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BIOLOGICAL AND POMOLOGICAL PROPERTIES OF SOME WALNUT SELECTIONS FROM THE NATIVE POPULATION

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The paper presents major biological and pomological properties of walnut selections singled out from the region of Central and Eastern Serbia over 2002 – 2005. The selections are abundant croppers of extremely high vigour. The vegetation cycle begins mainly in the third decade of April, whereas flowering and inflorescence formation occur in first decade of May. Fruits ripen in the third decade of September. These selections are extremely resistant or resistant to low winter temperatures and resistant to moderately resistant to *Gnomonia leptostyla*. The fruits are mainly medium large or large with fruit weight ranging from 14.0 – 11.3 g. The kernel is light coloured or yellow of good or very good taste, with high kernel ratio (50.0 – 45.1%). The majority of these selections have high oil content (68.2 – 61.8%) and medium raw protein content (18.3 – 15.4%). All the stated selections should be taken into consideration in respect of collection establishment and deserve to be

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excessively introduced into production upon testing under the respective conditions.

Key words: Walnut, population, selection, fruit, kernel

INTRODUCTION

Walnut population in Serbia, particularly in some regions, is heterogenous and very rich. Besides, walnut is anemophylous variety, which reflects in high polimorphic progeny (KORAĆ et al.,1976), MILETIĆ (1996), MITROVIĆ (2003), etc. Hence, available population genetic pool is the base of the selection, which therefore ensures high quality selection aimed at breeding new cultivars. The majority of the current walnut cultivars and selections have been developed spontaneously through selection within walnut populations (MITROVIĆ et al., 2005). For this very reason, selection *in situ* is being continuously performed, as not all possibilities have yet been exhausted.

The objective of walnut selection is directed towards selecting genotypes with late and shorter season, high fruit quality, regular cropping and resistance to both low winter temperatures and parasites. These selection criteria were particularly highlighted by NEDEV et al. (1976), KORAĆ et al. (1976), PAUNOVIĆ and GAVRILOVIĆ (1971), UNOHINI V. and VALII R. (1990), SZENTIVANI (1990), GERMAIN et al. (1983, 1997), MITROVIĆ et al. (2003). The principle objective of this breeding work is developing domestic walnut cultivars. However, the recent work on selection of new cultivars has not given new cultivars of superior quality. Therefore, bearing in mind diversity and walnut resources in Serbia we should consider this breeding work a challenge.

MATERIALS AND METHOD

Sorting out, keeping records, description, evaluation and assessment of fruit quality of natural walnut population have been conducted in a number of localities of the Central and the Eastern Serbia in which walnut is widely grown. Over 150 trees with properties that deserve attention were recorded through the selection procedure. Some 10 trees are the subject of this paper as the most distinguished ones.

Major phenological and biological characters of the tree, fruit and kernel as well as their winter hardiness and resistance to parasites (*Gnomonia leptostyla*) were assessed by the UPOV method. Fruit size and weight were evaluated by the precision calliper and precision technical balance “Mettler” respectively. Oil and raw protein contents were determined by the nuclear magnetic resonance method (NMR) and by the Kjendal method respectively.

The paper presents average results for the walnuts singled out over 2002 – 2005.

RESULTS

The third decade of April is principally the time of leafing onset of singled out selections. Selection 22/02, in which leafing begins in early May on average, is an exception, along with the selection 10/04 which has early leafing onset (end of the second decade of April). Pollen shedding and formation of female flower elements occur in the first decade of May, except for selections 2/04 and 10/04 in which these phenophases were registered in late April. These selections are vigorous to extremely vigorous, except for selections 11/02, 18/04 and 22/02 which exhibit moderate vigour. These selections are high to very high croppers (9 – 7). Fruits ripen in the third decade of September, with the exception of selections 22/02 and 10/04 which ripen in early October. The selections are extremely resistant or resistant to low winter temperatures and resistant to moderately resistant to *Gnomonia leptostyla,* which are considered valuable and favorable properties of the selections (Table 1).

Tab. 1 Some fruit characteristics of the studied walnut selections

Selection	*Leafing onset*	*Pollen shedding*	*Occurrence of female flowers*	*Vigour (0-9)*	*Cropping (0-9)*	*Ripening season*	*Susceptibility*	
							to frost (0-9)	G. leptostyla *(0-9)*
11/02	27.04	04.05	06.05	5	9	30.09	2	2
13/02	25.04	03.05	07.05	9	9	25.09	1	3
22/02	02.05	09.05	13.05	4	8	03.10	1	1
16/03	30.04	10.05	12.05	6	7	25.09.	2	5
26/03	28.04	06.05	11.05	7	8	20.09	2	5
2/04	21.04	30.04	30.04	6	7	25.09	1	3
8/04	22.04	01.05	05.05	9	8	30.09	2	3
10/04	18.04	25.04	29.04	9	7	02.10	1	2
18/04	25.04	02.05	04.05	5	9	25.09	1	3
10/05	26.04	02.05	06.05	8	9	30.9	1	2

Fruits of singled out selections are medium large to large. Fruit dimensions: height – 44.0 – 33.7 mm, width – 40.4 – 30.3 mm, thickness 40.2 – 31.4 mm. The fruits are mostly elongated and roundish. The suture is moderately pronounced or even, tightly or very tightly sealed. The shell surface is slightly wrinkled or even, mostly light or ash coloured. Besides, shell thickness ranges from 1.4 – 1.0 mm (Table 2).

The fruits are large with fruit weight ranging from 14.0 – 11.3 g. Very large fruits (16.0 – 14.1 g) are found in selections 10/04, 18/04 and 26/03. Kernel ratio is high, varying from 50.0 – 45.1%. In selection 16/03 kernel ratio is medium (44.9%), and in selections 2/04 and 8/04 kernel ratio is high, ranging from 51.8% - 51.7%. The kernel colour is either light or yellow and of very good taste. Oil content of the singled out selections is also high (68.2 – 61.8%), whereas oil content did not exceed 60% in all selections. In contrast to that, raw protein content was medium in all selections (18.3 – 15.4%) (Table 3).

Table 2. Major biological properties of selected walnut types over the period of study

Selection	Fruit dimensions (mm)			Fruit Shape	Suture prominence	Suture Hardness	Shell surface	Shell colour	Shell thick ness
	Height	Width	Thickn ess						
11/02	36.3	30.7	31.4	Long	Flat	Good	Smooth	Light	1,3
13/02	44,0	32,7	35,4	Long	Prominent	Excellent	Smooth	Light	1,0
22/02	34,5	31,1	32,1	Roundish	Moderately pronounced	Excellent	Smooth	Light	1,1
16/03	33,7	30,3	31,6	Long	Moderately prominent	Excellent	Smooth	Grey	1,2
26/03	42,7	33,4	37,7	Long	Small	Good	Slightly wrinkled	Light	1,1
2/04	40,4	34,6	38,1	Elliptical	Moderately pronounced	Very good	Slightly wrinkled	Grey	1,3
8/04	40,5	30,7	33,5	Long	Small	Good	Smooth	Light	1,1
10/04	41,8	40,4	37,2	Long	Prominent	Excellent	Slightly wrinkled	Grey	1,4
18/04	41,3	39,4	40,2	Roundish	Moderately pronounced	Very good	Slightly wrinkled	Grey	1,1
10/05	41,8	40,4	37,2	Conical	Pronounced	Excellent	Slightly wrinkled	Grey	1,4

Table 3. Tehnological fruit properties of the studied walnut selections

Selection	Fruit weight (g)	Kernel weight (g)	Kernel content (%)	Oil content (%)	Raw protein content (%)	Kernel Colour	Kernel taste
11/02	12,7	5,8	49,6	66,3	15,4	Light yellow	Excellent
13/02	14,1	6,9	48,9	61,8	15,9	Yellow	Good
22/02	12,2	5,9	48,4	68,2	16,4	Dark	Very good
16/03	11,8	5,3	44,9	65,0	18,3	Light	Very good
26/03	14,7	6,8	46,2	62,8	17,9	Light yellow	Good
2/04	13,5	7,0	51,8	58,5	16,2	Light brown	Good
8/04	13,2	6,7	50,7	63,1	15,8	Light yellow	Very good
10/04	16,0	7,6	47,5	55,2	17,2	Light yellow	Very good
18/04	14,8	7,7	52,0	63,5	16,8	Yellow	Good
10/05	11,3	5,4	47,8	65,5	19,4	Yellow	Very good

DISCUSSION

Serbia is an important region as regards potential for walnut growing. Relatively favourable agroecological conditions, generative propagation, natural selection and human activity have greatly contributed to the formation of abundant, heterogenous walnut population. Walnut cultivars developed at both Fruit Research Institute, Čačak (cvs Ibar, Vujan, Ovčar, Medveđa) and the Faculty of Agriculture, Novi Sad (cvs Šampion, Rasna, Kasni rodni, Kasni Grozdasti, Srem, Tisa, Mire) are valuables of the walnut collection (KORAĆ et al., 1993).

Besides, a group of authors that conducted investigations in various regions (ĐURĐEVIĆ (1968), the region of Kosovo and Metohija, JELENKOVIĆ (1974) and MILETIĆ (1996), the region of Timočka krajina, BUGARČIĆ et al., (1985), KORAĆ et al., (1986), MIŠIĆ et al., (1987) and MITROVIĆ et al., (1986), wide territory of Serbia) have selected and described a large number of promising selections with a number of favourable properties. Similar results on walnut selection were published by SER E.F. (1963) and FORDE (1975) USA, SZENTIVANI (1990) Hungary, GERMAIN (1997) France, etc.

Biological and pomological properties of the stated selections are either similar to the selections of the aforementioned researchers or more superior to them. Primarily, it refers to the favourable times of vegetation onset and vegetation end, which may be limiting factors for good performance of walnuts in particular regions. Selections with shorter vegetation cycle are those of particular significance. Thus, in selections 22/02 and 16/03 vegetation starts very late (beginning of May). Besides, end of the vegetation and harvest occur in October and damagees caused by both late spring and early autumn frosts are thus avoided. It also goes for the susceptibility to low winter temperatures as well as to the resistance to *Gnomonia leptostyla*. BALAŽ et al., (1991) have found that the majority of the 37 studied walnut genotypes were susceptible to very susceptible to the parasite. Fully resistant genotypes were not evidenced. Certain level of resistance was determined only in few genotypes with late vegetation onset.

Fruit size and weight as well as the kernel content of the singled out selections either correspond to the same properties of currently grown cultivars listed by CEROVIĆ et al., 2003 or are higher. It also goes for other characters of fruits (fruit shape, suture and its firmness, surface, colour and thickness of the shell) and kernel (colour and taste), which determine their commercial value. High biological potential reflected in high content of oils and raw proteins in walnut fruits, makes walnut highly valuable product, especially as dietary product.

As all singled out selections are successfully grown in different localities without additional cultivation and being of different age, vigour and vitality, more detailed comparative analyses are unreliable. Therefore, the current establishment of collections with the stated selections along with comparative analysis under identical, favourable conditions, will greatly add up to a more detailed study and selection of the best selections for commercial growing.

CONCLUSION

Walnut selections singled out from the populations of Central and Eastern Serbia over 2002 – 2005 are described as selections with numerous favourable properties.

The trees of the selections are extremely vigorous to vigorous and with high cropping potential. The start of the vegetation cycle is mainly in the third decade of April, whereas flowering and inflorescence occur in the first decade of May. Fruits ripen mainly in the third decade of September. The selections are extremely resistant or resistant to low winter temperatures and resistant to moderately resistant to the parasite *Gnomonia Leptostyla*.

Fruits of these selections are medium large to large, elongated or roundish. The suture is mostly moderately pronounced, tightly or very tightly sealed. The shell is slightly wrinkled or smooth, mainly light or ash coloured. The fruit weight ranges from 14.0 – 11.3 g. The kernel content is large, varying from 50.0 – 45.1%, light to yellow coloured with very good taste. Oil content of the kernel is large in the majority of the selections and it ranges from 68.2 – 61.8%, whereas raw proteins vary from 18.3 – 15.4%.

All stated selections deserve to be included in the walnut collection and subsequently, upon testing, introduced into larger scale production under the respective conditions.

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REFERENCES

BALAŽ J., M. KORAĆ, and S. CEROVIĆ (1991): Osetljivost genotipova oraha prema Gnomonia leptostyla (Fr) CES ET NOT. Prouzrokovaču lisne pegavosti. Jugoslovensko voćarstvo, *95-96,* 91-94.

BUGARČIĆ V., D. OGAŠANOVIĆ, M. KORAĆ, and M. MITROVIĆ (1985): Važnije biološkprivredne osobine odabranih tipova oraha. Jugoslovensko voćarstvo, 73-74:281-288.

CEROVIĆ S., M. MITROVIĆ, Č. OPARNICA, R. MILETIĆ, J. NINIČ-TODOROVIĆ, B. GOLOŠIN, and S. BJELIĆ (2003): Predlog novog Jugoslovenskog sortimenta oraha i leske. Savremena poljoprivreda, *1-2*:33-38.

GERMAIN E., P. JALIINAT, P. LEGLISE, A. MASSERON, C. TRONEL, and CHARTER A. (1983): Resultas de 20 ans d'experimentation (2re partie). Le noer, 357:43-49.

GERMAIN E. (1997): Genetic improvement of the Persian walnut (Juglans regia L.). Acta Horticulturae, *442*:21-31.

FORDE H. I. (1975): Walnuts Advances in fruit breding. Westtafayette, Indiana.

JELENKOVIĆ T. (1974): Neke karakteristike odabranih ekotipova oraha u Timočkoj krajini. Jugoslovensko voćarstvo, *27:* 49-53.

KORAĆ M., M. MITROVIĆ, S. CEROVIĆ, R. TODOROVIĆ, B. GOLOŠIN, and R. MILETIĆ (1993): Novi Jugoslovenski sortiment oraha. Jugoslovensko voćarstvo, *103-104*: 87-91.

KORAĆ M., D. SLOVIĆ, M. RUDIĆ and S. CEROVIĆ (1976): Karakteristike tipova oraha selekcije poljoprivrednog fakulteta u Novom Sadu. Jugoslovensko voćarstvo, 73/74:411-416.

KORAĆ M., D. SLOVIĆ, M. RUDIĆ, S. CEROVIĆ (1976): Rezultati selekcije i hibridizacije oraha na Poljoprivrednom fakultetuu Novom Sadu. Jugoslovensko voćarstvo, 37-38:411-416.

KORAĆ M., D. SLOVIĆ, M. RUDIĆ, S. CEROVIĆ, and B. GOLŠIN (1986): Rezultati selelcije i hibridizacije oraha na Poljoprivrednom fakultetu u Novom Sadu. Zbornik radova, Simpozijum o selekciji voća, Čačak, 101-109.

MITROVIĆ M., S. CEROVIĆ, B. GOLOŠIN, J. NINIĆ-TODOROVIĆ, and R. MILETIĆ (2005): Selekcija oraha i leske u Srbiji tokom poslednje dve decenije. Voćarstvo, *150*:187-195.

MITROVIĆ M. (2003): Selekcija oraha iz prirodne populacije. Jugoslovensko voćarstvo, *141-142*:31-36.

MILETIĆ R. (1996): Selekcija oraha i osobine odabranih na području Timočke krajine. Jugoslovensko voćarstvo. *113-114*:155-160.

MIŠIĆ P., M. MIRKOVIĆ, R. TODOROVIĆ, and Lj. JOVANOVIĆ (1987): Selekcija oraha (Juglans regia L.) iz prirodne populacije u SR Srbiji sa posebnim osvrtom na područje beograda. Genetika, *2*:89-96.

MITROVIĆ M., V. BUGARČIĆ, and D OGAŠANOVIĆ (1986): Selekcija oraha i osobine odabranih tipova. Jugoslovenski simpozijum o selekciji i oplemenjivanje voćaka, Čačak, 113-120.

NEDEV N., V. VASILEV, L. KAVARZIKOV, and K. ZDRAVKOV (1976): Orehoplodni kulturi. «Hristo Danov», Plovdiv.

PAUNOVIĆ S. and M. GAVRILOVIĆ (1971): Prilog proučavanju selekcija domaćih tipova oraha (*Juglans regia* L.). Zbornik radova, I simpozijum o lupinastom sađu, Ljubljana, 53-62.

SER E. F. (1963): Selecting suitable Walnut varietie. California Agricultural Experiments Station Rxtension Service.

SZENTIVANI P. (1990): Breeding early fruiting high producing walnut cultivars leafing after late spring frosts. Acta Horticulturae, *248*:175-182.

UNOHINI V. and VALII R. (1990): Winter Frost Damages on some Walnut Vartieties. Acta Horticulturae, *284:*273-278.

ĐURĐEVIĆ B. (1968): Proučavanje važnijih tipova oraha sa područja Kosova i Metohije. Doktorska disertacija, Priština.

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BIOLOŠKO-POMOLOŠKE OSOBINE NEKIH SELEKCIJA ORAHA IZ PRIRODNE POPULACIJE

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I z v o d

U radu su prikazane važnije biološko–pomološke osobine za izdvojene selekcije oraha sa područja centralne i istočne Srbije u periodu od 2002-2005. godine. Selekcije su ekstremno bujna i bujna stabla veoma visoke rodnosti. Početak vegetacije je najčešće u trećoj dekadi aprila, a resanje i cvetanje u prvoj dekadi maja. Sazrevanje plodova je najčešće u trećoj dekadi septembra. Prema niskim zimskim temperaturama selekcije su ekstremno otporne ili otporne, a prema parazitu *Gnomonia leptostiyla* su otporne do srednje otporne. Plodovi su najčešće srednje krupnoće ili krupni sa masom od 14,0 do 11,3 g. Sadržaj jezgre je veliki od 50,0 do 45,1%. Po obliku, plodovi su izduženi ili okruglasti. Šav je najčešće srednje izražen ravan, a čvrstina vrlo dobra ili odlična. Površina ljuske je malo naborana ili gladka, pretežno svetla ili pepeljasta. Boja jezgre je svetla ili žuta, a ukus dobar ili vrlo dobar. Sadržaj ulja u jezgri odabranih selekcija je kod većine selekcija veliki od 68,2 do 61,8%, a sirovih proteina je srednji od 18,3 do 15,4%. Sve navedene selekcije zaslužuju pažnju da se kolekcionišu i nakon testiranja u istim uslovima masovno šire u proizvodnju.

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