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PHENOLOGICAL CHARACTERISTICS, YIELD AND FRUIT QUALITY OF INTRODUCED APRICOT CULTIVARS IN THE REGION OF BELGRADE (SERBIA)

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Abstract

The evaluation of ten introduced apricot cultivars originated from Romania, Bulgaria and Hungary was carried out in the region of Belgrade over a period of six years (2009–2014). Control cultivar for comparison was ‘Hungarian Best’. Flowering of introduced cultivars was from two days before to two days after the control, while harvest was from 6 days before (‘Neptun’) to 13 days after (‘Litoral’). The average yield per tree ranged from 5.7 kg in ‘Kasna Drjanovska’ to 12.2 kg in ‘Mari de Cenad’ and ‘Roksana’, while the average fruit weight ranged from 45.1 g in ‘Umberto’ to 82.0 g in ‘Neptun’. Compared with the control cultivar, significantly higher yield was achieved in seven cultivars, while significantly higher fruit weight was found in six cultivars. The content of soluble solids varied from 14.2% in ‘Cegledi arany’ to 19.5% in ‘Kasna Drjanovska’. Cultivars ‘Roksana’, ‘Mari de Cenad’, ‘Gergana’ and ‘Neptun’ stand out for fruit appearance, and ‘Silistrenska kompotna’, ‘Kasna Dryanovska’ and ‘Mari de Cenad’ for fruit quality. Among studied cultivars, for growing in this region ‘Dacia’, ‘Gergana’, ‘Mari de Cenad’, ‘Neptun’ and ‘Roksana’ can be recommended, predominantly for fresh fruit consumption. In addition, cultivars ‘Silistrenska kompotna’ and ‘Kasna Drjanovska’ can also be recommended, mostly for fruit processing.

Key words: *Prunus armeniaca*, flowering, maturing, yield, fruit, stone

Introduction

Extensive research is conducted worldwide on the creation of new apricot cultivars with improved characteristics, such as better adaptability to different environmental conditions, higher resistance to disease-causing agents, higher yield, and better fruit quality. In the last 20 years, more than 500 new apricot cultivars were created. The largest number of new cultivars was created in the United States, followed by France, Italy, Romania, China, Czech Republic and Spain (Milatović, 2013a).

Apricot cultivars have limited ecological adaptability. Thus, the leading cultivars are different in each region of production. Due to the limited adaptability, the best results in the apricot production are achieved with cultivars bred in the similar environmental conditions.

Romania is one of the leading countries in apricot breeding with more than 40 new cultivars released. Breeding has conducted in fruit research stations in Mărculești, Băneasa, Constanţa and Oradea (Cociu, 2006; Bălan et al., 2010; Topor et al., 2010). In Bulgaria, apricot breeding is conducted in Experimental Station Silistra and Fruit Growing Institute in Plovdiv (Tsoneva and Tsonev, 1995; Lyubenov, 2005; Zhivondov, 2012). In Hungary, 20 new apricot cultivars are bred, and the leading institutions are Fruit Research Station Cegled and Faculty of Horticulture, Corvinus University of Budapest (Szalay et al., 2005; Pedryc and Hermán, 2012).

The aim of this study was the evaluation of ten introduced apricot cultivars originating from Romania, Bulgaria and Hungary. The best performing cultivars will be recommended for growing in the region of Belgrade, as well as in other regions with similar ecological conditions.

Material and methods

The study was conducted in the apricot collection orchard at the Experimental Station "Radmilovac" of the Faculty of Agriculture in Belgrade during the period of six years (2009–2013). The orchard was planted in 2007. The rootstock is Myrobalan (*Prunus cerasifera* Ehrh.) seedling, training system is central leader, and planting distance is 4.5 x 3 m. All cultivars are represented by five trees.

The study included ten apricot cultivars: five from Romania ('Dacia', 'Litoral', 'Mari de Cenad', 'Neptun' and 'Umberto'), four from Bulgaria ('Gergana', 'Kasna drjanovska', 'Roksana' and 'Silistrenska kompotna') and one from Hungary ('Cegledyi arany'). 'Hungarian Best' cultivar was taken as a control.

Flowering was recorded by recommendations of the International Working Group for pollination: start of flowering – 10% open flowers, fool bloom – 80% open flowers, end of flowering – 90% of the petal fall (Wertheim, 1996). Trunk cross-sectional area (TCSA) was calculated on the basis of trunk circumference measured at the height of 30 cm above the ground level. Cumulative yield efficiency was calculated by dividing the cumulative yield over six years by the TCSA in the last year (2014). Fruit characteristics were measured on a sample of 25 fruits per cultivar. Fruit shape index was calculated using the formula: length × length / width × thickness. Soluble solids were determined by refractometer and total acids (expressed as malic acid) by titration with 0.1 N NaOH. Sensory characteristics of the fruit (appearance and taste) were evaluated by a five-member jury, scoring the cultivars using the scale from 1 to 5 points.

The obtained data were statistically analyzed using analysis of variance. The significance of differences between mean values was determined using Tukey's test at 0.05 level of probability.

Results and discussion

Average time of flowering of apricot cultivars was late March and early April (Table 1). Among studied cultivars small differences in flowering time were recorded. The start of flowering was from two days before the 'Hungarian Best' ('Litoral') to two days after the control ('Cegledi arany', 'Kasna Drjanovska', 'Umberto' and 'Silistrenska kompotna'). The longest duration of flowering was recorded in 'Neptun' and 'Roksana' cultivars.

Table 1. Phenological characteristics of apricot cultivars (average, 2009–2014).

Cultivar	Flowering dates			Duration of flowering	Harvest date	No. of days comparing to control
	Start	Full	End			
Cegledi arany	29.03.	31.03.	05.04.	7.0	10.07.	+8
Dacia	26.03.	29.03.	03.04.	7.8	28.06.	–5
Gergana	26.03.	28.03.	01.04.	6.5	05.07.	+2
Kasna Drjanovska	29.03.	30.03.	05.04.	6.4	15.07.	+12
Litoral	25.03.	27.03.	02.04.	7.8	16.07.	+13
Mari de Cenad	26.03.	28.03.	02.04.	7.2	07.07.	+4
Neptun	27.03.	30.03.	05.04.	8.7	27.06.	–6
Roksana	27.03.	30.03.	04.04.	8.0	07.07.	+5
Silistrenska kompotna	29.03.	31.03.	06.04.	7.6	13.07.	+10
Umberto	29.03.	31.03.	05.04.	7.2	14.07.	+11
Hungarian Best (control)	27.03.	29.03.	03.04.	7.0	03.07.	0

Compared to the results of Milatović (2005) obtained at the same location for the ten-year period (1995–2004) duration of flowering was shorter by 2.8 days on average. This

difference can be explained by higher temperatures during flowering season in the period of study (2009–2014).

Average time of maturity was from 27th of June (‘Neptun’) to 16th of July (‘Litoral’). Compared to the control cultivar (‘Hungarian Best’) time of maturity was from 6 days before to 13 days after. Average difference in the date of maturity between the year with the earliest harvest (2009) and the year with the latest harvest (2010) was 8 days.

The average yield per tree ranged from 5.7 kg in ‘Kasna Drjanovska’ to 12.2 kg in ‘Mari de Cenad’ and ‘Roksana’ (Table 2). Compared with the control cultivar significantly higher yields were achieved in seven cultivars.

Table 2. Yield, trunk cross-sectional area (TCSA), and cumulative yield efficiency (CYE) of apricot cultivars.

Cultivar	Yield (kg per tree)							TCSA (cm^2)	CYE (kg/cm^2)
	2009	2010	2011	2012	2013	2014	Average		
Cegledi arany	0.1	5.3	1.7	8.5	14.9	27.6	9.7 ab	110.2 bc	0.53
Dacia	2.0	4.2	23.7	9.4	9.0	22.2	11.8 a	100.3 c	0.70
Gergana	0.2	2.2	11.5	12.1	0.1	24.2	8.4 abc	115.0 bc	0.44
Kasna Drjanovska	0.1	1.0	1.8	14.5	3.1	14.0	5.7 bc	133.8 b	0.26
Litoral	0.1	1.9	14.0	15.6	7.1	32.1	11.8 a	94.8 c	0.75
Mari de Cenad	0.6	7.7	24.3	12.8	0.5	26.9	12.2 a	97.0 c	0.75
Neptun	1.8	6.1	13.0	5.7	8.4	32.7	11.3 a	84.6 c	0.80
Roksana	0.8	6.8	16.7	11.4	1.3	36.3	12.2 a	85.8 c	0.85
Silistrenska kompotna	0.5	6.6	11.7	11.5	3.6	16.3	8.4 abc	147.2 a	0.32
Umberto	0.3	2.0	8.9	14.3	13.9	24.7	10.7 a	108.0 bc	0.59
Hungarian Best (control)	0.3	2.1	10.8	2.0	3.0	10.3	4.8 c	101.5 c	0.28

* Mean values followed by the same letter within a column do not differ significantly according to Tukey’s test at $P \leq 0.05$.

In most cultivars the highest yield was obtained in 2014 when the weather conditions were favourable. The lowest yield was recorded in 2013 because of the cold weather during the flowering which resulted in low fruit set (Zec et al., 2013). The obtained results of yield are in accordance with the results of Vachůn (2002), who studied the productivity of 24 apricot cultivars during six-year period and found variation of yield from 3 to 20 kg per tree.

Trunk cross-sectional area in two cultivars (‘Silistrenska kompotna’ and ‘Kasna Drjanovska’) was significantly higher than in the control cultivar. Cumulative yield efficiency ranged from 0.26 to 0.85 kg/cm^2. With the exception of ‘Kasna Drjanovska’, in all cultivars it was higher comparing to the control.

The average fruit weight ranged from 45.1 g in ‘Umberto’ to 82.0 g in ‘Neptun’ (Table 3). Compared to the control, significantly higher fruit weight was recorded in six cultivars.

Stone weight ranged from 2.9 g (‘Dacia’) to 4.7 g (‘Mari de Cenad’), and its share in the fruit weight ranged from 4.3% (‘Neptun’) to 8.7% (‘Silistrenska kompotna’). According to the classification given by Milatović (2013b) seven cultivars had small share in the fruit weight (under 5.50%). Two cultivars (‘Umberto’ and ‘Kasna Drjanovska’) had medium share of the stone in the fruit weight (6.51–8.50%), while one cultivar (‘Silistrenska kompotna’) had high share (above 8.51%).

Table 3. Fruit characteristics of apricot cultivars (average, 2009–2014).

Cultivar	Fruit weight (g)	Stone weight (g)	Stone share (%)	Fruit dimensions (mm)			Shape index
				Length	Width	Thickness	
Cegledi arany	65.1 c	3.7 d	5.7	48.3 b	50.3 ab	47.4 ab	0.98
Dacia	62.1 c	2.9 f	4.7	48.5 b	47.5 bc	44.8 abc	1.10
Gergana	70.8 b	4.5 ab	6.4	53.7 a	50.4 ab	46.4 ab	1.23
Kasna Drjanovska	55.7 d	4.5 ab	8.0	44.4 b	44.4 cd	43.8 c	1.01
Litoral	56.0 d	3.1 ef	5.5	54.1 a	45.0 cd	43.7 c	1.49
Mari de Cenad	81.8 a	4.7 a	5.7	57.2 a	53.1 a	48.9 a	1.26
Neptun	82.0 a	3.5 de	4.3	53.4 a	53.4 a	48.3 ab	1.11
Roksana	74.1 b	4.3 abc	5.8	55.4 a	50.8 ab	47.4 ab	1.28
Silistrenska kompotna	46.3 e	4.0 bcd	8.7	47.2 b	41.9 d	37.8 d	1.40
Umberto	45.1 e	3.1 ef	7.0	46.5 b	43.0 cd	41.7 cd	1.21
Hungarian Best (control)	51.7 d	3.8 cd	7.4	46.9 b	46.5 bcd	44.2 bc	1.07

* Mean values followed by the same letter within a column do not differ significantly according to Tukey's test at $P \leq 0.05$.

Fruit length of the studied cultivars varied from 44.4 to 57.2 mm, width from 41.9 to 53.4 mm, and thickness from 37.8 to 48.9 mm. Based on the fruit dimensions, the shape index was calculated, whose values ranged from 0.98 in 'Cegledi arany' (round flat shape) to 1.49 in 'Litoral' (elliptic shape).

Results of pomological fruit characteristics are in accordance with the previous findings for some cultivars (Cociu, 2006; Milatović et al., 2006; Korzin et al., 2010).

The content of soluble solids in tested cultivars varied from 14.2% in 'Cegledi arany' to 19.5% in 'Kasna Drjanovska' (Table 4). Cultivars 'Kasna Drjanovska' and 'Silistrenska kompotna' had significantly higher content of soluble solids than the control cultivar.

Table 4. Indices of fruit quality of apricot cultivars (average, 2009–2014).

Cultivar	Soluble solids (%)	Total acids (%)	Soluble solids /Total acids	Sensory evaluation (1–5)	
				Appearance	Taste
Cegledi arany	14.2 c	1.28 b	11.1	3.9 abcd	3.9 abc
Dacia	14.5 c	1.39 ab	10.5	3.9 abcd	4.0 ab
Gergana	15.5 c	1.25 b	12.4	4.2 abc	3.9 abc
Kasna Drjanovska	19.5 a	1.64 a	11.9	3.8 bcd	4.2 a
Litoral	14.9 c	1.66 a	8.9	3.5	3.4 c
Mari de Cenad	15.3 c	1.37 ab	11.2	4.4 ab	4.1 a
Neptun	16.1 bc	1.56 ab	10.4	4.2 abc	3.9 abc
Roksana	15.8 c	1.27 b	12.5	4.5 a	3.8 abc
Silistrenska kompotna	18.4 ab	1.35 ab	13.6	3.7 cd	4.3 a
Umberto	14.5 c	1.69 a	8.6	3.3	3.5 bc
Hungarian Best (control)	15.7 c	1.37 ab	11.4	3.6 cd	4.2 a

* Mean values followed by the same letter within a column do not differ significantly according to Tukey's test at $P \leq 0.05$.

The total acid content varied from 1.29% in ‘Gergana’ to 1.69% in ‘Umberto’. The ratio between soluble solids (consisting mostly of sugars) and acids contents indicates the sweetness of the fruit. It was the highest in cultivars ‘Silistrenska kompotna’ and ‘Roksana’ (more sweet taste) and the lowest in cultivars ‘Umberto’ and ‘Litoral’ (more acidic taste).

The data on the chemical composition of fruits are in accordance with the previous findings (Gurrieri et al., 2001; Ruiz and Egea, 2008).

Cultivars ‘Roksana’ and ‘Mari de Cenad’ stand out for attractive fruit appearance and got significantly higher scores than the control cultivar. The best scores for fruit quality got cultivars ‘Silistrenska kompotna’, ‘Kasna Drjanovska’ and ‘Mari de Cenad’. Cultivars ‘Litoral’ and ‘Umberto’ got significantly lower scores for fruit quality than the control cultivar.

Conclusion

Based on the six-year evaluation of ten introduced apricot cultivars in the Belgrade area, cultivars ‘Dacia’, ‘Gergana’, ‘Mari de Cenad’, ‘Neptun’ and ‘Roksana’ can be recommended for growing, predominantly for fresh fruit consumption. In addition, cultivars ‘Silistrenska kompotna’ and ‘Kasna Drjanovska’ can also be recommended, mostly for fruit processing.

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