PRODUCTIVITY OF EARLY AND MEDIUM EARLY APRICOT CULTIVARS IN THE BELGRADE AREA

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Abstract

Characteristics of productivity and growth (yield per tree, trunk cross-sectional area, yield efficiency and fruit weight) were studied in 40 apricot cultivars of early and medium early maturity in the Belgrade area during the six-year period (2009 – 2014). The cultivar 'Hungarian Best' was used as a control for comparison. The period of study was divided to initial bearing (age of trees three and four years) and full bearing (age of trees from five to eight years). Significant differences in yield between cultivars and years were found. Average yield in the period of initial bearing ranged from 0.3 to 11.3 kg per tree, and in the period of full bearing from 5.6 to 24.8 kg per tree. Compared with the control cultivar, significantly higher yield was obtained in 17 cultivars. Adverse weather conditions resulted in significant reduction of yield in two out of six years of study. Cumulative yield efficiency varied from 0.17 to 0.87 kg/cm^2 and in 19 cultivars it was significantly higher compared with the control cultivar. Fruit weight ranged from 27.7 to 80.1 g. Compared with control, fruit weight was significantly higher in nine cultivars, and significantly lower in 11 cultivars.

Keywords: *Prunus armeniaca*, yield, trunk cross-sectional area, yield efficiency, fruit weight.

Introduction

When selecting cultivars of fruit trees for growing, one of the most important characteristics is their productivity. Apricot is characterized by irregular cropping and large variation of yields among years. This is primarily a result of freezing of flowers and fruitlets due to the occurrence of spring frosts (Rodrigo et al., 2006; Milatović et al., 2013) and, to a lesser extent, the freezing of flower buds due to strong winter frosts (Ozturk et al., 2006; Szabó et al., 2010). Taking into account the variability of weather conditions in particular years, a many-year evaluation is necessary to obtain objective results of productivity of apricot cultivars (Vachůn, 2002a). Apricot cultivar assortment in Serbia is characterized by a small number of cultivars and a short period of maturing. Most apricot fruits are harvested in the season of 'Hungarian Best', which is the most grown cultivar, or at a short time (about ten days) afterwards. There is particularly a lack of early-maturing cultivars of high quality fruit. The introduction of new foreign cultivars and their study in Serbian environmental conditions allow better choice of cultivars, and may improve production of apricots (Milatović et al., 2012). Vachůn (2002a) studied the yield of 24 apricot cultivars in a period of six years and it was in the range of 3 – 20 kg per tree. Yield efficiency (expressed per unit area of trunk cross-sectional area) is a better indicator of productivity than yield level and it provides easier comparability of results (Vachůn, 2002b). Milatović et al. (2006) studied yield of 35 apricot cultivars in the period of eight years. On the basis of the average yield per tree, they classified apricot cultivars into four groups: poor yielding (< 10 kg), medium yielding (10 – 20 kg), high yielding (20 – 30 kg) and very high yielding (>30 kg). The aim of this study was to examine the productivity of a large number of introduced apricot cultivars of early or medium early maturity over a six-year period. The results can help in choosing varieties for cultivation or their use for further breeding work.

Material and methods

Studies were carried out in the apricot collection orchard of the Faculty of Agriculture in Belgrade, at the Experimental Farm "Radmilovac", in the period 2009 – 2014. The orchard was planted in 2007,

and during the study period the age of trees was 3 – 8 years. The study included 40 introduced apricot cultivars of early and medium-early maturity. The cultivar 'Hungarian Best' was used as a control for comparison. All cultivars are grafted on seedlings of Myrobalan (*Prunus cerasifera* Ehrh.) and are represented in the collection orchard with five trees. Training system is central leader, and planting distance is 4.5 × 3 m. The yield was determined by measuring the weight of harvested fruits and is expressed in kg per tree. Trunk cross-sectional area (TCSA) was calculated from the trunk diameter measured at a height of 30 cm above the graft union. Cumulative yield efficiency (CYE) is calculated as a ratio of cumulative yield per tree for six years (2009 – 2014) and TCSA in the last year of study (2014), and is expressed in kg per cm^2. Fruit weight was determined on a sample of 25 fruits per cultivar. Data were analysed statistically by the method of two-factorial analysis of variance. The significance of differences between mean values was determined by LSD test for the probability of 0.05.

Results and discussion

The average time of maturation of tested cultivars ranged from 3 to 26 days before the control cultivar - 'Hungarian Best' (Table 1). Given that the average date of maturity of the cultivar 'Hungarian Best' is 3 July, tested cultivars matured from 7 to 30 June. Productivity of apricot cultivars during the six-year period was uneven, both among years and cultivars (Table 1). Differences in yield between cultivars and years were statistically significant. Although the first yield was obtained in the third year after planting (2009), the first economically significant yield (7.3 kg per tree on average) was obtained in the fourth year (2010). The average yield per tree in the period of initial bearing ranged from 0.3 to 11.3 kg. Early coming into bearing and high initial yield was found in cultivars: 'Sylred', 'Dunstan', 'Pinkcot', 'Palava', 'Bella d'Imola', 'Ninfa', 'Lebona', 'Goldrich', 'Bobcot' and 'Lenova'. On the other hand, late coming into bearing and low initial yield was found in cultivars: 'Moldavsky Olympic', 'LE 5959' and 'Radka'. The average yield per tree in the period of full bearing varied from 5.6 kg in the cultivar 'Moldavsky Olympic' to 24.8 kg in the cultivar 'Sylred'. Compared with the control, a significantly higher yield was found in 17 cultivars. Obtained results for yield are consistent with previous findings (Vachůn, 2002a; Milatović et al., 2006; Fajt et al., 2013). Adverse weather conditions resulted in significant reduction of yield in two out of six years of study. In 2012, there was a winter frost of –20.7°C on 9 February, and a spring frost of –3.0°C on 10 April, after the end of flowering. In tested 33 apricot cultivars the average damage of flower buds from the winter frost was 32.8%, and the average damage of fruitlets from spring frost was 61.4% (Milatović et al., 2013). In 2013, there was a spring frost of -3.4°C on 25 March, which could lead to freezing of flowers of cultivars with early flowering time, that were then in the beginning of the flowering. However, the main reason for lower yields in this year was the cold weather during the flowering, that resulted in weak bee fly and poor fruit set. In 2014 the flowering was extremely early and started from 23 February to 17 March. A frost of –3.0°C occured on 1 March, and caused damage to the cultivars of early flowering time. Nevertheless, the highest average yield (20.5 kg per tree) was recorded in this year. High yield (16.1 kg per tree on average) was also recorded in 2011. On the basis of classification of Milatović et al. (2006), during the period of full bearing, the majority of tested cultivars (27) had medium yielding, (10 – 20 kg per tree) or low yielding, less than 10 kg per tree (13 cultivars). High yielding (more than 20 kg per tree) was found only in the cultivar 'Sylred'. The average yield per hectare in the period of full bearing of all cultivars was 8.9 t, and it ranged from 4.1 to 18.4 t. In some cultivars grown in the Mediterranean area under good cultural practices, including irrigation, a yield of 40 – 50 t per ha can be achieved (Egea et al., 1995). However, in conditions of continental climate, the average yield for a multi-year period is significantly lower due to the occurrence of spring frosts, as well as the decline of trees due to "apoplexy" (Vachůn, 2001). The lowest vigour expressed through the trunk cross-sectional area was determined in the cultivar 'Veselka' - 83.2 cm^2, and the highest in the cultivar 'Radka' - 203.0 cm^2 (Table 2). Significantly higher vigour compared with the control cultivar was found in 14 cultivars.

Table 1. Yield (kg per tree) of apricot cultivars

Cultivar	TM*	Initial bearing			Full bearing				
		2009	2010	Mx	2011	2012	2013	2014	Mx
Aurora	-26	0.1	5.2	2.7	10.1	0.2	4.1	17.5	8.0
Ninfa	-24	5.1	9.3	7.2	18.4	3.6	20.7	15.3	14.5
Zorky	-21	0.2	3.5	1.9	8.4	5.3	1.9	21.1	9.2
LE 5959	-18	0.2	1.1	0.6	4.7	4.6	2.1	31.5	10.7
Leskora	-18	2.2	4.8	3.5	22.0	6.6	5.1	30.9	16.1
Dunstan	-18	6.6	12.3	9.4	33.7	0.1	12.2	22.4	17.1
NJA-2	-17	1.1	4.3	2.7	15.5	10.8	1.0	8.8	9.0
Radka	-17	0.1	1.2	0.7	16.9	1.5	3.2	17.2	9.7
Lejuna	-16	2.0	4.0	3.0	14.1	0.0	3.8	12.7	7.6
Mary Lady	-15	0.1	2.9	1.5	8.5	0.0	2.4	31.5	10.6
Strepet	-15	0.3	5.2	2.8	12.5	13.7	0.1	31.9	14.5
Veselka	-14	0.7	5.9	3.3	16.5	10.7	5.7	18.7	12.9
Vesna	-14	0.5	7.8	4.1	8.4	4.2	3.6	10.1	6.6
Velita	-13	1.5	2.3	1.9	10.9	0.0	11.0	7.3	7.3
Tomcot	-12	0.9	8.1	4.5	15.3	4.7	21.9	18.4	15.1
Lenova	-10	3.1	9.7	6.4	19.3	3.1	1.4	21.4	11.3
Lebona	-10	1.1	13.3	7.2	12.7	5.1	2.1	10.2	7.5
NJA 55	-10	0.1	5.9	3.0	16.2	0.7	11.6	14.4	10.7
Moldavsky Olympic	-9	0.4	0.2	0.3	9.6	0.3	1.3	11.1	5.6
Orangered	-8	1.4	9.7	5.6	25.9	2.3	8.9	34.6	17.9
Legolda	-8	0.8	7.3	4.0	18.5	0.0	6.8	35.7	15.3
Harcot	-8	1.2	6.4	3.8	15.5	16.4	1.3	30.6	16.0
Pinkcot	-7	3.3	14.9	9.1	20.1	6.2	15.4	20.0	15.4
Sylred	-7	3.7	18.9	11.3	33.3	6.7	24.1	35.1	24.8
Palava	-7	2.9	14.7	8.8	30.1	0.8	13.4	5.7	12.5
Velvaglo	-7	0.3	6.7	3.5	17.7	0.5	6.8	9.4	8.6
Lerosa	-6	1.1	9.4	5.2	19.4	2.2	7.9	27.9	14.4
Neptun	-6	1.8	6.1	4.0	13.0	5.7	8.4	32.7	14.9
Effect	-6	2.4	6.1	4.2	12.1	1.4	4.9	31.3	12.4
Bobcot	-6	1.9	11.5	6.7	22.7	10.7	1.1	5.7	10.0
Stark Early Orange	-5	0.3	3.0	1.6	8.7	8.6	4.4	18.0	9.9
Dacia	-5	2.0	4.2	3.1	23.7	9.4	9.0	22.2	16.1
Sundrop	-4	1.5	12.6	7.1	24.7	7.2	2.2	21.4	13.9
Bella d'Imola	-4	2.2	14.2	8.2	12.3	14.8	18.4	14.8	15.1
Velikij	-4	0.4	9.4	4.9	9.8	7.4	0.2	26.9	11.1
Goldrich	-3	1.7	12.5	7.1	15.0	5.8	4.8	18.9	11.1
Forum	-3	0.5	3.4	1.9	13.3	22.6	4.1	11.7	12.9
Laycot	-3	2.8	6.7	4.8	15.5	3.2	2.0	20.8	10.4
Robada	-3	0.9	8.2	4.6	9.2	1.2	7.4	19.8	9.4
Lemira	-3	3.0	7.7	5.4	10.5	0.2	5.8	26.8	10.8
Hung. Best (control)	0	0.3	2.1	1.2	10.8	2.0	3.0	10.3	6.5
LSD 0.05				3.4					6.1

*TM – Time of maturation: Number of days comparing with the cultivar Hungarian Best

Yield efficiency is an important indicator of productivity of apricot cultivars, that combines yield and vigour. Cumulative yield efficiency (CYE) in the six-year period ranged from 0.17 kg/cm^2 in the cultivar 'Moldavsky Olympic' to 0.87 kg/cm^2 in the cultivar 'Sylred'. Compared with the control cultivar, significantly higher CYE was determined in 19 cultivars. The rank of cultivars according to yield (in kg per tree) and CYE is not identical. On the basis of CYE, low vigorous cultivars such as 'Neptun', 'Veselka', 'Strepet', 'Lenova' and 'Lemira' are much better ranked than on the basis of yield. The opposite is case with vigorous cultivars, such as 'Radka', 'Mary Lady', 'NJA 2' and 'NJA 55'.

Table 2. Trunk cross-sectional area (TCSA) in 2014, cumulative yield efficiency (CYE) and fruit weight (average 2009-2014) of apricot cultivars

Cultivar	TCSA (cm^2)	CYE (kg/cm^2)	Fruit weight (g)
Aurora	147.2	0.25	51.1
Ninfa	149.3	0.49	43.4
Zorky	95.9	0.42	33.2
LE 5959	127.4	0.35	49.2
Leskora	143.8	0.50	38.9
Dunstan	175.9	0.50	75.3
NJA-2	160.0	0.26	33.3
Radka	203.0	0.20	62.0
Lejuna	92.0	0.40	27.7
Mary Lady	184.2	0.25	65.1
Strepet	89.4	0.71	64.7
Veselka	83.2	0.70	53.5
Vesna	121.1	0.29	46.8
Velita	137.9	0.24	41.9
Tomcot	116.5	0.60	43.1
Lenova	93.1	0.62	40.8
Lebona	154.8	0.29	49.3
NJA 55	168.5	0.29	50.7
Moldavsky Olympic	130.6	0.17	43.8
Orangered	171.0	0.48	48.2
Legolda	139.6	0.50	53.3
Harcot	106.1	0.67	49.4
Pinkcot	113.5	0.70	50.3
Sylred	140.4	0.87	59.7
Palava	154.1	0.44	51.0
Velvaglo	158.8	0.26	55.4
Lerosa	138.4	0.49	50.5
Neptun	84.6	0.80	80.1
Effect	161.2	0.36	76.0
Bobcot	122.3	0.44	43.3
Stark Early Orange	147.2	0.29	53.1
Dacia	100.3	0.70	61.9
Sundrop	116.8	0.60	42.8
Bella d'Imola	112.7	0.68	55.3
Velikij	131.7	0.41	52.6
Goldrich	129.3	0.45	61.8
Forum	137.1	0.41	47.8
Laycot	99.6	0.51	58.5
Robada	141.6	0.33	62.3
Lemira	88.0	0.61	49.6
Hungarian Best (control)	101.5	0.28	53.3
LSD 0.05	41.7	0.18	8.3

Our results of CYE are within the ranges reported by other authors: Ogašanović et al. (1991) 0.48 – 1.63 kg/cm^2, Vachůn (2002b) 0.22 – 1.36 kg/cm^2; Milatović et al. (2006) 0.07 – 0.96 kg/cm^2; Licznar – Malanczuk and Sosna (2013) 0.07 - 0.41 kg/cm^2, Milošević et al. (2013) 0.17 – 0.82 kg/cm^2. Fruit weight ranged from 27.7 g in the cultivar 'Lejuna' to 80.1 g in the cultivar 'Neptun'. Compared with the control, nine cultivars had significantly higher and 11 cultivars significantly lower fruit weight. Our results of fruit size are consistent with previous findings for some cultivars (Drogoudi et al., 2008; Krška et al., 2013; Licznar-Malanczuk and Sosna, 2013; Szalay et al., 2013).

Conclusions

Productivity of apricot cultivars in the Belgrade area was uneven, both among years and cultivars. Adverse weather conditions resulted in significant reduction in yield in two years. High yields (above 15 kg per tree) in the period of full bearing were found in cultivars: 'Sylred', 'Orangered', 'Dunstan', 'Leskora', 'Dacia', 'Harcot', 'Pinkcot', 'Legolda', 'Tomcot' and 'Bella d'Imola'. A large fruit size (over 60 g) was determined in the following cultivars: 'Neptun', 'Effect', 'Dunstan', 'Mary Lady', 'Strepet', 'Robada', 'Radka', 'Dacia' and 'Goldrich'. On the basis of high yield and large fruit size, for growing in the Belgrade area cultivars 'Sylred', 'Dunstan' and 'Dacia' can be recommended.

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