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POSSIBILITY OF PRODUCING ONE-YEAR OLD SEEDLINGS OF THE AUTOCHTHONOUS BRANDY VARIETIES GRAFTING ON THE GENERATIVE ROOTSTOCK IN THE REGION OF NORTH MONTENEGRO

SUMMARY

Plum is the major fruit species in the area of North Montenegro. A study conducted over a period of 4 years in North Montenegro region included in situ identification of autochthonous plum cultivars. Observation and recording of their phenological and pomological traits were performed using IBPGR and UPOV methodologies. Flowering started between 26th March and 12th April and fruit ripening between 13th July (Petrovača) and 18th September (Trnovača). Fruit weight ranged from 6.65 ± 0.235 g to 53.88 ± 0.654 g and stone weight from 0.16 ± 0.003 g to 2.20 ±0,711 g. The cultivars were classified as being extremely small in terms of fruit size, except for cv. Crvena durgulja (bigger fruit size). Rounded fruit shape and light green ground color were dominant. Skin color ranged from amber to black. Yellow green was a dominant flesh color and medium flesh firmness predominated. The fruits of the above cultivars could be processed, particularly into plum brandy, or they could be used fresh or dried. The selected plum cultivars can be used both in breeding programs and as cultivars for organic plum orchards. This study was made to assess the performance of autochthonous plum cultivars (in situ) and seedling. Producing process consisted of 2 stages: a) initial selection from the population and pomological characterization, b) morphological and quantitative characteristics of one-year old seedlings for autochthonous brandy varieties of plum on Myrobalan seedling (*Prunus cerasifera* Erhr.).

Keywords: Plum, genetic bases, germplasm, *Prunus domestica L., Prunus insititia L.*

INTRODUCTION

Plum is ranked as the second most important fruit tree crop in the temperature climate after apple from the production point of view. It's tasty and good looking fruits have been used extensively during history as fresh or dried fruits, but also processed as jam, marmalade, jelly and brandy. Plums contain health promoting compounds, minerals, vitamins, fibers, and low in calories and among the highest in antioxidant containing foods and for those reasons are beneficial for human consumption (Botu *et al*., 2012).

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Plum cultivation has a historical tradition, economical, social and cultural implication for the Sout East of Europe. The European plum (*Prunus domestica* L.) genetic variability in the South East of Europe is large, unique and particularu evident in the characteristics of the fruit, plant and adaptability to different ecological conditions. In Serbia and Romania 80% of the plums go into the production of slivovitz or tuica.

Fortunately, some of plum cultivars and biotypes exhibit tolerance to *Plum Pox Potyvirus* (Botu *et al.*, 2012). As an example, Elisa test that was conducted on cultivar 'Crvena durgulja', proved presence of Sharka (PPV), howewer it did not affect the fruits. Also, 'Crvena durgulja' showed as very resistant to other pests and diseases. The cultivar 'Crvena ranka' is slightly susceptible to Sharka. The cultivar 'Komperuša', Elisa test showed absence of Sharka (PPV). Also, 'Komperuša' showed as very resistant to other pests and diseases (Botu *et al.*, 2012).

'Požegača' and number of cultivars used for brandy production predominant in the assortment. The Montenegro plum production is characterized by extensive growing technology, low unstable yields, low-quality fruit, PPV-induced problems and a multitude of cultivars. The cultivars include Požegača (35%), foreign standard and introduction newly bred cultivars (15%) and autochthonous (local, primitive) cultivars (50%), and their fruit is typically used for brandy production. Autochthonous plum cultivars are a limiting factor in improving plum production in Montenegro. Nevertheless, they are used as an outstanding source of germplasm and as a genetic basis underlying breeding activities, principally the development of new cultivars, clonal selection (Ogašanović *et al.*, 1994; Milošević, 2000), the development of new plum, apricot and peach rootstocks (Paunović, 1988; Djurić *et al.*, 1998), resistance to economically important diseases (Paunović and Paunović, 1994; Rodrigues *et al.*, 2009) or intensive cultivation (Mratinić, 2000). Similar investigations with focus on identical or similar objectives were also conducted in the other countries of the former Yugoslavia – Serbia (Milošević, 2000), Bosnia and Herzegovina (Buljko, 1977; Jarebica and Muratović, 1977), Croatia (Jelačić *et al.*, 2008) and Slovenia (Usenik *et al.*, 2007). In situ investigations of cultivars derived from *Prunus domestica* L. and *P. insititia* L. in Serbia were conducted by a number of researchers (Paunović *et al.*, 1985; Paunović, 1988; Paunović and Paunović, 1994; Petrović *et al.*, 2002) who defined important biological, pomological and technological traits of both fruit and tree. They reported that the selected cultivars could be used both as breeding programs and as rootstocks, as well as in further disease-related systematic studies under field and laboratory conditions. The main objective of this study was to determine in situ basic biological and pomological traits of some autochthonous plum cultivars derived from P. *domestica* L. and P. *insititia* L. in the area of North Montenegro that could be used as a genetic basis and source of germplasm for future breeding studies and as cultivars for organic plum orchards.

MATERIAL AND METHODS

The investigations were conducted continuously in years 2010, 2011, 2012 and 2013. They involved in situ identification, marking and careful observation of autochthonous plum cultivars (accessions) in the area of North Montenegro.

The researched genotypes or cultivars were selected in Western Serbia (Paunović *et al*., 1985). Majority of them, eighteen to be exact, derived from P domestica L., while, cultivars ʻTrnovačaʼ and ʻTurgulјaʼ were derived from *P. İnstitia* L., (Paunović *et al*., 1985). The sampled trees were aged 35 (ʻPlavski piskavacʼ) to 55 years (ʻTurgulјaʼ). The trees of all the cultivars grew on their own roots.

The study focused on few segments. Very first one included recording of the phenological traits - first flowering, full flowering, end of flowering and harvest date. Phenological characteristics were determined as below: the beginning of flowering was recorded when at least 5% of the flowers bloomed; full flowering was accepted when at least 80% of the flowers bloomed, the end of flowering was determined when 90% of the flowers bloomed and corollas began to fall off, and harvest date was established when the fruits were sufficiently colored and soft to be eaten (Funt, 1998). The other segment comprised pomological, i.e. physical [fruit weight (g), stone weight (g) and fruit size (on a scale of 1-9)] and sensorial traits of the fruit [fruit shape (1-6), ground color (1-5), skin color (0-9), flesh color (1-9), flesh firmness(1-9) and fruit usage (1-4)]. IBPGR and UPOV methodologies were used to describe the cultivars in phenological, pomological and sensorial terms (Zanetto *et al*., 2002). Measurements included the weight of 25 fruits and as much stones per cultivar. Fruit and stone weights were determined using a Metler 1200 technical scale (range of measurement 0.01-120.00 g, precision ±0.01 g). The data were subjected to statistical analysis of variance (ANOVA) and means were separated by LSD test at $P < 0.05$ significant level (SAS Institute, 1990).

One-year old seedlings from 20 autochthonous plum cultivars were planted in the nursery and raised seedlings were evaluated for nursery characteristics: plant height (cm), stem diameter (mm), bat take (%) seedling vigor, uniformity and branching. Uniformity was low (grade 1) when coefficient of variation was less than 15%, and high (grade 2) when it was from 15 to 25%.

RESULTS AND DISCUSSION

The data showed that the onset of flowering was recorded in the last five days of March and in the first twelve days of April (Table 1). The earliest onset of flowering was observed in cultivar ʻTrnovačaʼ (26.03) derived from P. insititia L., and the latest in cultivar ʻDupljankaʼ (12.04) derived from P. domestica L. Among the 20 cultivars examined, 8 (40 %) started to flower at the end of March, and 12 (60 %) during the middle of the first twelve-day period of April. The full flowering stage lasted from 30th March (ʻTrnovačaʼ) to 18th April (ʻDupljankaʻ), and the end of flowering from 7th April (ʻTrnovačaʼ) to 24th April (ʻDupljankaʻ).

Flowering lasted 9 (‘Turgulja’, ‘Plavski piskavac’, ‘Grkaja’, ‘Kapavac’ and ‘Komperuša’) to 14 days (‘Crvena durgulja’, ‘Mednica’, ‘Petrovača’, ‘Belošljiva’ and ‘Šara’).

Table 1. Phenological characteristics of autochthonous plum cultivars in the region of North Montenegro (2010, 2011, 2012, 2013 and average)

Cultivar	location			flowering				harvest
	longitude	latitude	altitude (m)	onset	full	end	duration	Date
Petrovača	19 ° 41' E	41° 01'N	879	25.03.2010 26.03.2011 30.03.2012 27.03.2013 **27.03** d	29.03.2010 30.03.2011 02.04.2012 01.04.2013 **31.03** d	07.04.2010 11.04.2011 14.04.2012 08.04.2013 **10.04** d	13 16 15 12 **14**a	10.07.2010 14.07.2011 17.07.2012 11.07.2013 **13.07** d
Mednica	19 ° 59' E	42° 70'N	670	27.03.2010 29.03.2011 02.04.2012 31.03.2013 **30.03** d	02.04.2010 03.04.2011 06.04.2012 01.04.2013 **03.04** d	11.04.2010 13.04.2011 16.04.2012 12.04.2013 **13.04** d	15 15 14 12 **14**a	20.07.2010 22.07.2011 30.07.2012 28.07.2013 **25.07** d
Kapavac	19 ° 29' E	42° 50'N	974	01.04.2010 03.04.2011 06.04.2012 02.04.2013 **03.04** c	04.04.2010 06.04.2011 09.04.2012 05.04.2013 **06.04** c	10.04.2010 12.04.2011 15.04.2012 11.04.2013 **12.04** d	9 9 9 9 **9**c	25.07.2010 27.07.2011 02.08.2012 31.07.2013 **29.07** d
Grkaja	19 ° 59' E	42° 70'N	670	28.03.2010 30.03.2011 02.04.2012 02.04.2013 **01.04** cd	03.04.2010 04.04.2011 06.04.2012 03.04.2013 **04.04** cd	08.04.2010 10.04.2011 14.04.2012 08.04.2013 **10.04** d	11 11 12 6 **10**c	30.07.2010 03.08.2011 06.08.2012 01.08.2013 **02.08** d
Crvena ranka	19 ° 43' E	42° 59'N	601	27.03.2010 28.03.2011 01.04.2012 29.03.2013 **29.03** d	01.04.2010 03.04.2011 07.04.2012 01.04.2013 **03.04** d	08.04.2010 12.04.2011 15.04.2012 09.04.2013 **11.04** d	12 15 14 11 **13**a	04.08.2010 04.08.2011 08.08.2012 04.08.2013 **05.08** cd
Mudara	19 ° 43' E	42° 59'N	601	29.03.2010 31.03.2011 04.04.2012 02.04.2013 **01.04** c	04.04.2010 06.04.2011 09.04.2012 05.04.2013 **06.04** c	11.04.2010 13.04.2011 15.04.2012 13.04.2013 **13.04** d	13 13 11 11 **12**b	04.08.2010 06.08.2011 10.08.2012 04.08.2013 **06.08** c
Belošljiva	19 ° 52' E	43° 03'N	850	27.03.2010 29.03.2011 04.04.2012 30.03.2013 **30.03** d	02.04.2010 02.04.2011 06.04.2012 02.04.2013 **03.04** d	12.04.2010 12.04.2011 16.04.2012 12.04.2013 **13.04** d	16 14 12 13 **14**a	05.08.2010 07.08.2011 11.08.2012 05.08.2013 **07.08** c
Crnošljiva	19 ° 20' E	42° 38'N	978	29.03.2010 30.03.2011 02.04.2012 01.04.2013 **31.03** d	03.04.2010 03.04.2011 07.04.2012 03.04.2013 **04.04** cd	11.04.2010 13.04.2011 16.04.2012 12.04.2013 **13.04** d	13 14 14 11 **13**a	06.08.2010 08.08.2011 12.08.2012 06.08.2013 **08.08** c
Šara	19 ° 57' E	42° 40'N	900	26.03.2010 28.03.2011 31.03.2012 27.03.2013 **28.03** d	30.03.2010 31.03.2011 04.04.2012 01.04.2013 **01.04** d	10.04.2010 10.04.2011 14.04.2012 10.04.2013 **11.04** d	15 13 14 14 **14**a	10.08.2010 12.08.2011 16.08.2012 10.08.2013 **12.08** c

Metlaš	19 ° 29' E	42° 51'N	984	28.03.2010 30.03.2011 03.04.2012 01.04.2013 **01.04** c	03.04.2010 06.04.2011 10.04.2012 05.04.2013 **06.04** c	10.04.2010 12.04.2011 16.04.2012 10.04.2013 **12.04** d	13 13 13 9 **12**b	10.08.2010 14.08.2011 16.08.2012 12.08.2013 **13.08** c
Crvena durgulja	19 ° 48' E	42° 57'N	870	26.03.2010 28.03.2011 05.04.2012 31.03.2013 **30.03** d	01.04.2010 03.04.2011 07.04.2012 01.04.2013 **03.04** d	11.04.2010 14.04.2011 15.04.2012 12.04.2013 **13.04** d	16 17 10 12 **14**a	13.08.2010 15.08.2011 19.08.2012 13.08.2013 **15.08** c
Plavski piskavac	19 ° 55' E	42° 33'N	940	05.04.2010 07.04.2011 10.04.2012 06.04.2013 **07.04** b	09.04.2010 11.04.2011 14.04.2012 10.04.2013 **11.04** b	12.04.2010 17.04.2011 20.04.2012 15.04.2013 **16.04** c	7 10 10 9 **9**c	19.08.2010 21.08.2011 25.08.2012 19.08.2013 **21.08** b
Turgulja	19 ° 56' E	42° 37'N	910	02.04.2010 04.04.2011 08.04.2012 02.04.2013 **04.04** c	06.04.2010 08.04.2011 11.04.2012 07.04.2013 **08.04** c	11.04.2010 13.04.2011 16.04.2012 12.04.2013 **13.04** d	9 9 8 10 **9**c	21.08.2010 24.08.2011 28.08.2012 19.08.2013 **23.08** b
Obični Piskavac	18 ° 49' E	42° 26'N	858	04.04.2010 07.04.2011 12.04.2012 05.04.2013 **07.04** b	08.04.2010 10.04.2011 14.04.2012 08.04.2013 **10.04** c	14.04.2010 17.04.2011 22.04.2012 15.04.2013 **17.04** c	10 10 10 10 **10**c	20.08.2010 25.08.2011 27.08.2012 20.08.2013 **23.08** b
Komperuša	19 ° 49' E	42° 43'N	850	07.04.2010 09.04.2011 12.04.2012 08.04.2013 **09.04** a	11.04.2010 13.04.2011 16.04.2012 12.04.2013 **13.04** b	16.04.2010 18.04.2011 22.04.2012 16.04.2013 **18.04** c	9 9 10 8 **9**c	21.08.2010 26.08.2011 29.08.2012 20.08.2013 **24.08** b
Mudovalj	19 ° 55' E	42° 33'N	940	06.04.2010 10.04.2011 13.04.2012 07.04.2013 **09.04** a	11.04.2010 16.04.2011 19.04.2012 14.04.2013 **15.04** ab	19.04.2010 21.04.2011 25.04.2012 19.04.2013 **21.04** ab	13 11 12 12 **12**b	29.08.2010 30.08.2011 05.09.2012 02.09.2013 **02.09** b
Dronga	19 ° 55' E	42° 33'N	940	06.04.2010 08.04.2011 12.04.2012 10.04.2013 **09.04** a	12.04.2010 17.04.2011 18.04.2012 13.04.2013 **15.04** ab	19.04.2010 22.04.2011 24.04.2012 19.04.2013 **21.04** ab	13 14 12 9 **12**b	06.09.2010 07.09.2011 13.09.2012 10.09.2013 **09.09** a
Dupljanka	19 ° 59' E	43° 02'N	1180	10.04.2010 12.04.2011 15.04.2012 11.04.2013 **12.04** a	16.04.2010 18.04.2011 22.04.2012 16.04.2013 **18.04** a	22.04.2010 24.04.2011 27.04.2012 23.04.2013 **24.04** a	12 12 12 12 **12**b	07.09.2010 10.09.2011 14.09.2012 13.09.2013 **11.09** a
Jesenka	19 ° 55' E	42° 33'N	940	07.04.2010 11.04.2011 14.04.2012 08.04.2013 **10.04** a	13.04.2010 18.04.2011 19.04.2012 14.04.2013 **16.04** a	20.04.2010 22.04.2011 26.04.2012 20.04.2013 **22.04** a	13 11 12 12 **12**b	08.09.2010 09.09.2011 15.09.2012 12.09.2013 **11.09** a
Trnovača	19 ° 20' E	42° 38'N	979	24.03.2010 26.03.2011 29.03.2012 25.03.2013 **26.03**. d	26.03.2010 29.03.2011 04.04.2012 30.03.2013 **30.03** d	04.04.2010 05.04.2011 12.04.2012 07.04.2013 **07.04** d	11 10 14 13 **12**b	13.09.2010 18.09.2011 20.09.2012 21.09.2013 **18.09** a
LSD005 **LSD 001**				**6.58** **7.84**	**3.45** **4.54**	**5.13** **6.11**	**2.15** **2.95**	**7.79** **8.32**

The harvest period was longer than the flowering period (Gunes, 2003), as it lasted from 13th July (‘Petrovača’) to 18th September (‘Trnovača’). Local plum cultivars began to flower at the end of March or at the beginning of April under the environmental conditions of Serbia (Paunović, 1988; Paunović and Paunović, 1994; Mratinić, 2000; Milošević, 2000). Similar data on the period and duration of flowering of autochthonous plum cultivars were reported by Jarebica and Muratović (1977) and confirmed by the results of this study. Somewhat later flowering under Slovenian conditions was reported by Usenik et al. (2007) and early flowering in the Tokat province (Turkey) by Gunes (2003), the reason being environmental, particularly climate effects (Buljko, 1977). In terms of fruit ripening, the results of this study were similar to the ones obtained by Paunović *et al.*, 1985; Paunović, 1988; and Mratinić, 2000. Measurable pomological characteristics of fruit and stone are given in Table 2.

Fruit weight ranged from 6.65 g ± 0.235 g (‘Plavski piskavac‘) to 53.88 ± 0.654 g (‘Crvena durgulja’). Jarebica and Muratović (1977) determined that the plum fruit weight ranged from 14.17 to 41.70 g. Jovančević (1977) reported minimum and maximum values of fruit weights of some local plum cultivars, being 5.03 and 23.86 g, respectively. In the study conducted by Petrović *et al*., (2002), fruit weight of eight local plum cultivars in Eastern Serbia and in the region of Čacak (Western Serbia) ranged from 15.20-26.40 g and from 6.68-36.50 g, respectively (Paunović *et al*., 1985). According to Mratinić (2000), fruit weight of autochthonous plum cultivars in a broader region of south-western Serbia and Šumadija fell within a range of 6.20-28.00 g with 50% of the cultivars having the fruit weight of 15.00 g.

Similar data for autochthonous plum cultivars were reported by researchers from other countries. In Turkey, for example, Gunes (2003) reported the fruit weight of local plum cultivars in the Tokat province to range from 5.23-25.18 g and from 8.30-29.50 g in the Van province. The results obtained in this study confirmed those provided by the above authors in terms of the high degree of genotypic variability in fruit weight of autochthonous (local) plum cultivars. The cultivars selected in this study were classified as being extremely small in terms of fruit size, whereas the fruits of cultivar ‘Crvena durgulja’ were the only ones classified as being small (Paunović *et al.*, 1985; Mratinić, 2000; Zanetto *et al*. 2002). ‘Crvena durgulja’-fruits are elongated 49 mm long, 44, 10 mm wide, 46, 8 mm thick and weight 60.65 g on average (Botu *et al*., 2012).

The most dominant fruit shape was rounded in twelve cultivars, followed by ovate - in four cultivars, elliptical - in three cultivars and oblong – in one cultivar (‘Grkaja’). Ground color in most of the cultivars was light green (10) and light yellow (6), being yellow in cv. ‘Trnovača’, cv. ‘Dupljanka’ and cv. ‘Grkaja’. Skin color ranged from white yellow (1) and red (1) and violet (1) and blue (1) and dark blue (1) , and to dark violet (2), black (2), mahagoni (4) to red violet (7 cultivars). Flesh color was yellow green in most cultivars (12) and light yellow only in cv. ‘Plavski piskavac’ and amber only in cv. ‘Dupljanka’.

Table 2. Pomological and sensorial characteristics of autochthonous plum cultivars in the Region of North Montenegro (2010, 2011, 2012, 2013 and average)

Cultivar		fruit	fruit	fruit	ground	skin	flesh	flash	use	stone
		weight (g)	size [1]	shape [2]	colour [3]	colour *	colour **	Firmness ***	****	weight (g)
Petrovača	2010	13.24±0.082	1	2	2	5	3	5	2	1.29±0.044
	2011	13.13±0.089	1	2	2	5	3	5	2	1.22±0.038
	2012	12.99±0.069	1	2	2	5	3	5	2	1.10±0.022
	2013	13.08±0.072	1	2	2	5	3	5	2	1.15±0.024
	average	**13.11±0.078**e	**1**	**2**	**2**	**5**	**3**	**5**	**2**	**1.19±0.032**c
Mednica	2010	16.33±0.220	1	4	2	3	5	3	2	1.51±0.079
	2011	16.27±0.230	1	4	2	3	5	3	2	1.47±0.079
	2012	15.99±0.234	1	4	2	3	5	3	2	1.40±0.074
	2013	15.77±0.208	1	4	2	3	5	3	2	1.34±0.068
	average	**16.09±0.223**e	**1**	**4**	**2**	**3**	**5**	**3**	**2**	**1.43±0.075**c
Kapavac	2010	11.95±0.090	1	3	2	8	3	5	2	0.61±0.009
	2011	11.92±0.085	1	3	2	8	3	5	2	0.52±0.006
	2012	11.86±0.081	1	3	2	8	3	5	2	0.55±0.007
	2013	11.79±0.080	1	3	2	8	3	5	2	0.44±0.006
	average	**11.88±0.084**e	**1**	**3**	**2**	**8**	**3**	**5**	**2**	**0.53±0.007**d
Grkaja	2010	14.89±0.782	1	6	4	2	2	5	2	0.99±0.080
	2011	14.80±0.795	1	6	4	2	2	5	2	0.97±0.080
	2012	14.76±0.748	1	6	4	2	2	5	2	0.88±0.074
	2013	14.67±0.787	1	6	4	2	2	5	2	0.76±0.066
	average	**14.78±0.778**e	**1**	**6**	**4**	**2**	**2**	**5**	**2**	**0.90±0.075**d
Crvena ranka	2010	19.45±0.051	1	4	3	3	3	5	1.2	0.74±0.006
	2011	19.42±0.050	1	4	3	3	3	5	1.2	0.81±0.004
	2012	19.25±0.040	1	4	3	3	3	5	1.2	0.59±0.003
	2013	19.08±0.023	1	4	3	3	3	5	1.2	0.50±0.003
	average	**19.30±0.041**e	**1**	**4**	**3**	**3**	**3**	**5**	**1.2**	**0.66±0.004**d
Mudara	2010	35.84±0.311	2	2	3	3	2	5	2	1.91±0.041
	2011	35.60±0.310	2	2	3	3	2	5	2	1.90±0.035
	2012	35.60±0.298	2	2	3	3	2	5	2	1.85±0.033
	2013	35.36±0.277	2	2	3	3	2	5	2	1.7±0.031
	average	**35.60±0.299**c	**2**	**2**	**3**	**3**	**2**	**5**	**2**	**1.87±0.035**b
Belošljiva	2010	14.15±0.318	1	2	3	0	3	3	2	1.12±0.031
	2011	14.12±0.295	1	2	3	0	3	3	2	1.03±0.028
	2012	13.85±0.280	1	2	3	0	3	3	2	0.95±0.022
	2013	13.48±0.307	1	2	3	0	3	3	2	0.86±0.019
	average	**13.90±0.300**e	**1**	**2**	**3**	**0**	**3**	**3**	**2**	**0.99±0.025**d
Crnošljiva	2010	12.95±0.225	1	3	2	7	3	7	2	0.58±0.011
	2011	12.85±0.222	1	3	2	7	3	7	2	0.52±0.011
	2012	12.55±0.217	1	3	2	7	3	7	2	0.49±0.008
	2013	12.73±0.220	1	3	2	7	3	7	2	0.41±0.006
	average	**12.77±0.221**e	**1**	**3**	**2**	**7**	**3**	**7**	**2**	**0.50±0.009**d

Šara	2010	19.22±0.062	1	2	2	4	3	5	2	0.92±0.023
	2011	19.11±0.058	1	2	2	4	3	5	2	0.88±0.021
	2012	18.95±0.055	1	2	2	4	3	5	2	0.78±0.017
	2013	18.80±0.053	1	2	2	4	3	5	2	0.70±0.015
	average	**19.02±0.057**e	**1**	**2**	**2**	**4**	**3**	**5**	**2**	**0.82±0.019**d
Metlaš	2010	18.55±0.088	1	2	3	3	3	7	2	0.80±0.008
	2011	18.44±0.080	1	2	3	3	3	7	2	0.74±0.010
	2012	18.29±0.062	1	2	3	3	3	7	2	0.68±0.007
	2013	18.04±0.054	1	2	3	3	3	7	2	0.58±0.011
	average	**18.33±0.071**e	**1**	**2**	**3**	**3**	**3**	**7**	**2**	**0.70±0.009**d
Crvena durgulja	2010	53.99±0.662	3	3	3	3	5	5	2	2.35±0.722
	2011	53.90±0.659	3	3	3	3	5	5	2	2.25±0.710
	2012	53.84±0.650	3	3	3	3	5	5	2	2.18±0.705
	2013	53.79±0.645	3	3	3	3	5	5	2	2.02±0.707
	average	**53.88±0.654**a	**3**	**3**	**3**	**3**	**5**	**5**	**2**	**2.20±0.711**a
Plavski piskavac	2010	6.69±0.238	1	2	4	7	4	5	2	0.59±0.021
	2011	6.67±0.235	1	2	4	7	4	5	2	0.54±0.020
	2012	6.63±0.229	1	2	4	7	4	5	2	0.48±0.013
	2013	6.61±0.238	1	2	4	7	4	5	2	0.47±0.006
	averae	**6.65±0.235**f	**1**	**2**	**4**	**7**	**4**	**5**	**2**	**0.52±0.015**d
Turgulja	2010	22.85±0.325	1	2	2	9	3	5	2	1.66±0.016
	2011	20.15±0.266	1	2	2	9	3	5	2	1.61±0.014
	2012	20.84±0.220	1	2	2	9	3	5	2	1.57±0.012
	2013	19.80±0.073	1	2	2	9	3	5	2	1.52±0.010
	average	**20.91±0.221**d	**1**	**2**	**2**	**9**	**3**	**5**	**2**	**1.59±0.013**c
Obični Piskavac	2010	13.75±0.053	1	2	2	6	3	5	2	0.82±0.006
	2011	13.70±0.046	1	2	2	6	3	5	2	0.74±0.004
	2012	13.55±0.040	1	2	2	6	3	5	2	0.70±0.002
	2013	13.48±0.029	1	2	2	6	3	5	2	0.70±0.004
	average	**13.62±0.042**e	**1**	**2**	**2**	**6**	**3**	**5**	**2**	**0.74±0.004**d
Komperuša	2010	16.99±0.109	1	2	2	7	3	5	2	1.25±0.038
	2011	16.90±0.105	1	2	2	7	3	5	2	1.22±0.035
	2012	16.84±0.103	1	2	2	7	3	5	2	1.15±0.029
	2013	16.79±0.107	1	2	2	7	3	5	2	1.14±0.030
	average	**16.88±0.106**e	**1**	**2**	**2**	**7**	**3**	**5**	**2**	**1.19±0.033**c
Mudovalj	2010	18.62±0.132	1	2	3	3	2	5	2	1.26±0.092
	2011	18.58±0.129	1	2	3	3	2	5	2	1.22±0.087
	2012	18.51±0.128	1	2	3	3	2	5	2	1.17±0.082
	2013	18.49±0.111	1	2	3	3	2	5	2	1.11±0.083
	average	**18.55±0.125**e	**1**	**2**	**3**	**3**	**2**	**5**	**2**	**1.19±0.086**c
Dronga	2010	21.05±0.244	1	2	2	5	3	5	2	1.03±0.19
	2011	20.00±0.240	1	2	2	5	3	5	2	1.03±0.15
	2012	19.89±0.229	1	2	2	5	3	5	2	0.96±0.13
	2013	19.66±0.219	1	2	2	5	3	5	2	0.94±0.13
	average	**20.15±0.233**de	**1**	**2**	**2**	**5**	**3**	**5**	**2**	**0.99±0.15**d

Dupljanka	2010	22.72±0.25	1	4	4	3	6	5	2	1.93±0.495
	2011	22.68±0.23	1	4	4	3	6	5	2	1.87±0.425
	2012	22.62±0.20	1	4	4	3	6	5	2	1.82±0.445
	2013	22.62±0.20	1	4	4	3	6	5	2	1.90±0.395
	average	**22.66±0.22**d	**1**	**4**	**4**	**3**	**6**	**5**	**2**	**1.88±0.440**b
Jesenka	2010	23.80 ±0.267	1	2	2	9	3	5	2	1.90±0.022
	2011	23.56±0.256	1	2	2	9	3	5	2	1.84±0.025
	2012	23.83±0.250	1	2	2	9	3	5	2	1.78±0.023
	2013	24.05±0.231	1	2	2	9	3	5	2	1.72±0.022
	average	**23.81±0.251**d	**1**	**2**	**2**	**9**	**3**	**5**	**2**	**1.81±0.023**b
Trnovača	2010	7.25±0.012	1	2	1	7	2	7	2	0.18±0.004
	2011	7.18±0.011	1	2	1	7	2	7	2	0.14±0.003
	2012	7.25±0.015	1	2	1	7	2	7	2	0.14±0.003
	2013	7.24±0.022	1	2	1	7	2	7	2	0.18±0.002
	average	**7.23±0.01**f	**1**	**2**	**1**	**7**	**2**	**7**	**2**	**0.16±0.003**e
	$LSD_{0.05}$	4.82								0.26
	$LSD_{0.01}$	6.39								0.36

IBPGR and UPOV Descriptor List for Plum:
[1] **Fruit size:** 1=extremely small, 2=very small; 3=small, 4=small/medium, 5=medium, 6=medium/large, 7=large, 8=very large, 9=extremely large
[2] **Fruit shape:** 2 = rounded, 3 = elliptical, 4 = ovate, 6 = oblong;
[3] **Ground color:** 1=green, 2=light green, 3=light yellow, 4=yellow, 5=deep yellow
***Skin color:** 0=white yellow, 1=pink, 2=red, 3=red violet, 4=violet, 5=dark violet, 6=blue, 7=mahagony, 8=dark blue, 9=black
****Flesh color:** 1=green, 2=light green, 3=yellow-green, 4=light yellow, 5=yellow, 6=amber, 7=light orange, 8=orange, 9=red
***** Flesh firmness:** 3 = soft, 5 = medium, 7 = firm;
****** Use:** 1 = fresh, 2 = processing, 4 = other (drying)

As for flesh firmness, it was medium in 15 cultivars, firm in three and soft in two cultivars. The fruits of all the cultivars could be used for different types of processing, particularly for plum brandy production (Joshi and Sandhu, 2000). ʻCrvena rankaʼ can be used fresh (Mratinić, 2000). ʻCrvena rankaʼ fruits can be consumed immediately. Fruits are also used to produce an alcoholic drink that is called ”Raki” in Albanian (Botu *et al*., 2012) The autochthonous plum cultivar ʻCrvena rankaʼ is cultivated in the Šumadija area (Serbia) since ancient times as a typical brandy cultivar (Mratinić, 2012). Althought it produces excellent quality brandy, it is less and extensively cultivated. The consequence of this type of production is irregular bearing, low yields and small atypical fruits of lower quality. Mratinić (2012) pointed out the study which aim was to determine the influence of necessary agro- and pomo-technical practices such as pruning and fertilizing to improve yields and fruit quality of this cultivar. In cultivar ʻCrvena rankaʼ, manure – agrozel combination achieved the highest yields, fruit weight (19.4 g) and fruit quality (17% soluble solid content, 13,25% total sugars and 1.05% total aciditivity).

Table 3. Morphological and quantitative characteristics of one-year old seedlings for autochthonous brandy cultivars of plum on Myrobalan seedling (*Prunus cerasifera Erhr.*).(2010, 2011, 2012, 2013 and average)

Cultivar		Plant height (cm)	Stem diameter (mm)	Branching	Uniformity	Bud take (%)	Grow of scions (cm)	Uniformity of scions
Petrovača	2010	88.7	8.0	1	2	64	156.2	2
	2011	86.0	7.8	1	2	54	151.6	2
	2012	85.9	7.7	1	2	52	150.2	2
	2013	84.2	7.7	1	2	50	143.6	2
	average	**86.2**c	**7.8**c	**1**	**2**	**55**e	**150.4**d	**2**
Mednica	2010	120.5	11.5	2	2	90	200.5	2
	2011	121.0	11	2	2	88	196.5	2
	2012	108.5	10.2	2	2	95	198.0	2
	2013	107.6	8.1	2	2	95	197.0	2
	average	**114.4**a	**10.2**ab	**2**	**2**	**92**a	**198.0**a	**2**
Kapavac	2010	74.0	7.4	4	1	70	192.8	1
	2011	71.5	7.0	4	1	65	190.2	1
	2012	73.2	7.1	4	1	75	192.0	1
	2013	74.1	7.3	4	1	62	206.6	1
	average	**73.2**c	**7.2**c	**4**	**1**	**68**d	**195.4**a	**1**
Grkaja	2010	113.0	9.8	2	1	85	190.5	1
	2011	115.0	10.0	2	1	90	191.5	1
	2012	104.4	9.0	2	1	89	188.5	1
	2013	114.4	9.2	2	1	88	183.1	1
	average	**111.7**a	**9.5**b	**2**	**1**	**88**ab	**188.4**b	**1**
Crvena ranka	2010	112.8	10.8	2	1	87	197.4	2
	2011	112.0	10.2	2	1	85	194.5	2
	2012	116.5	9.8	2	1	75	198.0	2
	2013	99.5	8.4	2	1	93	190.1	2
	average	**110.2**ab	**9.8**ab	**2**	**1**	**85**b	**195.0**a	**2**
Mudara	2010	131.5	12	1	2	91	160.5	2
	2011	133.5	11.8	1	2	95	165.0	2
	2012	129.0	11.4	1	2	98	150.0	2
	2013	120.8	10.4	1	2	96	144.5	2
	average	**128.7**a	**11.4**a	**1**	**2**	**95**a	**155.0**d	**2**
Belošljiva	2010	111.2	8.6	2	1	75	201.0	1
	2011	110.2	8.2	2	1	78	199.2	1
	2012	107.8	7.8	2	1	68	195.2	1
	2013	103.6	7.4	2	1	59	194.6	1
	average	**108.2**b	**8.0**bc	**2**	**1**	**70**c	**197.5**a	**1**
Crnošljiva	2010	114.8	9.4	4	1	65	195.4	1
	2011	110.4	9.4	4	1	82	195.2	1
	2012	104.5	9.0	4	1	78	198.4	1
	2013	109.1	9.0	4	1	83	185.0	1
	average	**109.7**b	**9.2**b	**4**	**1**	**77**bc	**193.5**a	**1**

Šara	2010	126.4	11.5	1	1	80	153.0	2
	2011	121.0	10.5	1	1	72	155.5	2
	2012	120.5	10.2	1	1	74	145.0	2
	2013	118.5	9.8	1	1	74	132.5	2
	average	**121.6**a	**10.5**a	**1**	**1**	**75**c	**146.5**d	**2**
Metlaš	2010	89.5	8.5	3	1	84	162.0	1
	2011	86.0	7.5	3	1	60	153.5	1
	2012	87.5	7.7	3	1	62	154.5	1
	2013	85.0	7.5	3	1	54	146.0	1
	average	**87.0**c	**7.8**c	**3**	**1**	**65**d	**154.0**d	**1**
Crvena durgulja	2010	136.8	12.8	1	1	97	208.5	1
	2011	132.5	12.4	1	1	98	206.5	1
	2012	128.5	11.7	1	1	99	202.8	1
	2013	129.8	11.1	1	1	98	202.2	1
	average	**131.9**a	**12.0**a	**1**	**1**	**98**a	**205.0**a	**1**
Plavski piskavac	2010	54.8	6.5	3	1	38	142.3	1
	2011	54.1	6.5	3	1	48	138.0	1
	2012	52.0	5.9	3	1	42	125.4	1
	2013	52.7	5.1	3	1	52	117.5	1
	average	**53.4**d	**6**c	**3**	**1**	**45**f	**130.8**e	**1**
Turgulja	2010	93.2	9.0	3	1	79	163.2	1
	2011	92.5	8.5	3	1	76	158.6	1
	2012	89.5	7.8	3	1	74	153.0	1
	2013	90.4	6.7	3	1	79	147.6	1
	average	**91.4**bc	**8.0**bc	**3**	**1**	**77**bc	**155.6**d	**1**
Obični Piskavac	2010	118.5	10.8	2	1	88	203.2	1
	2011	114.5	10.0	2	1	82	199.5	1
	2012	111.5	9.0	2	1	84	195.0	1
	2013	109.1	8.2	2	1	86	191.1	1
	average	**113.4**a	**9.5**b	**2**	**1**	**85**b	**197.2**a	**1**
Komperuša	2010	125.5	11.5	2	1	78	195.5	1
	2011	122.0	11.0	2	1	85	190.0	1
	2012	117.5	10.6	2	1	91	175.5	1
	2013	113.0	10.1	2	1	98	159.0	1
	average	**119.5**a	**10.8**a	**2**	**1**	**88**ab	**180.0**b	**1**
Mudovalj	2010	109.5	9.2	2	2	80	202.5	2
	2011	109.0	9.2	2	2	76	201.5	2
	2012	111.0	9.5	2	2	72	209.0	2
	2013	104.9	8.5	2	2	72	187.0	2
	average	**108.6**b	**9.1**b	**2**	**2**	**75**c	**200.0**a	**2**
Dronga	2010	124.1	11.0	2	2	78	204.2	2
	2011	118.5	10.6	2	2	87	194.3	2
	2012	116.5	9.5	2	2	92	192.0	2
	2013	116.9	8.9	2	2	95	191.5	2
	average	**119.0**a	**10.0**ab	**2**	**2**	**88**ab	**195.5**a	**2**
Dupljanka	2010	127.5	11.5	2	1	89	199.5	1
	2011	125.0	11.0	2	1	86	198.0	1
	2012	125.5	11.0	2	1	82	198.2	1
	2013	124.8	10.5	2	1	87	197.4	1
	average	**125.7**a	**11.0**a	**2**	**1**	**86**b	**198.2**a	**1**

Jesenka	2010	104.2	9.4	2	1	73	177.2	1
	2011	102.3	9.0	2	1	77	174.0	1
	2012	100.5	8.8	2	1	70	170.2	1
	2013	100.2	8.0	2	1	72	172.6	1
	average	**101.8**ab	**8.8**b	**2**	**1**	**73**c	**173.5**c	**1**
Trnovača	2010	57.8	6.8	3	1	42	132.8	1
	2011	57.2	6.8	3	1	45	132.0	1
	2012	56.8	6.2	3	1	49	131.5	1
	2013	57.8	6.2	3	1	56	132.5	1
	average	**57.4**d	**6.5**c	**3**	**1**	**48**e	**132.2**e	**1**
	$LSD_{0.05}$	13.1	1.25			0.41	14.02	
	$LSD_{0.01}$	17.4	1.66			0.47	17.94	

Similar data for Serbian autochthonous plum cultivars in terms of pomological, physical and sensorial characteristics were reported by Paunović *et al*.,1985; Paunović, 1988; Petrović *et al*., 2002; and Milošević and Milošević , 2012, and data on local cultivars grown in the former Yugoslavia were given by Jovančević, 1977; Jarebica and Muratović, 1977; Usenik *et al*., 2007; Jelačić *et al*., 2008. Stone weight ranged from 0.16 ± 0.003 g (ʻTrnovačaʼ) to 2.20 ± 0.711g (ʻCrvena durguljaʼ), which was in similar with the results obtained by Paunović et al., 1985; Paunović ,1988; Paunović and Paunović ,1994; Mratinić, 2000; and Milošević and Milošević, 2012. Those obtained values, particularly those for fruit weight and fruit size, were lower than the ones reported for standard commercial cultivars, both foreign and domestic ones.

The fact that substantial climate- and soil-dependent variations could occur in the above traits should be taken into account. Importantly, some cultivars are found to be promising in terms of fruit traits. Almost all the fruits can be processed, particularly into plum brandy, or used fresh (ʻCrvena rankaʼ). More importantly, the autochthonous (primitive, local) cultivars or accessions observed in this study can be used as an outstanding genetic basis and source of germplasm in plum breeding aimed at developing new cultivars and rootstocks (Đuric *et al*., 1998; Esmenjaud and Direlewanger, 2007).

The results of this research show that the plant height, stem diameter, branching and uniformity of one-year old seedlings of autochthonous plum cultivars are genetic characteristics of autochthonous plum cultivars, from which rapid growth and uniformity of scions depend (tab. 3). The plant height of one-year old seedlings of researched autochthonous cultivars of plum was from 53.4 cm (cv. ʻPlavski piskavacʼ), to 131.9 cm (cv. ʻCrvena durgujaʼ). The stem diameter of researched one-year old seedlings of autochthonous cultivars of plum was from 6mm (cv. ʻPlavski piskavacʼ), to 12 mm (cv. ʻCrvena durgujaʼ). The most significant nursery characteristics which must be estimated in selection of autochthonous plum cultivar are ability to propagate, growth-rate, uniformity and compatibility (Vachun, 1995). In most of autochthonous cultivars of plum height and steam diameter at the height of 10 cm above the ground were sufficient for successful grafting in August (tab. 3). The bud take data of researched one-year

old seedlings of autochthonous cultivars of plum was from 48 % (ʻTrnovačaʼ) to 98% (ʻCrvena durguljaʼ). The cultivars ʻCrvena durguljaʼ and ʻMudaraʼ, whose but take data was 98% and 95%, were also very interesting from the aspect of economic production of one-year old seedlings autochthonous plum cultivars.

Most of the germplasm resources have never been subjected to proper germplasm conservation research work. Many local types of genetic value have already disappeared or will be lost in the next few years without any possibility of recovery. Fortunately genetic resources in sparsely populated and less developed areas of Serbia and Montenegro have been less eroded. The main objective of this work was selection of old autochthonous cultivars with better bio-agronomic characteristics such as uniformity of growth, high productivity, reduction of vigour and adaptation to the pedology-climatic environment.

However, since the results obtained in this study are only preliminary, reliable estimation will be possible only through a multi-disciplinary approach to examining selected cultivars grown in a collection orchard as well as through further findings to be attained under field and laboratory conditions over the next five to ten years.

CONCLUSIONS

The onset of flowering was recorded in the last five days of March and in the first twelve days of April. The earliest onset of flowering was observed in cv. ʻTrnovačaʼ (26.03) derived from P. insititia L., and the latest in cv. ʻDupljankaʼ (12.04) derived from P. domestica L. Among the twenty cultivars examined, eight (40%) started to flower at the end of March, and twelve (60%) during the middle of the first twelve-day period of April. The full flowering stage lasted from 30 March (ʻTrnovačaʼ) to 18th April (ʻDupljankaʼ), and the end of flowering from 7th April (ʻTrnovačaʼ) to 24th April (ʻDupljankaʼ). Flowering lasted 9 dazs for cultivars ʻTurguljaʼ, ʻPlavski piskavacʼ, ʻGrkajaʼ, ʻKapavac and Komperuša') to 14 days (ʻCrvena durguljaʼ, ʻMednicaʼ, ʻPetrovačaʼ, ʻBelošljivaʼ and ʻŠaraʼ).

The harvest period was longer than the flowering period, as it lasted from 13th July (ʻPetrovačaʼ) to 18th September (ʻTrnovačaʼ).

The fruit weight ranged from 6.65 ± 0.235 g (ʻPlavski piskavacʼ) to 53.88 ± 0.654 g (ʻCrvena durguljaʼ). The most dominant fruit shape was rounded - in twelve cultivars, followed by ovate - in four cultivars, elliptical - in 3 cultivars and oblong – in one cultivar (ʻGrkajaʼ).

Ground color in most of the cultivars was light green (10) and light yellow (6), being yellow in cv. ʻTrnovačaʼ, cv. ʻDupljankaʼ and cv. ʻGrkajaʼ. Skin color ranged from white yellow (1), red (1), violet (1), blue (1), dark blue (1) to dark violet (2), black (2), mahagoni (4) to red violet (7 cultivars). Flesh color was yellow green in most cultivars (12) and light yellow only in cv. ʻPlavski piskavacʼ and amber only in cv. ʻDupljankaʼ.

As for flesh firmness, it was medium in 15 cultivars, firm in tree and soft in two cultivars.

Stone weight ranged from 0.16 ± 0.003 g (‘Trnovača’) to 2.20 ± 0,711g (‘Crvena durgulja’).

All the fruits could be processed, and cv. ‘Crvena ranka’ could be used fresh. The autochthonous plum cultivars or accessions observed in this study could serve as an outstanding genetic basis and a source of germplasm for plum breeding aimed at developing new cultivars and as cultivars for organic plum orchards.

The results of this research show that the plant height, stem diameter, branching and uniformity of one-year old seedlings are genetic characteristics of autochthonous plum cultivars, from which rapid growth and uniformity of scions depend. From the aspect of production of one-year old seedlings and evaluation of scions, the most interesting autochthonous plum cultivars are ‘Mednica’ and ‘Mudara’.

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