

Morphogenic Variability of Some Autochthonous Plum Cultivars in Western Serbia

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ABSTRACT

A study conducted over a period of two years in a Western Serbian valley included in situ identification of autochthonous plum cultivars. Observation and recording of their phenological and pomological traits were performed using IBPGR and UPOV methodologies. Fifteen cultivars derived from Prunus domestica L. and two cultivars derived from P. insititia L. were identified. Flowering started between 24 March and 7 April and fruit ripening between 12 July (Petrovača) and 16 September (Trnovača). Fruit weight ranged from 6.79±0.018 to 36.62±0.251 g and stone weight from 0.14±0.002 to 1.95±0.023 g. The cultivars were classified as being extremely small in terms of fruit size. Rounded fruit shape and light-yellow ground colour were dominant. Skin colour ranged from amber to black. Yellow green was a dominant flesh colour 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 programmes and as rootstocks as well as in further disease-related systematic studies under field and laboratory conditions.

Key words: Fruit, genetic bases, germplasm, *Prunus domestica* L., *Prunus insititia* L.

INTRODUCTION

In terms of total plum production, Serbia ranks fourth worldwide (Milosevic et al., 2008). The Serbian 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 Pozegaca (35%), foreign standard and Serbian newly bred cultivars (15%) and autochthonous (local, primitive) cultivars (50%), their fruits being generally used for brandy production (Mratinic, 2000). Autochthonous plum cultivars are a limiting factor in improving plum production in Serbia. 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 (Ogasanovic et al., 1994; Milosevic, 2000), the development of new plum, apricot and peach rootstocks (Paunovic, 1988; Djuric et al., 1998), resistance to economically important diseases (Paunovic and Paunovic, 1994; Rodrigues et al., 2009) or intensive cultivation (Mratinic, 2000). Similar investigations focusing on identical or similar objectives were also conducted in the other countries of the former Yugoslavia - Montenegro (Jovancevic, 1977), Bosnia and Herzegovina (Jarebica and Muratović, 1977; Buljko, 1977), Croatia (Jelacic et al., 2008) and Slovenia (Usenik et al., 2007).

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In situ investigations of cultivars derived from *Prunus domestica* L. and *P. insititia* L. in Serbia were conducted by a number of researchers (Paunovic et al., 1985; Paunovic, 1988; Paunovic and Paunovic, 1994; Petrovic 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 in breeding programmes 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 Western Serbia that could be used as a genetic basis and source of germplasm for future breeding studies.

MATERIALS AND METHODS

Investigations were conducted in 2007 and 2008. They involved *in situ* identification, marking and observation of autochthonous plum cultivars (accessions) in a valley in Western Serbia. Seventeen genotypes or cultivars, derived from *P. domestica* L., except for cvs. Trnovača and Turgulja originating from *P. insititia* L., were selected (Paunovic et al., 1985). The sampled trees were aged 42 (Cerovački Piskavac) to 79 years (Maričevka). The trees of all the cultivars grew on their own roots.

The study focused on two segments. The 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 coloured 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 colour (1-5), skin colour (0-9), flesh colour (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 Tehnica ET-1111 technical scale (range of measurement 0.01-120.00 g, precision ± 0.01 g).

Data were averaged over the two growing seasons and then subjected to statistical analysis performed using the SAS (SAS Institute, 2002).

RESULTS AND DISCUSSION

The phenological characteristics of autochthonous (local, primitive) plum cultivars are given in Table 1. The data showed that the onset of flowering was recorded in the last ten days of March and in the first ten days of April. The earliest onset of flowering was observed in cv. Trnovača (24.03) derived from *P. insititia* L., and the latest in cv. Bela Požegača (White Pozegaca in English) and Požegača (7.04) originating from *P. domestica* L. Among the 17 cultivars examined, nine (52.94%) started to flower at the end of March, and eight (47.06%) during the middle of the first ten-day period of April. The full flowering stage lasted from 28 March (Trnovača) to 13 April (Bela Požegača and Požegača), and the end of flowering from 5 April (Trnovača) to 19 April (Bela Požegača and Požegača). Flowering lasted 8 (Maričevka) to 14 days (Belošljiva, Crvena Ranka var. Derosavka, Čokešinka and Petrovača). The harvest period was longer than the flowering period (Gunes, 2003), as it lasted from 12 July (Petrovača) to 16 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 (Paunovic, 1988; Paunovic and Paunovic, 1994; Mratinic, 2000; Milosevic, 2000). Similar data on the period and duration of flowering of autochthonous plum cultivars were reported by Jovancevic (1977) and Jarebica and Muratovic (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 identical to the ones obtained by Paunovic et al. (1985), Paunovic (1988) and Mratinic (2000).

Measurable pomological characteristics of fruit and stone are given in Table 2. Fruit weight ranged

from 6.79 ± 0.018 g (Trnovača) to 36.62 ± 0.251 g (Mudara). It was above 20.00 g in cvs. Bela Požegača, Crvena Ranka var. Bardaklija, Požegača and Turgulja, and above 30.00 g in Mudara, as opposed to the fruit weight of the other cultivars being below 20.00 g. Jarebica and Muratovic (1977) determined that the plum fruit weight ranged from 14.17 to 41.70 g. Jovancevic (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 Petrovic et al. (2002), fruit weight of eight local plum cultivars in Eastern Serbia and in the region of Cacak (Western Serbia) ranged from 15.20-26.40 g and from 6.68-36.50 g, respectively (Paunovic et al., 1985). According to Mratinic (2000), fruit weight of autochthonous plum cultivars in a broader region of south-western

Serbia and Sumadija 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 cv. Mudara were the only ones classified as being very small (Paunovic et al., 1985; Mratinic, 2000; Zanetto et al. 2002).

Table 1 - Phenological characteristics of autochthonous plum cultivars in Western Serbia.

Cultivar (Local name)	Flowering			Duration (days)	Harvest date
	Onset	Full	End		
Arapka	4.04	8.04	13.04	9	17.08
Bela Požegaca	7.04	13.04	19.04	12	11.09
Belošljiva	28.03	1.04	11.04	14	5.08
Cerovački Piskavac	3.04	7.04	13.04	10	14.08
Crnošljiva	29.03	2.04	11.04	13	8.08
Crvena Ranka*	28.03	2.04	10.04	13	4.08
Crvena Ranka**	27.03	1.04	10.04	14	4.08
Čokešinka	28.03	1.04	11.04	14	13.08
Kapavac	3.04	6.04	12.04	9	29.07
Maričevka	3.04	6.04	11.04	8	10.08
Metlaš	30.03	4.04	10.04	11	11.08
Mudara	31.03	5.04	12.04	12	6.08
Obični Piskavac	4.04	7.04	14.04	10	20.08
Petrovača	26.03	30.03	9.04	14	12.07
Požegača	7.04	13.04	19.04	12	6.09
Trnovača	24.03	28.03	5.04	12	16.09
Turgulja	2.04	6.04	11.04	9	21.08

* Crvena Ranka var. Bardaklija; ** Crvena Ranka var. Derosavka

The most dominant fruit shape was rounded - in eight cultivars, followed by elliptical - in five cultivars, oblong - in 2 cultivars and ovate - in two cultivars (Paunovic and Paunovic, 1994). Ground colour in most of the cultivars was light yellow (8) and light green (8), being green only in cv. Trnovača. Skin colour ranged from amber (1) and black (1), to blue (2), dark violet (2), white yellow (2), red violet (4) to dark blue (5 cultivars). Flesh colour was yellow green in most cultivars, and light green only in cvs. Cerovački Piskavac and

Trnovača. As for flesh firmness, it was medium in 10 cultivars, firm in five 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). The fruits of Bela Požegača, Crvena Ranka var. Bardaklija and Požegača can be used fresh, and those of Požegača can also be dried (Mratinic, 2000). Similar data for Serbian autochthonous plum cultivars in terms of pomological, physical and sensorial characteristics were reported by

Paunovic et al. (1985), Paunovic (1988) and Petrovic et al. (2002), and data on local cultivars grown in the former Yugoslavia were given by Jovancevic (1977), Jarebica and Muratovic (1977), Usenik et al. (2007), Jelacic et al. (2008).

Stone weight ranged from 0.14 ± 0.002 g (Trnovača) to 1.95 ± 0.023 g (Mudara), which was in agreement with the results obtained by Paunovic et al. (1985), Paunovic (1988), Paunovic and Paunovic (1994) and Mratinic (2000).

The 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 (Bela Požegača, Crvena Ranka var. Bardaklija, Mudara and Požegača) and dried (Požegača). 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 (Djuric et al., 1998; Esmenjaud and Dirlewanger, 2007).

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.

Table 2 - Pomological and sensorial characteristics of autochthonous plum cultivars in Western Serbia[†]

Cultivar (Local name)	Fruit weight (g)	Fruit size ¹	Fruit shape ²	Ground colour ³	Skin colour ⁴	Flesh colour ⁵	Flesh firmness ⁶	Use ⁷	Stone weight (g)
Arapka	16.34±0.098	1	6	2	7	3	3	2	0.67±0.141
Bela Požegača	22.60±0.403	1	6	3	0	3	7	1,2	0.56±0.003
Belošljiva	14.00±0.200	1	2	3	0	3	3	2	0.93±0.019
Cerovački Piskavac	19.81±0.237	1	3	3	5	2	5	2	0.38±0.003
Crnošljiva	13.78±0.267	1	3	2	7	3	7	2	0.56±0.011
Crvena Ranka*	22.79±0.266	1	4	3	3	3	5	1,2	0.76±0.004
Crvena Ranka**	17.50±0.051	1	4	3	3	3	5	2	0.56±0.003
Čokešinka	19.66±0.098	1	3	3	7	3	5	2	0.74±0.003
Kapavac	11.11±0.064	1	3	2	8	3	5	2	0.43±0.002
Maričevka	15.81±0.038	1	2	2	6	3	5	2	0.83±0.006
Metlaš	17.36±0.051	1	2	3	3	3	7	2	0.66±0.004
Mudara	36.62±0.251	2	2	3	3	2	5	2	1.95±0.023
Obični Piskavac	14.39±0.034	1	2	2	6	3	5	2	0.62±0.003
Petrovača	12.10±0.084	1	2	2	5	3	5	2	1.12±0.028
Požegača	23.45±0.200	1	3	2	7	3	7	1,2,4	0.67±0.002
Trnovača	6.79±0.018	1	2	1	7	2	7	2	0.14±0.002
Turgulja	20.91±0.221	1	2	2	9	3	5	2	1.56±0.011

[†] IBPGR and UPOV Descriptor List for Plum (Zanetto et al., 2002);

* Crvena Ranka var. Bardaklija; ** Crvena Ranka var. Derosavka;

¹ Fruit size: 1 = extremely small, 2 = very small;

² Fruit shape: 2 = rounded, 3 = elliptical, 4 = ovate, 6 = oblong;

³ Ground colour: 1 = green, 2 = light green, 3 = light yellow;

⁴ Skin colour: 0 = white yellow, 3 = red violet, 5 = dark violet, 6 = blue, 7 = dark blue, 8 = black, 9 = amber;

⁵ Flesh colour: 2 = light green, 3 = yellow green;

⁶ Flesh firmness: 3 = soft, 5 = medium, 7 = firm;

⁷ Use: 1 = fresh, 2 = processing, 4 = other (drying)

CONCLUSIONS

The onset of flowering of the autochthonous plum cultivars derived from *P. domestica* L. and *P. insititia* L. lasted from the middle of the last ten-day period in March to the middle of the first ten-day period in April. The cultivars flowered from

the beginning of the second ten-day period in July to the end of the second ten-day period in September. The fruits were extremely small. Rounded shape, yellow-green ground colour and yellow-green flesh colour predominated. All the fruits could be processed, and some could be dried or used fresh. The autochthonous (primitive, local)

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 rootstocks.

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