Specific productivity of selected apricot genotypes

Z. VACHŮN

Mendel University of Agriculture and Forestry, Brno, Faculty of Horticulture, Lednice, Czech Republic

ABSTRACT: Specific productivity and some correlations between growth and productivity were evaluated in a set of 24 apricot (*Prunus armeniaca* L.) genotypes in 1994–1999. Even though the planting stock came from the same nursery, was of even age and on the same rootstock, the tree size of genotypes varied from planting to a permanent site. Differences in the tree size of genotypes slightly diminished over the six-year period, likely under the influence of uniform pruning used for all trees. Nevertheless, tree size evaluated from the area of stem cross-section can be considered as a genotype disposition. It is proved by a positive, highly significant correlation ($r = 0.84^{++}$) between the rank genotypes according to the area of stem cross-section in the fourth and eleventh year after planting. Confidence intervals also confirmed significance of differences in specific productivity. In total, specific productivity of twelve genotypes was significantly higher than in the control cultivar Velkopavlovická. A negative, significant moderate correlation ($r = –0.40^{+}$) was calculated between tree size and specific productivity expressed as yield weight per unit area of stem cross-section. Weakly growing genotypes had higher specific productivity. The highest specific productivity was recorded in cultivars Vynoslivyj and Priusadebnyj and in LE-1321 and LE-390 hybrids. Of them, the most interesting for producers and fruit quality was Vynoslivyj with average fruit weight 47 g and harvest ripeness 11 days after Velkopavlovická.

Keywords: apricot; genotype; tree size; specific productivity

Productivity is one of the basic production characteristics of apricot genotypes. Generally, it is average weight of yield in kg per tree or per hectare over a period. Annual weight of yield in kg/tree or cumulative weight of yield over a period calculated per unit area of stem cross-section (e.g. per mm^2) provide easier comparability of results. It is so called specific productivity. While specific productivity is evaluated relatively frequently in some fruit tree species (e.g. in apple-trees), few results are available in apricots. Sometimes weight of yield in kg/tree and tree size (stem girth, area of stem cross-section, crown diameter or crown volume) are determined in apricots separately but they are not correlated as specific productivity (PAPANIKOLOU-PAVLOPOULOU et al. 1999; VACHŮN 1996, 2001). The rank of cultivars according to yield weight in kg/tree and specific productivity is not identical. FAJT et al. (1999), who evaluated 16 apricot cultivars, reported the highest weight of yield in kg per tree in Giada and Sungiant while the evaluation according to specific productivity ranked the cultivars as follows: Hargrand, Laycot, Sungiant and Giada. A similar conclusion was drawn by VACHŮN (1998) in a set of 11 cultivars. In his experiment Vynoslivyj, Priusadebnyj, Volšebnyj and Lenova were the best by yield weight in kg per tree but the rank according to specific productivity was Lenova, Priusadebnyj, Vynoslivyj and Volšebnyj.

The objective of the present paper was to evaluate tree size and productivity in a selected set of apricot genotypes (cultivars and hybrids) over a six-year period, and to assess specific productivity as a synthetic indicator for selection of suitable genotypes for growing or further breeding.

MATERIAL AND METHOD

The evaluated collection comprised 24 apricot genotypes. Some cultivars were bred in the Czech Republic, other cultivars were received from the Slovak Republic, Canada and Ukraine. Numerals after genotype names designate clones and/or breeder's number. Selected crossbreds (hybrids) are designated by working numbers only, LE and M indicate the origin from Mendel University of Agriculture and Forestry at Brno, Faculty of Horticulture at Lednice. Velkopavlovická LE-6/2 is a control cultivar.

New genotypes (designated by abbreviations M, LE, LE-SEO and numbers) were included in the experimental orchard because they were interesting for growers after previous evaluations. Other cultivars were used for the purpose of comparison on the basis of evaluation and recommendation by foreign institutions that supplied these cultivars. Planting stock was produced

This paper is an output of Research program No. MSM 435100002 *Study of Biodiversity of Horticultural Plants in Relation to the Quality and Optimization of Post-harvest Treatments and Processes* supported by the Ministry of Education, Youth and Sports, and of the Project *Conservation and Use of Plant Gene Resources* in which Agricultural Faculty, Mendel University of Agriculture and Forestry, Brno, Faculty of Horticulture at Lednice participate and which is supported by the Ministry of Agriculture of the Czech Republic.

in a single nursery. Two-year bush trees with hollow crowns (stem height 90 cm) were planted in spring 1991 at Lednice locality on a flat plot at 6 × 2 m spacings, on Fluvisol of loamy texture. Apricot (*Prunus armeniaca* L.) seedling was used as a rootstock.

Five trees of each genotype were evaluated individually over the whole experimental period. Only exceptionally was the number of evaluated trees lower in some genotypes at the end of experiment. Commercial harvests started from the fourth year after planting in 1994. Identical cultural practices and protection measures were carried out on the plot during the six-year period of observations. No fruit thinnings were used to regulate productivity in a special way. Pruning of all planted trees was identical. Šitt's summer pruning was used in the first years after planting. Contour mechanical uniform pruning with a cutterbar was performed in the second half of August since the fourth year. Selective maintenance pruning with scissors was carried out in the flushing period. Even though long-term data on average temperatures and rainfall are favorable for the experimental locality and evaluated fruit-tree species (9°C, 526 mm), the particular years showed significant differences in temperature course and rainfall sums in the blooming period, which resulted in productivity fluctuations. The characteristics and detailed description of weather conditions, temperature variations and rainfall and their risks in particular years of the period of observations are given in another paper (VACHŮN 2002).

Weight of yield was determined individually by weight estimate in kg per tree. Tree size was determined in the rest period every year by measuring the stem girth at a height of 0.8 m above the ground. This measure was used to calculate the values of stem cross-section in mm^2. It is a modified methodology for apricot assessment (NITRANSKÝ 1992): different height of measurement above the ground was used and productivity was expressed per mm^2 in accordance with SI unit system. Multiples of this unit had to be used in graphs so that spatial representation and visual comparison would be feasible. Taking into account the uniform pruning it was not useful to measure and evaluate the crown diameter, projection or volume in the particular genotypes.

RESULTS AND DISCUSSION

Differences in tree size between the genotypes were significant in the fourth year after planting (at the beginning of the period of observations) as well as at the end of the period of observations (in the eleventh year after planting). It is confirmed by the values of stem cross-section shown in Table 1. Differences in the tree size of genotypes slightly diminished with increasing age (Fig. 1). Uniform contour pruning used in the orchard could be one of the reasons. In spite of this trend of diminishing differences it is to state that different tree size is a genotype disposition. Genotypes growing vigorously at the beginning of the experiment had greater tree sizes also at the end of the period of observations. It is demonstrated by a significant coefficient of correlation between the genotype rank according to the area of stem cross-section in 1994 and in 1999 ($r = 0.84^{++}$). The control cultivar Velkopavlovická LE-6/2 had an average tree size in the set.

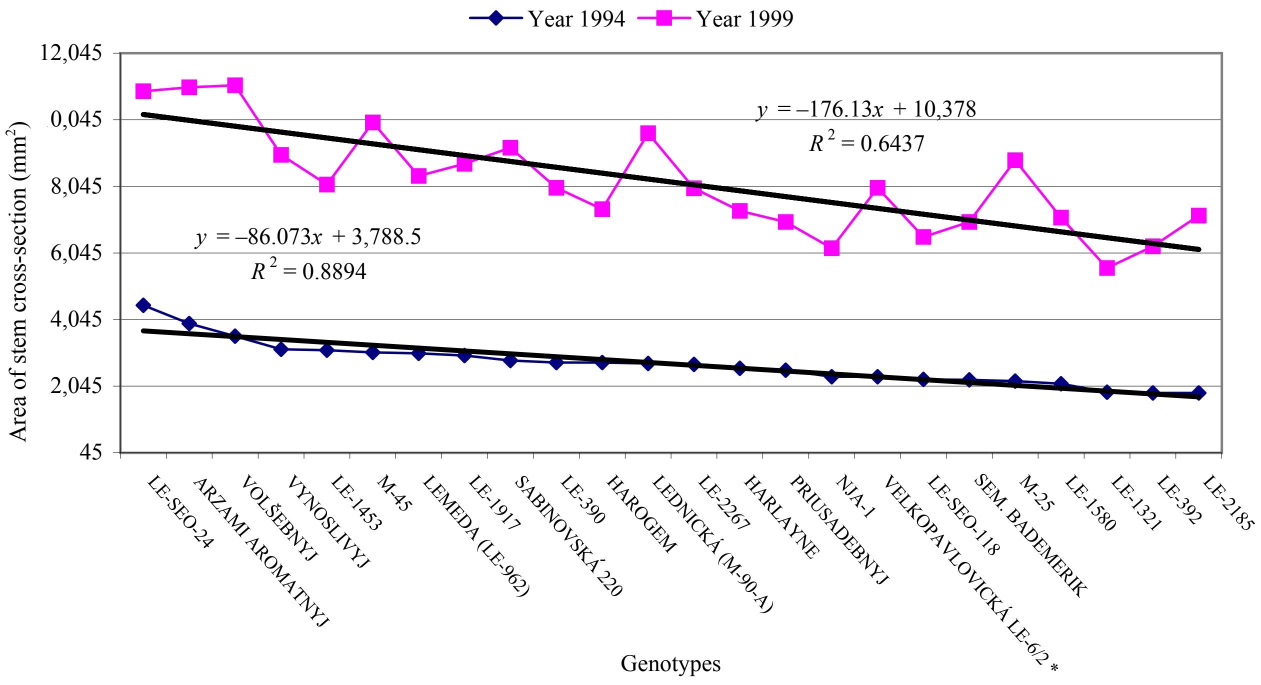

Fig. 1. Tree size of apricot genotypes according to the area of stem cross-section in mm^2 in 1999 in relation to the rank of tree size in 1994

Table 1. Stem cross-section areas of apricot genotypes in mm^2 in particular years of the period 1994–1999

Genotype	Stem cross-section area (mm^2)					
	1994	1995	1996	1997	1998	1999
Harlayne	2,580	3,121	4,175	5,177	6,198	7,310
LE-392	1,839	2,438	3,346	3,854	5,697	6,242
Priusadebnyj	2,523	2,874	3,680	4,936	6,198	6,976
Sem. Bademerik	2,234	2,763	3,389	4,540	5,860	6,413
LE-2267	2,696	3,313	4,548	6,078	7,166	7,986
LE-390	2,754	3,412	4,818	6,198	7,800	8,001
LE-1917	2,966	3,995	4,976	6,641	7,406	8,723
NJA-1	2,328	2,935	3,715	4,779	5,753	6,189
Arzami aromatnyj	3,924	4,510	5,847	7,900	9,753	11,018
Volšebnyj	3,545	4,397	5,977	7,900	9,686	11,801
Vynoslivyj	3,153	3,715	5,177	6,789	7,553	8,989
M-45	3,059	3,924	5,633	7,310	7,701	9,966
M-25	2,194	3,027	4,663	5,761	7,166	8,829
Velkopavlovická LE-6/2*	2,328	3,281	4,510	5,847	6,835	8,001
Harogem	2,754	3,090	4,067	5,761	6,929	7,358
LE-2185	1,839	2,301	3,226	4,976	5,753	7,166
LE-1580	2,115	2,814	3,784	4,830	5,646	7,108
Sabinovská 220	2,814	3,612	4,779	6,109	7,261	9,204
LE-1453	3,121	3,680	4,175	6,650	8,051	8,102
Lemeda (LE-962)	3,027	3,959	4,609	6,377	7,900	8,358
LE-1321	1,864	2,301	2,608	3,784	5,230	5,591
Lednická (M-90-A)	2,725	3,027	4,157	6,354	7,775	9,642
LE-SEO-118	2,247	2,914	3,555	4,976	5,912	6,526
LE-SEO-24	4,472	5,860	6,078	8,607	10,462	10,900
Average	2,713	3,386	4,396	5,922	7,154	8,183

*Control cultivar

Considering the relatively long period of tree size evaluation, potential effect of growing conditions in the particular years and different productivity in the particular years, variability of tree size was also evaluated according to stem girths within the evaluated genotypes at the beginning (1994) and at the end of observations (1999). Changes in the coefficients of variation for stem girths of the genotypes were relatively small. The average of coefficients of stem girth variation was 8.06% in 1994 (from 2.54 to 17.53%) and 7.96% in 1999 (from 2.76 to 13.82%). A positive, slightly close but insignificant correlation $r = 0.36$ was calculated between the rank of coefficients of variation in 1994 and 1999.

As expected, the values of growth parameters such as stem girth and stem cross-section area periodically increased with increasing age. But the productivity of apricot genotypes was substantially influenced by the conditions of particular years. It is documented by relatively high values of standard deviations and by fluctuations of variants. Yield depression for these reasons was highest in 1997 and 1998 (Table 2, Fig. 2). The differences in specific productivity over the six-year period, expres-

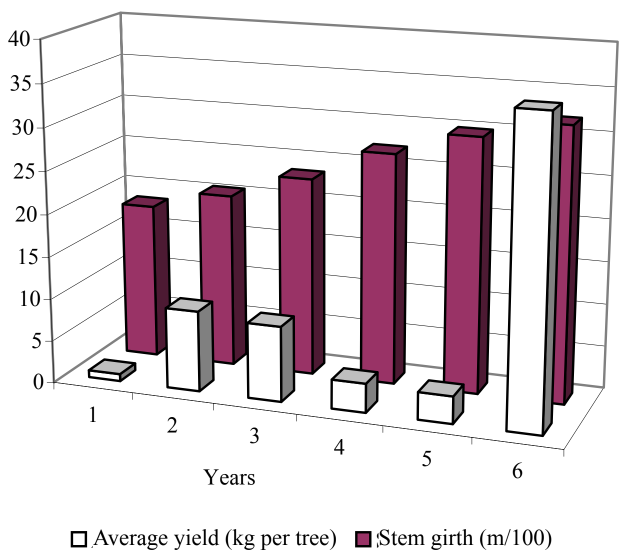

Fig. 2. Average yield and stem girth calculated for the whole set of 24 apricot genotypes in the first six years since the beginning of their commercial productivity

Table 2. Productivity of apricot genotypes in kg/tree and standard deviations of yields over a six-year period

Genotype	Year						Average	Standard deviation
	1994	1995	1996	1997	1998	1999		
Harlayne	0.24	11.02	7.00	1.10	0.26	23.50	7.19	8.31
LE-392	1.16	3.20	7.40	0.50	4.75	41.25	9.71	14.29
Priusadebnyj	4.40	17.02	18.00	0.34	2.40	43.00	14.19	14.60
Sem. Bademerik	1.75	2.30	8.25	2.50	2.38	48.25	10.91	16.85
LE-2267	2.70	2.24	5.80	3.70	2.50	41.67	9.77	14.32
LE-390	0.08	15.60	5.20	16.00	3.02	53.60	15.58	18.03
LE-1917	0.46	4.40	12.20	0.30	6.40	4.40	4.69	4.01
NJA-1	0.48	11.44	6.60	1.50	0.08	38.00	9.68	13.28
Arzami aromatnyj	0.14	23.20	8.60	7.40	5.00	57.60	16.99	19.48
Volšebnyj	0.32	28.40	17.20	1.13	13.25	50.75	18.51	17.32
Vynoslivyj	0.14	34.00	8.20	6.00	16.80	57.20	20.39	19.66
M-45	0.14	7.20	7.20	1.00	0.10	25.50	6.86	8.88
M-25	0.08	2.20	2.40	3.50	0.72	15.00	3.98	5.05
Velkopavlovická LE-6/2*	0.22	2.00	7.20	0.67	0.18	22.40	5.45	7.96
Harogem	2.30	15.60	5.00	1.60	0.08	44.20	11.46	15.50
LE-2185	0.70	10.20	3.25	6.25	4.50	32.67	9.60	10.72
LE-1580	0.40	4.20	7.40	3.00	2.50	24.00	6.92	7.92
Sabinovská 220	0.04	2.60	3.80	1.00	0.22	12.40	3.34	4.26
LE-1453	0.10	10.80	9.40	11.40	0.16	51.25	13.85	17.37
Lemeda (LE-962)	0.30	4.90	12.60	1.83	2.80	39.00	10.24	13.45
LE-1321	1.34	7.00	13.20	3.40	0.13	43.25	11.39	14.88
Lednická (M-90-A)	0.21	1.82	13.00	6.50	0.16	8.40	5.02	4.73
LE-SEO-118	0.14	2.50	14.00	0.10	7.00	39.30	10.51	13.74
LE-SEO-24	2.20	4.40	9.75	1.00	1.50	34.67	8.92	11.88
Average	0.84	9.51	8.86	3.41	3.20	35.47	10.21	11.72

*Control cultivar

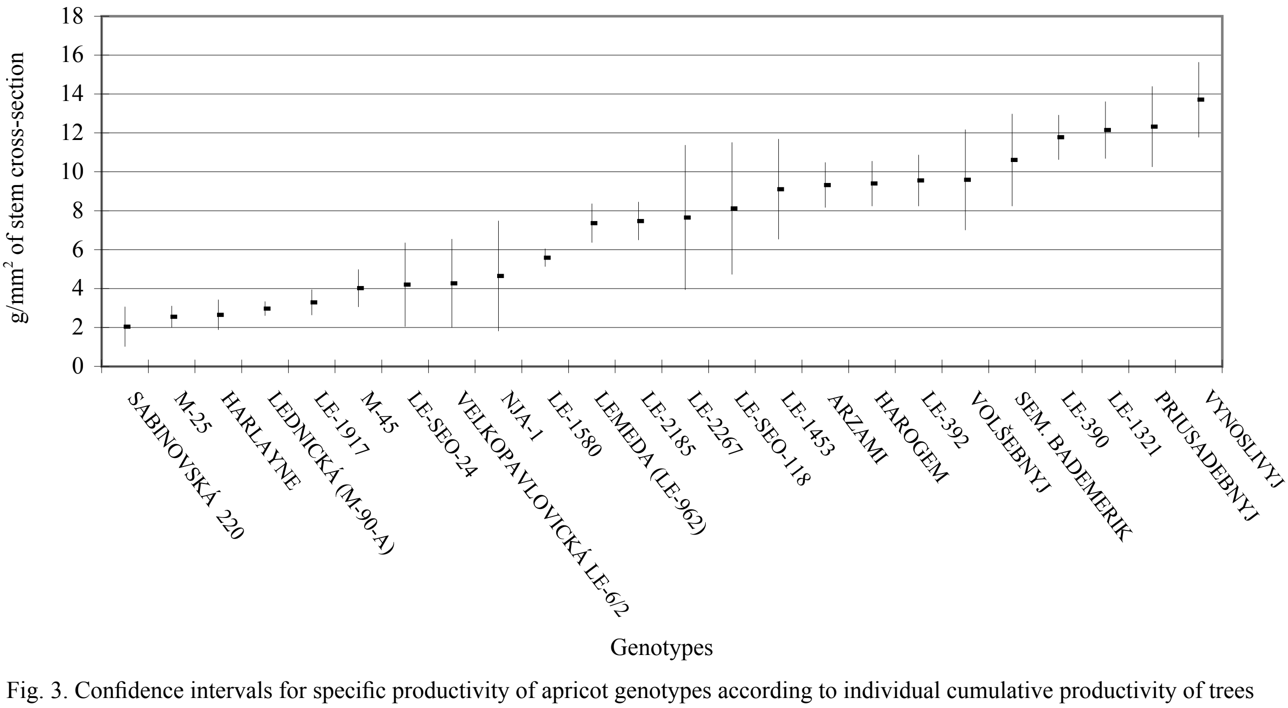

Fig. 3. Confidence intervals for specific productivity of apricot genotypes according to individual cumulative productivity of trees (significance level $P = 0.05$)

Table 3. Specific productivity of apricot genotypes in g/mm² of stem cross-section

Genotype	Sum of yields in kg/tree over 1994–1999	Sum of yields in g/tree over 1994–1999	Stem cross-section in mm² in 1999	Specific productivity in g/mm² in 1999**
Harlayne	43.12	43,120	7,310	5.90
LE-392	58.26	58,260	6,242	9.33
Priusadebnyj	85.16	85,160	6,976	12.21
Sem. Bademerik	65.43	65,430	6,413	10.20
LE-2267	58.61	58,610	7,986	7.34
LE-390	93.50	93,500	8,001	11.69
LE-1917	28.16	28,160	8,723	3.23
NJA-1	58.10	58,100	6,189	9.39
Arzami aromatnyj	101.94	101,940	11,018	9.25
Volšebnyj	111.05	111,050	11,801	9.41
Vynoslivyj	122.34	122,340	8,989	13.61
M-45	41.14	41,140	9,966	4.13
M-25	23.90	23,900	8,829	2.71
Velkopavlovická LE-6/2*	32.67	32,670	8,001	4.08
Harogem	68.78	68,780	7,358	9.35
LE-2185	57.57	57,570	7,166	8.03
LE-1580	41.50	41,500	7,108	5.84
Sabinovská 220	20.06	20,060	9,204	2.18
LE-1453	83.11	83,110	8,102	10.26
Lemeda (LE-962)	61.43	61,430	8,358	7.35
LE-1321	68.32	68,320	5,591	12.22
Lednická (M-90-A)	30.09	30,090	9,642	3.12
LE-SEO-118	63.04	63,040	6,526	9.66
LE-SEO-24	53.52	53,520	10,900	4.91
Average	61.28	61,283	8,107	7.56

*Control cultivar
**Calculated as the ratio of cumulative yield over 6 years per mm² of stem cross-section in 1999

sed in g of yield weight per mm² of stem cross-section in the last year of observations (1999), were marked; they were caused highly significantly by genotypes. The value 16.94 was calculated for a 0.01 significance level while the tabular value was 2.03 only (Tables 3 and 4). Confidence intervals also confirmed the significance of differences in specific productivity that was significantly higher in twelve genotypes than in the control cultivar

Table 4. Evaluation of significance of genotype effect on specific productivity in a set of apricots in 1994–1999

Source of variability	SS	Difference	MS	*F*	*P* value	*F* crit.
Between samples	1,376.723	23	59.857520	16.94111	1.34E-22	2.038604
All samples	296.7946	84	3.533269			
Total	1,673.517	107				

Table 5. Analysis of significance of the effect of particular trees on specific productivity in g/mm² in a set of 24 apricot genotypes in 1994–1999

Source of variability	SS	Difference	MS	*F*	*P* value	*F* crit.
Between samples	2,071.176	4	0.517794	0.031668	0.998041	2.463551
All samples	1,618.733	99	16.350840			
Total	1,620.804	103				

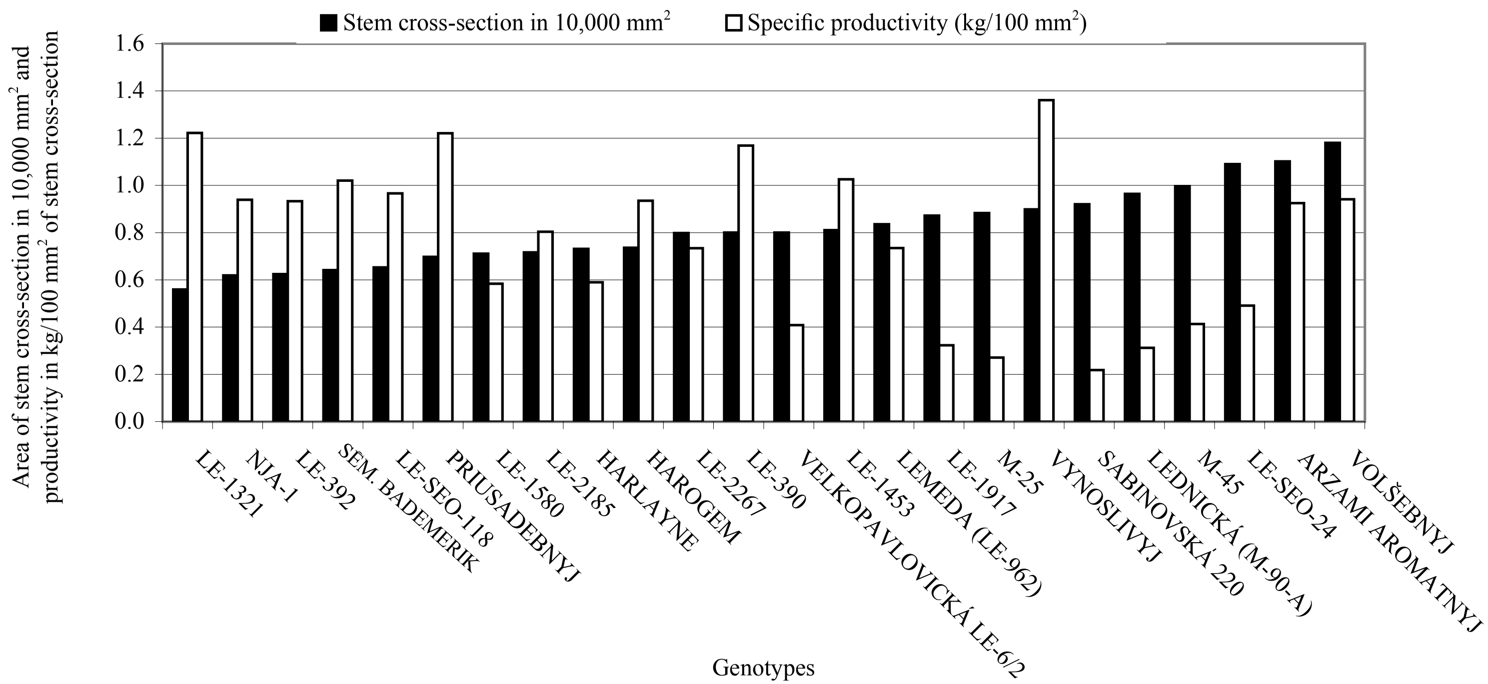

Fig. 4. Area of stem cross-section in apricot genotypes and specific productivity in 1999 ($r = -0.40^{+}$)

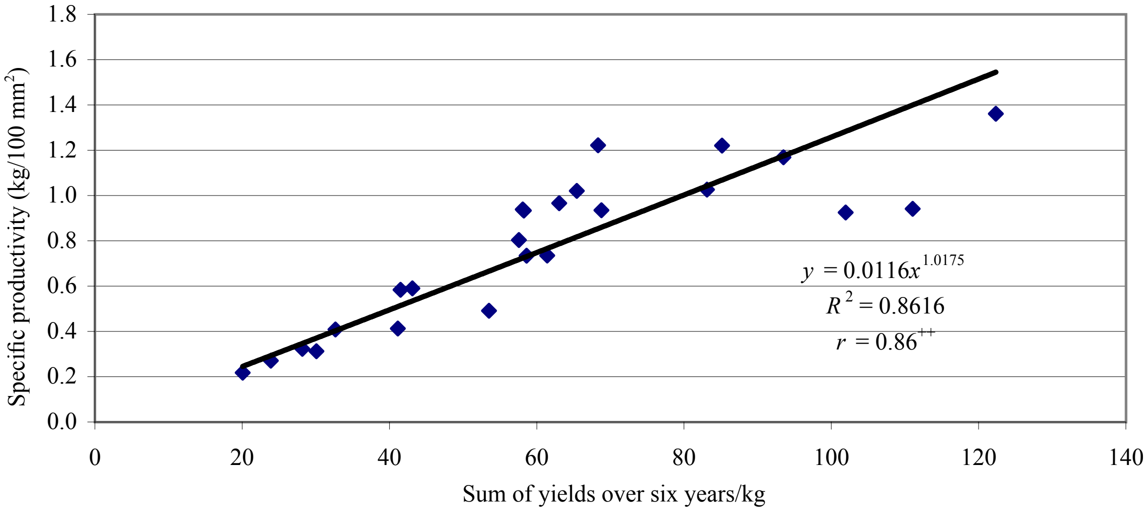

Fig. 5. Correlation between the sum of yields in kg/tree over six years and specific productivity in kg/100 mm^2 in 24 apricot genotypes

Velkopavlovická LE-6/2 (Fig. 3). Contrary to this fact, within no genotype of the evaluated collection did the individual trees influence significantly specific productivity in g/mm^2 of stem cross-section. Calculated F was 0.03, tabular F 2.46 (Table 5).

A significant negative correlation between the tree size of apricot genotypes and specific productivity was calculated for the studied collection (r = –0.40$^+$). With less vigorous growth specific productivity significantly increased. It indicates that the weaker growth of genotype was at least partly influenced by its higher productivity (Fig. 4). A positive, highly significant correlation was established between the sum of yields in kg per tree over six years and specific productivity in kg per unit area over this period (Fig. 5). Specific productivity was highest in Vynoslivyj, Priusadebnyj, LE-390, LE-1321 and Sem. Bademerik. Moreover, Vynoslivyj cv. has good quality of fruits, mean fruit weight (47 g) and later time of fruit ripening (11 days after Velkopavlovická cv.). An application should be filed to include Vynoslivyj cv. in registration tests and to grow it in the conditions of this country. Priusadebnyj is a cultivar with extraordinary earliness but smaller fruits. It is important for growing in gardens and for breeding.

References

FAJT N., KOMPARA H., USENIK V., 1999. Agronomic yield and quality evaluation of 16 apricot cultivars in coastal Slovenia. Convegno nazionale „La coltura dell´albicocco“, Metaponto, Italia, 24–25 giugno 1999. Italus-Hortus, *6*: 113–114.

NITRANSKÝ Š., 1992. Klasifikátor – Descriptor list – Genus *Armeniaca* P. Mill. Praha, VÚRV: 29.

PAPANIKOLAOU-PAVLOPOULOU X., POULIS J., KARAYIANNIS I., 1999. Evaluation of fourteen (14) different apricot varieties at the Agricultural Research Station of Rhodes. Proc. of the XIth International Symposium on Apricot Culture, Veria-Makedonia, Greece, 25–30 May, 1997, Vol. 1. Acta Hort., *488*: 185–189.

VACHŮN Z., 1996. Growth vigor, need of pruning and productivity of apricot genotypes in the growth and productivity period according to Šitt. Zahradnictví – Hort. Sci. (Prague), *23*: 41–45.

VACHŮN Z., 2001. Yield potential of new apricot cultivars and hybrids within the first eight years after planting. Hort. Sci. (Prague), *28*: 41–46.

VACHŮN Z., 2002. Production weight and its variability in 24 apricot genotypes over six years. Hort. Sci. (Prague), *29*: 105–113.

Received 10 June 2002

Specifická plodnost vybraných genotypů meruněk

ABSTRAKT: V letech 1994–1999 byla hodnocena specifická plodnost a některé vzájemné vztahy mezi růstem a plodností u souboru 24 genotypů meruněk (*Prunus armeniaca* L.). Přesto, že výsadbový materiál byl ze stejné školky, stejně starý a na stejné podnoži, byla vzrůstnost genotypů od výsadby na trvalé stanoviště rozdílná. Rozdíl ve vzrůstnosti genotypů se v průběhu šestiletého období mírně zmenšoval pravděpodobně pod vlivem uplatňovaného uniformního řezu. Přesto vzrůstnost, hodnocenou podle plochy průřezu kmene, je možné považovat za vlohu genotypu. Dokazuje to kladná velká vysoce průkazná těsnost závislosti (r = 0,84^{++}) mezi pořadím genotypů podle plochy průřezu kmene ve čtvrtém a jedenáctém roce po výsadbě. Rovněž konfidenční intervaly potvrdily průkaznost rozdílů ve specifické plodnosti. Celkem dvanáct genotypů mělo tuto specifickou plodnost průkazně vyšší než kontrolní odrůda Velkopavlovická. Mezi vzrůstností a specifickou plodností, vyjádřenou v hmotnosti sklizně na jednotku plochy průřezu kmene, byla zjištěna záporná průkazná mírně těsná závislost (r = –0,40^{+}). Slaběji rostoucí genotypy měly vyšší specifickou plodnost. Nejvyšší specifickou plodnost měly odrůdy Vynoslivyj a Priusadebnyj a hybridy LE-1321 a LE-390. Z nich pěstitelsky a kvalitou plodů nejzajímavější byla odrůda Vynoslivyj s průměrnou hmotností plodu 47 g a sklizňovou zralostí 11 dní po odrůdě Velkopavlovická.

Klíčová slova: meruňka; genotyp; vzrůstnost; specifická plodnost

---

Corresponding author:

Prof. Ing. Zdeněk Vachůn, DrSc., Mendelova zemědělská a lesnická univerzita, Brno, Zahradnická fakulta, Ústav ovocnictví a vinohradnictví, Valtická 337, 691 44 Lednice, Česká republika
tel.: + 420 519 340 105–7, fax: + 420 519 340 159, e-mail: vachun@mendelu.cz