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COMPARISON APPLE BIO PRODUCTION ON CULTIVATED AND GRASSED AREA

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Abstract

Biological agriculture is an important priority in the thematic priorities of the European scientific programs and in agricultural development policy in each country. This article presented apple bio production in the territory of the village of Yagodovo, Plovdiv district, Bulgaria. Growth parameters are monitored on two types of areas - cultivated and grassed. The analysed indicators are cross-sectional area of the stem, average weight of fruit, number of fruits per tree, productivity coefficient. Each of the parameters has a different impact on the biological development of the fruits. The results show better values when growing on a grassed area compared to a cultivated area, regarding the parameters: average weight of fruit, number of fruits per tree and productivity coefficient. The indicator `cross-sectional area of the stem` has a better result when growing apples on a cultivated area than on a grassy area. The results for each of the indicators are presented in a digital model by Geographic Information System-GIS, in order to more fast, rational and modern use of technology by young farmers.

Key words*: apple growing parameters, organic production, cultivated area, grass plot area, GIS.*

INTRODUCTION

Organic fruit production is a system that limits the use of artificial fertilizers, synthetic pesticides, growth regulators and genetically modified organisms (Ordinance No. 1 of 2013). The key principles and practices of organic production aim to maintain long-term soil fertility, supply plants with the necessary nutrients through natural or organic fertilizers, control weeds, enemies and diseases through crop rotation, use of natural predators and limitation of chemical treatments in order to protect the environment- biodiversity, water, etc. (Peck et al., 2006; Herencia et al., 2007; Merwin and Peck, 2009; Singhet al., 2009).

In recent years, the areas for organic production have been increasing, but for the venture to be successful, it needs effective management of soil fertility, ensuring economic profit and maintaining fruit quality standards.

The market for organically produced fruits grows and attracts more and more customers who choose a product with desired qualities and the idea that organic fruit production is a promising economic model is strengthened. Europe is a major global market and producer of organic food and the area continues to grow.

In Europe and in many countries around the world, the demand and production of organic fruit is increasing. Fresh fruits and vegetables are the most preferred organic products in Europe and are about 1/3 and 1/5 of those sold in markets.

Europe is the world leader in the sale and production of organic food. Areas under fruit crops include 192,700 ha of vineyards, 187,000 of nut, 94,800 of temperate fruit, 26,096 of berry and 31,800 of citrus. Western Europe has added a new 4,000 ha of organic apple production in the last two years, due to the increased market demand for organic fruit and the reduction in the cost of conventional production (Staneva and Gospodinova, 2018).

The development of apple industry played an important role in increasing the income of farmers and improving the live style people. However, in Bulgaria, the increasing in apple production is mainly dependent on the high input of agricultural means of production, particularly chemical fertilizers and pesticides. Statistics showed that Bulgarian's apple cultivation area accounts for 4433 ha, whereas the consumption of chemical fertilizers and pesticides increase. The excessive use of fertilizers and pesticides not only leads to the waste of resources, but also brings water eutrophication, increases greenhouse gas

emissions, and further degrades soil quality (Guo et al., 2010; Zhang et al., 2012), which, in turn, are all crucially connected to food safety problems, thereby prompting extensive social discussion on how to resolve these issues.

In Bulgaria, there are prerequisites for organic fruit production, but a lot of knowledge and a great desire of the producers are needed to deal with this type of production. In the country, organically produced fruit species are grown on 2155 ha.

With the intake of healthy foods, one of the positive aspects of organic farming is the desire to reduce the harmful effects of the application of pesticides and mineral fertilizers, since organic farming restores the natural balance in the environment.

The yields in organic production of apples are often 15-30% lower in comparison with conventional or integrated production guidance. Inconstant and lower yields are often due to insufficient fruit load, ineffective control of enemies, diseases, weeds and nutrient deficiencies. The reasons are: lack of sufficiently effective plant protection from diseases and enemies, strong competition with weeds, distinct alternative fruiting (Weibel, 2002; Bertschinger et al., 2004; Gianessi and Williams, 2006).

The studies by Reganold et al. (2001) of conventional, integrated and organic apple production in the USA showed that there were no significant differences in yields, but the organic system provided better soil quality and the environmental impact was lower compared to the conventional system. When comparing conventional and integrated systems with organic, it turns out that the latter provides sweeter and less acidic fruits, higher yield and greater energy efficiency.

A similar study was conducted in southern Brasilia, where yield and quality were assessed of fruit production in two varieties of apples (Royal Gala and Fuji) under conventional and organic production systems (Amarante et al., 2008). Trees grown under the biological system had lower potassium, magnesium and nitrogen content in leaves and fruit in the cultivars, smaller fruit and lower Fuji yield compared to the conventional system. Fruits picked when ripe for consumption from the organic garden have a stronger yellow skin colour, a higher content of soluble salts, density, hardness, more strong reddish-brown coloration.

The already established intensification in agriculture necessitated the use of non-traditional products in applied agricultural techniques for growing different crops. One of them is a soil moisture superabsorbent. As a result of its use, mainly in the production of fruit beds and in vegetable production, high achievements have been registered in terms of yields, savings of the most valuable natural resource - water, savings of human labour, improvement of soil structure, microbiological activity, good development, both on the above-ground mass of plants and on their root system, etc. (Popova et al., 2016; Dobrevska and Dallev, 2020; Atanasov et al., 2020).

These are the reasons why this product was studied in horticulture in the production of apple fruits. The aim was to determine to what extent changes in soil components, as a result of using a moisture absorbent, will change growing conditions and lead to obtaining first-quality apple fruits.

MATERIALS AND METHODS

This study presented information about previously applied agricultural practices in the field of apple bio cultivation. The presented practices have been managed for a period of five years in an orchard with Florina variety – grafted on MM106 rootstock – as a part of bio production of fruit at the Agroecological Centre of the Agricultural University - Plovdiv.

The experiment was conducted in experimental apple plantations of the Florina variety at the Agricultural University - Plovdiv, grown in a organic way.

The plants in the plantation for organic production are grown according to traditional technology. It includes plant protection measures (three prophylactic winter ones, directed against the wintering forms of economically important diseases and enemies and numerous vegetation ones), nourishing fertilizing, localized drip irrigation and several soil treatments. The processing was done with a specialized technique for deep and shallow processing in fruit plantations (Borovinova and Juvinov, 2013; Todorov et al., 1974). The inter-row distances in the plantation are maintained

in two ways – through a fallow system (cultivated area) and a mulching system (grassed).

In connection with the first, during the growing season, several shallow treatments were made in the inter-rows, which would lead to a good supply of nutrients, a good air and water regime. The treatments are also used to destroy weeds.

In autumn, a deep processing of the rows at 18-20 cm was also done. The tillage machinery system used is: plough, disc harrow, cultivator and tiller. In the second system of maintaining the rows, they are grassed, and the grass is periodically mowed.

Mowing is done with a mulcher, which saturates the mowed mass and places it in the inter row on the grasses. With their roots, they contribute to the good loosening of the soil, which leads to a favourable air and water regime in it. In this connection, the microbiological activity is also improved and the soil is enriched with organic substances.

The other agricultural practices carried out in the plantations are fertilization and plant protection. Fertilization was carried out with a centrifugal mounted fertilizer, equipped with deflectors for applying the granular fertilizers close to the trees. With a trailed fan sprayer, in addition to plant protection, liquid fertilizers were also applied.

The plants in the plantation for biological production are grown using technology without the application of mineral fertilizers and synthetic pesticides.

Bio fertilizers and bio plant protection preparations were used. The inter-row soil surface is supported by the same two systems described above.

Irrigation is well dosed and localized drip. In the spring, during the "early growth" phase of the "growth" phenophase, moisture absorbent was applied to the soil at a dose of 5.5 kg/dka.

RESULTS AND DISCUSSIONS

In this study, information regarding previously applied agricultural practices in the field of apple cultivation is presented to your attention.

The practices have been conducted for a period of five years with Florina apple variety orchards, grafted on MM106 rootstock, as a part of the bioproduction process at the Agroecological Center of the Agricultural University - Plovdiv, located nearby the village of Yagodovo, Plovdiv region.

Figure 1. Llocalization of the researched area within the borders of the Republic of Bulgaria

For maximum results when growing crops in an organic production environment, it is good to apply modern methods of localization and good presentation of the results of the experiments through the so-called Geographical Information System (GIS). The possibilities of GIS for presentation and analysis of the results are many and different, but the most important role of the system is the presentation of research visually on maps. In this way, the results are easier to perceive, the analyzes of multiple data are fast and easy to edit and modify. Multi-level information is created that is easy to transform into maps showing the results achieved.

In the study of different growth and reproductive indicators of apples variety Florina through bioproduction on a cultivated and grassed area, GIS presents the studied territory and its localization.

The village of Yagodovo is part of the Rodopi Municipality, which is located in southern Bulgaria, southwest of the city of Plovdiv and administratively belongs to the Plovdiv region of the same name. According to the provisions and territorial division of the Regional Development Act, it is included in the South Central Planning Region (South Central Planning Region, NUTS 2).

Figure 2. Map of the Yagodovo village in Plovdiv region

The village of Yagodovo is located in the Thracian plain, 9.5 km from the center of Plovdiv. It is located at 165m above sea level in the southern part of Bulgaria. The terrain is mostly flat with gently sloping terrain. For the studied territory, the average annual temperature is about 18°C.

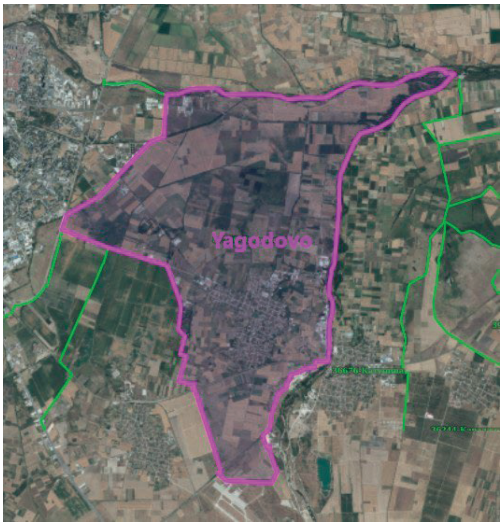

Figure 3. Terrain map of the studied area

Average maximum temperatures are within 30°C and average minimum temperatures are around 6.5°C. The amount and distribution of precipitation during the year varies widely, with a tendency to regroup in one spring and one winter maximum, within about 530-560mm. The plain territories of the Rodopi municipality are of the alluvial - deluvial meadow type, deluvial and deluvial-meadow type, with a predominant representation of the deluvial ideluvial-meadow soils.

The combination of very good soils, with a temperature sum for the growing season of 4,400°C, allows even the most heat-loving crops to be grown on these grounds. The low water reserves in the flat areas and the good soil and climate conditions for the development of an efficient agricultural sector, determine the need to introduce irrigation into the agricultural practice agriculture and technology (Integrated Development Plan of municipality of Rodopi for the period 2021-2027). The next map presented the studied area in coordinated systems WGS 84 / UTM zone 35N, the urban and agriculture parcels.

Figure 4. Property boundaries of the agricultural territory of the studied area

As a result of the experiment, higher values of instantaneous humidity were recorded during one of the most significant phases of the phenophase of apple growth - the "strong growth" phase. During the previous growing season, seven irrigations were made in the experimental plots by means of a drip system and an irrigation rate of 40 m^3/dka. As a result of the experiment, watering was reduced to four. A higher productivity coefficient was also

reported (Table 1). It expresses the weight of the fruit relative to the cross-sectional area of the stem. In both variants, with cultivated and cultivated area, higher values were shown by the trees in the cultivated areas.

Table 1. Growth and reproductive manifestations of apples variety Florina in organic production

Florina apple bio production		
	Types of area	
Parameters	Cultivated	Grassed
Cross-sectional area of the stem (cm^2)	116,92	110,05
Average weight of fruit (kg)	0,151	0,172
Number of fruits per tree	116,15	121,57
Productivity coefficient (kg/cm^2)	0,15	0,19

The plants from biological production field were cultivated according to a technology excluding the use of mineral fertilizers and synthetic pesticides. Only bio-fertilizers, as well as plant-protection agents were used. The soil surface in the inter-row space was maintained according to the aforementioned two systems. Localized drip irrigation was precisely-dosed.

During the research, growth and reproductive indicators of apples of the Florina variety were considered. The territory of the village of Yagodovo is favorable for the cultivation of organic production. The apple orchards are grown on two types of land - cultivated and grassed. The indicators that have been studied are: cross-sectional area of the stem (cm^2); mean fruit mass (kg); number of fruits per tree; productivity factor (kg/cm^2). In both variants of the area, the same plants were studied. The investigated indicators give different values for different areas.

In apple plants grown on a cultivated area, the index of cross-sectional area of the stem has a better value of -116.92 (Table 1), compared to apples grown on a grassy area with a coefficient of 110.05.

The indicator number of fruits per tree has similar values, with the harvested area having about 6 more apples than the cultivated area. The average weight of a fruit has better indicators in a grassy area than in a cultivated one.

The indicators are the same when studying the coefficient of productivity, and again with a grassy area the values are better.

In general, three of the studied indicators have better values when growing apples in a grassy area. This leads to the conclusion that in a grassy area apples of the Florina variety have better growth indicators.

Organic apple production on grassed area shows much better fruit parameters and leads to better economic and market benefits.

The main concern of organic production is that all activities protect the environment. At the same time, they must be economically viable. The implementation of plant protection measures according to these requirements is changing. It is economically acceptable for crops to be effectively protected against disease and pests, taking into account the impact on organisms.

This information, combined with future studies of soil composition, as well as vegetative and reproductive manifestations of plants, can be used to develop a database enhancing the access to knowledge and experience in the future and facilitating the comparison and selection of the most appropriate agricultural practices for apple cultivation.

CONCLUSIONS

A number of ecological factors influence fruit preservability and quality. While it is difficult to assess the weight of each factor individually, either one of them, including soil type, latitude, altitude and temperature fluctuations, etc., may be of significant importance.

The studied system for the production of apple fruits in the experimental plots for organic production with cultivated and weeded inter rows development shows:

- Reduction of watering during the vegetation;
- Higher values of instantaneous humidity during one of the most important phases of tree growth;
- Higher productivity factor.

This system can be implemented in practice and used as a model system in the production of fruit and other fruit species.

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