EVALUATION OF FRENCH APRICOT CULTIVARS IN THE REGION OF BELGRADE

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Abstract

The evaluation of 10 introduced apricot cultivars of French origin was carried out in the region of Belgrade over a period of four years (2009-2012). Control cultivar for comparison was 'Hungarian Best'. Average time of flowering was late March and early April, while average time of maturing ranged from June, 26 ('Sylred') to July, 15 ('Helena du Roussillon'), or from 7 days before to 12 days after the 'Hungarian Best'. Compared with the control cultivar, significantly higher yield was achieved in five cultivars: 'Sylred', 'Bergeron', 'Pinkcot', 'Silvercot', and 'Bergarouge', while significantly higher fruit weight was found in four cultivars: 'Silvercot', 'Sylred', 'Polonais', and 'Bergeron'. Among studied cultivars, the best results were shown by 'Sylred', 'Silvercot' and 'Pinkcot', which can be recommended for growing in this region, predominantly for fresh consumption. 'Bergeron' and 'Bergarouge' can also be recommended as cultivars of combined traits, both for fresh consumption and processing.

Key words: Prunus armeniaca, flowering, maturing, yield, fruit quality

Introduction

Assortment of apricots in Serbia is characterized by relatively small number of cultivars and short period of harvest. Most apricot fruits are harvested in the season of 'Hungarian Best', or at a short time (about ten days) afterwards. There is particularly a lack of early-season cultivars, maturing in June, and characterized by high quality of fruit.

A lot of work has been done in the world 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 (Milatovi , 2013a). The largest number of new cultivars was created in the United States, followed by France, Italy, Romania, China, Czech Republic and Spain. The introduction of new foreign cultivars and their study in Serbian climatic and soil conditions allow better choice of cultivars, and may improve production of apricots.

In France there is a public apricot breeding programme that takes place in the INRA (Institut National de la Recherche Agronomique) in Avignon. More than 20 new cultivars were created under this programme (Audergon et al., 1995; 2006; 2010). In addition, there are several important private breeding programs, which are mostly connected with the nurseries, such as IPS (International Plant Selection), Cot International, Escande, and Star Fruits (Milatovi , 2013b).

The aim of this study was the evaluation of 10 French apricot cultivars of different maturing time. 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 four years (2009-2012). The orchard was planted in 2007. The rootstock is Myrobalan (*Prunus cerasifera* Ehrh.) seedling, training system is Central Leader, and tree spacing is 4.5 x 3 m. All cultivars are represented by five trees.

The study included 10 apricot cultivars: 'Sylred', 'Pinkcot', 'Kyoto', 'Luiset', 'Silvercot', 'Polonais', 'Rouge de Rivesaltes', 'Bergarouge', 'Bergeron', and 'Helena du Roussillon'. Cultivar 'Hungarian Best' 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). The beginning of harvest was recorded as the date of maturing. Fruit characteristics were measured on a sample of 25 fruits per cultivar. Fruit shape index was calculated by the formula: length x length/width x thickness. Soluble solids content was determined by refractometer and total acids content (expressed as % of malic acid) by titration with 0.1 N NaOH. Sensory properties 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 for yield and fruit weight were statistically analyzed using analysis of variance. The significance of differences between mean values was determined using LSD test at 0.05 level of probability.

Results and discussion

Phenological traits included time of flowering and time of maturing, and the results are shown in Table 1.

Table 1. Phenological properties of apricot cultivars (average, 2009-2012)

Cultivar	Flowering dates			Duration of flowering (days)	Date of harvest	N^o of days comparing to control
	Start	Full	End			
Sylred	28.03.	30.03.	04.04.	7,3	26.06.	-7
Pinkcot	28.03.	30.03.	04.04.	7,5	28.06.	-5
Kioto	29.03.	31.03.	05.04.	7,5	01.07.	-2
Luiset	29.03.	31.03.	04.04.	6,0	04.07.	+1
Silvercot	28.03.	30.03.	03.04.	6,0	05.07.	+2
Polonais	29.03.	31.03.	04.04.	6,3	07.07.	+4
Rouge de Rivesaltes	28.03.	29.03.	03.04.	6,5	07.07.	+4
Bergarouge	28.03.	30.03.	03.04.	6,3	12.07.	+9
Bergeron	29.03.	31.03.	05.04.	7,0	13.07.	+10
Helena du Roussillon	28.03.	30.03.	03.04.	5,8	15.07.	+12
Hungarian Best (control)	29.03.	31.03.	04.04.	5,5	03.07.	0

Average time of flowering of apricot cultivars was late March and early April. Among studied cultivars small differences in flowering time were recorded. They were bloomed together with the control cultivar or one day before it. All introduced cultivars manifested longer duration of flowering than the control cultivar ('Hungarian Best' with 5.5 days). It

ranged from 5.8 days in cultivar 'Helena du Roussillon' to 7.5 days in cultivars 'Pinkcot' and 'Kioto'.

Compared to the results of MilatoviC (2005) obtained at the same location for the ten-year period (1995-2004) duration of flowering was shorter by three days in average. This difference can be explained by higher temperatures during flowering season in the period of study (2009-2012).

Average time of maturing was from 26th of June ('Sylred') to 15th of July ('Helena du Roussillon'). Compared to the control cultivar ('Hungarian Best') time of maturation was from 7 days earlier to 12 days later. Average difference in the date of maturing between the year with the earliest harvest (2012) and the year with the latest harvest (2010) was 8 days, and among cultivars it ranged from 7 to 10 days.

The average yield per tree ranged from 3.2 kg in 'Luiset' to 15.6 kg in 'Sylred' (Table 2). These data refer to the yield in the period of initial cropping, when the age of the trees was between three and six years. Cultivars 'Bergeron', 'Sylred' and 'Pinkcot' are characterized by precocity and high initial productivity. Compared with the control cultivar significantly higher yields were achieved in five cultivars: 'Sylred', 'Bergeron', 'Pinkcot', 'Silvercot', and 'Bergarouge'.

Table 2. Yield of apricot cultivars (kg per tree)

Cultivar	Years				Average
	2009	2010	2011	2012	
Sylred	3.7	18.9	33.3	6.7	15.6 a[*]
Pinkcot	3.3	14.9	20.1	6.2	11.1 b
Kioto	1.8	5.5	6.1	4.6	4.5 d
Luiset	0.2	3.7	6.7	2.3	3.2 d
Silvercot	1.1	8.2	23.5	0.5	8.3 bc
Polonais	1.5	5.5	8.1	2.7	4.4 d
Rouge de Rivesaltes	0.8	2.0	7.4	11.4	5.4 cd
Bergarouge	0.8	10.4	8.7	13.2	8.3 bc
Bergeron	5.4	18.5	30.2	7.6	15.4 a
Helena du Roussillon	0.3	4.0	7.2	6.1	4.4 d
Hungarian Best (control)	0.3	2.1	10.8	2.0	3.8 d

[*] Mean values followed by the same letter within a column do not differ significantly according to LSD test at P 0.05

In all cultivars the highest yield was obtained in 2011. Cultivar 'Sylred' achieved maximum yield of 33.3 kg per tree or 24.6 t per ha. In 2012 most cultivars achieved low yield due to the occurrence of winter frost (-20.7°C on 9 February), and late spring frost (-2.4°C on 10 April) (Milatovi et al., 2013). The highest yield in this year achieved cultivars 'Bergarouge' (13.2 kg per tree) and 'Rouge de Rivesaltes' (11.4 kg per tree), and they can be considered as less susceptible cultivars to frost.

The obtained results of yield are in accordance with the results of Vach n (2002). He studied the productivity of 24 apricot cultivars during six-year period and found variation of average yield from 3 to 20 kg per tree.

The average fruit weight ranged from 40.28 g in 'Kioto' to 67.05 g in 'Silvercot' (Table 3). Compared to the control cultivar significantly higher fruit weight had four cultivars: 'Silvercot', 'Sylred', 'Polonais', and 'Bergeron', while smaller fruit weight had also four cultivars: 'Kioto', 'Luiset', 'Helena du Roussillon', and 'Begarouge'. In most cultivars the lowest fruit weight was obtained in 2011, when the highest yield was recorded, while the highest fruit weight was obtained in 2012, when the yield was low.

Table 3. Fruit properties of apricot cultivars (average, 2009-2012)

Cultivar	Fruit weight (g)	Stone weight (g)	Stone share (%)	Fruit dimensions (cm)			Shape index
				Lenght	Width	Thickness	
Sylred	59.10	2.67	4.52	4.69	4.61	4.53	1.05
Pinkcot	50.02	2.75	5.50	4.46	4.31	4.25	1.09
Kioto	40.28	2.39	5.93	4.18	4.08	3.91	1.10
Luiset	41.96	3.25	7.79	4.30	4.29	4.00	1.07
Silvercot	67.05	3.94	5.88	5.30	5.09	4.46	1.24
Polonais	52.09	3.19	6.12	4.62	4.59	4.35	1.07
Rouge de Rivesaltes	46.09	2.92	6.34	4.67	4.44	4.11	1.19
Bergarouge	42.94	3.01	7.01	4.28	4.17	4.05	1.09
Bergeron	51.79	3.43	6.62	4.61	4.45	4.39	1.09
Helena du Roussillon	42.57	3.14	7.38	4.49	4.14	3.90	1.25
Hungarian Best (control)	47.36	3.51	7.41	4.59	4.61	4.36	1.05
LSD 0.05	3.02	0.18	-	0.22	0.22	0.20	-

Stone weight ranged from 2.39 g ('Kioto') to 3.94 g ('Silvercot'), and its share in the fruit weight ranged from 4.52% ('Sylred') to 7.79% ('Luiset'). Cultivars with larger fruit had relatively smaller stone, i.e. better share of flesh.

Dimensions of the fruit were correlated with the fruit weight. Fruit length varied from 4.2 to 5.3 cm, width from 4.1 to 5.1 cm, and thickness from 3.9 to 4.5 cm. Based on the fruit dimensions, the shape index was calculated, whose values ranged from 1.05 in 'Sylred' to 1.25 in 'Helena du Roussillon'.

Results of pomological fruit characteristics are in accordance with the previous findings for some cultivars (Audergon et al., 2006; Milatovi et al., 2006; Szalay et al., 2013).

The content of soluble solids in tested apricot cultivars varied from 12.7% in 'Kioto' to 17.4% in 'Polonais' (Table 4). Cultivars of early maturing time ('Sylred', 'Pinkcot', and 'Kioto') had significantly less content of soluble solids then the control ('Hungarian Best').

Table 4. Fruit quality properties of apricot cultivars (average, 2009-2012)

Cultivar	Soluble solids (%)	Total acids (%)	Soluble solids / Total acids	Sensory evaluation (1-5)	
				Appearance	Taste
Sylred	13.6	1.36	10.0	4.7	4.0
Pinkcot	14.0	1.12	12.5	4.2	3.7
Kioto	12.7	1.57	8.1	3.9	3.5
Luiset	14.8	1.36	10.9	3.0	3.5
Silvercot	16.8	1.63	10.3	4.6	3.9
Polonais	17.4	0.88	19.8	3.7	3.9
Rouge de Rivesaltes	15.1	1.51	10.0	3.4	3.3
Bergarouge	17.0	0.90	18.9	3.9	3.9
Bergeron	14.8	1.39	10.7	4.0	4.0
Helena du Roussillon	17.1	0.75	22.8	3.6	3.9
Hungarian Best (control)	16.2	1.42	11.4	3.5	4.1
LSD 0.05	1.8	0.30	-	0.5	0.6

The total acids content varied from 0.75% in 'Helena du Roussillon' to 1.63% in 'Silvercot'. Significantly less content of total acids than the control had three cultivars ('Helena du Roussillon', 'Polonais', and 'Bergarouge').

Ratio between soluble solids content (consisting mostly of sugars) and acids content indicates the sweetness of the fruit. Higher ratio than in the control was found in four cultivars: 'Helena du Roussillon', 'Polonais', 'Bergarouge', and 'Pinkcot'.

The data on the chemical composition of fruits are in accordance with the previous findings (Badenes et al., 1998; Gurrieri et al., 2001; Ruiz and Egea, 2008).

Most of the introduced cultivars obtained higher scores for fruit appearance than the control ('Hungarian Best'). Cultivars 'Sylred', 'Silvercot' and 'Pinkcot' particularly stand out for attractive fruit appearance. Taste of all introduced cultivars was evaluated with lower scores than the control.

Conclusion

Based on the four-year evaluation of 10 French apricot cultivars in the Belgrade area, the best results have shown by 'Sylred', 'Silvercot' and 'Pinkcot', which can be recommended for growing, predominantly for fresh consumption. In addition, 'Bergeron' and 'Bergarouge' can also be recommended as cultivars of combined traits, both for fresh consumption and processing.

Acknowledgements

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