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THE INFLUENCE OF GRAPEVINE PRUNING ON THE LEVEL CROP AND QUALITY IN CABERNET SAUVIGNON CLONES

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Abstract: *Yield is one of the factors with major influence on the quality of grapevine production. Winter pruning is the first way to control yield. In this study we applied 3 cutting variants to 4 clones of Cabernet Sauvignon from Sâmburești vineyard, one of the most famous Romanian vineyards for quality red wines. The results of the study show that in order to obtain the typical Cabernet Sauvignon wines in the Sâmburești vineyard, winter pruning is recommended with a maximum of 9 nodes/m2 or a delay in harvesting until more advanced stages of maturity compared to what we applied in this study.*

Keywords: red wine, pruning, clones.

INTRODUCTION

Crop yield is widely recognized as an important factor in the quality of resultant wines, but most prior research has shown no effect of yield on wine quality (Chapman D. et al., 2004). Grapevine yield and fruit composition largely depend on vine water status, which can be manipulated, especially in semiarid climates, by irrigation strategies and training systems (Mirás-Avalos J. et. al., 2017). Each training system involves specific grapegrowing conditions, which affect the concentration of volatile metabolites of grape (Mariagiovanna Fragasso M. et al., 2012).

The potential yield of grapevines is often inexpensively manipulated by altering the number of nodes retained per vine after pruning (Greven M.M. et. al., 2014). Minimal pruning (MP) is a technique used to reduce labor costs and produce high-quality winegrapes (Zheng W. et. al., 2017). Bunch number per node or shoot varies significantly between seasons and is a major cause of yield variation. Varying total node numbers by pruning is the least expensive way to regulate yield. However, there is little information available on how varying bearer length (and thus node number) in a machine-pruned canopy alters yield components (McLoughlin S.J. et. al., 2011).

Viticultural practices are highly influential in berry and wine composition. The effects of crop-level reduction on berry composition are normally an increase in soluble solids (Brix) and a concomitant increase in ethanol in the wine produced (Morena Luna L.H. et. al., 2018). Environmental factors such as light and field management practices have a combined effect on grapevine physiology and wine quality (Feng, H. et al., 2017).

Seasonal fluctuations in yield, grape composition and wine attributes, largely driven by variable climatic conditions, are major challenges for the wine industry aiming to meet consumer expectations for consistent supply, wine style and product quality (Clingeleffer P.R., 2010). Pruning during winter when grapevines are dormant is an important cultural operation grapegrowers use to regulate yield. Pruning is a relatively simple and straightfor-ward method that can be used to directly select the type of buds retained, as well as limit the number of buds per vine (Martin, S. R., Dunn G. M., 2000). Vines can be pruned leaving either a predominance of long canes (cane pruning) or short spurs (spur pruning) on a perennial "cordon" structure. Despite some well documented advantages of spur pruning including more uniform shoot growth and higher capacity for the storage of reserves (Bernizzoni et al., 2009).

MATERIALS AND METHODS

4 clones of Cabernet Sauvignon from the Sâmburești vineyard assortment were studied: 169, 337, 338, 685, all grafted on the rootstock SO4, in identical climate and soil conditions, in the year 2019. The plantation was established in 2010, with planting distances of 2.25 m between rows and 1 m per row, which means a density of

4545 vines/ha, and the training system was identical (Guyot).

3 pruning variants were applied, respectively three loads of eyes on the stem after the winter pruning, 9, 12, 15 nodes/m2, which means 20, 27 and 34 nodes/vine. For each experimental variant, 10 consecutive vines in the same row were studied.

The production from each vine was weighed and put in bags on each variant. The bags were transported to the University of Craiova, Faculty of Horticulture, Oenology Laboratory for analysis. The following were determined: the average weight of the bunches, the production per vine and per hectare, calculated by multiplying the average weight of the grapes by the average number of grapes per vine, the sugar content (g/L) by densimetric method and the total acidity (g/L acid tartaric acid) by titration with 0.1 N NaOH solution.

RESULTS AND DISCUSSIONS

As the number of nodes left on the vine after the winter pruning increases, the number of grapes on the vine increases, but the increases are uneven between variants (table 1). Thus, for the most severe pruning, which leaves only 9 nodes/m2 (which means 20 nodes/vine), the number of grapes harvested varies between 12 (per clone 169) and 15 (clones 338 and 685). Therefore, in all 4 clones, the number of grapes harvested was lower than the number of nodes left on the vine after winter pruning. This must be linked to several factors that did not result in a fertile shoot from each node left on the vine. The causes can be multiple, including low spring temperatures after budbrust.

For medium severity pruning (12 nodes/m2), equivalent to 27 nodes/vine, the number of grapes varied between 15 (clone 169) and 22 (clone 685) and for the longest pruning (15 nodes/m2, equivalent to 34 nodes/vine), the number of grapes was between 18 (clone 169) and 26 (clone 685). Therefore, for all pruning options, clone 169 had the lowest and clone 685 had the highest number of grapes.

In all pruning variants, the increase in the number of grapes per vine is accompanied by a decrease in their average weight.

At the cutting variant with 9 nodes/m2 the average weight of the grapes varies between 126.1 g (clone 685) and 185.1 g (clone 169). In the 12 nodes/m2 pruning variant, the average weight of the grapes varies between 119.2 g (clone 685) and 177.7 g (clone 169). In the 15 nodes/m2 pruning variant, the average weight of the grapes varies between 111.5 g (clone 685) and 168.5 g (clone 169). Clone 337 showed the largest decrease in average grape weight of 12 g from severe to medium pruning, while clone 685 showed the smallest decrease in average grape weight (7 g) between the two cutting variants. Between the medium (12 nodes/m2) and light (15 nodes/m2) pruning variants, the largest decrease in the average weight of the grapes was 11.6 g and was also in clone 337 but the smallest decrease was of 3.9 g and was recorded in clone 338.

Table 1. Number of bunches/vines and average weight of grapes

Pruning variant	Bunchs/ vine	Average weight grapes (g)
Clone 169, 9 nodes/m^2	12	185.1
Clone 169, 12 nodes/m^2	15	177.7
Clone 169, 15 nodes/m^2	18	168.5
Clone 337, 9 nodes/m^2	13	142.0
Clone 337, 12 nodes/m^2	16	130.1
Clone 337, 15 nodes/m^2	20	119.5
Clone 338, 9 nodes/m^2	15	129.8
Clone 338, 12 nodes/m^2	20	119.6
Clone 338, 15 nodes/m^2	25	115.7
Clone 685, 9 nodes/m^2	15	126.1
Clone 685, 12 nodes/m^2	22	119.2
Clone 685, 15 nodes/m^2	26	111.5

The production of grapes per stem varied between 1.85 kg (clones 337, 9 nodes/m2) and 3.03 kg (clones 169, 15 nodes/m2) and the production per hectare varied between 8,390 and 13,784 kg. In the cutting variant with 9 nodes/m2 only one clone had the production over 2 kg/vine (clone 169, with 2.22 kg), the other 3 clones having m yields less than 2 kg/vine: clone 337 (1.85 kg), clone 685 (1.89 kg) and clone 338 (1.94 kg). In fact, the 337 clone had the lowest yields of all cutting variants. At the cutting variant with 15 nodes/m2, clone 169 was noted, the only one with a production higher than 3 kg/ha and with 13,784 kg / ha. Two other clones (338 and 685) had yields over 13,000 kg/ha, only clone 337 had less than 13,000 kg/ha in the cutting variant with 15 13,784 nodes/m2 (table 2).

Table 2. Grape production

Pruning variant	Yield kg/ vine	Yield kg/ha
Clone 169, 9 nodes/m2	2.22	10,095
Clone 169, 12 nodes/m2	2.66	12,114
Clone 169, 15 nodes/m2	3.03	13,784
Clone 337, 9 nodes/m2	1.85	8,390
Clone 337, 12 nodes/m2	2.08	9,460
Clone 337, 15 nodes/m2	2.39	10,862
Clone 338, 9 nodes/m2	1.94	8,849
Clone 338, 12 nodes/m2	2.41	10,944
Clone 338, 15 nodes/m2	2.89	13,146
Clone 685, 9 nodes/m2	1.89	8,596
Clone 685, 12 nodes/m2	2.62	11,918
Clone 685, 15 nodes/m2	2.90	13,175

The values of the main grape composition parameters (sugars and total acidity) were significantly influenced by the production levels resulting from the application of different pruning variants. The most important finding from the analysis of data on the chemical composition of grapes is that in all clones, as the yield increases, the sugar content decreases.

Table 3. Sugars content and titratable acidity of grapes at harvest

Pruning variant	Sugars, g/L	Total acidity, g/L tartaric acid
Clone 169, 9 nodes/m2	228	4.10
Clone 169, 12 nodes/m2	210	4.22
Clone 169, 15 nodes/m2	192	4.85
Clone 337, 9 nodes/m2	236	4.00
Clone 337, 12 nodes/m2	212	4.52
Clone 337, 15 nodes/m2	198	4.95
Clone 338, 9 nodes/m2	232	4.12
Clone 338, 12 nodes/m2	208	4.48
Clone 338, 15 nodes/m2	195	5.10
Clone 685, 9 nodes/m2	224	4.16
Clone 685, 12 nodes/m2	204	4.78
Clone 685, 15 nodes/m2	190	5.20

In the 9 nodes/m2 cutting variant, the sugar content varied between 224 g/L (clone 685) and 236 g/L (clone 337), in the medium cutting variant the sugar contents varied between 204 g/L (clone 685) and 212 g/L (clone 337) and at the cutting variant with 15 nodes/m2 the sugar contents varied between 190 g/L (clone 685) and 198 g/L (clone 337). Therefore, of all the cutting variants, clone 685 had the lowest, while clone 337 had the highest sugar content. The data in Table 3 also show that in the 15 nodes/m2 cutting variant the sugar contents were below 200 g/L in all clones, which shows that this cutting variant is not suitable for obtaining quality wines.

The total acidity of the grapes increased as the grape production increased, contrary to the sugar content. The lowest total acidity was 4 g/L tartaric acid (clones 337, 9 nodes/m2), and the highest was 5.20 g/L tartaric acid (clones 685, 15 nodes/m2).

CONCLUSIONS

There was a strong link between the fruit load after winter pruning and the number of grapes per vine, but there was no directly proportional relationship between the increase in the number of noes and the increase in the number of grapes per vine. This is due to the fact that the nodes left on the vine after cutting is one of the main factors on which grape production depends, but it is not the only one, along with other factors of a technological or ecological nature. In all variants, the increase in the number of grapes per vine was accompanied by a decrease in their average mass in absolutely all cases. Even if the increase in the number of grapes on the stalk was accompanied by a decrease in their mass, the production of the vine increased as the fruit load increased.

The increase in yield has not proved to be conducive to increasing the quality of wine production. In the present study we took into account only the sugar contents and total acidity of the grapes at the time of harvest (so-called technological maturity). For this reason, the maximum fruit load, of 15 nodes/m2, which led to very high yields, led to sugar contents below 200 g/L, even dropping to 190 g/L. From such sugar contents are obtained wines with moderate alcoholic strengths of 11-12% vol., much of which is characteristic of quality wines obtained in the Sâmburești vineyard. Also, the cutting variants with a fruit load of 12 nodes/m2, have sugar contents of 204-212 g/L, also unsuitable for obtaining strong, rich, structured, generous Sâmburești wines, as recognized by informed consumers of quality wines from our country and how they are recognized on the domestic and international market of quality wines.

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