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# CHARACTERISTICS OF NEWLY CREATED GRAPEVINE VARIETIES VOŽD AND VLADUN

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This paper presents the most important morphological and production-technological characteristics of newly created grapevine varieties Vožd and Vladun, intended for the production of red wines. The newly created varieties were compared with the standard variety Cabernet Sauvignon during the three-year period of testing (2015-2017) in the relation studied properties. The variety Vožd obtained from the crossing combination Začinak × Prokupac, and the variety Vladun from the crossing combination Merlot × Župski Bojadiser. The investigated varieties differed considerably in terms of some morphological traits and represents unique genotypes. The newly recognized varieties have a hermaphrodite type of flower, dense bunch, globose berry shape and blue black color of berry skin. The yield, bunch weight, bunch length and bunch width were higher at both varieties than for the standard variety. The Vožd variety had a yield of 1.29 kg/m$^2$ and a bunch weight of 174.3 g, and the Vladun variety had a yield of 0.87 kg/m$^2$ and a bunch weight of 153.7 g. For the standard variety the grape yield was 0.78 kg/m$^2$ and the bunch weight was 134.0 g. The content of sugar and total acids in the must of the Vožd variety was 20.5% and 6.5 g/l, while for the Vladun variety it was 21.8% and 6.0 g/l respectively. Wine of both varieties was drinkable, harmonious, with a specific varietal of smell and taste and contained 12.1 vol. % of alcohol (Vožd variety), or 12.6 vol. % of alcohol (Vladun variety). Due to the many positive features of the grapes and wines from the Vožd and Vladun varieties, their spread to the production vineyards of Serbia is expected.

*Key words: Vitis vinifera*, hybridization, new variety, morphological traits, yield, quality

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## INTRODUCTION

Serbia has excellent conditions for grapevine growing, producing of grapes and grape products. Viticulture in the Republic of Serbia is therefore a very important agricultural branch. BEŠLIĆ *et al*. (2012), state that Serbia has a long viticulture tradition. The ancient peoples, the Thracians and the Greeks, are responsible for the spread of the culture of grapevine cultivation, but the first written data on the grapevine, varieties and method of cultivation date back to Roman times (IVANIŠEVIĆ *et al*., 2015a). Over a long historical period, there have been changes in the way of grapevine grown depending on religion, the rule of certain peoples, legal regulations and many other factors. Only in the last ten years in Serbia has been qualitative progress in viticulture, especially on private property. Thanks to the state's incentive measures, the development of the advisory service and the activities of scientific and educational institutions, the technology of viticulture and winemaking production are being modernized. Gradually, new technologies are introduced into viticultural practice and higher quality, clone-selected and certified planting material is used, and greater attention is paid to the choice of varieties, planting and cultivating vineyards.

TÖPFER *et al*. (2011) state that today there are almost 9,500 wine varieties, close to 4,500 table varieties, more than 1,200 varieties of combined properties (table and wine), about 110 varieties for drying and close to 1,400 vine rootstocks. The available fund of *Vitis vinifera* L. varieties, despite the exceptional number, still does not meet the existing economics of growing grapevine and the modern needs of consumption of grapes, wine and grape and wine products (NIKOLIĆ, 2012; 2015). Therefore, great attention is paid to the creation of new varieties in many countries around the world (MILUTINOVIĆ *et al*., 2000). A significant number of leading varieties in the viticultural production of many countries are relatively new varieties that have been created by breeding. Much progress has been made especially in terms of yield height, size and fruit quality between wild ancestors and today's grapevine varieties. This is a consequence of the huge variability of the hereditary basis of the grapevine and successful breeding work (NIKOLIĆ, 2012). Grapevine breeding, a long term viewed is investment into viticulture (NIKOLIĆ *et al*., 2018a).

Work on the creation of new grapevine varieties in scientific research institutions in Serbia (Faculty of Agriculture in Belgrade, Faculty of Agriculture in Novi Sad and the Center for Viticulture and Enology in Niš) began in the 1960s. During this work, 85 new varieties and clones representing significant genetic resources of the grapevine have been created and recognized in Serbia so far. Of that number, 33 are wine varieties, 25 table varieties and 27 clones of wine grapevine varieties. A number of newly created varieties have been examined and described in detail by many authors (AVRAMOV, 1991; CINDRIĆ *et al*., 1991; 1992; 1994a; 1994b; AVRAMOV *et al*., 1997; 2002; TARAILO *et al*., 1997; KORAĆ *et al*., 2002a; 2002b; 2005; MILUTINOVIĆ and NIKOLIĆ, 2007; IVANIŠEVIĆ *et al*., 2015b; 2019; NIKOLIĆ, 2018; RANKOVIĆ-VASIĆ *et al*., 2019). Some of these varieties have spread significantly in Serbia, and some are grown in other countries as well.

Although modern viticultural production imposes the need to create better grapevine varieties, their spreading and propagation in nurseries is preceded by detailed verification, comprehensive assessment of value, and finally official recognition and their inclusion on the List of varieties and hybrids of agricultural and forest plants of the Republic of Serbia.

RAKONJAC *et al*. (2014) state that morphological classifications provide useful guidelines to variety relations, developing further insight for plant breeders and gene bank managers. The first step in this study is to ampelographically described existing varieties. Ampelographic evaluation which is used for the description of grapevine varieties (IVANIŠEVIĆ *et al*., 2019) can be enable the variety identification and facilitate the defining of the origin and genetic relationship among varieties. New crossings should at least be evaluated more than twenty five years before released to the public (REGNER *et al*., 2004).

The work on creating new grapevine varieties at the Faculty of Agriculture, University of Belgrade is very intensive. Twenty three varieties of different purposes and ripening times were created by the method of planned hybridization, the last of which was recognized in 2001. In the period from 2017 to 2019, 9 new grapevine varieties were recognized, two of which, Vožd and Vladun, are intended for the production of red wines.

The aim of this study was to examine the most important morphological characteristics and determine the productional and technological value of newly created grapevine varieties Vožd and Vladun in comparative tests with the standard variety Cabernet Sauvignon, based on which it would be recommended to spread them to production's vineyards of Serbia.

## MATERIALS AND METHODS

All the investigations presented in this paper were carried out during three production years (2015-2017) on the experimental field "Radmilovac" of the Faculty of Agriculture, University of Belgrade. The experimental field "Radmilovac" belongs to the Belgrade wine-growing region and the Grocka wine-growing district. It is located at 44° 45' 24.66" north latitude and 20° 34' 54.50" east longitude. The altitude of the locality is 153 meters with a slope of 8-16%.

Figure 1. Variety Vožd (left) and Vladun (right).

Two newly created grapevine varieties Vožd and Vladun, intended for the production of red wines, were used as testing material (Figure 1). The variety Vožd was obtained from the crossing combination Začinak × Prokupac, and the variety Vladun was obtained from the crossing combination Merlo × Župski Bojadiser. The Cabernet Sauvignon variety was used as a

standard for comparison. The investigated varieties were grafted on *Berlandieri* × *Riparia* Kober 5BB rootstock and planted at a distance of 3.0 x 1.0 m in spring 2012. Guyot single cordon as a training system was formed on the vines, and standard agro- and ampelotechnical measures were applied in vineyard. Each variety in the experiment was represented by 6 vines that connotated repetitions.

The most important morphological and production-technological characteristics were studied in the examined varieties. Morphological characteristics of young shoot, flower, mature leaf, bunch and berry were determined using appropriate descriptors for grapevine (UPOV, 2008; OIV, 2009).

The ripening time was determined based on the date of harvest, ie. times when the berries had the maximum sugar content. Grape yield per unit area was established by calculation, based on the total number of vines per hectare and the average grape yield per vine. Bunch weight was determined by measuring of 10 bunches on a technical scale (CAS-Shollex type SHRE-122). The length and width of the bunch were determined by measuring with a ruler. Number of berries in the bunch was established by counting the total number of berries in the bunch. Berry weight was determined by measuring 100 berries on an analytical balance (Tecator-6110 Ballance). The length and width of the berry were established by measuring with a caliper. Sugar content in the must was determined using a digital refractometer (PocketPAL-1, Atago, Japan), and total acid content in the must was established by titration with n/4 NaOH.

Wine quality indicators (chemical and sensory analysis) were determined at samples produced by the microvinification process. Standard chemical analyzes of wine were performed 6 months after bottling with official OIV test methods (ECC regulation 2676/90) and included the determination of the following parameters: alcohol, total extract, ash, total acids, total phenolic content, colour intensity and transparency. The method of positive points from 0 to 100 was used to assess the sensory properties of wine (Rulebook on the manner and procedure of production and quality of table wines as well as wines with geographical origin "Official Gazette of RS", No. 41/09).

Statistical data processing was performed by the method of analysis of variance (ANOVA) of a two - factorial experiment, for $P < 0.05$ and $P < 0.01$. Comparison of mean values of newly created varieties with standard variety was performed using Dunnett test, for significance levels $P < 0.05$ and $P < 0.01$. Data analysis was made using the statistical software package Statistica (StatSoft, Inc., Tulsa, Oklahoma, USA).

## RESULTS AND DISCUSSION

The data represent in Table 1 show that the varieties Vožd and Vladun were quite similar in terms of morphological traits, but significant differences were found for certain traits between them, so that they represent unique genotypes.

Both varieties have a fully open tip of the young shoot (UPOV 2; OIV 001), weak coloration of the young shoot tip with anthocyanin (UPOV 4; OIV 003), fully developed stamens and gynoecium, ie. hermaphrodite type of flower (UPOV 16; OIV 151), dense bunch (UPOV 33; OIV 204), globose berry shape (UPOV 36; OIV 223) and blue black color of berry skin (UPOV 37; OIV 225).

*Table 1. Morphological traits of certain organs of newly created varieties Vožd and Vladun*.

| Descriptor | | Trait | Variety | | | |
|---|---|---|---|---|---|---|
| | | | Vožd | | Vladun | |
| UPOV | OIV | | Note | Mark | Note | Mark |
| 2 | 001 | Young shoot: openness of tip | Fully open | 5 | Fully open | 5 |
| 3 | 004 | Young shoot: prostrate hairs on tip | Dense | 7 | Very dense | 9 |
| 4 | 003 | Young shoot: anthocyanin coloration of tip | Weak | 3 | Weak | 3 |
| 16 | 151 | Flower: sexual organs | Fully developed stamens and gynoecium | 3 | Fully developed stamens and gynoecium | 3 |
| 18 | 067 | Mature leaf: shape of blade | Cordate | 1 | Circular | 4 |
| 20 | 068 | Mature leaf: number of lobes | Three-five | 2/3 | Three | 2 |
| 23 | 079 | Mature leaf: arrangement of lobes of petiole sinus | Half open | 3 | Closed | 5 |
| 33 | 204 | Bunch: density | Dense | 7 | Dense | 7 |
| 36 | 223 | Berry: shape | Globose | 2 | Globose | 2 |
| 37 | 225 | Berry: Color of skin | Blue black | 9 | Blue black | 9 |

In the variety Vožd, the prostrate hairs on the tip of the young shoot (UPOV 3; OIV 004) were dense, while in the variety Vladun they were very dense. The mature leaf had a cordate shape of blade (UPOV 18; OIV 067) in the variety Vožd, while in the variety Vladun it was circular. The variety Vožd had a leaf with three to five number of lobes (UPOV 20; OIV 068), while the variety Vladun had a three lobes. Arrangement of lobes of petiole sinus of the mature leaf (UPOV 23; OIV 079) was half open in the variety Vožd and closed in the variety Vladun. BEŠLIĆ *et al*. (2005), NIKOLIĆ *et al*. (2015), DUMITRU and ANTOCE (2016) and NIKOLIĆ (2018) similarly described new genotypes based on UPOV and OIV descriptors.

From the data in Table 2 it can be seen that the average ripening time of the variety Vožd (01.10.) and Vladun (29.09.) was significantly earlier than the ripening time of the standard variety Cabernet Sauvignon (06.10.). The average grape yield of the Vožd variety was 1.29 kg/m$^2$ and was very significantly higher than the grape yield of the standard Cabernet Sauvignon variety (0.78 kg/m$^2$). The average grape yield of the Vladun variety (0.87 kg/m$^2$) did not differ significantly from the grape yield of the standard variety. The bunch weight and length of the varieties Vožd (174.3 g; 14.25 cm) and Vladun (153.7 g; 12.74 cm) were very

significantly higher than the bunch weight and length of the variety Cabernet Sauvignon (134.0 g; 12.02 cm). The bunch width of the variety Vladun (8.97 cm) was very significantly higher than the bunch width of the variety Cabernet Sauvignon (7.47 cm), while the bunch width of the variety Vožd (8.41 cm) did not differ significantly from the bunch width of the standard variety. The number of berries in the bunch of varieties Vožd and Vladun (99; 101) also did not differ significantly from the number of berries in the bunch of the standard variety Cabernet Sauvignon (93).

*Table 2. Ripening time, grape yield and bunch traits of newly created varieties Vožd and Vladun and standard variety (average, 2015-2017).*

| Variety | Ripening time | Grape yield ($kg/m^2$) | Bunch weight (g) | Bunch length (cm) | Bunch width (cm) | Berries number in the bunch |
|---|---|---|---|---|---|---|
| Vožd | 01.10.* | 1.29** | 174.3** | 14.25** | 8.41 | 99 |
| Vladun | 29.09.** | 0.87 | 153.7** | 12.74** | 8.97** | 101 |
| Cabernet Sauvignon | 06.10. | 0.78 | 134.0 | 12.02 | 7.47 | 93 |

* $p<0.05$; ** $p<0.01$; means followed by stars within a column show the significance of difference Vožd and Vladun varieties in relation to standard determined by Dunnett's test.

FIDELIBUS *et al*. (2006) examined six types of the Cabernet Sauvignon variety and found that the grape yield varies in the range from 1.89 kg/vine to 2.30 kg/vine. Bunch weight in the work of these authors ranged from 171.7 g to 295.1 g, with the number of berries in the bunch ranging from 117-192. Deviations in the obtained values in the varieties Vožd, Vladun and Cabernet Sauvignon for the bunch weight and berries number in the bunch in relation to the above authors can be explained by the initial yield of the examined varieties. These results are in accordance with the results of BANJANIN and KULINA (2015) who, examining red wine varieties in the conditions of Trebinje, determined that the Cabernet Sauvignon variety had a bunch weight of 85.35 g in the initial years of productivity.

The average berry weight of the Vladun variety was 1.43 g and was significantly higher than the berry weight of the standard Cabernet Sauvignon variety (1.32 g). The average berry weight of the Vožd variety (1.40 g) did not differ significantly from the berry weight of the standard variety (Table 3). FIDELIBUS *et al*. (2006) found a variation in berry weight in the range of 1.34 g to 1.53 g in six types of Cabernet Sauvignon. The berry length and width of the Vožd variety (12.72 mm; 12.70 mm) were significantly higher than the berry length and width of the standard Cabernet Sauvignon variety (11.90 mm; 11.62 mm). The berry length of the Vladun variety (12.52 mm) was significantly higher than the berry length of the standard variety, while the berry width did not differ significantly from the berry width of the standard variety. The sugar content in the must of Vladun variety (21.8%) was significantly higher than the sugar content in the must of standard variety Cabernet Sauvignon (20.8%). On the other hand, the total acid content in the must of Vladun variety (6.0 g/l) was significantly lower than the total acid

content in the must of standard variety (6.8 g/l). The sugar and total acid content in the must of Vožd variety (20.5%; 6.5 g/l) did not differ significantly from the sugar and total acid content in the must of standard variety.

*Table 3. Berry traits and must quality of newly created varieties Vožd and Vladun and standard variety (average, 2015-2017).*

| Variety | Berry weight (g) | Berry length (mm) | Berry width (mm) | Sugar content in the must (%) | Total acid content in the must (g/l) |
|---|---|---|---|---|---|
| Vožd | 1.40 | 12.72** | 12.70** | 20.5 | 6.5 |
| Vladun | 1.43* | 12.52* | 12.20 | 21.8* | 6.0* |
| Cabernet Sauvignon | 1.32 | 11.90 | 11.62 | 20.8 | 6.8 |

* $p<0.05$; ** $p<0.01$; means followed by stars within a column show the significance of difference Vožd and Vladun varieties in relation to standard determined by Dunnett's test.

The genetic factors (different varieties) influence the quality of the grapes which is reflected in diversity compositional traits (sugar, organic acid, pH, phenolics, aromas, ect.) (PONI *et al*., 2018). A large diversity of grape varieties is used in the wine industry with distinct characteristics in berry traits, such as berry size, color, flavors, and aromas (THIS *et al*., 2006). Such a wide range of varieties is largely a result of sexual crossing (natural or introduced by breeders) and natural mutation (THIS *et al*., 2006; NIKOLIĆ *et al*., 2018b). Also, new grapevine varieties, Vožd and Vladun are results of planned sexual crossing.

The content of sugar and acid is a very important factor in the quality of grapes. The appropriate content of sugars and acids as well as their favorable ratio is the basis for obtaining quality wines. Too low acidity adversely affects the taste and thus the quality of the grapes (LIU *et al*., 2007). Knowledge of the content of sugars and acids in the must, together with other components, has great practical and scientific value, so that these data can be used to assess the technological value of one variety, and thus to choose the most suitable variety for a some wine-growing region.

In addition to the content of sugars, total acids and their ratio, the content of colored and other substances that give the taste and aroma of wine is of great importance for the quality of grapes intended for making wine. The parameters of chemical analysis of wine are shown in Figure 2.

The chemical and sensory quality of wines depends on many factors. Viticultural and enological activities contribute to wine composition. Viticultural practices including harvest date, harvest method and grape maturity have been found to influence both chemical composition and sensory properties of wines (GIL *et al*., 2012; BINDON *et al*., 2013; 2014).

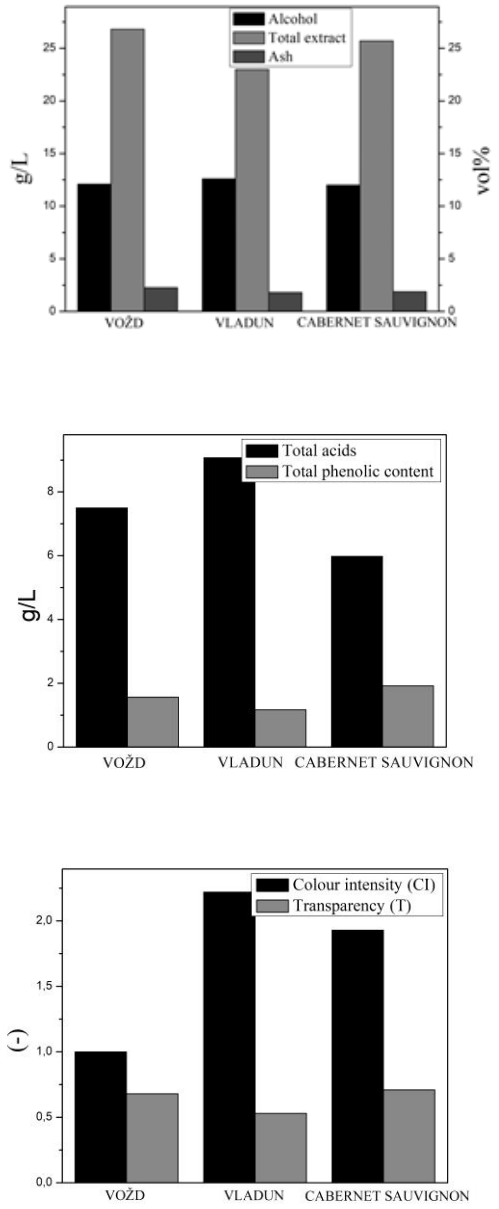


Figure 2. Wine quality indicators (alcohol, total extract, ash, total acids, total phenolic content, colour intensity and transparency) of newly created varieties Vožd and Vladun and standard variety (average, 2015-2017).

Similarly, the winemaking process has effect on the wine chemical composition (VILLAMOR *et al*., 2013). The climatic conditions, the genotype and the appropriate technology are very important for successful cultivation of grapevine and for obtaining quality wine (LUNG *et al*., 2012).

One of the important parameters for quality assessment is the alcohol content in wine. Its concentration in wine depends on the initial sugar levels in the grapes at harvest and proces of fermentation (JACKSON, 2014). RADOVANOVIĆ *et al*. (2012) analyzing wines from the Cabernet Sauvignon variety found an alcohol content of 11.7 to 12.5 vol. %. The results obtained in this paper for an alcohol content of 12.0 vol. % in the wine of the Cabernet Sauvignon variety are in agreement with the results of the mentioned authors. Wine from the Vožd variety also had a similar alcohol content (12.1 vol. %), while wine from the Vladun variety had a slightly higher alcohol content of 12.6 vol. %. Polyphenolics as a very important factors of quality of wine are a diverse group of compounds which originate mainly from the grapes (skin and seeds), with small concentrations being extracted from the oak cooperage and trace amounts from yeast metabolism (JACKSON, 2014). Phenolics influence the color (MARQUEZ *et al*., 2012), taste (MCRAE *et al*., 2013), mouthfeel (LANDON *et al*., 2008), and aromas (VILLAMOR and ROSS, 2013; VILLAMOR *et al*., 2013) of wines. In our work the concentration of total phenolic ranged from 1.17 g/l (Vladun) to 1.92 g/l (Cabernet Sauvignon). Variations of polyphenolic in red wines have been attributed largely to winemaking technique and viticultural practices, temperature, sunlight exposure, water status (HARBERTSON *et al*., 2008; LORRAIN *et al*., 2010).

Wine quality is usually discussed in terms of the relationships among its components and its sensory properties (LANDON *et al*., 2008). Different research has shown that the sensory properties of the wine are not only related to the individual concentrations of wine components, but also the interactions among these constituents (JONES *et al*., 2008; POZO-BAYON and REINECCIUS, 2009; VILLAMOR *et al*., 2013). Sensory analysis determined that all produced wines was drinkable, harmonious, with a specific varietal aroma and taste. In the wine of Vladun variety, the odor was dominated by Merlot tones, while the tannic structure, texture and softness of the taste can be attributed to the characteristics of both parents. The wine of the Vožd variety had a more neutral character on the odor, while the adstringency on taste originated from the second parent (Prokupac). The wine of the Vožd and Cabernet Sauvignon variety was evaluated with an average of 75 points, while the wine of the Vladun variety was evaluated with 72 points.

In addition to these two newly created wine varieties that are analyzed in this paper, a number of new genotypes of the Faculty of Agriculture in Belgrade are in the process of recognition. Many new crossings are also performed in order to select new promising genotypes with pronounced qualitative and quantitative indicators of grape and wine.

## CONCLUSION

The examined varieties differed significantly in terms of individual morphological characteristics and represent unique genotypes. The varieties Vožd and Vladun have a hermaphrodite type of flower, dense bunch, globose berry shape and blue black color of berry skin. Compared to the standard, the Vožd variety had significantly higher grape yield, bunch weight, bunch length, berry length and berry width, while the Vladun variety had significantly higher bunch weight, bunch length, bunch width, berry weight, berry length and sugar content in

the must. Produced wines were drinkable, harmonious, with specific varietal characteristics. Good production results qualify the newly created varieties Vožd and Vladun for cultivation both in the agro-ecological conditions of the Belgrade wine-growing region (Grocka wine-growing district), and in other similar wine-growing regions and districts.

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# KARAKTERISTIKE NOVOSTVORENIH SORTI VINOVE LOZE VOŽD I VLADUN

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Izvod

U ovom radu prikazane su najvažnije morfološke i proizvodno-tehnološke karakteristike novostvorenih sorti vinove loze Vožd i Vladun, namenjenih za proizvodnju crvenih vina. Novostvorene sorte su u odnosu na proučavane osobine upoređivane sa standardnom sortom Kaberne Sovinjon, tokom trogodišnjeg perioda ispitivanja (2015-2017). Sorta Vožd je dobijena iz kombinacije ukrštanja Začinak × Prokupac, a sorta Vladun iz kombinacije ukrštanja Merlo × Župski Bojadiser. Ispitivane sorte znatno su se razlikovale u pogledu pojedinih morfoloških osobina i predstavljaju jedinstvene genotipove. Novopriznate sorte imaju hermafroditan tip cveta, zbijen grozd, okrugao oblik bobice i plavo crnu boju pokožice. Prinos, masa grozda, dužina grozda i širina grozda bili su kod obe sorte veći nego kod sorte standard. Sorta Vožd imala je prinos od 1,29 kg/m$^2$ i masu grozda od 174,3 g, a sorta Vladun je imala prinos od 0,87 kg/m$^2$ i masu grozda od 153,7 g. Kod sorte standard prinos grožđa iznosio je 0,78 kg/m$^2$, a masa grozda 134,0 g. Sadržaj šećera i ukupnih kiselina u širi kod sorte Vožd bio je 20,5% odnosno 6,5 g/l, a kod sorte Vladun 21,8% odnosno 6,0 g/l. Vino od obe sorte bilo je pitko, harmonično, sa specifičnim sortnim mirisom i ukusom i sadržalo je 12,1 vol. % alkohola (sorta Vožd), odnosno 12,6 vol. % alkohola (sorta Vladun). Zbog niza pozitivnih osobina grožđa i vina od sorti Vožd i Vladun se očekuje njihovo širenje u proizvodne vinograde Srbije.

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