Scientific Papers. Series B, Horticulture. Vol. LXVIII, No. 1, 2024
Print ISSN 2285-5653, CD-ROM ISSN 2285-5661, Online ISSN 2286-1580, ISSN-L 2285-5653

EFFECT OF BUNCH THINNING ON THE GRAPES QUALITY IN CLONES 174 AND 470 FROM SYRAH VARIETY

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Abstract

The experiment was conducted in the experimental vineyard of the Agricultural University - Plovdiv, during the period 2020-2022. Two clones of the Syrah variety numbered 174 and 470 grafted onto the SO4 rootstock were used. The green pruning operation `bunch thinning` was applied, performed manually in the `pea size` phase. Differences were found in the bunch structure according to the indicators - normal berries (%), bunches (%), milleranded berries (%), raisined berries (%), theoretical yield (%), average bunch mass (g) and average cluster size (cm). The mechanical analysis was obtained from skins (%), seeds (%), mesocarp (%), average weight of 100 berries (g), number of seeds in 100 berries, average seeds weight in 100 berries (g), average berry size (mm). The grape ripening dynamics was monitored, through the quantitative change in the sugar content (%) and titratable acids (g/l). The application of bunch thinning, as a widely known viticultural practice, part of the Canopy management complex of activities involved in, has had a positive impact on accelerating the grapes ripening and increasing its quality in the studied clones.

Key words*: bunch thinning, clones, mechanical analysis, Syrah variety, technological maturity.*

INTRODUCTION

Climate changes require adaptation to higher temperatures, which includes changes of plant material (rootstocks, cultivars and clones) and modification of viticultural techniques (change in stem height, ratio of fruit weight to plant mass, time to carry out the pruning) so that the grape harvest takes place in the optimal period until the end of September or the beginning of October in the Northern Hemisphere (Van Leeuwen et al., 2019). The substrate has a significant influence on the quantity and quality of grapes, which is determined by the growth vigor, the different metabolism of the nutritional elements and compatibility with the variety, as well as in stress conditions caused by drought (Kocsis L. et al., 2012; Yoncheva T. et al., 2022). Moderate water stress during the veraison is favorable for sugar accumulation and also leads to an increase in the content of anthocyanins and tannins in the fruit (Van Leeuwen et al., 2009).

Increased climate instability (Webb et al., 2012), the implementation of sustainable management practices (Daane et al., 2018) and increasement in the price of raw materials are a test of sustainability in the development of viticulture sector. Due to the complexity of vine physiology, the effect of these practices on productivity can vary widely and results in yield parameters and fruit composition are varietal and location dependent. (Palliotti et al., 2014).

Bunch thinning is a widespread technological practice, improving grape quality depending on time and intensity of its application. The effect on Syrah is more noticeable in wine, but in order to make a decision and justify its price, a significant increase in the fruit quality must be achieved (De Bei et al., 2022).

Many studies have reported yield reductions in response to thinning at flowering stage (Reynolds et al., 1994), pea size stage (Keller et al., 2005; Sun et al., 2012) and during ripening (Keller et al., 2005; Gil et al., 2013). However, yield loss is not proportional to thinning intensity due to compensation, through increased berry and bunch weight (Reynolds et al., 2007; Sun et al., 2012; Gil et al., 2013).

Regina et al. (2005), found that clone 470 grafted on SO4 was the earliest and had the potential to produce grapes of good quality but with lowest productivity among the other clones.

Berry size is a quality factor directly related to grape thinning. The physical characteristics such as mass, volume and skin area increased with increasing size, showing a uniform trend.

Positive correlations were found between berry weight, volume and skin area, and these variables were negatively related to the number of berries in kilograms of grapes. Fruit volume is negatively correlated with dry skin weight. Skin area versus fruit volume is an indicator of the thinning effect associated with increasing size, as larger fruits have lower values (Melo et al., 2015).

Overloading the vines with grapes is the reason for incomplete shoots ripening and the insufficient supply of plastic substances (Popova, 2021). Recent research has revealed that grape thinning can increase sugar content and cause further changes to the grape composition (Wang Wen et al., 2022). Bunch thinning is an alternative method to improve ripening of wine grapes (Gil et al., 2013).

The purpose of the present study is to show the difference (deviation) in the ripening and grape quality, as a result of yield reduction in berries pea-size phase in clones 174 and 470 from Syrah variety, planted in the area of Brestnik village.

MATERIALS AND METHODS

For the purpose of the study, clones from Syrah variety numbered 174 and 470 were used, grafted onto Berlandieri x Riparia SO4 rootstock, planted in April 2011 at the Educational, Experimental and Implementation Base of the Department of Viticulture and Fruit Growing at the Agrarian University - Plovdiv, located in the land of the Kuklen town and the village of Brestnik, Rodopi municipality.

The vineyard is in full fruition. The planting distance is 3.0 m between the rows and 1.00 m between the vines in the row - 3330 vines per hectare. Vines are grown on high-stemmed. The training system is a double-sided cordon with the corresponding support trellis. The load in all variants was carried out by pruning spurs with two buds each, a total of 6 spurs/12 buds/ per vine. The inter-rows are grass covered, the soil surface between the vines is kept clean by treatment with herbicides.

Experimental scheme includes the following 4 options:

V1 - Syrah variety, clone 174 - non-reduced yield

V2 - Syrah variety, clone 470 - non-reduced yield;

V3 - Syrah variety, clone 174 - reduced yield;

V4 - Syrah variety, clone 470 - reduced yield.

Each variant includes 60 vines (4 repetitions x 15 vines).

The yield rationing was carried out during the vegetation in the "pea size" phase, leaving 8 bunches per vine.

The study includes indicators characterizing and describing the grape quality:

• Tracking the dynamics of sugars, with Abbe's laboratory refractometer, %.

• Tracking the change of titratable acids, by titration with 0.1 n NaOH, g/dm^3. The determination of sugars and titratable acids were studied from the beginning of veraison in order to establish the period of technological maturity (grape harvest), according to the methodology described in the Manual for Exercises in Winemaking (Bambalov, 2009).

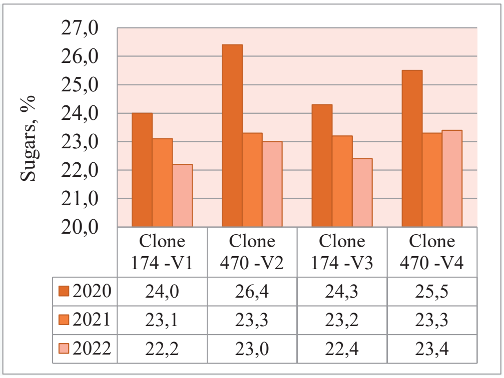
• Mechanical structure of bunch and berry: normal berries (%), bunches (%), skins (%), seeds (%), milleranded berries (%), mesocarp (%), theoretical yield (%), average bunch size - length and width (cm), average berry dimensions - length and width (mm), chemical composition of grape juice - sugars (%) and titratable acids (g/l). The mechanical analysis of grapes and berries in the studied clones was carried out with average samples of about 3 kg of grapes per variant, on the harvest day.

The indicators for the mechanical composition of the grapes were studied according to the generally accepted methodology described in the Students' guide to Ampelography (Roychev, 2014).

The obtained data were mathematically processed by the method of variance analysis using the SPSS program, and to establish the differences between the investigated variants, Duncan's multirank test was used, with the smallest significant difference (LSD) - 0.05 (5%).

RESULTS AND DISCUSSIONS

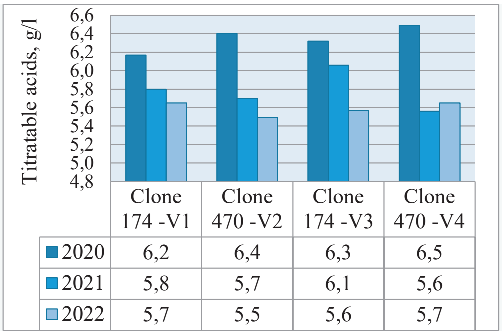
The grape quality for wine varieties depends mainly on the content of sugars and titratable acids, which serve to determine the technological ripeness. During the ripening period, which in phenological terms is from the beginning of ripening to grape harvest, the dynamics of sugar and acid content in the grapes was followed. During three experimental years, that is the period from the last ten days of July to the onset of technological maturity (beginning of September). The dynamics of sugars in clones included (Figure 1) proceeds smoothly without sharp fluctuations. Clone 470 is distinguished by a higher sugar accumulation, both in the vines with non-reduced yield (V2 - 26.4%, 23.3% and 23.0%), and in the vines with reduced yield (V4 - 25.5, 23, 3% and 23.4%).



	Clone 174 -V1	Clone 470 -V2	Clone 174 -V3	Clone 470 -V4
2020	24,0	26,4	24,3	25,5
2021	23,1	23,3	23,2	23,3
2022	22,2	23,0	22,4	23,4

Figure 1. Dynamics of sugar accumulation, %

Changes in titratable acidity is inversely proportional to sugars (Figure 2), which gradually decrease during grape ripening, with their values remaining slightly above the limits for quality red wines of 5.5-6.4 g/l.



	Clone 174 -V1	Clone 470 -V2	Clone 174 -V3	Clone 470 -V4
2020	6,2	6,4	6,3	6,5
2021	5,8	5,7	6,1	5,6
2022	5,7	5,5	5,6	5,7

Figure 2. Dynamics of titratable acids accumulation, g/l

Titratable acids were relatively high in the first experimental year (2020), when a higher sugar content was also found. Technological maturity for variants with reduced yield occurs on 2nd of September, and for non-reduced vines on 9th September, 2020.

In the second experimental year, the harvest was carried out on August 30, for the variants with reduced yield (V3 and V4), and on September 7, 2021, for the variants with non-reduced yield (V1 and V2). In the third experimental year, the grape harvest of the vines with reduced yield was carried out on August 30, and for the vines with non-reduced yield on September 8, 2022.

On the harvest day, the average values of sugar in the clones with non-reduced (V1 and V2) and reduced yield (V3 and V4) were 23.6%, and the titratable acid content 5.8-5.9 g/l, which is an indicator, that grapes from three harvests were harvested when the same values of the main components were reached. During the research period, when determining grape harvest date, together with the chemical composition of the grapes, we took into account both its sanitary condition and climatic conditions. From the complex assessment of these indicators, it was found that the variants with reduced yield (V3 and V4) managed to accumulate sugars faster, compared to the non-reduced variants (V1 and V2), which is indicative of the earlier onset of technological maturity in the three harvests.

For more detailed study on quality, a complete mechanical analysis was carried out, which expresses the ratio between the elements of grapes and berries - bunches, skins, mesocarp (fleshy part) and seeds, determined by weight, by their mass and number. The ratio between the bunch mass and berries, as well as the individual berry parts, in percentages relative to the total bunch mass, reflecting objective digital data, the correct sampling of average grapes is important (Popova, 2023). The test results are presented in detail in Tables 1, 2, 3 and 4, being determined on the average basis samples collected during the grape harvest.

The percentage of normally developed berries for all variants was high from 94% to 96%, which is a prerequisite for very good grape quality (Tables 1 and 2). There are proven mathematical differences between the individual experimental variants in the vines with reduced yield in clone 174 (V3) and 470 (V4). The percentage of berries for 2020 is from 4.20% (V1) to 5.55% (V3), in 2021 it is from 3.76% (V2) to 5.60% (V1) and from 3.08 (V4) to 4.39% (V3) for 2022.

The percentage of milleranded berries is small, with the largest proven difference in clone 470 (V4) in 2020. When summarizing the results, it was found that the average mass per bunch was significantly greater in the vines with reduced yield, with the most significant difference in 2022 at clone 470 (V4). Regarding the indicator of average bunch size, the trend for larger bunches is confirmed in the variants with reduced yield (V3 and V4). The theoretical yield is high in all three years, with no significant differences between variants.

Table 1. Cluster structure and construction in non-reduced variants, for the period 2020-2022

Exp. Variants/ Clone	Period (Year)	Normal berries,%	Skins,%	Milleranded berries,%	Dry berries,%	Theoretical mass,%	Average bunch weight, g	Average bunch size, cm	
								Length	Width
V_1 174	2020	95.80a	4.20a	0.47b	0.94b	80.70b	136.00b	19.20b	8.40a
	2021	94.40a	5.60c	0.59a	1.05b	79.14b	116.00ab	18.47a	10.35a
	2022	95.67a	4.33ab	0.18b	0.45a	80.57a	167.00b	19.45b	9.75a
	Average	**95.29**	**4.71**	**0.41**	**0.81**	**80.14**	**139.67**	**19.04**	**9.50**
V_2 470	2020	94.80a	5.12c	0.35a	0.81a	77.45a	142.00c	19.00b	8.80a
	2021	96.24a	3.76a	0.16a	0.99b	79.58ab	133.00c	20.50b	10.25a
	2022	96.28a	3.72a	0.12a	0.79b	80.88a	195.00c	19.50b	9.85a
	Average	**95.77**	**4.20**	**0.21**	**0.86**	**79.30**	**156.67**	**19.67**	**9.63**
LSD 5%	**2020**	**4.89**	**0.37**	**0.02**	**0.10**	**3.01**	**5.87**	**1.68**	**0.55**
LSD 5%	**2021**	**4.16**	**0.84**	**0.06**	**0.11**	**2.01**	**8.09**	**2.31**	**0.99**
LSD 5%	**2022**	**5.12**	**0.81**	**0.05**	**0.15**	**2.89**	**10.02**	**1.20**	**0.80**

*Comparative analysis with provenance α = 0.05.

Table 2. Cluster structure and construction in reduced variants, for the period 2020-2022

Exp. Variants/ Clone	Period (Year)	Normal berries, %	Skins, %	Millerandred berries, %	Dry berries, %	Theoretical mass, %	Average bunch weight, g	Average bunch size, cm	
								Length	Width
V_3 174	2020	94.45b	5.55b	0.43b	0.54b	79.78b	172.00d	22.10b	11.10b
	2021	95.19ab	4.81b	0.19a	0.52b	80.50a	154.00 b	20.05a	10.50a
	2022	95.61b	4.39c	0.13a	0.49a	80.96a	228.00b	21.90b	11.45b
	Average	**95.08**	**4.92**	**0.25**	**0.52**	**80.41**	**184.67**	**21.35**	**11.02**
V_4 470	2020	95.33b	4.67a	0.57c	0.55b	77.76a	166.00c	22.10b	10.60a
	2021	95.67b	4.33a	0.16a	0.72b	79.55a	155.00b	22.05c	10.60a
	2022	96.92c	3.08a	0.46b	0.10b	81.78a	276.00d	21.85b	10.95a
	Average	**95.97**	**4.03**	**0.40**	**0.46**	**79.70**	**199.00**	**22.00**	**10.72**
LSD 5%	**2020**	**1.35**	**0.51**	**0.15**	**0.26**	**2.02**	**5.87**	**0.50**	**0.55**
LSD 5%	**2021**	**1.07**	**0.31**	**0.17**	**0.18**	**2.48**	**4.18**	**0.36**	**0.73**
LSD 5%	**2022**	**1.05**	**0.48**	**0.20**	**0.28**	**2.50**	**5.21**	**0.55**	**0.60**

*Comparative analysis with provenance α = 0.05.

The indicators for bunch structure and construction (Tables 3 and 4) are determined by a sample of 100 berries in typical shape and size. It was selected in advance by counting three samples of 100 berries, weighed separately, and the average (intermediate) value sample was used (Popova, 2023).
The skin mass in three years period is from 11.15% (V3) in 2022 to 14.76% (V2) in 2021. The biggest difference was found in clone 470 (V4) during 2022. The seed percentage ranged from 3.19 (V3) to 3.99 (V4), where the greatest statistical difference was found, while in the mesocarp, no significant difference was observed.
The mass of 100 berries and the mass of seeds in 100 berries is higher in the variants with reduced yield (V3 and V4) compared to those with non-reduced yield (V1, V2). The data for average berry size (length/width) show a greater difference in the vines with reduced yield, the most significant difference being in the variant V3 (Tables 3 and 4).

Table 3. Berry structure and construction in non-reduced variants, for the period 2020-2022

Exp. Variants/ Clone	Period (Year)	Skins, %	Seeds, %	Mesocarp, %	Average weight per 100 berries, g	Number of seeds in 100 berries	Average seeds weight in 100 berries, g	Average berry size, mm	
								Length	Width
V_1 174	2020	12.26a	3.47b	84.27a	159.86b	205a	5.55b	14.40b	13.70b
	2021	12.89ab	3.27a	83.84a	132.29a	180b	5.65b	13.50a	11.80a
	2022	11.89a	3.89b	84.22a	177.8a	260b	6.90b	15.20a	13.50a
	Average	**12.35**	**3.54**	**84.11**	**156.65**	**215.00**	**6.03**	**14.37**	**13.00**
V_2 470	2020	13.42ab	3.54b	81.70a	151.03a	200a	5.35a	13.80a	12.60a
	2021	14.76b	3.89b	82.69a	136.70ab	225c	6.90c	13.40a	11.75a
	2022	12.21a	3.78b	84.01a	190.30b	245b	7.20c	15.70a	13.55a
	Average	**13.46**	**3.74**	**82.80**	**159.34**	**223.33**	**6.48**	**14.30**	**12.63**
LSD 5%	2020	3.05	0.35	7.13	5.18	30.13	0.23	0.57	0.77
LSD 5%	2021	2.66	0.36	8.26	8.41	20.77	0.36	0.75	0.60
LSD 5%	2022	2.81	0.34	5.29	6.27	20.01	0.39	0.67	0.69

*Comparative analysis with provenance α = 0.05.

Table 4. Berry structure and construction in reduced variants, for the period 2020-2022

Exp. Variants/ Clone	Period (Year)	Skins, %	Seeds, %	Mesocarp, %	Average weight per 100 berries, g	Number of seeds in 100 berries	Average seeds weight in 100 berries, g	Average berry size, mm	
								Length	Width
V_3 174	2020	12.34b	3.19a	84.47b	155.10b	160a	4.95a	13,80a	11,80b
	2021	12.09a	3.34a	84.57b	149.70b	190a	5.90ab	14,35ab	12,35ab
	2022	11.15b	4.17c	84.68a	195.60a	285c	8.15c	15,60b	13,85a
	Average	**11.86**	**3.57**	**84.57**	**166.80**	**211.67**	**6,34**	**14,58**	**12,67**
V_4 470	2020	14.85c	3.58b	81.57a	142.33a	175b	5,10b	13,80a	11,40a
	2021	12.86b	3.99d	83.15a	146.50ab	215b	6,60c	14,00a	12,26a
	2022	12.18d	3.65b	84.17a	198.30a	235b	7,25b	14,10a	13,95a
	Average	**13.30**	**3.74**	**82.96**	**162.37**	**208.33**	**6,32**	**13,97**	**12,54**
LSD 5%	2020	0.74	0.15	1.29	6.42	15.24	0,18	0,59	0,31
LSD 5%	2021	0.67	0.15	1.25	7.10	18.62	0,27	0,68	0,32
LSD 5%	2022	0.71	0.21	1.42	7.20	19.02	0,42	0,72	0,42

* Comparative analysis with provenance α=0,05

CONCLUSIONS

The studied Syrah clones are distinguished by a high percentage of normally developed berries over 95%, which is an indicator of good grape quality. Average mass per bunch was greater in the reduced yield variants, with weight ranging in clone 174 (V3) to clone 470 (V4). The same correlation was found for average bunch size, with the largest bunches being on clone 470 (V4). Reduced yield varieties have a lower percentage of skins and a higher percentage of mesocarp, which proves that an increase in berry size leads to a decrease in the ratio of skins to flesh.
Reduction in the number of bunches in the "pea size" phase has a favorable effect on the components for determining the technological maturity of grapes - the dynamics of sugar content and titratable acids. Within the experimental period, all variants reached the technological maturity stage early (beginning of September) for the studied area.
The grape harvest of vines with reduced yield (V3, V4) precedes those with non-reduced yield (V1, V2) by approximately one week.
Crop yield reduction during the growing season is a useful agriculture practice to increase grape size and improve overall grape quality.

ACKNOWLEDGEMENTS

This research was carried out with the support of the Center for Research, Technology Transfer and Intellectual Property Protection at the Agricultural University - Plovdiv, and the publication funded by Project 03-20, 2020.

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