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## **INFLUENCE OF GRAPE THINNING ON MUST QUALITY OF CHARDONNAY CULTIVAR IN KUTJEVO WINE-HILLS**

### **UTJECAJ PRORJEĐIVANJA GROZDOVA NA KAKVOĆU MOŠTA KULTIVARA CHARDONNAY U KUTJEVAČKOM VINOGORJU**

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#### **ABSTRACT**

Kutjevo wine-hills are located on southern slopes of Papuk and Krndija mountains. The area is the most famous by production of Graševina grapes, but increasing share of other varieties cannot be ignored. Chardonnay is the most widespread variety all over the world, and in Požeško-slavonska county is represented by 5 % of total vineyards area. The aim of this research was to determine the influence of cluster thinning in Kutjevo wine-hills on maturation and must quality of Chardonnay grapes. Research was conducted in 2020 in Podgorje location (Kutjevo wine-hills). Experiment was established by a randomized block schedule in two treatments with three repetitions. Five vines in a row makes one repetition. The following parameters have been determined: sugar content and total acidity in grapes in period of one month before harvest, number of clusters per vine, cluster mass, mass of 100 berries, density, total acidity, volatile acidity, tartaric acid, malic acid, lactic acid, pH, reducing sugars, extract, glucose, fructose, glycerol, alfa amino nitrogen, ammonia nitrogen and potassium. Results have showed that cluster thinning had a significant influence on cluster mass and number of clusters per vine, but majority of chemical parameters were not significantly different between two treatments. Statistically significant difference was only in case of pH, lactic acid and ammonium nitrogen.

Key words: grape maturation, acidity, sugar content, nitrogen, potassium

#### **SAŽETAK**

Vinogorje Kutjevo smješteno na južnim obroncima Papuka i Krndije najpoznatije je po uzgoju grožđa Graševina, međutim ne smije se zanemariti i sve veća zastupljenost ostalih sorti. Chardonnay je najraširenija vinska

sorta u svijetu, a u Požeško-slavonskoj županiji zauzima oko 5 % površine vinogradarskih nasada. Cilj ovog rada bio je odrediti utjecaj prorjeđivanja grozdova u vinogorju Kutjevo na kinetiku dozrijevanja grozdova, te kakvoću mošta kultivara Chardonnay. Istraživanje je provedeno tijekom 2020. godine na lokalitetu Podgorje (vinogorje Kutjevo), a pokus je postavljen po slučajnom bloknom rasporedu u dva tretiranja po tri repeticije. Repeticiju čini pet trsova u nizu. Ispitivani su sljedeći parametri: udio šećera i ukupna kiselost u grožđu u periodu mjesec dana prije berbe, broj grozdova po trsu, prosječna masa grozdova, te masa 100 bobica. U moštu su određeni sljedeći parametri: gustoća, ukupna kiselost, hlapiva kiselost, vinska, jabučna i mliječna kiselina, pH, reducirajući šećeri, ekstrakt, glukoza, fruktoza, glicerol, alfa amino dušik, amonijačni dušik, te kalij. Prorjeđivanje grozdova je statistički značajno utjecalo na broj grozdova, masu grozdova, pH vrijednost, mliječnu kiselinu i amonijačni dušik, dok kod drugih analiziranih parametara nije bilo statistički značajne razlike između pokusnih varijanata.

Ključne riječi: dozrijevanje grožđa, kiselost, sadržaj šećera, dušik, kalij

## INTRODUCTION

Kutjevo wine-hills are located in the central area of the wine-growing subregion of Slavonia. Vineyards are located along the southern slopes of Papuk and Krndija mountains with the total surface area of over 1250 hectares. The prime south facing vineyard positions are protected from the penetration of cold air from north, resulting in formation of the mesoclimatic features of wine-hills (Mirošević et al., 2011). The area is the most famous by production of Graševina grapes, but increasing share of other varieties cannot be ignored. Chardonnay is the most widespread variety all over the world grown on 130.000 ha worldwide. It has great capability to adapt to different soil and climatic conditions (Čuš, 2004), and in Požeško-slavonska county is represented by 5 % of total vineyards area (according to data by Croatian agency for payment in agriculture, fishery and rural development).

It is well known that crop level can influence quality parameters of wine grape. Cluster thinning and basal leaf removal are often used to improve grape composition, like increase in sugar, color and flavor in grapes at harvest (Kok, 2011). Many research already examined influence of cluster thinning at different stages, but final conclusion on economic significance and quality improvement cannot be generalized. Final conclusion regarding this tool

depends on year and climatic conditions, fertility and quality of cultivar, time of application and vineyard position (Filippetti et al., 2007; Palliotti and Cartechini, 2000; Van Schalwyk et al., 1995). Cluster thinning is an expensive process because of large labour requirements (Diago et al., 2010; Reynolds et al., 2007) so it should not be accepted as a universally effective tool to increase varietal typicity, it should be carefully and individually examined and other practices during wine making process (like yeast strain selection) should be considered (Reynolds et al., 2007).

The aim of this research was to determine the influence of cluster thinning in Kutjevo wine-hills on maturation kinetics and must quality of Chardonnay grapes. So far, some research regarding cluster thinning in Kutjevo wine-hills have been published, but they report on Muscat, Pinot blanc, Pinot gris, Merlot and Cabernet Sauvignon (Mesić et al. 2012; 2013. and 2020); but to the best of our knowledge data on Chardonnay variety in this location have not been published.

## MATERIALS AND METHODS

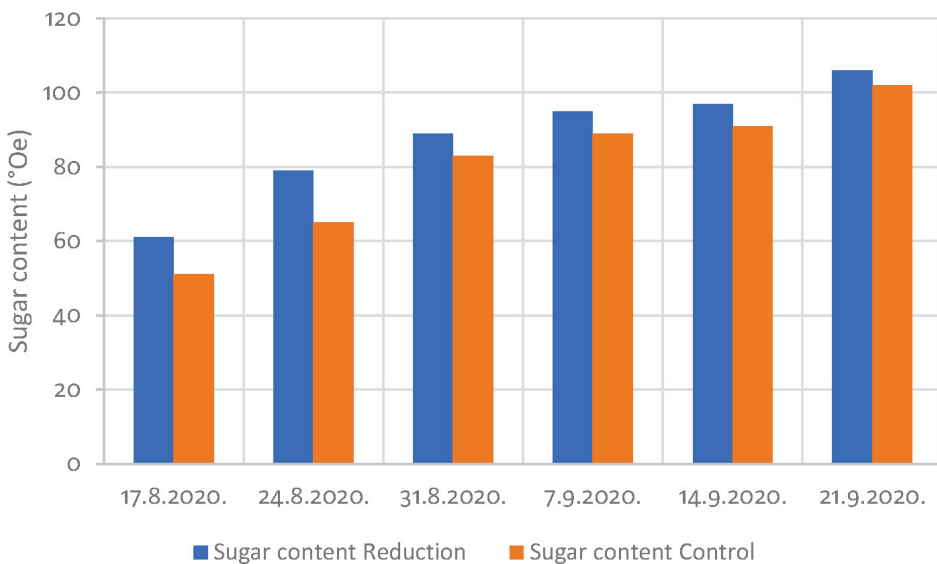
This research was conducted in the vineyards of Polytechnic in Požega (Croatia). Grapes of Chardonnay (*Vitis vinifera* L.) variety were used for the experiment. Vineyard is situated on the southern slopes of Papuk mountain at an altitude of 250 m in Podgorje location. Rows of test plantation extend from north to south, and it is planted in 2006. The training system is Guyot, the number of shoots per vine is 10, two of which are on the spur and the other eight on the cane. Experiment was established by a randomized block schedule in two treatments (Reduction - R and Control - C) with three repetitions. Five vines in a row make one repetition.

The removal of clusters was done at stage of fruit development, leaving one cluster per shoot (better positioned), removing about one third of bunches.

Starting from mid-August till the harvest grape samples from vineyard were collected once per week and the amount of sugar was determined by refractometer and total acidity according to official OIV method (OIV, 2007). Grapes were manually harvested on 23.9.2020, cluster number per vine and average cluster weight were recorded. Grape must analysis was done by FTIR wine analyser WineScan (Foss).

Data were analysed by Statistica 12 software, using *post hoc* LSD at 95% level.

## RESULTS AND DISCUSSION



*Figure 1 Sugar content accumulation during grape maturation*

*Slika 1. Akumulacija šećera tijekom dozrijevanja grožđa*

As it can be seen in Figure 1, sugar content in R treatment has been higher than in C from the beginning of measurements (61 °Oe for R and 51 °Oe for C), till the last measurement before harvest (106 °Oe for R and 102 °Oe for C), but from technological point of view, the difference between treatments in final measurement is not important. Similarly, the difference in total acidity values between treatments (Figure 2) decreased from mid-August (13 g/L for R and 13.9 g/L for C) till mid-September (6.2 g/L for R and 6.0 g/L for C). With the approach of harvest date difference in acidity between treatments became smaller.

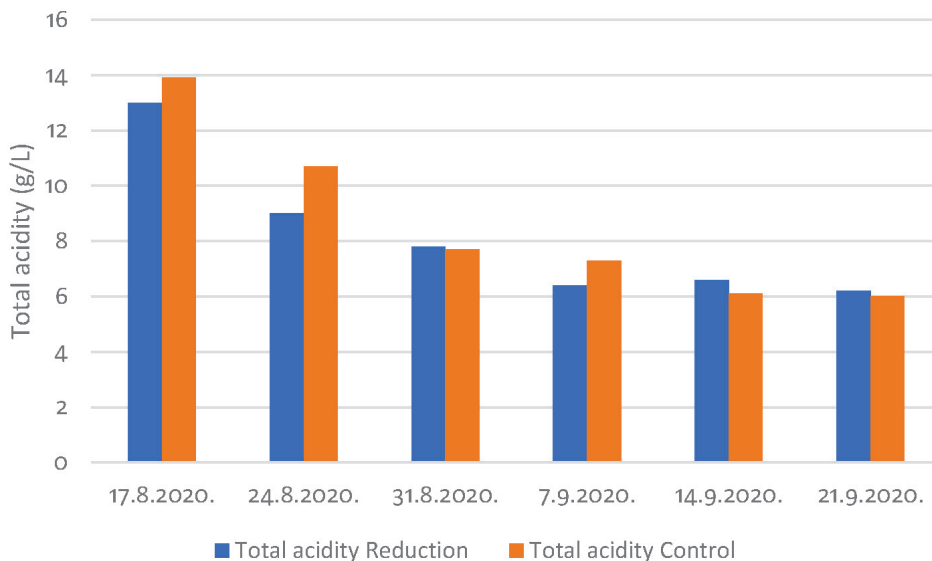


Figure 2. Total acidity during grape maturation  
Slika 2. Ukupna kiselost tijekom dozrijevanja grožđa

The right choice of time for cluster thinning can have a great impact on the final result of the process. When bunches are removed before veraison vine can compensate reduction by increase of a number of berries set, berry and bunch mass, resulting in a smaller reduction in yields. The best results in crop reduction are usually obtained when bunches are removed after veraison as berry set thing has been completed and cell division and growth ended (Ferree et al., 2003; Van Schalwyk et al., 1995). Besides, later period of thinning, after veraison, allows easier and more precise removal of less matured bunches (Jackson, 2000; Keller, 2010.). Table 1 shows significantly lower number of clusters per vine in R treatment and consequently significantly lower mass of clusters per vine. On the other hand, R treatment has higher mass of berries as a consequence of a reduction, but this increase of berry mass cannot be enough to fully compensate the loss of crop (Karoglan et al., 2011). Palliotti and Carthechini (2000) applied thinning just before veraison at levels 20 and 40 %. Reduction of yield was noticed only at level of 40 % because self-compensation of the vine caused increase of berry size and weight of the clusters in all tested cultivars (Merlot, Sangiovese and Cabernet Sauvignon).

**Table 1 Average number of clusters per vine, average mass of a cluster and mass of a hundred berries**<sup>A, B</sup>

**Tablica 1. Prosječan broj grozdova po trsu, prosječna masa grozda i masa sto bobica**<sup>A, B</sup>

	The number of clusters per vine	Average mass of clusters per vine (g)	Mass of a hundred berries (g)
C	13.8±3.45 <sup>b</sup>	1900.00±848.65 <sup>b</sup>	132.33±7.56 <sup>a</sup>
R	9.33±1.65 <sup>a</sup>	1317.47±337 <sup>a</sup>	145±0.82 <sup>b</sup>

<sup>A</sup> Results were expressed as the mean of three repetitions ± standard deviation

<sup>B</sup> Means followed by the same letter in the columns are not statistically different at 5% probability

**Table 2 Density and acidity parameters in must samples**<sup>A, B</sup>

**Tablica 2. Gustoća i parametri kiselosti u uzorcima mošta**<sup>A, B</sup>

	Density	Total acidity	Volatile acidity (g/L)	pH	Mallic acid (g/L)	Lactic acid (g/L)	Tartaric acid (g/L)
C	1.0984±0.003 <sup>a</sup>	5.7±0.14 <sup>a</sup>	0.1	3.34±0.005 <sup>a</sup>	1.43±0.18 <sup>a</sup>	0.37±0.04 <sup>a</sup>	3.90±0.16 <sup>a</sup>
R	1.1033±0.002 <sup>a</sup>	5.3±0.12 <sup>a</sup>	0.1	3.43±0.04 <sup>b</sup>	1.73±0.12 <sup>a</sup>	0.43±0.04 <sup>b</sup>	3.21±0.26 <sup>a</sup>

<sup>A</sup> Results were expressed as the mean of three repetitions ± standard deviation

<sup>B</sup> Means followed by the same letter in the columns are not statistically different at 5% probability

Acidity parameters and density are presented in Table 2. Although certain difference between treatments can be seen in the density values, it is not statistically significant. As expected, total acidity is lower in R treatment. Although such values are potentially technologically interesting because 5.3 g/L is quite low, close to the bottom level of acceptability in terms of a good balance with alcohol level expected to be obtained from must with 24.4 °Brix (Table 3), difference between treatments is not statistically significant. The same result is obtained for tartaric acid. On the other hand, malic acid and lactic acid values are higher in R treatment, but result is significant only in case of lactic acid. pH is significantly higher in R treatment, but such result is not technologically important. This result is in accordance with previously published results by Mesić et al. (2012; 2013, and 2020) for other varieties at the same vineyard position: Muscat, Merlot, Pinot Gris and Pinot Blanc. Bahar and Yasasin (2010) and Karoglan et. al (2011) also reported about same thinning effect on total acidity, tartaric, malic and citric acid in year of normal climatic conditions for grape maturation. But in year with very unfavourable conditions and very high results of acidity, grape thinning at the beginning of veraison resulted in decrease of total acidity.

**Table 3 Extract, sugar and glycerol content in tested must samples<sup>A, B</sup>**

**Tablica 3. Ekstrakt, sadržaj šećera i glicerola u uzorcima mošta<sup>A, B</sup>**

	Total extract (g/L)	°Brix	Reducing sugar (g/L)	Fructose (g/L)	Glucose (g/L)	Glycerol (g/L)
C	262.23±8.95 <sup>a</sup>	23.33±0.74 <sup>a</sup>	237.23±9.06 <sup>a</sup>	120.63±3.67 <sup>a</sup>	111.5±4.39 <sup>a</sup>	0.23±0.04 <sup>a</sup>
R	275.00±5.22 <sup>a</sup>	24.40±0.43 <sup>a</sup>	247.83±4.34 <sup>a</sup>	126.5±2.12 <sup>a</sup>	116.87±1.67 <sup>a</sup>	0.40±0.08 <sup>a</sup>

<sup>A</sup> Results were expressed as the mean of three repetitions ± standard deviation

<sup>B</sup> Means followed by the same letter in the columns are not statistically different at 5% probability

As presented in Table 3, thinning didn't affect extract and sugar level in significant level. Fructose/glucose ratio is approximately 1 in both treatments. Vranješ et al. (2012) pointed out that thinning effect is strongly dependent on cultivar which is applied on. Previous research on the same position gave different results for different varieties: It had significant influence on increase of sugar content in the case of Muscat and Cabernet Sauvignon, but it didn't have significant effect on Merlot, Pinot Gris and Pinot White (Mesić et al. 2012; 2013, and 2020.). Čuš (2004) pointed out that good yield and sugar content of Chardonnay could be obtained with normal or even slightly higher crop load in Vipava Valley (Slovenia).

**Table 4 Nitrogen parameters and potassium**

**Tablica 4. Parametri dušika i kalij**

	Alpha amino nitrogen (mg N/L)	Ammonium nitrogen (mg/L)	Potassium (mg/L)
C	69.33±5.44 <sup>a</sup>	31.67±1.70 <sup>a</sup>	1281.67±38.42 <sup>a</sup>
R	85±14.31 <sup>a</sup>	34.00±8.83 <sup>b</sup>	1562.33±110.07 <sup>a</sup>

There is a strong correlation between juice/wine pH and potassium concentration. Besides, potassium also influences titratable acidity and modify the tartaric acid/malic acid ratio as a consequence of a formation of a potassium salts with tartaric acid. As a concentration of potassium increases, concentration of free tartaric acid decreases (Moss, 2016) and ratio tartaric/malic acid shifts towards malic acid. In this research potassium level (Table 4) is higher in R treatment than in C treatment (1562.33 mg/L and 1281.67 mg/L, respectively). Although this difference between treatments is not statistically significant it is in correlation with previous statement regarding acidity because R treatment



has lower level of total acidity and tartaric acid, but higher level of malic acid than C treatment. Mpelasoka et al. (2003) stated regulation of crop load as one of the factors affecting K accumulation in berries. They also mentioned other factors like soil composition, variety, rootstock, berry growth, irrigation etc. Results presented in this research are typical for potassium level in berry's pericarp.

Nitrogen composition of grape must influences the growth and metabolism of yeasts, fermentation rate and the completion of fermentation (Beltran et al., 2005). Bell and Henschke (2005) reported that ammonium is one of the most preferred nitrogen sources by yeast and in grapes it ranges from 5 to 325 mg/L. Results presented in Table 4 are within mentioned range. Although R treatment has significantly higher amount of ammonium nitrogen, this difference cannot be considered as technologically important. Besides, the amount of ammonium in must is often manipulated in the wine cellar by the addition of ammonium salts. R treatment has higher concentration of alpha amino nitrogen than C treatment, but this difference is also not significant.

## CONCLUSION

Grape thinning of Chardonnay cultivar in Kutjevo wine-hills in 2020 hasn't been justified from technological and economical point of view. It significantly decreased the yield, but it didn't affect grape must quality. Statistically significant difference between treatments was observed only in case of pH and ammonium nitrogen, but the difference is not technologically important. To withdraw the final conclusion about justification of Chardonnay thinning in Kutjevo wine-hills, research should be continued through several vegetation seasons to see eventual relation of this procedure to climatic conditions in different seasons.

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