shoots number	Total flowers number	No. of opened flowers	No. of. bud flowers
'Veranda Scarlet'	50,2	40,5	36,7	89,0	58,2	30,8
'Picotte Purple'	68,4	59,6	51,6	152,6	96,0	56,6
'Surfinia Blue'	61,3	36,5	30,2	73,7	50,0	23,7
'Shihi Purple'	66,5	38,4	31,8	77,8	46,4	31,4

Studying correlations between different elements of growth and flowering plants were established direct correlations, positive and very strong between plant diameter and number of shoots (Fig. 1), number of shoots and number of flowers per plant (Fig. 2) and plant diameter and number The flowers on the plant (Fig. 3).

Fig. 3. The correlation between the plant diameter and the total number of flowers per plant



These correlations show that the elements between vegetative growth and flowering elements there is very closely related to each of the four varieties.

CONCLUSSIONS

These studies have established that for good branching Petunia plants, necessary for obtaining a maximum value of ornamental plants, pinching need three: first performed 10 days after planting rooted cuttings and these two in a months difference.

In terms of vegetative growths responded best plants of the varieties *'Picotte Purple'* and *'Blue Surfinia'* who had higher values of the indicators of growth right from the first pinch.

If after first picking moderate branching plant, after the second pinch branching plants that greatly intensifies after the third pinch plants to branch out into explosive pace.

Reaching potential ornamental plants is made up of three months after the last pinch.

Plant response to pinching the shoots is different depending on the variety, the final maximum level of vegetative growth and flowering occurring in variety *'Purple Picotte'* and lows in the variety *'Surfinia Blue'*.

For each of the four varieties, plant diameter, number of shoots per plant and total number of flowers per plant are closely linked by positive correlations, direct and very strong.

REFERENCES

[1] Graper D.F., Healy W., Lang D., 1990. *Supplemental irradiance control of petunia seedling growth of specific stages of development*. Acta Horticulturae (ISHS) 272: 153-158.

[2] Jauron, R., 1999. *Selecting and planting Petunias*. Horticulture and Home Pest New. February 19, 1999 issue, pp. 14-15.

[3] Lopez R.G., Runkle R.S., 2006. *Daily light integral influence rooting and quality of Petunia cutting*. Acta Horticulturae (ISHS) 711: 369-374.

[4] Selaru Elena, 2007. *The garden flowers culture*. Ed. Ceres, Bucureşti: 636-639.

[5] Toma Fl., 2003. *Floriculture and gazon*. Vol. II, Ed. Universitas Company Bucureşti: 46-48.

[6] Toma Fl., 2009. *Floriculture and Flowers art*. Ed. InvelMultimedia, Otopeni, Romania, vol. IV: 78-81.

[7] Toma Fl., Vasilescu Th., Petra Sorina, Zamfir-Vasca Diana, 2011. *Research concerning the propagation by cutting of some new cultivars of Petunia*. Scientifical Paper USAMV Bucharest, Serie B, Horticulture, vol. LV: 253-256.

Scientific Papers, Series B, Horticulture, Vol. LVI, 2012
CD-ROM ISSN 2285-5661, ISSN-L 2285-5653

RESEARCH ON THE BEHAVIOUR OF SOME HYACINTH VARIETIES IN DIFFERENT TYPES OF FORCING FOR BLOOMING IN OUT OF SEASON

Florin TOMA, Sorina PETRA, Diana Zamfir-Vasca, Oana TANASE

University of Agronomical Sciences and Veterinary Medicine Bucharest, Marasti 59 Street, zip code 011464, Bucharest, Romania, Phone: 040.21.318.22.66/040.21.318.25.64, Fax: 040.21.318.28.88.

Corresponding author email: florintoma@hotmail.com

Abstract

Forcing bulbs is frequently used to obtain hyacinths blooming in out of season. Both variety and forcing conditions are of major importance in obtaining a quality flowering. In this context, our research aimed followed behaviour of new varieties in four different forcing hyacinths. The hyacinth varieties were: 'Peter Stuyvesant', 'Delft Blue', 'Blue Jacket', 'Sky Jacket', 'City of Haarleem', 'Fondant',' Splendid Cornelia', 'Anne Marie' and 'Carnegie'. Variants were forcing the variation factors when applying the cold period (before or after planting) and place planting bulbs (in pots, directly in the greenhouse soil, vases with water). The results show that, for all varieties, the best option to forcing was the period of cold that was applied before planting bulbs and cold treated bulbs were planted directly in soil greenhouse. Forcing results in a vase with water to follow closely the values obtained for directly forcing greenhouse soil in pots while forcing led to the worst results. The quality of floral stems and flowers was superior varieties, 'Blue Jacket', 'Sky Jacket' and 'Delft Blue' while 'Splendid Cornelia', 'Anne Marie' and 'Carnegie' varieties were marked by the lowest values of the elements flowering. These results shows that the hyacinth, in cultures forced, cold therapy has maximum effect when applied before planting bulbs planting bulbs and previously treated with cold soil is directly in the greenhouse.

Keywords: *blooming, bulb, forcing, hyacinth, variety*

INTRODUCTION

Forcing flower bulb species is a widely used method for getting cut in season flowers [2, 3]. Duration and time of application of cold treatment on the bulbs have a major importance in the success of a culture forced hyacinths [1, 4]. The same type of treatment applied cold bulb variety is what significantly differentiates the quantity and quality of flowering hyacinth bulbs forced in culture [1, 4]. Given the widely acknowledged importance of the two factors in the process of obtaining hyacinths blooming in season - the variety and characteristics of the cold period applied bulbs - our experiences have turned to testing the nine varieties of hyacinths in four different variants of compulsion.

MATHERIAL AND METHOD

The biological material used to achieve these experiences was the nine of the most cultivated varieties of Hyacinth *'Peter Stuyvesant', 'Delft Blue', 'Blue Jacket', 'Sky Jacket', 'City of Harlee', 'flux', 'Splendid Cornelia', 'Anne Marie'* and *'Carnegie'*. For each of the nine varieties of cold treatment duration was 6 weeks. What was different when applying this treatment with cold (3 ° C) and place the cold treated bulbs were planted.

Thus, the combination of experimental factors results indicate four types of forcing, as illustrated below:

A. Planting the bulbs in pots → 6 weeks cold → forcing chamber (8-9 °) - Photo 1;

B. Cold 6 weeks → planting the bulbs in pots → greenhouse (21 °) - photo 2;

C. Cold 6 weeks → bulbs planted directly in soil in the greenhouse (21 °) - Photo 3;

D. Cold 6 weeks → put bulbs in vases with water (kept in the room to force the 8-9 °) - photo 4.

Quality elements used to forcing bulbs in this experience are presented in Table 1.

Observations were made on the evidence of vegetative and flowering growth: height of the cone of leaves, leaf length, leaf number, number of flower stems, stem length, number of flowers in bloom.

Photo 1. The pots of bulbs from variant A of forcing

Photo 2. The pots of bulbs from variant B of forcing

Photo 3. The pots of bulbs from variant C of forcing

Photo 4. The pots of bulbs from variant D of forcing

For items vegetative growth observations were made monthly and for those of flowering observations were performed every 2 weeks.
For statistical interpretation of the results were analyzed correlations between various elements of the biological cycle in relation to the alternative to force and variety.

Table 1. The elements of quality of bulbs used in forcing

Variety	Weight (g)	Diameter (cm)	Height (cm)	Circumference (cm)
SPLENDID CORNELIA	60,25	5,5	4,5	16,50
BLUE JACKET	100,5	6,5	4,5	19,25
SKY JACKET	84,25	5,5	5,5	16,25
ANNE MARIE	60,75	5,3	5,5	15,50
FONDANT	90,75	5,5	5,2	17,50
DELFT BLUE	80,5	5,0	5,5	16,50
CARNEGIE	88,5	5,5	5,3	17,75
CITY OF HAARLEEM	72,25	5,5	5,5	16,75
PETER STUYEVESANT	83,6	7,1	6,3	19,50

RESULTS AND DISCUSSIONS

The results show that, for all varieties, the best option to forcing was the period of cold that was applied before planting bulbs and cold treated bulbs were planted directly in soil greenhouse.

A. Forcing in pots placed in the chamber to force (8-9 °C).

From Table 2 it is found that the number of pounds does not vary greatly from one variety to another, ranging between 6.2 limits the varieties 'flux' and *'Peter Stuyevesant'* and 7.6 the variety *'Sky Jacket'*.

Table 2. The final values of vegetative growing and flowering of plants from variant A of forcing

Variety	Leaves number	Lenght of leaves (cm)	Lenght of steam flower (cm)	No. of flowers in inflorescence
SPLENDID CORNELIA	6,3	23,4	26,8	22,8
BLUE JACKET	6,5	19,6	26,2	35,4
SKY JACKET	7,6	28,4	30,4	29,2
ANNE MARIE	7,4	35,5	26,2	23,4
FONDANT	6,2	23,8	31,8	33,4
DELFT BLUE	7,4	18,2	33,4	31,2
CARNEGIE	6,5	25,4	29,6	34,6
CITY OF HAARLEEM	7,4	18,2	27,4	25,2
PETER STUYEVESANT	6,2	16,4	23,2	29,4

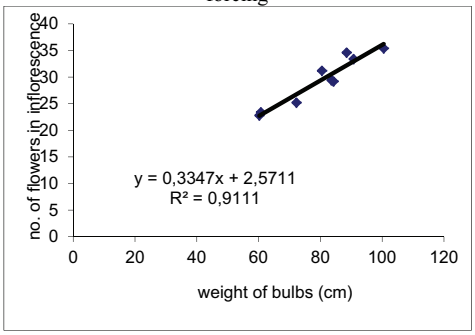
Leaves vary in length but wider range, from 16.4 cm to the variety *'Peter Stuyevesant'* at 35.5 cm from the variety *'Anne Marie'*.
Regarding the elements flowering - flower stem length and number of flowers in bloom, the hierarchy of varieties is generally different than vegetative growth elements. Thus, the rod

length floral exhibits the lowest value - 23.2 cm - the variety *'Peter Stuyevesant'*, the maximum - 33.4 cm - were recorded in cultivar *'Delft Blue'*. Number of flowers in bloom is the minimum variety *'Splendid Cornelia'* (22.8) and maximum variety *'Blue Jacket'* (35.4) - Photo 5.

Photo 5. The flowered plant from *'Blue Jacket'* variety in variant A of forcing

Distribution of these values of vegetative growth and flowering did not show a significant correlation between the two elements of the biological cycle of the plant.
Instead, there was a linear correlation, direct and weight of bulbs used in between planting and the number of flowers in bloom (Fig. 1), confirming the importance of quality planting bulbs use.

Fig. 1. The correlation between the weight of bulbs and number of flowers in inflorescence from variant A of forcing



B. Forcing in pots placed in the greenhouse (21°)

Analyzing data from Table 3 are found close to but slightly higher values than those recorded in variant A of forcing, both in terms of vegetative growth components and elements of flowering. In general, the hierarchy is preserved varieties for each of these elements. Thus, the number of leaves is the minimum (6.2) the varieties *'Peter Stuyevesant', 'Blue Jacket'* and *'Delft Blue'* and maximum (7.6) the variety *'City of Haarleem'*. Leaf length ranges from 16.3 cm to the variety *'Peter Stuyevesant'* and 35.8 cm from the variety *'Anne Marie'*. Floral stem length varies from 24.1 cm to the variety *'Peter Stuyevesant'* and 33.6 cm from the variety *'Delft Blue'*. The minimum number of flowers in bloom (23.2) meets the variety *'Splendid Cornelia'* and the maximum number (36.2) the variety *'Blue Jacket'* (Photo 6).

Table 3. The final values of vegetative growing and flowering of plants from variant B of forcing

Variety	Leaves number	Lenght of leaves (cm)	Lenght of steam flower (cm)	No. of flowers in inflorescence
SPLENDID CORNELIA	6,4	24,2	24,5	23,2
BLUE JACKET	6,2	18,6	28,4	36,2
SKY JACKET	6,6	30,6	32,8	30,3
ANNE MARIE	6,4	35,8	27,2	23,5
FONDANT	5,8	25,2	32,4	33,8
DELFT BLUE	6,2	20,8	33,6	33,2
CARNEGIE	7,4	27,3	29,4	34,8
CITY OF HAARLEEM	7,6	18,8	28,5	26,7
PETER STUYEVESANT	6,2	16,3	24,1	30,4

Photo 6. The flowered plant from *'Blue Jacket'* variety in variant B of forcing

Like the previous version to force, meet a linear correlation, direct and very strong only between weight and number of bulbs used in planting flowers in bloom (figure 2).

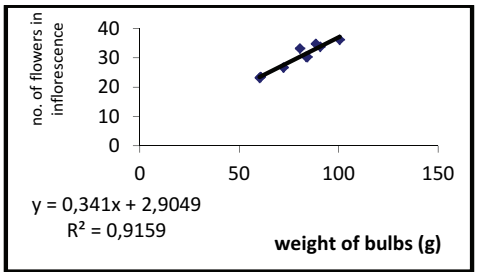


Fig. 2. The correlation between the weight of bulbs and number of flowers in inflorescence from variant B of forcing

C. Forcing directly in soil greenhouse (21°)

From Table 4 we find that, in general, ranking keeps forcing varieties from previous versions in terms of values of elements increases vegetative and flowering.

Table 4. The final values of vegetative growing and flowering of plants from variant C of forcing

Variety	Leaves number	Lenght of leaves (cm)	Length of steam flower (cm)	No. of flowers in inflorescence
SPLENDID CORNELIA	6,5	30,5	26,5	28,4
BLUE JACKET	7,8	23,6	29,8	43,2
SKY JACKET	7,2	34,2	34,2	34,4
ANNE MARIE	6,6	37,3	30,3	25,2
FONDANT	7,2	25,4	31,5	35,7
DELFT BLUE	6,2	18,4	35,2	38,4
CARNEGIE	7,6	30,1	32,6	35,6
CITY OF HAARLEEM	7,6	19,1	26,9	30,6
PETER STUYEVESANT	6,1	16,3	27,7	33,3

With few exceptions, these values are higher, which is explained by the fact that the bulbs were given a greater amount of nutrition.

Observe, such as minimum number of leaves (6.1) meets all the variety *'Peter Stuyevesant'* and the maximum number (7.8) is registered in the variety *'Blue Jacket'*.

Leaves are the minimum length (16.3 cm) from the variety *'Peter Stuyevesant'* and maximum (37.3 cm) from the variety *'Anne Marie'*.

The short flower stem (22.5 cm) occurs in the variety *'Splendid Cornelia'* and the long (35.2 cm) from the variety *'Delft Blue'* - Photo 7.

Photo 7. The flowered plant from *'Delft Blue'* and *'Splendid Cornelia'* variety in variant C of forcing

Variety *'Anne Marie'* is distinguished by the lowest number of flowers in bloom (25.2) followed by variety *'Splendid Cornelia'* (28.4). As with previous versions of compulsion, the largest number of flowers in inflorescences (43.2) to register the variety *'Blue Jacket'* - photo 8.

Photo 8. The flowered plant from *'Blue Jacket'* variety in variant C of forcing

Analyzing correlations between elements of the vegetative growth and flowering was found that only linear correlation, positive and very strong, is found all between weight and number of flower bulbs in bloom (Fig. 3).

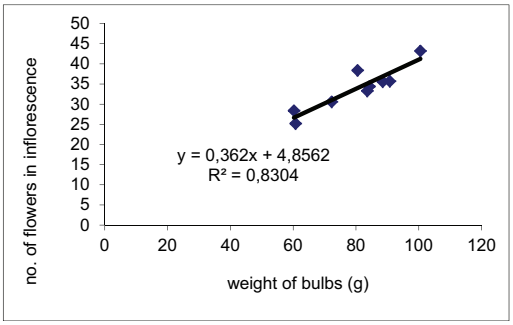


Fig. 3. The correlation between the weight of bulbs and number of flowers in inflorescence from variant C of forcing

D. Forcing in a vases with water located in forcing room (8-9 °C)

The data analysis presented in Table 5 notes that about elements increases vegetative variety hierarchy remains almost unchanged, at least the minimum and maximum limits.

Table 5. The final values of vegetative growing and flowering of plants from variant D of forcing

Variety	Leaves number	Lenght of leaves (cm)	Length of steam flower (cm)	No. of flowers in inflorescence
SPLENDID CORNELIA	6,2	21,3	25,1	25,6
BLUE JACKET	8,0	24,8	27,3	40,3
SKY JACKET	7,2	32,4	31,8	32,2
ANNE MARIE	6,7	25,2	25,3	25,0
FONDANT	7,0	28,2	29,9	33,6
DELFT BLUE	6,4	18,9	29,8	36,5
CARNEGIE	6,6	20,4	23,2	33,4
CITY OF HAARLEEM	6,8	16,9	24,3	29,2
PETER STUYEVESANT	6,0	14,6	24,5	32,5

Thus, the number of leaves varies between 6.0 to variety *'Peter Stuyevesant'* and 8.0 cultivar *'Blue Jacket'*.

Leaf length is 14.6 cm values between the variety *'Peter Stuyevesant'* and 32.4 cm from the variety *'Sky Jacket'*.

About elements that are found flowering variety *'Carnegie'* presents the minimum length of flower stems (23.2 cm) followed closely by the variety *'City of Haarleem* "(24.3 cm) - photo 9. A short length of flower stem is an advantage for this type of forcing it allows greater stability vase.Number of flowers in bloom is minimal (25.0) the variety *'Anne Marie'* followed closely by the variety *'Splendid Cornelia'* (25.6) and maximum (40.3) the variety *'Blue Jacket'* followed by variety *'Delft Blue '*(36.5) - Photo 10.

Photo 9. The flowered plant from *'City of Haarleem'* variety in variant D of forcing

Photo 10. The flowered plant from *'Delft Blue'* variety in variant D of forcing

And for this option to force linear correlation is confirmed, direct and very strong between weight and number of flower bulbs in bloom (Figure 4). Analysis graphs relating to variation of flowering and vegetative growth elements in terms of forcing hyacinths highlight, with few exceptions, close hierarchy of varieties for each of the four variants to force tested (Fig. 5-8).

These graphs highlight that, overall, the best option to force soil was directly forcing greenhouse.

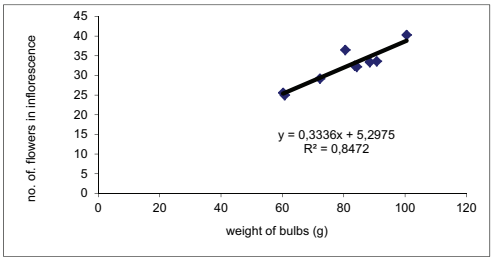


Fig. 4. The correlation between the weight of bulbs and number of flowers in inflorescence from variant D of forcing

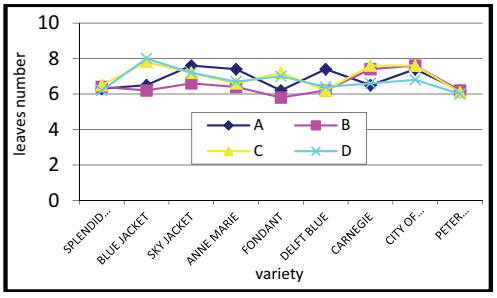


Fig. 5. The variation of leaves number in all the four variants of forcing

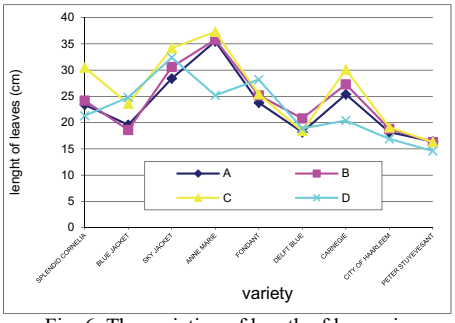


Fig. 6. The variation of length of leaves in all the four variants of forcing

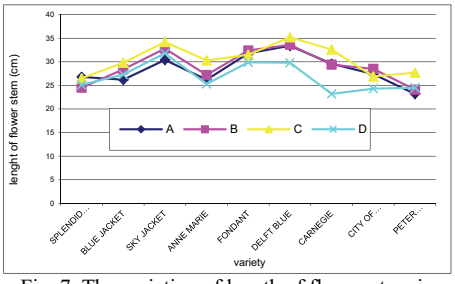


Fig. 7. The variation of length of flower stem in all the four variants of forcing

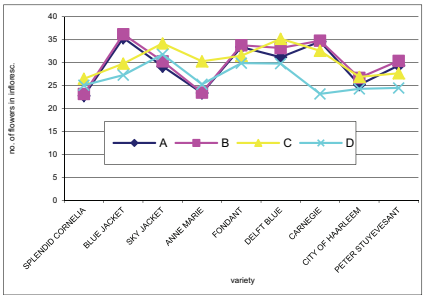


Fig. 8. The variation of number of flowers in inflorescence for all the four variants of forcing

CONCLUSSIONS

The best option to forcing was the period of cold that was applied before planting bulbs and cold treated bulbs were planted directly in soil greenhouse.

Forcing results in a vase with water to follow closely the values obtained for directly forcing greenhouse soil in pots while forcing led to the worst results. The quality of floral stems and flowers was superior varieties, *'Blue Jacket'*, '*Sky Jacket'* and *'Delft Blue'* while *'Splendid Cornelia'*, *'Anne Marie'* and *'Carnegie'* varieties were marked by the lowest values of the elements flowering.

These results shows that the hyacinth, in cultures forced, cold therapy has maximum effect when applied before planting bulbs planting bulbs and previously treated with cold soil is directly in the greenhouse.

REFERENCES

[1] Gwendolyn H. Pemberton, 1999. *Home forcing of Hyacinthus*. Horticulture Inform. Leflets, NCSU 6/99 Hill-8507.

[2] Şelaru Elena, 2002. *Cultures for cut flowers*. Ed. Ceres, Bucureşti: 258-266.

[3] Toma Fl., 2009. *Floriculture and Flowers art*. Ed. InvelMultimedia, Otopeni, Romania: 106-112.

[4] Toma Fl. and col., 2011. *Research on the influence of the cold period and type of substrat eon growth and flowering plants Hyacinthus orientalis L., the variety Ostara*. Scientifical Papers USAMV Bucuresti, Serie B, vol. LV, 2011: 257-260.

Scientific Papers, Series B, Horticulture, Vol. LVI, 2012
CD-ROM ISSN 2285-5661, ISSN-L 2285-5653

PREVENTING AND LIMITING THE SPREAD OF CROWN GALL IN VINEYARDS

Diana E. VIZITIU (BĂLĂȘOIU)[1], Liviu C. DEJEU[1], Ion RĂDULESCU[2], Carmen F. POPESCU[2]

[1] University of Agronomic Sciences and Veterinary Medicine - Bucharest, Faculty of Horticulture, 59 Mărăşti Blvd., Sector 1, Postal Code 011464, Bucharest, Romania, vizitiud@yahoo.com, liviudejeu@gmail.com
[2] National Research and Development Institute for Biotechnology in Horticulture, Stefanesti, Bucharest Street, No. 37, Postal Code 117715, Tel/Fax: 0248/266814, e-mail: radulescuion56@yahoo.com, carm3n_popescu@yahoo.com, Arges, Romania

Corresponding author email: vizitiud@yahoo.com

Abstract

Crown gall, produced by Agrobacterium vitis and Agrobacterium tumefaciens is a very dangerous disease that significantly reduces the growers' income. The pathogen attacks the roots, trunks and arms of vines, reduces plant vigour and finally decreases yield. Systemic survival of bacteria in vines and its spread into tissues plants represent the main difficulties to control this disease in vineyards. The aim of this review was to present the main feature of this pathogen and preventive measures recommended to be applied in vineyards and grapevine nurseries aiming to reduce its spread. In order to avoid bacteria invasion by grafting or cuttings is compulsory to detect and identify the presence of the pathogen in plants and soil (nurseries, plantations). The phytosanitary inspection in mother plantations is the safest procedure to prevent the spread of crown galls of grapevines. After removing the infected plants and their burning, is absolutely necessary to disinfect the soil to destroy the survival bacteria.

Keywords: *Agrobacterium tumefaciens, bacteria, grapevine nurseries, Rhizobium vitis, soil*

INTRODUCTION

The disease occurs most frequently by the appearance of small swellings on the root, on the stem near the soil line, or on aerial portions of the plant. Young tumors (resemble often with the callus tissue that results from wounding) are soft, somewhat spherical and white to cream colored even rose in some cases (Photo1-6). In time, the shape of tumors changed becoming irregular and also the color turning to brown or black. Tumors may be connected to the host surface by a small piece of tissue, or may appear as a swelling of the stem, not distinctly separated. Several tumors may appear on the same plant and may fall from the surface of the plant completely or partially, but may occur again in the same area, season after season. Other tumors become persistent, and every year, become increasingly larger. [2], [20], [36]. After the removing vines from the vineyard, the pathogenic bacteria survive in soil and plant debris for at least 2 years. So, *Agrobacterium* cells remain viable and active in soil and could infect the new planting material [6]; [14].

Photo 1. Vine roots necrosis produced by *Agrobacterium vitis* [6]

Photo 2. Crown gall of grape [4]

Photo 3. Crown gall formed on canes of grapevines [24]

Photo 4. Crown gall causing rough-surfaced swelling on a grape trunk [22]

Photo 5. Galls at graft unions [5]

Photo 6. *Agrobacterium vitis [51]*

Taxonomy

The pathogen that causes crown gall of grapevines belongs to the genus *Agrobacterium,* family *Rhizobiaceae*, the order *Rhizobiales*, class *Alphaproteobacteria*, Division *Proteobacteria*, kingdom *Bacteria*.

The most known species of *Agrobacterium* are: *Agrobacterium tumefaciens, Agrobacterium vitis, Agrobacterium radiobacter, Agrobacterium rubi, Agrobacterium larrymoorei*, *and Agrobacterium rhizogens.* Among these, the most distributed specia are *A. tumefaciens* (synonym biovar 1, *Rhizobium radiobacter), A. rhizogens* (synonym biovar 2; *Rhizobium rhizogens)* and A. *vitis* (synonym biovar 3, *Rhizobium vitis)* [1], [26]. Strains of *Agrobacterium* are classified in the three biovars based on their in vitro predominant nutrition with different carbohydrates and other biochemical tests applied for their detection.

The other species *Agrobacterium rubi* (*Rhizobium rubi*) and *Agrobacterium larrymoorei (Rhizobium larrymoorei)* are considered as minor pathogen [3], [50].

For the first time, the bacteria was isolated in 1897 by Cavara F. at the Laboratorio di Botanica del Recherci Instituto Forestale di Vallom Drosa in Naples, Italy and called it *Bacterium tumefaciens*. After ten years, Smith E. F. and Townsend C.O. in the United States isolated the same bacterium from *Chrysanthemum* and called it *Phytomonas tumefaciens*. The same authors subsequently changed the name in *Agrobacterium tumefaciens* [24].

Lately, some strains of *Agrobacterium* have been used in genetic engineering for gene transfer. Thus, *Agrobacterium*-mediated genetic transformation has become the preferred

method to generate transgenic plants [35]. Great progress has been made for *Agrobacterium*-mediated transformation of maize, wheat, sorghum, rice, cotton, soybean or ornamental plants as a key element in the process of varietal improvement [28].

The pathogen

Agrobacterium is a Gram-negative bacterium, rod-shaped, non-spore-forming, motile, having one to six peritrichous flagella. At the infected plants, virulent strain of *Agrobacterium* causes abnormal cell proliferation which results in tumor formation. At an optimum growth temperature of 25–28˚C, the bacteria metabolize a wide range of mono- and di-saccharides and salts of organic acids.

Crown gall produced by *Rhizobium vitis* is the most important bacterial disease of the grapevine in the world [6], [9], [39] [47] It is considered as the predominant tumorigenic specie-specific to *Vitis* spp. [48], but has been occasionally isolated from other hosts, such as *Actinidia* [40]. *Agrobacterium vitis* appears to be unique among pathogenic *Agrobacterium* species in being associated with roots decay symptoms [7].

Rhizobium rhizogenes was isolated from tumors that developed at the grapevines in Hungary [43] and Spain [29].

As a general aspect, the infection is a four-step process: injury the host plants; bacterial cells attach to the surface plant cells in wounded areas; Ti plasmid of bacteria is transferred into the host cells; the Ti-DNA integrates into the host cell genome. So, is well established that the plant injury is an essential step for the transformation process and also for attachment of bacteria to the plant surface cells, necessary for tumor initiation (fig. 1).

Infected planting material is the main source of pathogens. In the mother plantations dedicated for producing canes could be present infected plants without noticeable symptoms from which, material is harvested for grafting. Bacteria survive in canes, during the grafting process and also during growing seasons of vineyards, from which new pathogenic cells infect the surrounding soil. The bacteria can remain dormant for several years or cause galls to the grafting point and in areas where plants have been injured.

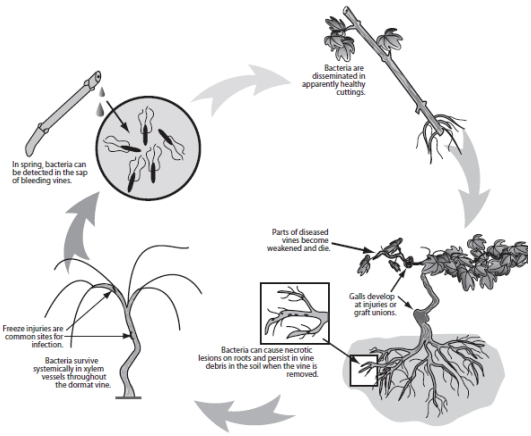


Fig. 1. Disease Cycle of Grape Crown Gall [6], [14]

The period of incubation for bacteria cells into the plant tissues varies, depending on plant age and environmental conditions. At a temperature of 20-25°C the incubation period is of 13-14 days, while at a lower temperature of 10-15°C are necessary 27-28 days for bacteria cell incubation. Infection potential is increased by a higher relative humidity of 80-90%, and decreased by light intensity. The disease is also favored by wet and compact soils, frost damage of plants, nitrogen fertilizers, low affinity between scion and rootstock, injury produced by hail, or attack of nematodes [41].

The *A. tumefaciens* bacteria cells are naturally present in the rhizosphere of woody plants and also of numerous herbaceous weeds. So, this pathogen is very easy spread during cultivation practices or disseminated as infected plant material with the soil, or with cultivation equipment when galls are removed manually with the same cutting tools used in pruning.

Biological control

Some strains of *A. tumefaciens* are sensitive to the agrocin antibiotic produced by *A. radiobacter*, a closely related bacterium that does not infect plants.

Knowing that *A. radiobacter* produced an analog of the opine, agrocinopine A (Agrocin-84) that inhibits DNA replication and also bacterial cell growth of *A. tumefaciens*, this feature was used for biological control [24]. So, a 1:1 ratio with cells of *A. tumefaciens* and A. *radiobacter* strain K84 suspended in water is used to treat seeds, seedling or cuttings before

planting. The Agrocin-84 acts only as a preventative treatment to protect any wound sites against pathogenic invasion, not to cure bacterial infections.

In the last years, has proposed utilization of non-pathogenic *A. vitis* strain F2/5 for biological control of virulent strains [10], [6]. This strain, like *Rhizobium leguminosarum* bv *trifolii*, produces an antibiotic (trifolitoxin - TFX) toxic to many *A. vitis* strains *in vitro*, reducing the number of galas, their size and in some cases killing pathogenic bacteria. Nonpathogenic *A. vitis* strains F2/5 may be applied on the injured tissues of the grapevines to prevent appearance of crown gall [23].

Another nonpathogenic strain of *A. vitis* (VAR03-1) was used by Kawaguchi and his team [25] as biological control agent against crown gall of grapevine plants. According to their data, by applying 1:1 ratio of pathogen/non-pathogenic strain suspension at tomato, sunflower and vines, were obtained a lower incidence of number of tumors. The authors considered this method as an effective one and recommended it to control crown gall of grapevine caused by tumorigenic *A. vitis, A. rhizogenes*, and *A. tumefaciens*.

Strain HX2 of *Rahnella aquatilis* was reported by Chen et al., [12] as a potential biological control agent for crown gall of grapevine. Antibacterial substance produced by this strain has a bactericidal effect against the virulent strain of *A. vitis*, both in vitro and in vivo conditions. *Rahnella aquatilis* HX2 was isolated from soil samples and has demonstrated to have a significant inhibitory effect in tumor growing at grapevines. By immersing the basal ends of grape cuttings in HX2 cell suspension was induced inhibition or completely prevented crown gall formation in plant material artificial infected with the virulent strain *A. vitis* K308. Further studies in vineyards revealed a normal plant growing and no microflora degradation on soil as result of HX2 cell suspension treatment [13].

For the control of *A. tumefaciens* pathogen were tested biological preparations of paurin and tumarin, obtained from *Pseudomonas fluorescens* cultures. Before planting, vines are dipped in solutions of paurin and tumarin for 10-15 minutes, or their roots are sprayed with these biological compounds to prevent further infection [27]

Chemical control

Studies on *Agrobacterium* pathogen infection in grapevines proved for the moment an ineffective effect of chemical compounds upon bacterial cells inside plant tissues, but benefic effects could be obtained by using different chemical solutions for treatment the infected soil. For example, it was established that antibiotics and copper compounds kill bacteria from galas, but do not destroy any pathogenic bacteria from plant tissues. As result, the pathogens are surviving and maintained through vascular system.

In the past was used methyl bromide with and without chloropicrin for pre-plant soil fumigation aiming to control of soilborne pathogens and weeds. Due to its dangerous effect on ozone layer of the upper atmosphere, the methyl bromide was forbidden since 2005. The researchers identified as alternatives to methyl bromide treatment a combinations of 1,3-dichloropropene, chloropicrin, and metam sodium. Other chemicals alternatives have been also proposed to replace the methyl bromide. One of these is acrolein (2-propenal), which has been formulated and registered for use as an aquatic herbicide in irrigation systems. This product was proved to have an efficient effect to control the *A. tumefaciens* in soil. It is also used to control microorganisms and bacteria in oil wells, liquid hydrocarbon fuels, cooling-water towers and water treatment ponds [18], [19]. The interaction between plants and pathogens was studied by Pu and Goodman [37] in vineyards established with indexed *Agrobacterium* free grapevines plants, but on *Agrobacterium*-infested vineyard soil. After 16 months, the bacteria were detected in grapevine plants. In early spring, when the sap begins to flow into the trunk was detected a high level of sap infection, revealing that the primary source of pathogens was the soil. So, was tested the influence of fumigation of the soil with Vorlex. The repeated analysis with the same trunks proved the decrease of initial infection level and also a lower frequency of tumours development as results of fumigation.

Other chemical substances, such as creosote-based compounds, copper-based solutions, and

strong oxidants (sodium hypochlorite) were tested to eradicate the crown galls. Every time the effect of applied treatment was a transient one. Eradication procedures with chemicals proved to be very laborious, need an adequate application, at a proper time, but with short time effects. Moreover, these type of treatments are costly and with unpredictable effect to the environment. The superficial treatments are ineffective against systemically infected plants. Generally, at the moment, chemicals are rarely used for control crown gall in grapevine plantation [24].

Possibilities to prevent the bacteria spread

A general acceptance is that there is no cure for crown gall disease in grapevine. Different methods were tested to remove the infected plants, or the surrounding infested soil, and parts of plants roots. Further are presented the main roles recommended to prevent the spread of *A. tumefaciens* bacteria:

- Grapevine propagation material must be provided from healthy mother plantations;
- Avoid setting up plantations in soil infected with virulent Agrobacterium spp. and / or with nematodes; do not establish a new plantation in clay soils, with poor drainage, in cold areas, wet, and northern exposure, or with low in nutrient or organic matter [46];
- Use frost resistant grapevine varieties for the new vineyards;
- Avoid the establishment of vineyards with susceptible varieties to crown gall, such as: 'Afuz Ali', 'Ceaus roz', 'Ceaus roşu', 'Italia', 'Merlot', 'Muscat de Hamburg', 'Regina viilor', 'Cardinal', 'Perla de Csaba', 'Cabernet Sauvignon', 'Chardonnay', 'Riesling italian', 'Baco Noir', 'Cabernet Franc', 'Chancellor', 'Gewürtztraminer', 'Limberger', 'Pinot Blanc', 'Pinot Gris', 'Pinot meunier', 'Pinot noir', 'Sauvignon Blanc' [22], [41];
- Use for the establishment of new vineyards less susceptible cultivars to crown gall, such as: 'Fetească regala', 'Furmint', 'Coarna neagra', 'Pinot gris', 'Zghihara de Husi', 'Cascade', 'Catawba', 'Concord', 'Delaware', 'Einset Seedless', 'Foch', 'Fredonia', 'Ives', 'Steuben', 'Vanessa', 'Ventura' [22], [33], [41];
- Use also as rootstocks only resistant or less susceptible varieties to crown gall, such as: 'Riparia Gloire', 'C 3309', 'SO 4', '101-14 Mgt', 'NAZ1', 'NAZ2', 'NAZ4', 'NAZ5' and 'NAZ6' [21], [31], [42], [43]. These rootstocks do not prevent infection but they have resistance to transformation. Rootstocks can greatly affect the severity of crown gall infection of grapevine [6]; [38]; [45];
- Strong recommendation is crop rotation in the vines nursery;
- Before planting, vines have to be carefully selected, sorted and excluded infected plants; in order to assure a good plant nutrition is recommended to supply the soil with nutrients and lime to avoid vine stress due to poor nutrition or low pH;
- Mud for sink vines roots before planting will be prepared with fungicide that provide protection against infections with bacteria, for example: copper sulphate 1%, Captadin 50 PU 1% Topas EC-0,025% [32] or Kasumin, Potassium salt 0,5%, Rovral, Mikal, Saprol in higher doses than to prevent fungal pathogens [49];
- All the equipments and tools used for cuttings and forcing the grapevines will be disinfected with formalin 2-5%, sodium hypochlorite 1-3%, before and during working;
- Disinfection of canes before storage;
- The planting material (scions and rootstocks) used for multiplication could be treated before grafting by: a) bathing for 15 minutes in formalin solution 0,3-1%; b) immersion in hot water at a temperature of 50-52°C, for 30-60 minutes [8] [11]; [16]; [30]; c) spraying or bathing with Chinosol W 0,5% or Solvochim 0,5%; d) dipping for 10-15 minutes in Captan 0,2% or copper sulphate 1% solution;
- After planting is important to avoid mechanical injury of the plants; for winter period is recommended to protect the trunks against frost, because any injury of the trunk as result of cold effect represent a gateway for bacteria entrance;
- Avoid as much as possible a supplementary nitrogen fertilization because could represent a food source for pathogenic bacteria cells;
- A supplementary potassium fertilization is recommended to improve vines resistance to cold, and also to obtain a better resistance of the canes to virulent species of Agrobacterium [6];
- Use the double or multiple trunk system of training. This system may be useful for

minimizing losses due to crown gall; if one trunk is infected, remove it. The remaining trunk can be pruned leaving a full number of buds until the second trunk can be renewed;

- Adopt a low or high management forms on the arms with periodic replacement;
- Avoid a prolong vegetation which is detrimental to cane maturation;
- Burying the mature grapevines canes for the winter period to avoid injury due to frost;
- Apply a correct treatment and in good time for Plasmopara viticola and Uncinula necator pathogens for a complete maturation of the wood [15];
- Treat the soil for nematodes presence; the nematodes injure the roots and stems of the grapevines and in the same time favor the penetration of bacteria into plant tissues [46];
- Apply specific treatment to kill all larvae and insects with chewing device, because they are passive carriers of the bacterium;
- From May to August are recommended treatments with products based on copper, such as: Turdacupral 50 PU 0,4 %; Funguran OH 50 WP 0,3%; Champion 50 PU 0,3%; Captadin 50 PU 0,2%; Captan 50WP 0,2% - to stop the proliferation of bacteria [32];
- Avoid cold water irrigation.
- Avoid plants mechanical injury during cultural practices;
- Remove the infected plants from nurseries and mother plantations;
- Diseased plant material will be collected and put into sealed packages to prevent the spread of infection to other plants or surrounding soil [32];
- All infected plants, or their debris will be burned;
- The soil have to be disinfected by steam; 2% formalin (10 l/m² especially in greenhouses) or leave gaps in the plantations for at least 3 years; the same procedure is applied for soil in greenhouses, with steam (82˚C for at least 30 minutes) or fumigants after removing all plant material. For soil fumigant are carefully followed all the manufacturer's directions and precautions;
- Weed control by mechanical work or/and with total herbicides is strongly recommended;
- Use the biological control methods to protect plants from possible infections with Agrobacterium tumefaciens - Galltrol-A, Nogall, Diegall and Norbac 84C before planting [17];
- Utilization products based on Bacillus subtilis for: disinfection of scion and rootstock strings for the production of grafted vines [32]
- Careful disinfection of spaces for grafting and forcing; tools used for cutting, or soil grinding in vine nursery have to be also disinfected periodically to prevent infection of healthy plants.

CONCLUSIONS

The best way to prevent the spread of crown galls in the vineyards is to use healthy planting material and to avoid soil contamination with the bacteria. So, in a mother plantations as source of producing scion and rootstock canes is compulsory to perform regularly phytosanitary inspections aiming to detect infected individuals, to remove these plants and then to destroy them. So, only healthy vine material, free of *Agrobacterium* virulent strains will be maintained in the vineyards and used as planting material. With grapevine, like any other crop plant, the most effective way is to use very efficient procedures to control and prevent the diseases. If the pathogen is detected in vineyards with valuable planting material are indicated chemicals and biological products treatments. These will stop, or reduce the spread of bacteria in the surrounding areas, but will not destroy the pathogen.

ACKNOWLEDGEMENTS

These results were obtained through POS-DRU/88/1.5/S/52614 project. The authors are thankful to the National Research and Development Institute for Biotechnology in Horticulture for the technical support.

REFERENCES

[1] Bautista-Zapanta J., Arafat H.H., Tanaka K., Sawada H., Suzuki K., 2007. *Variation of 16S-23S internally transcribed spacer sequence and intervening sequence in rDNA among the three major Agrobacterium species*. Microbiol. Res., 2009;164(6):604-12.

[2] Bobeş I., Comes I., Drăcea A., Lazăr A., 1972. *Fitopatologie*. Editura Didactică şi Pedagogică, Bucureşti, p.408.

[3] Bouzar H., Jones J.B., 2001, *Agrobacterium larrymoorei sp. nov., a pathogen isolated from aerial*

tumours of Ficus benjamina. Int J Syst Evol Microbiol 51, 1023–1026.
[4] Burr T.J., Crown Gall Disease – *Viticultural Information*. Crown Gall Disease – University of California, UC Integrated Viticulture, http://ucanr.org/sites/intvit/?uid=1&ds=351.
[5] Burr T.J., Bazzi C., Brissett M.N., 1991. *Crown gall, Agrobacterium tumefaciens* (Smith and Townsend) Conn. Integrated Pest Management.
[6] Burr T.J., Bazzi C., Sule S., Otten L., 1998. *Crown Gall of Grape: Biology of Agrobacterium vitis and the Development of Disease* Control Strategies. Plant Disease 82:1288-1297.
[7] Burr T.J., Bishop A.L., Katz B.H., Blanchard L.M., C. Bazzi, 1987. *A Root-specific decay of grapevine caused by Agrobacterium tumefaciens* and *Agrobacterium radiobacter biovar 3*. Phytopathology 77: 1424–1427.
[8] Burr T.J., Ophel K., Katz B.H., Kerr A., 1989. *Effect of hot water treatment on systemic Agrobacterium tumefaciens Biovar 3 in dormant grape cutting. Plant Disease* 73(3), 242–245.
[9] Burr T.J., Otten L., 1999. *Crown gall of grape: biology and disease management*. Annu Rev Phytopathol 37:53–80.
[10] Burr T.J., Reid C.L., 1994. *Biological Control of Grape Crown Gall with Non-tumorigenic Agrobacterium vitis Strain F2/5*. Am. J. Enol. Vitic. 45:2:213-219.
[11] Burr TJ, Reid CL, Splittstoesser DF, Yoshimura M., 1996. *Effect of heat treatments on grape bud mortality and survival of Agrobacterium vitis in vitro and in dormant grape cuttings*. *American Journal of Enology and Viticulture* 47, 119–123.
[12] Chen F., Guo Y.B., Wang J.H., Li JY, Wang H.M., 2009. *Biological control of grapevine crown gall: purification and partial characterisation of an antibacterial substance produced by Rahnella aquatilis strain HX2*. Plant Pathology, Volume 124, Number 3, 427-437.
[13] Chen F., Guo Y.B., Wang J.H., Li JY, Wang H.M., 2007. *Biological control of grape crown gall by Rahnella aquatilis HX2*. Plant Disease 2007 Vol. 91 Nr. 8 p. 957-963
[14] Creasap J.E., Burr T.J., 2006. *Grape Crown Gall. Integrated Pest Management*. http://nysipm.cornell.edu/factsheets/grapes/diseases/crown_gall.pdf.
[15] Dami I.E., 2005. *Mildwest grape production guide*. Ohio State University Extension - http://ohioline.osu.edu/b919/pdf/b919.pdf
[16] Dula T., Kölber M., Lázár J., Szegedi E. 2007. *Production of healthy grapevine propagating material: pathogens and methods*.
http://www.oiv2007.hu/documents/viticulture/Szegedi_OIV_2007_text.pdf
[17] Fravel D., Larkin R., 1996. *Availability and application of biocontrol products*.
http://wenku.baidu.com/view/4cfa12c34028915f804dc2c7.html
[18] Gerik J.S., Wang D., 2008. *Dose response of Agrobacterium tumefaciens to soil fumigants*. Page 110 in: Proc Annu. Intl. Res. Conf. Methyl Bromide Alternatives Emissions Reductions. http://mbao.org/2008/Proceedings/110GerikJmbao2008.pdf.
[19] Gerik S.J., Wang D., 2008. *Control of Agrobacterium tumefaciens with soil fumigants*. USDA/ARS San Joaquin Valley Agricultural Sciences Center, Parlier, CA, http://mbao.org/2008/110Gerik.pdf.
[20] Gheorghieş C., Cristea S, 2002. *Fitopatologie*. Vol.I, Editura Ceres, Bucuresti.
[21] Goodman R.N., Drimm R., Frank M., 1993. *The influence of grape rootstocks on the crown gall infection process and tumor development*. Am. J. Enol. Viti. 44:22-26.
[22] Hartman J., 2007. *Grape Crown Gall. Plant Pathology Fact Sheet*. www.ca.uky.edu/agcollege/plantpathology/ext_files/PPFShtml/PPFS-FR-S-11.pdf.
[23] Herlache T.C., Triplett E.W., 2002. *Expression of a crown gall biological control phenotype in an avirulent strain of Agrobacterium vitis by addition of the trifolitoxin production and resistance genes*. *BMC Biotechnology*, 2:2doi:10.1186/1472-6750-2-2, www.biomedcentral.com/1472-6750/2/2.
[24] Kado C.I., 2002. *Crown gall. The Plant Health Instructor*, DOI:10.1094/PHI-I-2002-1118-01, http://www.apsnet.org/edcenter/intropp/lessons/prokaryotes/Pages/CrownGall.aspx.
[25] Kawaguchi A., Inoue K., Sawada H., Nasu H., 2008. *Studies on diagnosis and biological control of grapevine crown gall*. Journal of Plant Pathology, 90 (2, Supplement), S2.81-S2.465.
[26] Kuykendall L.D., Young J.M., Martínez-Romero E., Kerr A., Sawada H., 2005. *Order Rhizobiales (new) Family Rhizobiaceae Genus Rhizobium. In Brenner, Krieg, Staley and Garrity (Eds), The Alpha-, Beta-, Delta- and Epsilonproteobacteria, The Proteobacteria, Part C, Bergey's Manual of Systematic Bacteriology, 2nd. Ed., Vol. 2*, Springer, New York, NY, pp. 324-340.
[27] Lemanova N.B., 1990. *Biological preparations for protection of grapes against bacterial canker*. Sadovodstvo i Vinogradarstvo 1990 No. 11, 30-32
[28] Li R., Qu R. 2010. *High throughput Agrobacterium-mediated switchgrass transformation. Biomass and Bioenergy*. doi:10.1016/j.biombioe.2010.11.025 http://www.cropsci.ncsu.edu/personnel/Qu_Ron/documents/Ruyu_B&B10.pdf
[29] López M.M., Palacio-Bielsa A., González-Abolafio R., Santiago R., Salcedo C.I., Penyalver R., 2008. *Tumorigenic Agrobacterium rhizogenes (biovar 2) isolated from grapevine in Spain*. Plant Pathol, 57:367.
[30] Mahmoodzadeh H., Nazemieh A., Majidi I., Paygami I., Khalighi A., 2003. *Effects of Thermotherapy Treatments on Systemic Agrobacterium vitis in Dormant Grape Cuttings*. Journal of Phytopathology, Volume 151, Issue 9, 481–484.
[31] Mahmoodzadeh H., Nazemieh A., Majidi I., Paygami I., Khalighi A., 2004. *Evaluation of crown gall resistance in Vitis vinifera and hybrids of Vitis spp*. Vitis 43 (2), 75–79, http://www.vitis-vea.de/admin/ volltext/e049975.pdf.
[32] Mihu G. et. al., 2010. *Solutii biologice de combatere a bacteriozelor patogene la plantele horti-viticole*. Editura Do-MinoR: Rawex Coms, Bucuresti.
[33] Naqvi SAMH, 2004. *Diseases of Fruits and Vegetables*. vol. 2, Kluwer Academic Publishers.

[34] Pacurar D.I., 2009. *Model organisms – a journey from the dawn of biological research to the post-genomic era Rom. Biotechnol. Lett.*, Vol. 14, No. 1, 4087-4094.
[35] Pacurar D.I., Thordal-Christensen H., Păcurar M.L., Pamfil D., Botez C., Bellini C., 2011. *Agrobacterium tumefaciens: From crown gall tumors to genetic transformation.* Physiological and Molecular Plant Pathology, Volume 76, Issue 2, 76-81.
[36] Pârvu M. 2010. Ghid *practic de fitopatologie*, Ediţia a III-a, Editura Presa Universitară Clujană, p. 386.
[37] Pu XA, Goodman R.N. 1993. *Effects of Fumigation and Biological Control on Infection of Indexed Crown Gall Free Grape Plants***.** Am. J. Enol. Vitic. 44:3:241-248.
[38] Ronald S.J., 2008. *Wine Science*. Editura Academic Pres, Ediţia a III-a.
[39] Sawada H., Ieki H., Takikawa Y., 1990. *Identification of grapevine crown gall bacteria isolated in Japan*. Ann Phytopathol Soc Jpn 56, 199–206.
[40] Sawada H., Ieki H., 1992. *Crown gall of kiwifruit caused by Agrobacterium tumefaciens in Japan*, Plant. Dis., 76-212.
[41] Severin V., Dejeu L., 1994. *Bolile şi dăunătorii viţei de vie*. Editura Ceres Bucuresti, p.124.
[42] Stover E.W., Swartz H.J., Burr T.J. 1997. *Crown gall formation in a diverse collection of Vitis genotypes inoculated with Agrobacterium vitis*. *Am. J. Enol. Vitic*. 48, 26-32.
[43] Stover E.W. 1993. *Resistance to crown gall in Vitis: Studies directed toward the identification of crown gall resistant rootstocks*. Maryland University, College park. Ph.D. Diss.
[44] Sule S. 1978. *Biotypes of Agrobacterium tumefaciens in Hungary*. J Appl Bacteriol 44, 207-213.
[45] Sule S., Burr T.J. 1998. *The influence of rootstock resistance to crown gall (Agrobacterium spp.) on the susceptibility of scions in grape vine cultivars*. Plant Pathology 47, 84-88.
[46] Sule S, Lehockzy J., Jenser G., Nagy P., Burr T.J. 1995. *Infection of grapevine roots by Agrobacterium vitis and Meloidogyne hapla.* J. Phytopathology 143, 169-171.
[47] Szegedi E., Bottka S., Mikulás J., Otten L., Sule S. 2005. *Characterization of Agrobacterium tumefaciens strains isolated from grapevine*. Vitis 44 (1), 49–54.
[48] Thies K.L., Griffin D.E., Graves C.H., Hegwood C.P., 1991. *Characterization of Agrobacterium isolates from muscadine grape*. Plant Dis. 75, 634–637.
[49] Tomoiagă L., 2011. *Şi viile încep să sufere de cancer.* Lumea Satului Nr.1, 1-15 Ianuarie 2011, http://www.lumeasatului.ro/si-viile-incep-sa-sufere-de-cancer_l918.html.
[50] Young J.M., Kerr A., Sawada H. 2005. *Genus II. Agrobacterium*. In: Bergey's manual of Systematic Bacteriology. Second Edition, Vol. 2 The Proteobacteria, Part C, Springer, New York, 340–345.
[51] h*ttp://*www.calspl.com/pdf/grapevine_crowngall.pdf (20.08.2011).

Scientific Papers, Series B, Horticulture, Vol. LVI, 2012
CD-ROM ISSN 2285-5661, ISSN-L 2285-5653

BEHAVIOUR OF SWEET CORN HYBRIDS GROWN AT DIFFERENT DENSITIES

Anne Marie VOICU (ENESCU)

Bucharest University of Agronomic Sciences and Veterinary Medicine, Faculty of Horticulture, 59 Mărăşti Avenue, postcode 011464, Bucharest, Romania, Phone +40 (21) 318 25 64, Fax +40 (21) 318 25 67, e-mail: annemarie_u2@yahoo.com

Corresponding author email: annemarie_u2@yahoo.com

Abstract

This paper presents research results of the Luduş, Mureş county on the influence of planting density (45,000, 60,000 and 75,000 plants / ha) on growth, development and production potential of four sweet corn hybrids of different origins. Data showed that culture density did not influence the conduct of any of the hybrids analyzed phenophases. Growing season ranged from 67-76 days, the earliest being hybrid Prima compared to H 702 (from Australia) which was delayed by nine days. In the average ear weight were recorded higher values for densities of 60,000 plants / ha, respectively 45,000 plants / ha, with a maximum on hybrid H 702 (400 g / ear). Lowest values were recorded for hybrid Prima grown at a density of 75,000 plants / ha (300 g / ear). The ears production varied differently compared with ear weight. Thus, there were higher mean values for density of 60,000 plants / ha, respectively 75,000 plants / ha, with a maximum of 29.36 t / ha in hybrid H 702. The lowest production was recorded in hybrid Prima on density of 45,000 plants / ha (17.94 t/ ha).

Key words: *development, growing, hybrid, Luduş, production.*

INTRODUCTION

Sweet corn, *Zea mays*, var. *rugosa* (Bonaf), convar. Saccharata Koprn (Sturt) is native to submountainous area of Peru and Bolivia, secondary center is Mexico and is one of the most popular vegetable crops in the United States and Canada [2]. In the U.S. is on second place like consumption volume after tomato and on seventh place like share between fresh vegetables [3]. Sweet corn is different by other types of corn by presence of a gene or genes that alter starch synthesis in endosperm [4].

The edible part of this plant is immature grain consists of endosperm and ovary wall. The sugar is the main component of taste for sweet corn. Taste is also determined by flavour, especially the bouquet that it appears during boiling of ears. Sweet corn is considered to be a real source of food, witch has proved to have a high caloric content and nutritional value compared to the usual corn. At technological maturity, seeds contain 25-27% dry matter, 14-15% carbohydrates, 5-5.5% protein, 0.75% fat, aminoacids, significant amounts of vitamins: C, B, PP, E and minerals (K, P, Ca, Mg, Fe) [5].

Sweet corn is used in food industry as raw material for canning, but it is also eaten fresh in the milk stage as boiled corn or in the preparation of different corn mashes, garnishes for steaks, stewed fruits, cream-soups of corn and flour from sugar corn is in the composition of various pastries [2, 6].

In Europe, significant areas are cultivated in France, Italy and Spain.

In our country sweet corn began to grow much later because of the fact that people used cultivars of corn for grain consumption, which is consumed during milk – wax stage, boiled or fried.

Recently, sweet corn began to be sold in supermarkets as fresh or preserved vegetable and because this product is known and appreciated by customers, explains the need for further studies on the development of technological measures to allow expansion of this culture in Romania.

The paper presents results of researches at Luduş, Mureş county concerning the influence of density on the growth,

development and productive potential of four hybrids of sweet corn.

MATERIAL AND METHOD

Experience was held in 2011 in Luduş, Mureş county. The trial was bifactorial, fitted by the method of subdivided parcels into four repetitions. The factor A was density of the culture, with three graduations (45,000, 60,000 and 75,000 plants/ha) and the factor B – hybrids, four graduations (Prima, Deliciul verii, Boston, H702) (Table 1).

During the experiment, it was realized many observations, measurements and determinations, which were used specific working methods namely (Photo 1):

Phenological determinations: sowing date, date of emerging, date of anthesis, date of silk emergence and date of harvest; calculation of number of days for each phenological phase and of the vegetation period.

Morphometric determinations: number of cobs/plant, length of cobs, number of rows of grains/cobs, number of grains/ rows. The determinations were made by variants and repetitions, on 10 plants by each plot.

Production potential was determined by recording the number of ears/plant, their average mass and calculation of the average production/plants or ha, for each variant studied. The results were interpreted statistically by analysis of variance [1].

The technology used in the experiences was selected from the literature for sweet corn [2, 5], except the density which was differentiated according to experimental variants.

Sweet corn harvesting occurs when they reach the maturity stage of consumption (milk-wax stage) when the cob is hard, well covered by leaves (sheets), and silk became brown and dry.

Table 1. The design of experience – Luduş 2011

Experience	Hybrid	Technological features		
		Method	Planting scheme (cm)	Density
Behaviour of sweet corn hybrids grown at different densities	Prima Deliciul verii Boston H702	sown directly	70/32 70/24 70/19	45,000 60,000 75,000

RESULTS AND DISCUSSIONS

The weather in Luduş, county Mureş in the vegetation period of year 2011 (April – August) coresponding to requirements of sweet corn, the warmest period was August.

Concerning the hidrological regime, the biggest quantity of precipitations was in June. The results concerning the influence of density of the culture on the phenological phases (phenophases) at sweet corn hybrids has been presented in Table 2.

It can be observed that density has no influence to phenophases at any hybrids. The length of period needed to reach each phenophase depends on hybrid. Also, the vegetation period depends by hybrid and it was of 67-76 days (from emerging to harvest). The earliest hybrid was Prima (67 days) and the latest was H702 (76 days).

Photo 1. Observation on the sweet corn variants

Table 2. The results concerning the influence of density of the culture on the phenological phases at some sweet corn hybrids Luduş - 2011

Density plants/ha	Specification	Phenological phases *				Vegetation period **
		Emergence	Anthesis	Silk emergence	Harvest	
45,000	Prima	14	58	61	81	67
	Deliciul verii	14	65	66	88	74
	Boston	16	65	67	89	73
	H702	16	68	70	92	76
	Average	15	64	66	87.5	72.5
60,000	Prima	14	57	60	81	67
	Deliciul verii	14	65	66	88	74
	Boston	16	65	67	89	73
	H702	16	68	70	92	76
	Average	15	64	66	88	73
75,000	Prima	14	58	61	81	67
	Deliciul verii	14	65	66	88	74
	Boston	16	65	67	89	73
	H702	16	68	70	92	76
	Average	15	64	66	87.5	72.5

*Days number from sowing (sowing time 10 May 2011);
**Days number from emergence to harvest.

The density influenced the elements which determine the production potential at sweet corn. The number of cobs/plant varied generally between 1-1.2 and only for H 702 varied from 1.5 at 45,000 plants/ha to 1.2 at 75,000 plants/ha. In the ear morphometry, it was noted that only one parameter varied – length of cob - which was between 17.3 cm (75,000 plants/ha) - 19.3 cm (45,000 plants/ha) (average values). H 702 was noted by the largest size cobs at all densities (Table 3).

Table 3. Morphometric characteristics of ears for different hybrids of sweet corn Luduş - 2011

Density	Hybrids	No. of cobs/plant	Ear length (cm)	Ear diameter (cm)	No.of rows	No. of grains /row
A1 (45,000)	Prima	1.1	17	4.00	12	36.7
	Deliciul verii	1.2	18	4.00	14	42.9
	Boston	1.1	21	4.00	16	37.5
	H702	1.5	21	4.00	20	42.7
	Average	1.2	19,3	4,00	16	38.3
A2 (60,000)	Prima	1.0	16	4.00	12	36
	Deliciul verii	1.1	16	4.00	16	36
	Boston	1.2	19	4.00	16	36
	H702	1.3	20	4.00	20	43
	Average	1.1	18	4.00	16	38
A3 (75,000)	Prima	1.1	14	4.00	12	37.5
	Deliciul verii	1.1	16	4.00	16	41.3
	Boston	1.1	19	4.00	16	41.9
	H702	1.2	20	4.00	20	42
	Average	1.1	17.3	4.00	16	40.7

In the weather conditions of 2011, at Luduş, Mureş county, average mass of ears was influenced by density. The biggest average mass was at density of 60,000 plants/ha (370g) and the smallest one at 75,000 plants/ha (309 g) (Table 4, Photo 2). Foreign hybrids has superior average mass compared to Romanian hybrids. On the first place was H702 at 60,000 plants/ha with an average mass by 400 g, which surpass the average value of the experience by 8.1%. On the last place was hybrid Prima at 75,000 plants/ha with an average mass of cob by 300 g, with 2.9% under experience average.

Hybrids studied were differentiated by weight components of the ear to its total mass.

The foreign hybrids was better than Romanian ones, with highest percentage (81.3%) of the ear without sheets from the total mass of the ear for hybrid H702 at 75,000 plants/ha, followed by Boston at 45,000 plants/ha (80.6%).

Concerning the average mass of cobs/plant, the behaviour of the hybrids was different, this fact explains by the different number of the cobs/plant. On the first place was H702 at all densities with the biggest value by 570 g/plant at 45,000 plants/ha. The smallest value (330 g/plant) was registered at hybrid Prima (75,000 plants/ha).

The average production for 45,000 plants/ha was surpassed by other two densities with very significant differences (Table 5).

Table 4. Influence of density of the culture on average mass of the ear at sweet corn hybrids, Luduş, 2011

Specification	The average mass(g)					The average mass g/plant
	Total ear+covering leaves	from which:				
		Ear (g)	% from total ear	covering leaves (g)	% from total ear	
45,000						
Average	362.5	275	75.9	87.5	24.1	435
Prima	360	250	69.4	110	30.6	396
Deliciul verii	350	260	74.3	90	25.7	420
Boston	360	290	80.6	70	19.4	396
H 702	380	300	78.9	80	21.1	570
60,000						
Average	370	255	69	115	31	407
Prima	340	240	71	100	29	340
Deliciul verii	360	240	67	120	33	396
Boston	380	260	68	120	31	456
H 702	400	280	70	120	30	520
75.000						
Average	309	225	72.8	84	27.2	340
Prima	300	200	66.7	100	33.3	330
Deliciul verii	310	210	67.7	100	33.3	341
Boston	306	230	75.2	76	24.8	337
H 702	320	260	81.3	60	18.7	384

Table 5. The influence of density on the sweet corn production, Luduş, 2011

Density	Average production (kg/ha)	(%)	Differences (kg)	Significance
a1(45,000)	20296.6	100.0		-
a2(60,000)	24973.9	123.0	4677.3	***
a3(75,000)	24757.1	122.0	4460.5	***
DL 5%			1089.6	
DL1%			1649.9	
DL 0.1%			2650.6	

If we discuss about the influence of the hybrid on the cobs production it can be observed that all hybrids surpass the hybrid Prima with very significant differences (Table 6).

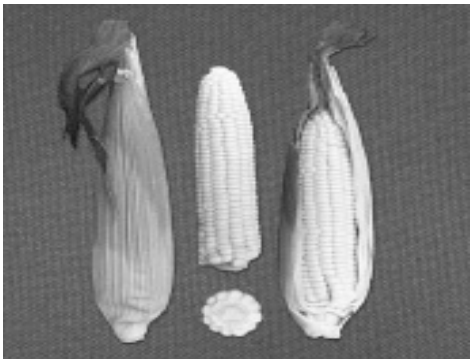


Photo 2. View of ear (cob) with and without sheets

Table 6. The influence of hybrid on the sweet corn production, Luduş, 2011

Density	Average production (kg/ha)	(%)	Differences (kg)	Significance
b1 -Prima	20,441.9	100.0	-	-
b2 – Deliciul verii	22,739.0	111.2	2,297.1	***
b3 - Boston	22,792.8	111.5	2,350.8	***
b4 -H702	27,396.5	134.0	6,954.6	***
DL 5%			678.2	
DL1%			916.4	
DL 0.1%			1,220.8	

Concerning the influence of hybrids on the sweet corn production at 45,000 plants/ha, it can be observed that hybrid H702 has the biggest production and surpass the hybrid Prima (control) with very significant difference (40.5% and 7,261 kg). The following ones was Deliciul verii which surpass the control with significant difference (8.5%, 1,520 kg) and Boston which realise insignificant difference (3.7%, 655.5 kg). At the density of 60,000 plants/ha all hybrids surpass the control with very significant differences and the biggest difference was at H702 (42.7%, 8,782.8 kg). At 75,000 plants/ ha only H702 surpass the control with very significant difference (21.1%, 4,820 kg) and the other two hybrids has significant differences (Table 7).

Table 7. The influence of hybrids on the sweet corn production at same density, Luduş, 2011

Density	Average production (kg/ha)	(%)	Differences (kg)	Significance
a1b1	17,937.5	100.0	-	-
a1b2	19,457.5	108.5	1,520.0	*
a1b3	18,593.0	103.7	655.5	-
a1b4	25,198.5	140.5	7,261.0	***
a2b1	20,575.8	100.0	-	-
a2b2	24,401.0	118.6	3,825.3	***
a2b3	25,560.3	124.2	4,984.5	***
a2b4	29,358.5	142.7	8,782.8	***
a3b1	22,812.5	100.0	-	-
a3b2	24,358.5	106.8	1,546.0	*
a3b3	24,225.0	106.2	1,412.5	*
a3b4	27,632.5	121.1	4,820.0	***
DL 5%			1,174.7	
DL 1%			1,587.3	
DL 0.1%			2,114.5	

If we consider both factors (density and hybrid), it can be observed that hybrid H702 behave uniform and surpass the other hybrids at all densities with very significant differences (Table 8).

Table 8. The influence of density and hybrid on the sweet corn production, Luduş, 2011

Variant	Average production (kg/ha)	(%)	Differences (kg)	Significance	Variant	Average production (kg/ha)	(%)	Differences (kg)	Significance
a1b1	17,937.5	100.0	-	-	a1b3	18,593.0	100.0	-	-
a2b1	20,575.8	114.7	2,638.3	**	a2b1	20,575.8	110.7	1,982.8	**
a2b2	24,401.0	136.0	6,463.5	***	a2b2	24,401.0	131.2	5,808.0	***
a2b3	25,560.3	142.5	7,622.8	***	a2b3	25,560.3	137.5	6,967.3	***
a2b4	29,358.5	163.7	11,421.0	***	a2b4	29,358.5	157.9	10,765.5	***
a1b2	19,457.5	100.0	-	-	a1b4	25,198.5	100.0	-	-
a2b1	20,575.8	105.7	1,118.3	-	a2b1	20,575.8	81.7	-4,622.8	000
a2b2	24,401.0	125.4	4,943.5	***	a2b2	24,401.0	96.8	-797.5	-
a2b3	25,560.3	131.4	6,102.8	***	a2b3	25,560.3	101.4	361.8	-
a2b4	29,358.5	150.9	9,901.0	***	a2b4	29,358.5	116.5	4,160.0	***
a1b1	17,937.5	100.0	-	-	a1b3	18,593.0	100.0	-	-
a3b1	22,812.5	127.2	4,875.0	***	a3b1	22,812.5	122.7	4,219.5	***
a3b2	24,358.5	135.8	6,421.0	***	a3b2	24,358.5	131.0	5,765.5	***
a3b3	24,225.0	135.1	6,287.5	***	a3b3	24,225.0	130.3	5,632.0	***
a3b4	27,632.5	154.0	9,695.0	***	a3b4	27,632.5	148.6	9,039.5	***
a1b2	19,457.5	100.0	-	-	a1b4	25,198.5	100.0	-	-
a3b1	22,812.5	117.2	3,355.0	***	a3b1	22,812.5	90.5	-2,386.0	00
a3b2	24,358.5	125.2	4,901.0	***	a3b2	24,358.5	96.7	-840.0	-
a3b3	24,225.0	124.5	4,767.5	***	a3b3	24,225.0	96.1	-973.5	-
a3b4	27,632.5	142.0	8,175.0	***	a3b4	27,632.5	109.7	2,434.0	**
DL 5%			1,309.0		DL 5%			1,309.0	
DL 1%			1,873.4		DL 1%			1,873.4	
DL 0.1%			2,761.9		DL 0.1%			2,761.9	

The productivity elments was in direct relation with the sweet corn production of cobs. The correlation between the average number of cobs/plant and the average production of cobs it was distinct significant for density of 45,000 plants/ha (r = 0.9935), significant for 60,000 plants/ha (r = 0.9819), respectively insignificant (r = 0.9395) for 75,000 plants/ha (Fig. 1, 2, 3).

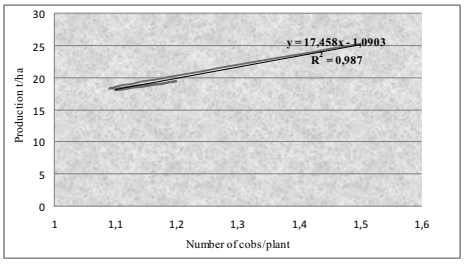


Fig. 1. Correlation between the number of cobs/plant and production (45,000 plants/ha).

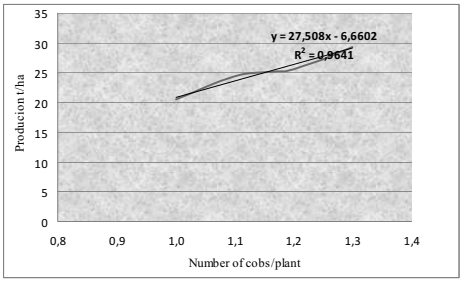


Fig. 2. Correlation between the number of cobs/plant and production (60,000 plants/ha).

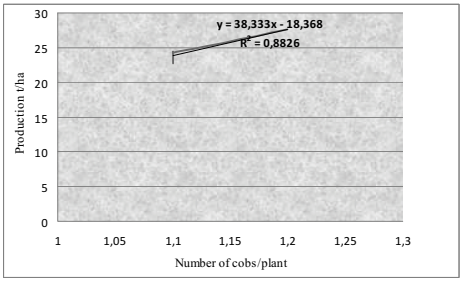


Fig. 3. Correlation between the number of cobs/plant and production (75,000 plants/ha)

The correlation between the average mass of the ear and the average production of ears/ ha was insignificant for the density of 45,000 plants/ha (r = 0.7183) and significant for 60,000 plants/ha (r = 0.9819), respectively 75,000 plants/ha (r = 0.978) (Fig. 4, 5, 6).

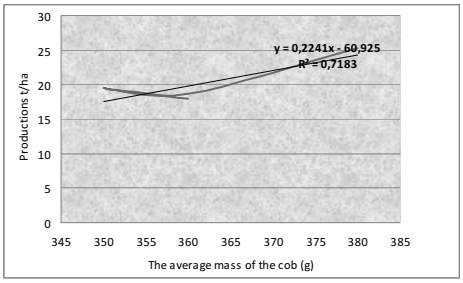


Fig. 4. Correlation between the average mass of the cob and production (45,000 plants/ha)

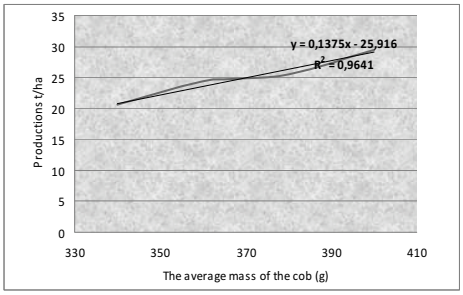


Fig. 5. Correlation between the average mass of the cob and production (60,000 plants/ha)

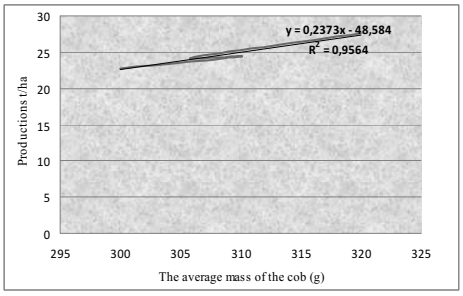


Fig. 6. Correlation between the average mass of the cob and production (75,000 plants/ha)

CONCLUSIONS

The density of culture does not influenced significant the display of phenophases.

The length of the ear decrease with the increasing of density and the diameter and the number of rows of grains/ cob remain at the same value.

The biggest value of trial average mass of the ear it was obtained at density of 60,000 plants/ha (370 g).

The rate of the trial average mass of the cobs without sheets from the total mass of the ear was the biggest at 45,000 plants/ha.

The average number of the ears/plant vary in small limits and decrease while the density increase from 1.2 ears/plant (45,000 plants/ha) to 1.1 ears/plant (75,000 plants/ha).

The average mass of cobs/plant decrease while the density increase from 435 g /plant (45,000 plants/ha) to 340 g /plant (75,000 plants/ha).

The best density was of 60,000 plants/ha, where it was registered the maximum value of 24,970 kg/ha.

From the analysis of the values of the correlation coefficient, it can be noted that only for the density of 60,000 plants/ha exists significant correlation between production and both productivity parameters (number of cobs/plant and average mass of cobs).

Concerning the results obtained in the vegetation conditions of 2011, it can be concluded that the optimum density of culture it was of 60,000 plants/ha.

REFERENCES

[1] Ardelean, M., Sestraş, R., Cordea Mirela, 2007, Horticultural experimental technique, AcademicPres Publishing House, Cluj-Napoca, p. 46-53.

[2] Ciofu Ruxandra, Stan, N., Popescu, V., Chilom Pelaghia, Apahidean, S., Horgoş, A., Berar, V., Lauer, K.F., Atanasiu, N., 2004, Treaty of vegetable crops, Ceres Publishing House, Bucharest, p. 890-899.

[3] Goldman, I.L., Tracy, W.F., 1994, Kernel protein concentration in sugary-1 and shrunken-2 sweet corn, Hort. Science 29 (3): 209-210.

[4] Haş Voichiţa, 1999, Variability of sweet corn hybrids under the influence of growing conditions, ICCPT- Fundulea Annals, vol. LXVI.

[5] Stan, N., 1992, Vegetable crops, Didactic and Pedagogical Publishing House, Bucharest, p. 350-352.

[6] Vâlceanu, G., 1982, Growing of less widely vegetables, Sweet corn, Ceres Publishing House, Bucharest, p. 209-212.


EX·TERRA·AVRVM

Scientific Papers, Series B, Horticulture, Vol. LVI, 2012
CD-ROM ISSN 2285-5661, ISSN-L 2285-5653

THE INFLUENCE OF THE TREATMENTS WITH GROWTH PROMOTERS AND FOLIAR FERTILIZERS ON PROTECTED CROPS OF TOMATOES

Jeni Gianina VOICU (SIMION)

Bucharest University of Agronomic Sciences and Veterinary Medicine, Faculty of Horticulture, 59 Mărăşti Avenue, postcode 011464, Bucharest, Romania, Phone: +40 (21) 318 25 64, Fax: +40 (21) 318 25 67, e-mail: gianina.simion@yahoo.com

Corresponding author email: gianina.simion@yahoo.com

Abstract

The work presents results obtained in protected culture of the tomatoes under different treatments with growth promoter (V4 - P & R) and foliar fertilizers (Folimax, Agriphyte). The hybrid Balkan grown in the south of Romania in plastic high tunnels, reacted favourably to the treatment experienced. The vegetation period of the plants have been reduced from 121 days (V1-untreated control) to 110-113 days (foliar fertilizers: V2 – Folimax, V3 – Agriphyte). For the growth promoter (P & R) the vegetation period have been reduced to 107 days. Therefore it is possible to see that the vegetation period was reduced with 14 days for V4 P&R and with 8-11 days (V2 Folimax, V3 Agriphyte). It has been remarked favourable effect on growth in height of the tomato plants (with 12-19 cm higher than V1). The treatments with growth promoter and foliar fertilizers also has determined an increase in the number of fruits on the plant and in the mean mass of the fruits (with 11 -12. 5 g than V1). The yield was 54.6 t/ ha (V1 untreated control), 59.4 t/ ha (V4 - P&R) 66.3 (V2 Folimax) and 69.6 t / ha (V3 Agriphyte), the differences being significant and very significant.

Key words**:** *Agriphyte , Folimax, Lycopersicon esculentum, Mill., P&R,, tomatoes.*

INTRODUCTION

Because of the big request for consumption, tomatoes are the most cultivated vegetable species on protected crops from Romania.

The benefits of this culture system are: possibility to obtain of sorts of vegetables according to the request of the market; earliness; good prices; possibility to obtain tomatoes almost all year; big productions/ha [6].

For obtaining good productions with maximum economic efficiency it needs to practice some technologies in which stimulating of growth and development of plants, fertilisation and pest control are the most important works. In the production technologies can be used different fertilizers, growth promoters and foliar fertilizers.

Researches on use of fertilisers in protected crops shows that use of foliar fertilizers has very good effects in vegetable crops in all growth and development phases [3, 4].

Foliar fertilisation is very used in vegetable protected crops and it has some advantages like: use of reduced concentration of mineral elements, easier application simultaneously with pesticides and rapid correction of nutritional deficiency [6].

Between foliar fertilizers, the literature mentions foliar fertilizers type F (231; 141; 411), the product Cropmax [2], liquid foliar fertilizer Folimax [5]. The growth promoters are used for the regulation of the processes of growth and development of plants especially when the microclimate conditions are not favourable.

Many authors recommended that the treatments must be applied when the flowers are completely opened with a solution of Tomatoset, Tomafix, Duraset, or Tomato-stim.

The paper presents partial results regarding the influence of the treatments with growth promoters and foliar fertilizers on growth, development and production of tomatoes for protected crops.

MATERIAL AND METHOD

The main objective of the research has been determining the optimal variant of stimulation

and foliar fertilization of tomatoes in protected crops in order to obtain early production of good quality fruits. Experience has been carried out in 2011 in Poiana, Ialomiţa County in high tunnel of 480 m^2.

The experimentation has been carried out in random blocks in three repetitions and experimental variants consist of three products: two foliar fertilizers and one growth promoter, which were compared with the control (untreated), (Table 1).

Table 1 Experimental variants -hybrid Balkan-2011

Variants / treatments	Specification
V1 Control (untreated)	-
V2 Folimax-0.3%	Foliar fertilizer with microelements; ensure steady growth, disease resistance, increase the number of fruits and production.
V3 Agriphyte-0.3%	Foliar fertilizer with 33% phosphorus, and 28% potassium; secondary has systemic fungicide properties.
V4 P&R-0.5%	Organic product with role of protection and recovery of the plants from damage caused by extreme temperatures or diseases; help to a better use of the nutrients in different types of soils; increase the assimilation of some nutrients (Fe, Zn, Mn, B, Cu); may be used together with protective agents for plants (herbicides, insecticides, fungicides).

Biological material has been represented by hybrid Balkan: early tomatoes indefinite, the plants are vigorous, fruits are round with 3-4 seeds lodge, dark red, uniform, of 250-300g weight and 4-5 fruit in a cluster, fruits are resistant to cracking, recommended for cultivation in plastic tunnels and field.

The technology used in the experiences was selected from the literature for tomatoes [2].

Under climatic conditions of the year 2011, the culture has been established by planting of seedling on 29 of the April. The seedling was by 60 days old, 20-22 cm height, 4-5 mm thickness of stem, 5-6 leaves and it has first inflorescence. The density used was 36.000 plants/ha. It has been applied fertilization with different fertilizers (Folimax, Agriphyte) and growth promoter (P&R), depending on experimental variants. Harvesting was done from the second decade of the July, by variants.

During the experimentation period has been carried out observations, measurements and determinations, which were used specific working methods namely:

Morphometric determinations - plant height - 10 plants /repetition (30 plants/variant);

Phenological determinations: sowing date, date of emerging, date of planting, date of flowering and date of harvest.

Production potential was determined by recording the number of fruits/plant, average mass of fruits and by calculation of the average production/plant and ha, for each variant studied. The results were interpreted statistically by analysis of variance and it has been determined the correlations between parameters of productivity and yield [1].

RESULTS AND DISCUSSIONS

In the conditions of the place Poiana, Ialomiţa county in the year 2011, emergence it has been produced on February 28, on 3 days after seeding. The period from emergence to flowering was different depending by variant: 75 days for variant V1 (control), 76 days for V2 (Folimax), 79 days for V3 (Agriphyte) and 81 days for V4 (P & R). From the analysis of these data it can be said that both of the two fertilizers as well as growth promoter used has determined a slight delay in the processes of development of the plants. Differences from the control in respect of flowering have been 1-4 days at Folimax and Agriphyte, and 6 days at P & R. The beginning of fruits setting it can be observed first at control on May 25, at 87 days from emergence. At the other variants beginning of fruits setting occurred at 88 days (V2), 89 days (V3) and, 90 days (V4), with a delay of 1-2 days on the two fertilizers and 3 days on the P&R.

Analyzing the beginning of the harvest it can be observed that it has been some changes. First variant has been harvested V4 - P&R (July 15, at 138 days from emergence and 63 days from treatment), followed by V3 – Agriphyte (July 18, at 141 days from emergence and 66 days from treatment), V2 – Folimax (July 21, at 144 days, respectively 69 days) and the last was V1 - control (July 29, at 152 days from emergence).

It can be observed the favourable effect of fertilizers and stimulators on decreasing of vegetation period. The treatments stimulate the maturity of fruits by 14 days for P&R, 11 days for Agriphyte and 8 days for Folimax (Table 2, Fig. 1, Photo 1).

Table 2. The influence of stimulation and foliar fertilization on the phenophasis of the protected cultures of tomatoes – hybrid Balkan - 2011

Variant	Sowing time	Emergence time	Flowering time		Beginning of fruits setting		Beginning of harvesting			Period of vegetation	
			Date	Days no. from emergence	Date	Days no. from emergence	Date	Days no. from emergence	Days no. from treatment	Days no. from emergence	Differences
V1 Control	25.02	28.02	13.05	75	25.05	87	29.07	152	-	152	-
V2 Folimax			14.05	76	26.05	88	21.07	144	69	144	8
V3 Agriphyte			17.05	79	27.05	89	18.07	141	66	141	11
V4 P&R			19.05	81	28.05	90	15.07	138	63	138	14

* Planting: April 29
** Application of treatment: May 13

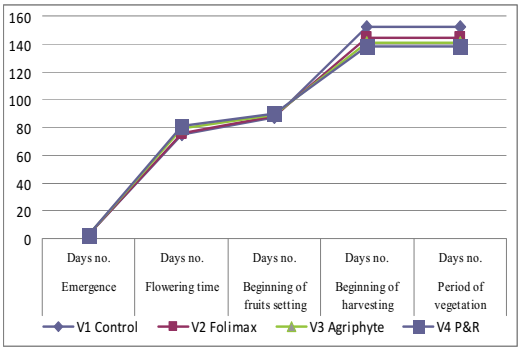


Fig. 1. The influence of stimulation and foliar fertilization on the phenophasis of the protected cultures of tomatoes –hybrid Balkan – 2011

Photo 1. Observation at tomato variants

The height of plants at 35 days from treatments (June 18) vary between 103,3 cm at V1-control and 122.9 cm at V4-P&R, which surpass the control by 19.6 cm. On the 28th of August, after three months of the treatments, the height of the plants was by 182.9 cm for V4, which surpass the control with 14.5 cm. The influence of treatments on the height of plants were bigger at first determination (35 days from treatments) than second one. The differences between treated variants and control was by 12.1-19.6 cm (first determination), bigger than the differences measured at second determination (9.9-14.5 cm). At both determinations the differences was very significant for P&R and for Agriphyte and distinct significant for Folimax (Table 3, Fig. 2).

Table 3. The influence of treatments with stimulators and foliar fertilizers on average height of plant at one month, respectively three months from treatments

Variant	Date	The average height			Significance	Date	The average height			Significance
		-cm-	Differences	% from control			-cm-	Differences	% from control	
V1 Control	18.06.	103.3	-	100.0	-	28.08.	168,4	-	100.0	-
V2 Folimax		115.4	12.1	111.7	**		178,3	9.9	105.9	**
V3 Agriphyte		122.1	18.8	118.2	***		182,6	14.2	108.4	***
V4 P&R		122.9	19.6	119.0	***		182,9	14.5	108.6	***
DL 5%		5.7198741				DL 5%	4.432251			
DL 1%		8.6615236				DL 1%	6.7116943			
DL 0.1%		13.914469				DL 0.1%	10.782129			

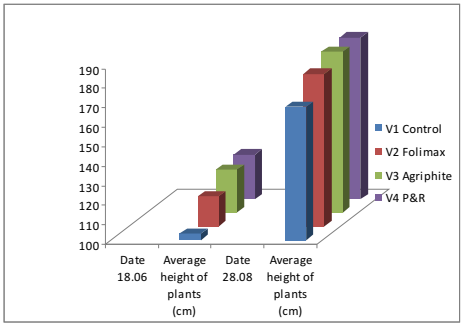


Fig. 2 The influence of treatments with stimulators and foliar fertilizers on average height of plants

The treatments has been influenced the dynamics of harvest at protected crops of tomatoes (Table 4, Fig. 3, Photo 2).

Regarding the precocity of harvest it can be observed that the best results were obtain at P&R, which was harvest with 14 days before control, followed by Agriphyte (6 days before control), respectively Folimax (3 days before control).

Consider the yield obtained until the end of July it can be observed that the treatments has been influenced the precocity of the harvest. On first place it was ecologic stimulator P&R which until end the July was harvested 55.5% from the total production, followed by Agriphyte (41.4%) and Folimax (36.2%). At the same time the control has only 23.4% from the total production.

Consider the total production on the first places it was the foliar fertilizers variants (V2 and V3) which surpass the control with 21-27%.

Table 4. Dynamics of harvest at tunnel tomatoes culture – Balkan-2011

Variant	Date								Total	
	15.07.	18.07.	21.07.	29.07.	Total July		10.08.	15.08.		
					Kg/pl.	% from total			kg/plant	%
V1 Control	-	-	-	0.356	0.356	23.4	0.400	0.764	1.520	100
V2 Folimax	-	-	0.313	0.353	0.666	36.2	0.432	0.742	1.840	121
V3 Agriphyte	-	0.134	0.310	0.355	0.799	41.4	0.464	0.667	1.930	127
V4 P&R	0.122	0.152	0.303	0.339	0.916	55.5	0.356	0.378	1.650	109

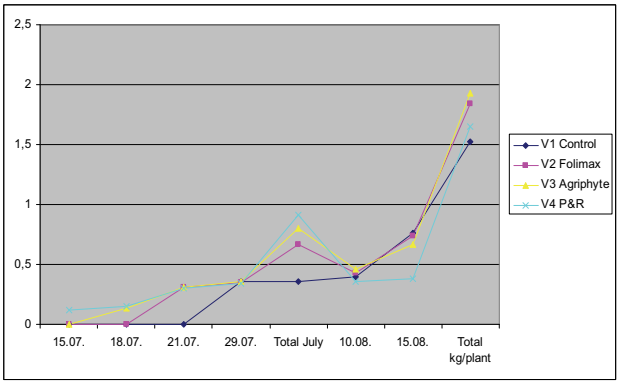


Fig. 3. Dynamics of harvest at tunnel tomatoes culture– 2011

Photo 2. Fruits of hybrid Balkan

In the climatic conditions of the year 2011 the number of fruits/plant was by 19 to 22. While applying foliar fertilizers Folimax and Agriphyte has caused a rise in the number of fruits on the plant with 6-9%, the stimulator P&R has caused decrease with 7% of the number of fruits (Table 5). The average mass of the tomato fruits was between 75 g (control) – 87 g (P&R). It can be seen that all treated variants surpass the control by 15-17%.

The production of tomato hybrid Balkan in the year 2011 was between 54.6-69.6 t/ha. The best results was obtained at variants treated with Agriphyte and Folimax, in witch the differences of 15 t/ha respectively 11.7 t/ha against the control it was very significant. The difference of 4.8 t/ha against the control

for P&R variant was distinct significant (Table 6).

Table 5. The influence of treatments with stimulators and foliar fertilizers on the productive potential- tunnel tomatoes – Balkan-2011

Variant	Fruits no. / plant	%	Average mass of fruits	%
V1 Control	20.4	100	74.6	100
V2 Folimax	21.6	106	85.4	115
V3 Agriphyte	22.3	109	86.7	116
V4 P&R	18.9	93	87.1	117

Table 6. The sinthesis of production results at tunnel tomatoes hybrid Balkan - 2011

Variant	Total production (t/ha)	%	Difference (t/ha)	Significance
V1 Control	54.6	100	-	-
V2 Folimax	66.3	121	11.7	***
V3Agriphyte	69.6	127	15	***
V4 P&R	59.4	109	4.8	**

DL 5% 2.4143518
DL 1% 3.6560184
DL 0.1% 5.8732802

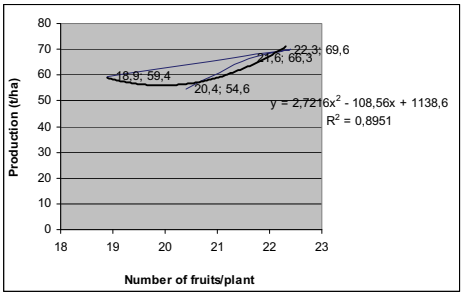


Fig. 4. Correlation between the number of fruits and tomatoes production

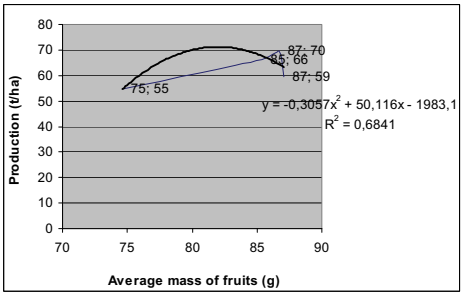


Fig. 5. Correlation between the average mass of fruits and tomatoes production

In Fig. 4 and Fig. 5 are shown correlation between total production of fruits and two parameters of production: fruits number/plant and average mass of the fruits.

The significant correlation coefficient (r = 0.950) between average number of fruits/ plant and average production at tomato hybrid Balkan indicates a strong relation between these characters. Contrary, the insignificant correlation coefficient (r = 0.827) between the average mass of the fruits and average production suggest that it doesn't exist any relation between these characters. These explain why the production of the fruits at P&R variant is lower than the other two treatment variants, despite of the bigger value for P&R variant average mass.

CONCLUSIONS

Treatments with stimulators and foliar fertilizers has been influenced the number of days necessary for each phenophase at tomato plants and reduced the period of vegetation (two weeks compare to control for P&R and 8-11 days at Agriphyte and Folimax).

The growth of plants was influenced very significantly by treatments with stimulator and foliar fertilizers. After one month the treated plants grow with 18.8 to 19.6 cm taller than control plants (untreated).

Foliar fertilizers determined the increasing of number of fruits/plant with 6-9% compare to control. On contrary P&R treatment determined decreasing of the number of fruits/plant with 7%.

The average mass of the fruits has been positively influenced by all treatments and the fruits was bigger with 15-17% than control. The biggest value of average mass of fruits was obtained at P&R variant.

There was discovered positive correlations between the productions and the two parameters of productions (number of fruits/plant and average mass of fruit). The value of correlation coefficient was bigger for the number of fruits/plant. The biggest productions of fruits was obtained at Agriphyte variant (69.6 t/ha) and Folimax 66.3t/ha which surpass the control very significantly, followed by P&R variant (59.4 t/ha) which surpass the control with a distinct significant difference.

REFERENCES

[1] Ardelean, M., Sestraş, R., Cordea Mirela, 2007. *Horticultural experimental technique*. Academic Pres Publishing House, Cluj-Napoca, p. 30-33.
[2] Ciofu Ruxandra, Stan, N., Popescu, V., Chilom Pelaghia, Apahidean, S., Horgoş, A., Berar, V., Lauer, K.F., Atanasiu, N., 2004. *Treaty of vegetable crops.* Ceres Publishing House, Bucharest, p. 308-319, 431-442, 603-646.
[3] Davidescu, D., and Davidescu Velicica, 2000. *Horticultural agrochemistry*. Ceres Publishing House, Bucharest.
[4] Lăcătuş, V., et al., 2005. *Vegetable crops in greenhouses and plastic tunnels*. Ceres Publishing House, Bucharest.
[5] Lăcătuş, V., 2006. *Fertilization of tomato plants cultivated in protected system*. Sesion of Scientific Paper, Vidra.
[6] Voican, V., Lăcătuş, V., 2002. *Protected culture of vegetables in greenhouses and plastic tunnels*. Ceres Publishing House, Bucharest.

Scientific Papers, Series B, Horticulture, Vol. LVI, 2012
CD-ROM ISSN 2285-5661, ISSN-L 2285-5653

INFLUENCE OF VARIETY AND TREATMENTS WITH GROWTHS PROMOTERS AND FOLIAR FERTILIZERS ON GROWING AND DEVELOPMENT OF LETTUCE IN PROTECTED CROPS

Jeni Gianina VOICU (SIMION)

Bucharest University of Agronomic Sciences and Veterinary Medicine, Faculty of Horticulture, 59 Mărăşti Avenue, postcode 011464, Bucharest, Romania, Phone: +40 (21) 318 25 64, Fax: +40 (21) 318 25 67, e-mail: gianina.simion@yahoo.com

Corresponding author email: gianina.simion@yahoo.com

Abstract

The work presents results obtained in protected culture of the lettuce for autumn – winter harvest under different treatments with growth promoter (V4 - P & R) and foliar fertilizers (V2 Folimax, V3 Agriphyte) grown in the south of Romania in plastic high tunnels. These two varieties used in the experience have been distinguished by both vegetation period (125 days and May King and 85 days at Great Lakes 118), as well as by specific reaction to the treatments application. Plant growth was influenced differently by the two foliar fertilizers, the biggest differences from the control was on V3 (Agriphyte) for the variety May King and on V2 (Folimax) for Great Lakes 118. Plant height has increased on average by 1-1.5 cm; diameter rosette of leaves has reached 32 cm , respectively 28 cm; average weight of the lettuce head has exceeded the control with 17% for variety May King and with 4% for Great Lakes 118. Concerning the production of lettuce (t/ha) the influence of experimental treatments was similar to that observed on plant growth. From the control, the greatest differences in production were obtained in variant treated with Agriphyte (17.5 %) for the variety May King and to the fertilizer with Folimax, in the case of the variety Great Lakes 118 (4 %). The smallest production differences for both varieties was registered at V4 (P&R).The results show that for the variety May King the yield was 24 t/ha (V1 control) to 28 t/ha (V3 Agriphyte . Variety Great Lakes 118, gives yield average by 26 t/ha (V1control) to 27 t/ha (V2 Folimax).

Key words**:** *Great Lakes 118, high tunnels, Lactuca sativa L., May King.*

INTRODUCTION

The lettuce is cultivated regularly at early in spring and in autumn late like successive cultures. This system of culture assure the needs of vegetables in these periods of the year, creates the possibility to use more intensive the constructions and assure more benefits to producers. Short vegetation period and reduced height of plants recommended lettuce like a very good associated culture [2].

The advantages of this system of culture are the following: possibility of obtaining of very early and early productions, possibility of obtaining good harvest long time during the year, good quality of the products, obtaining of big production/ha, avoiding of aparition of weather accidents. Lettuce is cultivated for its heads, which are consumed mostly fresh like salads.

In recent times because of orientation of the population to a nutrition regime more close to nature, lettuce has begun one of the most consumed vegetable [2, 3]. It has nutritional importance because of the high content of vitamins, mineral salts and nutritive substances as following: 100 g of lettuce contains 43 mg Ca, 32 mg P, 0.3 mg Fe, 350 mg K, 15 mg vitamin E, 4.2 mg vitamin A, 0.07 mg vitamin B_1, 0.08 mg vitamin B_2, 0.5 mg vitamin PP. It contains also in this quantity of leaves 0.1 % sugar, 1.4 % proteins, 0.5 % cellulose. Lettuce is a good vegetable for remineralization, cleanser, sedative, emollient. Its energetic value is of 16 calories. Lettuce juice has very good properties because of the high content in magnesium and iron. This species was cultivated long time ago. Egiptians, greeks and romans cultivate lettuce on large surfaces and apreciated this culture like a very valuable vegetable. In present, lettuce is spread on all continents, on large areas, especially in the countries from Western Europe, in USA and

Japan. In the US, for example, this culture occupies over 100,000 ha and the consumption/inhabitant reached 10 kg/year. In our country, lettuce is grown both in pure culture and in the system of associated and successive culture, in all counties and especially around big cities and industrial centers, occupying 14,000-15,000 ha annually.
Different authors recommended for prolongation of preservation of lettuce a big number of products. Relatively recent was discovered many regulators of growth and fruiting with a large application in vegetables crops. They are natural or synthetic hormonal substances which influence the processes of growth and development of plants [4]. The authors shows that is possible to apply these products in combination with foliar fertilizers.
These foliar fertilizers are used on large scale in vegetable protected crops because of some advantages like: reduced concentration of mineral elements and quickly correction of nutrition deficiencies [5].

MATERIAL AND METHOD

The main objective of research was to determine the optimal variant of stimulation and foliar fertilization of the lettuce in protected crops for obtaining early and hi quality production.
The experience was held in 2011 in village Poiana, Ialomiţa county, in high tunnels on a surface of 400 m^2. The installation of trial was done in subdivided parcels, in three repetitions.
The experimental variants consist of three products used: two foliar fertilizers and one natural stimulator, which are compared with a untreated control (Table 1).
The technology used in the experiences was selected from the literature for lettuce [2].
Under climatic conditions of the year 2011, the culture has been established by planting of seedling on 18 of the October. The seedling was by 49 days old, 5-6 leaves.
Biological material has been represented by two varieties: May King and Great Lakes 118, recommended for protected and open field crops. (Table 2, Photo 1). The density used was 160,000 plants/ha.

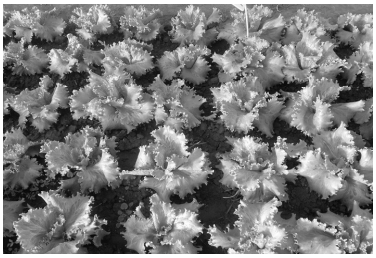


Photo 1. View with variety Great Lakes 118

Table 1 Experimental variants – 2011

Biological material	Treatments	Specification
May King Great Lakes 118	V1 Control (untreated)	-
	V2 Folimax-0.3%	Foliar fertilizer with microelements; ensure steady growth, disease resistance, increase the number of fruits and production
	V3 Agriphyte-0.3%	Foliar fertilizer with 33% phosphorus and 28% potassium; secondary has systemic fungicide properties
	V4 P&R-0.5%	Organic product with role of protection and recovery of the plants from damage caused by extreme temperatures or diseases; help to a better use of the nutrients in different types of soils; increase the assimilation of some nutrients (Fe, Zn, Mn, B, Cu); may be used together with protective agents for plants (herbicides, insecticides, fungicides).

Table 2. Description of the lettuce varieties from the trial

Biological material	Characterization
May King	Early variety, for protected and open field crops, for autumn and spring, with compact medium head, blade present corrugating; resistent to flowering.
Great Lakes 118	Mid – early variety, for protected and open field crops; with head by round to oval shape, with curled leaves, crisp and of iceberg type.

At two weeks from planting it was applied treatments with growth promoter (P&R) and foliar fertilizers (Folimax and Agriphyte) in accordance with experimental variants.
Harvesting was done from the first half of the December, by variants. During the experimentation period has been carried out observations, measurements and determinations, which were used specific working methods namely: Phenological determinations: sowing date, date of emerging, date of planting and date of harvest and was

counted the number of days necessary for each phenophase and also the vegetation period.
Morphometric determinations: average number of leaves, diameter of rosette and the height of plant on 10 plants/ variant; Production potential was determined by registering of the mass of each head harvested by variants.
The results were interpreted statistically by analysis of variance and it has been determined the correlations between parameters of productivity and productions [1].
The paper presents partial results regarding the influence of the treatments with growth promoters and foliar fertilizers on growth, development and production of lettuce for protected crops.

RESULTS AND DISCUSSIONS

In weather conditions of the year 2011 from Poiana, the emergence occured on 3rd of September (at 4 days from sowing) for May King and for Great Lakes 118 on 5th of September (6 days from sowing).
Planting was done on 18th of September, at 49 days for both varieties.
For May King, all treated variants was harvest before the control. First variant was V3 (Agriphyte), at 102 days, compare with control, at 107 days from sowing. The vegetation period was between 98-103 days. First variant for Great Lakes 118 was also Agriphyte at 97 days. Vegetation period was between 91-97 days depends by variants (Table 3, Fig. 1, 2).
The results shows the favourable effect of the stimulators and foliar fertilizers to earliness.

Table 3. The influence of stimulation and foliar fertilization on the phenophasis of the protected cultures of autumn lettuce varieties May King and Great Lakes 118 - 2011

Variety	Treatment	Sowing date	Phenophases*						Vegetation period **
			Emergence		Planting		Harvest		
			Date	Days no.	Date	Days no.	Date	Days no.	Days no.
May King	V1 Control	30.08.2011	3.09.2011	4	18.10.2011	49	15.12.2011	107	103
	V2 Folimax						12.12.2011	104	100
	V3 Agriphite						10.12.2011	102	98
	V4 P&R						14.12.2011	106	102
Great Lakes 118	V1 Control		5.09.2011	6		49	11.12.2011	103	97
	V2 Folimax						07.12.2011	99	92
	V3 Agriphite						05.12.2011	97	91
	V4 P&R						10.12.2011	102	96

* Days number from sowing
** Days number from emergence to harvest

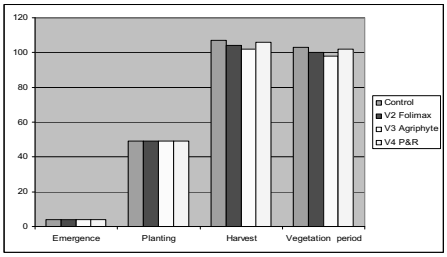


Fig.1. The influence of stimulation and foliar fertilization on the phenophasis of the protected cultures of lettuce May King – 2011

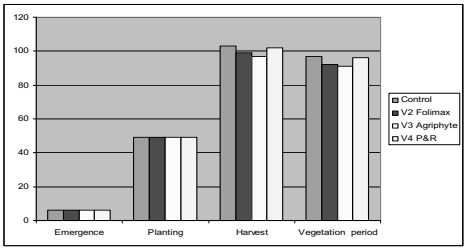


Fig.2. The influence of stimulation and foliar fertilization on the phenophasis of the protected cultures of lettuce Great Lakes 118– 2011

In the experimental conditions of 2011, the average number of leaves at May King was of 10 (control) to 11.2 (Agriphyte). The diameter of rosette varied between 27 cm (control) to 32 cm (Agriphyte). The average height of plants varied between 12.5 (control) to 13.5 (Agriphyte). At Great Lakes 118, the average number of leaves was of 7.3 (control) to 7.8 (Folimax). The diameter of rosette varied between 25 cm (control) to 28 cm (Folimax).
The average height of plants varied between 12.5 (control) to 14 (Folimax).
At both varieties the treatments was favourable for the growth of plants and the values of all morphometric characteristics was superior to the control ones (Table 4).

Table 4. The influence of treatments with stimulators and foliar fertilizers on morphometric characteristics

Variety	Treatment	Average no. of leaves	Diameter of rosette (cm)	Average height of plant (cm)
Great Lakes 118	V1 Control	7.3	25	12.5
	V2 Folimax	7.8	28	14
	V3 Agriphyte	7.7	27	13.5
	V4 P&R	7.4	26	13
May King	V1 Control	10	27	12.5
	V2 Folimax	11	30	13
	V3 Agriphyte	11.2	32	13.5
	V4 P&R	10.5	29	13

Concerning the average mass of the head at variety May King, the values varied between 150 g (control) and 176 g (Agriphyte). At Great Lakes 118, the average mass of the head varied between 162 g (control) and 168 g (Folimax) (Table 5, Photo 2).

Table 5. The influence of treatments with stimulators and foliar fertilizers on the average mass of the head and on production of lettuce -2011

Variety	Treatment	Average mass of head - kg/pl -	Production t/ha
May King	V1 Control	0.150	24.0
	V2 Folimax	0.170	27.2
	V3 Agriphyte	0.176	28.2
	V4 P&R	0.168	26.9
Great Lakes 118	V1 Control	0.162	25.9
	V2 Folimax	0.168	26.9
	V3 Agriphyte	0.166	26.6
	V4 P&R	0.163	26.1

In terms of total production achieved at the variety May King, this varied between 24 t/ha (control) and 28.2 t/ha (Agriphyte). For Great Lakes 118, on the first place was the variant treated with foliar fertilizer Folimax (26.9 t/ha), compare to the control (25.9 t/ha). Compare to variety Great Lakes 118, May King has an average production with 1% bigger, but the difference of productions was insignificant (Table 6). It can be observed that treatments applied favored average weight of the head and production.

Photo 2. View with variety May King

Table 6. The influence of the variety on the production at lettuce – Poiana – 2011

Variety	Average production (t/ha)	%	Differences t/ha	Significance
a1 -Great Lakes 118	26.4	100	-	-
a2 - May King	26.6	101	0.2	-
		DL 5%	0.745643	
		DL 1%	1.730586	
		DL 0.1%	5.479612	

Concerning the influence of the treatment on the production it can observe that all treated variants surpass the control with significantly distinct difference at variant V4 - P&R (1.6 t/ha) and very significant differences at Folimax (2.1 t/ha), respectively Agriphyte (2.5 t/ha) (Table 7).

Table 7. The influence of the treatment on the production at lettuce – Poiana – 2011

Treatment	Average production (t/ha)	%	Differences t/ha	Significance
b1Control	25.0	100	-	-
b2 Folimax	27.0	108	2.1	***
b3 Agriphyte	27.4	110	2.5	***
b4 P&R	26.5	106	1.6	**
		DL 5%	0.969835	
		DL 1%	1.361327	
		DL 0.1%	1.921874	

In the case in which the factor "a" is constant, it can observe that the treatment has a different influence depending on variety. In the case of the variety Great Lakes 118, the treated variants surpass the control with 0.2 t/ha (P&R), 0.7 t/ha (Agriphyte) and 1.0 t/ha (Folimax), but these differences are insignificant.

The variety May King obtained positive differences between 2.9 – 4.2 t/ha, which are very significant. It notes with the highest yield (28.2 t/ha) variant treated with Agriphyte (Table 8).

If we consider both factors (variety and treatment), the most constant production was obtained at Agriphyte variant, which is superior to other treatment variants in both varieties. This variant realizes significant and significantly distinctive differences at almost all combinations (Table 9).

Table 8 The influence of the treatments on the production of the lettuce at same variety - Poiana - 2011

Treatment	Average production (t/ha)	%	Differences -t/ha-	Significance
a1b1 (Control)	25.9	100	-	-
a1b2	26.9	104	1.0	-
a1b3	26.6	103	0.7	-
a1b4	26.1	101	0.2	-
a2b1 (Control)	24.0	100	-	-
a2b2	27.1	113	3.1	***
a2b3	28.2	118	4.2	***
a2b4	26.9	112	2.9	***
		DL 5%	1.37155	
		DL 1%	1.92521	
		DL 0.1%	2.71794	

Table 9 The influence of variety and treatment on the production at lettuce - Poiana – 2011

Treatment	Average production (t/ha)	%	Differences t/ha	Significance	Treatment	Average production (t/ha)	%	Differences t/ha	Significance
a1b1 (Control)	25.9	100	-	-	a1b3 (Control)	26.6	100	-	-
a2b1	24	93	-1.9	0	a2b1	24	90	-2.6	00
a2b2	27.1	105	1.2	-	a2b2	27.1	102	0.5	-
a2b3	28.2	109	2.3	**	a2b3	28.2	106	1.6	*
a2b4	26.9	104	1	-	a2b4	26.9	101	0.3	
a1b2 (Control)	26.9	100	-	-	a1b4 (Control)	26.1	100	-	-
a2b1	24	89	-2.9	00	a2b1	24	92	-2.1	00
a2b2	27.1	101	0.2	-	a2b2	27.1	104	1	
a2b3	28.2	105	1.3	-	a2b3	28.2	108	2.1	**
a2b4	26.9	100	0	-	a2b4	26.9	103	0.8	-
		DL 5%	1.3264				DL 5%	1.3264	
		DL 1%	2.0644				DL 1%	2.0644	
		DL 0.1%	3.8139				DL 0.1%	3.8139	

Between the number of leaves and production it was remarked the existence of a significant correlation for both varieties. The value of the correlation coefficient was for May King r=0.9722, respectively for Great Lakes r=0.9568 (Fig. 3, 4).

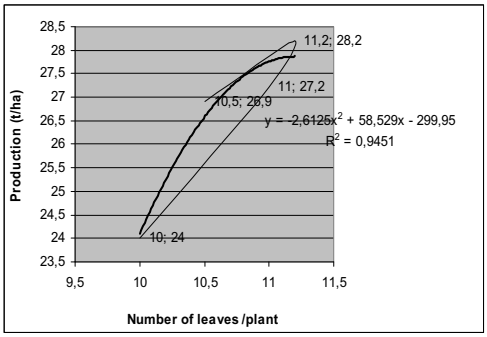


Fig.3 Correlation between the number of leaves and production at variety May King

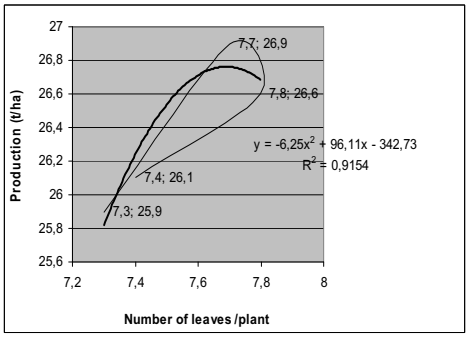


Fig.4 Correlation between the number of leaves and production at Great Lakes 118

Concerning the relation between the diameter of the rosette and production, the correlation obtained was significantly distinct for both varieties, respectively for May King r=0.9928 and for Great Lakes 118 r=0.990. (fig. 5, 6).

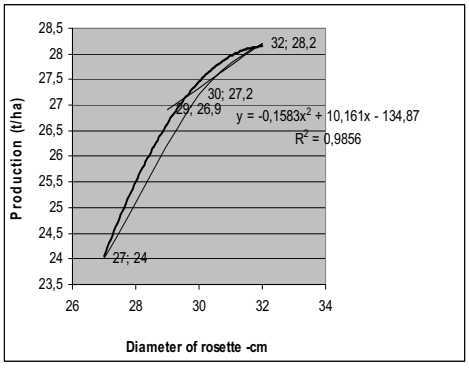


Fig.5 Correlation between the diameter of rosette and production at variety May King

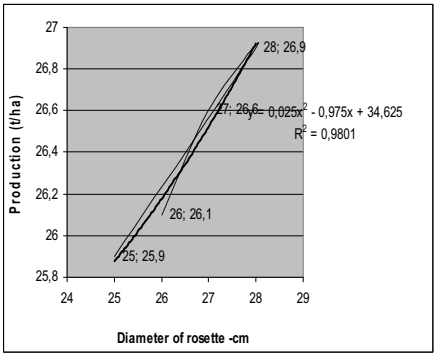


Fig.6 Correlation between the diameter of rosette and production at Great Lakes 118

CONCLUSIONS

The earliest variant for both varieties was V3 – Agriphyte. The vegetation period for the variety May King (Agriphyte) was by 98 days, with 5 days earlier than the control. For the variety Great Lakes 118 the vegetation period for Agriphyte treatment was by 91 days, with 6 days earlier than the control.

The biggest number of leaves was obtained at variants treated with Agriphyte, for variety May King (11.2 leaves) and for variety Great Lakes 118 (7.8 leaves).

The diameter of rosette at May King was between 27 cm (control) and 32 cm (Agriphyte). For Great Lakes 118 the diameter of rosette was between 25 cm (control) and 28 cm (Folimax).

The average weight of head at May King varied between 150 - 176g and the best variant was Agriphyte which surpass the control with 17%. For the varieties Great Lakes 118 the average weight of head varied between 162-168 g, with best results in the case of treatment with Folimax, which surpass the control with 4%.

It can be noted that the treatments has positive efects both for the average weight of head and for the production.

The best result was obtained for Agriphyte treatment (28.2 t/ha).

It was observed a significant correlation between the number of leaves and production, respectively a significantly distinct correlation between the diameter of rosette and production for both varieties.

REFERENCES

[1] Ardelean, M., Sestraş, R., Cordea Mirela, 2007. *Horticultural experimental technique*. AcademicPres Publishing House, Cluj-Napoca, p. 30-33.
[2] Ciofu Ruxandra, Stan, N., Popescu, V., Chilom Pelaghia, Apahidean, S., Horgoş, A., Berar, V., Lauer, K.F., Atanasiu, N., 2004. *Treaty of vegetable crops*. Ceres Publishing House, Bucharest, p. 308-319, 900-914.
[3] Indrea, D. and Apahidean, Al. S., 1997. *Culture of early vegetables*. Ceres Publishing House, Bucharest;
[4] Indrea, D. and al., 2007. *Culture of vegetables*. Ceres Publishing House, Bucharest, p.76-77 .
[5] Voican, V., Lăcătuş, V., 2002. *Protected culture of vegetables in greenhouses and plastic tunnels*. Ceres Publishing House, Bucharest.


EX·TERRA·AVRVM

HORTICULTURAL BIODIVERSITY AND GENETIC RESOURCES


EX·TERRA·AVRVM

Scientific Papers, Series B, Horticulture, Vol. LVI, 2012
CD-ROM ISSN 2285-5661, ISSN-L 2285-5653

FIELD PERFORMANCE OF SEVERAL PLUM GENOTYPES GROWN UNDER ENVIRONMENTAL CONDITIONS OF PITESTI – MARACINENI

Madalina BUTAC, Madalina MILITARU, Sergiu BUDAN, Irina ANCU

Research Institute for Fruit Growing, Pitesti, O.P.1, C.P. 73, Piteşti, Arges, 110006, Phone: 0040-248-278066; Fax: 0040-248-278477; E-mail: office@icdp-pitesti.ro

Corresponding author email: madalinabutac@yahoo.com

Abstract

The studies were carried out in the microfield trials of the Research Institute for Fruit Growing Pitesti - Romania, with 15 plum genotypes of different origin: 'Roman', 'Romanta', 'Romaner', 'Iulia', H 3/15, H 43/18 (Romania), 'Cacanska Lepotica', 'Cacanska Rodna', 'Cacanska Secer' and 'Mildora' (Serbia), 'Vision' and 'Valor' (Canada) and 'Oneida', 'Standard', 'Stanley' - control (USA). During 2010 - 2012 were carried out observations and determinations of: ripening times, production capacity, quality of fruit and response of plum genotypes to Plum pox virus. 'Čačanska Lepotica', 'Valor', 'Vision', 'Standard', 'Romanta' and H 3/15 had the highest yield per tree, whereas 'Mildora', 'Roman' and H 43/18 had the lowest yields. The largest fruits were recorded with 'Valor', 'Vision', 'Oneida', 'Roman', 'Romanta' and H 43/18. The mean harvest season of evaluated cultivars started by H 43/18 on the 17th July and ended by 'Standard' and 'Oneida' on the 6-7th September. Regarding the response of these genotypes to Plum Pox Virus, most of them showed no symptoms on leaves and fruits in the field. 'Valor' and 'Cacanska Lepotica' had the best performance, which indicates their good suitability for the modern plum orchard. 'Romanta' may also be of some interest for growers because of the best precocity and large fruit size, and 'Oneida' for prolonging the harvest season.

Keywords: *Prunus domestica* L., *genotypes, yields, quality, Plum Pox Virus.*

INTRODUCTION

Plum (*Prunus domestica* L.) is the most important fruit species in Romania. Production of 544,622 t (average 2008 – 2010) ranks Romania among the greatest plum producers in the world.

In plum production, the highest revenue is gained by growing table cultivars, especially of early ripening time [5, 8, 10].

However, the assortment of plum cultivars in Romania is dominated by those intended for processing, while other kinds of cultivars are present in relatively low numbers [2, 4, 7, 8].

The aim of the present paper was to study 15 autochthonous and foreign plum cultivars, in order to select the best cultivars suitable for growing in Pitesti area.

MATERIAL AND METHODS

The studies were carried out in the field trials of the Research Institute for Fruit Growing Pitesti - Romania, with 15 plum genotypes of different origin: 'Roman', 'Romanta', 'Romaner', 'Iulia', H '3/15', H '43/18' (Romania), 'Cacanska Lepotica', 'Cacanska Rodna', 'Cacanska Secer' and 'Mildora' (Serbia), 'Vision' and 'Valor' (Canada) and 'Oneida', 'Standard', 'Stanley' - control (USA). During 2010 - 2012 were carried out observations and determinations of: ripening times (date of harvest start), production capacity (in kg/tree, by weighing the fruit amount per tree at the optimum harvesting time and scoring from 0-5), physical characteristics (fruit weight – in g, by weighing a mean fruit sample of 25 fruit), chemical characteristics (soluble solids measured by the portable digital refractometer at the optimum ripening time, in % Brix) and organoleptic characteristics (by sensory evaluation, scoring from 1-5). The response of the plum cultivars to Plum Pox Virus was estimated only in the Lab Protection, RIFG Pitesti, by reference to a scale: (-) 1 – no attack; (+) 2 – slight attack; (+) 3 – mid attack; (+) 4 – severe attack [6, 9]. The data

were statistically processed by the variance analysis [1].

RESULTS AND DISCUSSION

The studied genotypes were successively maturing in the period from July 17 (H '43/18') to September 6-7 ('Oneida' and 'Standard'). Maturation time varied slightly between years (from 2 to 10 days). The earliest genotypes were: H '43/18', 'Cacanska Lepotica', 'Roman', 'Romanta', 'Romaner' and H '3/15' which ripe in the first decade of August (Table 1).

Table 1. Ripening time of the plum genotypes in Pitesti

No.	Cultivar	Ripening time			
		2010	2011	2012	Average
1	Roman	10.08	5.08	1.08	5.08
2	Romanta	11.08	7.08	2.08	7.08
3	Romaner	12.08	7.08	8.08	9.08
4	Iulia	27.08	25.08	25.08	26.08
5	H 3/15	10.08	7.08	10.08	9.08
6	H 43/18	18.07	15.07	17.07	17.07
7	Cacanska Lepotica	5.08	1.08	3.08	3.08
8	Cacanska Rodna	26.08	25.08	24.08	25.08
9	Cacanska Secer	27.08	25.08	26.08	26.08
10	Mildora	26.08	23.08	25.08	25.08
11	Vision	25.08	22.08	24.08	24.08
12	Valor	25.08	22.08	24.08	24.08
13	Oneida	5.09	6.09	10.09	7.09
14	Standard	4.09	5.09	8.09	6.09
15	Stanley (control)	27.08	25.08	26.08	26.08

Yield level is a property directly related to the profitability of production [8, 10]. The analysis of yield proves that only three cultivars ('Cacanska Lepotica', 'Vision' and 'Valor') had higher production than the control cultivar (over 19 kg/tree) and can be classified as high yield (average score = 4.8 – 5 points). Five cultivars ('Romanta', 'Standard', 'Stanley', 'Cacanska Rodna', and 'Oneida') had yields that are good, average score ranging from 4 to 4.5 points. Six genotypes (H '3/15', 'Cacanska Secer', 'Roman', 'Mildora', H '43/18' and 'Roamer') had medium good yield level (average score ranging from 2 to 3.5 points) and only one cultivar ('Iulia') gave very poor yield (6.90 kg/tree, average score = 1.5 points) (Table 2).
Fruit size is a very significant property in table cultivars, because cultivars with a larger-sized fruit are more appreciated and find a ready sale on the market [5, 8, 10]. Average fruit weight in studied cultivars ranged from 38.97 g ('Iulia') to 57.10 g ('Roman') (Table 3).

Table 2. Fruit yield of the plum genotypes in Pitesti

No	Cultivar	Fruit yield (kg/tree)				
		2010	2011	2012	Average	Scores (0-5)
1	Roman	9.4	10.8	12.0	10.73 ^{oo}	3
2	Romanta	16.5	18.4	20.8	18.56	4,5
3	Romaner	8.2	9.8	11.3	9.7 ^{ooo}	2
4	Iulia	7.0	6.5	7.2	6.90 ^{ooo}	1.5
5	H 3/15	11.3	14.5	15.9	13.90 ^{o}	3.5
6	H 43/18	9.2	8.5	12.7	10.13 ^{ooo}	2.5
7	Cacanska Lepotica	18.2	22.5	25.4	22.03	5
8	Cacanska Rodna	15.3	18.4	16.5	16.73	4
9	Cacanska Secer	12.7	11.0	15.9	13.20 ^{o}	3.2
10	Mildora	10.3	9.5	11.6	10.46 ^{oo}	2.8
11	Vision	20.6	21.6	25.0	22.40	5
12	Valor	15.8	18.8	22.5	19.03	4.8
13	Oneida	16.5	15.7	19.4	17.20	4
14	Standard	18.4	17.1	20.2	18.56	4.5
15	Stanley (control)	23.5	22.3	10.4	18.73	4.5

5% LSD=4.664 kg/tree; 1% LSD=6.287 kg/tree; 0.1% LSD=8.345 kg/tree

The majority of genotypes ('Roman', 'Romanta', H '43/18', 'Vision', 'Oneida') had larger fruit versus the control, their weight varying significantly. Large fruit had the following genotypes: 'Roman', 'Romanta', H '43/18', 'Vision', 'Oneida', 'Čačanska Rodna', 'Mildora', and 'Valor' – over 45 g (Table 3).

Table 3. Fruit weight of the plum genotypes in Pitesti

No	Cultivar	Fruit weight (g)			
		2010	2011	2012	Average
1	Roman	58.1	60.2	53.0	57.10 ***
2	Romanta	50.3	52.6	49.8	50.90 **
3	Romaner	42.5	40.6	44.0	42.37
4	Iulia	38.5	39.4	39.0	38.97 ^{ooo}
5	H 3/15	47.8	45.2	42.7	45.23
6	H 43/18	52.3	55.4	50.1	52.60 ***
7	Cacanska Lepotica	43.4	42.1	40.8	42.10
8	Cacanska Rodna	48.0	44.6	45.9	46.17
9	Cacanska Secer	42.0	43.5	40.1	41.87 ^{ooo}
10	Mildora	46.8	47.9	42.3	45.67
11	Vision	50.2	49.7	48.1	49.33*
12	Valor	48.0	45.2	45.0	46.07
13	Oneida	49.2	51.6	48.3	49.70 *
14	Standard	43.6	44.8	42.7	43.70
15	Stanley (control)	42.2	46.7	47.5	45.47

5% LSD=3.472 g; 1% LSD=4.681 g; 0.1% LSD=6.212 g

Soluble solids content varied between 12.10% ('Standard') and 21.33% ('Mildora'). The high content in soluble solids was recorded on

'Cacanska Rodna', 'Cacasnka Secer' and 'Mildora" cvs., and these cultivars can be also recommended for dehydration (Table 4).

Organoleptic qualities are an important pomological feature of cultivars, recommending them on the market [8, 10]. The extern properties were evaluated (size, shape, colour) as well as taste of fruit. Average score for extern properties was good for all cultivars and ranged from 4.0 ('Iulia') to 4.9 points ('Roman'), which indicates that cultivars are of attractive appearance.

The taste of fruit ranged from 3.5 ('Roman', 'Romanta' and 'H 43/18' genotypes) to 4.5 points ('Cacanska Rodna'). The best organoleptic qualities were found in 'Valor', 'Cacanska Rodna', 'Mildora', 'Vision' and 'Cacanska Lepotica' (over 9.0 points) (Table 4).

Table 4. Content in soluble dry weight of the plum genotypes in Pitesti

No	Cultivar	Soluble dry weight (%Brix)*	Sensory evaluation of fruit quality (Scores (1-5)		
			Appearance	Taste	Total score
1	Roman	13.70	4.9	3.5	8.4
2	Romanta	13.73	4.8	3.5	8.3
3	Romaner	14.00 *	4.5	3.9	8.4
4	Iulia	16.00 ***	4.0	4.0	8.0
5	H 3/15	13.77	4.2	3.8	8.0
6	H 43/18	13.97 *	4.9	3.5	8.4
7	Cacanska Lepotica	16.23 ***	4.6	4.4	9.0
8	Cacanska Rodna	19.13 ***	4.6	4.5	9.1
9	Cacanska Secer	20.57 ***	4.3	3.8	8.1
10	Mildora	21.33 ***	4.7	4.4	9.1
11	Vision	14.80 ***	4.8	4.3	9.1
12	Valor	14.60 ***	4.8	4.4	9.2
13	Oneida	13.80	4.8	3.9	8.8
14	Standard	12.10°	4.5	3.7	8.2
15	Stanley (control)	13.03	4.4	3.8	8.2

*5% LSD=0.846 %; 1% LSD=1.140 %; 0.1% LSD=1.513 %

The major objective in plum culture all over the world and Romania as well is the resistance and tolerance to virus diseases, PPV particularly, which is very hazardous to the plum culture. The annual spreading rate of this disease is very high, 20 – 45%, related to the variety, vector and infection source [3]. The response of plum genotypes to PPV proved that none variety showed any PPV tolerance, most genotypes showing a slightly and mid-attack on leaves. Five genotypes showed no symptoms of PPV on leaves or fruit ('Roman', H '43/18', 'Mildora', 'Oneida' and 'Standard'). One can see that there is no a positive correlation between the constant symptoms on leaves and fruit at the same variety and the attack was more severely on leaves than fruits (Table 5).

Table 5. Response of the plum genotypes to Plum Pox Virus

No.	Cultivar	Plum Pox Virus	
		On leaves	On fruit
1	Roman	1	1
2	Romanta	2	1
3	Romaner	2	1
4	Iulia	2	1
5	H 3/15	3	1
6	H 43/18	1	1
7	Cacanska Lepotica	2	1
8	Cacanska Rodna	3	2
9	Cacanska Secer	3	2
10	Mildora	1	1
11	Vision	2	1
12	Valor	2	1
13	Oneida	1	1
14	Standard	1	1
15	Stanley (control)	3	1

PPV: 1 (-) – no attack; 2 (+) – slightly attack; 3 (+) – mid attack; 4 (+) – severe attack.

CONCLUSIONS

The best properties had the following cultivars: 'Cacanska Lepotica', 'Valor', 'Vision' and 'Oneida' and they are recommended to spread in commercial orchards in Pitesti area. 'Roman' and 'Romanta' cvs. may be of some interest for growers because of the best precocity and large fruit size; 'Oneida' and 'Standard' cvs. are interesting for prolonging the whole harvest season; 'Cacanska Rodna', 'Cacasnka Secer' and 'Mildora" cvs. can be recommended for drying.

ACKNOWLEDGEMENTS

This research work was carried out with the support of Academy of Agriculture and Forestry Sciences Bucharest (ASAS – UMPP) and also was financed from Project ADER 119/2011.

REFERENCES

[1] Botu I., Botu M., 1997. *Metode si tehnici de cercetare in pomicultura*. Ed. Conphys, Romania: 236 – 239.

[2] Braniste N., Budan S., Butac, Madalina and Militaru, Madalina. 2007. *Soiuri de pomi, arbusti*

fructiferi si capsuni create in Romania. Ed, Paralela 45, Pitesti, Romania, pg. 141–182.
[3] Bozhkova Valentina, Butac Mădăina, 2009. *Behaviour of some plum cultivars in Plovdiv and Pitesti areas.* Lucrări ştiinţifice ICDP Piteşti Mărăcineni. Ed. INVEL Multimedia, Bucureşti, ISSN 1584-2231, pg. 28-34.
[4] Butac M., Dutu I., Ancu S., 2006. *New plum cultivars obtained in Pitesti, Romania. Eufrin Plum and Prune Working Group Meeting.* Research and Breeding Institute of Pomology, Holovousy, Czech Republic: 137-143.
[5] Butac M., Militaru M., 2006. *Behaviour of ex-Yugoslavian plum genotypes under the ecological conditions the region of Pitesti*. I Symposium on plum of Serbia, Book of abstract: 33.
[6] Butac M., Plopa C., Militaru M., 2009. *Identification of some genetic resistance sources to Plum Pox for obtaining the initial material needed in plum breeding.* Proceedings of the First Balkan Symposium on Fruit Growing. Acta Horticulturae 825, Plovdiv, Bulgaria: 177-180.
[7] Butac M., Zagrai I., Botu M., 2010. *Breeding of new plum cultivars in Romania.* Proceedings of the Ninth International Symposium on Plum and Prune Genetics, Breeding and Pomology. Acta Horticulturae 874, Palermo, Italia: 51-59.
[8] Cociu V., Botu I., Minoiu N., Pasc I., Modoram I., 1997. *Prunul*, Editura Conphys, Romania: 165-171.
[9] Isac Maria, Butac Mădălina, Gabriela Constantin, 2002. *The sensibility of some cultivars and hybrids to the natural infections with plum pox virus. Plant's health.* Special edition – Middle European Meeting′01 on Plum Pox, Romania: 25 – 28.
[10] Mratinic E., Milatovic D., Djurovic D., 2006. *Pomological characteristics of plum table cultivars in Belgrade Area*. Eufrin Plum and Prune Working Group Meeting. Research and Breeding Institute of Pomology, Holovousy, Czech Republic: 169-172.

Scientific Papers, Series B, Horticulture, Vol. LVI, 2012
CD-ROM ISSN 2285-5661, ISSN-L 2285-5653

PRELIMINARY RESEARCH CONCERNING THE IDENTIFICATION OF REISTANCE GENOTYPES ON CUCURBITACEAE FAMILY IN ARTIFICIAL INFECTION CONDITIONS WITH CMV (CUCUMBER MOSAIC VIRUS)

Madalin CHIUOARU, Gheorghita HOZA, Dan MANAFU

University of Agronomic Sciences and Veterinary Medicine of Bucharest, 59, Marasti Street, 011464, Bucharest, Romania, tel.: 0213182564, fax:0213182888, madalin_ch4@yahoo.com, hozagh@yahoo.com, danmanafu@yahoo.com

Corresponding author email: hozagh@yahoo.com

Abstract

Cucumber mosaic virus (CMV) was first described in detail in 1916 on cucumber (simultaneously by Doolittle and Jagger) and other cucurbits, but is now known to occur worldwide in both temperate and tropical climates, affecting many agricultural and horticultural crops. Development of genetic resistance to CMV in many vegetables has made a valuable contribution for disease management of this important virus disease. There are some CMV resistant (tolerant) cucumber varieties available that produce a good crop, but most other cucurbits are susceptible to CMV. The screening of the 37 field samples collected from six species of Cucurbitaceae were tested by TAS-ELISA, 13 samples were found to be infected by CMV. Among them. In IC-RT-PCR using the MAbs and specific primers in the region of the coat protein (CP) gene, samples shown that results obtained by TAS-ELISA gave one specific band about 500 nucleotides in length. The validity and reliability of the results of TAS-ELISA and IC-RT-PCR was confirmed by sequencing and phylogenetic analysis of nearly full-length CP genes of the isolates.

Keywords: *Cucumber mosaic virus; Monoclonal antibody; resistance, gene*

INTRODUCTION

Cucumber mosaic virus occurs worldwide and is considered a very important disease in temperate, tropic and subtropic regions of the world.

Crop losses vary from year to year since the amount of disease occurrence depends upon the number of aphids available for virus transmission in the spring or fall when the crops are established as determined by geographical location.

If the spring or fall is cool and wet, aphid numbers are decreased and virus spread is sporadic, with infected plants primarily located in rows bordering the edges of the field.

However, if the spring or fall is warmer with less frequent rains, aphid populations increase rapidly on perennial crops that harbor CMV, and virus spreads rapidly into crops that are young and especially attractive to migrating aphids. In such cases, infection rates may approach 100% and the crop may have to be abandoned.

On average, losses of 10-20% are common, and in some instances the crop may still be harvested, but is of poorer quality and appearance. Historically, *Cucumber mosaic virus* (CMV) was first described in detail in 1916 on cucumber (simultaneously by Doolittle and Jagger) (Fig. 1, 2) and other cucurbits, but is now known to occur worldwide in both temperate and tropical climates, affecting many agricultural and horticultural crops.

Development of genetic resistance to CMV in many vegetables has made a valuable contribution for disease management of this important virus disease.

CMV infects 1200 species in over 100 plant families and can cause significant economic losses in many vegetable and horticultural crops. CMV causes a systemic infection in most host plants, but may remain symptom less in some crops like alfalfa.

Symptoms of cucumber mosaic can vary greatly depending on the crop infected and the age of the plant when infection occurs.

Cucurbits: Almost all cucurbits are susceptible to CMV, with symptoms varying in severity (Fig. 1A-E).

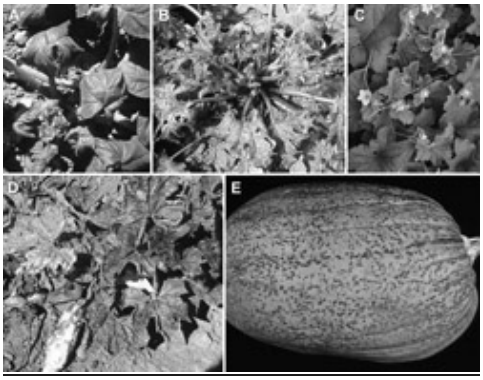


Fig. 1 A-E. CMV infection of cucurbits (www.apsnet.org)

Plants infected early in the season are severely stunted and leaves are malformed, and fruit are unmarketable because of pronounced rugosity (roughness) on the fruit surface, as shown on the infected zucchini plant and fruit in Figure 1B. Infection of vining crops, such as muskmelon, show severely stunted growing tips (Figure 1C), and although fruit may not show symptoms they are of poor quality. If the yellow squash variety grown lacks the precocious gene, color breaking will occur on the fruit, causing the fruit to show green blotchy patterns, but these symptoms are absent in yellow squash varieties with the precocious gene (Fig. 1D).

Color breaking on fruit of varieties without the precocious gene will also occur with *Watermelon mosaic potyvirus* (WMV) infection; however this protection does not hold true for *Papaya ringspot potyvirus* or *Zucchini yellow mosaic potyvirus*, where both foliage and fruit of yellow squash are severely affected. Pumpkin is another cucurbit, that when infected at any early stage, will express severe foliar mosaic and the fruit will show a mosaic pattern and would be unmarketable.

Because of its wide host range, numerous weeds can serve as reservoirs for CMV and contribute to virus spread to crops at the beginning of the season. Perennial, biennial, and winter annual weeds harboring CMV in roots, tubers and underground organs throughout the winter include common milkweed (*Asclepias syriaca*), yellow rocket (*Barbarea vulgaris*), marsh yellowcress (*Rorippa islandica)*, and yellow toadflax (also called butter-and-eggs, *Linaria vulgaris*). These were shown to be important sources for infection of lettuce in upstate New York. Seven additional weeds, including common chickweed (*Stellaria media*) were shown to be important overwintering sources in Britain for lettuce (Tomlinson, J.A., and A.L. Carter. 1970). It is important to note that infected weeds are often symptomless.

Development of genetic resistance is the simplest and most effective method of controlling virus diseases and is especially appropriate for CMV.

Success has been noted, especially for cucumber and spinach, but is variable among most other crops. The history of CMV resistance in cucumber (*Cucumis sativus*) dates back to 1927 when the oriental varieties 'Chinese Long' and 'Tokyo Long Green' were introduced to the US. After extensive study, it was concluded that homozygosity of three partially dominant genes was needed to convey a high level of resistance for cucumber.

This resistance formed the background for all modern day slicing and pickling cucumber varieties and has been effective for many decades, perhaps because resistance is based upon several genes.

Genetic resistance for CMV in melon (*Cucumis melo*) is derived from oriental melons, and depending on the source, resistance is controlled by two or three complementary recessive genes.

Some of these factors for resistance are strain and/or temperature dependent, with plants developing symptoms at temperatures below 20°C. No commercial muskmelon varieties with CMV resistance are available. Fortunately, most varieties of watermelon (*Citrullus lanatus*) are resistant to the most prevalent strains of CMV, with the exception of a specific strain that can infect plants systemically.

Eradication of weed hosts is often a difficult task because of the extensive host range of this virus.

However, elimination of several of the key perennial or biennial weeds located near the crop may reduce severe virus pressure, and has successfully been used to control CMV.

MATERIAL AND METHOD

The objectives for this work are the behavior of different genotypes of cucumbers, melons, loofah, that hybrids and varieties, the CMV infection; the implementation of the main methods for detection of viruses in plants; and the implementation of Markers assisted selection (MAS) for detecting CMV-resistant genotypes.

Virus sources

CMV virus is of French origin from INRA Bordeaux.

Plant material

The plant material consists in different species of cucurbitaceous and several varieties:

Varieties and hybrids of the species *Citrullus lanatus* :

1.Dulce de dabuleni
2.1AS1WM001
3.CATHERINE F1
4.SUGAR BABY
5.PEACE F1
6.CRIMSON SWEET
7.OLTENIA
8.1AS1WM011

Varieties and hybrids of the species *Cucumis sativus*:

1.Crisan
2.Cornison de Paris
3.Merengue F1
4.Kybria F1
5.Maresa F1
6.Mirabele F1

Varieties and hybrids of the species *Cucumis melo*:

1. Galben necacios
2. Machidimon F1
3. Citirex F1
4. Bulgaresti
5. Raymond F1

The species

1.*Cucurbita pepo var Maxima:*
2.Cucurbita moscata
3. Luffa cylindrica
4. Lagenaraia siceraria
5. Kivano (castravetele tepos)

Methods

ELISA. Triple antibody sandwich (TAS)-ELISA (Zhou et al., 1997) and antigen-coated plate (ACP)-ELISA (Jiang et al., 2003) were used for detection and characterization of MAbs against CMV with an alkaline phosphatase-conjugated goat anti-mouse IgG antibody (Sigma). Healthy tobacco plants and buffer alone were used as controls. The positive threshold was fixed at twice the average of the optical density obtained with the healthy controls. All tests were duplicated.

Immunocapture RT-PCR (IC-RT-PCR). Three CMV specific primers were designed based on the cDNA sequences of the CMV CP gene deposited in the GenBank database.

The forward primers CMV I-F (5′-CGACTTAATAAGACGTTAGCAGC-3′, corresponding to nucleotides 121–143 of CP gene of CMV S-I isolates) and CMV II-F (5′-TCCCAATGCTAGTAGAACCTCC-3′, corresponding to nucleotides 18–39 of CP gene of CMV S-II isolates) located at the upstream end of CP gene were specific for CMV S-I and CMV S-II isolates, respectively.

The reverse primer CMV-R (5′-TGCTCRAYGTCRACATGAAG-3′, complementary to nucleotides 601–620 of CP gene of CMV S-I and S-II isolates) was degenerate and based on the conserved sequence of CMV CP genes in both subgroups. The immunocapture was carried out as described (Jiang and Zhou, 2002).

RESULTS AND DISCUSSIONS

Table 1 Results (TAS)-ELISA

Species	Varieties	ELISA	PCR
CITRULUS LANATUS	Dulce de dabuleni	+	+
	1AS1WM001	-	+
	Katherine F1	+	+
	Sugar baby	-	-
	Peace F1	-	-
	Crimson sweet	+	+
	Oltenia	-	-

	1AS1WMO11	-	-
CUCUMIS SATIVUS	Castravetele tepos	+	+
	Cornison de Paris	+	+
	Crisan	+	+
CUCUMIS MELO	Galben necacios	-	-
	Makdimon	-	-
	Citirex	-	-
	Raimond	-	-
	Bulgaresti	-	-
CUCURBITA MAXIMA	Dovleacul de placinta	-	-
	Dovlecelul	-	-
TIGVA	-	+	+
LUFA	-	+	+
CASTRAVETE AMAR	-	-	-

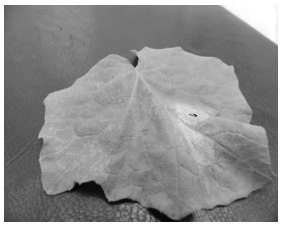


Fig. 2 and 3: CMV symptoms on the cucumber genotypes.

Aneling temperature of primers of 46 ° C for five cycles, followed by recovery at 50 ° C for 30 repeated cycles gave clear bands in agarose gel electrophoresis. Subsequently, these parameters were used in IC-RT-PCR.

Based on the optimization procedure, primers CMV IF / CMV-R (specific for isolated SI) gave a single band of approximately 500 nucleotides of CMV-Fny, CMV II-F/CMV-R while primers (specific for S -II isolates) produced a band of approximately 600 nucleotides of CMV-G2 (Fig. 2A). There was no band in terms of control samples, using primer pairs specific S-II.

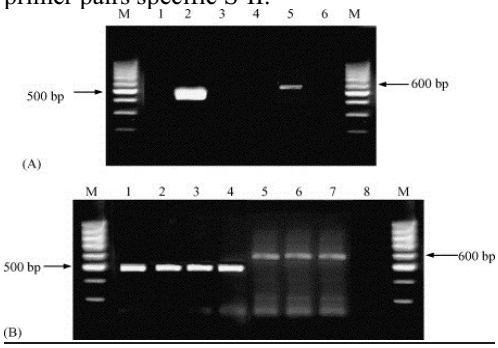


Fig. A and B: Electrophoresis gel 1.5% to revaluated a CMV infection.

Development of IC-RT-PCR for various genotypes cucurbitaceae in terms of CMV infection virus isolated subset I and II. (A), the amplified bands were obtained in terms of some genotypes II of CMV and CMV-R, amplified with CMV IF / CMV-R. (B), IC-RT-PCR from melon probs: 1.Dulce of Dabuleni, 2. Catherine 1, 3. 1AS1Wmoo1; 4.Peace F1: 5. Crimson Sweet and 6. Oltenia. Results demonstrated that the 6 genotypes studied only 2, namely Catherine and Crimson Sweet were revealed to be positive (presence elecroforeza band in agarose gel) electrophoresis A.

Using primers Begomo1 (CCGTGCTGCTGCCCCCATTGTCCGCGTC AC) and Begomo2 (CTGCCACAACCATGGATTCACG CACAGGG) for pumpkin and certain genotypes 1.LUFA. 2. Gourds, 3. Pumpkin pie, for cucumbers of varieties 4. Cornison de Paris, 5. Cucumber spiky, 6. Crisan, 7.melon Crimson sweet and 8. Negative control sample of tobacco showed a band of each PCR product of 500 bp and 600 bp respectively in 1.5% agarose gel. Electrophoresis B.

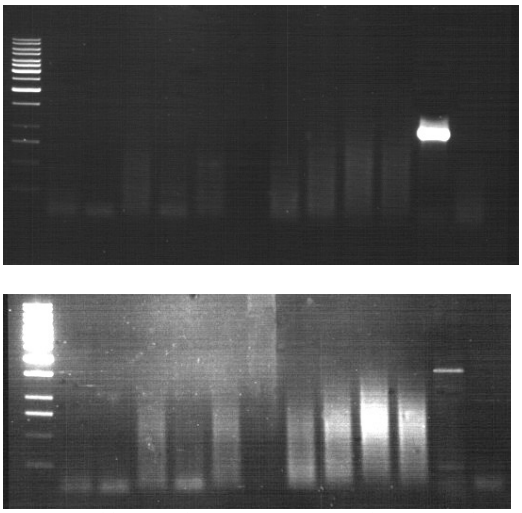


Fig 2 a and b: PCR detection of CMV in different melon genotypes.

Fig 2. PCR for detection of begomovirus using these primers for these genotypes of melon (Red Star, Raymond, Romanza, Nostalgia, Sorento, black spot, Macapadimon, Citirex, Colorado, Galben Necacios, Bulgarian). Fig. 2a. PCR with universal primers begomoviruses to produce a PCR product of approximately 1.1 kb. The Marker 1 Kb class is a scale used in most cases. Lanes 2-11 are samples from melon where no PCR product was not amplified. Lane 12 positive control in this case constitutes a sample of tomato and the tape 13 is negative control, where distilled water was added to the reaction mixture.

Method of IC-RT-PCR was then used to test the presence of CMV in samples of Melon, cucumber and pumpkin. A 500-nucleotide band could be amplified with primers specific pair and the evidence were revealed by TAS-ELISA negative. Similarly, samples containing S-II produced a band of 600 nucleotides (Fig. 2B). S I and S II pairs of primers have amplified specific1 melon genotypes, but have grown loofah, gourds, pie pumpkins, cucumbers (Paris Gherkins, Cucumber spiky and Crisan).

For detection of CMV's on cucurbitaceae (watermelon, cucumber, squash) serological ELISA methods are widely used. However, PCR has proved more reliable for detecting CMV isolates (Porta et al, 1989 and Hsu et al., 2000). In this study, we continued with the identification of new genotypes from Cucurbitaceae in terms of resistance to CMV may be proposed improvement works continue in these species.

Also in this paper has tried PCR's simple, and then IC-RT-PCR method. Differences were relevant. First, RNA extraction is difficult and costly, and RNA molecules are also slightly degraded due to the presence of RNase almost everywhere. Second, potential contamination of RT-PCR analysis was more difficult. However, the method of IC-RT-PCR Total viral RNA extraction avoid replacing the total DNA of plants, and was easily achieved in a single tube. These procedures have been developed to detect several viruses in plants, including Apple stem pitting virus, Cherry leaf roll virus, Grapevine leafroll-Associated Virus 1, Pepino mosaic virus, Plum pox virus and Raspberry Bushy Dwarf Virus (Wetzel et al , 1992, Kokko et al, 1996, James et al, 1997, KEIM-Konrad and Jelkmann, 1997, Werner et al., 1997, Sefc et al, 2000 and Mansilla et al., 2003)

CONCLUSIONS

In this paper, we developed a technique for IC-RT-PCR to detect CMV isolates from different genotypes cucurbitacea. Testing the samples in artificial conditions of infection using TAS-ELISA and IC-RT-PCR showed that this method of IC-RT-PCR is the most sensitive eficenta. Further analyzes aimed at identifying other genotypes of interest in terms of resistance to CMV. Of the 22 local and foreign genotypes of melons and cucumbers two genotypes: Yellow and black spot necacios their interest in terms of resistance to CMV. The IC-RT-PCR technique, we found that a single strong band of approximately 500 nucleotides that could be easily amplified by plants containing viral particles of insulation and while the band of 600 nucleotides in plants containing viral particles CMVizolatul S-II was relatively weak. These results coincide with those obtained by TAS-ELISA, suggesting that isolated S-II concentration in plants is lower than isolated. Although it is a natural infection and mixed with isolated CMV S-II in the samples tested, IC-RT-PCR procedure should be improved to detect possible mixed infections TAS-ELISA techniques and IC-RT-PCR developed in this study to detect CMV isolates

were also relevante. De use of molecular markers may be useful for screening a large number of genotypes to identify those of interest in terms resistance to CMV. Among the 33 samples tested in this study, only six samples (6.9%) were found to be infected with CMV isolate S-II. The reason for this is probably that the samples tested in this study were collected from the green house conditions in south of the country. In addition, host species could be an important factor for the incidence of CMV infection different (Hristova et al., 2002). To determine the prevalence of such infections in the south of Romania, are still necessary in other studies on multiple samples from different cultures, locations and years. RCP is actually more sensitive than serological methods ([Bousalem et al, 2000.] And [Jacobi et al, 1998.]). This may have some advantage in detecting the different CMV isolates that have low concentrations in plants . Moreover, PCR is more suitable for obtaining information on the viral genome. In contrast, TAS-ELISA facilitates rapid processing of large numbers of samples. A combination of the two above methods may be most suitable for epidemiological analysis and to study the genomic variations of the CMV strains.

ACKNOWLEDGEMENTS

This study was financed by project SharCO "Sharka containment"- FP7/2007 - Grant Agreement no 204429 funded by European Union.

REFERENCES

[1] Abad, J., G. Anastasio, A. Fraile, and F. García-Arenal 2000. *A search for resistance to Cucumber mosaic virus in the genus Lycopersicon*. Journal of Plant Pathology 82:39-48.

[2] Doolittle, S.P. 1920. *The mosaic disease of cucurbits*. United States Department of Agriculture Bulletin 879. 69 pp.

[3] Francki, R.I.B., D.W. Mossop, and T. Hatta, T. 1979. *Cucumber mosaic virus.* Descriptions of Plant Viruses, No. 213 (No. 1 revised). Commonwealth Mycological Institute, Association of Applied Biologists, Kew, Surrey, England.

[4] Gallitelli, D. 2000. *The ecology of Cucumber mosaic virus and sustainable agriculture*. Virus Research 71:9-21.

[5] Gonsalves, D., R. Provvidenti, and M.C. Edwards. 1982. *Tomato white leaf: the relation of an apparent satellite RNA and cucumber mosaic virus*. Phytopathology 72:1533-1538.

[6] Hooks, C.R.R., and A. Fereres. 2006. *Protecting crops from non-persistently aphid-transmitted viruses: a review on the use of barrier plants as a management tool.* Virus Research 120:1-16.

[7] ICTVdB Management. 2006. *00.010.0.04.001. Cucumber mosaic virus. In: ICTVdB* - The Universal Virus Database, version 4. Büchen-Osmond, C. (Ed), Columbia University, New York, USA. http://www.ncbi.nlm.nih.gov/ICTVdb/ICTVdB/00.010.0.04.001.htm

[8] Jones, R.A.C., B.A. Coutts, L.J. Latham, and S.J. McKirdy. 2008. *Cucumber mosaic virus infection of chickpea stands: temporal and spatial patterns of spread and yield-limiting potential*. Plant Pathology 57:842-853.

[9] Kyle, M.M. (ed.) 1993. Resistance to viral diseases of vegetables, genetics and breeding. Timber Press, Portland, OR.

[10] Mazourek, M., G. Moriarty, M. Glos, E. Henderson, D. Rumore, G. Palmer, A. Chickering, J.F. Murphy, M. Fink, M. Kreitinger, C. Kramer, D. Kean, J.R. Myers, and M. Jahn. 2009. *'Peacework': A cucumber mosaic virus resistant early red bell pepper for organic systems*. HortScience. In press.

[11] Murphy, J.F., E.J. Sikora, B. Sammons, and W.K. Kaniewski. 1998. *Performance of transgenic tomatoes expressing cucumber mosaic virus CP gene under epidemic conditions*. HortScience 33:1032-1035.

[12] Murphy, J.F., M.S. Reddy, C.–M. Ryu, J.W. Kloepper, and R. Li. 2003. *Rhizobacteria-mediated growth promotion of tomato leads to protection against Cucumber mosaic virus.* Phytopathology 93:1301-1307.

[13] Palukaitis, P., M.J. Roossinck, R.G. Dietzgen, and R.I.B. Francki. 1992. *Cucumber mosaic virus*. Advances in Virus Research 41:281-348.

[14] Palukaitis, P., and F. García-Arenal. 2003. *Cucumoviruses*. Advances in Virus Research. 62:241-323.

[15] Rist, D.L., and J.W. Lorbeer. 1989. *Occurrence and overwintering of cucumber mosaic virus and broad bean wilt virus in weeds growing near commercial lettuce fields in New York*. Phytopathology 79:65-69.

[16] Simons, J.N. and T.A. Zitter. 1980. *Use of oils to control aphid-borne viruses*. Plant Disease 64:542-546.

[17] Tomlinson, J.A., and A.L. Carter. 1970. *Studies on the seed transmission of cucumber mosaic virus in chickweed (Stellaria media) in relation to the ecology of the virus*. Annals of Applied Biology 66:381-386.

Scientific Papers, Series B, Horticulture, Vol. LVI, 2012
CD-ROM ISSN 2285-5661, ISSN-L 2285-5653

THE STUDY OF A PERSPECTIVE CLONE FOR OBTAINING WHITE WINES IN DRAGASANI VINEYARD

Sergiu Stefan GORJAN

University of Craiova, Faculty of Agriculture and Horticulture, Department of Horticulture and Food Science, Str. A.I. Cuza, No. 13, Postal Code 200585, Romania, Tel.: 0251 414398, Fax: 0251 411688, gorjansergiustefan@yahoo.com

Corresponding author email: gorjansergiustefan@yahoo.com

Abstract

The study was carried out in the years 2010-2011 in private plantations from Dragasani Vineyard on 'Carloganca' variety. From this study it was observed that some hubs of 'Carloganca' presents distinct characters distinct from other hubs in terms of fertility, productivity, quality and quantity yield, disease resistance, quality wine. This clone will be homologated, it is grafted and planted in the plot of verification to be introduced into culture.

Keywords: clone, fertility, old varieties, vineyard, quality

INTRODUCTION

Romania has one of the oldest European viticulture [1].

This study intended to restore the traditional assortment of Drăgăşani Vineyard, one of the oldest and reputed vineyards of Romania. The old Drăgăşani Vineyard assortment was consisted by 'Cârlogancă' ('Crâmpoşie'), 'Gordan', 'Braghină' and 'Tămâioasă Românească'. At Drăgăşani, 'Cârlogancă' ('Crâmpoşie') is part of the basic varieties that had made the old assortment, producing with 'Braghină' and 'Gordan' the famous "Tulburel de Drăgăşani". In this assortment 'Cârloganca' ('Crâmpoşie') holds the lead in terms of potential alcohol, and this fact made the old saying "Crâmpoşia gives strength,Gordan the foam and Braghina fills the barrel" [2].

In addition to restore the traditional assortment, is seeking valuables clones of these varieties.

Over time the Drăgăşani Vineyard have obtained valuable vine varieties, namely 'Cârlogancă' ('Crâmpoşia'), at SCDVV Drăgăşani by free fecundation was obtained Crâmpoşia selected [3], a good variety of COD (Controlled Origin Denomination) white wines.

From 'Crâmpoşie' were obtained and other important varieties in other research stations in the country namely 'Timpuriu de Cluj' and 'Cetăţuia' by sexual hybridization of 'Crâmpoşie'x'Frumoasă de Ghioroc'varieties, table grape varieties obtained at SCP Cluj and 'Unirea' variety by hybridization betwen 'Crâmpoşie' x 'Muscat Ottonel', obtained at SCDVV Iaşi.[4].

MATERIAL AND METHOD

The study was conducted in private plantations from Drăgăşani Vineyard in 2010-2011. After identifying the variety 'Cârlogancă' which began to be endangered, in several locations of the vineyard, we studied a plantation with a population of 10 individuals located Guşoieni-Spârleni wine realm.

The plantation is very old, planting distance between rows of 1.8 m, and 1.4 m between the hubs.

Of the 10 studied hubs, were noted 2 identical hubs with different characters compared to the others. To these 2 identical elites discovered was give the 10-20-30 code and after the omologation will be called Cârlogancă cl. 10 CD.

We analyzed the fertility, productivity, quantity and quality of yield, disease resistance, quality of wine compared the witness [5].

On must, for sugar we used the Carl Zeiss hand refractrometer method and titration method (H_2SO_4) for acidity [6].

RESULTS AND DISCUSSIONS

Studying the phenology, there were recorded small differences between the elite and witness. The period of bud break is the same, 14 April, the blooming at 10-20-30 is between 27th of May-5th of June and at witness the 28th of May-6th of June. We find a difference of a day between the elite and the witness at the beginning of berry ripening, full maturity of the berry and beginning of wood maturity (Table 1).

The elements of fertility and productivity of the elite are, generaly, superior to the witness (Table 2).

The number of shoots on a plant is 28 at the elite compared to 27 on witness and also the fertile shoots are superior to the elite (22) compared to the witness (20).

The number of the inflorescences is favorable to the elite, with 24 inflorescences/hubs, the witness having only 22 inflorescences/hubs.

The elites have a medium weight of the grape of 220 g compared to 218 g witness.

The coefficients of fertility and the indexes of productivity are greater at the elite compared to the witness, except for the absolute fertility coefficient wich is superior at the witness, and the absolute productivity index is equal.

Coefficients fertility and productivity indices calculated are:

The coefficient of fertility is 78 % at the elite compared to 74 % at witness.

The relative fertilty coefficient has a value of 0,85 % at the elite and 0.81 % at the witness.

The absolute fertility coefficient has a value of at the elite (1,09) compared to 1,1 at the witness.

The relative productivity index has a value of 187 at the elite and 176,58 at the witness. The relative productivity index is equal to both (239,8).

The grape medium productivity/hubs is superior at the elite (3,920 kg) compared to 3,750 kg at the witness.

The quality is better at the elite, 90 % being 'Standard' and 10 % first category. At the witness we have 80 % 'Standard' and 20 % first category. (Table 3).

The physiological characteristics are, generally, better at the elite regarding the vigour and maturity shoot, the disease rezistence.

The behavior at frost, drought, small grapes and non maturity, the degeneration of the grapes because of negative atmospheric conditions are equal in both studyied cases. (Table 4).

The technological characterization of both studiated varieties shows us that the elite accumulates more sugar then the witness (200 g/l compared to 191 g/l). The acidity is also grater (5,1/4,5 g/l H_2SO_4). (Table 5).

This 10-20-30 elite was grafted on 'Berlandieri x Riparia Kobber 5 BB Selecţia Crăciunel 2' rootstok and planted in pots and in the verification plot of SCDP Vâlcea.

In the photos bellow we present images with 10-20-30 elite, the grape at full maturity, young shoot, the adulte leave and planted in pots.

Photo 1

Photo 2

Photos 1,2. Elita 10-20-30 the grape at full maturity and young shoot (originally)

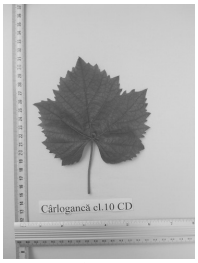


Photo 3

Photo 4

Photos 3,4. Elita 10-20-30 the adulte leave and planted in pots (originally).

Table 1. Phenological data

Code variety (hybrid)	Variety (hybrid)	Bud break	Blooming	Beginning of berry ripening	Full maturity of the berry	Beginning of wood maturity
10-20-30	'Cârlogancă cl. 10 CD'	14-04	27-05 – 05.06	07.08	19.09	09.08
witness	'Cârlogancă'	14-04	28-05 – 06.06	08.08	20.09	10.08

Table 2. Elements of fertility and productivity

Code variety (hybrid)	Variety (hybrid)	Shoots no.		Inflorescences no.	Medium weight of a grape (g)	Coefficients the ferilitate of shoots (%)	Fertility coefficients		Productivity indices	
		Total	Fertili				relative	absolute	relative	absolute
10-20-30	'Cârlogancă cl. 10 CD'	28	22	24	220	78,5 %	0,85%	1,09	187	239,8
witness	'Cârlogancă'	27	20	22	218	74 %	0,81%	1,1	176,58	239,8

Table 3. Production and quality data

Code variety (hybrid)	Variety (hybrid)	Number of hubs analyzed	Production kg/hub	Quality categories of total production %		
				'Standard'	I	II
10-20-30	'Cârlogancă cl. 10 CD'	2	7,84 kg	90 %	10 %	-
Mt.	'Cârlogancă'	8	30,0 kg	80 %	20 %	-

Table 4 Physiological characteristics

Code variety (hybrid)	Variety (hybrid)	Vigour	Maturity shoot	Behavior frost		Behavior drought	Floral accidents		Disease rezistence					
				Lost eyes	Shoot		Small grapes and non maturity %	Degeneration grapes%	*Plasmopara*		*Oidum*		*Botrytis*	
									F%	I%	F%	I%	F%	I%
10-20-30	Cârlogancă cl. 10 CD	32,5	24,1	4 %	Very good	Good	3	2	3,60	0,80	3,62	1,20	3,10	0,75
Mt.	Cârlogancă	27,2	18,4	4 %	Very good	Good	4	2	4,11	1,70	4,80	1,50	4,10	1,10

Table 5 The technological characterization

Code variety (hybrid)	Variety (hybrid)	Weight of 100 berries (g)	Sugar g/l	Acidity g/l H2SO4
10-20-30	'Cârlogancă cl. 10 CD'	270	200	5,1
Mt	'Cârlogancă'	250	191	4,5

CONCLUSIONS

In Drăgaşani Vineyard exists grape varieties genetical resources to save the germplasm which must be conserved *on farm*, *in situ* and *ex situ*, in ampelographic collections, to restore and enhance the traditional assortment of vineyard [7].

The 10-20-30 elite is very valuable presenting distinctive characters from the witness, it can be placed in the future in culture as 'Cârlogancă cl. 10 CD'.

From this study we see that this elite is very valuable, with good potential quantity and quality, very good resistance to disease.

It is very good for obtaining COD (Controlled Origin Denomination) wines.

ACKNOWLEDGMENTS

„This work was supported by the strategic grant POSDRU/CPP107/DMI1.5/S/78421, Project ID 78421(2010), co-financed by the EUROPEAN SOCIAL FUND – INVESTING

IN PEOPLE, whithin the Sectoral Operational Programme Human Resources Development 2007-2013".

REFERENCES

[1]Popa A., Dicu C., 2010 - Viticultura si Vinurile Romaniei, Editura Alma Craiova p. 230.

[2]Teodorescu I.C., 1943. *Podgoria Drăgăşani, Revista România viticolă*. Editura „Bucovina" IE Toruţiu, p 27.

[3]Staţiunea de cercetare şi Producţie viti-vinicolă Drăgăşani, 1986. *La 50 de ani de activitate ştiinţifică: 1936-1986*. Drăgăşani. Ed. Întreprinderea Poligrafică Sibiu. p 112-113.

[4] Varga N., Ion M., Stoian M., 2005. *Soiuri de viţă de vie roditoare realizate de cercetarea viticolă românească*. p.8-34.

[5]Dinu D.G., Mărculescu M., Vlădaşel M., Gorjan S. Ş., 2010. *Studiul unor elite de perspectivă pentru obținerea vinurilor albe de calitate superioară obținute la S.C.D.V.V. Drăgășani*. Analele I.C.D.V.V Valea Călugărească, vol XIX.

[6] Dinu D. G., Mărculescu M., Gorjan S.Ş., 2010. *The study of new elite of Cabernet Sauvignon for obtaining red choise wines*. Universitatea de Ştiinţe Agronomice şi Medicină Veterinară – Lucrări ştiinţifice, serie B-LIV, p. 554-556.

[7] Gorjan S. Ş., 2011. *The agrobiological study of old grape varieties in vineyard Dragasani*. Universitatea de Ştiinţe Agronomice şi Medicină Veterinară – Lucrări ştiinţifice, serie B-LV, p. 516 – 520.

Scientific Papers, Series B, Horticulture, Vol. LVI, 2012
CD-ROM ISSN 2285-5661, ISSN-L 2285-5653

SEROLOGICAL AND MOLECULAR RESPONS OF SEVERAL APRICOT ROMANIAN VARIETIES TO THE ARTIFICIAL INFECTION OF PPV (PLUM POX VIRUS)

Ligia ION, Dorel HOZA

University of Agronomic Sciences and Veterinary Medicine of Bucharest, 59, Marasti Street, 011464, Bucharest, Romania, tel.: 0213182564, fax:0213182888, ionnagyligia@yahoo.fr, dorel.hoza@gmail.com.

Corresponding author email: ionnagyligia@yahoo.fr

Abstract

Sharka disease, caused by this virus (PPV) is one of the most serious viral diseases of stone-fruit crops, including peach (Prunus persica L.), apricot (P. armeniaca L.), plums (P. domestica L. and P. salicina Lindl.) as well as sweet and sour cherries (P. avium L. and P. cerasus L.) that may be systemically infected by a few unique PPV strains. The goal of this work is to evaluate a large number of local apricot varieties concerninhg the resitance to PPV, and using them on the valuable breeding programs, is an interesting perspective in limiting the spread of this virus. In support of this idea we studied a large number of genotypes grafted on the mirobolan rootstocks and GF305 (considered indicator to PPV), that were previously artificial infected with PPV by chip budding. The rootstocks and the apricot varieties were tested by Elisa and RT-PCR.

Keywords: *plum pox virus, resistance genotypes, strains*

INTRODUCTION

Apricot is the third most important species among the stone fruit crops with a world production of approximately 2.69 million tons (FAO 2004). In Europe, PPV is the most important virus affecting Prunus fruit crops and the most limiting factor for the apricot cultivation in terms of economics [9]

The implementation of an aggressive eradication program to control its spread is an extremely costly way of controlling PPV. Ultimately, the introduction of resistant cultivars of stone fruits into the orchards is the best long-term solution in order to control the virus. [10]

Several PPV resistance programs aimed to obtain resistant or partially resistant apricot cultivars are carried out in Europe [3], [6], [5], [11], [12]. The majority of existing apricot cultivars show different level of susceptibility to PPV. Breeding for resistance is one of the effective measures for a protection against the Sharka disease.

Resistant apricot cultivars, along with the apricot's small genome size of 294 Mb [1] and haploid number of n=8, facilitate the study of the genetics of PPV resistance. Recently, three genetic maps for apricot have been published [4], [8], [13].

The goals of the work presented in this communication are the identification of a natural source of resistance to PPV, introduce this resistance into commercial cultivars well adapted in our country, and the implementation of marker-assisted selection (MAS), based on markers tightly associated with resistance, as a measure to substantially streamline the breeding process.

MATERIAL AND METHOD

The several Roumanian apricot varieties :" Traian", "Auras", "Ceres", "Sirena', "Olimp", "Ovidiu", "SEO", "Euxin", "Harcot", "Tudor","Augustin", "Amiral", "Danubiu", "Histria", were tested in the artificial infected conditions, in the greenhouse.

The young apricot sticks were grafted onto inoculated GF305 (used like susceptible rootstock) ready for testing to PPV resistance.

They were inoculated with a chip-bud collected from three experimental field plots containing conventional varieties planted at Fruit Research Station, Bistrita, Romania**.**

Phenotyping methods

For phenotyping this Romanian progenies, plants without sharka symptoms on shoots growing from the inoculum bud and with

negative enzyme-linked immunosorbent assay (ELISA) reaction were re-inoculated. PPV infection was evaluated over three consecutive growth periods through visual symptoms and ELISA [11]

For Elisa method the mashed leaves (samples) in extraction buffer (AFT 0,2 % + Dieca 2% + PVP – 10) were placed in holes in a plate previously tapisated with polyclonal immunoglobulins conjugated (anti-PPV) and incubated at 4 ^{0}C for 16h. After 3 washes (with AFT- Tween) were added 200 µI specific monoclonal antibodies for PPV and incubated at 37 ^{0}C for 2 h. The last step was the implementation of immunoglobulins conjugated with alkaline phosphatase 1:1000 (200µI) and incubated for 2h at 37 ^{0}C. The reading was made at 405 nm considering the positive values exceeding twice the value of negative test reading (T-x 2). (Figures 1 and 3)

Pruning was performed at the beginning of each growth period to induce vigorous new shoots for symptom scoring. The plants, in which PPV was not detected by ELISA, were tested by reverse transcription polymerase chain reaction (RT-PCR) using the PPV specific primers P1 and P2, [15] that amplifies a 243 bp fragment located at the C-terminus of the PPV CP gene. PPV was trapped with PPV-polyclonal antibodies adsorbed on an Eppendorf micro tube. Enhanced Avian kit provided by Sigma was used for RT-PCR. The thermal cycling scheme used was the following: RT- 30 min at *50°C,* denaturation / RT inactivation - 2 min at 94°C followed by *35* cycles: template denaturation - 30 s at 94°C, primer annealing - 45 s at 61°C and DNA elongation- 60 s at 72°C. Following to the last cycle, amplified DNA was elongated for 10 min at 72°C. An aliquot of the amplified products (10 µI) was fractionated onto *1.5%* agarose gel electrophoresis in 1x TBE buffer. Bands were visualized by ethidium-bromide staining under UV light. [7] ,[15] .(Fig 2)

Plants were classified as resistant if they did not show symptoms and positive ELISA or RT-PCR reaction in the last three growth periods that were evaluated.

RESULTS AND DISCUSSIONS

In artificial infection conditions in the greenhouse the results presented in Figure 1 (in the top of the Elisa plate) shows that the samples belonging to susceptible GF 305 rootstock were found to be positive compared with most samples of apricot genotypes,(in the bottom of the Elisa plate) even if they were collected on the same plant.

Under these conditions the virus is able to infect susceptible peach rootstock but not the majority of the apricot genotypes like Traian', 'Auras', 'Ceres', 'Euxin', 'Tudor', 'Augustin' [2].

These potential resistants individuals were tested in terms of molecular techniques to confirm the nature of resistance to sharka.

Results concerning the molecular detection performed by RT-PCR) using a primer pair (Pl/P2) that amplifies a 243 bp fragment located at the C-terminus of the PPV CP gene, proved, that some apricot varieties that were found to be negative after Elisa test, were revealed to be positive after molecular testing like 'Ovidiu' (Fig 1 and Table 1). This, it show us that it supports the sensitivity of molecular testing [15].

Plants were classified as resistant if they did not show symptoms and/or positive ELISA or RT-PCR reaction in the last three growth periods that were evaluated. Resistant individuals were coded as heterozygous for the trait and those susceptible were coded as homozygous recessives (consistent with [14].

Table1. Results concerning scoring to the Romanian apricot varieties after 2 years evaluation to the PPV infection.

Genotypes	2011 Das Elisa	2011 RT - PCR	2012 DAS Elisa	2012 RT-PCR
Traian	-	-	-	-
Auras	-	-	-	-
Ceres	-	-	-	-
Sirena	+	+	+	+
Olimp	+	+	+	+
Ovidiu	-	+	-	+
SEO	-	-	-	-
Harcot	-	-	-	-
Euxin	-	-	-	-
Tudor	-	-	-	-
Augustin	-	-	-	-
Amiral	+	+	+	+
Danubiu	+	+	+	+
Histria	+	+	+	+

The apricot genotypes 'Traian', 'Auras', 'Ceres', 'Euxin', 'Tudor', 'Augustin' and the recognized varieties 'SEO and Harcot' were found resistant to PPV as demonstrated by both serological and molecular tests (RT-PCR).

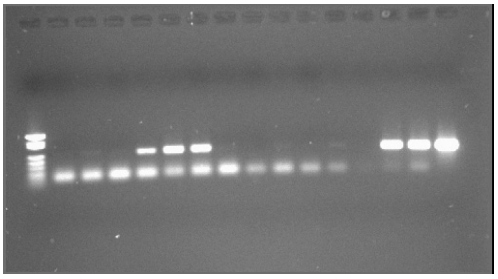


Fig. 1 The RT- PCR test concerning the PPV resistance on the Romanian apricot varieties.

M 1 2 3 4 5 6 7 8 9 10 11 12 13 14

CONCLUSIONS

The identifying of a natural source of resistance to PPV, using this resistant source into new crosses with Romanian commercial cultivars well adapted in our country, and the implement of marker-assisted selection (MAS), based on markers tightly associated with resistance, as a measure to substantially streamline the breeding process, may be a promising strategy to obtain apricot varieties with natural genetic resistance to PPV.

ACKNOWLEDGEMENTS

This study was financed by project SharCO "Sharka containment"- FP7/2007 - Grant Agreement no 204429 funded by European Union.

REFERENCES

[1] Arumuganathan K, Earl ED, 1991. *Nuclear DNA content of some important plant species.* Plant Mol Biol , 1991,Rep 9:211–215

[2] Cambra M, Asensio M, Gorris T, Garcıa JA, Moya JJ, Lopez-Abella D, Vela C, Sanz A, 1994. *Detection of Plum pox potyvirus using monoclonal antibodies to structural and non-structural proteins*. EPPO Bull. 24, 569–578.

[3] Hartmann W, 1998. *Strategy for breeding sharka resistant plums*. Acta Hortic (The Hague), 1998, 478:31–38.

[4] Hurtado M A, Romero C, Vilanova S, Abbott AG, Llacer G, Badenes ML, 2002. *Genetic linkage map of two apricot cultivars (Prunus armeniaca L.) and mapping of PPV (sharka) resistance*. Theor Appl Genet 105, 2002:182–192

[5] Jacob HB, 2002. *Breeding of plums, prunes and mirabelles in Geisenheim, Germany: breeding goals and previous realisation.* Acta Hortic. 2002 (The Hague) 577: 39–43.

[6] Jakubowski T, 1998. *Breeding of plum cultivars in Poland.* Acta Hortic, 1998, (The Hague) 478: 151–154.

[7] Kegler H, Fuchs E, Gruntzig M and Schwarz S, 2000. *Screening of plum, peach and apricot cultivars for resistance to Plum pox potyvirus*. Acta Hort, 2000, 538:397-405

[8] Lambert P, Hagen LS, Arus P, Audergon JM, 2004. *Genetic linkage maps of two apricot cultivars (Prunus armeniaca L.) compared with the almond Texas x peach Earlygold reference map for Prunus*. Theor Appl Genet, 2004,108: 1120–1130

[9] Llácer G, Cambra M,1998. *Thirteen years of sharka disease in Valencia Spain*. Acta Horti, 1998, 472:379–384

[10] Martinez-Gomez P, Dicenta F, Audergon JM.,2000. *Behaviour of apricot (Prunus armeniaca L.) cultivars in the presence of sharka (plum pox potyvirus) a review Agronomie*. 20: 407-422.

[11] Polák J, 1994. *Breeding for resistance to plum pox potyvirus in the Czech Republic*. EPPO Bull.,1994, 24:781–782.

[12] Ranković M, Ogašanović D, Paunović S, 1994. *Breeding of plum cultivars resistant to sharka (plum pox) disease.* Acta Hortic. The Hague, 359: 69–74.

[13] Vilanova S, Romero C, Abbott AG, Llacer G, Badenes ML, 2003. *An apricot (Prunus armeniaca L.) F2 progeny genetic linkage map based on SSR and AFLP markers mapping plum pox virus resistance and self-incompatibility traits*. Theor Appl Genet, 2003a, 107:239–247

[14] Vilanova S, Romero C, Abernathy D, Abbott AG, Burgos L, Llácer G, Badenes ML, 2003. *Construction and application of a bacterial artificial chromosome (BAC) library of Prunus armeniaca L. for the identification of clones linked to the self incompatibility locus*. Mol Genet Genomics, 269:685–691

[15] Wetzel T, Candresse T, Raveloanndro M and Dunez J, 1991. *A polymerase chain reaction assay adapted to plum pox potyvirus detection.* Journal of Virological Methods, 33: 355-365


EX·TERRA·AVRVM

Scientific Papers, Series B, Horticulture, Vol. LVI, 2012
CD-ROM ISSN 2285-5661, ISSN-L 2285-5653

FRUIT AND GRAPE PRODUCTION IN SERBIA

Natasha KLJAJIĆ[1], Zorica SREDOJEVIĆ[2], Svetlana ROLJEVIĆ[3]

[1]Institute of Agricultural Economics, Volgina street 15, Belgrade, e-mail: natasa_k@iep.bg.ac.rs
[2]University of Belgrade, Faculty of Agriculture-Zemun, Nemanjina street 6, Belgrade-Zemun, e-mail: zokas@agrif.bg.ac.rs
[3]Institute of Agricultural Economics, Volgina street 15, Belgrade, e-mail svetlana_r@iep.bg.ac.rs

Corresponding author email: natasa_k@iep.bg.ac.rs

Abstract

Economic and socio-economic importance of fruit and grape production in Serbia is very high due to favourable natural conditions of our country. Fruit and grapes and their derivatives can be very profitable, particularly regarding export. On the other hand, it directly or indirectly affect the development of other industries and their products such as the production of propulsion and auxiliary machinery, mineral fertilizers, plant protection and other inputs.
Accordingly, this paper presents the production of fruit and grapes for the period 1999-2010 in the Republic of Serbia (total), Central Serbia and Vojvodina, as the import-export trade and development prospects of fruit production in Serbia.

Key words**:** *fruit, grapes, production, import-export, yield, development directions.*

INTRODUCTION

Fruit growing, as a field crop production, is characterized by a number of comparative advantages over other branches of agriculture, but it is necessary to undertake substantial measures towards the intensification of production, as specialization and modernization of processing facilities.
Nowadays, the development of fruit output does not have production as the only goal because that product has to be placed on the market under favourable conditions. This means that in aim to maintain the successful fruit production (both intended for the market and for household purposes) planting beds with high quality and productive varieties of fruit trees, providing under the given agro-ecological conditions in the environment the optimal production and economic results, should be raised [3].
The importance of fruit is reflected in the fact that it is a good source of vitamins (especially A, B and C) and minerals as ingredients essential to human nutrition.
According to Vlahovic [6] one of the divisions of the fruits importance in the diet is:

- water-rich fruits like orange, lemons, grapes, raspberries, strawberries, blackberries, cherries, cherry, apricot, peach, apple, pear, plum, etc. (containing up to 95% water, small value of the energetic values, containing fats and proteins in very small quantities, but with significant amounts of minerals and vitamins (C, A, etc.).
- fruits rich in fat-walnut, almond, hazelnut, chestnut, peanut etc.. - are high in calories and contain significant amounts of fat, protein and carbohydrates, and little water.

A significant number of fruit species enables the use of a number of locations and areas with very different soil and climatic conditions for fruit production, and because of the wide range of distribution, fruit production is economically important activity in our country.

MATERIAL AND METHOD

The paper is part of the research project number 46006: "Sustainable agriculture and rural development accomplishing the strategic objectives of the Republic of Serbia within the Danube region, "an integral and Interdisciplinary Research (period 2011-2014); 46009 - Promotion and development of

hygienic and technological processes in the production of foods of animal origin in order to obtain high-quality and safe products competitive on the world market and the 179028 - Rural labour markets and rural economy of Serbia - the diversification of income and poverty reduction; funded by the Ministry of Education and Science of the Republic of Serbia.

RESULTS AND DISCUSSIONS

Among the official data, Statistical Office lists the following production results for the types of fruit: apples, pears, plums, cherries, cherry, apricot, peach, strawberry, and raspberry (Table 1).

Collected data were analyzed by mathematical standard and statistical methods and presented through tables and histograms.

Apple, as the most important fruit specie in the world and Europe, is very important in the diet as economically. It is spread in the wide open spaces because it successfully adapts to different climatic conditions. Chemical composition and organoleptic qualities make apple fruit very delicious, healthy and hygienic food with strong and multiply effect of dietary-therapeutic values. It is rich in varieties (over 20,000 varieties) and it can be use as the fresh apple fruit, or in the form of different products. The world's largest apple producer is China. In our country, apples are more or less grown in all areas particularly frequently in the Western Morava river basin and Moravice, in the surroundings of Ivanjica, Pozega, Arilje, Guca, in Toplica, in the valley of the River Ibar and Lim, around Subotica, etc.

Total apple production in the Republic of Serbia for the period 1999-2010 amounts to 207,900 t with an average yield of 14 kg per tree. In Central Serbia, the production is 129,200 t yield respectively 13 kg per tree, while in Vojvodina is slightly lower representing 78,800 t with an average yield of 16.2 kg per tree.

Table 1. The average fruit production (000 t) for the period 1999-2010 in the Republic of Serbia

Years	Republic of Serbia					
	Total		Central Serbia		AP Vojvodina	
	Production thounsands of tons	Average per tree, kg	Production thounsands of tons	Average per tree, kg	Production thounsands of tons	Average per tree, kg
apples	207.9	14.0	129.2	13.0	78.8	16.2
pears	57.0	11.3	45.1	11.9	11.8	10.2
plums	469.3	11.1	427.1	11.0	42.1	16.2
cherry	24.5	13.3	20.2	12.9	4.3	15.2
cherries	78.8	9.1	62.8	8.4	16.0	11.4
appricots	22.6	14.1	16.5	13.7	6.2	15.4
peaches	53.7	13.6	39.8	13.5	13.9	13.7
strawberries	33.7	4.1 t/ha	32.3	4.2 t/ha	1.3	2.2 t/ha
raspberries	79.9	5.3 t/ha	79.1	5.3 t/ha	0.9	2.2 t/ha

Data source: Statistical Yearbook of Serbia, 2004, 2009.

Pear is the oldest, highest quality and very profitable fruit specie. The best production results are obtained from the areas up to 600 m above sea level. The world, as well as in apple, pear production is largest in China, followed by Italy, USA, Spain, Argentina etc. The largest production centres in our country are located in Grocka- Smederevo area, West Morava Valley, Pomoravlje, eastern Serbia, Fruška Gora, and area of Bela Crkva.

The average production of pears in the Republic of Serbia covering the period 1999-2010 amounts to 57,000 t with an average yield of 11.3 kg per tree. In Central Serbia, the production is 45,000 t, respectively 11.9 kg per tree, whereas in Vojvodina is slightly

lower represented by 11,000 t with an average yield of 10.2 kg per tree.

Plum is a fruit that has a great energy merit as fresh and distinct protective, therapeutic values and dietary value in the dry state. It contains all the substances necessary for the functioning of the human organism. This specie is widespread because the fruit can be successfully grown on all continents of the world. The largest producer is China. In Serbia, it is mostly grown in the hilly and mountainous areas.

The average production of plums in the Republic of Serbia for the period 1999-2010 amounts to 469,000 t with an average yield of 11.1 kg per tree. In Central Serbia, the production is 427,000 t in other words 11.0 kg per tree while in Vojvodina is slightly lower with 42,000 t with an average yield of 16.2 kg per tree.

The largest producers of cherries in the world are Turkey, Iran and America. In our country the cherry grows most frequently in the mountainous areas at high altitudes over 1,000 m. The most significant area of cherry production in Serbia is Belgrade and the surrounding area of Smederevo and Dragačeva. In Vojvodina, the characteristic areas of production are Fruska Gora, Sombor and Subotica. The observed period of 1999-2010 has shown that average production of cherries in the Republic of Serbia amounted to 24,500 t with an average yield from 13.3 kg per tree. Much higher production was in Central Serbia with 20,200 t or 12.9 kg per tree compared to Vojvodina, where production was 4,300 t with an average yield of 15.2 kg per tree.

Cherry is a high quality and delicious fruit shake and a regular companion to cherries. Their characteristics are largely consistent with the difference that the cherry ripens later. It features high technological value of the fruit. Cherry is rich in various nutrients, and is widely in use in fresh and in processed condition. The average production of cherries in the Republic of Serbia in the past 12 years amounted to 78,800 t in other words 9.1 kg per tree.

Apricot is a very popular fruit in the domestic and foreign markets, but the extent of its production in our country does not meet market demands. The average production of apricots in the Republic of Serbia in the observed period amounted to 22,600 t or 14.1 kg per tree. Production in Central Serbia is 16,500 (13.7 kg per tree), and in Vojvodina 6,200 t (15.4 kg per tree).

Peach is a very honourable, good and profitable fruit. For a brief period it reaches full production capacity of 30 t/ha. The largest producer in the world is China, followed by North America and Asia. In Europe the largest producers of peaches are Italy, Greece, Spain and France. In our country the biggest peach production is realized in the vicinity of Belgrade, and in this area one third of domestic production of peaches is achieved. In addition, it has been successfully grown near Danube river, in Srem, Banat and South-North Backa. In the present research period, the average production of peaches in the Republic of Serbia amounted to 53,700 t with an average yield of 13.6 kg per tree. In Central Serbia two-thirds of domestic peach production is achieved with an average production of 39,800 t and average yield of 13.5 kg per tree.

Compared with other fruit species, strawberry is characterized by early entry into yield, fast return on investment in the strawberry fields, modest requirements in terms of natural conditions of production, a wide area of distribution, ease cultivation, a large and varied use-value, etc. [4].

The average production of strawberries in the Republic of Serbia amounted to 33,700 t (4.1 t/ha), except that regarding the production in central Serbia, 32,300 t (4.2 t/ha) Vojvodina produce 1,300 t (2.2 t/ha).

Raspberry is the most important type of berries. Raspberry is one of the most important export products, the backbone of rural development in certain areas, the real Serbian brand, its growth represents an important economic sector and many more. The fruit is attractive, delicious, with excellent flavour, juicy, high-nutrient, containing dietary and technological values for which the raspberry is highly appreciated and sought after fruit. It is the most profitable export product of Serbian agriculture.

The average production season in the Republic of Serbia for the period 1999-2010 amounts to 79,900 t with an average yield of 5.3 t/ha. In Central Serbia, the production is 79,000 t yield representing 5.3 t/ha whereas in Vojvodina yield is 900 t with an average of 2.2 t/ha. Values of fruit production in our country are shown in the Fig. 1.

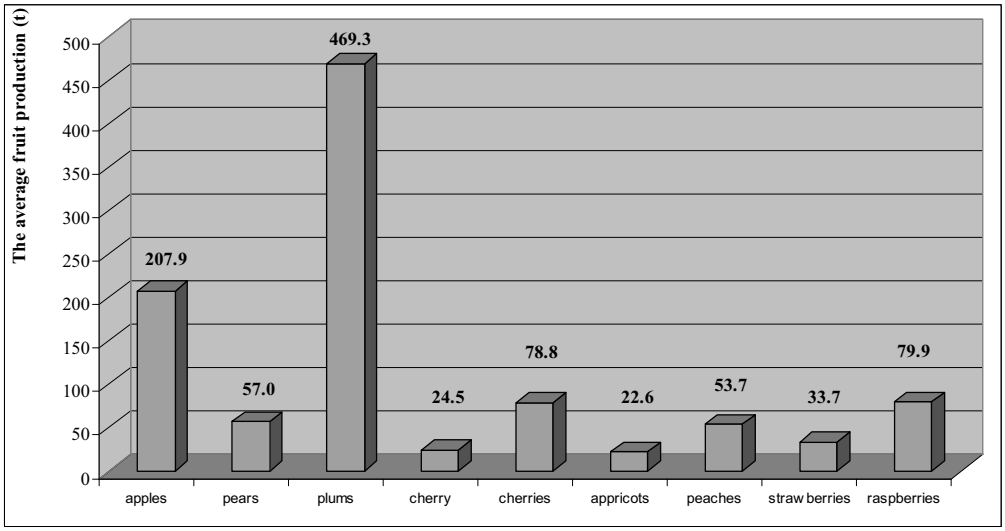


Fig. 1. The average fruit production in Serbia for the period 1999-2010

Grapevine has a wide world distribution as in the countries of Europe, and in our country and this is primarily due to the modest requirements in terms of natural conditions of production. For successful cultivation of grapes land with physical, chemical and other properties lower than average, and land with a greater slope and more complex terrain can be used. As the vines can thrive on poor soil quality, where with the same success rate arable crops cannot be cultivated, many vineyards change infertile land in productive. In this way we achieve significant intensification of agricultural production in general. Also, it is characteristic for the grape as a perennial plant that it does not make specific demands on the climate, it makes good use of solar energy, enough to rapidly proliferate and sporulates regularly. If the natural conditions are favourable, grapes can exist for a long time and give satisfactory yields and quality [3].

Areas under vineyards in the Republic of Serbia amounted to an average of 64,323 ha. These areas were in the previous ten years ranged from 57,103 ha (2010) up to 71,749 ha (1999). In recent years, a slight decline was acknowledged. Significantly larger areas of vineyards are in Central Serbia in relation to the AP Vojvodina. However, the areas under this crop and yield were not correlated. The highest production was achieved in 2003 showing 450,000 t with yield of 1.2 kg per vine, and the lowest in 1999 with 183,000 t with yield of 0.4 kg per vine in the Republic of Serbia (total). A similar situation applies to the territory of Central Serbia and Vojvodina (Table 2).

The EU has specific measures for the products of regional importance, which is facing pressure from the international market, namely: export subsidies, funds for promotions and other financial assistance.

Table 2. Grape productions in the Republic of Serbia for the period 1999-2010

Years	Vineyard (ha)	Vines (mil.)	Productivity (000 t)	Yield per vine kg
Republic of Serbia				
Average	64,322.8	362.2	354.0	1.0
Central Serbia				
Average	53,450.8	311.0	282.9	1.0
AP Vojvodina				
Average	10,872.0	51.3	71.1	1.5

Source: Republican Bureau of Statistics, www.stat.gov.rs

According to data from the Statistical Office RS main foreign trade partner in imports of fruits was Greece, from where fruit was imported representing the value of 13,141 (2005) to 27,662 (2009) USD $. Italy follows with a value of fruit exports to our country from 4,121 in 2005 up to $ 8947 thousand USD in 2008. Spain is the third country by the value of fruit exports to Serbia, the lowest value is achieved in 2005 with 13,141, and the highest in 2008 with thousands of USD $ 6.721. In the observed period there were no imports of fruit from Luxembourg, which is understandable, and from Ireland only in 2007, and from Slovakia during years 2007 and 2008 import was achieved. From the Czech Republic import was made in 2008. From Sweden in 2005 and 2008, and from England in 2008 and 2009. (http://agroekonomija.wordpress.com/2011/03/08/uvoz-svezeg-i-suvog-voca-iz-zemalja-evropske-unije-u-republiku-srbiju/).

In 2010, fruits imported represent 206,476 t as fresh and dry in the amount of $ 133,823,000 USD. The largest amount was imported from Greece, Turkey, Ecuador, the Republic of Macedonia and Croatia.

In the structure of agricultural products export raspberry is the most important and most profitable product. The movement of imports and exports in the country for the past few years, (the period 2005-2009) is shown in Table 3. Raspberry is exported at a price approximately of 1.4 to 1.5 € / kg, mostly frozen [2].

The value of imports in the Republic of Serbia for this period is € 82,490 on average, or 62,312 kg, while the export value is € 6,748,037, and 5,851,792 kg naturally expressed, made with a positive trade balance in the amount of 6,665,547.00 € or 5,851,792 kg. In Central Serbia in the observed period, exports of 5,715,629 kg or € 6,590,912 were dominant over the import of 62,296 kg or € 82,168, where it achieved a positive balance of 5,653,332 kg, respectively € 5,653,332. The area of Vojvodina is characterized by substantially lower production of raspberries in relation to Central Serbia but also in this area a positive balance of 198,459 kg, with respect to the export of 198,475 kg (€ 157,125.00) was significantly higher than imports, which amounted to 16 kg or € 322.00 is noticed (Table 3).

Fresh raspberries in the various forms are mainly exported to the European Union because the EU countries, deficient in raspberry, have a relatively high standard of living, and place raspberries as food safe fruit. Therefore, it is promising that exports with the appropriate marketing measures, could significantly increase [5].

Major problems of fruit production

Extremely favorable climatic and soil conditions are rational for fruit production in Serbia. The quality of most of the land is excellent but the zoning and land fragmentation properties represent an obstacle to the production unification. Water resources are also, of good quality but, unfortunately, are not used sufficiently. In the process of irrigation problem is the risk of used water contamination.

Genetic resources of Serbian orchards have been significant. Opportunities for biodiversity conservation exist, but production programs should not rely on the old varieties that have potential for development of quality fruit. The world market should be reached with organic production.

Table 3. Import and export of raspberries to the Republic of Serbia in the period 2005-2009

Years	Import			Export		
	Amount, kg	**Value/ dinars**	**Value/euros**	**Amount, kg**	**Value / dinars**	**Value/euros**
Republic of Serbia (total)						
2005	94,081	4,389,119	56,059	7,611,881	312,554,872	3,774,897
2006	22,004	974,889	11,965	5,632,170	377,796,296	4,478,316
2007	10,678	1,399,326	17,381	6,793,866	668,019,847	8,255,177
2008	79,791	12,945,172	165,647	4,997,713	915,225,757	11,557,824
2009	1,05,006	15,016,045	161,399	4,534,890	530,953,607	5,673,973
Average	62,312	6,944,910	82,490	5,914,104	560,910,076	6,748,037
Balance				**+5,851,792**	**+553,965,166**	**+6,665,547**
Central Serbia						
2005	94,081	4,389,119	56,059	7,100,452	291,418,872	3,521,066
2006	22,004	974,889	11,965	5,389,004	360,673,505	4,275,062
2007	10,662	1,368,424	16,990	6,556,086	641,425,243	7,926,633
2008	79,741	12,862,896	164,662	4,997,713	915,225,757	11,557,824
2009	104,994	14,993,788	161,164	4,534,890	530,953,607	5,673,973
Average	62,296	6,917,823	82,168	5,715,629	547,939,397	6,590,912
Balance				**+ 5,653,333**	**+541,021,574**	**+ 5,653,332**
AP Vojvodina						
2005	0	0	0	511,429	21,136,000	253,831
2006	0	0	0	243,166	17,122,791	203,254
2007	16	30,902	391	237,780	26,594,604	328,544
2008	50	82,276	985	0	0	0
2009	12	22,257	235	0	0	0
Average	16	27,087	322	198,475	12.970.679	157.125
Balance				**+198.459**	**+12.943.592**	**+ 198,459**

Source: Republican Bureau of Statistics, www.stat.gov.rs

Holdings engaged in fruit production in Serbia have a long tradition in fruit, but only to the extent that they provide free survival wishes for the introduction of new technologies. Holdings are fragmented, although there are opportunities to complete their merging in order to increase production. Necessary specialization of farms and the formation of associations and organizations, whose main task will be to assist manufacturers, represent an imperative. We should maximize the experience of other countries. There is also a drain of manpower and increase of the number of elderly households and it is necessary to create conditions for the return of youth to the countryside. Unskilled and uneducated labour performing seasonal work is enough, but it is still imported from Bulgaria and Romania, because domestic people have no interest in carrying out this work.

Generally, there is no vertical or horizontal linkages with producers and manufacturers have no real information. It is therefore necessary to perform association and organization of processing and marketing in all parameters with a proper division of labour and risk. A strategy that will have the task of connecting with the goal of a quality final product should be prepared.

High quality manufacturers association would solve any potential problems for further connectivity using the help of institutions and their advisors. It is necessary to establish a new vertical and horizontal organization.

The primary production covers only 14% of the population, due to inadequate product prices and subsidies that cannot specialize in

fruit growing. Primary production should stabilize while maintaining quality. It is necessary to clearly define what it is that we sell? What should be the quality of the product and what are the standards to be met in order to be successful. It is necessary to introduce the EU standards in all aspects of production, because there are real opportunities to increase exports of fresh fruit. Export prospects have a variety of wild fruits, which are a good opportunity for small producers.

Storage and production capacity is sufficient, but mostly useless. Refrigerators are positioned differently and there are large losses in transportation and most are privately owned. A small number of refrigerators have a „HACCP quality system". The problem is the unresolved status of common cold stores most of whom are not active. It is necessary to list all the cold stores and make the existing registry. It is necessary to accelerate the privatization process and to encourage construction of new modern cold stores to be able to follow all the requirements of new markets, using modern technological principles. The biggest problem for the survival of the cold stores is not meeting production standards.

Our problem is a very weak organization and marketing of local companies. The state should assist marketing, organizing symposiums and other activities, as there are companies that have great potential for marketing local products abroad. It is necessary to create a brand and the ability to define products. Certainly is the possibility of penetrating the market as well as in Eastern countries and in the region. It is necessary to intensify the performances of export-oriented companies to organize fairs and better logistics. Compliance with EU directives is necessary, as applying other countries experience. It is necessary to stimulate the production of cherries and berries and enhance activities in the domestic and foreign markets.

A very serious problem is too extensive representation of foreign manufacturers in domestic market, but tastes of the manufacturer change (for example, medicinal brandy and liqueurs, such as. Vermouth is more and more popular, at the expense of brandy), but our production is slow to react.

CONCLUSIONS

Looking at the production of fruit and grapes in the Republic of Serbia for the period 1999-2010, it was observed that our country is especially noted for the production of plums and apples. By far, the greater production of both fruits and grapes is concentrated in Central Serbia in relation to Vojvodina, which is understandable considering that Vojvodina is mainly producing industrial plants.

In the fruit production of Serbia, very important type of berries (in addition to strawberries) is raspberry, which is especially underlined in this paper in terms of exports. In our country, raspberry is the most profitable export item because there is a significant and stable export demand for it. Of the total production of raspberries more than 99% is targeted toward market. Approximately 95% of total production is exported, mainly in the frozen state, bringing foreign exchange earnings of 100 to $ 200 million [1].

In general, regardless of the favourable natural conditions, fruit production is Serbia is in pretty bad shape. Fragmentation of land under fruit plantations unable use of more productive machinery and perform the necessary agro-technical measures. The high share of obsolete (outdated) variety and diversity of cultivars represents a significant difficulty in terms of standard quality fruit supply. And many other unresolved issues (production of quality planting materials, the necessary funding for the establishment and regular production of fruit, etc..) represents also a serious obstacle to halt years of stagnation in fruit production.

The development of fruit growing in our country is not at a high level (irregular and low yields and poor fruit quality), despite the favourable conditions that our country has for its.

Market-oriented, fruit could be highly profitable in terms of growing technology harmonized with market demand and therefore the future development of the fruit

should be directed towards increasing production to achieve high yields of quality fruits and specialization and modernization of processing facilities.

REFERENCES

[1]Dimitrijević, B., 2009. Organizacioni model kooperative proizvođača maline. Magistarski rad, Poljoprivredni fakultet, Beograd, 2009.

[2]Kljajić Nataša, 2012. Ekonomska efikasnost investicija u različitim uslovima proizvodnje maline. Doktorska disertacija. Univerzitet u Novom Sadu. Poljoprivredni fakultet.

[3]Milić, D., Radojević, V., 2003. Proizvodno-ekonomskai upotrebna vrednost voća i grožđa. Novi Sad.

[4] Milić D., Sredojević Zorica, Vukoje V., 2009. Economic Determinants Quality of Fruits. PTEP-časopis za procesnu tehniku i energetiku u poljoprivredi (Jurnal on processing and energy in agriculture), Vol. 13, N0 1, pp. 88-91.

[5] Stevanović S. i sar., 2003. Razvoj proizvodnje maline u Republici Srbiji u funkciji izvoza. Ekonomika poljoprivrede, br. 3, Beograd.

[6]Vlahović, B., 1999. Potrošnja poljoprivredno-prehrambenih proizvoda u svetu i SR Jugoslaviji. Buducnost, Novi Sad, 1999.

[7]www.faostat.org

[8]www.statserb.sr.gov.rs

[9]www.pks.rs

[10]www.hidmet.gov.rs/

Scientific Papers, Series B, Horticulture, Vol. LVI, 2012
CD-ROM ISSN 2285-5661, ISSN-L 2285-5653

PROMOTING A METHODOLOGY FOR SHORTENING THE DURATION OF CREATING GENETIC DISEASE RESISTANT APPLE TREE CULTIVARS

Valeria PETRE, Gheorghe PETRE

Research Station for Fruit Growing Voineşti

Corresponding author email: statiuneavoinesti@gmail.com

Abstract

The creation of new cultivars, as any productive activity, is a continuous process and is based on a technology, whose chain loops must be continuously perfected, in order to increase the efficiency. In the genetic improvement programmes, for obtaining new cultivars, the conventional methods are used – the intra- or the inter-specific hybridization, characterized by a long duration (25 - 28 years) and by high costs. The new method, with shortening of the period of obtaining the genetic disease resistant apple tree cultivars, replaces the selection field of the hybrids on own roots with a field of elites, selected in the juvenile phase from the fortification field, according to the growing and disease resistance peculiarities, grafted on low vigour rootstock (M9), planted at the definitive place at the distance of 3 x 0.5 m. The possibility to select elites is created, according to their character of resistance against diseases and to their fruits quality, during 3 - 4 years – and then the rapid transfer into competition micro-cultures. The researches performed at the Research Station for Growing Fruit Growing (RSFG) Voineşti during the 2007-2011 period, point out the fact that, by promoting of chain loops for shortening the duration of obtaining of the genetic disease resistant apple tree cultivars in the process of improvement, the time period is reduced by 30-35%, as compared to the conventional method (25 - 28 years) - and almost 5 times the area for the selection fields - and to a significant amount the costs for the creation and the putting into account of a cultivar.

Key words**:** *new methods, with period shortening, performance solutions with reduced surfaces and costs*

INTRODUCTION

In our country the genetic improvement programmes are used for obtaining new cultivars, especially conventional methods – the intra or the interspecific hybridization, characterized by long durations and high costs. Branişte N. (1987) shows that in the improvement programmes [1], for the creation of apple tree cultivars, from the hybridization till the homologation and transferring the new cultivar into production, 25-28 years are needed.

The creation of new cultivars [2], like any other productive activity, is a continuous process, based on a technology whose chain loops must steadily be perfected, in order to increase the efficiency. In the tree growing improvement, good efficiency means shorter time and fewer costs for the creation of new high quality cultivars, which shall satisfy the 3 categories of beneficiaries: the cultivators, the trade, and the consumers.

The researches performed at the RSFG Voineşti contribute to the promotion of modern ideas for the creation of new hybrid generations and of new chain loops for shortening the duration of obtaining genetic disease resistant apple tree cultivars [3].

MATERIAL AND METHODS

In the programme for the creation of genetic disease resistant apple tree cultivars, at the RSFG Voineşti, annually were realized the most diverse hybrid combinations, using matern and pattern progenitors, wich had to respond to the proposed objectives.

The researches performed during 2007- 2011 period in the experimental fields started by setting up in the spring of the year 2007 a selection field with liners of the rootstock M 9, planted at the definitive place, at distances of 2.5 x 0.5 m (8000 trees/Ha). In August 2007, on each liner were budding eyes of elites selected by the growth and by the foliage disease resistance peculiarities, issued from the

apple tree hybrids field, resulted in the fortification year 2 (hybrid series 2005) and from those in the fortification year 1 (hybrid series 2006).
The budding was repeated in the years 2008 and 2009 in the nursery fields, 2 eyes on each M 9 rootstock being budded, from each selected elite of the hybrid series 2006, 2007, respectively 2008, from the fortification fields.
In the year 1 after budding, the behaviour of the elites was followed up under the aspect of the growth evolution and of the genetic resistance against diseases,
In the fortification fields annually observations and determinations were made by appreciating the apple tree hybrids by the growth strength and by the resistance against the apple scab and mildew attack.
In the years 2-3 after grafting, in the selection fields with apple tree elites grafted on the rootstock M 9, we followed up the flowering, the fruit forming degree, the fruit quality and the resistance against diseases. From the valuable elites, which corresponded to the proposed objectives, 2 eyes of each were budded on the rootstock M 26 in the nursery, in order to set up a competition micro-culture.

RESULTS AND DISCUSSIONS

Obtaining of apple trees represents a long duration and outstanding complex activity, especially when the aim is to obtain genetic disease resistant cultivars, regardless of the used research method.
The improvement process is continuous, so that this supposes the annual creation of new selection bases, composed of hybrid dependencies which posses a complex variability, being implied as matern and patern progenitors, cultivars or genotypes that gathered valuable genetic features, so that the deadline of realizing new valuable forms shall be shortened.
The use of progenitors which posses the resistance and productivity gene, imprints into the descendent a greater transmitting rate of the valuable characters, easing somehow the improver's work.
From the hybrid combinations performed during the 2005-2006 period resulted transcendences, which formed the base of setting up the fortification fields, of which were selected the elites, which were budded on the rootstock M 9 in the especially set up selection field or in the nursery (Table 1).
From the presented data results that during the years 2005–2006 21 hybrid combinations were performed, being pollinated in total 7.986 flowers, of which resulted 2,633 hybrid apple tree seeds. The fruit forming percentage was better in the year 2006 (39.8%), but an average percentage of 32.9% was registered - harvest-able hybrid fruits. From the 2,633 fruits were obtained 12,276 hybrid apple tree seeds, with an average of 4.7 seeds/fruit, confirming that the artificial pollination assures the fecundation of all seeds.
The seeds/flowers ratio shows us that from an apple tree flower result 1.5 hybrid seeds.
From the over 10,000 apple tree hybrids obtained in the hybrid series 2005 and 2006, existing in the fortification fields, was evaluated by the growth and disease resistance characteristics a number of 151 elites, which were budded in August 2007 on the rootstock M 9, liners planted on the definitive place in the especially set up selection field.
In the year 2008, the grafts resulted as rods and were left to grow without any cutting intervention, so that a number of 15 apple tree elites differentiated fruit bearing buds, which proved to be the most precocious.
In the year 2009, over half of the budded apple tree elites bore fruits; from these 18 apple tree elites were selected by the fruits quality and by the resistance against diseases.
The reduction scheme of the obtaining duration of the genetic disease resistant apple tree cultivars is presented as follows.
After establishing the genetic resources engaged in the hybridization schemes, the seeds and the seedlings are obtained from the performed hybrid combinations. The main objective being the creation of the genetic disease resistant apple tree cultivars, the selection of the seedlings obtained in solarium may be done after a previous infection with virulent apple scab strains, being continued also on the fortification field.
These activities are common, regardless of the used improvement method (table 1). After 2

years the hybrids of the fortification field are transplanted to the definitive place in the selection orchard. For growth and fruit bearing, the hybrids need a period of at least 10-12 years, a time in which the positive mass selection for the direct observation and marking of the selected hybrids takes place, in accordance with the selection criteria (resistance against diseases, pleasant fruits aspect and taste, fruit bearing potential, etc.), their grafting in the nursery and their introduction into competition micro-cultures, in view for their promotion in the DUS test (distinctness, uniformity, stability), mandatory for the homologation.

The new method proposes a shortening of these activities, by replacing the selection field of hybrids on own roots with an field of elites, selected from the juvenile phase of the fortification field, by the growth and disease resistance peculiarities, grafted on low vigour M.9 rootstock, planted on the definitive place.

In this case there is the possibility to do in the next 2-3 years the selection for disease resistance and for the fruits characteristics and quality.

This activity takes maximum 4 years, as compared with the present scheme, which takes 10-12 years.

From the researches performed at Voineşti, the hybrid apple tree seedlings on own roots, left in the fortification field, a part of them bore fruits in the year III after planting into the hybrids nursery. Maintaining of the apple tree hybrids a longer time on own roots in the fortification field puts in account a characteristics obtained by some of the hybrid combinations – the early fruit bearing start, which leads to a duration reduction by a considerable number of years, with reduced expenses. The transplantation of the apple tree hybrids on own roots into the selection field delays the fruit bearing start - these begin to bear fruits 4-5 and even 6-7 years after planting.

In this case, the period of 17 - 18 years may be reduced by another 2 years, the hybrids selected by the growth, fruits quality and genetic disease resistance peculiarities may be grafted directly on the rootstock M 26 or MM 106 in the nursery and transferred into competition micro-cultures.

In order to enter marketing, the apple tree hybrids selected and introduced into competition micro-cultures, must go through a testing period of 2-3 years, in full fruit bearing, a testing performed by State Institute for Variety Testing and Registration (SIVTR), a time in which they verify and confirm the authenticity, the varietal purity, the agronomic and use value. The introduction into culture takes place only after they have been registered in the Official Catalogue.

By promoting the new improvement scheme for obtaining of the genetic disease resistant apple tree cultivars, the period is shortened with 8-9 years.

Also much reduced is the land area needed for obtaining and testing the hybrid material till the homologation and the promotion in culture of the new cultivar (Table 2).

From the data presented in table 2, results that at a volume of 2500 hybrid apple tree seedlings, obtained in a hybrid series, after performing the selection for disease resistance and their transplanting into the hybrids nursery for fortification, an area of 340 m^2 is needed in both methods used for the creation of new apple tree cultivars.

At the conventional method, for the transfer into the selection orchard of the 2500 hybrid seedlings an area of 10,000 m^2 is needed.

At the period shortening method, the hybrids fortified in the hybrids nursery, are not transferred into the selection orchard. By a rigorous selection by the growth and disease resistance peculiarities, results a 10% maximum of genotypes from the total hybrids number, these being grafted on M 9 liners, planted on the definitive places, at distances of 3 x 0.5 m. Results a selection orchard with about 250 hybrids selected from the hybrids nursery and 1-2 eyes budded on the M.9 liners planted at the definitive places, which will bear fruits in the year 2 and 3 after grafting, covering an area of maximum 375 m^2.

At the Voineşti Station, from 151 hybrids selected by the growth and the apple scab resistance peculiarities, grafted on the rootstock M 9, in the year 3 a number of 15 apple tree elites bore fruits. From these were

budded in the nursery 20 eyes from each elite – only from those which presented fruits and resistance against diseases, in view of setting up of a competition micro-culture, which uses for both methods about 2400 m^2.

It is found that the conventional method uses a total area of 12,740 m^2, as compared with the period shortening method for obtaining genetic disease resistant apple tree cultivars using only 3115 m^2, representing about 25%, with an area reduction of 75%.

The promotion of the method of shortening the obtaining technology of genetic disease resistant apple tree cultivars stimulates the scientific foundation of the solutions proposed for the competence increase, in accordance with the new orientations in the scientific research in the European countries with an advanced tree growing.

Table 1. Hybridization works programme and initial biological material, resulted from the hybrid series 2005 and 2006

Hybrid series	Combi-nation number	Polle-nated flowers	Obtained hybrid fruits		Hybrid seeds (nr.)	Hybrid seedlings (nr.)	Reports	
			Nr.	%			Seeds / fruit	Seeds / flowers
2005	11	5.771	1.750	30,3	9.017	7.338	5,1	1,5
2006	10	2.215	883	39,8	3.259	2.738	3,9	1,5
Total	21	7.986	2.633	32,9	12.276	10.076	4,7	1,5

Table 2. Present scheme, as compared with the scheme for shortening of the obtaining period of the genetic disease resistant apple tree cultivars

Present scheme	New scheme
- Choosing progenitors - Hybridization - Hybrid seeds - Seed stratification (1 year)	- Choosing progenitors - Hybridization - Hybrid seeds - Seed stratification (1 year)
- Sowing in flower pots or jiffy-pots in solarium - Obtaining hybrid plants (selection by disease resistance) - Hybrids transplantation into the hybrids nursery for fortification (2 years)	- Sowing in flower pots or jiffy-pots in solarium - Obtaining hybrid plants (selection by disease resistance) - Hybrids transplantation into the hybrids nursery for fortification (1 year)
- Transplantation to the definitive place in the selection orchard - Hybrids growth (6 - 8 years)	- Hybrids growth in the hybrids nursery, selection by their growth and disease resistance peculiarities) - Grafting of 1-2 eyes from the selected elites on each weak strength graft bearer (M 9) (1 year)
- Hybrids selection (Quality test) (4 years)	- Selection of hybrids grafted on graft bearer M 9 (Quality test) (2 years)
- Grafting of the elites with perspective and introducing into competition micro-cultures (2 years)	- Grafting of the elites with perspective and introducing into competition micro-cultures (2 years)
- Observing the elites behaviour in competition micro-cultures (Production test) (4 - 5 years) - Registering the valuable elites at the ISTIS	- Observing the elites behaviour in competition micro-cultures (Production test) (4 - 5 years) - Registering the valuable elites at the SIVTR
- Elites testing at the SIVTR in view of homologation (3 years)	- Elites testing at the SIVTR in view of homologation (3 years)
- Introducing into mother plantations for multiplying (3 years)	- Introducing into mother plantations for multiplying (3 years)
Total **25 – 28 years**	Total **17 – 18 years**

The nourishing surface for an apple tree hybrid, depending on the planting distance in:

- the hybrids nursery: 0,90m x 0,15m = 0,135 m^2
- the selection orchard with fortified hybrids: 4m x 1m = 4 m^2
- the selection orchard with selected hybrids from the hybrids nursery and rootstock M9: 3m x 0,5m = 1,5 m^2
- the competition micro-culture: 4m x 2m = 8 m^2

Table 3.Comparative data regarding the land area used for obtaining apple tree cultivars by the conventional method and by the period shortening method

Methods used for the apple tree cultivars creation	Used area (m^2)				
	Hybrids nursery for fortification (2500 seedlings)	Selection orchard n with fortified hybrids (2500 seedlings)	Selection orchard with hybrids selected from the hybrids nursery and grafted on M 9 (250 selections)	Competition micro-culture (15 selections x 20 trees)	Total
Conventional method	340	10.000	-	2.400	12740
Period shortening method	340	-	375	2.400	3115 (24,45%)

CONCLUSIONS

From the hybrid series 2005 and 2006, with a number of 10,076 hybrid apple tree seedlings, existing in the fortification fields. 151 elites were selected, evaluated by the growth and disease resistance characteristics – and were budded in August 2007 on the rootstock M 9, planted at the definitive places into the especially set up selection field.

By promoting chain loops for the shortening of the duration of the de obtaining genetic disease resistant apple tree cultivars in the improvement process, the time period is reduced by 30-35%, as compared with the conventional method (25-28 years) and almost by 4 times the area destined for the selection fields – and to an appreciable extent the costs for the creation and putting in account of as cultivar.

By shortening the duration of obtaining the new cultivars, the economic efficiency increases by reducing the expenses and the afferent land area, the 3 beneficiary categories: the cultivators, the trade and the consumers being satisfied in a shorter time.

New selection bases are created, composed of the hybrid transcendences with complex variability, due to implying in the hybridization process of some valuable cultivars, corresponding to the proposed objectives, which lead to the creation of new genetic disease resistant apple tree cultivars.

REFERENCES

[1] Braniţte N., 1987. *Present and perspective strategies in the reduction of the research duration for the creation of new tree growing plant cultivars*. Documentary folder ICPP Piteşti, nr.13.

[2] Braniţte N. and colab., 2004. *The culture of genetic disease resistant apple tree cultivars in Romania*.

[3] Petre Valeria, 2009. *The technique for obtaining the apple cultivars with genetic disease resistance by mutagenesis*. The Moroşan Publishing House Bucharest.


EX·TERRA·AVRVM

Scientific Papers, Series B, Horticulture, Vol. LVI, 2012
CD-ROM ISSN 2285-5661, ISSN-L 2285-5653

ASIMINA TRILOBA (PAWPAW) GERMPLASM IN ROMANIA

Florin STĂNICĂ

University of Agronomic Sciences and Veterinary Medicine, nr. 59, B-dul Mărăşti, 011464, Bucureşti, Romania, Fax: +40.021.3182888, e-mail: florin.stanica@usamv.ro

***Corresponding author email*:** florin.stanica@usamv.ro

Abstract
In Romania the first reports on Asimina triloba came from a small village in Transylvania, north-western part of the country. At the beginning of the 20th Century, a Romanian immigrant brought from USA, some pawpaw seeds and from them few uncommon fruit bearing plants have been obtained. From the village of Pianu Nou, Alba County, some seedlings were sent to a private garden in Geoagiu, Hunedoara County and for nearly one hundred years, the specie remained unknown for the Romanian fruit scientists. It was around 2000, when the descendents of the first pawpaw plants introduced in Romania were planted in the Bucharest Faculty of Horticulture fields to be tested. Together with those, some other 10 pawpaw varieties and 3 hybrids were introduced from Italy in a small collection. The paper presents the characterization of the first Romanian found pawpaw genotype and of the other genotypes existing in Romania.

Keywords: *Asimina triloba,* history, genotypes, varieties, plant collection

INTRODUCTION

Northern banana (*Asimina triloba L.*) belongs to the Annonaceae Family being known in Northern America - its origin area, under the Indian name of Paw-Paw [1].
Asimina triloba or pawpaw is temperate fruit specie used by the local Indian population long before the colonization of the continent, but only in the last time was taken in consideration by specialists in the origin area and in few European countries [3].
After 1900 the plant was reconsidered as fruit specie and the first breeding works and researches on propagation, cultivation and fruit conservation and use initiated [7] [9].
Plant description
Asimina forms a high bush or can be grown as tree 3-7 m high. Foliage is thick, shining dark green, formed by obovate big leaves.
The solitaire flowers, formed from hairy flower buds at leaves axils, are hermaphrodites and have 3+3 brown-reddish petals (Photo 1). Pollination is ensured by flies, butterflies and other insects [4]. From each flower few fruits are formed but only 1-4 will reach the ripening stage [5]. Fruits are baccas with different shape and size: sferic or long, kidney shape having between 50 and 500 grams (Photo 2).

Photo 1. Flower of *Asimina triloba*

Fruit skin is thin, smooth, colored in pale green or yellowish green and covered with a typical white wax layer. Fruit flesh is yellow, sometime yellow to orange, fine, creamy, sweet, with an aroma that combines banana, pine apple and mango flavor [10]. In the fruit pulp there exist numerous brown seeds covered with a white tegument, kidney shape, disposed on two lines (Photo 3).

Photo 2. Fruits of *Asimina triloba*

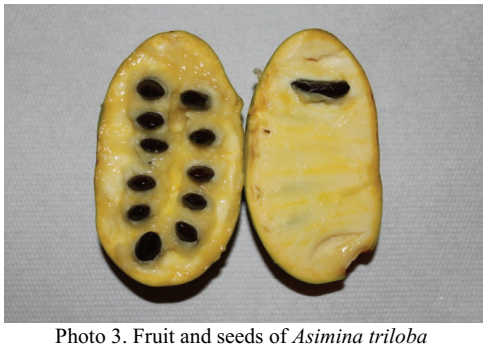


Photo 3. Fruit and seeds of *Asimina triloba*

Beside the exotic taste and flavor, asimina fruits are extremely appreciated for their high content in A and C vitamin, fatty acids (linoleic, palmitoleic, palmitic and oleic), essential aminoacids, minerals, especially Ca, Mg, Fe, K, P, Zn and Cu [6].

Asimina is winter hardy specie and can be successful cultivated in temperate areas. During the winter can resist to -25…-30°C. Even is well adapting to different soil types, it prefers well drained, rich soils with a neutral or slight acid reaction.

It needs around 160 vegetation days and grows well in areas with 700-800 mm precipitations per year. Water stress determine premature fruit drop and needs to be prevent by moderate irrigation.

The plant doesn't support the bare rooted planting and transplanting [8]. That's why these operations need to be done with root ball and the production of the planting material is made entirely in pots.

Asimina in Romania

Pawpaw (*Asimina triloba* Dunal) is a new fruit in Romania the first reports on *Asimina triloba* came from a small village in Transylvania, north-western part of the country.

At the beginning of the 20th Century, a Romanian immigrant family brought from USA, some pawpaw seeds in the village of Pianu de Sus, Alba County. The Suciu Family: Ioan, Maria and their son, Ioan Jr. left Toledo, Ohio, in 1926 and returned to Romania with few asimina fruits [11] (Photo 4).

Photo 4. Suciu Family just before their return to Romania in 1926

After their arrival they sow the seed in an angle of the typical Transylvanian courtyard protected by walls. The formed plant started to produce fruits even it had no pollinators. For many years the new plant was a curiosity for the locals but it was difficult to propagate it because of the lack of knowledge. During the time few seedlings have been spread in

nearby cities as Geoagiu and Orăştie, being planted in private gardens.
In 1978, the Suciu Family house was sold to the actual owner, Elena Voişan (age 85). In the courtyard the initial plant is still alive (Photo 5).

Photo 5. The initial plant in Pianu de Sus

Photo 6. The trunk of the initial plant in Pianu de Sus

No scientific studies have been done till recently on that plant.

The paper presents, beside the genotype from Pianu Nou, few other genotypes from Geoagiu and Bucureşti. In the same time an actual list of the asimina varieties and selections existing in Romania is presented.

MATERIAL AND METHOD

The recent improvement of the Romanian collection with asimina selections and varieties is presented as follows. In 2000, the author introduced 7 pawpaw varieties and 3 hybrids from Italy in three small collections: at the Faculty of Horticulture in Bucureşti and in two private collections in Argeş and Ilfov Counties.
In 2005, other 3 varieties received from USDA Corvallis Repository, USA, have been over grafted in the Faculty collection.
The last contribution to the collection was realized in 2012, by adding 6 new varieties from the American breeder Neal R. Peterson, Harpers Ferry, West Virginia, USA. Three of the pawpaw cultivars are patented by N.R. Peterson in the United States under the names Wansevwan (U.S. Patent PP 14,452), Levfiv (U.S. Patent PP 15,900) and Aidfievate (U.S. Patent PP 14,453), and sold under the trademarks Shenandoah, Susquehanna, and Rappahannock, respectively. The remaining three pawpaw cultivars have advanced selection identification numbers of 2-9, 1-7-2, and 4-2 respectively, and are sold under the trademarks Allegheny, Wabash and Potomac, respectively (Table 1).
After the first introduction in 2000 of asimina varieties and selections from Italy, several studies have been started at Faculty of Horticulture in Bucureşti. Different propagation methods were tested and the fruits physical and biochemical characteristics were analyzed.
In 2011, we have discovered the initial plant of asimina grown by Suciu Family from American seeds in the small village Pianu de Sus, Alba County (Selection PS). After that, a descendant seedling from that plant was identified in Geoagiu city, Hunedoara County (Selection LG). Leaves and fruit samples were collected to be studied. By comparison, another seedling from Geoagiu planted at the University of Agronomic Sciences and

Veterinary Medicine, Faculty of Horticulture in Bucureşti (Selection USAMV) and a plant from Bucureşti Botanical Garden (Selection GBB) were analyzed.

For the four genotypes the number of leaves per shoot and the single leaf area (cm^2) was calculated.

The fruit firmness (kgf/cm^2) was measured using a hand Effegi penetrometer with an 11 mm piston. The content in soluble solids (%) was determined with a hand refractometer BRIX 35 HP. Fruit average weight (g) was also calculated.

Table 1. The germplasm collection of *Asimina triloba* at the Faculty of Horticulture in Bucureşti

Variety	Trade mark	Year of introduction	Origin	Source
Sunflower		2000	USA	Domenico Montanari, Faenza, Italy
Selection 1216	Prima 1216	2000	Italy	Domenico Montanari, Faenza, Italy
Davis		2000	USA	Domenico Montanari, Faenza, Italy
Overleese		2000	USA	Domenico Montanari, Faenza, Italy
NC - 1		2000	USA	Domenico Montanari, Faenza, Italy
Ithaca		2000	USA	Domenico Montanari, Faenza, Italy
Prolific		2000	USA	Domenico Montanari, Faenza, Italy
Vitroplant 1		2000	Italy	Giuseppe Zuccherelli, Cesena, Italy
Vitroplant 2	Simina	2000	Italy	Giuseppe Zuccherelli, Cesena, Italy
Vitroplant 3		2000	Italy	Giuseppe Zuccherelli, Cesena, Italy
Taylor		2005	USA	Corvallis Repository
Wells		2005	USA	Corvallis Repository
Wilson		2005	USA	Corvallis Repository
Wansevwan	Shenandoah	2012	USA	Neal Peterson, Harpers Ferry, West Virginia, USA
Levfiv	Susquehanna	2012	USA	Neal Peterson, Harpers Ferry, West Virginia, USA
Aidfievate	Rappahannock	2012	USA	Neal Peterson, Harpers Ferry, West Virginia, USA
Selection 2-9	Allegheny	2012	USA	Neal Peterson, Harpers Ferry, West Virginia, USA
Selection 4-2	Potomac	2012	USA	Neal Peterson, Harpers Ferry, West Virginia, USA
Selection 1-7-2	Wabash	2012	USA	Neal Peterson, Harpers Ferry, West Virginia, USA

RESULTS AND DISCUSSIONS

Asimina collection

After 12 years of pawpaw (*Asimina triloba*) cultivation in Romania at the Faculty of Horticulture in Bucureşti all the varieties showed a good adaptation at the local conditions. During the first three years of growing, the plants were protected against direct sunlight by individual net shades. Even the hardest winters as 2005/2006, 2011/2012, with temperatures lower than -25 degrees Celsius, didn't affected the plants and the flower buds. All the varieties produced good quality fruits. The asimina plants haven't showed any pest and disease attack during their growth and no phytosanitary treatments have applied. In the same time, no chemical fertilizers have been applied during the trial.

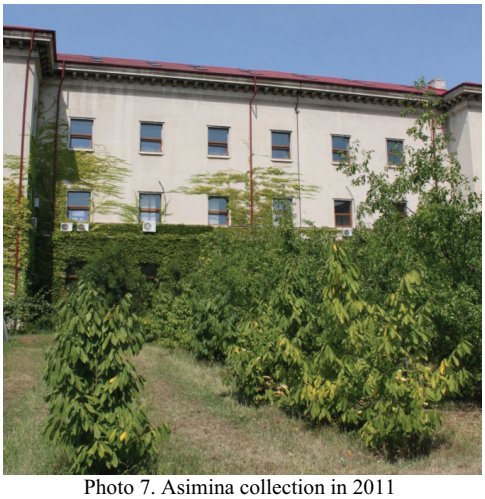


Photo 7. Asimina collection in 2011

Characteristics of pawpaw genotypes in Romania

After we found the first pawpaw plant introduced in Romania in Pianu de Sus (Selection PS) we tried to compare its

characteristics with two descendent genotypes: the Selection LG (planted in 1985) and the Selection USAMV (planted in 1998). Another genotype with unknown origin from the Bucureşti Botanical Garden (Selection GBB) was used as control.

The results are presented in table 2. As one can see, average number of leaves per shoot was similar at the four studied genotypes. The Selection PS had the highest leaf area (190.07 cm^2) while the Selection USAMV the smallest leaf area (106.07 cm^2). The biggest fruits were produced by the Selection USAMV (65.7 g), followed by the Selection LG (56.2 g). Even so, the fruits produced by the "Romanian genotypes" are smaller in comparison with the standard varieties. For example, the average fruit weight of the new variety Simina is over 200 g [12]. The fruit flesh firmness varied from 2.05 up to 7.50 kgf/cm^2. The values show some differences between the ripening moments, the Selection LG being later (Photo 8). Even so, the same selection showed the higher content in soluble solids: 23.6% in comparison with 18.2% at the original plant, the Selection PS.

Photo 8. The Selection LG in Geoagiu

Table 2. Pawpaw genotypes fruits and leaves characteristics

Genotype	Origin	Leaves/ shoot no.	Single leaf area cm^2	Fruit weight g	Flesh firmness kgf/cm^2	Soluble solids %
Selection PS	Ohio	9	190.07	36.7	2.93	18.2
Selection LG	Pianu de Sus	9	177.96	56.2	7.50	23.6
Selection USAMV	Geoagiu	9	106.07	65.7	3.00	20.4
Selection GBB	?	8	166.72	36.0	2.05	18.2

CONCLUSIONS

The "Romanian pawpaw genotypes" derived from the initial plant raised in Pianu de Sus are interesting for their resistance and adaptation to the local conditions. The fruit quality is lower in comparison with the bred varieties. It is important to mention that the Romanian genotypes seems to be self fertile, while in this moment it is know that Asimina varieties are usually self sterile with 2 single exceptions: Sunflower and Prima 1216 [2]. For the future, a genetic study of the Romanian genotypes and of the Ohio population parentage should be interesting.

After the first results obtained it is obvious that pawpaw is promising new fruit specie in Romania. Its high field resistance to pests and diseases recommend *Asimina triloba* for organic production. The nutraceutical fruit characteristics impose the pawpaws as some of the most valuable fruits in the market. For the future it is necessary to extend the trial plots in some other growing areas. In the same time, new varieties and selected hybrids need to be introduced.

Some new research on breeding, *in vitro* propagation [13], orchard technology and processing are necessary. Being a new unknown fruit specific marketing and consumer education activities are also recommended.

AKNOWLEDGEMENTS

Special thanks to the descendents of Suciu Family for the information and photo materials offered during the research.

REFERENCES

[1] Bellini E., Montanari D., 1992, *La coltura dell'Asimina (Asimina triloba), annonaceae per i climi temperati.* L'Informatore Agrario, 38, p.52-72.

[2] Bellini E., Montanari D., 2000, *L'Asimina triloba, una realtá per la frutticoltura amatoriale italiana,* Frutticoltura n-1, p. 54-61.

[3] Callaway, M.B., 1992, Current research for the commercial development of Pawpaw [*Asimina triloba* (L.) Dunal], HortScience, vol. 27(2), p.190-191.

[4] Callaway, M.B., 1993, *Pawpaw (Asimina triloba): A "tropical" fruit for temperate climates*. J. Janick and J.E. Simon (eds.), New crops. Wiley, New York, p. 505-515.

[5] Cepoiu N., Roşu A., Dănăilă-G. Silvana, Păun C., 2003, *Asimina o specie pomicolă de viitor pentru români,* Agricultorul român, 10 (58).

[6] Dănăilă-G. S., 2004, *Pawpaw (Asimina triloba L. Dunal) o specie pomicolă cu reale perspective pentru România,* Hortinform 11/147, p.25-28.

[7] Layne D. R., 1996, *The Pawpaw [Asimina triloba (L.) Dunal]: A new fruit crop for Kentucky and United States*, HortScience, vol. 31(5), p. 777-784.

[8] Peterson R. N., Snake C.J., Terrih - Angelah Turner, Pomper K.W., Ph. D, Layne D.R., 1990, *Pawpaw planting guide,* Pawpaw Foundation 'Paw paws in the garden'.

[9] Pomper W.K., Layne D. R., Peterson N. R., 1999, *The Pawpaw Regional Variety Trial,* J. Janick (ed.), ASHS Press, Alexandria, VA, p. 353-357.

[10] Stănică F., 2003*, Banana nordului o nouă specie pomicolă în România*, Rev. Căminul, Casa de vacanţă, nr. 4.

[11] Stănică F., Dănăilă-Guidea S.M., Ionescu M.R., 2011, Pawpaw germplasm in Romania, The 3rd International Pawpaw Conference, Kentucky State University, Frankfort, 9-10th September, 2011.

[12] Stănică F.**,** Zuccherelli G., Ionescu M.R. 2011, Simina – a new pawpaw variety**,** The 3rd International Pawpaw Conference, Kentucky State University, Frankfort, 9-10th September, 2011.

[13] Stănică F., Zuccherelli G., 2011, Successful micropropagation of *Asimina triloba* (Dunal), The 3rd International Pawpaw Conference, Kentucky State University, Frankfort, 9-10th September, 2011.

Scientific Papers, Series B, Horticulture, Vol. LVI, 2012
CD-ROM ISSN 2285-5661, ISSN-L 2285-5653

FLOWERING AND POLLINATION STUDIES AT SOME STRAWBERRY CULTIVARS

Monica STURZEANU[1,2], Florin STĂNICĂ[1], Mihail COMAN[2]

[1]University of Agronomic Sciences and Veterinary Medicine of Bucharest, Address: 59 Mărăşti Blvd., Sector 1, postal Code 011464, Bucharest, Romania, Phone: 0040788014935;
E-mail: post@info.usamv.ro
[2]Research Institute for Fruit Growing Pitesti, Romania, Address:Pitesti OP 1, CP 73 Romania;
Phone: 0040248278066; Fax. 0040248278477; E-mail: office@icdp-pitesti.ro

Corresponding author email: sturzeanu1980monica@yahoo.it

Abstract

Efficient pollination is fundamental for guaranteeing productivity of strawberry. The objective of this study is to investigate the effects of flowering and cross-pollination fruit set and seed number per fruit.The study carried out has revealed the main characteristics required for a good pollinizer, including: flowering, high viability and fertility of pollen grains, corresponding to high germinability.

Key words: *strawberry, flowering, cross-pollination, pollen germination, fruit set*

INTRODUCTION

Intraspecific hybridization is the main method for creation of strawberry variability, but to obtain seedlings with superior characteristics of their genitors and to avoid inbreeding is necessarily to use a large parental base. Comparative with other fruit species, the strawberry has the advantage of a short generative cycle. The low genetic recombination is often responsible for a relatively breeding low efficiency. That's why to obtain valuable combinations of characteristics, a big number hybridization it has to be made [7].
The main elements that influence the fruit setting are: the calendaristic date of flowering, its duration and environment conditions. This study emphasizes the hybridization compatibly of 9 strawberry varieties: 'Premial', 'Alba', 'Miss', 'Record', 'Mira', 'Onebor', 'Honeoye', 'Benton', 'Elsanta', 'Cambridge Favourite'.

MATERIAL AND METHOD

Investigation had been made in spring 2012, at Research Institute for Fruit Growing Pitesti and they consist in making controlled hybridization between 9 varieties with different characteristics: earliness, productivity, fruit quality and disease resistance. The following operations: selection of the flowers for pollination, flowers isolation; pollen conservation, pollination and achenes extraction, were made
For statistical processing has been used the number of days starting with the fist of January till flowering beginning [6].
Concerning statistical interpretation, there were calculated arithmetical average, the minim (the most earliest value of the flowering and of the ripe maturity), the maxim (the most late value of the flowering and the ripe maturity), amplitude (days), variability coefficient (s%) and standard deviation.
The way of calculations for determination of the variability coefficient (s%) was based on known methods [2,1] that admit arbitrary the next values:
- 0-10% - the variation coefficient little;

- 10-20% - the variation coefficient average;
- 20-30% - the variation coefficient big.

RESULTS AND DISCUSSIONS

The beginning of flowering is characteristic of each variety, being genetic determined. It takes place year by year, in the same succession, always the same, indifferently from the evolution of weather conditions from the beginning of the vegetation.

In 2012, the beginning of flowering tooks place on April 24th ('Premial') and on May 5th ('Mira'). The duration of flowering was between 9 days at 'Premial' and 20 days at 'Cambridge Favourite', ending on May 21st (Table 1).

Regarding the ripening fruits, the earliest variety was 'Premial' that with full ripening on May 25th and the latest variety was 'Record' that was full ripened of July 7th (Table 1).

Table 1. Phenological observations of strawberry cvs. flowering

No.	Cultivar	Early flowering	Late flowering	Early ripening	Full ripening
1	Premial	04.24	05.03	05.18	05.25
2	Honeoye	04.28	05.12	05.20	05.28
3	Miss	04.29	05.17	05.22	05.30
4	Benton	01.05	05.16	06.01	06.05
5	Cambridge Favourite	05.01	05.21	05.26	06.02
6	Elsanta	05.02	05.21	05.28	06.03
7	Onebor	05.03	05.18	05.28	06.04
8	Record	05.03	05.20	06.03	06.07
9	Mira	05.05	05.18	05.27	06.04

The average date of flowering at all strawberry varieties was on May the 1st, and the average data ripening was June the 1st.

The amplitude between the earliest and the latest value of flowering is 11 days, and between the earliest ripening and the latest ripening 13 days (table 2).

The variation coefficient (s%) has values between 2.69 and 2.83, that shows a little variation. According to the literature, in case of characteristics with a low variation coefficient value, exist the possibility of there inheritance [3] (table 2).

Tabel 2. Early flowering and fullt ripening index (days),coefficient of variation (%) and standard deviation

Year 2012	Flowering	Fruit ripening
Average: days	121.67	153.78
date	05.01	06.01
Minimum	115	146
	04.24	05.25
Maximum	126	159
	05.05	06.07
Amplitude	11	13
Coefficient of variation (%)	2.69	2.83
Standard deviation	3.28	4.35

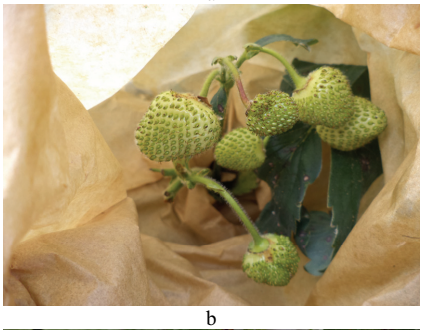
Dates concerning number of the pollinated flowers, number of set fruit and number of achenes / fruit, are presented in table 3. So, in the spring of 2012, were made 11 hybrid combinations, being artificial pollinated 779 flowers, resulting 623 hybrid fruits, and finally 20,510 achenes. Number of pollinated flowers on combination was between 24 ('Miss' x 'Premial' and 'Premial' x 'Miss') and 210 ('Benton' x 'Onebor').

The set fruit ranged from 50% ('Miss' x 'Premial') and 100% ('Record' x 'Mira').

Table 3. Cross combinations

No.	Cross combinations	No. of pollinated flowers	No. of fruit set		No. of achenes /fruit
			No.	%	
1	Miss ×Premial	24	12	50%	28
2	Premial × Miss	24	20	83%	34
3	Record × Premial	40	37	93%	13
4	Premial × Record	80	77	96%	9
5	Record × Mira	30	30	100%	26
6	Mira × Record	27	21	78%	47
7	Benton × Onebor	210	149	71%	36
8	Onebor × Benton	120	107	90%	46
9	Mira × Honeoye	44	37	84%	66
10	Benton × Cambridge Favorite	120	102	85%	34
11	Elsanta × Cambridge Favorite	60	31	52%	15
	Total	779	623	-	-
	Average	-	70.81		32.18

a



b

c

Photo 1. 'Miss' x 'Premial' cross pollination in open field

CONCLUSIONS

The study concerning the compatibility at hybridization of the 9 varieties of strawberry has shown that there are large differences of compatibility between varieties, there having different behavior as maternal or paternal genitors.

The full percent of fruit set was recorded at combination 'Record' x 'Mira', while 'Mira' x 'Record' had only 78% fruit set.

The combination 'Miss' x 'Premial', achieved the lowest percentage of fruit set (50%), while 'Premial' x 'Miss' recorded a percentage of 83%.

REFERENCES

[1] Botu I., Botu M., 1997, Metode şi tehnici de cercetare în pomicultură. Ed. Conphys, 100-104;

[2] Cepoiu, 1986, Metode statistice aplicate în experienţele agricole şi biologice, Ed. Agro - Silvică, Bucureşti;

[3] Cociu V., Oprea Şt.. 1989 , Metode de cercetare în ameliorarea plantelor pomicole, Ed. Dacia, Cluj-Napoca, 124 - 129;

[4] Coman M., 1995, Cercetări privind variabilitatea genetică în genul Fragaria şi detectarea unor genotipuri superioare de căpşun. Teză doctorat;

[5] Coman M. şi col., 1997, Ameliorarea genetică a căpşunului – realizări şi perspective, I.C.D.P. 30 de ani de activitate Piteşti;

[6] Diaconu C., 2006, Valoarea biologică şi culturală a germoplasmei de căpşun (*Fragaria x ananassa*) şi utilitatea ei în programele de ameliorare. Teză doctorat;

[7] Popescu N. A.,1998, Cercetări privind manipularea genetică a unor specii de Fragaria prin cultura "in vitro". Teză de doctorat;
[8] Koskela E., Kemp H., and van Dieren M. C. A., 2008, Flowering and Pollination Studies with European Plum (*Prunus domestica* L.) Cultivars, F. Sottile, Palermo, Italy.
[9] Tromp J., 2005, Dormancz. In: Tromp, Webster and Wertheim (eds.), Fundamental of Temperate Zone Tree Fruit Production. Backhuys Publishers, Leiden. 400p;
[10] Wertheim S.J. and Schmidt, H. 2005. Flowering, pollination and fruit set. In: Tromp, Webster and Wertheim (eds.), Fundamentals of Temperate Zone Tree Fruit Production. Backhuys Publishers, Leiden. 400p.

Scientific Papers, Series B, Horticulture, Vol. LVI, 2012
CD-ROM ISSN 2285-5661, ISSN-L 2285-5653

RESEARCH CONCERNING THE VARIABILITY OF THE MAIN CHARACTERISTICS OF THE DWARF BEAN PODS AT THE LOCAL POPULATIONS FROM EAST ROMANIA

Eliza TEODORESCU[1], Neculai MUNTEANU[1],Costel VÎNĂTORU[2], Vasile STOLERU[1], Bianca ZAMFIR[2]

[1]"Ion Ionescu de la Brad" University of Agricultural Sciences and Veterinary Medicine, Faculty of Horticulture, No 3, Mihail Sadoveanu Alley, 700490, Iaşi, Romania, Phone/Fax: 0040-232-274932, E-mail: neicu_eliza@yahoo.com , nmunte@uaiasi.ro, vstoleru@uaiasi.ro
[2]Vegetable Research and Development Station, No 23, Mesteacănului Street, 120024, Buzău, Romania, Phone/Fax: 0040–238–722560, E-mail: costel_vinatoru@yahoo.com, zamfir_b@yahoo.com

Corresponding author email: neicu_eliza@yahoo.com

Abstract

Since 2010, the Breeding Laboratory from Vegetable Research – Development Station Buzău initiated a great conservation program concerning the bean germplasm resources (Phaseolus vulgaris L.) from the traditional vegetable areas. There were procured, taken into study and cultivated in open field conditions over 50 local populations of dwarf bean (P. vulgaris var. nanus). The researches had the purpose to create a germplasm base for these species. The paper presents the main characteristics of the pods for 10 local populations. The results obtained dignified a great variability of the biological material taken into study, fact that offers it a great value for the following breeding works.

Key words**:** *breeding, germplasm, Phaseolus vulgaris L. var. nanus*.

INTRODUCTION

In context of vegetable variety diversification, in 2010, from the surface cultivated with vegetables, the green bean occupied 2,8% in the world and 4% in Romania. From the point of view of the surface cultivated with green bean, our country is situated on the 5th place in Europe, but on the 21st in what it concerns the mean yield made at the surface unit [8]. The low level of the yield comparative to other states from Europe determined the researches from the Vegetable Research – Development Station (V.R.D.S.) Buzău to initiate an ample breeding program for this species (*Phaseolus vulgaris* L.) in order to create productive varieties adapted to the new climatic conditions.

The first step made in order to realize a breeding program is represented by collecting or creating the biological material which posses the genes that can offer the wanted characteristics to the new cultivar [2].

The east zone of Romania is famous for the richness of the local populations for the vegetable varieties, including green bean [6]. Because of this fact, the initial biological material for breeding was represented generally by the local populations from Buzău vegetable area and from the neighboring vegetable areas.

The research presents the study of the initial collected material. This stage of the breeding process is very important because it allows to the researcher to orientate to the practical possibilities in order to realize new cultivars according to the breeding objectives proposed [4].

Collecting, introducing in culture and studying the local bean populations from the traditional vegetable area allow the enrichment of the germplasm collection and also it allows the biodiversity conservation at this species. In the same time, the enrichment of the initial biological material represents a safe guaranty to the breeding process [5].

MATERIAL AND METHOD

The enrichment of the germplasm collection for bean started in 2010 through local population collection. Until nowadays (2012) there were collected over 50 local populations for dwarf bean.

The researches were made at The Plant Breeding Laboratory from V.R.D.S. Buzău during 2010 – 2012.

The main objectives of the breeding process were the following: productivity, high accommodation capacity to the environmental conditions and earliness.

From the local populations procured, 8 of them manifested phenotypical stability and valuable characteristics, being comparative studied with *Ioana* variety:

- V_{1Mt} - Ioana variety, control variant;
- V_2 – local population 1 Buzău;
- V_3 - local population 2 Iaşi;
- V_4 - local population 12 Buzău;
- V_5 - local population 3 Iaşi;
- V_6 - local population 4 Iaşi;
- V_7 - local population 5 Bîrlad;
- V_8 - local population 23 Buzău;
- V_9 – local population 7 Bacău.

The biological material taken into study was cultivated in open field conditions, according to the technology recommended by the specialty literature [7].

There were made many determinations: length, width, pods thickness and weight, number of pods/plant and number of seeds from pod. These quantitative characteristics are determined in what it concerns the pods commercial aspect. All the proveniences taken into study do not present stringiness of ventral suture at the technological maturity.

The experiment was organized according to the randomized blocks method with three repetitions. There were made biometric mensurations in order to determine the variability of the of the main pods characteristics according to the specialty literature [1, 3].

RESULTS AND DISCUSSIONS

The analysis of a character variability quotient (s%) shows the uniformity of the plants taken into study (as the variability quotient is lower, as the analyzed plants are more stable for the analyzed character).

The control variant (*Ioana* variety) presented pods with a 14.03 cm mean length. V_6 and V_9 variants had values superior to the control variants (16.8 cm and 14.37 cm). The local populations taken into study presented a low variability (s%<10%), the variability quotient varying between 3.8% at V_8 and 8.24% at V_7 (Table 1).

Table 1. Pods length variability

Variants	Pods length (cm)	Variability quotient (%)	Differences than V_{1Mt} (cm)
V_{1Mt}	14.03	6.77	–
V_2	12.17	4.53	-1.86
V_3	10.40	6.31	-3.63
V_4	13.30	5.97	-0.73
V_5	11.73	4.69	-2.30
V_6	16.80	5.19	2.77
V_7	12.63	8.24	-1.40
V_8	12.43	3.80	-1.60
V_9	14.37	8.13	0.34

The mean length of the pods varied between 16.8 cm at V_6 and 10.4 cm at V_3 (Photo 1).

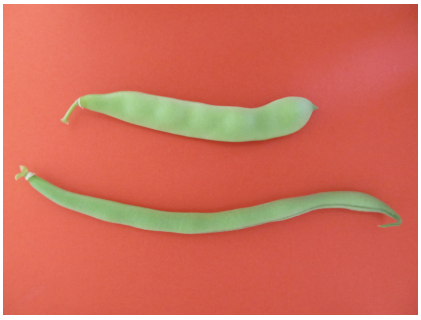


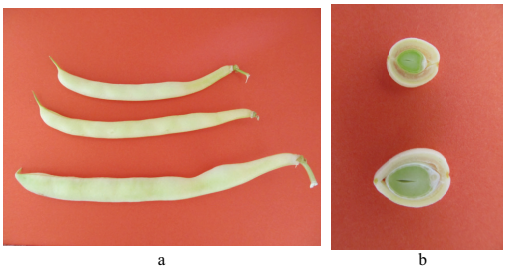
Photo 1. Comparison between pods length at V_3 and V_6 variants

Pods width had values within 1.47 cm at V_3 and 0.85 cm at V_7. V_3 and V_4 variants surpassed the control variants value with 0.47 cm and 0.37 cm (Table 2).

Table 2. Pods width variability

Variants	Pods width (cm)	Variability quotient (%)	Differences than V_{1Mt} (cm)
V_{1Mt}	1.00	10.00	–
V_2	0.88	3.27	-0.12
V_3	1.47	3.94	0.47
V_4	1.37	4.22	0.37
V_5	0.90	11.11	-0.10
V_6	1.13	5.09	0.13
V_7	0.85	5.94	-0.15
V_8	0.88	3.27	-0.12
V_9	0.95	5.26	-0.05

The variability quotient in what it concerns pods width had low values (s%<10%), except V_5 variant (11.11%) which had a mean variability quotient (s%=10 – 20 %).
The transversal sections through pod mark the differences determined by the width registered during the experiment (Photo 2).



a b

Photo 2. Pods width (a) and transversal sections (b) at V_8 and V_4 variants

The variability quotient of the pods width varied between 5.56% at V_9 and 12.74% at V_4 (table 3). V_4 and V_7 variants had mean variability, while the other variants presented a high stability for this character. At V_5 variant was registered the highest value of pods width (1.17 cm) and the highest value of the thickness/width proportion (1.3).

Table 3. Pods thickness variability

Variants	Pods thickness (cm)	Variability quotient (%)	Differences than V_{1Mt} (cm)	Thickness/width proportion
V_{1Mt}	0.92	8.33	–	0.92
V_2	0.77	7.53	-0.15	0.87
V_3	0.97	5.97	0.05	0.66
V_4	0.82	12.74	-0.10	0.60
V_5	1.17	9.90	0.25	1.30
V_6	0.83	6.93	-0.09	0.74
V_7	0.76	10.44	-0.16	0.90
V_8	0.75	6.67	-0.17	0.85
V_9	0.90	5.56	-0.02	0.95

At V_8 (0.75 cm), V_7 (0.76 cm) and V_2 (0.77 cm) variants were registered the lowest values in what it concerns pods thickness, while at V_4 (0.60 cm), V_3 (0.66 cm) and V_6 (0.74 cm) variants was observed the lower thickness/ width proportion. The shape of the pods transversal sections from in the experiment varied between elliptical, circular or "eight" shape (Photo 3).
In what it concerns the number of seeds/pod, the highest value was registered at the control variant (6.9), and the lowest value was registered at V_3 (4.67).

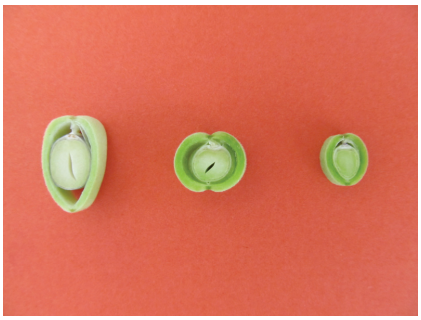


Photo 3. Transversal section through V_3, V_5 and V_6 pods

From the analysis of the seeds/pod number variability there can be observed the fact that most variants had a mean variability quotient. V_{1Mt} (8.07%) and V_5 (4.6%) variants presented a high stability of this character (table 4).

Table 4. Variability of the number of seeds from pod

Variants	Number of seeds from pod	Variability quotient (%)	Differences than V_{1Mt} (cm)
V_{1Mt}	6.90	8.07	–
V_2	5.67	10.19	-1.23
V_3	4.67	12.37	-2.23
V_4	5.13	15.75	-1.77
V_5	6.17	4.68	-0.73
V_6	6.17	12.39	-0.73
V_7	4.93	19.16	-1.97
V_8	6.67	17.32	-0.23
V_9	6.00	16.67	-0.90

Pods weight and the number pods/plant represents two very important characteristics because it determines productivity.
During the experiment, pods weight varied between 9.78 g at V_4 and 5.76 g V_2 (table 5).
At V_2 (5.76 g) and V_8 (5.89 g) variants were registered lower values than the control variant; the other variants presented higher values. V_2, V_4 and V_8 variants presented a mean variability of this character.

Table 5. Pods weight variability

Variants	Pods weight (g)	Variability quotient (%)	Differences than V_{1Mt} (cm)
V_{1Mt}	6.17	9.22	–
V_2	5.76	14.25	-0.41
V_3	9.26	7.39	3.09
V_4	9.78	14.83	3.61
V_5	8.89	8.36	2.72
V_6	7.60	6.20	1.43
V_7	9.47	7.51	3.30
V_8	5.89	10.81	-0.28
V_9	8.29	8.26	2.12

The variability quotient in what it concerns the number of pods/plant was low for most variants, mean for 3 variants (V_{1Mt}, V_2 and V_7) and high for V_3 variant (Table 6).

Table 6. Variability of number of pods/plant

Variants	Number of pods/plant	Variability quotient (%)	Differences than V_{1Mt} (cm)
V_{1Mt}	32.00	12.50	–
V_2	32.67	13.80	0.67
V_3	29.00	27.37	-3.00
V_4	27.40	4.44	-4.60
V_5	27.07	3.72	-4.93
V_6	34.20	8.36	2.20
V_7	28.33	11.35	-3.67
V_8	38.40	6.83	6.40
V_9	33.33	7.55	1.33

The highest number of pods/plant (38.4) was registered at V_8, and the lowest (27.07) at V_5 (Photo 4).

V_8

V_5

Photo 4. Plants aspect for V_8 and V_5

In what it concerns productivity, V_9 variant obtained the highest yield 276.33 g pods/plant, having 8.29 g mean pods weight and 33.33 mean number of pods/plant. The lowest yield was registered at V_2 variant (188.05 g) and it was determined by 32.67 mean pods/plant number and 5.76 g mean pods weight.

During the experiment, 4 variants had yellow pods (V_{1Mt}, V_2, V_4 and V_8) and 5 variants had green pods.

CONCLUSIONS

V_6 variant presented very long pods, and V_4 and V_3 variants had broad pods (elliptical transversal section).

Mean pods weight varied between 9.78 g at V_4 and 5.76 g at V_2.

At V_8 variant was registered the highest number of pods/plant (3.84), and the lowest (27.07) at V_5 variant.

At V_2 variant were registered the lowest values of: pods thickness, mean pods weight and yield.

V_5 variant manifested high stability for all studied characters, less in what it concerns pods width which presented middle variability.

The studied material presents high stability or mean stability for the studied characters, fact that offers a great value to the forthcoming breeding works.

ACKNOWLEDGEMENTS

This work was co financed from the European Social Fund through Sectorial Operational Program Human Resources Development 2007-2013, project number POSDRU /I.89 /1.5 /S62371 „Postdoctoral School in Agriculture and Veterinary Medicine area”.

REFERENCES

[1] Munteanu N., 1994. *Studiul comparativ al rezistenţei la principalii agenţi patogeni a unor noi surse de germoplasmă la fasole (Phaseolus vulgaris L.)*. Teză de Doctorat, U.Ş.A.M.V. Iaşi, Facultatea de Horticultură.

[2] Munteanu N., Fălticeanu Marcela, 2008. *Genetica şi ameliorarea plantelor ornamentale*. Editura „Ion Ionescu de la Brad”, ISBN 978-973-147-013-9, Iaşi, România.

[3] Popa Lorena – Diana, 2010. *Cercetări privind agrobiologia speciei Phaseolus coccineus L. în vederea optimizării cultivării*. Teză de Doctorat, U.Ş.A.M.V. Iaşi, Facultatea de Horticultură.

[4] Potlog A. S., Velican V., 1971, Tratat de ameliorarea plantelor, vol. I, Editura Academiei Republicii Socialiste România, Bucureşti

[5] Potlog A. S., Nedelea G., Suciu Z., 1984. *Îndrumător practic de ameliorarea plantelor*. Editura Facla, Timişoara

[6] Rădulescu I. M., 1940, Contribuţiuni la cunoaşterea sistematică a fasolei din România, Imprimeria Naţională, Bucureşti

[7] Ruşti G., Munteanu N., 2008. *Cultura fasolei de grădină urcătoare*. „Ion Ionescu de la Brad” Editura, Iaşi

[8] www.faostat.org

Scientific Papers, Series B, Horticulture, Vol. LVI, 2012
CD-ROM ISSN 2285-5661, ISSN-L 2285-5653

STUDY OF THE MAIN QUANTITATIVE CHARACTERS VARIABILITY AT COMMON BEAN MAURA VARIETY OBTAINED AT V.R.D.S. BUZĂU

Costel VÎNĂTORU, Eliza TEODORESCU, Bianca ZAMFIR

Vegetable Research and Development Station Buzău, No. 23, Mesteacănului Street, zip code 120024, Buzău, Romania, Tel./Fax: 0040 238 / 722560 Tel.: 0040 238 / 722593, costel_vinatoru@yahoo.com; neicu_eliza@yahoo.com; zamfir_b@yahoo.com

Corresponding author email: costel_vinatoru@yahoo.com

Abstract

Common bean Maura variety was obtained at Vegetable Research and Development Station Buzău in 2010 by C. Vînătoru and E. Teodorescu. The variety was introduced into production both for protected areas and open field in climbing system since 2010. Research towards obtaining this variety started in 1996 when were obtained as well two other dwarf bean yellow pod varieties, Ioana and Anisia. The study of the quantitative characters variability and correlation between them is very important for breeding process and conservative selection. The conservative selection scheme for each species it cannot be applied without knowing quantitative characters variability for each variety making easier the breeder activity in the selection process. Along with the culture introduction and conservative selection of the variety, a special attention was paid to maintaining the quantitative and qualitative characters variability limits focusing on assuring distinctness, homogeneity and stability. The objective of this study was to present the variability of the main Maura variety characters and their importance in conservative selection works.

Key words: breeding, diversity, homogeneity, selection, stability.

INTRODUCTION

Romanian varieties deficit at these species imposed a special research program at V.R.D.S. Buzău started since 1990. This program aimed at modern breeding of this species for obtaining valuable varieties adapted to the environmental conditions of our country and to the consumers and growers requirements.

Presently, considering our research, the station owns a rich germplasm collection consisting of 200 genotypes and 2 approved varieties of dwarf bean with yellow pod, Anisia and Ioana. The first variety creation with indeterminate growth was finished in 2010, registered by Maura name, variety presented in this study (photo 1). Once registered, this variety was incorporated into crop production, both in open field and protected grounds used in pallisate system. To protect the genetical heritage of this species, it was rigorously investigated in the conservative selection process.

As the phenotypical characters values are influenced by environmental conditions and biological material used, it is necessary to undertake research in the same environmental conditions as the breeding works took place.[1] Studying and knowing quantitative characters and the correlations between them give opportunity to conservative selection responsible to know better his own biological material. He can also apply indirect selection for some characters for easing the selection process. Conservative selection phases applied to the variety were used according to selection sheme publicshed in [3]. Experiment setting and experimental parameters evaluation were according with Saulescu A. and Saulescu N. presented method in [2].

MATERIAL AND METHOD

Research considering main quantitative characters variability of Maura variety were carried out at V.R.D.S. Buzau in 2008-2012. Evaluations and investigations were conducted during an identity preservation experiment in the selection field (SF) and progeny test field (PTF). The experiment took place in the research field of our station, in high tunnel solaria type polygon, on an alluvial medium developed type

of soil with 6,5-6,8 pH and 2,4% humus content. The crop was set in open solaria using their metallic structure to pallisate plants. The land was shaped at 1,4 cm, sowed in 70 cm distance equidistant rows and 30 cm space between plants/row. Previous year obtained super elite (SE) category seed was used as biologic material for selection field and for PTF (progeny test field) were used elites seeds obtained in the selection field. In the selection field were maintained and studied 1800-2000 plants and 400 lines for progeny test field. Phenological and biometrical investigations were performed during vegetation period according to identity preservation plan.

The studied parameters were: pod lenght, pod width, number of pods per plant, number of seeds per pod, number of seeds per plant. For a correct study of characters variability assesed in the selection plan two samples were tested: one at the pods technical maturity and one at the pods physiological maturity. The samples contained 400 individuals randomly chosen from the two populations (SF and PTF).

The main statistical indices were: arithmetic average ($\bar{x}$), standard deviation (s), variation coefficient (vc %), variation amplitude, class variation frequency and standard selection range (x+s). Considering our determinations, we estimate the studied characters variability and selection works were performed.

RESULTS AND DISCUSSIONS

Pod lenght character variability (Photo 1) is manifested by calculated statistical parameters (table 1). Arithmetic average determined in five years was at FS level of 19,9 cm with 19,2 and 20,4 cm variation. PTF value was close to FS (19,6 cm) with a variation between 19,3 and 19,9 cm.

Variation coefficient (VC%= S/$\bar{x}$ *100) values were small demonstrating clearly that this character confers variety distinctness and it is genetic stable contributing obviously at the variety identity.

Table 1. Pod length variability (cm)

Para-meters	Field	Year					Year avg.	Avg. SF and PTF
		2008	2009	2010	2011	2012		
$\bar{x}$	SF	20,4	19,2	20,1	20	19,8	19,9	19,7
	PTF	19,6	19,9	19,7	19,9	19,3	19,6	
S	SF	1,2	2	1,7	1,8	2,1	1,7	1,7
	PTF	1,2	1,7	1,9	1,9	1,9	1,7	
CV %	SF	5,8	10,4	8,4	9	10,6	8,8	8,7
	PTF	6,1	8,5	9,6	9,5	9,8	8,7	
$\bar{x}$ ±S	SF	19,2-21,6	17,2-21,2	18,4-21,8	18,2-21,8	17,8-21,8	18,1-21,6	18-21,5
	PTF	18,4-20,8	18,2-21,6	17,8-21,6	18-21,8	17,4-21,2	17,92-1,4	

Plants measured to determine pod length character variability were the same measured for pod width variability (Table 2).

This parameter also registered a small variability between fields or year by year. Arithmetic average value of five years of study was 18,2 mm for SF and 18 mm for PTF.

Variation coefficient values were small with a general average of 7,7 mm.

$\bar{x}$ ± S limits are 16,7-19,3 mm and there are not significant differences between the two fields.

Photo 1. Pod length evolution (2-19,7 cm)

Table 2. Pod width variability (mm)

Para-meters	Field	Year					Year avg.	Avg. SF and PTF
		2008	2009	2010	2011	2012		
$\bar{x}$	SF	18,9	19,1	18,2	19,2	15,7	18,2	18,1
	PTF	18,8	17,2	19,2	19	16,2	18	
S	SF	1,3	1,5	1,6	1,4	1,5	1,4	1,3
	PTF	1,6	1	1,6	1,6	1	1,3	
CV %	SF	6,8	7,8	8,7	7,2	9,5	8	7,7
	PTF	8,5	5,8	8,3	8,4	6,1	7,4	
$\bar{x}$±S	SF	17,6-20,2	17,6-20,6	16,6-19,8	17,8-20,6	14,2-16,6	16,7-19,5	16,7-19,3
	PTF	17,2-19,6	16,2-18,2	17,6-20,8	17,4-20,6	15,2-17,2	16,7-19,2	

The number of pods per plant character is the main character reflecting variety productivity. The evaluations of five years of study presented in table no. 3 show that the average number of pods per plant was 34,2. In the same year, there are not significant differences between the two fields (SF and PTF). Concerning standard deviation, a high coefficient was manifested with a value over 20%. Also $\bar{x} \pm S$ interval, considered standard for selection, had values between 28,1 and 40,3 which corespond a number of 22 and 48 pods per plant. Assesing these registered values we ascertain that these year by year yield fluctuations are generated by less favorable weather conditions (Photo 2).

Table 3. Number of pods per plant variability

Para-meters	Field	Year					Year avg.	Avg. F and PTF
		2008	2009	2010	2011	2012		
$\bar{x}$	SF	37,7	33,2	36	40,4	27,6	34,9	34,2
	PTF	37,2	32,6	32,8	37,9	27,2	33,5	
S	SF	6,2	5,6	6,2	8,2	4,8	6,2	6
	PTF	6	5,4	6	7,5	5	5,9	
CV %	SF	16,4	16,8	17,2	20,2	17,3	17,5	17,6
	PTF	16,1	16,5	18,2	19,7	18,3	17,7	
$\bar{x} \pm S$	SF	31,5-43,9	27,6-38,8	29,8-42,2	32,2-48,6	22,8-34,4	28,7-41,1	28,1-40,3
	PTF	31,2-43,2	27,2-38	26,8-38,8	30,4-45,4	22,2-32,2	27,5-39,5	

Evaluating the registered values in table no. 4 we ascertain the seeds number per pod variability had close values for the two fields, SF and PTF. Significant differences are shown year by year.

Average value obtained in five years of selection was of 7,1 seeds per pod respectively 7,2 SF and 7,1 PTF. And for lines at $\bar{x} \pm S$ level was 6-8,3.

According to these results appropriate elites and lines for selection process were obtained. The ones which not correspond this interval were eliminated. This operation was performed for every field and each year.

Table 4. Number of seeds per pod variability

Para-meters	Field	Year					Year avg.	Avg. SF and PTF
		2008	2009	2010	2011	2012		
$\bar{x}$	SF	7,5	6,6	8	7,3	7	7,2	7,1
	PTF	7,3	6,8	7,8	7,5	6,5	7,1	
S	SF	1,5	1,4	1,2	1,1	0,8	1,2	1,1
	PTF	1,5	1,4	1,2	1,1	0,7	1,1	
CV %	SF	20	20,5	15	15	11,4	16,3	16,3
	PTF	20,5	20,5	15,3	14,6	10,7	16,3	
$\bar{x} \pm S$	SF	6-9	5,2-8	6,8-9,2	6,2-8,4	6,2-7,8	6-8,4	6-8,3
	PTF	5,8-8,8	5,4-8,2	6,6-9	6,4-8,6	5,8-7,2	6-8,3	

Number of seeds per pod parameter variability is large, VC=20,8%. This reflects that the character is in direct correlation with number of pods per plant, which had also a large variability (Photo 3).

The two fields average value for five years was 255,2 seeds per plant with $\bar{x} \pm S$ limits variation between 201,4 and 309,1. In 2012 this parameter dramatically diminish for the same reason mentioned at average number of pods per plant.

The selection of elites and lines for progeny was made respecting $\bar{x} \pm S$ interval for every field and year.

Table 5. Number of seeds per plant variability

Para-meters	Field	Year					Year avg.	Avg. SF and PTF
		2008	2009	2010	2011	2012		
$\bar{x}$	SF	289,6	286,5	235	305,6	180,8	259,5	255,2
	PTF	285,5	272,6	226,7	297,2	173,4	251	
S	SF	57,2	59,7	48,8	67,2	34,6	53,5	53,8
	PTF	56,7	60,2	48,5	71	34,8	54,2	
CV %	SF	19,7	20,8	20,7	21,9	19,1	20,4	20,8
	PTF	19,8	22	21,3	23,8	20	21,3	
$\bar{x} \pm S$	SF	232,4-346,8	226,8-346,2	186,2-283,8	238,4-372,3	146,2-215,4	206-313	201,4-309,1
	PTF	228,8-342,2	212,4-332,8	178,2-275,2	226,2-368,2	138,6-208,2	196,8 305,3	

Photo 2. Number of pods per inflorescence = 4 (varies between 3-6). Number of pods per plant=34,2 (average)

Photo 3. Number of seeds per pod = 7,1 (average)

CONCLUSIONS

Maura variety obtained at V.R.D.S Buzău is an homogeneous population that manifests genetic stability concerning the main quantitative parameters, it qualifies for distinctness, homogeneity and stability normal criteria.
The studied quantitative characters record the following average values and variation limits ($\bar{x} \pm S$):

- pod length:
  $\bar{x}$ = 19,7 cm; $\bar{x} \pm S$=18-21,5 cm
- pod width:
  $\bar{x}$ = 18,1 mm; $\bar{x} \pm S$=16,7-19,3 mm
- number of pods per plant:
  $\bar{x}$ = 34,2; $\bar{x} \pm S$=28,1-40,3
- number of seeds per pod:
  $\bar{x}$ = 7,1 ; $\bar{x} \pm S$=6-8,3
- number of seeds per plant:
  $\bar{x}$ = 255,2 ; $\bar{x} \pm S$=201,4-309,1

REFERENCES

[1] Potlog, A., Velican, V., I.C.D.L.F. Vidra, Anale, vol. XIII, București, 1995, pag. 83-93.
[2] Săulescu, A., Săulescu, N., 1967. *Câmpul de experiență*, Editura Agro-Silvică, București, pag. 117.
[3] Vînătoru, C., 2008. *Metode de ameliorare a plantelor de cultură*. Editura Gama design, pag . 15-18, pag. 42, 58, 116.

PLANT PRODUCTION SYSTEMS


EX·TERRA·AVRVM

Scientific Papers, Series B, Horticulture, Vol. LVI, 2012
CD-ROM ISSN 2285-5661, ISSN-L 2285-5653

RESEARCH OF TECHNOLOGY DIVERSIFICATION OF THE CULTURE OF THE CARROT ON SOIL BROWN- RUSSETS

Diana CHETREANU, Nicolae ATANASIU, Gabriela NEAȚĂ

University of Agronomic Sciences and Veterinary Medicine of Bucharest, 59 Mărăşti Blvd., District 1, 011464, Bucharest, Romania, Phone: +40 21 318 25 64 / 232, Fax: + 4021 318 28 88,

Corresponding author email: chetreanudiana@yahoo.com

Abstract

Carrots require a deep friable soil for shapely roots. A well enriched loam deeply dug 25-30 cm is best suited for most varieties. For heavy soils is better to select short types as Carrot Rondo , Baby Type , Nantes, Chantenay Red Core. Carrot seeds are small and slow to germinate if they do not have sufficient moisture in the soil. Therefore, carrot crops require irrigation prior to germination to prevent a crust from forming on the soil which impedes germination [1,11]. A good irrigation and nutrient supply are required to enhance quick growth for good quality carrot roots. Too much nitrogen on carrots will cause excessive top growth and poor root development. Accumulating nitrates is made in the first place in leaf then in central cylinder and less in parenchyma [4].Weed management is essential for carrot crops to reduce the compete between them for sunlight , water, nutrients ,space and to produce maximum yields. A plot experiment was carried to study the cultural practices management in order to increase yield and enhance the quality of carrot roots.

Key words: management, moisture, variety, weeds

INTRODUCTION

The carrot is a specific plant of temperate climate and has no pretensions to temperature, but it is pretentious to water nonetheless, especially in the germination period and to light.
Soils in which it develops are well aerated, permeable, profound, with a light-to-medium texture and with a pH comprised between 6.5 – 7.
It has been found that on heavy soils the carrot does not react well, especially the assortment with a long vegetation period (over 130 days).
On such soils carrots can be successfully cultured by proper culture practice and by choosing he proper seeds, i.e. from the short vegetation period assortment, 60-90 days. Superior quality roots can be obtained with a proper form and color, that grow fast and without too many restrictions.
In order to highlight all these aspects and to improve the classical culture technology of the carrot, an experimental field has been placed in Prahova county and the research focuses on the following targets:

- studying an assortment of cultivars,
- studying some culture practices and some factors influencing the production and quality of the carrot roots.

MATERIAL AND METHOD

The experiment has been placed on a brown-reddish soil with clayish texture in Prahova County.
As a biological material, seeds have been used from the short vegetation period assortment: Carrot Baby Type, Purple Haze F1, Rainbow F1, Scarlet Nantes. The description of the cultivars used in this experiment is to be found in Table 1.

Table 1.Biological materials used for study

Variety	Germination (days)	Vegetation period		Root		Variant
		Maturity	No. of days	Shape	Length (cm)	
Purple Haze F1	10-15	semiearly	80-90	conical	20-25	V1
Rainbow F1	6-14	semiearly	70-80	cylinder	19-22	V2
Baby Type F1	17-21	early	50-60	conical	10-12	V3
Scarlet Nantes	10-21	early	60-65	cylinder	15-17	V4

[12]

Sowing date: 1st of March

The preparation of the seedbed is very important in the culture of the carrot if we wish to obtain quality, straight roots, without secondary ramifications.

The classical technology recommends the preparation of the land starting with the autumn, by suppressing the prior culture, disking, exploitation leveling, using chemical fertilizers, 250 kg/ ha superphosphate and 150 kg/ ha potassic salt and 20-30 cm deep ploughing to incorporate the fertilizers [4,6,7].

In early spring perpendicular harrowing is done on ploughing, ammonium nitrate fertilizers are used, the land is crushed and modeled if sowing is to be done on modeled land.[4,8].

Precision sowing influences the thickness growths of the carrot so that the planting density can be amended function of the results we wish [9,10].

Through such a planting scheme a density of 100 pl/ m² is obtained, with the advantage that the culture maintenance works can be done by equipments such as hoeing machines, harvesting machines, but also uniformity can be obtained in culture.

In the case of heavy soils the sowing depth must not exceed 1.5 cm.

Two experimental crops in rotation have been created, C1 and C2, using the sowing scheme and the aforementioned cultivars.

Unformed field with 2 rows per lane, 4 cm distance between rows, 4 cm between plants per row and 50 cm distance between lanes.

On the crop in rotation C1 the classical carrot culture technology has been applied and on the crop in rotation C2 certain culture practices have been created, to underline their influence on the quality and production of carrot roots.

On the crop in rotation C2 two harrowing works have been performed, one perpendicular on the other and after sowing a slight rolling has been performed, and then textile material was placed on the sowed area in order to maintain the soil moisture, knowing that in the last few years, springs have been droughty and the carrot seeds require sufficient water to germinate.

At the same time, in order to avoid hoeing or additional herbicidation, the space between the rows has been mulched with newspaper so that the carrot plants shouldn't have competitors among weeds.

In the classic culture, in order to have a weedless culture, 1-2 mechanical hoeings are necessary, 2 irrigations during the germination period and after the plants emerge, irrigation is done every 8-10 days function of the soil conditions.[2,3,10].

Phytosanitary protection measures have not been necessary, but in the case of some smaller areas, nets against pests can be put up.

The culture in the crop in rotation C2 has been fertilized with a smaller amount of ammonium nitrate, i.e. 50 kg/ha .

The amounts of fertilizers have been divided into 3 doses and applied in 3 different intervals [1,5] on both crops in rotation.

Observations and measurements have been made on the seed germination, on the influence of nutrition on the growth and development of the carrot plants.

RESULTS AND DISCUSSIONS

The germination has been influenced by the application of the textile material to maintain the soil moisture, so that on the crop in rotation C2 this occurred 2 days earlier than on crop in rotation C1. As an emergence percentage, one may follow the values in figure 1.

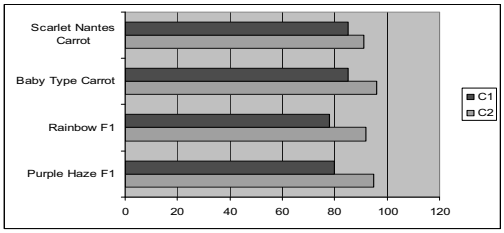


Fig. 1. The emergence percentage

Table 2. Number of days of emergence

Variety	C1	C2
	Germination (days)	Germination (days)
V1	13	10
V2	12	6
V3	18	15
V4	15	10

The plants in the crop in rotation C2 grew faster not having competitors, while on the crop in rotation C1 weekly hoeing have been performed in order to destroy the weeds.
For this reason, a certain ununiformity of the growths in this culture has been found, many plants developed more slowly.
The growth parameters have been measured 15 days and 30 days after the sowing and they have proved that the nutrition level influenced the plants' growth.
Measurements made 15 days after the emergence have shown bigger growths of the leaves in crop in rotation C1 that has been fertilized with a bigger dose of nitrogen, i.e. 100 kg/ha as compared to 50 kg/ha applied to the area C2.
And the measurements made 30 days after the emergence have revealed that on the crop in rotation C1 the growth of the aerial part is significantly bigger than on crop in rotation C2, the values can be checked in tables 3 .

Table 3. Leaf length variation

Cultivar	C1		C2	
	L1	L2	L1	L2
V1	10.1	20.7	8.5	15.4
V2	9.8	18.9	7.2	17.3
V3	8.0	16.9	7.9	16.5
V4	10.3	21.1	8.8	17.8

L1 = length of leaf after 15 days (cm);
L2 = length of leaf after 30 days (cm)

60 days after it has been found that the measured carrot roots show the fact that on the crop in rotation C2 where fertilization has been done with less nitrogen, the growths are significant as compared to the crop in rotation C1 where the aerial part is more developed. (see the values in table 4a,4b)

Table 4a.Influence of cultural practice on root length and girth variation (intermediate results)

No		Characteristic dimension of cultivar	
	Cultivar	L (cm)	Ø (cm)
1	V1	20-25	10-12
2	V2	17-18	10-12
3	V3	10-11	6
4	V4	15-17	10-12

L= length of root; Ø= thickness of root

Table 4b. Characteristic dimension of cultivars

No		C2		C1	
	Cultivar	L (cm)	Ø (cm)	L (cm)	Ø (cm)
1	V1	19.1	8.3	18.0	7.8
2	V2	16.3	8.2	15.7	7.1
3	V3	9.7	4.7	7.9	3.5
4	V4	16.2	10.9	15.1	8.2

L= length of root; Ø= thickness of root

Table 5. Weight root and leaves variation

Cultivar	C2		C1	
	WR +L (g)	WR (g)	WR +L (g)	WR (g)
V1	420	243	379	207
V2	286	146	269	117
V3	170	75	145	55
V4	296	167	276	141

WR+L = weight root + leaves; WR = weight root

CONCLUSIONS

The culture practices applied to heavy soils influence the conditions for the culture of the carrot so that good results can be obtained.
A production of 4.5 kg roots/ m² has been obtained in the case of the classical culture but with a good mechanization while on the crop in rotation C2, where the germination took place earlier and the culture was weed less, a production of 6.5-7 kg roots/ m² has been obtained.
In order to obtain a good carrot culture it is not enough only to choose the cultivar or the type of soil but the culture practice is also important, being the one that can influence the climatic conditions in the grower's favor.

REFERENCES

[1]Atanasiu, N., Popescu,V., 2000,Legumicultura vol.2,Ed. Ceres,Bucuresti
[2]Badea ,Rodica Liliana, 2003, Indrumar de practici traditionale si ecologice in agricultura, Ed. Estfalia, Bucuresti
[3]Burzo, I., Voican Viorica,Luchian Viorica, 2005, Fiziologia plantelor de cultura, vol.V, Ed. Elisavaros, Bucuresti
[4]Ciofu, Ruxandra, Stan, Nistor, Popescu, Victor, Chilom , Pelaghia, Apahidean , Silviu, Horgoș, Arsenie, Berar, Viorel,Karl, Fritz, Lauer, Atanasiu, Nicolae , 2003, Tratat de legumicultura, Ed. Ceres, Bucuresti
[5]Chilom, Palaghia, 2002, Legumicultura generala , Ed. Reprograph,Craiova
[6]Gedda, Agnes,2007, Gradina de legume ecologice, Ed. Polirom, Bucuresti

[7] Hoza, Gh., 2003, Sfaturi practice privind cultura legumelor, Ed. Nemira, Bucuresti
[8] Horgoş, A., 2003, Legumicultura speciala, Ed. Agroprint, Timisoara
[9] Indrea, Dumitru, Apahidean, Alex-Silviu, 2004, Ghidul cultivatorului de legume, Ed. M.A.S.T., Bucuresti
[10] Indrea, Dumitru- coordonator, 2007, Cultura legumelor, Ed. Ceres, Bucuresti
[11] Rubatzky, E.,Vincent, Mas, Yamaguchi, 1997, World Vegetable – Principles, Production and Nutritive Values, Second Edition, An Aspen Publications
[12] www.sustainableseedco.com

Scientific Papers, Series B, Horticulture, Vol. LVI, 2012
CD-ROM ISSN 2285-5661, ISSN-L 2285-5653

ESTABLISHMENT OF A TECHNOLOGY IN THE NONCONVENTIONAL CARROT CULTURE ON PERLITE LAYER

Diana CHETREANU, Nicolae ATANASIU

University of Agronomic Sciences and Veterinary Medicine of Bucharest, 59 Mărăşti Blvd., District 1, 011464, Bucharest, Romania, Phone: +40 21 318 25 64 / 232, Fax: + 4021 318 28 88

Corresponding author email: chetreanudiana@yahoo.com

Abstract

Soilles culture growing system are based on a new generation of rooting layers: inert, sterile, good permeability, uniform materials such as the perlite and rockwell. Perlite is physically stable, chemically inert and relatively cheap material. The porous nature of the cellular granule ensures a product that is light to handle, large quantities available moisture and has a strong capillary attraction for water [2]. It is free draining and well aerated, neutral pH, complete freedom from pests, pathogens and weed seeds [1]. All of these qualities make it ideal candidate rooting layer for commercial carrot crop production. Plant nutrition problems can be solved by application of nutrient solution. This solution must therefore provide all the essential macro and micro elements required for healthy growth and good development of carrot roots. Each nutrient from solution must be added at a rate which exactly matches its removal by the roots, that the toxicities can be avoided. A common problem associated with soilles culture is to find recipes for optimum nutrient solutions for each crop. The work of girl proposes testing of nutrient solutions and finding optimal prescription for the carrot crop in perlite layer. The main parameters, electroconductivity and pH have been monitored and adjusted function of the environment conditions and phenophases.

Key words: nutrient, management, soilles culture, variety

INTRODUCTION

Unconventional crops have developed significantly in recent years due to productivity, excellent quality of the production, continuous cycles of production.

All of these have led to the conclusion that this technology is one effective. Computerized control of all factors of vegetation in the space of culture and access to equipment of last generation determined from more and more farmers to turn toward this technology.

Growing tomatoes in fruits and vegetables soilless culture structure, same place and it holds and the growing world classical [1].

Other species of culture in non-conventional system are: lettuce, cucumbers, aubergines, peppers, strawberries but also areas intended for the production of cut flowers (rose, crizantema, carnation).

Most widely used substrate is all mineral wool but perlite layer begins to be more and more used and extended the range of cultivated species.

Perlite layer it is an organic substrate obtained from volcanic silicon rocks, it is chemically inert, it has a good capacity for the detention of water, it has very good porosity and a pH neutral.

For this reason they tried its use in roots crop fourfold good varieties and hybrids of small dimensions and with a growing season of 60-80 days.

Specialty literature and the other media does not indicate the exact types of solutions nutritional technology used in the framework of the culture of the carrot.

In fact we can't talk about a technology described but only a few items.

Research to propose to continue research begun last year with respect to an appropriate system of fertilisation culture of carrot on perlite layer substrate and the issue of technology clear.

MATERIAL AND METHOD

For the setting up of carrot culture on perlite layer substrate has been used pots made of plastic with volume of 6 l / pot , the basis of which have been practiced holes with a view to draining nutrient solution. The perlite layer substrate was used with a granule size of 2 mm

and the preparation of the solution nutrients were used 3 types of fertilizer complex manufactured by Scotts Netherlands. Fertilizer characteristics are presented in Table 1.

Table 1.Chemical composition of Universol fertilizer [5]

Nutritive elements	Green Universol 23+6+10+2	Yellow Universol 12+30+12+2	Violet Universol 9+9+27+3
Total nitrogen, (N) of which	23	12	9
N nitric	11.5	8.8	2.4
N ammoniacal	11.5	3.2	6.6
Phosphorum (P2O5)	6	30	9
Potassium (K2O)	10	12	27
Magnesium (MgO)	2.5	2.5	3.3
Iron (Fe) EDTA	0.06	0.06	0.06
Boron (B)	0.01	0.01	0.01
Copper (Cu) EDTA	0.01	0.01	0.01
Manganese (Mn) EDTA	0.04	0.04	0.04
Molybdenum (Mo)	0.001	0.001	0.001
Zinc (Zn) EDTA	0.01	0.01	0.01
Conductivity (EC) for solution with concetration 1g/l la 21 º C	1.5 mS/cm²	1.2 mS/cm²	1.3mS/cm²
Maximum solubility grams/liter	250	250	300

Bifactorial experience with the 8 variants have been carried out through a combination of 3 types of nutritional solutions with 4 cultivars F1 of 3 degrees of early.

Nutrient solution 1 has been implemented in Universol green , the solution 2 of Universol yellow and solution 3 from Universol violet .Solutions of the above have been necessary quantities of Ca and Mg so that final solution contain nutrients necessary roots carrot. Grade cultivars used in experience are sources U.K. and their features are to be found in table 2.

Table 2.Biological materials used for study

Variety	Vegetation period		Root shape
	No. of days	maturity	
Purple Haze F1	80-90	Semi late	cylinder
Rainbow F1	70-80	Semi late	conical
Baby Carrot F1	50-60	Extra early	conical
Rondo F1	80	Semi early	round

Electroconductivity nutrient solutions used have been adjusted to the values in table 3.

This undercoat of perlite layer has been entered in pots, it was humectants and then have sown seeds in a as backings of accuracy (PRO SEEDER) so as to ensure a density of 80 plants / m².

In the first phases of the sowing, nutrient solution has been applied by spraying area.

When the roots have developed enough, undercoat perlite layer has been irrigated by immersing the pots in containers containing nutrient solution.

The solutions have been periodically replaced, and this operation is the only work of care of the culture. They have not been necessary works to combat the pests and diseases.

In this experiment, observations and determinations have been made, regarding the number of days necessary for emergence, the percentage of emerged plants, the growing rhythm of the aerial part and at random the growing dynamics of carrot roots [3].

RESULTS AND DISCUSSIONS

Yet in the light of experience last year it has been found that the solution in a haste emergence plants and develop rosette of leaves. As soon as roots of carrot has tuber were applied nutrient solutions yellow and violet. It should be pointed out that fertilizer Universol is manufactured in several formulas according to the ratio of nutrients and these fertilizers have been chosen and adjusted in the light of experience phenophase plants and their requirements.(see table 3)

Table 3.Phenophases calendar

Week 1 from seedling	East 92 %
Week 2 from seedling	Fisrt appearance of true leaves; 1-2 leaves/ plant
Week 3 from seedling	Growth true leaves ; 5.5 cm the higher leaf
Week 4 from seedling	Rosette formation; 4-5 leaves per rosette
Week 5 from seedling	Growth rosette and higher leaf have 10.4 cm
Week 6 from seedling	Growth rosette and higher leaf have 15.7 cm
Week 7 from seedling	Growth rosette and higher leaf have 19.8 cm
Week8 from seedling	Growth rosette and higher leaf have 20.7 cm
Week 9 from seedling	Growth rosette and number of leaves at 7
Week10 from seedling	Growth of root; pencil dimension at 7.4 cm lenght

The nutrient solution concentration and pH nutrient solution has been insured by measuring the electrical conductivity of the solution and the pH thereof depending on the parameters it solution correction which nutrient is necessary for a correct of the plants [4]. Past experience has shown that the pH it is recommended to maintain the value 6.5 in such a way that trace

elements such as Fe, Mn not to precipitate and the roots of carrot able to absorb trace elements of nutrient solution [3] .
Reduction in the rate of growth, of absorption of nutrient solution and the sweat of the plants are determined by changes in electro-conductivity [1,4].
Electro conductivity (Ec) can be influenced by the temperature and it is good to be kept around 21°C. A fall in the entail its increase in value of Ec and at the same time slows down the rate of growth of the plants [3].
The measured parameters (electroconductivity, pH) in the tested nutritive solutions may be found in the tables 4a,4b and the influence of the nutritive solutions on the rosette and on the variation of the root length are to be found in the tables 5 and 6.

Table 4a. Mesurement of nutritive solution parameters
A – from sowing to the east; B – leaf emergence seed-lobe;C – vegetative growth , 30 days from east;

Pheno phase	**Green Solution**	
	Nutrient solution conductivity in substrate mS/ cm² at 21°C	pH
A	1.52	7.1
B	1.86	6.8
C	2.15	6.8

Table 4b.Mesurement of nutritive solution parameters
D – vegetative growth, 60 days from east

Phenophase	Violet Solution	
	Nutrient solution conductivity in substrate mS/ cm² at 21°C	pH
D	1.74	6.5

Table 5.Nutrient solution influence on rosette height and number of leave

Cultivar	S1		S2	
	Rosette height (cm)	No of leaves	Rosette height (cm)	No of leaves
Purple haze F1	20.7	7	17.5	6
Rainbow F1	18.9	6	17.3	5
Baby Carrot	16.9	7	15.8	6
Rondo	16.6	7	15.2	6

S1 = green solution + yellow solution ;
S2 = green solution + violet solution

Table 6.Influence nutrient solution on root length and girth variation (intermediate results)
L= length of root; Ø= thickness of root

Cultivar	S1		S2		Characteristic dimension of cultivar	
	L (cm)	Ø (cm)	L (cm)	Ø (cm)	L (cm)	Ø (cm)
Purple Haze F1	19.1	8.3	18.0	7.8	20-25	10-12
Rainbow F1	16.3	8.2	15.7	7.1	17-18	10-12
Baby Carrot	9.7	4.7	7.9	3.5	10-11	6
Rondo	4.2	9.4	3.9	8.2	4-5	12-15

S1 = green solution + yellow solution ;
S2 = green solution + violet solution

CONCLUSIONS

The results obtained can be pulled following conclusions:
Other than film which experienced influence is visible and cultivars with short period of the growing season is suitable for the best of such a substrate.
Complex fertilizers used in combination depending on the phenophase constitutes the basic ingredients to which we can add sources of Ca and Mg.
Influence of the 3 types of solutions nutrients on growth in roots of carrot is noticeable.
Will it be possible to obtain a culture of carrot on substrate of perlite layer even with a technical base material medium.

REFERENCES

[1] Atanasiu, N.,2009. *Culturi horticole fara sol*. Ed. Atar, p.44-47 , p.108-119
[2] Ciofu, R., Stan, N., Popescu, V., Chilom, P., Apahidean, S., Horgoş, A., Berar, V., Lauer, K.F, Atanasiu , N, 2003. *Tratat de Legumicultura*. Ed. Ceres, Bucuresti, p.511-524
[3] Chetreanu, D., 2011. *Research and results on the influence of nutritive solutions in the nonconventional carrot culture on perlite sublayer*. Scientific papers, p. 2-4
[4] Saavas, D. and Passam, H., 2002. *Hydroponic production of vegetables and ornamentals*
[5] *Universol- Solubil Fertilizer*. Technical Prospectus - Scotts International B.V. Holland


EX·TERRA·AVRVM

Scientific Papers, Series B, Horticulture, Vol. LVI, 2012
CD-ROM ISSN 2285-5661, ISSN-L 2285-5653

RESEARCHES REGARDING THE BEHAVIOUR OF LOCAL ECHALOTTE ONION POPULATIONS IN PRAHOVA COUNTY IN ORDER TO PRESERVE THE GERMPLASM RESOURCES

Gheorghiţa HOZA, Ruxandra GOGOŢ

University of Agronomic Sciences and Veterinary Medicine of Bucharest, 59, Marasti Street, 011464, Bucharest, Romania, tel.: 0213182564, fax:0213182888, hozagh@yahoo.com

Corresponding autor email: hozagh@yahoo.com; ruxyyy31@yahoo.com

Abstract

Echalotte onion is a species of onion cultivated in the past to supply the family need. Nowadays, its popularity and usage decreased dramatically in Romania. Worldwide, echalotte onions have a generally recognized position on the vegetable market and this fact represented the main cause for the decision to rehabilitate its position also on the Romanian market because the local supermarkets started to import products based on this vegetable. The present paper contains a study regarding many local populations of echalotte onion species (originating from Slon, Drajna and Periş, all with different sized bulbs), cultivated in Valenii de Munte area, an environment with the most appropriate conditions for the onion culture. In what regards the productivity and the vegetative process of the echalotte culture studied, the recorded data were at a satisfactory level, proving the resistance of this species in comparison with the common onion. Therefore, the diameter of leaf rosette registered values of over 20 cm, excepting the local population of Slon onion, with small sized bulb, which registered only 16,5 cm; the height of plants reached more than 40 cm, excepting the local population of Drajna, with small sized bulb, which reached 35 cm; the average weight of bulbs varied between 13,9 g and 15,9 g and the maximum number of bulbils per plant was 16. The largest production was obtained for the onion from Drajna with large bulbs, having a value of more than 25 t/ha.

Key words: *echalotte onion, local populations, production*

INTRODUCTION

Echalotte onion originates from the regions surrounding the Mediterranean Sea. It can be found as a wild species in Oriental Asia and Near East (Ceauşescu 1984, Indrea 2007). It has been cultivated for long, but only in the 16th century did J. Bauhin mention it under the name of *fertilis* onion. Nowadays, echalotte onion is cultivated on large areas in China, Japan, countries of the former USSR as well as in Western Europe. In our country, it is cultivated on smaller areas, especially in Transylvania, Subcarpathian regions from Muntenia and Oltenia and Northern Moldova.

Echalotte onion is cultivated for its bulbs and leaves. The bulbs are used at obtaining a large variety of dishes as well as in can industry. The leaves are used during early spring in salads and specific dishes (cooked green onion). Green onions are also used for fresh consumption. Moreover, the bulbs are smaller and hotter, similar to the ones from common onion, and are used to spice dishes and vegetable cans.

In addition to the large quantities of nutrients (1- 2% proteins, 5-12% carbon hydrates, 0,2% fats, calcium, iron, potassium minerals, B_1, B_2 vitamins), the onion contains also volatile substances called ”phytoncids”, which have antibiotic characteristics.

The therapeutic effect is given by the forerunners of the aromatic substances, which are the important “warehouses for sulfur compounds” that have a strong antibacterial and antifungal effect. Onion is recommended for preventing and treating atherosclerosis and coronary diseases and for decreases in the level of blood cholesterol. Onion and garlic extracts are recommended for treating diabetes, cancer and asthma. The volatile aromatic compounds from the echalotte onion bulbs and seeds have

strong effects on other organisms (Hoza 2003). Thus, they can be toxic for certain fungi, parasite bacteria and nematodes. The experiments "in vitro" demonstrated that the onion and garlic extracts inhibited more than 80 species of pathogenic fungi – allicin could be recommended as fungicide.

MATERIAL AND METHOD

The experiment was conducted in Drajna village, Prahova County. Drajna is located in the northern part of the Prahova County, being situated in the depression Drajna – Chiojd, in its south-western part; the depression comprises line hilly parts at the contact with Teleajen Valley.

The research was conducted by using five local echalotte onion populations, with different origins, during 2011 – 2012 with the following experimental scheme:

- V1 – onion from Slon, with small bulbs
- V2 - onion from Slon, with large bulbs
- V3 – from Periş
- V4 – from Drajna, with small bulbs
- V5 - from Drajna, with large bulbs

The planting was done in the first decade of April.

The planting scheme for the echalotte onion included a distance of 20 cm between rows and 15 cm between bulbs on the rows. The planting depth was 3-4 cm.

During the research conducted with the five local echalotte onion populations, maintenance works was performed, specific for the onion culture. Moreover, observations and measurements were made regarding the growth of the plants expressed through their height, the diameter of the leaf rosette, diameter of bulbs, average weight of bulbs and small bulbs, average weight of the green onion strain formed from bulbs and small bulbs, number of bulbils formed per plant, the onion production etc.

RESULTS OBTAINED

The diameter of the echalotte onion bulbs was slightly different among the two years. In the first year, the local populations of onion from Slon with small bulbs, from Periş and from Drajna with small bulbs formed bulbs with less than 2 cm in diameter, while in the second year the diameter was greater than 2 cm, only the population from Periş having 2 cm in diameter (Fig.1).

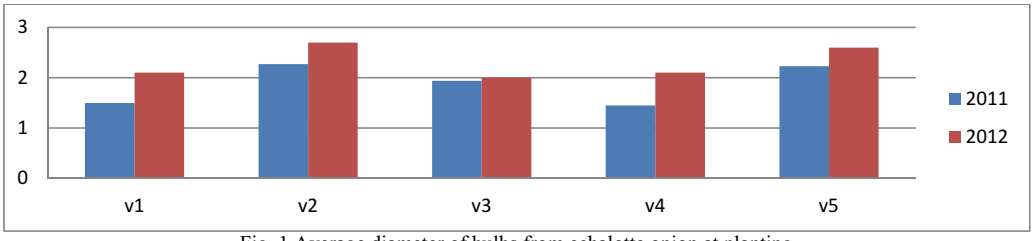


Fig. 1 Average diameter of bulbs from echalotte onion at planting

The average weight of the green onion strains/bulbs differed among the two years, due to the fact that in 2012 the climatic conditions were more favorable than in 2011. In 2012, the amount of rainfall was greater, the temperatures began increase when the plants had already begun to form bulbs and needed long days. There were no conditions to favor the appearance of manna. As a result of this, the echalotte onions were more vigorous in 2012 and had a bigger weight than in 2011 (Fig.2).

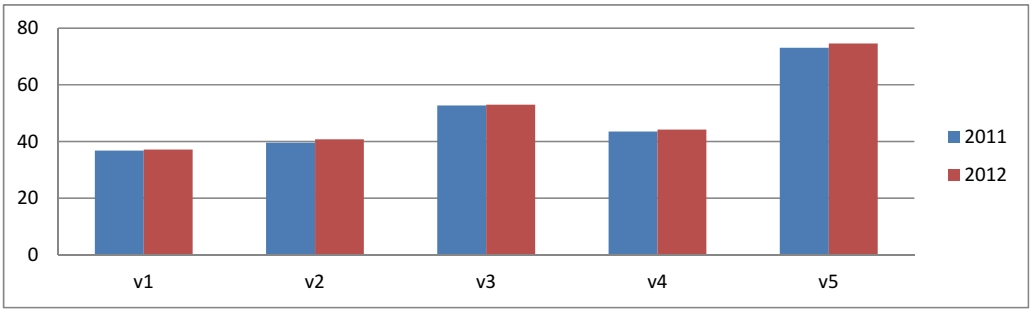


Fig. 2. Average weight of green onion strains/bulbs

The average weight of the green onion strains/bulbs was different for the two years, because the same conditions that influenced the weight of the green onion strains also influenced the weight of each green onion plant (Fig.3).

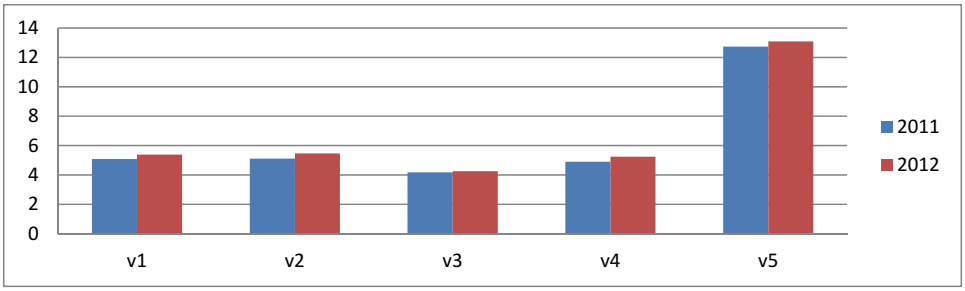


Fig. 3. Average weight of the green onion strains/bulbils

The dynamics of the leaf rosette was another indicator that differed among the two years, because the climatic conditions were more favorable in 2012 and greatly influenced the development of the echalotte onion. From the table below it can be observed that in 2012 the diameter of the leaf rosette recorded values similar to the ones from 2011, but 16 days earlier. Thus, in 2012, the echalotte onion had a much better development than in 2011 (table 1). The dynamics of the height of echalotte onions also varied among the two years mostly due to the fact that 2012 was a more favorable year from a climatic point of view, influencing greatly the development of the plants. From the table below (table 2) it can be noticed that in 2012 the measurements were made 16 days earlier than in 2011, due to the specific climatic conditions; however, the plants had a very good growth, some local onion populations recording values similar to the values from the previous year.

Table 1. Dynamics of the leaf rosette diameter, cm

Variant	2011	2012
1	15.59(21.05)	5.76(05.05)
2	17.57(28.05)	11.54(13.05)
3	19.66(04.06)	19.60(27.05)
4	20.71(18.06)	20.46(02.06)
5	21.19(25.06)	21.15(09.06)

Table 2. Dynamics of the echalotte onion height, cm

Variant	2011	2012
1	26.8(21.05)	15.4(05.05)
2	31.0(28.05)	19,8(13.05)
3	34.0(04.06)	27.8(27.05)
4	36.6(18.06)	33.8(02.06)
5	40.0(25.06)	41.2(09.06)

The average number of bulbils for the local echalotte onion populations varied. The highest number of bulbils was recorded for the local population of onion from De Periş, with 16 bulbs, while the lowest number was recorded for the onion from Slon with large bulbs with only 3 bulbs. The rest of the local population recorded intermediary values, their average being 8 bulbs (Fig.4).

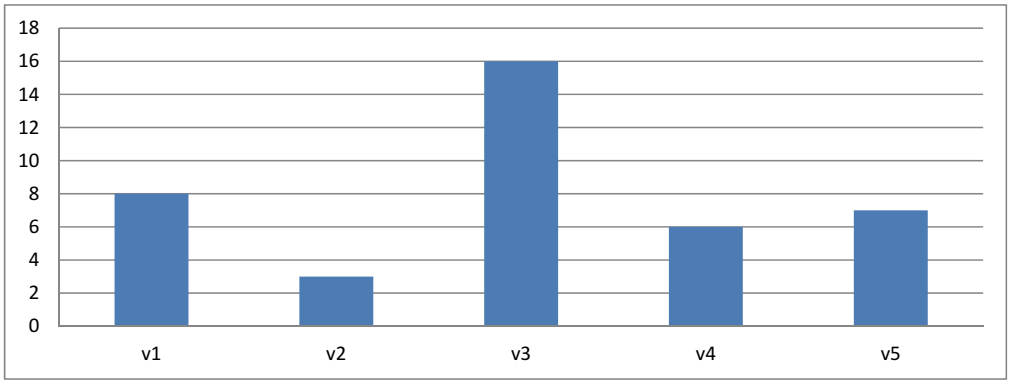


Fig. 4. Average number of bulbils (average data 2011-2012)

The average weight of the bulbils at harvest differed among the onion populations. The biggest weight of the bulbils at harvest was recorded for the onion from Drajna, with large bulb, having a value of 15,9 g, while the lowest value was recorded for the local population of onion from Periş, having only 4,5 gr. The remaining populations recorded intermediary values, having a mean weight of 10,12 g (Fig.5).

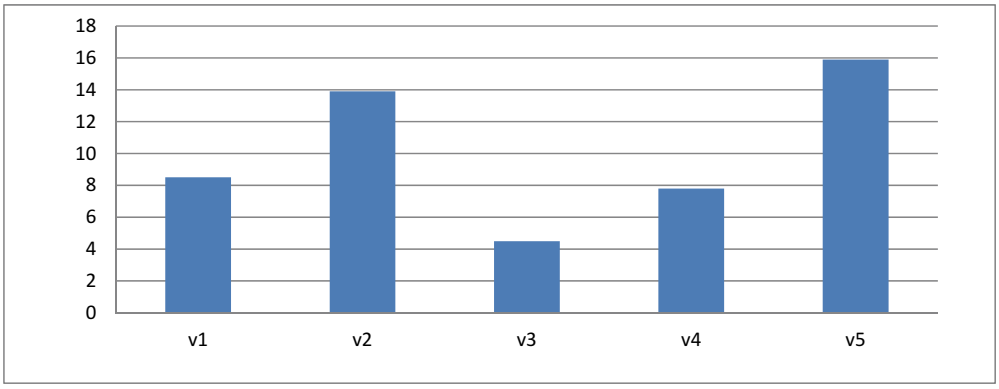


Fig. 5. Average weight of bulbils at harvest

The average weight of the bulbs at harvest was also different. The biggest weight was recorded for the population from Drajna with large bulbs with a value of 102.5 g, while the lowest weight was recorded for the onion from Slon with large bulbs, having a value of only 43.6 g. The remaining echalotte onion populations recorded intermediary values, having an average weight of 68.28 g (fig.6).

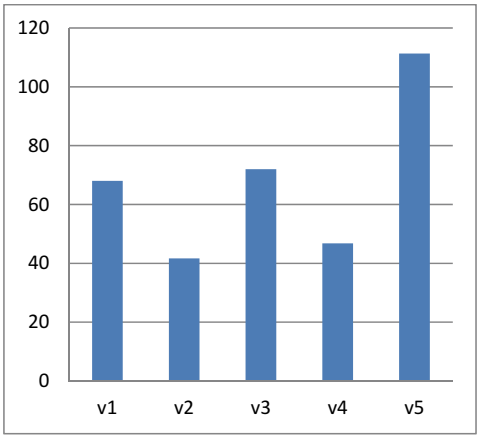


Fig. 6. Average bulb weight at harvest

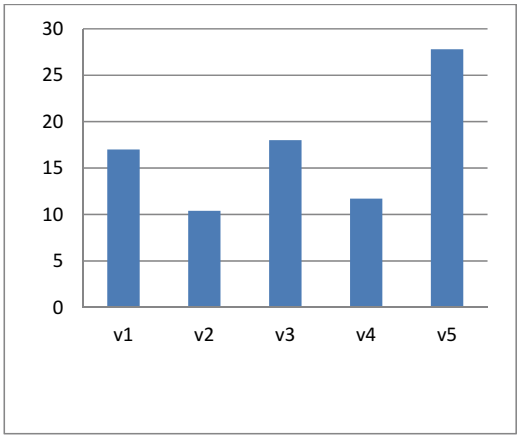


Fig. 7. Echalotte onion production, t/ha

The echalotte onion production per hectare varied according to each local population. Thus, the population with the largest production was the onion from Drajna with large bulbs, recording a production of 25,62 t/ha, while the population with the lowest production was the onion from Slon with large bulbs, producing only 10,9 t/ha. The remaining populations recorded intermediary values between 12,32 t/ha and 18,77 t/ha.(fig.7)

CONCLUSIONS

The echalotte onion cultivated in Văleni de munte area recorded very good results, being supported by the research conducted during 2011-2012. From this research, the following conclusions can be drawn:

- Echalotte onion has a better resistance than common onion and can be used as green onion and as onion for buls.
- In order to obtain onion for bulbs from echalotte onion, plants from Slon, with large bulbs can be used, because these plants recorded average weights of 13,9 g, and also onions from Drajna with large bulbs, which have an average weight of 15,9 g. These variants form on average 5 large bulbs.
- In order to obtain onions for leaves, it is recommended to use onion from Periş, because it forms 16 bulbs with an average weight of 4,5 g. At the same time, local populations from Slon and from Drajna with small bulbs can also be used, which have on average 7 bulbs with weights of 8,5 g and 7,9 g respectively.

Foto 1. Green echalot onion

Foto 2. Mature echalot onion from Periş

REFERENCES

[1] Ceauşescu Ion şi colab., 1984 - Legumicultură generală şi specială, Editura didactica şi pedagogică, Bucuresti, pag. 436
[2] Hoza Gheorghiţa, 2003 - Sfaturi practice pentru cultura legumelor, Editura Nemira, Bucuresti, pag. 175
[3] Indrea D. şi colab. - Cultura legumelor, Ed. Ceres, Bucuresti, 2007, pag. 393

Scientific Papers, Series B, Horticulture, Vol. LVI, 2012
CD-ROM ISSN 2285-5661, ISSN-L 2285-5653

EVOLUTION OF FRUIT PHYSICAL AND BIOCHEMICAL PARAMETERS OF SCAB RESISTANT APPLE VARIETIES DURING STORAGE

Iuliana ILIE, Florin STANICĂ

University of Agronomic Sciences and Veterinary Medicine Bucharest, 59 Mărăşti, District 1, 011464, Bucharest, Romania, Phone: +40 21 318 25 64/232, Fax: + 40 21318 28 88

Corresponding author email: jully_iulia85@yahoo.com

Abstract

In a young apple orchard with scab resistant varieties on the Romanian plain, trees were planted at 3.5 x 1.0 m on a brown-reddish soil and led as vertical axe. A trellis formed with 4.0 m oak wooden poles, 2 wires and bamboo canes was used to lead and to support the trees. The inter row was cultivated with a mixture of perennial grasses and mowed mechanically. Drip irrigation was provided on the row, having a continuous line with auto compensating drippers every 0.5 m. On the row, the soil was maintained clean by hand and mechanical cultivation. Organic foliar and soil fertilization was applied. For consecutive three years, fruits from 22 varieties have been studied during fruit storage, from September until April. Fruits main physical and biochemical characteristics were analyzed: fruit weight (g), fruit calibre (mm), flesh firmness (kgf/cm^2), soluble solids (%) etc. Fruit starch content was determined, based on the conversion level in soluble solids by coloration of the fruit transversal section. Sensory analysis of fruit have been realised by appreciating the external and internal fruit characteristics using a descriptors list for the "Level 1" of the "Eurofru" fruit test. Gold Rush had the best appreciations from the taste quality point of view, 45.40% of the tasters considering it of good quality and 25.20% of them, of excellent quality. Average fruit weight ranged from 89.8 g for Red Devil up to 232 g at Topaz. Flesh firmness at harvest ranged between 4.6 kgf/cm² at Rajka up to 13.8 kgf/cm² at Gold Rush variety, being an important indicator of fruit earliness and ability to storage.

Keywords: *Malus domestica, fruit characteristics, sensorial analysis*

INTRODUCTION

The high importance of apple growing is due to nutritional, prophylactic and therapeutic fruit values, apple trees biological and technological properties and value adding cropping. Apples are one of the main components in the diet of modern human nutrition. They are available all year as a fresh product and processed in several different ways. In fruit growing world, apple occupies a proeminent place in the production of fruit, hovering among tree roots in key species in temperate areas of the globe. [2] Apple storage capacity is extremely important for the new varieties launched on the market and an objective judgement of their commercial value should include some typical biochemical and sensorial analysis. For the scab resistant varieties, reaching a high quality level, similar of the non resistant ones is a major goal. This paper presents first results from a lot of varieties resistant to scab [4], insisting on the fruit characteristics and their evolution during storage.

MATERIALS AND METHODS

The apple orchard was planted on the Romanian plain on a brown-reddish soil. Apple trees of five scab resistant varieties: Ariwa, Gold Rush, Golden Orange, Rubinola and Topaz were planted at 3.5 x 1.0 m and led as vertical axe. A trellis formed with 4.0 m oak wooden poles, 2 wires and bamboo canes was used to lead and to support the trees. The inter row was cultivated with a mixture of perennial grasses and mowed mechanically. Drip irrigation was provided on the row, having a continuous line with auto compensating drippers every 0.5 m. On the row, the soil was maintained clean by hand and mechanical cultivation.

Foto 1. Apple plantation.

Fruits were harvested in September and stored in a cold chamber with normal atmosphere at 5°C.

At the picking moment and then, every month, fruit physical and biochemical characteristics were analysed as: fruit weight (g), fruit calibre (mm), flesh firmness (kgf/cm^2), soluble solids (%).

The starch content of fruit was determined according to their conversion into substances soluble solids by cross sections of the fruit color with iodine in potassium iodide .After staining was compared with a marked with a conversion chart for the dark blue noted whith 1 at 10, white, colorless.

The fruit sensorial analysis was done by appreciating the external and internal fruit characteristics. The sensorial analysis have been realised by group tasting, with students and teachers in February, after 4 month of cold storage.

The fruit tasting have been done using spread sheets with the most important fruit organoleptical characteristics included in the descriptors list for the "Level 1" of the "Eurofru" fruit test. The votes were between 1 and 9 for each character. Votes of 1-3 are considered unsatisfying, the ones from 4 to 6 are good and from 7 to 9, very good.

RESULTS AND DISCUSSION

The observation and measurements indicated that the ripening process in apple starts before the apple picking.

At picking time, the fruits were analysed in order to register their status before storage and to indicate exactly the stage of fruit maturity.

Firmness of flesh

Storage capacity of apple fruit firmness was determined by measuring pulp expressed in kgf / cm ² executed using a penetrometer with a sample of 11 mm piston being the mean of two measurements per fruit. As can be seen in Table 1 at harvest variety Goldrush highest value recorded over the three years of study, respectively 13.6 kgf / cm ² (2009), 13.8 kgf / cm ² (2010) and 12 , 9 kgf /cm² (2011). The lowest value was recorded in Romus 3 variety whit 7.2 kgf / cm ² (2009), 6.6 kgf / cm² (2010) and 7.4 kgf / cm ² (2011). During storage of pulp firmness varied according to genotype.

After 8 months of storage can be seen that the Goldrush variety register capable of storing values 6.2kgf/cm ² (2010), 7.2 kgf / cm ² (2010) and 6.1 kgf / cm ² (2012) while the other genotypes who have lost this ability after just four months of storage, that kind Ciprian 4.0 kgf / cm ² and Redix 4.3 kgf / cm ², the value reached in January.

Soluble solid-refractometric index

The apple content in soluble solids is extremely important, that characteristic having a major influence on fruit taste. This was determined by hand refractometer BRIX 35 HP. At picking, fruit content in soluble solids varied from 14.4% (2009), 15.6% (2010) and 16.6% (2011) at Red Devil but during storage may notice a slight decrease of this value shows that the varieties which begin to lose their ability conditioning, storage and marketing as with decreasing flesh firmness. After 8 months of storage registers Goldrush variety whit a best values, respectively 17.8% (2010), 17.4% (2011) and 18.4% (2012). (Table 2)

Fruit size

Apple weight and size are important in assessing the quality of their commercial variety being attributes that can be influenced to a greater or lesser extent the quantity of production, of rootstock, the culture technology applied, tree age and conditions climate of the year [5]. The average fruit weight of the studies varieties varied from 89.8 g at Red Devil, Goldrush 173.3 g, 181.5 g at Rubinola and 232 g Topaz variety. Fruit size varies from 50-55 mm

at Red Devil, 60-65 mm, 80-85 mm at Topaz and Ariwa. (Table 3)

Photo 2. Ariwa variety

The starch content

Analyzing the fruit coloured section with iodine in potassium iodide**,** was possible to see that, at the picking moment some of the studied varieties, were already ripped, Ariwa, Rebra and Rubinola (8C). For the other varieties of blue coloration was on 70% of the section (note 4) at Goldrush or 40% of the section (Note 6). Red Devil, Florina and Redix. Ariwa, Rubinola and Rebra are early ripe varieties and they have to be picked at least one month before (at least at 5 colouration stage) (Fig. 1).

Fig.1. The starch content

Senzorial evaluation

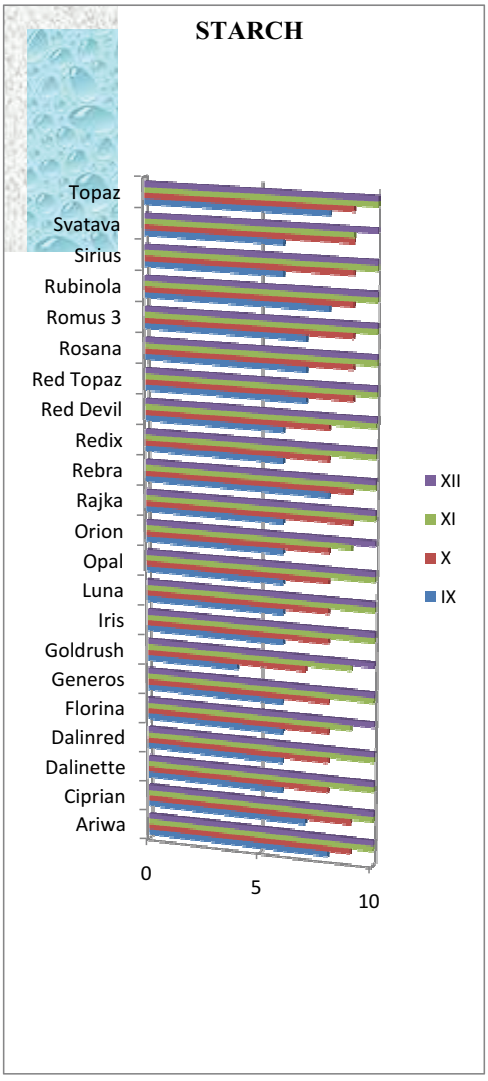
The first step in choosing products to consumers is organoleptic. Products causing pleasant sensations are retained for home use because they produce only simple recall appetite. This attitude is explained by the fact that the consumer's first contact with food is likely taste. He evaluates the product by size, color, shape, appearance, health, state of freshness, consistency, juiciness, flavor and taste. [1]

Some fruit characteristics are presented in Table 3. In Fig. 2 can be seen that 45.40% of tasters appreciated Goldrush variety of high quality, followed by Red Devil varieties, Topaz (41%) and Generos (40%). The Goldrush variety and quality was assessed as excellent by 25.20% of the tasters, followed by Ariwa, Red Devil and Red Topaz with 12%.

CONCLUSIONS

At the picking moment in three years of study, fruits had a high flesh firmness that indicates a high storage capacity and manipulation resistance.

Of the 22 genotypes studied best results in terms of conditioning they had varieties Goldrush, Dalinette, Red Devil, Svatava, Topaz, Opal and Sirius varieties compared with Ciprian, Rajka, Redix, Rosana, Romus 3 and Generos not last more than 4-5 months losing the ability conditioning, storage and marketing. During the storage period was recorded accumulation of soluble solids (sugars), with a positive effect on the fruit eating qualities. From the all studied varieties, Goldrush had the longest storage life and was considered on the first place by taste panel.



ACKNOWLEDGEMENTS

The research project was supported by World Bank-MAKIS nr.151929/2008.

REFERENCES

[1] Beceanu, D., 2002. *Technology of horticultural*. vol. I, Edit. Pim,

[2] Braniste N., Uncheasu G.2011. *Determined for apple varieties.*

[3] Stănică F. 2008 and Plato I. 2008. *Effects of Three Apple Tree planting System on Growth and Productivity*, IX International 4Stănică F. 2008. Behavior of new resistant apple varieties in different planting. Works. St. U.S.A.M.V.B. Series B, Vol LI.

[4] Stănică F., Davidescu V., A. Madjar, Dumitraşcu M., Ilie I. 2010. *Influence of the organic Cultural Practices on the Productivity and Efficiency of the year Apple Orchard Varieties Resistant Scabies*. International Horticultural Congress, Lisbon, August 22 to 27.

Table 1. Fruit firmness during 3 years of study

Variety	Flesh firmness kgf/cm²																							
	2009/2010								2010/2011								2011/2012							
	IX	X	XI	XII	I	II	III	IV	IX	X	XI	XII	I	II	III	IV	IX	X	XI	XII	I	II	III	IV
Ariwa	11.0	10.2	9.4	7.1	6.4	5.3	3.2	-	11.3	10.2	8.6	6.4	5.1	3,2	-	-	11.9	10.6	9.4	8.1	6.3	4.0	-	-
Ciprian	10.4	9.1	7.3	5.8	4.0	-	-	-	11.5	8 .0	5.7	4.2	3.4	-	-	-	8.6	7.4	6.1	5.2	3.7	-	-	-
Dalinette	10.8	10.9	10.7	9.4	8.3	7.5	5.4	5.3	12.9	11.2	11.2	9.6	7.4	7.6	5.6	4.7	11.7	11.4	10.8	8.9	7.5	6.4	5.1	4.1
Dalinred	11.4	10.9	9.9	7.4	6.6	5.4	3.7	-	11.6	11.2	9.4	5.4	4.4	3.1	-	-	10.6	9.9	10.0	7.5	7.6	6,3	4.3	-
Florina	10.6	9.8	8.7	7.3	6.3	5.4	5.3	4.6	10.2	8.0	6.6	4.0	3.4	4.0	-	-	9.0	9.2	8.6	6.9	5.3	4.4	4.6	-
Generos	9.8	8.4	7.1	5.3	4.6	4.2	-	-	10.2	7.8	6.8	4.2	3.7	-	-	-	8.9	9.0	7.4	6.1	5.5	4.2	-	-
Goldrush	13.6	12.4	11.6	11.8	10.2	8.7	8.2	6.2	13.8	11.4	10.4	10.8	9.9	9.7	8.1	7.2	12.9	12.8	11.7	10.9	9.1	8.3	7.1	6.1
Iris	9.9	9.1	8.7	7.6	6.3	5.4	4.1	-	9.8	9.4	8.3	6.4	5.1	4.7	-	-	8.4	8.2	7.4	5.6	4.3	3.2	-	-
Luna	10.4	10.5	9.7	7.9	8.0	6.3	5.5	4.1	11.3	10.8	9.5	7.1	6.2	5.3	4.4	-	9.6	8.3	6.6	6.5	5.2	4.9	-	-
Opal	11.2	10.8	8.9	8.7	6.4	5.5	5.6	4.3	11.0	10,2	10.8	9.2	8.6	7.4	5.7	5.2	10.3	9.8	8.7	6.7	6.4	6.0	5.5	-
Orion	9.2	9.0	8.6	7.5	6.1	5.3	4.6	-	9.5	9.6	8.7	6.9	5.4	4.3	-	-	8.5	7.5	6.2	5.5	5.6	4.8	-	-
Rajka	4.6	4.1	4.2	3.2	-	-	-	-	7.6	6.2	4.4	4.2	-	-	-	-	7.5	6.1	5.4	4.7	4.1	-	-	-
Rebra	10.9	9.2	9.3	8.0	7.1	6.4	5.3	5.0	10.2	9.6	9.2	8.2	7.4	6.1	4.7	-	9.7	9.2	8.5	8.2	7.1	6	5.4	5.2
Redix	8.2	7.1	6.2	5.3	4.3	-	-	-	8.5	7.2	6.4	5.2	4.1	-	-	-	10.4	8.9	7.6	6.2	5.4	4.0	-	-
Red Devil	8.9	7.4	7.4	6.6	6.2	5.2	5.3	4.7	8.5	8.0	7.6	7.8	6.7	5.9	5.4	5.2	8.0	8.1	7.4	6.2	5.7	5.4	4.7	4.4
Red Topaz	9.3	8.6	7.5	6.5	6.2	5.7	4.4	-	8.2	7.0	5.8	5.2	4.7	4.3	-	-	9.7	8.8	7.2	6.1	5.4	5.6	4.7	4.3
Rosana	7.9	6.2	5.5	4.3	-	-	-	-	8,1	7.2	5.2	4.5	3.3	-	-	-	8.9	7.6	6.3	5.5	5.2	4.1	-	-
Romus 3	7.2	6.3	5.4	4.7	4.5	-	-	-	6.6	6.4	6.0	5.2	4.7	4.2	-	-	7,4	6,9	5.9	5.6	4.9	4.5	3.7	-
Rubinola	9.8	8.7	7.4	6.1	5.3	4.7	-	-	10.0	6.2	5.2	4.8	3.9	-	-	-	7.9	6.1	5.7	4.2	3.2	-	-	-
Sirius	9.3	8.6	8.0	7.1	6.5	6.1	5.4	5.2	9.8	9.4	8.2	7.1	6.5	6.0	5.1	5.2	9.5	8.3	7.0	6.5	5.2	4.2	-	-
Svatava	11.2	10.0	8.9	7.4	6.0	5.7	5.4	4,7	11.5	9.8	7.6	6.9	5.6	5.1	4.3	4.7	11.7	10.2	8.7	7.6	6.6	6.2	5.6	5.0
Topaz	12.9	11.2	11.1	10.3	9.8	8.0	6.6	5.2	13.2	10.4	9.3	7.0	6.5	5.5	5.3	4.9	10.3	9.8	8.6	7.5	7.0	6.2	5.7	5.2

Tabel 2. Total soluble solids

Variety	S.U.S %																							
	2009/2010								2010/2011								2011/2012							
	IX	X	XI	XII	I	II	III	IV	IX	X	XI	XII	I	II	III	IV	IX	X	XI	XII	I	II	III	IV
Ariwa	13.2	12.6	12.8	13.2	12.6	13.0	12.8	-	13.4	12.8	13.2	13.6	13.6	13.8	-	-	12.0	12.8	13.2	13.2	12.6		-	-
Ciprian	14.4	13.8	13.8	13.2	13.0	-	-	-	14.6	12.8	12.4	11.6	11.6	-	-	-	14.2	13.8	14.6	13.8	12.4	-	-	-
Dalinette	13.0	13.8	14.2	14.2	14.4	14.8	14.8	14.2	13.2	14.4	14.8	14.4	14.6	14.6	14.4	14.2	12.4	14.8	15.8	14.8	14.6	14.4	14.4	14.2
Dalinred	10.2	10,4	10.4	11.2	12.4	13.2	13.4	-	10.0	10.2	10.4	11.0	11.4	11.4	-	-	11.4	12.8	14.8	14.0	14.0	14.2	13.8	-
Florina	13.2	13.0	12.8	12.8	12.4	12.6	12.4	12.0	13.0	13.2	11.2	10.6	11.0	10.8	-	-	12.0	13.0	15.4	15.2	14.8	14.8		-
Generos	15.4	15.4	14.6	15.0	15.2	15.0	-	-	15.8	15.4	15.8	15.6	15.6	-	-	-	15.6	14.6	15.8	14.8	14.0	14.2	-	-
Goldrush	13.0	13.8	14.6	15.0	15.6	17.2	17.4	17.8	12.8	13.4	13.8	15.2	16.8	17.0	17.8	17.4	12.2	14.6	17.8	17.8	18.2	18.6	18.4	18.4
Iris	10.2	12.6	12.8	13.0	13,4	12.8	12.8	-	10.8	13.0	13.6	13.8	12.8	13.0	-	-	16.4	14.6	14.2	14.0	13.8	13.8	-	-
Luna	10.6	11.2	11.2	11.6	13.4	12.8	12.4	12.4	11.0	12.4	12.4	13.8	13.8	13.4	13.8	-	10.4	13.2	13.0	12.8	12.4	12.4	-	-
Opal	13.4	13.4	13.8	15.2	16.4	16.0	16.2	16.4	14.2	15.6	17.0	16 .0	16.4	17.2	16.8	16.2	12.6	14.8	15.0	16.8	16.8	16.4	16.4	-
Orion	14.2	14.2	14.8	15.2	15.2	15.8	15.8	-	13.8	14.6	14.4	15.4	15.6	15.6	-	-	14.8	14.8	14.4	14.4	14.4	14.8	-	-
Rajka	13.4	13,8	14.2	14.8	-	-	-	-	13.8	14.0	13.2	13.4	-	-	-	-	14.8	14.4	12.0	13.8	14.2	-	-	-
Rebra	12.4	12.6	12.8	12.8	14.8	13.6	13.2	13.2	13.0	12.8	13.4	13.8	13.8	14.2	14.0	-	13.8	13.4	13.4	13.0	12.8	13.2	13.2	12.8
Redix	12.2	12.8	13.4	13.6	13.6	-	-	-	13.6	13.6	13.2	12.4	13.0	-	-	-	12.2	13.6	15.0	13.8	12.0	13.2	-	-
Red Devil	14.4	15.6	15.8	14.8	15.2	15.6	14.8	14,4	15.6	15.6	15.8	16.2	15.6	15.2	15.2	15.0	16.6	15.8	14.8	14.8	14.4	14.4	14.6	14.0
Red Topaz	12.8	12.8	13.2	13.8	14.0	13.4	13.4	-	12.8	13.2	12.6	12.4	12.8	12.8	-	-	14.2	13.4	13.6	13.6	13.2	13.8	14.0	13.8
Rosana	11.0	11.2	11.2	12.8	-	-	-	-	11.2	11.4	10.6	12.6	12.8	-	-	-	15.8	14.2	13.6	13.2	11.8	12.0	-	-
Romus 3	12.0	12.2	13.6	13.4	13.8	-	-	-	12.2	13.2	12.6	11.2	12.8	12.8	-	-	12.4	12.6	12.0	12.2	11.8	12	12.8	-
Rubinola	13.2	13.8	14.0	13.2	13.2	13.0	-	-	14.0	12.4	12.0	12.2	12.8	-	-	-	13.8	16.6	14.6	15.2	16.8	-	-	-
Sirius	13.8	14.4	14.4	15.0	15.2	14.8	16.0	15.8	13.2	14.2	14.2	14.8	15.2	15.8	16.0	16.0	14.2	16.4	15.8	15.8	15.6	15.6	-	-
Svatava	13.8	14.2	14.2	13.8	14.6	14.4	14.8	14.8	14.0	14.0	13.2	13.4	13.8	13.8	14.0	14.2	14.2	14.0	14.2	14.2	13.4	13.8	14.0	13.8
Topaz	12.8	13.4	13.4	14.0	13.8	13.8	13.4	13.4	13.2	14.8	14.4	14.0	14.2	14.4	13.8	13.6	10.8	14.0	15.2	14.2	13.8	14.2	14.0	14.2

Tabel 3. Indicators of quality fruit

Variety	Average fruit weight (g)	Grading size classes (mm)	Fruit colour	Ground colour	Over colour	Type of over color	Amount of over color	Calyx end	Fruit shape	Texture	Juicyness
Ariwa	156,4	60-65	Red	Orange	Red	Stightly blushed	51-75%	Half open	Globose conical	Fine	Rather dry
Ciprian	166.5	70-75	Dark Red	Green	Dark red	Complet over colour	76-100%	Half open	Globose conical	Fine	Juicy
Dalinette	110.6	50-55	Red	Green/ Yellow	Red	Stightly blushed	76-100%	Closed	Globose	Intermediate	Juicy
Dalinred	155.4	70-75	Red	Green/ Yellow	Red	Stightly blushed	76-100%	Half open	Globose	Intermediate	Juicy
Florina	140.5	65-70	Orange/ Red	Yellow	Red	Stightly blushed	51-75%	Closed	Globose conical	Intermediate	Juicy
Generos	174.5	75-80	Orange/ Red	Green-Yellow	Orange	Stightly blushed	51-75%	Closed	Globose	Intermediate	Juicy
Gold rush	173,3	70-75	Yellow/ Orange	Green/ Yellow	Portocaliu	Stightly blushed	1-25%	Open	Conical	Intermediate	Juicy
Iris	189.5	80-85	Red	Yellow	Rosie	Striped	76-100%	Closed	Globose	Intermediate	Juicy
Luna	176.3	70-75	Yellow	Green/ Yellow	Galbena	Stightly blushed	51-75%	Closed	Globose	Intermediate	Very juicy
Opal	186.3	75-80	Yellow	Green/ Yellow	Galbena	Complet over colour	76-100%	Closed	Globose	Intermediate	Very juicy
Orion	188.4	75-80	Yellow	Green/ Yellow	Galbena	Stightly blushed	76-100%	Half open	Globose	Intermediate	Juicy
Rajka	174.2	70-75	Red	Green/ Yellow	Red	Stightly blushed	76-100%	Closed	Globose	Intermediate	Rather dry
Rebra	192.4	75-80	Orange/ Red	Green/ Yellow	Pink	Stightly blushed	51-75%	Open	Globose conical	Intermediate	Juicy
Redix	171.5	70-75	Red	Green/ Yellow	Red	Complet over colour	76-100%	Open	Long conical	Fine	Rather dry
Red Devil	89.8	50-55	Red	Orange	Red	Stightly blushed	76-100%	Closed	Globose	Intermediate	Juicy
Red Topaz	146.7	60-65	Red	Green/ Yellow	Red	Stightly blushed	76-100%	Closed	Globose	Intermediate	Very juicy
Rosana	210.5	80-85	Orange/ Red	Green/ Yellow	Red	Stightly blushed	76-100%	Half open	Globose	Intermediate	Very juicy
Romus 3	145.5	60-65	Red	Green/ Yellow	Red	Stightly blushed	76-100%	Closed	Globose conical	Intermediate	Juicy
Rubinola	181,5	80-85	Red	Orange	Dark red	Complet over colour	76-100%	Half open	Flot	Intermediate	Juicy
Sirius	180.7	75-80	Yellow	Green/ Yellow	Yellow	Complet over colour	76-100%	Closed	Globose	Intermediate	Very juicy
Topaz	232.0	80-85	Orange/ Red	Green/ Yellow	Orange	Striped	51-75%	Closed	Globose	Intermediate	Juicy

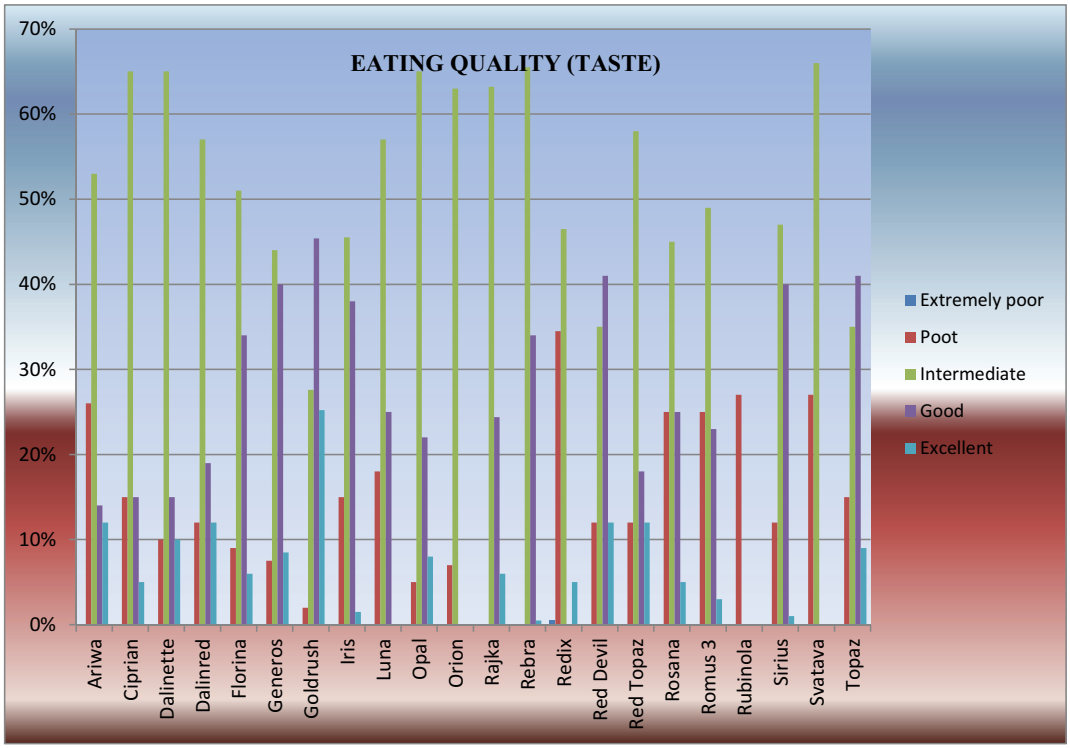


Fig. 2. Eating quality

Scientific Papers, Series B, Horticulture, Vol. LVI, 2012
CD-ROM ISSN 2285-5661, ISSN-L 2285-5653

INFLUENCE OF ORGANO-MINERAL FERTILIZERS ON THE PRODUCTIVITY AND EFFICIENCY OF AN APPLE SCAB RESISTANT VARIETIES ORCHARD

Iuliana ILIE, Florin STĂNICĂ

University of Agronomic Sciences and Veterinary Medicine, Bucharest, 59 Mărăşti, District 1, 011464, Bucharest, Romania, Phone: +40 21 318 25 64/232, Fax: + 40 21318 28 88

Corresponding author email: jully_iulia85@yahoo.com

Abstract

In a young apple orchard planted on the Romanian plain on a brown-reddish soil, organic cultural practices were applied. Apple trees of five scab resistant varieties: Topaz, Rubinola, Gold Rush, Generos and Redix, were planted at 3.5 x 1.0 m and led as vertical axe. A trellis formed with 4.0 m oak wooden poles, 2 wires and bamboo canes was used to lead and to support the trees. The inter row was cultivated with a mixture of perennial grasses and mowed mechanically. Drip irrigation was provided on the row, having a continuous line with auto compensating drippers every 0.5 m. On the row, the soil was maintained clean by hand and mechanical cultivation. For fertilization, organo-mineral products, derived from seaweed have been used. Tecamin Flower was applied before blooming, Tecamin Brix and Tecnokel Amino Ca B was use as foliar fertilizer and Agriful, for soil application. Different parameters as: tree growth, blooming intensity, fruit number, fruit size and productivity per tree have been influenced by the variety and by the applied fertilizers.

Keywords: *Malus x domestica,* organic fertilization, cutting, tree growth.

INTRODUCTION

Apple is the leading species in Romanian fruit growing and in the last 30 years the new orchards were planted mainly with scab resistant varieties. The use of scab and other diseases and pests resistant varieties is a key factor to reduce the chemical pressure on the orchard environment and to develop its sustainability. [3]

Control and monitoring of soil fertility is a set of principles and methods scientifically designed to address soil and plant analyzes, experiments and studies of complex traits evaluation of soil fertility, productivity and soil quality, to determine the measures to increase integrated multiple functions of soils and yields quantitative and qualitative superior crops [2]

The present work was to study the behavior of five apple genotypes in annual vegetativ and flowering shoots, flowering intensity, fruit number, fruit size, productivity and organo-mineral fertilization.

MATERIALS AND METHODS

Orchard characteristics

Within a World Bank- MAKIS project an apple orchard was planted in the spring 2009 at the Bucuresti Faculty of Horticulture on the Romanian plain, on a brown-reddish soil.

Three scab resistant varieties: Topaz, Rubinola and Gold Rush, grafted on M9 rootstock were planted at 3.5 x 1.0 m (2857 trees/ha) and then lead as a vertical axe. A trellis formed with 4.0 m oak wooden poles, 2 wires and bamboo canes was used to lead and to support the trees.

The inter row was cultivated with a mixture of perennial grasses and mowed mechanically. On the row, the soil was maintained clean, both by hand and mechanical cultivation.

Drip irrigation was provided on the row, having a continuous dripping line with auto compensating drippers (2 l/hour) every 0.5 m.

Fertilization

Fertilization was done with 4 products, 3 of them are foliar , respectively Tecamin Flower, Tecamin Brix,Tecnokel Amino CaB and Agriful for soil application. The fertilization was done in early spring with Techamin Flower, is a seaweed extract 4%, 3% L-amino

acids, 3% nitrogen (N), 10% phosphorus (P2O5) 1% boron (B), 0,5% molybdenum (Mo) with the implementation stage of floral button intended for stimulate flowering and fruit set. When trees have reached the stage of development of fruit was used for 3 months repeated fertilization of 15 to 15 days which a bio-stimulator Tecamin Brix for fruit development, improve fruit color and sugar content, fruit size, increases with the content 18% K2O, 0.2% B, 10% seaweed extract and Tecnokel Amino CaB which is a additionalt fertilization programs designed to increase fruit firmness and postharvest quality, increase resistance to cracking and control of physiological disorders associated, with a concentration of 10% CaO, 0.2 B, 6% L-amino acids. Agriful is a natural fertilizer effect which stimulates the development of root system quickly, latching enhances fruit on the tree, etc., with a concentration of 4.5% N, 1.0% P2O5, 1.0 % K2O,pH4,7. Dose applied was 0.6 ml / tree (17.4 l / ha) for application to soil and 0.3 ml / tree (9.52 l / ha) in the foliar. Were used four fertilization variants marked with V1- Control, V2- Tecamin Brix and Tecnokel CaB (foliar fertilization), V3- foliar fertilization + soil fertilization with Tecamin Brix, Tecnokel CaB and Agriful and V4-Agriful(soil fertilization).

Determinations and Measurements

Early in spring were determined annual vegetative and flower shoots (cm / tree), flowering intensity (no / tree), number of fruit-related (no / tree), fruit number after manual thinning and physiological fall) (no / tree), fruit set (%) and productivity (kg /tree, t/ha).

Soil characteristics: pH (potentiometric method), soluble salt content (%), N index (I_N%), P_{AL} ppm and K_{AL} ppm –Riehm Domindo Egnor method.

The dry matter content of leaves was determined by measurements of samples after storage at 65°C for 48 hours causing the N content (%) by the Kjeldahl method, P content (%) by colorimetric method and content of K (%) photometrica method.

RESULTS AND DISCUSSION

Trees growth

Annual average vegetative growth was achieved at the largest variety Topaz (4998.0 cm/tree) followed by Goldrush with 4619.9 cm/tree. The lowest value recorded in Generos with 631.0 cm/tree (Table 1). The greatest total length of flowering shoots was found in Goldrush with 9752.0 cm/tree followed by Topaz (7693.5 cm/tree) (Table 2).

Table 1. The annual growth of the vegetative shoots (cm/tree)

Variety	Vegetative shoots (cm/tree)			
	Spurs	Long shoots	Total	Sprouts
Generos	305.5	325.5	631.0	468.0
Goldrush	632.4	3987.5	4619.9	1574.0
Redix	361.0	2452.0	2813.0	910.5
Rubinola	523.5	3798.5	4322.0	1164.0
Topaz	493.0	4505.0	4998.0	3205.0

Table 2. The annual growth of the flowering shoots (cm/tree)

Variety	Flower shoots (cm/tree)			Total length (cm/tree)
	Flowering rods	Off shoots	Total	
Generos	3314.5	2400.5	6183.5	6814.5
Goldrush	3214.5	6537.5	9752.0	14371.9
Redix	5628.0	1420.0	7048	9861.0
Rubinola	2942.0	1908.5	6014.5	10336.5
Topaz	6023.0	1670.5	7693.5	12691.5

Flowering, fruit set, yield and productivity.

The highest numbers of flowers per tree in The was produced by Goldrush (125.5), meanwhile Rubinola produced only 25.5 flowers/tree. From the point of view of binding the fruits, Goldrush remains on the first place 97.5 (no/tree) followed by topaz with 57.5 (no/tree).(Fig.1)

Photo 1.Topaz flower

The fruit sizes varied from 173.3 g at Goldrush to 232.0 g at Topaz. Goldrush produced also the highest number of fruits per tree (70) and highest fruit yield (34.65 t/ha) followed by Topaz with 27.14 t/ha (Table 3).

Photo 2. Goldrush apple

Table 3. The final fruit number, fruit size and productivity (fruits/tree)

Variety	Final fruit (no/tree)	Fruit size g	Yield	
			kg/tree	t/ha
Generos	15.0	174.5	7.77	22.19
Goldrush	70.0	173.3	12.13	34.65
Redix	44.0	171.5	7.84	21.55
Rubinola	14.0	181.5	2.54	7.25
Topaz	41.0	232.0	9.5	27.14

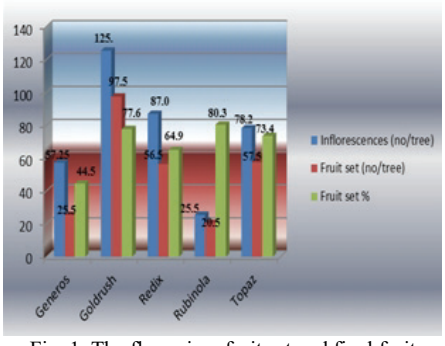


Fig. 1. The flowering, fruit set and final fruit

Effect of organo-mineral fertilizers on soil characteristics

Of the four variants studied can be seen as the best result in the content of soluble salts to obtain the V3 with a higher percentage of 0.041% soluble salts from the control sample (V1 whit 0,034%) and the highest I_N of 2.4% from the rest variants. I_N is synthetic indicator which is highlighted possible plant soil to provide nitrogen according to soil humus content and the degree of saturation of the soil base.

Insurance status of the soil with phosphorus and potassium mobile forms of the four variants V4 showed the highest value of 76.6 ppm P and 266.2 ppm K followed V3 with 76.4ppm P and 263.4 ppm K (Table 4.) Averaged and reported P_{AL} and K_{AL} scale interpretation for intensive orchards are: $\leq$ 36.0 ppm P_{AL} (very poor insurance) $\geq$ 144.0 ppm P_{AL} (very good insurance) and 132.0 ppm $\leq$ K_{AL} (poor insurance) $K_{AL} \geq$ 400.0 ppm (very good insurance)

Table 4. The chemical characteristics of soil

Variant	pH in H_2O	Total soluble salts %	I_N %	P ppm	K ppm
V_1 Control	6.0	0.034	2.2	73.0	256.7
V_2 Techamin Brix, Tecnokel CaB	6.0	0.039	2.25	74.2	258.5
V_3 Techamin Brix, Tecnokel CaB + Agriful	6.5	0.041	2.4	76.4	263.4
V_4 Agriful	6.5	0.040	2.35	76.6	266.2

Effect of organo-mineral fertilizers on NPK content in leaves and shoots

During the fertilization and nutrition tree vegetation can be controlled analytically by foliar diagnosis and the results are reported in normal nutrient content in dry matter. Average N content is 2.2 to 2.5%, P 0.18 to 0.20% and K 1.3 to 1.6%.[1].

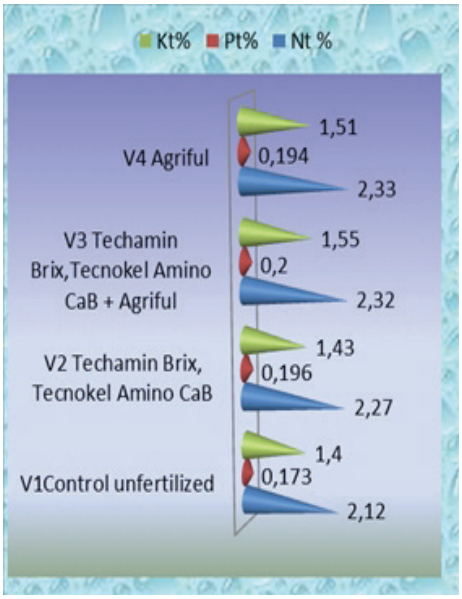


Fig. 2. Dinamic of apple leaves content in total NPK (%)

After studies effectuate can see that the V3 have the largest amount of NPK, respectively 2.33% N, 0.2% P, 1.55% K followed by V4 with 2.33% N, 0.194% P, 1.51% K (Fig. 2).

CONCLUSIONS

Following the study, we can deduce that variety ability to form vegetative and flowering shoots in a balanced number and the capacity to keep the fruits on the tree after the natural thinning, leads to high productivity (Goldrush and Topaz).

Fertilization in a plantation is necessary and mandatory for the increasing amount of our fruit branches, inflorescence, number of fruit-related and high production.

After this study we have seen the beneficial effects of organo-mineral fertilizers on plant and soil.

ACKNOWLEDGEMENTS

The research was supported by the World Bank-MAKIS project no. 151929/2008.

REFERENCES

[1] Davidescu D., Davidescu V., 1981, Modern Agrochemistry, RPR Academy Press, Bucharest.

[2] Hînga M. Claudia, *Research on the agrochemical preluvosolium typical and argic chernozem culture through diferentianted apple fertilization in Reghin area.*

[3] Stănică F. and Platon I. 2008. *Effects of Three Planting Systems on Apple Tree Growth and Productivity*. IX International Symposium on Integrating Canopy, Rootstock and Environmental Physiology in Orchard Systems. Geneva, U.S.A. August 1-10 (in press).

Scientific Papers, Series B, Horticulture, Vol. LVI, 2012
CD-ROM ISSN 2285-5661, ISSN-L 2285-5653

THE RELATIONSHIPS BETWEEN LEAF AREA AND OTHER PARAMETERS IN LOQUAT

Mehtap ŞENYURT, Turan KARADENİZ, Tuba BAK

Ordu University- Faculty of Agriculture, Department of Horticulture, 52100 Ordu-Turkey

Corresponding author email: turankaradeniz@hotmail.com

Abstract

The study about the relationships between leaf area of loquat and cluster length, cluster weight, fruit number per cluster, leaf length, leaf width, leaf stalk length, leaf stalk thickness, leaf area, fruit weight, fruit size, fruit stalk length, fruit stalk thickness, fruit volume, calyx basin width, calyx basin depth, fresh/seed ratio, seed number, seed weight, seed length, seed width, total soluble solids, pH, titratable acidity, leaf ash was made. A relationship was determined between leaf areas with some parameters. As a result of the research, there was a large negative correlation found between leaf area and fruit number per cluster, seed number, seed weight, seed width; a negative correlation found between leaf area and fruit weight, acids, and a large positive correlation found between leaf area and leaf stalk length. The aim of the study is to determine the relationships between leaf area and others parameters and this study can offer an insight to the future improvement researches in regard to Loquat in the Black Sea.

Key words: *Eriobotrya japonica*, leaf area, fruit characteristics, correlation

INTRODUCTION

The loquat cultivation in Turkey has developed noticeably in recent years. Production of loquat was 3.000 tons in 1980; 11.500 tons in 2000; 12.000 tons in 2005. While 96.64% of the total production is from Mediterranean Region, 2.09% of total production is from Aegean Region and 1.24% of it is from Black Sea Region [1].

In Black Sea Region, the loquat is consumed as fresh. There aren't any orchards in Black Sea Region; trees are found in the houses with a orchard for pleasure. This situation increases the importance of selection improvement for loquat fruit.

Leaves are essential parts of the plants and they are the food sources of the plants thanks to the photosynthesis. So, they undertake some important duties in the framework of blooming, fruit set, fruit growing and other physiological activities. Temperate fruit species blossom in spring after short day conditions in winter have passed. The number of the fruit species that blossom in autumn and have fruits in winter is very few. One of them is the loquat [2].

In this study, leaf and fruit characteristics of the loquat in the central districts of Ordu have been determined and the relations between the leaf area and important fruit criteria have been observed.

MATERIALS AND METHODS

This study has been conducted on the loquat that is cultivated in the central districts of Ordu (Photo 1,2). Physical and chemical analyses have been performed on the leaves and fruits that were obtained from the four vectors of the trees. In the types, some characteristics have been determined such as; clusterlength (CL, mm), cluster weight (CW, g), fruit number per cluster (FNC), leaf length (LL, mm), leaf width (LW, mm), leaf stalk length (LSL, mm), leaf stalk thickness (LST, mm), leaf area (LA, cm^2), fruit weight (FW, g), fruit size (FS, (fruit width+ fruit length)/2), fruit stalk length (FSL, mm), fruit stalk thickness (FST, mm), fruit volume (FV, ml), calyx basin width (CBV, mm), calyx basin depth (CBD, mm), fresh/seed ratio (F/S, %), seed number (SN), seed weight (SW, g), seed length (SL, mm), seed width (SWI, mm), total soluble solids (TSS, %), pH, titratable acidity (TA, g/L, malic acid), leaf ash (LA, %).

Correlation coefficients of these characteristics and direct and indirect effect of leaf area on the other characteristics have been identified by path analysis [3].

Photo 1. Selected of loquat in Ordu

Photo 2. Loquat in Ordu

RESULTS AND DISCUSSIONS

Negative and crucial relation between leaf area and fruit number per cluster, seed number, seed weight, seed width; positive and important relations with leaf stalk length; negative and important relations between fruit weight and acidity are observed.

Positive and important relationship is identified among cluster weight, fruit number per cluster and cluster length. (Table 1)

Positive and important relationship is identified between fruit number per cluster and cluster length. On the other hand, negative and important relationship is identified among leaf stalk length, fruit weight, fruit size, fruit volume and seed length. It is also identified that there is negative and important relationship between leaf stalk length and calyx basin width. Positive and significant relationships are determined between leaf width and leaf length, among leaf stalk length, leaf stalk thickness, calyx basin width, calyx basin depth, pH. Furthermore, positive and important relationship between fruit volume and fresh/seed ratio is determined. It is also identified that there is negative relationship with acidity and negative and important relationship between fruit stalk thickness and leaf ash.

Positive and significant relationships are determined between leaf length and leaf stalk length, between leaf stalk thickness, calyx basin width and calyx basin depth and pH. Positive and important relationship with fresh/seed ratio is identified, negative and important relationship with acidity is determined. There is also negative and important relationship with fruit stalk thickness.

Positive and significant relationships are determined between fruit weight and fruit size and between calyx basin width, fresh/seed ratio, seed weight and seed length. Negative and crucial relationship with pH is identified. Furthermore, positive and significant relationships are determined between fruit size and fruit volume, calyx basin width, fresh/seed ratio, seed length. It is also identified that there is positive and important relationship with calyx basin depth, negative and important relationship between pH.

Positive and significant relationships is identified between fruit volume and calyx basin width, fresh/seed ratio, seed weight, seed length, positive and important relationship with calyx basin depth is determined. It is also identified that there is negative and important relationship between fresh/seed ratio and seed number.

Direct relationship between leaf area and leaf ash, titratable acidity, cluster weight is exercised on the highest level. (Table 2)

This situation shows us that as it is expected, leaf area affects directly organic material in the leaf.

Table 1. Mutual relations between leaf area and other fruit characteristics

:	LA	CW	FNC	LW	LL	LSL	LST	CL	FW	FS	FSL	FST	FV	CBW	CBD	F/S	SN	SW	SL	SWI	TSS	pH	TA	LA
LA	1,00	-0,522**	-0,162	0,274	0,275	0,352*	0,290	-0,245	-0,354*	-0,300	0,093	-0,001	-0,2907	0,002	0,123	0,178	-0,522**	-0,509**	-0,213	-0,447**	-0,108	0,310	-0,329*	0,084
CW		1,00	0.572**	-0.128	-0.129	-0.120	-0.027	0.345*	0.309	0.274	-0.129	0.229	0.299	0.180	-0.036	0.030	0.314	0.280	0.033	0.079	-0.040	-0.090	0.127	0.024
FNC			1,00	-0.275	-0.204	-0.555**	-0.368*	0.424**	-0.466**	-0.471**	-0.054	0.034	-0.459**	-0.370*	-0.228	-0.293	0.016	-0.237	-0.478**	-0.033	-0.059	0.292	-0.212	-0.143
LW				1,00	0.916**	0.459**	0.714**	0.211	0.255	0.338	0.107	-0.371*	0.328*	0.573**	0.476**	0.329*	-0.216	-0.032	0.078	-0.277	-0.041	0.424**	-0.454**	-0.353*
LL					1,00	0.545**	0.595**	0.144	0.220	0.303	0.024	-0.365*	0.308	0.614**	0.492**	0.351*	-0.254	-0.076	0.075	-0.202	-0.085	0.521**	-0.585**	-0.179
LSL						1,00	0.488**	-0.077	0.471**	0.539**	-0.019	-0.056	0.553**	0.641**	0.344*	0.387*	-0.191	0.166	0.531**	-0.168	0.000	0.095	-0.176	0.249
LST							1,00	0.158	0.324*	0.381*	0.228	-0.081	0.340*	0.301	0.736**	0.381*	-0.327*	-0.049	0.318	-0.317	0.045	0.005	-0.025	-0.192
CL								1,00	0.064	0.099	0.525**	-0.352*	0.075	-0.084	0.027	-0.126	0.029	0.136	0.259	-0.251	0.096	0.230	-0.240	-0.185
FW									1,00	0.972**	-0.141	0.262	0.987**	0.658**	0.312	0.503**	0.294	0.644**	0.623**	0.171	-0.260	-0.378*	0.309	0.160
FS										1,00	-0.121	0.271	0.983**	0.697**	0.392*	0.530**	0.176	0.602**	0.677**	0.212	-0.233	-0.324*	0.288	0.085
FSL											1,00	-0.288	-0.156	-0.215	-0.005	-0.284	0.025	0.065	0.297	-0.290	0.210	0.001	-0.114	0.186
FST												1,00	0.235	0.061	0.232	0.276	-0.016	0.171	0.107	0.527**	-0.564**	-0.654**	0.704**	0.176
FV													1,00	0.724**	0.321*	0.533**	0.246	0.612**	0.617**	0.166	-0.283	-0.280	0.217	0.174
CBW														1,00	0.146	0.306	0.298	0.497**	0.370*	-0.043	-0.243	0.096	-0.136	0.081
CBD															1,00	0.538**	-0.509**	-0.146	0.295	0.109	-0.052	-0.158	0.171	-0.219
F/S																1,00	-0.541**	-0.297	0.007	0.332	-0.308	-0.087	-0.017	0.006
SN																	1,00	0.801**	0.199	-0.139	-0.081	-0.187	0.174	0.263
SW																		1,00	0.619**	0.007	-0.178	-0.415**	0.401*	0.162
SL																			1,00	-0.046	0.167	-0.347*	0.375*	0.182
SWI																				1,00	-0.362*	-0.416**	0.396*	0.012
TSS																					1,00	0.137	-0.073	-0.309
Ph																						1,00	-0.933**	0.032
TA																							1,00	-0.130
LA																								1,00

*, **: significant at 0.05 and 0.01 probability

Table 2. Direct and Indirect Effects of Leaf Area on Some Fruit Characteristics

	DE	INDIRECT EFFECT																						
		CW	FNC	LW	LL	LSL	LST	CL	FW	FS	FSL	FST	FV	CBW	CBD	F/S	SN	SW	SL	SWI	TSS	pH	TA	LAS
CW	31.48	-	21.10	0.63	0.62	0.26	0.29	2.76	8.17	3.51	0.09	4.13	4.31	5.20	0.15	0.44	7.49	0.72	0.92	0.54	0.64	0.41	5.37	0.64
FNC	26.89	13.11	-	1.00	0.72	0.89	2.91	2.47	8.99	4.40	0.02	0.44	4.82	7.80	0.69	3.18	0.28	0.44	9.72	0.16	0.68	0.98	6.53	2.78
LW	4.14	3.33	8.39	-	3.67	0.83	6.43	1.39	5.58	3.58	0.06	5.56	3.91	13.72	1.65	4.05	4.28	0.06	1.80	1.59	0.53	1.62	15.84	7.81
LL	4.07	3.42	6.34	3.85	-	1.01	5.44	0.97	4.90	3.27	0.01	5.56	3.74	14.95	1.73	4.40	5.10	0.16	1.76	1.18	1.15	2.02	20.82	4.03
LSL	1.73	2.98	16.12	1.80	2.07	-	4.17	0.48	9.82	5.43	0.01	0.79	6.28	14.58	1.13	4.53	3.59	0.33	11.68	0.92	0.00	0.34	5.87	5.24
LST	11.13	0.87	13.91	3.65	2.95	1.10	-	1.29	8.80	5.01	0.17	1.50	5.03	8.92	3.15	5.81	8.00	0.12	9.11	2.26	0.74	0.02	1.09	5.26
CL	9.86	13.39	19.27	1.29	0.86	0.20	2.11	-	2.09	1.56	0.49	7.86	1.33	3.00	0.13	2.30	0.85	0.43	8.92	2.15	1.89	1.30	12.50	6.10
FW	15.50	5.69	10.07	0.74	0.62	0.60	2.06	0.30	-	7.30	0.06	2.78	8.34	11.14	0.76	4.38	4.10	0.98	10.20	0.69	2.44	1.02	7.64	2.49
FS	7.61	5.11	10.31	1.00	0.87	0.70	2.46	0.56	15.26	-	0.05	2.90	8.41	11.96	0.97	4.67	2.49	0.92	11.22	0.87	2.21	0.88	7.21	1.34
FSL	1.23	6.57	3.21	0.86	0.18	0.06	4.02	6.81	6.31	2.52	-	8.44	3.65	10.09	0.03	6.85	0.98	0.27	13.47	3.27	5.45	0.01	7.83	8.05
FST	16.61	6.60	1.14	1.70	1.62	0.11	0.80	2.59	6.37	3.18	0.20	-	3.11	1.62	0.89	3.76	0.35	0.40	2.73	3.37	8.31	2.77	27.33	4.33
FV	8.57	5.58	10.06	0.97	0.88	0.72	2.19	0.35	15.53	7.48	0.07	2.52	-	12.44	0.79	4.71	3.49	0.94	10.24	0.68	2.70	0.76	5.45	2.76
CBW	21.57	4.23	1.20	2.13	2.22	1.05	2.44	0.50	13.00	6.67	0.12	0.82	7.80	-	0.45	3.40	5.31	0.96	7.70	0.22	2.91	0.33	4.27	1.62
CBD	4.26	1.15	8.58	2.43	2.43	0.77	8.16	0.22	8.42	5.13	0.00	4.28	4.73	4.30	-	8.16	12.40	0.38	8.41	0.77	0.84	0.74	7.37	5.97
F/S	14.51	0.91	10.56	1.60	1.65	0.83	4.03	0.98	12.98	6.62	0.21	4.86	7.50	8.63	2.19	-	12.60	0.75	0.17	2.25	4.81	0.39	0.70	0.15
SN	24.19	10.00	0.60	1.09	1.24	0.42	3.59	0.23	7.87	2.28	0.01	0.29	3.60	8.72	2.15	8.15	-	2.10	5.63	0.98	1.31	0.87	7.45	7.11
SW	1.83	6.24	6.18	0.11	0.26	0.25	0.37	0.77	12.06	5.46	0.03	2.18	6.24	10.16	0.43	3.13	13.53	-	12.23	0.03	2.017	1.35	11.99	3.05
SL	20.85	0.78	13.15	0.29	0.27	0.87	2.58	1.54	12.31	6.48	0.16	1.44	6.64	7.97	0.92	0.07	3.55	1.19	-	0.23	1.99	1.19	11.81	3.63
SWI	9.37	3.34	1.63	1.86	1.31	0.49	4.63	2.69	6.08	3.65	0.29	12.82	3.23	1.67	0.61	6.65	4.47	0.02	1.71	-	7.81	2.58	22.54	0.43
TSS	20.29	1.59	2.74	0.25	0.52	0.00	0.62	0.96	8.70	3.77	0.20	12.91	5.17	8.89	0.27	5.79	2.43	0.58	5.89	3.19	-	0.80	3.88	10.46
Ph	3.83	2.36	8.95	1.76	2.09	0.17	0.04	1.52	8.30	3.45	0.00	9.82	3.35	2.30	0.54	1.07	3.70	0.89	8.05	2.40	1.82	-	32.76	0.70
TA	34.67	3.28	6.42	1.86	2.32	0.31	0.22	0.31	6.71	3.02	0.07	10.45	2.57	3.21	0.58	0.20	3.41	0.58	8.58	2.26	0.95	3.53	-	2.84
LAS	34.93	0.99	6.89	2.30	1.13	0.71	2.73	1.93	5.52	1.42	0.18	4.17	3.28	3.07	1.19	0.11	8.20	0.54	6.64	0.10	6.48	0.19	7.17	-

In conclusion, leaf area in evergreen loquats affects important characteristics such as leaf ash, titratable acidity, cluster weight. On the other hand, as a result of analyses, important relationship is determined between fruit weight and fruit size, cluster weight and other characteristics. We could say that these results can offer an insight to the future improvement researches in regard to Loquat in the Black Sea.

REFERENCES

[1] Karadeniz, T., 2005. Yeni Meyve Türleri, Ordu Üniv. Zir. Fak. Ders Notu

[2]Ersoy, N., Kaynak, L., 2006. Yenidünya(Eriobotrya japonica Lindl.) Yapraklarında Farklı Fizyolojik Dönemlerde Belirlenen İçsel Zeatin Düzeyleri, Süleyman Demirel Üniversitesi Ziraat Fakültesi Dergisi 1(2):71-76

[3]Bostan, S. Z., 1994. Bazı Kayısı (*Prunus armeniaca* L.) Çeşitlerinde Önemli Bazı Meyve ve Yaprak Özellikleri Arasındaki İlişkiler. YYÜZF Dergisi, 4: 55-66.


EX·TERRA·AVRVM

Scientific Papers, Series B, Horticulture, Vol. LVI, 2012
CD-ROM ISSN 2285-5661, ISSN-L 2285-5653

LOQUAT AS A SOURCE OF NECTAR AND POLLEN IN THE WİNTER FOR BEEKEEPİNG

Turan KARADENİZ, Mehtap ŞENYURT, Tuba BAK

Ordu University- Faculty of Agriculture, Department of Horticulture, 52100 Ordu-Turkey

Corresponding autor email: turankaradeniz@hotmail.com

Abstract

Honeybees (Apis mellifera) are important pollinators of fruit species, and are considered an indispensable element of agriculture. Loquat (Eriobotrya japonica Lindl.) which blossom in winter and whose bloom period lasts at least 2 months, was evaluated as an important source of pollen nectar in beekeeping. Pollen length is between 1.290-1.799 mm (average 1.517mm) and pollen width is between 0.925-1.267 mm (average 1.116). Loquat flowers contain a large amount of nectar and has a prominent fragrance. Since there are no other flowers in the environment in winter months, bees should benefit from loquat nectar and pollens in this period.

Key words: Loquat, *Eriobotrya japonica*, pollination, pollen, nectar

INTRODUCTION

80% of the flowery plants on the earth is dusted by the insects and 85% of them are on the list of honeybees. A honey potential list has been prepared to detect the honey productivity of honeyed plants. This list is used in most of the countries worldwide. Honey productivity at the lowest capacity is evaluated as first class, and honey capacity at highest level is evaluated as the sixth class (Anonymous, 2010c). When the values such as water, soil, heath that affect the honey productivity are assumed at the highest level, on a land of one hectare (10 000 m^2), it is assumed that there is same honeyed plant as closure and the total nectar productivity of this land is evaluated. According to this evaluation, Loquat is in the group of plants with third class honey potential with 51-100 kg/hectare. However, according to blooming time, loquat takes place in the group of
"The plants that release nectar, sectarianize, pollinate in late autumn and winter" [3].
Loquat is grown as cultivated plan at coastal departments. It is important because, it blossoms in winter, has high pollen productivity and lots of blossoms. The loquat begins to come into flower in the end of October. Blooming can continue in December, January even in February. The flowers are 10-17 cm and like woody panicles. They are yellow and beige. Cultivation area is at the height of 0-400 m and coastline [3].
The most convenient climate for the cultivation of Loquat is hot mild climate where the temperature is not below the freezing point. At -3°C flowers and fruits get harmed. In April and May when the fruits start to mature, the early start of summer heats and rise of the temperature over 30°C cause sunburns on the fruits. Violent wind and pollination affects fertilization negatively and reduce productivity.
Loquat starts to yield fruit 2-3 years after vaccination. At the age of 10-12 they come to the level of economic yield. Their most productive terms are the first 23-25 years. The recommended plantation ranges for Japanese plums are 7x7 and 8x8 meters. The possible cultivation areas and bee colony conditions of these areas are given in the Table 1.

Table 1. The number of bee colony in the areas convenient for the cultivation of Loquat and honey production amount (Resource: http://www.aricilik.gov.tr) .

Regions	Colony Number (number)	Honey Production (Tones)
Black Sea	1.102.813	20.247
Aegean	995.155	9.200
Mediterranean	762.313	13.346
Marmara	460.387	6.639
Southeastern Anatolia	265.127	4.740
Turkey	4.888.961	81.364

Black Sea region plays an important role in Turkey's apiculture. Ordu in Black Sea Region, has the biggest bee colony. In Ordu, the total number of beehives is 323.901, honey production amount is 9.203,19 tones; the total number of beehives of Turkey is 4.888.961 and the honey production amount is 81.364,09 [1].

MATERIALS AND METHODS

The material of the workshop consists of the flowers from a kind of loquat on the 25 January 2010. Pollens have been received from the flowers and illustrated by photomicroscope and their breadths and heights have been measured.

RESULTS AND DISCUSSION

The aim of the fruit cultivation is to achieve abundant and qualified products. An important method for this is the realization of pollination and fertilization in a health way. Honey bees have an important role in the pollination of fruit species (*Apis mellifera* L.). Honey bees should be accepted as an inevitable element of agriculture and used in an effective manner. The Japanese plums (*Eriobotrya japonica* Lindl) that come into flower and the blooming period of which lasts 2 months, are accepted as an important pollen and nectar source for apiculture (Photo 1). It has been seen that in the flowers of Japanese plums have dense nectar and nice scent. It has been notified that in İzmir bees carry white pollens to their beehives in December and the source of the pollens have been loquat trees [1]. The more the bees contribute to the pollination of the product, the more mature and abundant the products are. Furthermore, honey that they produce is more essential than the other products. The contribution of bees to the agriculture economy is approximately 15-20 billion dollars for the USA.

Photo 1. Honeybee picking pollen and nectar from the loquat flowers

Bees perch on approximately 120 thousand flowers to produce 1 gram honey. 450 grams honey is accumulated with 17 thousand bees flying on 120 thousand flowers. A bee contributes to the honey com bone twelfth of a tea spoon during life time. The Anatolian people have a 3 thousand years of apiculture history. When honeybee is aforesaid, firstly honey comes into minds, but honey is not the only duty of honey bees, they also ensure the fertilization and production of the flower from which they pick nectar and pollen.

In the measurements of 10 pollen from the loquat plant trees that are grown in Ordu, it has been observed that: the height of pollen is between 1.299-1.799 mm; the breadth of pollen is between 0.925- 1.267 mm; the

average pollen height is 1.517 mm, pollen breadth 1.116 mm (Photo 2,3). It has been observed that loquat flowers have dense nectar and nice scent. The flowers are yellow and beige. Bees like that scent. A honeybee flies on approximately 1.500 flowers and fill its stomach and honey sac by picking nectar amounting half of its own weight. Female worker bees can fly away as far as 3.5 km from the nest. It means more than a 4.000 hectares field scanning around the colony.

Photo 2. The appearance of anther in the loquat flower.

In one loquat flower, it has been observed that there is 139.105 no/flowers, in one anther there is 6.014 no/anther and 0.0104 mg/anther pollen [6]. Besides nectarous, the amount and quality of the pollen produced are the most important ones. Because, the existence and abundance of the pollen ensure the pollination and pollen at high amounts have important roles such as ensuring pollination and attracting the insects, especially the honey bees. Honey bees contribute to pollination and on the other hand, they benefit form the pollen of the plants as a food source and they prefer high quality and abundant pollen for the land choice [5]. The main factor that reveals the nutritional value of the plants in terms of apiculture, nectar and pollen quality of the plants (Photo 4) that the honey bees benefit as a food source and the determination of these materials as weight per flower. Today, there are lots of methods to determine the amount of pollen of the plants [8-4-7]. It has been determined that in Japanese plum, pollen amount for per flower is 0. 2413 mg, for per anther is 0.0104 [7].

Photo 3. Breadth view of anther in the loquat flower.

While honey bees meet their pollen and nectar needs from the plants around, they also contribute to the growth of the plants, development of agricultural products, and the efficiency of feed crops as much as water and fertilizer. Because, when the loquat is considered, in the trees that aren't fertilized with bees, 4% of flowers fructify; but the flowers that are fertilized with bees fructify at the rate of 83 %. It has been observed that when trefoil, a feed crop is concerned, in the land that isn't fertilized with bees, 1-2 % of the land sets seed; but, in the land that is fertilized with bees this proportion is 53 % [2]). Albert Einstein knew the pollination ability of the bees and to emphasize the importance of bees for the agricultural products, he said that when the bees died the human beings would also die of hunger.

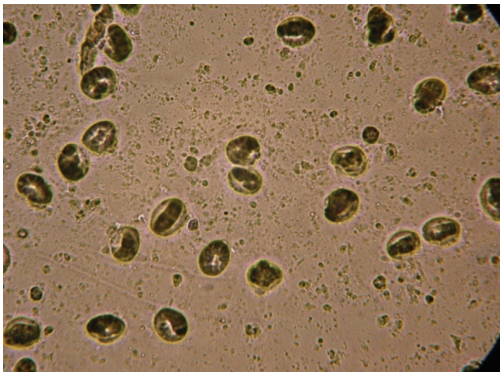


Photo 4. The view of the pollens in the loquat flower

The Loquat is an important fruit species for bees, because they can benefit form it as nectar and pollen source. This plant can be cultivated easily in the coastal strip of Turkey. The beekeepers carry their bees in summer to the Central and East Anatolia region so that they gain pollen and nectar; but they stay in shorelines in winter. It will be an important development in terms of apiculture that the Loquat will be acknowledged as an important plant among the plant species that are established under the name of honey and nectar forests. It goes without saying that most of 120 thousand plants in Turkey is nectar and pollen plant and thanks to this advantage Turkey can fulfill the EU communities' honey gap with honey import at an amount of 225 thousand tones.

REFERENCES

[1] Anonim, 2010a.www.aricilik.gen.tr
[2] Anonim, 2010b.www.inciari.com
[3] Anonim, 2010c.www.agaclar.net
[4] Eti, S., 1990. Çiçek Tozu Miktarını Belirlemede Kullanılan Pratik Bir Yöntem.Çukurova Üniversitesi Ziraat Fakültesi Dergisi, 5(4):49-58.
[5] Free, J. B., 1992. Insect Pollination of Crops. Academic Press Harcourt Brace. Jovanovich Publishers.
[6] Keleş, D., A.Korkmaz, S.Eti, 2002. Kayısı (*Prunus Armeniaca* L.) Ve Yenidünya (*Eriobotrya Japonica* Lindl.) Çiçeklerinde Üretilen Polen Miktarının Ağırlık Olarak Saptanması Alatarım,Cilt : 1,Sayı : 2: 31-35
[7] Korkmaz, A., D. Keleş ve S. Eti, 2003. Polen Sayımlarının Değerlendirilmesi İçin Basic Dilinde Bir Program. Alatarım 2003, 2 (1): 26-32.
[8] Roubik, D. W., 1995. Pollination of Cultivated Plants in The Tropics. FAO Agricultural Services Bulletin. No:118. Rome. p 196.

Scientific Papers, Series B, Horticulture, Vol. LVI, 2012
CD-ROM ISSN 2285-5661, ISSN-L 2285-5653

RESEARCHES REGARDING THE PRODUCTIVE AND ORNAMENTAL CHARACTERISTICS OF VEGETABLE GROWING IN UTILITARIAN GARDENS

Cosmin MIHAI, Gheorghiţa HOZA

University of Agronomic Sciences and Veterinary Medicine of Bucharest, 59, Marasti Street, 011464, Bucharest, Romania, tel.: 0213182564, fax: 0213182888, mcosminalexandru@yahoo.com, hozagh@yahoo.com

Corresponding autor email: hozagh@yahoo.com

Abstract
The purpose of this study is to highlight the productive and ornamental value of vegetable growing in order to create a utilitarian and decorative garden. Numerous plants were studied, which have been chosen considering the family need for daily food and the consumption of various fresh vegetables during one year time. The vegetable species have been placed on the field appropriate for this study, in regulate geometrical forms (square, quadrangle, rhombus, etc.), surrounded by alleys covered with turf aimed for circulation, on agro textile sheets. The sequence of cultures has been made according to the technical culture rotation rules, considering also the complete field occupation from spring to fall. The plants used have been the following: pea, radish, onion, garlic, tomato, lettuce, pepper, cucumber, etc. All species registered satisfactory productive results and due to the fact that along the year, depending on the species and period of time chosen, the plants proved ornamental value, this method of production gains popularity in the present family gardens.

Key words: *garden utilitarian, ornamental characteristics, vegetable growing*

INTRODUCTION

The gardens from individual homes represent a special category of landscape design on small areas, from 40-50 square meters until 400 – 600 square meters, being similar to closed spaces, limited by the surroundings.
The garden can be located differently related to the position of the building, in front or in the back of the house. The front gardens, when they have small or visually penetrable fences, can contribute to the urban aesthetics. Most of the time, these gardens represents narrow strips, which is why small ornamental plants are generally used, together with one or more vertical elements which do not disturb through excessive shadows or over development (Iliescu, 2008).
Often, the back gardens provide intimacy and protection against prying eyes. They serve as a resting place, where one can manifest his passion for gardening depending on the size and wishes of the beneficiary, the garden can include a platform for garden furniture that can be shady due to a pergola, turf, flowers, ornamental shrubs, a swimming pool, small parcels for cultivating different culture plants, some household amenities (warehouse, small greenhouses, yard, dog house etc., photo 1, 2) and others (R. Bird, 2008).

Photo 1. „Vegetable garden surrounded by walls” (Richard Bird)

The general arrangement of the individual garden can be free style or geometric, asymmetric, although symmetry is sometimes chosen in case of front garden, when the entrance into the building is centrally located.

One example of a utilitarian garden is the garden from the Villandry Castel from 1536, which has been appreciated since Renaissance (photo 3). Between the vegetable garden and church, the garden of spices can be found, which complies with the arrangement from the Middle Eve.

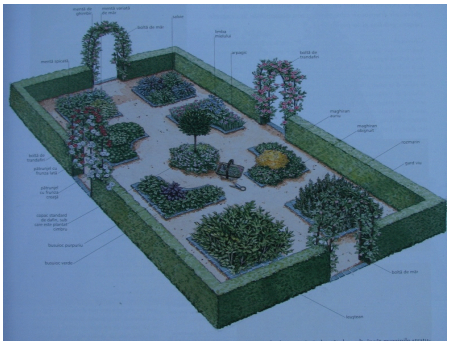


Photo 2. „Formal greens garden" (Richard Bird)

This is where aromatic, medicinal plants and other herbs are cultivated and further used in cooking. The garden contains approximately 30 plant varieties that were considered to be essential for a family during the period when the castle was built.

The vegetable garden is divided into nine rectangular areas, with equal sides, but which have different geometric shapes. These shapes contain different vegetable plants that create a chromatic contrast (blue leek, ornamental red cabbage, green carrot leaves) and leave the impression of a colorful game board.

Photo 3. Vegetable garden - Villandy Castle (www.gradinamea.ro)

The vegetable garden was created in the Middle Eve, being taken care of by the monks from the nearby monastery. Later on, the pragmatic Dr. Carvallo recreated the vegetable garden during the Second World War, by adding a number of 2.500.000 plants that nowadays have only an ornamental purpose. The garden used to contain only 40 species of cultivated vegetables. Numerous intersections from the garden remind us of the original monastery gardens. The monks were also the one to plant regular roses in order to embellish the gardens; according to the tradition, the roses were symmetrically planted.

The vegetable species are also used for their remarkable role in ensuring the décor in case of landscape of utilitarian gardens, during different periods of the year (Hoza, 2008). The elements through which these horticultural species manifest their ornamental characteristics are: the plant itself, degree of ramification, color of leaves, color of flowers and color of fruits.

The horticultural plants are characterized through different shapes, as follows:

- Bush: pepper, eggplant, some varieties of squash, dwarf bean, sage, rosemary, etc.
- Leaf rosette: lettuce, spinach, onion and garlic, carrot, dill, parsnips, parsley, celery, cabbage, red cabbage, cauliflower, broccoli, sorrel, patience etc.
- With one strain: tomatoes, cucumber, loofah, winter squash etc.
- Lianas: loofah, spiky cucumber, bitter cucumber, pumpkin, some varieties of squash, climbing bean etc.
- Crawler: pumpkin, squash, cucumber, sweet potato, winter squash etc.

The ramification degree is a species character and differs from one species to another. The vegetables like some species of cucurbitaceous (spiky and bitter cucumber, winter squashes) naturally form a large number of shoots, which allows using them for creating "green walls", with a reduced manual labor effort.

The color of the leaves is an element present during the entire year, with maximum effects during certain time periods, depending on the species. During spring time, the green color of the leaves awakes the nature and has a good disposition effect.

Thus, there are varieties of lettuce with different colors, as follows: yellowish green,

shiny dark green, purple red, with different intensity.
The sweet potato has leaves colored in dark green, light green and ruby red, which can be used either separately or grouped directly in the garden or in flower pots.
The mangold, through the different colors of the leaf petiole (while, ruby red, orange), is an extremely decorative plants, allowing to the associated with other vegetable plants or flowers from the summer decor.
The aspect of the leaf is very important, being the most exposed element for some species. Thus, the lettuce can have whole leaves or curled, wrinkled or oak shaped leaves, depending on the species. A simple association of the varieties with different aspect and differently colored leaves can ensure a pleasant décor. Moreover, Savoy has embossed leaves, associated with a very intense green color; the leaf cabbage has wrinkled light green leaves, covered in wax, which can found in the upper part of the plant, ensuring a palm tree aspect. The leaves that have many sections, such as the leaves from carrots, parsley, celery, are pleasant for the view, especially if they are associated with the shine found at parsley, celery etc.
The color of the flowers is a very important aesthetic element for some vegetable species. The beauty of the leaves is much more obvious for some species of onion, which have purple leaves, such as: chives – blooms in April and lasts for a month-a month and a half; winter onion – has cream-colored inflorescences on a background of shiny green leaves; rhubarb – inflorescences that at the beginning have a light greenish-red tone, but later become white. Furthermore, the very vigorous inflorescences that form from a big leaf rosette give a feeling of greatness and dominance in the garden. Later on, white leaves begin to form for peppers, yellow for tomatoes, loofah, cucumbers and pate, purple for eggplants, artichokes, and cardoons etc.
The color of the fruits represents an important ornamental element during the maturation period. For this purpose, we remember the tomatoes with small or big fruit (different tones of red, yellow, orange, spotted, white etc.), peppers (red, yellow, purple, black and green) and eggplants (green, white, purple).

MATERIAL AND METHOD

The experiment was conducted in Ilfov County, Dridu common, Sitaru village, north-east from Bucharest. The experiment represented the design of an ornamental and utilitarian vegetable garden in order to highlight the remarkable ornamental role of vegetables and to create a balance between the aesthetic and practical functions. The area of the experiment was 74,58 useful square meters (approximately for 2 persons), plus 46,42 square meters of grassed alleys. The style chosen for the design of the garden was a formal style, geometric, which allows the rotation of culture and the maintenance of plants (support, irrigation by dripping etc.).
The sketch of the garden is similar to a square with a 11 cm side (figure 1), inside which the following are found: 2 trapezes with concave top, 4 rectangular triangles with concave top, o rectangular strip which surrounds the garden, one circle in the middle of the garden and rectangular alleys that limit the previously mentioned shapes.
The structure of the culture was established in order to satisfy the needs of a family, wand the rotation of the cultures was established for four years.

RESULTS AND DISCUSSIONS

The ornamental and utilitarian vegetable garden with two previous cultures and one main culture created a balance between the aesthetic and practical functions of the plants, after corresponding design and maintenance works were applied. The plans for the garden, both for the previous and main culture, can be seen in photo 4.

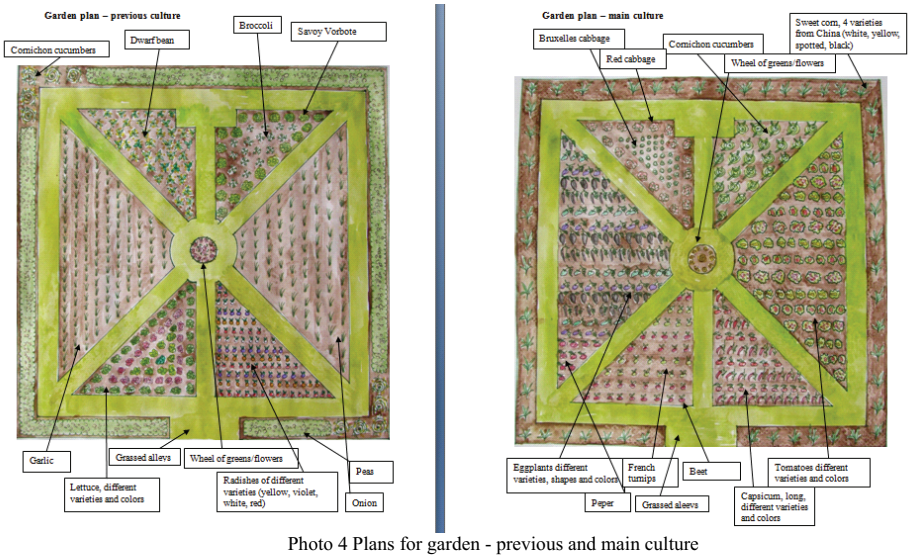


Photo 4 Plans for garden - previous and main culture

In what concerns the production for the cultivated species, varieties and hybrids, it is considered to be good and very good, except for some species and varieties (Table 1, 2).

Table 1 Production from the previous culture

Species	Variety	Production/plant(kg)	Production per sm(kg)	Average weight (g)
Lactuca sativa	Lollo rosa	0.440	2.80	440
	Lollo bionda	0.290	1.80	290
	Smile	0.480	3.12	480
	Great Lakes 118	0.550	3.57	550
Raphanus sativus conv. sativus	Viola	0.022	1.76	22
	Reisenbutter	0.025	2.00	25
	French Breakfast 3	0.027	2.16	27
	Zalta	0.022	1.76	22
	Icicle	0.029	2.32	29
Allium cepa	local variety	0.055	5,50	55
Brassica oleracea convar. botrytis var. italica	Calabrese Natalino	0.100	0.040	100
Brasica oleracea convar. capitata var. sabauda	Vorbote 3	1.100	4.40	1100
Phaseolus vulgaris convar. nanus	local variety	0.025	3.33	5
Allium sativum, ssp. vulgare	local variety	0.018	1.25	18
Pisum sativum ssp.sativum	local variety	0.020	1.00	4
Cucumis sativus	Libelle F1	0.400	1.60	60

Table 2 Production from the main culture

Species	Variety	Production/plant(kg)	Productiom per sm (kg)	Average weight (g)
Beta vulgaris var. conditiva	Detroit 2	0.200	1.80	200
Brassica oleracea conv. gongylodes	Gigant	0.600	2.10	600
Capsicum annuum	California Wander	0.500	1.75	150
	Opal	0.950	3.33	180
	Cosmin	1.080	3.79	165
	Cornel	0.140	0.49	90
Cucumis sativus	Libelle F1	-	-	-
Brassica oleracea var. capitata f. rubra	Red Amager	0.526	1.84	526
Brassica oleracea var. gemmifera	Long Island	0.270	0.81	15
Solanum melongena	*China* (black ovals)	0.366	1.46	300
	China (long)	0.490	1.96	270
	China (green ovals)	0.465	1.86	340
	Rodica	0.805	3.22	390
Zea mays convar. saccharata	*China* (white)	-	-	-
	China (black)	-	-	-
	China (spotted)	-	-	-
	China (yellow)	-	-	-
Lycopersicon esculentum	Buzău 1600	1.060	4.24	75
	Yellow prunis (local variety)	1.916	7,66	25
	China (yellow)	1.142	4.57	80
	Cherry	0.916	3.66	22

Photo 5 Tomatoes fructification

Photo 6 – Three lettuce varieties

Photo 7. Tomatoes and yellow pepper

Photo 8 Rouge pepper

Photo 9 General review

Photo 10 Onion and lettuce

CONCLUSIONS

The studied species, varieties and hybrids of vegetables, through the remarkable colors of the leaves, their shapes, habitus and fruits (photo), ensured an extraordinary decor within the garden, for a long period of time from spring to late autumn (cabbage varieties), which demonstrates that vegetables can be used in landscape design.

Planting the vegetable species in different parcels, according to the botanical families, based on culture rotation, allowed the creation of centers of interest within the garden, for a long period of time within the year, due to seasonal successions and longevity of the morphological characteristics.

The formal style, with geometric shapes, allowed the installation of an efficient irrigation system and also enhanced the rotation of the cultures.

The grassed alleys or access paths represent "natural reserves" for local edaphic flora and fauna, which, through migration, contribute permanently to the rehabilitation of the underground balance from the cultivated area. Thus, this is a method to help restore the natural soil fertility within the garden.

The cultivated vegetable species reached their ornamental and productive potential and are recommended to be used in landscape design for utilitarian and ornamental vegetable gardens, because these gardens represent a mix between their aesthetic and practica functions.

REFERENCES

[1] Ana-Felicia Iliescu, 2008. *Arhitectură peisageră.* Editura Ceres, Bucureşti. Pag. 68-79.

[2] Hoza Gheorghiţa, 2008. *Legumicultură generală.* Editura Elisavaros, Bucureşti. Pag. 7-42.

[3] Richard Bird, 2008. *Cultivarea fructelor şi legumelor.* Editura Aquila ’93, pag. 12-19.

*** 2008. *Amenajarea grădinii*. Editura Aquila’93, Oradea.

ORNAMENTAL PLANTS, DESIGN AND LANDSCAPE ARCHITECTURE


EX·TERRA·AVRVM

Scientific Papers, Series B, Horticulture, Vol. LVI, 2012
CD-ROM ISSN 2285-5661, ISSN-L 2285-5653

UPDATES BROUGHT BY THE NEW LAW REGARDING THE REGULATION AND MANAGEMENT OF GREEN SPACES IN BUILT-UP AREAS

Valentina CHIPER (MIHALCEA)[1], Alexandru-Marian CHIPER[2] & Sorin-Mihai CÎMPEANU[2]

[1]University of Craiova, Faculty of Law and Administrative Sciences, 13 A.I. Cuza Street, Craiova 200585, Romania, Phone: +40.724.622.142, Fax: +40.251.411.688, av_mihalcea@yahoo.com
[2]University of Agronomic Science and Veterinary Medicine in Bucharest, Faculty of Land Reclamation and Environmental Engineering, 59 Marasti Bulevardul, Bucharest 011464, Romania, Phone: +40.723.283.141, Fax: +40.21.318.28.88, alexchiper@yahoo.de, mscimpeanu@yahoo.fr

Corresponding author email: av_mihalcea@yahoo.com

Abstract

Law no. 47 of 19 March 2012 amending and supplementing Law no. 24/2007 regarding the regulation and management of green spaces in built-up areas, published in Official Journal no. 185 of 22 March 2012, aims mainly to introduce new categories of land among the green fields, such as nurseries and greenhouses, ensuring a minimum of 20 square meters of green space per inhabitant, prohibiting the change of destination, the reduction of surface or relocation of green areas and increases the amount of fines and their calculation on square meter of affected green areas. The legal obligations related to the protection and conservation of green areas has widened also for legal entities, which prior to these changes were not a subject to the fundamental regulation and obligations, "expresis verbis", such as the obligation not to charge with construction, not to cut in an unauthorized way, or not to throw any waste on green territories. By including the nurseries and greenhouses in the category of green spaces, the lawmaker hopes to stop the real-estate hunt and housing facilities, for the benefits of a healthy green environment, and not of an environment "made of concrete".

Keywords: *green spaces, minimum of green space per capita, obligations to protect and preserve green spaces*

INTRODUCTION

In the World Conference on the environment in Stockholm, June 5 to 16, 1972, organized by the U.N., the compulsory relation between man, namely the human rights and environmental protection was announced and recognized in principle no. 1: "man has a fundamental right to freedom, equality and satisfactory living conditions in an environment where quality allows him to live in dignity and prosperity" and a "solemn obligation to protect and improve the environment for present and future generations".
With the Treaty of Rome, the Single European Act as of 1986, the environmental protection is subject to Title VII, article 130 R, S, T of the Treaty and the article 130R sets out the objectives of Community environmental policy, namely preserving, protecting and improving the environmental quality.
"The Maastricht Treaty as of February 7, 1992 marks a new stage in the recognition of environmental problems in the primary Community law"[1] the legal framework strengthened by the Treaty of Amsterdam as of October 2, 1997, which also uses the notion of "sustainable development", stating that the development of economic activities must be harmonious, balanced but also sustainable. In this respect, we understand that the sustainable development has the function of link between the environment and the economic objectives adapted to a high level of protection and

improvement of environmental quality according to article 2 of the Treaty.
The international law has developed the concepts of environmental protection, unfortunately, most of the times, many of them answering to the "concepts and principles often related to the search for new international economic orders, focused on development"[2]. The International Court of Justice has considered that the environment is not an abstraction, but "the space where human beings live and which the quality of their lives and health, including the future generations, depend on", a mediator between nature and quality of life [3].
The often used term of sustainable development was established in 1987, in the Brundtland Report of the U.N. World Commission on Environment and Development, named "Our common future", then once with the Declaration of Rio de Janeiro in June 14, 1992, which proclaimed the need to facilitate a development to meet the "needs of the present without compromising the ability of future generations to meet their own needs". In the Community Law, the concept was first regulated by the Treaty of Amsterdam as of October 2, 1997, in paragraph 7.

MATERIAL AND METHOD

The researches were performed using specific methods of the international environmental law and the urban planning law, using comparative analysis, relation to the EU legislation and national legislation of the EU countries. Also, has used specialized research and consulting bibliography, available in the libraries and journals in the field, in relation to the European Treaties and European Directive, which has as objectives the Community environmental policy, namely preserving, protecting and improving the environmental quality. The study was focused on the degree of harmonization of European and national standards, also on the legal effects they are producing.
We followed the interaction between law and related fields of green spaces matter, by statistical analysis of existing green space available per capita in Europe.

RESULTS AND DISCUSSIONS

The criticism for the sustainable development aims at either the incompatibility of the concept of economic development primarily focused on achieving revenue and consumerism with the notion of "sustainable", or the incompatibility of renewable resources with the exploitation of forests, fish and soil, so that the concept of sustainable development remains "an incantatory than programmatic scope"[4] either for the non-reconciliation of development concerns with the environmental protection seen as disinterested protection of species, wildlife, biodiversity with the subordination of the environment to the economic and commercial policies[5]. Thus, the political and ideological implications of the new era of understanding the environment in relation to the present development of mankind are undeniable.
The Green Policy was regarded as being actually the policy closely related to the development of modern cities [6]. Starting with the Green Charter of Berlin in 1874 of the Countess Dohna Poninski, up to the Charter of Athens, the idea of free green spaces - material of urbanism which contributes to human health, has always accompanied the largest urban boulevards. However, with the air pollution, after the World War II, the green spaces have been given new ecological functions, namely biological balance, physical and mental balance of people, physical balance of living organisms and aesthetic, social or cultural functions [7]. At European level, the town planning aimed at developing the green spaces to improve the environmental quality. Thus, the development of green spaces is a major and indispensable chapter in the evolution of urban and rural development, both globally and nationally for Romania, being treated as a long-term national strategy for improving the environmental quality in populated areas.
In the last year’s Romania, by adopting and implementing the European strategies on the Community environmental policies, the national efforts were intensified both administratively and economically [8] and socially regarding the programming, design and green spaces development activities in

cities, both as new sites and rehabilitation and expansion of the existing ones.

I. Law no.47 as of March 19, 2012 for amending and supplementing the Law no.24/2007 on the regulation and management of green spaces inside the built-up areas, published in the Official Gazette no. 185 as of March 22, 2012 fought against pollution which has reached highest alarming rates in urban areas, either due to strong industrialization, or due to traffic, etc. to improve the environment. According to the substantiation note, it is estimated that one of the measures, which can change this situation, is the development of green spaces in urban areas, leading to the compliance with the Directive 2008/50/EC on the ambient air quality, limiting the exposure of citizens to micro-particles known as PM10[9]. The amendments focus primarily on the following issues:

1. Introduction of new categories of land among the green spaces, namely nursery gardens and greenhouses and ensuring a minimum of 20 square meters of green space per capita.

We consider by these new categories of land that it has been mainly aimed to enhance the green spaces in order to meet, for the immediate future, by the local governments, the obligation to provide out of the built-up area a surface of green space more than 26 m^2/ inhabitant, until December 31, 2013, the minimum value accepted in the European Union standards, although the World Health Organization recommends a green area of more than 52 m^2per capita.

European capitals, such as Stockholm and London, have now surfaces of 83 and 64 square meters / capita while in 2007 Bucharest had an area of only 9.08 square meters / capita and, according to the data from the National Environmental Protection Agency, in 2008 it increased to 12.39 square meters / capita [10].

However, by the inclusion in the category of green spaces of nursery gardens and greenhouses, we hope to stop the real estate hunting for the benefit of a healthy green environment and not a concrete environment.

According to French law, in case of cities with a population of at least 20,000 inhabitants, we should find a public green space of at least 500 meters from the inhabitant's home, and the landscaped areas should be at least 1000 square meters. Of the category of public green spaces, the French law provides: neighbourhood squares and spaces, recreation spaces for children, at a distance of 300-500 meters of housing, green spaces such as parks, specialized facilities such as stadiums and sports fields, botanical or zoological gardens, peripheral public green spaces, such as forests, at least 100 ha or private green spaces such as gardens in hospitals, high schools or other public services and family gardens.

Furthermore, article R. 118-7 of the French Code of Planning provides the possibility of authorities issuing building permit to request the development of a green space for play and recreation located close to the construction.

2. Prohibition of use change, reduction of areas or relocation of green spaces. Such modification is an actual statement of the previous regulation in the use change, which is sometimes interpreted as being applied only to the premises with official inventory and not for all categories of land classified as "green spaces" by Law no.24/2007.

However, the extension of the built-up area of cities shall be achieved only under the planning documents which are to provide a minimum of 5% public green spaces and a minimum of 20m^2 green spaces per capita. These rules are applicable for the transformation pf areas with other functions in residential areas and the building on lands with a surface more than 3,000m^2 which are private property.

The Bucharest Court of Appeal, Section VIII Contentious Administrative and Fiscal Matters, decided in October 2011 in the files no. 48436/3/2010 and no. 20095/3/2010 that the "lands developed as green spaces, although not listed as such in the planning documentation, are subject to the interdiction of being built on and changing their destination, according to article 71 of the Government Emergency Ordinance no. 195/2005 on the environmental protection, as amended and supplemented. In this respect the cancellation requests for two planning certificates issued by the Mayor of 1st District of Bucharest were rejected regarding two areas

of the Aviatiei neighbourhood, developed as green spaces between the blocks, but being privately owned. These planning certificates included the note that land is not constructible, although in terms of classification in the planning documentation they were placed in a built-up area" [11].

3. Increasing the fines and their calculation in square meters of affected green space.

Also, in parallel with fines, the measures to return the land to the condition before its occupation with constructions, at the expense of its owners, can also be applied.

4. Extending the legal framework of obligations related to the protection and conservation of green spaces for legal entities, who previous to these changes were not subject to the *expresis verbis* fundamental regulations, such as the obligation of not occupying it with constructions, not cutting without authorization, or not throwing any waste in the green space. The previous obligations for legal entities and individuals were quite elusive and with reference to the areas considered as green spaces, not to all lands in the legal category of green spaces.

II. General characteristics of green spaces.

In literature the green spaces are defined as those areas of land developed in terms of landscape, covered with vegetation and usually referring to parks, public gardens, squares, golf courses, private gardens, botanical gardens, etc. [12].

These areas of land may be made available for both the public use and selectively only for certain types of users, in case of private green spaces, within which one can access only with the consent of the owner.

The public green spaces are built on the principle of their multifunctionality and use diversely for recreational activities, which all citizens present in a certain area can benefit of, residents or visitors in those areas and their use must be open to all persons who wish to enjoy a pleasant environment [13].

Until the mid 20th century, the green spaces showed a predominant aesthetic role, currently earning an important social role "in pursuit of a better moral and physical health" of the citizen, becoming the "city's lung" [14], and an educational and cultural role, by providing opportunities for meeting, communicating and socializing, space for entertainment, artistic events, play and safety.

The need for the protection of green spaces and the extension of their framework envisage, first, the pressure of urbanization, congestion, disordered construction and finally the profit from real estate. It was estimated that the green spaces perform multiple functions such as production (forests, agriculture), natural and human resource preservation, rest, leisure and oxygen to the public[15]. The green spaces, if constructed in the dominant wind axis, can create the ventilation alleys, with micro-climate action. The atmospheric action, which depends on the function of oxygen, is the possibility of having a filter effect of the polluted atmosphere. Studies in Belgium have shown that the complete purification of polluted air of 0.100 mg of SO2 per cubic meter has been obtained, after passing through a hectare of forest, with a wind speed of 25 kilometres per hour [16].

Also, the benefit of green spaces consists of their earth and hydrological action by water filtration. The EC Directive no. 2000/60 as of October 23, 2000 regarding the establishment of a framework for a Community policy in the water domain establishes the water heritage conception presented in the first point of the head note: "Water is not a market product like the others, but a heritage to be protected, defended and treated as such". By the United Nations General Assembly resolution in July 2010 the right to drinking water and sanitation is proclaimed as a fundamental right, essential to full enjoyment of life and exercise of all human rights.

According to a study conducted in 2009 by Fuller and Gaston [17], in 2001 in the urban localities of the European Union there were about 170.6 million people, almost 34% of the Union population and the average area of green space amounted to 18.6% of the urban area. According to the study, worldwide over 50% of the population is grouped in urban areas.

According to the specifications issued by Fuller and Gaston, in Fig. 1, the points, representing cities, are coloured according to the percentage of green space coverage. The

country polygons are coloured according to the provision of green space (m^2) in urban areas, per capita. Countries whose data were not available are coloured in grey.

Nationally, according to the 2009 Statistical Yearbook of Romania[18], in 2008, there were approximately 9.73 m^2 of green space available per capita in localities and the total surface of public green space amounted to 21,124 hectares, with a territorial distribution shown in Fig. 2.

Through the national programs over the last five years, the development of the national green space network infrastructure in cities is encouraged selectively, both quantitatively and qualitatively, being particularly favoured those investments consisting in the creation of new spaces and extensions and then the development of the existing green spaces. In this regard, it aims at increasing the area of green space per capita in the built-up areas and the national target is to exceed 26 m^2 of green space per capita until December 31, 2013.

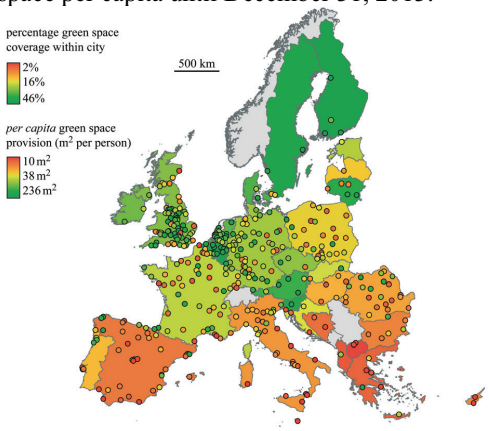


Fig. 1. Coverage of green spaces in urban area in Europe (according to Fuller and Gaston, 2009)

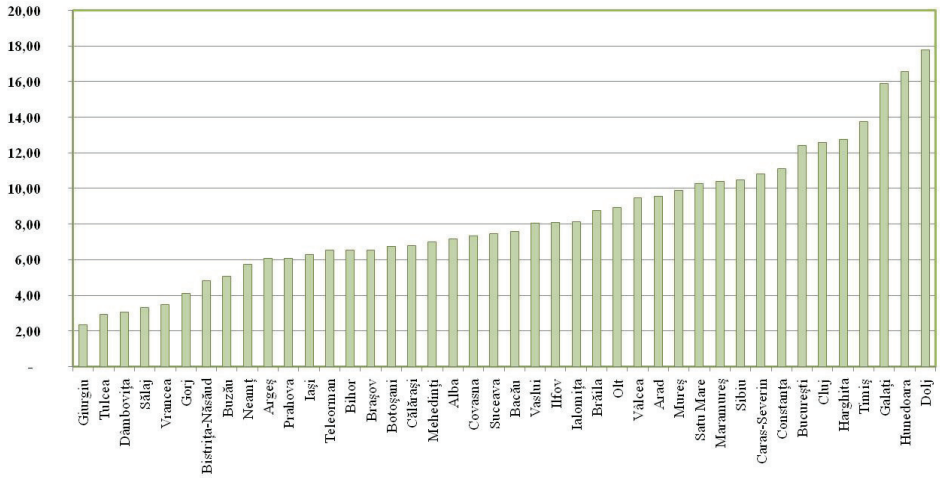


Fig. 2. Availability of green space (m^2/ capita) in the counties of Romania (according to INS)

CONCLUSIONS

Unlike in other European countries, our average area of green space per capita is reduced, far below European standards. The updates brought by the new law no. 47 of 19 March 2012, regarding the regulation and management of green spaces in built-up areas, aims mainly solve the issue through the introduction of new categories of land among the green fields. The prohibition to build and change the destination, propose protecting and guaranteeing the right to a healthy environment, provided by art. 35 of the Constitution so that the limitation of property right is justified by environmental protection, and therefore the existing green space, with a direct link with the public health, "which represents a value of national interest" [19].

It is advisable to perform and standardize national urban planning documentation, being known the discrepancy or even nonexistent the local authorities registers concerning the green spaces with the real situation on the ground, so

that no conflicts exist over the built or unbuilt area framing, existing between records of urban planning certificates and the classification from the urban planning documentation. Would be recommended also to be establishment an implementation system ho verify and monitoring the compliance with legal requirements, more efficiently and periodically, as well as solving the management problems of these areas, and the low degree of accessibility to urban services.

The future urban planning project should include the development of green space area, by regulating the minimum distance between residential areas and green space area.

The development of green spaces must be built on the principle of sustainable and environmentally friendly design of landscape development using the available resources responsibly, with the purpose of improving the surrounding area [20].

ACKNOWLEDGEMENTS

This work was supported by the strategic grant POSDRU/CPP107/DMI1.5/S/78421, Project ID 78421 (2010), co-financed by the European Social Fund – Investing in People, within the Sectoral Operational Programme Human Resources Development 2007 – 2013, University of Craiova, Faculty of Law and Administrative Sciences and POS-DRU/88/1.5/S/52614 grant of the University of Agronomic Science and Veterinary Medicine in Bucharest.

REFERENCES

[1] Van Lang A., 2011. *Droit de l´environnement*, 3-eme edition PUF (Presses Universitaires de France), Paris, p. 30.

[2] Romi R., 2010. *Droit de l´environnement*, 7-eme edition, Montchrestien, Lextenso éditions, Paris, p. 42;

[3]CIJ, 8 iulie 1996, in Philippe Ch.-A. Guillot, 2010- Droit de l´environnement, 2-eme edition, Edit. Ellipses, Paris, p.9.

[4] Kiss A., Beurier J.P., 2004, *Droit international de l´environnement*. Edit. Pédone, 3-eme edition, p. 470.

[5] Cans C., 2003. *Le développement durable en droit intern, aparence du droit et droit des apparences*. AJDA (Actualité juridique droit administratif), p. 201; Pallemaerts M., 1995, La Conférence de Rio, RBDI (, nr. 1, 175, p. 183 and next, Maljean-Dubois S., 2002, Le recours à l´outil économique: un habit neuf pour les politiques environnementales?, în L´outil économique en droit international et européen de l´environnement, La Documentation française, CERIC, p. 9 and next.

[6] Prieur M., 2011. *Droit de l´environnement.* 6-eme edition, edit. Dalloz, Paris, p. 879.

[7] Kiss A., Shelton D., 1995. *Traité de droit européen de l´environnement*. Une publication de la Conférece Permanente des Rectors, présidents et Vice-Chanceliers des Universités Européennes, Éditions Frison-Roche, Paris, p. 495 and next.

[8] Vandermeulen, V., Verspecht, A., Vermeire, B., Van Huylenbroeck, G., Gellynck, X., 2011. *The use of economic valuation to create public support for green infrastructure investments in urban areas*. Landscape and Urban Planning (103), 198– 206.

[9] After Comisia Europeană, 2011. *Mediu: Comisia dă în judecată Belgia la Curtea de Justiţie a UE şi avertizează România în privinţa nerespectării reglementărilor europene referitoare la calitatea aerului*. available on-line at: http://ec.europa.eu/romania/news/ 060411_avertisment_calitatea_aerului_ro.htm;

[10] After: www.mmediu.ro, www.anpm.ro.

[11] After Alexandru Moldoveanu, Director executiv – Direcţia Juridică a Primăriei Sectorului 1 Bucureşt pe sit-ul:. http://www.juridice.ro.

[12]Iliescu A.F., 2005. *Ahitectura peisageră*. Editura Ceres, Bucureşti.

[13] Byrne J.,Sipe N., 2010. *Green and open space planning for urban consolidation – A review of the literature and best practice*. Urban Research Program Issues Paper 11, Griffith University, ISBN 978-1-921291-96-8.

[14] Génin A., Plantiveau P., 1982. *Les services espaces verts des villes et des collectivités locales.* Organisation et réalisations, Ed. J.B.Baillière, Paris, pp. 5-6.

[15] Merlin-Françoise Choay P. , 2000. *Dictionnaire de l´urbanisme et de l´aménagement*. ediţia a 3-a,Ed. Presses Universitaires de France, Paris, pp. 339-340.

[16]*Rapport du Comité Interministériel d´action pour la nature et l´environnement du 20 juillet 1972 et pricipaux règlements*. 1973. Protection et aménagement des espaces verts, Collection Environnement, La Documentation Française, Paris, p. 12.

[17]Fuller R.A, Gaston K.J., 2009. *The scaling of green space coverage in European cities*. Biology Letters, (2009) 5, doi:10.1098/rsbl.2009.0010, Global change biology, 352–355.

[18]Institutul Naţional de Statistică, 2010. *Anuarul Statistic al României 2009*.

[19]Constitutional Court, *Decision no. 824/2008, 1416/2008, 1010/2009, and 136/2010, 1118/2011*.

[20] Calkins M., 2005. *Strategy use and challenges of ecological design in landscape architecture*. Landscape and Urban Planning (73), 29–48.

Scientific Papers, Series B, Horticulture, Vol. LVI, 2012
CD-ROM ISSN 2285-5661, ISSN-L 2285-5653

GREEN ROOFS/ROOF GARDENS. RESEARCH ON ROOF/TERRACE VEGETALIZATION; VEGETALIZATION SYSTEMS

Elisabeta DOBRESCU

University of Agronomic Sciences and Veterinary Medicine Bucharest, 59 Mărăşti, District 1, 011464, Bucharest, Romania, Faculty of Horticulture – Landscape architecture, Biodiversity and Ornamental Horticulture, phone number: +40 (21) 318 22 66, fax: +40 (21) 318 28 88, e-mail: veradobrescu@yahoo.com

Corresponding author email: veradobrescu@yahoo.com

Abstract

The research analyses and studies of the posibility to extend the area of green space in urban areas. According to this analysis, surfaces can become green roofs, designed in various systems of vegetalization, determined by maximum permissible loads on the structure of resistance (intensive systems, extensive or mixed). In the present premises to reach by 2013 a minimum area of 26 sqm / inhabitant, (according to OUG nr. 114/2011), the paper aims to highlight ways in which vegetation surfaces can be on flat or sloping roofs of buildings. Also in the analysis of structures with high we can make a premise of separating the typology of "green roof / green terrace" to the concept of "roof garden".

Key words: *garden, system, roof, terrace, vegetalization.*

INTRODUCTION

Progressive decrease in the surface area covered by urban greenery is likely to make itself a domino effect. Thus less vegetation brings to lower the humidity level and a more difficult recovery of the poor oxygen levels in the air, which leads to progressive reduction of the remaining green areas, which lose their capacity for self-healing and disappear if no steps are taken to maintain and improve them through appropriate maintenance systems.

In the largest urban agglomeration in Romania, Bucharest, there are areas with high levels of pollution that often overlap with densely inhabited areas. Polluted areas are found mainly in pericentral ring of Bucharest but now, it appears that pollution extends outside of the ring. The main factor of air pollution is road traffic, which leads to the discharge into the atmosphere of large quantities of carbon monoxide, nitrogen oxides, lead, oil, dust and so on. Intense car traffic arteries across the city in all directions near the houses, which causes real discomfort to the population. This discomfort will lead in future to a high degree of ill residents of the capital, unless preventive measures are taken.

As in any large European city, increasing the intensity activities led to increased need for space and often this need was satisfied - justified or not - by giving up some green areas, especially through the transformation of entire blocks of houses with ground floor, ground and first floor at the most, with landscaped and maintained gardens, in areas of multi-storey buildings or business buildings, in which building coverage ratio increased significantly at the expense of green surface coefficient.

Maintaining the current situation implies the same high costs of energy used for cooling buildings, more rapid degradation of their roofs, poor soundproofing and reduced protection against electromagnetic radiation and ultraviolet rays.

Also, in terms of climate and environmental protection, it has no contribution to reduce pollution, CO2 consumption, reduce humidity and temperature in the summer time.

Given the proven harmful effects of reduced surface of urban green space, but taking into account the current situation characterized by crowding and vertical development, which make for improper arrangement of green areas at ground level due to lack of space and lack of natural light is considered a worldwide

agreement that one of the solutions without adverse side effects (if properly implemented) is the solution green roofs or roof gardens.
A clear tie has to be done between "green roof" and "roof garden" concepts that often get confused.
A "green roof" is not covered with vegetation covers, "like a garden" [1], as circulated in treaties and projects on vegetalized roof. It's a subset that separates a building at the top and on which is provided, deliberately, by design, small vegetation [2], ranging from herbal plants that require very little culture substrate (3-10 cm.). Unlike green roof or green terrace, roof garden landscape is a more complex structure that integrates environmental functions, relaxation, recreation and short period leisure, sporting functions, games etc. In this case the culture substrate must ensure optimal development of a varied assortment of trees, shrubs, herbaceous plants and flowers (40-120 cm.)
The purpose of this paper is to define and differentiate in terms of scientific and technical concepts related to green roofs / green terraces and roof gardens. Another goal is to identify the different systems applicable to different types of vegetalization structures of existing roofs.

MATERIALS AND METHODS

The research refers to a comparative study between two major types of roofs vegetalization and their association with the terminology of "green roofs / terraces " or the "roof gardens" terminology.

The extensive vegetalization includes:

- Easy-load on structural strength (50-150kg./mp on saturation);
- Landscaping on any roof surface;
- Small and very small thickness of substrate vegetation (3-10 cm.);
- Very low or no-maintenance of all (the free, natural develompment);
- Ecological function of improving the microclimate.

Photo 1. Extensive vegetalization terrace [3]

The intensive vegetalization includes:

- Easy and immediate accessibility for residents and visitors;
- Large-load resistance structure (over 300kg./mp on saturation);
- Landscaping only on roofs that have deliberately set to have a heigh garden or on roofs which after a technical expertise were deemed to have a resistant structure to supports heavy loads.;
- Thick and very thick substrate and (40-120 cm.);
- Complex maintenance (irrigation, fertilization, maintenance);
- Complex functions, ecological and environmental, such as well landscaped gardens or parks on the ground (rest, relaxation, sport, play, promenade, etc.).

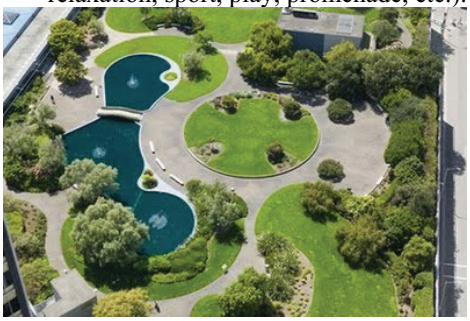


Photo 2. Intensive vegetalization terrace [4]

Scenario I – Vegetalization of roofs in an extensive system is a small investment, with significant benefits in terms of reduced operating costs of buildings, of prolonging their life by additional protection provided, with an important contribution to CO_2 consumption,

reducing pollution, and improve the comfort index of the population.
The minimum value of the investment basis for the green roof where scenarion I is applied varies between 13 and 20 Euro/sqm, depending on the surface to be resolved.
General technical elements required to implement extensive system vegetalization on roofs:

- Minimum resistance structure to support the additional load;
- 2% slope to ensure drainage conditions;
- Performant waterproofing and thermoisolation system;
- Drainage and filtration system;
- Substrate of fertile soil with a small additional charge;
- Balanced distribution of mineral and vegetable loads all over the roof;
- The existence of a landscaping project;
- Choosing an assortment of shallow rooting species (Sedum, Sempervivum, Festuca etc.);
- Dendro-floricultural material selection based on resistance to climatic conditions of the region.

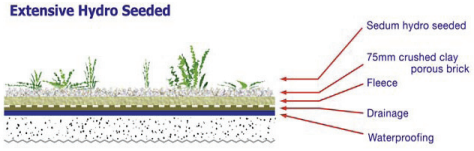


Fig. 1. Section view of an extensive hidro seeded [5]

Scenario II – Vegetalization on roofs in an intensive system is great investment option, obtaining maximum beneficial results both in terms of protection and insulation of buildings, improvement of regional pollution and the microclimate around buildings that the landscape is done.
Scenario II assumes a much thicker and looser layer of soil and may look like any other landscaped garden. The roof requires the same care as an ordinary garden and can only be achieved if the roof has a solid load bearing.
An intensive roof type can be compared to a plain garden or a park with no limit on the type of installed vegetation, including trees and shrubs. Also you can install the rest and promenade areas, sports and play areas, water areas, seating areas, cultural areas, etc.
Compared with extensive roof type, the intensive one needs operating costs considerably increased in addition to a greater investment value. The load bearings on the structures are considerable, and therefore, this type of roofing is suitable for newly constructed buildings, for which different structural elements supporting the roof are sized appropriately, taking into account these additional tasks. Installing an irrigation system is essential for this type of roof.
The minimum value of the investment to achieve green roofs where scenario II is applicable is between 55 and 80 Euro/sqm, depending on the surface to be resolved.
General technical elements needed to implement intensive system vegetalization roofs:

- Strong resistance structure to support the additional load in the garden;
- Minimum 2% slope to ensure drainage conditions;
- Performant waterproofing and thermoisolation system;
- Vapor barrier system and anti-root system;
- Drainage and filtration system;
- Advanced fertirigation system (automated);
- Substrate of fertile soil with a large additional load;
- Balanced distribution of mineral and vegetable loads all over the roof;
- The existence of a landscaping project.
- Ensure balanced proportions between compositional structures of landscaping (trees, shrubs, flowers, lawns, water, movement, light construction);
- Choosing the proper rooting assortment of species, depending on the thickness of the nutrient substrate available;
- Dendro-floricultural material selection, according to the volumetric register, color, seasonal decor, resistance to climatic conditions of the region.

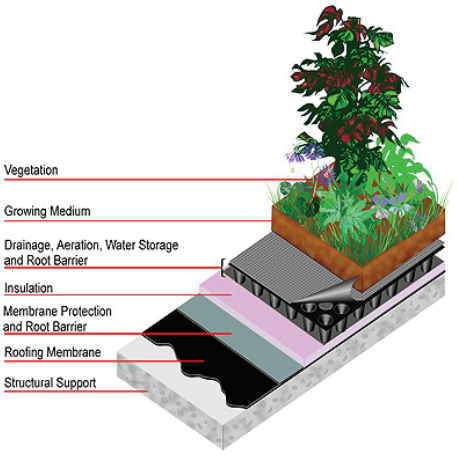


Photo 2. Layeres of an Intensive system [6]

To analyze the largest urban pole of Romania, Bucharest, most multi-floored residential buildings are in the category of old buildings, which were not originally scheduled to have a green roof project. For these types of buildings, considering the resistance structure analysis does not allow heavy loads, we used a multi-criteria analysis:

- Costs of design, weighting factor = 0.05;
- Investment cost, weighting factor = 0.10;
- Maintenance costs, weighting factor = 0.15;
- The duration of the investment, the weighting factor = 0.10;
- Isolation and protection, weighting factor = 0.05;
- Additional tasks in the structure of resistance, weighting factor = 0.15;
- Biodiversity species, weighting factor = 0.05;
- Risk on plantations to be replaced (inverse proportion to biodiversity species) weighting factor = 0.15;
- Quantity of materials needed for installation, weighting factor = 0.10;
- Diversity of functions, the weighting factor = 0.10.

Table 1. Comparative analysis of the to possible scenarios

Nr	CRITERIA	Weight factor	Scenario I		Scenario II	
			Abso-lute	Ponderate	Abso-lute	Ponderate
1	Design costs	0,05	10	0,5	8	0,8
2	Investment costs	0,10	10	2,50	3	0,75
3	Maintenance costs	0,15	10	1,50	6	0,90
4	Duration of the investment	0,10	10	1,00	5	0,50
5	Isolation and protection	0,05	8	0,40	10	0,50
6	Additional loads on the resistance structure	0,15	10	1,50	5	0,75
7	Species biodiversity	0,05	6	0,30	10	0,50
8	Risk regarding the need to replace plantations (inverse proportion to the species biodiversity)	0,15	10	1,50	6	0,90
9	Quantity of materials needed for installation	0,10	1	0,10	6	0,60
10	Function diversity	0,10	1	0,10	10	1
	TOTAL	**1**		**9,4**		**7,2**

As shown, the score obtained for Scenario I (extensive roof type) is more advantageous in relation to the criteria set, obtaining a score of 9.4 points out of a maximum total of 10 points. Scenario II with a score of 7.2 points out of a maximum total of 10 points, although it is less advantageous in terms of diversity functions offer greater advantages for maximum capacity and full use of facilities on the roof.

RESULTS AND DISCUSSIONS

Green roofs or roof gardens are a technology widely used in the fight against increasingly expanding wider urban heat islands. Their purpose is to provide shade roof, and reduce heat from the air through the process of evapotranspiration. These two mechanisms reduce the roof temperature and air nearby. A roof equipped with any type of vegetalization mentioned may have a temperature lower than ambient air, while a classic roof can record higher values up to 30 ˚ C. Roofs in extensive or intensive vegetalization can be installed on many types of buildings such as industrial, educational, commercial centers, office buildings and especially residential ones.
From the comparative study of the two major types of roofs a number of advantages can be drawn, but also accompanied by some disadvantages.

Scenario I has the following advantages:

- Improving the quality of urban life;
- Minimal additional loads on resistance to the existing structure;
- Can be installed on the buildings roof sloping up to 30˚ or more;
- Minimum quantities of materials for installation;
- Low maintenance with minimum prices, or no maintenance;
- Full implementation of the provisions of the legislation in force; [7]
- Small duration of achieving the project.

Disadvantages:

- Not a full appreciacion for the potential of the roof;
- Little isolation and protection of buildings;

Scenario II has the following advantages:

- Increase in the quality of urban life;
- Making the most of the roofs of buildings;
- Isolation and greater protection of buildings;
- Biodiversity plant composition;
- Full implementation of the provisions of the legislation in force; [8]
- Low economic disparities, environmental, and socio-cultural of our country and EU countries;
- Decrease the very large difference in level between urban built area per inhabitant and green area per inhabitant.

Disadvantages:

- Great additional loads to the building structure;
- Much higher investment cost;
- Long realization of project;
- Large amounts of material for installation;
- High costs of maintenance arrangement;
- Only roofs with a small slope degree can be installed.

Currently both the vegetalization scenarios are applied on an increasingly larger scale in the great cities of the world (and not only in cities). In Romania the concept of green roof / green or garden roof terrace is at a pioneering stage, needs of urban comfort enhancement by increasing the area of green space per inhabitant is very high and also even pressing at an European level. Given European policies to satisfy a healthy living environment, especially in urban areas, the largest urban agglomeration in our country, Bucharest, still does not meet the criterion of minimum green area per inhabitant imposed by the European Union (26 m/inhabitant)

Today, according to published statistics of the National Institute of Statistics [9] we have, in Bucharest, a factor of 23.21 sqm / inhabitant. Considering the built area of 159 km^2 recorded in 1992, [10] and assuming that only 5% of this area will be built by systems of roof vegetalization, we could reach a factor of 28 sqm / lociutor. This assumption may create alignment with European standards, which require a minimum of 26 sqm / inhabitant.

This solution expansion in urban green area is feasible and can be applied successfully in all cities deficient in green space. It aims to improve the microclimate around buildings that made the project both in terms of reducing temperature, humidity change during summer and reduce automobile pollution in adjacent areas. Planting on roofs meets the challenge of identifying urban solutions to counteract climate change (exacerbated by urban changes) which already causes increases in average temperatures of 2-4˚C during the summer months[11] in major urban agglomerations.

CONCLUSIONS

Considering the advantages and disadvantages of the two major types of vegetalization - extensive and intensive - we can draw the hypothesis that extensive vegetalization system can be applied to roofs of old buildings expertised to support maximum 250 kg./sqm and intensive system vegetalization can be implemented only on new buildings provided by the project to be vegetalizated, or old ones that after technical expertise are deemed to support loads higher than 300kg./m^2. The term "green roof" or "green terrace" may be associated only with roofs vegetalizated in extensive systems, with ecological and aesthetic functions, and the term "roof garden" can be associated only with intensive vegetalization system, which includes besides

aesthetic and ecological functions the ambient and relaxing ones.

REFERENCES

[1] S.C. Blizzart Design S.R.L., 2011, Studiu de fezabilitate aferent obiectivului "Acoperisuri verzi", proiect nr. 1187, p. 6, Bucuresti.

[2] UAUIM Bucuresti in colaborare cu INCERC Bucuresti, 2010, Proiectarea si excutia acoperisurilor verzi la cladiri noi si existente, p. 2, nr. UAUIM-CCPEC 24/2009, redactare 1, Bucuresti.

[3] N. Gromicko, E. London, Green Roof Inspection, http://www.nachi.org/green-roof-inspection.htm.

[4] Kaiser Roof Garden, Lake Merritt area, 300 Lakeside Drive, http://www.kaisergarden.com/.

[5] Livingroofs.org & Ecology Consultancy Ltd, 2004, GREEN ROOFS Benefits and cost implications, p. 9, London.

[6] Vicky Hes, 2009, Green Roof Design and Function, http://www.decohot.com/2009/07/green-roof-design-and-function/.

[7],[8] O.U.G. nr. 195/2005 privind Protectia mediului, modificata si completata prin legea nr. 265/2006 si in conformitate cu prevederile din Legea nr. 24/2007 privind reglementarea si administrarea spatiilor verzi din intravilanul localitatilor.

[9] Institutul Naţional de Statistică, 2009, Cadastrului Verde al Municipiului Bucureşti – Registrul Spaţiilor Verzi, Primăria Municipiului Bucureşti, http://www.pmb.ro/pmb/comunicate/presa_com.php?msj=470.

[10] V. Negulescu, 2011, Dinamica spaţiilor verzi în MUNICIPIUL Bucureşti după anul 1800, Teza de Doctorat, coord. Prof. Univ. Dr. Braghina Cristian, p. 4, Universitatea din Bucureşti. Facultatea de Geografie, Şcoala Doctorală „Simion Mehedinţi".

[11] S.C. Blizzart Design S.R.L., 2011, Studiu de fezabilitate aferent obiectivului "Acoperisuri verzi", proiect nr. 1187, p. 5, Bucuresti.

Scientific Papers, Series B, Horticulture, Vol. LVI, 2012
CD-ROM ISSN 2285-5661, ISSN-L 2285-5653

RESEARCHES CONCERNING THE EFFICACY OF TRICHODERMA HARZIANUM T-22 FUNGUS IN PREVENT OF SOIL PATHOGENS IN PETUNIA SEEDLINGS

Mădălina DOLTU, Marian BOGOESCU, Dorin SORA

Research and Development Institute for Processing and Marketing of the Horticultural Products – Horting, 1A Intrarea Binelui, District 4, 75614, Bucharest, Romania,
Phone: +40 21 461 07 06, Fax: +40 21460 07 25, E-mail: doltu_mada@yahoo.com

Corresponding author email: doltu_mada@yahoo.com

Abstract

The researches had aimed determining the effectiveness of Trichoderma harzianum (T-22) fungus, in to prevent soil pathogens (Pythium spp, etc.) in petunia seedlings. Selling of this hybrid stalk is made as the product called Trianum. The product contains spores of the fungus and was used as a solution in concentrations 0.08% and 0.1%; the treatments were applied on the nutritive substrate, after sown or after plants emergence. Experience was realized in 2012, on petunia healthy seedlings, in the pilot greenhouse of the Institute Horting Bucharest. The hybrids studied were Dreams Midnight, Dreams Wihte, Dreams Red. The nutritive substrate were peat fertilized middle. It was evidenced efficacy the product on the soil pathogens that cause "the fall of seedlings" (Pythium spp.). After research, it was concluded that the product have optimal effect in preventing this vascular disease on petunia seedlings; the fungicide had best biological efficacy on the Dreams Midnight hybrid, applied after plants emergence, in concentration 0.08 %.

Key words**:** *biological fungicide, efficiency, Petunia hybrida*

INTRODUCTION

All petunia varieties existing in culture belong of Petunia hybrid species and are grow through seedling and/or through seeding [2, 3].
The plants are senzitive at vegetation factors.
This species has a high sensitivity to the attack of the soil pathogens (Pythium spp); these pathogens produce "the fall of the seedlings".
In cold conditions associated with moisture excess in the soil and lack of regular ventilation, the base of the stalk is affected - it is necrotizing, it is soften and the plants fall (Photo 1).
"The fall of the seedlings" is a damaging disease.
It is well known the action of the biofungicidelor – complex action, micoparazitism, based on antagonistic fungi of the Trichoderma genus [1].
In this paper is presented the effectiveness of biolological fungicide – Trianum in prevent of vascular disease in petunia seedlings.

Photo 1. Petunia seedlings affected by Pythium spp.

MATERIAL AND METHOD

Experience was realized in the Laboratory for Protected Cultures (photo 2) of ICDIMPH-Horting Bucharest, during 2011-2012 period.
The biological material studied was petunia seedlings, plants derived from hybrid seeds; the seeds were imported, procured from units authorized for distribution of certified seed.
The hybrids researched were Dreams Midnight, Dreams Wihte, Dreams Red Dreams (Photo 3, 4, 5 - s*ource: www.estabrooksonline.com*).

Photo 2. Micro-greenhouse for producing seedlings

Photo 3. Dreams Midnight

Photo 4. Dreams Wihte

Photo 5. Dreams Red

The plants were produced in polystyrene trays, according to conventional technology for producing of annual flowers seedlings.

Nutritive substrate was peat, with an average fertilization potential, pH=6 and 0-6 mm granular structure. It was used a granulate biological product - Trianum (spores of Trichoderma harzianum T-22) – Photo 6, as a solution in concentration 0.08% and 0.1%.

Photo 6. Trianum, spores
of Trichoderma harzianum T-22

The product was used preventively, depending on the variant, as follows: a treatment applied on the nutritive cube, after sowing (0.1%) or a treatment after emergence of the seedlings, healthy plants (0.08).

Was organized an trifactorial type experience, in which the experimental factors were:

- Factor A – the hybrid: a_1 – Dreams Midnight, a_2 – Dreams Wihte, a_3 – Dreams Red;
- Factor B – the level of treatment: b_0 – irrigation with water, no biofungicid, b_1 – treatment with biofungicid, solution in a concentration 0.1%, b_2 – treatment with biofungicid, solution in a concentration 0.08%;
- Factor C – the moment when was applied the treatment: c_1 – after sowing, c_2 – after emergence.

The working variants have been: $V_1(a_1b_0)$, $V_2(a_1b_1c_1)$, $V_3(a_1b_2c_2)$, $V_4(a_2b_0)$, $V_5(a_2b_1c_1)$, $V_6(a_2b_2c_2)$, $V_7(a_3b_0)$, $V_8(a_3b_1c_1)$, $V_9(a_3b_2c_2)$.

For each variant were analyzed 1000 plants.

The effectiveness evaluation of the biofungicid (E%) on the soil pathogens was realized with Abbott's formula:

E = (1-d/D)x100

d = % of attack, in treated variant;

D= % of attack, in untreated variant.

RESULTS AND DISCUSSIONS

The results concerning the behavior of the petunia hybrids (Midnight Dreams, Dreams Wihte, Dreams Red) to the action of the fungal stalk are presented in Tables 1 and 2.

The assessment of losses caused by pathogens that produce "the fall of the seedlings"

demonstrates that variants biologically treated and untreated variants have different values, were important differences between hybrids (Table 1).

Table 1. The efficacy of the biological fungicide at petunia seedlings

Variant	Attack (%) phase: *seed-lobe leaves*	Efficacy (%)*	Attack (%) phase: *true leaf*	Efficacy (%)*	Attack (%) *Total*	Efficacy (%)*
V_1	2	-	2	-	4	-
V_2	0.5	75	0.3	85	0.8	80
V_3	0.2	90	0.2	90	0,4	90
V_4	2.5	-	2	-	4.5	-
V_5	1	60	0.7	65	1.7	62,5
V_6	0.5	80	0.4	80	0.9	80
V_7	2.2	-	1,9	-	4.1	-
V_8	0.6	73	0.4	79	1	76
V_9	0.4	82	0.3	84	0.7	83

*The biological effectiveness of the experimental variants is expressed in Abbott's %

It is remarkable the differences between variants treated: the percentage of attacked plants between hybrids ranged from 0.2%-0.5% (Midnight Dreams), 0.4%-1% (Wihte Dreams), 0.3%-0.6% (Red Dreams).

Observed the superior efficacy of product in the treatment applied after emergence plants. The biofungicid efficacy was in phase of seed-lobe leaves: 90% (Midnight Dreams), 82% (Red Dreams) and 80% (Wihte Dreams) and in phase of true leaf: 90% (Midnight Dreams), 84% (Red Dreams) 80% (Dreams Wihte), treatment with solution 0.08%, applied after plant emergence. The biofungicide efficacy was in phase of seed-lobe leaves: 75% (Dreams Midnight), 73% (Dreams Red) si 60% (Dreams Wihte) and in phase of true leaf: 85% (Dreams Midnight), 79% (Dreams Red), 65% (Dreams Wihte), treatment with solution 0.1%, applied after sowing.

The biological product is used as a good fungicide for the prevention of soil disease on the petunia hybrids researched.

Statistical analysis of data obtained shows that differences between application moments of biofungicid treatment are small $d(\bar{x}_2-\bar{x}_3)=0.2$, $d(\bar{x}_5-\bar{x}_6)=0.4$, $d(\bar{x}_8-\bar{x}_9)=0.15$ (Table 2).

The petunia seedlings at variants treated with Trianum had an uniform growth during the vegetation period, seedlings untreated with Trianum were inferior (Photo 7, 8, 9).

Table 2. Statistical analysis of experimental data

Variant	Attack (%) phase: *seed-lobe leaves*	*true leaf*	$\bar{x}$
V_1	2	2	2
V_2	0.5	0.3	0.4
V_3	0.2	0.2	0.2
V_4	2.5	2	2.25
V_5	1	0.7	0.85
V_6	0.5	0.4	0.45
V_7	2.2	1.9	2.05
V_8	0.6	0.4	0.5
V_9	0.4	0.3	0.35

Photo 7.Seedlings treated with Trianum

Photo 8. Seedlings untreated with Trianum

Photo 9. Seedlings treated, onset of flowering

CONCLUSIONS

The fungicide (Trianum) has preventive action and can ensure an optimal biological control of the soil microorganisms at petunias, using a pure culture substrate and directing the vegetation factors appropriate of the specie.

The efficacy evaluation on the health of the petunia plants led to the conclusion that the

product has an optimal effect, were obtained different values between the treated variants.

The petunia hybrids (Midnight Dreams, Dreams Wihte, Red Dreams) have responded well to biologic treatment administered preventive. Were recorded higher values of the effectiveness at variants with treatment made after emergence of plants, with solution in concentration 0.08%.

Midnight Dreams had higher values in all variants, followed by Red Dreams and Dreams Wihte.

At the treated seedlings with biological fungicide have found an uniform growth of the plants from emergence day to planting and a pace of higher development, comparative with the untreated plants; this impose a further research on goals, objectives and results obtained by applying the Trichoderma harzianum T -22 fungus.

ACKNOWLEDGEMENTS

This research work was carried out with the support of Ghesaf Trade company.

REFERENCES

[1]Baker, R., 1998, *Trichoderma spp. as plant-growth stimulants, CRC Crit Rev*. Biotechnol., 7, p.97-106

[2]Boieriu Adela, 2003, *Petunia*, http://www.121.ro/articole/art1522-petunia.html

[3]Doltu Mădălina, 2010, *Obtinerea rasadurilor de flori in sera*. Horticultura nr.3-4, Editura Agris Bucuresti, p.22

[4]Online: www.estabrooksonline.com/catalog2/annuals/annual.asp?id=Petunia

Scientific Papers, Series B, Horticulture, Vol. LVI, 2012
CD-ROM ISSN 2285-5661, ISSN-L 2285-5653

THE EFFECTS OF THE CROP'S SUBSTRATE AND OF THE ROOTING STIMULATORS ON THE INTERNAL STRUCTURE OF THE VEGETATIVE ORGANS OF THE GERANIUM PLANT (*PELARGONIUM PELTATUM*)

Mihaela Ioana GEORGESCU, Diana VÎŞCĂ-ZAMFIR, Elena SĂVULESCU

University of Agricultural Sciences and Veterinary Medicine, Bucharest, 59 Marasti, District 1, 011464, Bucharest, Romania, E-mail: mihaelaigeorgescu@yahoo.com; elenasavulescu@yahoo.com

Corresponding author email: mihaelaigeorgescu@yahoo.com

Abstract

The propagation by cuttings obtained from the stem is a frequently used way of vegetative multiplication in the species of the Pelargonium genus. The purpose of this work is to highlight the changes induced in the internal structure of the vegetative organs by the crop's substrate and by the growth promoters used for improving the rooting degree. Variations were observed in the number of layers of cells that make up the structure of tabular collenchyma from the stem's structure, in the mesophyll's thickness or in the degree of thickening of the cells' walls.

Key words**:** *growth promoters, internal structure, vegetative organs*

INTRODUCTION

Potting-up is a means of vegetative propagation, widely used for the species from the Pelargonium genus. It is necessary that the substrate used for rooting consist of mixtures of light soils, porous for the air, which can retain moisture for long periods and warm up easily [4]. Hastening the rooting is done by using artificial light, growth promoters or regulators. It is known that the plant-produced phytohormons, the auxins play a key role in stimulating the roots' branching and in the rooting of cutting-ins [1]. Besides these, cytokinin and gibberellins also play a role in the intensification of metabolic processes, cell division or growth in length [3]. Associating such compounds to rooting substrates allows the increase of the rooted percentage of the cuttings.

This paper aims at highlighting the influence of the rooting substrate and of the rootedness stimulators on the internal structure of the vegetative organs formed in the node cuttings.

MATERIAL AND METHOD

The experiments were conducted in the horticulture department's flower greenhouse, in the framework of USAMV Bucharest. The plant material analyzed consisted of cuttings from the tips of shoots harvested from mother plants of the species Pelargonium peltatum from the academic collection. Experimental variants for the rooting substrate were: peat + perlite (1:1), peat, perlite, sand and for stimulating substances: Clonex (gel - mixture of hormones, vitamins and mineral nutrients), Coralite (a powder consisting of vitamin A, the B complex, C, D, E, amino acids, trace elements); Radistim (powder - incentive for rooting).

Provisional anatomical preparations were obtained by cutting across vegetative organs (leaf, stems, and adventitious roots), clarification with chloride hydrate and staining with carmine alun and iodine green and images with a Panasonic DMC-LZ7 digital camera.

RESULTS AND DISCUSSIONS

The adventitious roots' structure

Most variants had adventitious roots with external primary tissues (epidermis and part of the cortex) peeling due to the formation of a suberized tissue by a monopleuric cork cambium, which appeared in the primary cortex (Photo 1).

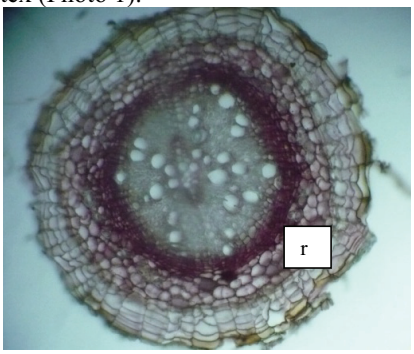


Photo 1. Perlite+peat+Clonex variant: suberized tissue (s)

In some sections, the primary tissue is not removed, although suber is well developed, while in the variant with peat rooting substrate and stimulant Radistim, the cork cambium didn't appear and the tissues of primary origin were kept on the outside (Photo 2).

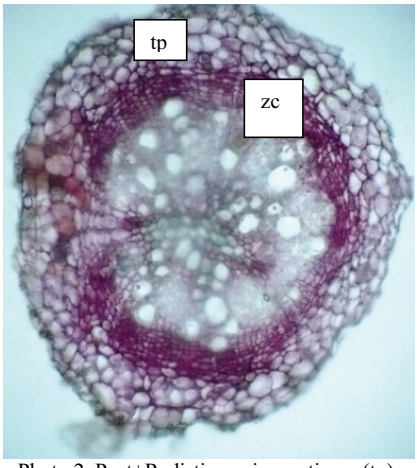


Photo 2. Peat+Radistim: primary tissue (tp); cambial zone (zc)

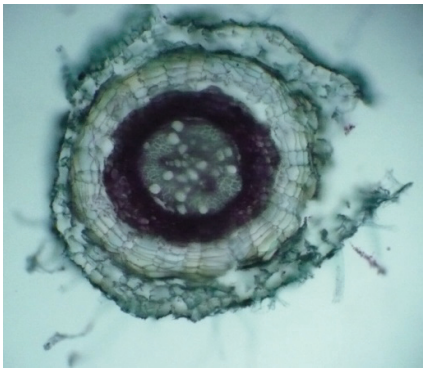


Photo 3. Perlite + peat control variant

In the central cylinder the cambium is active, without cell differentiation occurring yet; the central xylem consisting of elements primary origin for most variants (photo 2). In the control variant (without stimulants) perlite + peat substrate, no start of activity of the cambium was observed (photo 3). Another meristematic whose activity started is the pericycle which in the perlite + peat + Coralite variant, produced lateral roots (Photo 4).

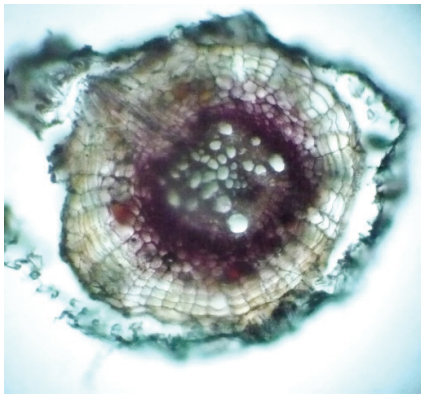


Photo 4. Perlite+ peat+ Coralite: lateral root (r)

Petiole structure

Petiole has a similar composition to the pulvinus - structures involved in the change of the leaf blade's position [2]: in the central area there is a conducting tissue surrounded by parenchyma. In the control variant (without rooting stimulators) substrate of sand, stem structure, representative of most cases of the experiment, shows, from the outside to the centre, the following types of

tissues (Photo 5): external epidermis, with one cells layer, provided with stomata and secretory structures (hairs, scales); hypodermis – one cells layer consisting of a tabular collenchyma; clorenchyme, composed of 4-5 layers of cells with chloroplasts, sclerenchymatous pericycle, consisting of 1-2 layers of cells in the interfascicular area; central cylinder composed of a fundamental parenchyma in which nine small bundles are arranged circularly, outward, and in the center a large bundle, all of the collateral type with the active interfascicular cambium (Photo 6).

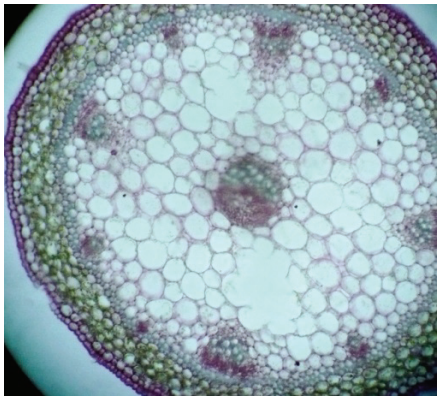


Photo 5. Sand variant: petiole structure

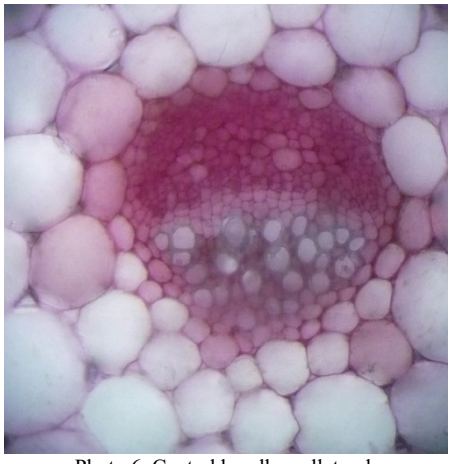


Photo 6. Central bundle, collateral, with cambium in activity

In the variants in which the Coralite product has been used as a rooting agent, parenchyma cells are larger and clorofilian parenchyma tissue consists of 7-9 layers of cells (photo 7).

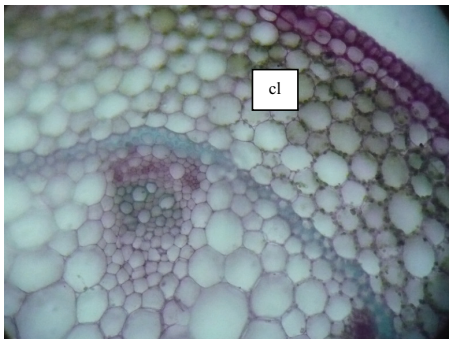


Photo 7. Perlite+peat+Coralite: clorenchyme (cl)

Leaf blade structure

Leaf blade is defined by an upper epidermis provided with secretory hairs and a lower one, in which, in addition to hairs, there are stomata (Photo 8).

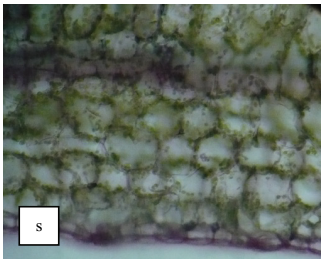


Photo 8. Stomata in lower epidermis (s)

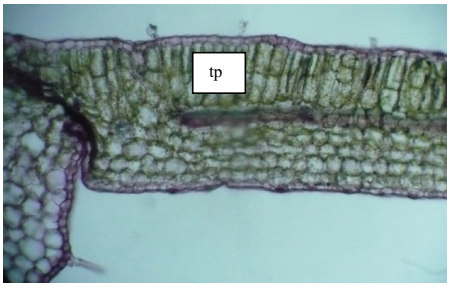


Photo 9. Perlite variant: palisade tissue (tp)

The bifacial type of mesophyll consists of a palisade tissue with two cell layers and a spongy parenchyma oriented towards the lower epidermis. The palisade tissue, in the variants with perlite as rooting substrate is composed of cells whose length exceeds about 3 times the width (Photo 9). In the remaining variants, the palisade tissue cells are nearly isodiametric, the mesophyll having a homogeneous aspect (Photo 10).

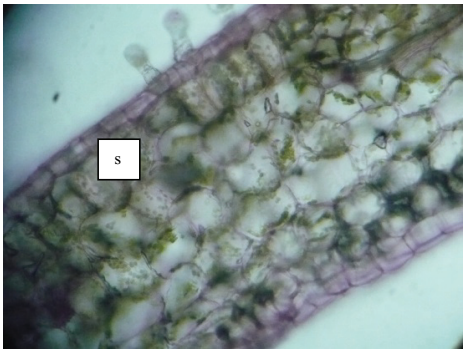


Photo 10.Peat variant: palisade tissue (tp)

CONCLUSIONS

The two factors - the rooting substrate and the rooting process stimulators produce ± relevant changes in the internal structure of the vegetative organs.
At the root level, they affect differently the activity of primary meristems - pericycle and of the secondary ones – cambium and cork cambium.

In stems, parenchyma cell size and number of constitutive layers of the collenchyma are increased in the variants based on Coralite. The palisade tissue in the leaves' mesophyll is clearly distinguishable from the spongy tissue by the cells' shape in variants with perlite as rooting substrate.

REFERENCES

[1] Champagnat R., Ozenda P., Baillaud L., 1969.Biologie vegetale III : croissance, morphogenèse, reproduction. Maisson et C^{ie}, Paris, p.137-142.
[2] Esau K., 1965. Plant anatomy. John Wiley & Sons, Inc., New York.London. Sydney, p. 427-430, 442-445.
[3] Lüttge U., Bauer G., Klugge M., 1992.Botanique (trad. Veronique et A. Sieffert). Tec et Doc - Lavoisier, Paris, p.488-489.
[4] Preda M., 1979. Floricultura. Editura Ceres, București, p.40-51, 63, 613.

Scientific Papers, Series B, Horticulture, Vol. LVI, 2012
CD-ROM ISSN 2285-5661, ISSN-L 2285-5653

MITES ASSOCIATED WITH PARKS AND ORNAMENTAL GARDENS IN URBAN AREA – BUCHAREST

Cătălin GUTUE, Minodora GUTUE, Ioan ROŞCA

University of Agronomic Sciences and Veterinary Medicine Bucharest, 59 Mărăşti, 011464, Bucharest, Romania, E-mail: gutue_catalin@yahoo.com

Corresponding author email: gutue_catalin@yahoo.com

Abstract

The paper presents the species of mites found on woody plants and flower plants from parks and ornamental gardens or private ornamental gardens in the north of Bucharest. It describes the frequency of attack, host plants, preference for a host plant, attack distribution on plant, the conditions for the attack to produce, the unaesthetic aspect of the attacked plant and possibilities of control. The excessive drought and high temperatures during the summer months favours the development of phytophagous mites, species belonging to the families Tetranychidae (Tetranychus urticae Koch., Eotetranychus tiliarium Hermann), Eriophyidae (Eriophyes tiliae exilis Nal., Eriophyes tiliae rudis Nal., Eriophyes triradiatus Nal.) and Tarsonemidae (Polyphagotarsonemus latus Banks). These species of mites have as host plants species of genera Tilia (T. cordata, T. platyphyllos, T. tomentosa), Salix (S. babylonica, S. matsudana "tortuosa"), Rosa, Impatiens etc. These pests sting and suck the sap from the plants, the leaves become yellow, dry and fall. The loss of leaves during the summer period reduces the accumulation of substances for provisions, the plants become sensitive to frost and draught and their ornamental value decreases. The paper also presents Schizotetranychus (Stigmeopsis) celarius Banks species, pest new to Romania, which entered the country with the host plant Phyllostachys aureosulcata. S. celarius produces a white web, in the shape of a nest, on the lower side of the Phyllostachys aureosulcata leaves. On the feeding site appear white-yellow spots that may look similar to variegation. Knowing, identifying and controlling these mites is very important in order to maintain the decorative value of plants from parks and gardens.

Key words**:** *mites, ornamental plants, control difficulties*

INTRODUCTION

In all developed countries, with a high urbanization level, the conservation and creation of verdure spots are represent an important to mean of protection for the humans and their life environment. They produce the oxygen necessary for life, reduce air pollution, decorative towns and creates a favorable microclimate for relaxing outdoors. Some of the have a cultural importance (gardens, museum gardens, historical or exhibition gardens) or scientific importance (botanical gardens, reservations, national parks) [3].

The change of the climatic conditions from the last years have determined the multiplication and spreading of several pests associated with parks and ornamental gardens like tetranychid, eriophyid and tarsonemid mites. These destroy the beauty of plants and gray colour of buildings is dominant.

MATERIAL AND METHOD

The paper presents the species of mites present on woody plants and flower plants from the urban environment, parks and public or private ornamental gardens situated in the north part of Bucharest.

The observations were made in green areas from the north part of Bucharest, during the period of 2008– 2011.

In order to monitor the mites associated to the ornamental plants from parks and gardens, trips were made periodically in the mentioned areas and pests were detected on different types of host plants.

For the species of the genus *Tilia* were annalyzed 262 trees (86 trees *Tilia cordata*, 25 trees *Tilia platyphyllos*, 139 trees *Tilia tomentosa* and 12 trees *Tilia americana*) placed in parks, public or private ornamental gardens and straightways along the streets. 25 leaves from the bottom of the tree head were annalyzed and the mite species was established taking into the

account the morphological criteria and the attack type (the gall's form) [2, 4, 5, 8]. The intensity of the attack was evaluated taking into account the percentage in which the leaves were attacked, related to the total number of leaves attacked.
It describes the frequency of attack, host plants, preference for a host plant, attack distribution on plant, the conditions for the attack to produce, the unaesthetic aspect of the attacked plant and possibilities of control.
Samples of attacked plants (damage type) and the respective pests were gathered, in order to be determined in the laboratory. The collected material was photographed directly or inside a lab using the Nikon camera.

RESULTS AND DISCUSSIONS

High temperatures and excessive draught during the summer months have favoured the development of phytophagus mites. Thus, after observations were made there were found species of mites belonging to the families *Tetranychidae* (*Tetranychus urticae* Koch., *Eotetranychus tiliarium* Hermann), *Eriophyidae* (*Eriophyes tiliae exilis* Nal., *Eriophyes tiliae rudis* Nal., *Eriophyes triradiatus* Nal.) and *Tarsonemidae* (*Polyphagotarsonemus latus* Banks), and the host plants belong to the genus *Tilia* (*Tilia cordata*, *T. platyphyllos*, *T. tomentosa, T. americana*), *Salix* (*Salix babylonica*, *S. matsudana "Tortuosa"*), *Rosa, Impatiens* (table 1). These pests sting and suck the sap from the plants, the leaves become yellow, dry and fall. The loss of leaves during the summer period reduces the accumulation of substances for provisions, the plants become sensitive to frost and draught and their ornamental value decreases. The species *Tetranychus urticae* Koch infected strongly the plants of *Rosa* during the entire observation period. The attack manifested especially in the areas in which the air circulation was decreased, as a result of a high planting density, interior gardens enclosed by high walls and buildings. Also, the type of pruning of plants during spring influenced the mites setting. The plants with a high number of scapes and with a compact distribution constituted the first pest hole of mites. When no control measures were taken it resulted defoliation of plants.
Eotetranychus tiliarium Hermann represented the most spread specie at the linden plants and with a strong impact on the ornamental value of the plants. The attack manifested itself strongly on the trees planted in a row, the asphalt effect contributing to the pest installation. The first pests were settled at the bottom of the trees and where the branches of the adjoining trees intersect. The leaves of these trees become grey-yellowish and in the middle of summer they were completely withered (Photo. 1). Also, high temperatures and excessive drought favoured the attack of this species. The trees planted isolated in parks were not attacked by this mite. As regards the preference for the host plant, this proved to be the specie *Tilia cordata*. In 2008, 86 trees of *Tilia cordata* were examined, in 2009 their number decreased to 78, in 2010 to 75 and in 2011, 71 trees. These were elliminated as a result of their withering, caused by the complex – mites, draught, sensitivity to pollution.

Photo 1. *Eotetranychus tiliarium* on *Tilia cordata*

In present it is known the fact that the sylviculturists consider the species of *Tilia* sensitive to pollution an don't recommend them to be planted in straightway along the streets. Taking also into account their sensitivity to the tetranychid mites attack we recommend them to be used carefully in urban arrangements.
The species of eriophyid mites met on the linden trees form different types of galls on the leaves, that can cause physiologic disfunctions to the host plants and can affect their ornamental features.
Eriophyes tiliae tiliae Pgst. was found on *Tilia platyphyllos, Tilia cordata* and *Tilia tomentosa*

(Photo 2). The most attacked were the young plants of *Tilia tomentosa* with a height up to 3 m. The big trees of *Tilia tomentosa* were attacked in the lower levels of the tree head. The species *Eriophyes tiliae rudis* Nal. Was present only on *Tilia tomentosa* (Photo 3). *Eriophyes tiliae exilis* Nal. was found on *Tilia platyphyllos* and *Tilia cordata* (table 2). The trees of *Tilia americana* weren't infected by mites during the studied period. The species of eriophyid mites didn't cause withering effects on plants, their attack causing just an unaesthetic aspect on the plants in urban areas.

Table 1. Mites associated with parks and ornamental gardens

Pest	Host plant	Damages	Impact
Tetranychus urticae Koch.	*Rosa spp.*	- delicate cobweb on lower side of leaves with black excrements; - yellowing of the leaves; - delicate cobweb on the growing peaks and floral buds.	- the plants lose their leaves in the middle of the summer.
Eotetranychus tiliarium Hermann	*Tilia cordata*	- discolouration of leaves; - delicate cobweb on the lower side of leaves.	- the leaves turn yellow and wither during summer; - the leaves fall during summer.
Eriophyes tiliae tiliae Pgst.	*Tilia platyphyllos* *Tilia cordata* *Tilia tomentosa*	- formed conical galls on the upper part of the leaves; - galls about 8 mm long and frequently coloured red; - the tip of the gall is sharp.	- the galls turn brown with time and wither, giving the plants an ugly appearance.
Eriophyes tiliae rudis Nal.	*Tilia tomentosa*	- formations with a felty aspect on the lower side of the leaves caused by the hypertrophy of the tomentum; - blistering of the tissues on the upper side of the leaves (galls).	- the galls turn brown and the leaves wither.
Eriophyes tiliae exilis Nal.	*Tilia platyphyllos* *Tilia cordata*	- form galls with a felty aspect on the lower side of the leaves close to the nervures and at their point of insertion; - on the upper side of the leaves, near the galls the tissues are slightly blistered and discoloured.	- the galls turn brown and the leaves turn yellow.
Eriophyes triradiatus Nal.	*Salix* spp.	- forming proliferations in a shape of witch broom, globular shaped.	- proliferation necrosis; - they wither and remain on the branches from one year to the next; -unaesthetic aspect of the plants.
Polyphagotarsonemus latus Banks	*Impatiens* spp.	- distorted growth of the plats; - twisting and decrease of the growing peaks; - abnormal or no lack flowers; - short internodes and stunted plants with glassy appearance.	- ornamental value of the plants is much decreased.
Schizotetranychus (*Stigmeopsis*) *celarius* Banks	*Phyllostachys aureosulcata*	- white web, in the shape of a nest, on lower side of leaves.	- leaves with variegated aspect, they will wither with time.

Table 2. Manifestation of the mites attack at *Tilia* genus in the period of 2008 – 2011

Mite	**Host plant**	**Frequency of the attacked plants (%)**				**Intensity of the attack (%)**			
		2008	2009	2010	2011	2008	2009	2010	2011
Eotetranychus tiliarium Hermann	*Tilia cordata*	90,69	81,39	75,58	82,12	92,50	76,00	34,25	90,24
Eriophyes tiliae tiliae Pgst.	*Tilia platyphyllos*	56,00	40,00	68,00	54,00	6,32	8,32	6,12	6,08
	Tilia cordata	15,11	30,23	17,44	20,42	0,65	0,23	0,12	0,15
	Tilia tomentosa	93,52	89,20	96,40	90,34	28,98	5,48	16,14	14,56
Eriophyes tiliae rudis Nal.	*Tilia tomentosa*	44,60	43,16	38,84	40,26	22,04	12,64	13,83	14,20
Eriophyes tiliae exilis Nal.	*Tilia platyphyllos*	16,00	8,00	12,00	10,00	1,22	1,49	1,08	1,28
	Tilia cordata	2,32	4,65	1,16	2,50	0,20	0,80	0,12	0,44

Photo 2. *Eriophyes tiliae tiliae* on *Tilia tomentosa*

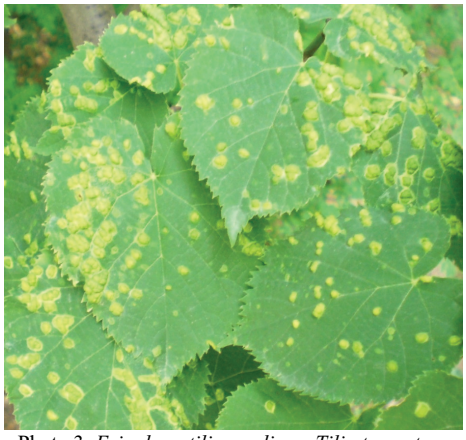


Photo 3. *Eriophyes tiliae rudis on Tilia tomentosa*

Eriophyes triradiatus Nal. was found on *Salix babylonica* (Photo 4) and *S. matsudana* "*Tortuosa"* (Photo 5).

Photo 4. *Eriophyes triradiatus* on *Salix babylonica*

Photo 5. *Eriophyes triradiatus* on *Salix matsudana "tortuosa"*

The attack is associated withe the forming of witch brooms with a globular shaped. These turn brown, wither and remain on the branches from one year to the next, reducing the ornamental value of the plants.

Polyphagotarsonemus latus Banks has been sporadically observed on the plants of *Impatiens* spp. placed in urban areas. Their infestation happened in the breeding spaces and the attack manifestated itself in the planting place. These plants lost their ornamental value in a little while and they needed to be replaced.

Schizotetranychus (*Stigmeopsis*) *celarius* Banks can be a new pest for Romania, that entered the country together with the host plant *Phyllostachys aureosulcata. Stigmeopsis celarius* was described in 1971 by Banks, it was renamed *Schizotetranychus celarius* by McGregor in 1950 [1] and recently returned again to *Stigmeopsis celarius*. Today it is considered that *S. celarius* is a complex mites, several species being identified: S. *celarius* Banks., *S. miscanthus* Saito, and *S. longus* Saito [6, 7]. This species form colonies on the lower part of the leaf in the guise of a delicate white cobweb and with an almost round shape (Photo 6). In general the mites stay under the formed cobweb where they feed and deposit eggs. Here there can also be observed black excrements. A part of the adults and larvas leave the web and form new nests. On a leaf can be seen an average of 80 individuals. The leaves have a variegated aspect (Photo 7) and they will wither

with time on. The attack of this species has manifested in 2008 and 2009 but it hasn't been present in 2010 and 2011.

Photo 6. *Schizotetranychus celarius* on *Phyllostachys aureosulcata* (white web, in the shape of a nest)

Photo 7. *Schizotetranychus celarius* on *Phyllostachys aureosulcata* (leaves with variegated aspect)

CONCLUSIONS

The possibilities to control these species are limited, taking into account the location of the plants (parks, public spaces, playgrounds for children, places for rest and relaxation, isolated trees, alignment trees, private gardens, size of the trees), the lack of pesticides with low toxicity or of biological control agents, the application difficulties and the costs of these treatments.

The difficulties of pest control are worsening by the urban environment in which the ornamental plants are placed. Thus, the pest control management is based on a series of components like: the identification of the pest centre; the types of harm and the intensity of the attack; the decision on different levels concerning the control methods; the identification of the key pests; promoting a natural pest control system; researches concerning the fighting strategy and methods; the characteristics of the pest control equipments; establishing the frequency of the treatments; the climatic conditions; the presence of water (lakes, ponds, flowing waters) in the landscape arrangements; the costs of the pest control treatments and the financial sources with this destination; the restrictions concerning the use of chemical products in the urban environment; minimizing the negative impact of pesticides over the environment; the training degree of the administrative personnel; communication with the public; communication inside the system and the political decision.

Prevention and control the pest from the urban areas implies the application of a group of integrated measures, like: cultural, technological, biological and chemical.

The cultural and technological measures consist of: choosing the flowers in the moment of setting up the verdure spots according to their decorative value, but also according to the ecological requests, in order to obtain strong plants, resistant to pests' attack; cutting the trees and bushes in order to ensure an airy leafage; cutting the dried branches; obliteration of the fallen leaves; wetting and fertilization of the plants; wetting the plants through aspersion in order to reduce the attack of mites and of

several species of insects. The chemical control can be used restrictively: using chemical products from the use of products accepted in ecological horticulture; the use of selective products; injection of the trees in order to minimize the negative effects.

Several ornamental plants have been investigated from parks and verdure spots of north Bucharest and tetranychid, eriophyid and tarsonemid mites have been discovered.

The unaesthetic impact of the yellow and grey trees on the streets, in the parks and gardens during summer months increases considerably the public interest towards these pests.

The control measures are necessary for the following species: *Tetranychus urticae* Koch., *Eotetranychus tiliarium* Hermann, *Polyphagotarsonemus latus* Banks and *Schizotetranychus* (*Stigmeopsis*) *celarius* Bank.

The difficulties to fight them depend on a series of factors like: the emplacement of the trees (street, verdure spot, private garden), the configuration of the trees (isolated, in group or in alignment), covered soil, the height of the trees etc. Also the presence of these pests in the urban areas calls for a minimizing of the chemical methods used to fight the pests.

The restriction of the pests' attack from the parks and decorative gardens is based on the application of a group of integrated measures, like: cultural, technological, biological and chemical methods. The plants infested with eriophyid mites present in general a good vegetation state and application of treatments is not necessary. The pest control management in parks and decorative gardens is influenced by the urban environment.

REFERENCES

[1] Baker, E.W. and D.M. Tuttle, 1994. *A guide to the spider mites (Tetranychidae) of the United States*. Indira Publ. House, Michigan, 1-347

[2] Buchta Ivan, Emanuel Kula, Magda Kresťanpolová, 2006. *Occurrence variations and spatial distribution patterns of Eriophyes tiliae (Pgst.) (Acari, Eriophyidae) subspecies in the urban environment*. Journal of forest science, 52 (12): 547-555

[3] Iliescu Ana Felicia, 2003. *Landscape Architecture*. Ceres Publ. House, Bucharest, p. 15

[4] Manolache C. şi colab., 1978. *Agricultural Zoology Treatise*, vol. I, Academy R.S.R. Publ. House, Bucharest

[5] Ostoja-Starzewski, J.C., 2000. *Schizotetranychus celarius (Banks) (Acari: Prostigmata) a mite pest of bamboo; first records for Britain and two hew host records.* British Journal of Entomology and Natural History. 13(2), July, 2000:95-97.

[6] Saito, Y., 1990. *Two new spider mite species of the Schizotetranychus celarius complex (Acari: Tetranychidae).* Appl. Ent. Zool. 25 (3): 389-396

[7]http://oregonstate.edu/dept/nurspest/Bamboo/bamboomite.htm

[8*]http://www.plantengallen.com/engels.htm*

Scientific Papers, Series B, Horticulture, Vol. LVI, 2012
CD-ROM ISSN 2285-5661, ISSN-L 2285-5653

ROMANIAN PICNIC REGULATION - THE LANDSCAPE SUSTAINABILITY GAPS

Alexandru Paul LAZĂR-BÂRA

University of Agronomic Sciences and Veterinary Medicine Bucharest, 59 Mărăşti, District 1, 011464, Bucharest, Romania, Phone: +40 723 910 679, E-mail: alexandru.lazarbara@gmail.com

Corresponding author email: alexandru.lazarbara@gmail.com

Abstract

Law 54 adopted by the Romanian Parliament in 2012 was meant to regulate public space picnic activities, in order to mitigate public health and environmental impacts associated to this traditional middle class leisure. This paper identifies the gaps between the present law and the sustainable approach of picnic in national context, from a landscape architect's integrative perspective. The analysis premise is landscape valuation, which picnic should naturally rely on – though the term 'landscape' is missing from the text of the law. First, a general concept is suggested, that connects all the complex systems involved in picnic activity; a set of principles deriving out of the concept is then identified. Foreign related regulations are presented along their implementation context and the effects they have on socio-ecologic systems. The principles of landscape valuation through picnic are then confronted with the Romanian law and with the foreign regulations selection. Results show the gaps between landscape sustainability key-lines and the law formula, indicating also alternative approaches from other countries. The conclusions show the need to integrate landscape architects in society on multiple levels, in order to enhance policy sustainability, administration effectiveness and management quality.

Keywords: *Environmental education, landscape valuation, picnic activities, picnic designated areas, public affluence dedicated areas*

INTRODUCTION

Public space suffers the direct impacts of cultural change, and since the 1990's Romania is a very dynamic ground. The ceased properties restitution triggered in 1991 by the Restitution Law, the capitalism revival, the climate change, the Globalization, the E.U. integration process and, more recently, the Economic Crisis are contributing to the construction of a new cultural identity of the Romanians. As a component of the socio-ecologic system, culture induces pressures on natural capital, especially in its turning moments, when environmental resilience is stretched. The Picnic Law is a late answer to some of the changes that the nation and the Romanian environment are passing through.

The environmental neatness seems to be the main reason behind this law. This study will prove that among others, this reason is insignificant, and consequently the law requires major enhancements. In the end, suggestions will be made, that will hopefully provide a base for the improvements.

MATERIALS AND METHOD

Among the recognized explanations of the word 'picnic', Romanian dictionaries offer almost undifferentiated answers: *jointly, open-air dinner* [5]. In a single case, the *open-air* context is explained between brackets as *outdoor green* [iarbă verde] [12]. Despite these, law 54/2012 [14] considers new meanings for *picnic*: *any public affluence recreational activity (...) involving drinks and/or food consumption and accordingly, eventual fire lighting* [14]. Significant fines enforce the law that forbids *picnic activities* anywhere else than in the *picnic designated areas* or in the *picnic arranged areas*.

A logical interpretation would result in:

- "Public space bretzel-chewing mobs are liable for severe penalties unless their chewing activity takes place in a *picnic designated area*", or
- "Running fountains installation outside the *picnic arranged areas* is prohibited, since they could instigate to disobedience regarding the Law of the picnic".

Obviously, the law was written and approved in a great hurry.

Considering the risk of being a shallow document on any level, starting with its motivation, a bottom-up approach was used for re-defining some of the true Romanian musts in the matter of picnic. A list of the possible reasons for a picnic law was the subject of a brief analysis: examples are found in a few western, culturally related countries, either historically or today's models. Picnic areas setup was found to be aiming:

- Environmental impact and public health risks mitigation: the Romanian law - [14]
- Public space alcohol consumption regulation: Montreal [15]
- Graveyard protection: USA – New Hampshire – Claremont [16]
- Proselytism prevention: Milwakee, USA [13]
- Finding spots for urban refugees: Alevkaya Picnic Area – North Cyprus [2]
- Urban public space quality enhancement: Vancouver, Canada [7]
- Urban hacktivism through guerrilla *picnic activities*: parking lot picnics in USA [8]
- Creating frameworks for hedonism – rose-garden picnics, as those promoted by Heirloom's Roses [3]
- Social recovery of forsaken territories: Waldpark in Potsdam, by the Dutch designers of Bureau B+B [1] proposes new uses for a former military training site of Easter Germany.
- Exercising freedom: in Dragoş Dascălu's formulation, the best picnic area *should not impose strict usage rules providing more freedom to visitors. A 'vague space' as Augustin Ioan would say, but with a clear image, owed to the very lack of interventions* (...) [9].
- Cultural identity and environmental culture: in Park Klarenbeek – Arnhem, recycled 16th century tomb stones from a nearby former Abbey [6]
- Natural, cultural and spiritual heritage valuation: the 500 km Majella National Park hiking trails (Italy) occasionally offer picnic spots [20]
- Wild landscape valuation: *desert discovery walks(...) afternoon walks through woodlands* and *termite tales* accompany the Picnic Day program in a near-city park of Central Australia [10]
- Social life dynamics: student campuses and many others.
- Green infrastructure integration of recreation, health and wellbeing objectives: provisions of picnic spots ensure mass attractivity of Ingrebourne Hill – London [11], especially when exercise is the subliminal goal.

These examples suite in different degrees the Romanian context: the geographic and ecological diversity of the country induce major restrictions on regulators; the cultural diversity in terms of area of influence, tradition age and dynamics of phenomenon is another difficulty that law form must overcome. The most 'simple' thing in this equation is the socio-economic system – still bearing the marks of the uniformisation imposed in the 50 years of communism.

National site diversity approach requires the introduction of the term *landscape* in the text of the law. Furthermore, Romania was one of the first countries to assume the European Landscape Convention of Florence 2000. The official commitment was signed 11 years ago, yet no steps were performed so far in the adaptation of the law system. No references were found that would dissociate picnic activity from the landscape approach.

Cultural diversity is partly included in *landscape* matter. Yet, the traditions and customs diversity induce phenomenological differences among the regions of the country, which derive in various patterns of picnic activity.

RESULTS AND DISCUSSIONS

Picnic sites necessity could be resumed as following:

- for mid-term circumstances, they provide social cohesion frameworks to local communities and organizations; a key social benefit – that skipped the ruler's intentions in Law 54/2002 form – is the connection between picnic activity and the discharge of social tensions, otherwise provided in very little circumstances, like festivals or sports competitions;

- economic impacts of picnic sites is of short-term interest, since they provide consumption raise opportunities, of mid-term impact when considering the life quality enhancement of the working class – inducing work productivity raise – and long-term impact – deriving in health costs decrease or even prevent emigration (according to Waltert & Schläpfer 2010 [19], *migrants are attracted by amenities nearly as often as by low taxes*)
- cultural identity and heritage valuation (either natural or cultural) through picnic facilities rely on education – this induces the long-term liquidation of the initial investment, since community or national identity recovery, as well as environmental culture inoculation involve social values change
- the immediate impact conflicts between picnic facilities and the supporting sites were circumstantially approached in law 54 [14]; environmental protection as depicted there relies exclusively on the responsibility of the picnic areas users; the control tasks are assigned to local police; force seems to be the only argument the law makers could bring forward. The police involvement – and its ecological footprint – could be drastically reduced if picnic sites protection relied rather on social appropriation, local and national pride; landscape valuation is the missing key-word from the text of the law – it would refer to the means of achieving the appropriation goal.

Common sense relies on cultural acceptance of real-world facts. This involves a great deal of change, deriving from the evolutionary character of culture. More than participating to common sense definition, culture is an identity factor on different scales of space and time, including the national level, which any national law should target in democracy. No cultural arguments were used for the law construct. A formal analysis could point out that the law creators' eluded democracy.

The Romanian Law of the picnic [14] lacks the nation-wide addressability; it also lacks *common sense* in the matters of public space approach (anachronism), *public affluence recreational activities* [14] recognized *public affluence areas* [14] and in the matters of landscape valuation, protection and enhancement. In the national law system, landscape is left as *lorem ipsum* [4] when picnic activities are involved. Environmental and human health seem to be the only values that Law 54/2012 rely on. Picnic opportunity derives from landscape amenities [17]. For urban targets, comfort and sense of security associated with picnic activities involve ensuring the following: *lighting, trash receptacles, information and directional signing, benches and street furniture, trailheads and trailhead parking, information kiosks, drinking fountains, public telephones, transit shelters, distance markers, bicycle parking, restrooms, picnic tables and protective shelters, ramps and stairways, grassy areas and buffer strips, shade trees, planters, textured walkway surfaces, statuary or artwork (sculpture), ornamental fountains, selective relocation of utility poles or burial of utility cables, up lighting of trees, monuments and gazebos* [18].

CONCLUSIONS

A Romanian law of the picnic should include the following issues:

- Social freedom expression (avoidance of flagrant fencing, facility and landscape diversity)
- Picnic sites should address equally to all social categories of the country – providing common interests for the rich and the poor, for the more or for the less educated people (their common values should be approached essentially through landscape valuation)
- Site adequacy to social pressure (traffic, inherent pollution, vandalism)
- Environmental protection should integrate environmental culture objectives in picnic site planning and management (trash disposal and selective waste collection – as regulated in the present law, but also water management and energy efficiency objectives, adapted to site specific)
- Site appropriation policy (local, regional and national identity valuation – the integration of the picnic areas in cultural and educational programs)
- Site adequacy to local culture (picnic facilities, noise levels, crowd density, access, security)

- Green infrastructures should integrate picnic site quotas, derived from the available local landscape resources, local culture, demography, environmental and urban requirements.
- Multifunctional landscaping should address among others the picnic site matters;
- Public space approaches – including picnic activity regulations – should valuate local identity, unlike the uniformity enforced by the present picnic law.
- Picnic areas designation should rely on national standards, since they provide national landscape valuation; they involve as well landscape change, and its impact should be properly assessed in the case of sensitive sites. Based on the landscape provisions of The National Territory Planning, the picnic spots densities, as well as their setup and maintenance costs should rely on national standards.
- Public affluence areas should be designated in connection to picnic site social targets – those of local interest should remain the responsibility of the local authorities, but those of regional or national interest should be approached as touristic sites and be integrated in regional or national touristic policies.

Landscape sustainability relies on the integration of all the aspects involved in its structure and functioning on scales of space and time. Since picnic activity is one of landscape's characteristic functions, it is a must to integrate it among the other characters of the landscape. The sectorial approach of picnic planning and management can result in resource squandering, negative socio-economic system impact and even jeopardize landscape integrity.

REFERENCES

[1] *** 2011. Waldpark in Potsdam by Bureau B+B. http*://www.landezine.com/index.php/2011/03/waldpark-in-potsdam-by-bureau-bb/*

[2] *** 2012. Alevkaya picnic Area. *http://www.cyprus-properties.com/cyprus/alevkaya.htm*

[3] *** 2012. Heirloom Roses. *http://www.gardendesign.com/product/heirloom-roses*

[4] *** 2012. Lorem Ipsum. *http://www.lipsum.com/*

[5] *** 2002. *NODEX* (The New Explanatory Romanian Dictionary) [in Romanian]. Litera International Publishing. Bucharest

[6] *** 2012. Picture Gallery of Arnhem. *http://picture.bbnl.nl/picture-of-arnhem.html*

[7] Beekmans, Jeroen. 2011. Picnurbia: An Urban Picnic Landscape. *http://popupcity.net/2011/09/picnurbia-an-urban-picnic-landscape/*

[8] Chow, Emma. 2012. Parking Lot Picnic. The Pop-up City blog. Amsterdam. Netherlands. *http://popupcity.net/2012/05/parking-lot-picnic/*

[9] Dascălu, Dragoş 2011. About the architect's Paradise (in Romanian). Arhi Forum. *http://arhiforum.ro/agora/despre-paradisul-arhitectilor*

[10] Department of Natural Resources, Environment, the Art and Sport 2009. Celebrate Picknick Day at Alice Springs Desert Park. Northern Territory Government Media Release. Australia. *http://www.nretas.nt.gov.au/__data/assets/pdf_file/0004/8482/20090727_picnic_day_asdp.pdf.*

[11] Landscape Institute, 2009. *Green infrastructure: connected and multifunctional landscapes. Landscape* Institute position statement. London

[12] Marcu, Florin 2000. *The Great Neologisms' Dictionary [in Romanian]*. Saeculum Publishing. Bucharest

[13] Milwakee Sentinel 1953. Picnic Law OK'd. Milwakee Sentinel 269(66): 25. *http://news.google.com/newspapers?nid=1368&dat=19530506&id=7pQxAAAAIBAJ&sjid=rQ8EAAAAIBAJ&pg=5377,2154725*

[14] Romanian Parliament. 2012. *Law 54/2012 regarding the picnic activities carry on*. The Official Monitor 201(1). Bucharest

[15] Spacing Media 2010. Rulebook: a drink in the park. Spacing Montreal. *http://spacingmontreal.ca/2010/05/01/rule-book-a-drink-in-the-park*

[16] Stupid Laws 2011. In cemeteries it is illegal to: get drunk, picnic, enter at night, and enter by one's self if that person is younger than 10 – United States – New Hampshire – Claremont. *http://www.stupidlaws.com/in-cemeteries-it-is-illegal-to-get-drunk-picnic-enter-at-night-and-enter-by-one%E2%80%99s-self-if-that-person-is-younger-than-10/*

[17] Vanslembrouck, Isabel; Van Huylenbroeck, 2005. *Guido*. Landscape Amenities.

[18] Vermont Agency of Transportation 2002. Pedestrian and Bicycle facility planning and design manual. Chapter 9: Landscaping and amenities. Vermont. USA. *http://www.google.ro/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&ved=0CEkQFjAA&url=http%3A%2F%2Fwww.aot.state.vt.us%2Fprogdev%2FPublications%2FDocumentsPUBLICATIONS%2FPedestrianandBicycleFacilityDesignManual.pdf&ei=5LD7T87YD4X1sga8kvTdBQ&usg=AFQjCNG11bM9W_KpFVTkjl0c0py6rJ6Ngw&sig2=f-medb1qOBTgokgiR1QN9A*

[19] Waltert, Fabian; Schläpfer, Felix. 2010. Landscape amenities and local development: A review of migration, regional economic and hedonic pricing studies. Ecological Economics 70(2):141-152. Elsevier. *http://www.sciencedirect.com/science/article/pii/S092180091000390 3*

[20] IUCN, Metsahalitus and WCPA 2010. *The Diversity of Sacred Lands in Europe.* Preceedings of the Third Workshop of Delos Initiative. Inari / Aanaar

Scientific Papers, Series B, Horticulture, Vol. LVI, 2012
CD-ROM ISSN 2285-5661, ISSN-L 2285-5653

RECREATIONAL POTENTIAL OF DANUBE WATERFRONT SEGMENT IN NOVI SAD

Radmila LAZOVIĆ [1], Marija BLAŠKOVIĆ [2]

[1]Faculty of Agriculture, Department of Landscape Architecture, University of Novi Sad, 8 Trg Dositeja Obradovića, 21000 Novi Sad, Serbia, Phone: +381 21 485 3460, E-mail: rlazovic@polj.uns.ac.rs
[2]Landscape architect, 8 Patrijarha Čarnojevića St., 21000 Novi Sad, Serbia, Phone: +381 21 634 1948, Email: blaskovic.marija@gmail.com

Corresponding author email: rlazovic@polj.uns.ac.rs

Abstract

The purpose of this research is to examine the potential of a segment of the Danube waterfront in Novi Sad for recreational and leisure activities. Today, the significance of the waterfront has been re-evaluated and it has become a great asset for the city, not only for the riparian ecosystem, but also in terms of public open space. The segment included in this research is a part of left Danube waterfront in Novi Sad, Serbia. The segment is a 50 m wide area, starting from the delta of the irrigation canal Danube-Tisza- Danube up to the city outskirts. It includes the river embankment and the safety zone, green areas and riverfront brownfields. The area is analysed from the aspect of land use, accessibility and availability of open space for recreational use in terms of urban equipment, maintenance and design. Furthermore, the inventory of the facilities for leisure, recreation and tourism is made. The results show that the accessibility of the Danube waterfront in Novi Sad is not satisfactory, neither in terms of water accessibility nor in terms of the access to the analysed area from the city. For the purpose of activating this area of the city as a green-blue infrastructure, the results of the analysis should be implemented by connecting, redesigning or introducing the area into the coherent system of public open space.

Keywords**:** *accessibility, Danube waterfront, Novi Sad, recreational use*

INTRODUCTION

In modern cities, with densely built areas, that have a tendency of further density increasing, waterfront is recognized as a very important structure. According to Marshal, especially in these areas we are in the position to "isolate and realize specific answers to problems of amorphness and confusion of contemporary urban space." [3].
Problems of development and significance of the waterfronts must therefore be dealt with multi-disciplinary approach in order to respond to wider social interest [2].
The utility function of streams is reflected not only in the importance of waterfronts in the system of public green areas, but also in their recreational potential. Recreation programs are not merely improvement of physical skills, but a set of activities that give individuals the change of pace in relation to work and improve the quality of life in the city. Waterfronts as a system of public green areas with high environmental values are an adequate place for the introduction of these activities.
Novi Sad is one of numerous towns in Vojvodina that was founded by the river. Although in the present day flooding of the Danube River has been largely under control, the town is still separated from its waterfronts, and with low usage of recreational potential of the river. Planning principles that would overcome these problems are to be found in the modern tendencies of planning and design of urban open space which are based on the freer usage of and relationship with open green spaces [4].

MATERIAL AND METHOD

Research included left bank of the river that belongs to the municipality of Novi Sad from the mouth of the Danube-Tisa-Danube Canal to the end of the cadastral municipality.

The area is designated as coastal zone and includes: the river bank, coastal land width of 50 m according to the Water Act [5], as well as areas that are functionally, programmatically, or physically in continuance to this belt. Nearby park areas, objects and facilities for hydro technical procedures are functionally related to the river, while the outdoor sports facilities, as well as the old city centre are programmatically related to the waterfront.

Spatial analysis included the aspect of land use, accessibility and availability of open space for recreational use in terms of urban equipment, maintenance and design. Furthermore, the inventory of the facilities for leisure, recreation and tourism is made.

The area is analysed from the aspect of quality and maintenance of existing open green space regarding the state of greenery and equipment, street furniture, organization and maintenance of paths and general organization of space. The accessibility of public space was also taken into consideration.

The following are the major categories in terms of improving recreational resources:

1. Unmaintained open spaces - refers to areas that are left to natural succession, do not have the equipment, the tracks are spontaneously formed or are not maintained.
2. Poorly maintained open spaces - this category refers to the open spaces that are not equipped with street furniture, adequate infrastructure, with lack of maintenance, and because of this the possibility of its usage is reduced.
3. Well maintained open spaces - this category includes areas that are equipped with street furniture, vegetation is maintained, with developed facilities and programs for leisure activities.
4. Inaccessible open spaces - in this category are included areas that are not available to public usage hence of its disrespect for the principle of public usage of river banks.

The analysis of the accessibility of Danube waterfront aimed to provide information about the movement pattern within the waterfront zone and between the waterfront and the urban areas. By improving deficiencies in this pattern, firm connections and involvement of all segments of the waterfront into urban fabric are consequently to be achieved. It covered the existing modes of transport from the aspect of availability of uninterrupted access to the waterfront, in particular to the water. Likewise, the communications which link together all segments of the shoreline were indicated. The following categories were defined:

1. Correlation between shoreline segments for pedestrian communication - pedestrian path along the waterfront.
2. Access to the embankment for pedestrians - paths that provide direct access to pedestrians and access by road, which is regulated by traffic lights are taken into account.
3. Access to water for pedestrians - access for pedestrians is provided directly to the water in the form of trails or stairways.
4. Access to motor vehicles - maintained trails available for motor vehicles that provide direct access to the water.
5. Feasibility of motor vehicle traffic along the waterfront segments - traffic routes along the waterfront.
6. Access to the embankment for motor vehicles - roads that provide direct access to the river bank and have parking spaces that do not obstruct other traffic participants were taken into consideration.
7. Access to the embankment for service vehicles - an embankment sections that allow the passage of service vehicles.
8. Access to embankment from bicycle route - describes the connection between waterfront segments and urban areas for bicycle traffic.
9. Access to waterfront by means of public transportation - stations of public transport.
10. Seasonal access to water - is the access for small boats.
11. Access for boats - an access to the large, cruise ships.

Likewise, inventory of programs that meet user needs for leisure and recreation (sports fields, playgrounds, water sports, shopping and catering facilities) was done. Inventory also included protected cultural and natural resources.

1. Outdoor sports facilities - this category includes public outdoor sports facilities. Sports that are represented are: football, basketball, tennis, bowling, athletics, beach volleyball, mini golf.

2. Children's playgrounds - this category includes all public children's playgrounds.
3. Beaches – includes only equipped, maintained beaches.
4. Water sports - this category includes water sports clubs, both public and private. These are kayak and canoe clubs, sailing clubs, yacht clubs.
5. Accommodation and catering facilities - restaurants, cafes, bars, resort, clubs.
6. Running trails
7. Bicycle lanes
8. Protected areas and landmarks – natural and cultural heritage, historical sites, landmarks, and archaeological sites.

RESULTS AND DISCUSSIONS

Analysis of suitability of waterfront segment for recreational usage in terms of maintenance and design showed that the majority of open green space is under-maintained and unequipped and the rest of the greenery are forests that are left to natural succession.
Unmaintained open spaces (Table 1) are characterized by an unfavourable organization of pedestrian paths, access roads and illegal parking lots are present along the river bank, while other roads are earthy, unfurnished. Spaces are not equipped with street furniture or lighting. The vegetation is dense and impenetrable, left to natural succession. Periodically, illegal waste dumps and parking lots are formed (Figure 1).
Apart from that, these unregulated areas are the last parts of indigenous vegetation within the settlement and the richest ecosystems of the river corridor within the town, but in the present unfavourable condition for purposes of recreational and other leisure activities.

Table 1. Categorization of open spaces of Danube waterfront in Novi Sad in terms of recreational usage

Unmaintained open spaces	Poorly maintained / unequipped open spaces	Well maintained / equipped open spaces	Inaccessible open spaces
Kamenička ada	Univerzitetski park	Greenery along the embankment from the mouth of the canal DTD to Danube to the beach "Štrand"	Beach "Štrand" - partially
"Ribarsko ostrvo" peninsula	Omladinski park	Beach "Štrand"	Open spaces around the sports clubs along the flooding edge of the embankment
Green belt from Navy to the end of analysed waterfront segment	The greenery around access points to the bridge "Varadinska duga"	Greenery around the student dormitories	Open spaces around Navy and Shipyard
Green spaces from beach "Štrand" to Navy	Open green spaces of the Museum of Contemporary Art	Tourist resort "Ribarsko ostrvo " on Ribarsko ostrvo peninsula	
		Sports center "Đačko igralište"	

Poorly maintained, i.e., unequipped areas (Table 1) are characterized by maintained greenery, but there is no street furniture, trails, or design concept. For these reasons, these areas in its current state are not suitable for recreational purposes and other leisure activities (Fig.1).
Well maintained spaces (Table 1) were equipped and well connected with paths and street furniture, lighting, vegetation in good condition.
Inaccessible open spaces do not respect the principle of public usage of waterfront areas (entrance is allowed only to certain groups of visitors). Beach "Štrand" allows only seasonal usage of space and does not fully comply with the previously mentioned principle (entrance is only allowed for a fee).

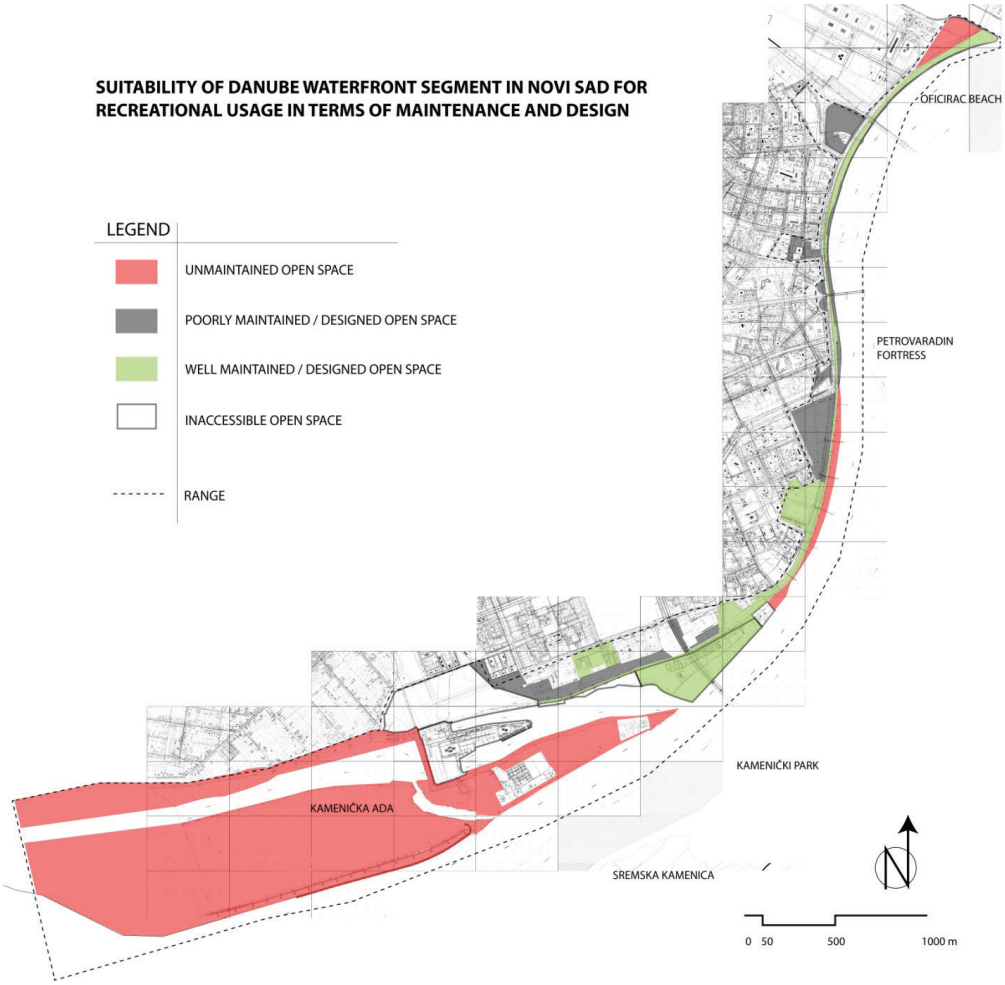


Fig. 1. Suitability of Danube waterfront segment for recreational usage in terms of maintenance and design

Accessibility analysis (Fig. 2) revealed that most of the waterfront segment (from the mouth of the channel DTD to the Navy) is connected via pedestrian and bicycle lines. Pedestrian access the embankment in the segment from the confluence of the DTD to Car Lazar Street was resolved with traffic light, which does not provide uninterrupted movement and reduces the overall availability of the embankment for pedestrians. There is no access for bicycle traffic. Access to means of public transportation is possible from the segment of the railway bridge to the beach "Štrand" and lines cover most of the urban areas, while the rest of the waterfront areas are not covered by public transportation. All segments of the embankment are available to motor vehicles, but there is a lack of parking lots, resulting in the present large number of illegal parking (car parks and roads that do not have adequate parking is not marked on the map, because it does not provide adequate access to the embankment for motor vehicles). Access to water in most segments is not safe, there is in the form of stairs or earthy, unregulated slopes (rough, spontaneously made tracks are not marked as adequate access to water).

Inventory of the facilities for recreational and leisure activities (Fig. 3) showed that for the entire area there are few children's playgrounds. Other facilities are mainly concentrated in the area of Sunny quay and the beach "Štrand" to the Navy.

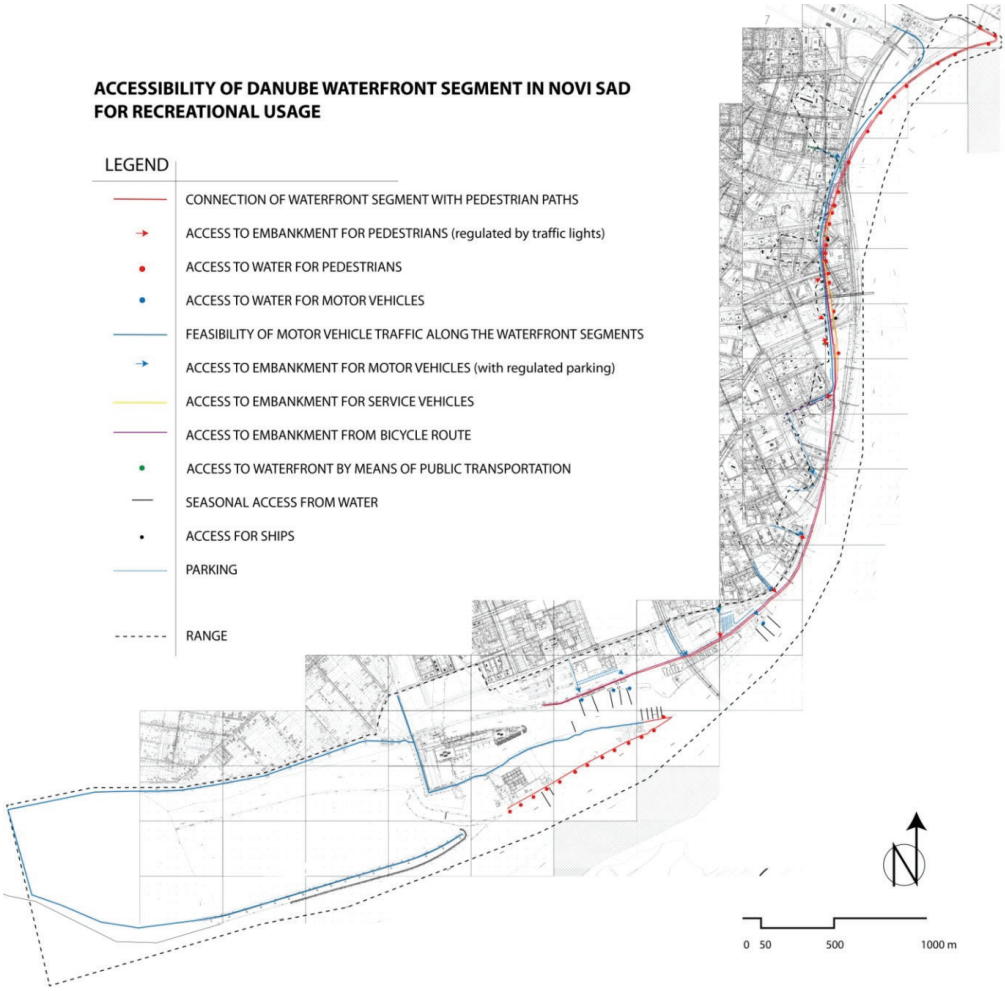


Fig. 2. Accessibility of Danube waterfront segment in Novi Sad for recreational usage

Areas from the mouth of the canal DTD to Car Lazar Street, and "Ribarsko ostrvo" peninsula facilitate a much smaller number of contents for recreational or leisure activities.

CONCLUSIONS

The utility function of streams is reflected in the importance of waterfront areas in the system of open green spaces in urban environment, but as well as a recreational area. To make the space functional, it needs to be accessible to all, linked to other green spaces in the city and hinterland, and to offer a variety of programs, tailored to the needs for recreation and that is attractive to visiting. "Recreational programs are helping people to develop interests and skills that enable them to constructively use their leisure time, which affects the physical and mental health, safety, community belonging, confidence and character development." [1].

In order to determine program offerings and recreational potential of the Danube waterfront segment in Novi Sad spatial analyses were made which included an analysis of accessibility, quality of maintenance and design and inventory of significant spaces for leisure activities according to defined categories.

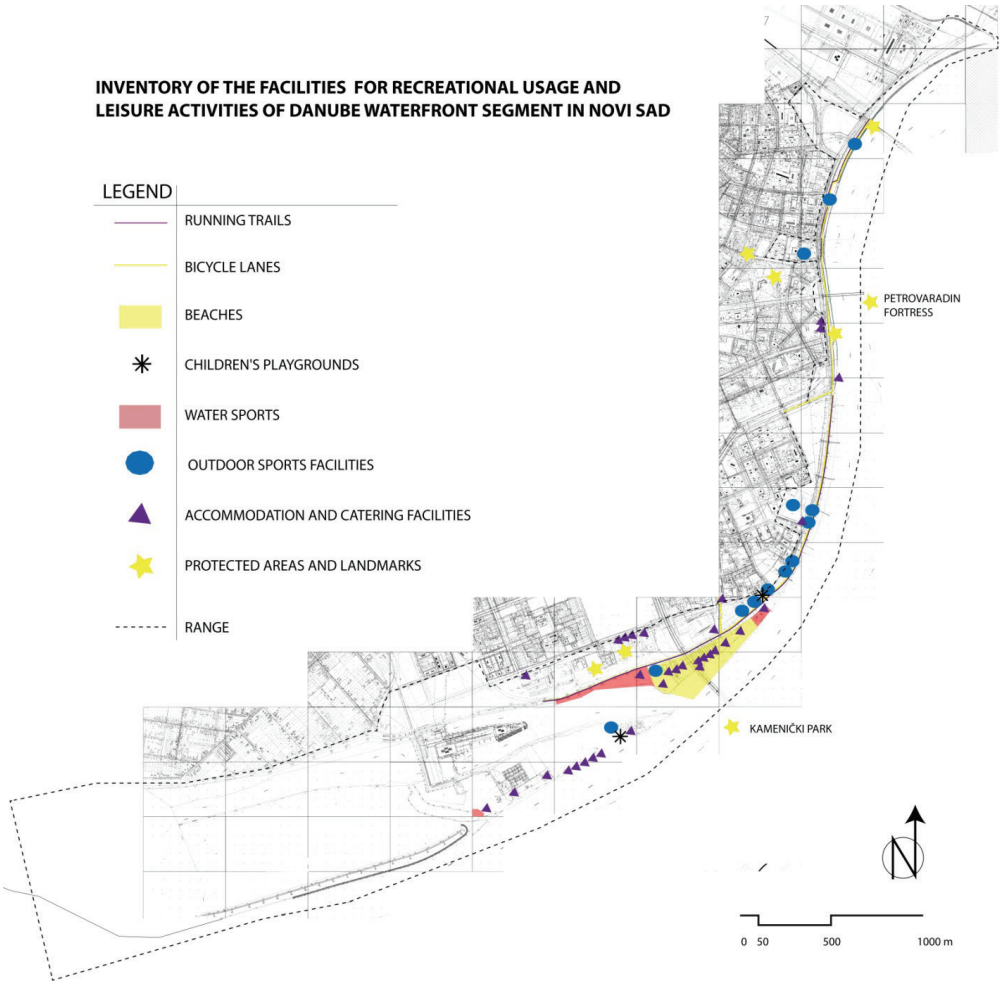


Fig. 3. Inventory of the facilities for recreational and leisure activities of Danube waterfront segment in Novi Sad

Results of analysis showed that in terms of recreational program waterfront areas do not satisfy user needs for recreational purposes, and that the river is insufficiently accessible from urban areas, green spaces are largely unequipped and under-maintained and that there are not enough facilities for leisure activities that rely on the proximity of water. Waterfront areas are mostly well-connected with pedestrian and bicycle paths, and connections to other parts of the city varies. Apparent is a need for new planning and design of open spaces, particularly in locations that are left to natural succession and insufficiently accessible.

REFERENCES

[1] Guggenheimer E.C., 1969. *Planning for Parks and Recreation Needs in Urban Areas. The center for New York City Affairs, New School for Social Research*. Twayne Publishers, Inc. New York.

[2] Hladnik J., 1998. *Vodni in obvodni prostor kot del integralnega prostorskega vrejanja, in: Zbornik 5. letnega strokovnega srečanja društva krajinskih arhitektov Slovenije*, Voda: raba, varovanje, oblikovanje, Ljubljana, p. 40.

[3] Marshall R., 2004. *Waterfronts in post-industrial cities*.Taylor & Francis, London, p.4.

[4] Thompson C. W., 2002, *Urban open space in the 21th century.* Landscape and Urban Planning, 60:59-72

[5] Water Act, 2010. *Službeni glasnik Republike Srbije* 30/10.

Scientific Papers, Series B, Horticulture, Vol. LVI, 2012
CD-ROM ISSN 2285-5661, ISSN-L 2285-5653

LIVABLE URBAN SPACES. PUBLIC BENCHES AND THE QUALITY OF DAILY LIFE

Alexandru MEXI, Ioana TUDORA

University of Agronomic Sciences and Veterinary Medicine Bucharest, 59 Mărăşti; Landscape Architecture, Biodiversity and Ornamental Horticulture Department. 59, Bd. Marasti, 011464, Bucharest, Romania, tel./fax +4021.318.36.36, gomealx@yahoo.com, itudora@gmail.com

Corresponding author email: itudora@gmail.com

Abstract

The contemporary urban politics are facing an important paradigm shift. The quality of life became the central topic of new development plans and the public space represents the cornerstone of urban planning. In this context landscape architecture plays an important role and landscape "soft" methods are replacing the "hard" urban design instruments. Our paper will analyse an apparently dull and simple object – the bench. Starting from a series of observation on Bucharest urban design we will try to define the "perfect bench" starting from some basic qualities that this object, apparently banal, should accomplish in order to assure a real quality of urban space and a pleasant experience: comfort, security, shelter, design, location are some of the characteristics that are guiding our analyse. The study is based on participatory and non-participatory observations and questionnaires realised in several Bucharest's public spaces in order to understand how people are perceiving these qualities and how good or bad design can influence the public life and the success of a landscape project. The observations and questionnaires are structured around a matrix inspired by Jan Gehl's analyse of public spaces quality [1]. The study shows the lack of concern with quality in public space design in Bucharest. Formalism, stereotypes, overloading with useless, ugly, uncomfortable and aggressive urban furniture as well as a low quality design of the overall space determine a dissatisfaction concerning the city's public spaces. In order to enjoy the urban experience and to create successful public gardens, parks or squares a special attention should be given to a simple, yet complex object as the public bench.

Key words**:** *public space, quality design, bench, comfort, liveability*

INTRODUCTION

The aim of the paper is to bring a better understanding of the public bench and its role in the general comfort of the public space. As Jan Gehl shows in his analyses the possibility of sitting is one of the most important features of the urban space when talking about comfort [2]. There are two main aspects when we analyse the public bench from the public space comfort perspective. The first aspect is concerns the bench itself, its design. The second one concern the relation with the space: arrangement, shelter, views, distances. In this general context our research tried to find how benches are adapted to a particular kind of public space: the urban gardens and parks. This kind of spaces, conceived for relaxation and rest, are demanding a greater attention to comfort, giving possibilities to spend and sit longer periods of time. Thus a bench in a park should be conceived in such a way that will offer great comfort and also great relation to the green space. As Steven Bourasa put it "briefly, people love landscapes with panoramic views and large places from which to observe them. They also prefer those places to be equipped with convenient refuges and they mainly dislike opened areas with no shelter. They also prefer places that not only have something to show, but they also have areas to explore" [3].

MATERIAL AND METHOD

In The research was led in two Bucharest's main green spaces in the central area: Cişmigiu Garden and Izvor Park. The two spaces were chosen for their central position in the city and for their general characteristics. The two spaces were created in different centuries, representing different socio-cultural paradigms and having a totally different ambiance and design, even if Cişmigiu was a source of inspiration for Izvor Park. The observations where done *in situ* during the autumn period. Our method was based on Gehl's perspective on the public space liveability and quality.

We tried to observe the manner the benches are used, the degree of comfort they are offering and their relation with the surrounding space in order to create interesting views and their capacities to create “talkscapes” [4].

The public bench is a functional object, but a bench stands for much more than function. This way, characteristic to it is the design as well as the comfort, material quality and the materials themselves, the location, the dimensions, the proximity to interest points, the security, and the correlation with the space around it and the shelter form bad weather. In order to do a survey concerning the public benches we tried to structure all the qualities that a bench should fulfil in order to satisfy all the demands in a matrix similar to Gehl’s one.

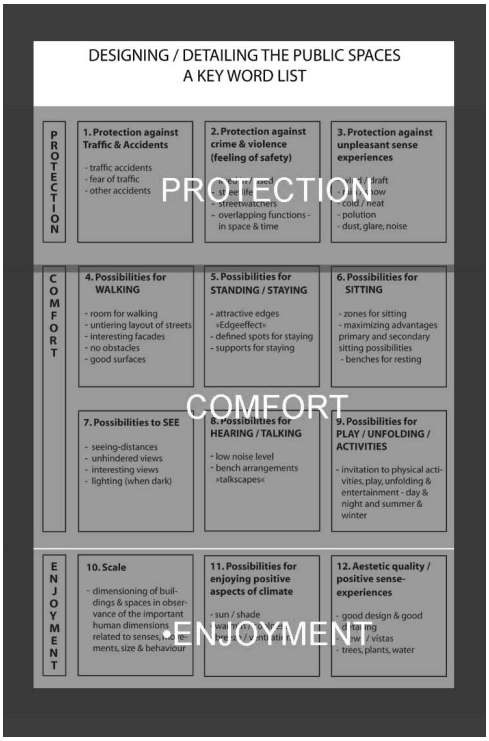


Fig. 1. 12 criteria of quality for pedestrian landscape cf. Jan Gehl, EFLA Regional Congress, Tallinn, 2011, in Gehl, 2012, p. 239

All of these characteristics should be interconnected, regardless of the category they belong to. Though, their separation helps to a better understanding of what a “perfect bench” should mean.

Objective characteristics	*DIMENSION*	*PROXIMITY*	*MATERIALS*
Subjective characteristics	*OBJECT SPECIFIC COMFORT*	*SHELTER*	*SECURITY*
Aesthetics	*STYLE ADEQUANCY*	*LOCATION*	*DESIGN*

Fig. 2. Analyse matrix of a bench features

Also, dividing according to the importance of a category helps to establish the pre-construction principles of a bench, on such a way, this bench will be able to take into account all of the nine general characteristics and to get closer to the idea of total comfort.

Thus, a bench should accomplish a series of qualities of different types:

- **Objective characteristics**

Are easy measurable and related to the material reality of the bench or of the space.

- ***Dimension.*** The dimensions of public benches are of great importance due to the fact that they, almost entirely, make up the comfort of a bench. Its length, but most important, its backrest height and the dimension of its seat define a bench and its grade of usage. According to ergonomic studies and architectural standards, the ideal dimensions are: 0.45 m height of the seat above the ground, 0.27 m height of the backrest, 0.45 m width of the seat and 110-120° between the seat and the backrest, and a 0 to 30° of the seat and the ground. Though there are mentions for the length of a bench: 0.6 m per person and 2 m for 3 persons, those dimensions are not as important due to the fact that they influence comfort the least.

- ***Proximity***. This quality refers to the physical distance between a bench and an interest point or centre. This centre can be a cultural, social or personal one; this means that a bench must be placed where it may be used. The interest centre may be an intimate one, a public or a social one and even one’s own home. For elders, most of the time, their own house serve as a centre of interest, as a bench placed nearby can make them leave their house for a short walk; a public plaza where benches are placed can work as a meeting or waiting place; a public park or garden where such urban

furniture is available serve as a recreation area; a set of benches located near a monument can be used by tourists, etc.

- ***Materials***. A very important aspect in designing a public bench is the material of which it will be made of. The main aspect to take into consideration is the comfort of the material or the materials both in summer and in winter. There are not to be neglected aspects like the aesthetics of the materials, its costs and its durability in time. Depending on the location of the bench, materials can be different; this way, outdoor materials are meant to endure sudden temperature rise/decrease and humid/dry changes; while indoor materials can be part of a wider range of products.

- **Subjective Characteristics**

Subjective characteristics are related to the personal perception that somebody could have about a bench. Based on the objective characteristics the subjective ones are also related to personal preferences, needs, habits or taste

- ***Object specific comfort.*** Comfort while sitting is probably the most important quality when it comes to public benches. Most of the time, seeking to rest, the first impulse and thought is to find a comfortable bench to lie on. Comfort is about how somebody's rest, about the pleasure he/she takes in sitting, touching, seeing and even in standing up again. This quality is also influenced by materials or dimensions, but it is also subjected to personal preferences or physics. A tall person might prefer a higher bench while an old person will prefer a bench without sit inclination. Also the psychical aspects or interests are important: a higher bench might be more appropriate for observing other people actions. A tired person might prefer a deck chair.

- ***Shelter***. A bench is an invitation to rest. For this reason only, in order to rest, you may need sometime a shelter as well. A shelter might be needed against bad weather, against noise or against other people. A shelter may be build artificially or naturally. Artificial shelter may be a canopy, a small construction that has to integrate the bench, etc. Also, semi artificial shelters are the ones built and covered mostly with climbing plants. Natural shelters are made by trees or other plants that can offer shadow or intimacy. Burke associates the category of sublime a feeling of "delicious fear". The sight of danger inspires terror as long as the threat is straight. From a certain distance, sheltered from the observed danger, fear is combined with a delicious pleasure. [5]. Though in this context, danger does not mean risk, it can stand for threat. For example, the threat from a coming storm is transformed into pleasure when you get sheltered from it and still in the middle of the storm.

- ***Security***. The security of a bench mainly refers to the materials of which it is made of, but also to its location. A bench characterized by trust and safety will surely be much more relaxing than one missing this quality. However, security can be deceiving and this can make it much more interesting.

- **Aesthetics**

Apparently, the least important characteristic is Aesthetics. The aspect of a bench doesn't seem to be a determining element concerning comfort, but in fact the pleasure we take in sitting on a bench is strongly influenced by the design or by the correlation with the space nearby.

- ***Style adequacy*** .An important element in order to experience pleasure is the style and the coherence of the entire space. In this sense the design of a bench should be correlated with the entire layout and the style of the garden of park. Benches should fade in, they should be part of the landscape, even if the contrast to it or not. The beauty of an object might be disturbing in an inadequate context, and thus both the object and the space can be ruined from aesthetical point of view. The excess and misusage of great design objects in the public space today leads to visual chaos and lack of meaning of the public space. Mostly in historical gardens discretion and style adequacy are needed, in order to emphasize the quality of the entire space instead of the quality of a strange and alien object.

- ***Location***. The position of a bench is a rather important characteristic. Due to the fact that the bench represents an invitation to rest, this quality will be noticed easier or not, depending on the place where the bench is placed. Also depending on the place it's placed in, the public bench can be designed and used for a longer or

shorter rest. An example would be the bench placed in a bus stop for a short rest and a bench in a public park or garden, for a longer rest. A bench's location is also about the physical and visual relationship with space, location also becoming similar to sight.

Location depends on a series a factors, the most important being the quantity of shade and/or sun over the bench. As Christopher Alexander putted it "people use public spaces if it is sunny, otherwise they tend not to, excepting those living near deserts" [6]. Though, cultural, social and climate aspects interfere in this topic. Alexander analyse was referring Great Britain, where the weather is mostly cloudy and rainy, sunny days being fewer than rainy days. Alexander's point of view is perfectly objective for this context, but it does not apply to areas with different weather. However, he does not states it is a general truth. Bucharest, from this point of view, is a very demanding city. If in early spring, late autumn or even the winter we might love the sun as much as British people during the hot summers the need for shadow became a real problem on streets as well as in parks and gardens.

- ***Design*** .The design of an object, in this case of a bench, as a characteristic, is probably the most important when it comes to the economical value of this piece of urban furniture. A bench with a unique design will draw attention and many will be curious to sit on it. The issue is that, when the other characteristics are neglected, and the bench, as impressive as it is, will not be used as much as it was intended to. Also some new designs are in fact unusable, uncomfortable and the only effect is the visual one. Having in mind this analyse matrix we realised an inquiry concerning the central area green spaces of the city: Cişmigiu Garden and Izvor Park. The main methods we used were participatory observations and interviews.

RESULTS AND DISCUSSIONS

Cişmigiu Garden

Cişmigiu garden was designed in the middle of the city, as a green area for relaxation and recreation for the citizens of Bucharest by the landscape architect Carl Friedrich Wilhelm-Meyer, who "foreseen the importance the garden will have in the Romanian society. In his notebook he requested buying and plating 200 benches in the garden, considering that they will still not be enough" [7]. According to Salma El-Shamali on the central axis, initially made up by three alleys with a double alignment of white poplars, numerous benches were placed. They were placed after Meyer observed that one of the most concerns of the time was the so called "urban gossip in Bucharest", and the benches located on the exterior alleys were placed for this purpose alone. [8]. Due to a large number of benches, Cişmigiu garden was and still is one of the most appreciated public city spaces for relaxation.

Case1.

Fig. 3 Bench row in Cişmigu.
Photo Alexandru Mexi

Though it cannot be said about this kind of benches that they have a very esthetic appearance, they are comfortable, and the wood is quite warm and pleasant for this period of time. Also they are shadowed during the summer, when they are intensively used.

Objective characteristics	*DIMENSION*	~~*PROXIMITY*~~	*MATERIALS*
Subjective characteristics	*OBJECT SPECIFIC COMFORT*	~~*SHELTER*~~	*SECURITY*
Esthetics	*STYLE ADEQUANCY*	*LOCATION*	~~*DESIGN*~~

Case 2.

Fig.4 Benches in Cişmigu. Photo Alexandru Mexi

Though those benches are as comfortable as the precedent, their aspect and location does not work as well as in the first case. The bad commissioning gives a sense of insecurity and a bad and uninteresting image of the place.

Objective characteristics	DIMENSION	~~PROXIMITY~~	MATERIALS
Subjective characteristics	OBJECT SPECIFIC	~~SHELTER~~	~~SECURITY~~
Esthetics	~~STYLE ADEQUANCY~~	~~LOCATION~~	~~DESIGN~~

Case 3.

Fig.5 Benches in Cişmigu. Photo Alexandru Mexi

Despite its ugliness, this type of public bench is appreciated by most of the people, paradoxically, due to its design and to the fact that it is comfortable. It is used as a piece of urban furniture for security and proximity to an interest point: the playground.

Objective characteristics	DIMENSION	PROXIMITY	MATERIALS
Subjective characteristics	OBJECT SPECIFIC COMFORT	~~SHELTER~~	SECURITY
Esthetics	~~STYLE ADEQUANCY~~	LOCATION	~~DESIGN~~

Case 4.

Fig.6 Bench in Cişmigu. Photo Alexandru Mexi

This bench blends in the landscape due to its design. The interesting location also might give quality to this spot. But the height of the bench as well as its general dimensions and the present conservation condition does not make it usable.

Objective characteristics	~~DIMENSION~~	PROXIMITY	MATERIALS
Subjective characteristics	~~OBJECT SPECIFIC COMFORT~~	~~SHELTER~~	~~SECURITY~~
Esthetics	STYLE ADEQUANCY	LOCATION	DESIGN

Case 5.

Fig.7 Chess players place in Cişmigu.
Photo Alexandru Mexi

Though all of the public furniture above is uncomfortable, the fact that it serve certain activities and that their position: in an intimate place, both on shade and under the sun, their placement makes them attractive.

Objective characteristics	~~DIMENSION~~	PROXIMITY	MATERIALS
Subjective characteristics	~~OBJECT SPECIFIC COMFORT~~	SHELTER	SECURITY
Esthetics	STYLE ADEQUANCY	LOCATION	DESIGN

Case 6.

Fig.8 Bench in Cișmigu. Photo Alexandru Mexi

This is a comfortable and stable bench, and due to the fact that it stands near food stands and on the sun, makes it usable and used, but only during this part of the season, despite the ugliness of the place.

Objective characteristics	DIMENSION	PROXIMITY	MATERIALS
Subjective characteristics	OBJECT SPECIFIC COMFORT	~~SHELTER~~	SECURITY
Esthetics	~~STYLE ADEQUANCY~~	~~LOCATION~~	~~DESIGN~~

Case 7.

Fig.9 Bench in Cișmigu. Photo Alexandru Mexi

Those benches, beside of their location in the sun and near food stands are used also because they are placed near the main entrance.

Objective characteristics	DIMENSION	PROXIMITY	MATERIALS
Subjective characteristics	OBJECT SPECIFIC COMFORT	~~SHELTER~~	SECURITY
Esthetics	~~STYLE ADEQUANCY~~	~~LOCATION~~	~~DESIGN~~

Those benches illustrate better the concept of placing in the sun/shade, depending on the season. Here, nor the comfort, nor the design and nor the security are defining, but the location.

Case 8.

Fig.10 Benches in Cișmigu. Photo Alexandru Mexi

Objective characteristics	DIMENSION	PROXIMITY	MATERIALS
Subjective characteristics	OBJECT SPECIFIC COMFORT	SHELTER	SECURITY
Esthetics	STYLE ADEQUANCY	LOCATION	~~DESIGN~~

Izvor park

Izvor Park was born on the ruins of two most beloved neighborhoods of Bucharest: Uranus and Izvor (the second giving the name of the park). The flat landscape of Izvor Park cannot suggest that here raised before a hill, with a monastery on top (transformed in the State Archives). The hill vanished as well as the neighborhoods which once with the communist systematization and the foundation of the House of People. The space stays as a scarce for part of Bucharest people while others are ignoring the past of the site.

Case 1.

Fig.11 Bench in Izvor Park. Photo Alexandru Mexi

The location of these benches is not attractive at all due to the nearby toilet and garbage trunk. However, the bench has a simple and comfortable design and it is placed near the entrance.

Objective characteristics	DIMENSION	~~PROXIMITY~~	MATERIALS
Subjective characteristics	OBJECT SPECIFIC COMFORT	~~SHELTER~~	SECURITY
Esthetics	STYLE ADEQUANCY	~~LOCATION~~	DESIGN

Case 2.

Fig.12 Bench in Izvor Park. Photo Alexandru Mexi

The fact that this bench is placed in the sun and it has a comfortable and simple design compensate the fact that it stands a nearby garbage bin and too near to a bicycle line.

Objective characteristics	DIMENSION	~~PROXIMITY~~	MATERIALS
Subjective characteristics	OBJECT SPECIFIC COMFORT	~~SHELTER~~	~~SECURITY~~
Esthetics	STYLE ADEQUANCY	~~LOCATION~~	DESIGN

Case 3.

Fig.13 Bench in Izvor Park. Photo Alexandru Mexi

Though those benches are comfortable, the fact that they stand to near to the garbage bin makes them not so welcoming.

Objective characteristics	DIMENSION	~~PROXIMITY~~	MATERIALS
Subjective characteristics	OBJECT SPECIFIC COMFORT	~~SHELTER~~	SECURITY
Esthetics	STYLE ADEQUANCY	~~LOCATION~~	DESIGN

Case 4.

Fig.14 Bench in Izvor Park Photo Alexandru Mexi

This bench is not welcoming because it seems to be stranded and because it has a garbage bin as only neighbor.

Objective characteristics	DIMENSION	~~PROXIMITY~~	MATERIALS
Subjective characteristics	OBJECT SPECIFIC COMFORT	~~SHELTER~~	SECURITY
Esthetics	STYLE ADEQUANCY	~~LOCATION~~	DESIGN

Case 5.

Fig.15 Bench near Izvor Park. Photo Alexandru Mexi

"Build bus stops as the will form small public centres […] so they will work with other kind of activities such as a newspaper stand, **different bench designs,** shops, café's, tree designs, interesting crossings, public baths, squares…" [9] This public bench belongs to the bus stop at Izvor park. This bench is totally uncomfortable having a straight backrest, a loudly electric generator behind, a dull, unattractive view, to not mention the design. This kind of urban design will never generate a small public centre.

Objective characteristics	~~DIMENSION~~	~~PROXIMITY~~	MATERIALS
Subjective characteristics	~~OBJECT SPECIFIC~~ ~~COMFORT~~	~~SHELTER~~	~~SECURITY~~
Esthetics	~~STYLE ADEQUANCY~~	~~LOCATION~~	DESIGN

Case 6.

Fig. 16. Lawn in Izvor Park Photo Alexandru Mexi

Though it is not a public bench, this small hill is very comfortable, it has a pleasant sight etc. Unhappily, the fact that it is not a build/designed object is not so welcoming for the citizens of Bucharest.

Objective characteristics	DIMENSION	PROXIMITY	MATERIALS
Subjective characteristics	OBJECT SPECIFIC COMFORT	SHELTER	SECURITY
Esthetics	STYLE ADEQUANCY	LOCATION	DESIGN

CONCLUSIONS

Our research reached in the end a paradoxical conclusion. Despite the large public scandals and number of articles about the excess of plants, benches and the general overdesign of the public spaces of Bucharest [10], no good public bench was to be found in the central parks of the city. The design is often of bad quality, the interest for good location and interesting views is absent. In this context however people are interested, or at least are paying attention to some details concerning the urban landscape. Thus, from our questionnaires made in Cişmigiu, we found out that people are appreciating mostly the comfort while sitting, the proximity and location aspects of the benches in the garden. They are less impressed by design, security, dimensions and design. Nor shelter, style or materials are important for them.

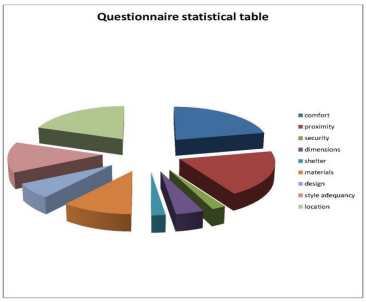


Fig. 17. Cişmigiu questionnaire statistical table

On another hand few people made comments about the lack of suitability of the new benches design in a historical park, part of Romanian heritage. In what concerns Izvor park the result are somehow similar, the comfort seems to be less important and material of the bench gains some attention. On the contrary, the style is even less important, fact that is easy to explain by the lack of character of the entire park.

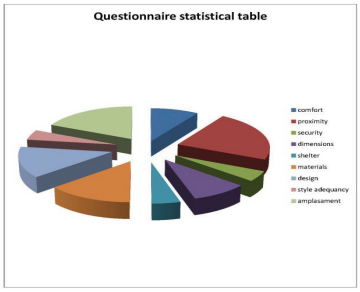


Fig. 18. Izvor questionnaire statistical table

This lack of interest for design or style as well as for location and vistas might be explained by a lack of aesthetical interest. But it will be the easy way out. Other researchers showed the official lack of interest in public space quality and the imposition of kitsch as an official policy [11]. In this context we can interrogate if Cişmigiu and Izvor parks are specific case studies or part of a larger picture. At least for these two parks the analyse show that, for most of people using these public spaces, as long that we can sit, that is accessible and it has a minimal functionality a bench is already perfect. No other expectations to have from it. This sad conclusion underlines the lack of interest concerning the quality of both the historical park – Cişmigiu – or for the new landscape design of Izvor. Both parks are

highlighting the logic of quantity dominating when thinking about urban design.

As a final conclusion we consider that a bench might be "a symbol of success in a park […] when people come here to rest […] sleeping in public is the most natural thing in the world. If someone sits on pavement or on a bench and fails asleep, it is possible that this should be treated strictly as a need. […] Keep the landscape filled with **generous benches**, comfortable places, areas to sit on the grass or lie down on sand" [12].

Fig. 19 Public square in Helsinki. Photo Ioana Tudora

REFERENCES

[1] Gehl J. 2012. *Orașe pentru oameni.* Igloomedia, Bucharest, p. 239

[2] Gehl J. 2012. *Orașe pentru oameni.* Igloomedia, Bucharest

[3] Kovacs K., 2011. *Peisaj cu casa și gradină*. Ed. Simetria, Bucharest, p. 106

[4] Gehl J. 2012. *Orașe pentru oameni*. Igloomedia, Bucharest, p.148, 239

[5] Kovacs K., 2011. Peisaj cu casa și gradină. ed. Simetria, Bucharest, p. 80

[6] Christopher A., Sara I., Murray S., 1997. *A Pattern Language*. vol. 2. Oxford University Press, New York, p.514

[7] El-Shamali S. 2011. *Contribuții privind studiul creațiilor din România ale peisagistului Carl Friederich Meyer și punerea acestora în valoare în contemporaneitate.* PhD thesis, USAMV Bucharest, p.6

[8] El-Shamali S. 2011. *Contribuții privind studiul creațiilor din România ale peisagistului Carl Friederich Meyer și punerea acestora în valoare în contemporaneitate.* PhD thesis, USAMV Bucharest

[9] Christopher A., Sara I., Murray S., 1997. *A Pattern Language*. vol. 2. Oxford University Press, New York, pp.453

[10] Cişmaşu C., Crasnopolschi A., Culescu M., Tudora I., 2011. *Why we [don't] love palm-trees? Landscape design between local identity and exoticism*. Scientifical Paper Serie B - LV - 2011 Horticulture USAMV Bucharest: 276-283; Tudora I., 2008. *Landshaft Architektur in Bukarest*. Garten+Landshaft no.4, Munich; Tudora I. & alii, 2011. *The politics of kitch landscape design between local identity and exoticism*. EFLA Journal1-2011 – Political Implications of Urban Landscape: 44-47

[11] Cişmaşu C., Crasnopolschi A., Culescu M., Tudora I., 2011. *Why we [don't] love palm-trees? Landscape design between local identity and exoticism*, Scientifical Paper Serie B - LV - 2011 Horticulture USAMV Bucharest: 276-283; Tudora I., 2008. *Landshaft Architektur in Bukarest*. Garten+Landshaft no.4, Munich; Tudora I. & alii, 2011. *The politics of kitch landscape design between local identity and exoticism*. EFLA Journal1-2011 – Political Implications of Urban Landscape: 44-47

Gehl J. 2012. *Orașe pentru oameni.* Igloomedia, Bucharest

[12] Christopher A., Sara I., Murray S., 1997. *A Pattern Language*, vol. 2. Oxford University Press, New York, pp.458-459.


EX·TERRA·AVRVM

Scientific Papers, Series B, Horticulture, Vol. LVI, 2012
CD-ROM ISSN 2285-5661, ISSN-L 2285-5653

STUDIES ON THE COLLECTION OF ROSES IN THE "DIMITRIE BRANDZA" BOTANICAL GARDEN - BUCHAREST

Eduard Marius NEGULICI

Faculty of Horticulture**,** University of Agronomic Sciences and Veterinary Medicine, Bucharest, 59 Marasti, District 1, 011464, Bucharest, Romania, Phone: +40 21 318 25 64/232, Fax: + 40 21318 28 88, E-mail: marius.negulici@gmail.com

Corresponding author email: marius.negulici@gmail.com

Abstract

The "Dimitrie Brandza" Botanical Garden - Bucharest University was founded in 1860 and has an important role in preserving the diversity of plants species and varieties through collections. The Rosarium contains one of the most varied collections of roses. It was established on the present location during 1976-1978. Between 2008-2010 the rose collection was reorganized in a proportion of 80%. The rose collection represents an important source of germoplasma, which is used to create new varieties, but also an important base for studies regarding the responses of new varieties purchase. Researches are developing on these varieties regarding the phenological phases, biodynamic growth, phitopatology aspects and resistance to extreme conditions caused by temperature differences. Following these studies some of these varieties are to be added to nurseries and gardens in the southern part of Romania.

Keywords*: collection, roses, cultivars classification, studies, purposes*

INTRODUCTION

In Romania the rose research started in 1888 with W. Mühle and his 'Mme Josephine Mühle' rose variety and continued with his son A. Mühle who created 20 new varieties between 1923 and 1929. Rudolf Palocsay started to work in Cluj in the early 30's and was considered a very important rose breeder. After World War II he worked with Stefan Wagner, who continued to work with roses after the death of Palocsay. Wagner created more than 20 new varieties in his career; some of them being developed in collaboration with Gabriela Roman [1].

About the collection of roses from the Botanical Garden, initially the Rosarium, was founded on the place where the greenhouses are placed today. In the beginning it was the host of 200 varieties of roses. Judging by the pictures found in the Botanical Museum (Photo 1, 2, 3), we can say that there was an important collection of grafted roses, but also hybrid tea, floribunda and polyantha etc. Everything was lost during the bombardments of World War II [2]. Once the greenhouses were built (1976-1978), the rosary was moved to the place where it stands today.

An important step in the development of the Rosarium was made during the reorganization of 2008; time when there were almost 900 roses planted, representing over 100 new varieties. This led to the reconstruction of almost 80% of the whole rose collection (photo 4). Presently, the rosary takes up almost 0.7 ha of surface, showcasing 3500 plants, 200 varieties and 7 species (*Rosa gallica* L.*, Rosa wichuraiana* Crépin*, Rosa arvensis* Huds*, Rosa multiflora* Thunb.*, Rosa jundzillii* Besser*, Rosa canina* L.*, Rosa chinensis* (Jacq.) f. *viridiflora* C. K. Schneid. The results presented in this essay are a compendium of several works from PhD theses; regarding to the study of 10 varieties from a phenological phases [3,4], growth bio-dynamics, disease resistance aspects and also resilience to high temperatures [1,5], point of view.

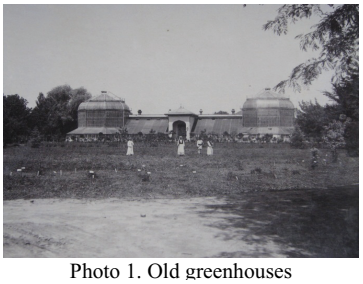


Photo 1. Old greenhouses

Photo 2. Aspects from the old collection

Photo 3. Aspects from the old collection

Photo 4. Present aspects

MATERIAL AND METHOD

The biological material for the studies is represented by 10 rose varieties, which were planted during 2008 and 2009 (‘Abraham Darby’, ‘Acapella’, ‘Angela’, ‘Caprice de Meilland’, ‘Christoph Columbus’, ‘Forever Young’, ‘Heritage’, ‘Ingrid Bergman’, ‘Rapsody in Blue’, ‘Red Berlin’). These varieties received the same climate conditions. Crop technology was done step-by-step in normal conditions, with spring cuts and also, cuts during the vegetation state for stimulating a new wave of bloom [1]. 2011 marked the beginning of the biodynamic growth, phonological phases studies and a study on the resistance to diseases and extreme temperature resilience.

Biodynamic growth was determined by measuring the longest shoot grown between May and November, once every 4 weeks [3, 4].
Phenological phases were visually determined during the most important steps (budding, leafing, blooming) [3, 4]
The disease resistance details were considered, by observing the plants resilience towards the most important pathogen agents: *Sphaerotheca pannosa*, *Phragmidium disciflorum*, *Diplocarpon rosae* [1,5]. The visual aspects were observed and verified in the mycology lab from the Faculty of Biology. Details regarding the resilience towards extreme temperatures were determined by observing wood loss after winter frosts; when spring cuts were performed in spring 2012 [1].

RESULTS AND DISCUSSIONS

The results of the observations were:
Regarding the budding and leaf phenological phases there were similarities recorded among varieties [3, 4]. Regarding early flowering 'Forever Young' (floribunda) was recorded as the earliest variety to bloom (May 19) the latest being 'Rhapsody in Blue' (June 7) (Table 1).

Table 1. Phenological phases for researched varieties

Variety	Budding	Leafing	Blooming
Abraham Darby	March 15	March 29	May 24
Acapella	March 15	March 29	May 30
Angela	March 15	March 29	May 23
Caprice de Meilland	March 14	March 29	May 24
Christoph Columbus	March 16	March 31	May 30
Forever Young	March 15	March 29	May 19
Heritage	March 15	March 29	May 25
Ingrid Bergman	March 15	March 29	May 26
Red Berlin	March 15	March 31	May 26
Rhapsody In Blue	March 15	March 31	June 7

Growth rate observed during May and November of 2011 is highlighted in Table 2, as well as in the graphs (Fig.1, 2, 3, 4).
Growth speed was influenced by suppression of past flowers along with some brushwood [1]. Overall, the growth rate was clearly higher, during spring season. Between the varieties of each group, the growth rate recorded different values; for example: in the hybrid tea group, the ‘Acapella’ variety had a longer period of active growth until the month of August; a strong fluctuation of growth was recorded on the Caprice de ‘Meilland’ variety (Fig. 1).

Table 2. Length of shoots monthly (cm)

Variety	Group	Mai	June	July	Aug	Sept	Oct	Nov
Angela	park rose	52	112	100	160	210	245	240
Abraham Darby	English rose	50	65	110	56	30	40	120
Heritage	English rose	24	65	110	161	161	52	150
Forever Young	floribunda	42	50	45	16	10	23	42
Rhapsody In Blue	floribunda	60	107	130	136	133	88	140
Acapella	hybrid tea	54	63	77	110	108	30	180
Caprice de Meilland	hybrid tea	40	60	90	34	93	50	104
Christoph Columbus	hybrid tea	63	80	101	52	45	26	165
Ingrid Bergman	hybrid tea	33	64	72	35	26	16	113
Red Berlin	hybrid tea	40	63	65	35	28	19	84

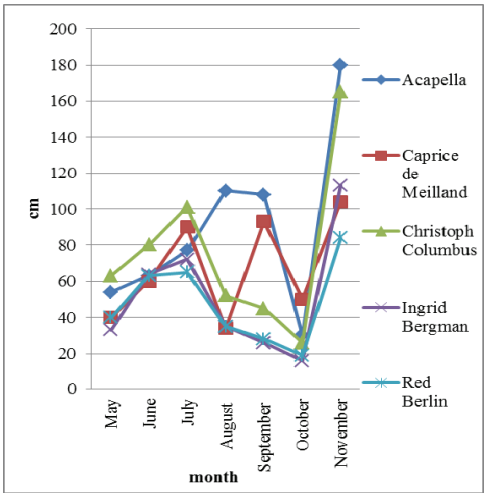


Fig. 1. Length of shoots during 2011 in hybrid tea rose group

In the English rose group, the two varieties studied, presented a progressive decrease in growth that began in July (Fig. 2)

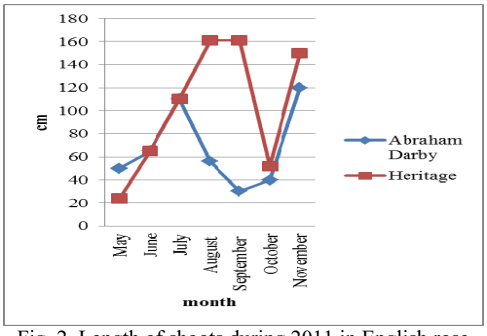


Fig. 2. Length of shoots during 2011 in English rose group

On the varieties in both groups, there was a decrease in growth when high temperatures started [1]; during the month of September, a new wave of growth was observed. Hybrid tea varieties had similarities with English rose varieties in the first part of vegetation when the growth rate is sustained and a decrease, during high temperature season [1]; in the floribunda group, some differences in growth rate were recorded (Fig. 3).

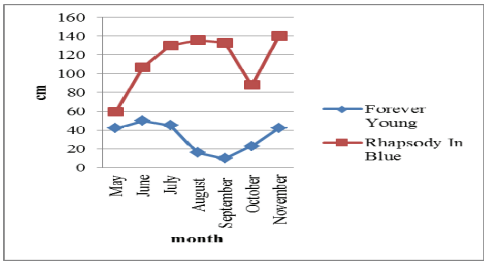


Fig. 3. Length of shoots during 2011 in floribunda group

The most representative variety in the park roses group - 'Angela' presented an almost constant growth rate and has not been strongly influenced by the cuts during the vegetation period (Fig. 4)

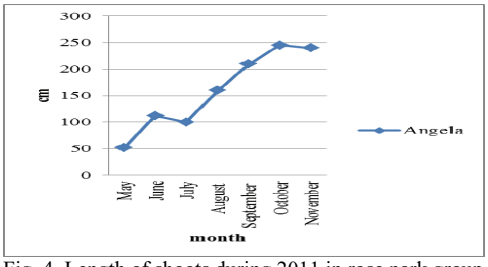


Fig. 4. Length of shoots during 2011 in rose park group

The graphs above (Fig.1, 2, 3, 4) show that the cuts made in the second decade of June have not slowed the growth rate of most varieties, up until July, when high temperatures occurred [1]. The energy for growth given by the maximum height growth of plants at the end of vegetation (table 3) showed a difference between groups of varieties, in terms of maximum length of shoots.

Disease resilience of the studied varieties is shown in Table 3 [1, 5]. 'Heritage' has shown high resistance; good/very good resistance was shown by 'Angela' and 'Christoph Columbus', as the rest of varieties have shown different levels of tolerance towards the different pathogen agents.

Tabel 3. Diseases resistance

Variety	*Sphaerotheca pannosa*	*Diplocarpon rosae*	*Phragmidium disciflorum*
Abraham Darby	++	++	+++
Acapella	+	++	+++
Angela	++	+	+++
Caprice de Meilland	+	+	++
Christoph Columbus	++	+++	+++
Forever Young	+	+	++
Heritage	+++	+++	+++
Ingrid Bergman	++	++	++
Red Berlin	+	+	++
Rhapsody In Blue	+++	++	++

+ weak resistance
++ good resistance
++ verry good resistance

Resistance to extreme temperatures was recorded in spring 2012 when losses on most varieties were significant (about 75% of growth) [1].

CONCLUSIONS

1. Overall, the results show different growth aspects according to rose variety group;
2. Climate conditions present during the spring of 2011 did not influence the different phenological phases of leaf and budding on the 10 varieties observed;
3. The differences observed during early blooming, indicate that this is something specific to each variety;
4. The growth rate was sustained during spring season, until mid-July without being held back by cuts after the first wave of blooming, with the exception of the 'Angela' variety (Group rose park) which had an almost continuous growth;
5. The variety with the most noticeable growth rate belongs to the rose park group; 'Angela' reaching even 245 cm. Also, some noticeable growth rates were observed in the hybrid tea group, especially on the 'Acapella' and 'Christoph Columbus' varieties;
6. The results of the first year of study on the 10 varieties of roses are shown, with the purpose of selecting and promoting some of them for the parks and gardens areas in Bucharest. More research will be conducted. These rose varieties will be the object of future studies that will consider different measurements regarding their growth;

ACKNOWLEDGEMENTS

This research represents the objective of the PhD theses in the POS-DRU project: POSDRU/107/1.5/S/76888

REFERENCES

[1] Wagner S., 2002., *The rose – from myth to the third millennium*. Cluj Napoca, p. 46-48; 89-95; 120-126, 160-161
[2] Ardelean A., Mohan G., Nedelcu G., 2003. *Profesor dr. docent Ion T. Tarnavschi (1904-1989) – 100 years birthday, "Vasile Goldis"*. University Press Publishing House, Arad, p. 108-110
[3] Burzo I., Delian Elena, Hoza D., 2005. *The physiology of crop plants*. vol IV, Elisavados Publishing House, Bucharest, p. 60-67; 90-98; 158-204; 346-363
[4] Burzo I, Amariutei Alexandrina, Zamfir Diana Vasca, 2005. *The physiology of crop plants*. vol VI, Elisavados Publishing House, p. 89-120
[5] Parvu M., 2004, Rose diseases, Book House of Science Publishing House, Cluj, p. 32-35; 35-38

Scientific Papers, Series B, Horticulture, Vol. LVI, 2012
CD-ROM ISSN 2285-5661, ISSN-L 2285-5653

LAND ART AND AGRICULTURE

Violeta RĂDUCAN

University of Agronomic Sciences and Veterinary Medicine Bucharest, 59 Mărăşti, District 1, 011464, Bucharest, Romania, Phone: +40 21 318 36 36/232, Fax: + 40 21318 28 88, E-mail: post@info.usamv.ro

Corresponding author email: violetaraducan@gmail.com

Abstract

The first landscape paintings, called 'paesaggio' were used as backgrounds for portraits. They were sceneries of agricultural fields of the Italian countryside (paese & immagine). Paesaggio became 'paysage' in French, (pays & image), 'peisaj' in Romanian and 'landscape' in English. In our days, the agricultural fields are often part of preserved landscapes, according to their aesthetical character, not only to their natural importance. Rice terraces, vineries or orchards are extremely interesting for the cultural landscape. The natural and manmade landscapes, including agricultural fields, are the field of visual artists and landscape architects. Their installations underline some features of the landscape. Artists Christo and Jeanne-Claude, Andy Goldsworthy, Walter de Maria, Nancy Holt, Maya Lin, Richard Long, Robert Smithson, and many others are famous for their land art works. The 'Power Lines', designed by the well known and awarded American landscape architect Martha Schwartz and German architect Markus Jatsch, located in Gelsenkirchen, Germany, is the most interesting intervention in an agricultural field. This installation will be presented as a case study. The main features of this installation are: a geometrical structure of linear corn-fields, the 'Red Corridor' pointing to the hill in that area and the Bismarck Tower placed on its top and the 'Black Heart', a circular room made of hay bales wrapped in black plastic. This artwork is a symbol of the difficulty in managing the power, politically and environmentally.[10].

Key words**:** *agricultural landscape, art, cultural landscape, land art*

INTRODUCTION

The first landscape paintings, called 'paesaggio' were backgrounds for portraits. They were sceneries of agricultural fields of the Italian countryside (paese & immagine). 'Paesaggio' became paysage in French, (pays & image), peisaj in Romanian and landscape in English. In the 20 century, the international legislation evolves: from **sites** (that are defined as "works of man or the combined works of nature and man, and areas including archaeological sites which are of outstanding universal value from the historical, aesthetic, ethnological or anthropological point of view" [3]), to **landscape** (which "means an area, as perceived by people, whose character is the result of the action and interaction of natural and/or human factors" [6]) and to **cultural landscapes** ("combined works of nature and of man" and which are illustrative for "the evolution of human society and settlement over time, under the influence of the physical constraints and/or opportunities presented by their natural environment and of successive social, economic and cultural forces, both external and internal." [4]).

In the chapter "Definition of World Heritage" of the *Operational Guidelines for the Implementation of the World Heritage Convention* (2008) [8], are presented the definitions of: Cultural and Natural Heritage, Mixed Cultural and Natural Heritage, Cultural landscapes. According to these definitions, agricultural landscapes may be an important part of cultural landscapes if they have an outstanding universal value ("Outstanding universal value means cultural and/or natural significance which is so exceptional as to transcend national boundaries and to be of common importance for present and future generations of all humanity." [4] Agricultural landscape has completed a long way, from the stage of being entirely ignored or being in the background, to the stage of being recognized as part of the World Heritage, according to its value.

MATERIAL AND METHOD

Agricultural landscape was studied as:
a. - ordinary landscape, b. - ordinary landscape in relation with historical monuments, c. - remarkable landscape of the World Heritage, and d. - the place of artistic installations and land art, generating new images and new ideas. The cases are very different and their variety is huge. There were analysed a very large number of cases and the synthesis of this research is presented in the next chapter.

RESULTS AND DISCUSSIONS

The ordinary agricultural landscape as a result of the interaction between men and nature, get a wide range of images. The pattern of the ordinary landscape is the result of the relation between the geographical features, the climate, the soil, irrigation etc. and the last but not the least, with the type of property. Each of these crucial elements determinate a large range of patterns and the combinations between these elements lead to a huge number of patterns/images/landscapes. A large gallery, which can be found on everywhere and especially on Google, confirm this statement [1] (Figure 1).

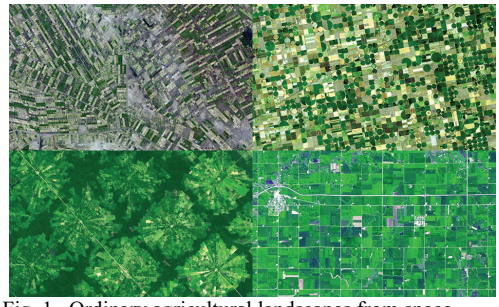


Fig. 1. Ordinary agricultural landscapes from space
Source:http://www.guardian.co.uk/environment/gallery/2011/mar/29/agricultural-patterns-space

The World Heritage List and the relation between agricultural landscape and a series of historical monuments with the same significance were analysed in detail. Every time, the ordinary agricultural landscape emphasise the historical monument. A large series of historical monuments (castles, bridges, towers etc.) were studied in relation with the agricultural fields. Bismarck Towers were chosen as exemplary for this research, because of their direct relation with the agricultural fields surrounding them, because of their great number (173 of 240 built between 1869 and 1934 are still standing) and because they are present in different locations (all over Germany and not only) [2]. These towers / fire columns / lookout towers, were placed on the top of a hill to be ignited in order to remember the Unification of Germany (1871), the great achievement of Chancellor Bismarck. They have various appearances, but all of them are emphasised by the agricultural landscape surrounding them: vineyards, rape culture etc. (Photo 1, 2, 3).

Photo 1. Bismarck Tower in Oberg, Germany
Source: www.flickr.com/photos/26261614@N05/3497169849/

Photo 2. Bismarck Tower in Lützschena-Stahmeln,
Source: www.flickr.com/photos/mha74/4748486104/

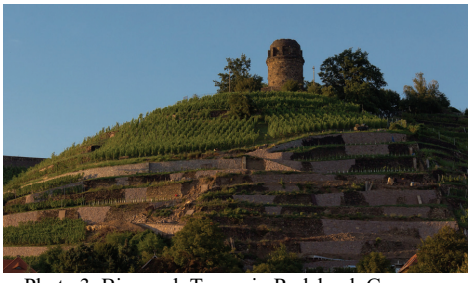


Photo 3. Bismarck Tower in Radebeul, Germany
Source: www.flickr.com/photos/mha74/4748486104/

Remarkable landscapes of the World Heritage are real 'works of art' generated by simply agricultural behaviours, techniques, relief, climate etc. The World Heritage List includes some remarkable agricultural landscapes as cultural landscapes (Table 1).

Photo 4. Landscape of the Pico Island Vineyard Culture (Azores), Portugal
Source: www.flickr.com/photos/ernstschade/5942144389

Photo 5. Rice Terraces of the Philippine Cordilleras
Source:http://www.scenicreflections.com/download/384325/Stairways_to_Heaven_Wallpaper/

It is important to underline that in the last years, the number of these landscapes is continuously increasing and they are extremely varied: from rice terraces, vineyard terraces, agro-pastoral cultural landscape to coffee cultural landscape, and so on (Photo 4, 5). Even so, there are a lot of remarkable agricultural landscapes which are not included in the World Heritage List, despite their huge cultural value: Vineyards of Lanzarote Island (Canary), Spain (Photo 6, 7).

Photo 6. Landscape of the Lanzarote Island
Source: http://static.panoramio.com/photos/large/6566085.jpg

Photo 7. Lanzarote Island
Source: Google Earth

Table 1. UNESCO's World Heritage List - Agricultural landscapes as cultural landscapes

UNESCO's World Heritage List			
Agricultural landscapes as cultural landscapes			
nr.	**Landscape**	**Country**	**Year of ratification**
1.	Rice Terraces of the Philippine Cordilleras	Philippine	1995
2.	Viñales Valley agricultural landscape, particularly tobacco cultures	Cuba	1999
3.	Archaeological Landscape of the First Coffee Plantations in the South-East of Cuba	Cuba	2000
4.	Agricultural landscape of Southern Öland	Sweden	2000
5.	Alto Douro Wine Region	Portugal	2001
6.	Mapungubwe Cultural Landscape	South Africa	2003
7.	Landscape of the Pico Island Vineyard Culture (Azores)	Portugal	2004
8.	Agave Landscape and Ancient Industrial Facilities of Tequila	Mexico	2006
9.	Lavaux Vineyard Terraces	Switzerland	2007
10.	Coffee Cultural Landscape	Colombia	2011
11.	Causses and Cevennes Mediterranean agro-pastoral cultural landscape	France	2011
12.	Val d'Orcia cultural landscape	Italy	2011

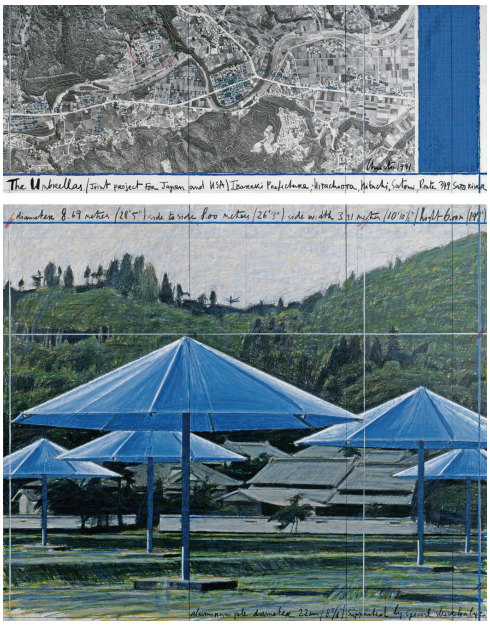


Fig. 2. The Umbrellas (Project for Japan and USA)
Source: www.christojeanneclaude.net/projects/the-umbrellas

Photo 7. The Umbrellas, Japan-USA, 1984-91
Source: www.christojeanneclaude.net/projects/the-umbrellas

Photo 8. Running Fence, Sonoma and Marin Counties, California, 1972-76
Source: www.christojeanneclaude.net/projects/running-fence

Sometimes, ordinary agricultural landscape is the place for artistic installations and land art, generating new images and new ideas. 'The Umbrellas' and 'The Running Fence' by Christo and Jeanne-Claude (Fig. 2. and Photo 7, 8) and many other installations offer a new perspective upon the landscape and especially upon the agricultural landscape.

In 1999, three of the four mentioned hypostases of the agricultural landscape (a, b and d) were combined in a single work of art: the 'Power Lines' designed by the well known and awarded American landscape architect Martha Schwartz and the well known and awarded German architect Markus Jatsch. Their work of art was part of the German program for the Ruhr Region: the Emscher Landscape Park, in the north side of Duisburg, Mechtenberg Landscape Park, on the borders of Gelsenkirchen, Essen and Bochum and many other landscape parks on Ruhr and Emscher Valley, tributary to Rhine River.

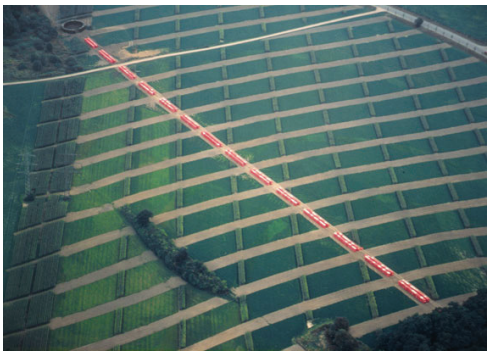
There are not many hills in this region, but one genuine hill and one hill constructed from the waste soil of the neighbouring mines are situated on Mechtenberg Landscape Park. Since 1899, the top of the genuine hill, 80 metre high, is crowned by one Bismarck Tower. Starting with 1990, a new project was implemented in this location, for preserving the agricultural areas and for creating new recreational areas. The 'Power Lines', the installation designed by the two great creators, implemented in 1999, was chosen as a significant case study for this research.

Martha Schwartz and Markus Jatsch created a link between the agricultural landscape and the historical monument in a contemporary work of art: a temporary installation. In this work, they approached the theme of power, involving: the German mythology - referring to God Wotan, God of Nature, God of wind, wisdom and fury [7,10]; the politics - with reference to Bismarck-myth and the unification of Germany in 1871 [7,10]; the technology - including the network of high-voltage cables in their work of art [7,10]; and the care for environment - with its wide range of issues [7,10] (Photo 9, 10, 11, 12, 13).

Photo 9, 10, 11, 12, 13.
Bismarck tower on Mechtenberg Hill, Gelsenkirchen – The relation monument - agricultural landscape in different seasons
Source: http://static.panoramio.com/photos/large/68368462.jpg
Source: http://static.panoramio.com/photos/large/47185347.jpg
Source: http://www.flickr.com/photos/der_dennis/5558940257/
Source: http://www.flickr.com/photos/ruhrblicke/5068662683/
Source: http://static.panoramio.com/photos/large/66779701.jpg

Photo 14.Mechtenberg Landscape Park, Gelsenkirchen, before the implementation of the 'Power Lines',
Source: Spaeth, Renate, 2011, p.22

Photo 15. Mechtenberg Landscape Park, Gelsenkirchen, after the implementation of the 'Power Lines' installation
Source:
www.biblio.polito.it/architettura_arte/osservare/suggestioni/sito_suggestioni/frameset.htm



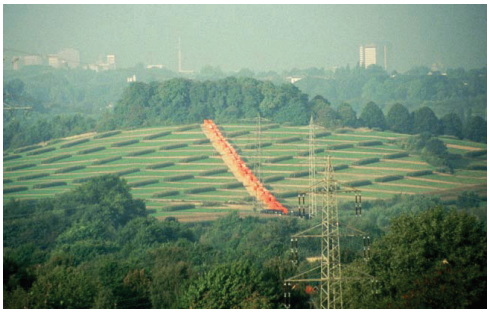


Photo 16, 17, 18, 19. 'Power Lines'
Source: www.markusjatsch.com/projects/installations_power_lines.php
Source: www.marthaschwartz.com/projects/powerlines.html
Source: www.marthaschwartz.com/projects/powerlines.html
Source: www.mai-nrw.de/Mechtenberg.46.0.html?&L=1

Photo 20. The 'Red Corridor', part of the 'Power Lines'
Source: http://www.marthaschwartz.com/projects/powerlines.html

In their work, we can find a lot of 'power lines', concrete and abstract. The high-voltage cables, the linear corn-fields and the 'Red Corridor' are the concrete 'power lines'.
The German mythology, politics, technology and the care for environment and human being are the abstract 'power lines' of this installation. All these 'power lines' are organically linked in a whole, creating a work of art full of significations. Each of the real components has its own signification.

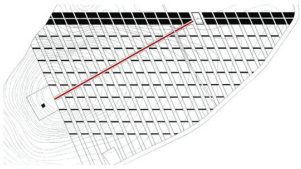


Fig. 3. The metamorphosis of the agricultural landscape (bottom) in 'Power Lines' installation (top)
Source: Google Earth (bottom)
www.markusjatsch.com/projects/installations_power_lines.php (top)

The 'Red Corridor', pointing the Bismarck Tower, crosses the geometrical network of linear corn-fields (Photo 14, 15 and Fig. 3). Its starting point is high-voltage line. So, the 'Red Corridor' creates a link between history and our days. This corridor is made from straw bales wrapped in red plastic. The authors of this installation have chose red as a symbol of power and also of blood and sacrifice. They have chose to create a very narrow hallway in order to force the visitors "to think consciously about who can pass when two people meet. In a very direct and immediate way, it presents the difficulty of dealing with power." [7,10] (Photo 16, 17, 18, 19, 20). The intersection between the 'Red Corridor' and the electric power line axes is emphasized by the 'Black Room' or the 'Black Heart', a circular room made from straw bales wrapped in black and paved with coal, as a remembrance of the main occupation in this region. (Photo 19) Martha Schwartz explains the symbol of this room: "Within this room, one might contemplate the high price we pay for power, both politically and environmentally" [10].

CONCLUSIONS

At the beginning of the 1990s, a national programme for central Ruhr area began with studies for the outline planning of regional green corridor C in the Emscher Landscape Park. In 2010, 'Two Hills - One Man-Made Landscape', the project for Mechtenberg, was part of 'Essen for the Ruhr', the European Capital of Culture 2010. The implementation of 'Power Lines' installation was possible with the civil society implication and with the support of the owners of the agricultural fields surrounding Mechtenberg. The aim of this project is "to unify agricultural areas and disused industrial sites, nature and art, the beautiful and the useful" [5]. This project contains some important elements: the 'Sky Stairs', Rheinelbe Sculpture Wood in Gelsenkirchen, the steel bridge designed by Frei Otto, the 'Power Lines' installation and some facilities: footpaths and cycle ways.

The safeguarding of the biotopes, the reassessment of the landscape through reforestation, tree planting and orchards were some other targets of this national project.
The belief of Martha Schwarts is worth to be mentioned here: "Through design, we can create a 'sense of place' and engender a sense of belonging and individuality. Through design we can enable people to make an emotional connection to a place by imbuing it with character, memory, identity, orientation and individuality." [9].

Photo 21. "Take a seat … relax …" Mechtenberg, 2010
Source: Spaeth, Renate, 2011, p.6

Photo 22. Corn maze, 2011, Lowell, Michigan
Source: http://www.heidisfarmstand.com/cornmaze.html

Photo 23. Straw bales maze, Maryland, 2007
Source: http://blog.patricksmithphotos.com/2007_10_01_archive.html

Important things can be emphasised by simple means. In our days, land art becomes a mass sport and the agricultural field becomes its place. Mazes and 'crop circles' are to be found everywhere in the world, maybe trivializing the sense of land art and installations, but in the same time they are the sign of a new opening onto the true art. (Photo 21, 22, 23)

ACKNOWLEDGEMENTS

This research work is based on information found on public sites, generously given by local and governmental administrations, international expert's organisations, NGOs, landscape architects, artists, people who are passionate about landscape architecture, land art and photography. The richness of this information is the testimony of the interest shown by a wide range of people and of the importance of this subject.

REFERENCES

[1] Agricultural patterns from space - in pictures, 2011, NASA Satellite Images, http://www.guardian.co.uk/environment/gallery/2011/mar/29/agricultural-patterns-space

[2] Bismarcktürme & Bismarcksäulen, 2012, Das Infoportal Bismarcktürme, http://www.bismarcktuerme.de/

[3] Convention concerning the Protection of the World Cultural and Natural Heritage, 1972, art.1, p. 2

[4] Cultural Landscape, 2012, World Heritage Centre, http://whc.unesco.org/en/culturallandscape/#1

[5] Emscher Landscape Park. Visitor's Guide, 2010, p. 58-59, www.emscherlandschaftspark.de

[6] European Landscape Convention, Florence, 2000, Chapter I - General provisions, Article 1] - Definitions

[7] Jatsch, Markus, 2012, Power Lines, Gelsenkirchen, Germany, www.markusjatsch.com/projects/installations_power_lines.php

[8] Operational Guidelines for the Implementation of the World Heritage Convention, 2008, p.14, whc.unesco.org/archive/opguide11-en.pdf

[9] Schwartz, Martha, 2011, Power Lines, Gelsenkirchen www.marthaschwartz.com/philosophy.html

[10] Schwartz, Martha, 2011, Power Lines, Gelsenkirchen, www.marthaschwartz.com/projects/powerlines.html

[11] Spaeth, Renate, 2011, Two hills - One Landscape. Aesthetic design of land used for agriculture and forestry in the Ruhr Metropolis - Mechtenberg and Rheinelbe , p.1-45, http://www.forestry.gov.uk/pdf/RenateSpath.pdf/$FILE/RenateSpath.pdf

Scientific Papers, Series B, Horticulture, Vol. LVI, 2012
CD-ROM ISSN 2285-5661, ISSN-L 2285-5653

STUDIES CONCERNING THE INFLUENCE OF SOME TECHNOLOGICAL CARE UPON THE PRODUCTION, GROWING AND BLOSSOMING OF PELARGONIUM PELTATUM PLANTS

Florin TOMA, Sorina PETRA, Diana ZAMFIR-VASCA, Andreeea PRICOPE

University of Agronomic Sciences and Veterinary Medicine Bucharest, 59 Mărăşti, 59 Street, zip code 011464, Bucharest, Romania, Phone: 040.21.318.22.66 / 040.21.318.25.64, Fax: 040.21.318.28.88.

Corresponding author email: florintoma@hotmail.com

Abstract

Pelargonium peltatum is one of the most popular flower species used in setting balconies during the warm season. Obtaining a plant bloom as rich and long-term target of the most research in this area. Our research focused on the one hand, the study of influence factors on rooting cuttings rizogen on the other hand, study the influence of fertilization regime on growth and flowering plants. To experience producing rooted cuttings was achieved trifactorial experience, the variation factors: type seedlings (seedlings, cuttings and seedlings tip sprouts fragments), the type of stimulus applied rizogen (without stimulating rizogen and Radistim rizogen) and type rooting substrate (peat fully and perlite and sand, in equal proportions). Experience tracking the type of fertilizer effect on growth and flowering plants included three variants of fertilization (Osmocote integrated mix of land used for planting, fertilizer NPK 7:4:5 and fertilizer NPK 7:5:6). The results showed that the cuttings settling down tip cuttings of shoots had a higher percentage of rooting cuttings compared with fragments of shoots, the best being the rooting substrate made of equal parts peat and perlite. It also was better at rooting cuttings treated with Radistim. Growth and flowering plant fertilizer applied according to the highest values were from plants fertilized with 7:5:6 NPK fertilizer, followed by 7:4:5 NPK fertilizer.

Keywords: *care, cuttings, fertilization, growing, blossoming*

INTRODUCTION

Pelargonium peltatum is one of the most popular flower species used in setting balconies during the warm season [5, 6]. Obtaining a plant bloom as rich and long-term target of the most research in this area [1, 2, 3, 4]. Period of cuttings is very important to obtain high quality plants, the end of August for mother plants and plants for sale in March are considered the best times [2, 4].

Treatment plants with the growth retardations stimulators is a very important link to obtain plants with compact growth and rich blossoming [3, 4].

Fertilization regime on plants is also of major importance in achieving growth and flowering plants with high [5, 6].

In this reason, our research focused on the one hand, the study of influence factors on rooting cuttings rizogen on the other hand, study the influence of fertilization regime on growth and flowering plants.

MATHERIAL AND METHOD

Biological material was the peak cuttings and seedlings sprout shoots of *Pelargonium peltatum* fragments, variety 'Ruby'. Each of the two types of seedlings were distributed into two groups: half of them were treated with Radistim before planting in the rooting substrate and the other half were not treated.

Each of these four types of cuttings were planted on two types of rooting substrate (sand and peat + perlite), resulting in eight experimental variants (Photo 1, Table 1).

Photo 1. The cuttings in the rooting substrate

Table 1. The experimental variants for rooting of cuttings

Variant	Type of cutting	Roots stimulator	Rooting substrate	Percent substrate (%)
V1	shoots	Radistim	sand	100
V2	shoots	Radistim	peat+ perlite	50:50
V3	shoots	-	sand	100
V4	shoots	-	peat+ perlite	50:50
V5	shoots fragments	Radistim	sand	100
V6	shoots fragments	Radistim	peat+ perlite	50:50
V7	shoots fragments	-	sand	100
V8	shoots fragments	-	peat+ perlite	50:50

To assess the quality of rooting, at the cuttings out of the rooting substrate was determined using the root volume of a cylinder with water. Rooted cuttings were planted in culture substrate made of equal parts of ground leaves, ground celery, peat and sand, in pots of 10 cm diameter (Photo 2).

Photo 2. Planting the rooted cuttings in culture substrate

Planting rooted cuttings used had an average length of 7 cm and 3 leaves. At planting, the one we built Osmocote variations in substrate culture in a 10 g to 1 kg substrate for the other versions we made fortnightly fertilization with fertilizers Agro and Vital Green (Table 2).

Table 2. The experimental variants for fertilizer regime of plants

Variant	Fertilizer	NPK ratio
V1	Agro	7:4:5
V2	Green Vital	7:5:6
V3	Osmocote	15:15:15

Observations were taken into account: the number of leaves per plant, number of shoots, number of inflorescences per plant, flower stem length, flower diameter, number of flower buds, number of open flowers.

RESULTS AND DISCUSSIONS

From Table 3, that settling down was superior to variants that had the rooting substrate mixture of peat + perlite variants compared with the rooting substrate was the sand, regardless of type of cuttings and the fact that they have or not treated with rooting stimulus (photo 3 and 4).

Table 3. The variation of percent of cuttings rooted and the roots volume

Variant	Percent of rooted cuttings	Roots volume (cmc)
V1	70,25 %	2,25
V2	92,50 %	3,50
V3	65,75 %	2,25
V4	70,00 %	3,00
V5	65,75 %	2,00
V6	80,25 %	2,50
V7	62,75 %	2,25
V8	74, 25 %	2,75

Photo 3. The rooted cuttings in sand substrate

Photo 4. The rooted cuttings in peat + perlite substrate

The shoot tip cuttings treated with Radistim had a higher rooting percentage than cuttings sprout fragments untreated with Radistim. This hierarchy of values remains sin for root volume.

Analyzing data from Table 4 is found that the evolution of plants after planting rooted cuttings is different depending on the type of fertilizer applied (Photo 5).

Table 4. The variation of vegetative growing of plants

Time after planting of rooted cuttings	Variant V1 of fertilizer		Variant V2 of fertilizer		Variant V3 of fertilizer	
	Length of shoots (cm)	Leav. no.	Length of shoots (cm)	Leav. no.	Length of shoots (cm)	Leav. no.
one month	7,2	3,1	8,0	3,6	7,5	3,5
wo months	8,0	4,6	8,8	4,8	8,2	4,5
hree months	8,8	5,4	9,5	5,7	8,5	5,6
our months	9,6	6,5	10,2	6,9	9,2	6,4
ive months	10,0	7,2	10,8	8,5	9,8	7,0
ix months	10,7	8,6	11,6	9,6	10,7	7,8
even onths	11,5	9,2	12,4	10,0	11,3	8,5
ight months	12,3	10,5	13,2	11,2	11,9	9,7
ine months	13,5	11,0	14,0	12,0	12,8	10,5

Photo 5. The aspect of experience after two months of planting of rooted cuttings in pots

Thus, in the number of leaves is found that one month after planting rooted cuttings in pots it varies between 3.1 to version V1 (Agro fertilizer N7: P4: K5) and 3.6 V version 2 (Vital Green fertilizer N7: P5: K6).

At the end of the heating season, before the introduction of plants in the rest relatively correlated with the intended fertilization, number of leaves varies from 10.5 to version V 3 (Osmocote fertilizer N15: P15: K15) and 12.0 V version 2 (Vital Green fertilizer N7: P5: K6).

Average length of shoots range from 7.2 (version V 1 fertilization) and 8.0 (version V 2 fertilization) at one month after planting rooted cuttings in pots and 11.0 (fertilization variant V 1) and 12.8 (version V 3 fertilization) to nine months after planting rooted cuttings in pots.

Analyzing correlations between the two elements of vegetative growth - length of shoots and number of leaves - it is found that for all three linear correlations fertilization, direct and very strong between the length of shoots and number of leaves (Fig. 1, 2, 3) .

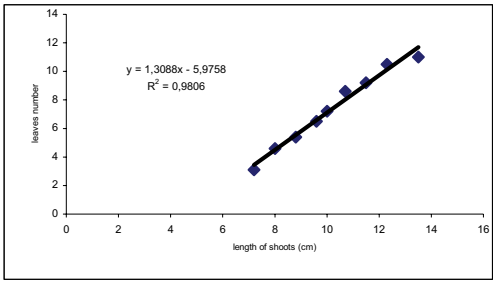


Fig. 1. The correlation between the length of shoots and leaves number for variant V 1 of fertilizer

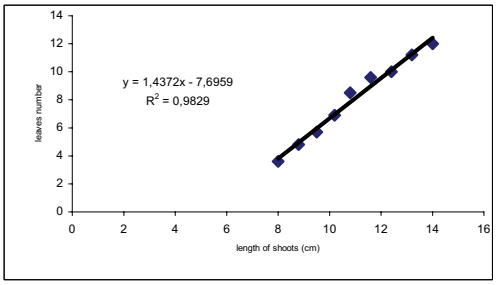


Fig. 2. The correlation between the length of shoots and leaves number for variant V 2 of fertilizer

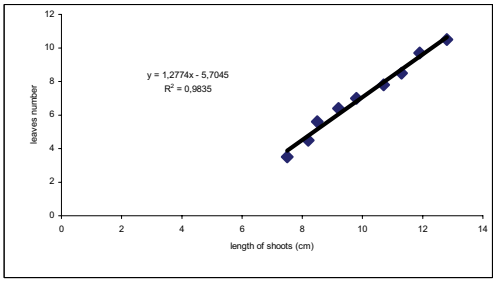


Fig. 3. The correlation between the length of shoots and leaves number for variant V 3 of fertilizer

In terms of flowering plants found in Table 5, the variant V2 is the earliest in terms of onset of flowering and presents the highest values of elements flowering.

Table 5. The variation of quality of plants flowering

Time after planting of rooted cuttings	Variant V1 of fertilizer			Variant V2 of fertilizer			Variant V3 of fertilizer		
	No. of fl. stem	Leng. of fl. stem (cm)	Infl. diam. (cm)	No. of fl. stem	Leng. of fl. stem (cm)	Infl. diam. (cm)	No. of fl. stem	Leng. of fl. stem (cm)	Infl. diam. (cm)
two months	0,0	0,0	0,0	0,3	5,2	5,0	0,0	0,0	0,0
three months	1,0	5,3	4,8	1,0	5,4	5,3	1,0	5,0	4,0
four months	1,3	6,0	5,2	1,4	6,5	6,0	1,2	6,2	4,8
five months	1,6	6,8	5,9	1,7	7,2	6,5	1,5	7,8	5,4
six months	1,6	7,3	6,3	1,8	8,6	7,1	1,4	9,0	5,0
seven onths	1,7	7,6	6,4	2,0	8,6	7,0	1,4	8,5	5,3
eight months	1,4	6,2	5,7	1,6	7,8	6,3	1,0	7,6	5,0
nine months	1,0	5,1	5,0	1,2	6,2	5,2	0,8	6,0	4,6

Thus, since the second month after planting rooted cuttings in pots this variant is distinguished by 0.3 inflorescences per plant with flower stem length of 5.2 cm and a diameter of 5 cm of the flower, the only one which presents flowers at this time. For version V1, bloom maximum is reached after seven months from planting rooted cuttings in pots (1.7 inflorescences per plant with flower stem length of 7.6 cm and 6.4 cm diameter flower) - Photo 6.

Photo 6. The flowered plants from variant V 1 in the moment of maximum blossoming

All seven months after planting rooted cuttings in pots and the peak flowering plants for fertilization variant V 2 (2.0 inflorescences per plant with flower stem length of 8.6 cm and 7.0 cm diameter flower) - Photo 7.

Photo 7. The flowered plants from variant V 2 in the moment of maximum blossoming

For plants fertilization variant V 3 but maximum flowering is reached after five months from planting rooted cuttings in pots (1.5 inflorescences per plant with flower stem length of 7.8 cm and 5.4 cm diameter flower) - Photo 8. These results show that Osmocote fertilizer applied at planting cuttings rooted determine substrate brought forward the timing of flowering within two months, even if this time is low volume as compared with other variants of fertilization.

Within each fertilization variants found that for every element of flowering - the number of flower stems per plant, flower stem length and flower diameter - no linear correlation, direct and very strong (Fig. 4, 5, 6).

Photo 8. The flowered plants from variant V 3 in the moment of maximum blossoming

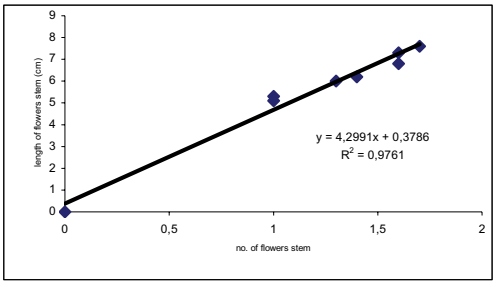


Fig. 4. The correlation between the number of flowers stem and length of flowers stem for variant V 1 of fertilizer

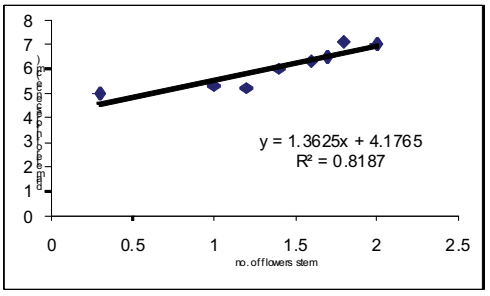


Fig. 5. The correlation between the number of flowers stem and diameter of inflorescence for variant V 2 of fertilizer

Analyzing correlations between the number of inflorescences per plant and number of flower buds and open flowers is found that linear correlations exist, direct and in between each of these elements (Fig. 7, 8, 9).

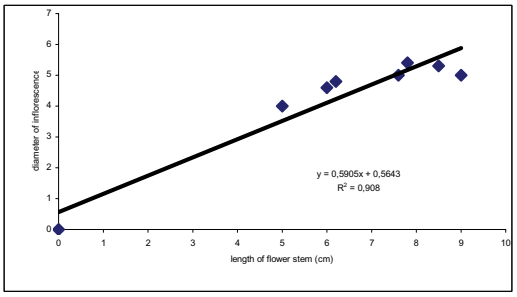


Fig. 6. The correlation between the length of stem flowers and diameter of inflorescence for variant V 3 of fertilizer

In the number of flowers in bloom can be seen from Table 6, the fertilization variant V 2 presents the highest values of total number of flowers - flower buds or open flowers throughout the observations.

Table 6. The variation and dynamical of number of florwers in inflorescence

Time after planting of rooted cuttings	Variant V1 of fertilizer		Variant V2 of fertilizer		Variant V3 of fertilizer	
	No. of bud flowers	No. of opened flowers	No. of bud flowers	No. of opened flowers	No. of bud flowers	No. of opened flowers
two months	0,0	0,0	4,5	3,2	0,0	0,0
three months	4,8	5,6	6,1	5,9	4,3	5,4
four months	6,4	7,5	7,0	7,6	5,4	7,2
five months	7,2	8,6	8,0	8,7	6,2	8,0
six months	7,3	8,8	8,1	9,0	6,5	8,2
seven onths	7,2	8,0	8,0	8,9	6,0	7,9
eight months	6,3	7,4	7,3	8,0	5,4	7,0
nine months	5,0	6,0	5,1	6,7	4,3	6,1

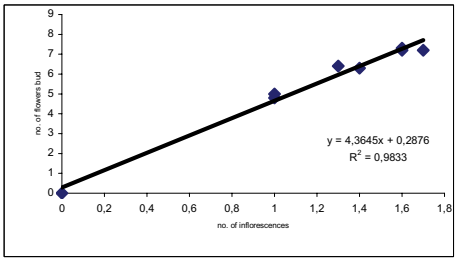


Fig. 7. The correlation between the number of inflorescence per plant and the number of flowers bud in inflorescence for variant V 1 of fertilizer

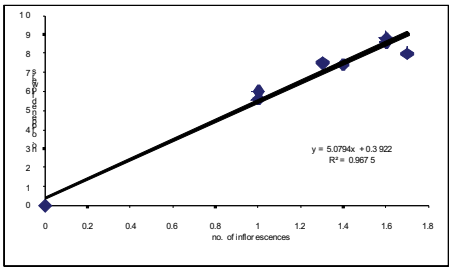


Fig. 8. The correlation between the number of inflorescence per plant and the number of opened flowers in inflorescence for variant V 1 of fertilizer

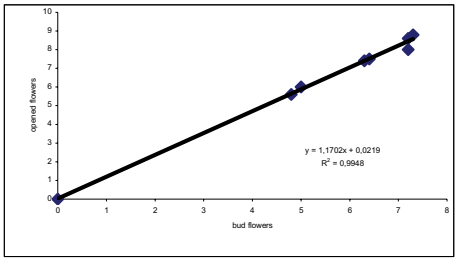


Fig. 9. The correlation between the number of Bud flowers and the number of opened flowers in inflorescence for variant V 1 of fertilizer

CONCLUSSIONS

Obtaining a maximum rooting percentage and a higher quality of rooting cuttings of *Pelargonium peltatum* are possible when using tip cuttings of cuttings treated with Radistim and planted in a rooting substrate composed of equal parts peat and perlite.

Obtain plants with high vegetative growth is possible when a product is used as fertilizer with NPK ratio in favor of nitrogen and potassium (7:5:6 - Vital Green, followed closely by the ratio 7:4:5 product - Agro) .

Use a fertilizer with NPK ratio in favor of nitrogen and potassium determined and the highest values in terms of quantitative and qualitative elements of the bloom, the best results for this question was obtained from plants fertilized with fertilizer N 7: W 5: K 6.

REFERENCES

[1] Graffard-Lenormand Cristine, 1997. *A la recherche du Pelargonium.* PHM Revue Horticole, vol. X, Octobre.

[2] Selaru Elena, 1984. *Influence of period of cutting upon the development of Pelargonium flowers.* Scientifical Papers IANB Bucharest, Serie B, vol. XXVII.

[3] Selaru Elena, Marconescu Mariana, 1985. *Studies concerning the influence of Cycocel upon the growing and flowering of Pelargonium plants*. Scientifical Papers IANB Bucharest, Serie B, vol. XXVIII.

[4] Selaru Elena, 1985. *Some aspects concerning the control of growing and flowering of Pelargonium plants*. Romanian Horticulture revue, no. 11.

[5] Selaru Elena, 1998. *The pot flowers*. Ed. Ceres, Bucharest: 144-148.

[6] Toma Fl., 2009. *Floriculture and Flowers art*. Ed. InvelMultimedia, Otopeni, Romania, vol. III: 82-85.

MISCELLANEOUS


EX·TERRA·AVRVM

Scientific Papers, Series B, Horticulture, Vol. LVI, 2012
CD-ROM ISSN 2285-5661, ISSN-L 2285-5653

METHODOLOGY FOR THE EVALUATION OF THE PREFERENCES REGARDING WINE AND INFORMATION NEEDS OF CONSUMERS

Arina Oana ANTOCE, Cătălin Florin PĂDURARU

University of Agronomic Sciences and Veterinary Medicine Bucharest, Faculty of Horticulture, Department of Bioengineering of Horti-Viticultural Systems, Center for Wine and Vine Studies and Sensory Analysis, 59, Mărăşti Ave., District 1, 011464 Bucharest, Romania, aantoce@yahoo.com

Corresponding author email: aantoce@yahoo.com

Abstract

The high competition on the national and international wine markets requires permanent adaptation to the consumers' preferences in order to present them with the most suitable offer. Also, it should be kept in mind that the recommendations of wine experts may not always or necessarily match the consumer preferences. Therefore the consumers should be kept informed, so that, by learning more about wine appreciation, they might choose to purchase more of the wines recommended by specialists. As such, providing targeted information training for both wine connaisseurs and novices is also an important goal. The present work aims to assess the nowadays consumers' preferences and their needs for information in order to improve the offer for training in the field of wine appreciation. The methodology proposed for this assessment is a survey based on a set of 10 carefully selected questions. The types of questions and the reasons for their inclusion in the survey are presented and explained. The method for the management of consumers' input in case of single answer and multiple answer questions is described and the expected types of results based on the data collected with this questionnaire are also presented.

Keywords: *wine preferences, questionnaire design, evaluation methodology*

INTRODUCTION

Knowing what consumers prefer and choose to buy is the key factor of success in any type of business which provides goods and services to the public. The attitude towards a product is also important, but not so often evaluated. The evaluation of consumer preferences and attitude for a product is often based on data collected with a questionnaire. The relevance of the data obtained and processed depends first of all on the selection of the appropriate number and type of questions. Several questionnaires were developed in time for the evaluation of the preferences for wines in various countries [10]. In Romania, the work of this kind was rather limited to certain surveys conducted by companies and not published. Some previous studies were also conducted by a group of researchers in cooperation with the Association of Authorized Winetasters of Romania in 2001-2003][1-7]. Although some trends are supposed to be stable and be transmitted to younger generations as traditional attitudes towards wines, most of the results of these surveys are no longer be valid, since the wine preferences should have greatly evolved in such a flexible market as that of wine. The changes in the offer of the national wine producers, the impact of imported wines on our market and the increasing range and amount of information continuously sent to wine consumers through various media channels are bound to have had a big impact on the attitude of consumers towards wines. Therefore, a new, more targeted evaluation is very much required. In this work not only the actual preference of the consumers for certain type of wines is under scrutiny, but also the information needs of these consumers about wine in general. Correct and targeted information is required for the consumers to form a preference and take an informed decision when buying. Based on the information needs identified, decisions regarding the type of information to be supplied to these consumers can be efficiently taken. Therefore, the questionnaire design is of utmost importance [9, 11-13].

In this work a new evaluation methodology regarding the preferences for wines and the

information impact and needs was proposed. As part of this study the design of a new questionnaire is presented and its expected results are explained.

MATERIAL AND METHOD

The design of the new questionnaire took into consideration the following main aspects: the goal, the length of the questionnaire and number of questions, the type of questions (open or close), the possibility and opportunity of multiple answer questions, the target respondents and the method of reaching them.

Goal of the questionnaire

The final goal of this questionnaire was to evaluate the information and training needs of the wine consumers so that more targeted and improved information should be offered in order to influence their decisions related to wine consumption.

Special attention was given to the information regarding wine contests and their effects and also to the necessity of a wine museum where large amounts of general information about vine, wine and oenological tourism could be transmitted in a recreational and interactive way.

The length of the questionnaire and number of questions

The total number of questions was limited to 10. Only one personal question was asked and no demographic questions were included. The response choices for each question were sufficiently detailed, some questions having as many as 6 possible answers, but brevity was also taken into consideration, aiming not to exceed two A4 pages.

Type of the questions (open or close) and type of the expected answers

With one exception out of 10, the questions were formulated as closed questions. However, 2 of the closed questions had also an open component (an open response-option), which is a part where some other opinion could be expressed in the respondent's own words.

The possibility and opportunity of multiple answer questions

Out of the 10 questions, 9 are multiple choice items, because they are the most popular type of survey questions and are likely to increase the response rate. They are not only easiest for a respondent to answer, but are also easiest to analyse.

In multiple answer questions the possibility of multiple answer selection was allowed. At the same time, for the purpose of data analysis, in this each answer selected by the respondent was awarded a fraction of one point, calculated as 1 divided by the number of answers selected – by similarity with the case of single-answer questions, where the answer selected by the respondent was given 1 point. This method of dealing with single-answer and multiple-answer questions was adopted after pre-testing the questionnaire, when it was found that few people are willing to select just the one answer which applies most to their behaviour, but usually they felt more comfortable by expressing several preferences.

Target respondents and the method of reaching them

The questionnaire was replied to by 168 respondents who took part in the Good Wine Fair between 18 and 20 November 2011 in Bucharest. The selected sample population accurately reflects only the relevant sub-group of wine lovers who deliberately chose to visit a wine fair. This can be regarded as a biased sample, but even so, the findings form this survey are considered useful for taking some decisions valid for the entire population, especially where specific needs are identified.

Survey location and pre-testing

Most of the survey work was assisted by Good Wine Fair personnel, the questions being read to the consumers by a survey assistant who made sure that respondents understood the questions and replied to all of them.

A pre-testing of the questionnaire was performed in a previous wine fair, Vintest, held in the same city one month before the full-scale survey was conducted. No corrections were considered necessary in the questionnaire content as a result of pre-testing, as the respondents showed good understanding of the questions. However, as explained before, after pre-testing the questionnaire it was decided that in the case of multiple choice questions multiple responses should be permitted.

The collected answers were introduced into an Excel database and analyzed.

RESULTS AND DISCUSSIONS

During our previous similar work, where a survey of 30 questions was performed [1], we observed that most of the respondents lose patience after the first several questions.

This was the reason why, this time, we limited our questionnaire to 10 questions, covering a maximum of 2 pages of text, under the form of a recto-verso A4 page which was printed and distributed. The most important questions were asked first, to benefit from the full attention of the subject.

Multiple choice questions are usually easier to analyse, especially when a single possible answer is supposed to be selected. In our case, for all multiple choice questions multiple choice answers were allowed.

For the analysis, the selected answers to a certain question were all allotted one point in total. If out of the 3 possible answers, only one was selected, that answer received 1 point. If out of the 3 possible answers 2 were selected, then each of the answers received 1/2 points. If of the 3 possible answers all 3 were selected, each answer received 1/3 points. The same calculation was applied in the case of 4-7 possible answers.

Irrespective of the selected answers for a certain question, the sum of the fraction points allotted for the selected answers accounted for a total of 1. Then, the points accumulated for the same answers were summed up, allowing in this way for a quantitative analysis.

The questionnaire started with the general questions and finished with some personal questions. No biographical or demographical data were included in this survey.

The questions related to wine contests were placed in the middle of the survey, while the questions regarding the information that should be provided to increase the knowledge and desirability of wine were left in the end.

Only one question deals with the wine museum as an alternative to provide wine information. In Table 1 the structure of the questionnaire is briefly described.

Table 1. Structure of the questions included in the questionnaire

Question	Type	Multiple choice	General	Personal	Wine contest related	Wine Museum related
QI	close	yes	yes	no	no	no
QII	close	yes	yes	no	no	no
QIII	close	yes	yes	no	no	no
QIV	close	yes	yes	no	no	no
QV	close /open	yes	yes	no	yes	no
QVI	close /open	yes	no	no	yes	no
QVII	close	yes	no	no	yes	no
QVIII	close	no	no	yes	no	no
QIX	open	no	no	yes	no	no
QX	close	yes	no	yes	no	yes

Hereafter, the questions included and their goal are presented and discussed.

QI. What kind of wines do you consume usually?
1. White wines
2. Rosé wines
3. Red wines

This question is a general one, meant to establish a preference for a certain kind of wine, the correlation with the wine offer on the market and the evolution of preference as compared to previous surveys conducted in similar circumstances. It is also an easy question meant to encourage the respondent to accept to complete this survey.

QII. What sugar level do you prefer in the wines you consume?
1. Dry wines (0-4 g/l sugar)
2. Half-dry wines (4-12 g/l sugar)
3. Half-sweet wines (12-45 g/l sugar)
4. Sweet wines (over 45 g/l sugar)

The second question is already a difficult one for a normal consumer. Many people do not know the ranges defined by legislation to separate the categories of wines in accordance to their sugar concentration. Many consumers prefer wines with some sugar, but cannot necessarily make the difference between the half-dry and half-sweet categories. The dry and sweet categories are easier identified. For this reason, the sugar concentrations for each category were included in the answer choices, although this aspect is already too technical for many respondents, who will still select in accordance with the description and not with the sugar concentration range.

QIII. On shop shelves you find wines with various labels. You select the wine which has written on its label:
1. Table wine
2. Controlled Denomination of Origin wine
3. Geographical indication wine
4. I select in accordance with the general label design
5. I select in accordance with the price.
This question does not respect the general principle of one dimension answer, combining answers regarding the category of wine (table, DOC and IG wine) with answers regarding the label design and even the price. With this type of question we want to test the preference for a certain quality category or the selection of the first-price wine irrespective of quality category. The answer regarding the label design tests the importance for a consumer of a quality category written on the label or the general aspect of the label. The level of understanding of quality category meaning is also implied in this multi-dimensional question, but it is not easy to assess only from this.
Although this question has a higher level of difficulty than the previous one, it is assumed that the respondent would find it easier to answer, due to the multi-dimensional multiple-choices available.

QIV. Considering the wine provenance what kind of wines do you prefer?
1. Romanian wines
2. European wines (France, Italy, Spain, Germany, Portugal etc.)
3. From outside of Europe (Chile, Argentine, New Zeeland, Australia etc.)
QIV is also an easy question, by which we may find out not only the preference for a certain origin of the wine, but also get clues on the impact that the import wines have on nowadays local consumers.

QV. How do you select a wine to drink at home? In accordance with the:
1. Price
2. Brand
3. Producer's notoriety
4. Region/country of provenance notoriety
5. Awards obtained in wine contests
6. Other criterion: .....
This is also a multi-dimensional question meant especially to find out the importance of the awards obtained by a wine in contests. This is the first question that introduces the issue of the wine contest.
This question will also allow us to understand to what aspect the consumer attaches more importance: on price or on the notoriety related to that wine (brand, region, producer). Other possible important aspects may be reported by the consumer in this open question.

QVI. In your opinion a wine awarded with a medal in a wine contest is:
1. The best wine obtained in that vintage year
2. A distinct wine, worth buying and keeping
3. A wine recommended by some experts
4. A wine better than others in the same category
5. A proper wine, which was sent and evaluated in a wine contest; many other 1000 wine out there can be better, but were not sent for the evaluation in that wine contest.
6. I do not trust the awards and evaluations in wine contest
7. Other comments: .....
This is a specific question meant to assess the knowledge of consumers regarding wine contests and the importance they may attach to wine contests as a warranty for wine quality.

QVII. Do you believe the Romanian wines are more appropriately judged in:
1. International wine contests organized abroad
2. International wine contests organized in Romania
3. National or local wine contests organized in Romania
4. In all wine contests the evaluation is the same, the experts in the jury being specialized and trained to constantly evaluate the samples
5. I do not know since I have no idea about the procedure of wine evaluation in a wine contest.
This question goes deeper into the wine contest issue, forcing the respondents to share their trust or distrust in contests organized in Romania with Romanian judges. For those consumers who do not pay attention to awards in the contest there is still the option to express no opinion by selecting answer no. 5.

QVIII. What is your approximate wine consumption?
1. I do not consume wine or I rarely try wine.
2. I consume one bottle of 0.751 /week
3. I consume 2 bottles of 0.751 /week
4. I consume more than 2 bottles of 0.751 /week.
Question VIII is included not to quantitatively assess the wine consumption of our respondents, but to correlate their preference for wine with the knowledge about wine and the willingness to receive more specific information about wine. For this reason, the answer no. 1 actually includes two answers, that is the "I do not consume wine" and "I rarely try wine". Both these answers indicate little implication in wine consumption and wine culture and this is why they are included together in just one answer. It is the only non-multiple choice answer question, as one answer excludes another.

QIX. On a scale of 1 to 10 how would you rate your knowledge about wine?
.....
This is the only question that can be sensitive for the respondents, asking them to self-rate their competence as regards to wine. It is also the one from which we obtain the most unreliable information, as the consumers would probably tend to exaggerate their knowledge about wines for their self-esteem or simply will not know where to place their level of knowledge on a scale. Even though self-ratings are often criticised for their lack of validity [8], we need this information even so, later on, when we evaluate the information needs of the population about wine. It is the only open question of the survey.

QX. In order to improve your knowledge about wine, what kind of method for information delivery or training would you prefer?
1. Basic informative classes organized by wine specialists
2. Informal wine-tastings, without too much technical information about wine
3. Speciality counselling at the sale point
4. Dedicated literature (written or posted on the internet)
5. Visits to Museums dedicated to wine.

This is a combined question assessing the information needs of the wine consumers and their preferred methods, trying to establish at the same time the impact of founding a wine museum. A direct question regarding the necessity and expectations from a wine museum was not included in the survey, as the wine museum is considered by many in Romania as an obsolete concept. A direct question might have triggered more misleading reactions and a higher rate of falsely positive answers regarding the necessity of a wine museum. Moreover, due to the length limitations of this survey, a complete approach regarding the creation of a new type of wine museum rather than a classical museum was not possible.

The distribution within the structure of questionnaire of the questions related to the main topics of the survey, wine contests and wine museums as marketing and information tools, is presented in Fig. 1. In the same figure the relationships with the rest of questions are included.

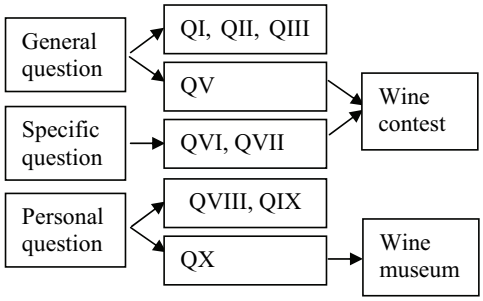


Fig. 1. Type of questions and their relationship with the wine contest knowledge assessments and the necessity of a wine museum as a source of information about wine

CONCLUSIONS

Surveys using questionnaires facilitate the acquisition of data regarding the knowledge, behaviour, attitudes, perceptions and even information needs of a population for a certain product.
The sample population selected in this study is not representative for Romania in general, but only for the category of wine connaisseurs, who deliberately chose to visit a wine fair and then answered a questionnaire. However, the lack of

information about wine identified in this sample population is certainly applicable, at least to the same extent, to the entire population of the country.

The formulation of some questions may not obey some of the most stated recommendations for the design of a questionnaire, but the reasons for this are explained.

As multiple answer choices were permitted for many questions, the quantitative analysis of answers required the weighting of the answers so the total points for a question would be equal to one, irrespective of the number of selected answers.

AKNOWLEDGMENTS

The design of the questionnaire was performed and tested in cooperation with the Centre for Wine and Vine Studies and Sensory Analysis and Good Wine Fair organized by ProActive Business Communication.

REFERENCES

[1]. Antoce O.A., 2003. *Personal preferences about wines as indicated by a survey of Romanian consumers*. Lucrări Ştiinţifice XLVI U.S.A.M.V.B., Seria Horticultură, CD-ROM pp. 330-333.

[2]. Antoce O.A., 2003. *The age of the consumers and its influence on the consumption of beverages in Romania.* Lucrări Ştiinţifice XLVI U.S.A.M.V.B., Seria Horticultură, pp. 334-337.

[3]. Antoce O.A., 2003. *Unele preferinţe şi diferenţe între consumatorii de vinuri, femei şi bărbaţi, din grupa de vârstă 19-29 de ani*. Sesiunea Stiinţifică Anuală a I.C.D.V.V. Valea Călugărească, 22 octombrie 2003 şi Analele I.C.D.V.V. Valea Călugărească.

[4]. Antoce O.A., 2005. *Preferinţele consumatorilor români de vin legate de caracteristicile senzoriale.*, Cea de-a III-a Conferinţă ştiinţifica Practică Internaţională "InWine 2005", 21-23 februarie 2005, Chişinău, Republica Moldova, pp. 6.

[5]. Antoce O.A., Gîţoi M., Grigorică L., Namolosanu I., 2002. *Study regarding the preferences in wine of the Romanian wine specialists*. Lucrări Ştiinţifice XLV U.S.A.M.V.B., Seria Horticultură, pp. 257-260.

[6]. Antoce O.A., Năməloşanu I., Grigorică L., Liţa C., Bândea F., 2006. *Studies regarding the perception of the wine quality by Romanian consumers*. Lucrări ştiinţifice Anul XLIX Vol 1 (49), Seria Horticultură, Ed. „Ion Ionescu de la Brad", pp. 425-430.

[7]. Antoce Oana Arina, 2003, A survey of Romanian consumers of alcoholic drinks: some differences between genders, Lucrări Ştiinţifice XLVI U.S.A.M.V.B, Seria Horticultură, CD-ROM pp. 326-329.

[8]. Braun E., Woodley A., Richardson J.T.E., Leidner B., 2012. *Self-rated competences questionnaires from a design perspective*. Educational Research Review, Vol. 7, Issue 1, pp. 1–18.

[9]. Crawford, I. M., 1990. *Marketing Research Centre for Agricultural Marketing Training in Eastern and Southern Africa*. Harare Zimbabwe.

[10]. Goulet E., Morlat R., 2011. *The use of surveys among wine growers in vineyards of the middle-Loire Valley (France), in relation to terroir studies*. Land Use Policy, Vol. 28, Issue 4, pp. 770–782.

[11] Rotariu T. and Ilut P., 2006. *Ancheta sociologică si sondajul de opinie*. Cap. III "Constructia chestionarului", Ediţia a II-a, Polirom Printing House, pp. 95-123, in Romanian.

[12] Sudman, S. and Bradburn, N. M. 1973. *Asking Questions*, pp. 208 - 28.

[13]http://www.surveysystem.com, Survey Design, retrieved on July 8th, 2012.

Scientific Papers, Series B, Horticulture, Vol. LVI, 2012
CD-ROM ISSN 2285-5661, ISSN-L 2285-5653

A 2011 SURVEY OF THE WINE PREFERENCES OF ROMANIAN KNOWLEDGEABLE WINE CONSUMERS

Arina Oana ANTOCE, Cătălin Florin PĂDURARU

University of Agronomic Sciences and Veterinary Medicine of Bucharest, Faculty of Horticulture, Department of Bioengineering of Horti-Viticultural Systems, Center for Wine and Vine Studies and Sensory Analysis, 59, Mărăşti Ave., District 1, 011464 Bucharest, Romania, aantoce@yahoo.com

Corresponding author email: aantoce@yahoo.com

Abstract

The survey was based on a questionnaire designed by the authors which included questions related to the preferences as well as the behaviours and attitudes of consumers in relation to the selection of wines. The survey was conducted during a wine fair, the respondents being considered knowledgeable wine consumers. The research included the assessment of the preference for categories of wines classified in accordance with the colour, sugar content, and quality category declared by the producer. Price, label design or origin of wine were variables also evaluated in the study. The influence of combined variables was also investigated. The results showed that the knowledgeable wine consumers prefer red wines (61%), dry (55%), with denomination of origin (58.1%), of Romanian provenance (66.3%), being in this way different from the average consumers. The distribution of preferences in accordance to combined parameters is also graphically presented and discussed with a view on the present situation regarding the supply on the market.

Keywords: *wine preferences, questionnaire survey, knowledgeable wine consumers*

INTRODUCTION

The wine market in Romania evolved greatly after joining the European Union [10], when the consumers got increased opportunities to experience wines produced in many famous wine regions from abroad. The information and the access to information also diversified, therefore the traditional preferences our consumers expressed for wines changed as compared to several years ago. A survey conducted in 2001-2003 in Romania [1-7], mostly on students or on educated people from large cities, by a group of researchers in cooperation with the
Association of Authorized Winetasters showed that majority of those consumers were interested in the aroma, flavour and taste of the wine [2, 3, 4, 6], very few subjects expressing any interest in the wine packaging or the label [2, 6].
Also, most of those consumers, especially women [1], preferred the white wines, especially from aromatic varieties, many did not understand the difference among the wine categories in accordance to their quality written on the label, did not understand the difference between hybrid and noble vine and wine [3].
The same research in which wine specialists were interviewed showed had this group had different preferences than the general population. The specialists selections in accordance with the wines colour were 41% red, 35% white and 12% rosé, while for the sweetness degree 79% preferred dry wines, 16% half-dry and 5% not decided [5].
This present survey was started in November 2011 and was intended to evaluate the evolution of the preferences of the wine consumers, so that the supply should be improved on the market in accordance to these new preferences.
The plantation re-conversion or the plantations to be set up in the future should be done in accordance to the new trends, so that the wine grape assortment reflects the present and future demand.
In this paper, the evaluation of the consumer general preferences about the type of wines and their origin was performed.
The evaluation was performed in accordance to a newly designed questionnaire [7].

MATERIAL AND METHOD

The survey was based on a questionnaire [7] designed by the Center for Wine and Vine Studies and Sensory Analysis and applied on 167 respondents who visited the Good Wine Fair Bucharest in the period of 18-20 November 2011.
The sample population consists therefore of knowledgeable wine consumers, who are consumers interested in the universe of wine and who deliberately chose to visit the wine fair.
This is actually the segment of population targeted by the wine producers and suppliers and their preferences will decide the demand, especially in the quality wine distribution chain.
The survey was performed with the assistance of some Good Wine Fair personnel, who interacted with the respondents, reading them the questions and filling the respondents' answers on the files.
A pre-testing of the questionnaire was performed in Vintest Wine Fair, a fair held one month before, also in Bucharest. As a result, it was considered useful that the multiple choice answers should be permitted multiple responses, so that the respondent should not be forced into selecting just one preference when she/he had got many to choose from. In this way, more useful information was collected, although the analysis was more demanding, involving distributing equal fractions of points for the several selected answers.
Irrespective of the number of selected answers for a certain question, the sum of the fraction points allotted for those selected answers accounted for a total of 1.
Then, the points accumulated for the same answer form all the respondents were summed up, a quantitative analysis being afterwards performed.
The collected data was introduced into an Excel database, points were granted for those questions where this type of analysis permitted and the responses were evaluated and interpreted.

RESULTS AND DISCUSSIONS

The questionnaire contained simple questions, so that the consumers would not get bored or tired with them. In the evaluation, however, the simple questions were combined, so that more information was extracted.
Firstly, the responses for the following questions *QI* and *QII* of the survey [7] were analysed.

QI. What kind of wines do you consume usually?
1. White wines
2. Rosé wines
3. Red wines

QII. What sugar level do you prefer in the wines you consume?
1. Dry wines (0-4 g/l sugar)
2. Half-dry wines (4-12 g/l sugar)
3. Half-sweet wines (12-45 g/l sugar)
4. Sweet wines (over 45 g/l sugar)

These are both questions with multiple answers allowed, therefore, for each type of answer fractions of points were obtained and collected into the database.
For a selected answer to a certain question a total of one point was assigned. In *QI*, if out of the 3 possible answers, only one was selected, that answer received 1 point. If out of the 3 possible answers 2 were selected, than each of the answers received 1/2 points. If of the 3 possible answers all 3 were selected, each answer received 1/3 points. The same calculation was applied in the case of *QII*, with 4 possible answers, where 1 point for a single answer, 1/2 for each of the 2 selected answers, 1/3 for each of the 3 selected answers or 1/4 for each of the 4 selected answers were allocated.

Table 1. Preference for the wine colour, irrespective of the sugar content and combined preferences for the colour and sugar content of the wine

Preference for wine colour	**White**	**Rosé**	**Red**	Total	%
Irrespective of the sugar content	**55**	**9.5**	**102.5**	167	100.00
% of answers	*32.93*	*5.69*	*61.38*		
Dry wines	**27.25**	**2.75**	**62.25**	92.25	55.24
% of answers	*49.55*	*28.95*	*60.73*		
Half-dry wines	**18.25**	**5.5**	**21**	44.75	26.80
% of answers	*33.18*	*57.89*	*20.49*		
Half-sweet wines	**9**	**1.25**	**15.75**	26	15.57
% of answers	*16.36*	*13.16*	*15.37*		
Sweet wines	**0.5**	**0**	**3.5**	4	2.40
% of answers	*0.91*	*0.00*	*3.41*		

From the combination of the answers for *QI* and *QII*, the quantitative analyses led to the data included in Table 1.
The distributions of preferences for the wine colour (*QI*) and for the sugar content in wine (*QII*) are shown in Fig. 1 and Fig. 2, respectively.

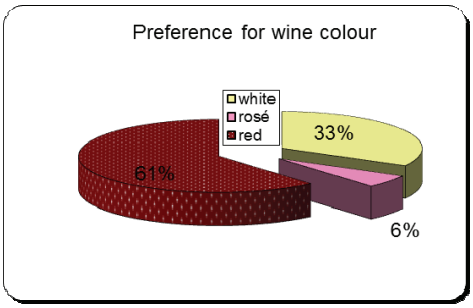


Fig. 1. Distribution of the preferences for the wine colour of the Romanian knowledgeable consumers in 2011

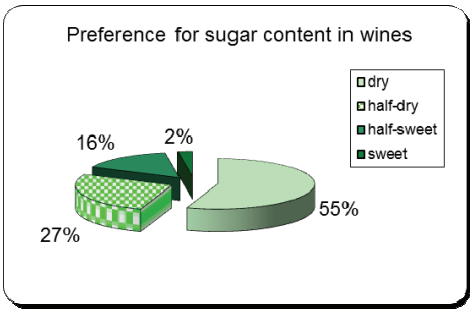


Fig. 2. Distribution of the preferences for the sugar content in wine of the Romanian knowledgeable consumers in 2011

The combined preferences for the sugar content in a wine of a certain colour are presented in the figures 3-5.

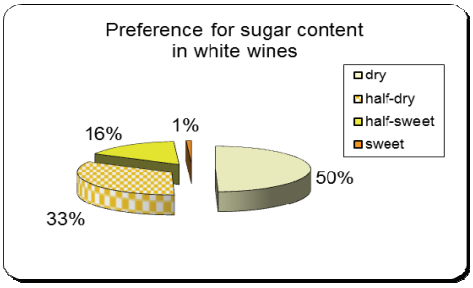


Fig. 3. Distribution of the preferences of the Romanian knowledgeable consumers in 2011 for the sugar content in white wines

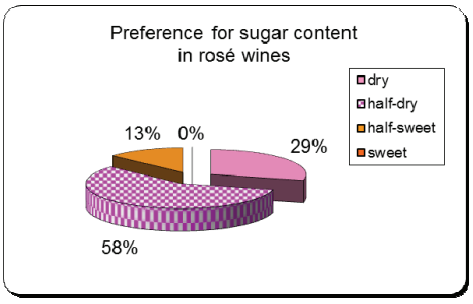


Fig. 4. Distribution of the preferences of the Romanian knowledgeable consumers in 2011 for the sugar content in rosé wines

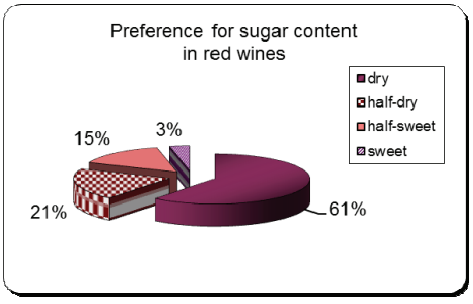


Fig. 5. Distribution of the preferences of the Romanian knowledgeable consumers in 2011 for the sugar content in red wines

The evaluation shows that knowledgeable consumers prefer red wines (61%) over the white and rosé. They also tend to prefer dry wines (55%), irrespective of the wine colour. Many of the white wines are still preferred with sugar, this category reaching the lowest preference for dry wines (50%), while rosé and red are preferred dry with 58% and 61%, respectively.
QIII evaluates the preference for the quality of wine suggested by the label. This question evaluates some aspects related to the quality, including not only the quality category of wine in accordance with our legislation (table, DOC and IG wine), but also the label design and price as markers of quality.

QIII. On shop shelves you find wines with various labels. You select the wine which has written on its label:
1. Table wine (without IG or DOC)
2. Denomination of Origin wine (DOC wine)
3. Geographical indication wine (IG wine)

4. I select in accordance with the general label design
5. I select in accordance with the price.
The respondent had the possibility here too to select multiple answers and the points for each answer were allotted by the above mentioned calculation methodology. For the evaluation, this question was kept as such, no partial information regarding only the quality category in accordance with the legislation being derived.
In fig. 6, we can see that the preference of the knowledgeable consumers is clearly in favour of DOC wines, a quality category supposedly including the wines with the highest quality, which in Romania represented in 2009 only 5% of the total wine sold including the table wine from hybrids [12] or 13.3% [9] - 15% [11] of the total noble wine marketed.

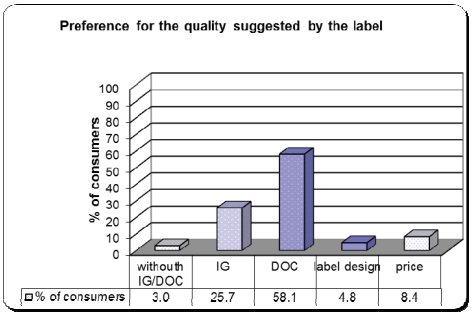


Fig. 6. Distribution of the preferences of the Romanian knowledgeable consumers in 2011 for the quality suggested by the label

The label design (including the brand name) is not yet established in Romania as a leading preference, only 5% of the interviewed consumers mentioning it as being of importance.
The price is however a component that cannot be ignored, 8.4% of the consumers selecting their wines irrespective of the quality category, solely in accordance to the price. The percentage is expected to be actually much higher in the entire population, taking into account that this survey was conducted at a wine fair, where the visitors are more knowledgeable in respect to wine types and styles and more willing to spend money for the perceived quality.

By combining the answers given by a person to the question *QIII* regarding the wine quality and *QII* regarding the sugar contents, we obtain the distribution of preferences included in Table 2.

Table 2. Distribution of answers (fraction of points allocated) describing the preference for the quality of wine and sugar content

Wine guality/ *Sugar content*	**withouth IG/DOC**	**IG**	**DOC**	**label design**	**price**
white dry	1.00	11.08	13.84	0.00	5.08
white with sugar	1.00	8.08	16.34	1.00	1.58
rosé dry	0.00	0.00	3.00	0.00	0.00
rosé with sugar	0.00	0.50	4.50	1.00	0.00
red dry	0.00	17.41	36.43	2.50	5.66
red with sugar	1.50	9.41	14.43	4.00	7.66

For the rosé there is no clear image regarding the level of expected quality in the bottle, therefore the consumers appear to make a selection in accordance with the offer in the market, which is mostly in the quality category DOC.
In white wines the preference for the dry wines is almost equal with that for the wines containing sugar (31 total points for dry wines and 28 points for sugar containing white wines), while for the red wines the preference is clear for the dry wines (62 total points for dry wines and 37 points for sugar containing white wines).
The combined distribution for quality suggested by the label (*QIII*), the sugar content of the wine (*QII*) and colour of the wine (*QI*) is presented in Fig. 7.

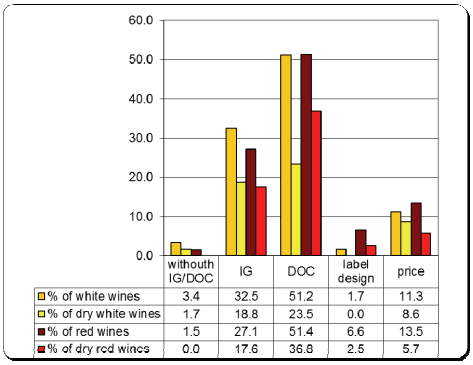


Fig. 7. Distribution of the preferences of the Romanian knowledgeable consumers in 2011 for the quality suggested by the label, sugar content and colour of wine

Then, by the use of *QIV*, the preference for the imported or Romanian wines was evaluated (Fig. 8), showing a high tendency towards the consumption of Romanian wine (66%).

QIV. Considering the wine provenance what kind of wines do you prefer?

1. Romanian wines
2. European wines (France, Italy, Spain, Germany, Portugal etc.)
3. From outside of Europe (Chile, Argentine, New Zeeland, Australia etc.)

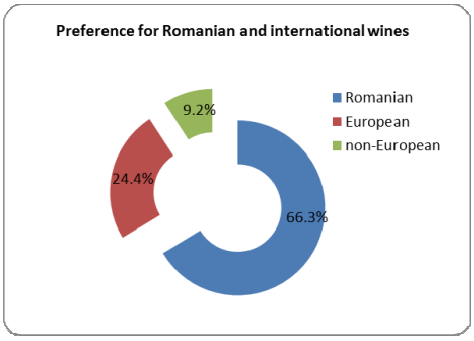


Fig. 8. Distribution of the preferences of the Romanian knowledgeable consumers in 2011 for the wine provenance

In combinations with the answers given to *QI*, the preference for the provenance of wine and the colour was evaluated (Fig. 8).

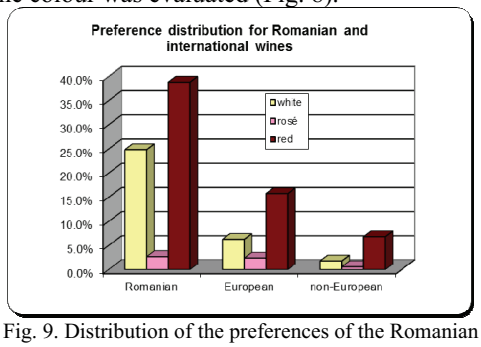


Fig. 9. Distribution of the preferences of the Romanian knowledgeable consumers in 2011 for the provenance and colour of wine

By also including into this evaluation the answers given to question *QII*, the preference distributions in accordance to provenance and sugar content are presented for white, rosé and red wines in figures 10-12. The points allocated for each type of response, as well as the percentage of that specific answer are both included in the graphical representation.

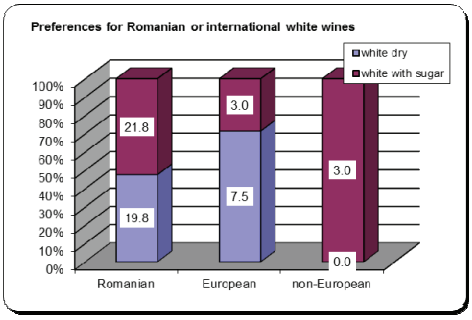


Fig. 10. Distribution of the preferences of the Romanian knowledgeable consumers in 2011 for the provenance and sugar content of white wines

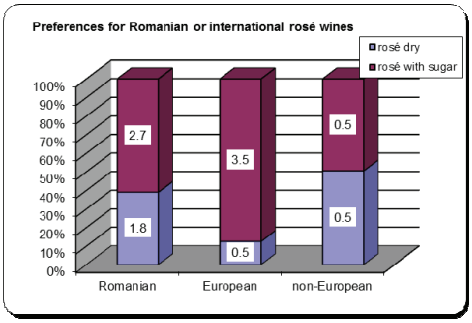


Fig. 11. Distribution of the preferences of the Romanian knowledgeable consumers in 2011 for the provenance and sugar content of rosé wines

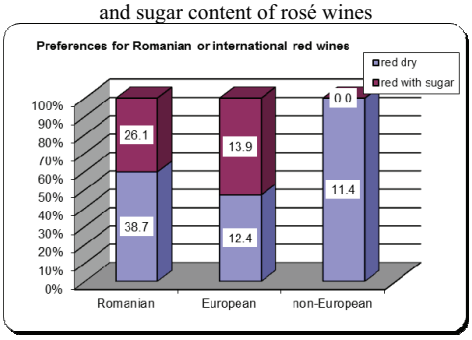


Fig. 12. Distribution of the preferences of the Romanian knowledgeable consumers in 2011 for the provenance and sugar content of red wines

Taking into account the answers given by the respondents to questions *QI*, *QII* and *QIV* we obtain the preference distribution of all these aspects (Fig. 13).

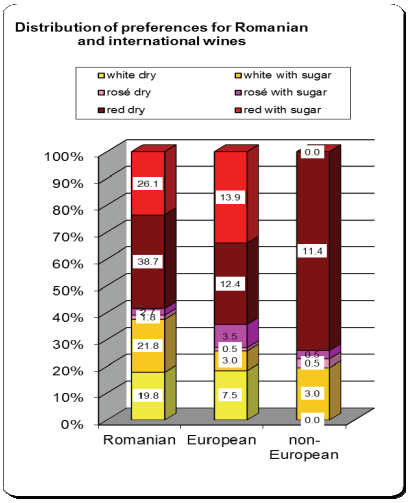


Fig. 13. Distribution of the preferences of the Romanian knowledgeable consumers in 2011 for the provenance, sugar content and colour of wines

We can see that the impact of the imported wines is not at all negligible, 25% of the preferences going to European wines and 8% to non-Europeans (Fig. 8). The non-European wines, coming from the so called New World, are still not enough known by the Romanian consumers, therefore most of their preferences went to the dry red wines (74.1%, Fig. 13), more imported and distributed on our market. The European (Old World) wines are better known and the preferences are in favour of red wines (64.5%), followed by white (25.7%) and rosé wines (9.8%). For the Romanian wines, the distribution is still in favour of red wines (58.5%), but the white wines are also important (37.5%) with the rosé appearing only occasionally (4.1%).

The distribution of the preferences for wines of various colours in accordance to their Romanian or international provenance shows (Table 3) that most of the white wines consumed are of Romanian origin (75.5%).

Table 3. Distribution of the preference for the wine colour in accordance to its provenance (in %)

	Romanian	European	non-European	Total
white total (%)	75.5	19.1	5.5	100.0
rosé total (%)	47.4	42.1	10.5	100.0
red total (%)	63.2	25.7	11.1	100.0

In case of red wines too there is a preference for the Romanian wines, but with a lower share (63.2%) than in the case of white wines, 25.7% of the preferences going to the European red wines.

For rosé wine there is no clear preference for Romanian or imported wines, the number of answers pointing towards rosé wine being too small to consider the distribution depicted in Table 3 significant.

CONCLUSIONS

As compared to the data obtained 7-10 years ago, this survey shows a clear evolution in Romanian consumer preferences for the types and styles of wines, towards a situation more in line with the international tendencies.

The knowledgeable consumers showed a preference for red wines (61%), a result never obtained on Romanian consumers before, as the prevalence of the white wines in the local chain of supply and demand is notorious. This result cannot be extrapolated to the entire population, where it is expected that the preference would be still in line with the present wine assortment that can be supplied on the internal market, that dominated in 2011 by 72% white wine [8]. However, it shows a tendency which is likely to shift more and more toward red wines.

In a market dominated by half-dry and half-sweet wine consumption (27.4% and 45.0% in 2011, [8]), the knowledgeable consumers appear to set a trend for more dry wine purchases, these wines reaching 55% in their preferences, as compared to only 12.4% for the general population [8].

The knowledgeable consumers are able to recognize the Denomination of Origin label as a sign of quality and their preference for this wine category is 58.1%, and 25.7% for IG, levels in total contrast to the proportions in the supply of Romanian wines, which in 2009 was in reverse order (5.3% for DOC, 19.9% for IG and 74.8% for wines without DOC or IG including the wine from hybrid varieties [12].

The impact of joining the European Union is visible too in the increased preference for international wines especially from Europe (24.4%). Still, the preference of knowledgeable wine consumers is for the Romanian wines

(66.3%); however, the preference of the general population for Romanian wines, correlated also with the notorious tendency to favour lower prices, is expected to be much higher. The knowledgeable wine consumers seem to care less for the price, basically selecting their wine in accordance with the desired quality. Still, 8.4% of the answers pointed out that the price is important for this category of consumers too.

AKNOWLEDGMENTS

The design of the questionnaire was performed and tested in cooperation with the Center for Wine and Vine Studies and Sensory Analysis and Good Wine Fair organized by ProActive Business Communication.

REFERENCES

[1]. Antoce O.A., 2003. *A survey of Romanian consumers of alcoholic drinks: some differences between genders*. Lucrări Ştiinţifice XLVI U.S.A.M.V.B, Seria Horticultură, CD-ROM pp. 326-329.

[2]. Antoce O.A., 2003., *Personal preferences about wines as indicated by a survey of Romanian consumers.* Lucrări Ştiinţifice XLVI U.S.A.M.V.B., Seria Horticultură, CD-ROM pp. 330-333.

[3]. Antoce O.A., 2003. *The age of the consumers and its influence on the consumption of beverages in Romania*., Lucrări Ştiinţifice XLVI U.S.A.M.V.B., Seria Horticultură, pp. 334-337.

[4]. Antoce O.A., 2005. *Preferinţele consumatorilor români de vin legate de caracteristicile senzoriale*. Cea de-a III-a Conferinţă ştiinţifica Practică Internaţională "InWine 2005", 21-23 februarie 2005, Chişinău, Republica Moldova, pp. 6.

[5]. Antoce O.A., Gîţoi M., Grigorică L., Namolosanu I., 2002. *Study regarding the preferences in wine of the Romanian wine specialists*. Lucrări Ştiinţifice XLV U.S.A.M.V.B., Seria Horticultură, pp. 257-260.

[6]. Antoce O.A., Năməloşanu I., Grigorică L., Liţa C., Bândea F., 2006. *Studies regarding the perception of the wine quality by Romanian consumers*. Lucrări ştiinţifice Anul XLIX Vol 1 (49), Seria Horticultură, Ed. „Ion Ionescu de la Brad", pp. 425-430.

[7] Antoce O.A., Păduraru C.F., 2012. *Methodology for the evaluation of the preferences regarding wine and information needs of consumers*. Lucrări ştiinţifice U.Ş.A.M.V.B., Seria B, vol. LVI, Section Miscelaneous, Congres CD, ISSN 1222-5312, 6 pages (in print).

[8] Ioniţă I.C., 2012. *Elaborarea campaniei de imagine Murfatlar vinul*. Cap. 1.2.1 and 1.2.2, Master Thesis, USAMVB, pp 7-9.

[9] Müller K., Antoce O.A., 2011. *Der rumäniche Weinbau-Gegenwart und Perspektive*. Deutsches Weinbau-jahrbuch 2011 (62 Jahrgang)-Verlag Eugen Ulmer, pp. 118-128, in German.

[10] Namolosanu I., Antoce O.A., Mocanu P., Axente D., 2004. *Transformations and legislation instruments in the field of vine growing and wine making in Romania in the context of the process of joining the European Union*. XXVIIIth World Congress of Vine and Wine (OIV Congress 2004), 4-9 July, Hofburg, Vienna, Austria, p. 143-144, Oenology Section, O-3.11 şi Congress Proceedings CD-ROM.

[11]2010. *The productive potential of vine plantations in the year 2009*. Press release No 255 of December 6th, 2010, National Institute for Statistics of Romania, *http://www.insse.ro/cms/files%5Cstatistici%5Ccomunicate%5Ccom_anuale%5Cprod_vie_09.pdf,* retrieved on July 13th, 2012.

[12]2012. Ministry of Agriculture and Rural Development, Viticulture and Enology, *http://www.madr.ro/pages/page.php?self=01&sub=0101&tz=010107, retrieved on July 13th, 2012.*


EX·TERRA·AVRVM

Scientific Papers, Series B, Horticulture, Vol. LVI, 2012
CD-ROM ISSN 2285-5661, ISSN-L 2285-5653

AN ASSESSMENT OF THE INFORMATION AND TRAINING NEEDS OF ROMANIAN KNOWLEDGEABLE WINE CONSUMERS

Arina Oana ANTOCE, Cătălin Florin PĂDURARU

University of Agronomic Sciences and Veterinary Medicine of Bucharest, Faculty of Horticulture, Department of Bioengineering of Horti-Viticultural Systems, Center for Wine and Vine Studies and Sensory Analysis, 59, Mărăşti Ave., District 1, 011464 Bucharest, Romania, aantoce@yahoo.com

Corresponding author email: aantoce@yahoo.com

Abstract

This work focuses on the evaluation of the usefulness of some tools used internationally for transmitting more information about wines to consumers in order to stimulate their interest in this horticultural product. On one hand, the importance of wine contests is assessed in relation to the consumers' selection of wines. Their knowledge regarding wine contests, what represents a medal-winning wine for them and to what extent they trust this marketing tool were some of the evaluated aspects and the responses from consumers were also correlated to their self-evaluation of their own knowledge about wines. On the other hand, the usefulness of a wine museum was assessed as a tool for increasing the interest in wine in general. The declared needs of the consumers for a certain type of training and the amount of wine consumed were also correlated to their knowledge about wine. These results showed that the importance that consumers attached to wine contests is low and the interest for a wine museum is even lower, therefore the information provided to consumers should be increased first if these otherwise powerful tools are to be applied efficiently at some time in the future.

Keywords: *wine information, wine contest, wine museum*

INTRODUCTION

In this era of information technology, any business needs to be promoted by making use of modern tools to spread the knowledge around efficiently. In our society, wine is regarded not only as a food companion, but also as a tradition carrier and cultural asset of the people from a certain region.

In Romania, the wine tradition has deep roots, but some of the ancient heritage was lost during the communist times, therefore the involvement of the present day people into the cultural aspects related to wine should be reconstructed.

In countries with uninterrupted strong tradition in wine culture, marketing and information tools such as the wine contests and wine museums are regarded as natural and useful for regional wine promotion.

In Romania, wine contests appeared only after the collapse of communism in 1989, and were received very well by the public. A series of national and regional wine contests were organized since then, some of them disappearing after a while due to lack of funding, some other appearing anew thanks to the enthusiasm of certain business oriented associations and groups. For example, in the 2011 Romania, two wine contests were organized in accordance to the rules of international wine contests [3], two national ones in Timisoara [13] and Alba Iulia [10] and another one, international, in Bucharest [8], under the auspices of the OIV [14]. Some other local and atypical contests were also organized, aside of some wine fairs, all meant to increase the interest of the consumers in correctly produced and priced wines. In this regard, many knowledgeable consumers are aware of the wine contests and some of them do follow with pleasure the results of the wines or the performance of the producers.

On the other hand, the wine museums are virtually unknown in Romania, although some very small wine museum exists, located in viticultural regions such as Dragasani [4], Harlau [7], Golesti [6] Teremia [12], Minis [5].

This work was performed to evaluate the importance the knowledgeable consumers attach to wine contests and wine museums, so that the use of these tools could be improved and their power as information communicators be increased. Moreover, the attitude of these consumers for other types of information communication or their training needs in the field of wine were also evaluated, by the use of a specially designed questionnaire [1].
The wine consumption and appreciation should be based on correct and targeted information and the training needs identified should be fulfilled efficiently.

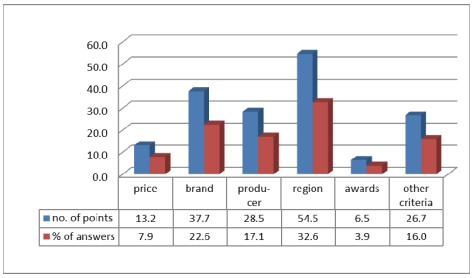
MATERIAL AND METHOD

The questionnaire used for the evaluation included, in its second part, certain questions for the evaluation of the aspects to which the consumer attaches more importance (such as the price or brand, region, producer notoriety), direct questions regarding the opinion on wines awarded with a medal in a wine contest and the correctitude of evaluations in wine contests, as well as questions on training information needs with indirect reference to the need for a wine museum. The survey included also questions regarding the self-evaluation of the wine knowledge and the general wine consumption.
The questionnaire was filled up by a number of 167 respondents who took part in the Good Wine Fair in 18-20 November 2011 in Bucharest. Most of respondents were assisted by the Good Wine Fair personnel, the questions being read to them by a survey assistant.
No biographical or demographical data were collected in this survey.
The answers to each question were quantified by allocating points to the answer given to single choice questions and fractions of numbers to the answers selected in multiple choice questions. In a question with multiple possible answers, in case 1 answer was selected it received 1 point, in case two answers were selected both answers received a fraction of ½ point, while in case of *m* answers selected, each answer received 1/*m* points. The data collected were processed with the Excel software package.

RESULTS AND DISCUSSIONS

The evaluation was based on a questionnaire with 10 questions [1]. However, the first 4 questions of the survey, dealing with the consumers' preferences for a certain type, style or provenance of wine, were left aside, being out of the scope of this analysis.
The first question (*QV*) taken into account for the purpose of this study investigated factors likely to influence the decision of buying a certain wine. This *QV* question included many possible apparently untargeted answers.
QV. How do you select a wine to drink at home? In accordance with the:
1. Price
2. Brand
3. Producer's notoriety
4. Region/country of provenance notoriety
5. Awards obtained in wine contests
6. Other criterion: .....

In fact, this question is meant especially to evaluate the importance the consumers attach to the awards obtained by a wine in contests, when confronted with other more powerful factors which usually influence the decision of buying.



	price	brand	produ-cer	region	awards	other criteria
no. of points	13.2	37.7	28.5	54.5	6.5	26.7
% of answers	7.9	22.5	17.1	32.6	3.9	16.0

Fig. 1. Distribution of answers selected by the Romanian consumers in 2011 as being of importance when the decision to buy a wine is taken.

As expected, the awards obtained by a wine in a contest are not likely to weigh much as compared to the notoriety of wine brand, region of provenance, or of producer. Fig. 1 contains the distribution of the answers selected by the consumers as being important

for the decision to buy a wine to drink at home.

As the survey was conducted on knowledgeable consumers, most of them appreciated more and based their decision of buying more on the notoriety of the provenance region (32.6%), followed by the brand notoriety (22.6%) and producer's notoriety (17.1%), as well as other relevant criteria related to quality (16.0%). Because this was question was partially open, the relevant criteria were also detailed, but the responses are not discussed here.

Less importance was attached by this category of wine consumers on price (7.9%), meaning that they prefer quality and are not looking for the lowest price in the market.

Although we interviewed mostly informed consumers of wines, we noticed, even from this first question, that an alarming low level of importance (3.9%) was attached to awards obtained by wines in national or international competitions.

Unless corrected soon, this fact may lead to a decrease in the participation of the wine producers in competitions and in investing in this type of advertising.

Therefore, a deeper investigation was conducted, to evaluate the level of understanding of the wine contest result by the consumers (question *QVI*), to which direct answers or comments or expected.

QVI. In your opinion a wine awarded with a medal in a wine contest is:

1. The best wine obtained in that vintage year
2. A distinct wine, worth buying and keeping
3. A wine recommended by some experts
4. A better wine than others in the same category
5. A proper wine, which was sent and evaluated in a wine contest; many other 1000 wine out there can be better, but were not sent for the evaluation in that wine contest.
6. I do not trust the awards and evaluations in wine contest
7. Other comments:

This specific question was meant to assess directly the knowledge of consumers regarding wine contests and the importance they attach to wine contests as a warranty for wine quality. The points obtained by each answer selected and the distribution of these answers (quantified in %) are reported in Table 1.

Table 1. Quantitative evaluation of the importance given by consumers to various aspects related to wine contest awards.

Aspects related to wine contest awards	Points (no. of selected answers)	% of selected answers
1. Wine for keeping	11	7
2. Best wine of the year	19	11
3. Wine recommended by experts	65	39
4. One of the best wines in its category of quality	33	20
5. Indifferent reaction: normal drinkable wine evaluated in a contest	29	17
6. Do not trust contest results	8	5
7. Other comments	2	1
Total	167	100

The first two answers in Table 1, which account for a total of 18% of the selected answers, represent an overestimation of the importance of an award obtained in a wine contest; a wine which obtains a medal is not necessarily a wine for keeping in a collection and is definitely not the best wine of a year. At the other extreme, in the last 3 answers (no. 5, 6 and 7) of Table 1, we can see that a sum of 23% of the consumers have an indifferent reaction to wine contests, with 5% among them not trusting the results).

The answers no. 3 and 4, accounting for 59% of responses, demonstrate that many knowledgeable consumers have a good image regarding what an award won in a wine contest really signifies. Still, as already shown in Fig. 1, they do not pay too much attention to this aspect when they select their wines, probably due to a lack of trust in the accuracy of the evaluations or even in the correctness of the wine contests.

For several reasons, we expected this reaction towards some wine contests, therefore in question *QVIII* we assessed the trust of consumers in wine contests organized in Romania and abroad.

QVII. Do you believe the Romanian wines are more appropriately judged in:

1. International wine contests organized abroad

2. International wine contests organized in Romania
3. National or local wine contests organized in Romania.
4. In all wine contests the evaluation is the same, the experts in the jury being specialized and trained to constantly evaluate the samples.
5. I have no idea about the procedure of wine evaluation in a wine contest.

Table 2. Quantitative evaluation of the consumers' trust into the judgement of wines in several types of wine contests

Consumers' trust into the judgement of wines in:	Points (no. of selected answers)	% of selected answers
1. Contests abroad	47	28
2. Romanian contests with international judges	*29.5*	*18*
3. Romanian contests with Romanian judges	21.5	13
4. All types of contests are similar	35	21
5. Know nothing about wine evaluation in contests	34	20
Total	167	100

The degree of trust in the Romanian wine contests is reflected in the conviction that Romanian wines are better judged in contests organized abroad. The degree of trust in wine contests is divided among contests organized abroad (28%, answer no. 1) and Romanian wine contests (31%, answers no. 2 and 3), with another group of 21% of respondents considering all the wine contests alike and of the same performance (answer no. 4).
Among the contests with international judges, the wine contests organised abroad (answer no. 1) are considered more trustworthy than our contests with international judges (answer no. 2), with 28% of the expressed preferences as opposed to 18%.
This question goes deeper into the wine contest issue, forcing the respondents to share their trust or distrust in contests organized in Romania with Romanian judges. Only 13% expressed their trust in Romanian wine contests with Romanian judges.
For those consumers who do not pay attention to awards in contests there was the option to express no opinion by selecting answer no. 5. Consequently, 20% of the interviewed persons admitted that they have little understanding regarding the evaluation performed in a wine contest.
Therefore, more transparency regarding the organisation, evaluation and award allocation is necessary, to make consumers trust the results of a wine contest and buy an award-winning wine, knowing exactly what to expect from that wine. For the producers too, the improvement in the eyes of the consumers of the image of these wine contests is imperative, if they are to use the awards obtained as marketing tools. At present, many producers participate with samples in wine contests to compare themselves with the competition, but not to influence the decision of the consumer.
Regarding the necessity of a wine museum, considering that museums of all kinds seem out of fashion and are shunned by younger generations, we did not want to ask a direct answer and get distorted (false positive) results. People are reluctant to admit they would not go and spend their free time in a museum and they might have selected the answer supporting the necessity of a wine museum, even though their intention of visiting such an institution was null. Accordingly, we included only a single answer (no. 5) concerning the wine museum into a larger question (*QX*) regarding all kind of information needs about wine.
QX. In order to improve your knowledge about wine, what kind of information delivering or training method would you prefer?
1. Basic informative classes organized by wine specialists
2. Informal wine-tastings, without too much technical information about wine
3. Speciality counselling at the sale point
4. Dedicated literature (written or posted on the internet)
5. Visits to Museums dedicated to wine.
This combined question is aiming to assess the information needs of the wine consumers and their preferred methods of getting this information, in the same time trying to indirectly establish the impact of founding a wine museum. The quantitative results

obtained from the multi-choice answer selections are included in Table 3.

Table 3. Quantitative evaluation of the consumers' instruction needs about wine and preferred methods for training (analysis based on multiple choice answers)

Types of instruction methods in wine field	Points (no. of selected answers)	% of selected answers
1. Organized by experts	55.01	32.9
2. Casual winetasting	47.43	28.4
3. Counseling at the point of sell	27.77	16.6
4. Written materials, including internet	21.94	13.1
5. Visits to a wine museum	14.85	8.9
Total	167	100

Many of the respondents attach importance to learning from the experts (32.9%, answer no. 1) and not by themselves from written materials or internet (13.1%, answer no. 4). In addition, they also expect to practice in class what they learn theoretically, preferring to participate in winetasting sessions, fact partly expressed in answer no. 2. This answer also includes the preferences of a group who would like to taste wines only for pleasure and do not want/need to be taught too many things about wines. This practical winetasting, both for pleasure and for learning purposes, accounts for a total of 28.4% of the selected training methods.

As predicted, the idea of wine museum is not very appealing, only 8.9% (answer no. 5) of the responses pointing to the necessity of such an institution. The consumers do not see the museum as a place where wine can be experienced, but rather as another written source of information. The fact that 32.9% (answer no. 1) are willing to learn more about wine from the experts is a starting point toward founding an interactive wine museum, designed for the transfer of knowledge rather than just presenting facts in a static way.

In order to establish the preferred training needs in the field of wine, the responses to the question QX were re-evaluated, by taking into account only the single option responses, to which 1 point was granted. All the other multiple-choice responses were grouped separately under the title "many types of instruction". This group includes the respondents who actually do not have a preferred training option. The quantitative results obtained as single option answer are included in Table 4.

Table 4. Quantitative evaluation of the consumers' instruction needs about wine and preferred methods for training (analysis based on single choice answers)

Types of instruction methods in wine field	Points (no. of selected answers)	% of selected answers
1. Organized by experts	40	24.0
2. Casual winetasting	40	24.0
3. Counseling at the point of sell	18	10.8
4. Written materials, including internet	19	11.4
5. Visits to a wine museum	10	6.0
6. Many types of instruction	*40*	*24.0*
Total	167	100

By excluding the respondents who actually do not have a preferred training option (those grouped in category no. 6, "many types of instruction"), the respondents who expressed a clear interest for wine museum is even less, reaching only 6%. The difference of 2.9% (up to 8.9% of selected answers shown in Table 3) represents the percentage of respondents who would choose to go to a wine museum among others.

To better understand the needs of the knowledgeable consumers in terms of training, we tried to correlate the actual wine drinking habits of our respondents with their self-evaluated knowledge about wine. Question *QVIII* and *QIX* ask the respondents to evaluate their wine consumption and to rate their knowledge about wine, respectively.

QVIII. What is your approximate wine consumption?

1. I do not consume wine or I rarely try wine.
2. I consume one bottle of 0.751 /week
3. I consume 2 bottles of 0.751 /week
4. I consume more than 2 bottles of 0.751 /week

QIX. On a scale of 1 to 10 how would you rate your knowledge about wine?

Question *QVIII* does not intend to determine the wine consumption of our respondents, but to correlate their preference for wine with the knowledge about wine and the willingness to receive more specific information about wine. For this reason, the answer no. 1 includes

both “I do not consume wine” and “I rarely try wine” options, because both show little implication in wine consumption and wine culture. With the rest of the answers groups of wine consumption level were established.

Question *QIX* is the only question that can be sensitive for the respondent, who is placed in the position to self-evaluate his/her competencies as regards to wine. The responses should be interpreted with caution, since some of the respondents tend to overrate their competencies out of self-esteem, while others may simply not know where to place their level of knowledge on a scale. Even though such self-evaluations are often criticised for their lack of reliability [2], we decided to use this information even so, in order to better evaluate the information needs of the population about wine.

Table 5. Wine consumption groups and their average self-rating regarding knowledge about wine

Wine consumption (in bottles of 0.75 l)	Points (no. of selected answers)	% of selected answers	Average and standard deviation for self-rating of knowledge about wine
Rarely (under one bottle a week)	28	17	5 ± 2.1
One bottle a week	76	46	6 ± 1.7
2 bottles a week	35	21	7 ± 1.8
More than 2 bottles a week	28	17	7 ± 1.5
Total	167	100	

We gathered the information from both *QVIII* and *QIX* questions in a common database, for each group with a certain level of wine consumption collecting the marks granted by those respondents to self-evaluate their competencies in wine. Then, the average mark for self-evaluated competencies was determined for each group of wine consumption level. The results are presented in Table 5.

We can see that 17% of the respondents rarely consume wine, but they have shown interest in wine culture by coming to a wine fair – an encouraging result. Among the knowledgeable consumers participating in the survey 46% enjoy wine in moderate quantities and only 17% declare a consumption of more than 2 bottle/week (which represents more than 72 l/year, hence more than double the wine consumption per capita in Romania in 2008, which was officially 25.30 [9]).

The self-evaluation of wine competencies is very well correlated with the number of bottles consumed per week (Fig. 2). In order to quantify the categories of wine consumption entitled “rare consumption” and “more than 2 bottles a week”, to the first category 0.1 bottles/week and to the last category 3 bottles/week were allocated, respectively.

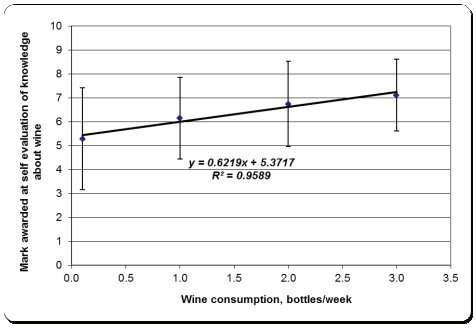


Fig. 2. Correlation of the wine consumed per week and the self-evaluation of the knowledge about wines.

Most statisticians say that one cannot use correlations with rating scales [11], because the mathematics of this technique assumes the differences between numbers in the scale are exactly equal, while in fact that may not be the case. As we can also observe with our data, many respondents avoided the extremes of the 1 to 10 scale, placing themselves in a “safer” position, somewhere in the middle of the scale. Therefore, the true difference between marks 3 and 4 may not be equal to the difference between marks 6 and 7, although arithmetically the difference appears equal to 1 in both cases. However, many survey researchers do use correlations with rating scales, because they found out that the results usually reflect the real world in a satisfactory fashion [11].

In our case too, the linear regression (Fig. 2) shows a very good correlation, the equation derived (y=0.62x+5.35) having a correlation coefficient (*r*) of 0.98, meaning that these two variables (wine consumption and self-evaluation of wine knowledge) are strongly directly related. The square of the coefficient

(or r^2) is 0.96, meaning that 96% of the variation in one variable is related to the variation in the other.
Therefore, we can safely assume that the more wine a consumer drinks per week, the more knowledgeable he/she thinks is in the field of wine.
However, the marks awarded for self-evaluation of knowledge are not significantly different from one group of level of wine consumption to another. The test ANOVA on ranks (Table 6), performed for the marks awarded to self-evaluation shows, however, that significant differences appear only among non-drinkers and heavy drinkers (zero bottles versus 3 bottles a week).

Table 6. ANOVA on ranks performed for the marks awarded to self-evaluation (Kruskal-Wallis One Way Analysis of Variance on Ranks)

Consumption Bottles/week	Group	N	Missing	Median	25%	75%
0	Col 1	28	0	6	3	7
1	Col 2	76	0	6	5	7
2	Col 3	35	0	7	6	8
3	Col 4	28	0	7	6	8

H = 14.155 with 3 degrees of freedom. (P = 0.003)

The results in Table 6 show that differences in the median values among the treatment groups are greater than would be expected by chance and that there is a statistically significant difference (P=0.003) among some groups. In Table 7, by Dunn's Method (an all pairwise multiple comparison procedure) we determined that significant differences exist only among Col 1 and Col 4, that is among the self-ratings of non-drinkers and heavy drinkers groups.

Table 7. Comparison on pairs for the groups of average marks awarded to self-evaluation

Comparison	Diff of Ranks	Q	P<0.05
Col 4 vs Col 1	43.25	3.347	Yes
Col 4 vs Col 2	27.485	2.571	No
Col 4 vs Col 3	11.968	0.976	Do Not Test
Col 3 vs Col 1	31.282	2.552	No
Col 3 vs Col 2	15.517	1.571	Do Not Test
Col 2 vs Col 1	15.765	1.475	Do Not Test

Overall, the opinion of the wine fair visitors about their own knowledge of wine is rather good, the average mark for their knowledge being 7 ± 1.7, irrespective of the amount of wine consumed, with the exception of the group with no wine consumption) with an average of 5 ± 2.1.
These average marks obtained for self-evaluation show the need for more training of consumers in the field of wine.

CONCLUSIONS

The survey shows that there is a need for more correct and readily available information about wines.
The knowledgeable consumers generally have a good impression about their own knowledge and understanding about wines, 51% of them granting themselves marks equal or above 7.
However, the wine consumers still lack the correct perception of the meaning of a wine contest and the significance of a medal obtained in a wine contest. For these consumers a campaign of information and promotion of wine contests seems necessary, with more transparent procedures and clear messages. Such a campaign will also help producers, who do not have enough incentives to send their wines to evaluation in wine contests, thus missing the opportunity to compare their wines with those of competitors, re-adjust the technologies when necessary and promote more efficiently their wines.
The organizations involved in wine business or in promoting wine culture should be more motivated to organise courses and practical sessions of wine appreciation to increase the attraction of this field for the general population. This survey was conducted on knowledgeable consumers and many deficiencies were identified. The sample population that participated in this survey is not representative for Romania in general, but only for the wine connaisseurs, who deliberately chose to visit a wine fair. However, there is reason to believe that the lack of information about wine identified in this sample population is, at least to the same extent, applicable to the entire population of the country. It is logical to assume that the general population is even in more need for training in the field of wine.
For the institution of wine museum, more evaluations should be hereafter performed to

identify the directions for the development of such a project. Before reassessing the reaction of people towards a wine museum, it should be explained to them that the intention is to establish a modern-type institution, where large general information about vine, wine and oenological tourism would be transmitted in a recreational and interactive way.

AKNOWLEDGMENTS

The design of the questionnaire was performed and tested in cooperation with the Centre for Wine and Vine Studies and Sensory Analysis and Good Wine Fair organized by ProActive Business Communication.

REFERENCES

[1] Antoce O.A., Păduraru C.F., 2012. *Methodology for the evaluation of the preferences regarding wine and information needs of consumers*. Lucrări ştiinţifice U.Ş.A.M.V.B., Seria B, vol. LVI, Section Miscelaneous, Congres CD, ISSN 1222-5312, 6 pages (in print).

[2]. Braun E., Woodley A., Richardson J.T.E., Leidner B., 2012. *Self-rated competences questionnaires from a design perspective*. Educational Research Review, Vol. 7, Issue 1, pp. 1–18.

[3]2009. *OIV standard for international wine competitions and spirituous beverages of vitivinicultural origin (OIV-CONCOURS 332A-2009) and Guidelines for granting OIV patronage of international wine and spirituous beverages of vitivinicultural origin competitions (OIV-concours 332b-2009), International Organisation of Vine and Wine, Edition 2009, OIV - 18, rue D'Aguesseau - 75008 Paris*. http://www.oiv.int/oiv/info/enplubicationoiv#world, retrieved on July 8, 2012.

[4]2012. *Dragasani Vine and Wine Museum*. http://www.romguide.ro/Viziteaza/Muzeul-Viei-si-Vinului_vt36f, retieved on July 13th, 2012.

[5] *** 2012. *Ghioroc Wine Museum*. http://ro.wikipedia.org/wiki/Fi%C8%99ier:Muzeul_Vinului_Ghioroc.jpg, retieved on July 13th, 2012.

[6] *** Golesti, 2012. *Viticulture and Fruitgrowing museum*. http://www.cimec.ro/muzee/golesti/index.htm, retieved on July 13th, 2012.

[7] *** 2012. *Harlau Vine and Wine Museum*. http://www.palatulculturii.ro/muzeuharlau.htm and http://costachel.ro/ati-fost-la-muzeul-viei-si-vinului-de-la-harlau/, retieved on July 13th, 2012.

[8] *** 2012. *International Wine Contest Bucharest, 2012*. 9th Edition, 7-10 June, 2012, http://www.iwcb.ro/, retrieved July 13th, 2012.

[9] *** 2012. "StatOIVExtracts", OIV, International Organization of Wine and Vine, http://www.oiv.int/oiv/info/enstatoivextracts2, retrieved on July 13, 2012.

[10] ***. 2012, *Strugurele de Aur Wine Contest Alba Iulia, 2012*., 6th Edition, 10-12 September, 2012, http://www.adar.ro/index.php?option=com_content&view=article&id=132:strugurele-de-aur-ediia-a-vi-a-10-12-sep-2012&catid=36:concursuri&Itemid=2 and http://www.oniv.ro/stiri.php?id=707 retrieved July 13th, 2012.

[11] *** 2012. *Survey Design*. http://www.surveysystem.com, retrieved on July 8th, 2012.

[12] *** 2012. *Teremia Mare Wine Museum*, http://ro.wikipedia.org/wiki/Fi%C8%99ier:Muzeul_Vinului_Teremeia_Mare_-_Capac_Butoi.jpg and http://www.banaterra.eu/romana/muzee/muzeul%20vinului/index.htm, retieved on July 13th, 2012.

[13] *** 2012. *The National Wine and Alcoholic Beverages Contest VINVEST Timisoara*. 7th Edition, 4-5 April, 2012, http://vinvest.ro/concurs/, retrieved July 13th, 2012.

[14] *** 2012. *Wine and spirits competitions*., OIV, International Organization of Wine and Vine, http://www.oiv.int/oiv/info/enconcours, retrieved on July 8, 2012.

Scientific Papers, Series B, Horticulture, Vol. LVI, 2012
CD-ROM ISSN 2285-5661, ISSN-L 2285-5653

STUDY OF THE POSSIBILITY OF DISCRIMINATION BY AN ELECTRONIC NOSE OF FETEASCA REGALA WINES PRODUCED WITH NEUTRAL AND AROMATIC YEASTS

Arina Oana ANTOCE

University of Agronomic Sciences and Veterinary Medicine of Bucharest, Faculty of Horticulture, Department of Bioengineering of Horti-Viticultural Systems, Center for Wine and Vine Studies and Sensory Analysis, 59, Mărăşti Ave., District 1, 011464 Bucharest, Romania, aantoce@yahoo.com

Corresponding author email: aantoce@yahoo.com

Abstract

Feteasca regala is a Romanian grape variety with a specific, non-mistakable aroma. This wine aroma is appreciated by many consumers accustomed with it, but there are also some consumers who tend to avoid it. In order to make this wine more acceptable for a greater number of consumers the aromatic profile may be manipulated by fermenting the grape juice with yeasts able to produce certain flavour compounds, which can cover the original specific varietal aroma. In this study, a highly aromatic yeast (Flavour 2000), a low aromatic yeast (Premium blanc) and a neutral yeast (Montrachet) were used to produce Feteasca regala wines with various aromatic profiles. In some samples, tannin was also added at fermentation time, as a supplementary protection against oxidation, so that the freshness of the wines would be increased. Two sets of samples were produced at one week interval. Aside of the maturation degree of the grapes all other experimental parameters remained unchanged. When analysed with a specialized gas chromatograph working on the principle of an electronic nose, the samples produced with the neutral yeast were clearly discriminated from the other samples produced with aroma inducing yeasts, irrespective of the addition of tannin at fermentation. The other yeasts and the presence of tannins lead to a lower degree of discrimination between samples, although Discriminant Factor Analysis (DFA) was able to differentiate the samples produced with tannin from those fermented in the absence of tannin. The electronic nose is a very sensitive instrument, therefore we can assume that, at least as far as the volatile profile of the wines is concerned, whenever the electronic nose cannot make a distinction, the human nose will not be able to do it either. However, human sensory analysis may find differences between samples by using the other senses rather than the olfactive sense. This research shows, however, that the aromatic profile of Feteasca regala can be modified to a certain degree, compared to the varietal profile, by using appropriate yeasts for fermentation and that tannin also helps to protect the volatile compounds from being oxidized, thus also benefiting the final aromatic profile.

Keywords: *aroma profile, electronic nose, Feteasca regala, wine*

INTRODUCTION

Feteasca regala is a Romanian grape variety, resulted supposedly from local varieties Feteasca alba and Grasa crossing [7, 11], very wide spread in the country, being present in all 8 viticultural zones of Romania [11, 18, 19] and covering over 13000 ha, ranking first among the cultivated varieties as far as the surface is concerned [9]. It is very popular in Romania for its semi-aromatic white wines with a specific varietal aroma [8, 7, 12], with floral and spicy notes. However, exactly this type of aroma makes it so different, compared to many of the most white wines sold abroad, and for this reason these wines are sometimes avoided by people outside our country. In this research the fermentation in the presence of some ester-producing yeast strains was used as a solution intended to induce some changes in the typical aroma of Feteasca regala wines. Actually, the usage of selected yeasts is often criticized on the international market for making typical wines of various regions more uniform [10]. However, uniformity or at least falling into a standardized pattern is not always a bad thing, many consumers preferring to buy products with "normal", recognizable aroma [17]. Fermentation aroma introduced in wines by esterogenic yeasts or yeasts having more β-glycosidasic enzymes, sometimes hide the varietal aroma of some

wines and make the wines more acceptable for the mentioned category of consumers.In this study, wines of Feteasca regala were produced by using 3 different yeasts and their volatile fingerprints were compared by using a specialized gas-chromatograph working on the principle of an electronic nose. The analysis with the electronic nose is more rapid than the sensory analysis done by a panel of winetasters and is more reliable too. For this type of preliminary study the electronic nose is the perfect tool, because it only assesses differences between samples and identifies the ones having a different aromatic profile, without expressing judgements regarding which one is superior or preferable.

MATERIAL AND METHOD

Raw materials

The wine samples were obtained in 2010 in the experimental vineyard of USAMV Bucharest. Two batches were produced at intervals of one week from each other, the grapes being harvested at September 27th and October 3rd. The grapes harvested in September accumulated sugars up to 22.1 °Brix and a total acidity of 8.39 g/l expressed as tartaric acid, being at the full maturity. The grapes harvested in October were in the early phase of over-ripening, a significant drop of acidity being recorded at that time (total acidity 5.20 g/l tartaric acid), while the sugar remained almost constant. Feteasca regala is a grape variety that does not benefit from overmaturation, because it does not accumulate more sugar as in the case of other varieties, while the aroma and the acidity decrease rapidly, the resulting wines losing a lot of freshness as a result.

Oenological substances and reagents

In modern technologies, for the fresh young wines which are not meant to be kept for aging, ascorbic acid is also added, aside of potassium metabisulphite, for antioxidant protection. A combined product was provided by Enologica Vason company, under the commercial name of Flavour-save [16], containing 65% of potassium metabisulphite (E224) and 35% of L-ascorbic acid (E300). The dosage of 15 g/hl was used in this study for all the wine samples, and the product was added before crushing, on the grapes. Flavour-save maintains the varietal aroma unoxidized, contributing to regulation of the rH of wines [14], allowing for a longer period of reducing action, provided that the free sulphur dioxide content is periodically checked and adjusted [5], otherwise the ascorbic acid itself will lead to oxidation in the wine.

Bentonite gel was prepared from sodium bentonite (Bentogran, AEB Group [13]) by adding 950 g/l bentonite in 6 litres of water and mixing for 4 hours in a plastic bucket until a gel of creamy consistency results. A dosage of 100 g/l bentonite was used to clarify the must (0.6 kg of this gel was added in 100 l must).

The yeasts used for fermentation were Montrachet (a neutral yeast), Premium blanc (a low aromatic yeast with β-glycosidasic enzymes) and Flavour 2000 (a highly aromatic ester producing yeast) all from Enologica Vason. All dry yeasts were rehydrated as follows: 20 g yeasts were added in 200 ml warm water, resulting a yeast suspension of 10%.

Montrachet [20] is a neutral *Saccharomyces cerevisiae* yeast strain selected in California for musts with low nitrogen content and high content of sulphur dioxide, giving clean aroma, due to low acetaldehyde and volatile acidity production. It respects the varietal aroma complexity of the grape, being used as control wine typical for Feteasca regala variety.

Premium blanc [21] is a *Saccharomyces cerevisiae* strain, but with killer phenotype and fast growth, ensuring its rapid prevalence against the wild yeasts. It has β-gycosidasic enzymes, contributing to an increase in of the normal aroma of the grape variety, by splitting the gycosidasic bonds of glucose combined volatile substances, especially of the terpenic ones. It is recommended for wines obtained from semi-aromatic grape varieties, such as Sauvignon, Rhein Riesling, Traminer, suggesting it is also suitable for Feteasca regala.

Flavour 2000 [15] is also a *Saccharomyces cerevisiae* yeast, considered “aromatic” due to its metabolic activity which leads to the

production of esters and some other secondary fermentation compounds. It also introduces in wines a rose-like aroma due to the production of β-phenyl-ethanol, a substance very appreciated by some consumers. Normally it enhances the aroma of neutral varieties and here it was intended to change the aroma type of the semi-aromatic variety Feteasca regala.

The yeast suspensions were activated by adding as nutrient 50 g/l suspension of V-Activ Premium [23] containing 40% yeast hulls, 30% granulated cellulose, 30% diammonium sulphate and diammonium phosphate and 0.06% thiamine chloride. In the must, along with the yeast suspension, 20 g/hl fermentation activator V-Activ [24] was added, containing diammonium sulphate 55%, acid ammonium sulphate 33%, filtration add 11.8% and thiamine chloride 0.2%.

For additional antioxidant protection, in some wine samples tannin was also added at fermentation time. The selected tannin was Ti Premium [22], a granulated cathequinic tannin extracted from green tea, used in a dosage of 2 g/hl. Although extracted from green tea leaves, Ti Premium is a cathequinic tannin with a chemical structure similar to that of the tannin extracted from grapes. It protects against oxidation not only due to its chemical antioxidant power, but also because it is highly reactive towards proteins, inactivating the oxidizing enzymes such as laccase ((EC 1.10.3.2, p-diphenol oxidase). This tannin improves wine aroma also by reacting and thus removing mercaptans and other sulphur containing compounds.

Winemaking sequence

The grapes were harvested in plastic boxes of 10 kg each and crushed immediately after having been brought into the experimental wine cellar of the university. The dosage of 15 g/hl of Flavour-save was used in this study for all the wine samples, and the product was added before crushing, on the grapes. The entire quantity of grapes was destemmed and crushed with a laboratory manual destemmer-crusher. The resulted must was collected in a plastic barrel of 130 l and treated with 100 g/hl bentonite and left to clarify at 15°C for 24 hours.

The clarified must was distributed the next day in equal quantities of 40 litres in a battery of 5 small stainless steel tanks of 50 l volume. The tanks are connected to a cooling system, fermentation being conducted at controlled temperature.

Each stainless steel tank was inoculated with 2.5 ml yeast suspension (10%). In each tank 5 g of V Activ was also added, to provide enough nutrients for the freshly inoculated yeast. Each stainless steel tank was inoculated with a different selected yeast strain, and in some tanks also 2 g/hl of Ti Premium tannin was added. The variants produced in the available stainless steel tanks are summarized in Table 1.

Table 1. Experimental wine variants of Fetească regala

Variant coding	Harvest date, year 2010	Yeast type and dosage	Tannin type and dosage
MoY-v1*	September 27th	Montrachet, 20 g/hl	-
MoY-TIF-v2*	October 3rd		TI Premium, 2 g/hl
PBY-v1	September 27th	Premium blanc, 20 g/hl	-
PBY-v2	October 3rd		
PBY-TIF-v1	September 27th	Premium blanc, 20 g/hl	TI Premium, 2 g/hl
PBY-TIF-v2	October 3rd		
FY-v1	September 27th	Flavour 2000, 20 g/hl	
FY-v2	October 3rd		
FY-TIF-v1	September 27th	Flavour 2000, 20 g/hl	TI Premium, 2 g/hl
FY-TIF-v2	October 3rd		

* Due to the fact that for each harvest time only 5 tanks were available for fermentation, the samples fermented with the neutral yeast, Montrachet, were produced without tannin for the first harvest time and in the presence of tannin at the second harvest time. Montrachet wine samples are considered control wines, this neutral yeast respecting the varietal aroma and giving typical wines.

Electronic nose

The analysis of the wine samples was performed with a dual column flash gas chromatograph produced by Alpha Mos company and called Heracles analyzer. Working on the principle of an electronic nose, this apparatus provides information regarding the volatile profile of a sample and allows the data processing in a similar way as

the brain does with the perceived volatile substances in a complex mixture. In this way, the result is a general, overall olfactory fingerprint of the volatile matrices and does not attempt the identification of each volatile component in the blend. For this apparatus, the "sensors" are the chromatographic peaks themselves, recorded and stored for each sample and later processed with a specialized software, Alpha Soft v. 11.0, allowing for a rapid and reliable discrimination between products.

The samples are introduced in 10 ml vials with metal cap. Each wine sample is analyzed in triplicate. The apparatus also includes a HS 100 auto-sampler from which 64 different samples can be automatically processed from two trays. In each vial 4 ml of wine is added and sealed. As in the sensory analysis, the volatiles analyzed from the wines are only those released from the wine in the atmosphere above the liquid (the headspace). The injected volatiles from the vial headspace are concentrated by passing through a Tenax trap, then the separation of the volatile compounds is performed on both columns (an non-polar column, DB-5 and a medium polar column, DB-1701) and detected simultaneously with two FID detectors. As combustion gas pure hydrogen produced with a gas station is used.

The analytical method applied is developed in our laboratory [6, 2, 1, 3,] and uses the following parameters: incubation temperature 60°C, incubation time 600 s, injected volume 2500 μl, injector temperature 200°C, detector temperature 220°C, measurement time 20 s, trap temperature: initial 40°C and 250°C at desorption, preheating trap time 20 s, baking time 60 s, pre-purging time 5 s. The programme of the gas chromatograph starts at a temperature of 40°C maintained for 2 s and increased by 5°C /s up to 200°C where it is also maintained for 5 s, then cooled down. The data acquisition time per sample is 40 s.

RESULTS AND DISCUSSIONS

The Heracles electronic nose based on dual-column gas-chromatography was used to differentiate Feteasca regala variants produced with various yeasts and tannin based on their volatile profiles. Knowing that each chromatographic peak corresponds to a volatile substance detected, these peaks can be considered virtual sensors specialized to detect a certain substance. The large number of peaks obtained on both chromatographic columns with complementary properties ensures a good sensitivity. However, not all peaks are taken into consideration for the analysis, but only those which are most important for the discrimination of one sample from the others. The common small peaks are generally disregarded.

By analyzing the database obtained for our samples, we applied two methods of multivariate statistics, PCA – principal component analysis and DFA – discriminating factor analysis. Both methods allow for graphic representations where the discrimination between samples or groups of samples is easily understandable. A parameter named "discrimination index" is correlated with the degree of discrimination success.

The first comparison was done for the samples harvested at the moment *v1*, September 27th, moment representing full maturation for the Feteasca regala grapes in 2010. In order to do this, both PCA and DFA analyses were performed and the results are presented in Fig. 1-4.

PCA analysis aims to reduce the number of variables by the formation of some new variables as linear combinations of the initial ones, resulted by direct analyses. In this way, the great variability of the initial experimental data can be easier explained and interpreted.

As seen in Fig. 1, in our case the software identified a principal component 1, which explains 68.33% of the variability induced by the initial data (the volatiles recorded as chromatographic peaks).

This principal component is a linear combination of the sensors (peaks) with discrimination power between 0.92 and 1.0, taken into account for this analysis from the multitude of the peaks recorded. The second principal component, placed perpendicular on the first one, explains 29.95% of the variability of the initial data. This fact shows that both the yeasts and tannin influenced the aromatic profile of the wines.

A good discrimination is observed for the wines produced with the neutral yeast, Montrachet (*MoY*), clearly separated from the wines produced with aromatic yeasts both in the presence and the absence of tannin. The wines fermented with the yeast Premium blanc (*PBY*), which, due to the presence of *β*-glucosidases, releases more aromatic compounds from those bound to glucose, but providing an aromatic profile based also on the varietal aroma, are also clearly separated from the wines produced with esterogenic yeast Flavour 2000 (*FY* and *FY-TIF*). The presence of tannin makes the samples more uniform in aroma, therefore, the wine variants *PBY-TIF* are not anymore discriminated from those produced with Flavour 2000, *FY-TIF*. The discrimination index is however small, 0.01, meaning that the differences between groups are quite small and very likely unnoticeable by a human subject.

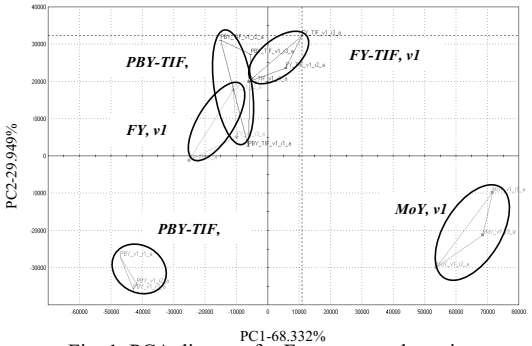


Fig. 1. PCA diagram for Feteasca regala variants harvested at full maturation (harvest moment *v1*). The discrimination power of the selected sensors for analysis was up to 0.92.

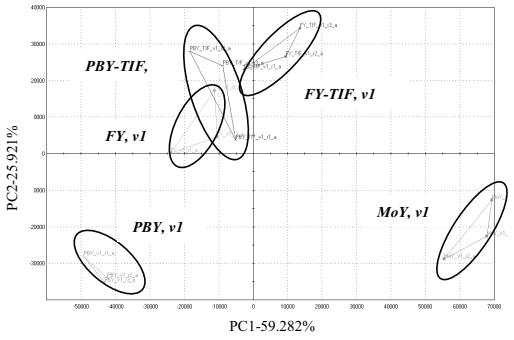


Fig.2. PCA diagram for Feteasca regala variants harvested at full maturation (harvest moment *v1*). The discrimination power of the selected sensors for analysis was up to 0.50.

In order to test the importance of the peak number selection, in Fig. 2 we present the same analysis as in Fig. 1, except for the fact that the peaks selectes as sensors were more numerous, being selected all those with a discrimination power superior to 0.50. Generally it is to be expected that a larger number of sensors will increase the sensitivity and provide a better discrimination. In this case too, an increas in the discrimination index is observed, from 0.01 to 0.3, but this is not sufficient to justify the increase in the number of chromatographic peaks taken into account.

In Fig. 3 the PCA analysis performed for the same samples as above is shown, but based on the sensors automatically selected by the Alpha Soft software, that is only those which have high discrimination power (peaks which are present in some of the samples and absent in others, due to the variations in the winemaking procedures). As expected, the discrimination index for this analysis increased to 88. However, the qualitative result is no different than the one obtained in the previous analyses, meaning that the selection of sensors has no big influence on the results, provided we select sensors with enough discriminant power. Again *MoY* variant is singled out as a separate group, while the samples fermented with non-neutral yeasts are grouped closer together.

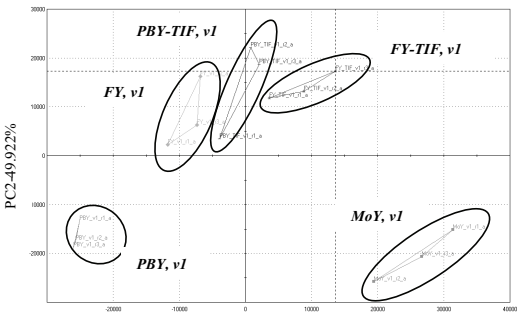


Fig.3. PCA diagram for Feteasca regala variants harvested at full maturation (harvest moment *v1*). The selected sensors for analysis were decided automatically by the Alpha Soft software based on their discrimination power.

In the case of the other analytical method, DFA (discriminant function analysis), other linear combinations of the initial variables, named discriminant functions, are computed, ensuring a separation (discrimination) as good as possible of the analyzed groups of samples. The DFA diagram depicted in Fig. 4 and obtained based on the same sensors as in the case of PCA diagrams in Fig. 1 - 3 shows a better discrimination of the groups of samples. In this case the five groups of samples are clearly separated, but still with a low discrimination power. Of all the samples, those fermented in the presence of the neutral yeast Montrachet are discriminated clearly by the electronic nose, giving hope for a possible change in aroma profile of Feteasca regala wines by fermentation with "aromatic" yeasts.

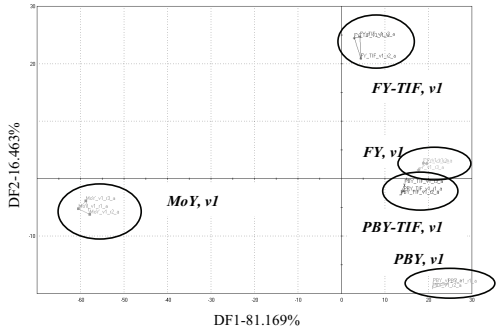


Fig. 4. DFA diagram for Feteasca regala variants harvested at full maturation (harvest moment *v1*)

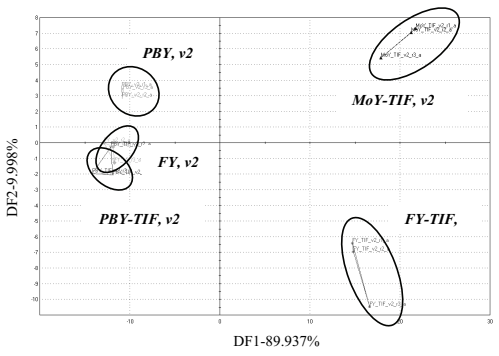


Fig. 5. DFA diagram for Feteasca regala variants harvested at over-maturation (harvest moment *v2*).

For the other harvesting moment, over-maturation moment (*v2*, October 3rd), a similar discrimination of the Montrachet fermented wines is observed (Fig. 5). In this diagram, because the samples produced with Montrachet yeast contained also tannin (*MoY-TIF, v2*), the profile is also influenced by tannin, therefore it is understandable that the distribution of the samples in the diagram is different than in the case of full maturation moment (*v1*, September 27th), where the Montrachet samples were produced in the absence of tannin (*MoY, v1*).

In order to assess further the influence of the tannin, we disregarded the harvest moment, grouping samples with the same technological treatment in the same group irrespective of the harvest time, resulting the following groups: *PBY (v1+v2), PBY-TIF (v1+v2), FY (v1+v2), FY-TIF (v1+v2), MoY (v1), Mo-TIF (v2).* The DFA analysis based on these groups showed (Fig. 6) that the tannin has its influence on the aroma of the wines, samples produced in the presence of the tannin (left part of the diagram) being grouped separately from those produced in the absence of tannin (right part of the diagram). Because of the low discrimination power showed on the graph scales we can safely assume that these differences would not be perceived by human observers. The tannin has its protection value as an antioxidant, therefore, after a period of evolution, significant differences in wine aroma could develop, so that the differences may become apparent also for consumers.

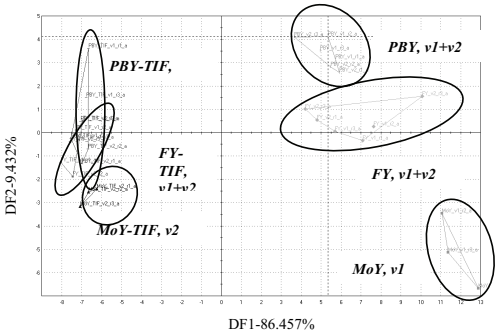


Fig. 6. DFA diagram for Feteasca regala variants with similar technological treatments, irrespective of the harvesting moment.

From the analyses performed it became apparent that the Montrachet yeast fermented wines have an easily detectable different aromatic profile than the wines produced with

the “aromatic” yeasts. This conclusion was also tested by calculating the distances, in odor units, of these wines as compared to the wines produced with Flavour 2000 and Premium blanc yeast and the analysis confirmed it (Fig. 7). The test was performed on wines produced in the absence of tannins, in order to assess only the influence of the yeast on the volatile profile.

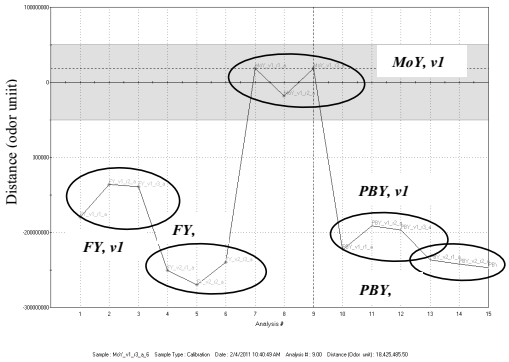


Fig. 7. Distance in odor units of the Feteasca regala wines produced with neutral yeast Montrachet (*MoY*) versus the wines produced with “aromatic” yeasts Flavour 2000 (*FY*) and Premium blanc (*PBY*)

CONCLUSIONS

Small differences in the aromatic profiles of wines are induced by the aromatic yeast, but these olfactory differences alone may not be noticeable by consumers, the varietal aroma of Feteasca regala being still the most important in the aromatic profile of the wines. The electronic nose is able to detect differences between groups of samples, even with small discrimination indexes (0.01 – 88.00), but human panelists may not be able to observe these differences. Some analyses showed that of all the samples the electronic nose discriminated clearly those fermented in the presence of the neutral yeast Montrachet from the other produced wines, indicating a possible significant modification in the volatile profile of Feteasca regala wines by fermentation with “aromatic” yeasts.

The treatment with tannin has a clear influence on the aroma of the wines, and the electronic nose discriminates these small differences, even though at this power of discrimination it can be safely assumed that these differences would not be perceived by human observers on young wines. However, the treatment with tannin should not be disregarded as a potential modulator of wine aroma, since with its antioxidant protection power tannin may lead to significant differences in wine aroma after a period of evolution, as compared to wines unprotected with tannin. In time, these small differences detected by the electronic nose may become apparent for consumers, too.

It is obvious that some yeasts can modify the varietal aroma of the wines. It was expected that the aroma profile induced by the ester-producing Flavour 2000 yeast through fermentation would be totally different than that of Premium blanc yeast, which only enhances the varietal aroma of a wine by releasing more aroma from bound compounds. Due to these aroma producing mechanisms, the Premium blanc fermented wines should have been closer in profile to the varietal aroma wines produced with the neutral yeast, Montrachet. However, the electronic nose showed that Montrachet is indeed different from all others, but the wines obtained with “aromatic yeasts”, in spite of their different aroma producing mechanisms, were grouped together.

Therefore, we can conclude that varietal aroma of Feteasca regala wines can be influenced by the presence of an aromatic yeast during fermentation, but not significantly erased so that the variety become unidentifiable. If this type of effect is desired, in order to make an impact on human observers, some other yeasts or treatments should also be tested to significantly change the varietal aroma of these wines.

REFERENCES

[1] Antoce A. O. and Namolosanu I., 2009, Volatile profiles of Fetească neagra wines from three regions differentiated by the use of an electronic nose. Sci. Papers U.S.A.M.V. Bucharest, Volume B, Issue LIII, pp. 534-538.

[2] Antoce A. O. and Namolosanu I., 2011, Rapid and precise discrimination of wines by means of an electronic nose based on gas-chromatography, Rev. Chim., Vol. 62, No. 6, pp. 593-595.

[3] Antoce A. O., Namolosanu I., Siret, R. and Maury, C, 2009, Application of an electronic nose to the differentiation of hybrid and noble wines. Proc. IN VINO ANALYTICA SCIENTIA – Angers, France, 2-4 July 2009, p. 220.
[4] Antoce O. A., Namolosanu I., and Tudorache A., 2008, Sensory and composition profile of Dornfelder and Regent wines obtained in Romania, XXXIth World Congress of Vine and Wine (OIV), June 15-21, 2008, Verona, Italy, Congress Proceedings DVD-ROM, 8 pages.
[5] Antoce O.A., 2007, „Oenologie; Chimie şi analiză senzorială" (Oenology – Chemistry and sensory analysis), Cap. 3.1. Transformări în timpul operaţiunilor prefermentative - 3.1.1. Transformări datorate prezenţei oxigenului, Universitaria Craiova Printing House, pp. 481-492,
[6] Antoce O.A., Nămoloşanu I., Peltea E., 2010, The flavouring of Feteasca neagra wines with oak chips and tannin and its influence on the colour and sensory parameters of young wines, Lucrări ştiinţifice U.Ş.A.M.V.B., Seria B, vol. LIV, 2010, Section Viticulture & Oenology, Congres CD, ISSN 1222-5312, pp. 494-499.
[7] Constantinescu G., Negreanu E., Lazarescu V., Poenaru I., Alexei O. and Boureanu C., 1959, Ampelography of Romania – ("Ampelografia Republicii Populare Romine"), Vol. II, Academia Republicii Populare Romine Printing House, Cap. galbena de Ardeal, pag. 627-644, in Romanian.
[8] Macici M., 1996, "Romania's wines", Alcomar Edimpex SRL Printing House, Cap. Present-day landmarks, pag. 20.
[9] Müller K., Antoce O.A., 2011, "Der rumäniche Weinbau-Gegenwart und Perspektive", Deutsches Weinbau-jahrbuch 2011 (62 Jahrgang)-Verlag Eugen Ulmer, pp. 118-128, in German.
[10] Nathalie Cayot N., 2007, "Sensory quality of traditional foods", Food Chemistry, Vol. 101, Issue 1, pp. 154–162.
[11] Oslobeanu M., Macici M., Georgescu Magdalena, Stoian V., "Zoning of the grapevine varieties in Romania" ("Zonarea soiurilor de viţă de vie în Romania"), 1991, Ed. ceres, Bucharest, Cap. 5.3.2, pp. 194-200, in Romanian.
[12] Pusca I.M., 2010, "Old Romanian grapevine varieties" ("Vechi soiuri romanesti de vita de vie"), 2nd Edition, Tipografia Intact Printing House, Bucharest, Cap. Feteasca ragala, pag. 118-120 , in Romanian.
[13] *** AEB Group website, http://www.aeb-group.com/or4/or?uid=aeb.main.index&oid=75569, retrieved on July 8, 2012.
[14] *** Enologica Vason Products, Flavour save http://www.vason.com/eng/prodotti.php?sector=vason &cat=13&product=106, technical sheet, retieved on July 11, 2012.
[15] *** Flavour 2000 yeast, Technical Sheet, http://www.vason.com/eng/prodotti.php?sector=vason &cat=10&product=152, Enologica Vason, retrieved on July 10th, 2012.
[16] *** Flavour-save, Technical Sheet, http://www.vason.com/eng/prodotti.php?sector=vason &cat=13&product=106, Enologica Vason, retrieved on July 10th, 2012.
[17] *** Jordan P. Ross, GOING WILD: WILD YEAST IN WINEMAKING, http://www.enologyinternational.com/yeast/wildyeast.html, retrieved July 10th, 2012.
[18] *** Ministry Order No. 179 of 13 March 2009 regarding the Annex modification of Agriculture, Food and Forestry Ministry Order No. 397/2003 for the approval of the designation of the viticultural regions and inclusion of the localities in viticultural regions, vineyards and viticultural centers, issued by the Ministry of Agriculture, Forestry and Rural Development, published in Official Gazette No. 271 of 27 April 2009.
[19] *** Ministry Order ORDIN No. 225 of March 31st, 2006 regarding the approval of the zoning of noble grapevine varieties allowed in the culture in the viticultural regions of Romania, issued by the Ministry of Agriculture, Forestry and Rural Development, published in Official Gazette No. 324 of 11 April 2006.
[20] *** Montrachet yeast, Technical Sheet, http://www.vason.com/eng/prodotti.php?sector=vason &cat=10&product=154, Enologica Vason, retrieved on July 10th, 2012.
[21] *** Premium blanc yeast, Technical Sheet, http://www.vason.com/eng/prodotti.php?sector=vason &cat=10&product=146, Enologica Vason, retrieved on July 10th, 2012.
[22] *** TI Premium tannin, Technical Sheet, http://www.vason.com/eng/prodotti.php?sector=vason &cat=9&product=244, Enologica Vason, retrieved on July 10th, 2012.
[23] *** V-Activ Premium, Technical Sheet, http://www.vason.com/eng/prodotti.php?sector=vason &cat=11&product=40, Enologica Vason, retrieved on July 10th, 2012.
[24] *** V-Activ, Technical Sheet, http://www.vason.com/eng/prodotti.php?sector=vason &cat=11&product=44, Enologica Vason, retrieved on July 10th, 2012.

Scientific Papers, Series B, Horticulture, Vol. LVI, 2012
CD-ROM ISSN 2285-5661, ISSN-L 2285-5653

RESEARCH REGARDING THE COST OF ARTIFICIAL PLAYING SURFACES IN MODERN SPORT AND EVALUATING THE DESSO GRASSMASTER SYSTEM

David BIRCH[1], Lancelot BUTTERS[2]

[1]J Mallinson (Ormskirk) Ltd, Sports field Construction, Lathom Vale Business Park, Vale Lane, Ormskirk, L40 6JH, E-Mail: davidbirch20@googlemail.com
[2]Myerscough College, Bilsborrow, Preston PR3 0RY +44 1995 642 222; University of Central Lancashire, Preston, Lancashire, PR1 2HE +44 1772 201 201, E-Mail: lbutters@myerscough.ac.uk

Corresponding author email: davidbirch20@googlemail.com

Abstract

Grassmaster, a semi synthetic sports turf surface which uses the principle of reinforced natural grass, is one of a few systems that have enabled increased hours of play and stadium use compared to more conventional surfaces. Modern sport demands that the playing surface is in pristine condition all year round, however with increased hours of play and a longer playing season, the pitch, the focal point of the stadium can become subject to criticism. Previous research has not explored the business and technical aspect of the surface. It is the aim of this project to:

- *Critically analyse the Desso Grassmaster system in terms of construction cost, maintenance and renovation costs compared to others sports surfaces such as natural turf and 3G.*
- *Investigate how the increased participation in sport at all levels has led to the need for more cost effective sports surfaces.*
- *Determine how the use of these new surfaces can able a return on investment*
- *Evaluate the impact that the increased use of these surfaces could have a negative impact on the groundsman and machinery industry.*

"The health and safety and social benefits from sports participation are more easily achieved if the playing surface provisions are safe, affordable and of a high quality. Investment, construction and research into artificial playing surfaces have increased to meet this provision" Stiles, V.H and Dixon, S.J (2006) (1). However, Full provision cannot be met without natural turf surfaces.

Keywords: *Artificial grass, sports surfaces, turf technology, stadium innovation's, pitch construction.*

INTRODUCTION

Playing surfaces have evolved significantly over recent years, particularly at professional level. Less than two decades ago it was acceptable to see a televised game of premier league football being played on no more than dust with a few line markings, however now with a televised game there is an expectation that not a blade of grass should have been disturbed or out of place, even if the stadium has hosted a concert with 50,000 fans music fans jumping up and down on the pitch the night before.

A modern pitch at any level is now required to serve multiple purposes in the aim of achieving a return on investment, whether that is hosting music concerts in large stadiums or enabling multiple sports in community sports areas (James, 2011)(2).

Artificial surfaces have also increased in popularity in recent years at both a recreational level and in professional sport; however this increase has also highlighted the concerns and scepticism of the health and safety implications of these surfaces. It is also unclear on the additional financial gains that can be made by using these pitches paired with the rumours that an artificial surface is maintenance free (Leigh spinners) (3).

Whilst modern pitches are required to meet certain standards such as the surfaces interaction with the player and the ball according to Bell et al (1985)[4] it is also required to cope withincreased hours of play, something of which natural grass pitches have been unable to adapt to. Desso Grassmaster however, which is a reinforced grass system that combines the playing characteristics of a natural turf pitch with the durability and increased hours of play of a fully artificial pitch, Desso (2009)[5]. This has allowed many famous sports venues to achieve a return on investment from their playing surface.

A stadium that has really put the Grassmaster system to the test and gained full return on investment is the Danish Parken Stadium, the home base for FC Copenhagen and the Danish national team. At this Stadium "more goes on there than just football, business seminars, pop concerts and other sports events, such as speedway, take place regularly.

MATERIAL AND METHOD

Two discreet strategies were adopted, a questionnaire to gather specific data related to sports turf usage and a critical examination of two separate sports turf complexes.

Groundsmen from a range of professional sports clubs from the premier league and championship were selected to take part in a questionnaire to find the different techniques carried out on each of the surfaces.

In order to collect the specific data required, it required an effective strategy to provide the most effective results. A list of all the suitable clubs were selected using their stadium capacity as a benchmark from World Stadiums (2012) [5]. From this, clubs with a capacity of 5,000 people and upwards were targeted. As well as choosing different sizes of sports organisations by using the stadium capacity as a guide, venues that host different types of sports were also compiled. Possible 165 sports venues in the United Kingdom were assessed of which 52 were chosen as the target audience.

Once the questionnaires were returned the results were collected and entered into a Microsoft Excel spread sheet for ease of analysis. From the results there was a good response with 23 per cent of the questionnaires being sent back which was considered to be a useable amount.

RESULTS AND DISCUSSIONS

For this part of the project two separate complexes were visited, one at an amateur level and another at professional level with usage and financial data being collected. In the industry there are major differences in the required standards of the sports surface both from players and spectators according to Baker et al [6]. At a professional level the pitch is required to be in perfect condition throughout the year and in all weather conditions, however with increasing standards from governing bodies such as the FA (Football Association) there is increasing standards for surfaces at an amateur or community level. The Federation International football association (FIFA) has outlined that by improving sports facilities at grass roots level and community level whilst increasing pitch usage offers local people to have access to games and coaching which will provide a significant role in player development (FIFA, 2008)[7]. This highlight the importance the increased required standards for modern surfaces.

In order to investigate this, two separate sports complexes were compared that used a range of sports surfaces. Both of the complexes used Natural grass in the forms of soil based pitches and Fibresand pitches, a Desso Grassmaster pitch and an artificial pitch.

The first complex, used by a university, has a Grassmaster pitch which is intensively used for mainly football and is one of the main match pitches used on the campus.

The second complex being a professional football stadium, which has a Grassmaster pitch used intensively for football throughout the season, plus a wide range of other activities both in and out of the football season.

For each complex, pitch use, annual expenditure of routine maintenance, annual expenditure of end of season renovations were researched enabling total costs and usage to be calculated; from this data the cost of maintenance per playing hour would be produced.

Table 1. Site 1 pitch comparisons

Surface	Annual expenditure (£)	Usage	Cost Per playing Hour
Soil Based Pitch	4125	190	£21.71
Fibresand Pitch	3250	225	£14.44
Grassmaster Pitch	4500	600 plus	£7.50
Artificial Pitch	N/A	Not monitored as the facility is also used by the public	N/A

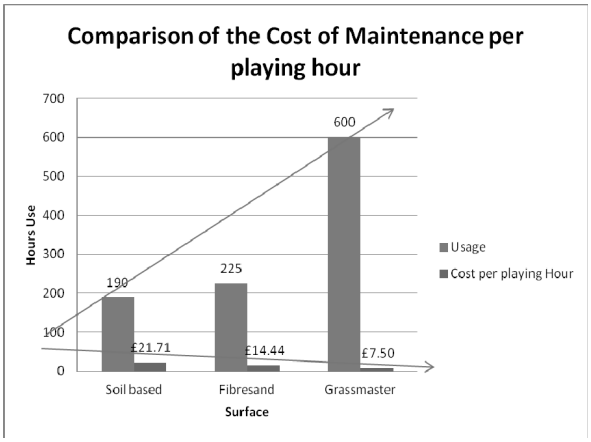


Fig. 1. Site 1 pitch comparisons chart

Table 2. Site 2 Pitch Comparisons

Surface	Annual expenditure (£)	Usage	Cost Per playing Hour
Soil Based Pitch	15,000	160	£93.75
Fibresand Pitch	20,500	190	£107.89
Grassmaster Pitch	32,250	125	£258
Artificial Pitch	8,500	766	£11.09

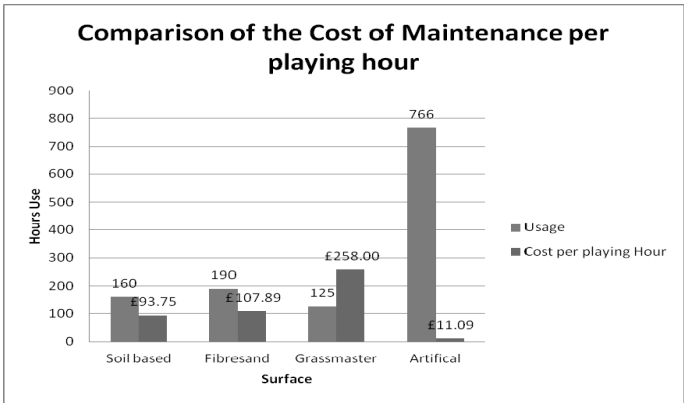


Fig. 2. Site 2 Pitch Comparison chart

Comparison of Sports Surfaces Using Players

In order to investigate the Grassmaster system other sports surfaces were critically analysed in a number of different aspects. The areas that were investigated where construction differences and costs this would highlight the characteristics In terms of speed and performance high specification artificial surfaces do have many advantages for players especially at a professional level. For this study a professional football team who train on a high specification FIFA 2 star artificial pitch were asked about their opinions of the surface and how it compares to their own natural grass stadium pitch.

Construction Comparisons

Construction comparisons were gathered using a well-known sports ground contractor, working on a standard pitch size of 8250m^2. Construction and renovation techniques vary significantly between each of the surfaces.

Table 3. Construction costs

Layer	Soil - low Spec	Soil - High Spec	Fibresand - low Spec	Fibresand – High Spec	Desso Grassmaster
Sand	80mm	Gravel Trenches	Gravel Trenches	-	-
Lower Rootzone	-	150mm	125mm	200mm	200mm
Upper Rootzone	-	100mm	175mm	175mm	100mm
Gravel Base	-	-	-	150mm	150mm
Cost	£110,050.00	£263,000.00	£352,000.00	£434,000.00	£707,000.00

Layer	3G – low spec.	3G high - spec
MOT Type 1 Sub Base	250mm	250mm
Macadam Base Layer	45mm	45mm
3G Synthetic Carpet	50mm	50mm
Polymeric Shockpad	-	15mm
Cost	£485,000.00	£560,000.00

Questionnaire

The questionnaire comprised of twenty questions:

1. Sports that the pitch is used for
2. What influenced the choice of surface used?
3. Specifications of the pitch
4. The choice of pitch and what it can enable
5. Area of the pitch
6. Weekly pitch use
7. Is the pitch used as a multi-use venue?
8. Does the pitch earn return on investment?
9. Staff for day to day maintenance on the pitch
10. Hours maintaining the pitch
11. Extra groundstaff on match days
12. Maintenance practices 1
13. Maintenance practices 2
14. End of season renovation
15. Extra adjustments to the pitch after construction
16. How long do you expect the pitch to last?

17. Annual expenditure on maintenance

18. Would you consider the use of another type of pitch?

19. Overall how do you rate the surface you currently use?

The questionnaire gathered a consistent range of results with clear correlations between each surface. In terms for the reasons for the choice of the playing surface increased required standards from both spectators and management showed that the capabilities and overall appearance is an important consideration when choosing the right type of playing surface as found by Adams and Gibbs (1994)[8]. The requirements for a more durable surface also formed an important consideration with the groundsmen that use both Grassmaster and 3G agreeing that the durability of the surface is a prime consideration.

The comparison of the two sports complexes showed that the prestige and the expectations of the surfaces are greater at a professional level even though the usage of each of the surfaces is less. The tests at the amateur level complex concluded that the most expensive pitch to maintain is the soil based, which also recorded the fewest hours of usage compared to the Grassmaster pitch which enable greater hours at a lower cost.

At a professional level the usage is less, however the maintenance costs are higher. As seen in the graph below the Grassmaster is recorded to have the highest operating cost per hour, however this is because it is used as a stadium pitch therefore appearance is the most important consideration.

The 3G pitch, recorded high levels of use and again the maintenance cost were low. From the comparisons both groundsmen agreed that the Grassmaster surfaces allowed better water infiltration and level surfaces retention, as also found in other areas of this investigation. They also agreed that the Grassmaster system and artificial system are expensive to install.

From the results and data that have been collected in this project it is possible to compare the results by applying these to a scenario. This scenario is based on an average size capacity stadium of 30,000 people, Ellen (2010) [9]. The scenario incorporates a comparison of each of the three surfaces investigated in this report and applies then to a real life situation.

The scenario is based on a premier league stadium of which achieves an average match attendance of 91% capacity Ellen (2010)[9].

Table 4. Return of investments

Soil High Spec.	Costs	Return on investment
Construction Cost	£263,000.00	
Maintenance (Per Year)	£38,755.00	
Maintenance (Per Week)	£745.00	
(Income per week) £1500	£755.00	6 years 5 months
(Income per week)£2000	£1255.00	4 years 1 month
(Income per week)£3000	£2255.00	2 years 3 months

Fibre Sand High Spec.		
Construction Cost	£434,000.00	
Maintenance (Per Year)	£38,755.00	
Maintenance (Per Week)	£745.00	
(Income per week) £1500	£755.00	11 years 1 month
(Income per week)£2000	£1255.00	6 years 7 months
(Income per week)£3000	£2255.00	3 years 9 months

The project highlighted that whilst Desso (2012)[11] claim that a Grassmaster surface canachieve 3 times as much usage compared to a natural surface, from the results in this project it showed that whilst the level surface retention can be maintained the cosmetics of the pitch may be affected this would be an issue a professional level. Adams & Gibbs (1994)[8] found that natural turf surfaces could only accommodate a maximum annual usage of 200 hours, with a zero per cent grass covering however, as found in this research project natural turf surfaces can achieve much more than that today.

The cost comparisons show that there are significant differences in the cost of construction of each surface, from a low specification soil surface costing £110,050 to a Grassmaster surface costing £707,000.

ACKNOWLEDGEMENTS

This research work was carried out with the support of J Mallinson, Ormskirk Ltd, Sportsfield Construction.

CONCLUSIONS

From the research it has shown that there are many influences that have led to the technological advancements in the industry both internally with improved plant and soil science, as well as external factors such as an increased participation in sport.

It has been shown that there is a link between the external factors, with the increased requirement from a modern surface in order to achieve an end goal of increased return on investment as also explored by Gale (2006)[10]. The research project has proved that there is a link between usage and maintenance cost and that this can differ significantly between each of the surfaces.

At a professional level, it has been concluded that the choice of the surface is not determined by the low cost option in terms of maintenance. Clubs will choose to pay more for a surface that is able to guarantee a constant level of quality throughout the season. For many premier league clubs that only use their pitch for around 125 hours per season having a pitch that costs in excess of £700,000 seems foolish, however for them having a pristine pitch from the start to the end of the season is priceless.

Desso Grassmaster		
Construction Cost	£707,000.00	
Maintenance (Per Year)	£48,916.00	
Maintenance (Per Week)	£940.00.00	
(Income per week) £1500	£560.00	24 years, 3 months
(Income per week)£2000	£1060.00	12 years, 10 Months
(Income per week)£3000	£2060.00	6 Years, 7 months

This project has proved that professional level players are affected by the surface and that if the surface is level, with not divots their game will be improved, so the requirement for a perfect pitch must be paramount. From the tests it found that in particular would improve the players speed and reactions on the surface, thus aiding them it a match the use of artificial surfaces for training purposes scenario.

REFERENCES

[1] James, I.T 2011. *Advancing natural turf to meet tomorrows challenges*.
[2] Leigh Spinners, *Maintenance document – Artificial surfaces.*
[3] Bell, M.J et al ., 1985. *Playing quality of sports surfaces: A review*, j. Sports Turf res. Inst. Vol 61.
[4] World Stadiums. 2012. *Stadiums in England*. Accessed: 12/2/12.
[5] Baker, S.W., 1992. *The effects of shade and changes in microclimate on the quality of turf at professional soccer clubs – pitch survey*. J. Sports Turf Res. Inst. Vol. 71.
[6] FIFA, 2008. *Turf Roots.* Football turf a credible alternative.
[7] Adams,W.A. and Gibbs, R.J., 1994. *Natural turf for sport and amenity :science and practice: CAB international.*
[8] Ellen. L., 2010. *Strategic sport marketing and the football industry- increasing attendences In football clubs.*
[9] Gale, L., 2006. *Magazine* The "F"Plan, www.pitchcare.com, Accessed; 17/4/12.
[10] Desso, 2012. *Benefits of hybrid natural grass*. www.dessosports.com. Accessed 23/2/12

Scientific Papers, Series B, Horticulture, Vol. LVI, 2012
CD-ROM ISSN 2285-5661, ISSN-L 2285-5653

ASSESSMENT OF LOQUAT AND ITS EFFECTS ON HUMAN HEALTH

Tuba BAK, Turan KARADENİZ, Mehtap ŞENYURT, Tarık YARILGAÇ

Ordu University - Faculty of Agriculture, Department of Horticulture, 52100 Ordu - Turkey

***Corresponding author email**:* turankaradeniz@hotmail.com

Abstract

The loquat is indigenous to China and Japan in Turkey breeding has been carried out in western and southern Anatolia and in the Black Sea Region where it is also known as Malta plum. Loquat does not lose their leaves in the winter and are used as both landscape plants and as a fruit crop. It is one of the earliest ripening fruits and because there are few alternatives, price is high. Loquats are consumed fresh, and processed as juice, marmalade, liquor, wine, tea, jam, cake, bonbon, ice cream and added to yoghurt. The fruit is frozen and canned. Its fruits and leaves are used to prevent constipation. The liquid which is acquired by boiling its fresh and dried leaves is an effective remedy for diarrhea. Its fruits are astringent. Loquats are rich in vitamins, minerals and fibers. Loquat fruits have been recommended for preventing cardiovascular disease and curing digestion system problems.

Key Words: Loquat, human health, loquat products, fruit joice,

INTRODUCTION

Loquat is grown in the limited areas of Aegean and Mediterranean shores in Turkey [12]. Loquat, a tree in the gardens for a long period, is grown increasingly due to the domestic consumption and demand for import [9]. Loquat has various species and it has 7-10 main species, having commercial importance in respect to cultivation and being edible [8].
Loquat is Chinese and Japanese-origin fruit. In Turkey, it is grown in the western and Southern Anatolia and Black Sea region. It is one of the precocial fruits in the spring. This fruit is sent to the markets betimes and it is priced out of the market due to the lack of alternative fruits in the market.

USAGE AREA OF THE FRUIT

Usage as fresh fruit

When it comes to our country, the most important feature of the fruit is that it is early comer. Spring, when our country is geographically in this belt, is the poorest period in respect to fresh fruit. In this period when season of winter fruits over, summer fruits has doesn't grow mature yet. During this period, loquat grows mature at the same time as gage, green almond and strawberry. It provides the consumers with fresh fruits considerably. Potentiality for storage is limited. Hence, it as regarded as edible [9].

Usage as Processed Food

It is stated that besides its consumption as a fresh fruit, loquat can be processed to make jam (Photo 1) or marmalade [6] or it can be kept as canned (Photo 2) [7]. It is also expressed that 10% of the crop is processed with the aim of canning [14]. The results of a study conducted in Turkey shows that suitable species have been determined to make marmalade, nectar or to can. This division is made by taking into consideration some physical and chemical features [15]. Moreover this study reveals that loquat-like fruits can be processed to these products economically. This studies and similar surveys increase consumption areas of loquat, and some by-products are consumed such as fruit juice, marmalade, liqueur (Photo 3), wine, ice cream, tea, syrup, composte, can, jam, cake, sweet (Photo 4) candy (Photo 5), fruit yoghurt, frozen (Photo 6), shampoo, perfume etc. Peeled and seedy fruits are consumed fresh; sometimes it is used with sliced banana, orange slice and grated coconut.
Tasty stewed fruits can be made by adding some sugar. Canned fruits are exported from

Taiwan. Moreover, some people make flavored fruits by putting ground clove, cinnamon, vinegar and lemon then fill them into glass jars. In the meantime, the fruits have adequate pectine to make jello and jams when they grow mature. In the past, small amount of jello produced in California with commercial aim [1] (Photo 7). It is also consumed in Gaziantep as "Loquat kebab" (in Turkish yenidünya kebabı) (Photo 8).

Photo 1. Loquat jam

Photo 2. Loquat canned

EFFECTS OF THE FRUIT ON HEALTH

For at least 40 years, syrups, exported from Hong Kong, are sold as decongestion, chronic bronchitis, cough and lung decongestant in the food shops of USA and China (Photo 9). As a result of the studies conducted in South China University of Agriculture, high level of ursolic acid was detected in the content of this nice-scented fruit. Also it is found that it includes compounds of palliative cough, rather than the other species. Therefore, it is expected that loquats, included in the Chinese culture, are used rather than wild loquat for the development of traditional medicine. China also uses the fruit with the aim of consuming fresh and medicine. The fruits are tested successfully in the production of fruit juice, tea, cake or wine [3] (Photo 10).

The fruit is close- grained and it has too may leaves. It is also filling. The liquid, made by boiling fresh and dried leaves of the fruit is antidiaretic. On the other hand, the fruits have binging characteristics. Loquats are rich in some mineral substances and vitamins, especially fibers. The fruits are beneficial for the cure of cardiovascular diseases and nerve system disorders.

When it is compared to other pome fruits, loquat is characterized by high level of sugar, acid and pectine. The fact that sugar content is over 10% is the major cause of preference by consumers. Moreover, loquat is rich in carotenoids, especially Vitamin A [12].

Loquat includes vitamins (A, B, C), minerals (phosphorus and calcium), mineral salts and sugar [8;10]. Loquat is the resource of Vitamin A for the teeth and eye health of humans. It is used as a diet due to its rich fiber content.

Photo 3. Loquat liqueur

Photo 4. Loquat sweet

It is useful for protecting health with its low saturated fat and cholesterol content. Extract, obtained from leaves of loquats in the past, is an important compound for cure of lung diseases. It is also stressed that the leaves of loquat alleviate nausea and cough. Furthermore it is expressed that it is also expectorant. Besides, it includes some nuclein, known as anti-cancer vitamins which help prevent cancer [4].

Organic loquat leaves are used as detox feet band by helping mucus solve and by acting like mucolytic agent. It reinforces pancreas and it can be used as a tropical cream to fight against HIV, to decelerate skin cancer, to protect skin

inflammation, histamine skin contraction and oedema [5].

It is stated that species of loquat is of vital importance for human health with its high level of HP content and antioxidant [13]. They have too may leaves. They are also filling. The liquid, made by boiling fresh and dried leaves of the fruits is antidiaretic and this tea is not hazardous (Photo 11). On the other hand, the fruits have binging characteristics [11].

Photo 5. Candy

Photo 6. Frozen loquat

Usage as ornamental plant

Loquat plants are used not only in fruit growing, but also in houses and parks decoratively. They are one of the unique plants which are evergreen in winter time. Since loquat trees blossom in winter months, in this season when there can't be seen flowers around, their outlook is very charming and they give off pleasant odor. As their leaves are always green, they help clean dirty air and landscape.

CONCLUSIONS

Development of subtropical fruit growing will ensure important raw material sources for food industry sector. By this way, recovery can be observed among the sectors, it will help provide raw materials and profitable working opportunities for the enterprises, producing fruit juice, can, jam, marmalade, candy and ice cream. Processed products of subtropical fruits will play an important role in the increase of export [2]. Studies related to current subtropical fruits are relatively inadequate.

Photo 7. Loquat jelo

Photo 8. Loquat kebab

Photo 9. Loquat syrups

Photo 10. Loquat vine

Photo 11. Dried leaves

REFERENCES

[1]Anonymous, 1987. www.hort.purdue.edu/newcrop/morton/loquat.html#Food%20Uses.

[2]Anonymous, 1997. Meyvecilik. Yedinci Beş Yıllık Kalkınma Planı Özel İhtisas Komiyonu Raporu, Yayın No: DPT 2469 ÖİK 516, Ankara.

[3]Anonymous, 2007. www.actahort.org/chronica/pdf/ch4702.pdf#page=12

[4]Anonymous, 2010a. http://www.loquatworld.com/

[5]Anonymous, 2010b. http://www.globalhealingcenter.com/loquat-leaf.html

[6]Camobell, C.W. and Malo, S.E., 1968. The Loquat. Fruit Crops Fact. Sheet. No:5.

[7]Campbell, B.A and Campbell, C.W., 1983. Preservation of Tropical Fruit by Drying *Proc. Fla State. Hort. Soc.* 96: 229-231.

[8]Demir, Ş., 1987, Yenidünya Yetiştiriciliği T.C. Tarım Orman ve Köy İşleri Bakanlığı Naranciye Araştırma Enstitüsü Müdürlüğü. Genel Yayın No:12, Teknik Yayınları:6, Antalya 31 s.

[9]Demir, Ş., 1989, Yenidünyalarda (*Eriobotrya japonia* L.) Fizyolojik, Biyolojik ve Morfolojik Araştırmalar. Çukurova Üni. Fen Bil. Ens. (Doktora Tezi), Adana 221 s.s

[10]Erdoğdu, H., 1987. Investigations on Determination of Phenological and Pomological Characteristics of Some Local and Foreign Loquat Cultivars at Erdemli Location Conditions. MSc Thesis, Çukurova Univ.

[11]Karadeniz, T., 2004. Şifalı Meyvler. ISBN 975288867-4. 208 s.

[12]Özçağıran, R., Ünal, A., Özeker, E., İsfendiyaroğlu, M., 2004. Ilıman İklim Meyveleri. Yumşak Çekirdekli Meyveler. Cilt: II. Ege Üniv. Zir. Fak. Yayın No: 556, 200p.

[13]Polat, A., 2010. Determining Total Phenolic Content and Total Antioxidant Capacity of Loquat Cultivars Grown in Hatay. http://www.phcog.com/article.asp?issn=0973-1296;year=2010;volume=6;issue=21;spage=5;epage=8;aulast=Polat

[14]Shaw, P.E. and Wilson, C.W., 1982. Volatile Constituents of Loquat (*Eriobotrya japonica* Lindl.). Fruit. Journal of Food Science. 47: 1743-1744.

[15]Topuz, A., 1998. Yenidünya Çeşitlerinin (*Eriobotrya japonica* L.) Bazı Fiziksel, Kimyasal Özelliklerin ile Marmelat, Nektar ve Konserveye İşlenebilme Olanaklarının Belirlenmesi. Akdeniz Üniv. Fen Bil. Ens. Gıda Müh. Anabilim Dalı, Yüksek Lisans Tezi.106 s.s.

Scientific Papers, Series B, Horticulture, Vol. LVI, 2012
CD-ROM ISSN 2285-5661, ISSN-L 2285-5653

THE HARMFUL FAUNA OF PEAR IN ECOLOGICAL CONDITIONS OF BUCHAREST IN 2012

Iuliu CEAN[1], Mirela CEAN[2], Florin STĂNICĂ[1]

[1]University of Agronomic Sciences and Veterinary Medicine of Bucharest, 59 Blvd. Mărăşti, Bucharest, 011464, Romania, phone: +40(21)3182888, E-mail: iuliucean@yahoo.com, flstanica@yahoo.co.uk;
[2]Central Phytosanitary Laboratory, 11 Blvd. Voluntari, Ilfov, 077190, Romania, tel. +40 (21)27032 54, mirela.cean@lccf.ro

Corresponding author email: iuliucean@yahoo.com

Abstract

Pears provide high-quality fruit for eating or processing, but they are susceptible to wide range of pest. The observation regarding pests from pear culture under ecological agricultural system were made in the orchard of University of Agronomic Sciences and Veterinary Medicine of Bucharest. The aim of the researches was to study the harmful fauna of pear (Pyrus communis L.) following a classical methodology. There were carried out observations on pest attack in pear plots, together with determination of the useful insect. The identification of the biological collected material was made in the Entomology Laboratory of Central Phytosanitary Laboratory. Weather conditions during spring season were favorable for certain pest emergence and development. Data on the abundance and diversity of insects found in the canopy of pear orchard are presented. Main species recorded in the spring of 2012 were: Epitrimerus pyri Nalepa, 1981 (Acari-Eriophyidae), Eriophyes pyri Pagenst, 1857 (Acari-Eriophyidae), Cacopsylla pyri (L.) (Hemiptera-Psylloidea), Cacopsylla pyricola (Förster) (Hemiptera-Psylloidea), Epidiapis leperii (Signoret, 1869) (Homoptera-Diaspididae).

Key words: pear varieties, Romania, insects.

INTRODUCTION

The aim of this study is identification of harmful fauna in a pear orchard from south-east of the country, in the condition of this year. It is very well known that *Pyrus* L. species are susceptible to presence of some pest that could lead to a poor and low quality production. A better knowledge of local specific pest of pear and also of beneficial insects and their relationship could prevent or reduce losses and costs for culture.

MATERIAL AND METHOD

Survey was carried in a modern four year old pear orchard planted with the cultivars Fetel Abe, Williams, General Leclerc, Conference, Kaiser, Bankreta, Lukosova, Red Favoritka. Planting distance was 2 m within the row and 4 m between the rows. Two complementary sampling methods, foliar inspections and yellow sticky traps, were used in this study in our work field. Yellow sticky traps were placed 1,5-2 m above the ground in tree canopy using one trap/15-20 tree. Insect pest and natural enemy populations were monitored weekly. Sampling for harmful organisms and predators began in late March and has continued till end of June. A part of the specimens collected directly from plants or captured by traps were either prepared and mounted on microscopic slides in Hoyer's medium or stored in alcohol 70% or kept dried. In the laboratory, insects were counted and dissection were made with the help of Leica MZ 12_5 stereomicroscope. Microscopic slides were observed at Zeiss Axio Imager. A1. microscope.

RESULTS AND DISCUSSIONS

The structure of insects collected on yellow sticky traps (fig. 1) has comprised a varied number of systematic groups, such as:

Thysanoptera (36%), *Diptera* (30%), *Hemiptera* (22%), *Coleoptera* (5%), *Hymenoptera* (6,9%) and *Lepidoptera* (0,1%) (Table 1).

Complementary after examination of detached pear leaves, branches or fruit in laboratory were detected and identified mites, such as: *Eriophyes pyri* Pagenst, *Epitrimerus pyri* (Nal.), *Tetranychus urticae* (Koch), scale insects as: *Epidiasis lepperii* (Signoret), *Quadraspidiotus perniciosus* (Comstock), jumping plant lice insects: *Cacopsylla pyri* (L.), C*acosylla piricola* (Föster), aphids: *Aphis pomi* De Geer.

Table 1. Structure of the insect fauna captured by sticky traps, in 2012- spring

Insect orders	No. of specimens	Abundance (%)
Thysanoptera	181	36
Diptera	152	30
Hemiptera	111	22
Hymenoptera	35	6.9
Coleoptera	28	5
Lepidoptera	1	0.1
Total	508	100

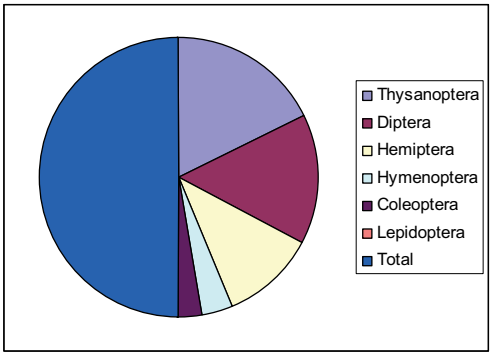


Fig. 1. The structure of insects captured by sticky traps, at USAMV, 2012-spring

Some of the identified insects are very important pest of the pear culture and they can be classified as key factors for orchard development in this year. Having regard the great number of individuals found on trees in this category are name *Epitrimerus pyri, Eriophyes pyri, Epidiaspis leperii, Cacosylla pyri* and we present some date related with their biology and few morphological characters useful for identification.

Epitrimerus pyri (Nal.) with common name pear rust mites occurs in most pear-growing areas of the world. They cause by their feeding discoloration of the leaf tissue, young green twigs or fruit peel as russeting (photo 1). Badly russeted fruit are not suitable for fresh marketing, so this mite could be an important pest for pear. The pear rust mites overwinter under loose bark, in crevices and under the loose scale of dormant bud [7]. The mites feed and oviposit first in the scars of the buds, then move on the leaves and flower receptacles/ young fruit. Feeding of the offspring and subsequent generation leads to browning of undersides of leaves and russet of fruit [7]. These mites have elongate body with two pairs of legs at the anterior end and they are microscopic side (0,17-0.25 mm). Also, they are fusiform and have the prodorsal shield more or less triangular in shape (photo 2). The color is yellowish to brownish-orange [1].

Photo 1. Russeted fruit

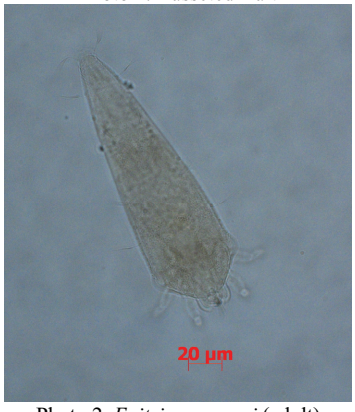
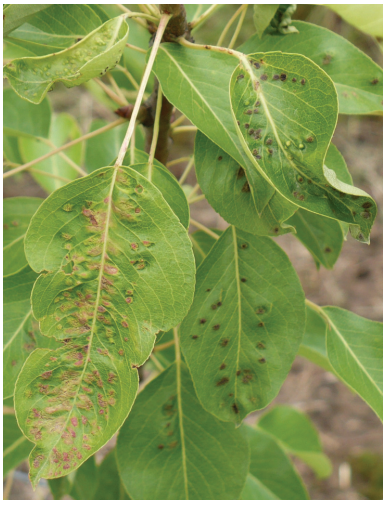


Photo 2. *Epitrimerus pyri* (adult)

A



B

Photo 3. Leaves with blisters A (green) and B (red and necrotic)

Eriophyes pyri Pagenst may affects pears, apple, quince and other pomaceous plants [6]. Pear leaf blister mite, also known as pear bud mite is an eriophyid mite which damages flower buds, ovaries and fruits, provoking their decease and falling out during strong infestation. They produce blisters on the undersides of pear and apple leaves, especially younger foliage, usually in a row along the mid vein [1]. The blisters are tiny green swellings at first (photo3A), later expanding and turning pinkish or red on the lower surface of the leaf blade [4]. There may be damage to the fruit which appear as pale pustules around the calyx fruit or sunken, russeted areas and occasionally fruit may drop early [6]. At heavy infestation the whole leaf becomes covered with blisters and undergoes deformation, finally blackens (photo 3B), withers and is shed. In these formation the leaf tissue between the two epidermal layers becomes spongy and dies [2].

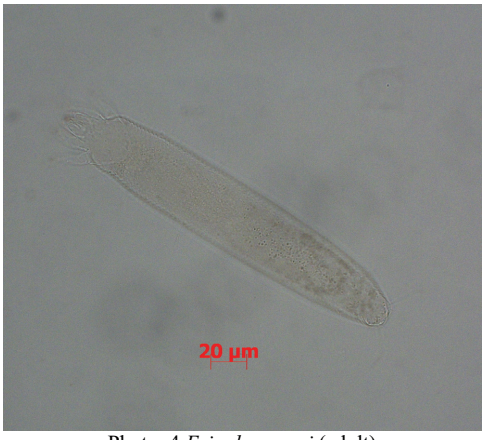


Photo. 4 *Eriophyes pyri* (adult)

The mite is yellowish, slender and worm-like (photo 4), body annulated [9] and measuring 200-230 microns long. The feather claws are 4-rayed; the dorsal shield has a distinct design of a broken median ridge flanked by a pair of longitudinal ridges, with the ends curving and joining posteriorly; the dorsal setae are directed forward [4].

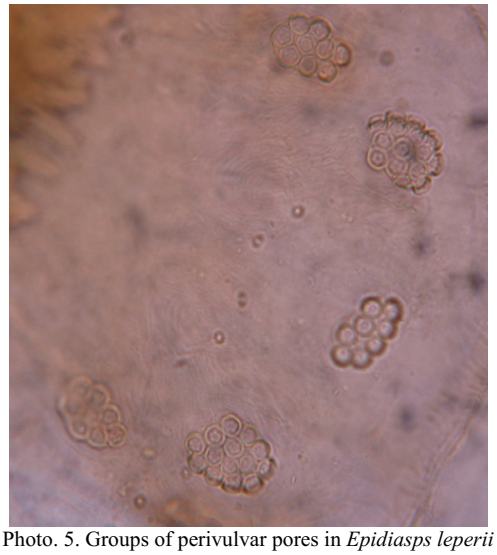


Photo. 5. Groups of perivulvar pores in *Epidiasps leperii*

Epidiaspis leperii (italian pear scale) can be found on twigs, branches and trunk and does not infest leaves or fruit. Adult female presents a scale light grey or white, with a yellow or brown central or sub central exuvium; body light pink, becoming dark red brown toward the end of the egg laying period. The following morphological characters showed on microscopic slide are important for scale diagnosis: median lobes close together, never apically divergent, second lobes tending to be reduced, third lobes never developed as more than a minute point; perivulvar pores in four or five well developed groups (photo 5) [3].
E. leperii causes pitting of the young stems of pear, apple and plum [3]. Heavy infestations cause distortion and death of branches, especially on pear and plum. At the feeding sites of *E. leperii* plant tissue stops growing, making the branches become deformed so that they break easily at these points [5].

Cacopsylla pyri has winter form dark brown, legs brown with femora very dark brown; end of abdomen also very dark brown, wing veins brown black, wing are held to body in a roof manner and project 0,7 mm beyond body.. Summer form with head, thorax and abdomen sclerites, wing pads, antenna and legs yellow-orange, membranes colorless to pale yellow; dorsal surface of body and wing pads with short simple seta. Circumanal ring of nymphs consist in one row of wax pores, forewing-pad margins with one capitate seta (photo 6C) [8].

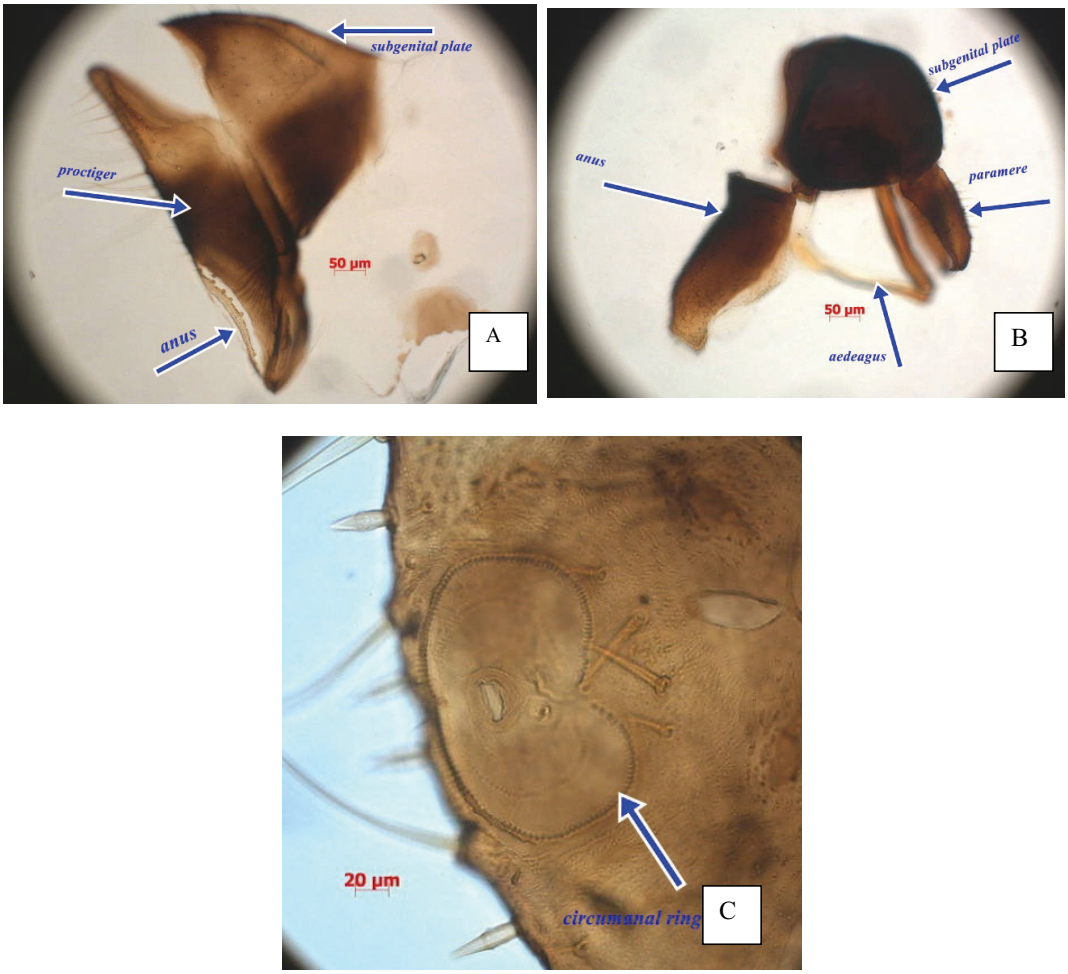


Photo 6. *Psylla pyri*: A female; B male; C nymph

Following our field observation there were identified also beneficial insects in pear tree canopy. They belong to different taxonomic orders, such as: *Dermaptera*: *Forficulidae* (*Forficula auricularia* L.), *Thysanoptera*: *Phlaeothripidae* (*Cryptothrips latus* Uzel), *Coleoptera*: *Coccinellidae* (*Coccinella septempunctata*L., *Coccinella undecimpunctata* L., *Stethorus punctillum* Weise), *Neuroptera*: *Chrysopidae* (*Chrysopa carnea* Stephens), *Hemiptera*: *Anthocoridae* (*Orius* spp.), *Acarina*: *Trombiidae* and *Tideidae*.

CONCLUSIONS

The present study shows that the species diversity is high in pear orchard, placed in south east of the country (Bucharest) and there are harmful insects for pear trees and also beneficial fauna. There were identified pests belong to six systematic groups. Some of the insect could become key-insects for pear culture due to weather's condition, cultivation methods and even period of the time for pest detection. In this spring the problematic pests were eryophyid mites, as *Eriophyes pyri*, *Epitrimerus pyri*. The beneficial insects present in culture are insufficient for limitation of some specific pest population, so this year having regard especially the attack produced by eriophyid mites should be applied chemical treatments in order to reduce the level of existing population.

ACKNOWLEDGEMENTS

This work was carried out with the support of Central Phytosanitary Laboratory and also financed by POSDRU/CPP 107/DMI 1.5/S/76888 Project.

REFERENCES

[1] Alford D.V., 1999. *A Textbook of Agricultural Entomology*. Blackwell Science.

[2] Avizov Z., Harpaz I., 1969. *Plant pests of Israel.* Israel Universities Press.

[3] Gill R.J., 1997. *The scale insects of California Part. 3. The Armored Scale (Homoptera: Diaspididae)*. California Department of Food and Agriculture Technical Series in Agricultural Biosystematics and Plat Pathology. Number 3.

[4] Keifer H.H., Baker E.W., Kono T., Delfinado M., Styer W.E., 1982. *An illustrated guide to plant abnormalities caused by eriophyid mites in North America. United States* Department of Agriculture. Agric. Res. Service. Agric. Handbook. No. 573.

[5] Kostarab M., Kozár F., 1988. *Scale insects of Central Europe.* Akademiai Kiadó. Budapest pp.456.

[6] Krantz G.W., Walter D.E, 2009. *A manual of acarology, third edition*. Texas Tech University Press.

[7] Lindquist E.E., Sabelis M.W., Bruin J., 1996. *World crop pests- Eriophyid mites their biology, natural enemies and control*. Elsevier Science B.V.

[8] White I.M., Hodkinson I.D. 1982. *Psylloidea (nimfal stages), Hemiptera, Homoptera. Handbook for the identification of British Insects*. Vol II. Part. 5 (b).

[9] Zhi-Qiang Zhang, 2003. *Mites of greenhouses-identification, biology and control*. CABI Publishing.


EX·TERRA·AVRVM

Scientific Papers, Series B, Horticulture, Vol. LVI, 2012
CD-ROM ISSN 2285-5661, ISSN-L 2285-5653

RESEARCHES REGARDING THE DETERMINATION OF OPTIMAL TIME FOR APRICOT HARVESTING BY USING THE COLOUR CODE

Lenuța CHIRA[1], Adrian CHIRA[1], Elena DELIAN[1], Constanța ALEXE[2], Elena SĂVULESCU[1]

[1]University of Agronomic Sciences and Veterinary Medicine, Bucharest, 59 Marasti Blvd, District 1, 011464 – Bucharest, Romania, phone nr., 0212243617, email adress: lenutachira@yahoo.com
[2]Research and Development Institute for Processing and Marketing of the Horticultural Products – HORTING, Bucharest, nr. 1A, Intrarea Binelui, 042159, District 4, Romania, phone nr. 0214603440, email adress:tantialexe@yahoo.com

Corresponding author email: lenutachira@yahoo.com

Abstract

The physical and biochemical fruit properties such as the colour code, the texture, the soluble dry matter and acidity represent very significant quality indicators, which one can make use of in order to establish the optimal harvesting time. The aim of this study was to mark the interrelation between the colour code of the Dacia, Olimp and Augustin varieties and other quality features with the aid of the colour code. In addition, the farmer must also choose the harvesting time according to the moment of the sale, because after harvesting, the increase of the sugar content is very slim. Research has shown that if one wants to store the fruit for a short period of time and later have it sent out, a harvesting within the regular parameters is recommended, which would correspond to the following values of the colour code: 6,7 for the Augustin variety, 5 for Dacia and 6 for Olimp. On the other hand, if the fruit is intended to be consumed right away or involved in an industrialized process a tardily harvesting is advisable, hence the following values of the colour code: 8 for the Augustin variety, 6 for Dacia and 7 for Olimp.

Key words**:** apricot, harvesting, colour code, variety, quality

INTRODUCTION

Many studies tried to establish a correlation between the basic colour at the time of harvesting and the fruit quality, the stages of maturation being empirically classified as green-yellowish, yellow-greenish, yellow-orange and orange [1].

The physical and biochemical fruit properties such as the colour code, the texture, the soluble dry matter and acidity represent very significant quality indicators, which one can make use of in order to establish the optimal harvesting time.

The aim of this study was to mark the interrelation between the colour code of the Dacia, Olimp and Augustin varieties and other quality features with the aid of the colour code.

In addition, the farmer must also choose the harvesting time according to the moment of the sale, because after harvesting, the increase of the sugar content is very slim [2].

For some cultivars there were attempts to define the correlation between the colour and the essential quality compounds: firmness, sugar and acidity, thus establishing a ten shade colour - codex to be easily used by fruit tree growers in order to help in assessing the quality of fruit lots at the moment of harvesting [5].

MATERIAL AND METHOD

The fruits were harvested from the experimental field of the Horticulture Faculty in Bucharest. The orchard was three years old.

In the present, the existing correlation between the basic fruit colour in the Romanian cultivars Dacia, Olimp and Augustin and the other qualitative characteristics has been established by using the colour codex.

For this aim, the fruits have been harvested at three stages of the basic colour, assessed "by eyesight" meant to stimulate the precocious, commercially normal and tardy harvesting. For each stage, three apparently homogenous lots of 25 fruits have been individually chosen and analysed in the matter of the main qualitative characteristics.

The results have been voluntarily expressed in classes from 1 to 4 stars. In the first table, the correspondence between these and the physico-chemical analysis is presented [6].

Table 1. The correspondence between the X notations and the defined values of the physico-chemical properties

Notations	XXXX	XXX	XX	X
Firmness (kgf/cm2)	Very firm >3,0	Firm 2-3,0	Medium 1,5-2,0	Unsufficient <1,5
Soluble dry Matter %	Very sweet >13,5	Swet 12 – 13,5	Medium 10,5 - 12	Unsufficient <10,5
Titrable acidity (% acid malic)	Very swet 1,15 – 1,45	Swet 1,45 – 1,65	Acidified 1,65 – 1,85	Acid >1,85

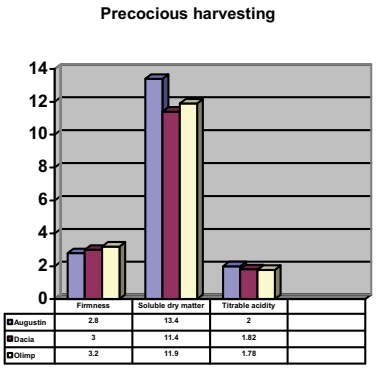
RESULTS AND DISCUSSIONS

The synthesis of these evaluations demonstrated the differences among cultivars, as revealed by using the colour-codex (Table 2).

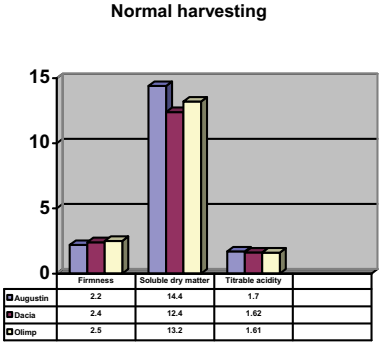
Table 2. The apricot quality of harvesting according to the basic colour evaluated by using the colour codex

Cultivar	Precocious harvesting			
	Color -Shade-	Firmness -kgf/cm2	Soluble dry matter -%-	Titrable acidity (acid malic)
Augustin	5	2,8 XXX	13,4 XXX	2,0 X
Dacia	4	3,0 XXX	11,4 XX	1,82 XX
Olimp	5	3,2 XXXX	11,9 XX	1,78 XX
	Normal harvesting			
Augustin	6-7	2,2 XXX	14,4 XXXX	1,70 XX
Dacia	5	2,4 XXX	12,4 XXX	1,62 XXX
Olimp	6	2,5 XXX	13,2 XXX	1,61 XXX
	Tardy harvesting			
Augustin	8	1,7 XX	14,9 XXXX	1,62 XXX
Dacia	6	1,9 XX	13,2 XXX	1,54 XXX
Olimp	7	2,2 XXX	13,7 XXXX	1,47 XXXX

As regards the firmness, the Augustin and Dacia cultivars must be harvested at the point when the fruit's colour is still basic green, in order for it to have sufficient firmness, but sometimes in the detriment of the gustative quality (cv. Dacia). Instead it is not recommended to harvest cv. Olimp at a too green stage, because this one may gain in quality by keeping a higher firmness.

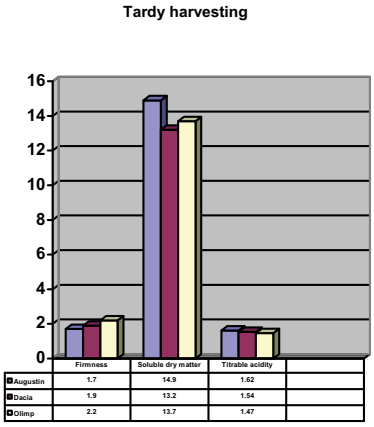


The main element in assessing the gustative quality is represented by sugars, their variation being often in an inverse ratio in comparison with the firmness [3]. From the data presented in table 2 there are relevant differences between cultivars at the same stage of maturation. Thus at the stage of precocious maturation, the soluble dry matter has values of 11,9% for Olimp cv. and respectively 13,4% for Augustin cv. as in the case of a tardy harvesting in all cultivars the values of the soluble dry matter are over 13%.



Therefore, the fruit-tree grower must choose the moment of harvesting according to this goals and the respective market, because after harvesting the gain in sugars is lower [7]. In the present situation, if for example the fruits are planned for being stored for a certain time as for being sent to long distances, it is recommended a normal

harvesting (6,7 the basic colour for Augustin cv., 5 -basic colour for Dacia cv. and 6-basic colour for Olimp cv.) while for immediate consuming or for industrial processing a tardy harvesting, that corresponds to the following shades of the basic colour: 8 for Augustin cv., 6- for Dacia cv. and 7-for Olimp cv, is recommended.



The fruit quality related to the aspect is not neglectable in the consumer's decision for buying, but the performed investigations revealed that the red colour shade does not mean a superior gustative quality, but rather a cultivar characteristic [4].

The performed experiment confirmed the correlation between the basic colour at the harvesting and the lot quality, having specificity for every cultivar, because all apricots turn from green to orange without having the same gustative quality.

The quality "presumption" at harvesting according to the basic colour must be admitted, but without neglecting the consequences of the natural and pedo-climatic factors.

CONCLUSIONS

1. Combining the phenological and physico-chemical criteria (especially by using the colour-codex) may be of help for planning the harvesting time and for establishing the optimal moment, according to the destination of the yield.

2. It is primarily important that the harvesting take place at the right time, because the quality of the apricot lots is closely correlated to the stage of harvesting.

3. Thus if harvested too early, the fruits will have firmness but also low quality, and if harvested to late, they will not be of appropriate quality due to the subsequent manipulations and during a too long time until they reach the market, the basic colour being in this way a good non-destructive indicator of the maturation stage.

4. For the fruits which are meant to be stored or to be sent on long distances, a normal harvesting is recommended (6,7 the basic colour for Augustin cv., 5 basic colour for Dacia cv. and 6 basic colour for Olimp cv.).

5. For the fruits intended for immediate consumption or for industrial processing a tardy harvesting, that corresponds to the following shades of the basic colour is recommended: 8 for Augustin cv., 6 for Dacia cv. and 7 for Olimp cv.

REFERENCES

[1.] Balan Viorica si colab., 2008. *Caisul si caisele*, Editura Ceres, Bucuresti, p. 579-630.

[2.] Banu C. si colab., 2007. *Calitatea si analiza senzoriala a produselor alimentare*. Editura AGIR, Bucuresti, p. 150-157.

[3]. Chira A., Chira Lenuta, Hoza D., 2005. *Norme de calitate la caise si piersici*. Editura Elisavaros, Bucuresti, p. 43-47.

[4.]Lichou J., Jay M., Chamet C., Pinet C and Broquaire J.M., 2006, Proceeding of the Twelfth ISHS Symposium on Apricot Culture and Decline, Acta Horticulture, vol. I, p.551-553.

[5.] Planton, G., Ferre, G., 1992. *Pomme Gala: un code de couleur pour raisonner la qualite*. Infos-CTIFL, 82, p. 39-42.

[6.]Planton, G., 1994. *Un code de couleur au service de la qualite*. Infos - CTIFL, 101, p.36 - 40.

[7.] Rossier J., Darbellay C., Azodanlou R., and Villettaz, 2006. *Proceeding of the Twelfth ISHS Symposium on Apricot Culture and Decline*. Acta Horticulture, vol. II, p. 575-577.


EX·TERRA·AVRVM

Scientific Papers, Series B, Horticulture, Vol. LVI, 2012
CD-ROM ISSN 2285-5661, ISSN-L 2285-5653

STUDIES REGARDING THE IMPLEMENTATION OF FOOD SAFETY MANAGEMENT SYSTEM ON TOMATO PROCESSED PRODUCTS

Adrian CHIRA[1], Lenuta CHIRA[1], Constanta ALEXE[2]

[1]University of Agricultural Sciences and Veterinary Medicine, Bucharest, 59 Marasti Blvd, Sector 1, 011464 – Bucharest, Romania, phone nr., 0212243617, email adress: lenutachira@yahoo.com
[2]Research and Development Institute for Processing and Marketing of the Horticultural Products – HORTING, Bucharest, nr. 1A, Intrarea Binelui, 042159, sector 4, Romania, phone nr. 0214603440, email adress: tantialexe@yahoo.com

Corresponding author email: achira63@yahoo.com

Abstract

HACCP is the abbreviation for the English expression "Hazard Analysis and Critical Control Points". To obtain high – quality products, capable of meeting the consumer's demands and complying with the Food safety standards, it is recommended that certain risk-prevention and control methods should be applied. In the tomato product processing, the application of a HACCP system allows the identification of the key-elements of the technological process. The system analyses the hazard related to the product and the process, indicating the critical control points to the hygienic quality of the product. During the technological process, there are a large number of factors affecting the safety of the horticultural products. Starting from the fact that these products are highly requested there are major concerns regarding the level of pesticides and other chemical contaminants, as well as the maintenance of hygiene during harvesting and handling.
In order to prevent or reduce the above-mentioned hazards, the big specialised companies and small producers must apply HACCP prevention methods, not methods based on the final product control (which may affect consumer's health and may lead to important economic loss). In order to keep under control the tomato processed product were identified the following CCPs: CCP1- Heat treatment and CCP2 – Sorting of end product.

Key words**:** CCPs, HACCP, food safety, tomato processed products

INTRODUCTION

The sanitary status of tomato processed products is a foremost quality attribute, even though it is among the less discernible traits for the consumer. Tomato processed products can contain chemical, physical, and microbial hazards and contaminants or some synthetic pollutants (residues of fertilizers, herbicides and pesticides). Food safety management systems like ISO 22000:2005 and Hazard Analysis Critical Control Point (HACCP) can secure food safety by preventing potential hazard at source points of the process.
In order to guarantee tomato processed products safety, it would be desirable to structure the production according to HACCP principles. In the tomato processed products, the critical control points can be detected mainly for microorganisms.

MATERIAL AND METHOD

The studies were developed on the processing of tomato processed products, according the flow diagram described in Fig.1.
For each step of the process was performed the risk analysis, in order to identify the chemical, physical and biological hazards correlated to the product and process and also the preventive actions and control measures which are necessary to keep under control these hazards.
In order to the CCPs in all steps where it's possible to implement specific control measures regarding food safety, the CCP decision tree was applied. The control of each CCP, according HACCP principles are planned in HACCP

plan and the implementation of the control measures and shown by specific records.

RESULTS AND DISCUSSIONS

The safety of food products which are processed by means of conservation is higher than that of fresh products.

In comparison with fresh horticultural products or minimally processed ones, which have an increased metabolic activity and are microbiologically vulnerable, tomato cans (tins), due to the fact that they have been treated under heat, are stable as far as microbiological aspects are concerned.

The inconvenience of conserved (canned) products is the fact that through their exposure to high temperatures a part of the vitamins is lost and, furthermore, the product's colour is also altered.

According to the HACCP conception, the purchasing of the quality row material, phased transport and in adequate circumstances as well as its input into the production flow in a time interval as short as possible represent good manufacturing practices (GMP) which have major impact on food safety.

In order to keep control of the microorganisms it is important to respect the sterilization diagram which corresponds to each and every product.

Starting from these aspects, in the table 1 are presented the process step and related potential hazards including the preventive actions and the control measures, from which one of the most important is the temperature control.

Table 1. Hazard analysis regarding the processing of tomato processed products

Process step	Hazard	Preventive actions/Control measures
1. Receiving of row materials	B- Pathogenic micro organisms C- Pesticides residues - Heavy metals - Fertilizers Ph – Foreign matter	Visual control Supplier assessment Product analysis
2. Storage	B - Idem	Sanitation programme Regular maintenance FIFO system Temperature control during storage
3. Washing Preparation	B- idem Ph – Metal piece from cutting machine	Cleaning programme Right equipment Personal hygiene rules
4. Boiling	B – idem	Cleaning programme Right equipment Personal hygiene rules Process control (time/temperature)
5. Filling /closure	B – idem Ph – Foreign bodies	Cleaning programme for equipment Personal training
6. Heat treatment	B – idem	Process control (time/temperature) Personal training
7.Closure check	B - idem	Regular maintenance of equipment Visual control Personal training
8.Storage of end product	B – idem	Storage parameters control GMP measures GHP measures
9. Sorting	B - idem	Visual control Personnel training GMP measures GHP measures
10. Labelling		
11. Delivery	C – chemical residues	Right transportation vehicles Cleaning programme; Personnel training

Table 3. HACCP plan regarding the processing of tomato processed products

Process step	CCP Nr.	Critical limits	Monitoring process				Corrective action	Corrective action responsable
			Responsable	Method	Frequency	Records		
Heat treatment	CCP 1	Temp=100 - 120° C Timp = 10-30 minute Pres=1,6-1,7 bari	Termical treatment worker	Visual control of parameter	Each lot	Sterilization diagram	Maintenance equipment Personal training	Technical manager Production manager
Sorting of end product	CCP 2	Without no clossing recipient Without mould	Storage worker	Visual control	Each recipient	Sorting register	Removal of nonconforming products Personal training	Storage responsable

By using the CCP decision tree, in table 2 are presented the two CCPs identified, which, are focused to keep under control the microorganisms.

Table 2. CCP determination during processing of tomato processed products

Process step	Hazard	Decision tree questions				PCC Nr.
		Q1	Q2	Q3	Q4	
1.Heat treatment	B – Pathogenic organism	Yes	Yes	-	-	PCC1
2. Sorting of end products	B – idem	Yes	Yes	-	-	PCC2

The HACCP Plan (Table 3) is one of the most important document from food safety management system, which contain the mainly information necessary in order to implement the control measures and keep under control the identified CCPs.

As we know, the monitoring of finished food product is no guarantee of safety because Unsafe samples may be not analysed. For that, the HACCP system is a structured approach to the identification, associated with the processing of tomato canned products.

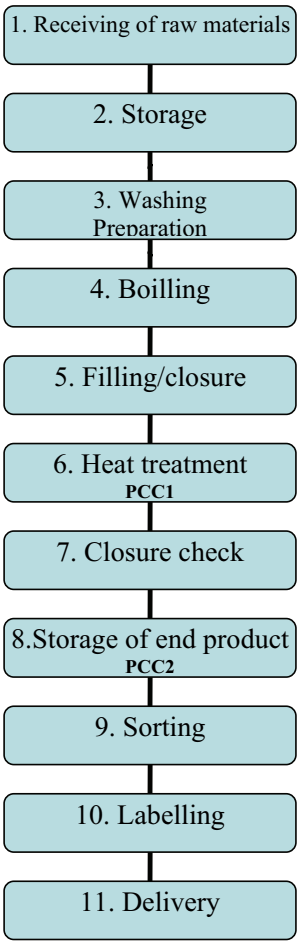


Fig. 1. Flow diagram - tomato canned products

REFERENCES

[1]. Chira A., 2000. *Assuring the quality of horticultural products by HACCP system*. Lucrari stiintifice USAMV Bucuresti. Seria B, p. 181-185.

[2]. Tiecco G., 2001. *Igiene e tecnologia alimentare*, Calderini, Edagricole, Bologna.

Tofan Clemansa, 2001. *Igiena si securitatea producelor alimentare*. Editura AGIR, Bucuresti, p.245-255.

[4]. Varzakas T., Arvanitoyannis I., 2001. *Application of ISO 22000 and comparison to HACCP for processing of ready to eat vegetables.* International Journal of Food Science and Technology, 43,p. 1729-1741.

[5]. CAC/RCP 1-1969, REV. 4 -2003. *Code d'usages international recommande, Principes genereaux d'hygiene alimentaire.*


EX·TERRA·AVRVM

Scientific Papers, Series B, Horticulture, Vol. LVI, 2012
CD-ROM ISSN 2285-5661, ISSN-L 2285-5653

A NEW REFRACTOMETRIC METHODOLOGY USED TO MONITOR FERMENTATIONS

George A. COJOCARU, Arina Oana ANTOCE

University of Agronomical Sciences and Veterinary Medicine of Bucharest, Faculty of Horticulture, Department of Bioengineering of Horti-Viticultural Systems, 59, Mărăşti Ave. Sector 1, 011464 Bucharest, Romania

***Corresponding author email*:** cojocaru.george@ymail.com

Abstract

A new refractometric methodology for monitoring fermentations was developed. Refractive index is influenced by two facts that occur simultaneously during fermentations, the decrease of sugars from wine (leading to a decrease of refractive index) and the increase of alcohol concentration, due to fermentation of sugars (leading to an increase of refractive index). This deviation of refractive index induced by the presence of alcohol in solution can be corrected by applying some mathematical equations derived by polynomial regressions. By this methodology a good prediction model can be obtained. The methodology allows the winemaker to follow the fermentations and decide when to add nutrients or cool down the wine to slow the fermentation. If the fermentation rate is too slow, real Brix values determined refractometrically decreases by 0.2-0.4 units/day and a decision is rapidly required. Also, the decision of pressing red-wine at a certain sugar concentration or the establishment of the fermentation ending can also be based on accurate refractometric determinations.

Keywords: *refractometry, fermentation, brix, refractive index*

INTRODUCTION

Monitoring alcoholic fermentation evolution is absolutely necessary for many reasons, but especially in order to prevent the stuck fermentations. Many methodologies are applied worldwide for monitoring the progress of alcoholic fermentations [2, 5, 10]. This paper proposes a new methodology of fermentative process monitoring by using a handheld refractometer with automatic temperature compensation.

The novelty of this methodology is that includes mathematical calculations that corrects the direct readings of Brix units (actual Brix) in order to compensate the effect of alcohol continuous increase on the refractive index.

To make an accurate methodology, it is absolutely necessary to determine the initial refractive index (initial Brix) in grape juice (before yeast inoculation or fermentative process begins), and then to record the evolution of this index during fermentation, under the form of a fermentation graphic.

As well known, when the fermentative process evolves, the refractometer readings change due to the presence of alcohol in the solution, as shown in figure 1 as an exemple.

Multiple polynomial regression equations are able to correct these values and the calculated refractometric units can be used to monitor the residual sugar evolution.

In a sugar solution a direct relationship exists between Brix degrees and refractive index that has been determined using conversion tables [4, 6, 7, 12]. Also, a direct relationship between alcoholic concentrations in solutions and the measured refractive index of that solution [14].

MATERIALS AND METHODS

Starting from the facts exemplified in figure 1 and the simplification that the fermenting wine is a solution of sugar, water and alcohol the following equation can be derived:

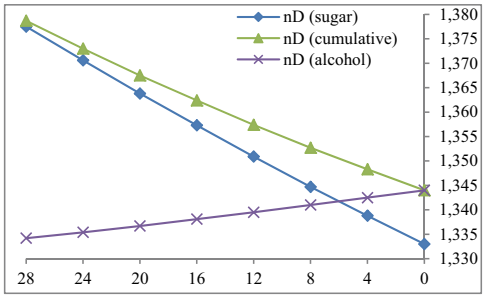


Fig. 1. Relative measurements of refractive indices in solutions of sugar and alcohol [13]

$n_D = n_{D\,wat.} + \Delta n_{D\,alc.-wat.} + \Delta n_{D\,sug.-wat.}$
(Eq 1)

where:
n_D – uncorrected refractive index of the wine measured during fermentation;
$n_{D\,wat.}$ – refractive index of distilled water;
$\Delta n_{D\,alc.-wat.}$ – difference between the refractive index of an alcohol solution of known concentration and the refractive index of distilled water;
$\Delta n_{D\,sug.-wat.}$ - difference between the refractive index of a sugar solution of known concentration and the refractive index of distilled water;

The mathematical model was developed taking into account the maximum values of sugars and alcohol which can be found in wines. Regression analyses were by using the tabulated values for alcohol and sugar solutions, measured in the range of 0 to 28 Brix and from 0-16% vol./vol., respectively. The goal was to find the relationships between refractive index and degrees Brix, in the case of sugar solutions and the relationships between refractive index and alcoholic strength by volume, in the case of alcohol solutions.
Based on mathematical regression a complex mathematical model was created so that to replace hydrometers for monitoring of alcoholic fermentation.
Commonly used in winemaking, Brix refractometer, with automatic temperature compensation is used to measure the concentration of sugars in musts. Used on wines, due to the presence of alcohol, they give higher values on the Brix scale than the normal values directly correlated with the existing amount of sugar.
When alcohol starts to accumulate in fermenting must, to find out the correct alcoholic concentration during fermentation by refractometery, the difference between initial and real Brix degrees should be calculated.
Do to these contrary influences of sugar and alcohol on the refractive index the actual Brix values read on the refractometer is misleading and the directly measured value unusable as such. Theoretically, on the Brix scale the value of 0 signifies that the fermentation is finished. Practically, by calculating the differences between initial Brix value and real Brix value, the amount of probable alcohol from wine can be determined by the following equation:

$c\%\ v/v = (a - d) \times b;$
(Eq 2)

where:
$c\%\ v/v$ – probable amount of alcohol that was formed into the fermentative process;
a - initial Brix value (in grapejuice);
b - conversion of Brix value to alcohol concentration, for values ranging from 0.55 and 0.63 [1, 3, 8].
d - real Brix value;

By using equation 2, knowing the amount of alcohol present in the fermentation tank at a certain time, the real Brix value (d) can be calculated using adjusted refractive indices.

RESULTS AND DISCUSSION

From the tabulated Brix values for the various sugar solutions we can derive Equation 3 and use it to calculate the refractive indices corresponding to the initial and real Brix values:

$n_D = 6e - 6 \times {}^{\circ}B^2 + 0.0014 \times {}^{\circ}B + 1.333;$
$(r^2 = 1)$
(Eq 3)

where:
n_D- refractive index of a sugar solution;
${}^{\circ}B$- Brix degrees of sugar solution;

Equation 4 is derived in a similar way from the tabulated Brix values for the various sugar solutions [4, 6, 7, 12] and is used to calculate the corresponding Brix values for a refractive index:

$$^{\circ}B = -1504.2 \times {n_D}^2 + 4705.3 \times n_D - 3599.4;$$
$$(r^2 = 1)$$
(Eq 4)

where:
n_D- refractive index of a sugar solution;
$^{\circ}B$- Brix degrees of sugar solution;

From the tabulated values for the various alcohol solutions with concentrations expressed as mass percent (% w./w.) we can derive Equation 5 and use it to calculate the refractive indices corresponding to a solution with a certain alcohol concentration:

$$n_D = -2e-7 \times c\%^3 + 1e-5 \times c\%^2 + 0.0006 \times c\% + 1.333;$$
$$(r^2 = 1)$$
(Eq 5)

where:
n_D- refractive index of an alcoholic solution;
$c\%$- alcoholic concentration in mass percentage (%w./w.);

For the case of alcoholic solution with concentrations reported as volume percentages (%v./v.) as in tables [9, 11, 14] the equation 5 becomes equation 6:

$$n_D = 5e-6 \times c\%^2 + 0.0005 \times c\% + 1.333;$$
$$(r^2 = 0.9999)$$
(Eq 6)

where:
n_D- refractive index of an alcoholic solution;
$c\%$ - alcoholic concentration in volume percentage (%v./v.);

The transformation of volume percentage in mass percentage for the alcoholic solutions is easily achieved by using equation 7:

$$c\%\ w/w = \frac{c\%\ v/v \times 0.79074}{d_{20}^{20}};$$
(Eq 7)

where:
$c\%\ w/w$ – alcoholic concentration in mass percentage (%w./w.);
$c\%\ v/v$ – alcoholic concentration in volume percentage (%v./v.);
0.79074 – relative density of ethanol at 20°C;
d_{20}^{20}- relative density of a solution of alcohol with c% v/v concentration;

This type of transformation can also be expressed under the form of a table (Table 1).

Table 1. Relation between ethanol concentration and relative density at 20°C [9, 11].

Ethanol % w./w.	Ethanol % v./v.	d_{20}^{20} of alcohol solutions
0.00	0.00	1.00000
1.00	1.26	0.99813
2.00	2.52	0.99629
3.00	3.77	0.99451
4.00	5.02	0.99279
5.00	6.27	0.99113
6.00	7.51	0.98955
7.00	8.75	0.98802
8.00	9.98	0.98653
9.00	11.21	0.98505
10.00	12.44	0.98361
11.00	13.66	0.98221
12.00	14.88	0.98084
13.00	16.10	0.97948
14.00	17.32	0.97816
15.00	18.53	0.97687
16.00	19.74	0.97560

In order to validate the model, several simulations were performed.
For example, we took the case of a grape juice which fermented 12 real Brix degrees. Assuming that the initial value for the grapejuice before the start of fermentation was 24, in accordance with the equation 3, the refractive calculated index was 1.37006.
Real Brix value was the difference between the initial value and the fermented Brix value, that is 24 - 12 = 12, to which the corresponding refractive index calculated by using equation 3 is 1.35066. Then, by using equation 2 and the conversion of Brix values into alcohol concentrations (in the range 0.55 and 0.63) we

can calculate the amount of alcohol formed in the fermentation process.
We disregarded here the fact that the conversion factor is slightly influenced by the temperature of fermentation, the yeast strain, the variety and so on. Therefore, by using an average Brix-alcohol conversion factor of 0.59 we obtain an alcohol concentration of 7.08% expressed as v./v. This alcohol concentration of 7.08% v./v. is equal to 5.66% w./w. alcohol according to equation 8. According to equation 6, the refractive index corresponding to a solution of alcohol 5.66% w./w. alcohol can be calculated. Then, by using equation 1 it is calculated the uncorrected refractive index (corresponding to the actual Brix value), that is the value one would actually measure by using a refractometer on the fermenting grapejuice at that certain time.

***

By solving similar equations for all other possible cases that can be found in the process of turning grape juice into wines, a matrix of results was built and analysed so that to derive an equation based on which the real Brix values be obtained form the actually measured Brix values.
For the mathematical data processing the following software packages were used: Origin Pro 8.0, SPSS 17.0, Statistica 10.0.

Origin Pro 8.0 software was used to calculate manual repeated regressions until they led to equation 8, that calculates real Brix degrees (d) with high precision, taking into account initial Brix degrees (a), conversion factor Brix-alcohol (b) and current Brix degrees (c).

$$d = (k_1) \times c^2 + (k_2) \times c + (k_3)$$
(Eq 8)

where:
$k1 = (ka1) \times a + (ka2);$
$k2 = (kb1) \times a^2 + (kb2) \times a + (kb3);$
$k3 = (kc1) \times a^2 + (kc2) \times a + (kc3);$

where:
$ka1 = 4.0385e-4 \times b - 1.21202e-4;$
$(r^2 = 0.98091)$
$ka2 = -0.03113 \times b + 0.00942;$
$(r^2 = 0.99999)$
$kb1 = -6.63638e-4 \times b + 2.60639e-4;$
$(r^2 = 0.99159;)$
$kb2 = 0.0522 \times b - 0.01953;$
$(r^2 = 0.9956)$
$kb3 = 0.60913 \times b + 0.97331;$
$(r^2 = 0.99985)$
$kc1 = -0.00325 \times b + 7.20833e-4;$
$(r^2 = 0.98434)$
$kc2 = -0.96363 \times b + 0.23933;$
$(r^2 = 0.99741)$
$kc3 = 1.25163 \times b - 3.02807;$
$(r^2 = 0.95666)$

where:
a – initial Brix value, measured before the strat of fermentation;
b – Brix-alcohol conversion factor (from 0.55 to 0.63) [1, 3, 8];
c – actual Brix value, measured with then refractometer in the process of fermentation (two times per day);
d – real Brix value, calculated by manually repeated regressions (calculus that exclude the effect of alcohol on the refractive index);
k1, k2, k3 – coefficients of primary polynomial regression;
ka1, ka2 – coefficients of k1 coefficient polynomial regression;
kb1, kb2, kb3 – coefficients of k2 coefficient polynomial regression;
kc1, kc2, kc3 – coefficients of k3 coefficient polynomial regression;

The data processing with Statistica 10.0 and by using multiple polynomial regression analysis resulted in the following equation:

$$d = -0.00268 \times c^2 + 1.41448 \times c - 0.40253 \times b^2 - 5.35318 \times b + 0.00115 \times a^2 - 0.33467 \times a + 0.61759;$$
$(r^2 = 0.999357);$
(Eq 9)

where a, b, c, d have the same meaning as in equation 8.

SPSS 17.0 was used to calculate the matrix with intermediary data. Multiple linear regression was preformed and lead to the following equation:

$d = -0.28699 \times a - 5.73434 \times b + 1.33082 \times c + 0.78605;$
$(r^2 = 0.99919);$
(Eq 10)

where a, b, c, d have the same meaning as in equation 8.

Statistica 10.0 was used to compare the results, by calculating the correlation between theoretical real Brix values and calculated by using the 3 equations previously determined (Eq. 8, 9 and 10).
The correlation coefficients are presented in Table 2, showing a very good correlation between all the derived equations, meaning that all the equations provide reliable results.

Table 2. The correlation between 3 equations derived with 3 different software packages for the real Brix value calculation

Real Brix degrees (d)	Theoretical	Origin Pro 8.0	SPSS 17.0	Statistica 10.0
Theoretical	1.000000	0.999998	0.999595	0.999678
OriginPro 8.0	0.999998	1.000000	0.999597	0.999681
SPSS 17.0	0.999595	0.999597	1.000000	0.999917
Statistica 10.0	0.999678	0.999681	0.999917	1.000000

*Correlations significant at $p < 0.05$;
N=987 (Casewise deletion of missing data);

From correlation analysis that was preformed for all calculated equations against theoretical real Brix degrees, it can be said that the most accurate results was obtained using the program OriginPro 8.0 with manually repeated regressions, that lead to Equation 9, which has an r = 0.999998 for statistical assurance level of 99.5% (risk failure 0.5%).

The results of this study allowed us to obtain equations with which we can estimate the relative density, alcohol concentration and sugar content during fermentation.

The same equations can be modified so that the measurements should be done not only with a refractometer, but also with a hydrometer with Brix scale or any other scale correlated with Brix.

Estimation of sugar content from must
This estimation can be obtained with the equation 11.

$$Sugar\ g/l = \frac{a}{1.75} \times 16{,}83; \quad \text{(Eq 11)}$$

where:
a – initial Brix value, measured before the strat of fermentation;
1.75 – approximate Brix value for a sugar solution form which 1% v./v. alcohol results [1];
16.83 – grams of suchrose that produce through fermentation 1% v./v. alcohol [1];

Estimation of residual sugar content from fermenting wine

This estimation can be obtained with the equation 12.

$$Sugar\ g/l = \frac{a-d}{1.75} \times 16.83; \quad \text{(Eq 12)}$$

a – initial Brix value, measured before the strat of fermentation;
d – real Brix value, calculated by multiple regressions (calculus that exclude the influence of alcohol on the refractive index);
1.75 – approximate Brix value for a sugar solution form which 1% v./v. alcohol results [1];
16.83 – grams of sucrose that produce through fermentation 1% v./v. alcohol [1];

CONCLUSIONS

The methodology proposed allows for sugar and alcohol estimation in a grape juice undergoing fermentation, by using a simple measurement method, such as refractometry.
The equations derived for sugar and alcohol estimation at a certain moment of fermentation can easily be used by any winemaker. Also, the equations can be used to plot with a common software, such as Excel, the evolution of sugar and alcohol concentration during fermentation.
Monitoring the fermentations with this refracto-metric methodology has a series of advantages, as follows:

- as opposed to the measurement with the hydrometer the readings are not influenced by carbon dioxide bubbles that are released into the fermentation;
- although the determination of Brix values before fermentation is a prerequisite, the determination of potential alcoholic strength and the sugar concentration of sugars in the grape juice is simple;
- the graphical display of the kinetics of fermentation allows to intervene in time to control the fermentation rate and, to some extent, allows the selection of an appropriate yeast strain for a certain type of wine.

REFERENCES

[1] Antoce Oana Arina, 2007. *Oenologie - Chimie și analiză senzorială.* Editura Universitaria, Craiova.

[2] Bisson Linda F., 2002. VEN 124 LAB MANUAL. An Introduction to Wine Production, Department of Viticulture and Enology University of California, Davis, p.36-41;

[3] Boulton R., Singleton V. L., Bisson L. F. şi Kunkee R. E., 1998. *Principles and practices of winemaking. Aspen Publishers*. Gaithersburg, Maryland, p.137-138.

[4] Bureau Of Sugar Experiment Stations, 1970. *Laboratory Manual For Queensland Sugar Mills*. 5th Edition. Watson Ferguson And Company, Brisbane, Australia;

[5] Cotea Valeriu D., 1985. *Tratat de oenologie vol. I. Vinificaţia şi biochimia vinului*. Editura Ceres, Bucureşti.

[6] Frederick J. Bates and associates, 1942. *National Bureau of Standards. U.S. Department Of Commerce. Circular 440 Table 114 - Polarimetry, Saccharimetry and the Sugars*. By United States Government Printing Office Washington.

[7] International Organisation of Legal Metrology, 1993. *Refractometers for the measurement of the sugar content of fruit juices*.

[8] Jackisch Philip, 1985. *Modern Winemaking*. Cornell University Press, New York, p.43-45.

[9] Norbert Lange (editor), 1961. *Handbook of Chemistry, 10th edition.* Mcgraw Hill Publishers, New York.

[10] Ribéreau-Gayon P., Dubordieu D., Donèche B., Lonvaud A., , 2006. *Handbook of Enology (volume 1.) - The Microbiology of Wine and Vinifications*. 2nd Edition, John Wiley & Sons Ltd.

[11] Technology Reports Centre, Department of Industry for the Department of Prices and Consumer Protection (Orpington), 1975. *Alcoholometry* "International alcoholometric tables". Fourth International Conference on Legal Metrology, English Translation by BIML.

[12] United States Department of Agriculture, 1981. *Technical Procedures Manual*. Sucrose table conversion, 135-A-50.

[13] Wilkes Eric, 2005. *Surviving Baume, Brix and Vintage*. Fosters Wine Estates IWAG Seminar Mildura.

[14] http://www.refractometer.pl/ refraction-datasheet-ethanol, accessed on 15th march 2012. *Refractive indices of ethanol solutions at 20°C*. 589.29 n;

Scientific Papers, Series B, Horticulture, Vol. LVI, 2012
CD-ROM ISSN 2285-5661, ISSN-L 2285-5653

CHEMICAL AND BIOCHEMICAL MECHANISMS OF PRESERVATIVES USED IN WINE: A REVIEW

George A. COJOCARU, Arina Oana ANTOCE

University of Agronomical Sciences and Veterinary Medicine of Bucharest, Faculty of Horticulture, Department of Bioengineering of Horti-Viticultural Systems, 59, Mărăşti Ave. Sector 1, 011464 Bucharest, Romania,

***Corresponding author email*:** cojocaru.george@ymail.com

Abstract

Wine stability is a very important step when it comes to marketing. Antioxidant and antiseptic protection of wines can be achieved by using preservatives, a procedure that is regulated by the European laws. Wines are biochemically complex systems and because of this winemakers have to take informed decisions to manage with precision the preservation of their wines. Wine laboratories can ease the work of the winemaker offering at least the minimum routine analyses, such as pH, alcohol concentration and free sulphur dioxide. The results of these analyses can be used in some mathematical calculus to obtain more useful and precise results, such as the content of molecular sulphur dioxide. Molecular sulphur dioxide is the part of the free sulphur dioxide that confers microbiological stability to wines. Also, based on pH and alcohol concentration determinations, the dosage of potassium sorbate can be precisely calculated to preserve wines with residual sugar and prevent a second fermentation in the bottle. In addition, the usage of the combination ascorbic acid and sulphur dioxide in white dry wines can be risky if it is not properly managed. In the presence of sulphur dioxide the ascorbic acid is a strong reductive agent, therefore it can react faster than sulphur dioxide with oxygen. On the other hand, in the absence of sulphur dioxide, the addition of ascorbic acid it can be very unsafe for wines, because it reacts with dissolved oxygen and releases hydrogen peroxide, a more powerful oxidizing agent. Therefore, only proper management of dissolved oxygen and reductive state preservation can lead to quality wines. This paper reviews the main preservation methods and presents a new perspective in the use of preservatives in wine.

Keywords: *antioxidants, antimicrobials, mechanisms, doses, wine*

INTRODUCTION

Antimicrobials are added into wines to inhibit the growth of microorganisms, enzyme-catalysed reactions, non-enzymic browning, and to act as antioxidants and reducing agents. Sulphur dioxide appears to date back to the end of the 18th century in winemaking. It is used for its properties as antiseptic, antioxidant, antioxidasic, and for ethanal binding [1, 41].

Sorbates are used exclusively in wines with residual sugar, only in the presence of sulphur dioxide. Winemakers use sorbates to avoid a second fermentation in sweet wines. The maximum legally accepted concentration, in sorbic acid used in winemaking is 200 mg/l. The necessary dosage can be lower in wines with high alcohol concentration and low pH. Generally, instead of sorbic acid, potassium sorbate is used for its high solubility in water. Potassium sorbate solution, must be introduced slowly into wine, and mixed properly to avoid the insolubilization of the acid. Is used only before filtration and after that wine underwent tartaric stabilization [41].

Ascorbic acid (vitamin C), is an antioxidant used in winemaking for its effectiveness in reactions with oxygen. It can protect the sensitive oxidisable wine components such as phenolic and flavour compounds and has the capacity to reduce the oxidised phenolic compounds (Fig. 4.) [6, 15, 33, 46].

However, ascorbic acid could not be used as a complete replacement for sulphur dioxide, because it does not have antimicrobial properties, will not bind to residual aldehydes in wine, has no impact on oxidative enzymes and the reaction of ascorbic acid with oxygen

produces oxidative radicals and molecules, such as hydrogen peroxide. However, in the presence of sulphur dioxide, hydrogen peroxide is scavenged with the formation of sulphuric acid [31, 41].

MATERIALS AND METHODS

Sulphur dioxide (SO_2) behaves like an antioxidant and inhibit the microorganisms as shown in figure 1. In grape juices and wines it is present in molecular form, inorganic and organic combinations.

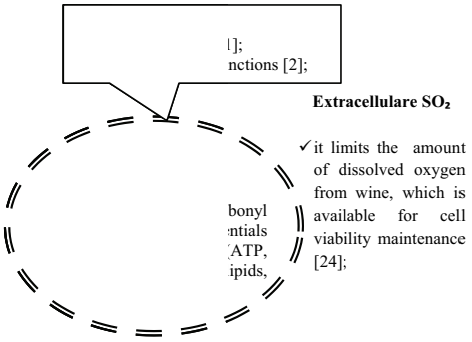


Fig 1. Different modes of action of SO_2 on microorganisms (adapted [8, 42])

Total sulphur dioxide represent an assemble of different forms of sulphur dioxide (mineral and organics) present in grape juices and wine in free state and bound. It results by adding up of free and bound sulphur dioxide [3, 41].

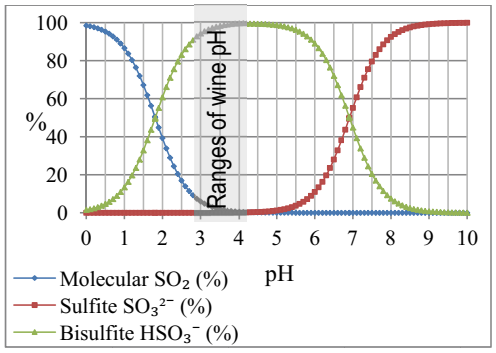


Fig 2. Ionisation forms of sulphur dioxide depending on pH value (adapted to pKa_1=1.81 and pKa_2=6.91) [3, 41]

Free sulphur dioxide consists of ionisation forms of sulphite and bisulphite which have a proportion of 90-98% and dissolved sulphur dioxide (SO2•H2O), which represent a proportion of 0.5 to 9.5% as shown in figure 2. Dissolved sulphur dioxide is the only part that shows antiseptic and antioxidant proprieties and is also called **molecular sulphur dioxide**. Free sulphur dioxide represent 15-30% of the total sulphur dioxide [3, 14, 41].

Combined sulphur dioxide results from reactions of SO_2 with many organic forms from grape juice and wine. Bounding reactions that occur in wines involve aldehydes, cetonic acids, sugars, uronic acids, oxidation sugar products, phenolic compounds and so on. It can be defined as the difference between total sulphur dioxide and free sulphur dioxide. In grape juice and wine, combined sulphur dioxide represent about 70 to 80% from total sulphur dioxide. This form of sulphur dioxide does not have antiseptic and reducing properties [3, 41]. Binding ratio with acetaldehyde is 1 : 1.46 which means for instance that 30 mg of acetaldehyde binds with 44 mg of sulphur dioxide [41].

The fraction of ionic forms of free sulphur dioxide as shown in the figure 2., can be determined as percentage with the following equations 1-3 derived from Smith C. in 1982 [46]:

$$Molecular\ SO_2(\%) = \frac{100}{[10^{(pH-pKa1)} + 1]}$$

(Eq 1)

$$Sulphite\ SO_3^{2-}(\%) = \frac{100}{[10^{(pKa2-pH)} + 1]}$$

(Eq 2)

$$Bisulphite\ HSO_3^-(\%) = \frac{100}{[10^{(pH-pKa2)} + 1]} - SO_3^{2-}$$

(Eq 3)

where:

pH - wine pH value;

pK_{a1} - natural logarithm of the opposite sign of the first acid dissociation constant of sulfur dioxide in wine, K_{a1};

pK_{a2} - natural logarithm of the opposite sign of the second acid dissociation constant of sulfur dioxide in wine, K_{a2};

1 - water value;

100 - value which report the result in percentages.

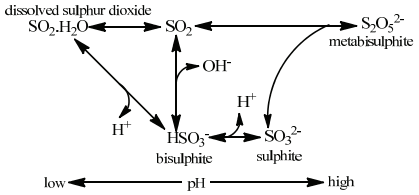


Fig 3. Structural relationships of the sulphur dioxide-generating compounds (adapted form) [14]

To calculate the molecular SO_2 in solutions the following formula [32, 44] can be used:

$$Molecular\ SO_2(mg/l) = \frac{Free\ SO_2(mg/l)}{[10^{(pH-pKa1)} + 1]}$$

(Eq 4)

where:
pH – wine pH value;
pKa_1- natural logarithm of the opposite sign of the first acid dissociation constant of sulfur dioxide in wine, K_{a1};
1 – water value;

Often, in practice a pKa1 value of 1.81, seems to be a good compromise, since it appears to have good results for most alcoholic concentrations close to 14% vol./vol. alcohol, at storage temperatures between 13-15°C. In order to obtain more accurate results of molecular SO_2, pKa1 can be calculated with the equation 5.

$$pK_{a1} = 1.9499 + a \times 0.0322 + b \times 0.01971$$

(Eq 5)

where:
a - difference between wine temperature (°C) and 20 value (T°C $- 20$);
b – difference between alcoholic concentration of wine in volume percentage (% vol./vol.) and 10 value ($c\% - 10$);

The recommended levels of sulphur dioxide cited from many authors are shown in the Table 1.

Oxidation of sulphur dioxide. In order to choose the optimal required dosage of molecular SO_2, the winemaker must take into account the amount of oxygen from wine.

$$SO_2 + \frac{1}{2}O_2 \xrightarrow{slow} SO_3$$

Table 1. Optimal molecular SO_2 levels (mg/l) for different situations

Situation	Molecular SO_2 (mg/l)
Storage[20, 26]	0.50-0.80
Market[20]	0.40-0.60
Fungicide & bactericide[20, 26]	0.60-0.82
Bacteriostatic[11]	0.40
Inhibition of Brettanomyces[1]	0.30
Biocidal effect on *Brettanomyces*[1, 11]	0.50-0.8
Biocidal effect on acetic bacteria[41]	0.90
Biocidal effect on lactic bacteria[41]	0.60
Mutage[41]	1.2
Bottling dry white wines[22]	0.4-0.8
Bottling dry red wines[22]	0.3-0.6
Bottling sweet wines[22]	0.8-1.2
Olfactory perception[22]	2.0

Experimentally, it was demonstrated that one molecule of oxygen consumes two molecules of sulphur dioxide, which means for instance that 1 mg/l of dissolved oxygen, consumes 4 mg/l of free sulphur dioxide [15, 16].

Ascorbic acid (AA) does not have antimicrobial properties, but is used for its contributing to the antioxidant properties of sulphur dioxide. In most countries it is used up to a concentration of 150 mg/l, always in combination with sulphur dioxide [41].

Ascorbic acid is a more rapid and effective oxygen scavenger than sulphur dioxide and reacting preferentially with oxygen [4].

Ascorbic acid has the ability to react with oxygen more rapidly than wine phenolic compounds and hence increases the rate of hydrogen peroxide production, which in turn should be scavenged by sulfur dioxide [4].

Consequently it protects from oxidation the sensitive oxidisable wine components, including phenolic and flavour compounds [4, 15, 28].

Ascorbic acid has the role of an antioxidant and behaves as an weak acid due to its enediol functional group of C3 and C4 as shown in figure 4 [4].

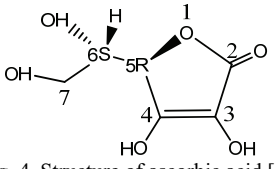
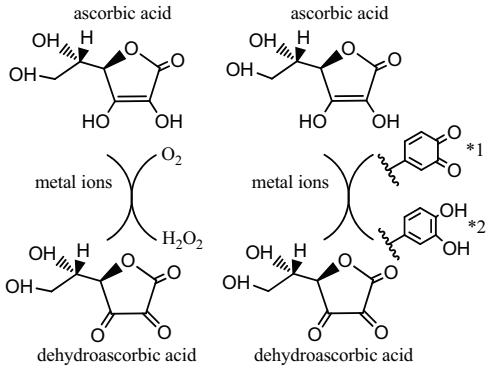


Fig. 4. Structure of ascorbic acid [4]



*1 - ortho-quinone; 2-ortho-dihydroxybenzene;
Fig. 5. The antioxidant action of ascorbic acid [4]
a. overall reaction of ascorbic acid with molecular oxygen; b. reduction of *ortho*-quinone compounds by ascorbic acid.

In acidic medium (like wine), an ionisation of ascorbic acid occurs, primarily via the C4 hydroxyl group, due to a pKa value of 4.25, while the C3 hydroxyl group is only weakly acidic (pKa = 11.8) [9].
In wine, ascorbic acid exists mostly in the non-ionised form. In fact, at pH 3.2, only 5% of ascorbic acid is in the mono-anionic form, and even if the pH is raised to pH 3.5, which is relatively high for white wine conditions, the mono-anionic form will only accounts 15% of the total ascorbic acid [4].
Ascorbic acid has been claimed to have the capacity to reduce the oxidised phenolic compounds and brings them back to their original state as shown in figure 5 [6, 15, 33].

Oxidation of ascorbic acid. Assuming a 1 : 1 ratio in the reaction between oxygen and ascorbic acid, in a sulphur dioxide – ascorbic acid – dissolved oxygen system, the consumption mole ratio would be theoretically 1.7 : 1 : 1. Theese ratios are not confirmed due to the absence of oxygen mesurements [7].
Barril Célia demonstrated in his PhD thesis in 2011 that the combination of sulphur dioxide and ascorbic acid significantly inhibited the production of pigmented phenolic compounds by a ratio of 2 : 1 [4].
Moreover, a synergic relationship between sulphur dioxide and ascorbic acid has been confirmed [4].
To minimise pigmentation development in white wine, the ratio of sulphur dioxide: ascorbic acid should be at least 2 : 1 [4].
In brief, we can say that ascorbic acid is used in wines due to its capacity to react faster with dissolved oxygen than other substances.
Experimentally, one molecule of oxygen consumes one molecule of ascorbic acid and two molecules of sulphur dioxide, in other words 1 mg/l of dissolved oxygen consumes 5,5 mg/l ascorbic acid and 4 mg/l of free sulphur dioxide [4, 15, 16].

Sorbates are used under the form of sorbic acid and potassium sorbate to prevent a second fermentation of sweet wines. Sorbic acid is authorized in many countries at maximum concentration of 200 mg/l. Concentration of sorbic acid from potassium sorbate is given by the following formula [20, 41]:

$$KS = SA \times \frac{150.22}{112.13} \quad \text{(Eq 6)}$$

where:
KS – potassium sorbate (mg/l);
SA – sorbic acid (mg/l);
150.22 – molar mass of potassium sorbate (g/mol);
112.13 - molar mass of sorbic acid (g/mol);

Sorbic acid is relatively insoluble in water (1.5 g/l at room temperature), due to this inconvenient, in winemaking is usually used as a potassium salt, which is readily soluble (58.2 g/l) [20].
The required amount of potassium sorbate should be first hydrated in cold water prior to addition to wine [20]. The solution should be prepared prior wine administration to prevent its oxidation. The adition should be done slowly in wine to prevent the insolubilisation of sorbic acid due to wine acidic pH. If its concentration at a given moment is too high, it will precipitate. Due to its concentration in potassium ions, it is recommended to be used only prior to tartrate stabilisation treatment of wine. Also, the dosage is lower in wines with good limpidity or filtered and a number of yeast cells under 5000 cells/ml, preferably under 1000 cells/ml [41].

It is known that the antiseptic proprieties are conferred by the non-dissociated free acid molecule. Due to its pK of 4.76 it is known that in the pH range of wines, the non-dissociated free acid state varies between 90 to 98% [2].
Potassium sorbate dosages are mainly influenced by alcoholic concentrations and pH. At high levels of pH, the lower the alcohol concentration, the more potassium sorbate is used.
According to Henderson - Hasselbalch equation [10, 18], effective and non-effective forms of sorbic acid can be calculated as follows:

$$E\% = \frac{100}{10^{(pH-pKa)} + 1}$$
(Eq 7)

where:
E% - effectiveness, expressed as percentage of non-dissociated from of sorbic acid;
pH – wine pH value;
pKa – acid dissociation constant of sorbic acid which is 4.76 at 20°C;
1 – value of water;

Non-effective form of sorbic acid can be calculated as follows:

$$N\% = \frac{100}{10^{(pKa-pH)} + 1}$$
(Eq 8)

where:
N% - non-effectiveness, expressed as percentage of dissociated from of sorbic acid;
pH - wine pH value;
pKa - acid dissociation constant of sorbic acid which is 4.76 at 20°C;
1 – value of water;

In 1984 Emile Peynaud has tested in laboratory the various dosages of sorbic acid against *Saccharomyces bayanus*, in order to prevent a second fermentation of sweet wines. Laboratory tests consisted of inoculation of *Saccharomyces bayanus* to a 5 x 10^{-3} cells/ml. According to Henderson - Hasselbalch equation and the results of Peynaud (1984), it was developed the following equation given by statistical software Statistica 10.0, using repeated polynomial regressions [41, 10, 18, 38, 40]:

$$SA = (k1) \times c\%\ vol./vol.alc + (k2)$$
(Eq 9)

where:
SA – sorbic acid dosage in mg/l;
$k1 = -73.254 \times pH^2 + 148.09 \times pH - 137.44$
$k2 = 21.972 \times pH^4 - 259.72 \times pH^3 + 1170.2 \times pH^2 - 2365.5 \times pH + 2196$
$c\%\ vol./vol.alc$ – alcohol concentration from wine in volume percentages;

Interactions between preservatives. In wines that have minimum two types of preservatives interactions occur between them.

SO_2 with AA. Sulphur dioxide inhibits ascorbic acid oxidation and is therefore frequently used in white and rose wines, in order to preserve their aromas. They can react
under anaerobic or aerobic conditions [1, 41].
Hydrolysis of the ascorbic acid lactone ring, under anaerobic condition, could be catalysed by the highly nucleophilic sulphite ion [1, 17].
Decarboxylation and dehydration reactions can slowly form 3,4-Dideoxypentosulos-3-ene [1, 17].
Dominant form of SO_2 under wine pH is bisulfite ion (HSO_3^-), readily adds across the double bond to yield 3,4-dideoxy-4-sulphopentosulose as shown in the figure 6. [1, 4, 17].
Under aerobic conditions, dehydroascorbic acid, oxydised form of ascorbic acid, can form with bisulphite ion (HSO_3^-), monohydroxysulphonate as shown in the figure 6. [1, 4]

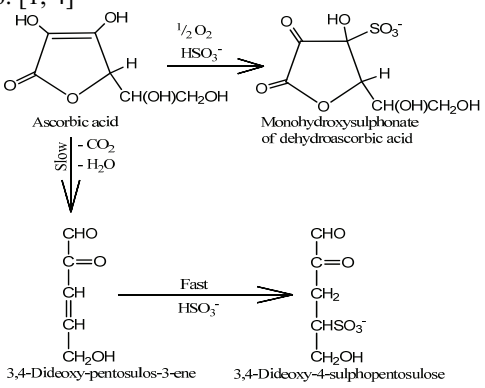


Fig. 6. The reaction of sulphur dioxide with ascorbic acid degradation products [1, 4]

SO_2 with sorbic acid. Sorbic acid is used in combination with sulphur dioxide in sweet wines in order to prevent fermentations. Under neutral conditions, bisulphite reacts with sorbic acid, apparently by 1,2-addition across the diene bound as shown in Fig. 7 [29]. Oxygen interferes with the reaction, hypothetically through sulphite-mediated oxidation in which free radicals such as -OH and -O oxidise sorbic acid. [23]

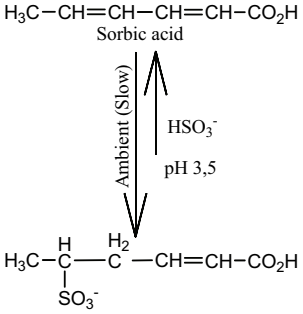


Fig. 7. The reaction of sulphur dioxide with sorbic acid [29]

Oxygen management. Solubility of O_2 in wines is highly dependent on its partial pressure and the temperature. For instance, at atmospheric pressure and room temperature, oxygen saturation with air is reached at approximately 8.5 mg/l. This solubility increases by 10% if the temperature is lowered to 5°C [30].

Literature shows indicative amounts of dissolved oxygen during the entire process of winemaking as shown in the following tables 2, 3 and 4.

In practice is required to calculate the total life cycle package oxygen from wines (TLCPO) using the following equations [45]:

$I_{DO} + P_{DO} = F_{DO}$ (Eq 10)

where:

I_{DO} - initial dissolved oxygen from wine before filling (mg/l);

P_{DO} - dissolved oxygen pickup during filling (mg/l);

F_{DO} - final dissolved oxygen after filling; (mg/l);

$HO = \frac{(V_1 \times \%O_2 \times 1.429)}{V_2}$ (Eq 11)

where:

HO – headspace oxygen right after filling (mg/l);

V_1 - headspace volume in ml;

$\%O_2$ – the percentage of oxygen from headspace (varies from 0 to 21%);

1.429 – density of oxygen to convert from ml to mg;

V_2 - volume of packaged wine in liters;

Table 2. Estimated quantities of oxygen absorbed during vatting (values expressed in mg/l O_2) [39]

Operation	Maximum	Minimum
Prefermentation skin contact	8	5
Alcoholic fermentation (pumping over)	60	30
Post-fermentation vatting	4	1
Running-off	6	4
Total during vinification	78	40

Table 3. Oxygen dissolved during various operations involved in the aging of red wines [39, 48, 49]

Process	Dissolved oxygen (mg/l)
Operation[48]:	
✓ pumping	2
✓ transfer	4-6
✓ racking without aeration	3
✓ racking with aeration	5
✓ topping up barrels	0.25
✓ earth filtration	7
✓ plate filtration	4
✓ centrifugation	8
✓ bottling	3
Storage[49]:	
✓ age 1 year (Bordeaux 2.25 hl barrel)	0.4
✓ age 2 year (Bordeaux 2.25 hl barrel)	0.2
✓ age 3 year (Bordeaux 2.25 hl barrel)	0.2
✓ stainless steel vat (70 hl)	< 0.1

Table 4. Oxygen exposure of wine during storage and operations

Process/Receptacle	Rate (mg/l/year)	Amount (mg/l)
Bottle closures (white wine)		
Natural cork, inverted[27]	0.85	-
Screw cap (Stelvin), inverted[27]	0.61	-
Natural cork, horizontal[12]	1.18	-
Microoxygenation		
1 month at 10 ml/l/m. then 4 months at 5 ml/l/m.[34]	-	42
0-5 ml/l/m., 3-6 months	-	≤42
30-40 ml/l/m. up to 4 weeks prior to completion MLF[37]	-	42-56
Full saturation		
20°C[36]	-	8.4

*ml/l/m. – ml/l/month

%O2 from headspace, can also be expressed using the following equation [45]:

$$\%O_2 = \frac{P_{kPaO_2}}{T_{kPaO_2}} \quad \text{(Eq 12)}$$

P_{kPaO_2} - partial pressure (kPa)

T_{kPaO_2} - total pressure, determined with an aphrometer in the case of sparkling wines (kPa);

$\%O_2$ - volume fraction of oxygen component.

Partial pressure of oxygen (kPa). Each gas has a partial pressure which is the pressure which the gas would have if it alone occupied the entire volume. Partial pressure of oxygen can be calculated with the following equation [45]:

$$P_{kPaO_2} = T_{kPaO_2} \times \%O_2 \quad \text{(Eq 13)}$$

where:

P_{kPaO_2} - partial pressure (kPa)

T_{kPaO_2} - total pressure, determined with aphrometer in the case of sparkling wines (kPa);

$\%O_2$ - volume fraction of oxygen component.

For example at T_{kPaO_2}= 101.325 kPa, and 21% O_2, P_{kPaO_2}= 21.28 kPa. A T_{kPaO_2}= 101.325 kPa, would work for still wines. In a sparkling wine bottle with a total pressure of 500 kPa, 15% O_2, the partial pressure would be 75 kPa.

Total pressure (kPa): The total pressure of a gas mixture is the sum of the partial pressures of each individual gas in the mixture. Average sea-level pressure is 101.325 kPa, value that work for still wines [45].

$$F_{DO} + HO = TPO \quad \text{(Eq 14)}$$

where:

F_{DO} - final dissolved oxygen after filling; (mg/l);

HO – headspace oxygen right after filling (mg/l);

TPO – total package oxygen right after filling (mg/l);

$$TPO + I_{O_2} = TLCPO \quad \text{(Eq 15)}$$

where:

TPO – total package oxygen right after filling (mg/l);

I_{O_2} - ingress of O_2 in filled package during several months of storage (mg/l);

$TLCPO$- total life cycle package oxygen during several months (mg/l);

$$TLCPO - I_{DO} = TOP \quad \text{(Eq 16)}$$

where:

$TLCPO$- total life cycle package oxygen during several months (mg/l);

I_{DO} - initial dissolved oxygen from wine before filling (mg/l);

TOP – total oxygen pickup during several months (mg/l);

RESULTS AND DISCUSSIONS

Usage of SO_2 in wines. The sulphur dioxide alone is used only for dry wines in order to prevent oxidation and microbial wine spoilage.

A model dry white wine may have the following parameters:

- ✓ Alcohol concentration % vol./vol.: 12.5;
- ✓ Temperature of wine: 18°C;
- ✓ pH: 3.4;
- ✓ Free sulphur dioxide: 18 mg/l;
- ✓ Initial dissolved oxygen from wine before filling: 0.5 mg/l;
- ✓ Dissolved oxygen pickup during filling: 3 mg/l;
- ✓ Percentage of oxygen from headspace (%O2): 9.2%;
- ✓ Headspace volume: 8.7 ml;
- ✓ Bottle volume: 0.75 l;
- ✓ Rate of oxygen through cork: 0.85 mg/l/year O2;
- ✓ Expected time of delivery: 6 months;

In order to give an accurate dosage of sulphur dioxide in wine, the winemaker should calculate the total life cycle package oxygen during several months (*TLCPO*). In the case of the above mentioned model wine, the *TLCPO* should be calculated for 6 months.

According to Equation 10, the final dissolved oxygen after filling (F_{DO}) is 3.5 mg/l. Then, in accordance to Equation 11, the headspace oxygen immediately after filling (*HO*) is about 1.53 mg/l. By applying equation 14, the resulted total package oxygen immediately after filling (*TPO*) is 3.5 + 1.53 = 5.03 mg/l.

In accordance with equation 15, the total life cycle package oxygen during 6 months (*TLCPO*) is 5.03 + (0.85/2) = 5.455 mg/l O_2

Then, based on Equation 5, pK_{a1} of sulphur dioxide, for given values is: 1,9348. Using the Equation 4, the molecular SO_2 for given values is: 0,60 mg/l.

In compliance with a consumption ratio of oxygen : sulphur dioxide of 1 : 2, knowing that

1 mg/l of *TLCPO* consumes 4 mg/l of sulphur dioxide. Following this, admit that 5.455 mg/l O_2 of *TLCPO* consumes 21.82 mg/l of sulphur dioxide in 6 months.
Therefore, the free SO_2 needs to be increased with 21.82 mg/l in order to achieve the level of 18 + 21.82 = 39.82 mg/l SO_2.
The molecular sulphur dioxide level will be 1,32 mg/l SO_2 at 18°C. After storage, sulphur dioxide will react with *TLCPO* leading to a molecular sulphur dioxide value about 0.6 mg/l at 18°C.

Usage of SO_2-AA in wines. Is used only for dry, semi-dry white and rose wines in order to preserve the aroma. It should be used judiciously, because it may cause oxidation during wine aging.
Using the same parameters from previous studied wine and knowing that 1 mg/l of dissolved oxygen, consume 5.5 mg/l ascorbic acid and 4 mg/l of free sulphur dioxide we can calculate the precise dosage of ascorbic acid and sulphur dioxide.
To reduce 5.455 mg/l O_2 of *TLCPO,* we need 30 mg/l of ascorbic acid and 21.82 mg/l of sulphur dioxide to be consumed in 6 months.
Free SO_2 need to be increased with 21.82 mg/l in order to achive the level of 18 + 21.82 = 39.82 mg/l SO_2.
The molecular sulphur dioxide level will be 1.32 mg/l SO2 at 18°C. After storage, ascorbic acid will react with *TLCPO*, then will release oxidative compounds, which react with free sulphur dioxide.
After 6 months, molecular sulphur dioxide should have a value about 0.6 mg/l. at 18°C.

Usage of SO_2-Sorbate in wines. Is used only for sweet wines in order to prevent a second fermentation in bottles due to the capacity of sorbates to inhibith the metabolism of yeasts.
We can assume that a sweet white wine has the following parameters:
✓ Alcohol concentration % vol./vol.: 11.2;
✓ Temperature of wine: 18°C;
✓ pH: 3.54;
✓ Free sulphur dioxide: 28 mg/l;
✓ Initial dissolved oxygen from wine before filling: 0.5 mg/l;
✓ Dissolved oxygen pickup during filling: 3 mg/l;
✓ Percentage of oxygen from headspace (%O2): 9.2%;
✓ Headspace volume: 8.7 ml;
✓ Bottle volume: 0.75 l;
✓ Rate of oxygen through cork: 0.85 mg/l/year O2;
✓ Expected time of delivery: 1 year;
First of all, for a wine with the parameters given above, we need to calculate the dosage of potassium sorbate needed to prevent a second fermentation in the bottle.
According to Equation 9, the winemaker can calculate the precise dose of sorbic acid that is necessary to prevent a second fermentation. The calculation shows that a concentration of 124.6 mg/l of sorbic acid will prevent a second fermentation. The amount of potassium sorbate, as results from Equation 6, is 167 mg/l. Potassium sorbate additions require clear wines, with yeasts population of no more than 5000 cells/ml. After potassium sorbate treatments, wines should be stabilized by cold or other treatment for tartaric acid stabilization.
According to Equation 10 and 11, the final dissolved oxygen after filling (F_{DO}) is 3.5 mg/l and the headspace oxygen immediately after bottle filling (*HO*) is aprox. 1.53 mg/l, respectively.
According to Equation 14 and 15, total package oxygen immediately after filling (*TPO*) is 3.5 + 1.53 = 5.03 mg/l and total life cycle package oxygen during 6 months (*TLCPO*) is 5.03 + 0.85 = 5.88 mg/l O_2, respectively.
From Equation 5, pK_{a1} of sulphur dioxide, for given values is calculated as 1.9092. Using the Equation 4, molecular SO_2 for given values is: 0.64 mg/l. Therefore, in order to give a good stability of wine, molecular sulphur dioxide should be at least 0.8 mg/l.
In compliance with a consumption ratio of oxygen : sulphur dioxide of 1 : 2, we know that 1 mg/l of *TLCPO* consumes 4 mg/l of sulphur dioxide. Following this, we find that 5.88 mg/l O_2 of *TLCPO* consumes 23.52 mg/l of sulphur dioxide in 1 year.
To ensure a level of 1 mg/l of molecular sulphur dioxide, after the reduction of *TLCPO* which occurs for 1 year, free sulphur dioxide needs to be increased with 15,7 mg/l + 23.52

mg/l = 39.22 mg/l SO_2, in order to achieve the level of 28 + 39.22 = 67.22 mg/l free SO_2.
The actual level of molecular sulphur dioxide will be 1.54 mg/l SO_2 at 18°C. After one year storage, sulphur dioxide will react with *TLCPO* leading to a molecular sulphur dioxide value of about 1 mg/l at 18°C.

CONCLUSIONS

The proper usage of preservatives according *TLCPO*, wines retain their qualities for a longer time and will be microbiologically stable. Also, in this way the levels of sulphur dioxide will be in the moment of the consumption at the recommended levels presented in Table 1. Management of oxygen is decisive for the wine quality and should be constantly monitored.
By finding an equation for potassium sorbate additions, which depends on wine pH and alcohol concentration, the precise dosage required for wine stabilization was achieved.
Also, a solution was found for the establishment of the optimal ratio of ascorbic acid and sulphur dioxide needed to prevent the pigmentation development as a result of incorrect ascorbic acid additions.
Therefore, the determined optimal ratio of ascorbic acid and sulphur dioxide of 1 : 2 (or higher) also confirmed that sulphur dioxide and ascorbic acid act synergistically.
Also, a proper management of sulphur dioxide in the presence of dissolved oxygen is required in order to preserve the quality in wines. With the equations derived by researchers the calculation of molecular sulphur dioxide is easily performed by any winemaker.

REFERENCES

[1] Adams J. B., 1996. *Food additive-additive interactions involving sulphur dioxide and ascorbic and nitrous acids: a review. Campden & Chorleywood Food Research Association, Chipping Campden, Gloucestershire GL55 6LD, UK*. Food Chemistry, Vol. 59, No. 3, pp. 401409, 1997, Published by Elsevier Science Ltd;
[2] Anacleto J, van Uden N., 1982. *Kinetics and activation energetics of death in Saccharomyces cerevisiae induced by sulfur dioxide.* Biotechnology and Bioengineering 24(11):2477-2486. Laboratory of Microbiology, Gulbenkian Institute of Science, 2781 Oeiras codex, Portugal.
[3] Antoce Oana Arina, 2007. *Oenologie - Chimie şi analiză senzorială*, Editura Universitaria, Craiova.
[4] Barril Célia, 2011. *The chemistry of ascorbic acid and sulfur dioxide as an antioxidant system relevant to white wine (phd thesis)*. National Wine and Grape Industry Centre, School of Agricultural and Wine Sciences - Charles Sturt University, Wagga Wagga, Australia.
[5] Beech F. W., Thomas S., 1985. *Action antimicrobienne de l'anhydride sulfureux*. Bulletin de l'O.I.V. 58:564-81;
[6] Boulton R. B., Singleton V. L., Bisson L. F., Kunkee R. E., 1996. *Principles and practices of winemaking*. New Dehli: CBS Publishers and Distributors.
[7] Bradshaw M. P., Scollary G. R., Prenzler P. D., 2004. *Examination of the sulfur dioxide-ascorbic acid anti-oxidant system in a model white wine matrix*. J. Sci. Food Agr., 84 (4), 318-324.
[8] Branen A. Larry, Davidson P. Michael, Salminen Seppo, Thorngate John H. (editors), 2001. *Food Additives*. 2nd edition, Revised and Expanded, Marcel Dekker, New York;
[9] Buettner G. R., Jurkiewicz B. A., 1996. *Chemistry and biochemistry of ascorbic acid.* In E. Cadenas & L. Packer (Eds.), Handbook of antioxidants (pp. 91-115). New York: Marcel Dekker.
[10] Cairns Donald, 2003. *Essentials of Pharmaceutical Chemistry*. 2nd edition, Pharmaceutical Press, Publication Division of the Royal Society of Great Britain;
[11] Carrascosa Alfonso V., Muñoz Rosario, González Ramón, 2011. *Molecular Wine Microbiology*. 1st edition, Elsevier Inc.
[12] Casey J., 1994. Is *cork a good seal for wine?* Aust. Grapegrower Winemaker No. 372, 39-41.
[13] Chatonnet P., 2000. *La contamination des vins par Brettanomyces au cours de la vinification et de l'élevage : incidence, détection et moyens de lutte*. Revue des Oenologues. 96, 23-26.
[14] Coultate Tom, 2009. *Food: the chemistry of its components.* 5th edition, RSC Publishing, Cambridge, UK, 500 pp;
[15] Danilewicz, J. C., 2003. *Review of reaction mechanisms of oxygen and proposed intermediate reduction products in wine: Central role of iron and copper*. American Journal of Enology and Viticulture, 54 (2), 73-85.
[16] Danilewicz John C., Seccombe John T., Whelan Jonathan, 2008. *Mechanism of Interaction of Polyphenols, Oxygen,and Sulfur Dioxide in Model Wine and Wine*. American Journal of Enology and Viticulture 59:2;
[17] Davies C. G. A., Wedzicha B. L., 1992. *Kinetics of the inhibition of ascorbic acid browning by sulphite*. Food Additives and Contaminants Journal, 9, 471-477.
[18] Davis Whitten, Stanley Peck, 2003. General Chemistry, 7th edition, Brooks Cole, California, United States
[19] De Erich Lück, Martin Jager, S. F. Laichena. *Principles of food chemistry Antimicrobial food additives: characteristics, uses, effects*. Volumul 2
[20] Fugelsang Kenneth C., Edwards Charles G., 2007. *Wine microbiology. Practical Applications and*

Procedures. Second edition, Springer Science+Business Media, LLC;
[21] Garbay, S., Lonvaud-Funel, A., 1994. *Characterization of membrane-bound ATPase activity of Leuconostoc oenos: growth conditions*. Appl. Microbiol. Biotechnol. 41, 597 – 602.
[22] Gibson Richard, 7 April 2006. *Director, Scorpex Wine Services*. Australia. 35th Annual New York Wine Industry Workshop. Ascorbic Acid – Friend or Foe?
[23] Goddard S. J., Wedzicha B. L., 1992. *Kinetics of the reaction of sorbic acid with sulphite species*. Food Additives and Contaminants Journal, 9, 485-492.
[24] Heard G. M., Fleet G. H., 1988. *The effect of sulfur dioxide on yeast growth during natural and inoculated wine fermentation*. Australian and New Zealand Wine Industry Journal, 3, 57-60.
[25] Hornsey Ian, 2007. *The Chemistry and Biology of Winemaking.* Published by The Royal Society of Chemistry, Thomas Graham House, Science Park, Milton Road, Cambridge CB4 0WF, UK iness Media, Inc.
[26] Jacobson Jean L. 2006. *Introduction to Wine Laboratory Practices and Procedures*. Springer Science+Bus;
[27] Keenan, C.P., Gozukara, M.Y., Christie, G.B.Y. and Heyes, D.N., 1999. *Oxygen permeability of macrocrystalline paraffin wax and relevance to wax coatings on natural corks used as wine bottle closures*. Aust. J. Grape Wine Res. 5, 66-70.
[28] Kilmartin, P. A., Zou, H. & Waterhouse, A. L., 2001. *A cyclic voltammetry method suitable for characterizing antioxidant properties of wine and wine phenolics.* Journal of Agricultural and Food Chemistry, 49 (4), 1957-1965.
[29] Khandelwal G. D., Wedzicha B. L., 1990. *Nucleophilic reactions of sorbic acid*. Food Additives and Contaminants Journal, 7, 685-694.
[30] Laurie F., Law R., Joslin W., Waterhouse A., 2008. *In situ Measurements of Dissolved Oxygen during Low-level Oxygenation in Red Wines*. American Journal of Enology and Viticulture, 59 (2) :215-219.
[31] Liu S. Q., Pilone G. J., 2000. *An overview of formation and roles of acetaldehyde in winemaking with emphasis on microbiological implications*. International Journal of Food Science and Technology, 35 (1), 49-61.
[32] Margalit, Y. 1997. *Concepts in Wine Chemistry* (Crum, J., ed.), The Wine Appreciation Guild, San Francisco, CA.
[33] Mathew, A. G., Parpia, H. A. B., 1971. *Food browning as a polyphenol reaction.* In C. O. Chichester, E. M. Mrak & G. F. Stewart (Eds.), Advances in food research (Vol. 19, pp. 75-145). New York & London: Academic Press.
[34] McCord J., 2002. *Application of toasted oak and micro-oxygenation to ageing of Cabernet Sauvignon wines.* Allen, M.; Bell, S.; Rowe, N.; Wall, G., (eds). In: Proceedings of ASVO seminar 'Uses of Gases in Winemaking'; 10 October 2002. Glenside, South Australia. pp 28-33.
[35] Millet Vincent, 2001. *Dynamique et survie des populations bactériennes dans les vins rouges au cours de l'elévage: interactions et équilibres (thèse de doctorat)*. Université Victor Segalen Bordeaux II;
[36] Moutounet, M. and Mazauric, J. P., 2001. *L'oxygene dissous dans les vins*. Revue française d'oenologie. 186, 12-15.
[37] Otto C., 2002. *The Vasse Felix approach to the use of micro-oxygenation*. Allen, M.; Bell, S.; Rowe, N.; Wall, G., (eds). In: Proceedings of ASVO seminar 'Uses of Gases in Winemaking'; 10 October 2002. Glenside, South Australia. pp 39-44.
[38] Peynaud Emile, 1984. *Knowing and Making Wine*. second French edition, trans. by Alan Spenser. John Wiley and Sons.
[39] Ribéreau-Gayon P., Glories Y., Maujean A., Dubourdieu D., 2006. *Handbook of Enology*, Volume 2. The Chemistry of Wine Stabilization and Treatments 2nd Edition. John Wiley & Sons Ltd, The Atrium, Southern Gate, Chichester, West Sussex PO19 8SQ, England;
[40] Ribéreau-Gayon J., Peynaud E., Ribéreau-Gayon P., Sudraud P., 1977. *Sciences et Techniques du Vin. Vol. IV: Clarification et Stabilisation, Matériels* et Installations. Dunod, Paris.
[41] Ribéreau-Gayon P., Dubourdieu D., Donèche B., Lonvaud A., 2006. *Handbook of Enology, Volume 1, The Microbiology of Wine and Vinifications*. 2nd Edition, John Wiley & Sons, Ltd;
[42] Renouf Vincent (PhD thesis), 8 décembre 2006. *Description et caracterisation de la diversite microbienne durant l'elaboration du vin: Interactions et equilibres – Relation avec la qualite du vin.* Institut National Polytechnique de Toulouse.
[43] Romano P., Suzzi G., 1993. *Sulfur dioxide and wine microorganisms. In: Wine microbiology and biotechnology*. G. H. Fleet Ed., Harwood Academic Publishers GmbH, Chur Switzerland, 373-393;
[44] Sadraud P., Chauvet S., 1985. *Activite antilevure de l'anhydride sulfureux moleculaire.* Connais. Vigne Vin, 19 (1), p 31-40.
[45] Shea Patrick, Vidal Jean-Claude, Vialis Sophie, 2010. *The measurement of Total Oxygen in filled BIB wine.* Wine packing seminars: Environmentals Impacts & O_2 mesurement, Bordeaux, France;
[46] Smith C., 1982. *Review of basics on sulfur dioxide.* Part 1 and 2. Enology briefs Vol. 1, Number 1 and 2, Issue 1, Berkeley, California, Cooperative Extension, University of California;
[47] Usseglio-Tomasset L., 1995. *Chimie oenologique*. Tec and Doc Lavoisier, Paris.
[48] Vivas N., 1997. *Recherches sur la qualité du chêne français de tonnellerie (Q. petraea L., Q. robur L.) et sur les mécanismes d'oxydoréduction des vins rouges au cours de leur élevage en barriques*. Th`ese Doctorat, Université de Bordeaux II.
[49] Vivas N., Glories Y., 1993. *Revue française d'œnologie*. 142, 33.

Scientific Papers, Series B, Horticulture, Vol. LVI, 2012
CD-ROM ISSN 2285-5661, ISSN-L 2285-5653

ENZYMATIC BIOPROCESSING OF VEGETABLE OILS FOR THE PRODUCTION OF BIODIESEL

Alexandra GHIORGHIȚĂ, Gheorghe CÂMPEANU, Mircea POPESCU, Florentina ISRAEL, Gabriela NEAȚĂ

Center for Applied Biochemistry and Biotechnology from Bucharest (BIOTEHNOL), 59 Mărăşti Street, 011464, 1st District, Bucharest, Romania

Corresponding author email: alexandra_ghiorghita@yahoo.com

Abstract

Biodiesel is a renewable, alternative fuel for diesel engines, that has captured the attention of the whole world, as it can be used both alone and mixed with diesel for unmodified diesel engines. It is easily obtained from common raw materials, as well as wastes. Biodiesel obtained through biotechnological procedures (biocatalysis) is of superior quality to chemical synthesis biodiesel. The use of purified lipases, such as pig pancreas lipase, Thermomyces lanuginosus lipase or lipase B from Candida antarctica as a biocatalyst for biodiesel obtainment has shown great results and the optimum control parameters have been studied. The production of biodiesel from vegetable oils using different lipases has been investigated. Results have shown that the type of lipase, reaction media and operational parameters (reaction time, temperature, lipase load, alcohol:oil molar ratio and water concentration) have influenced biodiesel yield. In order to establish the best composition and process conditions, an optimization procedure has been carried out. The enzymatic transesterification was performed in an organic solvent-containing system, in agitated flasks, at various temperatures (40-50ºC) and for different periods of time (10-14 hours). Also, variations of the alcohol:oil molar ratios, enzyme concentrations and added water percent were studied. A statistic evaluation of the results was performed, for the proper optimization of the process parameters in regard to conversion. Under optimal operating conditions, the fatty acid methyl esters (biodiesel) yields were >90%.

Keywords: *biocatalysis, biodiesel, lipase, transesterification*

INTRODUCTION

Fatty acid methyl esters (FAME), commonly known as biodiesel, have received great attention during recent years, due to concerning depletion of fossil fuels, oil price increase and biodiesel benefits towards the environment. Biodiesel can be produced from various animal and plant fats, by transesterification with methanol [4, 10]. Biodiesel obtained through biotechnological procedures (biocatalysis) is of superior quality to chemical synthesis biodiesel [16] and presents many advantages over diesel fuel. The most important are its renewability, biodegradability [18], the emissions of toxic compounds at lower levels [22], and its higher combustion efficiency [5].

Industrial scale production of biodiesel continues to be limited due to undesired by-products obtainment and their hard collection, glycerol recovery, inorganic salts and water, wastewater treatment, and the energy requirement [11]. In order to overcome these impediments, research activities regarding enzymatic catalysis have been carried out [3, 7, 20].

For the production of biofuels, one of the most reported enzyme groups is represented by lipases [12]. The use of purified lipases, such as pig pancreas lipase, Thermomyces lanuginosus lipase or lipase B from Candida antarctica as a biocatalyst for biodiesel obtainment has shown great results and the optimum control parameters have been studied [13, 23, 24]. The process of enzymatic transesterification presents certain advantages over chemical transesterification, along with its environmental benefits [6, 14]. Lipases can catalyze a variety of transesterification and esterification reactions relatively efficiently under mild conditions and in non-aqueous environments [2, 21, 9].

The type of lipase, reaction systems and operational parameters (lipase load, reaction time, temperature and alcohol:oil molar ratio) have a great influence on biodiesel yield [8].

Regarding alcohol to oil molar ratio, the stoichiometric equation requires 3 moles of alcohol and one of triglycerine for the obtainment of 3 fatty acid methyl ester moles and 1 mole of glycerol. Higher molar ratios would lead to higher biodiesel yields. The use of solvents has proven to be necessary to maintain the miscibility between the methanol and triglicerides with the purpose of forming a monophasic system [17]. The water content is also an important parameter [1, 15], and seems to be the subject of dispute. The effect of water in the system depends on the enzyme, immobilization support and the medium (with or without solvent). Probably the main disadvantage in biocatalytic biodiesel obtainment is the cost of the enzyme. Enzymes present different capacities to maintain their activity after recovery and repeated use, probably due to catalyst inactivation in the oil phase, the type of carrier used immobilization or enzyme sensitivity to long-term exposure [17, 19].

The main purpose of this paper was to better understand the relationship between reaction variables (time, temperature, enzyme concentration, substrate molar ratio and added water content) and process response (conversion in mass percentages) in order to optimize biodiesel biosynthesis.

MATERIAL AND METHOD

The substrates used during the enzymatic catalyzed experiments consisted of Olina palm oil, commercially available on the market, and methanol from the National Institute for Chemical-Pharmaceutical Research and Development, Bucharest.

As biocatalyst, pig pancreas lipase (PPL) from Sigma-Aldrich (22,7 U/mg) was employed.

6 mL of n-hexane (Merck Chemical Co. Darmstadt, Germany) were added to the reaction mixture, in order to permit a better solubilization of the mixture and to facilitate enzymatic biosynthesis.

For the optimization of the biodiesel obtainment process, an optimization methodology was employed to determine the interaction of different factors, optimizing one or more experimental responses. To this purpose, a Hadamard experimental matrix has been developed, with elements corresponding to 2 levels of the key factors, -1 and +1. The matrix was built by circular permutation starting from a basic generator, the factors of last experiences being always taken as level -1.

We therefore developed a matrix with 22 experiments and 5 key process parameters at 2 variation levels (chosen as minimum and maximum). Oil to biodiesel conversion was considered as response factor (Table 1).

The matrix was build based on the variation of the 5 essential parameters, for which maximum and minimum levels were chosen. The 5 parameters were: time (x_1), temperature (x_2), enzyme (x_3) (% from weight of oil), alcohol to oil molar ratio (x_4) and water (x_5) (% of oil weight) (Table no 1).

Table 1 – Experimental matrix for the optimization of biodiesel obtainment technology at laboratory level

Experiment no.	Factors					Response: (Y_i)
	X_1	X_2	X_3	X_4	X_5	
1	-	-	-	-	-	Y_1
2	-	-	-	-	+	Y_2
3	+	-	-	-	-	Y_3
4	-	+	-	-	-	Y_4
5	-	-	+	-	-	Y_5
6	-	-	-	+	-	Y_6
7	-	-	-	+	+	Y_7
8	+	-	-	-	+	Y_8

9	+	+	-	-	-	Y_9
10	-	+	+	-	-	Y_{10}
11	-	-	+	+	-	Y_{11}
12	-	-	+	+	+	Y_{12}
13	+	-	-	+	+	Y_{13}
14	+	+	-	-	+	Y_{14}
15	+	+	+	-	-	Y_{15}
16	-	+	+	+	-	Y_{16}
17	-	+	+	+	+	Y_{17}
18	+	-	+	+	+	Y_{18}
19	+	+	-	+	+	Y_{19}
20	+	+	+	-	+	Y_{20}
21	+	+	+	+	-	Y_{21}
22	+	+	+	+	+	Y_{22}

The reaction mixture contained palm oil (2 g) to which 4 portions of methanol were added throughout the process at specific time intervals in order to avoid enzyme inactivation, 6mL *n*-hexane (Merck Chemical Co. Darmstadt, Germany), water (5% and 15% weight of oil) and enzyme, PPL – 45% and 55% weight of oil. The system was stirred (250 rpm) at 40 and 50^{o}C and for 10 and 14 hours. The molar ratios used were 3:1 and 5:1 methanol to oil.

For the obtainment of biodiesel at laboratory level, a Heidolph Unimax 1010 reactor with a stirring unit and Heidolph Inkubator 1000 was used. The samples were vortexed with a Vortex Heidolph Reax Top, for 10 seconds, at the beginning of the experiment and after each methanol aliquot was added.

The sample analysis was performed by injecting a 1mm^3 aliquot in split less mode into a Hewlett Packard 6890 gas chromatograph (Avondale, PA, USA) equipped with a flame-ionization detector (FID), and a CP-Select CB for FAME 50m x 0.25mm x 0.25µm Varian capillary column.

RESULTS AND DISSCUSSIONS

The purpose of the experiments was the study of biodiesel obtainment and the optimization of the process.

The process has been designed using a matrix with 22 experiments to evaluate the effects of five key factors: temperature, time, enzyme concentration, alcohol:oil molar ratio and water concentration. These factors showed a significant influence on biodiesel production, each of them evaluated at two variation levels (Table 2).

Table 2. Biodiesel conversion according to the Hadamard experimental matrix

Experiment no.	Factors					Conversion (%)
	Time (hours) X_1	Temperature (^{o}C) X_2	Enzyme (%) X_3	Alcohol:oil molar ratio X_4	Water (%) X_5	
1	10	40	45	3:1	5	39.8601
2	10	40	45	3:1	15	67.4214
3	14	40	45	3:1	5	41.2884
4	10	50	45	3:1	5	13.7727
5	10	40	55	3:1	5	98.5646

6	10	40	45	5:1	5	12.18309
7	10	40	45	5:1	15	41.475
8	14	40	45	3:1	15	31.6088
9	14	50	45	3:1	5	14.9689
10	10	50	55	3:1	5	19.0209
11	10	40	55	5:1	5	87.8042
12	10	40	55	5:1	15	32.7987
13	14	40	45	5:1	15	18.7578
14	14	50	45	3:1	15	14.9156
15	14	50	55	3:1	5	19.768
16	10	50	55	5:1	5	29.4874
17	10	50	55	5:1	15	79.9573
18	14	40	55	5:1	15	51.943
19	14	50	45	5:1	15	28.2946
20	14	50	55	3:1	15	18.6713
21	14	50	55	5:1	5	78.685
22	14	50	55	5:1	15	26.3884

As it can be observed, experiment no. 8 had the highest yield (98.5646% conversion) after 14 hours, at 40°C, 45% enzyme concentration, 3:1 alcohol to oil molar ratio and 15% water. The lowest rate of conversion was registered for experiment no. 6 (10 hours reaction time, 40°C, 45% enzyme concentration, 5:1 molar ratio and 5% water).

From the obtained results, a classification of the factors with a significant influence on the process response was made, according to linear coefficients (Table 3):

$$b_0 = \sum \frac{y_i}{N} \qquad b_i = \sum \frac{x_i y_i}{N}$$

Where:
b_0, b_i = linear coefficients
x_i = independent variables
y_i = process response (conversion %)

Table 3. Influence of significant factors

b0	**b1**	**b2**	**b3**	**b4**	**b5**
39.43796	-4.58145	-8.17159	0.515073	0.617654	8.552937

Thus, $b_i > 0$ represents a positive influence and $b_i < 0$, a negative influence, obtaining the linear objective polynomial function of the form:

$Y=b_0 + b_1X_1 + b_2X_2+...+b_kX_k = 39.43796 + (-4.58145)\ X_1 + (-8.17159)\ X_2 + (0.515073)\ X_3 + 0.617654\ X_4 + 8.552937\ X_5$

It can thus be observed that enzyme concentration (x_3) (% from weight of oil), alcohol to oil molar ratio (x_4) and water content (x_5) (% weight of oil) had a positive influence on the bioprocess response, while time (x_1) and temperature (x_2), had a negative influence.

CONCLUSIONS

The purpose of this experiment was to achieve the biodiesel process optimization through the use of an experimental factorial plan represented by a Hadamard matrix. By circular permutation of 5 key process parameters, at two variation levels, the significance of their effect was evaluated according to biodiesel conversion yield.

The highest conversion yield was 98.57% after 10 hours, at 40°C, 55% enzyme concentration, 3:1 alcohol to oil molar ratio and 5% water.

According to the determined linear coefficients, enzyme (x_3), alcohol to oil molar ratio (x_4) and water (x_5) had a positive influence on the bioprocess response, while time (x_1) and temperature (x_2) presented a negative influence.

In accordance to the optimization method, in order to obtain a better settlement of the optimal regions, a new experimental plan will be established in which the variable factors will be alcohol to oil molar ratio and water, the rest of the factors remaining unchanged.

ACKNOWLEDGEMENTS

The researches performed throughout this paper have been developed under the POSDRU/107/1.5/S/76888 programme from the University of Agronomical Sciences and Veterinary Medicine Bucharest, Romania.

REFERENCES

[1] Adlercreutz, P., 2000. *Biocatalysis in non-conventional media, Applied Biocatalysis*. A.J.J. Straathof and P. Adlercreutz. (eds.), Harwood Academic Publishers, pp. 295–316.

[2] Azocar L, Ciudad G, Heipieper HJ, Navia R, 2010. *Biotechnological processes for biodiesel production using alternative oils.* Appl Microbiol Biotechnol 2010, 88:621-636.

[3] Bajaj A., Lohan P., Jha P. N., and Mehrotra R., 2010. *Biodiesel production through lipase catalyzed transesterification: an overview.* Journal of Molecular Catalysis B: Enzymatic, 2010, 62(1):9–14

[4] Chen Hsiao-Ching, Ju Hen-Yi, Wu Tsung-Ta, Liu Yung-Chuan, Lee Chih-Chen, Chang Cheng, Chung Yi-Lin, and Shieh Chwen-Jen, 2011. *Continuous Production of Lipase-Catalyzed Biodiesel in a Packed-Bed Reactor: Optimization and Enzyme Reuse Study*. Journal of Biomedicine and Biotechnology, 2011, Article ID 950725, 6 pages

[5] Demirbas A. 2007. *Progress and recent trends in biofuels*. Prog Energy Combust Sci 33(1):1–18

[6] Fan X, Niehus X, Sandoval G, 2012. *Lipases as biocatalyst for biodiesel production*. Methods Mol Biol. 2012; 861:471-83.

[7] Fjerbaek L., Christensen K. V., and Norddahl B., 2009. *A review of the current state of biodiesel production using enzymatic transesterification*. Biotechnology and Bioengineering, 2009, 102(5):1298–1315

[8] Hernandez-Martin, E., Otero, C. 2008. *Bioresour*. Technol., 99:277–278

[9] Kawakami Koei, Oda Yasuhiro and Takahashi Ryo, 2011. *Application of a Burkholderia cepacia lipaseimmobilized silica monolith to batch and continuous biodiesel production with a stoichiometric mixture of methanol and crude Jatropha oil*. Biotechnology for Biofuels, 2011, 4:42

[10] Kralova, I. and Sjoblom, J., 2010. *Biofuels-renewable energy sources: a review*. Journal of Dispersion Science and Technology, 2010, 31(3):409–425

[11] Lee Ja Hyun, Yoo Hah-Young, Suh Young Joon, Han Sung Ok, Park Chulhwan and Seung Wook Kim, 2012. *Process Development using Co-immobilized Lipases for Biodiesel Production*. International Conference on Future Environment and Energy, IPCBEE, vol.28

[12] Ribeiro Bernardo Dias, Machado de Castro Aline, Coelho Maria Alice Zarur, and Freire Denise Maria Guimarães, 2011. *Production and Use of Lipases in Bioenergy: A Review from the Feedstocks to Biodiesel Production*. Enzyme Research, Volume 2011, Article ID 615803, 16 pages

[13] Rosset, G. I., Tavares H., C. M., Assaf, M. E., & Porto M., L. A., 2011. *Catalytic ethanolysis of soybean oil with immobilized lipase from Candida antarctica and 1H NMR and GC quantification of the ethyl esters (biodiesel) produced*. Applied Catalysis A: General, 2011, 392(1-2):136-142

[14] Salihu A, Alam MZ, AbdulKarim MI, Salleh HM, 2012. *Lipase production: An insight in the utilization of renewable agricultural residues, Resour*. Conserv. Recy., 58:36-44.

[15] Salis, A., Monduzzi M. and Solinas V., 2005. *Enzymes for biocatalysis in non-aqueous media.* Biocatalysis: Chemistry and Biology. A. Trincone. Kerala, Research Signpost. 29–53.

[16] Shi Shuobo, Valle-Rodríguez Juan Octavio, Siewers Verena, Nielsen Jens, 2011. *Prospects for microbial biodiesel production*. Biotechnology Journal, 2011, 6(3):277–285

[17] Soumanou, M.M. and Bornscheuer U.T. 2003. *Lipase-catalyzed alcoholysis of vegetable oils*, Eur. J. Lipid Sci. Technol, 105: 656–660.

[18] Speidel H. K., Lightner R. L., and Ahmed I., 2000. *Biodegradability of new engineered fuels*

compared to conventional petroleum fuels and alternative fuels in current use., Applied Biochemistry and Biotechnology A, 2000, 84−86(1−9):879–897

[19] Stoytcheva Margarita, Montero Gisela, Lydia Toscano, Gochev Velizar and Valdez Benjamin, 2011. *The Immobilized Lipases in Biodiesel Production*. Biodiesel – Feedstocks and Processing Technologies, ISBN: 978-953-307-713-0, pg, 397-410

[20] Szczesna Antczak M., Kubiak A., Antczak T., and Bielecki S., 2009. *Enzymatic biodiesel synthesis—key factors affecting efficiency of the process*. Renewable Energy, 2009, 34(5): 1185–1194

[21] Tan T, Lu J, Nie K, Deng L, Wang F, 2010. *Biodiesel production with immobilized lipase: a review*. Biotechnol Adv 2010, 28:628-634.

[22] USEPA, 2002. *A comprehensive analysis of biodiesel impacts on exhaust emissions*. Draft Technical Report.

[23] Verdugo, Cristóbal, Luna Diego, Posadillo Alejandro, Sancho Enrique D., Rodríguez Salvador, Bautista Felipa, Luque Rafael, Marinas José M. and Romero Antonio A., 2011. *Production of a new second generation biodiesel with a low cost lipase derived from Thermomyces lanuginosus: Optimization by response surface methodology*. Catalysis Today, 2011 167(1):107-112

[24] Yücel Yasin, 2011. *Biodiesel production from pomace oil by using lipase immobilized onto olive pomace*. Bioresource Technology, 2011, 102(4):3977-3980

Scientific Papers, Series B, Horticulture, Vol. LVI, 2012
CD-ROM ISSN 2285-5661, ISSN-L 2285-5653

INFLUENCE OF POSITION WITHIN THE TERRACES PLATFORM ON SOME CHEMICAL COMPONENTS IN CASE OF THREE SOIL TYPES IN A HIGH DENSITY APPLE ORCHARD

Mihail IANCU, Adrian TEBEICĂ

Research Institute for Fruit Growing Pitesti Romania, Piteşti, Arges County, code 110006,
Tel.: 0040-248-278066; Fax: 0040-248-278477

Corresponding author email: office@icdp-pitesti.ro

Abstract

Preparation of sloped terrain to establish fruit trees plantations on terraces built upon the classical method „Debleu-rembleu" determine an uneven disposition of the soil properties on the platforms, with negative consequences on fruit trees behaviour. In order to limit these inconvenients, at RIFG Pitesti Romania, in the year 1983 was experimented a new method for terraces building, including a more uniform way of vegetal floor disposition on the terraces platforms. The terraces were 25 m wide and the transversal declination of the platform between 9.4 - 12.3%. On each platform of the five terraces, seven rows of apple trees were planted at 3.6 m between the rows. The following bifactorial experimental scheme was set up: A factor = the soil type, with the graduations: a_1 = eutricambosoil with coluvic character; a_2 = slightly eroded eutricambosoil; a_3= typical eutricambosoil; B factor = the position on the terraces platform, with the graduations: b_1 = downstream platform, located on the interval between the tree rows 1 and 2; b_2 = middle platform located on the interval between the rows 2 and 3; b_3 = middle platform located on the interval between the rows 3 and 5; b_4 = upstream platform, located on the interval between the rows, 6 and 7. During 2011, 27 years after the fruit trees establishment, inside of each experimental treatment, in four replications and three soil depths, the humus content, mobile phosphorus, mobile potassium and pH values were analysed. In average, on the three soil types and three soil depths investigated, the values of the chemical components registered on downstream positions compared with the upstream ones were higher in the case of mobile phosphorus (64%), mobile potassium (25%), humus content (21%), but 4.4% lower in the case of the pH values. The differences registered between the two positions inside the terraces platform are much lower than the ones presented in the literature, due to the different methods used in the two situations for terraces building.

Key words**:** *apple, terrace, humus, phosphorus, potassium*

INTRODUCTION

The previous researches [1, 2, 3, 4, 5, 7, 8] revealed that on the terrains with a slope higher than 12% soil erosion control and provision of the conditions for mechanization of the works in the fruit trees plantations can be realised by soil preparation in terraces of different types and dimensions. The terraces building was realized using the classical method „debleu-rembleu", by soil movement from the upstream of the further platform to the downstream, until the realisation of the proper transversal declination. The terraces built in this way had some advantages but presented also the disadvantage of the uneven disposition of the surface fertile soil on their platform [8]. In order to diminish this inconvenient, starting with the year of 1983, at Colibasi farm belonging to RIFG Pitesti - Romania a new method for terraces building was experimented. In this paper, are presented the effects of this new method registered 27 years after trees establishment, on the disposition of some chemical components on three soil types and four positions delimited inside the terrace platform.

MATERIAL AND METHOD

The terraces placement was realized on a hill side with a slope up to (16%) which made the transition between the second and the third terrace of Doamnei River. In order to keep the

vegetal and more fertile soil layer on the surface of the further terraces, from the surface of the first terrace proposed to be realized downstream to the hill side, the vegetal superficial soil layer, 25-30 cm thick, was gathered and pushed with the bulldozer blade in the inner part of the second terrace, situated upstream of hill side. Then, on the resulting terrain, the transversal declination of the first terrace was realized by pushing the soil on the terrace downstream. After that action, the vegetal superficial soil layer, disposed in the inner part of the second terrace, was brought back on the first terrace and distributed as uniform as possible. In the same manner, the vegetal superficial soil layer from the further second terrace was disposed in the inner part of the third terrace and so on, until the preparation of the entire hill side. The terraces had a platform of 25 m wide and the transversal declination between 9.4 and 12.3%. On each terrace platform, seven tree rows at 3.6 m between the rows and 1.5 m between the trees along the row were planted. The following experimental scheme was organized: A factor = the soil type, with the graduations: a_1 = eutricambosoil with coluvic character; a_2 = slightly eroded eutricambosoil; a_3 = typical eutricambosoil. B factor = the position on the terraces platform, with the graduations: b_1 = downstream platform, located on the interval between the tree rows 1 and 2; b_2 = middle platform located on the interval between the rows 2 and 3; b_3 = middle platform located on the interval between the rows 3 and 5; b_4 = upstream platform, located on the interval between the rows, 6 and 7. The soil samples in four replications on the depths: 0-20 cm; 20-40 cm; 40-60 cm were taken. Each sample was constituted by 5-6 sub-samples taken from the points distributed as uniform as possible inside the experimental treatments. The humus content (%), mobile phosphorus (ppm), mobile potassium (ppm) and pH values were analysed.

RESULTS AND DISCUSSIONS

Influence of soil type and the position on the terrace platform on some chemical components of the soil

Mobile phosphorus content (ppm)

On the depth 0 - 20 cm, in average of the four position delimited on the terrace platform (b_1, b_2, b_3, b_4) among the three soil types (a1, a_2, a_3), the highest value of the mobile phosphorus was registered on the slightly eroded eutricambosoil (36.058ppm). This value was distinctly significant higher 78%, compared with the value registered on the eutricambosoil with coluvic character (20.3 ppm). Under the same conditions, the value of the mobile phosphorus registered on the typical eutricambosoil (32.733 ppm) was significantly higher 61%, compared to the one registered on the eutricambosoil with coluvic character (Fig. 1).

In average, on the three soil types (a_1, a_2, a_3) the value of the mobile phosphorus registered downstream the platform b_1, was significantly higher with 15.77% compared to the values registered on the positions b_2 and b_3 and distinct significantly higher with 113.6% compared with the value registered upstream platform (b_4).

On the depth 20-40 cm, in average on the four positions delimited on the terrace platform (b_1, b_2, b_3, b_4), among the three soil types, the highest value of the mobile phosphorus content was registered on the slightly eroded euticambosoil (12.05 ppm). This value was distinct significantly higher 62%, compared to the one registered on the eutricambosoil with coluvic character (7.417 ppm) and 95.4% higher, compared to the value registered on typical eutricambosoil (6.161).

In average, on the three soil types (a_1, a_2, a_3) the value of the mobile phosphorus content registered downstream the terrace platform b_1, was distinct significantly higher with 60-68%, compared to the values registered on the positions b_2 and b_3 (Fig. 1).

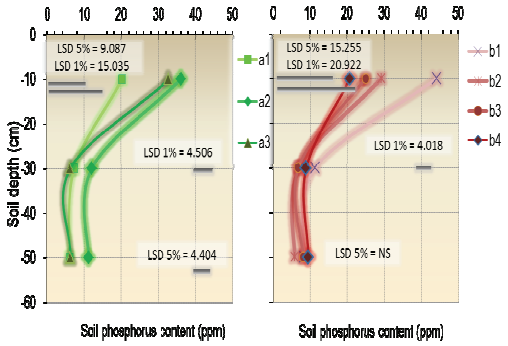


Fig. 1 Influence of soil type and of the position in the terrace platform on P content within the 3 soil depths (mean values of A/B experimental factors graduations) Significance of the experimental factors graduations (a_1, a_2, a_3 and b_1, b_2, b_3, b_4) is shown in Chapter „Material and method"

The mobile potassium content (ppm)

On the depth 0 - 20 cm, in average on the four position delimited on the terrace platform (b_1, b_2, b_3, b_4), among the three soil types (a_1, a_2, a_3), the highest value of the mobile potassium was registered on slightly eroded eutricambosoil (287 ppm). This value was significantly higher with 50% compared to the value registered on the typical eutricambosoil (190.7 ppm).

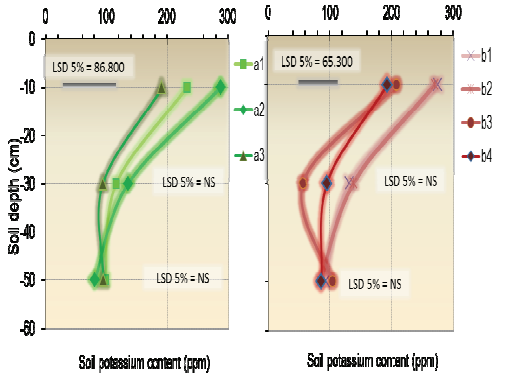


Fig. 2 Influence of soil type (a_1, a_2, a_3) and of the position in the terrace platform (b_1, b_2, b_3, b_4) on K content within the 3 soil depths (mean values of A/B experimental factors graduations). Significance of the experimental factors graduations (a_1, a_2, a_3 and b_1, b_2, b_3, b_4) is shown in Chapter „Material and method"

In average, on the three soil types (a_1, a_2, a_3) the mobile potassium content registered in position b1 from the terrace platform was significantly higher with 32.43% compared with the values registered on the positions b_3 and b_4. In addition, the value of the same chemical characteristic, registered on the position b_2 (270.0 ppm), was significantly higher with 40% compared with the one registered on the position b_4 (192.9). On the others soil depths (20-40 and 40-60 cm), the values of mobile potassium content were not significantly different among them, both on the three soil types (a_1, a_2, a_3) and on the four positions on the terrace platform (b_1, b_2, b_3, b_4) (Fig. 2).

The pH values

On the depth 0-20 cm, the pH value registered on the typical eutricambosoil (5.364) was significantly higher with 4.8% compared to the value registered on the eutricambosoil with coluvic character (5.117). On the depth 20-40 cm, in average on the three soil types (a_1, a_2, a_3) the pH value registered on b_4 position of the terrace platform was distinct significantly higher 4.1 - 4.2%, compared with the values registered on the positions b_1 and b_3, and very significantly higher 6.3% compared to the value registered on the position b_2 (4.816). On the depth 40-60 cm, in average on the three soil types (a_1, a_2, a_3), the pH value registered on the position b4 of the terrace platform (5.294) was very significantly higher with 6.7 - 8.5%, compared to the values registered on the positions b_1, b_2 ,b_3, Fig. 3.

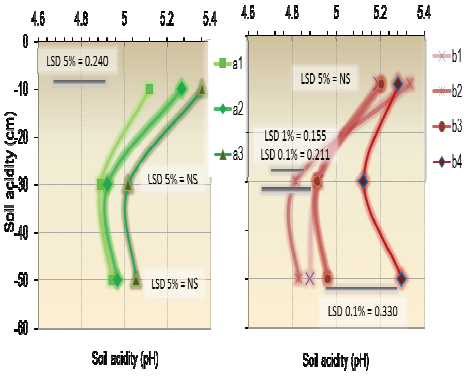


Fig. 3 Influence of soil type (a_1, a_2, a_3) and of the position in the terrace platform on pH values within the 3 soil depths (mean values of A/B experimental factors graduations) Significance of the experimental factors graduations (a_1, a_2, a_3 and b_1, b_2, b_3, b_4) is shown in Chapter „Material and method"

The humus content (%)

In average, on the three soil types (a_1, a_2, a_3) and on the three depths investigated (0-20; 20-40; 40-60 cm), the highest value of the humus content (2.60%) was registered on the position from platforms downstream and the lowest value (2.14%) was registered upstream of the terrace platform (Fig. 4).

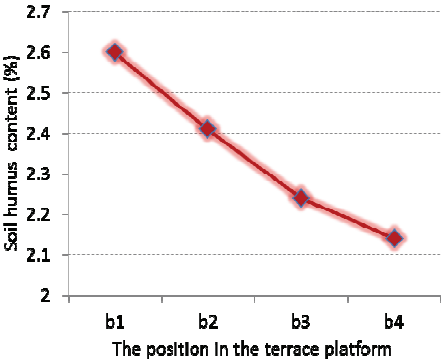


Fig. 4. The influence of the position in the terrace on the platform on the humus content %. (Average values on three soil types and 0-60 cm depth). Significance of the experimental factors graduations (a_1, a_2, a_3 and b_1, b_2, b_3, b_4) is shown in chapter „Material and method"

The influence of the position inside the terrace platform (b_1, b_2, b_3, b_4), on three soil types (a_1, a_2, a_3) on the mobile phosphorus, mobile potassium and pH values

The mobile phosphorus content (ppm)

On the depth 0 - 20 cm, among the three soil types studied (a_1, a_2, a_3), the values of the mobile phosphorus content registered on the four positions of terrace platform (b_1, b_2, b_3, b_4) were significantly differentiating among them, only in the case of the typical eutricambosoil (a_3). In the case of this soil type, the value of mobile phosphorus content registered on the b_1 position of the terrace platform (64.07) was distinct significantly higher with 243-274%, compared with the values registered on the positions b_3 and b_4. On the depth 20-40 cm, on the slightly eroded eutricambosoil (a_2), the value of mobile phosphorus content registered on b_1 position from the platform terrace (21.233 ppm), was significantly higher with 73%, compared with the value registered on the position b_4 (12.3) and distinct significantly higher with 165 - 218%, compared to the values registered on the positions b_2 and b_3. At the depth 40-60 cm, on the slightly eroded eutricambosoil, the value of the mobile phosphorus content registered on the b_4 position of the terrace platform (15.5) was significantly higher 111% compared with the value registered on the position b_2 (7.333) - Fig 5.

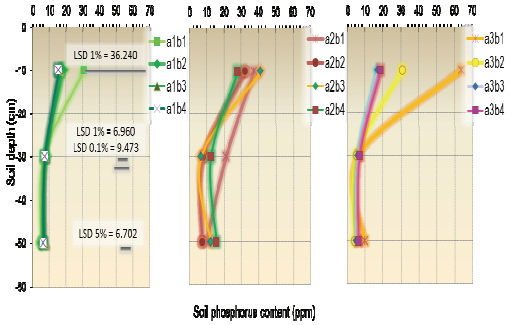


Fig. 5. Influence of the position in the terrace platform on P content within 3 soil types and their 3 depths (interaction of A/B experimental factors graduations). Significance of the experimental factors graduations (a_1, a_2, a_3 and b_1, b_2, b_3, b_4) is shown in Chapter „Material and method"

The mobile potassium content (ppm)

On the depth 0 - 20 cm, on the eutricambosoil with coluvic character, the mobile potassium value registered in the position b1 of the terrace platform (318.17 ppm) was distinct significantly higher with 99% compared with the value registered on the b_3 position (160.0 ppm). At the same depth, on the slightly eroded eutricambosoil, the value of mobile potassium content registered on b_2 position (386.7 ppm) was significantly higher with 64% compared with the value registered on b_4 position (236.7) and distinct significantly higher with 77% compared with the value registered on the b1 position (218.7 ppm). In the same way, on the typical eutricambosoil (a_3), the potassium content value registered on b_1 position (288.0 ppm) was significantly higher with 83% compared to the value registered on the b_3 position and distinct significantly higher with 134% compared with the value registered on

the b_4 position (123.3%). At the depth of 20-40 cm, on the slightly eroded eutricambosoil, the value of the mobile potassium content registered on b_2 position (245.3 ppm) was significantly higher with 116%, compared with the value registered on b_1 (113.3 ppm) and distinct significantly higher with 159 - 175% compared with the values registered on the positions b_3 and b_4 (Fig.6).

The pH values

On the depth 0 - 20 cm, on the slightly eroded eutricambosoil the pH value registered on b_2 position (5.473) was significantly higher with 7.5% compared with the value registered on b_1 position, placed downstream the terrace platform (5.093).
On the depth 20 - 40 cm, on the eutricambosoil with coluvic character (a1), on b_4 position, situated upstream of terrace platform, the pH values (5.093) was significantly higher with 6.8%, compared with the pH values registered on the positions b_1 and b_2. At the same depth, on slightly eroded eutricambosoil, the pH value registered on b_1 position, situated downstream the terrace platform (5.070) was significant higher with 4.7 - 7.5 % compared with the values registered on the positions b_2 and b_3 placed in the middle of terrace platform.

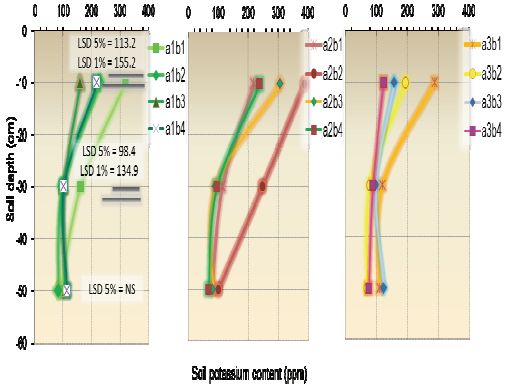


Fig. 6. Influence of the position in the terrace platform (b_1, b_2, b_3, b_4), on K content within the 3 soil types (a_1, a_2, a_3) and their 3 depths (interaction of B/A experimental factors graduations). Significance of the experimental factors graduations (a_1, a_2, a_3 and b_1, b_2, b_3, b_4) is shown in Chapter „Material and method".

Also, at the same depth (20-40cm), on the typic eutricambosoil a_3, the pH value registered on the position placed upstream terrace platform (5.213) was significantly higher with 4.8 - 5.1% compared to the values registered on the positions b_2 and b_3 situated in the middle of the terrace platform and distinct significantly, higher with 6%, compared with the value registered downstream the terrace platform (4.920) - Fig. 7.

Influence of A, B experimental factors graduations on the variation coefficients values (%) (Average values for phosphorus and potassium content and pH values on threes soil depth

In average, on the four positions delimited on the terrace platform (b_1, b_2, b_3, b_4), among the three soil types (a_1, a_2, a_3), the highest value of the variation coefficient for the three analyzed chemical components, was registered in the case of typical eutricambosoil (36.2%).

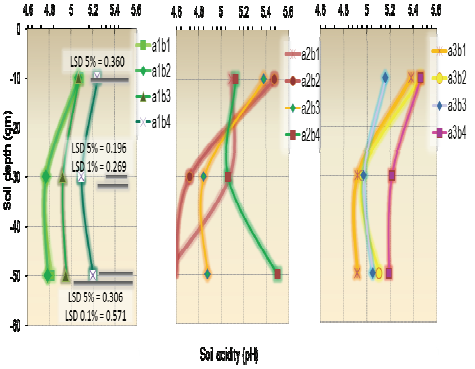


Fig. 7. Influence of the position in the terrace platform (b_1, b_2, b_3, b_4), on 3 soil types (a_1, a_2, a_3), on the pH values within 3 depths (interaction of B/A experimental factors graduations). Significance of the experimental factors graduations (a_1, a_2, a_3 and b_1, b_2, b_3, b_4) is shown in chapter „Material and method".

This value was 2.2% higher compared with the one registerd in the case of slightly eroded eutricambosoil (35.4%) and with 78% compared with the value registered on the eutricambosoil with coluvic character (20.3%). In average, on the three soil types and three soil depths analyzed, the highest value of the variation coefficient for the three analyzed chemical components, were registered in the case of b_1 position (35.6%), followed by the very similar values registered in the case of b_2 position (32.3%) and b_3 position (32.1%); the

highest value was registered in the case of b_4 position (26.4%). In average, on the seven graduations of the experimental factors A and B, the highest value of the variation coefficient was registered in the case of the phosphorus content (47.7%), followed by the registered value in the case of the potassium content (41.8%), and finally on the last place was the value registered in the case of the pH values (4.1). In consequence, the uniformity of the individual values of pH was much higher than the individual values of phosphorus and potassium content.

The data presented until now regarding the four chemical characteristics revealed a light tendency of decreasing from the downstream to the upstream of the terraces platform of the humus, mobile phosphorus and mobile potassium content and a light increase in the same direction of the pH values in the more profound soil depths. By comparing, the differentiation of registered values belonging to the chemical components with the data presented by [8] one can observe that in the case presented, the differences were very small. The fact, can be explained by the different methods used in two situations for terraces building.

Table 1. Influence of A, B experimental factors graduations of the variation coefficient (%) (mean values of P, K and pH contents studied) within three soil depths

Experimental factors graduations a, b	Phosphorus (ppm)	Potassim (ppm)	pH	Average
a_1	24.1	33.3	3.6	20.3
a_2	50.9	49.4	5.8	35.4
a_3	61.1	43.8	3.8	36.2
b_1	62.8	40.4	3.4	35.6
b_2	35.7	56.8	4.4	32.3
b_3	54.7	39.1	2.7	32.1
b_4	44.5	29.5	5.2	26.4
Average	47.7	41.8	4.1	

As previously was shown in the present work, the terraces building was realized by the integral preservation of the fertile soil layer on the terraces platform surface. In the case of the work presented by [8] the vegetal soil layer was mixed in the soil profile. This was done in the moment of soil movement for terraces building, from upstream to downstream of the further terraces platforms. By comparing the differences between the values registered upstream and downstream of the terraces for the four chemical components analysed, it can be observed that the highest differences were registered in the case of the mobile phosphorus. Despite these facts, the data presented in Fig. 5 revealed that among the three soil types these differences regarding the mobile phosphorus were registered only on two from the three soil types studied. The high differences between the two positions inside the terrace platform registered for the mobile phosphorus compared to the ones registered for the mobile potassium can be explained by the higher differentiation on the soil profile [3] of the mobile phosphorus compared to the ones registered for the mobile potassium.

CONCLUSIONS

In average, for the three soil types and the three soil depths (0-20; 20-40; 40-60 cm), the chemical components values registered on the position situated downstream the terrace platform, compared to the ones registered upstream the terrace platform were 64% higher in the case of the mobile phosphorus, 25% in the case of the mobile potassium, 21% in the case of the humus content. The mobile phosphorus values registered downstream the terrace platform were higher compared to the ones registered upstream the terrace platform only for two of the three soil types studied.

Under the same conditions, the pH values registered on the position from upstream terrace platform were 6% higher compared to the ones registered downstream the terrace platform, the differences being more evident on the more profound soil layers (20-40; 40-60 cm).

Regarding the analysed chemical components, the differences between the values registered downstream the terrace platform and the ones registered upstream the terrace platform, were much lower in the present work compared to the ones presented in the literature. This fact can be explained by the different methods used in the two situations for terraces building.

REFERENCES

[1] Iancu M., 1967. *Comportarea plantațiilor tinere de păr pe terase*. Revista de Horticultură şi Viticultură, nr. 10;

[2] Iancu M., Neamțu I., Negoiță Mariana, Tănăsescu N., Aldea Viorica, 1998. *Cercetări privind unele probleme agroameliorative ale solului în plantațiile de pomi*. Lucrările științifice ale ICDP Piteşti – Mărăcineni, Vol. XIX: 87-104;

[3] Moţoc M., 1963. *Eroziunea solului pe terenurile agricole şi combaterea ei*. Editura Agro-silvică, Bucureşti;

[4] Moţoc, M., Munteanu S., Băloiu V., Stănescu P., Mihai Gh., 1975. *Eroziunea solului şi metode de combatere*. Editura Ceres, Bucureşti;

[5] Moţoc, M., Popa, V., 1962. *Probleme privind amenajarea terenurilor în pantă pentru cultura pomilor*. Grădina, via şi livada, nr. 8;

[6] Mihai, Gh., 1975. *Cap. IV în Eroziunea solului şi metode de combatere.* Moţoc, M., Munteanu, S., Băloiu, V., Stănescu, P., Mihai Gh., Editura Ceres, Bucureşti;

[7] Popa, V., 1966. *Tipuri de terase pentru plantațiile de pomi din zona premontană*. Lucrări ştiinţifice, ICHV, Redacţia Revistelor Agricole, Bucureşti, Vol. VIII: 51-64.;

[8] Price D., 1968. I*nfluenţa amenajării terenului în pantă asupra creşterii şi rodirii prunului.* Analele Institutului de Pomicultură Piteşti, vol. I;


EX·TERRA·AVRVM

Scientific Papers, Series B, Horticulture, Vol. LVI, 2012
CD-ROM ISSN 2285-5661, ISSN-L 2285-5653

RESEARCHES ON WINE MOTHS FLIGHT CAPTURED ON PHEROMONE TRAPS

Oana Ecaterina POPA

University of Agronomic Sciences and Veterinary Medicine Bucharest, 59 Marasti, District 1, 011464, Bucharest, Romania, Phone: +40 21 318 25 64/232, Fax: + 40 21318 28 88, E-mail: margareta_oancea@yahoo.ca

Corresponding author email: oanaecaterina_popa@yahoo.com

Abstract

The forecasting and warning system in Romania started with a control programmes applied against Plasmopara viticola*, the most important pathogen of grapevine. Since then, studies and new techniques have been developed and applied to other important pests of vineyards, including Lobesia botrana and Eupoecilia ambiguella, different models have been evaluated as an important part of the control strategy, field monitoring using pheromones traps is used to formulate warnings that are sent out to farmers about the need to spray or not. Our researches were done in village Fantanele, county Prahova situated on the "wine road" which capitalize famous "Dealul Mare" vineyard. The biology (flight curves of moths) of Lobesia botrana (grape vine moth), Eupoecilia ambiguella (European grape vine moth) was monitored in vineyard, in 2010-2011 using a sex pheromone traps, with a view to forecasting the damage rate and determining the best time to apply insecticides. Our data confirm that grape vine moth has 2-3 annual generations the moths appear from the end April until the end May flights spread over 2 to 3 weeks, the second flight takes place end of June-July and the third flight occurs in August-September, in the same time European grape vine moth has 2 annual generations, the moths arising from overwintered pupae appear at variable dates depending on year, the second flight takes place 2 to 2.5 months after the first. Data obtained confirm previous information's that before the 1st chemical application against adults, the peak of the flight curve should have been reached, for 1st flight the flower buds should be formed, and the pests' infestation rate in the vineyard should be at least 20%. For the 2nd application, at least one flight peak should have occurred, the grapes should be the size of peas and the infestation rate should be 1%. Sex-pheromone trapping have been used in determination of critical biological stages of these pests. Generally a total of 2-3 treatments used to be applied against these pests but, using a proper warning system based on counting of captures from pheromone traps the number of chemical treatments could be reduced to 1.*

Key words: *Lobesia botrana, Eupoecilia ambiguella, sex pheromone traps, flight curves*

INTRODUCTION

In Romania are reported in the culture of vines over 70 species of the animal kingdom, of which 20 are harmful. Side effects that occurred and occur continuously from excessive use of chemicals some positive influence on the quantity and quality of the harvest times, and on the other fermentation and thus adversely affect wine quality. European grapevine moth (*Lobesia botrana* Den. et Schiff.) and European grape berry moth (*Eupoecilia ambiguella* Hb.), species with 2-3 generations per year, moths appear in the first decade of June, but may occur earlier, in mid-May, with a twilight flight when the temperature exceeds 15^0 C. Larvae appeared in June to feed on flower buds and green beans, larvae of the second generation, emerging in August feed on seeds from pulp soir early, while the third generation with ripe berries of late varieties. Attacked grape fruits, shrivel up and are often infected with the fungus *Botrytis cinerea* or *Penicillium glaucum* and rot, and the wine is bad and can not keep the wine cellar. Appreciation of the necessity of treatment can be done to combat the pests taking into consideration curve recorded flight of adults with pheromone traps Atrabot respectively Atrambig. Fighting against grape moths is generally preventive, because the larvae are sensitive to pesticides only immediately after hatching [6, 7].

In the village Fantanele, county Prahova situated on the "wine road" which capitalize famous "Dealul Mare" vineyard in the period 2010-2011 observations have been made

on the evolution of the most harmful pests (European grapevine moth (*Lobesia botrana* Den. et Schiff.) and European grape berry moth (*Eupoecilia ambiguella* Hb.) basically with the purpose to establish the population level, to improve warning and forecast activities for these pests, based on sexual attractive pheromone traps (type Atrabot and Atrambig) to establish proper time to apply the control treatments for small farmers from area.

MATERIAL AND METHOD

In village Fantanele, county Prahova situated on the "wine road" which capitalize famous "Dealul Mare" vineyard, in the period 2010-2011 observations have been made on the evolution of the moths European grapevine moth (*Lobesia botrana* Den. et Schiff.) and European grape berry moth (*Eupoecilia ambiguella* Hb.). The installation of pheromone traps in vine plantation was making in spring at the end of April to beginning of May (Fig. 1).

Fig. 1. Type of ICCN pheromone traps in vine plantation

Two traps with each type Atrabot and Atrambig (from "*Raluca Ripan*" Institute for Research in Chemistry), were installed in the vineyards in order to establish the population level of pests. The captured moths were registered biweekly, moth flight curve was drown, established the moment of flight start, peak flight activity, number of generations succession, for each pests. The synthetic sexual pheromones lures were replaced once/month and sticky parts of traps were replaced when it considered necessary, at the beginning of flights or when the moths captured were no so many the captured moths were taken off with needle or when there are too many moths captured the sticky traps were replaced with new one.

RESULTS AND DISCUSSIONS

In the literature there is mention of the species *Eupoecilia ambiguella* in Wallachia respectively at Ştefăneşti vineyard, [1] but there are no specific data on the presence of pest in vineyards surrounding Fantanele village, which prompted this study. Of course the European grapevine moth (*Lobesia botrana*) is a common pest of grape and it was no a surprise for us that we captured a lot of moths on pheromone traps. It was determined the presence of two pest species of Lepidoptera namely *Lobesia botrana* and *Eupoecilia ambiguella* in village Fantanele vineyard and was established the flight curve of the two species with pheromone traps. Bărbuceanu and Andriescu [1] shows that according to Bovey [2], in most grape growing regions where damage, species evolve in two annual generations, because preferences for regions with cool, wet climate, *Eupoecilia ambiguella* is called "Northern insect " compared to other grape moth (in Romania generally it has two generation/year), in the same time, *Lobesia botrana*, called "Southern insect" (in Romania generally it has three generations/year). Luke [4, 5] quoted by Barbuceanu and Andriescu made some observations on the biology of *Eupoecilia ambiguella* in Moldova and states that have two generations, and in warmer years and indicates the presence of the third generation. Our observations confirm the assumption that in village Fantanele vineyard the European grapevine moth (*Lobesia botrana*) has three generations annually, with three flight peaks recorded in May, July and August. Analysing the data of year 2010 (Table 1) it was registered the maximum moth captured/traps for GI on 22 May (41.0 moth/trap) and for the G II a max value on 10 July (66.5 moth/trap), the flight continuing until the mid July, and GIII reached the max value on 21 August (84.0 moth/trap). European grape berry moth (*Eupoecilia*

ambiguella Hb., according to pheromone traps moths captures has only two generations/year first with a sharp pick on 22 May (33.5 moth/trap), the second around the time of 24 July with few moths captured (4.55 moth/trap). In 2010 the high temperatures and the atmospheric drought and we presume that this situation it was followed by a pest population reducing and reflected in decreasing of mating number of eggs laid their dehydration and increasing of larval mortality and in this respect the pest populations of both pest species were reduced. Analysing the data of year 2011 (Table 2) European grapevine moth (*Lobesia botrana*) has also similar three generations/year, with three flight peaks recorded in May, July and August, when it was registered the maximum moth captured/traps for GI on 21 May (32.0 moth/trap) and for the G II a max value on 09 July (47.5 moth/trap), and GIII reached the max value on 20 August (101.0 moth/trap). European grape berry moth (*Eupoecilia ambiguella* Hb. has also two generations/year first with a sharp pick on 11 June (87.0 moth/trap), the second around the time of 23 July with a lot of moths captured (100.5 moth/trap). Year 2011 was favourable for developing of moth pest populations.

By means of the pheromone traps (Atrabot and Atrambig) installed in vine plantation could be determined the level of population, and based on the moths flight curve it could be establishing, by farmers, the moment of applying the control treatments, the plotting of the moth flight curves [3,8,9].

Table 1. Flight curve registered in 2010 on the evolution of the moths European grapevine moth (*Lobesia botrana* Den. et Schiff.) and European grape berry moth (*Eupoecilia ambiguella* Hb.).

Pest	Number of captured moth/trap								
	08-V	**22-V**	**12-VI**	**26-VI**	**10-VII**	**24-VII**	**07-VIII**	**21-VIII**	**11-IX**
European grapevine moth (*Lobesia botrana* Den. et Schiff.)	33.0	41.0	11.0	1.5	66.5	11.0	38.5	84.0	**5.5**
European grape berry moth (*Eupoecilia ambiguella* Hb.	14.5	33.5	10.0	2.5	0.5	4.5	1.5	0.5	0

Table 2. Flight curve registered in 2011 on the evolution of the moths European grapevine moth (*Lobesia botrana* Den. et Schiff.) and European grape berry moth (*Eupoecilia ambiguella* Hb.).

Pest	Number of captured moth/trap								
	07-V	**21-V**	**11-VI**	**25-VI**	**09-VII**	**23-VII**	**06-VIII**	**20-VIII**	**10-IX**
European grapevine moth (*Lobesia botrana* Den. et Schiff.)	11.5	32.0	5.5	22.0	47.5	11.5	22.0	101.0	16.5
European grape berry moth (*Eupoecilia ambiguella* Hb.	44.0	63.5	87.0	5.5	0.5	100.5	10.5	1.0	0

CONCLUSIONS

It was determined the presence of two pest species of European grapevine moth (*Lobesia botrana* Den. et Schiff.) and European grape berry moth (*Eupoecilia ambiguella* Hb.) in village Fantanele vineyard and was established the flight curve of the two species with pheromone traps.

Our observations confirm the assumption that in village Fantanele vineyard the European grapevine moth (*Lobesia botrana*) has three generations annually, with three flight peaks recorded in May, July and August.

Our observations shows that in analysed area, European grape berry moth (*Eupoecilia ambiguella* Hb., according to pheromone traps moths captures, has only two generations/year first in May, the second around the end of July.

By means of the pheromone traps (Atrabot and Atrambig) installed in vine plantation, moth flight curves could be determined, and based on it the moment of applying chemical treatments for pest control.

ACKNOWLEDGEMENTS

This research work was carried out with the support of farmers from village Fantanele, county Prahova.

REFERENCES

[1]Bărbuceanu Daniela si Andriescu I., 2005. Contribuţii la studiul biologiei şi ecologiei moliei strugurilor *Eupoecilia ambiguella* Hb. (Lepidoptera: Tortricidae) in conditiile podgoriei Ştefăneşti-Argeş. Lucrări Ştiinţifice, Seria Horticultură, , Editura "Ion Ionescu de la Brad", Anul XLVIII (48), 1175-1180.

[2]Bovey P., 1966. Super-familie des Tortricoides. In Balachowsky, A.S., Entomologie
Appliquee a l'Agriculture, Tom II: Lepidopteres, Ed. Masson & C-ie, Paris, 1: 461-486.

[3]Geest van der, L.P.S. and Evenhuis H.H., 1991. Tortricid pests their biology, natural enemies and control, World Crop Pests, 5: 507-512.

[4]Luca N., 1981. Contribuţii la studiul sistematic, biologic, ecologic şi combaterea lepidopterelor dăunătoare la cultura viţei de vie în podgoria Bucium-Iaşi, Teză de doctorat – rezumat, Facultatea de Agronomie, Iaşi

[5]Luca N., 1986. Ciclul biologic al moliei strugurilor Eupoecilia ambiguella Hb. în perioada anilor 1973-1981, în condiţiile podgoriei Bucium – Iaşi, Lucrările celei de a III-a Conferinţe de Entomologie, Iaşi, 20-22 mai 1983: 365-371.

[6]Mirica I. şi Mirica Afrodita, 1972. Combaterea bolilor şi dăunătorilor la viţa de vie, Ed. Ceres, Bucureşti, 116 p..

[7]Rosca I. si Istrate Rada, 2009. Tratat de Entomologie (Agricultura, Horticultura, Silvicultura). Ed. ALPHA MDN, 699 p..

[8]Tăbăranu G. si colab., 2007. Influenţa unor factori climatici asupra biologiei şi comportamentului moliei strugurilor (*Lobesia botrana* – Den et Schiff) în plantaţiile viticole din podgoria' Dealu Bujorului. Lucrări Ştiinţifice, Seria Horticultură, , Editura "Ion Ionescu de la Brad", Anul L (50), 1101-1106.

[9]*** 1980. Metodici de prognoză şi avertizare a tratamentelor împotrira bolilor şi dăunătorilor plantelor de cultură. Ministerul Agriculturii şi Industriei Alimentare Bucureşti - Redacţia de Propagandă Tehnică Agricolă, 184 p.

Scientific Papers, Series B, Horticulture, Vol. LVI, 2012
CD-ROM ISSN 2285-5661, ISSN-L 2285-5653

THE SWOT ANALYSIS STUDY ON ENVIRONMENTAL PROTECTION LEVEL IN URZICENI, IALOMIŢA, IN ORDER TO DEVELOP THE SUSTAINABLE DEVELOPMENT STRATEGY

Ionuţ PRAVĂŢ, Gheorghe CÂMPEANU

University of Agronomic Sciences and Veterinary Medicine Bucharest, 59 Mărăşti, 011464, Bucharest, Romania, Phone: +40 21 318 25 64/232, Fax: + 40 21318 28 88, E-mail: ionut_pravat@yahoo.com

Corresponding author email: ionut_pravat@yahoo.com

Abstract

The SWOT analysis study on environmental protection level in Urziceni, Ialomiţa allows the analysis of the quality of the environment in this area in order to elaborate a strategy for sustainable development to ensure a balance between the socio-economic systems and the elements of nature. SWOT matrix is based on the community profile or on the resources that the place holds. It is a diagnosis which aims to output the future objectives necessary for a harmonious development. Some results are shown on the total surface of green space and the structure of green spaces in the city Urziceni, they have an important role in the health of the population. There are shown some results concerning the total surface of green space and the structure of green space in Urziceni, having an important role in the health of this town population. As a consequence of the results, one may proceed to the establishment of the problems that the town is facing concerning the protection of the environment and the measures that are to be taken.

Key words**:** *environmental protection, green space, sustainable development, Urziceni*

INTRODUCTION

The concept of sustainable development stands for all forms and methods of socio-economic development, which foundation is firstly represented by a balance between the socio-economic systems of the natural elements [3].
The sustainable development means and tries to find a stable theoretical framework for decisions in any situation where such a report as man / environment is to be found, be it environmental, economical or a social one.
Increased attention to environmental is the basis of the sustainable development of Urziceni [6].
Developing such strategies on the environment is a complex process involving various technical analysis, coordination and cooperation between the participants in this action, such as economic, industrial employers' associations, local civic organizations, local officials and the public.
The process of developing and implementing a strategy for environmental quality is specific to the area and it is conditioned by a number of factors:

- the geographic extent of the application area;
- existing and applicable environmental regulations;
- types of pollution sources and their control;
- air quality status and progress;
- the institutional and decisional makers involved;
- business and civil society.

MATERIAL AND METHOD

Environmental quality analysis is realised using the SWOT matrix. based on community profile or resource that town holds SWOT matrix is realised. It is a diagnosis of which to future goals can be extracted.
The matrix shows a visual layout and concentrates in more precise and concrete formulations the realities of the town.
- S = strenghts
- W = weaknesses
- O = opportunities
- T = threats

Strengths and weaknesses are related exclusively to the internal environment resources, of the community. Opportunities and

threats come from the external environment and are related to the legal framework, external actors which can have a positive or negative influence on the community (Government, the County Council).
Using such a method allows identifying the following:
- existing possibilities in the social en economic development of the town and of the areas of intervention
- facilitates the formation of a clear perception of the local necessities.
The analysis of these areas allows the identification of the development stages and of resources needed to ensure a sustainable development.

RESULTS AND DISCUSSIONS

The environment in which men live is defined primarily by air, water, land, housing, food consumed, and the place where men work. Closely related to these factors, and influenced, immediately or after a period of time , is the health of the population[2].
Assessing the health of the population, followed in the National Priority Health, in the whole country, so in Urziceni, is dependent on the following risk factors related to:
- drinking water;
- urban air quality;
- collecting and removing liquid and solid residues;
- urban noise;
- habitat;
- quality of all kinds, given to the population.
On the basis of community or profile or of natural resources that the city holds have been established:
- S = strenghts
- W = weaknesses
- O = opportunities
- T = threats (Table1)

Table 1. The SWOT analysis result of on the Environmental Protection in Urziceni

Strenghts	Weaknesses
■ low degree of degree of soil and air pollution ■ the existence of considerable green areas that may improvethe microclimate - the possibility of their extension. ■ project in progress for the roads ■ the use of chemicals for subsistence agriculture ■ phonic pollution decreased thanks to traffic pollution ■ there are no not large industrial emitters next to the town.	■ pollution caused by the lack of a modern system of collection and treatment of waste ■pollution caused by burning solid fuels for war up, in areas where there is a lack of gas supply system ■pollution of soil, water and air caused by lack of a modern system of collection and treatment of wastewater ■ the lack of programmes to educate/inform people on the effects of the pollution on one's healts ■ poor awareness of population and economic agents in the field of environmental protection ■ lack of preoccupation for organic farming type ■ shortage of the planted areas
Opportunities	**Threats**
■ the possibility of he developing technologies in the field of waste management and recycling it ■ the opportunity of adopting some measures concerning planting trees on certain areas of land for environmental protection against the harmful factors(damaging factors) ■ possibility of applying some measures for the population awareness regarding the development and environmental sustainable development ■ availability of EU funds allocated for the environment sector ■ the existence of the structural funds for the integrated management of waste ■ availability of funds for nature protection ■ the involvement of people with authority in the commune in developing educational programs for public awareness on environment preservation ant protection	■ difficulties in supporting the investment costs of major infrastructure projects in the environment field ■ any form of pollution may have significant economic consequences on the population activity. ■ pollution effects on he population's health ■ enlargement of built in preference

Green represents the green space in the cities and municipalities, defined as a tiled or a system of semi-natural ecosystems, whose vegetation is determined by the specific (Woody, arborescence, shrubby, floricultural/ floristic and herbaceous) [4].
Green spaces consist in:
- parks
- gardens
- green street area
- green areas in neightbourhoods
- playgrounds for children

In Urziceni, in 2012, the total area of green space occupies 32 Ha, of which 24 Ha are

forest and the rest are parks, squares (i.e. 4.7% of the built-up area) structure of green spaces, presented in Table 2.

Table 2. Structure of green spaces in the city Urziceni (ha)

Parks, gardens, green spaces to budgetary institutions	Green street areas	Green areas in neighbourhoods	Lakes	Playgrounds for children
1,6	1,4	4	20	0,50

World Health Organization (WHO) provides in its rules, the area of green space / inhabitant is 50 sqm.In Romania, the average is about 18 sqm / inhabitant, while diminishing green areas is obviously a major problem.

In terms of area green spaces/inhabitant, Urziceni is under the standard media (25-30sq m/inhabitant) at the value of just 18.5 sq m/inhabitant (Table 3).

Table 3. Status of green areas in the City in 2012

The green areas (ha)	Reported green area to total area of the city (%)	Green area per inhabitant (m / inhabitant)
8	0,60	17,4

Photo 1. View green space from Urziceni

Photo 2. View central park Urziceni

CONCLUSIONS

Among the major environmental problems of the residential areas there are:
- the discomfort of smoke and odors
- reduce the visibility
- negative effects on human health and on vegetation produced by dust and greenhouse gases
- damage to constructions caused by dust and corrosive gas.

Low awareness of population and economic agents in environmental issues, environmental education taking place only in the superior education system

Possibility of extending the green areas in the City League.

Maintaining the quality of the atmosphere within acceptable limits, with the tend of bringing it to natural parameters, is an essential strategic line of a program of environmental management in a zone of which program aims to the ecological rebuilding and to the ensuring of the sustainable development.

REFERENCES

[1] Daduianu U., Vasilescu I.,-1994. *Environmental protection*. Information and Documentation Bucharest Center p.55-60

[2] Ionescu, Al., Sahaleanu, V;Bindiu, C, 1975. *Environmental protection and environmental education.* Ceres Publishing House, Bucharest, p. 10-12

[3] Manoliu Mihai, Ionescu Cristina. 1998. *Sustainable development and environmental protection*, Bucharest, H.G.A., p.25-27

[4] Matei C-tin, Buleandră Al., Geacu S., Barbu I, 2006. *The Monograph of Urziceni, Slobozia*. p. 20-30.

[5] *National Institute for Statistics*, Statistical Yearbook, 2011

[6] Platon, V, *Environmental protection and economic development*- Didactic and Pedagogic Publishing House 79-81


EX·TERRA·AVRVM

Scientific Papers, Series B, Horticulture, Vol. LVI, 2012
CD-ROM ISSN 2285-5661, ISSN-L 2285-5653

STUDIES REGARDING THE WINE CONSUMPTION IN GERMANY AND THE PERSPECTIVE OF INCREASING THE ROMANIAN WINE EXPORT ON THIS MARKET

Cristina VEITH, Ioan NĂMOLOȘANU

University of Agronomic Sciences and Veterinary Medicine Bucharest, 59 Mărăști, 011464, Bucharest, Romania, Phone: +40 722314552, E-mail: christineveith@yahoo.de; ioannamolosanu@yahoo.com

Corresponding author email: christineveith@yahoo.de

Abstract

The aim of this work is to present the evolution in what concerns the world wine marketing during the period 2000-2011 mainly in the German wine market. It is based on the statistical data provided by the German Wine Institute and the OIV. The data have been processed into the following indicators: world vine surfaces, world wine production, world wine exports-mainly Germany-the wine consumption. During the analyzed period, the surfaces have continuously been decreasing, but the production and the consumption of wine was stable. Germans drink less wine in restaurants and more at home in order to save money. That's why; the already well-known wines are easier to be sold. The online sales of wine have also increased fact which represents a real for the Romanian wine, to build up a market with a low budget. The main quantities of wine are sold in Germany through the discounter Aldi. Aldi buys only already "sold wines". The Romanian wine needs more explanations and time to reach the customer. As a conclusion, the German wine market is a difficult, but interesting one for the Romanian high quality wines. The task is to convince the customer by a good price, quality report in a certain period of time when the economical crises makes the customer more careful in this buying decisions.

Key words**:** *wine, demand evolution, German market, Romanian export*

INTRODUCTION

Wine is an important product of the Romanian agriculture as well as, a "multifaceted product, rich in tradition which can, in many regards, be distinguished from other consumer goods. Nowadays, wine serves not only as a thirst quencher, but often plays cultural functions as meeting friends and family, socializing, indicating social class; in order it may be consumed in conjunction with eating and visiting restaurants, as an aperitif, etc." [6].

Respecting the overall EU economy, Romania needs to find its own resources and align its products with the European Union required standards.

In this direction Romania has to do a lot. Beginning with the year 1994, Romania has received support from the German government, through the organization named GTZ under the motto: "Help for self-help".

This German bilateral initiative, which was carried out on behalf of the Federal Ministry for Economic Cooperation and Development (BMZ) by the agency of the Society for Technical Cooperation (GTZ), was not a singular case.

There were a number of EU projects, such as PHARE or others defined as twinning projects, which tried to increase competitiveness in Romania. The projects were carried out in different industries and with different budgets as well as differentiated task description. The common aim of all of these projects was to make Romania a strong partner in Europe.

In the "Agenda 2000- Chapter of the extension" are shown the specific agricultural programs meant to assist the applicant countries, such as SAPARD.

Romania should develop the industries where it has the potential to come up to the market with products which cannot be produced in other countries at the same quality or with the same dedication. For example, the wine production for which Romania has the optimum climatic conditions and ideal soil conditions is a perfect sector for increasing the export. This is also one of the main EU objectives: to achieve a better

balance between supply and demand in the domestic market, and, on long term, to improve the competitiveness of the sector (AGENDA 2000).
The origin is increasingly seen as a determining factor in food consumer's choice. Consumer research in the food industry shoes that the country of origin or region of origin is one of the most important factors which determines the decisions to purchase [1].
Wine is for Romanian agriculture a very important product, on the one hand, the surface and on the other one, for social reasons regarding the approximately one million people working in the wine industry.
The German wine market is the largest export market for the Romanian wines and in the same time, the largest import market for wines in the world.
A vast array of product differentiation and a large number of international suppliers characterizes the German wine market. As a result, we find an extremely strong competition regarding supply and a vide diversity for the consumer's needs satisfaction. The consumer selects the product that maximizes his utility, based on his own preference structure [12].
Buying wine is not an easy task any more. The customer is confronted with a great deal of information which influences the purchase [10]. The German wine market is incredibly crowded with a lot of suppliers from all over the world. In comparison with the purchase of consumer goods, the wine buying faces numerous influencing factors.
Thus, in addition to price, product characteristics, product brand, country of origin, grape variety, the name of the winemaker, the vintage, the alcohol, taste, packing and quality is important for the purchase decision [9].
In 2006, the authors Gergaud and Livat considered that "regarding wines, consumers mainly rely on the label to infer quality" [4].
Using a multi-attribute Conjoint Analysis, Haller & Ebster from the University of Applied Science in Burgenland/Austria, discovered in 2005 that a part price, the closure of a bottle influenced the purchase intention most.
What follow is the grape variety and the country/region of origin. Label and alcohol came after these factors, with comparably smaller significance [5].

MATERIAL AND METHOD

The demand theory provides conceptual constructs the forward-looking statements within the empirical demand analysis to develop and analyze the relationship between demand and its determinants.
The theoretical basis for empirical demand analyzes are due to the economic theory of demand.
The empirical investigation leads to a casual relationship between the manifest demand determinants, with the aim to derive predictions about future developments in demand and the formulation of general hypotheses [12].
The marketing theory has always paid a special attention to the determinants of the consumer's behaviour.
A particular interest is not only the simple view in the purchase decision process, but also the information about the effect of various marketing tools and other environmental factors on the buying behaviour [11].
The types of consumer behaviour focus on the activity of the individual in the field of information extraction and their processing.
According to Meffert, there are four types of buying behaviour:

- First Rational behavior,
- Second Habitual behavior,
- Third Transient response,
- Fourth socially dependent behavior.

Rational behaviour is defined as a deliberate and planned use of resources to achieve goals and the best possible use of information.
When custom behaviour is dispensed, new solutions and transient response is to act spontaneously at the moment.
If the consumer is directed according to the norms of his environment, he has social-dependent behaviour [11].
Purchasing decisions can be influenced by various determinants.

The most important are structured as follows [8]:
- First Intrapersonal variables:

a. Activating a process
   i. emotions
   ii. motives
   iii. settings
b. cognitive processes
   i. perception
   ii. Learning
   iii. problem-solving
c. predisposing variables
   i. communications
   ii. Personality
- Second Interpersonal Variables
a. influences on a company level.
   i. cultural influences
   ii. subcultures
   iii. social classes
b. influences on the level of the group
   i. membership groups
   ii. Family
   iii. Reference groups.

In order to evaluate the German wine market, the following indicators have been used: total vine cultivated surface, total production, wine import and wine export. The period looked into in this study was 2000-2011. The data, collected from the OIV, have been statistically processed and interpreted, building the trend time.

The customers have to evaluate the products according to their personal preference and to put them in an order as: the best, the second best, etc. The attributes presented were the country of origin (Germany, Chile, Romania), price (less, than 5.00€, between 5.00€ and 9.00€, more than 9.00€ and the colour of the wine (red or white).

The conjoint analyses are a technique allowing the determination of the preferences regarding product by using a decomposition model. The advantage of the conjoint analyses is the possibility to simulate a real choice situation where products with a combination of attributes are available [3].

A purchase without tasting the wine was simulated for the conjoint analysis. By presetting a buying motive (a friend's birthday party on a Saturday night) and the attributes presented before the variables for the preliminary decision were defined.

RESULTS AND DISCUSSIONS

The world total vineyard surface seriously decreased a lot in the period 2000 - 2011.

But the decrease has come mainly from the European countries. The surfaces of vine in USA or China are continuously increasing.

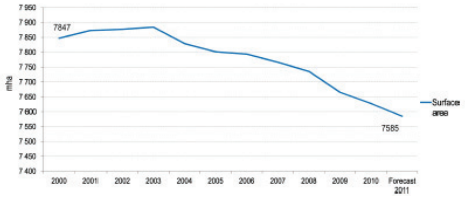


Fig. 1: Evolution of world vineyards [14]

A totally different trend is to be noticed in what concerns the grape production, which increased during the same period.

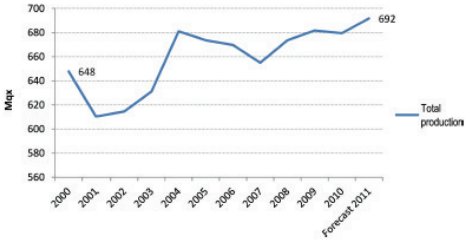


Fig. 2: World grape production [14]

Alike the increasing grape production is the wine production which, once up the down, has become more or less stable along the last 12 years.

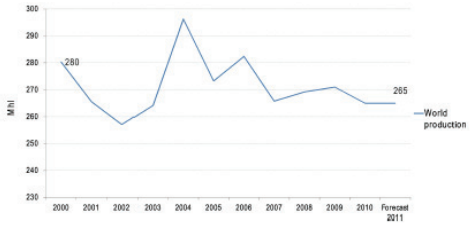


Fig. 3: World wine production [14]

Not only that Germany is one of the top 10 wine producers of the world, but it still remains the most important importer of the world.

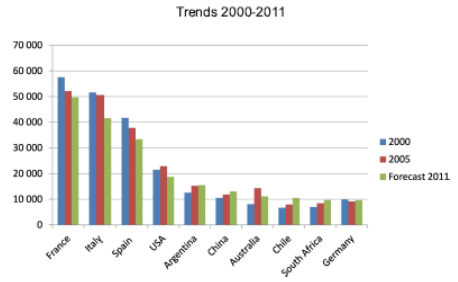


Fig. 4: World wine production [14]

Germany needs to import wine, because it is also the fourth biggest world wine consumer. Here is to be mentioned that Romania is on the tenth position.

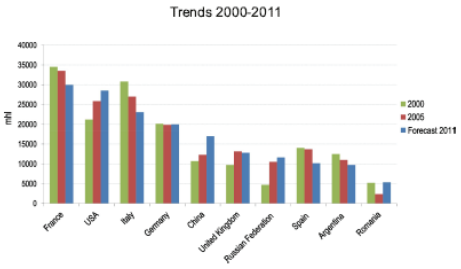


Fig. 5: World wine consumption [12]

Germany is one of the top 10 exporters of wine in the world, but the target of German wines does not aim to Europe.

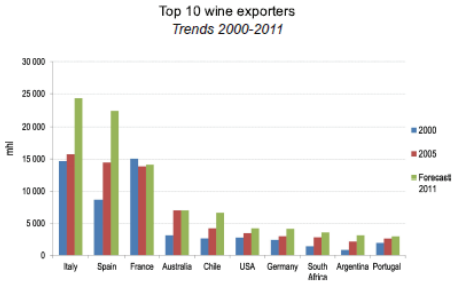


Fig. 6: World wine exporters [14]

The economic crisis did not have a major effect on the total German wine market. The total consumption has remained relatively stable, but consumers switched from on-trade to off-trade consumption; the share of still wines sold in the off-trade declined from 19% in 2008 to 16% in 2009 (Deutsches Weininstitut, 2010 /2011). Consuming wine at home saves them costs.

Off-trade consumption accounts for approximately 84% of the German wine market [13]. Off-trade consumption is especially successful due to discounters and private label offerings (one third share in volume). Discounters have a relatively strong position in the German market compared to other EU countries, with Aldi being the leading sales channel. Supermarkets and discounters accounted for 73% of the sales volume of wine but for only 54% of the sales value in 2009, thus illustrating their focus on low pricing, which is particularly successful during the current economic downturn [2].

In the German market, the positive sales and turnover development of recent years came to a stop in 2010, down by minus five and minus six percent, respectively. Nevertheless, with a 46% share of volume and 52% of value, German wine producers retained their leading position in the German market by a wide margin. Overall, consumers in Germany spent somewhat less on wine in 2010 (minus 2.7 percent), regardless of its origin. With only a slight decline in volume (minus 0.7 percent), sales could be viewed as relatively stable compared with the year before. [13]

In 2009, white wines posted a small increase in sales, the market share for German white wines increased from 46 to 48 percent, which reflects the fact that the vineyard area devoted to white wine varieties – particular Riesling and white Pinots – grew from 63.6 to 64.1 percent during the past two years [13].

"With the international market exports of quality wines were worth 285 million €, or six percent more than in 2009, and reached a volume of 1.2 million hectolitres, an increase of eight percent in 2010. In 2010, the demand for quality wines from Germany's wine-growing regions remained strong. Exports of quality wines were worth 285 million Euros, or six percent more than in 2009, and reached a volume of 1.2 million hectoliters, an increase of eight percent in 2010. Since official statistics on wine exports have been adjusted to reflect the introduction of the EU wine classification based on indication of origin, smaller volumes of wine without a protected indication of origin and Landwein have been recorded than in the previous years. Bearing this in mind, total wine exports in 2010 were valued at 355 million Euros, a decrease of 9.9 percent, and a total of

1.74 hl were exported, or fifteen percent less than in 2009.
Based on the new classification criteria, the 2010 statistics reflect significant decreases in the value and volume of exports to Great Britain and the Netherlands: declines of 37 and 36 percent in Great Britain, and 33 and 30 percent in the Netherlands, respectively.
On the other hand, developments in Germany's most important export market, the USA, were particularly positive with 21 percent increases in both value and volume during the past year. Scandinavian markets also showed growth, particularly in the white wine segment. With a market share of 33 percent of white wine sales, German wines were market leader in Norway in 2010. German white wines also ranked well in Sweden (2nd place) and in Finland (3rd place) among white wine imports. In up-and-coming markets, such as China, German wine exports showed growth rates in value (+69 percent) and volume (+64 percent). Values of exports to other markets also increased in 2010: Canada (+15%), Russia (+11%), Japan (+5%), and Switzerland (+29%).
Increasingly positive media mentions as well as growing recognition of the high quality German wines among wine professionals worldwide are encouraging signs that the value and volume of quality wine exports will increase in coming years.
However, because of the extremely short crop in 2010, it will be a great challenge for German wine producers to achieve this goal in 2011" [13].
Health is a value of great importance for the German consumer, but over time it has changed its meaning breaking away from the purely medical understanding. The concept of health has changed lately, turning into a merely general well-being state, provided by the quality and joy of life.
The many players in their heterogeneous structure and the diversity of the wines are again reflected in the various distribution channels. A rough distinction is first seen in direct sales, for example the marketing of wine to the consumer (sales from the farm), and indirect sales through the various forms of trade and catering [7].
The channel of sales from the farm, the winery, vineyard or wine cooperative is mainly the channel for German wines.
Romanian wines are currently represented only at the discount stores and food retailers (99%). Less than 1% of the quantity exported is sold through mail order, retail and other shopping sites. The relative importance of the attributes in the conjoint analysis are calculated by means of this analysis.

Table 1. Relative importance of the conjoint attributes

Relative importance of the attributes	Price 39,5%	Origin 30,6%	Color of the wine 29,9 %
Path – worth of attribute level	≤ 5,00 € -0,300	Germany 0,150	White -0,252
	5,00 € - 9,00 € +0,421	Chile +0,078	Red +0,252
	≥ 9,00 € -0,121	Romania -0,228	

Therefore Romanian wines are bought only price. We have no image in the market. Our wines are therefore unknown for the consumer in the best case. In the worse case the Romanian wines are known as a cheap, sweet wine at a discount store. Therefore, the Romanian wine average price per liter is 0.58 €. This price does not even cover the production costs, taking into account the low income, the low production per ha and the lack of automatisation.
Higher prices and qualities are not accepted by the importers for anonymous commodity on the world market.
Statistics show that generally foreign wines are sold through discounters, supermarkets and food retailers. Requirement for a distribution is a large budget to ensure the sale, to ensure advertising and merchandising.
But in case the budget for advertising is too low, this situation can be improved only through the advice of the supplier and the top quality of the products.
Online sales show a growing trend in Germany, and can provide opportunities to DC suppliers.

CONCLUSIONS

By selling their wine online, exporters who are not well-known on the German market can

provide information to the customers and importers about their wines.

The online wine sales can be used as a promotion of the Romanian wines, as well as for increasing the information about Romania as an important wine growing country. Moreover, this can save transportation / storage and distribution costs.

What sometimes happens is that importers place an order online, and have it shipped directly to their customers, which saves costs again. This is the chance for Romanian wine to build up a market with a minimum budget.

The main quantities of wine in Germany are sold through the discounter Aldi. Aldi is buying only already "sold wines". Romanian wine needs more explanations and time to reach the customer.

As a second conclusion, we may say that the German market is a difficult one, but as well as one for the high quality wines from Romania, which can convince the customer by a good price quality report in a period of time when the economical crises makes the customer more careful in his buying decisions.

The price quality report in the case of the Romanian wines needs to demonstrate a real quality advantage for the same price as other well known and already established wines on the German market.

ACKNOWLEDGEMENTS

This research work was carried out with the support of Professor Dr. Ioan Namolosanu from the University of Agricultural Sciences and Veterinary Medicine, Bucharest and was privately financed.

REFERENCES

[1]BECKER, T. 2000. *Quality Policy and Consumer Behaviour in the European Union.* Kiel: Editura Ştiinţifică Vauk.

[2]Database, C. M. 2012. *www.cbi.eu/disclaimer*. Retrieved July 07, 2012, from marketinfo@cbi.eu: www.cbi.eu

[3]GEEN, P., & SRINIVASAN, V. 1978. Conjoint Analysis in Consumer Research. Issues and Outlook. *Journal of Consumer Research, Vol. 5* , 103 - 123.

[4]GERGAUD, O., & LIVAT, F. 2006. How do Consumers Use Signals to Assess Wine Quality? *Proceedings of the 3rd International Wine Business and Marketing and Research Conference.* Montpellier, France.

[5]HALLER, T., & EBSTER, C. 2006. *Ermittlung der Akzeptanz alternativer Verschlusssysteme bei Wein, Ergebnisbericht einer Studie aus Ostösterreich.* Eisenstadt, Austria: foaie de lucru a Fachhochschule - Magisterstudiengang Internationales Weinmarketing.

[6]HATAK, I. 2008. PURCHASING WINE AS A GIFT. *4th International Conference of the Academy of Wine Business Research*, (p. 1). Siena.

[7]HOFFMANN, D. 2012. Der Weinmarkt in der Welt. *www.gjae-online.de.* [Online] 2012. [Cited: 07 July 2012.] GJAE, Supliment.

[8]KROEBER-RIEL, W. (1992). *Konsumentenverhalten.* München, Germany: 5th Edition.

[9]LEITNER, E. 2007. *Einflüsse auf das Kaufverhalten von Weinkonsumenten im LEH. Eine Studie am österreichischen Markt mittels der Best-Worst Methode.* Burgenland, Austria: Master Thesis, University of Applied Sciences.

[10]LOCKSHIN, L., & HALL, J. 2003. *Consumer Purchasing Behaviour for Wine: What We Know and Where We Are Going.* Adelaide, Australia: Proceedings of the International Colloquium in Wine Marketing.

[11]MEFFERT, H. (2000). *Grundlagen marktorientierter Unternehmensführung.* Wiesbaden: Gabler, 9th Edition.

[12]ROSÁRIO, T. 2002. *Marktanalyse eines kleinen Anbieters in einem heterogenen Markt - das Beispiel portugiesischer Weine in Detschland.* Stuttgart: Universität Geisenheim.

[13]*www.deutscheweine.de*. (n.d.). Retrieved July 07, 2012

[14] *www.oiv.com (n.d.). March Report*