

PRODUCTION AND TECHNOLOGICAL CHARACTERISTICS OF THE PROKUPAC WINE VARIETY IN THE NIŠ WINE-GROWING REGION

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Abstract: The paper presents the results of the study of some production and technological characteristics of the Prokupac wine variety in the Niš wine-growing region. The research was conducted in the collective vineyard of the "Center for Viticulture and Oenology" in Niš. During the study period, the conditions were favorable for the expression of the production and technological characteristics of the Prokupac wine variety. The level of yield and its fluctuations from year to year indicate a high and stable fertility of the studied variety. The sugar content in the grape must was 21.58% and the total acidity 7.61 g/L. The chemical analysis of the wine showed that the wine obtained was of good quality. The results of examination confirm that the cultivation of the Prokupac wine variety in the Niš wine-growing region is justified.

Key words: phenological observations, bearing capacity, grape yield, grape and wine quality.

Introduction

The Prokupac wine variety is the most important autochthonous Serbian grapevine variety. In addition to Serbia, it is also cultivated in the Republic of North Macedonia and in Bulgaria.

It can be found under synonyms: Kameničarka, Prokupka, Crnina, Crnka, Rskavac, Niševka, Zarčin, Skopsko Crno, etc.

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Prokupac is an old autochthonous grapevine variety that was much more important in the past than it is today. In recent years, however, this variety has taken up significant areas in the assortment of the Republic of Serbia.

The aim of our paper was to verify the most important production and technological characteristics of the Prokupac wine variety in the conditions of the Niš wine-growing region.

Materials and methods

The research was carried out in the collection vineyard of the "Center for Viticulture and Oenology" in Niš. The vineyard belongs to the Niš wine-growing region. The altitude of the vineyard is 210 meters, the slope of the terrain is gentle and the exposure is north. The vineyard was planted in 1995 on an area of 2 hectares with over 200 grapevine genotypes.

The subject of this paper is the Prokupac wine variety, which was planted at a distance of 3.0 x 1.2 metres. The rootstock on which it was grafted is *Berlandieri x Riparia* Kober 5 BB. The training system was "Karlovački" with a tree height of 80 cm, using mixed pruning. The trellis support consists of a wooden stakes, concrete pillars and wire, which ensure the correct arrangement of shoots, leaves and bunches in space. During pruning on vine, one spur with 2 buds and two shoots with 10 buds each were left on the vine. In this way, all vines were loaded with the same number of buds, which eliminated the influence of the different loads on the vines on the yield and quality of the grapes.

The study was conducted in the period 2011-2013 and were divided into the field part of the trial and the laboratory chemical analysis of grapes and wine. The field part of the experiment included 10 vines per each trial treatment. The trial was designed using the completely randomised design method with ten replicates (10 vines) within a variant, with each vine served as a separate experimental unit. The laboratory analyses were conducted in the laboratories of the "Center for Viticulture and Oenology" in Niš, the Agricultural Extension Service in Niš and the Faculty of Agriculture in Belgrade.

The study included the following indicators: phenological observations, bearing capacity, yield and mechanical composition of the bunch, grape quality, chemical composition of the wine and sensory evaluation of the wine.

During the study period, the climatic conditions were favorable, as can be seen from the data in Table 1.

Table 1. Values of the basic climate indicators

| Serial num. | Indicator | Year | | | Average |
|-------------|--|--------|--------|--------|---------|
| | | 2011 | 2012 | 2013 | |
| 1 | Mean annual air temperature in °C | 12.20 | 13.10 | 13.30 | 12.80 |
| 2 | Mean vegetation temperature in °C | 18.60 | 20.10 | 18.90 | 19.20 |
| 3 | Annual amount of precipitation in mm | 411.10 | 631.20 | 581.80 | 541.30 |
| 4 | Precipitation in vegetation period in mm | 273.00 | 370.20 | 297.30 | 313.15 |

The thermal conditions in this wine-growing area are favorable for the cultivation of vines and allow the normal ripening of grapes at all ripening epochs. In 2011 and 2013, the annual and vegetation temperature values were slightly higher than in 2012. In 2011, there was a drought during the vegetation period. In contrast, in 2012, precipitation was frequent and plentiful.

Results and discussion

Phenological observations

The timing of the individual phenophases in the annual development cycle of the Prokupac wine variety can be seen from the data listed in Table 2. The budburst occurred slightly earlier in 2011 and 2013 (April 12) and slightly later in 2012 (April 17). Flowering began on average 48 days after budburst (June 1). An average of 172 days passed between budburst and the first harvest. The first grape harvest was on October 1 at the earliest and October 5 at the latest. The veraison appeared on average (August 4) and the full ripeness of the grapes (October 3). Similar values are given by Zirojević (1974) for the conditions of the Niš wine-growing region and Garić et al. (2019) for the conditions of the Toplica wine-growing region.

Table 2. Phenological stages of the Prokupac wine variety

| Year | Phenological phase | | | | | | |
|---------|--------------------|-----------|--------|-------------------|----------|---------------|----------------|
| | Budburst | Flowering | | Berry development | Veraison | Ripening time | Number of days |
| | | Beginning | Ending | | | | |
| 2011 | 12.04. | 30.05. | 14.06. | 20.06. | 03.08. | 01.10. | 173 |
| 2012 | 17.04. | 03.06. | 17.06. | 23.06. | 05.08. | 05.10. | 171 |
| 2013 | 12.04. | 02.06. | 15.06. | 20.06. | 03.08. | 02.10. | 173 |
| Average | 14.04. | 01.06. | 15.06. | 21.06. | 04.08. | 03.10. | 172 |

Bearing capacity

Based on the data shown in Table 3, it can be concluded that the highest values of all bearing capacity potential coefficients were recorded in 2013. The lowest values of the coefficient of potential and relative bearing capacity were in 2011. The highest absolute bearing capacity rate was in 2013 and amounted to 1.5, the relative bearing capacity rate was slightly lower (1.2) and the potential bearing capacity rate was the lowest (1.1).

Table 3. Coefficients of bearing capacity of the Prokupac wine variety

| Prokupac wine variety | Year | Coefficient of the potential bearing capacity | Coefficient of the relative bearing capacity | Coefficient of the absolute bearing capacity |
|-----------------------|---------|---|--|--|
| | 2011 | 0.8 | 0.9 | 1.4 |
| | 2012 | 0.9 | 1.0 | 1.2 |
| | 2013 | 1.1 | 1.2 | 1.5 |
| | Average | 0.93 | 1.03 | 1.36 |

Yield and quality of grapes

Based on the analysis of the data shown in Table 4, the following can be concluded. The yield of grapes per vine depended on the number of bunches per developed and fertile shoot, as well as on the size and weight of the bunches. The highest yield of grapes per vine was achieved in 2013 (4.50 kg), and slightly lower in 2011 (4.35 kg). The yield of grapes per hectare was calculated and amounted to 12,246.57 kg/ha. The largest bunch mass was achieved in 2013 (283.30 g), and the lowest in 2011 (205.68 g). The average length of the bunch was 15.87 cm and the width of the bunch was 9.10 cm. Similar values for the Prokupac wine variety are given by Zirojević (1974), Marković et al. (2013), Garić et al. (2019) and others.

Table 4. Mean values and indicators of yield variability, grape quality and grape characteristics of the Prokupac wine variety

| Characteristic | Year | | | | Indicator of variability | |
|-------------------------------------|--------|--------|--------|-----------|--------------------------|--------|
| | 2011 | 2012 | 2013 | \bar{X} | S | Cv (%) |
| Grape yield per vine (kg) | 4.35 | 4.49 | 4.50 | 4.41 | 0.95 | 21.49 |
| Number of bunches per vine | 18.1 | 21.4 | 18.2 | 19.23 | 2.80 | 15.08 |
| Bunch mass (g) | 205.68 | 240.90 | 283.30 | 243.29 | 66.42 | 27.30 |
| Bunch length (cm) | 15.7 | 16.2 | 15.7 | 15.87 | 1.83 | 11.55 |
| Bunch width (cm) | 9.2 | 8.9 | 9.2 | 9.10 | 1.75 | 19.22 |
| The number of berries in a bunch | 106.4 | 84.8 | 103.7 | 98.30 | 21.4 | 21.92 |
| Mass of grape stalk (g) | 7.00 | 6.22 | 4.80 | 6.01 | 1.98 | 33.01 |
| The sugar content of grape must (%) | 21.70 | 20.80 | 22.21 | 21.58 | 1.21 | 5.63 |
| Content of total acids (g/L) | 8.1 | 7.8 | 6.8 | 7.56 | 1.24 | 16.25 |
| Alcohol content in wine (% Vol.) | 12.96 | 12.71 | 13.10 | 12.92 | / | / |
| Sensory evaluation of wine | 60 | 63 | 61 | 61.33 | / | / |

The number of grape berries in a bunch varied from 84.8 to 106.4 g. The mass of the grape stalks ranged from 4.80 to 7.0 g. Also, it was determined that the yield of grapes per vine, the number of bunches per vine and the weight of the bunches varied within the studied variety (Cv=21.49, Cv=15.08, Cv=27.30).

Table 5. Mean values and indicators of variability of sugar content and total acids in the grape must of Prokupac wine variety

| Characteristic | \bar{X} | S | Cv (%) |
|--|-----------|------|--------|
| Sugar content in grape must (%) | 21,58 | 1,21 | 5,63 |
| Total acid content in grape must (g/L) | 7,61 | 1,24 | 16,25 |

The data in Table 5 show that the sugar content of Prokupac grape must was 21.58% and the total acid content of grape must was 7.61 g/L. The variability, expressed by the coefficient of variation, was low for both characteristics.

Table 6. Statistical significance of the influence of genotype and year on the sugar and total acid content of grape must of the Prokupac wine variety

| Sources of variation | The sugar content in grape must | | The content of total acids in grape must | |
|----------------------|---------------------------------|----------------|--|----------------|
| | ANOVA | | | |
| | <i>F-value</i> | <i>p-value</i> | <i>F-value</i> | <i>p-value</i> |
| Genotype | 34.90** | 0.00 | 3.03 ^{nz} | 0.05 |
| Year | 3.53* | 0.03 | 0.21 ^{nz} | 0.81 |
| Genotype x Year | 4.00** | 0.005 | 3.60* | 0.01 |
| DUNNETT-test | | | | |
| Prokupac | 21.58** | | 7.61 ^{nz} | |

^{nz} for $p > 0,05$; * for $p < 0,05$; ** for $p < 0,01$

The results of the analysis of variance in Table 6 show that the influence of the year was not significant for the sugar content in the grape must and also not for the content of total acids in the grape must ($p > 0.05$). The joint influence of genotype and year was very significant for the sugar content in the grape must and significant for the content of total acids in the grape must.

Conclusion

Based on the results of the study on the production and technological characteristics of the Prokupac wine variety in the Niš wine-growing region, the following conclusions can be drawn:

In the agro-ecological conditions of the Niš wine-growing region, there are favorable conditions for the normal development of the Prokupac wine variety and the achievement of high-quality grapes and wine.

The Prokupac wine variety had the earliest budburst on April 12, the beginning of flowering on May 30 and grape ripening on October 1.

The coefficients of potential, relative and absolute bearing capacity as indicators of cropping potential showed the highest values for the studied variety.

The highest yield of grapes per vine (4.50 kg) was achieved in 2013, while the highest number of bunches per vine was recorded in 2012 (21.4).

The quality of the grapes, assessed on the basis of the sugar and total acid content in general and the health of the grapes, can be classified as very good.

The sugar content of the grape must was between 20.80 and 22.10 % and the total acidity between 6.8 and 8.10 g/L.

The sensory evaluation of wines in the Prokupac wine variety was from 60 to 63 points.

From the results of the study of the production and technological characteristics of the Prokupac wine variety under the conditions of the Niš wine-growing region, it can be concluded that the Prokupac wine variety can be successfully cultivated in this region.

References

- Avramov L. (1991). Vinogradarstvo. Nolit, Beograd.
- Cindrić P., Korać N., Medić M. (1992). Ispitivanje proizvodnihi tehnoloških osobina crnih vinskih sorti. VI Vinogradarsko-vinarski kongres Jugoslavije, Zbornik radova str. 301-317. Beograd.
- Cindrić P., Korać N., Kovač V. (2000). Sorte vinove loze. Promotej. Novi Sad.
- Garić M., Ristić M., Vera V. (2019). Agrobiološka i tehnološka svojstva sorte Prokupac u Topličkom rejonu. Zbornik radova 2, XXIV Savetovanje o Biotehnologiji, str. 565-571, Čačak.
- Marković N., Atanacković Z. (2012). Neke tehnološke karakteristike klonova sorte prokupac. 14. Kongres voćara i vinogradara sa međunarodnim učesćem. 9-12.10.2012., Vrnjačka Banja. Zbornik apstrakata, str. 116.
- Marković N., Atanacković Z. (2013). Uvometric and technological clonal variation of Serbian black wine cultivar Prokupac. 36th World Congres of vine and wine: "Vine and Wine Between Tradition and Modernity" Bucharest-Romania. Prceedings of th 36th Word Congres of vine and wine. ISBN: 979-10+91799-16-4.
- Zirojević D. (1974) Poznavanje sorata vinove loze I. Beograd.
- Žunić D., Garić M. (2017). Posebno vinogradarstvo. Poljoprivredni fakultet, Priština-Lešak.