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ANALYSES OF THE INFLUENCE OF CROP LOAD ON BIOLOGICAL AND PRODUCTIVE CHARACTERISTICS OF SOME TABLE GRAPE VARIETIES GROWN IN THE SEVERIN VINEYARD

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Abstract

The paper presents the results regarding the influence of the regulation of inflorescences on the vegetative phases of the Cardinal, Alphonse Lavalleé, Afuz-Ali and Victoria varieties. In parallel, the influence on some technological properties was studied, such as: the production of grapes, extra quality class, and first quality, second quality of grapes, carbohydrate content and acidity. The study was carried out over a period of three years, within the Severin vineyard, in the Severin - Dealul viilor wine center. The results showed that the number of inflorescences on the stem influences the moment of the initiation of the vegetative phases but also the productive properties; the crop load has been identified and ensures optimal results for each studied variety.

Key words*: grape, quality, vegetative phases, crop load.*

INTRODUCTION

Studies conducted on climate change in recent years have shown favourable ecological conditions for cultivating table or wine grape varieties but also the need to adapt viticulture technologies to new ecological challenges (Buzatu & Mărăcineanu, 2015; Mărăcineanu et al., 2020, 2021). Therefore the conclusion of a recent study (Chevet et al., 2011) was that the unfavourable influence of climate on the yield decreased over time due to the technological improvement.

The most favourable conditions for the cultivation of table grape varieties are in Romania, in the wine centers located in the south of the country, because the light and temperature resources are at a high level. This favours the creation of competitive varieties consisting of varieties with early, medium and late maturation, so that the market can be supplied for a long period of time. However, in the last 30 years, in Romania, the production of table grapes has decreased by 63% and the cultivated area has decreased by 73% while consumption is increasing after 2010 and is supplied by imports (Cichi et al., 2019). Another current issue refers to the insufficient promotion and cultivation of the newly created varieties, with proven superior productive features (Stroe, 2016).

Facing ecological and economic challenges, studies in recent years have focused on how the climate and the applied technology influence the vegetation phases and the quality of production in order to ensure the profitability of this crop.

A study conducted in France, over a long period of time, showed that the warm years ensure precocity in flowering, ripening and maturation, while the cold years extend the growing season. Also, after 1985, the trend of advancing the data for the onset of vegetation phases was noticed (Chevet et al., 2011).

The study was also confirmed in terms of the influence of extreme weather conditions on production by other researchers (Fontes et al., 2016).

The author also demonstrated the existence of climate variability within the vineyards, which requires a local climate assessment. Other researchers (Ruml et al., 2013; Jiang et al., 2020) show that temperature has higher influence on the onset of vegetation phases than the genetic factor and the difference between varieties increases in the years with extreme climate. There are also differences between clones, the longest period of time between

flowering and ripening being of 16 days between early and late clones (Houten et al., 2020). The inconsistency between the onset of phenophases for the same variety has also been reported (Reis et al., 2020). In Turkey, current climatic conditions lead to an increase in vegetative growth and the amount of wood removed during pruning (Demirkeser & Kamiloglu, 2020), while a solution to improve the carbohydrate/acidity ratio would be to set up plantations at a higher altitude.

The plantation maintenance system also proved to have an influence on the vegetation phases. Thus, full maturity for some wine grape varieties was recorded one or two days earlier, in the case of organic viticulture, compared to conventional viticulture (Stroe et al., 2020).

For table grape varieties, the summer pruning is important, as it ensures an increase in the quality of the grape harvest. A remarkable review of these works, with the description of the effects and the way of working was made by Lorenzo et al., 2011. However, the application of summer pruning remains an expensive technology because it is done manually. Good results were recorded for the Cardinal variety in the shoots thinning but also in the inflorescences thinning and shortening (Costea D.C. et al., 2017). Studies on the King Ruby variety have shown that it reacts well to shortening internodes, simultaneously with defoliation and ringing (Belal et al., 2016).

The influence of defoliation was also monitored for wine grape varieties and its effects are influenced by the characteristics of the variety and the time of execution. Thus, defoliation performed before flowering ensured the increase of grape berries skin thickness, maintaining the acidity of the stum and improving the taste qualities, leading to a better resistance to thermal stress but to a lower production (Poni & Bernizzoni, 2010).

The improvement of the grapes taste qualities, by defoliation at the beginning of ripening and its repetition after 15 days, was also confirmed by Pessenti et al., 2020. On the other hand, defoliation carried out 2-3 weeks after the end of flowering is able to reduce the attack of diseases but reduces the production by decreasing the weight of the grapes. In this case, the effects of defoliation are reduced if the variety has a long period of vegetation and high vigour (Nicolosi et al., 2012). In terms of crop load, it influences both the yield and the biological characteristics of the varieties. Basically, the high crop load leads to an increase in production but also to a decrease in the fertility of the respective variety and the weight of the grapes. The leaf area is larger in this case and is correlated with improved pollination (Lorenzo & Pisciotta, 2019). On the other hand, the low crop load favours the fertility of the varieties and the growth of the grapes (Abo-Elwafa, 2018). According to the author, it ensures a higher growth of leaves, shoots and chlorophyll content when distributed on shorter canes.

Studies carried out in Romania on Victoria and Coarnă neagră varieties have reached similar results. Thus, the high crop load is correlated with the decrease of the varieties fertility, with the decrease of the grape weight, the increase of the acidity and the grape yield and the decrease of the carbohydrate content (Popescu C., 2012).

MATERIALS AND METHODS

The study was located in a private plantation in the Severin vineyard and was carried out during of three years. The influence of the crop load, expressed by the number of inflorescences per plant, on the vegetation phases and the recording of the effect on the quantity and quality of production was observed. Four table grape varieties (Cardinal, Alphonse Lavalleé, Afuz-Ali and Victoria) and 6, 8, 10, 12 and 14 inflorescences per plant were used. For each variant, the date of ripening, the date of full maturation, the carbohydrate content, the acidity content and the grape production were noted. The organoleptic properties of the production were evaluated through scoring by a tasting committee composed of three specialists. The appearance, consistency, colour, aroma and taste were evaluated.

RESULTS AND DISCUSSIONS

From a climatic point of view, the average of the last 20 years indicates: the average annual temperature - 12.8ºC, the average temperature in July - 24.8ºC, the annual amount of precipitation - 693 l/m^2, the annual insolation -

2335 hours. In this context, the oenoclimate aptitude index (IAOe) was calculated in order to establish the favourability of the vineyard from this point of view. The high value of this indicator (5241) shows a favourable area for obtaining high quality white and red wines but also for cultivating table grapes varieties, with early, medium and late maturation.

The phenological observations made on the four varieties showed that the date of the onset of the vegetation phases depends on the climatic conditions. For example, in 2016, the colder climate prolonged the vegetation period, compared to the following year, when lower rainfall and higher temperature led to an advance of vegetation (Table 1). Considering the De Martonne aridity index, the climate in the first year is characterized as humid (32.6) and the following year as semi-humid (20.3).

Table 1. The data on the vegetation phases

Variety	year	Number of inflorescences/plant									
		6		8		10		12		14	
		BBCH 81	BBCH 89	BBCH 81	BBCH 89	BBCH 81	BBCH 89	BBCH 81	BBCH 89	BBCH 81	BBCH 89
		Number of day in the year									
Cardinal	2016	197	210	197	214	197	214	197	216	197	216
	2017	193	209	196	213	196	213	196	213	196	216
	2018	193	207	193	213	196	213	196	216	196	216
	average	194	209	195	213	196	213	196	215	196	216
Victoria	2016	202	222	204	223	207	223	210	228	214	233
	2017	204	220	205	224	207	227	210	233	213	236
	2018	204	221	203	222	206	222	208	232	210	232
	average	203	221	203	223	207	224	209	231	212	234
Alphonse Lavalée	2016	225	245	225	250	228	254	228	255	233	264
	2017	224	242	224	246	227	251	227	253	229	263
	2018	226	244	226	246	227	253	227	254	230	263
	average	225	244	226	247	227	253	227	254	231	263
Afus-Ali	2016	228	243	228	245	233	249	233	254	235	258
	2017	227	248	232	253	232	253	232	258	232	258
	2018	227	248	232	251	232	253	232	255	232	255
	average	227	247	231	250	232	252	232	256	232	257

Regarding the influence of the number of inflorescences per plant, on the passage of the vegetation phases, there is a delay in the onset of the ripening and full maturity phases as the number of inflorescences per plant increases.

The vegetation phases we are referring to started earlier, regardless of the existing climatic conditions, in the case of the variant with 6 inflorescences per plant and started the latest in the case of the variant with 14 inflorescences (Figure 1).

The recorded differences ranged between 2 days (Cardinal variety) and 9 days (Victoria variety), the average being 5.5 days for the ripening phase. For the maturity phase of the grapes, the same influence was observed on the number of inflorescences per plant, with the difference that the delay was more accentuated. Thus, the differences ranged from 7 days (Cardinal variety) to 19 days (Alphonse Lavaleé variety). The average value of the varieties is 12.2 days.

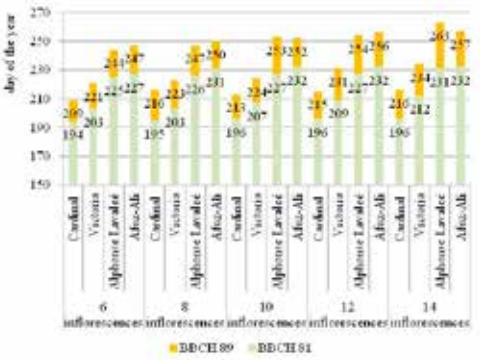

Figure 1. The date of the vegetation phases onset (average values)

For all four varieties, the tendency to delay the BBCH 81 and BBCH 89 vegetation phases was highlighted as the number of inflorescences per plant increased (Figure 2). The correlation is positive and the values of the correlation and determination coefficient have high values, the dependence between the two variables being close.

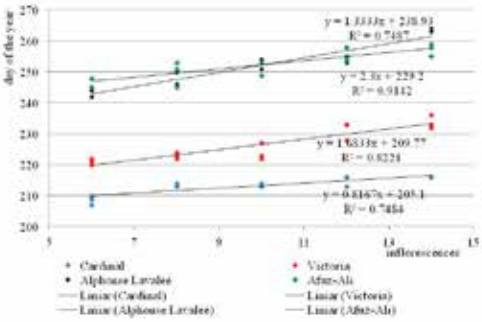

Figure 2. The correlations between the number of inflorescences per plant and the date of phenophases onset

Regarding the grape maturation period, this delay does not create problems in this area, because the Severin vineyard is located in the southern part of the country, where the special climatic conditions also ensure the maturation of the late varieties.

In terms of quantity of production, its increase was observed simultaneously with the increase of the number of inflorescences (Figure 3).

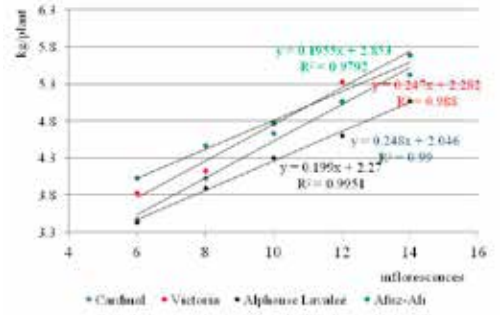

Figure 3. The correlations between the number of inflorescences per plant and the yield rate

Also in this case, the correlation is positive, the correlation and the determination coefficient recording high values, which indicates a close dependence between the two variables. The difference was between 1.64 kg/stem, in the Alphonse Lavalleé variety, and 1.96 kg/stem, in the Cardinal variety, and it was in favour of the variants with 14 inflorescences per stem.

Acidity followed the same trend (Figure 4). It has increased as the number of inflorescences per plant has increased, so it has evolved in the same direction as the production obtained on the stem and in the opposite direction, if we relate to the amount of accumulated carbohydrates (Figure 5).

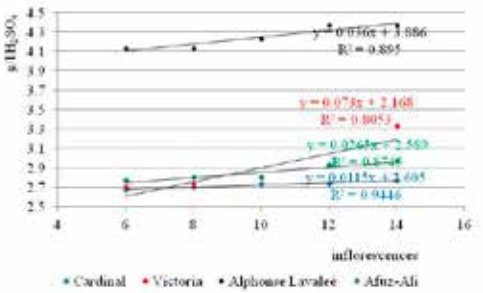

Figure 4. The correlations between the number of inflorescences per plant and acidity

In this case we find a decrease in the amount of carbohydrates that accumulate simultaneously with the increase in the number of inflorescences per plant. The correlation is negative for all four varieties and has similar values, according to the determined coefficients. The lowest difference, of only 9 g, is recorded by the Cardinal variety and the highest, of 30 g, by the Victoria variety. Also this variety recorded the highest difference in acidity (0.63 g/l H_2SO_4) between the variant with 14 inflorescences and the one with 6 inflorescences/plant and the lowest value was recorded by the Cardinal variety.

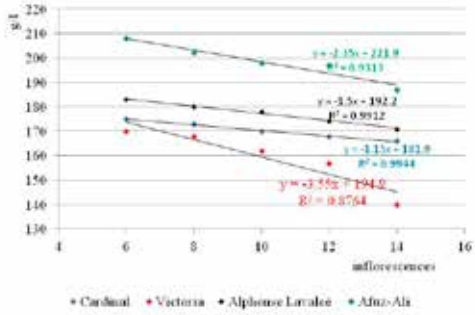

Figure 5. The correlations between the number of inflorescences per plant and the amount of accumulated carbohydrates

In this respect, Victoria is the variety that reacts the most to the regulation of inflorescences, which is why we consider that we must pay attention to the crop load to find the optimal value depending on the area and the applied technology. For the table grape varieties, an important quality parameter is the maturation index, which must have a value that ensures the freshness and fruitfulness characteristic. The recommended value is 2.5-4.5. The values for the studied varieties of this indicator are presented in Table 2.

Table 2. The evolution of the gluco-acidimetric index depending on the number of inflorescences per plant

Variety / No. of inflorescences	Cardinal	Victoria	Alphonse Lavaleé	Afuz-Ali
6	6.6	6.3	4.4	7.5
8	6.4	6.2	4.4	7.2
10	6.2	5.8	4.2	7.1
12	6.2	5.4	4.0	6.7
14	6.0	4.2	3.9	6.3

From its analysis, it can be concluded that Alphonse Lavaleé is the variety that maintains an optimal value of the gluco-acidimetric index regardless of how the number of inflorescences per stem evolves. This can be explained by the greater ability to maintain acidity in the conditions of the Severin vineyard. For the other varieties, the gluco-acidimetric index

decreases as the number of inflorescences per plant increases. In many cases it remains above the optimal range. This means high levels of accumulated carbohydrates, due to the lower acidity, specific to the southern areas.
However, the taste characteristic of table grapes is not the only quality parameter; when released for consumption, these varieties must meet other characteristics which may prevail in the purchasing decision. Therefore, the grapes were sensorial evaluated taking into account the appearance, consistency, colour, aroma and taste through the scoring scale method (Figure 6).

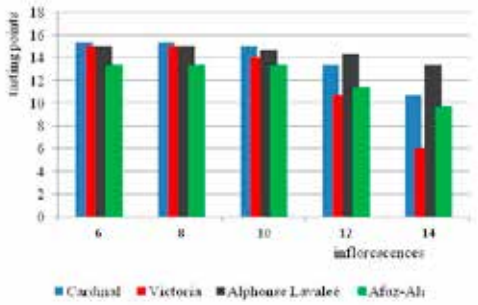

Figure 6. The evolution of tasting notes in relation to the number of inflorescences per plant

Taking these aspects into account, the analysis of the tasting sheets showed that the organoleptic properties of the grapes decrease as the number of inflorescences per plant increases. The most pronounced decline is in the Victoria variety, while the least affected is the Alphonse Lavaleé variety. The score for each analysed characteristics is shown in Figure 7 for the two varieties.
We note that in the case of a small number of inflorescences per plant, both varieties are characterized by maximum organoleptic characteristics. The alteration of the organoleptic qualities is manifested in the consistency of the grape and the taste, for the Victoria variety, starting with a crop load of 10 inflorescences per plant. Starting with 12 inflorescences per plant, the organoleptic characteristics are further diminished, and affect all parameters.
An impairment of organoleptic properties for the Alphonse Lavaleé variety was observed, starting with 12 inflorescences per plant, but at a lower level compared to the Victoria variety.

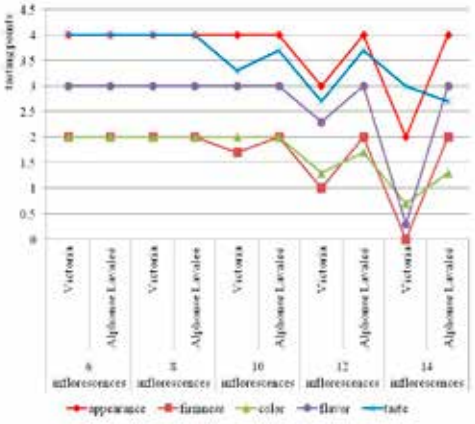

Figure 7. The evolution of organoleptic properties in Victoria and Alphonse Lavaleé varieties

One consequence of this development is the fact that, as organoleptic properties deteriorate, the production in the extra class and quality class I decreases and the production in the quality class II increases.

CONCLUSIONS

The study showed that the start date of the vegetation phases is influenced by the number of inflorescences per stem; the higher their number, the higher the delay.
From a productive point of view, the large number of inflorescences per stem is correlated with the increase in grape production, the increase in acidity and the decrease in carbohydrate content. For this reason, an optimal value has been identified for each variety. For example, a maximum of 10 inflorescences per stem for the Victoria variety is recommended in this area; for the others, higher loads can be used, but not maximum of 14 inflorescences per plant.

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