THE INFLUENCE OF CLUSTERS THINNING ON THE PRODUCTION OF GRAPES IN THE VITICULTURAL AREA OF BANU MARACINE

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Abstract

The yield, expressed as the production of grapes per surface unit or per plant, plays a role of first importance in the set of factors on which wine production and its quality depend. The control of the yield and the possibilities of intervention for its adjustment are of major importance especially for obtaining high quality wines. Cluster thinning at fallow has proven to be a very effective method to regulate the yield and quality of grape production by increasing sugar content and decreasing total acidity. The vine will have the opportunity to ripen a smaller number of grapes in the interval from véraison to harvest. In this study, cluster thinning resulted in larger and riper grapes remaining at harvest compared to the control where the number of grapes per cluster was not reduced.

Keywords: cluster thinning, yield management, vine, grapes.

INTRODUCTION

Final berry mass, a major quality factor in wine production, is determined by the integrated effect of biotic and abiotic factors that can also influence berry composition. Under field conditions, interactions between these factors complicate study of the variability of berry mass and composition. Depending on the observation scale, the hierarchy of the impact degree of these factors can vary (Triolo Roberta e.a., 2018). For wine grape producers, achieving an optimal balance between vegetative and reproductive growth is a key factor in producing high quality fruit and meeting production quotas. Tis balance is often measured as the leaf-area-to-yield ratio. To increase this ratio, producers often use "cluster thinning" (CT), a management practice involving a selective removal of grape clusters from vines (VanderWeide J. e.a., 2024). Cluster thinning has been widely applied in yield management and its effect on green leaf volatiles (GLVs) in wines has seldom been studied. GLVs are important flavor compositions for grapes and wines (Xiaoyu Xu e.a., 2024). Cluster removal during the growing season is a widely utilized vineyard management practice aiming to balance crop load to the capacity of the vine to ripen the fruit (King Petra e.a., 2015).

Bunch compactness is an important morphological trait in viticulture because it affects bunch susceptibility to pathogen and hence, fruit quality. The size and number of the berries and the rachis length are the main elements that define bunch compactness in grapevine (Vitis vinifera L.). This trait is of scientific and commercial interest because it strongly influences phytosanitary status and quality of the fruits (Mataffo A. e.a., 2023). Cluster thinning is a viticulture tool used to correct overcropping, to improve fruit composition, and to find a balance between shoot growth and berry development (Condurso Concetta e.a., 2016).

Two levels of manual cluster thinning treatments were performed on grape vines in two farms in the Northwest of China. Cluster thinning affected both the yield components of grapes and the level of linolenic acid, as well as green leaf volatiles, which are important for the aromatic quality of Cabernet Sauvignon grapes and wines. In Y-farm, medium cluster thinning (CT2) significantly increased the average cluster weight of harvested berries. Additionally, both cluster thinning treatments (CT1 and CT2) increased fatty acids in harvested berries and CT2 resulted in an increase in C6 esters and a decrease in C6 alcohols in wines of Y-farm under the warmer and

drier 2012 vintage. However, the effect of cluster thinning on the viticulture parameters, the production of fatty acids, and C6 and C9 volatiles in grapes and wines were likely negative in G-farm, presumably caused by the wetter soils and excessive organic matter (Xiaoyu Xu e.a., 2024). The differences in physiological and chemical properties between the grapes were investigated to which cluster thinning was applied at two different times and those without cluster thinning. According to the research results, CTBV was more effective in the berry fresh weight, dry weight, berry volume, skin weight, skin surface, cluster width, cluster length, cluster weight, and cluster volume parameters than CTAV. Likewise, the levels of total phenolic compounds, total anthocyanins, and antioxidant capacity increased by 9%, 27%, and 30%, respectively, compared to the control group without cluster thinning. Among the phenolic compounds, trans-resveratrol showed the highest increase of 38%, and petunidin-3-glucoside increased the most (12%) among anthocyanins (Tahmaz H., 2023).

Viticultural practices and irrigation have a major impact on fruit development and yield, and ultimately on must quality. The effects of water deficit (WD), defoliation (Def), and crop-thinning (CT) on Solaris plants and fruit development, as well as on the chemical composition of grape juice were investigated (Aru Violetta e.a., 2022). Problems with attaining optimum ripening and minimising variability in maturity within vineyards are due to a range of soil, climatic and cultural factors. An imbalance between vegetative and fruiting phases of vine growth is a major contributor to this variation in ripening and grape composition. Management practices commonly used to compensate for this imbalance involve manipulation of canopy architecture through trellising and training systems, and crop removal to balance the ability of the vine leaf area to ripen fruit (King Petra e.a., 2015). Cluster thinning applications can modify grapes' physical and chemical characteristics at different times. The "véraison", where the grapes lose their green color and which results in ripening, is a turning point that can significantly affect the results of cluster thinning applications. Therefore, the decision on the timing of cluster thinnings before and after this point affects the composition of the final grape (Tahmaz H., 2023).

MATERIAL AND METHOD

This work was carried out starting from a study carried out in the 2023 wine year in the Banu Mărăcine vineyard, in a plantation established in 2016, so the plantation is in the 8th year after planting, which means that it is young, vigorous, in full fruition. Planting distances were 2.2 m between rows and 1 m between plants per row, resulting in a planting density of 4,545 vines/ha. The land on which the plantation is located has a slight slope with a western exposure, being located on the first row of hills in the eastern part of the municipality of Craiova. The variety is Merlot, clone 181, grafted on rootstock S04.

Three levels of loads were left at the winter pruning: 9, 12 and 15 nodes/m^2, which means 20, 27 and 34 nodes/plant. The cluster thinning was carried out, for each of the 3 pruning variants, at véraison. Along with the control variant (without cluster thinning), there were two thinning variants: one moderate and one severe. The moderate variant meant leaving one grape on the shoots that had two grapes, removing one of them (the one positioned higher, further from the base of the shoot), half the number of shoots that contained two grapes each. The severe variant involved halving the number of grapes per stem, leaving a maximum of one grape per shoot.

The grapes were harvested on the same day, at the beginning of October 2023, weighed and transported to the Oenology laboratory at the Faculty of Horticulture in Craiova, where the physical-chemical analyzes were carried out, namely the sugar content and total acidity, the main

indicators of the quality level of the grapes - raw material for the wine industry.
The sugar content of grapes was determined by the refractometric method, using a digital refractometer HI96814, which takes readings in 3 scales. The total acidity content was determined by the titration method with a 0.1 N solution of NaOH, expressed in g/l tartaric acid.

RESULTS AND DISCUSSIONS

After clusters tinning at the véraison, a control variant was left for each pruning variant, so that the same number of grapes remained on the vine: 22 in the first pruning variant, 28 in the second pruning variant and 36 in the third pruning variant . The variant of moderate cluster thinning consisted in the removal of a single cluster from the shoots that had two grapes each, respectively the clusters located higher on the shoot. In this way, in the first cutting variant, 17 grapes remained on the vine after this operation, in the second pruning variant 22 grapes remained on the vine, and in the third pruning variant 28 grapes remained on the vine.

The severe cluster thinning variant reduced the number of grapes per bunch by half compared to the control variant. In this sense, apart from the removal of the second grape from all the shoots that had two grapes, as in the previous version, the single grape was also removed from the bunches that were in more shaded or less accessible positions. Under these conditions, 10 grapes remained on the vine in the first pruning variant, 15 grapes per vine in the next pruning variant, and 18 grapes remained in the last pruning variant.

Cluster thinning carried out at veraison had a significant influence on grape size and grape production per vine and hectare, regardless of winter pruning. Thus, during the short pruning in winter, at 20 nodes/vine, in the control variant without removing part of the grapes, 22 grapes were harvested from a vine with an average weight of 106 g, which led to a production of 2.64 kg/vine, respectively 11,000 kg/ha. By applying the medium-severity cluster thinning variant, 17 grapes/bunch were harvested but with a higher average weight, respectively 112 g. Under these conditions, the production of grapes in this variant was 1.90 kg/vine, respectively 8,653 kg/ha. By applying the severe variant of cluster thinning, which consisted in removing half of the total number of grapes, only 10 grapes/bunch with an average weight of 128 g were harvested, so that the production was 1.28 kg/vine , respectively 5,817 kg/ha.

In the medium winter pruning variant, with 27 nodes/vine, in the case of the control subvariant, without cluster thinning, 28 grapes were harvested per vine, with an average weight of 100 g, the production being 2.80 kg/vine, respectively 12,726 kg/ha. At moderate cluster thinning, 21 grapes/bunch were harvested, with an average weight of 112 g, resulting in a production of 2.35 kg/vine, respectively 10,690 kg/ha. In the case of severe cluster thinning, only 15 grapes were harvested, with an average weight of 125 g, obtaining a production of 1.87 kg/bunch, respectively 8,726 kg/ha.

In the long winter pruning, which left the highest load, 34 nodes/vine, without cluster thinning a number of 36 grapes were harvested per vine, with an average weight of 87 g, so that the production was the highest, i.e. 3.13 kg/vine, respectively 13,744 kg/ha. In this pruning variant, the moderate thinning of the clusters led to obtaining a number of 28 grapes/vine with an average weight of 108 g, which led to a production of 3.02 kg/bush, respectively 14,498 kg/ha. When the most severe cluster thinning was applied, after which only 18 grapes with an average weight of 122 g remained per vine, the production of grapes at harvest was 2.20 kg/vine, respectively 9,980 kg/ha.

The reduction in the number of grapes per vine did not only change their size and the level of production, but also the values of the main parameters of the composition of sugar content and total acidity as shown in table 2. In all cases,

regardless of the pruning variant, the reduction in the number of grapes on the vine at entry significantly increased the sugar content expressed as Brix degrees and reduced total acidity, but the decrease in acidity was less obvious than the increase in Brix degrees.

Thus, in the short winter pruning, in the control variant, without bunch thinning, 22 grapes were harvested from one vine with a measured sugar content of 23.6 ^{o}Brix. Reducing the number of clusters to 17 per vine resulted in the grapes remaining at harvest having a higher sugar content of 25.2 ^{o}Brix, while severely cluster thinning by halving their number resulted in 10 grapes being harvested/vine with 26 ^{0}Brix. This means that the wines obtained from those grapes have higher alcohol contents.

In the medium winter pruning variant, when harvesting the grapes without performing the thinning operation (under the control variant), 28 grapes/vine with a sugar content of 22 ^{0}Brix were harvested. Moderate cluster thinning resulted in grapes containing sugar at harvest rated at 23.2 ^{0}Brix, while severe cluster thinning at 15 per vine resulted in grapes containing a sugar level of 23.8 ^{o}Brix at harvest.

In the long winter pruning variant, without cluster thinning, a number of 36 grapes/vine with a sugar content of 20.8 ^{o}Brix were harvested. The cluster thinning at véraison made the grapes at harvest present higher sugar contents, respectively 21.6 ^{o}Brix in the moderate thinning variant by which the number of grapes was reduced to 28 and 22.6 ^{o}Brix in the severe thinning by which the number of grapes was reduced to 18 per vine.

Cluster thinning led to slight decreases in total grape acidity in all winter pruning variants. Between the control variant, without cluster thinning and moderate cluster thinning the decrease in titratable acidity of the grapes was 0.26 g/L tartaric acid in short winter pruning, 0.36 g/L tartaric acid in medium winter pruning and 0.40 g/L tartaric acid in long winter pruning. Between and severe bunch thinning the decrease in titratable acidity of the grapes was 0.68 g/L tartaric acid in short winter pruning, 0.36 g/L tartaric acid in medium winter pruning and 0, 60 g/L tartaric acid in long winter pruning.

CONCLUSIONS

In viticulture, yield control is of particular importance because quality wines are obtained only from harvests with limited yields. In fact, for all the designations of controlled origin authorized in our country, the specifications clearly stipulate production limits for each variety and each D.O.C. level. The cluster thinning carried out during the vegetation period, at véraison, has proven to be particularly effective and presents a series of definite advantages for controlling the yield and the quality of grape production.

The adjustment of the yield must take into account all the economic and qualitative aspects. Severe thinning of the bunches greatly reduces the yield, obviously increases the quality, but also increases the production costs considering the fact that the production expenses are spread over a smaller quantity of grapes.

Under these conditions, the intensity of bunch thinning must take into account the type of wine to be obtained. Compared to winter pruning, bunch thinning has the advantage of allowing the yield to be regulated much closer to the time of harvest, therefore more precisely according to the goals pursued.

Cluster thinning has proven to be an effective method for yield control, corresponding to the compositional and sensory characteristics of the wine to be obtained.

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Table 1

Grapes, stems and berries average weight and grape productions after cluster thinning

Pruning variant, nodes/vine	Cluster thinning variant	Grapes/ vine after cluster thinning	Average weight of grapes - g -	Berries - g -	Stems - g -	Grape production	
						kg/vine	kg/ha
20	Control	22	106	101	5	2,22	10.999
	Moderate	17	112	107	5	1,90	8.653
	Severe	10	128	122	6	1,28	5.817
27	Control	28	100	96	4	2,80	12.726
	Moderate	21	112	107	5	2,35	10.690
	Severe	15	125	120	5	1,87	8.521
34	Control	36	87	83	4	3,13	13.744
	Moderate	28	108	103	5	3,02	14.496
	Severe	18	122	117	5	2,20	9.980

Table 2

Sugar content and titratable acidity of grapes at harvest

Pruning variant, nodes/vine	Cluster thinning variant	Grapes/vine after cluster thinning	°Brix	Aciditate totală g/L acid tartric
20	Control	22	23,6	6,20
	Moderate	17	25,2	5,94
	Severe	10	26,0	5,52
27	Control	28	22,0	6,56
	Moderate	21	23,2	6,20
	Severe	15	23,8	6,02
34	Control	36	20,8	6,90
	Moderate	28	21,6	6,50
	Severe	18	22,6	6,30