COMPARATIVE STUDIES OF SOME WHITE WINE CULTIVARS IN THE SUB-REGION OF BELGRADE AND NIŠ

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Abstract: In two wine-growing areas with different climatic characteristics 12 cultivars intended for the production of white wines were studied. The climatic characteristics include: mean annual air temperatures, mean vegetation air temperatures, heliothermal coefficient, hydrothermal coefficient and active temperatures sum from the moment of the growth of shoots to their full maturity for each studied cultivar. Elements of buds fruitfulness (6 features in total), yield, cluster mass, sugar quantity and grape quality were observed in both localities.

In the vineyards of Grocka and Kutina high yielding varieties Ugni blanc and Dimyat can be grown with great success. Italian Riebling produced higher yields and better quality of unfermented grape juice in the vineyards of Grocka in comparison with the vineyards of Kutina. Pinot blanc in both localities was characterized by high yield, but the quality of unfermented grape juice was better in the vineyards of Grocka. Variety Rkaciteli produced high yield and good quality of unfermented grape juice in the experimental period in the vineyards of Kutina.

Key words: white wine cultivars, fruitfulness, grape quantity and quality.

Introduction

The selection of cultivars in one locality includes knowledge of their quantitative, qualitative characteristics and phenological changes during vegetation, on one side, and climatic conditions, on the other side. Ampelographic

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studies of a greater number of cultivars in collection plantings under the same or
similar ecological conditions have numerous advantages (Colapetra, 1987).
As a rule, a cultivar of wide adaptability has high genetic potential and in
favorable ecological conditions produces high yields and in unfavorable produces
lower yields and grapes of poor quality. That is the reason that favorability and
soil, as well as a complex of adequate agrotechnical measures taken by man
intentionally with regard to the needs of a plant, are the key factors of success in
grape production. (Sivčev, 1997). Optimal loading of vines with fruitful buds
according to Bondarenko (1989) is directly dependent on the harmonious
relationship between ecological factors. Fregoni et al., (1992) determined
favorability of growing for the three most represented wine cultivars: Barbera,
Croatina and Malvasia di Candida aromatic in the area of Val Tidone, based on
interdependence of yield, quality of unfermented grape juice and wine, sum of air
temperatures expressed in Winkler’s index, altitude, terrain exposition and type of
soil. According to Bravdo (2001), vine foundation and locality also have
significant influence on the concentration of free and bound monoturpenes, as
well as other aromatic substances in unfermented grape juice and wine.
Simultaneous growing of greater number of vine cultivars on one locality
enables better use of climate and soil and contributes to more efficient resistance
to limiting factors of the environment. In this paper 12 white wine cultivars were
studied, grown in two different localities with the aim of comparing and
recommending them based on climatic characteristics and their 12 features.

Material and Method

The studies were conducted in the collective plantings of the Faculty of
Agriculture, University of Belgrade, “Radmilovac” (λ=44° 45´ N, φ=20° 35´ E,
H=135 m) and Viticulture and Wine Production Center of Niš, Institute of
Agricultural Studies “Srbija” (λ=43° 61´ N, φ=22° 32´ E, H=200 m). The lot on
experimental farm “Radmilovac” is situated on a mild slope, rows are distributed
in southeast-northwest direction. The planting distance is 3 x 0.75 m, the training
system is double-branched cordone with mixed cutting applied. The hilly terrain,
semiarid and mildly warm climate on a carbonate geological foundation enabled
the formation of rigosoil. The soil structure is nutty to clatty. According to its
mechanical contents, it is clay to sandy clay, of good permeability and high
absorption power. Nitrogen is present only in the field soil layer (0.10-0.15%),
averagely provided with available potassium and poorly provided with easily
available phosphorus.

The experimental lot of the Viticulture and Wine Production Center is
situated on a slope with medium slant up to 5º, the rows are directed southeast-
northwest. The distance between the rows is 2.5 x 1.3 m (planting in the "nest")
with the exception of cultivars Dimyat and Rkaciteli where the distance is somewhat larger 2.8 x 1.5 m. The training system is single-branched cordone with mixed cutting applied. The mechanical contents of the soil is heavier relative to the soil at Experimental Station “Radmilovac’, which is confirmed by lower value pH=5.5 and the absence of carbonates; it is heavy rigosoil. The surface layer of the soil is well provided with humus (3.15%) and the quantity gradually decreases with depth. The quantity of potassium in the surface layer of the soil is 24.6 g/100g a.d.s.\(^4\) and decreases with depth. The surface layer of soil is poorly supplied with phosphorus and it appears only in traces in deeper layers.

The studies were conducted at Wine Production Center of Niš in the period from 1993 to 1995. Cultivars of three main ecological-geographical groups were included in the study:

* **I convarietas Pontica**
  - *subconvarietas Balcanica*: Dimyat, Hungarian Riezling, Kujundžuša, Ocatac Blanc
  - *subconvarietas Georgica*: Rkaciteli, Malvasia Istriana

* **I convarietas Occidentalis**
  - *subconvarietas Gallica*: Pinot Blanc, Riesling Italico, Müller-Thurgau
  - *subconvarietas Iberica*: Ugni Blanc

* **III convarietas Orientalis**
  - *subconvarietas Caspica*: Muscat Blanc, Ag Izom (synonym Bayan Chirey)

Fruitfulness of buds and shoots was determined applying standard methods for the following features. The yield of grapes was determined per vine and calculated per unit of area. Apart from the yield, the number of clusters per vine was measured and average grape mass was calculated. Sugar contents was determined based on the thickness of unfermented grape juice, the contents of total acids by neutralization with N/4 NaOH. The quantity of sugar per hectare was determined per hectare based on grape yield, percentage of unfermented grape juice and sugar percentage in unfermented grape juice.

**Results and Discussion**

Comparative results of the elements of climate are shown in table 1 and graph 1.

Climate in the subregion of Niš (vineyards of Kutina) is the warmest in comparison with the Belgrade subregion (vineyards of Grocka). Based on hydrothermal coefficient the vineyards of Grocka are situated in an insufficiently humid area and the vineyards of Kutina are situated in dry area. In 1993 both

\(^4\) a.d.s. abbreviation for air dry soil
localities were singled out as extreme with respect to precipitation: during 
vegetation 266.8 mm of precipitation was recorded at the Experimental Station 
“Radmilovac” and 223.5 mm in the Viticulture and Wine Production Center of 
Niš. The temperature and precipitation conditions are in accordance with the 
results of Avramo et al. (2000).

Table 1. - Climatic data

|                                | Experimental Station “Radmilovac” h=135 m (vineyards of Grocka) | Viticulture and Wine Production Center Niš h=200 (vineyards of Kutina) |
|--------------------------------|-----------------------------------------------------------------|-----------------------------------------------------------------------|
|                                | 1961-1993            | 1996-2001            | 1961-1995            | 1996-2001            |
| 1. Mean annual air temperature | 10.8°C               | 11.8°C               | 11.7°C               | 11.9°C               |
| 2. Mean vegetation air temperature | 16.4°C               | 17.5°C               | 17.2°C               | 17.8°C               |
| 3. Heliothermal coefficient    | 4.10                 | 4.71                 | 4.60                 | 4.89                 |
| 4. Hydrothermal coefficient for the year 2000 | 1.24                 | 1.40                 | 0.96                 | 1.05                 |

Air temperature tendency in Belgrade and Niš for the period of 20 years 
(1982-2001), graph. 1, indicates increase of mean annual and mean vegetation 
temperatures, which is in accordance with the forecast climatic changes (Houghton, 1991). In the last decade of the second millenium air temperature 
fluctuations for successive years in both Belgrade and Niš are significant, which 
is a risk factor for grapevine.

Graph. 1. - Air temperature in Belgrade and Niš (period from 1981 to 2001)

We can conclude that, when analyzing climatic conditions, main meteorological elements tendencies must be analyzed at the same time.

Hydrothermal coefficient was calculated separately for the periods April-June and July-October (1996-2001). It indicates redistribution of precipitation in the 
vineyards of Grocka: maximum in September (R=87.8 mm) is more prominent 
than the spring maximum. Intensive summer precipitation (R=88.8 mm) is also noticeable in these vineyards.
| Variety            | Number of buds shoots % | Coefficient of Fertile fertility | Productivity of buds g | Yield grape weight g | Sugar % g/l | Content acids Sum active temp C |
|--------------------|--------------------------|----------------------------------|------------------------|---------------------|-------------|-------------------------------|
| Pinot blanc        | 35.8 55.84 0.8733 1.1333 1.3900 | 89.8 14.27 101 22.0 7.6     | 2250 3057            |
| Riesling italico   | 30.3 61.72 1.1500 1.3133 1.5633 | 136.7 18.55 118 22.3 7.7    | 2870 3151            |
| Mueller-Thurgau    | 27.1 63.72 1.1867 1.3667 1.6200 | 165.2 19.69 134 20.5 6.0    | 2810 3085            |
| Ugni blanc         | 25.5 62.34 1.1100 1.4100 1.5667 | 237.2 25.59 234 18.4 9.2    | 3290 3122            |
| Dimyat             | 20.3 61.97 0.9467 1.1167 1.3467 | 242.4 21.08 255 16.6 7.8    | 2470 3209            |
| Hungarian riezlcing| 26.9 60.97 1.0433 1.2767 1.5800 | 164.3 18.83 155 19.0 6.4    | 2520 3181            |
| Kujundzusa         | 21.8 62.19 1.0600 1.2367 1.4667 | 248.0 23.39 233 21.5 6.1    | 3530 3147            |
| Ocatac blanc       | 20.7 56.15 0.9233 1.2300 1.4833 | 223.0 20.25 243 21.2 8.6    | 2930 3090            |
| Malvasia Istriana  | 23.1 66.59 1.2300 1.3667 1.6233 | 205.6 20.56 167 21.5 7.7    | 3110 3071            |
| Rkacitieli         | 30.3 51.48 0.5400 1.1167 1.0300 | 94.9 11.14 175 17.1 6.4    | 1320 3178            |
| Muscat banc        | 33.8 53.69 0.7767 1.4100 1.3367 | 121.1 17.18 158 19.8 6.4    | 2340 3192            |
| Ag izom            | 26.8 45.12 0.6433 0.7800 1.3333 | 157.0 17.79 237 18.1 7.4    | 2240 3294            |
| Average            | 26.8 58.47 0.9567 1.1722 1.4450 | 174.0 19.03 185 19.8 7.3    | 2640 3148            |

| Variety            | Number of buds shoots % | Coefficient of Fertile fertility | Productivity of buds g | Yield grape weight g | Sugar % g/l | Content acids Sum active temp C |
|--------------------|--------------------------|----------------------------------|------------------------|---------------------|-------------|-------------------------------|
| Pinot blanc        | 15.97 81.90 1.6200 1.8333 2.0867 | 153.50 14.97 96 20.4 6.9 | 2447 3163            |
| Riesling italico   | 20.76 86.10 1.3000 1.4333 1.5900 | 104.80 10.34 81 20.9 6.8 | 2691 3303            |
| Mueller-Thurgau    | 16.77 87.93 1.1100 1.2433 1.3533 | 133.50 13.75 121 19.4 6.0 | 2142 3110            |
| Ugni blanc         | 17.03 84.40 0.9867 1.0367 1.2667 | 175.70 18.45 180 18.7 5.6 | 2842 3363            |
| Dimyat             | 15.67 92.40 1.2300 1.2967 1.0670 | 204.30 15.17 166 17.5 7.5 | 2829 3357            |
| Hungarian riezlcing| 14.13 79.47 1.0800 1.3300 1.4333 | 157.30 13.28 145 14.0 8.4 | 2142 3368            |
| Kujundzusa         | 18.87 77.93 0.8967 1.0133 1.4330 | 143.00 15.89 155 17.7 5.9 | 2492 3329            |
| Ocatac blanc       | 16.67 84.47 0.8567 1.0000 1.1367 | 153.40 15.86 179 18.3 6.9 | 2371 3338            |
| Malvasia Istriana  | 16.43 86.90 0.9333 1.0567 1.2067 | 146.80 14.64 160 16.7 5.8 | 2351 3314            |
| Rkacitieli         | 18.00 85.93 1.0462 1.1800 1.3400 | 160.70 17.64 121 19.4 8.2 | 1999 3336            |
| Muscat banc        | 16.20 77.50 0.9200 1.0933 1.3330 | 127.30 12.63 139 20.1 6.0 | 2696 3159            |
| Ag izom            | 14.23 85.30 1.0300 1.1467 1.3330 | 194.90 17.16 188 14.8 5.4 | 1946 3598            |
| Average            | 16.73 84.30 1.0839 1.2219 1.3872 | 154.60 14.98 147 18.2 6.6 | 2108 3312            |
Mean values for the studied features of fruitfulness, for the experimental period, are shown in special tables for the Experimental Station “Radmilovac” (tab. 2a) and Viticulture and Wine Production Center Niš (tab. 2b), so that comparisons may be made within a locality and among them by cultivars. Data indicate that burdening of vines with fruitful buds in Radmilovac ranges from 20 to 30, and in Niš from 15 to 20, which is a consequence of different vegetation potential and growing system. This produced effects on the share of fruitful shoots, which is on the level of mean values for all cultivars 58.5% in Radmilovac and 84.3% in Niš. Productivity of buds was greater in Radmilovac (174.0 g) in comparison with the productivity of buds in Niš (154.6 g). Cultivars with higher buds productivity value in the vineyards of Grocka were: Kujundžuša, Dimyat, Ugni Blanc, Ocatac Blanc and Malvasia Istriana, and in Niš: Dimyat, Bayan Chirey, Ugni Blanc, Rkaciteli and Hungarian Riezling (Cvetkovc, 1998).

Nakamic and Garic (1995) point out that in the vineyards of Orahovac, in the phase of growing fertility, Riesling Italico gave the best results with mixed cutting and with the length of arches of 10-12 buds and burdening of vines- 28-30 buds.

Significant differences were observed in the grape yield per year and mean values for the experimental period in both locations per cultivar. The following cultivars are prominent in both localities: Ugni Blanc, Kujundžuša, Dimyat and Ocatac Blanc. Ugni Blanc belongs to ecological-geographical group subconvetias Iberica and Dimyat, Kujundžuša and Vugava to ecological-geographical group subconvetias Balcanica. Pinot blanc, Müller-Thurgau, Muscat blanc and Riesling Italico are the cultivars which produce excellent results in both localities and which made high contents of sugar in unfermented grape juice in the experimental period. According to Eibach (1990) external factors: climate or grapevine growing method were not exclusive factors of grape quality. As early as in 1927, Sartorius established negative correlation between the yield and contents of sugar in unfermented grape juice, known as the relationship between quality and quantity. Bader (quoted by Eibach) showed that this relation is not the same in all cultivars, correlation is more prominent between the contents of sugar in unfermented grape juice and cluster mass in comparison with the contents of sugar in unfermented grape juice and number of clusters per vine.

Sugar quantity was calculated per hectare in accordance with the yield. On average, sugar quantity at the Experimental Station “Radmilovac” was 2640 kg/ha and in Viticulture and Wine Production Center Niš 2168 kg/ha. If we compare this with the values of heliothermal and hydrothermal coefficient we can notice that the climatic conditions in the vineyards of Grocka are favorable relative to the vineyards of Kutina. High fertility and adaptability to different ecological conditions is the characteristic of cultivar Ugni Blanc, which is confirmed by the results of Gal et (1979) and Melita Fazinic (1987). Cultivar Bayan Chirey
produced high yields in the studied conditions, but it matures late and collects little sugar in unfermented grape juice, which is the reason why it is not recommended for propagation in the regions of Serbia.

**Conclusion**

The climatic conditions in the vineyards of Grocka and Kutina are different. The vineyards of Grocka are colder, with more precipitation and larger heliothermal and hydrothermal coefficients in comparison with the vineyards of Kutina. Extremely late vine cultivars cannot be grown successfully in the vineyards of Grocka. The vineyards of Kutina are warmer, with less precipitation and regular droughts.

The studied collective plantings differ in their age, vegetation and fruitful potential of vines. The most important is the price of success of growing several cultivars for each of the vineyards individually.

Cultivars Kujundžuša, Dimyat, Ugni blanc, Ocatac blanc and Malvasia Istriana in the vineyards of Grocka are characterized by high buds productivity. Dimyat, Bayan Chirey, Ugni Blanc and Rkaciteli are cultivars with high buds productivity in the vineyards of Kutina.

Cultivars Ugni Blanc, Kujundžuša, Dimyat, Malvasia Istriana, Riesling Italico and Müller-Thurgau are characterized by high grape yields in the vineyards of Grocka. In the vineyards of Kutina, cultivars Ugni Blanc, Rkaciteli, Kujundžuša, Pinot blanc, Müller-Thurgau and Dimyat produced high grape yields in the experimental period.

In both vineyards cultivars Riesling Italico, Pinot blanc, Muller-Thurgau and Muscat blanc produced high contents of sugar in unfermented grape juice.

Based on the achieved results, we can recommend the following cultivars for successful growing in the vineyards of Grocka: Riesling Italico, Ugni Blanc, Dimyat and Pinot Blanc; for the vineyards of Kutina we recommend cultivars Pinot Blanc, Ugni Blanc, Rkaciteli and Dimyat.

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UPOREDNA ISPITIVANJA NEKIH BELIH VINSKIH SORTI U BEOGRADSKOM I NIŠKOM PODREJONU

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Rezime

U dva vinogorja, sa različitim klimatskim karakteristikama ispitivano je 12 sorti namenjenih za bela vina. Gročansko vinogorje pripada beogradskom podrejonu i šumadijsko-velikomoravskom rejonu (λ=44o 45´ N, φ=20o 35´ E, H=135 m) a kutinsko vinogorje niškom podrejonu i nišavsko-južnomoravskom rejonu (λ=43o 61´ N, φ=22o 32´ E, H=200 m). Klimatske karakteristike obuhvataju: srednje godišnje temperature vazduha, srednje vegetacione temperature vazduha, heliotermički koeficijent, hidrotermički koeficijent i sumu aktivnih temperatura od prorastanja lastara do pune zrelosti za svaku ispitivanu sortu. Tendencija temperatura vazduha u Beogradu i Nišu za 20 godina (1981-2001), graf. 1 ukazuje na porast srednjih godišnjih i srednjih vegetacionih temperature, što je u saglasnosti sa prognoznim klimatskim promenama. Hidrotermički koeficijent ukazuje na preraspodelu padavina u gročanskom vinogorju: maksimum u septembru (R=88,8 mm) izraženiji je od proljetnog maksimuma. Uočavaju se i intenzivne letnje padavine u letnjem periodu u ovom vinogorju.

Elementi rodnosti okaca (ukupno 6 obeležja), prinos, masa grozda, količina šećera i kvalitet grožđa praćeni su u oba lokaliteta. Sorte sa visokom vrednošću produktivnosti okaca u gročanskom vinogorju su: Kujundžuša, Smederevka, Juni blan, Bugava i malvazija bela, a u Nišu: Smederevka, Bajan širej, Juni blan, Rkacitel i Sremska zelenika.

Uspešno se mogu gajiti u gročanskom i kutinskom vinogorju Juni blan i Smederevka. Rizling italijanski u gročanskom vinogorju ostvario je viši prinos i bolji kvalitet u poređenju sa kutinskim vinogorjem. Burgundac beli u oba vinogorja odlikuje se visokim prinosom, u gročanskom vinogorju kvalitet šire je bolji u poređenju sa kutinskim vinogorjem.

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