



Agrobiological, economical, and technological characteristics of the Ribier table grape variety depending on the different vine loads with fertile buds

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Abstract

The study of the impact of different vine loads on the agrobiological, economical, and technological characteristics of the Ribier variety was carried out in 2020 and 2021 with the aim of determining the optimal load for this variety. The tests were carried out in the experimental vineyard of the Biotechnical Faculty in Podgorica. Four different vine loads with fertile buds were applied, namely 8, 12, 16, and 18 buds. The results of this study have shown that the applied loads had a significant impact on the examined parameters of the Ribier variety. The results obtained on the average yield of grapes have shown that the lowest value of this parameter was found in the variant with a load of 8 buds - 4.2 kg/vine, while the highest grape yield was recorded for the variant with a load of 18 buds (7.0 kg/vine). V1 had the highest average cluster weight (396 g), while V4 had the lowest cluster weight (325 g). The content of sugar in grape juice also varied significantly under the influence of the load on the vines. The highest sugar content was recorded in the variant with a load of 8 buds - 16.1%, and the lowest in the variant with 18 buds - 14.7%. The acid content did not differ significantly between the tested varieties.

Key words: Ribier, yield, cluster weight, sugar, acids.

Introduction

Due to the Mediterranean climate in the Podgorica vineyard, conditions are ideal for growing table grape varieties of all maturity periods (Popović, 2020). However, despite the favourable agro-ecological conditions, the production of table grapes has been neglected for no obvious reason, so the cultivation of table varieties is much less prevalent compared to wine varieties. Of the total vineyard areas in Montenegro (2800 ha), more than two-thirds (69.01%) comprise varieties used for the red wine production, smaller areas of vineyards (23.11%) include white wine varieties, while the smallest areas (7.89%) are those where varieties for fresh consumption are grown (Rezonization, 2017). Apart from the very early table variety Cardinal, which is dominantly represented in the vineyards of Montenegro, the Ribier, Italy, Victoria, Matilda, Muscat Hamburg, and other varieties are grown to a lesser extent. The Ribier variety (Alfons Lavale) is a well-known variety that is characterized by large beautiful clusters and berries with a very attractive appearance. Grapes of this variety are very suitable for transportation and market (Božinović, 2010). According to data available in the literature, the Alfons Lavale variety was created from the combined crossing of Bellino x Lady Downe's Seedlings. However, through DNA analysis, it was determined that this variety originated from the crossing of Karistvala Kolkhuri (Dodreljabi, Gross Kolman) and Muscat Hamburg, which was confirmed by Ibanez et al. (2009) and Lacombe et al. (2013). Ribier is grown in many countries around the world, especially in France, USA, Algeria, Israel, Greece, and Italy (Matijašević, 2021). In southern, warmer areas, it gives particularly good results (Žunić & Garić, 2017).

Mature pruning is one of the most important ampelotechnical measures in the grape production technology (Senthilkumar et al. 2015; Bindon et al. 2008). Numerous authors state that this measure regulates the vegetative and reproductive potential and indirectly affects the quantity and quality of the grape yield (Friend & Tought, 2007; Feitosa, 2018; Jovanović-Cvetković & Mijatović, 2017). In order to properly load the vine with buds, its vegetative potential, agro-ecological growing conditions, and the quality of the grape yield that is to be achieved must be taken into account (Vujović, 2013). Excessive loading of the vines with buds leads to delayed and uneven ripening of grape, lower grape quality, and finally the exhaustion of the vines (Miller et al., 1993; Prculovski, 2019). On the other hand, an insufficient number of buds or harsh winter pruning leads to stronger occurrence of infertile shoots, flower shedding, more intensive bud growth, higher sensitivity to diseases and pests, as well as weaker resistance to low winter temperatures (Karoglan et al., 2017).

Considering that different genotypes may have different reactions to different loads of the vines with fertile buds, the investigation of the optimization of winter pruning is of great importance in improving the quantitative and qualitative characteristics of the product (Qardash et al., 2023). Thus, in every wine-growing region it is necessary to establish the optimal load for all grape varieties and cultivation forms in accordance with the technology of grape production, which will give the most favourable production results (Marković, 2012; Popović, 2023). Any subsequent hiring of labour for the purpose of regulating and correcting fertility during the growing season puts an additional economic burden on the production.

The aim of this study was to examine the influence of different loadings of the vines on some biological and technological characteristics of the Ribier variety in the agro-ecological conditions of the Podgorica subregion.

Material and Methods

The study of the impact of different vine loadings with fertile buds on the agrobiological, economic, and technological characteristics of the Ribier variety was carried out in 2020 and 2021. The tests were carried out in the experimental vineyard of the Biotechnical Faculty in Podgorica - 42° 26' 78" N and 19° 12' 57" E. The Ribier variety was grafted onto Berlandieri x Riparia Kober 5 BB, and the vineyard was planted in 2005 with a planting distance of 2.4 m between rows and 1 m between vines in a row. The training system of the vine is a two-arm horizontal cordon with a tree height of 80 cm. Short and mixed pruning was applied. During the research, the experimental vineyard was irrigated with a drop-by-drop system. The tests were carried out on 120 vines, that is, in three repetitions with 10 vines each. The trial included the following variants: V1 - 8 buds (4 canes with 2 buds each), V2 - 12 buds (4 canes with 3 buds each), V3 - 16 buds (2 canes with 4 buds each and 2 canes with 5 buds each), and V4 - 18 buds (2 canes with 3 buds each and 2 canes with 6 buds each).

During the two-year study, the following parameters were monitored:

The grape yield was obtained by weighing the harvested grapes from each vine, and the bunch weight was determined from the ratio of the yield achieved and the number of bunches.

After the grape harvest, the length and width of the bunch and the berry were measured, as well as the average weight of the berry.

The sugar content in the grape juice was determined hydrometrically (with Oechsle hydrometer), and the proportion of total acids in the grape juice was determined by neutralizing all acids and their salts with an n/10 NaOH solution with the bromothymol blue indicator.

Data from the meteorological station in Podgorica were used in the analysis of the climatic conditions in Podgorica.

Processing of the obtained results was carried out by using the analysis of variance for a completely random block system. Testing was performed using the LSD test for pairwise comparisons at two significance levels: 0.05 and 0.01.

Results and Discussion

Based on the data from Table 1, the mean annual and vegetation air temperatures were quite uniform in the studied period. The average annual and vegetation temperature in 2021 (17.0°C and 22.3°C) was slightly lower compared with 2020, when it was 17.2°C and 22.4°C.

The vegetation sum of temperatures in 2020 was 4809.3°C and was higher than in 2021 - 4776.3°C. The Winkler index had high values during the studied period, and in 2020 it was 2669.3°C, and in 2021 it was 2636.3°C.

The results presented in Table 2 show that the annual amount of precipitation was higher in the second year of the research (1590.5 l/m²) compared with the first year with 1498 l/m² of rainfall. During the growing season, more precipitation occurred in 2020 - 775.0 l/m².

Tab 1. The average monthly, annual, and vegetative air temperature (°C)

Year	Months												Year av.	Veg. av.	Veg. sum
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII			
2020	6.2	9.6	11.6	15.7	20.3	23.7	28.7	28.1	24.5	16.2	11.9	9.4	17.2	22.4	4809.3
2021	7.1	9.5	10.0	13.0	19.9	26.6	29.4	28.5	23.2	15.5	13.6	8.2	17.0	22.3	4776.3
Average	6.6	9.5	10.8	14.3	20.1	25.1	29.0	28.3	23.8	15.8	12.7	8.8	17.1	22.35	4792.8

Tab 2. The average monthly, annual and vegetative rainfall (l/m²)

Year	Months												Year av.	Veg. sum
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII		
2020	70.0	74.0	150.0	63.0	54.0	55.0	29.0	112.0	231.0	231.0	1.0	426.0	1498.0	775.0
2021	436.1	193.5	103.4	129.2	44.7	10.8	19.6	45.0	33.2	93.6	191.6	289.8	1590.5	376.1
Average	253.0	133.7	126.7	96.1	49.3	32.9	24.3	78.5	132.1	162.3	96.3	357.9	1544.2	575.5

Agro-ecological conditions, the pruning method, and agrotechnics applied in the vineyard significantly affect the number of buds per vine, and thus the grape yield (Neis et al., 2010). Based on the results presented in Table 3, the lowest number of clusters per vine in the two-year average was found in the variants with loads of 8 and 12 buds per vine (10.5 and 14.6), while the variant with 18 buds was the one with the highest number of clusters (21.1). All variants had a statistically significantly higher number of clusters compared with the variant with the lowest load. In addition, the V4 variant had a very significantly higher number of clusters compared with V2 and V3, and the V3 variant only compared with V2. Numerous authors have noted an increase in the number of clusters in variants with a higher load on the vines with buds (Savić & Petranović, 2004; Chalak, 2011; Kalkan et al., 2022), which is in agreement with the results of this study.

The cluster size, as a very important parameter for the table grapes quality, was determined based on the average weight, length, and width of the bunch. The results of the research on the average weight of the grapes of the Ribier variety are shown in Table 3. In the two-year average, the V4 variant had the smallest average weight of the clusters - 325.0 g, while the highest cluster weight was measured in V1 and V2, 396 g and 371 g, respectively. Statistical data analysis has shown that the V1 variant had a very significantly higher cluster weight compared with the V3 and V4 variants and significantly higher compared with the V2 variant. In addition to the variant V1 (8 buds), other variants with a lower load on the vines with fertile buds (12 and 16 meshes) had a significantly higher cluster weight compared with the variant with a load of 18 buds per vine. In all tested varieties, the average cluster weight was higher in 2020, which is a consequence of the higher amount of precipitation in the May-July period, that is, in the period when the berries grow intensively. The results are in accordance with the results of Popescu (2012) and Popović (2020; 2023), who established an increase in the cluster weight in variants with a lower load on vines.

The grape yield depends on a number of factors, such as the genetic potential of the variety, production technology, as well as the age of the vineyard, climatic conditions and the health condition of the vines (Popović, 2012). Based on the results of Table 3, which were obtained for the average grape yields by variants with different loads on the vines, significant variations can be observed between the tested variants. The highest grape yield in the studied period was obtained in the variants with a load of 16 and 18 buds per vine (6.9 kg/vine and 7.0 kg/vine), while the variety with 8 buds (4.2 kg/vines) had the lowest yield. Statistical data processing established that all tested variants had a significantly higher yield compared with V1. In addition, the variants with a load of 16 and 18 buds had a significantly higher yield compared to the V2 variant.

Tab 3. The cluster weight and grape yield of the Ribier variety

Variant	Number of clusters		Average	Cluster weight (g)		Average	Grape yield (kg/vine)		Average
	2020	2021		2020	2021		2020	2021	
8	10.4	10.5	10.5	413	379	396	4.3	4.0	4.2
12	14.4	15.0	14.6	388	354	371	5.6	5.3	5.5
16	19.2	19.5	19.3	369	343	356	7.1	6.7	6.9
18	20.7	21.5	21.1	343	307	325	7.1	6.6	7.0
Average	16.2	16.6	16.4	378	346	362	6.0	5.8	5.9

Parameter	Number of clusters		Cluster weight		Grape yield	
	LSD 0.05	LSD 0.01	LSD 0.05	LSD 0.01	LSD 0.05	LSD 0.01
2020-2021	0.506	0.715	20.768	29.308	0.440	0.621

The difference in grape yield between the varieties with 16 and 18 buds did not reach the limit of statistical significance. Many authors state that reduced intensity of pruning leads to an increase in grape yield (Wessner & Kurtural, 2013; Miele & Antenor, 2013; Popović et al., 2023), which is in agreement with the results of this study.

The effect of pruning level on the length and width of clusters (Table 4) has shown significant variations in our research. The V1 variant had the highest values of both length and width of clusters (22.9 cm; 12.5 cm), while the smallest length (20.2 cm) and cluster width (10.5 cm) was found in the V4 variant.

Tab 4. The length and width of cluster of the Ribier variety

Variant	Cluster length (cm)		Average	Cluster width (cm)		Average
	2020	2021		2019	2020	
V1	23.4	22.4	22.9	12.9	12.1	12.5
V2	22.7	21.5	22.1	12.1	11.5	11.8
V3	22.0	21.3	21.7	11.9	11.3	11.6
V4	20.9	19.5	20.2	10.9	10.1	10.5
Average	22.25	21.2	21.7	11.9	11.2	11.6

Parameter	Cluster length		Cluster width	
	LSD 0.05	LSD 0.01	LSD 0.05	LSD 0.01
2020-2021	0.671	0.947	0.398	0.562

All tested variants had a significantly greater cluster length and width compared with the V4 variety. The variant with a load of 8 buds had a significantly greater length and width compared with the V3 and V2 variants. The results are consistent with those of Fawzi et al. (2015), who state that the maximum length and width of clusters in the Superior Seedless variety was at the lowest load on the vines with fertile buds. Al-Saif et al. (2023) obtained similar results in terms of cluster length and width in the Thompson Seedless variety in the agroecological conditions of Egypt.

Based on the data presented in Table 5, it can be seen that the berries of the Ribier variety had the greatest length (24.1 mm) and width (21.8 mm) in the variant with the lowest load of buds, while the smallest berries were in the variant with a load of 18 buds - 20.8 and 18.9 mm. Statistical analysis has shown that the V1 variant had a very significantly larger length and width of berries compared with the V4 and V3 variants, and significantly larger compared to the V2 variant. In all tested variants, the length and width of the berries were greater in 2020, which is a consequence of more favourable climatic conditions in that year of research, primarily a more favourable distribution of precipitation during the growing season of that year. Similar results were obtained by Abdel-Mohsen (2013) and Popović (2023), who state that an excessive number of buds on the vine leads to the reduction of the diameter of the berries.

Table 5. Physical characteristics of the Ribier variety berries

Variant	Berry length average (mm)		Average	Berry width (mm)		Average	Berry weight (g)		Average
	2020	2021		2020	2021		2020	2021	
V1	24.4	23.8	24.1	22.5	21.1	21.8	6.9	6.4	6.6
V2	23.7	23.3	23.5	21.5	20.9	21.2	6.3	6.2	6.2
V3	22.5	21.7	22.1	20.9	20.3	20.6	5.9	6.1	6.0
V4	21.1	20.5	20.8	19.3	18.5	18.9	5.8	5.2	5.5
Average	22.9	22.3	22.6	21.0	20.2	20.6	6.2	6.0	6.1

Parameter	Berry length		Berry width		Berry weight	
	LSD 0.05	LSD 0.01	LSD 0.05	LSD 0.01	LSD 0.05	LSD 0.01
2020-2021	0.565	0.795	0.537	0.757	0.471	0.664

In addition to the smallest average length and width of the berry, the smallest berry weight was found on the vines on which mixed pruning was applied with a load of 18 buds - 5.5 g. In the case of V1 (8 buds), the weight of

the berry was the highest in the two-year average and amounted to 6.6 g. Statistical data processing established that the V1 and V2 variants had a significantly higher average weight of berries compared with V4 and V3. The difference in the berry weight was also significant between the V3 and V4 variants. According to Fawzi et al. (2010; 2015), the berry weight in the Superior Seedless and Crimson Seedless varieties was significantly lower in the variants with a higher load, which is in agreement with the results of this study.

Tab. 6. Chemical characteristics of the Ribier variety berries

Variant	Sugar content		Average	Acid content		Average
	2020	2021		2020	2021	
V1	15.8	16.4	16.1	5.7	5.3	5.5
V2	15.6	16.0	15.8	5.8	5.4	5.6
V3	15.1	15.7	15.4	5.7	5.5	5.6
V4	14.6	15.0	14.8	6.1	5.7	5.9
Average	15.3	15.8	15.5	5.9	5.5	5.7

Parameter	Sugar content		Acid content	
	LSD 0.05	LSD 0.01	LSD 0.05	LSD 0.01
2020-2021	0.398	0.562	-	-

In addition to the appearance of clusters and berries, the quality of table grapes is determined by the taste of grapes, which depends on the sugar and acid content, aroma, flesh consistency, skin thickness, and many other elements (Matijašević, 2009). From the results presented in Table 6, the application of different loading on the vines in the examined years had a significant effect on the sugar content in the grape juice. In the two-year average, the V1 variant had the highest sugar content - 16.10%, while the V4 variant had the lowest sugar content - 14.80%. Statistical data processing has shown that the varieties with a lower load on vines with fertile buds (8, 12, and 16 buds) had a very significantly higher sugar content compared to the V4 variant with 18 buds. In addition to these differences, the difference in sugar content between variants V1 and V2 compared with v V3 was rated as significant, while the difference between V1 and V2 did not reach the limit of statistical significance. Similar results were obtained by Popović et al. (2020) and Abo-ELwafa (2021), who found a higher content of sugar in grape juice in variants with a lower load on the vines.

Conclusion

Based on the conducted research, it can be concluded:

The average grape yield in the two-year period was the highest on the vines loaded with 18 buds, while the lowest yield was achieved on those loaded with 8 buds.

The number of clusters varied significantly between the examined variants and ranged from 10.5 in the V1 variant to 21.1 in the V4 variant.

The average weight of the clusters was between 325 and 396 g. The highest weight, length, and width of clusters were in the vines loaded with the lowest number of buds, that is, the vines on which short pruning was applied.

The average weight of the berry was the highest in the variants V1 - 6.6 g and V2 - 6.2 g, while the smallest berries (5.5 g) were found in the V4 variant. The average berry length and width were also the highest in the variety with 8 buds load, while the berries in the V4 variety had the lowest length and width.

In the two-year average, the V1 variant had the highest sugar content - 16.1%, while the V4 variant - 14.80% had the lowest sugar content.

The content of acids in the must was characteristic for the tested variety in the Podgorica vineyard. The highest content of acids (5.9 g/l) was found in the variant with the highest load on the vines.

Finally, based on the results presented in this paper, it can be anticipated that under the influence of different loads on the vines, there were significant differences in the grape yield, number of clusters, weight, length and width of the clusters and berries, and sugar content of the Ribier variety, while there were no statistically significant differences for the total acidity of grapes. The vines loaded with 16 buds had an obvious advantage over the other varieties, as with this level of pruning a high yield of grapes and the desired characteristics of the cluster were obtained.

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Агробиолошке, економске и технолошке карактеристике стоне сорте грожђа Ribier у зависности од различитог оптерећења чокота родним окцима

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Сажетак

Проучавање утицаја различитог оптерећења чокота родним окцима на агробиолошке, економске и технолошке карактеристике сорте Ribier обављено је у току 2020. и 2021. године са циљем да се утврди оптимално оптерећење за ову сорту. Испитивања су изведена у огледном винограду Биотехничког факултета из Подгорице. Примјењена су четири различита оптерећења чокота родним окцима: 8, 12, 16 и 18 окаца. Резултати истраживања су показали да су примјењена оптерећења значајно утицала на испитиване параметре сорте Ribier. Добијени резултати о просјечном приносу грожђа, показују да је најмању вриједност овог параметра имала варијанта са оптерећењем од 8 окаца - 4.2 кг/чок, док је највећи принос грожђа забиљежен код варијанте са оптерећењем од 18 окаца (7.0 кг/чок). Највећу просјечну масу грозда (396 г) имала је варијанта В1, док је са најмањим гроздом (325 г) била варијанта В4. Садржај шећера у грожђаном соку је такође значајно варирао под утицајем оптерећења чокота родним окцима. Највећи садржај шећера у шири евидентиран је код варијанте са оптерећењем од 8 окаца – 16.1%, а најмањи код варијанте са 18 окаца – 14.7%. Садржај киселина се није значајно разликовао између испитиваних варијанти.

Кључне ријечи: Ribier, принос, маса грозда, шећер, киселине

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Received: February, 27, 2024

Accepted: September 23, 2024