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 South East of Europe. The European plum (Prunus domestica L.) genetic variability in the South East of Europe is large, unique and particularly 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), however 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 ‘Trnovača’ and ‘Turgulja’ were derived from P. Ìnstitia L., (Paunović et al., 1985). The sampled trees were aged 35 (’Plavski piskavac’) to 55 years (’Turgulja’). 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 ‘Trnovača’ (26.03) derived from P. insititia L., and the latest in cultivar ‘Dupljanka’ (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 (’Trnovača’) to 18th April (’Dupljanka’), and the end of flowering from 7th April (’Trnovača’) to 24th April (’Dupljanka’).
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 | longitude | latitude | altitude (m) | longitude | latitude | altitude (m) | onset      | full          | end          | duration | Date      | harvest     | Date       |
|--------------|----------|-----------|----------|--------------|-----------|----------|--------------|------------|---------------|-------------|-----------|-----------|-------------|------------|
| Petrovača    | 19 ° 41' E | 41° 01' N |           | 879          | 19 ° 41' E | 41° 01' N |           | 27.03 2010 | 27.03 2010 | 27.03 2010 | 14       | 13        | 01.04 2013  | 10.07 2010 |
| Mednica      | 19 ° 59' E | 42° 70' N |           | 670          | 19 ° 59' E | 42° 70' N |           | 30.03 2010 | 30.03 2010 | 30.03 2010 | 14a       | 13.07     | 01.04 2013  | 25.07 2010 |
| Kapavac      | 19 ° 29' E | 42° 50' N |           | 974          | 19 ° 29' E | 42° 50' N |           | 03.04 2010 | 03.04 2010 | 03.04 2010 | 9c        | 02.08     | 01.04 2013  | 02.08 2013 |
| Grkaja       | 19 ° 59' E | 42° 70' N |           | 670          | 19 ° 59' E | 42° 70' N |           | 29.03 2010 | 29.03 2010 | 29.03 2010 | 13a       | 06.08     | 01.04 2013  | 06.08 2013 |
| Crvena ranka | 19 ° 43' E | 42° 59' N |           | 601          | 19 ° 43' E | 42° 59' N |           | 29.03 2010 | 29.03 2010 | 29.03 2010 | 12a       | 05.08     | 01.04 2013  | 05.08 2013 |
| Mudara       | 19 ° 43' E | 42° 59' N |           | 601          | 19 ° 43' E | 42° 59' N |           | 29.03 2010 | 29.03 2010 | 29.03 2010 | 12a       | 06.08     | 01.04 2013  | 06.08 2013 |
| Belošljiva   | 19 ° 52' E | 43° 03' N |           | 850          | 19 ° 52' E | 43° 03' N |           | 30.03 2010 | 30.03 2010 | 30.03 2010 | 14a       | 07.08     | 01.04 2013  | 07.08 2013 |
| Crnošljiva   | 19 ° 20' E | 42° 38' N |           | 978          | 19 ° 20' E | 42° 38' N |           | 31.03 2010 | 31.03 2010 | 31.03 2010 | 13a       | 08.08     | 01.04 2013  | 08.08 2013 |
| Šara         | 19 ° 57' E | 42° 40' N |           | 900          | 19 ° 57' E | 42° 40' N |           | 28.03 2010 | 28.03 2010 | 28.03 2010 | 14a       | 12.08     | 01.04 2013  | 12.08 2013 |
| Location    | Longitude | Latitude | Sample Size | LSD005 | LSD001 |
|-------------|-----------|----------|-------------|--------|--------|
| Metlaš      | 19°29' E  | 42°51' N | 984         | 2.95   | 0.65   |
| Crvena drugalja | 19°48' E  | 42°57' N | 870         | 2.95   | 0.65   |
| Plavski piskavac | 19°55' E  | 42°33' N | 940         | 2.95   | 0.65   |
| Turgulja    | 19°56' E  | 42°37' N | 910         | 2.95   | 0.65   |
| Obični Piskavac | 18°49' E  | 42°26' N | 858         | 2.95   | 0.65   |
| Komperuša   | 19°49' E  | 42°43' N | 850         | 2.95   | 0.65   |
| Mudovalj    | 19°55' E  | 42°33' N | 940         | 2.95   | 0.65   |
| Dronga      | 19°55' E  | 42°33' N | 940         | 2.95   | 0.65   |
| Dupljanka   | 19°59' E  | 43°02' N | 1180        | 2.95   | 0.65   |
| Jesenka     | 19°55' E  | 42°33' N | 940         | 2.95   | 0.65   |
| Trnovača    | 19°20' E  | 42°38' N | 979         | 2.95   | 0.65   |
|             |           |          |             | LSD005 | LSD001 |
The harvest period was longer than the flowering period (Gunes, 2003), as it lasted from 13th July (ʽPetrovačaʼ) to 18th September (ʽTrnovačaʼ). 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 (ʽPlavski piskavacʼ) to 53.88 ± 0.654 g (ʽCrvena durguljaʼ). 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 Čačak (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 ʽCrvena durguljaʼ were the only ones classified as being small (Paunović et al., 1985; Mratinić, 2000; Zanetto et al. 2002). ʽCrvena durguljaʼ-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 (ʽGrkajaʼ). Ground color in most of the cultivars was light green (10) and light yellow (6), being yellow in cv. ʽTrnovačaʼ, cv. ʽDupljankaʼ and cv. ʽGrkajaʼ. 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. ʽPlavski piskavacʼ and amber only in cv. ʽDupljankaʼ.
### Table 2. Pomological and sensorial characteristics of autochthonous plum cultivars in the Region of North Montenegro (2010, 2011, 2012, 2013 and average)

| Cultivar     | fruit weight (g) | fruit size | fruit shape | fruit colour | fruit colour * | ground colour | skin colour | flesh Firmness | flesh Firmness *** | flesh Firmness **** | skin use | stone weight (g) |
|--------------|-----------------|------------|-------------|--------------|---------------|---------------|-------------|---------------|-------------------|-------------------|-----------|-----------------|
|              | 2010            | 1          | 2           | 2            | 5             | 3             | 5           | 2             | 1.29±0.044        |                   |           |                 |
| Petrovača    | 2011            | 1          | 2           | 2            | 5             | 3             | 5           | 2             | 1.22±0.038        |                   |           |                 |
|              | 2012            | 1          | 2           | 2            | 5             | 3             | 5           | 2             | 1.10±0.022        |                   |           |                 |
|              | 2013            | 1          | 2           | 2            | 5             | 3             | 5           | 2             | 1.15±0.024        |                   |           |                 |
|              | average         | 1          | 2           | 2            | 5             | 3             | 5           | 2             | 1.19±0.032        |                   |           |                 |
| Mednica      | 2010            | 1          | 4           | 2            | 3             | 5             | 3           | 2             | 1.51±0.079        |                   |           |                 |
|              | 2011            | 1          | 4           | 2            | 3             | 5             | 3           | 2             | 1.47±0.079        |                   |           |                 |
|              | 2012            | 1          | 4           | 2            | 3             | 5             | 3           | 2             | 1.40±0.074        |                   |           |                 |
|              | 2013            | 1          | 4           | 2            | 3             | 5             | 3           | 2             | 1.34±0.068        |                   |           |                 |
|              | average         | 1          | 4           | 2            | 3             | 5             | 3           | 2             | 1.43±0.075        |                   |           |                 |
| Kapavac      | 2010            | 1          | 3           | 2            | 8             | 3             | 5           | 2             | 0.61±0.009        |                   |           |                 |
|              | 2011            | 1          | 3           | 2            | 8             | 3             | 5           | 2             | 0.52±0.006        |                   |           |                 |
|              | 2012            | 1          | 3           | 2            | 8             | 3             | 5           | 2             | 0.55±0.007        |                   |           |                 |
|              | 2013            | 1          | 3           | 2            | 8             | 3             | 5           | 2             | 0.44±0.006        |                   |           |                 |
|              | average         | 1          | 3           | 2            | 8             | 3             | 5           | 2             | 0.53±0.007        |                   |           |                 |
| Grkaja       | 2010            | 1          | 6           | 4            | 2             | 2             | 5           | 2             | 0.99±0.080        |                   |           |                 |
|              | 2011            | 1          | 6           | 4            | 2             | 2             | 5           | 2             | 0.97±0.080        |                   |           |                 |
|              | 2012            | 1          | 6           | 4            | 2             | 2             | 5           | 2             | 0.88±0.074        |                   |           |                 |
|              | 2013            | 1          | 6           | 4            | 2             | 2             | 5           | 2             | 0.76±0.066        |                   |           |                 |
|              | average         | 1          | 6           | 4            | 2             | 2             | 5           | 2             | 0.90±0.075        |                   |           |                 |
| Crvena ranka | 2010            | 1          | 4           | 3            | 3             | 3             | 5           | 1.2            | 0.74±0.006        |                   |           |                 |
|              | 2011            | 1          | 4           | 3            | 3             | 3             | 5           | 1.2            | 0.81±0.004        |                   |           |                 |
|              | 2012            | 1          | 4           | 3            | 3             | 3             | 5           | 1.2            | 0.59±0.003        |                   |           |                 |
|              | 2013            | 1          | 4           | 3            | 3             | 3             | 5           | 1.2            | 0.50±0.003        |                   |           |                 |
|              | average         | 1          | 4           | 3            | 3             | 3             | 5           | 1.2            | 0.66±0.004        |                   |           |                 |
| Mudara       | 2010            | 2          | 2           | 3            | 3             | 2             | 5           | 2             | 1.91±0.041        |                   |           |                 |
|              | 2011            | 2          | 2           | 3            | 3             | 2             | 5           | 2             | 1.90±0.035        |                   |           |                 |
|              | 2012            | 2          | 2           | 3            | 3             | 2             | 5           | 2             | 1.85±0.033        |                   |           |                 |
|              | 2013            | 2          | 2           | 3            | 3             | 2             | 5           | 2             | 1.76±0.031        |                   |           |                 |
|              | average         | 2          | 2           | 3            | 3             | 2             | 5           | 2             | 1.87±0.035        |                   |           |                 |
| Belošljiva   | 2010            | 1          | 2           | 3            | 0             | 3             | 3           | 2             | 1.12±0.031        |                   |           |                 |
|              | 2011            | 1          | 2           | 3            | 0             | 3             | 3           | 2             | 1.03±0.028        |                   |           |                 |
|              | 2012            | 1          | 2           | 3            | 0             | 3             | 3           | 2             | 0.95±0.022        |                   |           |                 |
|              | 2013            | 1          | 2           | 3            | 0             | 3             | 3           | 2             | 0.86±0.019        |                   |           |                 |
|              | average         | 1          | 2           | 3            | 0             | 3             | 3           | 2             | 0.99±0.025        |                   |           |                 |
| Crnošljiva   | 2010            | 1          | 3           | 2            | 7             | 3             | 7           | 2             | 0.58±0.011        |                   |           |                 |
|              | 2011            | 1          | 3           | 2            | 7             | 3             | 7           | 2             | 0.52±0.011        |                   |           |                 |
|              | 2012            | 1          | 3           | 2            | 7             | 3             | 7           | 2             | 0.49±0.008        |                   |           |                 |
|              | 2013            | 1          | 3           | 2            | 7             | 3             | 7           | 2             | 0.41±0.006        |                   |           |                 |
|              | average         | 1          | 3           | 2            | 7             | 3             | 7           | 2             | 0.50±0.009        |                   |           |                 |
|               | 2010     | 2011     | 2012     | 2013     | average   | 2010     | 2011     | 2012     | 2013     | average   | Šara |
|---------------|----------|----------|----------|----------|-----------|----------|----------|----------|----------|-----------|------|
| Šara          | 19.22±0.062 | 19.11±0.058 | 18.95±0.055 | 18.80±0.053 | 19.02±0.057 | 12 | 2 | 2 | 4 | 3 | 5 | 2 | 0.92±0.023 |
| Metlaš        | 18.55±0.088 | 18.44±0.080 | 18.29±0.062 | 18.04±0.054 | 18.33±0.071 | 12 | 2 | 3 | 3 | 3 | 7 | 2 | 0.80±0.008 |
| Crvena durgulja | 53.99±0.662 | 53.90±0.659 | 53.84±0.650 | 53.79±0.654 | 53.88±0.654 | 3 | 3 | 3 | 3 | 3 | 5 | 5 | 2.20±0.711 |
| Plavski piskavac | 6.69±0.238 | 6.67±0.235 | 6.63±0.229 | 6.61±0.238 | 6.65±0.235 | 12 | 2 | 4 | 7 | 4 | 5 | 2 | 0.70±0.009 |
| Turgulja      | 22.85±0.325 | 20.15±0.266 | 20.84±0.220 | 19.80±0.073 | 20.91±0.221 | 3 | 3 | 3 | 3 | 5 | 5 | 2 | 1.59±0.013 |
| Obični Piskavac | 13.75±0.053 | 13.70±0.046 | 13.55±0.040 | 13.48±0.029 | 13.62±0.042 | 12 | 2 | 2 | 6 | 3 | 5 | 2 | 0.74±0.004 |
| Komperuša     | 16.99±0.109 | 16.90±0.105 | 16.84±0.103 | 16.79±0.107 | 16.88±0.106 | 3 | 3 | 3 | 3 | 5 | 5 | 2 | 1.19±0.033 |
| Mudovalj      | 18.62±0.132 | 18.58±0.129 | 18.51±0.128 | 18.49±0.111 | 18.55±0.125 | 12 | 2 | 3 | 3 | 3 | 5 | 2 | 1.19±0.086 |
| Dronga        | 21.05±0.244 | 20.00±0.240 | 19.89±0.229 | 19.66±0.219 | 20.15±0.233 | 12 | 2 | 2 | 5 | 3 | 5 | 2 | 0.99±0.151 |
Possibility of producing one-year old seedlings of the autochthonous \textit{brandy} varieties...

\begin{tabular}{|l|c|c|c|c|c|c|c|c|}
\hline
\textbf{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 \\
 & \textit{average} & \textit{22.66±0.22d} & 1 & 4 & 4 & 3 & 6 & 5 & 2 & \textit{1.88±0.440b} \\
\hline
\textbf{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 \\
 & \textit{average} & \textit{23.81±0.251d} & 1 & 2 & 2 & 9 & 3 & 5 & 2 & \textit{1.81±0.023b} \\
\hline
\textbf{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 \\
 & \textit{average} & \textit{7.23±0.017f} & 1 & 2 & 1 & 7 & 2 & 7 & 2 & \textit{0.16±0.003e} \\
\hline
\textbf{LSD} & 0.05 & 4.82 & 0.26 & \\
\textbf{LSD} & 0.01 & 6.39 & 0.36 & \\
\hline
\end{tabular}

\textbf{IBPGR and UPOV Descriptor List for Plum:}

\footnotesize
\begin{itemize}
\item \textbf{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
\item \textbf{Fruit shape:} 2 = rounded, 3 = elliptical, 4 = ovate, 6 = oblong;
\item \textbf{Ground color:} 1=green, 2=light green, 3=light yellow, 4=yellow, 5=deep yellow
\item \textbf{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
\item \textbf{Flesh color:} 1=green, 2=light green, 3=yellow-green, 4=light yellow, 5=yellow, 6=amber, \\
7=light orange, 8=orange, 9=red
\item \textbf{Flesh firmness:} 3 = soft, 5 = medium, 7 = firm;
\item \textbf{Use:} 1 = fresh, 2 = processing, 4 = other (drying)
\end{itemize}

As for flesh firmness, it was medium in 15 cultivars, firm in three and soft \textit{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). ‘Crvena ranka’ can be used fresh (Mratinić, 2000). ‘Crvena ranka’ 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 ‘Crvena ranka’ is cultivated in the Šumadija area (Serbia) since ancient times as a typical brandy cultivar (Mratinić, 2012). Although 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 ‘Crvena ranka’, 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 acidity).
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      | **86.2c**         | **7.8c**           | **1**     | **2**      | **55e**     | **150.4d**          | **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      | **114.4a**        | **10.2ab**         | **2**     | **2**      | **92a**     | **198.0a**          | **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      | **73.2c**         | **7.2c**           | **4**     | **1**      | **68d**     | **195.4a**          | **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      | **111.7a**        | **9.5b**           | **2**     | **1**      | **88ab**    | **188.4b**          | **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      | **110.2ab**       | **9.8ab**          | **2**     | **1**      | **85b**     | **195.0a**          | **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      | **128.7a**        | **11.4a**          | **1**     | **2**      | **95a**     | **155.0d**          | **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      | **108.2b**        | **8.0bc**          | **2**     | **1**      | **70c**     | **197.5a**          | **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      | **109.7b**        | **9.2b**           | **4**     | **1**      | **77bc**    | **193.5a**          | **1**               |
| Variety         | 2010  | 2011  | 2012  | 2013  | Average | Total | Year |
|-----------------|-------|-------|-------|-------|---------|-------|------|
| Šara            | 126.4 | 121.0 | 120.5 | 118.5 | 121.6a  | 153.0 | 2    |
|                 |       | 10.5a | 10.2  | 9.8   | 10.5a   | 162.0 | 1    |

| Metlaš          | 2010  | 2011  | 2012  | 2013  | Average | Total | Year |
|-----------------|-------|-------|-------|-------|---------|-------|------|
|                 | 89.5  | 86.0  | 87.5  | 85.0  | 87.0c   | 162.0 | 1    |

| Crvena durgulja | 2010  | 2011  | 2012  | 2013  | Average | Total | Year |
|-----------------|-------|-------|-------|-------|---------|-------|------|
|                 | 136.8 | 132.5 | 128.5 | 129.8 | 131.9a  | 153.0 | 1    |

| Plavski piskavac| 2010  | 2011  | 2012  | 2013  | Average | Total | Year |
|-----------------|-------|-------|-------|-------|---------|-------|------|
|                 | 54.8  | 54.1  | 52.0  | 52.7  | 53.4d   | 143.2 | 1    |

| Turgulja        | 2010  | 2011  | 2012  | 2013  | Average | Total | Year |
|-----------------|-------|-------|-------|-------|---------|-------|------|
|                 | 93.2  | 92.5  | 89.5  | 90.4  | 91.4bc  | 158.6 | 1    |

| Obični Piskavac | 2010  | 2011  | 2012  | 2013  | Average | Total | Year |
|-----------------|-------|-------|-------|-------|---------|-------|------|
|                 | 118.5 | 114.5 | 111.5 | 109.1 | 113.4a  | 138.0 | 1    |

| Komperuša       | 2010  | 2011  | 2012  | 2013  | Average | Total | Year |
|-----------------|-------|-------|-------|-------|---------|-------|------|
|                 | 125.5 | 122.0 | 117.5 | 113.0 | 119.5a  | 135.0 | 1    |

| Mudovalj        | 2010  | 2011  | 2012  | 2013  | Average | Total | Year |
|-----------------|-------|-------|-------|-------|---------|-------|------|
|                 | 109.5 | 109.0 | 111.0 | 104.9 | 108.6b  | 159.0 | 1    |

| Dronga          | 2010  | 2011  | 2012  | 2013  | Average | Total | Year |
|-----------------|-------|-------|-------|-------|---------|-------|------|
|                 | 124.1 | 118.5 | 116.5 | 116.9 | 119.0a  | 132.5 | 1    |

| Dupljanka       | 2010  | 2011  | 2012  | 2013  | Average | Total | Year |
|-----------------|-------|-------|-------|-------|---------|-------|------|
|                 | 127.5 | 125.0 | 125.5 | 124.8 | 125.7a  | 132.5 | 1    |
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 (‘Trnovača’) to 2.20 ± 0.711g (‘Crvena durgulja’), 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 (‘Crvena ranka’). 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. ‘Plavski piskavac’), to 131.9 cm (cv. ‘Crvena durgulja’). The stem diameter of researched one-year old seedlings of autochthonous cultivars of plum was from 6mm (cv. ‘Plavski piskavac’), to 12 mm (cv. ‘Crvena durgulja’). 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
Possibility of producing one-year old seedlings of the autochthonous brandy varieties...

old seedlings of autochthonous cultivars of plum was from 48% (‘Trnovača’) to 98% (‘Crvena durgulja’). The cultivars ‘Crvena durgulja’ and ‘Mudara’, 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. ‘Trnovača’ (26.03) derived from P. insititia L., and the latest in cv. ‘Dupljanka’ (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 (‘Trnovača’) to 18th April (‘Dupljanka’), and the end of flowering from 7th April (‘Trnovača’) to 24th April (‘Dupljanka’). Flowering lasted 9 days for cultivars ‘Turgulja’, ‘Plavski piskavac’, ‘Grkaja’, ‘Kapavac and Komperuša’) to 14 days (‘Crvena durgulja’, ‘Mednica’, ‘Petrovača’, ‘Belošljiva’ and ‘Šara’).

The harvest period was longer than the flowering period, as it lasted from 13th July (‘Petrovača’) to 18th September (‘Trnovača’).

The fruit weight ranged from 6.65 ± 0.235 g (‘Plavski piskavac’) to 53.88 ± 0.654 g (‘Crvena durgulja’). 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 (‘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), 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. ‘Plavski piskavac’ and amber only in cv. ‘Dupljanka’.

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 (ʽTrnovača’) to 2.20 ± 0.711g (ʽCrvena durgulja’).

All the fruits could be processed, and cv. ʽCrvena 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 ʽMednica’ and ʽMudara’.

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