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RESEARCHES REGARDING QUALITY AND QUANTITATIV PERFORMANCE OF SOME TABLE GRAPES IN THE EXPERIMENTAL FIELD OF USAMV BUCHAREST

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Abstract

The main processes of fecundation and pollination on vine are largely influenced by the genetic profile of the variety, external factors involved like - temperature, precipitation, insolation, relative humidity and also by special crop techonology applied. The aim of this research was to study some of the most grown table grapes varieties in Romania (and also worldwide), varieties which belong to a the same kin group - 'Muscat Hamburg' cv., 'Muscat d'Adda' cv., 'Afuz Ali' cv. and 'Victoria' cv. For example, 'Muscat d'Adda' cv. has been obtained by self-pollination of 'Muscat Hamburg' variety and 'Victoria' variety has been obtained by crossing of two cultivars Cardinal and 'Afuz Ali'. The results showed that the quantity and qualitative performance of these varieties, expressed by productive indices, carpometric values of grapes and berry and also organoleptic qualities has been influenced both by special crop technology (isolation of inflorescences and pinching fertile shoots a few days before blooming) and by environmental factors recorded during the study. In the study, has been obtained higher average values of the most analyzed indicators and the best results have been recorded by: 'Muscat Hamburg' cv., 'Muscat d'Adda' cv., 'Afuz Ali' and lesser, but also in positive limits, 'Victoria' variety.

Key words*: cluster, inflorescences, phenology, table grape, yield.*

INTRODUCTION

It is well known that the quantitative and qualitative parameters of the harvested crops are influenced by the environmental factors, like the soil type, the technology applied, the genetic nature of the varieties, but from all these factors, the greatest impact has the climate, (Jones, 2005; Cleland et. al., 2007; Gladstones, 2011; Shinomiya et al., 2015; Van Leeuwen and Darriet, 2016). Practically, in the most wine-growing areas, there are recorded more and more changes in the climate as a results of the high average temperatures, due to low precipitations followed by extreme events (Tomasi et al., 2017). Even though, the annual sequence of phenological stages of grapevine is commonly observed to be accelerated with an increase in temperature (Duchêne and Schneider, 2005; Duchêne et al., 2010; Parker et al., 2013; Blanco-Ward et al., 2017), the annual cycle of the vine, the flowering, fruit set and also the ripening of the grapes depends very much on the factors mentioned above.

Due to unfavourable conditions during flowering and the way the pollination process has been carried out, the percentage of fruit growth will be different and the fruit set will have a different evolution developing the millerandage phenomenon (Dobrei et al., 2005). This phenomenon is quite common on the grape varieties that require foreign pollen, like 'Muscat Hamburg', due to the low pollen germination and in this case the growth of berries it stops at 6-7 mm, due to the lack of hormone substance, this it may also occur in grapes varieties that develop incompatibility of its own pollen (Constantinescu et al., 1959; Lepadatu, 1979; Stroe et al, 2014). After this phenomen occurs, the berries start ripening earlier and gain higher quantities of sugar, but, at the time of harvesting, the quality of grapes is shortcoming, especially in table grapes varieties. Even more, various studies have shown that gaining excessive sugar, it is not

followed anymore by an optimal polyphenolic and aromatic ripening; the intake of grapes is alterated; in fact, the difference between aromatic and phenolic content and tehnological ripening (ratio between sugars/acids) is always higher. This may lead to the conclusion that obtaining well-balanced yield in terms of quantitative and qualitative parameters is a constant challenge for the viticulturist. Based on this consideration, the aim of this study has been to analyze the evolution and influence of climatic factors in 2017, in a critical period for the vine (20 May - 20 June), in conjunction with 2 special cultural techniques - the isolation of the inflorescences and pinch of the growth peak of fertile shoots on table grapes. The result of the experience has been analyzed also by quality parametres of the grapevine products (yield) influenced by this factors.

MATERIALS AND METHODS

2.1. Plant material and growth conditions

Four grape varieties were taken in the study: 'Muscat Hamburg' cv., 'Muscat d'Adda' cv., 'Afuz Ali' cv., from the world collection and 'Victoria' cv., variety obtained in Romania in 1978 by 'Victoria' Lepădatu and Gh. Condei (Table 1). The main updated data on these varieties can be found in the Vitis International Variety Catalog (www.vivc.de). In Romania, the first three listed varieties occupies the largest areas, although all three varieties have proven over the years to be sensitive to temperature and humidity factors during flowering phenophase. Grape table varieties are located in the experimental field of the ampelographic collection from the University of Agronomic Sciences and Veterinary Medicine of Bucharest. During the study, has been made basic observations and determinations, commonly used in the current technology, but attention was directed to the carpometric elements that define the productive and qualitative potential: average weight of a grape (g), average weight of a berries (g), yield (kg/vine), ^{0}Brix, (refractometric), total acidity (g tartaric acid/L by titration), sugar-acidity indices.

2.2. Phenological and temperature data

During the study, meteorological parameters (temperature, precipitation, relative humidity) have been analyzed during 20 may - 20 june 2017, using the daily average from 6 hourly data (05:00, 08:00, 11:00, 14:00, 17:00, 20:00, 23:00) registered at Bucharest - Baneasa, Romania. The forecast was performed over a longer period just to ensure a better accuracy of the results, although the flowering phenophase of the studied varieties lasted 12 days (29 May-10 June 2017). For the acknowledgement of the flowering phenophase, the study used the updated version of the universal scale for the description of Monocots and Dicotyledons numbered 00-97, with a special look at the main growth stage 6: Flowering, stages 61 and 67 and main growth stage 7: Development of fruits, 71 and 77 (Pierot and Rochard, 2013). Three observations have been made at different growing stage (Table 1), taking into account all the inflorescences on 6 vines but the isolation of the inflorescences in waxed paper bags and pinching fertile shoots were applied on three vine a few days before flowering for each variety, resulting in a total of 8 experimental variants. Harvesting of the grapes has been carried out at the full ripening stage of each variety.

RESULTS AND DISCUSSIONS

The studied varieties have reacted differently, indifferent by cultural applied techniques, in terms of the percentage of fruit set, the percentage of shaking of the formed flowers and the manifestation of millerandage phenomenon. The distinct character of the wine year 2017 in terms of climatic peculiarities led to an early age in terms of flowering onset (Cleland et al., 2007; Stroe et al., 2017), noting that all analyzed varieties bloomed at the end of the third decade of May. The phenophase period has been lasting for approximately 12 days (29 May-10 June 2017), with a gap of 2-3 days between varieties, as follows: on 'Muscat d'Adda' cv. and 'Afuz Ali' cv., blooming started on May 29, and at 'Victoria' cv. started later in two days. During the period of interest, the daily average temperature values have had significant fluctuations (Figure 1), but the 18.59ºC average, was even lower than the optimum of varieties in the first decade of May, only 15.5ºC, but in full flowering the value was

19.84ºC, even recording a ceiling of 20ºC between 3rd and 8th of June.

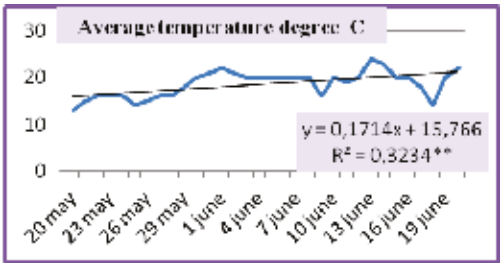

Figure 1. Evolution of the average temperature (°C) for flowering stage

In this matter, it can be seen that in the period mentioned above, the first three varieties were in the process of flowering, being known in the viticultural practice that a percentage of 20-30% of the total flowers bloom in the first 2-3 days of flowering, in the next 3-4 days bloom 60-70% and only a small percentage of flowers open at the end of the phenophase.

One important note is that the temperature at the end of phenophase for 'Victoria' variety was only 16°C (June 9), and this resulted in forming of a larger number of uneven berries, whatever experimental variant had analyzed. Figure 2 analysis the relative humidity values and their impact to the studied varieties. The average value had been 67.25% and the highest was 91% registered in the first decade of May. Practically, optimal values, close to the normal blooming range, 55-65%, had been registered on 26th of May.

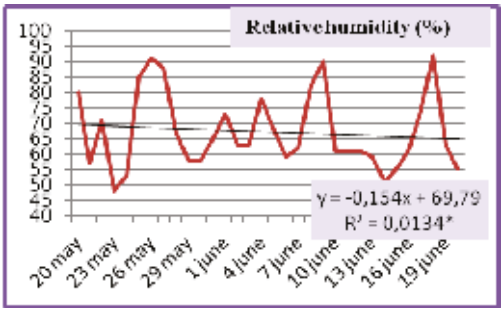

Figure 2. Evolution of the average relative humidity (%) for the period 20 may-20 june 2017

In the same period mention above, rainfall records a value of 37 mm, and in full flowering process, 24 mm (Figure 3).

Regarding to the special vine techniques - the isolation of the inflorescences and the pinch of the growth peak of fertile shoots - applied on

Table 1. The genetic origin of studied varieties

Prime name	Muscat Hamburg	Muscat d'Adda	Afuz Ali	'Victoria'
Variety number VIVC	8226	8050	122	13031
Country of origin of the variety	U. K.	Italy	Liban	România
Species	*Vitis vinifera L.*	*Vitis vinifera* L.	*Vitis vinifera* L.	*Vitis vinifera* L.
Pedigree as given by breeder/bibliography	Trollinger x Muscat Alexandria	Muscat Hamburg SP	-	-
Pedigree confirmed by markers	Schiava grossa x Muscat Alexandria	-	-	Cardinal x 'Afuz Ali'
Prime name of pedigree parent 1	Schiava grossa	-	-	Cardinal
Prime name of pedigree parent 2	Muscat Alexandria	-	-	'Afuz Ali'
Year of crossing	1850	-	-	1964
Last update	18.01.2018		18.01.2018	18.01.2018
Principal growth stage 6: Flowering				
61: Beginning of flowering: 10% of flower hoods fallen				
67: 70% of flowerhoods fallen				
Principal growth stage 7: Development of fruits				
71: Fruit set: young fruits begin to swell, remains of flowers lost				
77: Berries beginning to touch (if bunch are tight) I observation (31.05.2017) 70% of flowerhoods fallen; II observation (10.06.2017) Small-berry grape only formats; III observation (01.07.2017) Berries beginning to touch				
Muscat Hamburg	**'Muscat d'Adda'**	**'Afuz Ali'**	**'Victoria'**	
Isolation of the inflorescences + pinching fertile shoots 'Muscat Hamburg' (a)	Isolation of the inflorescences + pinching fertile shoots 'Muscat d'Adda' (a)	Isolation of the inflorescences + pinching fertile shoots 'Afuz Ali' (a)	Isolation of the inflorescences + pinching fertile shoots 'Victoria' (a)	
Pollination open 'Muscat Hamburg' (b)	Pollination open 'Muscat d'Adda' (b)	Pollination open 'Afuz Ali' (b)	Pollination open 'Victoria' (b)	

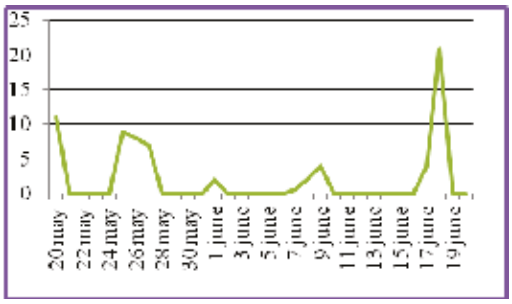

Figure 3. Evolution of the rainfall (%)
for the period 20 may-20 june 2017

27th of May 2017 for all experimental variants, in order to observe the percentage of berries formed (fruit set), self-pollination and open pollination, on one hand, and the uniformity of their size, on the other hand, it was observed that the percentage of berries binding (fruit set) varies from one species to another (Figure 4a), as follows: 'Muscat d'Adda' varieties and 'Muscat Hamburg' recorded the lowest percentage (21% and 23%, respectively), followed by 'Afuz Ali' (31%) and the highest percentage of berries formed by the 'Victoria' variety (48%), in the case of self-pollination and pinching fertile (a).

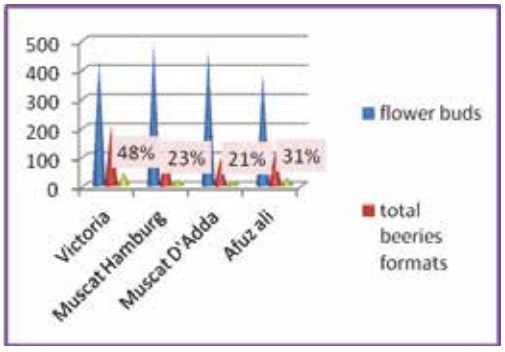

Figure 4a. Evolution of fruit set (a)

In the case of open pollination, a similar evolution had been observed, but the percentages registered a higher value for all four grape varieties (Figure 4b).
This shows that some varieties, even if they have normal functional hermaphrodite flowers, they have proved to have incompatibility with their own pollen (Lepadatu, 1979) as seen in the 'Afuz Ali' variety.

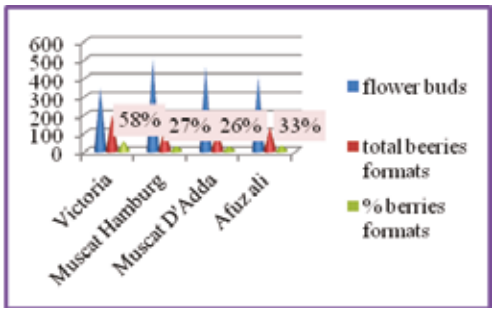

Figure 4b. Evolution of fruit set (b)

Figures 5a, 5b provide details of the size categories in which the berries are engraved, expressed as a percentage, and it was noticed that 'Muscat Hamburg' had developed very high percentage of normal berries (76.1%), followed by the 'Muscat d'Adda' (74%) and 'Afuz Ali' (71.1%), and the lowest percentage of normal berries was registered by 'Victoria' variety with only 55.5%, when the two cultural techniques were applied.

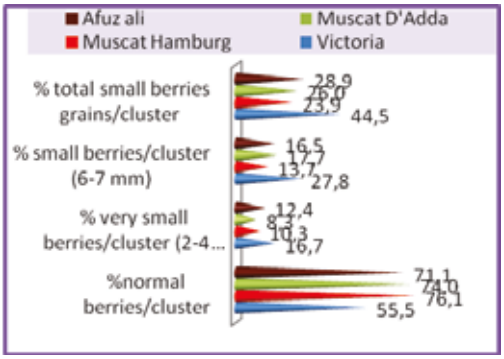

Figure 5a. Evolution of the categories
of grains formed (a)

For experimental variants with open pollination, the same things have been noticed, but with slightly higher values. Interesting and also surprising is that although 'Afuz Ali' and 'Victoria', for the two experimental variants, had the highest percentage of berries formed (fruit set), the proportion of grapes with a very small berries (2-4 mm millet grain size) and small berries (6-7 mm pea size) was more pronounced. Thus, the 'Victoria' variety had recorded 44% non-uniform berries in the case of the isolation of the inflorescences and 42% in the case of open pollination.

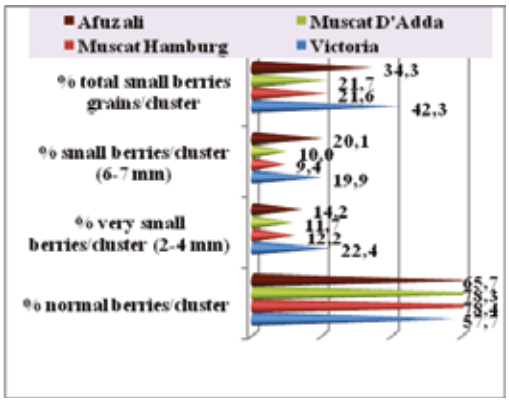

Figure 5b. Evolution of the categories of berries formed (b)

Variety 'Afuz Ali' had recorded smaller values, but different in both studied variants, a precentage of 29% in the isolation of the inflorescence and 34% in open pollination. This things indicates that it had been influenced by the climatic conditions on the last days of flowering phenophase when temperature recorded was 16ºC. The results obtained at this stage of development (flowering) are outlined in the quantitative and qualitative parameters of the obtained products (Table 2), reaching a high productive potential due to the large grape sizes, whose values are within the performance limits of the varieties analyzed. Regarding the quality, which is appreciated by the size of the berries and their uniformity, the data show at least for the 'Victoria' variety that the remaining berries are large, uniform in size, especially for grapes of the 'Victoria' variant (a) were the applied technology resulted in notable production increases (Paolicelli M. et al., 2013). To the other three varieties exposed to free pollination were found a similar evolution, with greater uniformity and bigger berries. (Rolle L. et al., 2015). The total content of sugars at full ripening expressed by °Brix or Total Soluble Solids shows that the varieties obtain optimal quantities, given by factors such as the gene of the variety, ripening period and also by the footprint of the climate factors, the values varies between 14.12 ^{0}Brix - 'Victoria' (s) and 22,13 ^{0}Brix - 'Muscat Hamburg' (b). In general, the values recorded are within the limits specified by O.I.V. and CODEX STAN 255 (2007, 2008b). According to CODEX STAN 255 (2007), table grapes can be harvested when the refractometric index reaches at least 16 ^{0}Brix. Grapes with a lower refractometric index are accepted provided the sugar/acid ratio (Total Soluble Solids/Tritatable Acidity – TSS/TA) is at least equal to 20:1 if the Brix level is comprised between 12.5 ° and 14 °Brix, 18:1 if the Brix level is comprised between 14° and 16 ^{0}Brix. Some table grapes, like the varieties chosen in this study can accumulate TSS higher than 16 °Brix, with low levels of acidity, thus leading to a TSS/AT ratio even greater than 30:1, (Antonacci et al., 2017). Some table grapes, as in the present case, can accumulate TSS higher than 16 ° Brix with low levels of acidity, leading to a TSS/AT ratio even greater than 30: 1.The concentrated values of sugars are followed by an acidity that gives the varieties balanced sugar-acidity indices, the highest values being recorded in 'Afuz Ali' (b) 5.52, and the lowest value for 'Victoria' 3.61, 'Victoria' variant (a).

CONCLUSIONS

The special cultural techniques for table grape varieties have a positive impact on quantity and quality parameters, but all of them on the background of a set of generous climatic factors, recorded in critical phenophase of vine (flowering, ripening). In all experimental variants, the quantities of sugar accumulated had been adequate, being in correlation with acidity, ensuring in this balanced sugar-acidity indices and also in line with the standards demanded by the consumer in the market.

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Table 2. Evolution of quality parameters on the experimental varieties

Experimental Varieties		^{0}Brix (as Total Soluble Solids, g/L)	Total acidity (g tartaric acid/L)	Gluco-acidometric index	Average weight of a berries (g)	Average weight of a grape (g)	Yield (kg/vine)
'Victoria'	a	12.68 109.87	3.51	3.61	6.44	889.47	9.33
	b	**14.12** 124.74	3.63	3.89	5.0	673.1	7.06
'Muscat Hamburg'	a	18.66 172.59	5.04	3.70	2.96	460.42	14.04
	b	**22.13** 209.7	4.65	4.76	3.34	364.06	8.00
Muscat d.Adda	a	19.22 178.9	5.3	3.63	3.97	502.23	11.80
	b	19.6 183.15	5.1	3.84	4.61	433.34	6.39
'Afuz Ali'	a	18.26 168.28	3.67	4.98	4.20	432.65	5.98
	b	20.7 194.83	3.75	5.52	5.55	447.88	6.19

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