Variability and differences of growth vigour in the set of 36 genotypes of apricot (*Prunus armeniaca* L.).

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Summary: Growth vigour of 36 apricot cultivars and new hybrids grafted on apricot seedling rootstock (*Prunus armeniaca L.*) was evaluated on the base of measurements of stem girth from the 4th to the 10th year after planting. There were differences in growth vigour of genotypes under study. In the evaluated set of genotypes the control cultivar *´Veecot´* may be classified as a genotype with below-average growth vigour. Only four genotypes (*´Reale d´Imola´, ´Sanagian rannii´, ´Moldavskii krupnoplodnyi´ and ´LE-2385´*) were found with significantly higher growth vigour than that of control cultivar *´Veecot´* in years of the end of experimental period. Two genotypes (*´Farmingdale´, ´LE-SEO-24´*) were found with significantly higher growth vigour only at the beginning of experimental period and one cultivar (*´Vivagold´*) with significantly lower growth vigour in the first four years. Genotypes with different growth vigour can be used in further breeding programmes and/or as components inhibiting or supporting the growth in indirect vegetative propagation. Within the whole experimental period, the rank of growth vigour of genotypes practically did not change. This was demonstrated by highly significant or significant coefficients of correlation existing between individual pairs of years (r=0.32+ to r=0.96++). As far as the time difference between years in individual pairs of years was higher, the correlation coefficients were lower. In individual years, variability of growth vigour was relatively low and ranged from 9.83 to 13.64%.

Introduction

In pomological publications, the growth vigour of cultivars is evaluated as weak, medium and strong (Kutina et al., 1991). In spite of the fact that e.g. girth of the stem is an easily measurable parameter for the evaluation of growth vigour in comparable conditions, concrete values for individual varieties are usually not given.

Apricot species, groups and cultivars vary greatly in growth vigour, size and growth habit. Species range in size from the small trees of *Prunus sibirica L.* to the large trees of *Prunus mandshurica L.* and *Prunus armeniaca L.* (Mehlenbacher et al., 1991). Depending on their growth vigour, apricot trees can reach the heights from 4 to 10 metres (*Smykov*, 1989, *Vachùn*, 1971).

To obtain genotypes with a different growth vigour (with a different size) is one of the objectives of stone-fruit tree breeding. In case of apricots this was not the main objective of selection, but it was not fully neglected either (*Vachùn*, 1986).

Genotypes showing a reduced growth vigour were studied in Italy (*Quarta* et al., 1986) in Moldavia (*Smykov*, 1988) or in China (*Gu*, 1988). It seems to be sources of genes for different growth vigour.

Significant differences were observed not only between cultivars but also between clones. As compared with the control clone of cultivar *´Velkopavlovická´* these differences made as much as 30% (*Vachùn*, 1995, 1996).

Growth vigour represents above all a genetic trait but the site, pruning and health conditions of propagated clone or rootstock can influence it. An ill rootstock (infested by viroses or by phytoplasmoses) reduces the growth vigour by 10 to 15%, increases consumption of nutrients by as much as 50% and decreases the yields of grafted varieties by 10 to 15% (*Dosba* et al., 1991).

Differences in growth vigour, resulting from cultivar, rootstock and/or stem forming cultivar should be respected when deciding about spacing of trees (*Nitranský*, 1996, *Vachùn*, 1971). For example the girth reduced by 10% reduces the crown diameter by approximately 0.5 m (*Vachùn*, 1971).

The aim of presented research work was the evaluation of differences in growth vigour in one set of apricot

genotypes *Prunus armeniaca L.* for to use new information in the further breeding work and/or in propagation programmes i.e. using of selected genotypes as components inhibiting or supporting the growth in indirect vegetative propagation.

Material and methods

The experimental plantation was established in the spring of 1991. Apricot seedlings *(Prunus armeniaca L.)* were used as rootstocks. This study evaluates the growth vigour of 36 genotypes (cultivars and selected hybrids) within the period from the 4th to the 10th year after planting. Obtained data cover completely a period of seven years. Genotypes in experimental plantation were established in five tree blocks. Each genotype had five replications with five individually evaluated trees. As control *'Veecot'* was used, as a very known cultivar in European and American conditions. Growth vigour of *'Veecot'* is very similar to *'Hungarian Best'* or *'Velkopavlovická'* cultivars often cultivated in Central European conditions.

Girth of stem (circumference) in mm at 0.8 m above the soil was measured every year in autumn. Experimental set of trees involved older cultivars and also some new apricot cultivars and hybrids. This is only one part of genepool of apricots evaluated in Lednice. The other groups of cultivars of different age were evaluated and the results published separately.

Cultivars *'Farmingdale'*, *'Riland'*, *'Veecot'*, *'Velvaglo'*, *'Vivagold'* and *NJA-2'* originated from U.S.A., *'Sabinovská'*, *Velbora (VS-12/41)'* *'Vestar (VS-51/4)'*, *'VS-0/32'* and *'Pastyrik 146'* were from the Slovak *Republic*, *'Litoral'* and *'Murfatlar'* from Romania, *'Reale d'*Imola' originated from Italy, *'Efekt'*, *'Moldavskii krupnoplodnyi'*, *'Sanagian rannii'* and *'Zorkii'* were from Ukraine, cultivars *'Juan-Sin'* and *'Moi-chua-sin'* originated from China. Remaining genotypes (cultivars and hybrids) were from the Czech Republic. Genotypes with initial letters LE originated from the breeding programme of the Faculty of Horticulture MUAF in Lednice. Numbers and letters behind some names of genotypes indicate preliminary numbers or clones.

Before statistical calculations Bartlett test of homogenity was used. Statistical analysis of date about growth vigour was carried out in such a way that data from each year were analysed separately using intervals of confidence so it was possible to test the significance of differences between the evaluated genotype and the control cultivar 'Veecot'.

Table 1 Girth of stem of apricot genotypes within the period 1993–1999. Plantation established in the spring of 1991.

Number	Genotype	Girth of stem (mm) within years.						
	1993	1994	1995	1996	1997	1998	1999	
1	EFEKT	125	161	190	209	272	315	353
2	FARMINGDALE	169	201	215	235	260	278	298
3	JUAN-SIN	125	154	178	198	231	261	260
4	LE-1321	121	153	170	181	218	256	265
5	LE-1453	153	198	215	229	289	318	319
6	LE-1580	128	163	188	218	246	266	299
7	LE-2007	160	196	216	243	263	280	298
8	LE-2185	119	152	170	201	250	269	300
9	LE-2193	159	193	196	222	252	275	285
10	LE-2385	128	173	215	231	325	343	368
11	LE-SEO-24	192	237	231	276	329	363	370
12	LEDNICKÁ (M-90-A)	144	185	215	228	283	313	348
13	LEMEDA (LE-962)	151	195	223	241	283	315	324
14	LITORAL	124	160	176	209	258	285	303
15	M-30	132	172	198	217	269	329	340
16	M-33	118	145	169	197	239	270	313
17	M-44	129	168	199	219	281	326	369
18	M-48	160	200	221	245	284	299	329
19	M-52	123	149	179	212	293	332	363
20	MOJ-CHUA-SIN	111	144	159	174	223	264	289
21	MOLDAV.KRUPNOPLODNYI	139	185	218	235	305	337	367
22	MURFATLAR	131	174	193	208	283	320	336
23	NJA-2	143	180	195	211	258	296	310
24	PAST'RIK 146	116	151	188	203	247	275	312
25	REALE D´ IMOLA	139	182	214	249	301	324	336
26	RILAND	130	157	169	185	255	290	309
27	SABINOVSKÁ 220	153	188	213	245	277	302	340
28	SANAGIAN RANNII	168	215	244	257	327	358	385
29	VEECOT *	141	174	196	220	253	280	297
30	VELBORA (VS-12/41)	121	153	185	202	260	297	333
31	VELKOPAVLOVICKÁ LE-6/2	130	171	203	238	271	293	317
32	VELVAGLO	120	167	188	209	273	301	313
33	VESTAR (VS-51/4)	149	177	200	219	248	265	303
34	VIVAGOLD	106	141	153	174	229	251	263
35	VS-0/32	150	190	216	237	272	307	325
36	ZORKII	140	168	191	220	254	272	298

* control cultivar 'Veecot'

Table 2 Rank of apricot genotypes according to the girth of stem in mm, multiple comparisons within and in % to the control (100%) in 1999.

Rank	Genotype	Girth of stem		
		in mm	multiple comparisons **	in % (the control = 100%)
1	JUAN-SIN	260,0	I	87,5
2	VIVAGOLD	262,5	II	88,6
3	LE-1321	265,0	II	89,2
4	LE-2193	285,0	III	96,0
5	MOJ-CHUA-SIN	288,8	III	97,3
6	VEECOT *	296,7	IIII	100,0
7	FARMINGDALE	297,5	IIII	100,3
8	LE-2007	297,5	IIII	100,3
9	ZORKII	298,3	IIII	100,3
10	LE-1580	298,8	IIII	100,7
11	LE-2185	300,0	IIII	101,0
12	LITORAL	302,5	IIII	102,0
13	VESTAR (VS-51/4)	303,3	IIII	102,0
14	RILAND	308,8	IIII	104,0
15	NJA-2	310,0	IIII	104,4
16	PAST˙RIK 146	311,7	IIII	105,0
17	M-33	312,5	IIII	105,4
18	VELVAGLO	312,5	IIII	105,4
19	VELKOPAVLOVICKÁ LE-6/2	317,0	IIII	106,7
20	LE-1453	319,0	IIII	107,4
21	LEMEDA (LE-962)	324,0	IIII	109,1
22	VS-0/32	325,0	IIII	109,4
23	M-48	328,8	IIII	110,0
24	VELBORA (VS-12/41)	333,0	IIII	112,1
25	MURFATLAR	336,3	IIII	113,1
26	REALE D´ IMOLA	336,3	IIII	113,1
27	M-30	340,0	IIII	114,5
28	SABINOVSKÁ 220	340,0	IIII	114,5
29	LEDNICKÁ (M-90-A)	348,0	III	114,5
30	EFEKT 22/7-24	353,3	III	118,9
31	M-52	363,3	II	122,2
32	MOLDAV. KRUPNOPLODNYI	367,0	II	123,6
33	LE-2385	368,0	II	123,9
34	M-44	369,0	II	124,2
35	LE-SEO-24	370,0	II	124,6
36	SANAGIAN RANNII	385,0	I	129,6

* control cultivar , Veecot´
** multiple comparisons 95% Tukey – HSD interval

Table 3 Significance of differences in growth vigour of apricot genotypes evaluated on the base of the stem girth (circumference) in relation to the control cultivar ´Veecot´ within the period 1993–1999.

Number	Genotype	Significance of differences in growth vigour in years						
		1993	1994	1995	1996	1997	1998	1999
1	EFEKT	0	0	0	0	0	0	´+ H
2	FARMINGDALE	´+ H	´+ H	´+ H	0	0	0	0
3	JUAN-SIN	0	0	0	0	0	0	0
4	LE-1321	0	0	0	0	´+ L	´+ L	0
5	LE-1453	0	0	0	0	´+ H	´+ H	0
6	LE-1580	0	0	0	0	0	0	0
7	LE-2007	0	0	0	0	0	0	0
8	LE-2185	0	0	0	0	0	0	0
9	LE-2193	0	0	0	0	0	0	0
10	LE-2385	0	0	0	0	´+ H	´+ H	´+ H
11	LE-SEO-24	´+ H	´+ H	´+ H	0	´+ H	0	0
12	LEDNICKÁ (M-90-A)	0	0	0	0	´+ H	0	´+ H
13	LEMEDA (LE-962)	0	0	0	0	0	0	0
14	LITORAL	0	0	0	0	0	0	0
15	M-30	0	0	0	0	0	0	´+ H
16	M-33	0	0	0	0	0	0	0
17	M-44	0	0	0	0	0	0	0
18	M-48	0	0	0	0	0	0	0
19	M-52	0	0	0	0	0	0	0
20	MOJ-CHUA-SIN	0	0	´+ L	´+ L	0	0	0
21	MOLDAV.KRUPNOPLODNYI	0	0	0	0	´+ H	´+ H	´+ H
22	MURFATLAR	0	0	0	0	0	0	0
23	NJA-2	0	0	0	0	0	0	0
24	PAST˙RIK 146	0	0	0	0	0	0	0
25	REALE D´ IMOLA	0	0	0	0	´+ H	´+ H	´+ H
26	RILAND	0	0	0	0	0	0	0
27	SABINOVSKÁ 220	0	0	0	0	0	0	0
28	SANAGIAN RANNII	0	0	0	0	´+ H	´+ H	´+ H
29	VEECOT *	0	0	0	0	0	0	0
30	VELBORA (VS-12/41)	0	0	0	0	0	0	0
31	VELKOPAVLOVICKÁ LE-6/2	0	0	0	0	0	0	0
32	VELVAGLO	0	0	0	0	0	0	0
33	VESTAR (VS-51/4)	0	0	0	0	0	0	0
34	VIVAGOLD	´+ L	´+ L	´+ L	´+ L	0	0	0
35	VS-0/32	0	0	0	0	´+ H	0	0
36	ZORKII	0	0	0	0	0	0	0

* control cultivar ´Veecot´
´+ H girth of stem significantly higher than in control
´+ L girth of stem significantly lower than in control
0 non - significant difference

Results and discussion

Within the seven-year period important differences in growth vigour between some genotypes were found. This is demonstrated by multiply comparisons. The most vigour genotype *'Sanagian rannii'* in the 9th year after planting (in 1999) reached the average girth of stem 385-mm and the less vigour genotype *'Juan-sin'* only 260-mm. The control cultivar *'Veecot'* was classified as a variety with below-average growth vigour. (*Table 1 and 2.*) Genotypes with a higher or lower intensity of growth can be used in further breeding work and/or as interstock components increasing the growth in programmes of indirect vegetative propagation.

Only four genotypes were found with the significantly higher growth vigour in last three years of controlled period than the control variety *'Veecot'*. There was not found any genotype with the significantly lower growth vigour in the second half of research period. *Table 3.* As an example only one of all confidence intervals, calculated for individual years and used for evaluation, was presented. (*Fig. 3).*

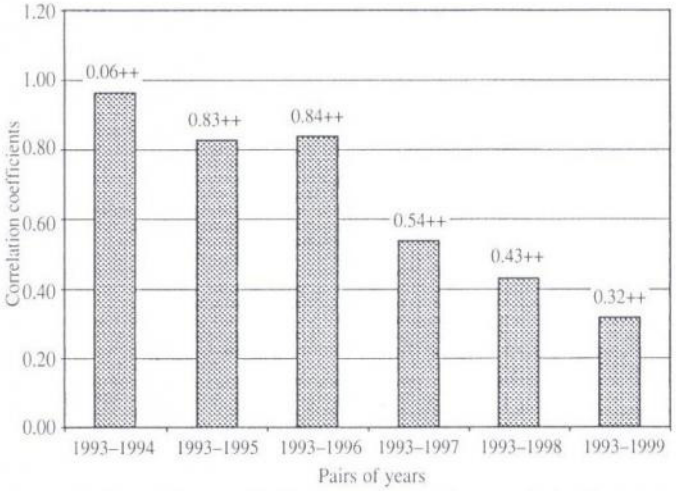

Figure 1 Correlation coefficients of growth vigour existing between apricot genotypes in the pairs of years

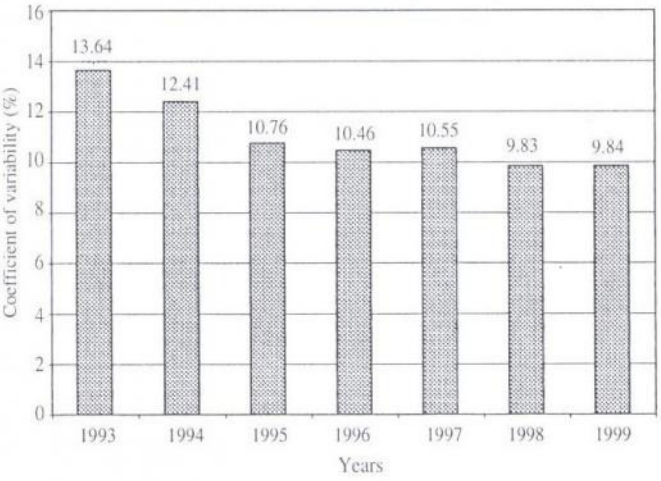

Figure 2 Coefficients of variability in growth vigour of apricot genotypes in individudal years evaluated on the base of girth values of stemm in mm

There was a highly significant relationship between the rank of the growth vigour of apricot genotypes in individual pairs of years within evaluated period. This was demonstrated by significant or highly significant correlation

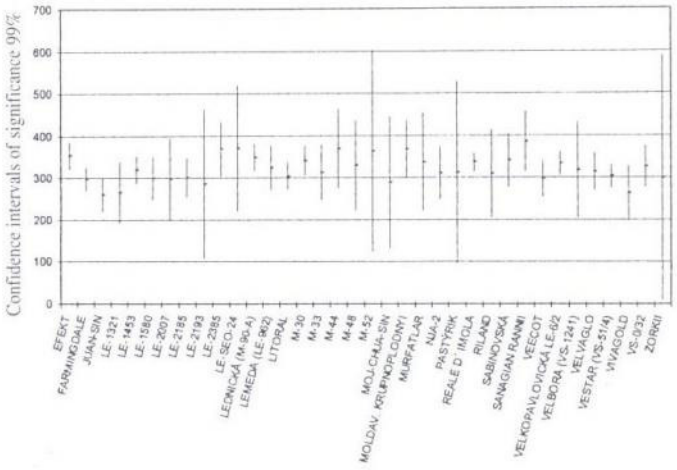

Figure 3 Confidence intervals for girth of stem (mm) of apricot genotypes in 1999

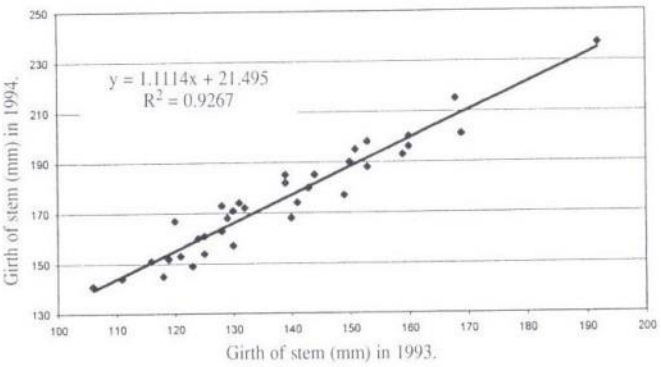

Figure 4 Correlation between girth values of stem (mm) of 36 aprioct genotypes in 1993 and 1994

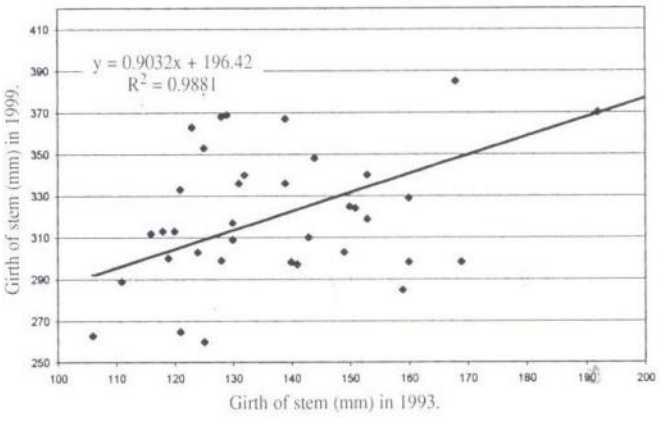

Figure 5 Correlation between girth values of stem (mm) of 36 apricot genotypes in 1993 and 1999

coefficients from r=0.32+ to r=0.96++. As far as the time difference between years in individual pairs of years was higher, the correlation coefficients were lower (*Fig. 1., Fig. 4 and Fig.* 5).

Values of variability coefficients were relatively low and ranged from 9.83% to 13.64% (*Fig. 2*). Variability of growth vigour was influenced by generatively propagated non-selected rootstock from *Prunus armeniaca L.* This variability could be reduced, if such selected apricot rootstocks (e. g. *'M-LE-1', 'M-VA-2', 'M-VA-3', 'Manicot'* and others) were used. Unfortunately this selected rootstock was not available at the moment of the establishment of this experiment.

A generally lower danger of occurrence of viroses is one of the most important advantages of the use of generatively propagated rootstocks from *Prunus armeniaca L.* in comparison with vegetatively propagated rootstocks as *Saint Julien A, Pixy* and others. By pollen and seeds only some viroses are disseminated, e. g. PNRSV (Prunus Necrotic Ring Spot Virus). Seed material used for the production of rootstocks was obtained from mother trees non-tested for the occurrence of PRNSV so it was not possible to eliminate a potential effect of this and/or some other of still uncontrolled factors.

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