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EFFECT PHYTOTECHNOLOGICAL FACTORS ON TWO RED WINE GRAPE VARIETIES

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Abstract

Among the most extensively grown plants worldwide are grapes. Numerous religions place a high value on grapes and wine. The objective of the experiment was to examine the impact of varying cluster loadings (30% and 50%) on the yield of two distinct grape varieties ('Zweigelt' and 'Fetească neagră'/'Feketeleányka'), both in terms of quantity and quality. The experiment was carried out Mica village, in Mureș County. From the yield numbers, could be deduct that the control variety yielded the highest. The sugar content was highest and the acid level was lowest at 30% cluster load. The values were pretty close at 50% load. In terms of wine production, the 50% load was the most appropriate to the control. In terms of grape berries number, at 'Fetească neagră'/'Feketeleányka' the highest values were reached at 50 % cluster load and in the case of 'Zweigelt' the highest number was recorded at 30% load.

***Key words**: cluster load, grape varieties, production.*

INTRODUCTION

Grape is the fruit that is cultivated on a large scale, ranking third in popularity after citrus and banana (Singh et al., 2017). In certain parts of the world with ideal climates, winegrowing and winemaking have a very long history. The wine served as the crown gem of Greek, Roman, and Egyptian cuisine. Because wine was purer than readily available water, it was preferred by nobility for a very long period (Kádár, 1973). For many centuries, wine consumption has been widespread throughout the world (Snopek et al., 2018). Red wine serves as more than just a source of pleasure; it also possesses medicinal properties (Balla et al., 2023). Wine's health advantages were recognised by the ancient Romans, who also popularised it (Lukacs, 2012). It was demonstrated that wine-derived phenolic compounds play a significant role in human health (Antoce & Stockley, 2019). Grosso et al. (2017) research has shown that these compounds have proven effects in reducing the risk of all-cause mortality.

The colour of red wine holds significant importance as it is the primary characteristic that wine consumers notice, and it is closely linked to the wine's overall quality (de Freitas et al., 2017). Viticultural literature defines crop load as the ratio of canopy size to fruit yield, serving as a tool to evaluate source-sink dynamics in relation to vine well-being and sugar content in berries (Reeve et al., 2018). In a study Naor et al. (2002) suggested that the amount of crop load, as rather than the yield, could serve as a more accurate measure of wine quality.

In a previous study is mentioned that the treatment with 8 buds per cane resulted in the highest recorded value for both berry weight and volume, along with the greatest percentage of total soluble solids and T.S.S./Acidity, while also showing the lowest total acidity content (Khamis et al., 2017). Moreover, is also reported that a blend of leaf removal and cluster thinning is increase the quality of grapes and wines (Song et al., 2018). Canopy management encompasses various viticultural techniques, including the implementation of trellis systems, controlling vine vigor, trimming shoots, thinning clusters, and removing leaves, these practices have been extensively employed in grape production worldwide for numerous years (Osrečak et al., 2015; Sivilotti et al., 2016).

In the present paper the aim was to find the greatest cluster load for red wine varieties, to achieve a greater quantity of grapes, moreover a higher quality of wine.

MATERIALS AND METHODS

The experiment was conducted in Mica, Mureş County in a vineyard in 2020. The average temperature was 10°C (Figure 1) and the highest precipitation was in July approximatively ~135 mm and the lowest August when 21 mm (Figure 2).

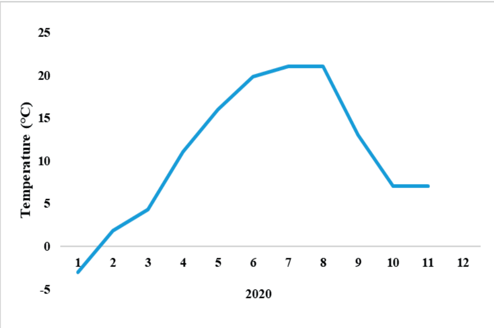

Figure 1. Temperature during the experiment

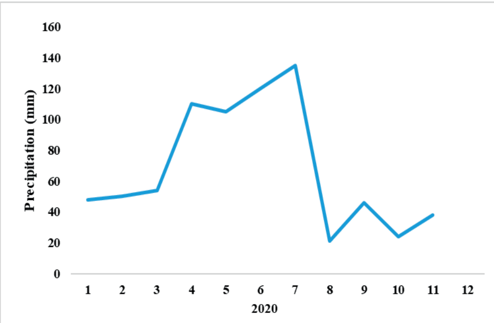

Figure 2. Precipitation during the experiment

The soil type was determined on the experimental site clay-washed, brown forest soil.

US 2) Clay-washed, brown forest soil

Description:

Ap (0-10 cm) clayey – adobe, dark brown, granular structure, frequent root system, coprolitic, loose.

Ao (10-40 cm) clayey – adobe, dark brown, granular structure, frequent root system, coprolitic, loose.

Bt (40-68 cm) clay-washed, yellow-brown, prismatic structure.

Ck (68 cm–) clay-washed, yellow, dense, lime concentration.

US 2) Luvisol

Description:

Ap (0-10 cm) clay-loam texture, dark brown, granular structure, frequent root presence, coprolitic, loose.

Ao (10-40 cm) clay-loam texture, dark brown, granular structure, frequent root presence, coprolitic, loose.

Bt (40-68 cm) leaching clay accumulation (illuviation), yellow-brown, prismatic structure

Ck (68 cm–) leaching clay accumulation (illuviation), yellow, compact, lime concentration.

Table 1. Chemical analysis of US 2) soil

Horizont	Ap	Ao	Bt	Ck
Depth (cm)	0-10	10-40	40-68	68
pH	5.34	5.30	5.90	8.14
Humus	6.50	4.08	1.03	0.59
N %	0,311	0.183	0.076	-
P ppm	7	3	2	-
K ppm	18.5	8.1	10.2	-

Table 2. Physical analysis of US 2) soil (grain size analysis)

Horizont	Ap	Ao	Bt	Ck
Depth (cm)	0-10	10-40	40-68	68
Coarse sand () 2–0.2 mm	1.9	2.7	0.7	0.2
Fine sand 0.2–0.02 mm	32.7	33.3	18	16
Powder				
0.02–0.002 mm	28	31	29.4	40.1
Clay				

As plant material we have selected 'Zweigelt' and 'Fetească neagră'/'Feketeleányka' red wine varieties. In the case of 'Fetească neagră'/ 'Feketeleányka' the cultivation area is 3 m^2 (2.5 × 1.2 m) and at 'Zweigelt' 2.25 m^2 (2.5 × 0.9 m). The 'Zweigelt' variety is native to Austria it is a cross-breeding between Blaufränkisch and St. Laurent varieties since 1920. About the 'Fetească neagră'/'Feketeleányka' it is assumed to be native near to the Prut flow.

In the study two types of treatments and one untreated (control) was set up. The treatments were carried out in 4 repetitions on 12 plants per repetition, so the effects of each treatment were examined on a total of 48 plants, per variety. The cluster thinning was made after the flowering stage, when the 50 and 30% cluster loads were set up, moreover in the case of control clusters remained in the same way. At the 50% cluster thinning in every case the shoot first cluster was kept, and the rest of the clusters were removed. In the case of the 30% cluster load, on the grape's productive bases from the two kept shoots from one of the shoots every cluster was removed, and from the other shoot the second and the third clusters were removed. We have evaluated the grape berry weight (g), cluster weight (g), harvest quantity (t/ha), sugar content (g/L), acid level (g/L), dry matter content (%), and the number of seeds.

The following methods were applied to determine the acidity, sugar, and dry matter content.

Determination of dry matter content

Measurement of volume using a pycnometer for wine and water, along with distillation and subsequent calculations.

Removal of carbon dioxide from the wine through stirring.

Thorough rinsing of the pycnometer with the wine to be analyzed, followed by insertion of the wine and thermometer.

Adjustment of the wine to 20°C.

Filling the pycnometer to the mark, drying it, and weighing it to four decimal places.

Calculation:

Density = (mass of wine - mass of empty pycnometer) / mass of water.

Extract = 1 + wine density - distillate density.

Result interpretation using a reference table.

Calculation of Non-reducing Dry Extract:

Non-reducing dry extract = Total dry extract – residual sugar.

Determination of sugar

Utilization of the Rebelein method

Preparation:

In a flask, combine 10 mL of copper sulphate ($CuSO_4$), 5 mL of Seignette salt, a few grains of pumice stone, and 2 ml of the wine to be analysed.

Boil the solution for 2 minutes and allow it to cool.

Titration:

Add 10 mL of potassium iodide solution, 10 mL of sulfuric acid, and 10 mL of starch to the cooled solution.

Titrate the dark-colored solution with sodium thiosulfate until a yellowish-white color is achieved. Read the sugar content directly in g/L from the biuret. Dilution, if necessary, for sugar content above 28 g/L, dilute the wine with distilled water according to the specified factors.

Determination of total acidity

Employment of the Schliessmann reagent/method

Preparation:

In a flask, prepare 25 ml of the wine to be analysed, ensuring removal of carbon dioxide by heating and subsequent cooling.

Titration:

Titrate with BLAULAUGE 1/3 N solution until a dark green color is reached (indicating neutral pH, confirmed with pH paper).

The amount of sodium hydroxide solution used corresponds to the acidity of the wine.

The significance of the differences between the treatments was tested by applying one-way ANOVA, at a confidence level of 95%. When the ANOVA null hypothesis was rejected, Tukey's post hoc test was carried out to establish the statistically significant differences at $p < 0.05$.

RESULTS AND DISCUSSIONS

Considering the grape berry weight could be clearly observed that the 30% cluster load is significantly higher compared to the other two (Figure 3). Moreover, no significant differences were observed between the control and the 50% cluster load.

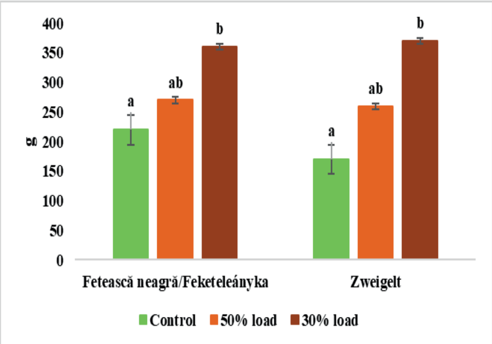

Figure 3. Grape berry weight under the effect of cluster load (50 and 30%). Bars represent the means ± SE (n = 48). Different letters above the bars indicate significant differences between cluster load ($p < 0.05$)

Here again, the greatest cluster weight at both varieties was recorded at the 30% cluster load, which is significantly different compared to the other two treatments (Figure 4). Beside the 50% cluster load also recorded a higher cluster weight when comparing to control. Additionally significant differences were determined also between the 50 and 30% cluster loads.

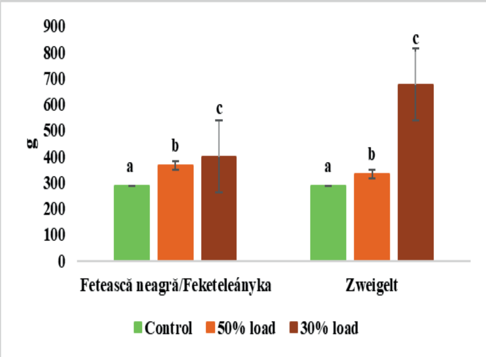

Figure 4. Cluster weight under the effect of cluster load (50 and 30%). Bars represent the means ± SE (n = 48). Different letters above the bars indicate significant differences between cluster load ($p < 0.05$)

As was expected the highest quantity of grapes were determined at the control plants (Figure 5), where significant differences were observed compared to the other two treatments, at both red wine varieties. In the case of the cluster thinning plants no significant differences were recorded.

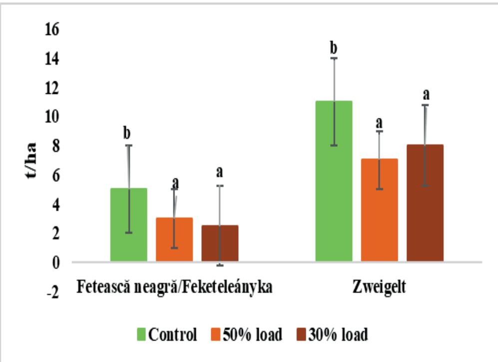

Figure 5. Harvest quantity under the effect of cluster load (50 and 30%). Bars represent the means ± SE (n = 48). Different letters above the bars indicate significant differences between cluster load ($p < 0.05$)

Sugar content did not record significant differences between the cluster thinning methods (Figure 6). Only a small inhibition of sugar content was observed at the 'Zweigelt' variety control treatment, which was not significantly difference compared to 30 and 50% bud load.

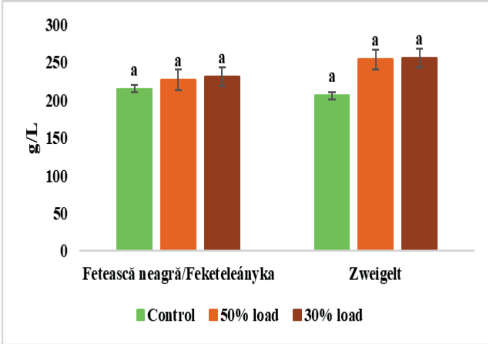

Figure 6. Sugar content under the effect of cluster load (50 and 30%). Bars represent the means ± SE (n = 48). Different letters above the bars indicate significant differences between cluster load ($p < 0.05$)

Once more no significant differences were observed at the acid level (Figure 7). At the 'Feteasca neagră' variety the acid level was approximatively ~ 7 g/L, and in the case of 'Zweigelt' ~ 12 g/L.

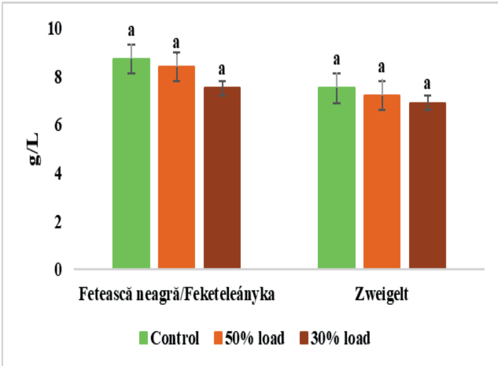

Figure 7. Acid level under the effect of cluster load (50 and 30%). Bars represent the means ± SE (n = 48). Different letters above the bars indicate significant differences between cluster load ($p < 0.05$)

When comparing the dry matter content an inhibition was recorded at the 'Feteasca neagră' variety at control plants compared to the other two treatments (Figure 8). However, in 'Zweigelt' no significant differences were reported, in this case the dry matter was approximately ~ 19%.

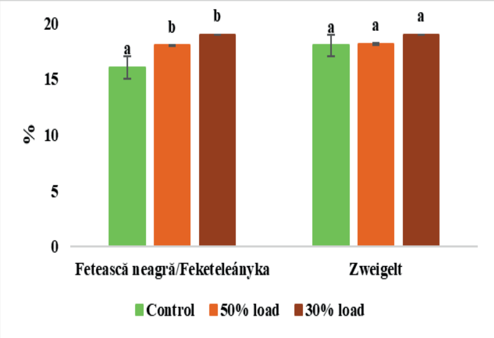

Figure 8. Dry matter content under the effect of cluster load (50 and 30%). Bars represent the means ± SE (n = 48). Different letters above the bars indicate significant differences between cluster load ($p < 0.05$)

At the control and 50% cluster load increase could be observed 3, 4 seed/berry value and decrease are determined at 1 seed/berry (Figure 9). A common value could be observed at 2 seed/berry. The 50 and 30% cluster load an increase is determined at 1 and 2 seed/berry, and decrease at 3, 4 seed/berry.

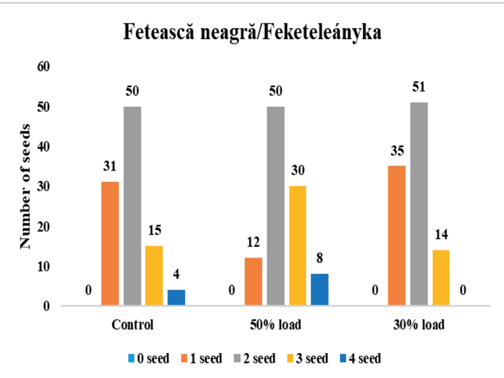

Figure 9. Number of seeds under the effect of cluster load (50 and 30%).

Regarding the 'Zweigelt' variety increase could be determined between control and the two treatments in regard to 3 and 4 seed/berry respectively and decrease at 1 and 2 seed/berry (Figure 10). A similar value could be observed at 2 seed/berry at the 50 and 30% cluster load.

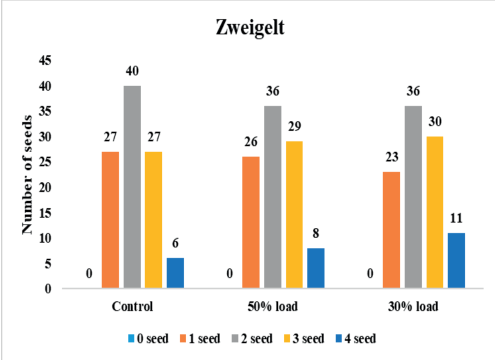

Figure 10. Number of seeds under the effect of cluster load (50 and 30%)

CONCLUSIONS

From the present data could be concluded that in the case of grape berry weight and cluster weight the highest amount was determined at 30% cluster load, moreover the 50% cluster load also achieved a higher quantity compared to control. Regard to the harvest quantity the control treatment reported the highest amount at both red wine varieties. The cluster load did not influence the sugar content and the acid level of the varieties. In the case of number of seed/berries at the 'Zweigelt' the 30% cluster load was the most favoured. However, at 'Feteasca neagră' the 50% cluster load achieved the best results. Concerning the dry matter content the 50 and 30% cluster loads are exceling compared to control. Altogether, at the selected red wine varieties the greatest results were determined at 30% cluster load.

Under our experimental conditions we recommend that cluster thinning could have a positive effect on the grape, however the 30% cluster load achieve a higher achieved greater amount as the other two.

REFERENCES

Antoce, A.O., & Stockley, C. (2019). An overview of the implications of wine on human health, with special consideration of the wine-derived phenolic compounds. *AgroLife Scientific Journal*, *8*(1), 21–34.

Balla, G., Lunka, T.A., Joó, J., Moldován, C., Szekely-Varga, Z., Csorba, A.B., & Kentelky, E. (2023). Impact of Fermentation Temperature and Duration on Anthocyanin Concentration and on Quality of Cabernet Sauvignon Wine. *Scientific Papers. Series B. Horticulture*, *2*, 201–208.

de Freitas, V.A.P., Fernandes, A., Oliveira, J., Teixeira, N., & Mateus, N. (2017). A review of the current knowledge of red wine colour. *Oeno One*, *51*(1).

Grosso, G., Micek, A., Godos, J., Pajak, A., Sciacca, S., Galvano, F., Giovannucci, E.L. (2017). Dietary flavonoid and lignan intake and mortality in prospective cohort studies: Systematic review and dose-response meta-analysis. *American journal of epidemiology*, *185*(12), 1304–1316.

Kádár, GY. (1973). Vinery (Borászat). Budapest, HU: Mezőgazdasági Publisher.

Khamis, M.A., Atawia, A.A.R., El-Badawy, H.E.M., Abd El-Samea, A.A.M. (2017). Effect of buds load on growth, yield and fruit quality of superior grapevines. *Middle East Journal of Agriculture Research*, *6*(1), 152–160.

Lukacs, P. (2012). Inventing wine: A new history of one of the world's most ancient pleasures. *WW Norton & Company*.

Naor, A., Gal, Y., & Bravdo, B. (2002). Shoot and cluster thinning influence vegetative growth, fruit yield, and wine quality of Sauvignon blanc'grapevines. *Journal of the American Society for Horticultural Science*, *127*(4), 628–634.

Osrečak, M., Karoglan, M., Kozina, B., Preiner, D. (2015). Influence of leaf removal and reflective mulch on phenolic composition of white wines. *OENO One*, *49*(3), 183–193.

Reeve, A.L., Skinkis, P.A., Vance, A.J., McLaughlin, K.R., Tomasino, E., Lee, J., Tarara, J.M. (2018). Vineyard floor management and cluster thinning inconsistently affect 'Pinot noir'crop load, berry composition, and wine quality. *HortScience*, *53*(3), 318–328.

Singh, S., Arora, N.K., Gill, M.I.S., Gill, K.S. (2017). Differential crop load and hormonal applications for enhancing fruit quality and yield attributes of grapes var. Flame Seedless. *Journal of Environmental Biology*, *38*(5), 713.

Sivilotti, P., Herrera, J.C., Lisjak, K., Baša Česnik, H., Sabbatini, P., Peterlunger, E., Castellarin, S.D. (2016). Impact of leaf removal, applied before and after flowering, on anthocyanin, tannin, and methoxypyrazine concentrations in 'Merlot' (Vitis vinifera L.) grapes and wines. *Journal of agricultural and food chemistry*, *64*(22), 4487–4496.

Snopek, L., Mlcek, J., Sochorova, L., Baron, M., Hlavacova, I., Jurikova, T., Kizek, R., Sedlackova, E., & Sochor, J. (2018). Contribution of red wine consumption to human health protection. *Molecules*, *23*(7), 1684.

Song, C.Z., Chao, W.A.N.G., Sha, X.I.E., Zhang, Z.W. (2018). Effects of leaf removal and cluster thinning on berry quality of Vitis vinifera cultivars in the region of Weibei Dryland in China. *Journal of integrative agriculture*, *17*(7), 1620–1630.