SECTION 2: VITICULTURE AND WINE PRODUCTION

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CLONAL SELECTION AND ESTABLISHMENT OF MOTHER PLANTATIONS OF VRANAC VARIETY

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Abstract
Bearing in mind the importance of vranac variety for the Montenegrin viticulture, work on clonal selection of this variety has started in 2004 year. After conducting mass positive selection, genotypes with the best characteristics were chosen. Selected mother vines that have passed sanitary control (ELISA, PCR and indexing) are propagated and included in the further process of selection. In the period of 2008/2009 year prebased mother plantation of potential clones was planted. Paper presents ampelographic and economic-technological characteristics of clonal candidates. In specific features potential clones have surpassed population of variety and by its structure, fullness and fruity wine character, clone candidate NC V 15-13 was stood out. Mother plantation of based category is planted in 2010. Mother plantation of high genetic potential and sanitary controlled will serve as repromaterial for the production of certified grapevine grafts-clones of vranac variety.
Key words: vranac, clonal selection, sanitary status, mother plantation.

Introduction

Viticulture production and winemaking of Montenegro is mostly based on breeding of autochthonous grapevine varieties (vranac, kratosija, krstac and zizak). Vranac is the main autochthonous grapevine variety in Montenegro. The most famous vineyard area in Montenegro is Crmnica, which is considered as a homeland of *Vranac* variety. On this area, autochthonous *Vranac* variety was cultivated for centuries and was used for producing the wine of superior quality. From Crmnica, variety *Vranac* was spread throughout Montenegro. Today, the company „13. Jul Plantaze” owns 2310 hectares of vineyards in one complex and 70% of vineyards have been planted with *Vranac* variety. Many authors, Stojanovic (1929), Bulic (1949), Ulicevic (1959, 1966) state about Vranac variety only as Montenegrin variety from Crmnica, and recently, Buric (1995), Bozinovik (1996), Cindric (2000), Avramov (2001) state that Vranac is autochthonous grapevine variety in Montenegro. Nastev (1967) points out that ‘Vranac’ is Montenegrin variety spread in Crmnica and in Montenegrin seacoast. In Macedonia ‘Vranac’ was transferred and planted 1950 on experimental field (Butel) and later it spread out in Macedonia throughout the former Yugoslavia. Bearing in mind the importance of autochthonous assortment for Montenegrin viticulture and wine making sector, it is intensively working on clonal selection of autochthonous grapevine varieties in Montenegro, primarily variety vranac. As a previous result of work on clonal selection of vranac variety, within the population of variety, certain vines which passed complete sanitary control were selected, propagated and planted. After the first crop of planted clone candidates, their ampelographic, technological and economic characteristic were comparing successively for several years with the population of the variety. Clone candidates with some positive characteristics clearly

expressed and transmitted to the vegetative offspring by which they surpass the population of variety will be included in the process of recognition.

Appreciating the importance of conservation of varietals purity and quality of the grafts, in planting new vineyards at the same time work on improving the production of grapevine grafts is performed. Quality vine grafts are the main base of a successful and economic viticulture. By planting mother plantations with selected material, the base for the production of certified grafts of vranac variety will be created. In this way, beside improvement of agribiological, economic and technological characteristics of vranac variety, clonal selection will contribute to the preservation of varietal purity, spread of sanitary and healthy grapevine grafts, and therefore prevention of the variety degradation and quality of wines characteristic for this variety.

Material and methods

The research was conducted at Cemovsko field, on the vineyards of the company "13. jul Plantaze". By visual observation during the growing season from population of variety, vines that have stood out by their characteristics were selected. Sanitary status of population is analysed by ELISA, PCR and indexing. Testing on the viruses was conducted on 145 vines of vranac variety. From vranac population, 5 vines have passed complete sanitary control. Selected vines that have passed sanitary control are propagated and planted on the soil free from nematodes. Planted vineyard serves for the research of the potential clones and at the same time represents mother plantation of pre-based category. Vineyard is planted on object Nikolj crkva, on base rootstock 1103P.

The distance of planting in the vineyard is 2.6 x 1.2m. Vines were formed in the shape of double horizontal cordon, height 70 cm from the ground. Back was constructed by a combination of concrete posts and wire. The mixed pruning was applied.

After the first crop, during 2009-2012 all potential clones and population of variety were observed and their ampelographic and technological characteristics were compared. Ampelographic data were collected as specified by the Organisation Internationale da la Vigne et du Vin (OIV 2001).

Quality of wines of potential clones is examined with standard methods and wine is produced in cellar of microvinification of company "13. jul Plantaze".

Mother plantation of based category of vranac variety population (potential clones) was formed 2010. on the object Kuce Rakica, using vine grafts obtained from the reproduction material from mother plantation of prebased category and based rootstock 1103P.

Results and discussion

Selection of mother vines and their sanitary control

After multi-years of visual observation during vegetation, in 2004. within the population of vranac variety vines with the certain positive phenotip characteritics (uniformity of varietal characteristics and the absence of symptoms of major diseases transmitted by vegetative propagation) were marked, what represents a start of work on clonal selection. Paralely with ampelographic characterisation and confirmation of varietal identity as vranac variety (by SSR markers), their sanitary control was done.

Marked vines of the population of vranac variety were tested on the presence of viruses by ELISA, PCR and indexing. Testing on the viruses was conducted on 145 vines of vranac variety. Most samples – 55 vines (37.93%) were infected by virus LR3 and 45 vines (31.03%) by GVA+LR3. There were not infected vines by AR3 virus. Using ELISA test, the presence of viruses was not

identified in 17 vines (11.72%). Vines which passed sanitary control by ELISA test were also tested by PCR. Out of 17 tested vines, 5 vines (29.41%) were infected with RSP and the same (29.41%) with RSP+NN. From the total number of tested vines by PCR and indexing, presence of virus was not identified in 5 vines (29.41%). Vines that are negative represent very useful material which entered in procedure of individual clone selection. Selected vines in population of vranac that passed complete sanitary control – mother vines were grafted on based rootstock Paulsen 1103, propagated and planted, in order to continue with their examination and selection. Plantation which serves for examination of potential clones (mother plantation of prebased category) is planted in 2008 on the locality Nikolj Crkva.

Ampelographic characteristic

Beside regular sanitary control, after first crop of propagated mother vines (2009), it was started with ampelographic observations. Ampelographic descriptions of potential clones relative to top of young shoot, mature leaf, inflorescence, bunch and berry, according to the OIV descriptors are presented in Figure 1. Within the population of vranac variety and most of potential clones, top of young shoot is medium anthocyanin colorated on prostrate hairs (Code 003 – notation 5), exept potential clone NC V 62-7, which has low anthocyanin coloration on prostrate hairs (notation 3). Density of prostrate hairs on the top of young shoot (Code 004) is lower (notation 3) of potential clones NC V 62-7 and NC V 62-8, compared with population of variety and the rest of potential clones (notation 5). For visual assessment of mature leaf 6 OIV descriptors are presented. Differences are observed in the shape of the leaf (Code 067) of potential clones NC V 62-7 and NC V 62-8 (notation 2), while all the others leaf descriptors were identical in the population of variety and potential clones.

GROUP	Top of young shoot		Shoot	Mature leaves						Inflor.	Bunch				Berry						
OIV CODE	003	004	016	067	068	076	079	084	085	151	201	202	204	206	220	223	225	231	235	236	241
Potential clones																					
NC V 62-7	3	3	1	2	3	2	5	1-3	3	3	2	3	7	1	3-5	2	6	1-3	2	5	3
NC V 62-8	5	5	1	2	3	2	5	1-3	3	3	2	5	5	1	3-5	2	6	1-3	2	5	3
NC V 62-13	5	3	1	3	3	2	5	1-3	3	3	3	5	5	1	3-5	2	6	1-3	2	5	3
NC V 14-39	5	5	1	3	3	2	5	1-3	3	3	2	5	5	1	3-5	2	6	1-3	2	5	3
NC V 15-13	5	5	1	3	3	2	5	1-3	3	3	3	5	5	1	3-5	2	6	1-3	2	5	3
POPULATION	5	5	1	3	3	2	5	1-3	3	3	2	5	5	1	3-5	2	6	1-3	2	5	3

Figure 1. Ampelographic characteristics of potential clones and population of vranac variety

Number of bunches per vine (Code 202) was the highest in NC V 62-13 and NC V 15-13 (2.1-3 bunches – notation 3). In term of based bunch characteristics, potential clone NC V 62-7, was stood out with short and dense bunch (Code 202 – 3 and Code 204 - 7), in comparison with population and other clones, which have medium lenght and medium dense bunch (notation 5). In all examinated potential clones and population of vranac variety, berry is short to medium long (Code 220), globose (Code 223), blue black colored (Code 225).

Quality of grapes, must and wine of potential clones and population of vranac variety

In figure 2. are presented four-years results of number of bunches per vine, ampelometric examination of bunch and berry (weight, lenght and width) as well as the quality of grapes and

wine. Quality of grapes is expressed as content of sugar, toatal acids and pH values in must. Chemical analysis of wine are done by standard method.

PARAMETERS 2009/2012							Must			Wine				
POTENTIAL CLONES	Num. of bunches per vine	Weight of bunch (g)	Length of bunch (cm)	Width of bunch (cm)	Length of berry (mm)	Width of berry (mm)	Sugar (%)	pH	Total acids (g/l)	Alcohol (vol%)	Total extract (g/l)	Total acids (g/l)	Anthocy-anins (mg/l)	Total polyphe-nols (g/l)
	$\bar{x}$	$\bar{x}$	$\bar{x}$	$\bar{x}$	$\bar{x}$	$\bar{x}$	$\bar{x}$	$\bar{x}$	$\bar{x}$	$\bar{x}$	$\bar{x}$	$\bar{x}$	$\bar{x}$	$\bar{x}$
NC V 62-7	14	254.27	13.15	8.65	15.75	14.13	23.45	3.75	5.22	13.81	31.00	5.88	781	3.39
NC V 62-8	16	326.52	16.89	9.43	15.77	14.46	21.95	3.66	4.81	13.08	28.40	5.45	750	2.63
NC V 62-13	19	323.97	16.35	9.18	15.41	14.34	21.35	3.66	5.35	12.83	29.00	5.66	686	3.03
NC V 14-39	20	302.26	16.59	9.53	15.31	13.70	24.60	3.75	4.29	14.50	35.75	5.92	793	2.73
NC V 15-13	18	310.94	15.92	9.23	15.19	13.52	24.90	3.73	4.54	14.79	38.60	5.75	963	3.14
POPULATION	20	232.30	17.05	9.55	16.21	14.75	22.25	3.55	4.74	13.44	29.45	6.23	704	2.96
MAX.	20	326.55	17.05	9.55	16.21	14.75	24.9	3.75	5.35	14.79	38.60	6.23	963	3.39
MIN.	14	232.30	13.15	8.65	15.19	13.52	21.35	3.55	4.29	12.83	28.40	5.45	686	2.63

Figure 2. Quality of grapes, must and wine of potential clones and population of vranac variety

The biggest morphological differences compared with other potential clones and population of vranac variety, are noticed in potential clone NC V 62-7. The highest sugar content is measured in clone candidate NC V 15-13, following by potential clone NC V 14-39, while the highest content acids has potential clone NC V 62-13. According to these chemical parameters of must, mentioned potential clones surpass population of vranac variety. By quality of wine potential clone NC V 15-13 stand out in which the highest content of alcohol, total extract and anthocyanins are measured. The highest content of total polyphenols has potential clone NC V 62-7.

Establishment of mother plantation of potential clones

Mother plantation of prebased category of population of vranac variety, at the same time, represents plantation for examination and recognition of clones candidates of vranac variety. Vineyard was planted with grafts obtained from propagated vines which were selected and passed complete sanitary control within population of vranac variety (mother vines) on the based rootstock Paulsen 1103. As early mentioned, vineyard is situated on Nikolj Crkva. First grafts were planted in 2008 and in the next years, addition of plantation is continued. Currently, the plantation consists of 489 vines of vranac variety. Mother plantation of based category of vranac variety population was planted with reproduction material originated from prebased mother plantation of vranac variety and base rootstock Paulsen 1103. Plantation was formed in 2010. on Kuca Rakica, on the soil previously tested on the presence of nematodes. In the first year, 1872 grafts were planted, and in the next years that number is increased. In table 3. number of planted grafts in based mother plantation of variety vranac is presented. By planting of this vineyard, base for the production of certified gratfs of vranac variety was created. By planting of this vineyard, base for the production of certified grafts of vranac variety was created.

Conclusions

Within population of vranac variety from 145 tested vines, 5 vines have passed complete sanitary control. These vines entered in process of clonal selection. After propagation of selected vines, plantation of prebased category was formed by potential clones and in it their ampelographic, technological and economic characteristics were observed. By quality of wine potential clone NC V

15-13 stand out in which the highest content of alcohol, total extract and anthocyanins are measured. The highest content of total polyphenols has potential clone NC V 62-7. From the all potential clones and population of vranac variety, potential clone NC V 15-13 was stood. By planting of mother plantation of prebased and based category it is created base for production the highest quality category of vine grafts - certified gratfs of vranac variety.

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КЛОНСКА СЕЛЕКЦИЈА И ФОРМИРАЊЕ НА МАТИЧНИ ЛОЗЈА ОД СОРТАТА ВРАНЕЦ

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Апстракт

Имајќи ја во предвид важноста на сортата вранец за лозарството на Црна Гора, клонската селекција на оваа сорта започна во 2004 година. Откако се изврши масовна позитивна селекција, генотиповите со најдобри карактеристики беа употребени. Селектираните матични лози кои ја поминаа санитарната контрола (ELISA, PCR и индексирање) се размножени и вклучени во натамошниот процес на селекција. Во периодот 2008/2009 година предбазниот материјал на потенцијалните клонови беа уматичени. Овој труд ги презентира ампелографските и економско технолошките карактеристики на кандидатите за клонови. Во одредени карактеристики потенцијалните клонови ја надминуваат популацијата на сортата во однос на структурата, полноста и овошниот карактер на виното, клонскиот кандидат NC V 15-13 се истакна. Матични лозја од базна категорија се подигнати во 2010. Матични лозја со висок генетски потенцијал и санитарно контролирани ќе послужи како репорматеријал за производство на сертифицирани калемени садници од сортата вранец.

Клучни зборови: вранец, клонска селекција, санитарна состојба, матични лозја.

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TECHNOLOGICAL CHARACTERISTICS OF THE AUTOCHTHONOUS TABLE VARIETY MONASTERY WHITE, SIGNIFICANT FOR HER REPRESENTATION OF THE MACEDONIAN MARKET

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Abstract
With respect to the use and preservation of domestic genetic fund of the vine, in newly discovered variety monastery white (klis izjum) made ampelographic identification, collection and propagation. Domestic, autochthonous grape varieties have a range of positive attributes that can be used for further selection. For this purpose, in the variety monastery white performed a number of tests, of which the most significant are the tests of technological features. In their examination can get a realistic picture quality, economic and use value of this variety and the possibility of its entry into assortments, and therefore greater representation in the market in the Republic of Macedonia. Technological characteristics were examined; mechanical composition of the bunch of grape and grain, mechanical properties of the bunch of grape and grain (transportability and reaction strength), chemical composition of grapes, during storage in the refrigerator and organoleptic evaluation. From the obtained results it can be seen that the variety monastery white has a high percentage of packaged grapes, characterized by good transportability and successfully kept in the refrigerator for several months. It also has favorable chemical composition and high general organoleptic evaluation. It meets the criteria for quality table variety. Negative in this variety is that sometimes occurs unequally (unevenly) fertilization.
Key words: monastery white, klis izjum, genetic fund, identification, technological features, autochthonous varieties, transportability.

Introduction

Variety white monastery is found in a limited place in Valandovo site, that it is found as individual lineages in monastery near Valandovo of it taken coil branches propagated planting in individual manufacturer. Then he plant variety is breed and introduced in the Collection plantation of Agricultural Institute, where made a number of tests on a number of parameters to prove its autochthony. White variety monastery tests were carried out in the period 2003 - 2006. The main task of the tests in this variety was ampelografical and genetically to identify and prove its origin (whether indigenous or autochthonous our area) with a common goal to further enter into assortments Republic of Macedonia. Also, one of the objectives of the test is a collection of the variety and use of its positive properties for further positive selection planned. Technological features are most valid features that prove the suitability of a variety into assortments, to be further distributed market and crowds out other varieties. Therefore in this paper examined the technological features with several parameters to prove the quality of the white variety monastery.

Material and methods

In the period from 2003 to 2006 and beyond in the variety monastery white investigated following technological properties; mechanical composition of grapes and grain, the mechanical properties of the cluster and grain (transportability and reaction strength), chemical composition of grapes, during storage the refrigerator and organoleptic evaluation. The mechanical composition of grapes and grain, mechanical properties of grapes and grain (transportability and reaction strength) and the structure of the cluster and grain are determined according to the standards of the OIV (International Bureau of grapes and wine). Chemical composition of the grapes was analyzed by HPLC methods. Examining the length of time for storage of grapes used ordinary refrigerator temperature 2^{o}C to 3^{o}C in special containers without the addition of some chemicals. Organoleptic assessment is carried out by tasting commission standards for table grapes and examined the following characteristics; taste, appearance, consistency, specifics of grapes and eventually gets an overall score.

Results and discussion

Studies of the mechanical composition of the bunch showed that the weight of the cluster in the white variety monastery averages 367,16 grams, length is averages 17,80 cm, width is approximately 12,17 cm, ratio length / width is 1,46 and the number of fertilized grains in the cluster averages 99,07. According to the tests of the mechanical composition of the grain showed that the weight of the grain averages 5,00 grams, length is approximately 21,1 mm, width is 20,5 mm and average ratio length / width is 1,03.

Table 1. Mechanical composition of the bunch of grape (weight, length, width)

Variety	Weight of the cluster (g)	Length (cm)	Width (cm)	L/W	Number of fertilized grains in the cluster
Monastery white	367,16	17,80	12,17	1,46	99,07

Percent of grapes and grain structure are shown in Table 3, where it can be seen that this variety has a high percentage of structural indicator of 9,93% which suggests that the variety with a high percentage of usable (the consumer) structure. Mechanical properties of grapes and grain represented by transportability and reaction strength of the grapes. Research show that white variety monastery is characterized by favorable mechanical parameters; reaction strength (resistance to pressure) of grain is 2047 (g) and resistance to splitting of grain (g) is 711. Chemical composition of the grapes is represented by the amount of sugar and total acids in grape juice analyzed as appropriate fractions of the HPLC detector. Average sugar is 188 g/dm3 and total acids 5,1 g/dm3. In Table 6 we can see the time the variety store in months, the loss of water and the dynamics of maintaining fresh consumption. The variety has a loss of water (3,9%, 4,8%, 6,7% and 8,9%), but is in good condition, not a waste and is suitable for medium term storage. In Table 7 we can see the individual scores for appearance, consistency, taste, specifics, overall impression and overall score (15,8). White variety monastery as a table variety is highly appraised of tasting commission.

Table 2. Mechanical composition of the grain of grape

Percentage of bunch stem	2,55	2,56	2,38	2,52	2,50
Percentage of skin	3,80	5,23	4,25	5,68	4,74
Percentage of seeds	1,82	2,35	1,65	2,28	2,03
Percentage of meat	91,83	89,86	91,71	89,52	90,73
Skeleton	6,34	7,79	6,63	8,20	7,24
Solid residue	8,17	10,14	8,29	10,48	9,27
Structural indicator	11,24	8,86	11,07	8,54	9,93

Table 3. Grapes and grain structure

Variety	Weight of the grain (g)	Length (cm)	Width (cm)	L/W
Monastery white	5,00	21,1	20,5	1,03

Table 4. Mechanical properties of the bunch of grape and grain (transportability and reaction strength)

Variety	Reaction strength (resistance to pressure) (g)	Resistance to splitting of grain (g)
Monastery white	2047	711

Table 5. Chemical composition of grapes

Variety	Sugar g/dm^3	Total acids g/dm^3
Monastery white	188	5,1

According to the first tests made in this paper and according to the reference data of the authors examined other autochthonous varieties (Aradhya MK and col., 2003), (Galet P. 1998), autochthonous feast breed white monastery is a variety that meets the standards for quality and has high organoleptic evaluation (grade). The only negative feature of this variety is unbalanced fertilization because it is a hermaphrodite. This indigenous variety is suitable for warm places in our country and is recommended for Macedonian assortments and Macedonian market.

Table 6. During storage in the refrigerator

Variety	Beginning in December (about 40-50 days from harvest)	Beginning in January (about 70-90 days from harvest)	Beginning in February (about 100-120 days from harvest)	Beginning in March (about 130-150 days from harvest)	Note
Monastery white	3,9%	4,8%	6,7%	8,9%	The variety has a loss of water, but is in good condition (not a waste) suitable storage medium

Table 7. Organoleptic evaluation

Variety	Outdoor. appearance 1 - 3	Consistency 1 - 3	Taste 1 - 3	Specifics 0.1 - 1	A general impression to 10	TOTAL
Monastery white	2,5	2,5	2,4	0,5	7,9	15,8

Figure 1. Variety monastery white

Figure 2. Organoleptic evaluation

Conclusions

In the white variety monastery bunch is a nice, large, medium dense, with a high percentage of packed grapes but often with more unfertilized grain table average 367,16 g and percentage of meat from 89,52 to 91,83%.

White variety monastery also features large grain (average 5,00 g), good transportabilityt and successfully kept in the cooler months.

This variety has an average of 188 g/dm3 sugar and 5,1 g/dm3 total acids. According degustation assessment, which is obtained by multi-tasting varieties by tasting commission, the highest overall assessment monastery white is 15,8 points.

With this assessment, newly discovered, indigenous, white table variety monastery, found in the Republic of Macedonia is an attractive way ahead to become part of assortments and it is with its further research and dissemination fully reveal its quality and to break into the market.

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ТЕХНОЛОШКИ КАРАКТЕРИСТИКИ НА АВТОХТОНАТА ТРПЕЗНА СОРТА МАНАСТИРСКО БЕЛО, ЗНАЧАЈНИ ЗА НЕЈЗИНА ЗАСТАПЕНОСТ НА МАКЕДОНСКИОТ ПАЗАР

Биљана Коруноска, Звонимир Божиновиќ, Елизабета Ангелова, Сребра Илиќ-Попова

Апстракт

Цел на истражување. Од аспект на искористување и зачувување на домашниот генетски фонд од винова лоза, кај новооткриената сорта манастирско бело (клис изјум) направени се ампелографска идентификација, колекционирање и размножување. Домашните, автохтони сорти винова лоза имаат низа позитивни својства кои можат да се искористат во понатамошната селекција. За таа цел кај сортата манастирско бело извршени се голем број на испитувања, од кои позначајни се испитувањата на технолошките карактеристики. Со нивно испитување може да се добие реална слика за квалитетот, стопанската и употребната вредност на оваа сорта и можноста за нејзино влегување во сортиментот, а со тоа и поголема застапеност на пазарот во Р. Македонија. Применети методи. Од технолошките карактеристики беа испитани; механичкиот состав на гроздот и зрното, механичките својства на гроздот и зрното (транспортабилност и реакциона цврстина), хемискиот состав на грозјето, време на чување во ладилник и органолептичка оценка. Резултати. Од добиените резултати може да се види дека сортата манастирско бело има висок процент на пакувано грозје, се карактеризира со добра транспортабилност и успешно се чува во ладилник и по неколку месеци. Исто така има поволен хемиски состав и висока општа органолептичка оценка. Со тоа ги задоволува критериумите за квалитетна трпезна сорта. Негативно кај оваа сорта е што понекогаш се јавува реулавост (неизедначеност) во оплодувањето.

Клучни зборови: манастирско бело, клис изјум, генетски фонд, идентификација, технолошки карактеристики, автохтони сорти, транспортабилност.

UDC:634.8-152.75
Original scientific paper

AGROBIOLOGICAL AND TECHNOLOGICAL INVESTIGATION OF ELITE HYBRID VINE FORMS FROM CROSSES OF THE CULTIVAR GAMZA

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Abstract
An agrobiological and technological investigation of elite hybrid vine forms obtained from crosses of the cultivar Gamza has been conducted. It has been established that according to the time of maturation, these forms ripen late and very late – their grapes reach technological maturity during the second half of September and in the middle of October. There are no significant differences in the duration of the separate phenophases during the vegetation period. The hybrid forms have a distinct wine character, with medium-sized clusters and berries, high actual fertility and yield. In their growing region, the amount of sugars and acids in the must does not meet the standards for the production of quality red dry wines.
Key words: elite hybrid vine forms of the cultivar Gamza, agrobiological and technological investigation.

Introduction

Gamza is one of the well-known old vine cultivars, which has been grown since ancient times in North Bulgaria. In spite of its excellent adaptation to the local soil-climatic conditions, it is also characterized by certain agrobiological disadvantages related to the later ripening of grape, insufficient resistance to low winter temperatures and the disease grey rot (Botrytis cinerea), etc. (Donchev, Stoev 1982, Boshkov et al., 1996, Vladimirova 2009, Bozinovik, 2010). The improving of the commercial qualities of this cultivar has been performed by means of the selection methods sex hybridization and clone selection, aiming at the development of analogous cultivars possessing its positive characteristics, but not its technological drawbacks. Evaluation of the selected elite vine forms includes their ampelographic characterization, which is especially important for their recognition in practical viticulture (Valchev 1990, Magriso et al., 1979). The purpose of this investigation is to determine the phenotypic values of the most commercially-important agrobiological and technological indices of selected elite hybrid forms from crosses of the cultivar Gamza.

Material and methods

The experiment included 25 plants from each of the three selected elite hybrid forms from crosses of the cultivar Gamza, developed in the Institute of Viticulture and Wine Production – Pleven by Yordan Ivanov, PhD, and grown since 1990 in the selection field and ampelographic assortment of the Educational and Experimental Centre of the Department of Viticulture, Agricultural University – Plovdiv: Gamza x Malbek XII-13, Gamza x Pinot Noir XXII-23, Gamza x Game Noir XXII-71.

After the initiation of complete productivity of the vines from the three hybrid forms and the cultivar Gamza, grafted on the rootstock Berlandieri x Riparia SO 4, phenological observations, determination of the actual fertility and mechanical analysis of cluster and berry were conducted for a period of three years – 2008-2010, using methods described in Bulgarian Ampelography (1990). The fertility indices were established at an equal quantity of winter buds per vine – 8-10 nodes with 2 buds and one arrow with 6 buds. The statistical processing of the obtained results was carried out through dispersion analysis and multi-direction comparing test (Mokreva, Murgova 1997). All necessary agrotechnological care for the normal development of the experimental vines was provided throughout the entire growing period on Moser training system. No extreme climatic conditions were reported in that region for the period of the study.

Results and discussion

The data derived from phenological observations performed throughout the duration of the investigation of the hybrid forms, shows that the budding phenophase starts at the beginning of April – 05.04 – 09.04., the mass manifestation of this phenophase – 09.04. – 13.04., and its end – in the middle of the same month – 13.04. – 16.04. (Table 1). The appearance of the first leaf on young shoots takes place in the period 15.04. – 20.04., and the first inflorescence emerges from 18.04. to 23.04. One of the most important phenophases – flowering of vines – starts at the beginning of June – 02.06. – 04.06., its mass manifestation is observed 3-4 days later, and the end is from 10.06. to 14.06. The analyzed phenophases have almost identical duration in the three hybrid forms. The beginning of berry colouring is reported in the last days of July – 28.07. – 30.07., and the end of this essential for grape ripening phenophase is found to take place at the beginning of August – 04.08. – 07.08. Technological maturity in the hybrid form Gamza x Malbek XII-13 occurs about 21.09, in Gamza x Pinot Noir XXII-23 – 25.09., and in Gamza x Game Noir XXII-71 – approximately on 16.10. According to the time of ripening, the first two forms ripen late, and the third one ripens very late. In the mother cultivar Gamza budding and appearance of the first leaf and inflorescence begin later, flowering takes place almost simultaneously, berry colouring is during the second half of August, and technological maturity is reached at the end of September. Only the hybrid form Gamza x Game Noir XXII-71 ripens later than the cultivar Gamza. The actual fertility indices show certain differences through the years of the study, Gamza having the lowest phenotypic values. The percentage of developed buds is high in all three hybrid forms – from 77,83 % for Gamza x Game Noir XXII-71 to 84,24 % for Gamza x Pinot Noir XXII-23 (Table 2). The same refers to the percentage of fruiting shoots, which varies from 81,63 % to 97,16%. The actual fertility coefficient is a very important trait from the agrobiological characterization of each cultivar. All studied hybrid forms are characterized by comparatively high values of this index within the range 1,41 – 1,64. The fertility of substitute buds is from 0,44 to 0,65. The comparative mathematical analysis of the data shows that in all reported indices of actual fertility, three groups of reliability of differences form – a, b and c. It has been mathematically proven that the cultivar Gamza differs from the hybrid forms in most of the studied indices, with the exception of fertility coefficient of fruiting shoot and substitute shoot. Two groups – a and b – are more commonly observed in them, and the main differences exist between Gamza x Malbek XII-13 and the other two forms, which demonstrates the role of the father parent cultivar in the inheritance of these traits. The data obtained from the mechanical analysis of cluster shows that the percentage of stems in the three hybrid forms is from 3,24 % to 4,24 %, and the percentage of berries is from 95,76 % to 96,76 % (Table 3). The amount

of millerandage berries is the lowest in Gamza x Game Noir XXII-71 – 0,42 %. Within berry structure skins are 6,05 % - 9,02 %, seeds – 3,60 % - 5,35 %, and mesocarp – 85,63 % - 90,35 %. The analysis confirms that no considerable differences exist between the researched hybrid forms in relation to these indices. The average yield per vine is the highest in Gamza x Game Noir XXII-71 – 7,07 kg, and the lowest in Gamza x Pinot Noir XXII-23 – 3,97 kg. The hybrid forms are characterized by predominantly middle-sized clusters and berries. The weight of cluster and berry is comparatively greater in Gamza x Game Noir XXII-71 – 244 g and 3,97 g respectively. The sugar content is insufficient for the production of quality red wines – from 19,1 % to 21,5 %. Its values vary in separate years, which suggests its heavy dependence on external factors. In Gamza x Malbek XII-13 23,8 % sugars were accumulated in 2008. The average amount of acids is comparatively high – from 6,3 g/dm^3 to 7,5 g/dm^3. The theoretical output of must is within the limits 75,49 % - 84,11 %. The results from the mechanical and chemical analyses of cluster and berry form two groups of reliability (a and b) – for percentage of stems, berries, seeds and mesocarp, and in the remaining indices three groups are observed – a, b and c. Proven differences in the separate indices are present both between hybrid forms, and between them and the cultivar Gamza, but no steady trends are developed. The latest-ripening hybrid form - Gamza x Game Noir XXII-71 – is characterized by comparatively larger cluster and berry, high yield, percentage of berries, mesocarp and amount of acids, but it contains less sugars. Gamza x Malbek XII-13 possesses relatively better technological indices, and it surpasses the cultivar Gamza in the amount of sugars and acids and cluster sizes, but it has smaller berries.

Table 1. Phenological observations of the studied hybrid forms – average for the period 2008-2010

Hybrid combination	BUDDING			Appearance of the first leaf	Appearance of the first inflorescence	FLOWERING			BERRY SOFTENING			Technological maturity
	beginning	mass	end			beginning	mass	end	beginning	mass	end	
Gamza	13.04	15.04.	18.04	21.04	25.04	04.06	08.06	13.06	12.08	15.08.	23.08	29.09
Gamza x Malbek XII-13	06.04	09.04.	13.04	16.04	19.04	02.06	05.06	11.06	29.07	02.08.	06.08	21.09
Gamza x Pinot Noir XXII-23	05.04	10.04.	12.04	15.04	18.04	02.06	04.06	10.06	28.07	31.07.	04.08	25.09
Gamza x Game Noir XXII-71	09.04	13.04.	16.04	20.04	23.04	04.06	07.06	14.06	30.07	3.08	07.08	16.10

Table 2. Actual fertility of the studied hybrid forms – average for the period 2008-2010

Hybrid combination	Developed buds %	Fruiting shoots %	Shoot fertility coefficient	Main shoot fertility coefficient	Fruiting shoot fertility coefficient	Substitute shoot fertility coefficient
Gamza	67,40 c	75,00 c	1,30 c	1,43 c	1,57 c	0,40 c
Gamza x Malbek XII-13	79,85 b	97,16 a	1,64 a	1,75 a	2,17 a	0,65 a
Gamza x Pinot Noir XXII-23	84,24 a	88,97 b	1,47 b	1,57 b	1,91 b	0,51 b
Gamza x Game Noir XXII-71	77,83 b	81,63 b	1,41 b	1,52 b	1,64 c	0,44 c

Table 3. Mechanical and chemical analysis of cluster and berry in the studied hybrid forms – average for the period 2008-2010

Hybrid combinations	Mechanical analysis						Chemical analysis		Yield per vine kg	Average cluster weight, g	Cluster sizes		Average weight of 100 berries, g	Berry sizes	
	Cluster			Berry											
	Stems %	Berries %	Milleranda e berries %	Skins %	Seeds %	Mesocarp %	Sugars %	Acids g/dm^3			Length cm	Width cm		Length mm	Width mm
Gamza	a 4,20	ab 95,80	b 1,88	c 6,70	b 3,20	a 90,10	a 21,0	c 5,9	b 4,500	b 200,0	c 15,4	c 8,2	b 255	b 16,2	b 15,6
Gamza x Malbek XII-13	b 3,65	a 96,35	a 5,74	b 7,31	b 3,72	b 88,97	a 21,5	a 7,5	b 4,850	b 215,5	a 18,1	b 9,9	c 205	c 14,5	c 14,3
Gamza x Pinot Noir XXII-23	a 4,24	ab 95,76	a 5,21	a 9,02	a 5,35	b 85,63	b 20,2	b 6,3	c 3,970	c 173,0	b 16,7	b 9,3	c 200	c 14,5	c 14,8
Gamza x Game Noir XXII-71	b 3,24	a 96,76	c 0,42	c 6,05	b 3,60	a 90,35	c 19,1	b 6,5	a 7,070	a 244,0	a 17,5	a 10,5	a 397	a 17,9	a 17,8

Conclusions

The studied elite hybrid forms from crosses of the cultivar Gamza ripen late and very late. Their grapes ripen during the second half of September and in the middle of October. There are no significant differences in the duration of the separate phenophases during the vegetation period.

The hybrid forms have a distinct wine character, with a high percentage of stems and skins and high theoretical output. They are characterized by high actual fertility and yield, medium-sized clusters and berries. In their growing region the amount of sugars and acids in the must does not meet the standards for the production of quality red dry wines.

There is comparatively high mathematically proven specificity in terms of the observed agrobiological and technological indices in the studied cultivar Gamza and the elite hybrid forms, which can be used for selection purposes. The agrobiological and technological investigations of the hybrid forms, which ripen earlier than the cultivar Gamza - Gamza x Malbek XII-13 and Gamza x Pinot Noir XXII-23, should be continued in other micro-regions where the production of grapes of a higher quality is possible.

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АГРОБИОЛОШКИ И ТЕХНОЛОШКИ ИСПИТУВАЊА НА ЕЛИТНИТЕ ХИБРИДИ ВИНОВА ЛОЗА ДОБИЕНИ СО ВКРСТУВАЊЕ НА СОРТАТА ГАМЗА

Венелин Рojчев

Апстракт

Агробиолошки и технолошки испитувања на елитните хибриди добиени со вкрстување на сортата гмза беа изведени. Времето на созревање кај овие единки е касен и многу касен период, од средината на септември до средината на октомври. Непостојат разлики во фенофазите. Хибридните форми имаат јасен вински карактер, со средна големина на гроздот и зрното, висока фертилност и принос.

Клучни зборови: елитни хибридни форми од сортата Гамза, агробиолошки и технолошки испитувања.

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Original scientific paper

TABLE GRAPE VARIETIES FOR COOL CLIMATES

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Abstract
In order to expand the land areas for table grape growing and to introduce new varieties a research was conducted on the production and biological characteristics of large number of table grape varieties with different mature phases in the wine growing region of Fruška Gora. The objective was to develop a technology for growing table grape in cold weather conditions and to select the most appropriate varieties. Phenological investigations have shown that over the last twenty years there has been a trend of early beginning of all phenophases and earlier maturity of all varieties. Karmen and Serbia varieties reach their maturity phase at the same time as Cardinal variety, while Ljana, Muscat plevenski, Viktoria and Black magic mature at the same time as Chasselas. Lasta, Terez, Belgrade seedless and Kišmiš moldavski have medium maturity phase. All investigated varieties are characterized as highly productive, particularly Karmen and Viktoria varieties, while Ljana, Lasta, Muscat plevenski and Kišmiš moldavski have excellent organoleptic characteristics. The problem of frost sensitivity for most table grape varieties can be overcome by selection of proper training system, while quality improvement of table grape can be achieved with the introduction of additional ampelotechnical measures and development of different agro-techniques. It can be concluded that besides the standard table grape varieties some new domestic and introduced table grape varieties can also be grown in Serbia.
Key words: Table grape, phenology, frost sensitivity, yield, quality.

Introduction

Agroecological conditions in most of the wine growing regions in Serbia are favorable. Still, production of table grapes is unreasonably neglected and the assortment is old and inadequate. Table grapes are typically grown in small private estates and gardens. Out of a total area covered in grapevine around 2.000 ha (5%) is used for growing table grapes. Muscat Hamburg is the predominant variety, around 90%, while other table grape varieties are underrepresented (Kardinal, Chasselas, Afuz-ali, Italia, Karmen, Lasta, Srbija and others). Production of table grape varieties is the same as for wine grape varieties, but without the application of additional ampelotechnical measures and irrigation. Some wine grape varieties are still used as table grapes (Slankamenka, Smederevka, Portugizac and other). Demand for table grapes is met through import and consumption is low in comparison to other countries (3-4 kg per capita) (Žunić, Todić, 2002; Žunić, Matijašević, 2003). In Serbia, there is a large number of new domestic and foreign table grape varieties, as well as the grapevine clones. Modern technology and integral concept of growing grapes offer possibilities to increase table grape production so that at least local demands could be

met. Climate changes have made some wine growing regions suitable for table grape production, that is, the regions with colder climate where until recently wine grapes only have been traditionally grown (Jones *et al* 2005; Orduna 2010; Petrovic *et al* 2006).

The aim of this research was to select the best quality table grape varieties with different epochs of maturation, based on their biological and production characteristics in the conditions of moderate continental climate. This would enable greater coverage of land with table grapes in Serbia and production of high quality table grapes for domestic market.

Material and methods

Material -Twenty table grape varieties of different epochs of maturation were chosen for the purpose of this research. Most of the varieties had very early and early maturation stage: Super ran Bolgar, Beogradska rana, Kardinal, Favorit, Panonia kincse, Srbija, Karmen, Viktoria, Black magic, Muscat plevenski, Chasselas rouge and Ljana. Varieties with medium maturation epochs were: Lasta, Muscat Hamburg, Kišmiš moldavski, Terez and Beogradska seedless. The selected grape varieties with late maturation were: Afuz-ali, Italia and Moldova.

Object and conditions - All the tests were performed in the period from 1986 to 2011 in experimental and production vineyards located on the experimental field which is in the property of the Faculty of Agriculture in Novi Sad. The experimental field is located in Sremski Karlovci which is 12 km away from Novi Sad (Vojvodina region, wine growing region of Srem, wine growing region of Fruška Gora).Table 1 shows the basic data on the experimental field and conditions during research.

Methods - Phenological investigations were performed for 25 years continuously and the dates of the most important phenophase beginnings were recorded (budding, flowering, veraison and the date of the first partial harvest). Frost sensitivity of winter buds of table grape varieties was tested under the conditions of artificial freezing in cold chamber at a critical temperature of - 20.0 ºC and with the exposure of 10 hours. The tests were performed in the middle of December, middle of January and at the end of February with the aim of determining level and type of sensitivity of varieties. The percentage of survived, partially frozen and frozen buds was calculated and the results were presented in the graph (Cindrić *et al*, 2000).

The application of standard methods showed following production characteristics: total grape yield, quantity of classified grapes, sugar and acid content in must, cluster and berry masses and level of infection with grey mold.

The data are shown in tables and graphs and the correlation between the indicators of the quality of table grapes was calculated by Statistical 10 software program.

Table 1. Experimental field of the Faculty of Agriculture in Novi Sad (Sremski Karlovci)

Indicator	Description
Longitude	20º 10´ E
Latitude	45º 10´ N
Altitude	110 - 130 m/m
Mean annual temperature (on average:1954-2011)	11.7ºC
Mean temperature during vegetation	17.3ºC
Annual sum of warm temperatures	4.225 ºC
Sum of warm temperatures during vegetation	3.720 ºC
Annual amount of precipitation	578 mm
Amount of precipitation during vegetation	353 mm
Absolute minimum of temperatures in the period 1981-2012:	1987 = - 19.5°C 2005 = - 18.2 ºC 2012 = - 22.7 ºC
Soil type	Eutric cambisol on loess
Grapevine training system	Single Guyot
Pruning	12+2 bud/grapevine
Planting distance	3.0 x 1.2 m
Number of grapevines in the experiment	Minimum 20

Results and discussion

Phenological investigations

All tested varieties started budding in the period from April 3 to April 19, and the flowering started from May 24 to June 6. Significant differences between the varieties were observed in the beginning date of veraison (starting from July 7 to August 14) and even greater differences were observed in the harvesting date. Super ran Bolgar grape variety was picked first – August 2, and Moldova variety was the last to be picked (October 3). With the selection of the mentioned assortment table grapes could be consumed for over two months. The period from the beginning of budding to the harvesting date for the tested varieties lasted from 116 to 169 days (Table 2).

Analysis of phenological results for a longer period of time showed that over the last twenty years there has been a tendency of varieties to enter certain phenophases earlier than expected. This rarely occurred with budding and flowering phases, but veraison and ripening phases started particularly early with all varieties. Commonly grown varieties, such as Chasselas rouge and Afuz ali, show descending trendline (figures 1. and 2.). These changes were directly related to extremely high temperatures during July and August which caused faster grape ripening.

Table 2. Phenology (Sremski Karlovci. Period: 1986-2012)

Varieties	Beginning of the phenophases			4. Grape harvest dates	Number of days: 1-4
	1.Bud burst	2. Flowering	3. Veraison		
Super ran Bolgar	April 08	May 31	July 08	August 02	116
Muscat plevenski	April 05	June 03	July 12	August 12	120
Beogradska rana	April 11	June 01	July 11	August 10	121
Cardinal	April 16	June 04	July 19	August 20	126
Favorit	April 07	May 31	July 12	August 13	128
Panonia kincse	April 11	June 02	July 17	August 25	136
Karmen	April 13	May 30	July 14	August 23	132
Srbija*	April 03	May 24	July 07	August 21	140
Chasselas rouge	April 11	June 01	July 24	Sept. 02	144
Viktoria*	April 07	May 26	July 15	August 26	141
Black magic*	April 13	June 03	July 14	Sept. 02	142
Ljana	April 11	June 01	July 26	Sept. 06	148
Kišmiš moldavski *	April 03	May 27	July 18	Sept. 08	158
Lasta	April 14	May 31	July 27	Sept. 19	158
Beogradska seedless	April 13	June 06	July 30	Sept. 13	153
Terez	April 13	May 30	July 31	Sept. 20	160
Muscat Hamburg	April 17	June 02	July 29	Sept. 20	156
Afuz-ali	April 17	June 06	August 01	Sept. 28	164
Moldova	April 17	June 04	August 05	October 03	169
Italia	April 19	June 06	August 14	October 01	165

*Serbia – data for the period: 1999-2011

* Viktoria – data for the period: 2009-2011.

* Black magic – data for the period: 2009-2011.

* Kišmiš moldavski – data for the period: 1999-2011.

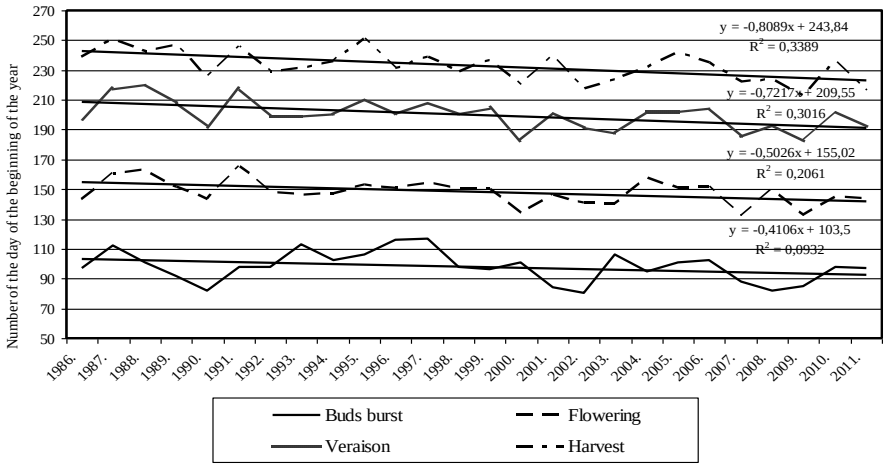

Figure 1. Chasselasrouge - Phenophases

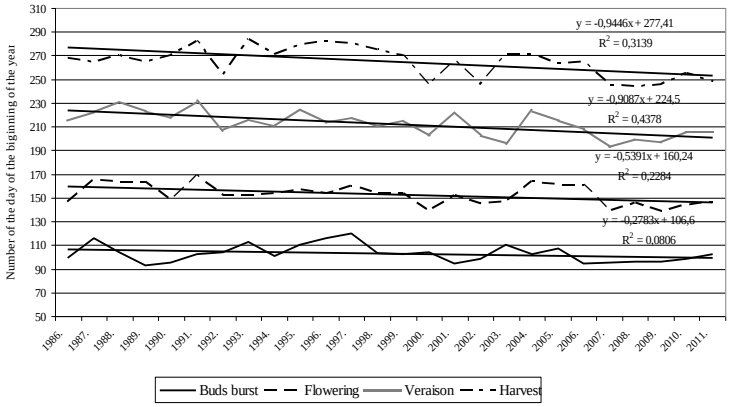

Figure 2. Afus - ali - Phenophases

Low temperature susceptibility

Figures 3 and 4 show the results obtained from testing the susceptibility of winter buds of table grape varieties to low temperatures.

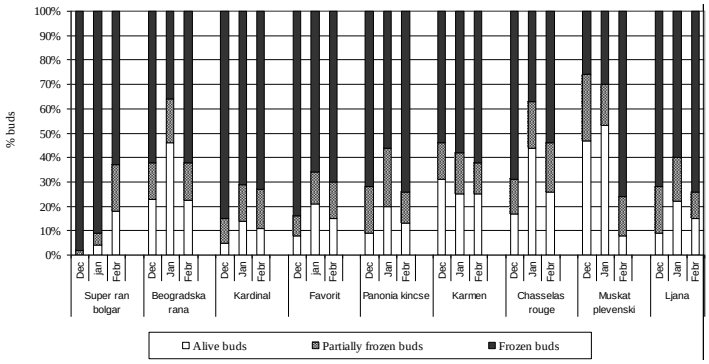

Figure 3. Susceptibility to low temperatures. Very erly and ripening varieties (Sremski Karlovci –mean for 10 years

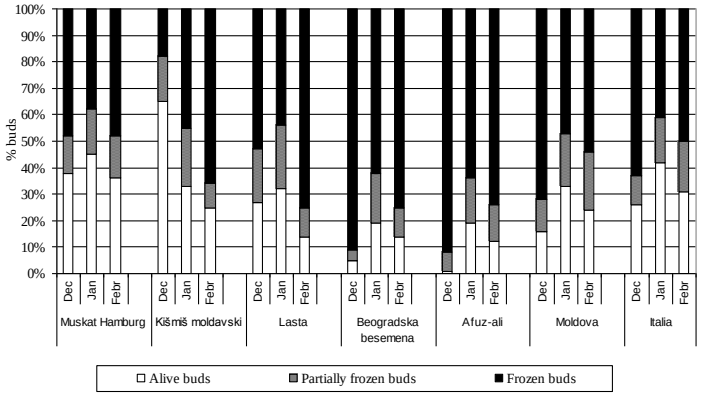

Figure 4. Susceptibility to low temperatures. MIdle late and late varieties (Sremski Karlovci –mean for 10 years

Most tested varieties showed high sensitivity to low winter temperatures. The varieties with medium sensitivity were: Muscat Hamburg, Kišmiš moldavski and Muscat plevenski. In the conditions of moderate continental climate, where extremely low temperatures occur every ten years, it is of utmost importance to adjust the growing of table grape varieties to the environmental conditions (Cindrić, Korać, 1990). Better production can be ensured by selecting the shoot positions, retaining an extra spur near the bottom of the trunk, balanced nutrition of the grapevine and by applying other measures (Korać *et al* 1991).

Production characteristics

The selected table grape varieties grown in conventional, simple trellis training system without irrigation and additional ampelotechnical measures gave good production results (Table 3). Highly productive varieties (> 2 kg/m^2) were: Karmen, Moldova, Viktoria, Chasselas rouge and Panonia kincse, but nothing less productive were the following varieties: Kišmiš moldavski, Beogradska seedless, Italia, Cardinal and Afuz-ali. The variety with lowest yield was Super ran Bolgar. Similar results were obtained by the authors: Korać et al. (1991), Korać, Cindrić (2003), Dimovska et al (2012), Mijatović et al. (2010), Žunić, Todić (2002), Žunić, Matijašević (2003).

Varieties that gave over 80% of (commercially) valuable table grapes were: Lasta, Ljana, Karmen, Kardinal, Muscat plevenski, Black magic and Kišmiš moldavski. Application of additional measures (inflorescence attenuation, removal of excess shoots, irrigation, etc.) could increase the quantity and quality of other table grape varieties as well.

The highest sugar content in the must was found in the following varieties: Kišmiš moldavski, Lasta, Black magic and Afuz ali (> 18%) and Super ran Bolgar had the lowest sugar content. However, subjective feeling of sweetness greatly depends on the sugar-acid ratio in the must, thus it could be said that all the tested varieties had sufficiently sweet and juicy grapes.

Judging by the taste, Muscat Hamburg is still the leading variety, although Muscat plevenski, Italija, Lasta and Ljana varieties are also characterized by excellent sensory properties. All varieties had large, loose or medium dense clusters. The largest berries were observed in Viktoria variety and the smallest ones in Beogradska rana variety. The following varieties had similar size and color of berries: Lasta, Ljana, Muscat plevenski, Favorit, Italija and Super ran Bolgar, while Muscat Hamburg, Viktoria and Panonia kincse varieties had berries that greatly varied in their size and color.

Medium sensitivity to Botritys was observed with Favorit, Muscat Hamburg, Afuz ali, Italia and Viktoria varieties in the conditions of regular application of chemical protection against fungal diseases. Positive, medium, correlation was determined between the size of clusters and yield, sugar and acid contents in must and harvesting date, and between berries and cluster masses. Strong negative correlation was observed between Botritys infected grapes and the amount of commercial table grape (Tab. 4). Figure 5 shows the relation between quality indicators for table grape varieties and their comparison to Cardinal variety which was taken as a standard.

Table 3. Grape yield and quality (Sremski Karlovci, period: 1986-2012)

Variety	Total grape yield (kg/m^2)	Commercial table grape (%)	Sugar in must (%)	Acid in mus (g/l)	Cluster weight (g)	Weight of 100 berries (g)	Botritys (%)
Super ran Bolgar	1.07	76	10.6	4.3	340	335	7
Beogradska rana	1.41	72	13.5	7.6	366	275	5
Cardinal	1.65	84	12.7	6.3	485	690	2
Favorit	1.52	70	14.4	6.7	348	390	12
Panonia kincse	2.07	63	13.3	6.6	495	480	4
Karmen	2.74	86	12.2	6.8	520	524	3
Srbija*	1.46	74	16.4	5.6	356	568	2
Chasselas rouge	2.04	76	14.5	6.2	258	246	4
Muscat plevenski	1.67	83	13.8	6.8	490	434	2
Viktoria**	2.26	82	13.6	4.2	660	927	8
Black magic**	1.52	82	18.4	3.8	385	535	0
Ljana	1.38	87	16.2	6.7	338	437	0
Kišmiš moldavski **	1.78	76	20.6	7.5	740	433	4
Lasta	1.25	87	19.2	8.6	345	490	1
Beogradska seedless	1.78	56	15.2	7.4	438	336	9
Terez*	1.58	66	12.9	5.9	628	558	2
Muscat Hamburg	1.37	42	17.6	7.6	344	427	12
Afuz-ali	1.65	67	18.2	7.3	498	542	11
Moldova	2.29	74	15.7	8.2	470	478	5
Italia	1.78	65	14.1	9.4	520	645	9

*Srbija – Data for the period: 1999-2011.

* Viktoria – Data for the period: 2009-2011.

* Black magic – Data for the period: 2009-2011.

* Kišmiš moldavski – Data for the period: 1999-2011.

Table 4. Table grape - Correlation. Marked correlations are significant at p< .05000

Variable	Total grape yield	Commercial grape yield	Sugar in must	Acids in must	Cluster weight	Weight of 100 berries	Botritys on grape	Harvest data
Total grape yield	1.0000	0.1266	-0.2375	0.0541	0.5009	0.3126	-0.0180	0.1020
Commercial grape yield	0.1266	1.0000	-0.1125	-0.2949	0.1072	0.2457	-0.7281	-0.3860
Sugar in must	-0.2375	-0.1125	1.0000	0.2570	0.1116	-0.0234	-0.0894	0.5959
Acids in must	0.0541	-0.2949	0.2570	1.0000	0.0707	-0.2101	0.2115	0.6414
Cluster weight	0.5009	0.1072	0.1116	0.0707	1.0000	0.5624	0.0700	0.1691
Weight of 100 berries	0.3126	0.2457	-0.0234	-0.2101	0.5624	1.0000	-0.0158	0.1209
Botritys on grape	-0.0180	-0.7281	-0.0894	0.2115	0.0700	-0.0158	1.0000	0.2884
Harvest data	0.1020	-0.3860	0.5959	0.6414	0.1691	0.1209	0.2884	1.0000

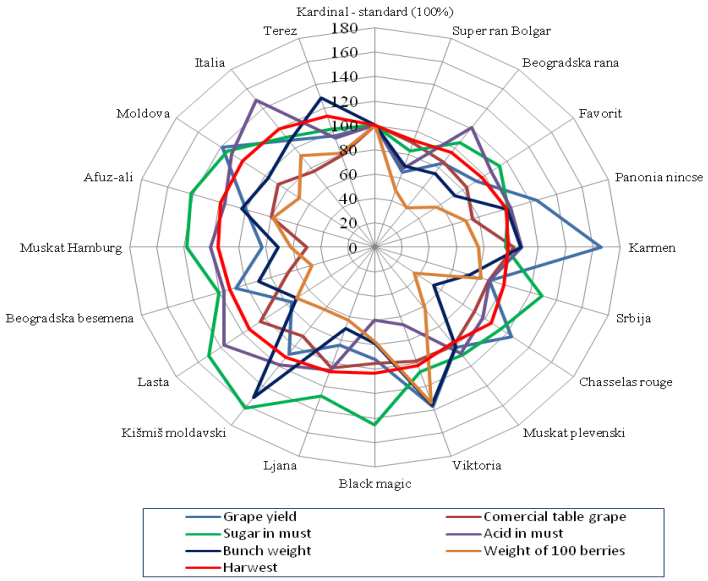

Figure 5. Producion characteristics of the table grae varieties in relation to the Cardinal

Conclusions

Table grape varieties with different maturation epochs can be successfully grown in the conditions of moderate continental climate where extremely low temperatures occur every ten years. Proper variety selection is very important. Besides Muscat Hamburg, the leading table grape variety in Serbia, all other tested varieties, with very early, early and medium maturation epochs are also recommended to be grown. Varieties with late maturation should be grown with greater attention, on smaller land areas and best positions. Development of appropriate agrotechnical measures, implementation of additional ampelotechnical measures and irrigation are necessary for cultivation of all table grape varieties.

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ТРПЕЗНИ СОРТИ ГРОЗЈЕ ЗА ЛАДНИ КЛИМАТСКИ УСЛОВИ

Корач Нада, Иванишевиќ Драгослав, Медиќ Мира, Куљанчиќ Иван, Румл Мирјана, Славица Тодиќ, Попов Милена

Апстракт

Заради ширење на површините со винова лоза и воведување на нови сорти, изедени се испитувања на производните и биолошки карактеристики на поголем број на трпезни сорти грозје со различни фази на созревање во виногорјето Фрушка Гора. Целта е да се развие технологија за одгледување на трпезното грозје во ладни климатски услови и да се селектираат соодветни сорти. Фенолошките испитувања покажуваат дека во последните дваесет години има тренд на порнао започнување на сите фенофази и порано созревање на на сите сорти. Кармен и Србија созреваат во исто време со Кардиналот, додека Љана, Мускат плевенски, Викториа и Блек меџик созреваат во истов реме со Шасла. Ласта, Терез, Белградска бессемена и Кишмиш молдавски имаат среден период на созревање. Сите испитувани вариетети се карактеризираат со висока продуктивност посебно сортите Кармен и Викторија, додека Љана, Ласта, Мускат плевенски и Кишмиш молдавски имаат извонредни органолептички карактеристики. Проблемот со чуствителоност кон мразевите кај повеќето трпезни сорти грозје може да се надмине со одбирање на соодветен систем на одгледување, додека подобрувањето на квалитетот може да се изведе со воведување на дополнителни ампелотехнички мерки и развој на различни агротехнички мерки. Може да се заклучи дека покрај стандардните трпезни сорти грозје некои домашни и интродуцирани трпезни сорти можат исто така да бидат одгледувани во Република Србија.

Клучни зборови: трпезни сорти грозје, фенологија, чуствителност на мразеви, принос, квалитет.

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WINE GRAPE CULTIVARS SUITABLE FOR ORGANIC PRODUCTION

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Abstract
Organic grape production has been increasing considerably in Serbia and all over the world. Besides this, there are number of unresolved issues relating to the organic grape production. The primary aim of this research was to determine the suitability of domestic white grape cultivars such as Bačka, Petka, Panonia and Morava for organic grape and wine production in the wine growing region of Fruška Gora by testing their biological properties and production characteristics. Petka wine grape cultivar showed high resistance to fungus diseases when grown without chemical protection against these diseases, which is why it is recommended to be grown without application of chemical protection. Other cultivars can be grown with greatly reduced protection. Bačka wine grape cultivar had the highest yield in the observed period. Similarly, high yield was also achieved with Petka cultivar. In the observed period Panonia grape wine cultivar had the highest content of sugar and acid in grape juice and its wine was evaluated as high quality wine. Panonia wine grape cultivar can give the top quality wine under favorable conditions, while other grape cultivars can give quality wines. Even though a period of three years is not enough for identification of cultivar characteristics, it could be said that white wine grape cultivars Bačka, Petka, Panonia and Morava, developed at the Faculty of Agriculture in Novi Sad, are suitable for organic grape and wine production under the agro-ecological conditions of Fruška Gora.
Key words: Wine grape, organic production, varieties, biological characteristics, production characteristics.

Introduction

Organic grape production has been increasing considerably in Serbia and all over the world. Still there are a number of unresolved issues related to the organic grape production. In organic production cultivar is of crucial importance (Korać et al., 2011). For several decades now breeders from all over the world have been working on the creation of cultivars which would be resistant to fungal diseases and which would be suitable for organic production of grapes and wines (Kozma and Hajdu, 1984; Pouget, 1998; Alleweldt 2000; Cindrić et al., 2000; Motoc et al., 2010; Topfer et al., 2011). In the mid 1970s of the XX century, the breeding, which focused on the creation of cultivars resistant to stress factors, was started on the experimental field which is in the property of Faculty of Agriculture from Novi Sad, and which is located in Sremski Karlovci. Up to now several wine grape cultivars suitable for organic production have been created (Cindrić and Korać, 1990; Korać et al., 2005). Cultivars tolerant to fungal diseases are becoming increasingly important for organic grape production in some countries (Germany, Switzerland, Austria, Eastern Europe and

eastern parts of the USA), while in other parts of the world those cultivars are less present (Geier et al., 2005; Dufour, 2006).

By testing biological and production properties of domestic white wine grape cultivars, such as Bačka, Petka, Panonia and Morava, this research focused on determining their suitability for organic production of grape and wine in the wine growing region of Fruška gora.

Material and methods

Objective - All tests were performed during a three year period (2008, 2009 and 2010) in the experimental vineyard located on the experimental field in Sremski Karlovci which is in the property of the Faculty of Agriculture in Novi Sad, Department of Fruit Growing, Viticulture, Horticulture and Landscape Architecture. The vineyard is located at longitude 45º 10´ North, at latitude 20º 10´ East and at the altitude of 120 m. The vineyard was developed in 2000. Interrow planting distance was 2.7 m and the distance between the grapevines was 1.6 m. The grapevines were planted in pairs which means that there were two grapevines planted at the same place. The nutrient area of one grapevine was 2.16 m². There were 160 to 300 grapevines of each cultivar. The training system of grapevine was single Guyot. After pruning one cane with 12 buds and one spur with 2 buds were left per grapevine. Plant protection chemicals and mineral fertilizers were not applied in the experimental vineyard during the research.

Tested cultivars - All tests were performed on Bačka, Petka, Panonia and Morava cultivars that were created at the Faculty of Agriculture in Novi Sad.

Bačka cultivar was obtained by cross-breeding Petra and Bjanka cultivars. The creators of this cultivar are P. Cindrić, N. Korać and V. Kovač. The grapevine of this cultivar is quite strong with long erect shoots. Cluster is of medium size and density, about 200g, cone-shaped, on a long peduncle. Berries are round, small with thick greenish skin and partially rose in color on the sun-facing side. It is characterized by high and regular yield. Its property of sugar accumulation is satisfactory. It can give wine of pure, neutral aroma and harmonious taste. This cultivar is not susceptible to gray mold, and it is highly resistant to powdery mildew and downy mildew. It is also resistant to low winter temperatures, especially at the beginning of winter.

Petka cultivar originates from the same cross-breeding combination as Bačka cultivar. Its creators are P. Cindrić, N. Korać, V. Kovač and M. Medić. Grapevine is very dense with long semi-erect shoots. Cylindrical-shaped cluster is of medium size, dense, with round yellow-greenish juicy berries. Grape ripens in the second epoch and gives high yield. It accumulates a lot of sugar in its must and has medium acidity. Its wine is highly qualitative and harmonious. It is gray mold resistant and fairly tolerant to downy mildew and powdery mildew. It can be grown with little protection.

Panonia cultivar was also created by cross-breeding of Rhine Riesling and domestic high quality genotype SK 86-2/293 (SK 77-7/4 x Bjanka). It was created by P. Cindrić, N. Korać and V. Kovač. Cluster is loose, widely cone and wing-shaped. Berries are round, small (around 1.6 g), green-yellow, very juicy and of pleasant flavor. A small number of erect shoots are developed. Distinguishing characteristic of this cultivar is that its laterals stop growing after several leaves are formed. The rows are always of low density and neat. It ripens in the first epoch. Panonia cultivar is highly resistant to powdery mildew and downy mildew, and it has low sensitivity to gray mold if harvest is performed on time. Most of the years, it can be grown successfully without pesticide application. It is resistant to low winter temperatures.

Morava cultivar was created by the same cross-breeding as Panonia cultivar. Its shoots are erect and numerous on the grapevine. It has strong laterals which often carry small grape clusters with few berries. The cluster is loose, wide and cone-shaped with 1−3 wings. The peduncle is short. Berries are oblong, medium (2, 3 g), green with juicy pulp and of characteristic flavor. Morava cultivar ripens in the third epoch. It is highly resistant to downy mildew and gray mold on grapes. It shows medium resistant to powdery mildew. It should be mentioned that powdery mildew is less common on fruit than on the leaves. It is highly resistant to low temperatures. This cultivar is characterized by high acid content which is even higher than in Rhine Riesling. It gives high quality wine with sharp flavor resembling the one of Sauvignon.

Climatic conditions - Meteorological data given in Table 2 were collected from local weather station located on the experimental field in Sremski Karlovci. The weather conditions in 2008 were extremely dry and hot. Vegetation period was characterized by high average vegetation temperature and small amount of precipitation. The weather in 2009 was very hot and dry because of high mean annual and vegetation temperature which exceeded average values of the same parameters in the period from 1952−2010.

Year of 2010 was characterized by high humidity and slightly lower average vegetation temperature. There was around 200 mm more precipitation than during the vegetation period, and almost 300 mm more precipitation during the entire year with respect to multi-annual average values. Considerable amount of precipitation created favorable conditions for the development of fungal diseases in 2010.

Tolerance to fungal diseases - Evaluation of resistance to fungal diseases was performed in the fields, on leaves and grapes twice during the vegetation period (in June and July). IPGRI descriptors were used for determining the level of infection (1997). Descriptor 9.2.3 was used for determining the susceptibility to downy mildew on leaf and the scale ranged from 1 to 9, where 1 represents high resistance and 9 represents high sensitivity. Descriptor 9.2.4 was used for assessing fruit infection with downy mildew and the scale ranged from1 to 9 (1,3,5,7 and 9).

Table 1. Meteorological data for period from 2007 to 2010 (Sremski Karlovci)

	Year	2007	2008	2009	2010	Multi-annual average 1952-2010
Air temperature (°C)	Annual average	13.2	13.7	13.6	12.0	11.9
	Average vegetation	19.8	18.6	19.7	17.4	17.8
Precipitation (mm)	Annual sum	867.1	515.1	521.5	912.6	622.7
	Vegetation sum	343.4	310.2	217.5	598.4	389.3

Descriptor 9.2.5 was used for assessing the leaf infection with powdery mildew and the scale also ranged from 1 to 9, and descriptor 9.2.6 was used for assessing fruit infection with powdery mildew with the same scale (1 – 9). Descriptor 9.2.2 with the scale from 1 to 9 was used for assesing the fruit infection with gray mold.

Phenological observations - Phenological observations determined the beginning of budding, flowering and veraison: the time of bud burst was the date when first buds on a grapevine started opening; the beginning of flowering was the date when 5 % of flowers was open; time of berry

ripening (veraison) was the date when the first berries were changed in this phenophase (Avramov, 1991). The date when grapes reached full maturity was the date of harvetsing.

Production-technological characteristics - The grape yield was determined by measuring the mass of harvested and full mature grape. Grapes were harvested from 24 grapevines of every cultivar. The grapevines were grouped in 3 repetitions. There were 8 grapevines per each repeptition. Oechsle scale was used for determining sugar content of the must. Salleron table served for transferring Oechsle levels into percentages of sugar in the must. Average values were determined based on weighted mean, and weight represented the yield.Acid content in the must was determined by neutralization method of all acids and their salts with n/10 NaOH solution. Acid content was expressed in g/l of tartaric acid.

Average mass of a cluster was determined during harvesting by dividing the mass of harvested grapes with the number of harvested clusters. This was repeated for every cultivar. Microvinification procedure in 10 litre glass vessels was used in the production of wine from these cultivars. The wine had free-run (without the use of press). Two thirds of sulphur were used in the wine production, as regulated by *Wine Law* (Mirošević and Karoglan-Kontić, 2008). In that way organic wine production procedure was followed.

Analysis of chemical composition of wine was performed in the accredited laboratory for enology at he Faculty of Technology in Novi Sad. The wine analysis was performed in accordance with the International methods of wine and must analysis (OIV, 1990). The following parameters were analyzed: alcohol content (% vol) – determined by the picnometry method , OIV (A 2); extract without sugar (g/l) – determined by picnometry method, OIV (A 3); total acids (such as tartaric acid, in g/l) – determined by method of titration with base solution in the presence of bromothymol blue as the indicator, OIV (A 31); pH value – determined by potentiometer, OIV (A 31); phenolic compunds (gallic acid, in g/l).Sensory evaluation was done by the experts. The wine was evaluated by using maximum 20 point scoring scale: maximum 2 points for color, maximum 2 points for clarity, maximum 4 points for aroma and maximum 12 points for taste. Based on the taste evaluation the wines were categorized as: Table wine – at least 15.00 points; Quality wine – at least 16.50 points; Top quality wine – at least 18.51 points.

Statistical results

The obtained data were statistically processed by STATISTICA 10 (StatSoft Inc., Tulsa, USA) and average values were compared by using Fisher's LSD test ($P<0.05$).

Results and discussion

Resistance to fungal diseases

Based on the results obtained from the evaluation of cultivar resistance to fungal diseases (Table 2, it was determined that in dry and warm season, which was during 2008 and 2009, Bačka, Petka and Panonia cultivars were highly tolerant to downy mildew (caused by *Plasmopara viticola),* powdery mildew (caused by *Oidium Tuckeri)* and gray mold on fruit (caused by *Botrytis cinerea)*, while Morava cultivar was quite resistant to downy mildew and gray mold on fruit and it showed high tolerance towards powdery mildew. During the rainy season which was in 2010, Bačka cultivar showed medium to high tolerance to downy mildew, high tolerance to powdery mildew and very good tolerance to gray mold on fruit; Petka cultivar showed high tolerance to powdery and downy mildew on fruits and very good tolerance to powdery mildew on leaves and gray mold on fruits; Panonia cultivar showed medium tolerance to powdery and downy mildew on leaves and high

tolerance to downy mildew on fruit and gray mold on grapes; Morava cultivar was highly tolerant to gray mold on grapes and downy mildew on leaves, it showed medium tolerance to downy mildew and powdery mildew on fruit, and low tolerance to powdery mildew on leaf. The obtained results confirmed the previous research (Cindrić et al., 2002, 2004; Korać et al., 2005b; Balaž et al., 2006). In the observed period, Bačka cultivar had the highest yield and the largest cluster (Table 4); Petka cultivar also had relatively high yield. Yields of both cultivars were statistically significantly higher than those of Panonia and Morava cultivars. In the observed period Panonia cultivar had the highest sugar and acid content in must which affected the alcohol and acid content in wine made from this cultivar (Table 5). Wine made from Panonia cultivar had the highest level of extracts without sugar. Gourmets noticed that this wine had high and balanced content of acid, similar to Rhine Riesling cultivar, which gave the wine pleasant and refreshing taste. This wine was evaluated as the best quality wine and during some years it was even evaluated as the top quality wine (in 2010). All the previously mentioned confirmed the results obtained by Cindrić et al. (2003). In comparison to Panonia, Petka and Bačka cultivars had somewhat lower content of sugar and considerably lower content of acid in must which affected the wine quality. Wine made from Petka cultivar was evaluated as the wine of the poorest quality, but it could still fall into the category of qualitative wines. On average, wine made from Panonia cultivar was, by quality, somewhat better than the wine made from Bačka cultivar which was in 2009 evaluated as the best quality wine. Morava cultivar, in the observed period, had the lowest sugar content and high acid content in must which affected the total content of alcohol and acid in wine. Wine made from this cultivar maintained the similar quality to the wine made from Panonia cultivar. The obtained results proved some authors right who claimed that wine made from some interspecies cultivars was of similar quality to the wines made from *Vitis Vinifera* cultivars (Dufoura, 2006; Kopfer and Willer, 2001; Pavlousek, 2010a).

Table 2. Resistance to fungal diseases (Sremski Karlovci)

Cultivar	Year	Disease causing agents				
		Plasmopara viticola		*Oidium Tuckeri*		*Botrytis cinerea*
		leaf	fruit	leaf	fruit	fruit
		9.2.3[1]	9.2.4[1]	9.2.5[1]	9.2.6[1]	9.2.2[1]
Bačka	2008	1	1	1	1	1
	2009	1	1	1	1	1
	2010	3	15	3	3	1
	Average	1,7 a	2,3 a	1,7 ab	1,7 a	1 a
Petka	2008	1	1	1	1	1
	2009	1	1	1	1	1
	2010	2	3	1	3	1
	Average	1,3 a	1,7 a	1 a	1,7 a	1 a
Panonia	2008	1	1	1	1	1
	2009	1	1	1	1	1
	2010	4	3	4	4	3
	Average	2 a	1,7 a	2 ab	2 ab	1,7 a
Morava	2008	1	1	3	3	1
	2009	1	1	3	5	1
	2010	3	5	6	5	3
	Average	1,7 a	2,3 a	4 b	4,3 b	1,7 a
	LSD	2,3	3,4	2,5	2,5	1,5

Note: Values marked with different letters are statistically significantly different at the significance threshold of **0.05** (LSD test).

[1] IPGRI descriptors.

Phenological observations

During the research, Panonia cultivar had the earliest beginning of budding, flowering, veraison and harvesting time, while these phenophases occurred later with Morava cultivar which was harvested the last (Table 3).

Table 3. Date of phenophase beginning (Sremski Karlovci)

Cultivar	Year	Beginning of budding	Beginning of flowering	Beginning of veraison	Harvesting date
Bačka	2008	22.03.	23.05.	12.07.	27.08.
	2009	06.04.	17.05.	11.07.	07.09.
	2010	08.04.	28.05.	23.07.	14.09.
	Average	02.04.	23.05.	15.07.	06.09.
Petka	2008	24.03.	23.05.	16.07.	03.09.
	2009	03.04.	17.05.	09.07.	07.09.
	2010	09.04.	25.05.	13.07.	14.09.
	Average	02.04.	22.05.	13.07.	08.09.
Panonia	2008	16.03.	23.05.	16.07.	26.08.
	2009	03.04.	17.05.	06.07.	20.08.
	2010	08.04.	24.05.	08.07.	14.09.
	Average	30.03.	21.05.	10.07.	31.08.
Morava	2008	30.03.	26.05.	23.07.	24.09.
	2009	06.04.	19.05.	30.07.	14.09.
	2010	11.04.	29.05.	05.08.	05.10.
	Average	05.04.	25.05.	30.07.	25.09.

Production-technological characteristics

Table 4. Production characteristics for 2008, 2009 and 2010 (Sremski Karlovci).

Cultivar	Year	Grape yield (kg/m²)	Average cluster mass (g)	Sugar content in must (%)	Acid content in must (g/l)
Bačka	2008	2.25	242	20.5	7.2
	2009	1.87	278	25.2	5.0
	2010	1.65	203	18.8	6.5
	Average	1.92 a	241 b	21.6 ab	6.3 a
Petka	2008	2.07	211	22.1	6.4
	2009	1.69	179	26.2	4.2
	2010	1.76	130	20.4	6.6
	Average	1.84 a	173 b	22.8 a	5.8 a
Panonia	2008	1.13	131	25.4	8.2
	2009	1.20	158	22.2	9.7
	2010	0.80	93	20.9	6.3
	Average	1.04 b	127 c	23.1 a	8.3 b
Morava	2008	1.32	135	20.0	7.2
	2009	1.25	149	20.7	9.1
	2010	1.10	90	18.1	8.3
	Average	1.22 b	125 c	19.7 b	8.2 b
	LSD	0.28	32.1	2.25	1.12

Note: Values marked with different letters are statistically significantly different at the significance threshold of **0.05** (LSD test).

Table 5. Sensory and chemical analysis of wines 2008−2010 (Sremski Karlovci).

Cultivar	Year	Wine tasting evaluation	Alcohol (% v/v)	Extract without sugar (g/l)	Total acids (g/l)	pH	Phenol (g/l)
Bačka	2008	16.7	11.70	17.2	6.4	3.3	0.26
	2009	18.1	15.23	17.8	5.5	3.5	0.24
	2010	17.6	12.87	16.2	5.4	3.2	0.25
	Average	17.5 ab	13.27 a	17.1 a	5.8 a	3.3 a	0.25 a
Petka	2008	17.2	13.05	18.5	6.2	3.3	0.25
	2009	16.6	15.97	17.1	5.5	3.5	0.23
	2010	17.8	12.51	14.0	5.7	3.2	0.21
	Average	17.2 a	13.84 a	16.5 a	5.8 a	3.3 a	0.23 a
Panonia	2008	18.4	14.77	20.3	9.4	3.2	0.47
	2009	18.0	11.57	22.0	8.5	3.1	0.38
	2010	18.6	13.31	16.0	6.3	3.2	0.32
	Average	18.3 b	13.22 a	19.4 a	8.1 b	3.2 a	0.39 b
Morava	2008	17.9	12.00	18.8	6.7	3.5	0.32
	2009	17.4	12.42	19.1	8.1	3.1	0.38
	2010	18.3	11.65	19.5	7.4	3.2	0.22
	Average	17.9 ab	12.02 a	19.1 a	7.4 ab	3.3 a	0.31 ab
	LSD	1.0	2.89	3.7	1.7	0.3	0.11

Note: Values marked with different letters are statistically significantly different at the significance threshold of **0.05** (LSD test).

Conclusions

Growing wine grapes without any application of chemicals against common fungal diseases showed that the wine grape cultivar Petka had the highest level of tolerance and could be recommended for growing without the application of any chemicals. In dry season Bačka cultivar can be successfully grown without the application of chemicals against fungal diseases, while in rainy season it can be grown by applying the reduced protection against downy mildew only. Panonia cultivar can also be successfully grown in dry season without using the chemicals against fungal diseases while in rainy season it can be grown by applying the reduced protection against powdery mildew and downy mildew. During warm period Morava cultivar can be grown without additional chemicals for protection against downy mildew and gray mold on fruit, while the reduced protection should be used against powdery mildew. In rainy season Morava cultivar can be grown with moderate protection against powdery mildew and reduced protection against downy mildew.

In comparison to other tested cultivars, Panonia cultivar entered first the phenophases of budding, flowering and veraison and its grapes were the first to reach the full maturity. Morava cultivar was the last to enter the budding phenophase as well as the other phenophases and its grapes were the last to reach the full maturity. Apart from genetic potential, annual climatic conditions also significantly affected the starting date of certain phenophase.

During the observed period, Bačka cultivar had the highest yield and cluster mass; Panonia cultivar had the highest content of sugar and acids in must and its wine was evaluated as the best quality wine. Panonia cultivar can give a top quality wine under more favorable conditions. This wine is characterized by pleasant taste which is similar to Rhine Riesling wines. In comparison to Panonia, Bačka and Petka cultivars had somewhat lower content of sugar and considerably lower content of acids in the must. Wine made from Petka cultivar was evaluated as the wine of poorest quality but it falls into the category of qualitative wines. During the period of observation, Morava cultivar had the lowest content of sugar and high content of acids in must, and its wine maintained the similar quality to the wine made from Panonia cultivar. Although a three year period is short for determining all the properties of cultivars, it can be concluded that white wine grape cultivars such as Bačka, Petka, Panonia and Morava, which were created at the Faculty of Agriculture in Novi Sad, are suitable for organic grape and wine production in agro-ecological conditions of Fruška Gora.

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СОРТИ ВИНОВА ЛОЗА ПОГОДНИ ЗА ОРГАНСКО ЛОЗАРСТВО

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Апстракт

Производството на органско грозје се зголемува значајно во Србија и во целиот свет. Покрај тоа постојат нерешени прашања во однос на органското лозарство. Примарната цел на ова испитување беше да се опрелат можностите на автохтоните сорти како Бачка, Петка, Панониа и Морава за органско производство во Фрушкогорското виногорје со испитување на нивните биолошки и производни карактеристики. Петка е винска сорта која покажува висока отпорност на габни заболувања кога се одгледува без хемиска заштита поради што и препораката е да се одгледува без хемиска заштита. Другите сорти можат да бидат одгледувани со големо намалување на заштитата. Бачка е винска сорта покажа највисок принос за испитуваниот период, висок принос беше утврден и кај сортата Петка. Во испитуваниот период, сортата Панониа покажа највисока содржина на шеќер во ширата додека нејзиното вино беше оценето со највисок квалитет. Панониа е винска сорта која може да висок квалитет во поволни услови, додека другите сорти даваат квалитетни вина. И покрај ова периодот од 3 години е недоволен за идентификација на карактеристиките на сортите, но може да се каже дека сортите Бачка, Петка, Панониа и морава, добиени на Факултетот за земјоделство во нови Сад се погодни за производство на органско грозје и вино во агроеколошките услови на Фрушка Гора.

Клучни зборови: винско грозје, органско производство, сорти, биолошки карактеристики, производни карактеристики.

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Originial scientific paper

SOME AMPELOGRAPHICAL RESEARCH ON THE INDIGENOUS VARIETY PROKUPAC

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Abstract
Prokupac is indigenous variety originating from Serbia with long history in growing the variety in the country and wider. The research was conducted from 2009 to 2011 on 6 variants of Prokupac varieties with different shapes of cluster. Cluster density (Codes N°204) was different depending from the variant and it was from: very loose (grade 1) at variant K-1, loose (grade 3) at variant K-3, medium compact (grade 5) at variant K-5, compact (grade 7) at variant 7, very tight cluster (grade 9) at variant K-9, while the standard variant had compact to very tight cluster (grade 8-9). The numbers of clusters per vine was variable from average 11,5 at variant K-1 untill 15,5 at variant K-5.The rest of the variants also had higher than the average clusters that the standard variant had (12,5). The cluster weight was also variable and it was from 110g at variant K-1 until 150g at variant K-5, while the standard variant was 140g. Yield per hectare was also variable, varying from 10.453 kg at variant K-1 to 19.216 kg at variant K-5. The yield at the rest variants was higher than the standard one which was 14.463 kg. For the period the research was conducted the highest sugar content had variant K-5 (21,6%), or 1% more than the standard variant which had 20,65%. The lowest sugar content had variant K-9 (20,35%). Lowest total acid had variant K-1 (6,6 g/l), lower from the standard by 0,20 g/l. The highest total acid was recorded at variant K-9 (7,05 g/l) or by 0,25g/l more than the average standard variant.The best result from the research gave the variant K-5 because of the earlier ripening by 8-10 days comparing to the average standard variant.
Key words: variant, cluster, yield, sugar content, total acids, time of ripening.

Introduction

Prokupac is indigenous variety originating from Serbia with long history in cultivating this variety in the country and wider. The cultivation of indigenous varieties brought a lot of attention in the region and wider. These varieties are protected in the countries where they are grown by the O.I.V standards, but in Serbia the protection has yet to be made. In this region there are vines that are more than a 100 year old, which enables us to make a quality selection. Dr. D. Zirojević in his PhD thesis in 1965 has selected several types that he considerate Prokupac variety. He did not work on exact selection of Prokupac, but he worked on separation on Prokupac as a sole variety. A lot of authors both foreign and domestic had mention in their published works this variety (Avramov L., Briza K., Bozinović Z., Žunić D., Zirojević D., Nastev D., Stojanović M., Toskić V., Cvetković D., Cindrić P.). Ampelographical researches for this variety are yet to be made.

The intention of the work is to conduct ampelographical researches on the chosen types of the indigenous variety Prokupac with purpose to select the potential clone which will be better than the standard type.

Material and methods

The research has been conducted from 2009 to 2011 in vineyard that has been planted in 1930. The location on the vineyard is in „Biljeska Čuka", in Toplica wine subregion which belongs to the Prokupje wine region, a place which is considerated to be with optimal conditions for vine growing.

The vineyard of the Prokupac variety is planted on a area of 20 are, on Kober rootstock with a distance of 1.1 x 1.1 m, i.e.8.265 vines/ ha. The rows are located north – south, with head (gobelet) vine training system with typical Župa type of pruning (low spur). The vines were pruned on 5 kondirs with 2 buds (kondir-last year vine pruned), which is total 10 buds. The research was conducted on 6 variant types that included 15 vines by variant. The variants were marked as: K-1, K-3, K-5, K-7, K-9 and standard S. Standard climate elements are processed such as: air temperature, length od sunshine radiation, precipitations, relative humidity and winds in selected areas. The physical and chemical characteristics on the soil were conducted by using standard methods of research.Phenological research and the characteristics of the variants of the Prokupac variety were followed by phenophases of development (weeping, budbreak,early flowering, end of flowering ,begin of ripening, full ripe, vine shoots maturing and leaf fall). The description od the chosen vines of Prokupac is conducted by the methods of the International office for grape and wine (O.I.V - Code Des Caracteres Des Vitis Anonimus 1983). The fully developed leaf is described before the grape ripening with the use of 10 leafs from vine that are taken from the 10 th or 11 th node of the vine shoot. The grade, shape, colour, hairyness, separation, shape of the sinus and tooth is conducted visual, but the size of the leaf, angle of the nervature and the length of the petiole are measured.

The cluster (bunch) is described in the time of harvest which 10 clusters are taken from 10 vines. The size of the cluster is determined with must measurement and the length of the clusters taken from each variety separately. The cluster weight is determined as average from sample of 30 clusters. The tightness of the clusters is visually determined and the length of the petiole is found by measuring of 10 cluster from all variants.

The chemical compound of the must is determined by measuring the sugar content with Oechsle mustmeter and Saleron's table, which is used in O.I.V – e Cod 505 (Anonymous 1983.

Important climate and land characteristics

Meteo data for Prokuplje was used for the climate characteristics. Period from 2009 until 2011 is considerated. On base of this period, basic climate elements are made that show heat conditions, sun conditions, humidity and winds in selected areas.

Air temperature - middle vegetation temperature in the researched period was 16,8ºC.

Temperature sum in the researched period was 3610ºC.

The warmest month is July with average midday temperature from 22,9 ºC to 23,4 ºC and January as the coldest with average midday temperature from -1 ºC to -1,4 ºC.

Extreme low temperatures were recorded in January and February with – 22,1 ºC.

Absolutely maximum temperatures were recorded in July and August with 42,1 ºC.

Length of sunshine radiation had optimal value for all the conducted locations and was 1682 h.

Precipitations were varying about 627mm.

On the location, the soil type is ganjaca. It has shallow humus horizon and light mechanical compound. Chemical characteristics of the soil is low acid (pH 6,4 - 6,6) and percentage of humus is 2,1 -2,7 %. The missing macro and micro elements from the soil is compensated with fertilizing.

Results and discussion

The leaf description is shown in Table. 1. Mature leaf (Codes N˚065) is oval, medium size (grade 5). Picture 1. Number of lobes (Codes N˚068) was mostly 3 part (grade 2) as in the standard, with the exception of the variant K-9 which had 5 part lobe (grade 3). Picture.1. K-1, K-3, K-5, K-7, K-9 and standard.

Table 1. Botanical description of the leaf by variants

Variant	K-1	K-3	K-5	K-7	K-9	Standard
Codes	grade					
Codes N˚o65	5	5	5	5	5	5
Codes N˚068	2	2	2	2	3	2
Codes N˚076	2	2	2	2	2	2
Codes N˚079	3	3	3	4	5	3
Codes N˚084	7	7	7	7	7	7
Codes N˚085	1	1	1	1	1	

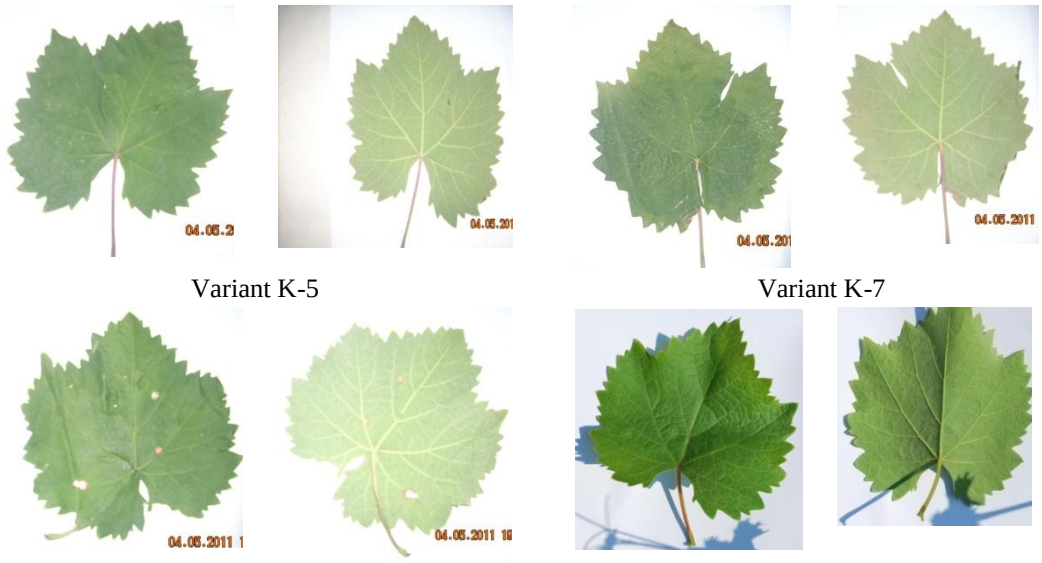
Shape of teeth (Codes N^0 076) was the same in all variants as in the standard (grade 2) – straight. The degree of opening of petiole sinus (Codes N^0 079) was different from the standard. Variants K-1,3,5 were open (grade 3) as the standard. Variants K-7 had slightly opened (grade 4), but variant K-9 had closed form of petiole sinus (grade 5).

Density of prostrate hairs between the main veins on lower side of blade (Codes N^0 84) was high and equal as the Standard.

Density of erect hairs between the main veins on lower side of blade (Codes N^0 085) in all variants and the standard was very low (grade 1), but on the nervature of the leaf was medium (grade 5).

Variant K-1

Variant K-3



Variant K-5 Variant K-7

Variant K-9 Standard

Picture 1. Face and back of leafs in variants

Cluster (bunch) description

Cluster description in ampelography gives solid evidence in determination of the variety. In table 2 are given the following description of the cluster.

Table 2. Botanical Bunch (cluster) description by variants

Variants	Codes N˚202	Codes N˚203	Codes N˚204	Codes N˚206
K-1	3	3	1	3
K-3	3	3	3	3
K-5	5	5	5	3
K-7	5	5	7	3
K-9	5	5	9	3
Standard	5	5	8	3

Cluster (bunch) size (Codes N^0 202) was different (pic.2). The small bunch (grade 3) was in variant K-1 and K-3, medium (grade 5) in variant K-5, K-7, K-9 and also in the standard.

K -1

K-3

K-5

K-7

K-9

Standard

Picture 2. Size and Cluster (bunch) density by variants

Bunch legth (Codes N˚203) was different. The smallest length (grade 3) had variants K-1 and K-3 (13 and 14 cm), the other variants K-5, K-7, K-9 and the Standard had length with grade 5 (18,18,17,18 cm). Bunch density (Codes N^0 204) was different from: very loose (grade 1) at variant K-1, loose (grade 3) at variant K-3, medium (grade 5) at variant K-5, dense (grade 7) at variant K-7, The Standard had dense or very dense bunch (grade 8-9), Picture 2. The length of peduncle of primary bunch (Codes N˚206) was at all variants short (grade 3) 5-7 cm. Phenophase development was given in Table 3.

Table 3. Phenophase development of variants - average (2009 – 2011)

Variants/Phenophase	K-1	K-3	K-5	K-7	K-9	Standard
Weeping	14-3	13-3	15-3	13-3	16-3	15-3
Bud break	5-4	7-4	5-4	6-4	7-4	7-4
Early flowering	26-5	26-5	27-5	23-5	25-5	24-5
End of flowering	4-6	3-6	6-6	3-6	4-6	4-6
Begin of ripening	7-8	7-8	4-8	3-8	7-8	7-8
Full ripe	10-10	11-10	1-10	4-10	11-10	10-10
Vine shoots maturing and leaf fall	4-11	5-11	30-10	3-11	3-11	3-11

Juice movement was variable as per year and variants. The latest juice movement was recorded at variants K-9 (16-3), earliest at variants K-3 and K-7 (13-3). The difference between variants was just 1 day. The earliest bud break and vine shoot growth was recorded at variant K-1 and K-5 (5-4), which was 2 days earlier that the Standard. The difference between variants was 2 days.
The earliest flowering had variant K-7 (23-5), but latest variant K-5 (27-5).
The shortest flowering had variant K-3 (8 days), the longest had variants K-7 and the Standard. Flowering recorded after the Standard had variants: K-1, K-3, K-5 and K-9, but before the Standard just K-7.
Begin of ripening was almost same at all variants in August. Nearly all variants had begun ripening as the Standard (7-8), just variant K-7 was exception which had earliest ripening (3-8), followed by variant K-5(4-8).
The full ripe was earliest recorded at variant K-5 (1-10), which was 10 days before the Standard (10-10), at variant K-3 and K-9 (11-10) was recorded the latest, 1 day after the Standard.
The most early leaf fall and vine shoot maturing had variant K-5 (30-10), three days before the Standard, variant K-3 (5-11) had the latest, 2 days after the Standard.
The elements of yield are shown in Table 4 as averages.

Table 4. Elements of yield – averages (2009- 2011)

Variant/ elements	Cluster weight in *g*	Number of clusters/ vine	Yield/ vine in *g*.	Yield/vine shoot in *g*.	Yield / Bud in *g*.	Yield /hectare in кg.
K-1	110,0	11,5	1.265	148,8	126,5	10.453
K-3	135,0	13,5	1.822	214,3	182,2	15.058
K-5	150,5	15,5	2.325	244,7	232,5	19.216
K-7	145,0	14,5	2.102	247,2	210,2	17.373
K-9	130,0	13,5	1.755	195,0	175,5	14.505
Standard	140,0	12,5	1.750	194,4	175,0	14.463

The grape yield was variable which confirms that some variants had good fertility. The grape cluster mass was also variable from 110g. in variant K-1 to 150 g. in variant K-5, the Standard had 140g. The number of cluster per vine was variable per variants, K-1 had the lowest number (11,5), the highest had variant K-5 (15,5), also the others variants had higher numbers than the Standard. On the grape yield per vine, several factors had impact such as the grape cluster mass and the number of clusters per vine varying from 1.265 g. at variant K-1 to 2.325 g. at variant K-5. Also the others variants had higher yield than the Standard (1.750g.). The grape yield pre vine shoot was variable depending on the grape yield per vine and the number of vine shoots. The lowest grape yield per vine shoot had variant K-1 (148,8 g.), the highest (247,2) variant K-7, also the others had higher numbers than the Standard (194,4 g.).
The yield per bud was variable from 126,5 g at variant K-1 to 232,5 g. at variant K-5. Also in the other variants the yield was higher than the Standard (175,0 g), with exception from the K-9 which was almost the same as the Standard (175,5 g.). The yield per hectare was from 10.453 kg at variant K-1 to 19.216 at variant K-5. Also the yield at the other variants was higher than the Standard, which was 14.463 kg. Sugar content and total acids is given in Table 5.

Table 5. Sugar content % and total acids /l – average (2009-2011)

Variant	K-1		K3		K5		K7		K9		Standard	
Year 209/2011	Sugar content %	Total acid g/l	Sugar content %	Total acid g/l	Sugar content %	Total acid g/l	Sugar content %	Total acid g/l	Sugar content %	Total acid g/l	Sugar content %	Total acid g/l
Average	20,95	6,6	20,5	6,7	21,6	6,65	21,25	6,7	20,35	7,05	20,65	6,8

In the researched period the highest sugar content had variant K-5 (21,6%) which is 1,0 % more than the Standard (20,65), but lowest had K-9 (20,35%).Total acids were also variable per variants. The lowest total acids had variant K-1 (6,6 g/l), lower than the Standard per 0,20 g/l, but the variant K-9 had the highest (7,05 g/l) or 0,25 g/l more than the Standard. The other variants had total acids between these measured numbers.

Conslusions

The climate conditions in Toplica vine sub region are favorable for all the researched variants.

The soil conditions are suitable for cultivating vine, especially on south exposition where the physical and chemical properties are favorable in cultivating.

The phenological research gave us a possibility to separate the most productive variant.

The number of days in vegetation from bud break to full maturing was shortest in variant K-5 (175 days – 5 days shorter than Standard), K-7 (178 days – 3 days shorter than Standard) and Standard (180 days).

The grape yield was variable per variants and years. The smallest cluster mass had variant K-1 (110 g.) and the largest mass had K-5 (150g.), greater than the Standard for 10 g.

The most yield per vine and hectare had variant K-5 (2.325 g), which is more than 575 grams than the Standard (1.750g.), after that is K-7. Grape yield per vine shoot was highest in variant K-7 (247,2 g.), then variant K-5 (244,7 g.), which is higher than the Standard (194,4 g.). Yield per hectare was highest in variant K-5 (19.216 kg) which is 4.753 kg more than the Standard.

The highest sugar content in the researched period had variant K-5 (21,6%), more than the Standard per 1 %, then variant K-7 (21,25%). The rest of the variants had similar sugar content like the Standard.

There were no high oscillations in measuring total acids in the rest of the variants and they were from 6,6 g/l in variant K-1 until 7,05 g/l in variant K-9. The Standard and the rest of the variants had similar content of total acids.

The best results has given variant K-5 , then variant K-7. On the base of the information of the research, we should continue monitoring the variant K-5 in purpose for clone selection.

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НЕКОИ АМПЕЛОГРАФСКИ ИСПИТУВАЊА НА ДОМАШНАТА СОРТА ВИНОВА ЛОЗА ПРОКУПЕЦ

Б. Јанковиќ, П. Христов, Д. Цветковиќ, З. Божиновиќ, Р. Христов

Апстракт

Прокупец е домашна, автохтона сорта со потекло од Србија со долга историја на одгледување во земјата и пошироко. Испитувањата се изведени од 2009 до 2011 во шест варијанти од вариететите на Прокупец со различни форми на гроздот. Збиеност на грозд (Codes N˚204) е различна во зависност од варијантата: многу растресит кај варијантата К-1, растресит кај варијантата К-3, средно збиен кај варијантата К-5, збиен кај варијантата К-7 и многу збиен грозд кај варијантата К-9, додека стандардната варијанта има збиен до многу збиен грозд. Бројот на гроздови на една лоза варира од просечно 11,5 кај варијантата К-1 до 15,5 кај варијантата К-5. Останатите варијанти исто така имаат повисок коефициент во однос на стандардната варијаната. Тежината на гроздот е истот така варијабилна, од 110 g кај варијантата К-1 до 150 г кај варијантата К-5, додека стандардната варијанта има тежина од 140 г. Приносот по хектар исто така варира од 10,453 kg кај варијантата К-1 до 19,216 kg кај варијантата К-5. Приносот кај останатите варијанти е повисок во однос на стандардот кој изнесуваше 14,463 kg. За приодот на испитување утврдивме највисока содржина на шеќер кај кај варијантата К-5 (21,6%) или за 1% помалку во однос на стандардната варијанта која има 20,65%. Најниска содржина на шеќер има варијантата К-9 (20,35%), Најниска содржина на вкупни киселини има варијантата К-1 (6,6 g/l), пониска од стандардната варијанта за 0,20 g/l. Повисока содржина на вкупни киселини се забележани кај варијантата К-9 (7,05 g/l) или за 0,25 g/l повисоки во однос на просечната стандардна варијанта. Најдобри резултати во испитувањата даде варијаната К-5 поради пораното созревање за 8-10 дена во споредба со просечната стандардна варијанта.

Клучни зборови: варијанта, грозд, принос, содржина на шеќер, вкупни кислеини, време на созревање.

UDC:634.863:663.252.2
Original scientific paper

AGROBIOLOGICAL CHARACTERISTICS OF MERLOT VARIETY POPULATION IN GROCKA VINEYARDS

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Abstract
In the period from 2006 to 2011, the research of agrobiological characteristics of Merlot variety population was done on Radmilovac locality in Grocka vineyard district. The research covered several agrobiological indicators and this paper will analyse the following: cluster mass, yield of grapes, sugar content in the must and the total acid content in the must.
Key words: cluster mass, yield of grapes, must, sugar, total acid, clone, population.

Introduction

The results showed that Merlot variety population is very homogeneous. This especially applies to indicators such as yield components, cluster mass, yield of grape, sugar content in the must and total acid content in the must. In order to obtain more accurate data on the population diversity, according to the methodology applied in the clonal selection of grapevine, the research of Merlot variety population was done in Grocka vineyard district and the results are presented in this paper.

Material and methods

Radmilovac locality is located in the territory of Experimental school farm Radmilovac – Vinca of the Faculty of Agriculture in Zemun. Experimental vineyard was planted in 1991. It was arranged in the form of a double horizontal cordon with 80-cm high seedlings spaced at 3 x 1 m. Grapevines were grafted on rootstock Kober - 5BB. The mixed pruning was applied leaving a total load of 24 buds per vine.

The materials used for the research were Merlot variety clones and populations. The experiment was set up according to a block plan. For the purpose of description each clone and population was represented by 10 vines, each vine being a separate experimental unit. Grapevines in the experimental vineyard were of consistent vigour, productivity and health. Data collection was done using standard methods. The analysis of the collected data was performed using descriptive and analytical statistical tools available in the statistical package STATISTICA for Windows 8.

First, indicators of descriptive statistics were calculated for all characteristics of tested genotypes: average value, standard error of the average value ($S\bar{x}$) and standard deviation. In order to reach objective conclusions about the effects of analysed factors on the changes of the characteristics of grapes and wine, and the potential application of parametric tests (ANOVA and LSD test), the homogeneity of variances was tested using Hartley's, Cochran's, Bartlett's and Levene's test (Hadživuković, 1977). Given that in all cases the assumption of homogeneity of variance was met, the further application of parametric tests was possible. The size of the effect of each factor, as well

as their interaction, was measured by a partial eta squared coefficient which was then classified according to Cohen's system (Cohen, 1988).

Major climatic and soil conditions- The vineyard is located in the zone of moderate continental climate. The sum of active temperatures during the growing season is 3422 degrees C. Winter frosts have not damaged buds and shoots. The average annual total precipitation is 642 mm. The maximum precipitation is in the spring and early summer. The growing season takes about 2/3 of the total annual precipitation. The land is eroded forest soil. Hydro-ameliorative interventions have been done before raising a vineyard. The soil is suitable for growing Merlot variety populations and clones.

Results and discussion

The research results concerning the characteristics of grapes have been statistically analysed and presented in Tables and Figures 1-4.

Variation in cluster mass

Table 1 shows a distribution of the cluster masses between the analysed Merlot variety populations and clones over the years of research. The largest values are measured for clone 022 (average mass of 98.71 g), and the smallest for clone 029 (average mass of 94.44 g). Data are consistent with the results of Cindrić (2000). Differences in cluster masses of clones and populations were statistically significant. Thus, the Merlot variety population had a mass significantly different from the clone 022 and clone 029, while clone 029 had significantly smaller cluster mass compared to other clones and a standard Merlot variety.

Weather conditions in these years had a profound effect on the change in the cluster mass of clones. Thus, the highest average cluster mass was measured in 2009 (104.04 g), which is statistically significant compared to the masses in all other years. The last experimental year (2011) was least favourable in terms of the formation of the cluster mass. The average cluster mass was 91.35 g and it was significantly smaller than the mass achieved in previously analysed years ($p < 0.05$). Interaction between the analysed factors (variety x year) was also statistically significant ($p < 0.01$). It is interesting to measure not only a statistical significance but also the size of the effect of the analysed factors on the cluster mass using eta squared coefficient which in this case is $\eta 2 = 0.2597$ for A factor (variety and cultivar), $\eta 2 = 0.6880$ for the years, and $\eta 2 = 0.6187$ for the factor of interaction. According to Cohen's system, the obtained eta squared values indicate that the effect of the analysed factors and their interactions on the mass of the cluster is extremely high. Moreover, climatic conditions over the years have stronger effect on the cluster mass than the analysed clones.

Table 1. Significant differences in cluster masses between standard Merlot and clones over the years of research

Cultivar (A)	Cluster mass						$\bar{x} \pm S\bar{x}$
	Year (B)						
	2006	2007	2008	2009	2010	2011	
Merlot standard	95.972	98.412	91.840	104.660	92.836	93.664	96.23^{a} ±0.952
Clone 022	94.748	104.300	95.696	107.296	95.564	94.668	98.71^{b}±1.088
Clone 025	99.408	94.540	106.632	106.632	90.108	89.012	97.63^{ab} ±1.410
Clone 029	93.360	99.424	90.344	97.564	97.872	88.068	94.44^{c} ±0.881
$\bar{x} \pm S\bar{x}$	95.87^{c}± 0.820	99.17^{b}± 1.036	95.99^{c}± 1.605	104.04^{a}± 1.042	94.10^{c}± 0.861	91.35^{d}± 0.836	

a, b, c –Values without same letter in superscript are significantly different ($p<0.05$)

Effect	F-test	p-level	LSD		Partial eta-square η^2
			0.05	0.01	
A	11.200	0.000002	1.518	1.998	0.2597
B	42.300	0.000000	1.859	2.448	0.6880
A x B	10.400	0.000000	3.719	4.895	0.6187

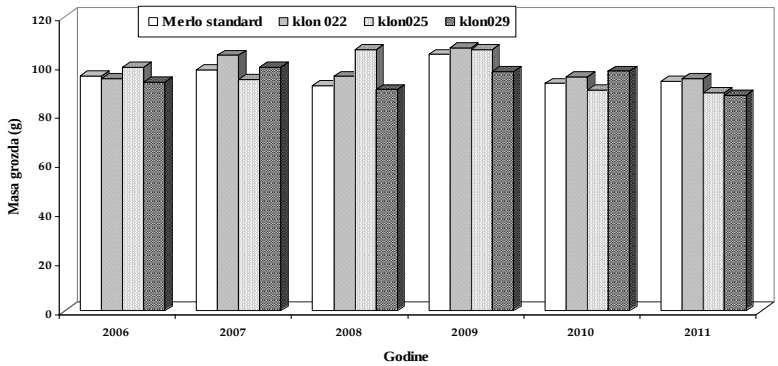

Figure 1. Variations in cluster mass - standard Merlot and clones by years

Variation in grape yield

The average yield of grapes per vine in analysed clones was not significantly different (Table 2). The smallest yield per vine was measured in clone 029 (the average of 1.99 kg / vine), and the highest in clone 025 (the average of 2.06 kg / vine). The data are consistent with the data of Žunić (2010). However, the difference in average yields based on LSD test was not statistically significant, Table 2 ($p>0.05$). Weather conditions have not influenced higher variability in grape yield of s per vine. Significantly higher yield was recorded in 2008 compared to all other years (p

<0.05). In other years, there was not a significant difference in measured yield of grapes per vine (p>0.05). Interaction between the analysed factors was not statistically significant (p>0.05).

Table 2. Significant difference in the yield between standard Merlot and clones over the years of research

Cultivar (A)	Yield						$\bar{x} \pm S\bar{x}$
	Year (B)						
	2006	2007	2008	2009	2010	2011	
Merlot standard	1.916	2.036	2.296	1.976	1.928	2.016	$2.03^{a}\pm0.034$
Clone 022	2.064	2.072	2.032	2.028	2.012	2.000	$2.03^{a}\pm0.025$
Clone 025	2.004	2.020	2.232	2.160	1.996	1.960	$2.06^{a}\pm0.031$
Clone 029	2.016	1.984	2.080	1.892	1.980	1.980	$1.99^{a}\pm0.026$
$\bar{x} \pm S\bar{x}$	$2.00^{b}\pm0.030$	$2.03^{b}\pm0.034$	$2.16^{a}\pm0.043$	$2.01^{b}\pm0.037$	$1.98^{b}\pm0.026$	$1.99^{b}\pm0.029$	

a, b –Values without same letter in superscript are significantly different (p<0.05)

Effect	F-test	p-level	LSD		Partial eta-square η^2
			0.05	0.01	
A	1.270	0.2887	0.074	0.098	0.0382
B	4.130	0.0019	0.091	0.120	0.1771
A x B	1.370	0.1766	0.182	0.240	0.1766

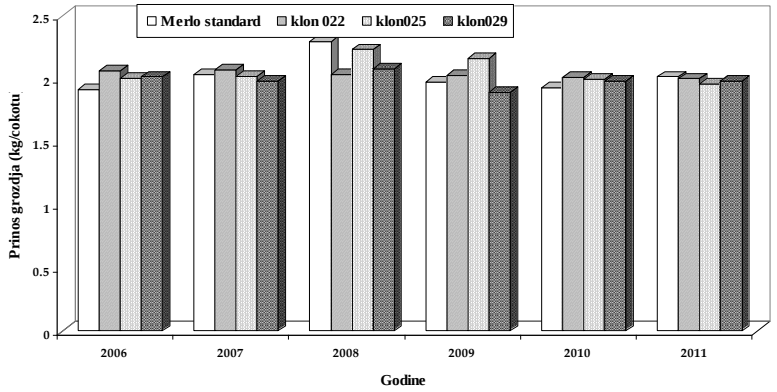

Figure 2. Variations in the yield of grapes - standard Merlot and clones by years

The partial eta squared coefficient for the analysed factor B (year) has a high value (Table 2) and clearly shows that the years characteristics determine the yield of grapes per vine, by over 17%.

Variation in sugar content in the must

The results showing the sugar content in the must are given in the following table (Table 3). The sugar content in all clones and standard Merlot is uniform, so when being tested using LSD test of individual parameters their differences are not statistically significant (p>0.05). These results are in line with Božinović (1996). The year of research as a factor showed a significant effect on the change in the concentration of sugar in the must. The lowest sugar content was found in 2007

compared to the highest content in 2008 and 2011. Thus, these yields show a statistically significant difference, $p < 0.05$ (Table 3). The interaction between the analysed factors in terms of changes in the analysed characteristic was not statistically significant ($p > 0.05$).

Table 3. Significant differences in the sugar content between Merlot standard and clones over the years of research

Cultivar (A)	Sugar						$\bar{x} \pm S\bar{x}$
	Year (B)						
	2006	2007	2008	2009	2010	2011	
Merlot standard	20.876	20.784	21.152	20.832	20.996	21.172	$20.97^{a} \pm 0.067$
Clone 022	20.884	20.912	20.964	20.900	20.716	20.848	$20.87^{a} \pm 0.055$
Clone 025	20.848	20.812	21.112	21.116	20.868	20.944	$20.95^{a} \pm 0.054$
Clone 029	20.888	20.596	20.980	20.800	20.972	21.048	$20.88^{a} \pm 0.067$
$\bar{x} \pm S\bar{x}$	$20.87^{ab} \pm 0.072$	$20.78^{b} \pm 0.074$	$21.05^{a} \pm 0.068$	$20.91^{ab} \pm 0.071$	$20.89^{ab} \pm 0.072$	21.00a±0.082	

a, b –Values without same letter in superscript are significantly different ($p < 0.05$)

Effect	F-test	p-level	LSD		Partial eta-squared
			0.05	0.01	η^2
A	0.600	0.5988	0.175	0.231	0.0192
B	1.700	0.1477	0.215	0.283	0.0808
A x B	0.600	0.8756	0.429	0.565	0.0845

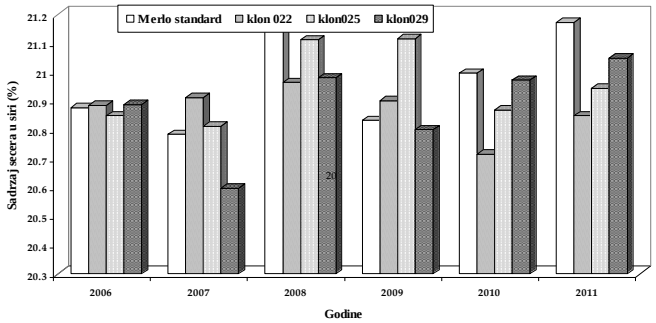

Figure 3. Variations in the sugar content in the must - standard Merlot and clones by years

Variation in total acid content

The total acid content did not significantly vary between the years. The average content was about 6.9 g / l. The results are similar to those found in Cindrić (2000). Therefore, their differences were not statistically significant ($p > 0.05$). Analysed clones gave different total acid content. Thus, clone 022 had the highest concentration of acid (6.98 g/l) and it was significantly higher than the concentration of the acid in the clone 029, as well as in the standard Merlot ($p < 0.05$). Clone x year interaction was not statistically significant for the change in the total acid content ($p > 0.05$).

Table 4. Significant differences in the total acid content between Merlot standard and clones over the years of research

Cultivar (A)	Acids						$\bar{x} \pm S\bar{x}$
	Year (B)						
	2006	2007	2008	2009	2010	2011	
Merlot standard	6.916	6.868	6.860	6.856	6.940	6.924	6.89^{b}±0.029
Clone 022	7.044	6.984	6.952	6.940	6.960	7.004	6.98^{a}±0.022
Clone 025	6.916	6.912	6.928	6.856	6.940	6.880	6.90^{ab}±0.029
Clone 029	6.872	6.780	6.872	6.844	6.904	6.892	6.86^{b}±0.028
$\bar{x} \pm S\bar{x}$	6.94^{a}±0.037	6.89^{a}±0.045	6.90^{a}±0.031	6.87^{a}±0.032	6.94^{a}±0.030	6.92^{a}±0.032	

a, b–Values without same letter in superscript are significantly different ($p<0.05$)

Effect	F-test	p-level	LSD		Partial eta-squared η^2
			0.05	0.01	
A	3.000	0.0349	0.082	0.107	0.0854
B	0.600	0.7373	0.100	0.132	0.0279
A x B	0.200	0.9996	0.200	0.263	0.0292

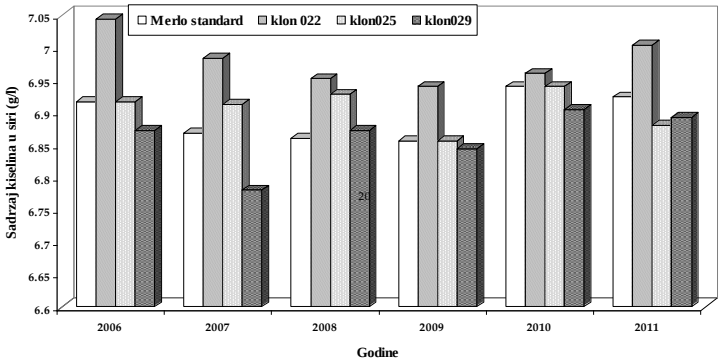

Figure 4.Variation in the total acid content in the must - standard Merlot and clones by years

Conclusions

Based on the research of the Merlot variety population in Grocka vineyard, the following can be concluded:

Climate and soil in this wine-growing region are ideal for growing Merlot variety populations.

The average cluster mass varied from 94.44 to 98.71 g. There were statistically significant differences between the clones. The average yield of grapes varied from 1.99 to 2.06 kg / vine. There were no statistically significant differences between the clones. The average sugar content in the must varied from 20.87 to 20.97%. There were no statistically significant differences between the clones. The total acid content varied depending on clones and ranged from 6.86 to 6.98 g / l. There were statistically significant differences between the clones.

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АГРОБИОЛОШКИ КАРАКТЕРИСТИКИ НА ВАРИЕТЕТИТЕ ОД ПОПУЛАЦИЈАТА ОД СОРТАТА МЕРЛОТ ВО ВИНОГОРЈЕТО ГРОЦКА

Вујовиќ Драган, Малетиќ Радојка, Дана Буцало

Апстракт
Во периодот од 2006 до 2011, изведени се испитувања на агробиолочките карактеристики на вариететите од популацијата на сортата мерлот во локалитет Радмиловац, виногорје Гроцка. Испитувани се неколку агробиолошки индикатори, во овој труд се анализирани следните, маса на гроздот, принос на грозје, содржина на шеќер во ширата и вкупни киселини во ширата.
Клучни зборови: маса на грозд, принос на грозје, шира, шеќер, вкупни кислеини, клон, популација.

UDC: 634.8-152.76 (497.11)
Original scientific paper

UVOMETRIC AND TECNOLOGICAL CHARACTERISTICS OF PROKUPAC CLONES 42/1, 43/2 AND 43/6

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Abstract
Research were carried out in the vineyard of Experimental field "Radmilovac" at Faculty of Agriculture in Belgrade and included 3 Prokupac clones-42/1,43/2 and 43/6. For the purpose of research the mechanical composition of grape and berries by Prostoserdov method are selected five vines of each clone from which it picked five representative bunches for analysis. Grape quality expressed through sugar content was determined with Oechsle mostwaage while the total acid content was determined by titration method with n/4 NaOH. The maximum bunch length was recorded for clone 43/2, and the lowest for clone 42/1. Clone 42/1 is characterized by the largest bunch width (7,54 cm), while clone 43/6 had the lowest (6,4 cm). Clone 42/1 had the highest % of bunch stem (3,36%) but the lowest % of berries in bunch (96,64%), compare to clone 43/2, which had the lowest % of bunch stem (3,05%) but the highest % of berries in bunch (96,95%) and seed number (3,28). Clone 43/2 characterized with the highest level of accumulated sugar (22,05%), while the highest total acid content was noted for clone 43/6 (6,79 g/l). The highest levels of variation were found for seed number in berry (CV= 21.30%), whereas % of berry in bunch (CV= 0.62%) and % of berry meet (CV= 1.04%) indicate the lowest difference between clones. Wine analysis showed that lowest content of free SO_2 and volatile acids was recorded from clone 42/1. With each of three clones longer fermentation affected increased content of extract, ash and potassium in wine.
Key words: Prokupac, clone, mechanical composition, wine analysis, fermentation.

Introduction

By definition clones are population of vines all derived by vegetative propagation from cutting or buds from a single mother by deliberate clonal selection (Creasy et al., 2009). In clonal selection the most important parameters are: vigor, shape and bunch size, bunch and berry mechanical composition, grape and wine quality as well as disease resistance (Rühl et al. 2004). Clonal selection could be positive or negative. Positive selection is more spread, effective and useful method to determine new plant with specific morphological characteristics (Nakalamić and Marković, 2009). With science developing except clonal selection by selecting based on morphological indicators, it is possible to talk about selection on level of DNA where is commonly used DNA screening (Cervera et al., 1998, Scott et al., 2000 a, b) or polymorphic DNA markers (Hancock, 2008; Konrad et al., 2003; Jackson, 2008; Schmid et al. 2009). Prokupac is autochthonous black wine Serbian variety with an undetermined the exact origin, but is assumed to be spread in the area surrounding Prokuplje and Aleksandrovac (Župa). It is often found under the

synonyms: Kameničarka, Rekovačka crnka, Nikodimka, Rskavac, Prokupka and Niševka. It is characterized with strong vigor and yielding capacity, which manifests as a well provided or low fertility soil. Prokupac shoots are developed and strong with standing growth. Prokupac bunch is medium large, with cylindrical or conical form and medium compact. Berries are medium large, round or slightly snippy with a thick and dark blue epidermis. Prokupac can be grown at lower training systems without post system. Yielding varieties whereat should be emphasized that the lowest buds on a shoot are with good fertility. For Prokupac is appropriate short pruning on which provides excellent yield. Some Prokupac varieties is characterized by the increased resistance to *Botrytis cinerea*. Prokupac wine is refreshing and well red colored (Avramov et al. 2001; Žunić and Garić, 2010). According to Zirojević (1964) exist: Prokupac with basic characteristics, Prokupac with smaller leaves and less yielding, Prokupac with leaves and flowers anomalies and Prokupac with bad pollination . Zirojević also established the existence of so-called "White Prokupac" which mutations occur in the direction of anthocyanin degradation and loss of typical black skin color. Research by Marković (2001,2012a) showed that some of these characteristics varied under influence of different rootstocks on which is Prokupac grafted, also mechanical composition of grapes and berries in the highest level was influenced by the rootstocks K 5BB compared to the rootstock 41B and SO4.

Marković et al. (2007, 2008, 2012b,2012c) has allocated 42 Prokupac clones which are in testing process on experimental field Faculty of Agriculture-Radmilovac. During examining years the morphological and technological characteristics of 25 clones, 11 were recognized by the Ministry of Agriculture as a technologically better clones compared to the standard variety and they are expanding into further production. Following clones from paper are recognize (indices in brackets are designation of Ministry of agriculture): 40/5 (ПР 1), 40/8 (ПР 14), 41/1 (ПР 3), 41/3 (ПР 9), 41/4 (ПР 10), 41/6 (ПР 15), 42/1 (ПР 4), 42/2 (ПР 11), 43/2 (ПР 6), 43/6 (ПР 7), 43/7 (ПР 12). From this group in paper sre present clones: 42/1 (ПР 4), 43/2 (ПР 6) and 43/6 (ПР 7). The objective of this study was (1) to examine the variability of morphological traits within the clone collection and (2) to identify the most useful variables for discrimination among clones and (3) to recommended clones suitable for further exploitation based of numerous desirable characteristics.

Material and methods

Research was carried out in the vineyard of Experimental field “Radmilovac” at Faculty of Agriculture in Belgrade and included 3 Prokupac clones-42/1, 43/2 and 43/6. For the purpose of research mechanical composition of grape and berries are selected five vines of each clone from which it picked five representatives bunches for analysis. After bunches selecting was measured their individual weight, length and width, subsequently rachis (pedicel) is separate on each berries with scissors carefully in order to the brush left with less possible mesocarp. Also is determined berries number per bunch, berry mass per bunch and mass of stems measuring on analytical balance. For the purpose of mechanical analysis were selected 100 berries from each clone and after the measured berries masses were separated berry skin and seeds. The mass of seeds and skin of 100 berries was measured on the analytical balance, while seed number of 100 berries were determined by counting. Other parameters shown in Table 1 were obtained by computation. Grape quality expressed through sugar content was determined with Oechsle mostwaage and values were determined using Dujardin-Salleron table, while the total acid content was determined by titration method with n/4 NaOH. Glicoacidometric index is determined as ratio of sugar content and total

acid content. Statistical analysis was performed using average values from three-year measurements. Vine analysis it is done using standard laboratory procedure. Data analysis was conducted using the 'Statistica' (StatSoft, Inc., Tulsa, Oklahoma, USA).

Results and discussion

Mechanical analysis results of grape and berry for 3 Prokupac clones is showed in table 1. The maximum bunch length was recorded for clone 43/2 (14.36 cm), and the lowest for clone 42/1 (12.56 cm). Clone 42/1 is characterized by the largest bunch width (7.54 cm), while clone 43/6 had the lowest (6.4 cm). Observing berries number per bunch and bunch mass from table 1, it can be concluded that the clone 42/1 had the highest value of this morphological characteristics (99.09 and 232.93 g, respectively). The bunch structure is expressed trough % bunch stem (rachis) and % berries in bunch. Clone 42/1 had the highest % of bunch stem (3.36%) but the lowest % of berries in bunch (96.64%), compare to clone 43/2, which had the lowest % of bunch stem (3.05%) but the highest % of berries in bunch (96.95%). The biggest seed number was recorded for clone 43/2 (3.28) also for same clone is recorded the smallest seed mass (0.035 g). Berry weight variation during three-year test period were no significant except that clone 42/1 figure with maximum berries mass (2.6 g). According to the values of berry structural composition of the expressed through % berry skin, % berry meet and % seeds, dissociate clones 42/1 (% berry skin-5.77%, and % seed-2.92%) and 43/2 (% of berry meat-94.27%). Clone 43/2 characterized with the highest level of accumulated sugar (22.05%), while the highest total acid content was noted for clone 43/6 (6.79 g/l). Glikoacidometric index varied from 3.38 (clone 43/6) to 3.95 (clone 42/1).

The overall mean values of all traits showed high differences between the clones indicating a high level of morphological variation. This is also confirmed by relatively high values of coefficients of variation established for the majority of examined traits (table 1). In general, the highest levels of variation were found for seed number in berry (CV= 21.30%), whereas % of berry in bunch (CV= 0.62%) and % of berry meet (CV= 1.04%) indicate the lowest difference between clones.

After microvinifikacion proces, produced wine of investigated clones were analyzed by standard laboratory methods. Observing the obtained values (table 2) is noticed clearly differences in qualitative wine composition. The lowest content of free SO_2 and total SO_2 in wine was recorded at clone 42/1. The total acid content expressed as tartaric acid minimum values had for clone 43/2, while the other two clones had approximately the same, but a higher total acid content.

Fermentation length among all three clones resulted in an increased extract content in wine which is shown at fig 1, 2 and 3. With increasing number of days in the fermentation there was a better wine coloration. After fermentation finishing were still obvious differences in the colors intensity and colors nuances between clone 43/2, which had higher values of these characteristics and clones 42/1, 43/6, which had the wine, somewhat less color intensity and nuances (fig. 4,5 and 6).

Observing fig. 7, 8 and 9, it can be concluded that the increased length of fermentation (in days) resulted in sudden increase of ash content in wine at clone 42/1, while clones 43/2 and 43/6 had a higher ash content in wine, except that values for ash content had not so drastic growth at clone 42/1. The potassium content was slightly higher in wine for clones 42/1 and 43/6, while the potassium content in wine at clone 43/2 is dramatically increased with longer fermentation.

Table 1. Mechanical analysis results

Parameter	Clones			CV
	42/1	43/2	43/6	
Bunch length	12,56	14,36	13,24	6,69
Bunch width	7,54	6,84	6,40	12,44
Berry number per bunch	99,09	88,76	98,44	12,38
Bunch mass	232,93	188,50	217,70	12,67
Bunch structure				
% of bunch stem	3,36	3,05	3,24	16,16
% of berry	96,64	96,95	96,76	0,62
Seed number in berry	1,70	3,28	1,60	21,30
Seed mass	0,047	0,035	0,036	7,83
Berry mass	2,6	2,17	2,5	8,28
Berry structure				
% of berry skin	5,77	3,50	3,84	14,27
% of seed	2,92	2,23	2,40	16,91
% of berry meet	93,31	94,27	93,76	1,04
Sugar content	20,10	22,05	21,38	7,29
Total acid content	5,34	6,22	6,79	12,37
Glicoacidometric index	3,95	3,81	3,38	17,77

Table 2. Chemical content of vine

Clon	Free SO_2 (mg/l)	Total SO_2 (mg/l)	Total acid like tartaric acid (g/l)	Tartaric acid (g/l)	Volatile acid like acetic acid (g/l)	Ash (g/l)	Potasium (g/l)	Potasium (%)	Color intensity	Color nuance
42/1	15,36	79,36	9,31	2,10	0,22	2,24	0,86	38,4	0,44	1,23
	10,24	58,88	9,25	0,60	0,26	2,53	0,90	35,6	1,65	0,70
	23,04	76,80	10,14	1,30	0,30	2,62	1,06	40,5	3,08	0,59
43/2	48,64	135,68	7,24	0,90	0,30	1,94	0,63	32,5	0,29	1,23
	10,24	53,76	8,14	0,70	0,26	2,16	0,82	28,0	1,91	0,70
	12,80	76,80	10,97	1,90	0,31	2,44	0,84	34,4	2,86	0,59
43/6	23,04	135,68	9,31	2,00	0,28	1,83	0,57	31,1	0,33	0,93
	5,12	81,92	8,97	3,10	0,26	2,08	0,75	36,1	2,00	0,43
	20,48	110,08	10,14	1,50	0,29	2,26	0,84	37,2	2,30	0,57

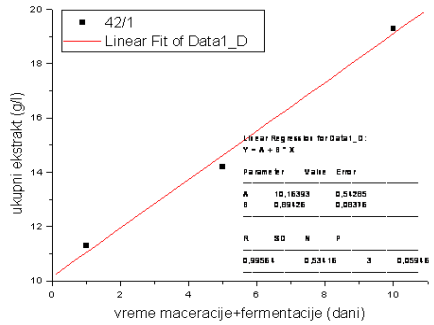

Figure 1. Extract content at clone 42/1

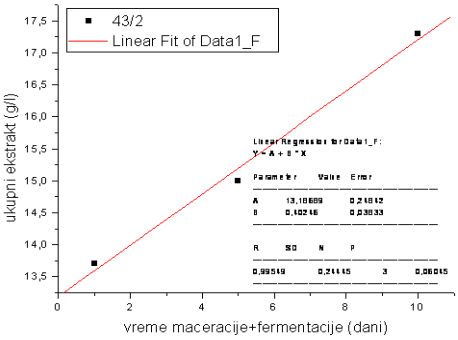

Figure 2. Extract content at clone 43/2

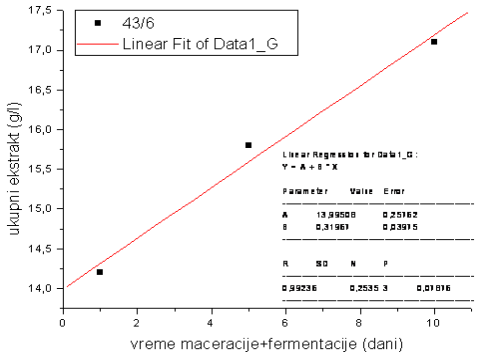

Figure 3. Extract content at clone 43/6

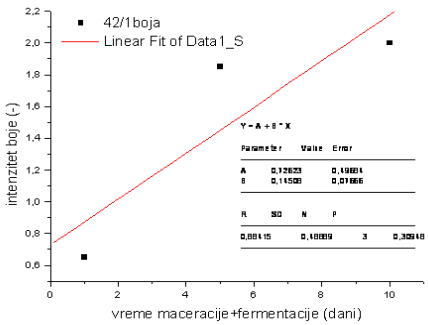

Figure 4. Vine color intensity at clone 42/1

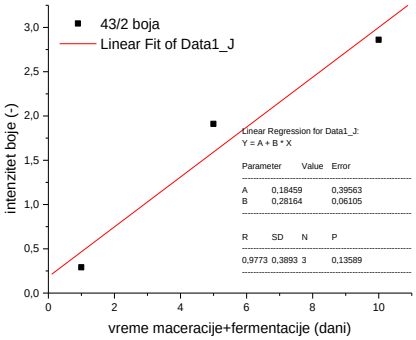

Figure 5. Vine color intensity at clone 43/2

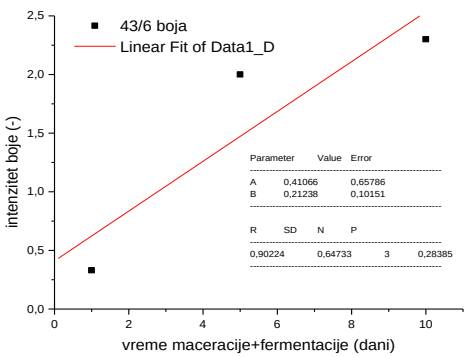

Figure 6. Vine color intensity at clone 43/6

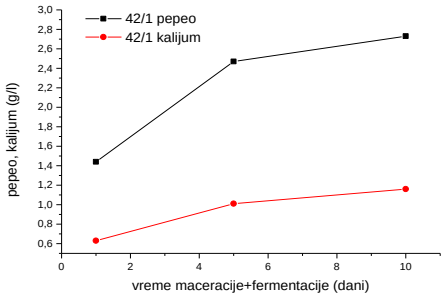

Figure 7. Ash and potassium content in wine at clone 42/1

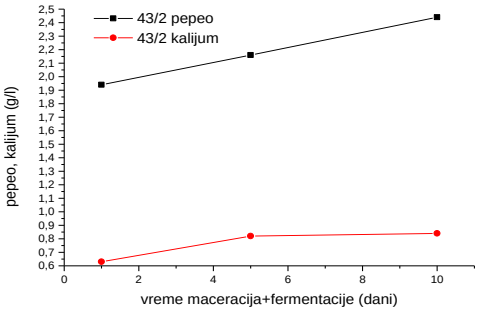

Figure 8. Ash and potassium content in wine at clone 43/2

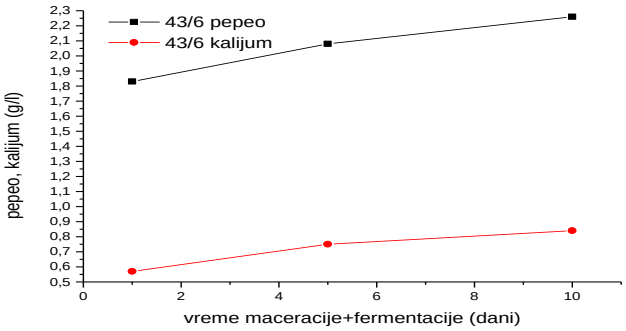

Figure 9. Ash and potassium content in wine at clone 43/6

Conclusions

After research can be done the following conclusions:

The results of this study considerable morphological and biological diversity among 3 selected Prokupac clones.

Morphological characteristics of berries and grapes showed great variation which is present by CV whose values ranged from 0.62-21.30%. The highest variation was observed in the seeds number per berry, % of berry in the cluster and berry meat.

Length fermentation process has satisfactory affect the color of the obtained wine and the ash content of the wine.

In wine of the clone 42/1 was recorded a lower content of free and total SO_2 and lower content of volatile acids expressed as acetic acid, while the wine of clones 43/2 and 43/6 was characterized with higher content of extract, tartaric acid, ash and color nuance.

The potassium content in wine has steadily increased with longer fermentation process.

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УВОМЕТРИСКИ И ТЕХНОЛОШКИ КАРАКТЕРИСТИКИ НА КЛОНОВИТЕ 42/1, 43/2 И 43/6 ОД СОРТАТА ПРОКУПЕЦ

Н. Марковиќ, З. Атанацковиќ, З. Ранковиќ-Васиќ

Апстракт

Испитувањата беа изведени на експерименталните лозја во „Радмиловац“ на Факултетот за земјоделство во Белград, вклучувајќи три клона 42/1, 43/2 и 43/6. За целта на истражувањето механичкиот состав на гроздот и зрното се анализирани со методот на Простосердов, избрани се 5 репрезентативни лози од кои се издвоени 5 репрезентативни грозда. Квалитетот на гроздот е прикажан преку содржината на шеќер, утврдена со Екслов широмер додека вкупните киселини беа определени преку титрациски метод со n/4 NaOH. Максималната должина на гроздот е забележана кај клонот 43/2 додека најмала кај клонот 42/1. Клонот 42/1 се карактеризира со најголема ширина (7,54 см) додека клонот 43/6 има најмала ширина (6,4 см). Клонот 42/1 има најголем % од гроздинка (3,36%) но најмал процент на зрна во гроздот (96,64%), во споредба со клонот 43/2 кој има најнизок процент на гроздинка (3,05%) но најголем процент на зрна во гроздот (96,95%) и број на семки (3,28). Клонот 43/2 се карактеризира со највисоко ниво на акумулиран шеќер (22,05%) додека највисока содржинха на вкупни киселини е забележана кај клонот 43/6 (6,79 g/l). Највисоко ниво на варирање е најдено во бројот на семки (CV= 21.30%), додека % на зрна и каде процентот на зрна во гроздот (CV= 0.62%) и процентот на месо (CV= 1.04%) покажува најмалите разлики помеѓу клоновите. Анализата на виното покажува најниска содржина на слободен SO2 кај клонот 42/1. Кај сите три клона долгата ферментација предизвика зголемена содржина на екстракт, пепел и калиум во виното.

Клучни зборови: Прокупец, клон, механички состав, анализа на вино, ферментација.

UDC:634.8-152.61 (497.16) 2004/2009
Original scientific paper

RESEARCH ON ORIGIN AND GENETIC SANITARY EVALUATION OF AUTOCHTHONOUS GRAPEVINE VARIETIES IN MONTENEGRO

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Abstract
Viticulture and wine production in Montenegro are mainly based on production of grapes and wine from autochtonous grapevine varieties (vranac, kratošija, krstač and žižak). Paper presents multi-years results of research on origin of those varieties which indicate their long presence and growing on affirmed vineyard localities in Montenegro. Beside that, paper shows the genetic evaluation (DNA analysis) of autochthonous grapevine varieties where it was found the originality of vranac, krstač and žižak varieties and that kratošija has the same genetic profile as zinfadel. Sanitary evaluation included testing of selected vines within the population of autochtonous grapevine varieties on the presence of viruses (GFLV, ArMV, GLRaV-1, GLRaV-3, GVA, GFkV) by serological assay ELISA, molecular assay PCR and indexing. In period of 2004-2009, it has been tested 145 interesting vines within the population of vranac variety from which 5 vines have passed complete sanitary control and 2 are still in testing. Out of 45 tested vines of kratošija, only one is still in testing and all the others have had a significant presence of the virus. Testing results of selected vines within the population of krstac and zizak varieties showed that all 15 tested vines of krstac variety and all 15 tested vines of zizak variety were infected with viruses therefore they did not passed sanitary control. Further, through the projects SEEDNET (2009-2010) and SEERA NET 91/01 (2010-2012), sanitary evaluation of new samples of our autochtonous grapevine varieties was done. Sanitary control was conducted on additional 19 samples of vranac, 26 samples of kratosija, 15 samples of krstac and 2 samples of zizak variety.
Key words: origin of variety, population, vine, genetic and sanitary evaluation.

Introduction

It is well known that the breeding of grapevine is related with territory, history and tradition. All this contributes to emphasis of its origins and importance of terroir in the expression of its best features. Autochthonous grapevine varieties that are grown for centuries in Montenegro define and to the greatest extent create the viticulture and winemaking of this country and participate in its promotion as a "small country of great wines." From the distant past to the nowadays as support of that there are numerous awards of Montenegrin wines from autochthonous varieties.

Vranac and kratosija are now economically the most important grapevine varieties for red wines in Montenegro. A big part in the production of white wine in Montenegro takes a wine produced from autochthonous variety krstac. Variety zizak is grown on a small area in Montenegro and in its

coastal region. Given the importance of autochthonous grapevine varieties for viticulture and wine making sector in Montenegro, research towards a better understanding of our autochthonous varieties, in the first place of their origin, was done. Research was done in order to collect all available literature data about origin and tradition of breeding autochthonous grapevine varieties in Montenegro. In collaboration with international partners, a genetic evaluation of our varieties as a indicator of their autochthonous character was done. Sanitary evaluation of selected vines within population of variety, aiming in determination of species and level of the viral infections as an indicator of the long growing of these varieties on viticulture localities in Montenegro, was done. These activities have created the conditions to begin the work on clonal selection of these varieties in order to enhance their agrobiological, economic and technological properties.

Material and methods

After visiting the renowned vine-growing areas in Montenegro and marking materials, its characterization and evaluation, collected material from different parts of Montenegro has been identified in the period of 2004-2011 (cooperation between ”13. jul Plantaže” and Istituto Sperimentale per la Viticoltura-Conegliano, Italy).

Firstly, identification of the material of varieties which are indicated in the literature as Montenegrin autochthonous varieties (vranac, kratošija, krstač, žižak) was done. Then, it was proceeded with the identification of 17 biotypes of kratošija variety that have been collected and planted in vineyards in the collection of the Biotechnical Institute (kratošija velja, kratošija mala, kratošija, kratošija srednja, crni krstač, ljutica, vrančina, vran, vranac, vrančić, kratošija sa dubokim urezom, velji vranac, srednji vranac, kratošija ili vran, bikača, čestozglavica and rehuljača).

In order to identify the accessions of autochthonous varieties from different viticulture areas in Montenegro, genotyping was performed with 11 SSR loci routinely employed at CRA-VIT for cultivar identification (VVS2, Thomas and Scott 1993); VVMD5, VVMD7, VVMD27 and VVMD28 (Bowers *et al*. 1996 and 1999); VrZAG62 and VrZAG79, (Sefc *et al.* 1999); ISV2, ISV3 and ISV4 (Crespan 2003) and VMCNG4b9 (Welter *et al*. 2007) as described in Crespan *et al.* (2006).

By visual observation during the growing season from population of variety, vines that have stood out by their characteristics were selected. Sanitary status of population is analysed by ELISA, PCR and indexing. During 2004-2009, testing on the viruses was conducted on 145 vines of vranac variety and 45 vines of kratosija variety. Beside these, 15 vines of both, krstač and žižak varieties, were tested. Selected vines that have passed sanitary control are propagated. In period of 2009-2012, as a result of work on projects SEEDNET and SEERA NET 91/01, sanitary status of more samples of autochthonous varieties (19 samples of vranac, 26 samples of kratosija, 15 samples of krstac and 2 samples of zizak variety) was done.

Results and discussion

Origin research of Montenegrin autochthonous grapevine varieties

As early as in 1891. M. Plamenac points out that Crmnica's wine is the best wine in Montenegro and that can be compared with the wines from Bordeaux. Particularly inspired Jergovic, (1892) writes about quality of wine. He states that this wine is produced from grapes of vranac variety and somewhere kratosija variety. The first remarkable description of the Kratošija variety was made by Petar Plamenac in the Ampelography Viale and Vermonela (1910). More detailed descriptions of

Montenegrin varieties was made by Vujović (1956) and Vojvodić (1956). Vujović described two types of Kratošija, marked them as type 1 and type 2, and Vojvodić described kratošija in the context of a few most remarkable varieties of Montenegro. Plamenac and Vujović (1956) indicate the winged bunches in the shape of the cross which is characteristic for krstac variety how it probably gets its name. For žižak variety it is written that it is grown in Bay of Kotor and it can be found under synonym žižak bijeli (Bulić, 1949). Ulićević (1959) describes žižak variety as important variety from which in some places in Boka, desert wine type Prošek is produced. Burić (1995) states that this variety gives quality refreshing wines.

According to Ulićević (1966), what is characteristic for Montenegrin varieties is that vranac, kratosija and bijeli krstac have been grown on a relatively very narrow strip. Fifty-sixty years ago, the growing area of vranac was not wider than 30 km, 40-50 km of bijeli krstac and 100-150 km of kratosija variety.

In recent years, thanks to its quality, vranac has undergone expansion and become the main variety for the production of red wines, not only in Montenegro, but in the neighborhing countries (Macedonia, Herzegovina, Dalmatia). Today, because of its heterogeneous population kratošija is rarely represented in pure varietal plantings and it is mostly found in the combination with vranac variety which dominates in the assortment of red grapevine varieties. Heterogeneity of kratosija has been writen by many authors (Bulić, 1949; Jelaska, 1954; Stojanović, 1954; Ulićević 1966, Pejović, 1988, Avramov, 1980, 1988; Burić, 1995; Božinovik, 1998; Maraš, 2000, 2004).

Unlike kratošija, krstač is considered as homogenous variety. By Ulićević (1959) it is the most represented in Podgorica subregion in the locality of Doljani, Beri and in lesser extend in Lješanska nahija. Ulićević (1966) states that in Doljani it is called as krstača bijela, while in Vražegrmcima as bijela krsta and in Beri as bijela vinogradarska. Author points out that in Crmnica where is less frequent, it is known under the name bijela loza, bioka and some other synonyms.

Taking into account the importance of vranac and kratosija for Montenegrin viticulture and wine making including as well the neighbour contries, in studied literature many authors state out autochthonous of vranac and kratosija as well as their growing areas.

Stojanović (1929), Bulić (1949), Ulićević (1959, 1966), Nastev (1967), Ćetković (1978), Zirojević (1979), Avramov (1988), Pejović (1988), Cindrić (1994, 2000), Burić (1995), Božinoviќ (1996), Maraš (2000, 2004), Milosavljević (2008), Žunić and Garić (2010) state that vranac and kratosija are autochthonous grapevine varieties originated from Montenegro. These two varieties in the production of wine complement excellent, kratosija mostly has more total acides in grapes (sometimes sugar also) and vranac is richer in coloured substances.

Bulić (1949) gives descriptions of kratosija from nine municipalities of Montenegrin cost, with synonyms (gartošija, grakošija i kratkošija). He states that “something” of this variety is represented in Dalmatia and nowadays it has been planted in Herzegovina. Moreover, he states that the variety is most likely from Montenegro came to Dalmatia.

Surely, the most important researh of origin, description and importance for Montenegro of vranac variety and kratosija variety is given by academician Ulićević (1959, 1966). He states that vranac is characteristic variety of Montenegrin viticulture area which covers about 40 % of assortment. According to author this is the only viticultural area where it dominates and the only one where it is represented to a greater extent. It is in a proper sense Crmnica's variety. Until First World War, author reports that vranac was mostly represented in Crmnica and later it has been spread to Montenegrin cost.

Another variety almost equally important in Crmnica vineyards is kratošija. Due to the fact that it is very dominant in all plantations older than 60-70 years, that often represents 90% in grapevine assortment in the other viticultural areas of Skadar subregion and that is in the coast and older plantations even more prevalent, Ulićević (1959) considering that it is the main and probably the oldest Montenegrin variety.

Author states that in that period vranac and kratosija have not been grown outside of Montenegro, exept perhapas in the experimental plantations, and that they represent our autochthonous and original material for the production of high quality red wine. Ulićevic (1956) states that „the oldest and the most represented Californian variety zinfandel is identical with our kratošija and that probably originates from this regions from where it was been spread out by our immigrants".

Confirmation that Ulićević (1959) was right is the result of recent research of Callo *et. all* (2008), in which it is confirmed by DNA analysis, that Kratošija has the same genetic profile as Zinfandel.

Genetic identification of of Montenegrin autochthonous grapevine varieties

As a result of cooperation between the company "13. jul Plantaze" and Italian partners (Instituto sperimentale per la viticulture Susegana-Conegliano TV) it has been done genetic identification of Montenegrin autochthonous grapevine varieties. Originality has been confirmed with vranac, krstač and žižak. SSR profiles for 11 markers for three autochthonous Montenegrin varieties are presented (Table 1). The samples of krstac and zizak show original SSR profiles, not present in CRA-VIT database.

Table 1. SSR profiles of autochthonous Montenegrin varieties

VARIETY	VVS2		VVMD5		VVMD7		VVMD27		VrZAG 62		VrZAG 79		VVMD28		ISV2 (VMC6E1)		ISV3 (VMC6F1)		ISV4 (VMC6G1)		VMCNG4B9		
VRANAC	133	133	226	226	247	249	181	181	193	199	258	258	239	251	151	165	133	139	177	177	164	172	Autochthonous
KRATOŠIJA	133	143	226	236	247	249	179	181	199	203	236	258	251	261	141	165	139	139	177	177	150	164	Zinfadel/Primitivo
KRSTAČ	133	139	232	240	239	239	185	185	187	195	250	258	247	261	145	151	133	139	169	177	158	166	Autochthonous
ŽIŽAK	143	145	240	240	239	263	179	191	187	193	250	250	251	261	141	159	139	139	183	187	150	152	Autochthonous

DNA analyses have showed that Montenegrin autochthonous variety kratosija has identical genetic profile as zinfandel from California, primitivo from Italy and crljenak kastelanski from Croatia (Callo *et al.* 2008). After confirming the genetic profile of kratošija as zinfandel, based on a sample sent from Montenegro, five more samples of kratošija variety from different viticulture locations of Montenegro were sent. All these samples showed identical genetic profile as zinfandel-primitivo. In the same study, DNA analysis showed close relationship between vranac and kratosija (zinfandel) and that there is the first level of relation (the closest relation parent-offspring). The population of kratosija variety is very heterogeneous which indicate its long growing in Montenegro. Ampelographic research (Maras, 2000) were done on kratosija´s biotypes which are known under different names-synonyms in viticulture areas in Montenegro: velja kratošija, velji vran, crni krstač, vrančina, bikača, vran, srednja kratošija, kratošija or vran, srednji vranac, vranac, vrančic, ljutica, kratošija, cestozglavica, kratošija mala, kratošija with deep notches and rehuljača. All 17 analyzed biotypes of kratošija have the same molecular profile like zinfandel/primitivo (unpublished results).

Sanitary status of Montenegrin autochthonous grapevine varieties

Evaluation of sanitary status of autochthonous grapevine varieties in Montenegro was done to assess the presence and the incidence of virus diseases with regard to occurrence of economically important viruses. The sanitary assessment was done by ELISA, PCR and indexing. In period of 2004-2009., it was tested 145 samples (vines) of vranac variety. Most samples of the population of vranac variety -55 vines (37.93%) were infected by LR3 virus and 45 vines (31.03%) by inf. mix GVA+LR3. There were not infected vines by ArV. Using ELISA test, the presence of viruses was not identified in 17 vines (11.72%). During 2009-2012., through the international projects SEEDNET (2009-2010) and SEERA NET 91/01 (2010-2012), 19 more samples of vranac variety were sent on ELISA testing. Presence of virus was identified in 14 (73.7%) samples, while 5 samples (26.3%) were virus-free. Results showed the prevalence of FLV (21.1%) and inf. mix of GFV+LR3 (15.8%). The significant presence was of LR1 (10.5%), LR3 (10.5%) and inf. mix of AMV+GFV (10.5%). The presence of ArV and KV was not identified. Table 2. represents ELISA results the tested vines within the population of vranac variety for total observed period.

Table 2. Sanitary status of vranac variety (ELISA test) - incidence of different viruses (2004-2012)

Number of vines	Ar	Ar+FL	FL	FL+LR3	FL+GVA +LR3	K	GVA+LR3	LR1	LR3	LR1+LR3	Negativ
0	-	-	-	-	-	-	-	-	-	-	-
2	-	+	-	-	-	-	-	-	-	-	-
15	-	-	+	-	-	-	-	-	-	-	-
3	-	-	-	+	-	-	-	-	-	-	-
5	-	-	-	-	+	-	-	-	-	-	-
5	-	-	-	-	-	+	-	-	-	-	-
45	-	-	-	-	-	-	+	-	-	-	-
5	-	-	-	-	-	-	-	+	-	-	-
57	-	-	-	-	-	-	-	-	+	-	-
5	-	-	-	-	-	-	-	-	-	+	-
22	-	-	-	-	-	-	-	-	-	-	+
164	0.00%	1.21%	9.14%	1.82%	3.04%	3.04%	27.43%	3.04%	34.75%	3.04%	13.41%

Vines which passed sanitary control by ELISA test in the first testing period were also tested by PCR and indexing. Out of 17 tested vines, 5 vines (29.41%) were infected by RSP and the same (29.41%) by RSP+NN. From the total number of tested samples (17), 5 samples have passed PCR and indexing (29.41%) - there were no viruses. They represent very useful material which entered in procedure of individual clone selection. Five samples which were included later and turned out to be virus free (by ELISA), need to be subjected to further testing (PCR). In period of 2004-2009, samples of the population of kratosija variety were also tested on the presence of viruses by ELISA and PCR. It was tested 45 samples (vines). Most samples -14 vines (32%) were infected by inf. mix GVA+LR3. The presence of inf. mix GVA+LR1 was also very significant (24%). There were no infected vines by Ar, K and FL viruses. In last four years, through the mentioned projects, more samples of kratosija variety were subjected to virus testing. From 26 ELISA samples tested, the absence of virus was in 12 samples (negative). Virus incidence was: LR1 (8 samples -46.15%), ArV (4 samples -15.38%) and FL (2 samples -7.69%), respectively.

Vines which passed sanitary control by ELISA test (4 vines -9%) in the first testing period, were also tested by PCR and indexing. PCR showed that 2 of these samples were infected with RSP+GVA and 1 did not pass indexing. One sample is still in indexing. For 12 negative samples from the second period of testing, further sanitary control need be done.

Total of 15 samples of krstac variety were subjected on virus testing during 2004-2009. All these samples were positive on some of the tested viruses. The most significant was the presence of inf. mix GVA+LR3 (10 samples -67%). During the projects, 15 new samples of krstac variety were included in the virus testing. Most samples were positive (11 samples -73.33%), while 4 samples were negative (by ELISA).

Table 3. Sanitary status of kratosija variety (ELISA test) -incidence of different viruses (2004-2012)

Number of vines	Ar	Ar+LR3	FL	FL+GVA+ LR3	K	GVA+LR3	LR1	GVA+LR1	LR3	LR1+LR3	K+LR1+ LR3	K+GVA+LR1 +LR3	Negativ
0	-	-	-	-	-	-	-	-	-	-	-	-	-
4	+	-	-	-	-	-	-	-	-	-	-	-	-
1	-	+	-	-	-	-	-	-	-	-	-	-	-
2	-	-	+	-	-	-	-	-	-	-	-	-	-
4	-	-	-	+	-	-	-	-	-	-	-	-	-
14	-	-	-	-	-	+	-	-	-	-	-	-	-
8	-	-	-	-	-	-	+	-	-	-	-	-	-
3	-	-	-	-	-	-	-	+	-	-	-	-	-
6	-	-	-	-	-	-	-	-	+	-	-	-	-
11	-	-	-	-	-	-	-	-	-	+	-	-	-
1	-	-	-	-	-	-	-	-	-	-	+	-	-
1	-	-	-	-	-	-	-	-	-	-	-	+	-
16	-	-	-	-	-	-	-	-	-	-	-	-	+
71	**5.63%**	**1.40%**	**2.81%**	**5.63%**	**0.00%**	**19.71%**	**11.26%**	**4.22%**	**8.45%**	**15.49%**	**1.40%**	**1.40%**	**22.53%**

Table 4. Sanitary status of krstac variety (ELISA test) - incidence of different viruses (2004-2012)

Number of vines	Ar	FL	GVA+LR3	K	K+GVA+ LR3	LR1	LR3	FL+LR3	LR1+LR3	Ar+LR1+ LR3	Ar+LR3	Ar+FL+ LR3	Ar+FL+LR 1+LR3	Negativ
0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10	-	-	+	-	-	-	-	-	-	-	-	-	-	-
2	-	-	-	-	+	-	-	-	-	-	-	-	-	-
2	-	-	-	-	-	+	-	-	-	-	-	-	-	-
3	-	-	-	-	-	-	+	-	-	-	-	-	-	-
2	-	-	-	-	-	-	-	+	-	-	-	-	-	-
2	-	-	-	-	-	-	-	-	+	-	-	-	-	-
2	-	-	-	-	-	-	-	-	-	+	-	-	-	-
1	-	-	-	-	-	-	-	-	-	-	+	-	-	-
1	-	-	-	-	-	-	-	-	-	-	-	+	-	-
1	-	-	-	-	-	-	-	-	-	-	-	-	+	-
4	-	-	-	-	-	-	-	-	-	-	-	-	-	+
30	**0.00%**	**0.00%**	**33.33%**	**0.00%**	**6.66%**	**6.66%**	**10,00%**	**6.66%**	**6.66%**	**6.66%**	**3.33%**	**3.33%**	**3.33%**	**13.33%**

From 15 tested samples of zizak variety (in period of 2004-2009), ELISA results showed the highest deegre of viral infections by inf. mix GVA+LR3 (12 samples -80%). Two samples were infected by inf. mix K+GVA+LR3 (13.3%), while one sample showed infections by inf. mix GVA+LR3 (6.7%). There were no negative samples from zizak variety. As a result of SEERA NET 91/01 project, 2 more samples of zizak variety were tested, resulting in one positive (infected by LR1 virus) and one negative sample (Table 4).

Results of virus testing in different vine-growing regions of Montenegro disclosed a widespread presence of viruses and a low occurrence of non-infected vines. High presence and incidence of the different viruses is an indicator of long cultivation of these varieties in the wine-growing regions of Montenegro. Detection of multiple infections by two or even three viruses was observed. The most widespread was the presence of inf. mix GVA+LR3 (28.72%), following by single infection of LR3 (23.40%) (Table 6).

Table 5. Sanitary status of žižak variety (ELISA test) - incidence of different viruses (2004-2012)

Number of vines	Ar	FL	GVA+LR3	K	GVA+LR1 +LR3	LR1	LR3	K+GVA+ LR3	Negativ
0	-	-	-	-	-	-	-	-	-
12	-	-	+	-	-	-	-	-	-
1	-	-	-	-	+	-	-	-	-
1	-	-	-	-	-	+	-	-	-
2	-	-	-	-	-	-	-	+	-
1	-	-	-	-	-	-	-	-	+
17	0.00%	0.00%	70.58%	0.00%	5.88%	5.88%	0.00%	11.76%	5.88%

Table 6. Sanitary evaluation of autochthonous grapevine varieties - percentage of different virus incidence

Number ofvines	Ar	FL	GVA+LR1	K	GVA+LR3	LR1	LR3	LR1+LR3	Ar+LR3	Ar+FL	FL+LR3	K+LR1+ LR3	GVA+ LR1+LR3	K+GVA+L R1+LR3	FL+GVA+ LR3	K+GVA+ LR3	Ar+LR1+ LR3	Ar+FL+ LR3	Ar+FL+ LR1+LR3	Negativ
4	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
17	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
81	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
66	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-
18	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-
2	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-
2	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-
5	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-
1	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-
1	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-
1	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-
9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-
4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-
2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-
1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-
1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-
43	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+
282	1.41%	6.02%	1.06%	1.77%	28.72%	5.67%	23.40%	6.38%	0.70%	0.70%	1.77%	0.35%	0.35%	0.35%	3.19%	1.41%	0.70%	0.35%	0.35%	15.24%

Conclusions

Numerous literature data verily indicate long tradition of viticulture in Montenegro and the dominant place in the assortiment belongs to the autochthonous grapevine varieties vranac, kratošija, krstač and žižak. Genetic identification has confirmed the authenticity of Montenegrin varieties cv Vranac, cv Krstac, cv Zizak and for cv Kratosija is confirmed to have identical DNA profile as cv Zinfadel, cv Primitivo and cv Crljenak kastelanski. Also, all 17 biotypes of kratosija variety are shown the same molecular profile like zinfandel/primitive/crljenak kastelanski. Evaluation of sanitary status of autochthonous grapevine varieties in Montenegro was done to assess the presence and the incidence of virus diseases with regard to occurrence of economically important viruses. The most widespread was the presence of inf. mix GVA+LR3 (28.72%), following by single infection of LR3 (23.40%). Very heterogeneous population of kratosija variety in Montenegro as well as a complete summary of the sanitary status representing a high degree of infections of selected vines within the population of varieties vranac, kratošija, krstač and žižka, confirms their growing for centuries on the territory of Montenegro.

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ИСПИТУВАЊЕ НА ПОТЕКЛОТО И ГЕНЕТСКО САНИТАРНА ПРОЦЕНКА НА АВТОХТОНИТЕ СОРТИ ВИНОВИ ЛОЗИ НА ЦРНА ГОРА

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Апстракт
Лозарството и винарството на Црна Гора главно се базира на производство на грозје и вино од домашни сорти винова лоза (вранец, кратошија, крстач и жижак). Трудот ги прикажува повеќегодишните резултати од испитувањето на потеклото на овие вариетети што покажува нивно долго присуство во афирмираните локалитети во Црна Гора. Покрај ова во трудот е прикажана генетската евалуцаија преку анализа на ДНК на автохотните сорти, каде е пронајдена оригиналност на сортите вранец, крстач и жижак , како и тоа дека сортата кратошија има исти генетски профил како зинфандел. Санитарната евалуцаија ги вклучува испитувањата на селектирани лози во популацијата на автохтоните сорти во однос на присуство на вируси (GFLV, ArMV, GLRaV-1, GLRaV-3, GVA, GFkV) со серолошки метод на ELISA, молекуларни методи PCR и индексирање. Во период 2004-2009 тестиравме 145 интересни лози во популацијата на сортата вранец од кои 5 лози целосно ја поминаа санитарната контрола а 2 се сеуште во тестирање. Кај сортата кратошија од 45 единствено една е сеуште во фаза на тестирање, кај другите е пронајдено присуство на вируси. Сите 15 тестирани лози кај крстач и сите 15 лози кај сортата жижак се инфицирани со вируси и не ја поминаа санитарната контрола. Понатаму преку проектот SEEDNET (2009-2010) и SEERA NET 91/01 (2010-2012), санитарната евалуација на нови примероци од автохтоните сорти е извршена. Санитарната контрола беше спроведена на дополнителни примероци, 19 од сортата вранец, 26 од сортата кратошија, 15 од сортата крстач и 2 од сортата жижак.
Клучни зборови: потекло на сортите, популација, лоза, генетска и санитарна евалуација.

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TECHNOLOGICAL CHARACTERISTICS OF MERLOT VARIETY CLONES IN GROCKA VINEYARDS

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Abstract
In the period from 2006 to 2011, several clones of Merlot grape variety (022, 025 and 029) were tested in Grocka vineyards. The tests included several indicators: ethyl alcohol content, content of polyphenolic substances, anthocyanin content, content of tannin substances and wine tasting grades. The results showed no statistically significant differences among the tested clones concerning the ethyl alcohol content, content of polyphenolic substances, tannin content and wine tasting grades.
Key words: clone, Merlot, alcohol, polyphenols, anthocyanins, tannins, wine.

Introduction

Merlot grape variety is quite widespread in Serbia. It is grown as a pure grape variety or in combination with Cabernet Sauvignon and Cabernet Franc. Merlot provides quality - high quality grapes and wine, alone or blended with the above mentioned varieties. Merlot is characterized by a cluster mass of 120 - 180 g, where skin accounts for 84% - 88% of the cluster structure. Sugar content in the must is 21% - 23.5% and total acidity 7g / l - 8 g / l. The wine contains 11, 5% - 13% alcohol and is well coloured.

Material and methods

Radmilovac locality is located in the territory of Experimental school estate Radmilovac – Vinča of the Faculty of Agriculture in Zemun. Experimental vineyard was planted in 1991. It was arranged in the form of a double horizontal cordon with 80-cm high seedlings spaced at 3 x 1 m. Grapevines were grafted on rootstock Kober - 5BB. The mixed pruning was applied leaving a total load of 24 buds per vine. The following wine indicators were tested: ethyl alcohol content, content of polyphenolic substances, anthocyanin content, content of tannin substances and wine tasting grades.
The analysis of the experimental data was performed using analytical tools available in statistical package SPSS version 17. The indicators of descriptive statistics were calculated for all characteristics of tested genotypes (average value, standard error of the average value ($S\bar{x}$) and standard deviation). In order to reach objective conclusions about the effects of analysed factors on the changes in the technological characteristics of grapes and wine, and apply parametric tests (ANOVA and LSD test), the homogeneity of variances was tested using Hartley's, Cochran's, Bartlett's and Levene's test (*Hadživuković, 1977*). Test results indicate that variances of tested characteristics are homogenous and do not need a detailed analyses. The effect size of each factor, as well as their interaction, was measured by the partial eta squared coefficient which was then classified according to Cohen's system (*Cohen, 1988*).

Results and discussion

The research results concerning the technological properties of grapes are presented in Tables and Figures 1-5.

Variations in the content of ethyl alcohol

Variations in the content of ethyl alcohol in analysed clones of the Merlot grape variety are given in Table 1. The content of ethyl alcohol in wine was not significantly different among the analysed clones. Variations ranged from 12.63 vol% (clone 029) to 12.65 vol% (standard Merlot and clone 025). Similar results were obtained by Singleton et all (1992). Therefore, the differences were not statistically significant ($p>0.05$). The year of production, as a factor, significantly influenced the content of ethyl alcohol in wine. The highest content of ethyl alcohol was found in the wine produced in 2010 (12.90 vol%) and the lowest in the wine produced in 2007 (12.34 vol%). The concentration of ethyl alcohol also varied in other experimental years, so the application of ANOVA test showed that these differences were statistically highly significant ($p <0.01$).

Table 1. Significant differences in ethyl alcohol (vol%) between standard Merlot variety and its clones over the years of research

Cultivar (A)	Ethyl alcohol -vol% year (B)						$\bar{x} \pm S\bar{x}$
	2006	2007	2008	2009	2010	2011	
Merlot standard	12.772	12.268	12.540	12.596	12.884	12.832	12.65^{a}±0.072
Clone 022	12.892	12.576	12.716	12.536	12.912	12.828	12.64^{a}±0.067
Clone 025	12.764	12.256	12.592	12.544	12.916	12.848	12.65^{a}±0.067
Clone 029	12.760	12.276	12.516	12.528	12.868	12.844	12.63^{a}±0.066
$\bar{x} \pm S\bar{x}$	12.65^{a} ±0.07	12.34^{a} ±0.10	12.59^{a} ±0.09	12.55^{a} ±0.08	12.90^{a} ±0.04	12.84^{a} ±0.032	

A – Values without same letter in superscript are significantly different ($p<0.05$)

Effect	F-test	p-level	LSD		Partial eta-square η^2
			0.05	0.01	
A	0.009	0.9954	0.1678	0.2209	0.0007
B	7.100	0.0000	0.2056	0.2706	0.2713
A x B	0.800	0.6885	0.4111	0.5412	0.1095

Interaction between the analysed factors did not significantly affect the content of ethyl alcohol in wine.

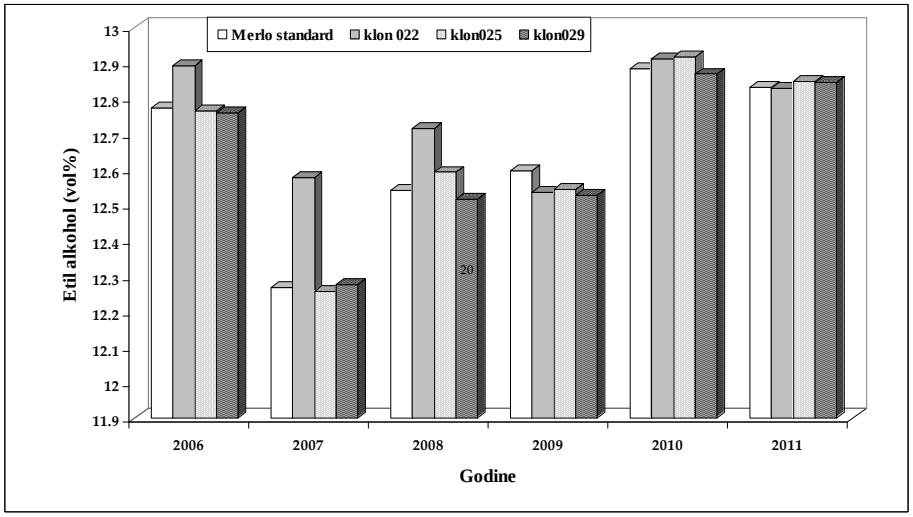

Figure 1. Variations in the content of ethyl alcohol in wine – Merlot standard and clones by experimental years

Considering the results of ANOVA test, it was interesting to calculate the value of partial eta squared coefficient for a year as a factor, since it was statistically significant for the changes in the content of ethyl alcohol. The value obtained ($\eta 2 = 0.2713$) indicates that years with their weather conditions influence the content of ethyl alcohol in wine of Merlot variety clones by more than 27%.

Variations in the content of polyphenolic substances

The total content of polyphenolic substances did not show significant variations by any factor (either by clones or by years). The content of polyphenolic substances ranged from 1.87 g / l to 1.91 g / l over years. Similar results can be found in Piljac et all. (2005). Therefore, their differences were not statistically significant - Table 2 ($p > 0.05$) by any factor, and neither was the interaction of the same factors. Given the fact that the factors had no statistically significant effect on the content of polyphenolic substances, it is needless to observe the values of partial eta squared coefficients and analyse them. since they do not have a significant effect in changing the content of polyphenolic substances.

Variations in the content of anthocyanins enidol

Table 3 presents the variations in the content of anthocyanins in wine. The largest concentration was recorded in standard Merlot variety (142.83 mg / l) and the lowest in clone 029 (142.14mg / l). Similar results can be found in Puškaš et all. (2005). However, the differences between the varieties were not statistically significant, Table 3 ($p>0.05$). The year of production, as a factor, influenced variations in the content of anthocyanins much more.

The largest concentration of anthocyanins was measured in the wine produced in 2007, and the lowest in the vine produced in 2011. The LSD test showed a statistically significant difference between the content of anthocyanins in wine produced in 2007 and all the other experimental years. Also, the content of anthocyanins in wine produced in 2008, 2009 and 2010 is significantly different than its content in 2006, 2007 and 2011. Wine produced in 2006 and 2011 has the content of

anthocyanins which is not statistically significant. The interaction between the analysed factors (variety x year) did not significantly affect the content of anthocyanins.

Table 2. Significant differences in the content of total polyphenolic substances between standard Merlot variety and its clones over the years of research

Cultivar (A)	Total polyphenolic substances						$\bar{x} \pm S\bar{x}$
	Years (B)						
	2006	2007	2008	2009	2010	2011	
Merlot standard	1.912	1.920	1.940	1.916	1.876	1.912	$1.91^{a}\pm0.023$
Clone 022	1.852	1.880	1.856	1.896	1.848	1.868	$1.87^{a}\pm0.023$
Clone 025	1.888	1.916	1.876	1.896	1.928	1.876	$1.90^{a}\pm0.022$
Clone 029	1.876	1.908	1.872	1.832	1.860	1.866	$1.87^{a}\pm0.019$
$\bar{x} \pm S\bar{x}$	$1.88^{a}\pm$ 0.029	$1.91^{a}\pm$ 0.024	1.89 $^{a}\pm0.028$	$1.88^{a}\pm$ 0.028	$1.88^{a}\pm$ 0.025	$1.88^{a}\pm$ 0.029	

a –Values without same letter in superscript are significantly different ($p<0.05$)

Effect	F-test	p-level	LSD		Partial eta-square η^2
			0.05	0.01	
A	0.890	0.4511	0.2074	0.2730	0.0270
B	0.120	0.9872	0.2540	0.3344	0.0063
A x B	0.140	0.9999	0.5081	0.6688	0.0217

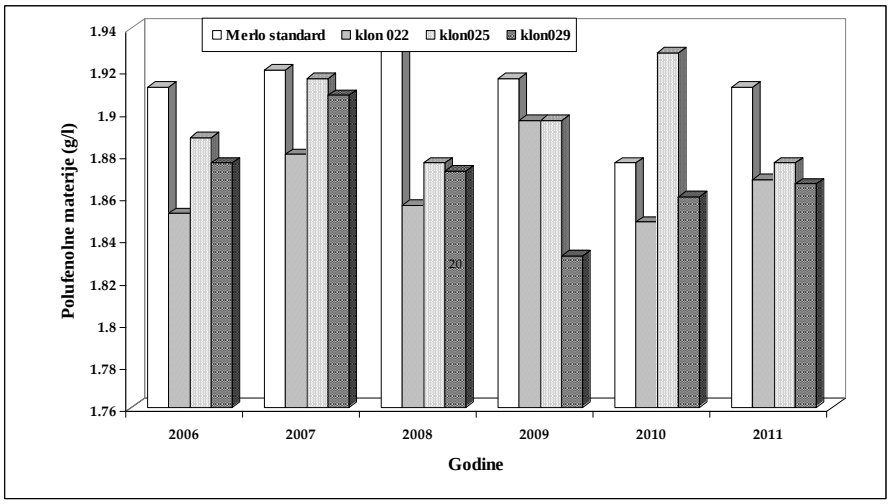

Figure 2. Variations in the content of polyphenolic substances in wine - Merlot standard and clones by experimental years

Table 3. Significant differences in the content of anthocyanins enidol between standard Merlot variety and its clones over the years of research

Cultivar (A)	content of anthocyanins enidol						$\bar{x} \pm S\bar{x}$
	Year (B)						
	2006	2007	2008	2009	2010	2011	
Merlo standard	141.204	146.660	144.424	142.672	142.324	139.708	142.83^{a}±0.695
Clone 022	136.884	146.000	142.748	140.880	141.416	139.432	141.23^{b}±0.722
Clone 025	140.608	146.260	143.000	141.588	141.96	140.812	142.29^{ab} ±0.613
Clone 029	140.448	146.140	142.232	142.868	142.536	138.636	142.14^{ab} ±0.597
$\bar{x} \pm S\bar{x}$	139.79^{c}± 0.556	146.27^{a}± 0.0338	143.10^{b}± 0.730	142.00^{b}± 0.0636	141.94^{b}± 0.770	139.65^{c}± 0.578	

a, b, c –Values without same letter in superscript are significantly different ($p<0.05$)

Effect	F-test	p-level	LSD		Partial eta-square η^2
			0.05	0.01	
A	1.500	0.2191	1.5182	1.9984	0.0448
B	13.400	0.0000	1.9584	2.4476	0.4106
A x B	0.500	0.9518	3.7188	4.8950	0.0679

Bearing in mind the fact that the year of production had a statistically significant effect on the variations in the content of anthocyanins in wine, it would be good to calculate the value of partial eta squared coefficient ($\eta 2 = 0.4106$) for this factor. It clearly indicates that the years with their specificities significantly affect the changes in the content of anthocyanins by more than 41%, which is a very high effect size by Cohen's gradation. *Variations in the content of tannin substances*

In the period from 2006 to 2011 the content of tannin substances in wine of Merlot variety clones was analysed. Table 4 shows the results.

Wine produced from Merlot variety clones had the same average content of tannin substance (mean 1.12 g / l). Similar results can be found in Revilla et all. (1997). Their differences were not statistically significant.

The changes in content of tannins in wine were much more affected by the second analysed factor (year of production). The highest content of these substances was measured in the wine produced in 2007 and 2008 and their content was significantly higher compared to other experimental years ($p <0.05$). The content of tannins in wine produced in other years was not statistically significant.

The interaction between the analysed factors did not show statistical significance ($p>0.05$).

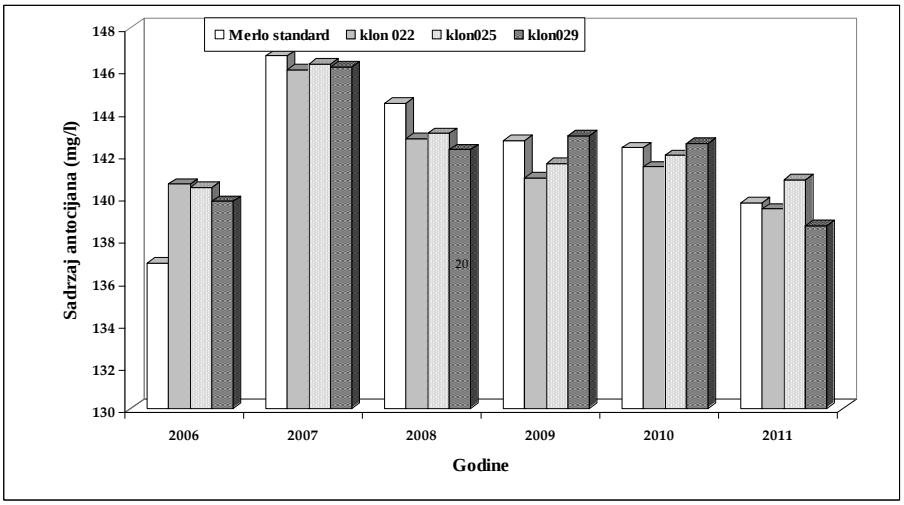

Figure 3. Variations in the content of anthocyanins enidol in vine - Merlot standard and clones by experimental years

Table 4. Significant differences in the content of tannins (g/l) between the standard Merlot variety and its clones over the years of research

Cultivar (A)	Content of tannins g/l						$\bar{x} \pm S\bar{x}$
	Year (B)						
	2006	2007	2008	2009	2010	2011	
Merlo standard	1.086	1.144	1.159	1.092	1.102	1.113	$1.12^{a}\pm0.008$
Clone 022	1.096	1.138	1.166	1.133	1.095	1.112	$1.12^{a}\pm0.008$
Clone 025	1.112	1.158	1.166	1.100	1.104	1.113	$1.12^{a}\pm0.007$
Clone 029	1.094	1.149	1.168	1.130	1.100	1.107	$1.12^{a}\pm0.008$
$\bar{x} \pm S\bar{x}$	$1.10^{a}\pm$ 0.006	$1.15^{a}\pm$ 0.010	$1.16^{a}\pm$ 0.007	$1.11^{a}\pm$ 0.009	$1.10^{a}\pm$ 0.006	$1.11^{a}\pm$ 0.006	

a –Values without same letter in superscript are significantly different ($p<0.05$)

Effect	F-test	p-level	LSD		Partial eta-square η^2
			0.05	0.01	
A	0.400	0.4270	0.0182	0.0240	0.0135
B	11.500	0.0000	0.0023	0.0765	0.3740
A x B	0.400	0.9692	0.0447	0.0588	0.0620

Partial eta squared coefficient for the year factor is very high (η^2=0,3740) which clearly shows that weather conditions affect the content of tannins by more than 37%.

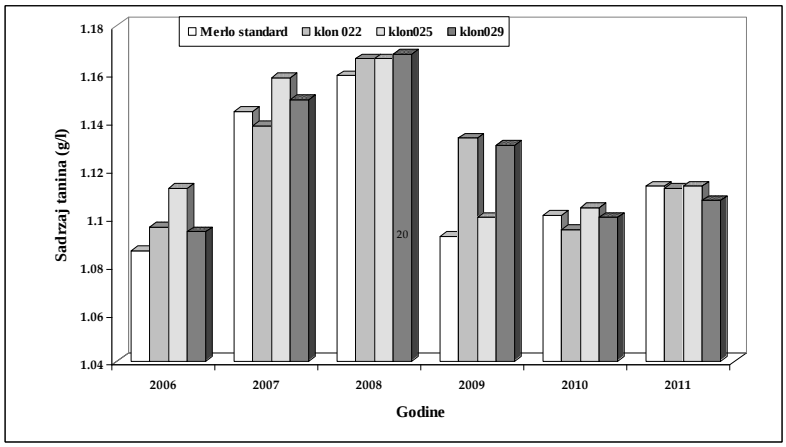

Figure 4. Variations in the content of tannins in wine - Merlot standard and clones by experimental years

Variations in the wine tasting scores

Wine tasting scores were not significantly different either by clones or by years. The average scores among the clones of Merlot variety ranged from 18.01 (clone 022) to 18.06 (clone 025). These differences were not statistically significant. Observed by experimental years, the biggest wine tasting score was in 2008 and 2009 (18.059), compared to the lowest in 2011 (17.97). Neither of these wine tasting scores was statistically significantly different. Also, the interaction clone x year showed no statistical significance ($p>0.05$). Given that the factors and their interactions did not show a statistically significant effect on the variations in the wine tasting scores, the analysis of partial eta squared coefficients made no sense.

Table 5. Significant differences in wine tasting scores between the standard Merlot variety and its clones over the years of research

Cultivar (A)	Wine tasting score						$\bar{x} \pm S\bar{x}$
	Year (B)						
	2006	2007	2008	2009	2010	2011	
Merlo standard	18.016	18.084	18.024	18.032	18.024	17.984	$18.03^{a}\pm0.037$
Clone 022	18.092	17.932	18.004	18.100	17.968	17.964	$18.01^{a}\pm0.036$
Clone 025	18.004	18.148	18.112	18.056	18.036	17.976	$18.06^{a}\pm0.035$
Clone 029	18.032	18.016	18.076	18.028	18.024	17.972	$18.02^{a}\pm0.030$
$\bar{x} \pm S\bar{x}$	$18.04^{a}\pm$ 0.048	$18.04^{a}\pm$ 0.036	$18.05^{a}\pm$ 0.045	$18.05^{a}\pm$ 0.053	$18.01^{a}\pm$ 0.032	$17.97^{a}\pm$ 0.038	

a–Values without same letter in superscript are significantly different ($p<0.05$)

Effect	F-test	p-level	LSD		Partial eta-square η^2
			0.05	0.01	
A	0.300	0.8530	0.1012	0.1332	0.0081
B	0.500	0.7977	0.1240	0.1632	0.0239
A x B	0.300	0.9941	0.2479	0.3263	0.0452

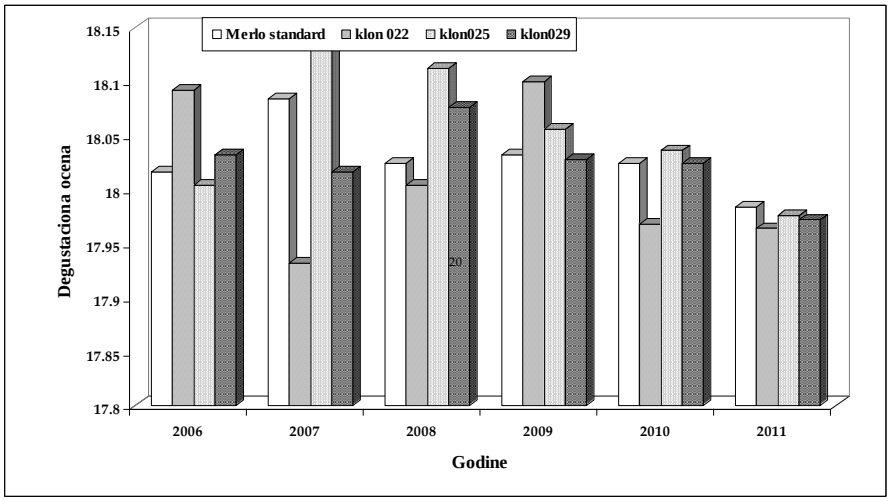

Figure 5. Variations in the wine tasting scores - Merlot standard and clones by experimental years

Conclusions

Based on the analysis of technological characteristics of the Merlot variety population in Grocka vineyards, the following can be concluded:

The average content of ethyl alcohol in clonal wine ranged from 12.63 to 12.65%.

The average content of polyphenolic substances in clonal wine ranged from 1.87to 1.91g/l.

The average content of anthocyanins in wine in clonal wine ranged from 141.23 to 142.83 mg/l.

The average content of tannins in clonal wine was 1.12 g / l.

The average clonal wine tasting scores ranged from 18.01 to 18.06.

Merlot grape variety is of special interest to the grape - wine production because it belongs to the group of varieties for the production of top-quality colour wines.

Merlot variety population was tested for the presence of 7 major viruses; the material is free from them.

The best clones of Merlot variety were planted at 2 locations (Radmilovac and Sremski Karlovci) for further monitoring and possible placement to the list of varieties of the Republic of Serbia.

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ТЕХНОЛОШКИ КАРАКТЕРИСТИКИ НА КЛОНОВИТЕ ОД СОРТАТА МЕРЛОТ ВО ВИНОГОРЈЕТО ГРОЦКА

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Апстракт
Во периодот од 2006 до 2011, неколку клонови од сортата мерлот (022, 025 и 029) беа тестирани во виногорјето Гроцка. Тестовите вклучуваат неколку показатели: етил алкохол, полифенолни соединенија, антоцијани, танини и сензорна оценка. Резултатите покажуваат статистички значајна разлика помеѓу тестираните клонови во однос на содржината на алкохол, полифенолните соединенија, танините, и сензорните карактеристики.
Клучни зборови: клон, мерлот, алкохол, полифеноли, антоцијани, танини, вино.

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Original scientific paper

INFLUENCE OF SOIL MAINTENANCE IN THE VINEYARD ON CERTAIN BIOLOGICAL AND TECHNOLOGICAL CHARACTERISTICS OF THE VRANAC VARIETY

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Abstract
In this paper, three methods of soil maintenance have been presented (permanent grassing by sowing a meadow grass mixture, bare untilled soil with herbicide applied and tilled soil), that is, their influence on agrobiological and commercial and technological characteristics of this variety. The research was conducted on a Trial Plot of the Biotechnical Faculty in Podgorica, Lješkopolje locality. The trial vineyard was set up in 2005. Based on the research work conducted so far, there are grounds to conclude that permanent grassing over results in a good wine quality, with no significant difference in either vigour or fruitfulness of grapevine among bare, tilled and untilled plots.
Key words: grape vine, Vranac, grassing over, tillage, herbicides.

Introduction

Grape vine is one of the oldest plant cultures grown. It represents an important Christian symbol, particularly as it used for winemaking. The gape vine cluster is an attribute of deity, crop production and fertility and it represents the wine of life. The grape vine growing culture dates back to a long time ago. There are many theories about its origins, as well as about where the first steps in viticulture had been made. According to majority of these theories, the domesticated grapevine occurred first in the Middle East. According to Milosavljević (1990) traces of grape vine cultivation date back to more than 9000 years ago, in the South Caucasus and Mesopotamia, 6000 years ago in Egypt and in the Balkans, the grape vine cultivation dates back to between 4,000 to 5,000 years ago. According to Pejović et al. (2004) the grape vine distribution area is broad and it may be grown from latitude 52° north and latitude 45° south. Montenegro's viticulture was developed further by ancient masters – Romans, who made numerous records of varieties and methods of grape vine growing. According to Marco Aurelio, the Roma Emperor, wine from the area around the Lake of Skadar prevents aging, it extends life. A part of Montenegro where grape vine has been grown since the old times is the zone with modified Mediterranean climate. Today, „13. jul Plantaže" a.d. is the major producer of wine and table grapes in the region. About 70% of the vineyard set up is the Vranac variety, and wine made of it has become the national brand name and also the best-known and the best product of the company „13. jul Plantaže" a.d. which has promoted Montenegro as an important wine destination. There are about 4,000 ha under vineyards in Montenegro, situated in the

Podgorica and Coastal vineyard areas. Of that area, 2,200 ha under vineyards are the property of „13. jul Plantaže“ a.d. producing more than 20 million kg of grapes, processing of which results in about 15 million wine units at the national and foreign markets. For that reason, „13. jul Plantaže“ a.d. is the backbone of Montenegro's viticulture and winemaking and it spreads the glory of Montenegro's wines.

The objective and the significance of the research

The main objective of the research is to analyse and establish what soil maintenance method (permanent grassing by sowing a meadow grass mixture, bare untilled soil with herbicide application and tilled) in a vineyard produces the best effect on agrobiological and commercial and technological characteristics of the Vranac variety. Grassing over of soil in a vineyards is as old as the grape vine culture, but in various forms. Only as of lately has the grassing over been recommended for soil maintenance in a vineyard. Namely, the scientific community is divided when it comes to grassing over the soil in a vineyard, since soil composition has not been sufficiently studied. For that reason, intensive research activities on this topic have been in place in the past few years and significant advantages of grassing over the soil in a vineyard have been proved. The results of many studies show that permanent grassing may double the organic matters content in soil. Furthermore, it has been established that under irrigation and fertilization, grape vine's vigour is lower than that of grape vine in bare, tilled and untilled soil, but the yield is about the same. Consequently, the motive of the work behind the Master's Thesis on this topic was to get a better insight into the effect of grassing over in a vineyard. The objective of this research, in addition to the abovementioned, has been also to study and present some agrobiological and commercial and technological characteristics of the Vranac grape vine variety. The results obtained will show what is the most favourable method of soil maintenance for this specific variety, that is how the permanent grassing by sowing a meadow grass mixture, bare untilled with herbicide application and tilled influences the fruitfulness and vigour of the Vranac variety, as well as its quality. Also, one of main objectives of this work was to establish whether different soil maintenance methods in plantations of the Vranac variety reduce or increase the yield compared to the normal soil maintenance method (in the form of fallow or clean cultivation). The Vranac variety, which is the object of the research in this paper, in the Podgorica vineyard area gives supreme quality with a very balanced proportion of sugar and acids, and for that reason it is widespread and in high demand at the market.

Facilities, materials and method of work

The research on influence of the soil maintenance methods in a vineyard certain biological and technological characteristics of the Vranac variety was done on the Trial Plot of the Biotechnical Faculty – Lješkopolje locality, in the vicinity of Podgorica. The research work, which began in March 2011, covers the Vranac variety. Among numerous well-known authors who wrote about this variety, academician Marko Ulićević stands out, as he dedicated most of his work on research of this variety. The vineyard in which the trial was conducted was set up in 2005. The vine plant spacing in the vineyard is 2.4 x 1.2 m, while the spacing from one post to the other is 7 m. In the interstice, the Vranac variety was represented with 6 vine plants each. The training system is the Guyot two-folded cordon. The trellis in the vineyard is the espalier, constructed by a combination of concrete posts with galvanized wire, and mixed pruning is applied. The research and measuring conducted on the Vranac variety in the period concerned included the following:

- Agrobiological characteristics of the variety

- Commercial – technological characteristics of the variety

Results and discussion

The phenophases observed in the trial vineyard were as follows: sap flow phenophase, budbreak phenophase, flowering phenophase and ripening phenophase.

Sap flow phenophase

The overview of the beginning and the end of the sap flow in the Vranac variety is given in the Table 1 below. The research trial was divided into 3 equal parts (grass, herbicides, tillage) so the sap flow phenophase of the Vranac variety was observed in each part separately. The Table 1 shows that no significant difference was noted among the soil treatment methods specified. The onset of the sap flow phenophase was in the period 19 March 19 – 21 March, that is, in the third and the fourth decade of March.

Table 1. Beginning and the end of the sap flow phenophase in the Vranac variety under research

Vranac variety	Sap flow phenophase	
	Sap flow beginning	Sap flow end
Grass	19/03	15/04
Herbicides	21/03.	13/04
Tillage	21/03.	14/04

Based on the data given in the table above (Table 1) it can be stated that the phenophase in this trial period lasted from 24 to 28 days. Pejović and Mijović (2004) state that this phase lasts 13-24 days on average, while in extreme cases it lasts from 8 to 45 days. The same authors state that this phase is short in case of high soil and air temperatures, as high temperatures enable budding within a short time.

Budbreak phenophase

The second phenophase in the annual development cycle during the vegetation period is the budbreak phenophase, that is, the beginning of the growth of shoots and other organs. The Table 2 below gives an overview of the beginning and the full budbreak of the Vranac variety observed in the year of the research work (2011).

Table 2. Beginning and the full budbreak of the Vranac variety observed

Vranac variety	Budbreak phenophase	
	Budbreak beginning	Full budbreak
Grass	29/03	06/04 – 50 % 11/04 - 100 %
Herbicides	31/03	06/04 – 80 % 10/04 - 100%
Tillage	30/03	06/04 – 90 % 10/04 - 100 %

It can be noted in the table above (Table 2) that in the fourth decade of March, i.e. at the end of March, budbreak began in the area where the Vranac variety was treated by different soil methods. The full budbreak in all 3 soil methods began on the same day, i.e. on April 6, which is seen from the results presented in the Table 2. Differences in budbreak (in %) were noted among permanent grassing by sowing meadow grass mixture, tilled soil and bare untilled soil with herbicide

application. In this trial period, the budbreak phenophase lasted from 50 – 52 days, depending on the soil treatment method, which correspond with the assertions of Pejović and Mijović (2004), who stated that this phenophase lasts from 30 – 60 days, depending on the climatic conditions.

Flowering phenophase

Flowering phenophase begins once the flowerhoods fall off under the pressure from anthers. The beginning of the flowering of the Vranac variety observed, full flowering and the end of flowering is presented in the Table 3.

Table.3. Beginning, full flowering and the end of flowering of the variety observed

Vranac variety	Flowering phenophase		
	Beginning of flowering	Full flowering	End of flowering
Grass	19/05	23/05	28/05
Herbicides	17/05	22/05	27/05
Tillage	16/05	21/05	26/05

In all three soil maintenance methods, the Vranac variety flowered in the period 16/05 to 19/05, that is, in the third decade of May. Earlier beginning of the flowering was caused by high temperatures in May recorded in the year of research. Such effect on temperatures on flowering was also pointed out by authors Fazinić (1971) and Burić (1972). Based on the results obtained in the table above (Table 3) we note that the difference between the earliest and the latest flowering was 1- 3 days, while the flowering phenophase in the soil methods concerned lasted from 9 to 12 days.

Grape ripening phenophase

Ripening and grape harvesting phenophase of the Vranac variety observed is presented in the Table 4. For the research, the day of harvesting is taken as the day of ripe grape. In the year of the research, the grape ripening phenophase lasted from 66 to 68 days. The assertions of Merzanian (1951) and Negrulj (1959) who state that this phenophase lasts from 1.5 to 2 months match to a certain extent with the results obtained in the year of the research.

Table 4. Ripening phase and the grape harvesting for the Vranac variety observed

Vranac variety	Grape ripening phenophase	
	Veraison	Grape harvesting
Grass	06/04	10/09
Herbicides	04/07	10/09
Tillage	04/07	10/09

Grape yield

The grape yield per vine plant, as an absolute indicator of fruitfulness of a variety depends on a large number of factors, more significant ones being the biological traits of the variety as well as environmental conditions in the year of research. The influence of these factors is presented in the Table 5.

The number of clusters harvested from 5 vine plants is presented in the Table 5 above, which shows also the average number of clusters per vine plant and the average grape yield per vine plant. The

table shows that the average number of clusters per vine plant ranged from 13.9 to 16.3. The average grape yield (kg) per vine plant in the soil maintenance methods stated above ranged from 2.82 kg to 3.83 kg. On the basis of ten-year research, Ulićević et al. (1983) ascertained that the average ten-year grape yield per vine plant amounted to 2.32 kg on grassed, 3.16 kg on bare untilled and 3.23 kg on tilled areas.

Table 5. Number of clusters on 5 vine plants, average number of clusters per vine plant and average grape yield per vine plant of the Vranac variety

Vranac variety observed	Number of clusters on 5 vine plants	Average number of clusters per vine plant	Average grape yield per vine plant (kg)
Grass	81	16.3	3.14
Herbicides	57	11.5	2.82
Tillage	69	13.9	3.83

Sugar content in grape juice

Sugar content in grape juice – must was determined using Oechsle must-tester, designed in 1850 by the German scientist Ferdinand OECHSLE (MERCZ 1990). Table 6. shows the data of average content of sugar in must.

Table 6. Sugar content in grape juice (%)

Vranac variety analysed	Sugar content by Oechsle must-meter
Grass	21.7
Herbicides	21.5
Tillage	21.2

The sugar content in grape juice of the Vranac variety observed, according to data presented in the Table above (Table 6) ranged from 21.2% to 21.7%. In the year of research, the climatic and edaphic conditions in the ripening period (and temperature in particular) were balanced and favourable, hence they did not cause any significant differences in sugar content in grape juice. According to assertions of Burić (1995) ripe grapes' must of the Vranac variety contains 20-24% of sugar. These assertions match to a certain extent with the results obtained in the year of the research (2011).

Total acid content in grape juice

The influence of the Vranac variety observed and environmental conditions in the year of the research (2011) to the total acid contents in grape juice is presented in the Table 7.

Table 7. Total acid content in grape juice (g/l)

Vranac variety analysed	Total acid content
Grass	4.96
Herbicides	4.93
Tillage	4.78

On the basis of the results obtained in the year of the research (2011) presented in the Table 7 above, it can be stated that the soil maintenance methods mentioned above, when it comes to the Vranac variety, have not differed much with regard to the total acid content in the grape juice – must, and they ranged from 4.78% to 4.96%, which results from the different conditions under which the research was done. Mijović (2000) states that on the basis of the results obtained in the period (1985-1989) average total acid content on shallow ploughed soil amounted to 6.15 g/l, with application of NPK fertilizer it was 6.23 g/l. The same author states that the average total acid content in grapes from the grassed soil amounted to 6.30 g/l, while with application of NPK fertilizer, it was 6.21 g/l.

Conclusions

Based on the results of the research obtained in the course of 2011 with regard to the influence of the soil maintenance method on certain biological and technological characteristics of the Vranac variety, the following conclusions may be drawn:

There were no significant differences between the observed soil maintenance methods for the Vranac variety in the annual biological cycle of grape vine development. The onset of the sap flow phenophase occurred in the period 19/03 to 21/03, that is, in the third and the fourth decade of March. The earliest sap flow onset was recorded in the area where Vranac variety soil was grassed over with meadow grass – on 19/03, while the sap flow of the Vranac variety in the part where herbicides were applied on soil began two days later compared to the grassed over area, i.e. on 21/03, the same day as with the tilled soil. The difference between the earliest and the latest onset of sap flow phenophase was 2 days, budbreak 2 days, flowering 3 days.

The earliest onset of the beginning of veraison was recorded on the same day (04/07**)** in the tilled and untilled soil maintenance method in the vineyard. Change in the colour of skin and softening of grapes (veraison) occurred two days later, that is, on 06/07, in the part where the soil under the Vranac variety was grassed over, so the difference between the earliest and the latest veraison recorded was 2 days.

Grape harvest in all 3 soil maintenance methods took place at the same time, in early September. It was induced by various circumstances, among others, the assessment that ripening was quite uniform. The harvesting of the grapes of the Vranac variety in the part which was grassed over by the meadow grass mixture, tilled soil and bare untilled soil with herbicide application was done at one go, on 10 September.

The largest average number of clusters per vine plant of the Vranac variety in the part where soil of the trial vineyard was grassed over was 16.3, in the part with bare untilled soil with herbicide applied the lowest average number of clusters per vine plant was recorded and it was 11.5, while the average number of clusters in the tilled soil under the Vranac variety was 13.9. The highest yield of the Vranac variety observed was recorded in tilled soil (3.83 kg)**,** while with the soil maintenance method of grassing over, the grape yield per vine plant amounted to 3.14 kg. The lowest yield of the Vranac variety was recorded in bare untilled soil with herbicide applied and it amounted to 2.83 kg 2.82 kg**.** The highest average sugar content determined by the Oechsle must-meter was recorded in the part where the soil under the Vranac variety was grassed over (21.7%). The lowest sugar content of the Vranac variety was in the part of the tilled soil (21.2%). The average sugar content recorded in the part of the bare untilled soil with herbicide applied amounted to 21.5%. The highest total acid content in must of the Vranac variety was recorded in the part of the soil that was grassed over (4.96

g/l). Total acid content in the must of the Vranac variety from the bare untilled soil with herbicide applied was 4.93 g/l, while in tilled soil under this variety, the total acid content in the must was the lowest, amounting to 4.78 g/l. Based on the results obtained, it can be concluded that there are no significant differences between bare untilled soil and tilled soil when it comes to phenological phases of the Vranac variety, which applies also to the elements of fruitfulness and the mechanical properties of the cluster and grapes, while by sugar content and total acid content in grape juice – must, grassed over soil stands out, as the quality of wine made from those grapes had the highest wine tasting score.

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ВЛИЈАНИЕ НА ОБРАБОТКАТА НА ПОЧВАТА ВРЗ ОДРЕДЕНИ БИОЛОШКИ И ТЕХНОЛОШКИ КАРАКТЕРИСТИКИ НА СОРТАТА ВРАНЕЦ

Ана Павичевиќ, Славко Мијовиќ, Анита Газивода

Апстракт
Во овој труд, три методи за обработка на почвата се презентирани, постојана затревеност со сеење на ливадска тревна смеса, примена на хербициди без обработка и трето со постојана обработка на почвата и нивното влијание врз биолошките и технолошките карактеристики на сортата вранец. Испитувањето е изведено во опитното поле на Биотехничкиот факултет во Подгорица, локалитет Љешко поле. Опитното лозје е подигнато во 2005 година. Врз основа на испитувањата можеме да заклучиме дека постојаната затревеност резултира со добар квалитет на виното, со незначајна разлика во бујноста или плодноста на лозата помеѓу варијантите со хербицирање, обработена и необработена почва.
Клучни зборови: винова лоза, Вранец, затревеност, обработка, хербициди**.**

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EFFECT OF ALTITUDE ON THE QUALITY AND QUANTITY OF THE INDIGENOUS VARIETY OF PROKUPAC GRAPE

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Abstract
Considering the configuration of the terrain and altitude localities, extending from 110 to 550m above sea level, and bearing in mind the quality of grapes, which will meet the market demands, the aim was to establish to what altitude we can successfully cultivate this variety. Plant vines have been erected on the ground Kober 5 BB with a distance of 1.2 x 1.0 m, i.e.8.333 vines / ha. The investigations included: number of bunches per vine, cluster weight, grape yield per vine and hectare and the quality of grapes grown at sites with different altitudes (130, 220, 320 450 and 550m). A variety of Prokupac showed good yield at all sites, cluster mass was higher for 15 grams at the sites of altitudes of 450 and 550m, but the sugar content was lower by 2.8%, and higher total acidity of 1.7 g / l . In the years when we have an early fall frost at an altitude of 550m and 450 it does not mature completely.
Key words: altitude, cluster, cluster weight, sugar content, total acidity, yield.

Introduction

Prokupac is indigenous grape vine variety mostly represented in the Toplica wine sub region. Today over 90 % of the Toplica wine sub region is planted with this grape vine variety. The indigenous grape varieties and it's products are starting to get attention in Serbia and wider in the world.A lot of authors were writing about the research of this variety, both domestic and foreign: (Avramov, L., Briza K., Bozinovic, Z., Zunic D., Zirojevic D., Nastev D., Stojanovic M., Toskic V., Cvetkovic D., Cindric P.,). Considering the configuration of the terrain and altitude localities, extending from 110 to 550m above sea level, and bearing in mind the quality of grapes, which will meet the market demands, the aim was to establish to what altitude we can successfully cultivate this variety.

Material and methods

The research was conducted from 2008 until 2011 in the Toplica wine subregion on Prokupac variety, which is often used to produce table and quality red wine. Plant vines have been erected in 1990 on the ground, on Kober 5 BB rootstock with a distance of 1.2 x 1.0 m, i.e.8.333 vines / ha. The research included: number of bunches per vine, cluster weight, grape yield per vine and hectare and the quality of grapes grown at sites with different altitudes (130, 220, 320 450 and 550m).
Important climate and land characteristics:
Meteo data for Prokuplje was used for the climate characteristics. Period from 2000 until 2011 is considerated. On base of this perios, basic climate elements are made that show heat conditions, sun

conditions, humidity and winds in selected areas. Air Temperature - middle vegetation temperature in the reasearched period was from 15,9ºC (on 550 m altitude) to 16,9 ºC (on 130 m altitude). Temperature Sum - In the researched period the sum varied from 3365ºC (on 550 m altitude) to 3610ºC (on 130 m altitude). The warmest month is July with average midday temperature from 22,9ºC to 23,4ºC and January as the coldest with average midday temperature from -1ºC to -1,4ºC. Extreme low temperatures were recorded in January and February with -21ºC. Absolutely maximum temperatures were recorded in July and August with 42,1ºC. Length of sunshine radiation had optimal value for all the conducted locations and was 1682 h. Precipitation were varying from 531 mm (on 130 m altitude location) to 590 mm (on 550 m altitude location). On the location the soil type is ganjaca. It has shallow humus horizon and light mechanical compound. Chemical characteristics of the soil is low acid (pH 6,4 - 6,6) and percentage of humus is 2,1 -2,7%. The missing macro and micro elements from the soil is compensated with fertilizing.

Results and discussion

The fertility of the researched grape variety was good on all locations.

In table 1 is shown number of bunches and cluster weight per vine on different locations.

Table 1. Number and weight of clusters/vine 2008-2011

Altitude locality m.	Number cluster/vine	Cluster weight g.
130	15,5	140,7
220	15,1	142,0
323	14,6	143,5
452	13,4	155,0
550	13,3	155,4
Cv%	-	5,2

From Table 1 we can conclude that the highest number of cluster per vine (15,5) was on location of 130 m altitude and the lowest number (13,3) on location of 550 m altitude. With the increase of the altitude there was reducing of the number of cluster per vine, but increasing the cluster weight. The cluster weight was varying from 140,7 g on location of 130m altitude to 155 g to location of 452 m. The cluster weight was higher on locations of 452 and 550 m from 13g to 15 g. Grape yield per vine and hectare was variable per vine on the location and years (Tab. 2)

From the Table 2, we can conclude that grape yield was varying very little per vine and hectare with change of altitude location. Grape yield per vine was 2.067 (550m altitude location) to 2180 (130m). Grape yield per hectare was varying per locations from 17.224 kg (550m altitude location) to 18.169 kg (130m altitude location). Sugar contents and total acids was variable dependant from altitude location (Tab.3).

Sugar content was varying depending from altitude of the location. The highest sugar content (21,1) was in grape on location of 130m altitude, but lowest (18,2) on location of 550m altitude. The difference in between the sugar content per locations was 2,8%. In 2009 in all variants the sugar content was lowest by 3% which points that on higher altitudes sugar is not enough collected

Total acids were variable as per years and per locations. On higher altitudes, the content of total acids was raising. Lowest total acids (6,3 g/l) was in grape on altitude location of 130 m, highest (8,0 g/l) in grape on location of 550 m altitude. The difference between acids was varying by 1,7 g/l.

Table 2. Grape yield per vine and hectare locations in g

Year	Altitude location				
	130	220	323	452	550
2008	2.056	2.220	2.088	2.218	2.131
2009	2.150	2.100	2.102	2.160	2.150
2010	2.205	2.300	2.230	2.260	2.210
2011	1.990	1.960	1.980	2.150	2.010
Average ƙg/vine	2.180	2.144	2.095	2.077	2.067
Grape yield in ha / kg	18.169	17.865	17.457	17.307	17.224

Table 3. Sugar contents by years

Year	Location				
	130	220	323	452	550
2008	21,20	19,8	18,9	17,9	17,3
2009	18,9	18,5	18,0	16,8	16,2
2010	21,8	21,2	20,9	20,2	19,1
2011	22,3	214	21,2	20,5	20,1
Average	21,1	20,2	19,7	18,8	18,2

Table 4. Contents of total acids g/l (average 2008 - 2011)

Total acids g/l	Location				
	130	220	323	452	550
	6,3	6,9	7,1	7,8	8,0

Conclusions

The climate conditions on selected locations are not suitable for grape growing of the researched grape vine variety (452 and 550m). Earth conditions are optimal on all locations. Number of clusters per vine varied seamlessly with increasing of altitude. Cluster weight was seamlessly higher with increasing of altitude. Grape yield per vine was optimal on all locations, with increasing of altitude it was lowering. Sugar content was variable and was dependant of the climate conditions. In certain years where rainy autumns were on location on 423 and 550m altitude, the grape cannot mature by collecting enough sugar, making difficult to make good wine. With increasing of altitude the sugar content in grape is lowering, but is satisfactory untill 323 m altitude. Total acids were varying, increasing with higher altitudes. In this grape growing region we can grow the Prokupac on location from 323 m and on location of 452 and 550 m just in selected years. The reason is that this grape variety matures in 4 th epoch, in the first decade in October.

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ЕФЕКТОТ НА НАДМОРСКАТА ВИСИНА ВРЗ КВАЛИТЕТОТ И КВАНТИТЕТОТ НА АВТОХТОНАТА СОРТА ВИНВОА ЛОЗА ПРОКУПЕЦ

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Апстракт

Имајќи ја во предвид конфигурацијата на теренот и надморската висина на локалитетите, од 110 до 550 м над морското ниво, и имајќи ги во предвид квалитетот на грозјето кое ќе ги задоволи барањата на пазарот, целта на испитувањето беше да се утврди на која надморска висина можеме успешно да ја одгледуваме оваа сорта. Сортата е калемена на подлога Кобер 5 ВВ, растојание меѓу лозите од 1,2 х 1,0 м, со 8,333 лози/ха. Испитувањето ги опфати: бројот на гроздови на лоза, тежина на гроздот, принос на грозје на лоза и хектар и квалитетот на грозјето одгледувано локации со различна надморска висина (130, 220, 320 450 и 550m). Сортата Прокупец покажа добар квалитет на сите локации, поголема тежина од 15 грама на локациите со 450 и 550м, но содржина на шеќер пониска од 2,8% и повисока содржина на вкупни кислеини од 1, g / l. Во годините кога се појавија рани есенски мразеви на надморска висина од 550 и 450 м, грозјето не созреа целосно.

Клучни зборови: надморска висина, грозд, тежина на грозд, содржина на шеќер, содржина на киселини, принос.

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INFLUENCE OF DRIP IRRIGATION IN YIELDS ON TABLE GRAPES

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Abstract
With the growth of the world population increased demands for agricultural products. While on the other hand last year's our country as well as the entire region is facing with high temperatures as a result of climate change, and with the distribution of irregular rainfall and often facing with the lack of rain during vegetation periods.The main purpose of this paper is to highlight the impact of drip irrigation in table grape on yields to respectively varieties Afus-ali and Hamburg in agro-ecological conditions of Kosovo (Dukagjini valley). The experiment was situated in the vineyard with regular fruitiness at the age of 15 in Suva Reka. They have been divided into irrigation plots (experimental) and without irrigation (control). Research were followed during 2008-2009. Grape yield is expressed in kg/vine and kg/ha. It has been verified that the differences between experimental plots (with water) and non-experimental plots without water were with high significances. Yield to variety Afus-ali has increased to 47.3% in 2008 and 20.6% in 2009, which were dependent on the amount of annual rainfall and their distribution within the year. Hamburg variety yield increased by 69.9% in 2008, by 74% in 2009. Finally we conclude that drip irrigation has shown a positive impact on increase of productivity. The results date has been calculated and processing, using SPS package. Acquired research results are statistically analyzed with variance analysis.
Keywords: productivity, table grapes, irrigation, varieties.

Introduction

Pedo-climatic conditions which characterize the region of the territory of Orahovac & Suhareka enabled cultivation, intensification and increasing viticulture areas for different purposes. Since antiquity Kosovo has been known for grape cultivation. Archaeological discoveries proved this fact. Ancient tradition, experience and cheap labor power in the cultivation of the vine, which characterize Dukagjini area, have enabled great success to cultivate large areas when in 1990 they reached 8300 ha, of which in the social ownership were 5277 ha, which for political reasons known almost entirely destroyed by the end of 1999, while the rest were under private sector. The importance of the cultivation of the vine is of particular benefit. Is of great interest for the country. Affects in comprehensive income nationally. Has impact on social problem of employment, increases consumption of grapes, affects the development of grape processing technology with the production of quality wines, activate land with vineyards etc.

The importance and role of research

To increase the productivity of grape vine, irrigation may have special importance, especially "Drip irrigation". From the Sixties of the last century comes to new ways of irrigation so-called "Drip irrigation". This form of irrigation was first used in Israel, then California, Australia etc. In the

Balkans appear in the seventieth century 20, when it starts to apply in Kosovo, mainly in fruit growing, vegetarian, etc. Within H. S. The "Radoniqi" on surfaces within the social sector were involved 720 ha of the land under irrigation system. However, irrigation is not applied to any vineyard because of lack of experience for the role and impact of this agro measure. Thus, in the vineyards of Kosovo, this is the first time and at use in experimental form. Irrigation of vineyards in our country is applied in rare cases and in limited area. For this reason "Drip-irrigation", the newest and most rational way was of interest to investigate its effect on specific conditions of Dukagjini after lacking the necessary experience for this type of irrigation. Therefore, the results obtained in this direction present special contribution to Kosovo vineyards and for the region of Balkan Peninsula.

The purpose of the research

The purpose of the study was the observation of the impact of "Drip irrigation" in yield, grape quality, growth and development intensity of (two varieties) of grapes, the formation and maturation of the berries, but also gaining new scientific knowledge about relationship between irrigation and the elements mentioned in the varieties of inquiry. With the aim of linking the soil and climatic conditions and the effect of irrigation, were followed and analyzed climatic conditions for 2008 and 2009 such as: temperature, humidity (precipitation), sun shine etc, which are compared with the average of many years, in this region. With the issue of "Drip-irrigation" are taken not so many authors in the region because it is a relatively new irrigation method. Dates from the '70's in our country. Avramov, L. (1988), states that the method of irrigation with drip (Drip Irrigation) has great efficiency in the production of grapes. This irrigation is done automatically, which ensures the optimal level of moisture in the ground. Larry E. Williams. (2001). the author has researched "Drip irrigation" in condition of California, USA. Are explored vineyards with table grapes and wine, main regions of California, the country which is characterized by high temperatures during the day and low at night. The author states that the amount of water needed for irrigation depends on: vine development phase, planting distances, evapotranspiration, the intensity of vegetation and soil moisture (rainfall during the vegetation). Researches are made in the vineyard which has been at the age of four years, in the period from budding until October. During the vegetation used 1550 gallon or 5859 liters per vine, or the daily amount ranges 11 gallons per day or 39.46 liters per vine.

The author states that the amount of water that needs to be given to irrigation depends on the size and growth of leaves (surface of transpires), a fact which shows the correlation between the amount of irrigation and vine leaf growth. Kabashi, B. (1994) noted that water has the effect of increasing the yield and the amount of sugar in the grapes. And as a suitable form for irrigation of vineyards prefers "Drip irrigation". In this way the irrigation, in addition will be provided optimum moisture in the ground but also may be used for relevant fertilization with (macro-and microelements). Koronica, B. (1996), states that the irrigation of table grape varieties is preferable but can be used also to those of wine varieties, but special care should be taken to the water regime in the stage of maturity of the grapes in order to avoid the reduction of the quality of grapes.

Kabashi, B. (2005) points out that in the region of vineyards in (Dukagjini region) falls in the year about 780 mm rainfall, but which are not properly distributed. Namely, during the vegetative stage, when the need is greater for plants we have lack of rainfall. This deficit in the moderately dry vegetation period is 329 mm and that during the months of June, July, August. Therefore for high yield and quality, have used regular irrigation of the vineyard which enables increased productivity and the amount of sugar in the grapes. Kabashi, B. Dula, Sh. (2005), suggests that the only limiting

factor for high and stable production of grapes is the lack of moisture in the ground (lack of rainfall in the summer).

Agro – ecological condition

Climate-Vine grape (Vitis vinifera) is characterized by great adaptability to diverse climatic conditions. The Dukagjini valley characterized by Mediterranean and continental climate, with warm currents permeability from white Drini river valley. This makes this area very suitable for the cultivation of the vine and achieve higher yields per unit and area.

Table 1. Temperatures in territory of Suva reka, for 2008 – 2009

Temperature (2008)													
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Yearly
T. average °C	0.2	5.2	9.2	13.8	19.6	23.6	25.1	26.2	18.3	14.4	12.8	5	14.4
Absolute Max.°C	12.4	22.5	21.9	28.2	35.8	37	38.1	40.6	38.2	24.8	23.6	0	40.6
Absolute min °C	-16.8	-10.4	3.1	7.3	10.2	9.1	16.1	16.1	11.1	7.8	6.9	-4	-16.8
Temperature (2009)													
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Yearly
T. average °C	0.3	3.2	7.3	14.1	19.3	21.4	24.5	25.3	21	10.2	8.3	5.5	13.4
Absolute Max.°C	16.2	17.5	25.1	25.1	33.4	35.7	38.5	36.5	0	20.8	19.9	20.3	38.5
Absolute Min °C	-17.9	-7.2	-3.6	2.4	4.3	9.5	11.3	13.3	0	-2.1	-2.9	-13.3	-17.9
Long term T. 1951 – 1980	-0.2	2.7	6.2	11.0	16.0	19.4	21.5	21.5	17.5	12.0	7.0	2.0	11.4

Table 2. The amount of long-term temperatures and years of experimentation by months vegetation season in Suva Reka

Months	IV	V	VI	VII	VIII	IX	Total
2008	414	607.6	708	778.2	812.2	549	3869 °C
2009	421	598.3	642.0	759.5	784.3	630	3835 °C
1951 -1980	330	496	582	668.2	666.5	525	3268 °C

From the analysis of dynamic of the temperatures during vegetative period, we find that the sum of the temperature in 2008 was 3869 ° C, which is about 601 ° C higher than the average perennial. While, in 2009, it was 567 ° C higher than the perennial average. This means that two years of the research have been characterized as the years with very hot and very high temperatures during the vegetation, which has had a positive impact on productivity and quality of irrigated grapes.

Rain fall-In Dukagjini valley or territory of Prizren, in the average amount fall sufficient rainfall. However, they characterized by their poor ranking through the months of the year. They lacking in the vegetative period, in which only 40% of the annual precipitation fall precisely when the need for vine are greater. Therefore appear deficit of rainfalls, which can be met only with irrigation.

From meteorological data taken from meteorological station of KFOR in Suharekë respectively Topliqan, it appears in the year of 2008 there was high rainfall deficit. During this year have dropped a total of 521 mm, while during the vegetation period a total of 193.7 mm and during the three summer months (June, July, August) have fallen a total of 88.6 mm, which represent

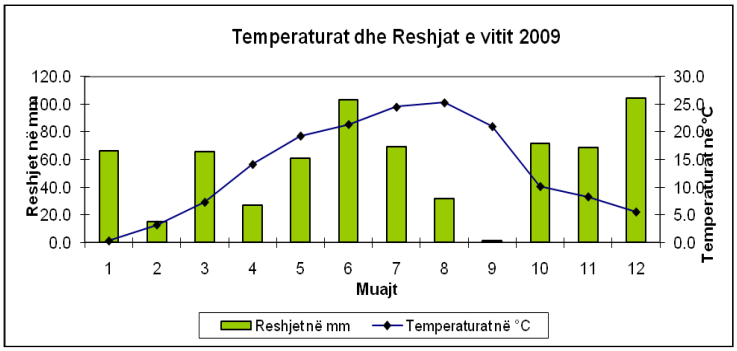
extremely high rainfall deficit. In 2009 have fallen more rainfall, 684.8 mm, of which vegetation months (April - September) 293.3 mm, while during the three summer months (June, July, August) 204.3 mm, which compared to 2008 have better ranking during the vegetation and low rainfall deficit.

Table 3. The amount of annual rainfall in Suva Reka (2008 - 2009)

Sasia e reshjeve													
Muajt	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	∑ Vjetore (mm)
2008	34.3	14.7	132.0	11.1	16.7	42.6	39.2	6.8	77.3	38.7	42.5	65.1	521.0
2009	66.0	14.8	65.6	26.8	60.6	103.4	69.3	31.6	1.6	71.6	68.9	104.6	684.8
Aver. perennial	57.1	46.5	46.6	53.6	76.1	62.0	42.8	25.1	58.2	61.4	73.0	68.1	695

Table 4. Rainfall during the vegetation (2008 - 2009)

	IV	V	VI	VII	VIII	IX	∑ during the vegetatin (mm)
2008	11.1	16.7	42.6	39.2	6.8	77.3	193.7
2009	26.8	60.6	103	69.3	31.6	1.6	293.3
Aver. perennial	13.6	76.1	62	42.8	25.1	58.2	277.8



Soil conditions - Soil represents the place where plants are reinforced, where water is supplied with nutrients and mineral substances. It introduces basic ecological factor for growth and development. Location where the research was is the type of mountain red soil, pedological profile ABC. Data from mechanical and chemical composition of soil are presented in the tables below. During the experiment were made soil analysis (in Peja Biotechnology Institute).

This year is characterized by low rainfall deficit (soil moisture) compared to 2008, which amounted to 372.4mm. If removed May months (due to very small deficit (9.1mm), and September (month which should not be involved with irrigation due to the maturation process), it appears that irrigation should be provided 275 mm, for meet the needs of grapes. Irrigation - The irrigation was done with the system of "Drip irrigation". Where dropper distances were as the distance between the plants in the sequence (1.20 m) for each plant by a dropper, with a capacity of 4 ℓ / hr.

Table 5. Physical composition (mechanical) of soil

Depth cm	Mechanical soil structure					
	2.0-0.2	0.2-0.02	0.2-0.002	<0.002	Sand	Clay
0-20 cm	12.0	33.0	28.0	27.0	45.0	55.0
20-40 cm	10.5	37.5	26.0	26.0	48.0	52.0
40-60 cm	19.0	32.5	21.5	27.0	51.5	48.5

Table 6. Chemical Composition

Depth (cm)	Sample nr	Humidity %	Ph-water	CaCO%	Humus %	Elements			
						$P_2 0_5$ mg/ 100g	$K_2 0$ mg/100g	Ca mg/100g	Mg mg/100 g
0-20	1	15.9	6.9	-	2.6	9.0	38	380	48
20-40	2	20.7	6.9	-	1.0	< 1	19.0	240	45
40-60	3	22.5	6.8	-	0.8	< 1	19.2	235	50
0-60	0	18.4	6.9	-	1.5	< 3	34	320	47

Table 7. Tabular presentation of calculating soil humidity deficit for 2008, (calculation methodology given by Professor Dr. B. Kabashi). (ETP - is calculated according to the method Penmani-t.)

Months	Amount of moisture from winter reserves used by plants (mm)		Rainfall (mm)		Potential Evotranspirations (ETP) (mm)	State of the moisture in the ground (mm)		Soil moisture deficit (mm)	
			Real	Effectives		Based on real rainfall	Based on effective rainfall	Based on real rainfall	Based on effective rainfall
April	120	120	11.1	8.9	84	+47.1	+45.0	0.0	0.0
May	47.1	45.0	16.7	13.4	115	-50.3	-56.6	50.3	56.6
June	0.0	0.0	42.6	34.1	141	-98.4	-106.9	98.4	106.9
July	0.0	0.0	39.2	31.4	161	-121.9	-129.2	121.9	129.6
August	0.0	0.0	6.8	5.4	136	-129.2	-130.6	129.2	130.6
September	0.0	0.0	77.3	61.8	90	-12.7	-28.2	12.7	28.2
Moisture deficit								412.5	448.9

In experimental plots were irrigated four rows with 30 vines/rows, or a total of 120 vines. In 2008, which were characterized by very low rainfall, especially during the vegetation season (April - September) with a total of 155 mm effective rainfall, or only 70 mm, during the three summer months (June, July, August), and with a very high deficit (soil moisture).

- Irrigation was made during the first two days, with 5 to 6 July 2008, with the amount of 4000 ℓ water or with 33 ℓ / vine (plant).
- Second Irrigation was done over two days, July 26 to 27 2008, with 3000 ℓ water or with 25 ℓ / vine.
- Third Irrigation was done with 13 to 14 August 2008, with the amount of 4000 ℓ water or 33 ℓ / vine and
- Fourth Irrigation was done with 28 to 29 August 2008, with the total amount of 4000 ℓ water or 33 ℓ / vine.

Calculated as irrigation rate expressed in m^3 / ha, it appears that the first irrigation were given 238 m^3/ ha, with second irrigation 179 m^3/ ha, third irrigation 238 m^3/ ha and fourth irrigation 238 m^3/ ha. Or in total.

$\Sigma = I + II + III + IV = 238 + 179 + 238 + 238 = 893\ m^3$ / ha.

Were attempted to do irrigation only during the dry vegetation and be more rational. However, as a relatively deficient irrigation it has shown very convincingly that has been evident impact on average productivity growth for two varieties of nearly 58%,) grape cluster length, its size, growth and weight grains, the amount of sugar etc.

Year 2009 has been a year with more rainfall than in 2008, with 684.8 mm or 104 mm longer and better ranking during the vegetation period. For this reason, the rainfall deficit, calculated. There has been much lower than in 2008.

This year has been a total of 3 irrigation, mainly in August - beginning of September where:

- Irrigation was made during the first two days, on 12 to 13 August 2009, with the amount of 3000 ℓ water or with 25 ℓ / vine (plant).- Second Irrigation was done over two days, August 24 to 25 2009, 3000 ℓ water or with 25 ℓ / vine.
- Irrigation third is made of 06-07 September 2008, with a quantity of 3000 ℓ water or 25 ℓ / vine and
- $\Sigma = I + II + III = 179 + 179 + 179 = 537\ m^3$/ ha.

However this year the rains of June and July have been nearly enough to cover the requirements of the plants. Rainfall shortages occur during the month of August (total dropped 25.3 mm) and subsequently in September (have dropped a total of 1.3 mm). Watering made during these two months, have given very good results which increases the yield to 40% (tab 8), as well as all other parameters.

It should be noted that according to the analysis, if irrigation were higher rates or approximately calculated ones, grape yields would be even higher.

Material and methods

Investigations were carried out in the vineyard owner Mr. Muhamet Kryeziu Suharekë respectively location called "Street of Peqan".

The vineyard has an area of 0.20 ha, table grapes, which is planted alone, surrounded by meadows, and with vineyards on the eastern and western. The altitude of vineyard is 420 m.Planting distance is 2 X 1.15 m, or 4348 trees per 1 ha, with row direction north-south. The vineyard is in regular fructification at age 13.Betony sticks with wires.Type of establishment (Crown) is simple giot.

During 2008 and 2009, all agro and pomo technic measures were the same for both options, as the irrigation as well without irrigation, for both research varieties.

- Spring plowing 35 cm soil depth, between orders and plow in raw.
- Additional Delivery prior to flowering, between bulky and heavy plow.
- Soil cultivation in order to improve the air regime termination of capillarity, holding moisture in ground, eliminating weeds.

Pomo technical measures

- Regular winter and summer pruning same time for both versions.
- Disease control has been the under the same program for vineyard protection by applying same treatment for both varieties in both years and in both variants with irrigation and without irrigation.

The area of vineyard where conducted the research is 0,20 Ha, from which to experiment samples were taken by "block method" and the random choice, as follows: 20 vine trunk of variety Muscat

hamburg, 20 vine trunk of variety the variety Afus – ali, 20 vine trunk of variety control (no irrigation), 20 vine trunk of variety control (no irrigation).

The data obtained from the research were processed statistically with factorial variance analysis. Studies included the following parameters: budding of buds, lossom (beginning, its duration and finish, visual concrete sight), marking grain color (followed by visual methods), technological maturity, grape yield (Measured 20 vine / varieties and 20/control), the weight of grape cluster (60 cluster), the number of berry / cluster (20 clusters), the number of seeds on 20 clusters / variety and variation, the amount of sugar as measured by 5 kg / variety (Refractometer), the amount of acid measured by 5 kg / variety (measured by the method of nitrimit with NaHO).

During the research material have served as a table grape varieties: Afus - ali and Muscat, Hamburg, the grafted rootstock Kober 5 BB, the network of irrigation system.

For irrigation were installed special network of pipelines with dropper and other accompanying material for these purposes. During the installation of the irrigation network are mounted:

- Tank (drum) - plastic tanks with a capacity of 1000 liters, with its location height of 3.5 m above the plantation.

In this system were used these elements:

1. Main pipeline with a diameter of ¾ "
2. Distribution pipeline
3. Valve for Closing –open
4. Reducing 6/4 "
5. Reducing 5/4 "
6. Duple nipple etc.
7. Dropper pipes (3/4, ½ European model).
8. Dropper (European Model. Capacity 4 ℓ / h).

As work tools for different measurements were used: measurement (to measure the performance), meter, plastic labels (resistant to weather conditions, digital camera (photographing), refractometer, mushtometer etc.

Characteristics of investigated varieties

Muscat hamburg

Botanical characteristics-Large grains round-oval shape in which characterize with dark blue grain. His cluster characterized by a cylindrical shape and large enough that its weight ranges 150 – 400 g.Agro biological characteristics: overall yield ranging from 12000 - 18000 kg/ha, while irrigation achieve even higher yields. Technological characteristics-Wine contains 18-22% sugar. Characterized by a pleasant aroma. Transported well and is very attractive on the market.

Afus – ali

The most common synonyms: Regina, Razaki, amber etc. Botanical characteristics - its grains are extended in the form of the ovary or similar to those of palma. The grape cluster is large enough with weight of 200 - 500 g. Agro biological characteristics - is a variety with high fructification where yields range from 15,000 - 20,000 kg / ha, while with irrigation can reaches well over 30,000 kg/ha. Technological features- Wine contains 18 - 20% sugar. With grape clusters very attractive and very pleasant and refreshing taste. It is resistant to transport and can be exported easily and stored up to 60 days in the refrigerator.

Results and discussion

Budding of buds

From surveys carried out on the time of budding buds shows that Hamburg variety in the level of 5% has been flourishing between the dates 19 - 22.03.2009, and 90% level, between the dates 24 - 28.03.2009. But variety Afus - ali at 5%, has started budding between the dates 23 - 27. 03. 2009, and 90% level between the dates 27.03 - 03.04.2009. So the comparison between the two varieties shows that variety Hamburg started budding earlier than variety Afus - ali that is the result of relevant genetic base of the variety.

Grape blossom

From surveys conducted, resulting that the flourishing of variety Afus - ali at level of 5%, were flourished between the dates 21 - 26.05. 2009, and 90% level, between the dates 27.05 - 08.06.2009. But, variety Hamburg, at 5%, were flourished between the dates 19 - 22.05.2009, whereas the 90% level, between the dates 24 - 30.05.2009. From the comparison between the two varieties is seen that variety Hamburg started flowered earlier than variety Afus - ali that is, as a result of genetic base of the variety.

Marking of grape grain (initial colority)

Surveys have shown that the differences between the two varieties based on marking time of the grains were significant difference. Variety, Muscat Hamburg has started marking at 5%, on 29.08.2008, and lasted until 03.09.2008. While 90% level marking, and in comparison with the control plots (without irrigation) is observed delay of 4 days in 2008, or delay in the control plot (without irrigation) was observed in 2009 by 3 days.

Variety Afus - ali at 90%, marking the difference between the control plots (without irrigation) and the experimental (with irrigation) is for 3 days in 2008 and earlier application of irrigation. But in 2009 this difference was 4 days earlier with irrigation plots.

The weight of grape cluster

From measure conducted it was concluded that irrigation variant had significant difference compare with variant without irrigation. They have been quite significant (tab 8).

This year is characterized by low rainfall deficit (soil moisture) compared to 2008, which amounted to 372.4mm. If removed May months (due to very small deficit (9.1mm), and September (month which should not be involved with irrigation due to the maturation process), it appears that irrigation should be provided 275 mm, for meet the needs of grapes.

Irrigation - The irrigation was done with the system of "Drip irrigation". Where dropper distances were as the distance between the plants in the sequence (1.20 m) for each plant by a dropper, with a capacity of 4 ℓ / hr.

From the results in tab 8, it appears that the impact of “Drip irrigation” is high (significant) between the control plots (without irrigation) and the experimental (with irrigation). But, of cluster measured differences between varieties surveyed were not significant (NS) (tab).

Table 8. The weight of the grape cluster (gr)

Variety (A)	Year (B)		Forms of treatment (C)		Average AB	Average A		
			No irrigation	With irrigation				
	2008	300	468	384				
Afus – ali	2009	296.2	440	368		376 NS		
	Aver. AC	298.1	454**					
Hamburg	2008	250	418	334		339		
	2009	273	415	344				
	Aver. AC	261.5	416.5		Avarage B			
Year x Forms of treatment	2008	275	443 **			359 NS		
BC	2009	284	427.5			356.1		
Forms of treatment (C)		279.5	435.25**					
Differences singnificants		Faktors		Intereakcionet between factors				
		A	B	C	AB	AC	BC	ABC
LSD	0.01	91.85	44.38	57	69.91	89.15	89.15	160.42
	0.05	67.34	32.54	42	46.15	62.68	62.68	102.29

The lengths of grape cluster

The observed significant differences between varieties surveyed. Positive in favor of those with irrigation. Length of clusters is functionally related to the size and extent. But also the differences between the investigated varieties are the result of their genetic base. Differences between varieties are manifested by 28.1%. Greater length is manifested to variety Afus - ali than Muscat Hamburg.

The comparison between years there has been no significant differences (NS). Seen that irrigation also has high impact and significant cluster length. Irrigation variant average is about 32.1%, in comparison with that without irrigation.

The number of seeds in the grape grain

Seed as generative organ formed at the end of the flowering stage. Grains of grape contain 1 to 4 seeds, usually 1 - 2 seeds. We counted grape seeds to ascertain what has been the effect of irrigation and analyzed if the irrigation has impact in this regard. It was found that in the version in which was applied irrigation, there was high significant difference in the number of seeds compare with variant without irrigation.Where the grape is not used irrigation, the average number was 1.58 and seeds to irrigation plots, the average has been around 2.62 seeds, respectively about 62.4% higher. Meanwhile, even among varieties were observed significant changes also higher. To variety Afus - ali in both years, the average was 3.04 while the Hamburg variety seeds 2 seeds for grain grapes. While significant differences between the years of research has not been (NS) (tab 9).

Table 9. The number of seeds in grape

Varieties (A)		Year (B)	Treatment (C)		Average AB	Average A
			No irrigation	With irrigation		
Afus – ali		2008	2.14	3.04	2.59	2.7 **
		2009	2.06	3.04	2.55	
		Avg. AC	2.1	3.04 **		
Hamburg		2008	1.06	2.02	1.54	1.54
		2009	1.06	2	1.53	
		Avg. AC	1.06	2.01 **	Average B	
Year x Forms of treatment		2008	1.6	2.53		2.07 NS
BC		2009	1.56	2.52		2.04 NS
Forms of treatment (C)			1.58	2.53 **		
Significance		Factors		Interaction between factors				
		A	B	C	AB	AC	BC	ABC
LSD	0.01	0.126	0.073	0.08	0.116	0.126	0.126	0.226
	0.05	0.093	0.054	0.06	0.082	0.088	0.088	0.144

Number of grains grapes

From graph 1, seen that variant with irrigation grape clusters had on average 11.3% higher number than the grains without irrigation option. For both varieties controls (without irrigation) has been 101.4 grains, while 113.2 irrigation respectively. Between varieties were found low significant differences. Once the number of grains/cluster is around 100 in total. This number is taken as the average of the samples. But, in terms of comparison between years, in 2009 there were minor significant differences.While the comparison between the investigated varieties are not observed significant difference (NS).

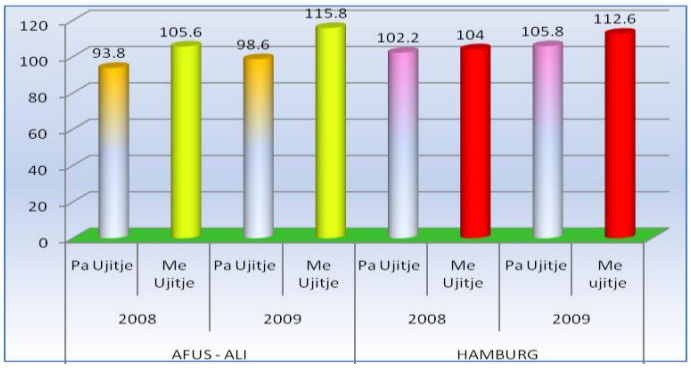


Figure 1. Number of grain in grape clusters

Technological maturity of the grape

Effect of 'Drip irrigation'' clearly manifested in the time of technological maturity of grapes. Differences are evident between the control plots (without irrigation) and the experimental (with irrigation), especially in 2008, which has been at the level of 90%, from 5 days in Hamburg variety.

But in 2009 this difference was observed varying from 2 days. Even to variety Afus - ali is the observed difference of 2 days during 2008 and 2009. These timing differences in technological maturity have always been in favor of the variant with irrigation.

Yield per vine

Comparing the results measured between control plot (without irrigation) and the experimental (with irrigation) shows clearly the positive effect of irrigation. From measurement it is concluded that: varieties Muscat Hamburg showed higher significance between control plots (without irrigation) and the experimental (with irrigation) with differences of 69.9% in 2008 and 74% in 2009, while varieties Afus-ali, experimental plots (irrigation), showed significance changes to the control plots (without irrigation) with difference of 47.3% in 2008 and 20.6% in 2009.

Table 10. The yield per vine

	Muskat Hamburg (kg/Vine)		Afus – ali	(kg/Vine)
Tretman	2008	2009	2008	2009
No irrigate	3.900	3.675	4.800	6.052
With irrigate	6.627	6.400	7.070	7.300
Increase in % .	69.9	74.1	47.3	20.7

Data of author Kabashi.B (2005), on grape irrigation especially of table varieties, proving the fact that this agro-technical measure, regularly increase the yield of grapes. This fact is proven by the annual results achieved in the Republic of Macedonia. From the calculation of the yield per vine obtained the results of yield per hectare.

From the results listed in tab 12, it can be concluded that: where the plots is made irrigation in 2008, both noted that the grape varieties has won the highest percentage of sugar and lower amounts of acids. In 2009 it was concluded the same thing. This has made possible the withdrawal of the larger quantities of mineral nutrient by water, thus enabling higher synthesis of sugar while smaller amounts of acids. In the control plot (without irrigation) the amount of absorption of water and mineral substances was lower, due to the lack of moisture in the soil, resulting in the synthesis smallest carbon hydrates. Results from tab 12. show that yield has correlation with the amount of sugar. This report comes from the supply of large quantities of water that enable supply good nutritional mineral matter which turn into more sugar acids. This conclusion may be related to adverse balance between sugar and acid. Samples that have given more sugar in cider manifest less acidic.

Table 11. The yield per ha

	Muskat Hamburg (kg/ha)		Afus – ali (kg/ha)	
Tretman	2008	2009	2008	2009
No irrigation	15.310	16.247	20.000	25.213
With irrigation	26.662	27.608	29.454	30.412
Increase on % with irrigation	69.9	74.1	47.3	20.7

Total sugar and acids in the grape juice

Based on the analysis, it is observed that the grape varieties which are irrigated characterized by high significant differences as to the amount of sugar as well as the amount of acid. These data are presented in tab 12.

Table 12. Sugar and acids

Afus – ali								Hamburgu							
2008				2009				2008				2009			
Sugar (%)		Acids (g /l)		Sugar (%)		Acids(g /l)		Sugar (%)		Acids (g /l)		Sugar (%)		Acids (g/l)	
No irrigation	With irrigation	No irrigation	With irrigation	No irrigation	With irrigation	No irrigation	With irrigation	No irrigation	With irrigation	No irrigation	With irrigation	No irrigation	With irrigation	No irrigation	With irrigation
16.1	17.2	7.7	4.5	14.8	15.1	5.4	5.2	18.5	20.4	4.7	4.1	18.6	19.1	5.7	4.9

Conclusions

Based on two-year research on the effect of "Drip irrigation" in productivity of table grape, in condition of Dukagjini region in Rep. of Kosovo, we come to these conclusions. The impact of “Drip irrigation” on increase of productivity and improve the quality to the table grape varieties Muscat Hamburg and Afus-ali is very high. Effect of positive impact is manifested in overall productivity, growth to 47.7%, ragman in 7.4% and 0.95% sugar. While irrigation has reduced the amount of acid, because it has increased the amount of sugar. Irrigation has contributed significantly to the growth of grape cluster and their length in the two varieties with 51.2%. This has impacted in the increase in the number and size of grains. While increase of the number of seeds is the result of increase of overall yield. Irrigation form "Drip irrigation" influenced early maturity of grapes that enabled the earliest exit in the market and realization of higher price. Irrigation has greatly influenced to increase in the value of table grapes, until the market has shown higher profitability. From the Two-year research results it can be concluded that irrigation of vineyards is almost necessary measure in the area of territory of Dukagjini valley in Kosovo This agro technical measure is necessary, especially in the first four years of the establishment of the vineyard, and should not be overlooked. The amount of water used for irrigation depends on the climatic conditions of the concerned year such as insolation, temperature, precipitation and soil conditions.

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ВЛИЈАНИЕ НА НАВОДНУВАЊЕТО СО КАПКА ВРЗ ПРИНОСОТ НА ТРПЕЗНИТЕ СОРТИ ГРОЗЈЕ

Сами Криезиу

Апстракт

Со порастот на хуманата популација се зголемува и потребата од земјоделски производи. Од друга страна, нашата земја и целиот регион беше зафатен од високи температури со несоодветна распределба на дождот односно често недостаток на дожд во вегетациониот период. Главната цел на истражувањето е влијанието на наводнувањето на трпезните сорти врз нинвиот принос, кај сортите афус али и мускат хамбург, во агроеколошките услови на Косово, долината на Дукаџини. Староста на насадот е 15 години, поделен на два дела, со наводнување и без наводнување. Испитувањата беа изведени во 2008 и 2009 година. Приносот е изразен како кг/лоза и kg/ha. Утврдени се рзлики меѓу варијантите. Приносот кај сортата афус али е зголемен за 47,3% во 2008 и 20,6% во 2009 година, зависно од големината на годишните колчини на врнежи и нивната распореденост во текот на годината. Приносот кај сортата мускат хамбург се зголеми за 69,9% во 2008 и за 74% во 2009 година. Можеме да заклучиме дека наводнувањето со капка покажува позитивно влијание на зголемување на продуктивноста. Резултатите се пресметани со SPS package и статистички обработени со анализа на варијанса.

Клучни зборови: продуктивност, трпезно грозје, наводнување, сорти.

UDC:634.8-195 (497.6)
Original scientific paper

CLIMATE CHARACTERISTICS OF WINE GROWING IN MOSTAR WINE AREA

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Abstract
The purpose of the paper is to study climatic characteristics, indexes and coefficients in the Mostar area of vineyards in order to evaluate area suitability for vine growing. In this paper, climatic parameters have been analyzed for the period 1961/1990 and 2000/2010 year. In the region under study, the average annual air temperature was 15.6ºC, and the vegetative air temperature had a value of 21.0ºC. The annual temperature sum was 5701.1ºC, the vegetative sum had a value of 4492.2ºC. The elements studied showed higher values when compared to the average (1961/1990). The annual rain sum was 1498.1mm, the vegetative rain sum had a value of 663.3 mm, yielding lower values compared with the period (1961/1990). On the basis of the values of effective temperature sum, it can be concluded that the Mostar area of vineyards (Winkler, 1974) belongs to the climatic zone C. The values of the hydrothermal coefficient indicated that there was an irregular pattern of humidity in the vineyard area where the research was conducted. The helio-thermal coefficient had a value of 6,89, and the bio-climatic index had a value of 5,61. The results of this research indicate that the Mostar area of vineyards is favorable for production of table and wine grape varieties that ripen from I to IV epoch.
Key words: climatic characteristics, indexes, coefficients, grapevine.

Introduction

Certain environmental conditions are needed for normal development of vines, fruiting and in order to regularly obtain high yields of high quality grapes. Different grape vines species and varieties have different requirements to the external environment and react to it unevenly. These demands by environmental conditions, especially the climate, the plants have acquired during their phylogenetic development (Buric, 1972). The requirements of the grapevine for certain climatic conditions refer to a characteristic it gained during its growing culture. Plans to grow certain varieties of grapevine should be in close relation with the climatic and microclimatic elements of the environment (Ilic-Popov, 2003). Almost the entire production of grapes in BiH is located in Herzegovina, where, for many years, a ratio of approximately 80% of the land under vine and 20% of the area under table grapes has been retained. Mostar vineyards in the wine-growing region of Herzegovina are under the direct influence of the Adriatic Sea and have all the characteristics of the modified Mediterranean or Adriatic-highland climate (Vuksanovic and Mijatovic, 1982., Mijatovic and Šećerov, 1990). Limestone cascading from the mountain tops to the sea has important impact on the climate conditions of this area. Bare limestone in certain periods of the year has a special effect on the temperature regime. The most prominent form of fluvial region is the valley of the Neretva

River and its tributaries, which is more extended in the Mostar valley to the delta. Authochthonal cultivars Žilavaka and Blatina have the most significant factors in the production of wine in Herzegovina region (Vuksanovic, 1977).

Material and methods

For the analysis of the climatic conditions in the Mostar area of vineyards and their suitability from the climatic aspect and for successful raising of certain varieties of grapevines, we used meteorological data of the meteorological Stations in Mostar for the period of 1961/1990 and 2000/2010. We made estimations of the coefficients and the indexes in accordance with the accepted methodologies in the world grapevine circles. On the basis of the sum of effective temperatures and the established viticulture zones A, B1, C1, C2 and C3 (Winkler, 1974), we also established division of the areas of vineyards in climatic zones where the research was conducted. The international grapevine circles accepted the division according to Winkler.

Results and discussion

Since the grapevine requires certain conditions in the sense of climatic conditions, it is indispensable, prior to the introduction of every variety in the production, to study the climatic conditions in the production region in terms of the production potential of the culture to be exploited, so that good crop and high quality grape can be obtained. In our research, we have carried out an analysis of some climatic elements. In Table 1, data of the warmth and rainy conditions in the areas of vineyards where the research has been conducted are shown.

Table 1. Warmth and rainy conditions in Mostar areas of vineyards

	Year	T_{year}	$T_{iv\text{-}x}$	ΣT	Σ $T_{iv\text{-}x}$	ΣH	Σ$H_{iv\text{-}x}$	ΣEffect.T	ΣEffect.$T_{iv\text{-}x}$
Mostar	61/91	15,6	21,0	5701,10	4492,2	1498,1	663,3	2382,50	2352,2
	00/10	14,6	19,6	5333,70	4204,2	1523,0	676,0	2086,30	2064,2

In the Mostar area of vineyards, for the period of 2000/2010, the average annual air temperature is 15.6ºC and ranged from 14,6ºC (2005) to 16.1ºC (2003, 2007 and 2008). In the period of 1961/1991, the average annual air temperature ranged from 13,6ºC (1976) and 13,7ºC (1980) up to 16,1ºC in 1961. The vegetative air temperature had a value of 21,0ºC, and ranged from 19,9C (2003) to 21,5ºC (2007). In the period of 1961/1991, the vegetative air temperature ranged from 18,4ºC (1974, 1976) up to 21,1ºC in 1961. The annual temperature sum had a value of 5701,10ºC, and the vegetative sum was 4492,2ºC. Compared with the perennial average, the examined elements have higher values. The average annual sum of rain had a value of 1498,1 mm, and ranged from 1043,8 mm (2006) to 2544,7 mm (2010). The vegetative sum of rain was 663,3 mm, and ranged from 408,60 mm (2007) to 1047,8 mm (2010). In some years (2004, 2009 and 2010), the annual sum of rain deviated widely from the average. The heaviest rains were during the winter period, then in autumn, and the least during summer. Numerous researches about the influence of climate upon the grapevine contributed to the formation of bio-climatic data for the culture. With their application, the zones for growing the grapevine varieties can be differentiated and defined. On the basis of the value of the effective temperature sum, it can be concluded that the Mostar area of vineyards belongs to the climatic zone C_2. For establishing the supply of the vine with the necessary quantities of water, a hydrothermal coefficient is determined (HiTK). The values of the

hydrothermal coefficient are also determined (HeTK), being a safe indicator of the warmth conditions and sunshine. To determine potential conditions for growing the culture, we have defined bio-climatic index (BKI), which represents a complex indicator because at the same time it connects warmth, light and rain conditions with a biological characteristic of the grapevine and the duration of the vegetation period. In Table 2, the values of the climatic coefficients and indexes for the period of 2000/2010 are shown.

Table 2. Climatic coefficients and indexes in Mostar area of vineyards, 2000/2010

	Year	TK	HiTK	HeTK	BKI
Mostar	61/91	5,26	1,48	6,89	5,61
	00/10	10,05	1,61	6,05	4,90

Thermal coefficients for the period 2000-2010 amounted to 5.26 and are significantly lower than the mean values of thermal coefficient for the period (61/91) with a value of 10.05. The value of the thermal coefficient indicates favorable temperature conditions during the growing season. The values of the hydrothermal coefficient indicate that, in the study areas of vineyards, there is an irregular distribution of humidity. The values of the helio-thermal coefficient 2,8 -4,5 indicate that the viticulture unit is favorable for raising vines. In the Mostar area of vineyards, the helio-thermal coefficient had a value of 6,89. The value of the bio-climatic index is used for evaluating the climatic conditions of the viticulture unit for growing grapevines, and also for correct selection of varieties. Its optimal value is 10, and is considered good enough, increased or reduced by 5. In the study area of vineyards, the bio-climatic index had a value of 5,61.

Conclusions

The analysis of climate indicators for Mostar vineyard was done through comparative review of relevant parameters from the current zoning of Bosnia and Herzegovina and the parameters collected and analyzed for the periods 1961/1991 and 2000/2010. Temperature conditions in the Mostar area are favorable for vine growing. High air temperatures during the growing season are suitable for grape ripening and successful shoot ripening. Rainfall is quite frequent throughout the year, but it is quite low during the growing season and unevenly distributed. It is particularly low in the seventh month when grape has intensive shoot growth and development of young berries in most of varieties. Precipitation is abundant in September. The duration of sunshine is very favorable for the cultivation of almost all varieties of grape.The results of this research indicate that the Mostar area of vineyards is favorable for production of table and wine grape varieties that ripen from I to IV epoch.

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КЛИМАТСКИ КАРАКТЕРИСТИКИ НА МОСТАРСКОТО ВИНОГОРЈЕ

Јовановиќ Цветковиќ Татјана, Мијатовиќ Драгутин, Радојевиќ Ивана

Апстракт

Целта на испитувањето се климатските карактеристики, индекси и коефициенти во подрачјето на мостарското виногорје заради проценка на погодноста за одгледување на винова лоза. Во овој труд климатските карактеристики се анализирани за периодот 1961/1990 и 2000/2001 година. Просечната годишна температура изнесува 15.6ºC, додека просечната вегетациона температура изнесува 21.0 ºC. Годишната сума на температури изнесува 5701.1ºC, а вегетационата сума на темпратури 4492.2ºC. Вредностите на проучуваните елементи се повисоки во однос на просекот (1961/1990). Годишната сума на врнежи изнесува 1498.1mm и вегетативната сума која изнесува 663.3 mm, се пониски во однос на периодот (1961/1990). Врз основа на вредностите на ефективните температурни суми, може да се заклужи дека подрачјето на мостарските лозја (Winkler, 1974) припаѓаат на зона Ц. Вредноста на хидротермичкиот коефициент покажува дека постои мала неправилност. Хелиотермичкиот коефициент има вредност од 6,89 а биоклиматскиот индекс 5,61. Резултатите од ова испитување покажуваат дека подрачјето на Мостар е поволно за производство на трпезни иински сорти на грозје кои созреваат од I до IV епоха.

Клучни зборови: климатски карактеристики, индкеси, коефициенти, винова лоза.

UDC: 634.8-167/-18 (497.16)
Original scientific paper

ECONOMIC-TEHNOLOGICAL CHARACTERISTICS OF GRAPES "VRANAC" DEPENDING ON THE FERTILIZATION AND IRRIGATION

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Abstract
The paper presents three-year results of the research the effect of different types of fertilizers and irrigation on the growth quantity, quality of yield and vegetative potential varieties Vranac. Investigations were carried out at the site of Podgorica's vineyards "Ljeskopolje".It was applied eight different fertilization variants, which are also subject to irrigation, as well as in conditions without irrigation. (Control, NPK 8:16:24, cow manure, poultry manure,peat and manure Combination of the above). All investigated variants of fertilization achieved in the three-year average yield higher than unfertilized variants. The highest yield had a variation where as cattle manure fertilizer used. Irrigation has had a positive impact on this indicator yields. Most varieties of fertilizers have yielded positive results in terms of sugar content in must. The highest sugar content in must of the three-year average was the variant with peat. Different types of fertilizers did not show a significant impact on the total content of acids in must. Both indicators of the quality of grapes had higher values reflected in the irrigated area compared to the part of the experiments, which are not irrigated. The greatest potential for vegetative had a variant where the fertilizer was used as a combination of cattle manure and peat. In all variants of fertilization discarded vine pruning weight was higher in irrigated than in no irrigated conditions.
Key words: fertilization, irrigation, yield, sugar, acid, vegetative potential.

Introduction

The viticulture of Montenegro is mainly represented in Podgorica, where the cultivation of vine, and the production of grapes and wine are an integral part of the economy of this region. In the structure of wine varieties the leading place has the autochthonous, high quality Vranac variety grapes that produce premium quality grapes. Most vineyards perched on skeletal, mostly infertile soils of the southern part of Montenegro vegetate and bearing fruit in terms of lack of basic elements of nutrition. In such conditions, the application of mineral and organic fertilizers is a very important factor in increasing yield and improving its quality, but also a very important factor for improving the physical and chemical properties of soil (Popović, 2008). Podgorica's vineyards are characterized by a Mediterranean climate with high annual precipitation, which are unevenly distributed. The land is saturated with water during resting period, and insufficiently supplied with water in times of greatest plants' activity. Under such conditions, irrigation is necessary agro-technical measure. The aim of this study was to examine how different types of mineral and organic fertilizers and combinations, as well as irrigation, affect the amount, quality and vegetative yield potential of the cultivar Vranac.

Material and methods

Studies were performed in the period 2003/2005 on the experimental farm of the Biotechnical Institute in Podgorica. The experimental vineyard was planted in 1986. The spacing between rows was 2.50 m and the distance between the vines in the row was 1.20 m. Growing form is a double cordon about 80 cm high. Studies were performed on the Vranac variety of grapes which was grafted on a rootstock Kober 5BB.

The experiment included the following combinations and variants:

Combinations: A – Irrigated, B – Unwatered. Variants: 1. Control – without fertilization, 2. NPK (8:16:24) – 500 kg/ha, 3. Cow manure – 20 t/ha, 4. Poultry manure – 10 t/ha, 5. Peat – 10 t/ha, 6. Cow + poultry manure – 10 + 5 t/ha, 7. Cow manure + peat – 10 + 5 t/ha, 8. Poultry manure + peat – 5 + 5 t/ha.

Basic fertilizer entered the soil during the period of rest by plowing a furrow in the middle of the space between the rows in 25-30 cm deep. The furrows were filled with a calculated amount of fertilizer for a corresponding variant, half the amount on one side and the other half on the other side of the row. The irrigation was carried out over the surface – not flowing through the furrows. In the space between the rows a single furrow was ploughed.

The irrigation was carried out as soon as the soil moisture dropped 17% below. It was carried out by pumping the water from the canals near the experimental location.

Each variant had 18 vines arranged in three replicates with six rows of vines. Selected vines in each year of the research were pruned by the same criteria, using the mixed pruning with two canes with 10 buds and two 1-yr-old-canes with two buds each. This made a total burdening of 24 buds per vine which was in accordance with the usual way of pruning of the Vranac variety in the plantation growing of Montenegro. Yield was obtained by measuring the harvested grapes and by the conversion of yield per m^2.

The content of sugar in the grape juice was determined areometrically (by Oechsle Scale), while the content of total acids in grape juice was determined by neutralization of all acids and their salts n/10 solution NaOH with indicator Bromothymol blue. The pruning weight was determined during winter pruning, weighing all the pruned canes on decimal scale. The data were analysed by using the variant of a completely random block system. The significance of differences was determined by using the LSD test.

Results and discussion

The yield of grapes -The highest yield of grapes, on average for all three years of research (table 1.), was measured in the variant with cow manure – 1.49 kg/m^2 . In the combination with poultry manure and peat and the variant with poultry manure alone the yield was a little lower – 1.43 and 1.42 kg/m^2 . The area that was fertilized with mineral fertilizer the yield was 1.41 kg/ m^2 . The variants 7, 5 and 6 had the yield lower than 1.40 kg/ m^2 (1.38; 1.33; 1.23 kg/ m^2). The variant 6 had the yield that was only for 0.6 kg/ m^2 higher than the control.

All the tested variants of feeding in the three-year average had a higher yield than the variant without fertilisation where the yield was only 1.16 kg/ m^2 . Despite demonstrated differences in the yield of grapes there was no statistically significant difference between the different variants of feeding. The results are in contrast with those given by Lazic (1954) who achieved the best results in the yield of grapes in areas fertilized with mineral fertilizers and then in the areas fertilized with

manure and green manure. Besides variations in yield according to the variants of feeding, Table 1. shows the variation of yield depending on the application of irrigation as well.

Table 1. The yield of grapes (kg/ m^2)

Combination	Irrigation (N_1)			Average (N_1)	Without irrigation (N_2)			Average (N_2)	Average (A)
	2003	2004	2005		2003	2004	2005		
A_1	0,91	1,23	1,44	1,19	0.97	1,25	1,21	1,14	1,16
A_2	0.98	1,45	1,87	1,43	1,12	1,56	1,50	1,39	1,41
A_3	1,52	1,60	1,73	1,62	1,31	1,27	1,50	1,36	1,49
A_4	1,39	1,33	1,63	1,45	1,20	1,53	1,47	1,40	1,42
A_5	1,34	1,68	1,50	1,51	0,91	1,07	1,47	1,15	1,33
A_6	1,19	1,44	1,37	1,33	1,06	0.99	1,33	1,13	1,23
A_7	1,29	1,68	1,74	1,57	0,93	1,35	1,27	1,18	1,38
A_8	1,11	1,72	1,54	1,46	1,39	1,32	1,45	1,40	1,43
Average B	1,22	1,52	1,60	1,44	1,11	1,29	1,40	1,26	1,35

LSD	A	B
0.05	0.814	0.407
0,01	1.096	0.548

Comparative results of the two combinations of experiment (unwatered and irrigated) reveal interesting details that lead to the conclusion that the application of fertilizers have a completely different character in the conditions of dry viticulture in comparison to the viticulture in the conditions of irrigation. In fact, under the dry viticulture the variants of fertilization like 5, 6 and 7, which gave a very low yield of grapes, proved to be very good under the irrigation, which further means that the conclusion obtained on the basis of yield under the dry viticulture would have no adequate value in the terms of viticulture with irrigation. In the three-year average the yield of grapes in irrigated area was 1.44 kg/ m^2 , while in the unwatered experimental area it was 1.26 kg/ m^2 . Despite the clear positive tendency of the influence of irrigation on the yield of grapes there was no statistically significant difference in the three-year average compared to the yield obtained under the dry viticulture. The yield of grapes in all the variants of feeding was within the results that various authors emphasize for the Vranac variety of grapes: Pejovic (1982), Ulicevic (1966, 1991), Buric (1995), Cindric (2000), Popovic (2003).

Sugar content of must - Based on the results (Table 2) it can be seen that the sugar content of the must was quite satisfactory and characteristic of the tested variety in the field. Most varieties with fertilizers had positive results, except for variant no. 7 in which the sugar content amounted 22.35%, which is 0.25% less sugar content than in the unfertilized area, where the sugar content was 22.60%. The highest sugar content of the three-year average was at variant with peat 25.90%. Variant with poultry manure had also high sugar content: 24.85%, as well as variants 3 and 6 with 24.65 and 24.45% sugar in the must. Despite the demonstrated differences in the contents of the sugar in the must according to the nutritive variations, in the three-year average, only variant 5 achieved statistically significant difference in relation to variants 7, 1 and 8. The variant with poultry manure compared with a variant no.7 and no. 1 had significantly higher sugar content in must, while variant

where beef manure was combined with peat showed statistically significant difference only in relation to variant no.7.

Table 2. Sugar content in the grape juice (%)

Combination	Irrigation (N_1)			Average (N_1)	Without irrigation (N_2)			Average (N_2)	Average (A)
	2003	2004	2005		2003	2004	2005		
A_1	23.90	22.00	23.00	22.95	22.60	22.30	21.90	22.30	22.60
A_2	26.50	23.50	24.25	24.75	24.00	21.90	23.20	23.00	23.90
A_3	23.95	25.40	26.55	25.30	23.45	23.40	25.10	24.00	24.65
A_4	24.50	28.10	24.50	25.70	24.50	24.00	23.40	24.00	24.85
A_5	28.00	26.90	25.10	26.70	23.30	25.45	26.60	25.10	25.90
A_6	24.40	24.80	24.50	24.60	23.60	25.20	24.30	24.40	24.45
A_7	22.95	23.45	23.20	23.20	21.90	20.40	22.00	21.45	22.35
A_8	25.70	24.70	22.80	24.40	20.50	21.30	22.60	21.50	22.95
Average B	25.00	24.85	24.25	24.70	23.00	23.00	23.60	23.20	23.95

LSD	A	B
0.05	2.083	1.042
0,01	2.805	1.403

In all tested variants the sugar content was in the range of values that were stated as characteristic of the cultivar *Vranac*, by Ulićević (1966.1991), Avramov (1991), Burić (1995), Pejović (1982), Popović (2003). Lazić (1954) noted that the sweetest must was obtained in variants with mineral fertilizer, and then variants with organic fertilizer and green fertilizer, which is in contrast with the results of these investigations. The sugar content in the irrigated area for all variations in the three-year average was 24.70% and was significantly higher than in non-irrigated part of investigation where it amounted 23.20%.

The content of total acids in the must - The data presented in table 3. showed that different variants of nutrition showed no significant effect on the total acid content in must.

The amount of total acids in the general three-year average was the highest in the variant that is fertilized with peat - 6.36 g / l and then at the varieties with beef manure -6.35 g / l.

In other investigated variants acid content in must was lower compared to control, where the total acid content was 6.23 g / l. The lowest content of acids in the three-year average had variant no. 6 (5.95 g / l). In the irrigated conditions the total acid content in the general average and in all the variants of nutrition was significantly higher compared to the part of the test which was not irrigated. The difference is highly significant so that it can confirm that the use of irrigation increases the total acid content in must.The total content of acids in the average of all variations on the irrigated part of the experiment was 6.40 g/l and was significantly higher compared to the part that was not irrigated and amounted 5.93 g/l.

Table 3. Acidity in the grape juice (g/l)

Combination	Irrigation (N_1)			Average (N_1)	Without irrigation (N_2)			Average (N_2)	Average (A)
	2003	2004	2005		2003	2004	2005		
A_1	8.10	5..40	5.90	6.46	7.70	5.10	5.20	6.00	6.23
A_2	8.50	5.50	5.40	6.46	7.30	5.00	5.10	5.80	6.13
A_3	7.90	6.70	5.30	6.63	7.40	5.70	5.10	6.06	6.35
A_4	8.00	5.60	5.10	6.23	7..30	5.10	5.50	5.97	6.10
A_5	8.30	6.20	5.20	6.56	7.10	6.10	5.30	6.17	6.36
A_6	7.00	5.70	5.70	6.13	6.90	5.40	5.00	5.76	5.95
A_7	7.10	5.60	5.40	6.00	7.10	5.10	5.80	6.00	6.00
A_8	8.40	6.00	5.80	6.73	6.60	5.20	5.40	5.73	6.23
Average B	7.91	5.83	5.47	6.40	7.18	5.32	5.29	5.93	6.16

LSD	A	B
0.05	0.601	0.300
0,01	0.809	0.405

Vegetative power of vines - Through the mass of vine-leaves we find out about the exuberance of vines as an indirect indicator of vegetative power of the plant. Exuberance of vines, which is the resultant of number of sprouts and their development length and thickness, depends on the biological characteristics of the variety, soil moisture, air temperature, availability of nutrients, pruning, the position of sprouts, etc. Based on the results (table 4.) it can be concluded that that variants of nutrition and use of irrigation in years of research have had significant influence on exuberance of vines, or the pruning weight. All fertilized areas had significantly more vine-leaves from unfertilized areas where the average pruning weight amounted 0.20 kg / m². At variant that was fertilized with mineral fertilizer NPK 8:16:24 and variants 6, difference in pruning weight, compared to the control, was the smallest and amounted only 0.01 kg / m².On land fertilized with organic fertilizer the pruning weight was higher and ranged from 0.22 kg / m² in the variant with peat up to 0.26 kg / m² in variant where a combination of cattle manure and peat was used as fertilizer. Accomplished difference in pruning weight between variant 7 in relation to variant without fertilization and the variant with mineral fertilizer, as well as in relation to the variants 6 and 5 is statistically very significant, while the difference between variant 7 and variants with poultry manure is statistically significant. The difference between variant 7 and 8 amounted 0.02 kg/m² and has not reached the limit of statistical significance.

Variant without fertilization had significantly very smaller pruning weight in relation to variations 8 and 3 and significantly lower in relation to the variant with poultry manure. Besides variant 7, variant 8 also had significantly higher pruning weight in relation to the variant with mineral fertilizer and variant 6.On the irrigated area the average pruning weight for all tested variants was 0.24 kg/m2, while at the non-irrigated part it amounted 0.21 kg/m2. The irrigation obviously had significant effect on the vegetative potential of vine which has been proved by analysis of variance.

Table 4. Pruning weight (kg/m2)

Combination	Irrigation (N_1)			Average (N_1)	Without irrigation (N_2)			Average (N_2)	Average (A)
	2003	2004	2005		2003	2004	2005		
A_1	0,20	0,21	0,22	0,21	0,16	0,21	0,21	0,19	0,20
A_2	0,22	0,22	0,22	0,22	0,18	0,21	0,20	0,20	0,21
A_3	0,25	0,25	0,24	0,25	0,20	0,24	0,25	0,23	0,24
A_4	0,24	0,26	0,23	0,24	0,21	0,20	0,21	0,21	0,23
A_5	0,23	0,24	0,23	0,23	0,20	0,20	0,19	0,20	0,22
A_6	0,22	0,22	0,21	0,22	0,15	0,21	0,20	0,19	0,21
A_7	0,28	0,29	0,25	0,27	0,26	0,27	0,20	0,24	0,26
A_8	0,26	0,27	0,25	0,26	0,20	0,21	0,22	0,21	0,24
Average B	0.24	0.24	0.23	0.24	0.19	0.22	0.21	0.21	0.22

LSD	A	B
0.05	0.024	0.012
0,01	0.032	0,016

Conclusions

Based on the obtained results, the following conclusions can be drawn:

The highest yield had the variant with beef manure, while the lowest yield was recorded at unfertilized surface. Irrigation had a positive influence on this indicator of fruitfulness of the cultivar.

The highest level of sugar in the must had the variant where the peat was used as the fertilizer. Sugar content in the irrigated area for all tested variants in the three-year average was very significantly higher than in non-irrigated part of the experiment. Different type of nutrition showed no significant effect on the total acid content. In the irrigated conditions the total acid content in all variants of nutrition was significantly higher compared to the part of the experiment that was not irrigated. The application of organic fertilizer had positive effect on the vegetative potential of variety *Vranac*. In all the variants of nutrition the average pruning weight was higher in relation to the unfertilized surface and surface fertilized with mineral fertilizer.The greatest pruning weight, during the three year average and under the conditions of irrigation and non-irrigation, had a variant where a combination of cattle manure and peat was used as fertilizer. Irrigation has a positive effect on the vegetative potential of the plant. In all variants of fertilization discarded vine pruning weight was higher in irrigated than in no irrigated conditions.

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СТОПАНСКО ТЕХНОЛОШКИ КАРАКТЕРИСТИКИ НА СОРТАТА ВРАНЕЦ ВО ЗАВИСНОСТ ОД ЃУБРЕЊЕТО И НАВОДНУВАЊЕТО

Поповиќ Т., Мијовиќ С., Раичевиќ Д., Пајовиќ Р.

Апстракт
Во трудот се прикажани трогодишните резултати од испитувањето на ефектот на различни типови на ѓубриво и наводнување врз порастот, квалитетот на приносот и вегетативниот потенцијал на сортата вранец. Испитвањата се изведени во опитното поле во Подгорица, Љешко поље. Аплицирани се 8 варијанти со ѓубрење, комбинирани со наводнувањеи без наводнување. Контролната варијанта, NPK 8:16:24, говетско арско ѓубриво, арско жубриво од живина, тресет и комбинации од ѓубривата. Кај сите испитувани варијанти забележан е поголем принос во однос на неѓубрените варијанти. Највисок принос е забележан во варијантите со говетско арско жубриво. Наводнувањето има позитивно влијание на приносот. Поголемиот број на варијантите со ѓубрење имаат позитивни резултати во однос на содржината на шеќер, највисока содржина е забележана кај варијантата со тресет. Различните варијанти не покажуваат значајно влијание врз содржината на киселини во ширата. Двата инидкатори за квалитет имаат поголеми вредности во варијантите каде е употребено наводнувањето. Најголемиот влијание врз вегетативниот потенцијал има варијантата каде е направена комбинација од говедско ѓубриво и тресет. Во сите варијанти со ѓубрење, забележан е поголем принос на зрели ластари со наводнување во однос на варијантите со ненаводнување.
Клучни зборови: ѓубрење, наводнување, принос, шеќер, киселини, вегетативен потенцијал.

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EFFECT OF DIFFERENT BUDS LOAD PER VINE ON GRAPES AND WINE QUALITY OF KRATOSIJA VARIETY

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Abstract
This paper presents the results of the effect of five different buds loads of vine on the quality of grapes and wine of autochthonous Montenegrin grapevine variety kratosija, in subregion Podgorica. On experimental field, different number of buds per vine (5 buds/vine, 6 buds/vine, 8 buds/vine, 9 buds/vine and 11 buds/vine) were left by winter pruning. During vegetation, yield parameters and quality of grape and wine produced by process of microvinification were monitored. Based on obtained results it was concluded that at load of 9 buds/vine, high yield with satisfactory quality of grapes and wine was achieved. At load of 6 buds/vine, lower yield per unit area and high quality wine were achieved but differences in quality are not too significant compared with quantity
Key words: load of buds, yield, quality of grapes, quality of wine.

Introduction

Load of vine with fertile buds, beside other factors, greatly influence on variation of fertility, yield and quality of grape. It is generally believed that heavy crop loads inhibit the development of quality wine grapes and many winemakers are showing a preference for fruit sourced from low yielding vineyards. However, other research has shown that there was little response to variations in yield. It is clear that the yield/quality relationship is not a straightforward one and wine grape growers should investigate certain agro-ecological conditions optimum yields that will still produce quality wine grapes. Based on indicators of potential fertility, yield, as well as, on results of chemical analysis of must and wine, the aim of this work was to determine the impact of different load of vine with buds of kratošija variety, in conditions of sub region Podgorica. According to many literature data (Ulićević, 1966; Pejović, 1988; Maraš, 2000), kratošija is Montenegrin autochthonous grapevine variety, appeared and introduced in culture of breeding quite before vranac was. Regarding the characteristics and attributes, it belongs to eco-geographical group of varieties (*Convarietas Pontica Negr.*), a subgroup *balcanica*. It is grown for centuries in Montenegro and belongs into the category of recommended varieties for quality and top quality wine. Nowadays, because of its heterogeneity kratošija is underrepresented and it mostly can be found in combination with vranac variety. Heterogeneity of kratošija in term of expressing its features led to the degradation of this variety and to the appearance of series varieties-biotypes with obviously differences, what caused its lower representation in Montenegrin vineyards. Differences occurred as consequences of long vegetative propagation and various levels of used agro-techniques in divers agro-ecological conditions of Montenegrin viticulture regions.

Material and methods

Experimental vineyard with kratošija variety/1103P, was planted in 2003 at Ćemovsko field-locality – Dinoš. The distance of planting in the vineyard is 2,60m x 0,70m (5495 vinesa/ha), each vine receives food area of 1,82m^2. Vines were formed in the shape of single Guyot with trunk height of 70cm. In order to plan load of vine with buds, data about average productivity of one bud (potential bud fertility coefficient), average bunch weight and desired yield per vine were used. Used value of bud fertility coefficients (1,0) and average bunch weight (252g), were reached as average value of examination results done by Burić (1995), Ulićević (1966), Maraš (2000), Savić (2003) and of internal data reached in company „13. Jul Plantaže" a.d. for grapevine variety – kratošija. Based on planning results, winter pruning was done and planned load was correctly staggered on fertile elements (spurs and canes). In order to realize tasks, we have followed the most important agro-bilogical, economics and technological characteristics of five examined load of vine with buds (5, 6, 8, 9 and 11buds per vine). Examination of potential and real fertility were done on 15 vines (three repeating with 5 vine) for every combination of vine load. Potential fertility as one of the most important characteristics of variety was determined in May, in the time when it is easy to notice flowers, and based on reached data, fertility coefficients (*potential buds fertility coefficient, shoot fertility coefficient and absolute shoot coefficient*) were calculated. Yield was determined by measuring ienof picked grapes weight in phase of technological maturity. Weight of picked grapes was measured separately per every vine, and its average value is shown at results. In order to complete evaluation of grape quality and its wine, grape processing of all load combinations was done in cellar for microvinification, in microvinficators of Ganimede brand. Sensory analysis was done in accordance with recommendations of OIV – *International Organisation of Vine and Wine,* where the system of evaluation up to 100 points is applied.

Results and discussion

Fertility coefficients of buds at different load

Number of left buds by pruning at grape variety kratošija, ranged from 5 buds per vine at combination A to 11 buds per vine at combination E. Degree of load vine with buds and its disposition on fertile elements, beside other factors, influenced on number of activated buds, the number of fertile shoots, yield and grape quality. On the basis of the data on potential fertility, recorded in experimental vineyard during months May, fertility coefficients were calculated for all combination, average values are shown in Graph 1.

Average number of flowers per bud that was left by pruning or potential buds fertility coefficient was the highest at combination D (1,18). Regarding to other combinations, values of these coefficients was quite lower than 1,0, and the lowest value was noticed at combination A, i.e. at combination with the lowest load. Values of this coefficient for all combinations were quite lower than those cited in literature (1,2 – 1.6) Ulićević (1966) and Avramov et al. (2001). The highest value of relative fertility coefficient was noticed at combination D (1,09), what means that on average every shoot had more than one bunch, while the lowest value of this indicator was at combination A. Also, Graph 1 shows that highest number of bunches that one fertile shoot had was noticed at combination D (1,28), and combination B had the lowest value of this coefficient (1,07).

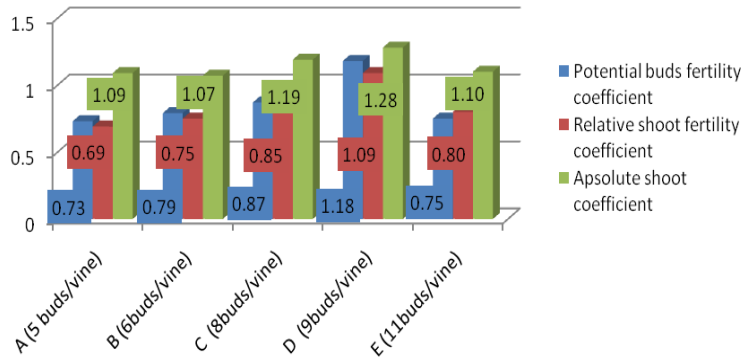

Figure 1. Fertility coefficients of grape variety kratošija at different combination of load vine with buds (2009).

Grape yield per vine at different combination of load vine with buds

By analysing of reached data (Table 1) can be concluded that the lowest average bunch weight (183,18 g) was at combination D. Average bunch weight at combination D is for 68,82 g less than average bunch weight used in planning of load vine (252.0 g). Grape variety kratošija is known as variety with big bunches (about 250 g) (Ulićević, 1966; Cindrić et al., 2000), and on the basis of the results can say that in concrete conditions, at all examined load combinations except at combination C is reached significantly lower bunch weight. Unfavourable weather conditions at the end of May and during June in 2008 caused poorly formation of crop and largeness of flowers for next year. Extremely high rainfall in month June of 2009 – 234.9 mm (even 280% more comparing to multiyear average for this month), when flowering and fertilization were still running on, caused to the lower fertilization, primary infection and later development of botrytis (*Botrytis cinarea)*, what for sure influenced on average bunch weight and reached yield. Kuljančić et al. (2007) stated that cold weather with high rainfall in May and June (in previous year), during the time of crop formation for next year, in buds that were left by pruning on shoot, cause decline of coefficient fertility value in next year. Differences in achieved values of average bunch weight and fertility coefficients to values values used during load planning, caused reaching quite lower yields, as per vine and so per unit of surface (Table 2). Increase of vine load with fertile buds and increase ol fertile elements lenght is not followed with proportionate enhancement of yield.

Table 1. Achieved grape yield per vine and per unit of surface at different combination of load vine with buds of grape variety kratošija (2009)

	Combinations of load	Number of bunches per vine (X)	Average bunch weight (g)	Yield per vine (X) (kg/vine)	Average yield per ha (t/ha)
KRATOŠIJA	A (5 buds/vine)	6.10	204.89	1.24	6.81
	B (6 buds/vine)	5.50	190.42	1.04	5.75
	C (8 buds/vine)	5.30	268.69	1.43	7.88
	D (9 buds/vine)	10.00	183.18	1.78	9.78
	E (11 buds/vine)	7.90	213.79	1.68	9.23

Quality of grapes and wine

Grape quality expressed through the sugar content, total acids and pH value in must (Table 2) was on approximately the same level at all examined combinations, suggesting that vine load with fertile buds like this did not lead to the significant reduction in grape quality. Stoev (1973) stated that all varieties don't react in the same way on change of load, e.g. Cabernet sauvignon belongs to varieties that stand up high load with no noticeable reduction of sugar content in grape must. Chemical analyses results of wine (Table 2) indicate that the highest alcohol content had the sample of B combination – 15,2vol %, and the lowest alcohol content was in the sample A, D i E - 14,7vol %. Generally can be ascertain that in all wine samples of grape variety kratošija alcohol values are high, what is, beside high total acid content, one more expressive feature of this variety. Wine quality largely depends on extract content. Wines with low extract content are inharmonious and empty, while wines with too much extract are too heavy and dense. Desirable fullness and harmoniousness are characteristics of wine with good extract content. Extract content without sugar range between 18 – 40g/l in red wines (Blesić, 2006). Chemical analyses results indicate that these wines are very extractive and that value of this parameter ranged from 30,2g/l (E combination) to 32,3g/l (combination B). Phenolic compounds accumulate with development of berry, as secondary product of sugar catabolism. Healthy and mature grapes give wine with high phenolic compounds content. In analysing wines polyphenolic content ranged from 2,07g/l (E combination) to 2,33g/l (D combination). Values of anthocyanin content in examined wines ranged from 241 mg/l (E combination) to 374 mg/l (B combination). Low values of anthocyanins are primarily features of grape variety, and then the other factors. By sensory analysis, wine of B combination (load of 6 buds/vine) received the most points (94,5), and it is characterized as balanced wine, with good relation of acids and alcohol, good structure and body. Wine with highest load (11 buds/vine) received the lowest mark and it is assessed as wine with no expressed odour, covered aromas of variety, weak body and inharmonious.

Table 2. Results of must and wine chemical and sensory analyses of grape variety kratošija (2009).

Combinations of load	Chemical analysis							Sensory analysis	
	Must		Wine						
	Sugar (%)	Total acids (g/l)	Ph	Alcohol (vol%)	Total acids (g/l)	Total extract (g/l)	Total polyphe-nols (g/l)	Anthocyanins (mg/l)	Total mark
A	24.2	7.05	3.39	14.70	6.50	32.00	2.10	299	83.20
B	24.4	6.96	3.40	15.20	6.52	32.3	2.08	374	94.50
C	24.4	6.87	3.46	15.00	6.6	31.00	2.29	341	87.30
D	23.6	6.97	3.42	14.70	6.46	31.00	2.33	288	80.50
E	24.2	6.96	3.42	14.70	6.22	30.20	2.07	241	66.80

Conclusions

Analysing all previosly stated results, D combination (load 9 buds/vine), separated as combination which achieved high yield and satisfying quality of grape and wine. B combination, with quite lower grape yield (load of 6 buds/vine), distiguinshed with wine quality, but because of economic

justification of production, this load could be recommended only for production of grape on small surfaces and production of high quality wine. Although achieved results are positive, it should be noted that data collected during one year are not sufficient to make a judgment about optimal load of grape variety kratošija. It is neccesery to do this examination for many years contaniously. Even though, one year results can serve us as significant source of information in term of solving this and similar problems of grape variety kratošija.

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ЕФЕКТ ОД РАЗЛИЧНОТО ОПТЕРЕТУВАЊЕ СО ОКЦА ВРЗ ГРОЗЈЕТО И КВАЛИТЕТОТ НА ВИНОТО ОД СОРТАТА КРАТОШИЈА

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Апстракт

Во овој труд се презентирани резултатите од ефектот на пет различни оптеретувања со родни окца на лозата врз квалитетот на грозјето и виното на автохтоните црногорски сорти винова лоза кратошија во подреонот Подгорица. На експерименталното поле, различен број на окца по лоза (5 окца/лоза, 6 окца/лоза, 8 окца/лоза, 9 окца/лоза и 11 окца/лоза) беа оставени со зимска резидба. За време на вегетацијата, приносот и квалитетот на грозјето и виното произведени со методот на микровинификација беа разгледувани. Врз основа на добиените податоци заклучивме дека оптеретувањето од 9 окца на лоза дава висок принос со задоволителен квалитет на грозје и вино. На оптеретување од 6 окца/лоза понизок квалитет на единица површина и висок квалитет на вино беа добиени но разликите во квалитетот не се толку значајни споредени со квантитетот.

Клучни зборови: оптеретување со окца, принос, квалитет на грозје, квалитет на вино.

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APPLICATION OF CLUSTER ANALYSIS IN AN INVESTIGATION OF THE VARIABILITY OF QUANTITATIVE TRAITS IN THE HYBRID COMBINATION SUPER EARLY BOLGAR X RUSSALKA

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Abstract
The variability of commercially significant quantitative traits and the possibilities for selection of elite seedless and seeded forms in F_1 progeny of the cross Super Early Bolgar x Russalka have been studied by means of Cluster Analysis and Principal Component Analysis (PCA). It has been found that only seven of the principal components are enough to explain 85,186 % of the total variation in the entire plant population, six principal components – 88,462 % of the total variation in the seeded seedlings and 90,663 % – in the seedless. The most significant are the traits total number of shoots – fruiting shoots – clusters, yield, shoot fertility coefficient, cluster length and width, average weight of 100 berries, berry length and width. Seeded forms № 1, 6, 8, 13, 17, 21 and seedless form № 2 have the greatest potential for selection purposes, and for the development of new crosses forms № 17, 1 and 8 should be used.
Key words: F_1 progeny, commercially significant traits, Cluster Analysis and Principal Component Analysis, selection.

Introduction

Polymorphism and polygenetic determination of commercially-valuable traits in vine require the utilization of methods, which provide high precision in the process of their investigation. The cluster method has obtained wide application for evaluation and grouping of vine cultivars according to their genetic remoteness (Moreno-Arribas et al., 1999, Labra et al., 2002, Grassi et al., 2003, Fanizza et al., 2003, Hvarleva et al., 2004, Varga et al., 2006, Fujita et al., 2009). This method decreases the influence of the subjective factor, facilitates the selection of elite hybrid forms and assists in the correct determination of parent pairs in accordance with the concrete selection purpose (Dimova, Bojinov, 2001). The relative significance of separate traits, which influence to the greatest extent the division of genotypes into groups is presented by means of Principal Component Analysis (PCA). The application of these two analyses makes it possible to reduce the number of researched traits as soon as the first stages of the selection procedure, and to explain the reasons for their clustering. The purpose of this study is to establish the variability of important ampelographic traits and the possibilities for selection of elite seedless and seeded forms in F_1 progeny of the cross Super Early Bolgar x Russalka, through cluster analysis and principal component analysis.

Material and methods

The experiment included 30 plants from F_1 progeny of the hybrid combination Super Early Bolgar x Russalka. For a period of four consecutive years 22 ampelographic traits determining the

commercial value of each vine cultivar, were observed: 1. Yield, kg; 2. Coefficient of shoot fertility; 3. Coefficient of main shoot fertility; 4. Coefficient of fruiting shoot fertility; 5. Millerandage berries, %; 6. Average cluster weight, g; 7. Cluster length, cm; 8. Cluster width, cm; 9. Average weight of 100 berries, g; 10. Berry length, mm; 11. Berry width, mm; 12. Index of berry shape; 13. Budding-flowering (days); 14. Flowering-softening (days); 15. Softening-technological maturity (days); 16. Budding - technological maturity (days); 17. Sugars, %; 18. Acids, g/dm^3; 19. Total bud number; 20. Total shoot number; 21. Total fruiting shoot number; 22. Total cluster number (Bulgarian Ampelography 1990). Seedlings were grouped by means of cluster analysis, and the significance of the traits for the division of genotypes was established by the application of principal component analysis (Everitt 1979, Preigel et al., 1986, Philippeau 1990). The two analyses were carried out in the entire population of F_1 progeny and in the seedless and seeded seedlings separately.

Results and discussion

All plants from F_1 progeny of the hybrid combination Super Early Bolgar x Russalka are divided into two large groups and four subgroups (Figure 1). The first subgroup includes seedlings № 8, 12, 15, 11, 13, 6 and 14; the second subgroup – seedlings № 2, 9, 3, 10, 7, 4, 29, 26 and 23; the third - № 1, 17, 24, 30, 20, 16, 27, 18, 19 and 21; the fourth – № 28, 25, 5 and 22. The relative distance between them varies from 0,000 to 301,549. Only seven principal components are enough to explain 85,186 % of the total variation (Table 1). The traits with the greatest influence on the division of genotypes into groups, are total number of fruiting shoots, yield, total shoot number, shoot fertility coefficient, berry length, average weight of 100 berries, cluster width, millerandage berries and cluster length. Their relative variation degree is the highest in the first principal component, which explains 27,608 % of the total variation. The second principal component explains 15,034 % of the variation through fewer traits, which are almost completely identical with the mentioned ones – total number of clusters, millerandage berries, cluster length, average weight of 100 berries, berry length. The third principal component explains 12,980 % of the total variation through the traits sugars, acids, main shoot fertility coefficient, average cluster weight, berry shape index, berry softening - technological maturity and budding – technological maturity. The remaining components explain respectively: 10,371% of the total variation - fourth component, 8,675 % - fifth component, 5,619 % -sixth component and 4,899 % - seventh component. According to the values of the traits from the first and second principal component, the greatest attention in the course of selection should be paid to seedlings № 1, 2, 6, 17 and 21 (Table 2). These seedlings are not included in the first or fourth subgroup and therefore they are not suitable for future crosses. The seeded plants in this hybrid combination are divided into two large groups, the second one comprised of three subgroups (Figure 2). The first group encompasses seedlings № 17, 24, 30 and 22; the first subgroup of the second group - № 26, 10 and 25; the second subgroup of the second group - № 5, 19, 6, 21, 13 and 7, and the third subgroup of the second group - № 1 and 8. The relative distance between the variants is from 0,481 to 155,837. The principal component analysis shows that only six of them are enough to explain 88,462 % of the total variation (Table 3). The first principal component explains 33,156 % of the variation and these are half of the studied traits – yield, shoot and main shoot fertility coefficient, total number of shoots – fruiting shoots and clusters, cluster width, berry length and width, budding – technological maturity and average weight of 100 berries. The traits total bud number, millerandage berries, cluster length, total cluster number, acids and sugars are

characterized by the highest variability in the second principal component, which explains 17,945 % of the total variation.

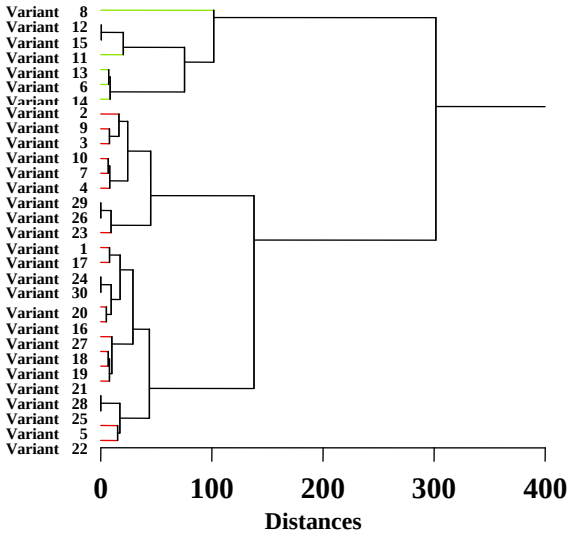

Figure 1. Dendrogram of cluster analysis of the genotypes of F_1 progeny of the hybrid combination Super Early Bolgar x Russalka

Table 1. Results from Principal Component Analysis of F_1 progeny of the hybrid combination Super Early Bolgar x Russalka

Traits	Principal Components						
	1	2	3	4	5	6	7
1	0,842	0,216	0,222	0,032	0,334	-0,129	0,085
2	0,830	0,254	0,200	0,043	0,343	-0,161	0,095
3	0,396	0,028	0,591	0,188	0,053	-0,224	-0,358
4	0,362	-0,020	0,206	-0,152	-0,641	-0,367	0,145
5	-0,595	0,675	-0,116	0,092	0,041	0,109	-0,011
6	0,302	0,106	0,526	-0,166	-0,157	0,139	-0,479
7	-0,569	0,615	-0,139	-0,019	-0,045	0,129	-0,262
8	-0,677	0,450	0,226	-0,225	0,126	-0,061	0,270
9	-0,699	0,530	0,078	-0,022	-0,066	-0,426	0,017
10	-0,706	0,495	0,224	-0,277	0,013	0,004	0,167
11	-0,163	0,224	-0,170	0,395	-0,136	-0,764	-0,173
12	-0,051	0,233	0,585	0,459	0,059	0,175	-0,258
13	0,267	0,218	0,093	-0,846	0,172	-0,099	0,060
14	-0,345	-0,222	-0,042	0,833	-0,076	0,079	0,184
15	-0,230	0,170	0,563	0,404	0,223	0,100	0,312
16	-0,047	-0,165	-0,511	0,145	0,681	-0,199	0,052
17	0,115	-0,107	0,627	0,021	-0,469	0,056	0,433
18	0,354	0,328	-0,586	0,036	-0,495	0,165	-0,118
19	0,391	0,484	-0,455	0,213	-0,388	0,085	0,112
20	0,841	0,372	-0,228	0,077	0,080	0,058	0,218
21	0,869	0,421	-0,045	0,155	-0,016	-0,065	0,121
22	0,384	0,833	0,021	0,137	0,155	0,224	-0,050
Explained % of the total variation	27,608	15,034	12,980	10,371	8,675	5,619	4,899

Table 2. Values of the studied traits for the seedlings from F_1 progeny of the hybrid combination Super Early Bolgar x Russalka

.. Plants	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1	5,580	1,25	1,30	1,45	22,21	124,0	17,67	8,81	195	15,40	12,7	1,21	59	44	26	129	14,44	6,22	42	36	31	45
2	6,840	1,09	1,12	1,46	18,13	180,0	14,50	10,30	282	16,38	15,3	1,07	60	49	21	130	15,00	5,96	48	35	26	38
3	1,240	0,34	0,34	1,00	20,44	124,0	13,50	8,40	300	17,53	16,0	1,09	59	48	24	131	16,80	5,12	32	28	10	10
4	2,109	1,13	1,13	1,30	16,27	111,0	16,15	8,10	238	14,96	13,5	1,10	58	53	24	134	19,30	5,38	25	17	15	13
5	1,500	0,93	0,93	1,47	57,47	60,0	16,35	7,45	170	14,50	13,1	1,11	59	48	21	128	15,20	4,64	44	27	17	25
6	5,424	0,69	0,75	1,50	14,28	226,0	16,90	11,20	322	19,56	15,6	1,25	68	41	26	135	16,70	3,88	41	34	16	24
7	1,760	0,96	1,00	1,53	4,26	110,0	12,40	8,50	265	18,38	13,8	1,32	62	46	25	133	14,45	7,66	20	17	10	16
8	2,379	0,56	0,56	1,18	14,27	183,0	13,50	8,50	690	20,25	18,6	1,08	62	50	28	140	17,86	6,03	29	23	11	13
9	1,628	0,42	0,44	1,22	44,44	148,0	12,90	8,90	312	19,41	15,1	1,28	61	45	26	132	15,00	7,19	33	26	9	11
10	2,750	0,72	0,87	1,22	13,05	125,0	9,80	8,50	269	17,92	15,4	1,16	58	53	23	134	20,17	4,56	35	31	18	22
11	1,302	0,50	0,55	1,22	18,42	93,0	16,13	7,40	383	21,52	15,6	1,37	64	41	27	132	16,80	6,36	39	27	11	14
12	2,080	0,68	0,68	1,36	22,22	130,0	17,68	10,22	443	22,40	17,0	1,32	59	50	22	131	15,83	5,13	35	24	12	16
13	1,491	0,23	0,26	1,00	19,32	213,0	11,25	10,30	326	21,20	15,2	1,39	54	51	20	125	20,14	4,71	40	30	7	7
14	1,491	0,23	0,26	1,00	19,32	213,0	11,25	10,30	326	21,20	15,2	1,39	60	27	48	135	20,14	4,71	40	30	7	7
15	1,820	0,59	0,59	1,33	22,22	130,0	17,68	10,22	443	22,40	17,0	1,32	59	50	22	131	15,83	5,13	35	24	11	14
16	1,869	0,58	0,58	1,50	14,28	89,0	12,56	8,31	172	15,98	12,4	1,29	61	41	26	128	17,65	3,83	45	36	14	21
17	4,032	1,21	1,31	1,50	10,61	144,0	14,53	9,31	193	17,31	12,7	1,36	61	51	22	134	21,67	4,07	35	23	19	28
18	1,188	0,39	0,39	1,10	14,86	108,0	18,86	8,28	147	14,50	12,2	1,19	61	50	22	133	15,10	5,11	40	28	10	11
19	2,250	1,09	1,09	1,39	28,00	90,0	16,39	8,06	147	14,43	12,5	1,15	61	42	29	132	15,90	6,27	32	23	18	25
20	1,919	0,59	0,59	1,27	16,28	101,0	16,38	8,19	188	14,42	13,5	1,07	61	45	28	134	15,40	6,11	41	32	15	19
21	3,360	1,07	1,07	1,43	28,01	112,0	15,46	5,95	125	15,09	11,5	1,31	62	50	23	135	18,40	5,97	37	28	21	30
22	2,496	1,30	1,41	1,79	56,04	52,0	15,45	5,95	105	15,69	11,1	1,41	60	51	23	134	16,81	5,81	44	37	27	48
23	0,896	0,86	0,88	1,25	17,31	56,0	15,38	6,38	235	13,16	12,1	1,09	61	43	24	128	24,45	5,59	25	19	13	16
24	1,344	0,57	0,60	1,00	19,31	112,0	13,70	8,86	177	14,41	12,5	1,16	58	50	22	130	15,95	3,69	45	21	12	12
25	1,856	0,89	0,89	1,14	15,25	58,0	13,50	6,60	145	13,72	11,7	1,18	58	44	27	129	24,17	4,66	45	36	28	32
26	0,913	0,57	0,57	1,10	21,15	83,0	15,80	7,30	223	15,96	14,4	1,11	61	45	26	132	16,80	5,16	29	20	10	11
27	1,030	0,50	0,50	1,00	13,04	103,0	13,00	8,60	133	15,40	11,7	1,32	60	27	48	135	16,27	7,65	31	20	10	10
28	1,900	0,94	0,98	1,14	16,02	68,0	14,27	6,84	151	14,32	10,6	1,35	57	46	25	128	20,07	4,12	47	35	29	33
29	1,122	0,52	0,59	1,10	20,85	95,0	16,34	7,46	231	15,86	14,7	1,08	60	46	28	134	16,58	5,31	30	21	10	11
30	1,386	0,59	0,62	1,00	18,11	122,0	14,29	8,96	183	15,01	12,4	1,21	56	52	23	131	15,65	4,66	44	22	13	13

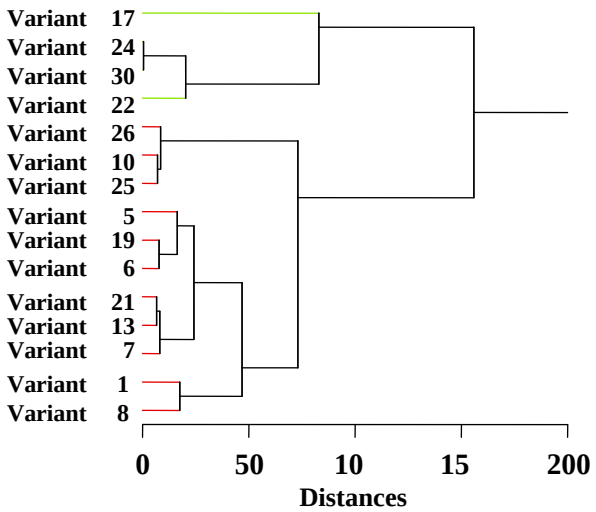

Figure 2. Dendrogram of cluster analysis of the genotypes of F_1 progeny of the hybrid combination Super Early Bolgar x Russalka - seeded plants

Table 3. Results from Principal Component Analysis of F_1 progeny of the hybrid combination Super Early Bolgar x Russalka - seeded plants

Traits	Principal Components					
	1	2	3	4	5	6
1	0,900	-0,038	0,312	-0,008	-0,203	-0,150
2	0,896	0,001	0,308	-0,009	-0,255	-0,136
3	0,745	0,074	0,370	-0,107	0,171	-0,403
4	0,251	-0,252	-0,587	-0,158	0,499	0,096
5	-0,469	0,734	0,093	0,109	-0,093	0,190
6	0,446	0,078	0,211	0,018	0,482	-0,482
7	-0,270	0,780	0,031	0,277	0,065	-0,221
8	-0,591	0,007	0,559	0,217	0,387	0,164
9	-0,815	0,209	0,103	0,141	0,298	-0,329
10	-0,629	0,110	0,435	0,343	0,441	0,228
11	-0,555	0,204	-0,275	-0,147	-0,011	-0,674
12	0,008	0,264	0,548	-0,559	0,360	-0,096
13	0,321	-0,438	0,180	0,803	0,004	0,078
14	-0,481	0,292	-0,014	-0,709	-0,242	0,121
15	-0,318	-0,004	0,786	-0,352	-0,094	0,299
16	-0,514	0,156	0,145	0,140	-0,616	-0,128
17	0,340	-0,621	-0,004	-0,336	0,371	0,244
18	0,271	0,657	-0,495	0,019	0,320	0,144
19	0,239	0,793	-0,365	0,019	0,107	0,299
20	0,877	0,369	0,077	0,059	-0,084	0,131
21	0,872	0,413	0,070	-0,005	0,036	0,060
22	0,614	0,710	0,259	0,085	-0,003	0,128
Explained % of the total variation	33,156	17,945	12,471	9,358	8,630	6,880

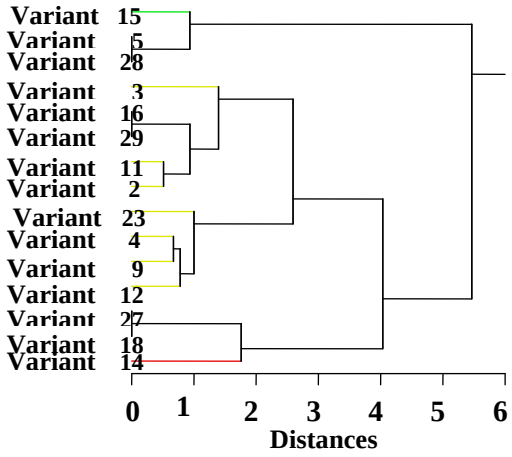

Figure 3. Dendrogram of cluster analysis of the genotypes of F_1 progeny of the hybrid combination Super Early Bolgar x Russalka - seedless plants

The third principal component explains 12,471 % of the total variation, predominantly through the traits berry softening – technological maturity, berry shape index, cluster width

and fruiting shoot fertility coefficient. The fourth, fifth and sixth principal component explain respectively 9,358 %, 8,630 % and 6,880 % of the entire variation, the greatest share belonging to the traits budding – flowering, flowering – berry softening, berry shape index, budding – technological maturity and berry width. The most considerable potential for selection purposes is reported for seedlings № 1, 6, 8, 13, 17 and 21, and for crosses – seedlings № 17, 1 and 8, since they are included in the first and third group. Seedless seedlings are divided into four groups according to their degree of similarity (Figure 3). The first group of the dendrogram includes plants № 15, 5 and 28, the second group - № 3, 16, 29, 11 and 2; the third - № 23, 4, 9 and 12; the fourth - № 27, 18 and 14.

Table 4. Results from Principal Component Analysis of F_1 progeny of the hybrid combination Super Early Bolgar x Russalka - seedless plants

Traits	Principal Components					
	1	2	3	4	5	6
1	0,841	0,194	0,147	0,210	0,275	0,245
2	0,840	0,211	0,185	0,198	0,258	0,216
3	0,025	0,732	-0,109	0,251	0,373	-0,485
4	0,612	0,372	-0,298	0,240	-0,162	-0,282
5	-0,294	0,355	0,694	-0,420	-0,221	0,254
6	-0,123	0,579	-0,224	0,432	-0,512	0,269
7	0,519	0,050	0,521	-0,512	-0,208	0,033
8	-0,691	-0,044	0,272	0,553	0,262	0,001
9	0,015	0,652	0,511	-0,186	0,279	-0,435
10	-0,704	0,267	0,214	0,389	0,027	-0,268
11	0,639	0,322	0,209	-0,499	0,205	-0,169
12	-0,115	0,796	-0,035	0,209	0,151	0,133
13	0,339	0,056	0,525	0,524	-0,538	-0,022
14	-0,247	0,095	-0,503	-0,671	0,432	0,052
15	0,128	0,831	-0,029	-0,332	-0,120	0,154
16	0,125	-0,580	0,202	0,199	0,649	0,210
17	0,095	0,577	-0,674	-0,156	-0,291	0,221
18	0,452	-0,490	0,197	-0,302	-0,542	-0,338
19	0,688	-0,243	-0,179	-0,087	-0,216	-0,337
20	0,913	-0,308	-0,012	0,052	0,015	0,104
21	0,978	0,022	-0,041	0,089	0,076	-0,062
22	0,699	0,304	0,533	-0,113	0,063	0,237
Explained % of the total variation	30,568	19,606	12,575	11,972	10,099	5,843

The relative distance between them is small – from 0,000 to 54,641. Six of the principal components determine 90,663 % of the total variation (Table 4). The first principal component explains 30,568 % of the variation, mainly through the traits total number of

fruiting shoots – shoots – clusters, yield, shoot and fruiting shoot fertility coefficient, cluster length and width, berry length and width, total bud number. The second principal component explains 19,606 % of the variation, predominantly through the traits main shoot fertility coefficient, average cluster weight and average weight of 100 berries, berry shape index, berry softening – technological maturity, budding – technological maturity and sugars. Some of the traits from the second component repeat in the third one - millerandage berries, average weight of 100 berries, cluster length, budding – flowering, flowering – berry softening, sugars and total number of clusters. The third component explains 12,575 % of the total variation. The fourth, fifth and sixth principal component explain 11,972 %; 10,099 % and 5,843 % respectively of the total variation. Seedling № 2 is found to be an elite form, possessing the best selection indices, and seedlings № 12, 14 and 15 should be investigated further.

Conclusions

In the hybrid combination Super Early Bolgar x Russalka only seven of the principal components are enough to explain 85,186 % of the total variation in the entire plant population, six principal components – 88,462 % in seeded seedlings and 90,663 % in seedless ones. The most significant are the traits total number of shoots – fruiting shoots – clusters, yield, shoot fertility coefficient, cluster length and width, average weight of 100 berries, berry length and width. Seeded forms № 1, 6, 8, 13, 17, 21 and seedless form № 2 have the greatest potential for selection purposes, while forms № 17, 1 and 8 can be used for the development of new crosses.

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ПРИМЕНА НА КЛАСТЕР АНАЛИЗАТА ВО ИСПИТУВАЊЕ НА ВАРИЈАБИЛНОСТА НА КВАНТИТАТИВНИТЕ КАРАКТЕРИСТИКИ НА ХИБРИДИТЕ ОД SUPER EARLY BOLGAR X RUSSALKA

Венелин Ројчев

Апстракт

Варијабилноста на комерцијално значајните квантитативни карактеристики и можноста за селекција на елитни бессемени и семени форми од Ф1 генерацијата добиена од вкрстување на Super Early Bolgar x Russalka се проучувани преку примена на Cluster Analysis и Principal Component Analysis (PCA). Утврдивме дека само седум од основните компоненети се доволни за објансување на 85,186 % од вкупните варијации кај семените и 90,663 % – кај бессемените. Најзначајни се карактеристиките на бројот на ластари, родни ластари , гроздови, принос, коефициентите на родност на ластарите, должина и ширина на гроздот, просечна тежина на 100 зрна, должина и ширина на зрно. Семените форми № 1, 6, 8, 13, 17, 21 и бессемената форма № 2 имаат значаен потенцијал за целите на селекцијата и за развој на нови вкрстени форми № 17, 1 и 8 можат да бидат употребени.

Клучни зборови: Ф1 генерација, комерцијално значајни карактеристики, кластер анализа (PCA) анализа, селекција.

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Original scientific paper

INFLUENCE OF THE YIELD AND TYPE OF VINIFICATION ON THE QUALITY OF WINE VRANAC

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Abstract
The results of testing the influence of yield and type of fermentors on the quality of the wine Vranac are presented in this work. The research was done on 4 types for yield: 8 t/ha, 10 t/ha, 12 t/ha and 15 t/ha. The fermentors made by SIFA, GANIMEDE and GIMAR were used and the control sample was taken from the classic vinification in PVC vat. The results showed that the best quality grapes for obtaining high quality wines have been achieved with yield of 8t/ha. All three types of fermentors gave better phenolic compounds of wine and better sensory characteristics than the classic vinification in the barrel. The yield of 10 t/ha gives grapes for producing quality wines for fast consumption.
Key words: Vranac, yield, red wine, fermentors, polyphenols, anthocyans, sensory characteristics.

Introduction

Vranac is an autochtonous Montenegrin grape variety and the leading vine variety in the red wine production. The red wine Vranac, made of autochtonous grape variety has become national brand and the most famous and the best brand of the company ‘13 jul –Plantaze’, which has promoted Montenegro as a significant wine destination in previous years.Therefore, there is a will for improving and researching the enological potentials, new and greater possibilities of the grape variety Vranac itself as well as the quality of the Vranac wine itself. The goal of the research was to determine the influence of the yield and type of vinification on the quality of the grape and wine of Vranac.The goal of the research is to determine the influence of the yield and methods of vinification on the grape quality, polyphenols and sensory quality of wine. The idea was to determine the optimal yield and vinification method by which the wine with high polyphenol contents and sensory potential is made.

Material and methods

Experimental plantings with Vranac grapevine variety are situated on Nikolj Crkva locality on the Cemovsko field. This locality is a part of the Podgorica’s subregion of the

Montenegrin basin of Lake Skadar. Microvinifications were performed in the microvinification section of the company "13 jul-Plantaze" ad. For the research and monitoring of the data, 4 types of yield were set (8, 10, 12, 15 t/ha) and the grapes were vinified in four types of fermentors (Sifa, Ganimede, Gimar and classical pvc vat).

Table 1. Schematic review of the experiment.

	Types of fermentors		MARK
Examined factors	Yield 8t/ha	Classiicalvinificationpvc vat	B-1
		Fermentor“sifa”	S-1
		Fermentor“ganimede”	Ga-1
		Fermentor“gimar”	G1-
	Yield 10t/ha	Classiicalvinificationpvc vat	B-2
		Fermentor“sifa”	S-2
		Fermentor“ganimede”	Ga-2
		Fermentor“gimar”	G-2
	Yield 12t/ha	Classiicalvinificationpvc vat	B-3
		Fermentor“sifa”	S-3
		Fermentor“ganimede”	Ga-3
		Fermentor“gimar”	G-3
	Yield 15/ha	Classiicalvinificationpvc vat	B-4
		Fermentor“sifa”	S-4
		Fermentor“ganimede”	Ga-4
		Fermentor“gimar”	G-4

The grape quality parameters were monitored, based on its mechanical and chemical properties, chemical and polyphenol contents and sensorial quality of wines, made of Vranac grape variety. For the determination of the mechanical contents of grape, modified method by Negrul is applied. The sensory wine analysis is done, complied with the OIV principles by the application of 20 points evaluation system

Results and discussion

Yield

For each type, number of bunches per vine, yield per vine and yield per ha were measured (Table 2). From the results of the research we could conclude that the grape mass varies from 200,7 g to 224,9 g, which means that bunch of Vranac variety belongs to the category of medium big bunches (PhD Z Božinovik, 2010).

Table 2. Mechanical analysis and grape yields

Elements	Types			
	8 t/ha	10 t/ha	12 t/ha	15 t/ha
Number of bunches per vine	12.3	13.7	16.4	20.2
Yield per vine (kg)	2.45	2.95	3.44	4.51
Yield per ha (kg)	8.909	9.995	11.825	14.586

Number of bunches is in proportion with yield per vine and ranges from 12,3 for the yield 8 t/ha to 20,2 bunches for 15t /ha, with grape mass per vine from 2,45 kg to 4,5 kg..

Mechanical properties of bunches and berries

The analysis of the mechanical properties of the grapes has been performed, by testing the mass of grape bunches and berries, properties of berries, number of berries in the bunch, mass of stems, based on which the theoretical ratio between the quantity of grapes and the quantity of wine produced of it, plays a very important indicator of the quality of the grapes and wine (Table 3).

Table 3. Mechanical properties of grapes and berries

Elements	8 t/ha	10 t/ha	12 t/ha	15 t/ha
Bunch mass (g)	224,9	215,2	209,6	200,7
Berries mass without stems(g)	218,8	208,9	203,2	195,2
Berry mass(g)	2,35	2,33	2,69	2,63
Stems%	11,3	20,0	10,8	10,64
R %	86,3	85,4	86,5	86,9

Theoretical ratio of the quantity of the grapes and quantity of wine made (R %), ranges from 85,4 % to 86,9 % for 15 t/ha yield. Based on this data we could conlude that the grape vine yield has great influence on grape quality, with higher yields there is a higher number of bunches, bigger berries, theoretical ratio of the quantity of the grapes and quantity of wine made, as well as the negative ration between the solid-liquid phase, which is the indicator of the lower grape quality for winemaking. Based on this data, we could conclude that the bunch of Vranac grape variety is medium big,cone shaped, of medium density, of grey black colour. By comparing these data with the data from literature (Ulićević, 1966; Avramov, 1991, Burić 1995, Božinovik 2010) a great similarity is noticeable.

Chemical and polifenolic properties of grape

Chemical properties of grapes, sugar contents, total acids and pH values were measured (Table 4), so we could notice that there are no great differences related to the chemical composition of the grapes in relation to the projected yield. By measuring chemical properties of wine we could also conclude that there are no big differences related to the total acids, pH values, but it is obvious that sugar contents declines with the increasing of the yield.

Polyphenol properties, polyphenol and anthocyanins content of Vranac grape wine variety is shown in table 5. from which we could concluded that Vranc is grapevine variety with high polyphenol and anthocyanins content.

Table 4. Chemical analysis of grape must

Compounds	Types			
	8 t/ha	10 t/ha	12 t/ha	15 t/ha
Sugar g/dm^2	257	247	231	221
Total acids g/dm^2	5.27	5.19	5.08	5.00
pH	3.47	3.46	3.48	3.4

Table 5. Polyphenol compounds of skins, seeds and berry pulps

Indicator	total polyphenols mg/kg	anthocyanins mg/kg
skin	1.940	3.860
seed	5.210	-
pulp	21	53
total	7.171	3.913

Chemical properties of wine

According to the testings of wine and by analysis of chemical compounds, it can be concluded that regarding the tested chemical compounds for all types of yields as well as for all four types of fermentation, there are no significant differences (Table 6). Measuring the alcohol content, total acids, residual sugars, pH it is obvious that there is a slight difference in the alcohol contents for the types with classical vinifications, where some more non fermented sugars remained. All other parameters are at expected levels. For the yields of 12 t/ha and 15 t/ha there is a higher content of malic acid in the wine which shows slightly lower tehnological ripeness of the grapes at the moment of harvest.

Table 6. Chemical properties of wine in relation to yeald and type of vinifications

	Type of vinification							
	Classical (vat)		Fermentor“sifa“		Fermentor Ganimede		Fermentor Gimar	
	8 t/ha	10 t/ha	8 t/ha	10 t/ha	8 t/ha	10 t/ha	8 t/ha	10 t/ha
Alcohol%v/v	15,48	15,58	15,4	15,82	15,64	15,8	15,58	15,88
Total extract g/lit	31,3	31,9	33,7	32,5	33,5	32,8	33,5	32,3
Total acids g/lit	6,72	6,86	6,71	6,9	6,76	6,72	7,1	6,88
pH-value	3,46	3,45	3,47	3,41	3,33	3,41	3,36	3,43
malic acid g/l	-	-	-	-	-	-	--	-
lactic acid g/lit	0,85	0,79	0,83	0,78	0,86	0,88	0,81	0,85
Non fermented sugar gr/l	2,28	3,36	4,38	2,78	2,02	2,4	2,24	2,02

Table 7. Type of vinification

	Type of vinification							
	Classical		Fermentor“sifa“		Fermentor		Fermentor	
	12	15	12 t/ha	15 t/ha	12	15	12	15
Alcohol%v/v	13,9	13,6	13,5	13,37	13,45	13,35	13,42	13,5
Total extract g/lit	30,01	30,5	30,5	30,28	30,9	30,6	30,4	30,05
Total acidsgr/lit	7,07	7,38	7,15	7,04	6,56	6,8	6,51	6,85
pH-value	3,45	3,25	3,41	3,42	3,40	3,44	3,42	3,45
malic acid g/l	0,5	0,8	0,7	0,35	-	-	-	-
lactic acid g/lit	0,75	0,7	0,81	0,74	0,85	0,85	0,8	0,89
Non fermented	1,44	2,08	2,11	3,48	1,92	3,45	2,11	2,68

By testing chemical and polyphenol parameters of wine in relation to the yield and type of vinifications, we can see from the table that polyphenols and anthocyanins are divided in two levels.Polyphenol and anthocyanin for the tested variants are shown at Figures 1, 2, 3, 4. For wines with yields of 8t/ha (Fig 1.) and 10t/ha (Fig. 2) polyphenol contents are rather high ranging from 2,95 – 3,23 g/l as well as for the anthocyanins, between 620-780 mg/l which means that for these types we can expect a good wine aging potential, especially for vinifications with Gimar and Ganimede fermentors.

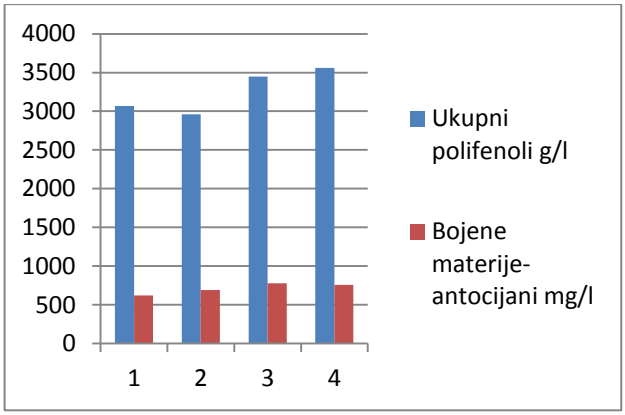

Figure 1. Relation of polyphenols and anthocyanins 8 t/ha

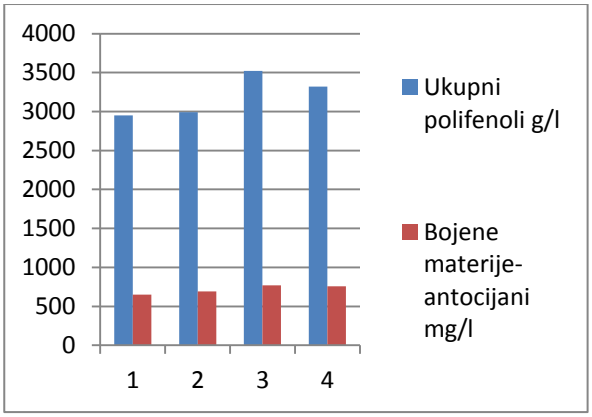

Figure 2. Relation of polyphenols and anthocyanin 10 t/ha

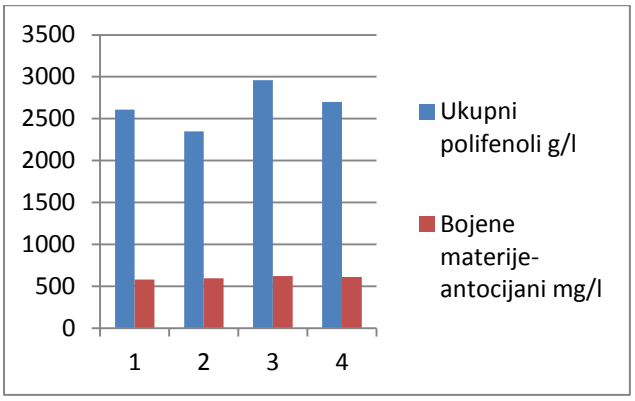

Figure 3. Relation of polyphenols and anthocyanins 12 t/ha

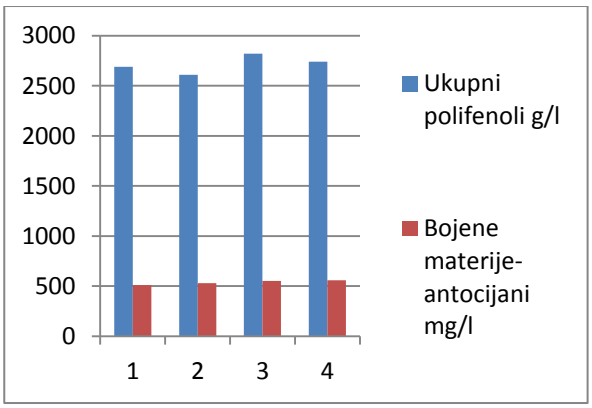

Figure 4. Relation of polyphenols and anthocyanins 15 t/ha

In diagrams No. 3 and 4 is shown polyphenol contents of wine with yields of 12 and 15t/ha from which it can be seen that polyphenol contents is 2,6 - 2,82 g/l, and anthocyanin contents is also rather low, 580 - 620 g/l from which can be concluded that those wines are

the wines with good polyphenol contents, but not the ones which have a good wine aging potential.

Organoleptic evaluation

It has been performed by 20 points evaluation method. The highest points of 19,4 and 19,1, had wines Gi 8 and G 8. Those wines are very rich on structure, strong, rounded, with good balance and fine,soft tannins, wine with great aging potential. The type B -8 on nose had cooked aromas as a consequence of classical vinification. If we assume sensorial characteristics of wine with yield of 8 t/ha on Sifa fermentor and classical fermentor, it can be concluded that those fermentors do not give high quality wines regardless the low yield.

Yields of 12 and 15 t/ha also gives good wines, with satisfying quality for lower wine category, with recognizable varietal characteristics, but not wines with longer aging potential regardless the method and type of vinifications.

Conclusions

Based on this evaluation and results, conlusions can be made, as follows:

1. In regards of the mechanical properties, the differences between types are expressed on the bunch mass, berries mass, and theoretical ratio between the quantity of grapes and the quantity of wine produced of it. The biggest bunch mass has yield type 8t/ha – 224,9 g and the lowest yield type 15 t/ha – 200,7 g. Theoretical ratio between the quantity of grapes and the quantity of wine produced of it is 85,4 for 10 t and 86,9 for yield type 15 t.
2. The chemical composition of the must is characterized by high sugar contents for all types, low acids and moderate pH. Sugar contents is 221 g/l for the type 15 t/ha and 246 g/l for the type 8 t/ha. It is noticeable that yield has a low influence on total sugar and acids.
3. Types of 12 t/ha and 15 t/ha gave wine with slightly lower alcohol contents. The amount of the malic acid is higher, so the malolactic fermentation has not finished. Polyphenols for the all types of vinifications are low, so these wines do not possess aging potential.
4. Yields per ha and types of fermentation have the biggest influence on sensorial characteristics of wines. For all types of classical type of fermentation, the wines are with low aromatic complex. The types of 12 and 15 t/ha, regardless the type of vinification , give wines with a bad, aromatic potential and a very poor structure.
5. Based on chemical, polyphenols and sensorial evaluations of wines, it can be stated that there is a great influence of the yields and types of vinifications on the quality of the obtained wines and their longevity. Types of 8 and 10 t/ha can be recommended for making wines of good potential, rich structure and suitable for long aging. On the other hand, high yields of 12 and 15 t/ha,regardless the manner and type of the applied vinification, give wines with poor structure, which have not a long aging potential, wines of lower quality category and for fast consumption.

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ВЛИЈАНИЕ НА ПРИНОСОТ И ТИПОТ НА ВИНИФИКАЦИЈА ВРЗ КВАЛИТЕТОТ НА ВИНОТО ВРАНЕЦ

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Апстракт
Резултатите од тестирањето на влијанието на приносот и тиопот на ферментаторите врз квалитетот на виното Вранец се презентирани во овој труд. Испитувањето го извршивме на 4 типа на принос: 8 t/ha, 10 t/ha, 12 t/ha и 15 t/ha. Ферментатори од типот на SIFA, GANIMEDE и GIMAR беа споредени во однос на стандардната враијанта со класична винификација во пластични буриња. Резултатите покажуваат дека најдобар квалитет на вино се добива со принос од 8t/ha. Сите три ферментатори даваат подобар состав на фенолните компоненети на виното и подобри сензорни карактеристики во однос на класичната винификација во буре. Приносот од 10 t/ha дава горзје за производство на вино за брза консумација.
Клучни зборови: Вранец**,** принос, црвено вино, ферментатори, антоцијани, сензорни карактеристики.

UDC:663.25 (497.16)
Original scientific paper

THE IMPACT OF VINIFICATION METHODS ON CHEMICAL COMPOSITION AND SENSORY PROPERTIES OF THE VRANAC WINE VARIETY

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Abstract
The goal of testing was to establish the impact of the vinification method on the chemical composition and sensory properties of the red wine variety Vranac. To achieve that goal an experimental apparatus was set up in the microvinification plant of the company "13. jul Plantaze" in Podgorica. The grape raw material from Cemovsko field, which belongs to the Podgorica sub-region, was used. The research entailed four processing ways (methods): processing in the Sifa, Ganymede and Gimar fermentation tanks and the classic-traditional method. The obtained results showed that the vinification method has no significant influence on the chemical composition of wine, and the impact on the sensory properties of wine is evident. The highest tasting score received the wine produced by the Ganymede method, because of its good structure and the potential for long-term maturation and high quality.
Keywords*:* Vranac, chemical composition, sensory properties, Sifa, Ganimede, Gimar.

Introduction

Knowledge of chemical composition of must is of great importance in the technology of wine making, since the quality of wine for the most part directly depends on it. The sensory properties of a wine are the main indicators of the wine quality. Based on the sense of sight, the sense of smell (olfactory assessment) and taste (gustatory assessment) we assess the clarity and color, the smell and the taste of a wine, that is, we determine the sensory profile of a wine. In producing red wines, in order to achieve better chemical composition and sensory characteristics of a wine, that is, in order to obtain better quality wines, different technologies and methods of vinification are applied. During this research, the processing of the Vranac grape variety, i.e., vinification, was done in 4 ways or methods of vinification: the classic method and three modern technologies in the Sifa, Ganymede and Gimar fermentation tank using the standard oenological tools. The objective of this research was to determine whether, and to what extent the vinification method affected the chemical composition and the sensory properties of a wine, thus, obtaining a justification for the application of modern methods of making the Vranac wine.

Material and methods

The research was conducted on an autochthonous Montenegrin wine variety - Vranac. The analysis of the chemical composition of a wine, depending on the way, that is, the method of vinification was carried out in the period from 2008 to 2011. In order to determine the chemical composition of a wine and the sensory properties of a wine, the same conditions of vinification were provided for all the variants of winemaking within the research (the classic method and three modern technologies in the Sifa, Ganimede and Gimar fermentation tanks).

The classic-traditional method of winemaking – the vinification was carried out in the traditional manner using the standard procedure. After the grape was harvested at full maturity and crushed, whereby the stems were removed, the pomace was placed into a PVC fermentation tank. The pomace immersion was performed manually. After completion of the fermentation, decantation into vessels for wine aging was carried out.

The SIFA fermentation tank – is a modified form of the Gimar fermentation tank. It consists of two parts, which are not fixed and can be separated. The first part of the fermentation tank is filled with the pomace to a certain level, and the second part is filled with the liquid part, through the pump and a side pipe. During remontage (after the cap has been formed), the pump draws liquid from the lower part and transports it through the side of the tube to the upper part of the fermentation tank. The bottom of the upper part is funnel-shaped with a mobile plate that closes the vessel during filling, and after the vessel is filled the cap is opened and rinsed.

The GANIMEDE fermentation tank - consists of two parts that are connected, with the funnel-shaped upper part. The fermentation tank has two bypasses (shortcuts), which allow the liquid part to reach the cap by a shorter way, break it and, therefore, wet it, and possibly turn it, depending on the amount of CO_2 released during fermentation.

The GIMAR fermentation tank - within its container it includes a small vessel attached to the cover, which is filled with liquid through the pump and a side pipe. At the bottom of the vessel is a fixed plate, and between the walls of the vessel and the plate is an open space through which the liquid part flows out, while at the same time an aeration of the liquid part and sprinkling of the cap is performed . Processing-vinification was performed in a microvinification plant, which is part of the company, "13.jul -Plantaze " in Podgorica. Grapes are harvested at full maturity which is determined on the basis of sugar content, pH and total acidity in the grapes. After crushers where the grapes were destemmed, the pomace was placed into fermentation tanks. The standard oenological tools were used. The pomace was treated with 5g/100l of sulphur dioxide, the selective yeast was added (BDX, Lallemand) in the quantity 10/100l and the fermaid E yeast nutrient (Lallemand) in the the amount of 20 gr/100l of must (10 gr/100l of must in the pomace and 10 gr/100l of must at 1/3 of fermentation), for all the methods applied. The immersion of pomace was performed manually in the traditional manufacturing vessels, while automatic remontages were performed in the fermentation tanks. After completion of the fermentation, decantation was carried out in the vessels for wine aging.The analysis of the chemical composition of must and wine was performed 3 months after the end of fermentation. The chemical analyzes were performed at the oenological laboratory of the Biotechnical faculty and the laboratory

of the company "13.jul Plantaze", in Podgorica. They were performed under the Rules on quality and other requirements for wine (Sluzbeni list SRJ br.no. 54/99 and 39/2002).
Sensory properties of the wine were determined by tasting with the pointing-scoring method according to Buxbaum (max.20 points). The properties evaluated were: *clarity* (0-2), *colour* (0-2), *smell* (0-4) and *taste* (max.12). The organoleptic evaluation was carried by a tasting committee consisting of 6 members. The statistical processing of the obtained data was performed by calculating the average value, a variable expressed as a percentage and ANOVA (Student Newman Klaus test) in order to determine possible significant differences between all the analyzed wines.

Results and discussion

Chemical composition of the must and wine of the examined Vranac wine variety

The chemical composition of must is of great importance for the quality of a wine, and not only the amounts of certain ingredients, but their volume ratio. As one of the main indicators of the quality of must and the future wine is the concentration of sugar and the total acidity in grapes. The chemical composition of the must of the examined Vranac wine variety is shown in Table 1.

Table 1. Chemical composition of must

Vintage year	Sugar (%)	Total acidity (g/l)	pH	Sweetness index
2008	23.7	4.8	3.4	49.38
2009	23.9	4.7	3.5	50.84
2010	23.6	4.47	3.49	52.8
x	23.73	4.66	3.46	51.47
CV	0.64	3.63	1.59	3.33

x – average value, CV % - coefficient of variation

The average sugar content in the must during the three-year research was 23.73%, and the total acidity was 4.66 g/l, which is characteristic of the Vranac variety (Ulićević, 1966). The Student Newman-Klaus test showed that there is no statistically significant differences ($p<0.05$) between the values of the examined must parameters in the three different vintage years. The table shows that the sugar content in the must was rather high, and that the total acid content was in the range typical for this variety. The pH value of the must examined was relatively high, which is consistent with the total acid content of the must.

In order to obtain a better picture of the quality and degree of ripeness of the grapes, in addition to sugar and acid content, the sweetness or the glucoacidomeric index was determined which is the sugar acid ratio in grapes. The high sugar content and low acidity caused the sweetness index of the variety examined to be very high: 51.47.

After examination of the chemical composition of the Vranac wine variety must, we can conclude that the Vranac variety grapes were of excellent quality and that there were no significant variations in its quality over the years of research. The chemical composition of the wines made by the 4 vinification methodis is presented in Table 2. The specific gravity of the wine ranged from 0.9934 to 0.9944 on average. The value of this parameter depends

on the amount of extract and the concentration of alcohol in a wine. Based on the tabulation of the chemical components of the examined wines it can be concluded that all the wines, on average, have a high content of alcohol in accordance with the content of sugar in must. It ranges from 14.0 to 14:33 vol%.

Analogous to the high content of sugar in the must, the total extract content in the tested wines is also high. The extract of wine is an important component of its quality and by this term we mean the set of all volatile substances in a wine. The obtained average values range from 29.37 to 31.50 g / l. In the wines obtained a high content of total acids in wine is evident ranging from 6:03 to 6:33 g / l. In terms of reducing sugars, all the wines were dry and there was no difference among the variants. Based on the above mentioned parameters of the examined wines chemical composition, it can be concluded that all the wines have excellent characteristics, typical of the Podgorica area, which are characterized by a high content of alcohol and extract. A higher total acid content is evident, which is not typical for the wines produced from the Vranac variety, since they could be distinguished by a lower content of total acids. The higher content of total acids is caused by addition of tartaric acid in order to raise the low acid content in the must. Based on the results obtained on the chemical composition of wine, it can be concluded that the wines were of approximately the same chemical composition and that the vinification method has no statistically significant effect ($p > 0.05$) on the chemical composition of wine.

Sensory properties of wine in the wines tested

Based on the average tasting score for the 3 years of research, we have obtained results for all the vinification methods, which are shown in Table 3. After obtaining the average sensory scores, it can be concluded that the sensory properties of wine to a large extent depend on the vinification methods. Based on the data in Table 3 we can conclude that there is a significant impact of the modern vinification methods on sensory properties of a wine (control wine) compared to the classic one. The wines produced using modern vinification methods have a higher tasting score ranging from 0.4 to 0.9 points compared to the control wine, that is the wine made by a conventional method of vinification. Modern vinification methods differ slightly in the overall sensory evaluation

The highest average sensory evaluation of 18.2 points during the 3-year research period received the wine made using the Gimar method (G), while the lowest of 17.3 points received the wine produced by the classical method of vinification (K).

Table 2. Chemical composition of Vranac wines

Vintage year	Relative density	Alcohol (vol%)	Total extract (g/l)	Total acidity (g/l)	Volatile acids (g/l)	pH	Tartaric acid (g/l)	Potassium (mg/l)	Reducing sugar (g/l)
	The classic method								
2008	0.993	14	29.2	6.5	0.42	3.3	3.4	861	1.9
2009	0.9932	14.1	29.6	5.7	0.28	3.4	3.06	851	2.1
2010	0.994	13.9	29.3	5.9	0.52	3.45	3.2	850	2.3
X	0.9934	14.0	29.37	6.03	0.41	3.38	3.22	854	2.10
CV%	0.05	0.71	0.71	6.90	29.64	2.26	5.31	0.71	9.52
	The Sifa method								
2008	0.9939	14.3	29	6.4	0.37	3.31	3.31	920	1.8
2009	0.9941	14.5	30.4	6	0.29	3.39	3.33	884	2
2010	0.9942	13.8	30.2	5.95	0.45	3.45	3.28	899	2.2
x	0.9941	14.2	29.87	6.12	0.37	3.38	3.31	901	2.00
CV%	0.02	2.54	2.54	4.03	21.62	2.08	0.76	2.01	10.00
The Ganimede method									
2008	0.9935	14.4	31.9	6.3	0.28	3.4	3.6	855	2.2
2009	0.9941	14.6	32.7	7.1	0.22	3.26	3.48	827	2.4
2010	0.994	14	29	5.6	0.39	3.43	3.4	840	2.7
x	0.9939	14.33	31.2	6.33	0.30	3.36	3.49	841	2.43
CV%	0.03	2.13	6.24	11.85	29.06	2.70	2.88	1.67	10.34
The Gimar method									
2008	0.9937	14.46	33	6.8	0.3	3.29	3.8	860	2.7
2009	0.9951	14.54	32	6.6	0.28	3.31	3.7	830	3.1
2010	0.9945	13.9	29.5	5.55	0.41	3.4	3.62	840	2.7
x	0.9944	14.30	31.5	6.32	0.33	3.33	3.71	843	2.83
CV%	0.07	2.44	5.72	10.63	21.21	1.76	2.43	1.81	8.15

x – averaga velue, CV % - coeficient of variation

Table 3. Sensory characteristics of tested wines (2008-2010)

Vinification	2008	2009	2010	Average
K	17.4	17	17.5	17.3
S	17.7	17.7	18.3	17.9
Ga	17.7	17.9	18.6	18.1
G	/	18.0	18.4	18.2

However, since during the first year of research, processing in the Gimar fermentation tanks was not performed and having observed the last two years of the research when all the methods of vinification were present, a higher average score was obtained by the wines produced using the Ganimede (18.3) than using the Gimar method (18.2). There is a small difference in sensory evaluation, which is not to statistical significance.

Conclusions

Based on the results obtained during the three-year research, it can be concluded that:

The vinification method did not affect significantly the chemical composition of the tested wines, i.e., all the wines are of approximately the same chemical composition.

On the basis of the average sensory scores it can be noted that there is a significant influence of modern winemaking methods on the sensory properties of a wine compared to the traditional method (control wines). The wines produced by modern vinification methods have better sensory properties, better tannin structures necessary for high quality, more harmonious wines with the potential for medium and longer storage. The wines produced by the Ganimede and Gimar mehod due to its good structure have the potential for long-term maturation and high quality. With a proper selection of the vinification method a positive impact on the extraction of components from grapes is achieved, that is, from must into wine, as well as the possibility to control the maceration process, and to manage this process means to get the desired type of wine and the maximum quality out of the raw material at disposal.

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ВЛИЈАНИЕ НА МЕТОДОТ НА ВИНИФИКАЦИЈА ВРЗ ХЕМИСКИОТ СОСТАВ И СЕНЗОРНИ КАРАКТЕРИСТИКИ НА ВИНОТО ОД СОРТАТА ВРАНЕЦ

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Апстракт
Целта на испитувањето беше да влијанието на методот на винификација врз хемискиот состав и сензорните карактеристики на црвеното вино од сортата Вранец. За добивање на овие резултати експериментален апарат за микровинификација беше оспособен во компанијата "13. jul Plantaze" во Подгорица. Грозјето е добиено од лозовите насади во Чемовско поле кое припаѓа на подреонот Подгорица. Испитувани се 4 начини на процесирање, со Sifa, Ganymede и Gimar ферментациони цистерни и класичниот традиционален метод. Добиените резултати покажуваат дека винификациониот метод нема значајно влијание врз хемискиот состав на виното но евидентно е влијнаието врз сензорните карактеристики. Највисоки оценки се добиени кај варијантите со добиени со методот на Ganymede поради добрата структура и потенцијалот за долго созревање и високиот квалитет.
Клучни зборови: Вранец, хемиски состав, сензорни карактеристики, Сифа, Ганимеде, Џимар.

UDC:663.531:634.21 (497.16)
Original scientific paper

THE EFFECT OF THE LENGTH OF MACERATION ON THE PHENOLIC CONTENT IN WINE VRANAC IN PODGORICA SUBREGION

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Abstract
This paper presents the results which have been obtained by examining the effect of the duration of maceration on the phenolic content in wine Vranac in Podgorica subregion. The study was carried out in 2005 by vinifying grapes of the Vranac variety for 14 days. During the maceration, the content of anthocyanins, total phenolic compounds, catechins, as well as the intensity and hue of the colour were monitored daily. Using an OIV descriptor, a sensory evaluation was performed for the wines which were produced after 7 and 14 days of maceration. The analysis of the phenolic content was carried out by means of spectrophotometric methods. The results showed that the length of maceration had influence to the content of all phenolic compounds especially catechins in wines. The content of anthocyanins had rapidly grown since the first day, reaching a maximum on day seven and slightly decreasing with the passage of time. The content of total polyphenols and catechins recorded an upward trend from the first to the last day of maceration. The sensory evaluation rated the wines as premium quality. On the basis of the obtained results, we have concluded that the duration of maceration must be adapted to the type and style of the wine we want to produce. If we want fresh, fruity and aromatic wine, a shorter maceration of up to 7 days is needed. For wines that are to be aged for a longer period of time, requiring a stronger tannic structure, a longer maceration of 14 days is necessary. The degree of grape maturity and the maceration conditions could have a decisive role in this regard.
Key words: length of maceration, the wine Vranac and phenolic compounds.

Introduction

The maceration is an essential stage for transferring phenolic compounds from grape into wine. These compounds play a very important role in achiving wine quality - sensory properties, in particular color and astringency. They have influence in wine stability and aging. The initial color of red wine is mainly due to anthocyanins extracted from the skins, whereas their astringency and bitterness are largely due to flavan-3-ols (catechin and proanthocyanidins) extracted from solid parts of grape (skins and seeds). During maceration, the release of phenolic compounds from solid parts of grapes depends on various factors, including grape varieties, maceration time, cap punching programme, temperature, alcohol content, $S0_2$ level (Dallas and Laureano, 1994).

It was found that under normal red winemaking conditions, the color intensity and total anthocyanin content increased significantly at early stage of maceration, reached in few days their maximum and then decreased during the latter stage (Scudamore-Smith et al., 1990). Concerning total phenolics, similar profile was observed at early stage of maceration, nevertheless the content of total phenolics went on increasing until the end of fermentation (Watson et al., 1994, Sprangler et al., 2000, Gomez-Plaza et al., 2000). However, the effects of extended maceration on total and polymeric phenol concentration in wines were considerably differents among cultivars (Mazza et al., 1999).

To high level of tanins (condensed proanthocyanidins) may contribute to excessive astringency and bitternes. Therefore, the optimal length of maceration should be matched with desired style of wine. If we want to produce lighter, fruity wine it is preferable shorter maceration, while producing wine taninic style, suitable for longer storage, requires a longer period of maceration (Schmidt and Noble, 1990). Grape variety Vranac has a high content of coloring compounds – anhtocyanins (Pajovic et al., 2009). It is noted that this variety easily released coloring compounds mostly in the first days of maceration. However, the process of extracting polyphenolic substances during maceration for this variety is not well examined. The aim of this paper is to determinate dynamics of transfer polyphenolic substances from the solid parts of the grape of the wine during maceration, for a period of 14 days. We also determinated optimal length maceration for wine Vranac.

Material and methods

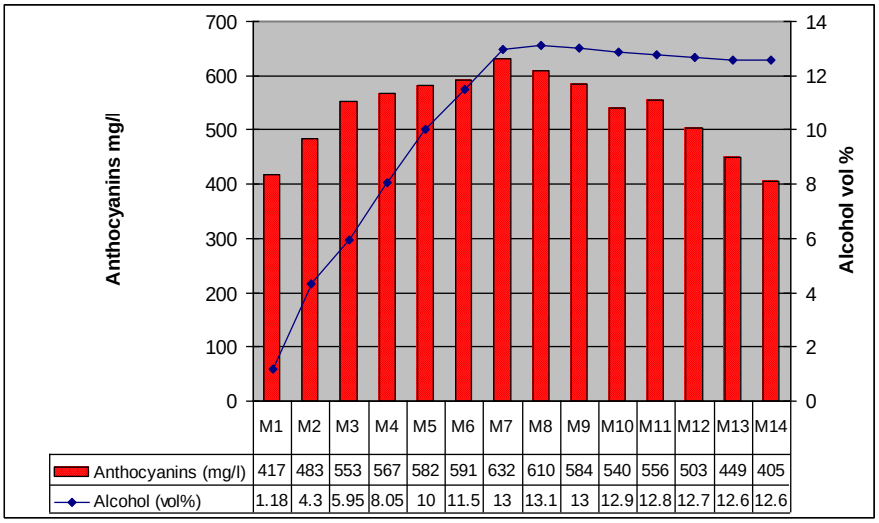
Experiment was carried out at the winery of Biotechnical faculty during vintage 2005. Grape variety was harvested in the period of technological maturity from experimental vineyard of Biotechnical Faculty, which is located on the Podgorica - Lješkopolje within the Podgorica subregion.

Procedure of wine preparation was done with following procedures: crushing grape, sulphuring, addition of yeast, vinification. Experiment was conducted in three groups (2 types of vinification 7 and 14 days). During the maceration, the content of anthocyanins, total phenolic compounds, catechins, as well as the intensity and hue of the colour were monitored daily. After that period the wines were racked without pressing. One month later the wine were racked again. After the spontaneous malolactic fermentation has occurred, the wines were racked again and sulphur dioxid was added. The wines for each length of maceration (7 and 14 days) were sensory evaluated four months after finishing fermentation using an OIV descriptor (OIV, 2009). Phenolic substances were analyzed using spectrophotometric methods with a spectrophotometer Jenwey 6405. Total phenols were analyzed by the Folin-Ciocalteu method (Singleton et al., 1999), with gallic acid standard, and results were expressed as gallic acid equivalent (GAE). Chromatic characteristics of wine were determined by measuring absorbance at 420, 520, 620 nm in a 1 mm cell in regard to double distilled water (Glories, 1984). Total anthocyanins were determined by spectrophotometry at 520 nm (Ough, 1984). Total flavan-3-ols content was analyzed by the vanillic method (Revilla et al., 1990) by use of (+)-catechin as a standard. In this paper we present the average results of three measurements of phenolic compounds.

Results and discussion

Dinamic of extraction phenolic compound in wine Vranac for 14 day of maceration

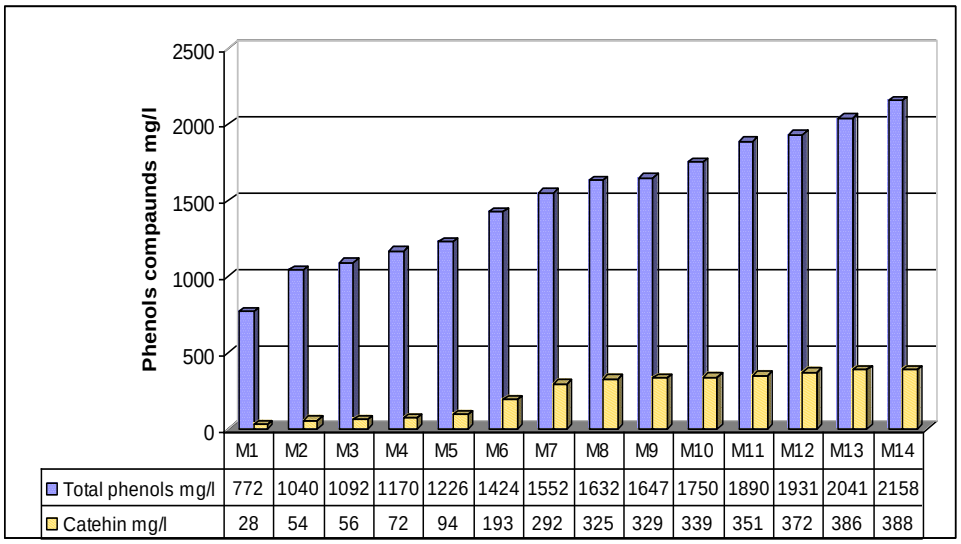
The knowledge about evolution of phenolic compounds in red wines during fermentation may help in determining the ideal wine-making process to control wine phenolic composition or to produce the wine style expected. The evolution of extraction anthocyanins, total phenols and catechins in wine Vranac during maceration for 14 days is presented in graphs in Figure 1 and Figure 2.



	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11	M12	M13	M14
Anthocyanins (mg/l)	417	483	553	567	582	591	632	610	584	540	556	503	449	405
Alcohol (vol%)	1.18	4.3	5.95	8.05	10	11.5	13	13.1	13	12.9	12.8	12.7	12.6	12.6

Figure 1. Content of anthocyanins (malvidin mg/l) and alcohol (vol %) during 14 days of maceration

As shown in graph, Figure 1, a great content of the anthocyanins was found already on the first day and the most intense extraction of the anthocyanins occurred during the first three days of the maceration. The alcohol contents in the wine during these three days ranged from 1,18 to 5,9 vol%. That is the alcohol contents in the wine during which the maximum extraction of the anthocyanins has been made (Mazza et al., 1999). During next four days of the maceration, a considerably slower growth of the anthocyanin contents was expressed, until the maximum contents of the anthocyanins was reached on the seventh day. The obtained results correspond to the results of the authors Scudamore-Smith et al. (1990) and Sprangler et al. (2000) who stated that maximum contents of the anthocyanins was reached in the period from the 4^{th}-6^{th} day. Later reaching of the maximum extraction of the anthocyanins in our experiment (only one day) may be explained by a lower temperature of the maceration during fermentation.

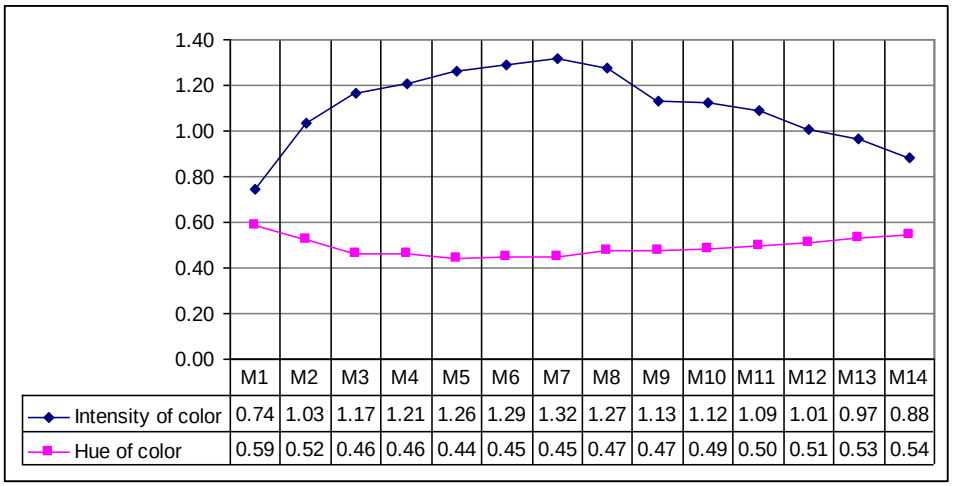


	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11	M12	M13	M14
Total phenols mg/l	772	1040	1092	1170	1226	1424	1552	1632	1647	1750	1890	1931	2041	2158
Catehin mg/l	28	54	56	72	94	193	292	325	329	339	351	372	386	388

Figure 2. Content of total phenols and catechins in wine during 14 days of maceration

As shown in Figure 2, the contents of the total polyphenols increased successively with the increase of the length of the maceration. On the first day of the maceration, the contents of the total polyphenols amounted to 772, and on the last, i.e. on the fourteenth day 2158 mg/l. Such results correspond to the research of Gracin et al., (2000) who proved that with the prolonged contact of wine with the pomace, the contents of the total polyphenols and tannins has been increased.

The contents of the catechins in the wine increased with the prolongation of the length of maceration. A slower increase was expressed from the first to the fifth day of maceration and then, it was more intense from the sixth to the eighth day. After that, the increase in the contents of the catechins was slow and successive with the maximum, reached on the 14th day of maceration. The obtained results related to the increasing values of the total polyphenols and catechins (potential procyanidins) correspond to the results of Gomez-Plaza et al. (2000) who stated that the examined phenolic components had greater concentration in wine after 10 days of maceration and that prolonged maceration time increased the contents of the catechins and proanthocyanids in the wine. The review of the intensity and hues of the wine colour, kept on the pomace for 14 days, is shown in Fig. 3.



	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11	M12	M13	M14
Intensity of color	0.74	1.03	1.17	1.21	1.26	1.29	1.32	1.27	1.13	1.12	1.09	1.01	0.97	0.88
Hue of color	0.59	0.52	0.46	0.46	0.44	0.45	0.45	0.47	0.47	0.49	0.50	0.51	0.53	0.54

Figure 3. Intensity and hue of color during 14 days of maceration

The graph in Fig 3, shows the increase in the colour intensity by the seventh day of maceration and later it decreased which was in accordance with the range of the contents of the anthocyanins in the wine. Hue values moved in the opposite direction to color density. The results of our research corresponded to the research of Yokatsuka et al., (1999) who proved, by monitoring the parameters of the pigment absorbance at 420 and 520 nm and colour intensity, that these parameters grow with the length of maceration, reach the maximum on the fourth or eighth day and then, decrease.

Phenolic composition of examined wine during maceration

During the maceration, phenolic components from the grape skin pass into the wine. The length of maceration is the factor which influences considerably on the dynamics of the transition of the phenolic components. The shorter maceration the greater concentration of the anthocyanins, but they are then, less stable and they sediment more easily. Longer contact of the wine with the pomace leads to greater polymerization of the pigments and better stability of the colour in later stages of wine keeping, which always depends on the grape variety (Mazza et al., 1999). In the table 1, the review of the polyphenolic composition of the researched wines Vranac, by maceration days, is given.

As we consider the polyphenolic composition of wine in the table 1, we may conclude that length of maceration has affected the content of catechin in wine where the coefficient of variation was 61%. The contents of anthocyanins and phenolics were also changing under the influence of the length of maceration, but lower (13 and 27%).

Polyphenolic composition of wine in all of the samples and particularly in the wine on the seventh day of maceration was very favorable. Thus, the anthocyanins reached the maximum, the contents of total phenols and catechin is very high. After the seventh day, also, the examined wines had a very high content of anthocyanins and very high contents of the total polyphenols which had a considerable impact on the colour stability. In the wines from the eighth to the fourteenth day of maceration, there is also, a high content of the catechins, which is according to Kovač (1992) a positive characteristic for the colour

stability which has a positive effect on the sensory properties of wine. The data on the polyphenolic composition of wine correspond to the results of Pajović et al., (2001), obtained during the research of the length of maceration of the wine, made of the variety Vranac.

Table 1. Phenolic content of wine during maceration long 14 days

	Alcohol vol%	Anthocyanins mg/l	Total polyphenols mg/l	Catchins mg/l	Intensity of color	Hue of color
M_1	1.2	417	772	28	0.74	0.59
M_2	4.3	483	1040	54	1.03	0.52
M_3	6.0	553	1092	56	1.17	0.46
M_4	8.1	567	1170	72	1.21	0.46
M_5	10.0	582	1226	94	1.26	0.44
M_6	11.5	591	1424	193	1.29	0.45
M_7	13.0	632	1552	292	1.32	0.45
M_8	13.1	610	1632	325	1.27	0.47
M_9	13.0	584	1647	329	1.13	0.47
M_{10}	12.9	540	1750	339	1.12	0.49
M_{11}	12.8	556	1890	351	1.09	0.50
M_{12}	12.7	503	1931	372	1.01	0.51
M_{13}	12.6	449	2041	386	0.97	0.53
M_{14}	12.6	405	2158	388	0.88	0.54
CV	38	13	27	61	15	9

CV- Coefficient of variation (%)

The analysis of the sensory properties of the obtained wines were also performed. The wines were described by OIV Descriptor (OIV, 2009). *Wine* M_7 (macerated 7 days) is limpid, intense red colour, open, medium aromatic, luxurious aroma with predominant fruit aroma, with pronounced blackberry aroma. On palate it is rich with good structure, balanced, very harmonious and with good aging potential. *Wine* M_{14} (maceration 14 days) was very limpid with intense red colour, it has open aromatic complexity with the spectrum of odours of generally ripe fruit aroma. The taste is intense, fine structure, long and pleasant.

Conclusions

The results showed that the length of maceration had influence to the content of all phenolic compounds especially catechins in wines. The content of anthocyanins had rapidly grown since the first day, reaching a maximum on day seven and slightly decreasing with the passage of time. The content of total polyphenols and catechins recorded an upward trend from the first to the last day of maceration. The color intensity grew up to the seventh day, declining slightly afterwards. The sensory evaluation rated the wines as very good.

On the basis of the obtained results, we have concluded that the duration of maceration must be matched with type and style of the wine we want to produce. If we want fresh, fruity and

less tanninc type of wine, a shorter maceration of up to 7 days is needed. For wines that are to be aged for a longer period of time, requiring a stronger tannic structure, a longer maceration of 14 days is necessary. Both produced types of wine Vranac (M7 and M14) were the premium red wines with sensory differences that make them specific.

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ЕФЕКТ НА ДОЛЖИНАТА НА МАЦЕРАЦИЈА ВРЗ СОДРЖИНАТА НА ФЕНОЛНИ МАТЕРИИ ВО ВИНОТО ВРАНЕЦ ВО ПОДРЕОНОТ ПОДГОРИЦА

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Апстракт
Во овој труд се презентирани резултатите кои се добиени со проучување на ефектот на должина на мацерацијата врз содржината на феноли во виното вранец во подреонот Подгорица. Испитувањето е изведено во 2005 година со винификација на сортата вранец во должина од 14 дена. За време на мацерацијата, секој вршени се анализи на антоцијаните, тоталните феноли, кетехини и интензитет на боја. Со дескрипторот на ОИВ извршена е сензорна анализа на вино добиено после 7 дена и после 14 дена мацерација. Содржината на фенолните материи се анализирани со спектрофотометар. Резултатите покажуваат зависност на содржината на фенолните материи од должината на мацерација, посебно врз содржината на катехините, антоцијаните рапидно се зголемуваат од првиот до седмиот ден а потоа благо опаѓаат со текот на времето. Вкупните полифеоноли и катехините покажуваат постојан пораст од првиот до последниот ден на мацерација. Должината на мацерација влијае на квалитетот на виното, за добивање на свежи, овошни вина, потребна е кратка мацерација до 7 дена, додека за вина предвидени за созревање, за кои се бара поголема количина на танински материи потребна е долга мацерација од 14 дена. Степенот на зрелост на грозјето и условите на мацерација би можеле да влијаат пресудно во оваа смисла.
Клучни зборови: должина на мацерација, вино вранец, фенолни материи.

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Original scientific paper

THE INFLUENCE OF pH ON COLOUR PARAMETERS OF RED WINE MERLOT AND PINOT NOIR

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Abstract
Results of pH influence (2.80, 3.20 and 3.80) on colour characteristics of red wine Merlot and Pinot Noir (after fermentation, and after 12 month period aging in a bottle) are shown in this paper. The colour intensity decreased and the hue increased along with the increase of pH value. The share of the red component in colour intensity was decreasing along with increase of pH of the wine, while the share of blue and yellow components increased, in the case of blue component with lower intensity. After a 12 month aging period in a bottle, the share of yellow colour increased in intensity in all investigation variants, but considerably more with higher pH values. With the increase of pH wine value, the ionisation anthocyanin content decreased, while the colourless anthocyanin content increased, because of witch the colour of wine became „brighter", especially after 12 month aging period in the Pinot Noir wine.
Key words: red wine, Merlot, Pinot Noir, colour parameters, pH.

Introduction

Phenol compounds and the products of their reaction with other compounds affect the sensory characteristics of wine. Anthocyanins are simple compounds that give wine its red color, whose intensity, hue and durability depend on the type and quantity of anthocyanins, but also on other phenolic compounds which are transferred from grapes to wine. The color manifested in the solution of anthocyanins is the manifestation of the pH value of the medium. In an acid medium, the anthocyanins are red, in a neutral or alkaline ones they are blue, and in the intensively alkaline medium they are yellow. The change of color takes place because in various media, the molecule structures are modified. The maximum intensity of red colour is encountered in very acid medium where pH value is lower than 3 and it is a result of the presence of double flavylium cations, whereas at pH value slightly higher than 3 (as in most wines) the red color becomes less intensive, since there emerge a lot of anthocyanin molecules called pseudo basa which are colorless as they lack certain double bonds and they are in equilibrium with red forms (Buccelli et al. 1991). As the pH value increases, this balance, shifts to the colorless carbinol pseudo base, which is related to the decrease in color intensity (Dallas and Laureano,1994).

The research of Sims and Morris (1984) showed that pH has a significant influence on the wine color. When pH value increases from 3.0 to 4.0 the content of colorless pseudo base

increases in respect to the red carbonium ion. If pH is near neutral reaction, the blue base of anthocyanin becomes dominant. Higher pH results in an increase of brown color, reduction of red color during nine months of wine storage. According to Ribereau-Gayon et al. (1998) in an acid medium, a certain equilibrium between the red form of flavylium and colorless products is established. The balance status depends on pH value. In the experiment with the model solution the colour of anthocyanins was 36 units on pH=1,6 and 1 unit on pH=3,9. The aim of this paper is to examine the influence of three pH values on colour parameters of Merlot and Pinot Noir during the period of their storage.

Material and methods

Vinifications has been carried out using the usual methods under laboratory conditions in Centre for Viticulture and Winemaking in Nis, Serbia. The grapes were crushed with a laboratory crusher, the stems was removed, the pomace was placed in 5-litre glass recipients, followed by addition of sulphur dioxide (10g/hl) in the form of potassium metabisulphite. After 6 hours, 2% of basic culture of wine yeasts (*Saccharomyces cerevisiae,* MO), was inoculated into the fermentation recipients. The fermentation was performed under the temperature of 25 to 28˚C. The cap was punched down twice a day. After 15 days, the wine was pressed. After that, the wine was kept at the temperature between 15 and 18˚C. The procedure and treatment was as follows: three pH values and two wine storage periods. The starting pH was 3,20 (B variant). Lower pH value (A variant) was obtained by adding 10% HCl solution to the wine, and the higher pH value (C variant) by adding $CaCO_3$ ($CaCO_3$ affects on titratable acidity and increases pH by the precipitation tartarates and somewhat less malates). $CaCO_3$ was added to the wine and left to settle down for seven days. The wine was analysed immediately after being treated, then again after six months, and once again after one year. The following analyses were performed: antocyanins at wine pH, after adding the rest of the SO_2, and at pH=1, polymers, as well as the Somers and Evans (1977) "chemical age" index, colour intensity as the sum of absorbencies at 420, 520 and 620 nm, then the share of yellow, red and blue colour in the intensity, as well as the Glories (1984) spectrum shape, Sudraud (1958) hue, and the real acidity (pH) was determined with the pH-meter, which is standardised up to pH 4,00 and 7,00 with buffer solutions.

Results and discussion

The values of colour intensity, hue, share of colours and dA% on different pH values are presented in Table 1. The biggest value for colour intensity was for investigation variant on pH=2,80 (0,756) in the case of Merlot wine and 0,546 in Pinot Noir wine, and the lowest value for colour intensity was 0,555 (Merlot), and 0,422 (Pinot Noir) on pH=3,80. Hue of the colour increased along with increasing of pH values from 0,403 to 0,558 in Merlot wine, and from 0,416 to 0,640 in Pinot Noir wine.

The share of red component in the colour intensity decreased with the increasing of pH value of the wine in both cases, while the share of yellow component increased. High pH value increased the share of blue component in colour intensity. This indicates that the blue form of anhydro base appears on higher pH values.

Values for spectral shape (dA%) decreased with increasing of pH values of the wine (with increasing share of yellow and blue colour and decreasing of red colour) from 75,0% (Merlot) and 73,9% (Pinot Noir) respectively on pH=2,80 to 65,7% (Merlot) and 57,5% (Pinot Noir) respectively on pH=3,80.

Table 1. Investigation results of pH influence on the colour of red wine (instantly after treatment)

Parameter	Variant					
	A (pH = 2,80)		B (pH = 3,20)		C (pH = 3,80)	
	Merlot	Pinot Noir	Merlot	Pinot Noir	Merlot	Pinot Noir
Colour intensity	0,756	0,546	0,685	0,502	0,550	0,422
Hue	0,403	0,406	0,449	0.527	0,558	0,640
A_{420}%	26,9	27,3	28,9	31,8	32,9	34,6
A_{520}%	66,7	65,7	64,2	60,3	58,9	54,0
A_{620}%	6,4	7,0	6,9	7,9	8,2	11,4
dA%	75,0	73,9	72,1	67,1	65,7	57,5

Table 2. Investigation results of pH influence on phenolic compounds in red wine (instantly after treatment)

Parameter	Variant					
	A (ph = 2,80)		B (ph = 3,20)		C (ph = 3,80)	
	Merlot	Pinot noir	Merlot	Pinot noir	Merlot	Pinot noir
Free antocyanins (mg/l)	455,0	230,0	452,8	228,6	450,0	229,6
Ionisation antocyanins(mg/l)	81,6	51,2	67,1	39,1	44,8	21,2
Colourless antocyanins (mg/l)	373,4	178,8	385,7	189,5	405,2	208,4
Polymers, mg/	19,2	20,8	19,5	21,5	20,0	21,2
„chemical age“ index	0,040	0,083	0,041	0,086	0,043	0.087

The influence of pH on content of free, ionisation and colorless anthocyanins, as well as Index of chemical age of wine are shown in Table 2. The content of total free anthocyanins didn't varies between investigation variants. The bigger variation were shown for ionisation and free anthocyanins. With the increase of pH value, the content of ionisation anthocyanins decreased, while the content of colourless anthocyanins increased, witch affected on decrease of colour intensity.

High pH leads to a brighter wine color (Table 3). This effect was there at the beginning of the test, but it was especially prominent after 12 months period of storage. This color reduction is both the result of the increase of dominance of colorless pseudo form of anthocyanins over the carbonium ion form and the result of the loss of free anthocyanins (Table 4 and Figure 1). Wine becomes brown during keeping, and in 12 months, the share of yellow color increases in all variants, but significantly more at higher pH values, as in the wine Pinot Noir.

Table 3. Investigation results of pH influence on colour of red wine (after period of 12 months)

Parameter	Variant					
	A		B		C	
	Merlot	Pinot noir	Merlot	Pinot noir	Merlot	Pinot noir
Colour intensity	0,620	0,466	0,549	0,396	0,410	0,303
Hue	0,446	0,582	0,508	0.736	0,626	0,963
A_{420}%	28,8	34,0	31,2	38,1	35,2	43,2
A_{520}%	64,5	58,4	61,4	53,3,3	56,3	45,0
A_{620}%	6,7	7,6	7,4	8,6	8,5	11,8
Da%	72,5	64,3	68,6	54,9	61,2	38,6

Age index is the way of describing the colour of the wine; greater chemical aging have the wines with lower values of monomeric anthocyanins, and higher concentration of polymers. After the fermentation, the wines had low values of this quotient, which started to rise as the wine started to age (Figure 3). The lowest value when the testing started had the variant with the lowest pH value, and the highest the variant with the highest pH value. After one year aging period of the wine, chemical age index increased, but the same trend persisted among the variants. Its value is affected by the variety. At the beginning, as well as at the end of the testing, the lowest value had variety Merlot, and the highest Pinot Noir.

Table 4. Investigation results of ph influence on phenolic compounds in red wine (after period of 12 months)

Parameter	Variant					
	A		B		C	
	Merlot	Pinot noir	Merlot	Pinot noir	Merlot	Pinot noir
Free antocyanins (mg/l)	309,5	153,6	260,1	122,8	206,4	90,4
Ionisation antocyanins (mg/l)	68,2	30,0	40,1	19,8	21,3	1,6
Colourless antocyanins (mg/l)	241,3	123,6	220,0	101,6	185,1	88,8
Polymers, mg/l	29,2	24,4	27,3	21,5	25,0	25,6
„chemical age“ index	0,086	0,137	0,095	0,147	0,108	0,221

The influence of pH on the share of polymers and ionisation antocyanins on the colour of Merlot and Pinot Noir wine after 12 month period are shown in Figure 2. Results presents that the increase of pH value lead to lower content of ionisation anthocyanins and bigger content of polymers in wine colour.

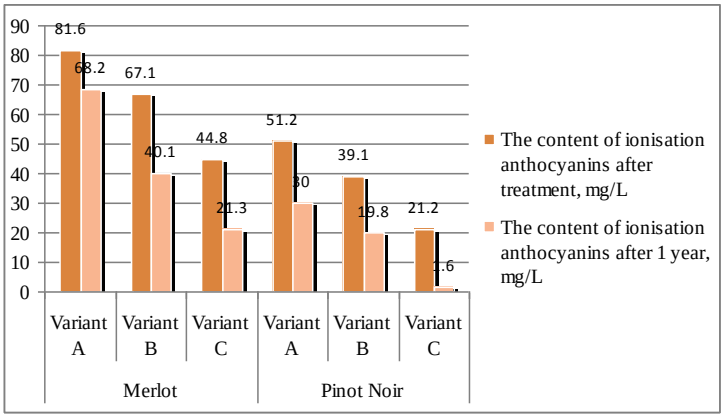

Figure 1. Influence of pH value on the content of ionisation anthocyanins in wines (Merlot and Pinot Noir)

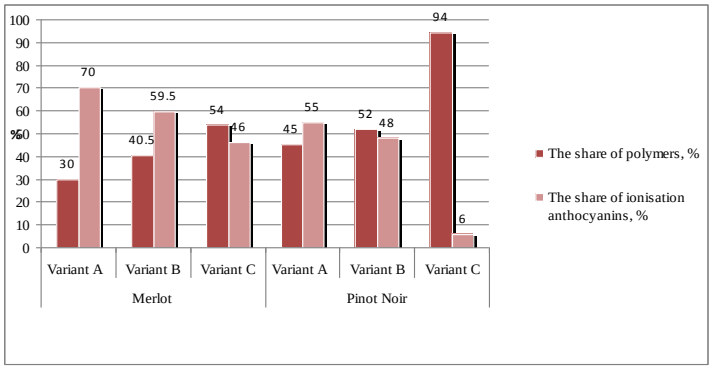

Figure 2. Influence of pH value on the share of polymers and content of ionisation anthocyanins in the colour of wines Merlot and Pinot Noir after 12 mounth period

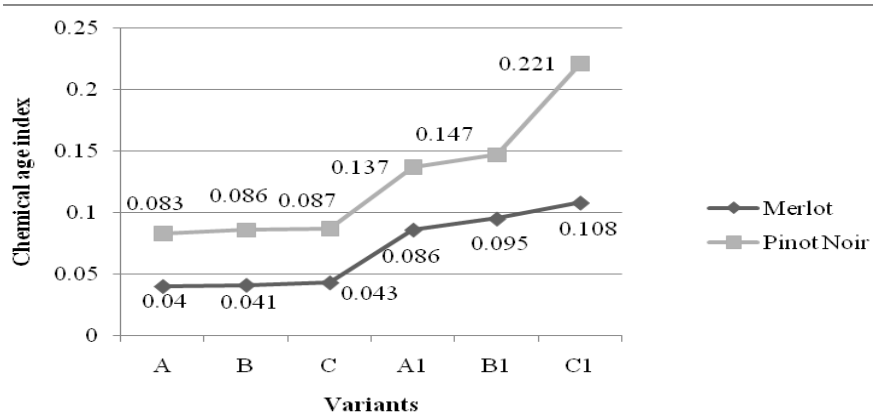

Figure 3. Influence of pH on „chemical age“ index of the wine on the beginning (A,B and C) and after investigation period of 12 month (A1, B1 and C1)

Conclusions

According to the results presented in this paper the following conclusions can be made:

- The content of ionisation anthocyanins decreased while the content of colourless anthocyanins increased with increase of pH value.
- High pH value lead to „brighter“ wine colour. This effect was detected from the beginning of investigation, but especially after 12 month period of wine aging. Reduction of colour was influenced by increase of colourless pseudo form anthocyanins under the carbonium form, as well as by the greater loss of total free anthocyanins.
- The share of the red component in colour intensity decreased with ageing of wine, while the share of blue and yellow components increased, in the case of yellow component with bigger intensity.
- Higher pH value of wine decrease the content of ionisation anthocyanins, and increase the content of colourless anthocyanins, because of witch the colour of wine became „brighter“, especially after 12 month aging period in the Pinot Noir wine.
- Spectrum (dA%) had sharp absorption maximum for wine with lower pH value, where the red colour is dominant, while in the case of higher pH values spectrum had stretched maximum, where yellow and blue colour are dominant.

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ВЛИЈАНИЕ НА pH ВРЗ ПОКАЗАТЕЛИТЕ ЗА БОЈА ВО ЦРВЕНИТЕ ВИНА НА МЕРЛО И ПИНО НОАР

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Апстракт

Резултатите од влијанието на pH (2.80, 3.20 и 3.80) врз показателите за боја на црвените вина од сортите мерлот и пино ноар (после ферментација и 12 месеци после зреење во шише се прикажани во овој труд. Интензитетот на боја се намалува а нијансата се зголемува со порастот на вредноста на pH. Учеството на црвените компоненти во интензитетот на бојата се намалува со зголемување на pH на виното, додека учеството на сината компонента и жолтата компонента се зголемуваат, во случајот со сината компонента со помал интензитет. После 12 месеци на созревање во шише, учеството на жолтата компонента се зголемува во интензитет кај сите испитувани варијанти но значајно при повисоки pH. Со зголемување на pH, содржината на јонизирани антоцијани се намалува, додека безбојните антоцијани се зголемуваат поради што бојата на виното станува по сјајна посебно кај виното Пино ноар после 12 месеци созревање.

Клучни зборови: црвено вино, Пино ноар, показатели за боја, pH.

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EFFECT OF REDISTILLATION CUTS ON QUALITY OF 'CRVENA RANKA' PLUM BRANDY

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Abstract
"Crvena ranka" (Red ranka) is among in the plum producing superior quality. The aim of this study was to determine the influence of the moment of separation and patoka fraction of the heart during the redistillation of the quality - the chemical composition and sensory characteristics of red plum rank. Different moments of separation medium fractions of fractions at patoka redistilling have influenced the plum brandy produced significant differences in the content of total acids, total esters, 1-hexanol, and other ingredients that exceed the allocations at the end of distillate fractions or medium at the beginning and during the extraction fraction patoka. There were no significant differences in sensory scores obtained plum.
Keywords: Plum, Red Ranka, redistillation, chemical composition, sensory characteristics.

Introduction

Ranka is a red old native plum brandy, is widespread in Serbia, especially in Šumadija (Misic, 1996). It belongs to the plum plum to produce high-quality (and Nikićević, Tešević, 2010). In order to unify the quality in the last decade have dramatically improved technological process of brandy made from this variety, especially in terms of primary production of plums and control of alcoholic fermentation (Nenadović-Mratinić et al., 2007). Traditional processing of this sort of brandy includes double distillation Alambic. During the first distillation (distillation of fermented plum mash) no separation of fractions, and the content of ethanol in the distillate obtained (raw soft plum brandy) ranges from 20 to 25% v / v, often up to 30% v / v. During the second distillation (crude redistillation soft plum brandy) are separated fractions firstborn heart and patoka, with only the middle fraction (heart) used to produce the final brandy. The traditional production of ethanol content in middle distillate fraction is about 50% v / v. Dynamics of the most important ingredients in the distillation process of redistillation traditional crude brandy soft red varieties rank studied by Radovanovic et al. (1963). In contemporary ways redistillation recommended earlier separation fractions of fractions of heart patoka, where the ethanol content in the medium fraction obtained more than 50% v / v and can range up to 65% v / v (Daničić Paunovic, 1967; Nikićević and Tešević , 2010). In the production of other renowned spirit drinks, fruit and grapes need to be at the right moment redistilling perform

separation of fractions of fractions patoka heart, in order to achieve the highest quality final strong alcoholic beverages (Leaute, 1990, Guan and Pieper, 1999; Malcata and Silva, 1999; Cortes et al., 2002; Nikićević and Tešević, 2010).

Given that some manufacturers still apply traditional redistillation, while others separate the medium fraction with ethanol content greater than 50%, even 60% v / v, the objective of this study was to determine the influence of the moment of separation and patoka fraction of the heart during redistillation of the quality - the chemical composition and sensory characteristics of red plum rank.

Material and methods

For this experiment we used raw soft brandy obtained directly from a commercial producer of Scotch. Crude soft brandy is produced by fermentation and distillation of pomace plum seeds of red rank on alambiku 100 liter, without separating factions. Ethanol content in raw soft brandy was 25.8% v / v. Its chemical composition is shown in Tables 1 and 2.

Redistillation soft raw brandy was carried out in the pilot batch distillation device made of copper - alambiku, volume 25 liter cauldron. The tank is heated by direct flame (gas burner). During all experimental redistillation separated fractions firstborn same amount (1% of the volume of crude soft plum brandy that is filled cauldron). Depending on the time of separation fraction of the heart and patoka medium fractions were obtained which contained 50.0%, 52.5%, 55.0%, 57.5%, 60.0% and 62.5% v / v ethanol. The content of ethanol in the distillate fractions obtained secondary deionized water was reduced to 45% v/v. For the analysis of the content of ethanol, higher alcohols, acids, esters, aldehydes, furfural, methanol, benzaldehyde and HCN in the middle fractions obtained by the redistillation, using standard methods prescribed by legislation Serbia (Official Gazette 70/87). Gas chromatographic analysis of the content of acetaldehyde, ethyl acetate, methanol, 1-propanol, 2-methyl-1-propanol, 1-butanol, and 2/3-metil-1-butanola 1-hexanol was used 4-methyl-1-pentanol as internal standard. Used a gas chromatograph HP 5890 chromatographic column and CHROMPACK CP-WAX 52 CB (capillary column, length 50 m, polyethylene glycol stationary phase, internal diameter 0.32 mm and film thickness 1.2 μm). Injector temperature was 233° C, was injected into 2 mL of sample in split mode (1:1). Temperature program: from 40° C to 222°C to 4.3°C / min and 20 min to 222°C. Carrier gas: hydrogen (H2) at a flow rate 1.2 ml / min. Detector: plamenojonizujući (FID), T = 300°C. Sensory analysis was conducted by an expert committee modified the method by Buxbaum-in.Statistical data analysis was performed using the Statistica 7 (StatSoft, Inc.., Tulsa, OK, USA).

Results and discussion

According to the legislation of Serbia and EU quality plum brandy is considered in terms of the effect of the individual components of the safety (methanol, HCN) and sensory characteristics (other volatile components) brandy. Tables 1 and 2 shows the chemical composition of the raw soft plum (containing ethanol 25.8% v / v) and medium fractions obtained by the redistillation of her (with an ethanol content of 50.0 to 62.5% v / v). Table 3 presents the results of the sensory analysis of final plum brandy containing ethanol 45.0%

v/v, which are obtained by reducing the ethanol content in produced high fractions of deionized water.

Table 1. The influence of the time of separation medium fractions (rate) fraction of patoka redistillation of the raw soft plum brandy (ethanol content of 25.8% v / v) on the chemical composition of the medium fractions – heart

ethanol content (% v/v)	(% V / v) Higher alcohols	(mg / L AA) Acids	(mg / L AA) Esters	(mg / L AA) Aldehydes	(mg / L AA) Furfural	(mg / L AA) Evaporative ingredients	(mg / L AA) Evaporative ingredients without acid	(mg / L AA) Methanol	(g / L AA) benzaldehyde	(mg / L AA) HCN
Crude soft plum										
25,8	2469	2842	1985	42	8	7346	4504	5,40	85	13,41
Intermediate fraction (heart) obtained by the redistillation										
50,0	2419	691	1496	33	8	4647	3956	4,83	85	3,88
52,5	2360	685	1492	31	8	4576	3891	4,83	84	3,87
55,0	2512	696	1353	33	8	4602	3906	4,83	84	3,84
57,5	2335	555	1306	29	7	4232	3677	4,96	84	2,88
60,0	2500	506	1292	31	8	4337	3831	4,12	83	3,36
62,5	2490	421	1328	44	8	4291	3870	4,96	85	2,88
CV (%)	5,82	16,05	5,47	19,81	5,67	4,06	2,50	6,28	0,75	18,53
r	0,42	- 0,94	- 0,86	0,50	0,20	- 0,85	- 0,46	- 0,23	0,01	- 0,83

Irrespective of the time of separation fraction of the heart and patoka, all middle distillate fractions, obtained during the redistillation, meet the requirements of the legislation of Serbia and the EU which state that the presence of methanol is up to 12 g / l AA, HCN content of up to 50 mg / l AA (Serbia), or 70 mg / l AA (EU), the content of benzaldehyde to 100 mg / l AA and volatile matter content of at least 2000 mg / l AA The content of volatile matter is the sum of the concentration of higher alcohols, acids, esters, aldehydes, and furfural.

The use of different modes redistillation we found that, compared with the raw soft brandies that are placed on a binding constraint, the obtained mean frakcijame to contain 76-85% less total acid, less than 25-35% of total esters and 5-37% less than 1 - hexanol. The dynamics of the distillation components investigated variants in the traditional way that suits redistillation (ethanol content in the heart was 50.0% v / v) is in agreement with the results obtained by examining the dynamics of distillation of these components get Radovanovic et al. (1963) and Nikićević Paunovic (1989).

By selecting different moments of separation and patoka heart were obtained by the redistillation of the middle fractions were differing by the content of those components that the distillate generally exceed appropriations at the end or middle fractions during the extraction fraction patoka. As we have emphasized, the greatest differences were observed

in the content of total acids, total ester and 1-hexanol. Therefore, the highest values are correlation coefficients between ethanol content and the contents of the above ingredients in the middle distillate fraction: the total acid ($r = -0.94$, $p = 0.006$), for a total esters ($r = -0.86$, $p = 0.028$) for 1-hexanol ($r = -0.99$, $p = 0.000$). Also, the highest values of coefficients of variation were found for total acid content (CV = 16.05%) and 1-hexanol (CV = 15.59%).

Table 2. The influence of the time of separation medium fractions (rate) fraction of patoka redistillation of the raw soft plum brandy (ethanol content of 25.8% v / v) the content of acetaldehyde, ethyl acetate, methanol and higher alcohols in some medium fraction - the heart

ethanol content (% v/v)	(% V / v) acetaldehyde	(mg / L AA) Ethyl acetate	(mg / L AA) Methanol	(g / L AA) 1-propanol	(mg / L AA) 2-methyl-1-propanol	(mg / L AA) 1-butanol	(mg / L AA) 2/3-metil-1-butanol	(mg / L AA) 1-hexanol	(mg / L AA) Total higher alcohols	(mg / L AA) Total higher alcohols - 1-propanol
Crude soft plum										
25,8	122	720	6,29	1857	773	123	1952	747	5452	3595
Intermediate fraction (heart) obtained by the redistillation										
50,0	71	364	5,69	1727	709	113	1822	713	5084	3357
52,5	77	380	5,99	1836	748	118	1923	699	5325	3489
55,0	73	364	5,83	1804	731	117	1885	638	5177	3372
57,5	76	372	5,64	1770	720	116	1854	593	5053	3283
60,0	84	388	5,56	1772	720	114	1850	528	4986	3214
62,5	81	386	5,35	1752	720	119	1852	473	4917	3168
CV (%)	6,44	2,84	3,86	2,17	1,81	2,06	1,89	15,59	2,85	3,55
r	0,82	0,70	- 0,78	- 0,14	- 0,16	0,39	- 0,15	- 0,99	- 0,73	- 0,85

Earlier fractions separating the heart from the fractions obtained Patoka medium fractions with lower total acid content, especially if the content of ethanol in the heart of greater than 55.0% v / v. This is understandable, given that Radovanovic et al. (1963) and Guan and Pieper (1999) emphasize that acetic acid, the acid as the most common brandy, exceeds the maximum distillate fractions during separation patoka. Similar behavior and have more fatty acids with 6-12 C atoms (hexanoic, octanoic, dodecanoic acid and decanal) and, to a lesser extent, present, fatty acids with 3-5 carbon atoms.

Content of total ester also decreases with increasing ethanol content in the medium fraction, especially if it contains more than 55.0% v / v. Given that contain significant amounts of plum and etillaktata dietilsukcinata (Crowell and Guymon, 1973, Popovic et al., 2009), which distils mostly at the end of the middle fractions and fractions at the beginning of patoka (Leaute, 1990, Guan and Pieper, 1999), before separation heart leads to a reduction

in the content of these ingredients, and thus a decrease in the total content of esters in the final brandy. The content of 1-hexanol decreased significantly with increasing ethanol content in the medium fraction obtained by the redistillation.

According to Cortes et al. (2002) this higher alcohol distilled mostly at the end of the extraction fraction of the heart and the beginning of the extraction fraction patoka. Higher alcohols from similar behavior in a distillation and 2-phenylethanol (Leaute, 1990, Guan and Pieper, 1999), which, unfortunately, is not included in the analysis of gas chromatographie.

No significant changes in the concentration of the other analyzed constituents in produced high fractions depending on how redistillation. It is primarily concerned with substances that pass into the distillate as the firstborn of impurities (acetaldehyde, ethyl acetate), or as an admixture to pass into the distillate mainly in fractions firstborn and heart (methanol, 1-propanol, 2-methyl-1-propanol, 1-butanol , 2-methyl-1-butanol, 3-methyl-1-butanol). This is evident by the very low values of the coefficient of variation (CV).

Table 3. The influence of the time of separation medium fractions (rate) fraction of patoka redistillation of the raw soft plum brandy (ethanol content of 25.8% v / v) on the sensory characteristics of the middle fractions - rate reduced to 45% v / v

ethanol content (% v/v)	(% V / v) Color	(0-1) The clarity	(0-1) typicality	(0-2) Odor	(0-6) The taste	(0-20) Total
	Crude soft plum					
25,8	1	1	2	5,43	8,40	17,83
	Intermediate fraction (heart) obtained by the redistillation reduced to 45% v / v					
50,0	1,00	1,00	2,00	5,50	8,53	18,03
52,5	1,00	1,00	2,00	5,53	8,47	18,00
55,0	1,00	1,00	2,00	5,45	8,47	17,92
57,5	1,00	1,00	2,00	5,43	8,47	17,90
60,0	1,00	1,00	2,00	5,45	8,45	17,90
62,5	1,00	1,00	2,00	5,43	8,52	17,95
CV (%)	0,00	0,00	0,00	0,75	0,38	0,30
r	-	-	-	- 0,80	- 0,18	- 0,71

Furfural can be considered a component that goes into most of the middle distillate fraction (Radovanovic et al., 1963), which explains the inability to reduce its content in relation to the initial soft brandy in the middle fractions obtained in the course of our experiments, in which the highest content of ethanol was 62.5% v / v. Leaute (1990) states that furfural is a partial fraction of the cross and if patoka start with separation much earlier, as is the case for the redistillation in the production of cognac, such that the average fraction of more than 62.5% v / v ethanol.

According Nikićević Paunovic (1989), benzaldehyde passes into the distillate distillation of all time, and using a simple redistillation can not reduce its content in the medium fraction obtained, compared to the initial soft brandy. Also, how can the redistillation influence its

content in the medium fractions obtained. HCN content is reduced in comparison to the initial soft brandy for 71 to 79%, solely due to the binding of copper parts of the distillation unit, with a moment of separation fractions of fractions of heart patoka no importance for the reduction of this compound in the middle fractions obtained by the redistillation. The approximate content of HCN in the middle fractions obtained indicating very uniform binding of this compound to the copper parts of the distillation unit. Different moments of separation fraction heart of the patoka redistillation of fraction did not significantly impact on the sensory evaluation of the final plum. Scope of smell score ranged from 5.43 to 5.53, for a taste of 8.45 to 8.53, and the sum of 17.90 to 18.03. Top rated plum were those produced from medium fractions containing ethanol 50.0% (from 18.03), 52.5% (from 18.00) and 62.5% v / v (from 17.95). Generally, the earlier the separation of fractions of fractions patoka heart with one hand can improve the sensory characteristics of the final brandy due to the reduction of acetic acid content and certain fatty acids. On the other hand, in this way reducing the content of components that contribute to the fullness of flavor, distinctive aroma and fruity plum (etillaktat and dietilsukcinat), freshness (1-hexanol) and smell the roses (2-phenylethanol). Cortes et al. (2002) point out that excessive elimination of certain components (such as 2-feniletanola, 1-hexanol, etc.). Premature separation of patoka during redistillation may lead to loss of structure and brandy adversely affect the flavor. Normally, these considerations make sense when you put on redestilaciju flawless soft brandy (brandy and soft without excessive production of acids and other ingredients that remain high even after redistillation and can negatively affect the sensory quality of the finished product).

Conclusions

Based on chemical analysis of secondary fractions obtained by various methods and sensory analysis redistillation final plum was found that the separation of momentum fractions of fractions patoka heart affects the appearance of differences in the content of individual components are important for the quality of Scotch. It is therefore essential that redistillation be conducted so as to maximize remove components that could adversely affect the health and sensory characteristics of the final value of brandy, and at the same time preserve the components of the optimal degree of importance for the fine aroma of top plum. This depends largely on the skill and knowledge and technology-destilatera, making the distillation of fruit brandy is both science and art.

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ЕФЕКТ ОД МОМЕНТОТ НА ИЗДВОЈУВАЊЕ НА ФРАКЦИИ СО РЕДЕСТИЛАЦИЈА ВРЗ КВАЛИТЕТОТ НА БРЕНДИ ОД СЛИВАТА ЦРВЕНА РАНКА

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Апстракт

Црвена ранка е меѓу сортите сливи кои даваат супериорен квалитет. Целта на ова испитување беше да се определи влијанието на моментот на оделување на фракцијата патока од срцето за време на дестилација врз квалитетот, хемиски состав и сензорни карактеристики. Различните моменти на одделување на фракцијата влијае значајно на разликите во составот на вкупните киселини, вкупни естри, 1-hexanol, и други состојки. Не е утврдена значајна разлика во сензорните карактеристики на ракиите од слива.

Клучни зборови: слива, Црвена Ранка, редестилација, хемиски состав, сензорни карактеристики.

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LANDSCAPE ECOLOGY IN THE WINE CENTER

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Abstract
The criteria on location of the wine celler on the north slope of Vrshats hill have been defined based on analysis of the natural conditions and the climate, the erosion of the slope and the pedological types. A vineyard complex along with a production wine cellar has been regulated.
Key words: climate, erosion, vineyard.

Introduction

Malo Sredishte is situated in the territory of Vrshats municipality, 7.5 km east from Vrshats and 10.7 km from the border on Romania. The Malo Sredishte brook basin drains the northern slopes of Vrshats bank (at an altitude 463 m) and Gudrichki top (at an altitude of 641 m). Three morphological units are distinguished on the terrain: hilly-mountaneous part at an altitude of over 200 m, a prolluvial – dilluvium fan at an altitude of 200 – 120 m and the third geomorphological unit is the alluvial plain of the Malo Sredishte brook and Mali Rt (small cape) as a local erosion base (Dimiskovska, 2012).

Material and methods

For the purpose of arrangement of the production-tourist centre, the climatic, geomorphological, geological and pedological conditions of the environment have been analyzed. The extent of erosion has been defined by the analytical method developed by S. Gavrilovic (Spalevic, 1997). The insight into all the natural characteristics of the area has enabled application of bioengineering as well as maximum utilization of the genetic potentials regarding wine and table types of grapes for the given agroclimatic region and ecological production of grape.

Results and discussion

The main elements of the basin that are important for the occurrence of land erosion are area F, length L, perimeter O and its shape. The basin has an area of F=5.17 km^2, length L=2.87 km and perimeter O=11.25 km. The parameters of the basin are: the lowest level of 120 m, the highest level of the brook of 300 m, the watershed level of 641 m, the average grade of the brook bed of 7.5%, the average height of the basin of 210 m, the average difference in height of 90 m, the average grade of the basement 15%, and the coefficient of average

erosion energy of the relief of 62 $mkm^{-1/2}$. In the upper part of the basin area, there are shales, different varieties of gneisses susceptible to physical-chemical disintegration and pronounced erosion. In the lower and the middle part of the basin, i.e., in the zone of the prolluvial-dilluvial fan, the valley of the brook is carved into neogene and quaternary sedimentary rocks undergoing intensive processes of ravining. These are slight to moderately water impermeable rocks which contribute to the non-resistance of the land against erosion (Sekularac et. al., 2008).

In the basin area, under the effect of pedogenetic factors, the following types of land are present: skeleton and skeletoid land on gneisses, loessized podzol soil on gneisses as well as clay soil and podzolized clay soil on neogene clays (Zivkovic at al., 1972).

The climatic elements contributing to the processes of land erosion are precipitations and temperature. For MS Vrshats, the period between 1966 – 2009 has been taken for analysis. The meteorological station covers the agroklimatic area of southeast Banat. The multiannual average precipitation amounts to 661,7 mm. The distribution of precipitation per seasnos is as follows: winter 127.2 mm, spring 177.7 mm, summer 228.4 mm, autumn 148.3 mm and 407.2 in the vegetation period. The primary annual maximum precipitation takes place in June with an average precipitation of 89.3 mm, which is higher than the Vojvodina average value for 7.5 mm. The primary minimum is expressed in this agroclimatic area only in March, with an amount of precipitation of 36.1 mm and is lower than the average value for Vojvidina for 0.1 mm. The relative variation of precipitation is R = 8%. The average annual temperature amounts to 11.6^{o}C. The average temperatures vary with the seasons: the maximum is always in July, with air temperature of 21.5^{o}C. In the analyzed period of 18 years, August is warmer than July for 0.3 – 4.8^{o}C on the average. The minimal monthly temperatures are observed in January, amounting to 0.4 ^{o}C (Stojiljkovic et al., 2011).

Based on analysis of the natural characteristics of the basin, measures against erosion have been proposed as follows: terracing of the terrain along with grassing trackways and placement of retaining walls constructed of gneisses from place to place, as well as placement of watteles and doubs in the area of terrain ravining. As to the flow itself, it is anticipated to strengthen and arrange the banks by stone lining and cascading of the brook bottom for the purpose of decelleration of the torrential flows. At the compound itself, a retention reservoir has been designed. At all parts of the terrain with skeletoid land and big inclination, bioengineering has been designed - the same as the measures against erosion.

Preliminary Solution of the Production-Tourist Compoun

The location of the production-tourist compound is in an area of orchards and vineyards. The lot is situated beteen 11 m and 146 m and covers the right and the left slope of Malo Sredishte brook. In the vicinity of the compound, there are the natural forests of the Vrshats mountains as a hunting potential, the vicinity of the town of Vrshats and the good connection with the road network. Functional zones have been distinguished with the preliminary solution Fig.1 as follows: 1. Representative zone, 2. Camping zone, 3. Protective zone, 4. Production and processing of grapes zone, 5. Recreation zone and 6. Economic zone.

1. Representative zone: it is situated in the highest part of the terrain. In this zone, the guests are accepted and the vehicles are parked. It is anticipated for holding manifestations,

meetings and cellebrations. Situated in this zone is the hunting house as a catering facility along with a restaurant at the ground floor and rooms for guests in the attic. In front of the hunting house, above the wine cellar is the summer terrace oriented to the south, with a line of sight over the small ridge of Vrshats. Beside the hunting house, there is a canopy for processing of wine and entrance into the cellar. The possibility of involving the guests in each part of the work related to the vineyard, through the harvesting of the grapes up to making wine gives an authenticity and charm to the entire compound. At the highest level of the lot, there is a gazebo with a capacity of up to 100 guests.

2. Camping zone: it is situated between the previous zone and the east boundary of the lot. This part of the compound is in a valley with a natural forest. In this part, there are seven camp houses consisting of a room, a small kitchen, a bathroom and a terrace. In this zone, there are retaining walls – dry walls constructed of gneiss with a height and width of 0,5 m designed as a counter erosion measure.

3. Protective zone: In this zone, the inclination of the terrain is the greatest, around 50%. Complete afforestation and placement of a gabion in three rows along the contours and then terracing of the terrain and construction of a retaining – decorative wall as a dry wall made of gneiss with a height and width of 0,5 m, is anticipated for this zone.

4. Production zone: the total area of 2,83ha covered with vineyards is divided into two units – the first on the rift and the second on the banks of the brook. Out of the total area, 1,05 ha is planned on the rift and 1,78 ha is planned on the banks. Planting is designed to be carried out along the contours along with terracing of the terrain and grassing between the vine rows (Kis, 2011). This measure is aimed at avoiding frequent cultivation of the land and disturbance of the land structure and enabling treatment of vineyards by machinery immediately after rain. Cultivation of grape vines is planned on lanes with acacia sticks and galvanized steel wires placed in four rows.

5. Recreation zone: this zone covers the central, i.e., the lowest part of the compound. Planned for this zone is construction of a dam and creation of a retention lake. The lake has three functions: to reduce the speed of flow of the Malo Sredishte brook and prevent erosion; to provide sufficient quantity of water for irrigation in the dry periods of the year and to serve for recreational purposes (bathing, paddling, fishing). The area covered by the lake is 2233 m2. Its has an average depth of about 2 m, a length of 150 m and an average width of 18 m. The capacity of the lake is between 4000 – 4500 m3 water.

6. Economic zone: it is located in the northeast, the highest part, along the boundary of the compound. It is mainly on podzolized clay soil. The justification of selecting this place is the low productivity of this type of land in the vicinity of the main road. Situated in this zone are economic structures where the stable for the horses, the storehouse, the shed for the pasturage and the shed for the mechanization are located. In front of the structures, there is an area for training horses which is in a good line of sight from the terrace of the hunting house.

Conclusions

The effects on the environment have been evaluated as follows: the measures for repair of the Malo Sredishte brook contribute to improvement of the environmental conditions and

does not pose any threat for the environment, while the structures, according to their contents and function, are to function safely and contribute to the reduction of the extent of erosion within the basin. The preliminary solution well fits in the space and does not disturb the neighbouring contents but contributes to the repair of the existing erosion processes and the landscape in the zone of the compound, improving the microclimate, as well.

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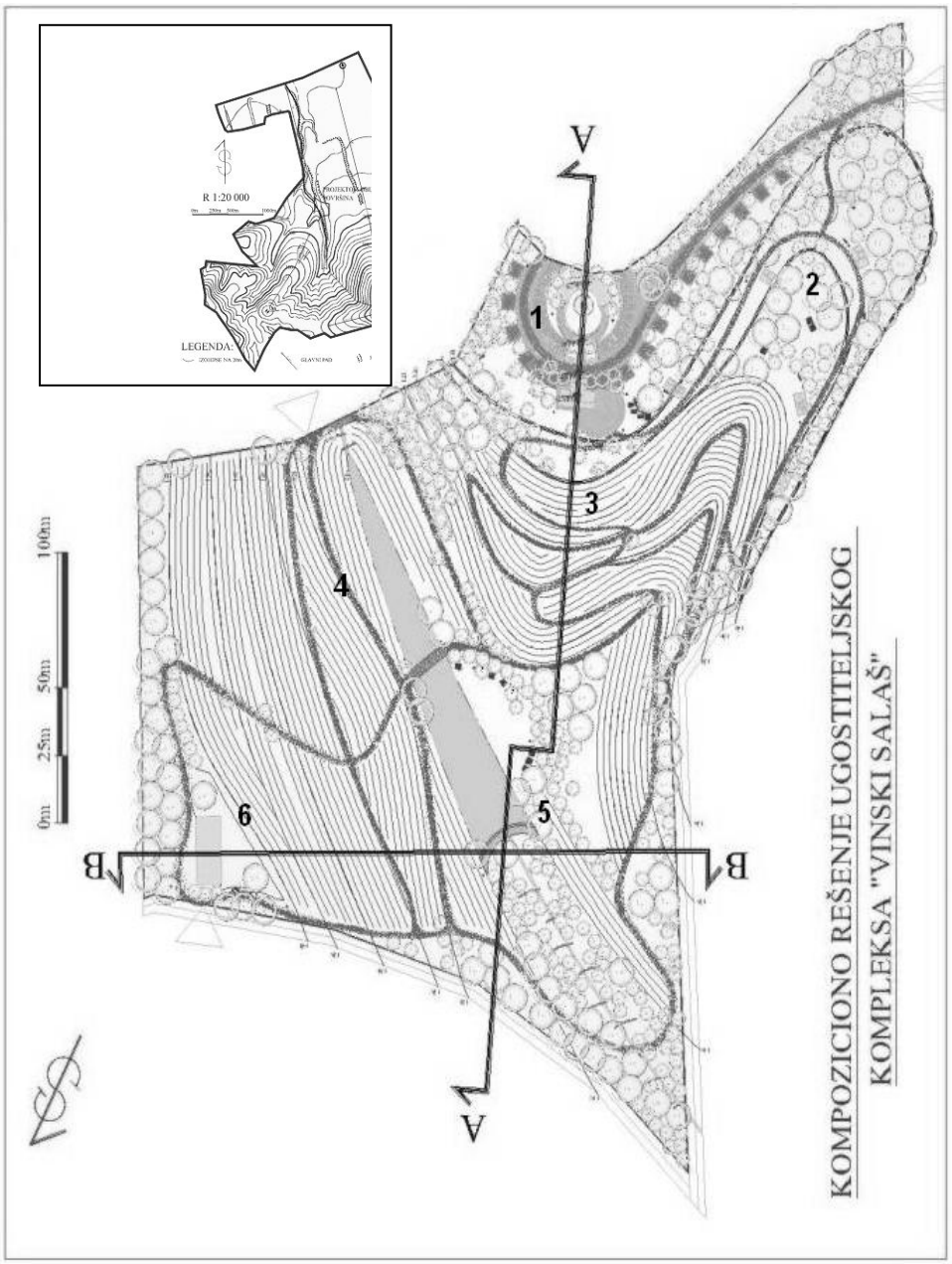

Figure. 1. Preliminary solution of „Vinski Salash“ compound with distinguished functional zones.

Legend: 1. Representative zone, 2. Camping zone, 3. Protective zone, 4. Production and processing of grapes zone, 5. Recreation zone, 6. Economic zone. COMPOSITION SOLUTION OF THE „VINSKI SALASH“CATERING COMPOUND

ЕКОЛОГИЈА НА ПЕЈСАЖОТ ВО ВИНСКИ ЦЕНТАР

Драгица Стоињковиќ, Тибор Кис, Бисерка Димишковска

Апстракт
Критериумите на локацијата на внарскито продрум на северната падина на ридот Вршац се дефинирани врз основа на анализа на природните услови и климата, ерозијата на наклонот и педолошките типови. Лоарскиот комплекс заедно со производството на винарската визба е предходно регулирано.
Клучни зборови: клима, ерозија, лозјето.

UDC:663.26-027.16
Original scientific paper

ECONOMIC POTENTIALS OF WASTE PROCESSING OF GRAPES

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Abstract
The volume of the grape waste produced directly relates to the volume of grapes pressed and in turn depends on the specific climatic conditions of the relevant vintage. The grape waste in EU-27 during 2008 was estimated for a wine production of 159.3 Miohl (International Organization of Vine and Wine - OIV, 2010) in, approximately 1138 x 10^3 tons/year of grape stalk, 3186 x 10^3 tons/year of grape marc, 1365 x 10^3 tons/year of wine lees and 95 x 10^6 m3 of winery wastewater. Serbia constitutes one of the middle grape and wine producers, with a grape production during 2010 was 330 070 tonnes of which remains about 7 000 tons of grape by-products, which is only used for the production of alcohol, and most of ending up in landfills as organic waste (Statistical Serbian Office –RZS, 2012). Our results of analysis of grape by-products show high content of polyphenols reflecting their high antioxidant activity. The grape waste, constitute a very cheap source for the extraction of phenolic antioxidants, which can be an alternative source for obtaining nutritional antioxidants (dietary supplements), thus providing an important economic advantages.
Keywords: Grape waste, economic potential, nutritional antioxidants.

Introduction

According to the Food and Agriculture Organization (FAO), 75 866 square kilometers of the world are dedicated to grapes. Grapes are the world`s largest fruit crop with more than 60 million metric tons (67.5 x 106 tons during 2009) produced annually. Europe represents 44% of this worldwide production (International Organization of Vine and Wine - OIV, 2010). Approximately 71% of world grape production is used for wine, 27% as fresh fruit, and 2% as dried fruit (www.oiv.int).

The European Union (EU-27) has an important presence in the world wide market of wine, with approximately 49% of the vine growing area of the world and 60% of the wine production. The world production of the wine during 2008 was about 267.4 Miohl in the EU-27, about 159.3 Miohl, the Mediterranean countries (Italy, France and Spain) being the main producers. Spain constitutes one of the main wine producers, with the highest vineyard area of the world (1165 mha, equivalent to 15.1 % of the world total vineyard area) and with a wine production during 2008 of 35.9 Miohl (13.4% of the world wine production) (OIV, 2010).

However wine making leads to the generation of large quantities of waste (around 5-9 million tonnes per year, worldwide), which considerably increase the chemical oxygen

demand (COD) and the biochemical oxygen demand (BOD) due to a high pollution load (high content of organic substance such as sugars, tannins, polyphenols, polyalcohols, pectins and lipids) with detrimental effects on the flora and fauna of dischanged zones (Oreopoulou et al. 2007). According to the European Council Regulation (EC) No. 479/2008 on the common organization of the market in wine (EC, 2008), grape marc and wile lees are considered by-products and must be sent to alcohol distilleries to extract alcohol and tartarates, producing a solid waste, exhausted grape marc and a liquid waste, vinasse. Grape stalk is obtained after the esteeming process and contains the stems of the grape, while grape marc, obtained after the pressing process, consists of processed skins and seeds.

Wine lees are produced throughout the fermentation and clarification steps in the wine producing processed. On the other hand, the aerobic depuration of the winery effluents, vinasse and winery wastewater, generates another solid waste, winery sludge (Moure et al., 2001; Scola et al., 2010). The composition of grape waste varies considerably, depending on grape variety, vintage and technology of winemaking. Thus, the waste generation of the winery industry during 2008 was estimated for a wine production of 159.3 Miohl in, approximately 1138 x 10^3 tons/year of grape stalk, 3186 x 10^3 tons/year of grape marc, 1365 x 10^3 tons/year of wine lees and 95 x 10^6 m3 of winery wastewater (OIV, 2010). Serbia constitutes one of the middle grape and wine producers, with a grape production during 2010 was 330 070 tonnes of which remains about 7 000 tons of grape by-products, which is only used for the production of alcohol, and most of ending up in landfills as organic waste (Statistical Serbian Office –RZS, 2012, www.stat.gov.rs). Therefore, the treatment and disposal of winery waste must is a serious environmental problem and winery waste must find another use other than as animal feed or as fertilizers.

The problem of all these waste materials is their disposal and treatment due to their seasonal character (during September - November) and some characteristics which difficult their management. The cost of waste disposal and the penalties imposed on companies have therefore increased significantly, often reaching 30,000 – 40,000 Euros in EU. In recent years, the growing concern about the environment has led authorities to look for economically viable solutions for recycling and /or valorising grape waste.

The grape waste is characterized by high-phenol content because of poor extraction during winemaking, so that its use supports sustainable agricultural production. (Arvanitoyannis et al. 2006). Polyphenols that might protect against human diseases related to oxidative stress. The active ingredients contained in this value-added are proanthocyanidins (Da Silva et al. 1991). Recent studies in animals, as well as some human studies, have shown that grape proanthocyanidin possess a broad spectrum of biological, pharmacological and chemoprotective properties against free radicals and oxidative stress (Baydar et al. 2004; Gorduza et al. 2000; Kennedy 2008; Radovanović et al. 2010). Together with tannins and polyunsaturated fatty acids, these grape constituents display inhibitory activities against several experimental disease models, including cancer, heart failure and other disorders of oxidative stress. The aim of this work is to evaluate grape stalk as a sources antioxidant polyphenols for their possible use as food antioxidants. To this purpose antioxidant capacity and total polyphenolic content of four grape stalk samples of different grape varieties, grown in Serbia was investigated.

Material and methods

Chemicals and samples

All chemicals used for analysis were of analytical degree of purity from Merck (Darmstadt, Germany). There was used the following chemicals: 2,2`-diphenyl-1-picrylhydrazyl free radical (DPPH), methanol, ethanol, acetone, hydrochloric acid, trifluoroacetic acid (TFA), gallic acid. The used reagents were of analytical quality.

The grape stalk samples of four grape varieties: Vranac, Merlot, Gamay and Italic Riesling which was used for analysis, were grown at the vineyards of Serbia (vintage September, 2011). Samples were collected at physiological ripeness phase.

Preparation of grape stalk extracts

0.5 g of stalk was extracted with 10 ml of solvent mixtures (methanol /acetone/water/TFA). The samples were stirred for 30 min on a magnetic stirrer, and then centrifugated at room temperature (Tehnica LC-320, Železniki, Slovenia) at 4000 rpm for 10 min the supernatants from three extraction procedures.

Determination of total polyphenols

Total phenol contents in the grape stalk extracts were determined spectrophotometrically, as already reported (Mazza et al. 1999). After about 15 min, the absorbances (A) at 280 nm were recorded using an Agilent 8453 UV-visible spectrophotometer (Agilent Technologies, Santa Clara, CA, USA). Absorbance at 280 nm was used to estimate total phenols content, by using gallic as the standard compound.

Determination of antioxidant activity

Antioxidant activity of test grape stalk samples was determined by using free radical scavenging (DPPH) assay. This antioxidant assay is based on the measurement of DPPH· colour loss due to the changes in absorbance at 517 nm, caused by the reaction of DPPH· with the test sample. After 20 min at room temperature, $A_{517\ nm}$ was measured against the blank. The DPPH-scavenging activity of each wine sample was calculated from the decrease in absorbance according to the following relationship: Antioxidant activity (%) = [1 – (A_{sample} - A_{blank})/$A_{control}$] x 100, where: $A_{control}$ is the absorbance of control (8.0 x 10^{-5} M methanol solution of DPPH·), A_{blank} is the absorbance of diluted wine sample and A_{sample} is the absorbance of the diluted wine sample with the same concentration of DPPH-radical as in control. The radical scavenging activity (%) was plotted against the leaves extract concentration (mg g^{-1}) to determine the concentration of extract that reduces activity by 50% (EC_{50}).

Statistical analysis

Three analytical replicates were carried out on each grape sample. Measurements were averaged and results are given as mean ± standard deviation (SD). The standard deviation was calculated by ANOVA using the Minitab statistical package (Minitab Inc., State College, PA, USA).

Results and discussion

The phenolic composition in grape varies widely and is usually determined by several factors, such as: the variety of grape and conditions under which they was grown: soil,

geographical location, light exposure, temperature, sun exposure of the clusters and weather (Gil-Munoz et al. 2010; Mazza et al. 1999; Xu et al. 2011).

Also, the amount and types of phenol compounds present in a particular grape waste can vary and is greatly influenced by the extraction process, as well as the source, variety and storage of the used waste. Polyphenols in grape waste are mainly flavonoids, including the monomeric flavan-3-ols and procyanidin dimers, trimers and more highly polymerized procyanidins (Kennedy 2008; Lachman et al. 2009). The content of total polyphenols of four grape stalk extracts obtained from the international grape varieties: Merlot, Gamay and Italic Riesling, as well as the autochthonic grape variety Vranac has been determined by spectrophotometric assays.The antioxidant activity of the tested grape stalk extracts was estimated by their ability to scavenge the stable free radical, DPPH· method. The EC_{50} values used in this work, which reflect the equivalent concentration of antioxidant sample able to scavenge 50% of the DPPH-radical. It should be noted that as higher antioxidant activity of the sample is, the lower EC_{50} value is (Tab 1. and Figure 1).

Table 1. Content of total polyphenols of Vranac, Merlot, Gamay and Italic Riesling grape stalk samples, expressed as mg g^{-1} fresh weight and their antioxidant activity, expressed as EC50 (mg g^{-1} ± SD)

Variety of grape stalks	Total polyphenols (mg g^{-1})	Antioxidant activity (EC50)
Vranac	82.06 ± 0.45	1.92 ± 0.06
Merlot	58.18 ± 0.46	2.23 ± 0.08
Gamay	48.78 ± 0.23	2.31 ± 0.03
Italic Riesling	79.11 ± 0.61	1.95 ± 0.02

*p > 0.05

In the appropriate environmental conditions, these grape varieties have great economic importance because that their quality wines are very appreciated in the domestic and foreign markets.

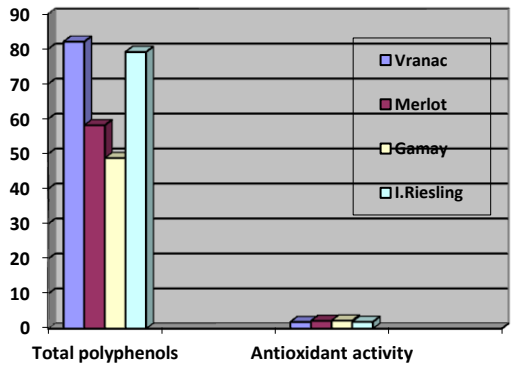

Figure 1.Content of total polyphenols of grape stalk samples, expressed as mg g^{-1} fresh weight and their antioxidant activity, expressed as EC50 (mg g^{-1} ± SD)

Investigated grape stalk extracts had antioxidant capacity which is in excellent correlation ($R^2 = 0.9946 \pm 0.0178$) with their total polyphenolic content (Figure 2):

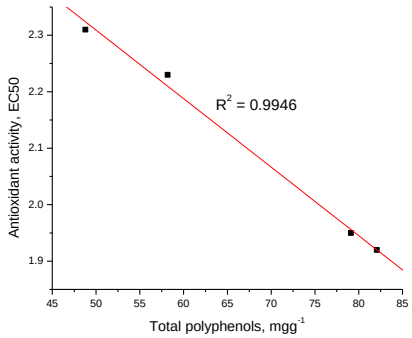

Figure 2. Correlation between content of total polyphenols and antioxidant activity of tested grape stalk samples ($p < 0.01$)

Conclusions

Based on results of this research we can conclude that investigated grape stalk samples have significant antioxidant activity, which is in excellent correlation with their total polyphenolic content. For this reason, extraction of polyphenols from grape waste has emerged as an opportune and vital business for the wine, food and pharmaceutical industry.

Acknowledgment

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ЕКОНОМСКИОТ ПОТЕНЦИЈАЛ НА ОТПАДОТ ОД ПРЕРАБОТКАТА НА ГРОЗЈЕТО

Владимир Радовановиќ, Снежана Џекиќ, Блага Радовановиќ

Апстракт
Волуменот на отпадот добиен во преработката на грозјето директоно е во релација со волуменот на пресуваното грозје зависи од специфиќните климатски услови на едно виногорје. Отпадот од грозје, во ЕУ-27 за време на 2008 е преоценет на 159.3 Miohl (International Organization of Vine and Wine - OIV, 2010) во, приближно 1138 x 10^3 ton/year од гроздинка, 3186 x 10^3 tons/year комиње, 1365 x 10^3 tons/year од вински талогоf 95 x 10^6 m3 искористена вода во винариите. Србија претставува среден производител на грозје и вино, со производство од 330 070 ton во 2010 година од кои остануваат околу 7 000 тони грозје за нуспроизводи, најмногу алкохол или како органско ѓубриво. (Statistical Serbian Office –RZS, 2012). Нашите резултати од анализите покажуваат висока содржина на полифеонеоли во нуспроизводите од грозје, тие претставуваат многу ефтина суровина од која со екстракција се добиваат антиоксиданти употребливи во исхраната на човекот.
Клучни зборови: отпадок од грозје, економски потенцијал, хранливи антиоксиданти.

UDC: 663.25 (497.714)
Original scientific paper

HERBONIZATION – METHOD FOR PRODUCING SPECIFIC WINES

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Abstract
Herbonizacion is a specific amphelotechnical method which allows production of wines with bigger content of alcohol, total acids, extract, polyphenols and aromatic compounds. The aim of the investigation was to produce wines with specific compound of chemical and polyphenol compound, and sensory properties. Research was done on varietes Vranec, Merlot and Cabernet sauvignon, grown in Tikves wine region. Wines were produced in winery Stobi Gradsko. By the results we conclude that the method herbozinization allows production of specific wines with bigger content of alcohol, total acids, extract and color compounds. Wines are characterized with emphasized fruit aroma.
Key words: herboniziation, polyphenolic compound, extract, aromatic metters, sensory characteristics.

Introduction

More wine regions are affirmed and developed the production of special and specific wines. The production of grapes and wine apply specific amphelotechnical measures and technological procedures. There are several methods that are used to increase the concentration of sugar in the must. In wine production, also apply technological methods for obtaining special or specific wines. Special or specific wines are characterized with a specific chemical composition and sensory properties. Based on the environmental conditions, varietes and equipment we applied an amphelotechnical measure called herbozinizacija. The purpose of the application was to provide raw material for the production of a specific wine. By applying herbozhinizacija started in 2004 in the "Bovin" - Negotino. Then in 2005 ”Winery Valandovo" produce wine "Alexander" which won several international awards. Due to the high quality of wine it comes into regular production program in "Winery Valanovo". In 2011 herbonization is applay in the winery "Stobi" from Vranec and Merlot. Herbozinizacija as a method to produce specific wines, allows bigger contents of sugar, acids, collor materials and flavors in the grapes. Wines obtained by applying herbozinizacija are characterized by increased alcohol content, total acid, extract, anthocyanins, and aromatic substances.

Object and method of operation

Herbozinizacion is applied in production vineyards of the "Crveni Bregovi" - Negotino and processed grapes and produced wine in the winery "Stobi" - Gradsko. The survey included Vranec and Merlot varieties grown on training system using double Guyot method of pruning. The vines were left with two arches with 8 buds and two parts with two buds.

During regular production applied agro-technical measures. At the time of technological maturity grapes contain 200-210 g/l sugar is made shorter bows with removal of the final two tendrils. They were left to hang on the supporting structure. After 10-12 days became drying of leaves and rying of grape on cutting branches. Dynamics of maturing was analyzing by the content of sugars in the standard grape production, and in the grape producing by herbozation with dynamics of sugars in the grapes from cutting bunches and remaining bunches. Determination of specific gravity and glucose in the must is done by Oechle and content of sugar in the must is calculated by using Saleronov form. The total acids were determined by potentiometric titration using an indicator bromtimolsino. Chemical analysis of the wine is made according to the methods of the Law on Wine (Official Gazette of RM br.69/2004). Total polyphenols were determined using FOLIN-CHIOCALTES method. The content of anthocyanins was determined by the method STONESTREET. The intensity of the hue of the color is determined by spectrophotometric measurement absorbence of 420 and 520 nm. Sensory properties of wine tasting and determined by applying positive twenty point system.

Results and discussion

The results of the chemical composition of the must Vranec are presented in Table 1, and the variety Merlot in Table 2. Based on the results, shown in Table 1 and Table 2 we can conclude herbozhinizacijata impact on the content of sugar and acid. The content of sugars is enhanced in terms of standard 4,1 - 4,2 g/dm^3 in potsushenoto herbozhinizirano grapes and the grapes for all herbozhiniziranoto 12-14 g/dm^3. The total acids in grapes dried-herbonizated increased compared to the standard of 0,75 to 0,91 g / l. The results of the chemical composition of wine is presented in Table 3. There are significant differences in the chemical composition of wines obtained by the standard method and the method of herbozinization. Wines derived ampelotechnical measure herbozinizacija contain more alcohol than 1,1 to 1,4 vol% of the standard and more total acids from 1,19 to 0,42 g / l. Wine produced by the method of herbozation contains more dry extract standard 3,4 - 4,0 g /l. Table 4 shows the figures for poliphenolic composition of wines obtained by standard methods and application of herbozinizacion. Based on the obtained results we found a significant influence on the herbozinization on poliphenolic composition of wines. Wines obtained herbozinizacion contain more total phenols from 519-881 mg/l standard of guilt. Wine Vranec obtained by herbozinizacion containing 895 mg/l anthocyanins, and standard 640 mg/l. The wine of Merlot variety have an anthocyanins content ranges from 417 mg/l in the standard, and 551 mg/l in wine made with herbozinizacion. Herbozinizacion has a positive impact on the hue and intensity of color. The results of the sensory properties of the tested wines are presented in Table 5. Based on the results obtained we concluded that herbozinizacion has a great influence on olfactory characteristics and taste qualities of wines. Wines obtained herbozinizacion are features with pronounced fruit flavors and tastes better qualities.Sensory total score obtained by the guilt herbozhinizacion is higher by 1.1 to 1.2 points by default fault.

Table 1. Chemical composition of the must Vranec

Standard	223	6,35
Herbonizated – total	234	6,30
Herbonizated - dried	265	7,10

Table 2. Chemical composition of grape must from grape Merlot

Variation	Total sugars g/l	Total acids g/l
Standard	221	5,61
Herbonizated – total	235	5,58
Herbonizated - dried	262	6,52

Table 3. Chemical composition of wine

Parameter	Vranec		Merlot	
	Standard	Herbonizated	Standard	Herbonizated
Alcohol vol %	13,2	14,6	13,3	14,4
Total acids g/l	5,95	6,14	5,12	5,54
Total extract g/l	32,3	38,5	32,8	36,5
Dry extract g/l	28,8	32,8	28,3	31,7

Table 4. Polipphenolic composition of wine

Parameter	Vranec		Merlot	
	Standard	Herbonizated	Standard	Herbonizated
Total phenols mg/l	1.653	2.534	1.488	1.907
Anthocyanins mg/l	640	895	417	551
Intensity	0,77	0,8	0,91	0,93
Hue	2,05	3,58	1,31	1,61

Table 5. Sensory properties of wine

Parameter	Vranec		Merlot	
	Standard	Herbonizated	Standard	Herbonizated
Color	2,0	2,0	1,8	2,0
Clarity	2,0	2,0	2,0	2,0
Smell	3,1	3,6	3,0	3,5
Taste	10,5	11,1	10,5	11,0
Total	17,6	18,7	17,3	18,5

Conclusions

Based on the results obtained can be drawn the following conclusions:

By applying ampelotecal measure herbozinizacion getting raw material enriched with grape-sugar content, total acid, polyphenols and primary aromatic substances..Wines obtained

herbozinizacion contain more alcohol, total acid, extract and polyphenols. They have improved taste and olfactory qualities.
With herbozinizacion it is possible to produce specific wines suitable for aging. It can be successfully applied to varieties Vranec, Merlot, Cabernet Sauvignon, Syrah and other varieties.
Research should continue to more locations and determine specifics arising due to climate conditions, variety, creativity applied vinification and human resources.

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ХЕРБОЖИНИЗАЦИЈА – МЕТОД ЗА ДОБИВАЊЕ СПЕЦИФИЧНИ ВИНА

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Апстракт
Хербожинизацијата е специфичен ампелотехнички метод со кој се овозможува добивање вина со зголемена соджина на алкохол, вкупни киселини, екстракт, полифеноли и ароматични материи. Цел на испитувањето беше да се добијат специфични вина по хемиски и полифенолен состав и сензорни својства. Испитувањата се вршени кај сортите вранец и мерло, одгледувани на шпалирен систем во Тиквешкото виногорје. Виното е произведено во Винарија Стоби – Градско. Врз основа на добиените резултати констатиравме дека методот хербожинизација овозможува добивање на специфични вина со зголемена содржина на алкохол, вкупни киселини, екстракт и боени материи. Винатa се карактеризираат со нагласени овошни ароми.
Клучни зборови: хербожинизација, полифенолен состав, екстракт, ароматични материи, сензорни својства.

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THE INFLUENCE OF DIFFERENT SELECTED YEAST STRAINS ON YOUNG WINE VRANEC FROM TIKVES WINE REGION

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Abstract
In this study we have presented the examination results of the influence of different selected yeast strains on young wine Vranec from the tikves wine region. The analysis were done on wines from the cultivar Vranec, which is the leading variety in the tikves wine region. During the research the following selected yeast strains were used: *Saccharomyces cerevisiae ph.r. cerevisiae* PB2031, and *Saccharomyces cerevisiae ph.r. cerevisiae* PB2590 which are commercial yeast strains. In order to determine the influence of these selected yeast strains on the young wine, the study was focused on determination of the fermentation kinetics of the yeasts which is in tight correlation with the kinetics of the alcoholic fermentation. The study was also focused on the determination of the total number of selected yeast strains, including the number of the viable and dead yeast cells in certain stages. Finally, the quality of the young wines was observed through microbiological, chemical and sensorial analysis, and the differences originated from the different wine treatments were commented. The obtained results should provide theoretical and practical knowledge and to improve the future work with selected yeast strains.
Key words: selected yeast strains, Vranec, kinetics, viable cells.

Introduction

Our goal was to investigate the influence of different selected yeast strains on young wine Vranec derived from tikvesh wine region in Macedonia. For that purpose the following yeast strains were seleceted:*Saccharomyces cerevisiae ph.r. cerevisiae* PB2031,*Saccharomyces cerevisiae ph.r. cerevisiae* PB2590, which are commercial yeast strains, and we have decided to make this research with grapes from the cultivar Vranec, since is leading cultivar in our winegrowing areas. Aims of our research were: Establishing the dynamics of the selected yeast strains, which is in tight correlation with the dynamics of the alchocolic fermentation, Determination of total yeast cell number in certain phases, Determination of viable and dead yeast cells, Determination of percentage of activity of the yeast strains during fermentation, Determination of the quality obtained, through microbiological, chemical and sensory evaluation of the young wines.

Our examination included microbiological analyses and collection of sterile samples through all the phases of the production process, where as the counting of the viable cells was done

through the method of Howard (hemocythomer), than monitoring of the yeast activity and with that monitoring of the inhibitory conditions was concluded as well. The obtained results were compared with the declaration of the producer. The producer of the selected yeast strains had declared that the yeast strains were produced in March 2007, with expiry date within 24 months if the strains are kept below 20C, and below 4C the expiry date is within 36 months. According the producer, in 1g dry yeast there is cca. 2×10^{10} active cells, and after the biological rehydration there is 4×10^{6} active cells in one mL. On the second day of the fermentation the yeast cells number rises up to 6×10^{7} cells and this number may vary according the ecological conditions in the environment, but minimum is 4×10^{7} cells, and maximum $1{,}1 \times 10^{8}$ cells in mL. In these phase if the cell number drops to 4×10^{7}, the fermentation can be stucked or sluggish. At the end of the alchocolic fermentation the total cell number drops to 3×10^{7} cells in mL.

Method of work

Scheme of the method applied is displayed in Table 1.

Table 1. Scheme of the research

Trials						
No	Cultivar	Qty	Strain	Qty aplied	Antioxidant	Qty aplied
1	Vranec	1hL	PB2031	25g/hL	Galovit C	30g/hL
2	Vranec	1hL	PB2031	25g/hL	H_2SO_3	50mg/L
3	Vranec	1hL	PB2590	25g/hL	GalovitC	30g/hL
4	Vranec	1hL	PB2590	25g/hL	H_2SO_3	50mg/L
5	Control Vranec	1hL	No strain	0	Galovit C	30g/hL
6	Control Vranec	1hL	No strain	0	H_2SO_3	50mg/L

As displayed in Table 1 we had six different trials. At each trial we used selected yeast strain and antioxidant, except for the controls were we didn't used any strains, and only antioxidant was used. As antioxidants were used H_2SO_3 and commercial additive by the name of Gallovit C. Gallovit C is a combination of 30% ascorbic acid and 70% gallo tanins. Microbiological research was done with the use of both methods - direct method and the culturelle method. Total cell number was monitored directly with Spencer chamber, as well as with petry dish (indirect method), while the counting of the number of viable cells was done only with the direct method.Sterile sampling was done at the grape crusher, after the addition of SO_2, and ascorbic acid, and after the biological activation of the both selected yeast strains. The dilution of the samples was10^{1}, only we had dilution of 10^{10} at the samples taken after the biological activation. The monitoring of the yeast population grow, the determination of viable and dead yeast cells in fermentation was done from the first to the seventh day of the trials.

Results and discussion

Microbiological research in grape must

In our trials the following yeast strains were used: *Saccharomyces cerevisiae ph.r. cerevisiae* PB2031, *Saccharomyces cerevisiae ph.r. cerevisiae* PB2590 ,which are commercial strains. Before fermentation in the grape must we had total number of cells of 1.5×10^7, where as in the samples were gallo tannins, ascorbic acid and SO_2 was added, the total number of cells was lower and was at the rate of 1.4×10^7, and at the trial were SO_2 was added, total yeast number decreased significantly due to the effect that it has, and the total cell number was 9×10^6. At the samples from the crusher and the gallo tannins there were no dead yeast cells, while at the sample taken after the addition of SO_2, the mortality rate was 5.26%. After the bilolgical activation of *Saccharomyces cerevisie ph.r. cerevisiae* PB2031, the total cell number was 1.5×10^{10} , with mortality rate of 6.66%. Obtained results were different than what was declared by the producer, but several factors may influence on this high mortality rate such as for example the inadequate storing temperature before delivery or the loss of vacuum in the package, etc.. After the bilolgical activation of *Saccharomyces cerevisie ph.r. cerevisiae* PB2590, the total cell number was 1.95×10^{10} , with mortality rate of 2.56%. Obtained results were in correlation with what was declared by the producer for this yeast strain that in 1g dry yeast there are 2×10^{10} cells. *S.cerevisiae ph.r.cerevisiae* PB2590 in comparison with *S.cerevisiae ph.r.cerevisiae* PB2031 had higher number of viable cells and also, *S.cerevisiae ph.r.cerevisiae* PB2590 had lower mortality rate.

Table 2. Total yeast cell number before fermentation in grape must

	After crusher	After gallo tannins and ascorbic acid	after SO_2	After activation of *S.cerevisiae* PB2031	After activation of *S.cerevisiae* PB2590
Live cells	1.5×10^7	1.4×10^7	9×10^6	1.4×10^{10}	1.9×10^{10}
Dead cells	0	0	5×10^5	1×10^9	5×10^8
Total cell number	1.5×10^7	1.4×10^7	9×10^6	1.5×10^{10}	1.95×10^{10}
% of dead cells	0	0	5.26%	6.66%	2.56%
% of activity	100%	100%	94.7%	93.33%	97.4%

The results from the counting of cell colonies are shown in Table 3:

	After crusher	After gallo tannins and ascorbic acid	after SO_2	After activation of *S.cerevisiae* PB2031	After activation of *S.cerevisiae* PB2590
Total yeast number	1.4×10^7	1.2×10^7	7×10^6	1.2×10^{10}	1.5×10^{10}

Table 4. Obtained differences between direct and indirect method

Total yeast number	After crusher	After gallo tannins and ascorbic acid	after SO_2	After activation of *S.cerevisiae* PB2031	After activation of *S.cerevisiae* PB2590
Direct method	1.5×10^7	1.4×10^7	9×10^6	1.5×10^{10}	1.95×10^{10}
Indirect method	1.4×10^7	1.2×10^7	7×10^6	1.2×10^{10}	1.5×10^{10}

Chemical and microbiolocal analysis of young wine Vranec. Detailed results of the chemical analysis is shown in Table 5.

	Vranec Sample 1 *S.cerevisiae* PB2031, Gal.C	Vranec sample 2 *S.cerevisiae* PB2031, $H2SO_3$	Vranec sample 3 *S.cerevisiae* PB2590, Gal.C	Vranec sample 4 *S.cerevisiae* PB2590, $H2SO_3$	Vranec sample 5 Control, Gal.C	Vranec sample 6 Control $H2S0_3$
Relative density	0,9955	0,9953	0,9954	0,9954	0,9957	0,9959
Alcohol Vol%	13,27	13,3	13,8	14	13	12,95
Total extract g/dm^3	31,2	31,9	31,3	31,3	30,8	31,9
Total acidity g/dm^3	6,1	6,2	6	6,1	6,3	6,4
Volatile acidity g/dm^3	0,28	0,26	0,26	0,27	0,32	0,52
Glycerol g/dm^3	8,1	8,1	8,9	8,7	7,6	7,4
Free SO_2 mg/L	23,04	25,6	24,02	27,5	20,48	33,02
Total SO_2 mg/L	39,4	43,24	45,5	39,8	35,84	48,19
Residual sugar g/dm^3	3,7	4	4	3,5	6	6,4

Table 6. Total number of cells and percentage of viable and dead yeast cells at sample 1

Vranec *S.cerevisiae* PB2031+Gal.C	Total cell number	Viable yeast cells	Dead yeast cells	%of dead yeast cells	% of viable cells
1 day	1×10^7	$9{,}5 \times 10^6$	5×10^5	5%	95%
4 day	$1{,}05 \times 10^8$	$1{,}02 \times 10^8$	$2{,}5 \times 10^6$	2,38%	97,61%
7 day	$4{,}05 \times 10^7$	$3{,}8 \times 10^7$	$2{,}5 \times 10^6$	6,17%	93,83%

Table 7. Total number of cells and percentage of viable and dead yeast cells at sample 2

Vranec *S.cerevisiae* PB2031+H_2SO_3	Total cell number	Viable yeast cells	Dead yeast cells	%of dead yeast cells	% of viable cells
1 day	$9,5 \times 10^6$	9×10^6	5×10^5	5,26%	94,73%
4 day	1×10^8	$9,85 \times 10^7$	$1,5 \times 10^6$	1,5%	98,5%
7 day	4×10^7	$3,65 \times 10^7$	$3,5 \times 10^6$	8,75%	91,25%

Table 8. Total number of cells and percentage of viable and dead yeast cells at sample 3

Vranec *S.cerevisiae* PB2590+Gal.C	Total cell number	Viable yeast cells	Dead yeast cells	%of dead yeast cells	% of viable cells
1 day	$9,5 \times 10^6$	9×10^6	5×10^5	5,26%	94,73%
4 day	$1,07 \times 10^8$	$1,02 \times 10^8$	5×10^6	4,65%	95,35%
7 day	$4,15 \times 10^7$	$3,9 \times 10^7$	$2,5 \times 10^6$	6,02%	93,97%

Table 9. Total number of cells and percentage of viable and dead yeast cells at sample 4

Vranec *S.cerevisiae* PB2590+H_2SO_3	Total cell number	Viable yeast cells	Dead yeast cells	%of dead yeast cells	% of viable cells
1 day	$1,05 \times 10^7$	1×10^7	5×10^5	4,76%	95,24%
4 day	$1,09 \times 10^8$	$1,04 \times 10^8$	$4,5 \times 10^6$	4,18%	95,87%
7 day	$4,3 \times 10^7$	$4,05 \times 10^7$	$2,5 \times 10^6$	5,81%	94,18%

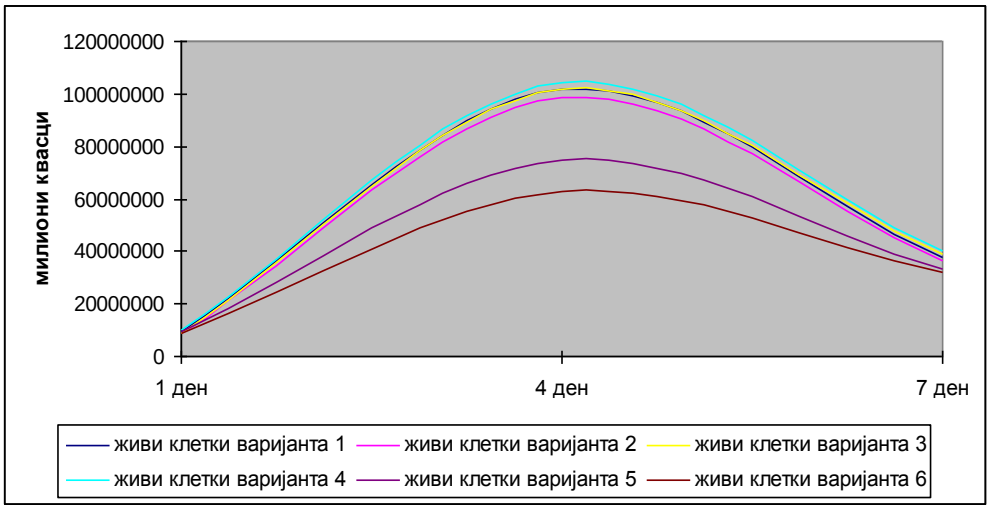
Table 10. Total number of cells and percentage of viable and dead yeast cells at sample 5

Vranec Control Gal.C	Total cell number	Viable yeast cells	Dead yeast cells	%of dead yeast cells	% of viable cells
1 day	1×10^7	$9,5 \times 10^6$	5×10^5	5%	95%
4 day	$8,2 \times 10^7$	$7,45 \times 10^7$	8×10^6	9,75%	90,85%
7 day	$3,85 \times 10^7$	$3,35 \times 10^7$	5×10^6	12,98%	87,01%

Table 11. Total number of cells and percentage of viable and dead yeast cells at sample 6

Vranec Control H_2SO_3	Total cell number	Viable yeast cells	Dead yeast cells	%of dead yeast cells	% of viable cells
1 day	$1,05 \times 10^7$	$8,5 \times 10^6$	2×10^6	19,04%	80,95%
4 day	$7,3 \times 10^7$	$6,3 \times 10^7$	1×10^7	13,70%	86,30%
7 day	$3,7 \times 10^7$	$3,2 \times 10^7$	5×10^6	13,51%	86,49%

Graph 1 is showing the viable cells at all six trials



From the graph is easy to see that in the samples were the inoculation with seleceted yeast strain was conducted, they all had similar nuber of viable yeast cells, where as in the last two samples were no inoculation was done, they had significantly lower number of viable cells, which can later resukt with stuck or sluggish fermentation.

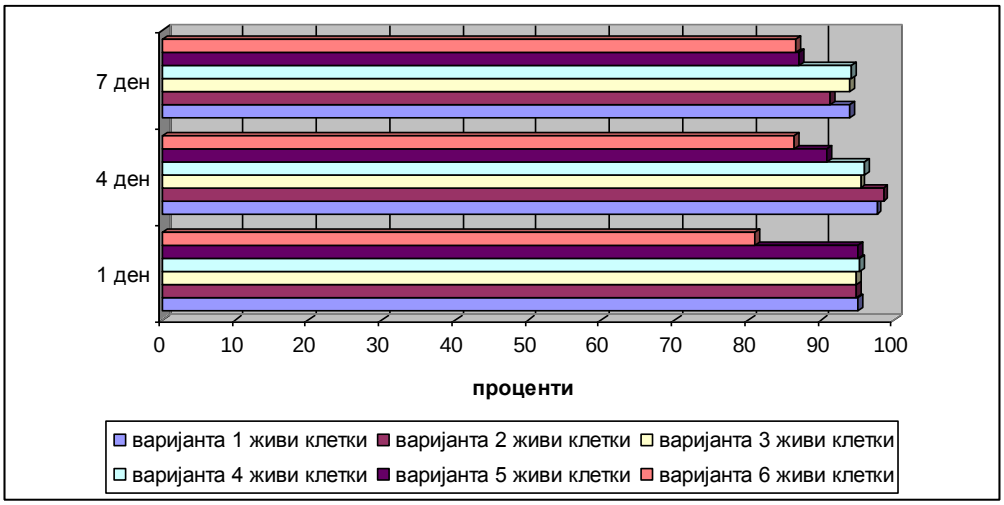


Figure 2. Acitvity percent of the selected yeast strains at all trials

As we can see from the graph, samples 1-4 have higher percent of viable yeast cells than samples 5 and 6, and the maximum is reached at the sevnth day. This difference can be caused due to several inhibitory factors, such as alcohol, vitamins and sterol insufficiency, etc..

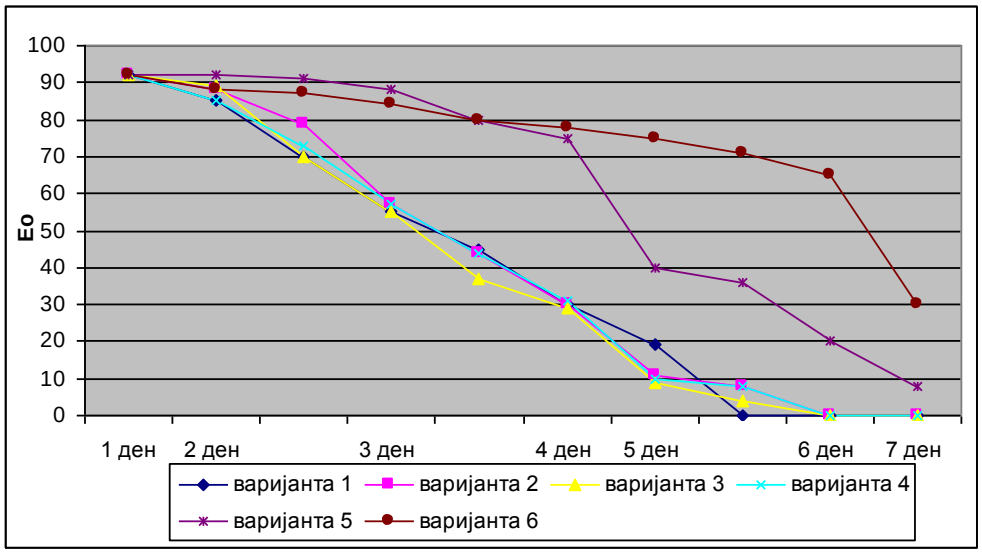


Figure 3. Fermentation kinetics at samples 1 - 6

From the graph we can conclude that the obtained results for the number of viable yeast cells at all samples are in correlation with the fermentation kinetics and due to the lower nuber of viable yeast cells at samples 5 and 6 has caused to have slower fermentation kinetics, which later on can caused stuck and sluggish fermentation and producing of off flavours and attracting high volatile acids. From chemical point of view the young produced wine Vranec has clearly shown its tipicity – wine with higher alcohol, high extract and amount of glycerol which gives longevity of the wine. From microbiological point of view, we can conclude that we were able to confirm the declaration of the producer of the selected yeast strains for the number of viable and total cell number in different stages of the fermentation process. The obtained results from the microbiological research of the young wine Vranec has clearly shown that for normal start of the fermentation it is necessary to inoculate with minimum 4 x 10^6 cells in 1mL in grape must. The resuts obtained are in correlation with results which were earlier obtained from Bubalov (1998) who has studied the dynamics and composition of the yeast microflora in grape must of vranec from the valandovo vine growing region. Oragnoleptics characteristics of young wine Vranec in the tikvesh wine region

One of the aims of this research was to establish the quality of the produced wine through their sensory evaluation. Analysis results obtained from the microbiological and chemical analysis of the wine clearly speak that the produced wine meets the criteria to be classified as quality wine. What is very important in order to establish the overall report on the quality of the wines is the sensory evaluation of the wine. Therefore, we did the sensory evaluation with the code of description OIV – panel tasting and the maximum points is 100.

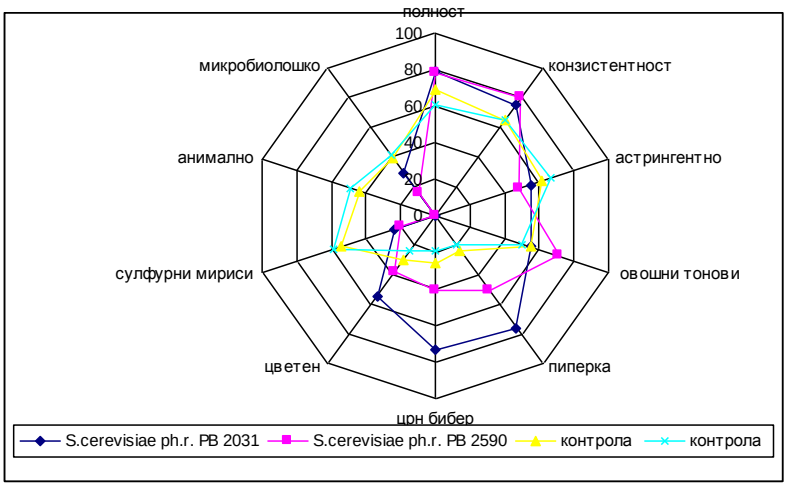


Figure 4. Differences in aromatic profile at all samples 1-6

From the graph we can see that the use of selected yeast strains is strong tool in the production of wines which are characterized as typical for the cultivar, with high concentration of fruity aromas, while on the palate the wines are smooth, consistent and long lasting. At the control trials were no selected yeast strain was used, we established that these wines are with olfactory defects caused by high volatile acidity and microbiological off flavours. Therefore it is strongly recommended to use selected yeast strains in the winemaking process in order to obtain correct start and finish of the alcoholic fermentation.

Conclusions

Based on the research and on the analysis report we have come to the final conclusions:

Leading variety for production of quality red wine in the tikvesh vine area is Vranec, which symbolized the type of Macedonian red wines. After the activation of the strain *S.cerevisiae phr. cerevisiae* PB2031 total cell number in 1mL pomace was 1,5 x 10^{10}, viable cells in 1mL pomace was 1,4 x 10^{10}, which enabled 93,33% viability of the cells. These findings confirmed the declaration of the producer for the strain *S.cerevisiae phr. cerevisiae* PB2031 who had declared that in 1g dry yeast there are 2 x 10^{10} cells. After the activation of *S.cerevisiae phr. cerevisiae* PB2590 total yeast number in 1mL pomace was 1,95 x 10^{10}, viable cells in 1mL pomace was 1,9 x 10^{10}, with 97,4% activity. These findings confirmed the declaration of the producer for the strain *S.cerevisiae phr. cerevisiae* PB2590 who had declared that in 1g dry yeast there are 2 x 10^{10} cells. The grape must of Vranec prior to fermentation had 1,5 x 10^{7} total cells. This total number of cells is sufficient for spontaneous start of the alcoholic fermentation.

Rapid start of the alcoholic fermentation is in correlation with the inoculation rate and minimum is 4 x 10^{6} cells in 1mL. Fermentation kintetics is strongly depended from the supply with yeast nutrients, aeration and correct biological activation of the strains. The samples which were inoculated with the strain *S.cerevisiae phr. cerevisiae* PB2031 had total

cell number of 1 x 10^7 on the first day, on the fourth day had 1,05 x 10^8, and on the seventh day 4,05 x 10^7. The samples which were inoculated with the strain *S.cerevisiae phr. cerevisiae* PB2590 had total cell number of 1,05 x 10^7 on the first day, on the fourth day had 1,09 x 10^8, and on the seventh day 4,3 x 10^7. The samples which were not inoculated had total cell number of 1,05 x 10^7 on the first day, on the fourth day had 8,2 x 10^7, and on the seventh day 3,7 x 10^7. These samples had high mortality rate which on the seventh day was at the rate of 13,51%.

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ВЛИЈАНИЕ НА РАЗЛИЧНИТЕ СТАРТЕР КУЛТУРИ КВАСЦИ ВРЗ МЛАДО ВИНО ВРАНЕЦ ОД ТИКВЕШКОТО ВИНОГОРЈЕ

Дане Јованов, Михаил Петков, Звонимир Божиновиќ

Апстракт

Во овој научен труд прикажани се резултатите од проучувањата на влијанието на различните стартер култури квасци врз младо вино Вранец од тиквешкото виногорје. Испитувањата се вршени кај вината од сортата Вранец која е водечка сорта во тиквешкото виногорје. При испитувањата беа користени следните стартер - култури квасци: *Saccharomyces cerevisiae ph.r. cerevisiae* PB2031 и *Saccharomyces cerevisiae ph.r. cerevisiae* PB2590 кои се лабораториски комерцијални изолати. Со цел да се утврди влијанието на овие стартер култури врз младите вина беше одредена и утврдена динамиката, т.е. кинетиката на селекционираните стартер култури квасци, која пак е во тесна корелација со динамиката на алкохолната ферментација. При истражувањата се утврди и вкупниот број на стартер - култури квасци во поодделни фази, и утврдување на живи и мртви клетки како и одредување процент на активност на квасците при алкохолната ферментација. Испитуван беше и квалитетот на добиените млади вина преку нивна микробиолошка, хемиска и сензорна евалуација, а испитувани беа и добиените разлики како резултат на различните третмани (со или без стартер култури).

Клучни зборови: селекционирани стартер - култури, Вранец, динамика, кинетика на ферментација.