First results of an orchard trial with new clonal sweet cherry rootstocks at Holovousy

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ABSTRACT: Ten clonal dwarf or semi-dwarf sweet cherry rootstocks were evaluated for 5 growing seasons in a orchard that was established in the spring 1999 at Holovousy within international cherry rootstock trials that are co-ordinated in Europe by the Danish Institute of Plant and Soil Science at Aarslev, Denmark. Lapins cv. was used as a scion tester for all these rootstocks; five of them were also tested by Regina cv. Among the new rootstocks, G 195/5 was evaluated as the most promising for Lapins cv. It produced trees even smaller than P-HL-A or Tabel (Edabriz), with higher yield efficiency and good fruit size. In agreement with the results of earlier experiments, both P-HL-A and Tabel (Edabriz) proved to be quite reliable rootstocks for modern sweet cherry orchards established there. Among the semi-dwarf rootstocks, G 154/7 also seemed to be interesting because of high yields and fruit size. Weiroot 158 was found as relatively the most promising rootstock for Regina cv. On the other hand, the most disappointing results were obtained with the rootstock Weiroot 53 because of its inferior graft compatibility and its negative influence on fruit size. Some of the tested rootstocks significantly changed the time of flowering and the time of fruit ripening. Several relationships between the observed characteristics were found within this study and they are more thoroughly discussed.

Keywords: sweet cherry; rootstocks; cultivars; tree growth; yields; yield efficiency; time of flowering; time of ripening; fruit size

In sweet cherries for many years rootstocks were used only as a means of propagating selected scion cultivars. After recent changes in this crop culture, new features of rootstocks modifying tree growth and cropping have become an object of primary interest. Modern sweet cherry orchards of small trees planted at higher densities require to use suitable dwarf or semi-dwarf rootstocks possessing reliable compatibility with scion cultivars that promote early and high yields, and positively influence also fruit quality or other important economic characteristics. Therefore, an impressive range of cherry rootstocks has been developed and tested worldwide during the last thirty years (Franken-Bembenek 1995; Schimmelpfeng 1996; Webster, Schmidt 1996; Riesen, Wagner 1998; Werthheim 1998; Pfannenstiel, Schulte 2000).

In the Czech Republic, the first dwarf cherry rootstocks of P-HL series were bred in the Research and Breeding Institute of Pomology at Holovousy as early as in the sixties of the last century. They have been tested extensively and trials have been conducted there since 1975. The results gathered from several experiments running at Holovousy were published in a range of papers (Blažek 1983; Kloutvor 1991; Blažková 1997, 1998, 1999; Kloutvor, Paprštein 1999; Blažková 2001). On the basis of these works, P-HL-A was chosen as the most suitable rootstock from the series that was at that time the most frequently used in this country in new dense plantings of sweet cherries.

More recently, new promising rootstocks selected abroad were also included in newer trials for comparison with those of the P-HL series (Blažková, Hlušičková 2001, 2003). In these studies, Gisela 5 and Tabel (Edabriz) also proved to be very valuable rootstocks for modern sweet cherry orchards, especially in combinations with particular cultivars.

Since 1994, international cherry rootstock trials in Europe have been co-ordinated by the Danish Institute of Plant and Soil Science at Aarslev, Denmark. The Research and Breeding Institute of Pomology joined these trials as one of the partners, and established a new orchard experiment with several new cherry rootstocks in the spring 1999 using the nursery stock material that had been propagated in Aarslev. This paper deals with results of the first five years of the trial.

MATERIAL AND METHODS

For this study, ten sweet cherry rootstocks [G 154/7, G 195/20, G 209/1, G 497/8, Gisela 4, Gisela 7, P-HL-A, Tabel (Edabriz), Weiroot 158, Weiroot 53] were chosen. P-HL-A was considered as a standard (control) for all the others. As a scion cultivar, Lapins (of Canadian origin) was used for all these rootstocks. For five of them, cultivar Regina from Germany was grafted as another tester. Nursery stock of the material was grown from bench-grafted rootstocks in the Danish Institute of Plant and Soil Science at Aarslev, Denmark. It mostly consisted of two-year-old trees without ramification.

The experiment was established in the spring 1999 at Holovousy. Trees were planted in three randomised blocks with three trees per each Lapins cv. rootstock replication using a spacing of 5 × 1.5 m. In the case

Supported by the Ministry of Agriculture of the Czech Republic, Projet QD 1047.

of Regina, only one tree per replication was planted on each tested rootstock. Climatic conditions at Holovousy are characterised by an average annual temperature of 8.1°C and an average annual rainfall of 650 mm. The soil was medium loam sandy with a rather deep cultivated layer on gravel substrate. The orchard was located at the altitude of 280 m a.s.l. and it was situated on a very gentle slope facing north.

Experimental trees were cut back just after planting to induce side branching at the height of 0.7 m above the ground level. Then they were trained as spindles using strong wooden stakes as supports and shoot binding and pegging to achieve a more horizontal position of the side branches. No irrigation was applied in the orchard. Clean strips were maintained under trees by contact herbicides, whereas a frequently cut sod was kept in alleys between tree rows. Fertilisers were applied according to soil analyses. Spraying treatments against pests and diseases were conducted according to the recommendations for commercial orchards.

After the end of every growing season, the length of shoot elongation and characteristics necessary for the calculations of canopy volume and trunk cross-section area were measured on all experimental trees. From the second year, the date of beginning of flowering (25 flowers open), flower set, fruit set, the date of beginning of fruit ripening, weight of yield and mean fruit weight were further recorded. Besides these characteristics, the health status of every tree was regularly monitored during the course of this experiment.

Phenological data were recorded as successive calendar dates starting on January 1st. These phenological data from other years were transformed to the mean of 2000 for their use in regression analyses. Flower and fruit sets were estimated subjectively using a 1–9 rating scale (1 = no set). Beginning of fruit ripening was also estimated subjectively according to taste and firmness of the majority of fruits. Mean fruit weight was determined by weighing a randomly gathered sample of 50 fruits. In the case of a smaller crop, all fruits were weighed. All gathered data were processed by ANOVA and regression analyses. Intervals of least significant difference were calculated to separate the rootstock means.

RESULTS

During this study, noticeable tree dieback was observed only with Weiroot 53. In the first two years, 3 trees of Lapins were lost on this rootstock. Furthermore, some gumming was recorded with Lapins cv. trees on Weiroot 53, Weiroot 158 and Gisela 4 in the place of the grafting union. All trees of Lapins were infected by cherry leaf spot disease in the second half of the growing season in 2001. Flower buds of Regina cv. were repetitively injured in 2002 and in 2003 by spring frosts.

Tree vigour

Significant differences between rootstocks in the canopy volume (CV) development were observed with Lapins cultivar since 2001 onward (Table 1). The rootstock G 154/7 had the largest canopy (7.7 m^3) in the final year of this evaluation, followed by Gisela 7 and Gisela 4. On the other hand, the smallest canopy (2.7 m^3) was observed among the trees on G 195/20 followed by Weiroot 158. The control rootstock P-HL-A had a significantly smaller canopy volume than Tabel (Edabriz). With trees of Regina cultivar, differences between rootstocks in the canopy volume were much smaller and mostly insignificant. Trees on Tabel (Edabriz) had the smallest canopy of the rootstocks tested by Regina cv.

Development of trunk cross-section area (TCA) had similar patterns in this study like that of the canopy volume (Table 2). Within the trees of the Lapins cv. Gisela 7 had the largest TCA followed by G 497/8 and Gisela 4. On the other hand, the smallest TCA was observed in Weiroot 53, followed by G 195/20 and then Weiroot 158. The control rootstock P-HL-A did not practically

Table 1. Development of the tree canopy volume (m^3) of Lapins and Regina cvs. according to rootstocks

Rootstock	Lapins					Regina				
	2000	2001	2002	2003	Mean	2000	2001	2002	2003	Mean
G 154/7	0.02	0.6	2.1	7.7	2.6					
G 195/20	0.07	0.2	0.5	2.7	0.9					
G 209/1	0.04	0.3	1.0	4.5	1.4					
G 497/8	0.12	0.2	1.4	6.5	2.0	0.2	0.4	3.1	7.4	2.8
Gisela 4	0.08	0.4	1.6	6.7	2.2	0.1	0.7	2.6	7.6	2.8
Gisela 7	0.12	0.6	2.4	7.6	2.7	0.1	0.4	3.0	7.2	2.7
P-HL-A	0.08	0.2	0.8	3.7	1.3					
Tabel (Edabriz)	0.07	0.4	1.3	5.4	1.8	0.1	0.3	2.1	5.6	2.0
Weiroot 158	0.04	0.2	0.9	3.5	1.2	0.1	0.3	3.0	6.3	2.4
Weiroot 53	0.01	0.1	1.0	4.5	1.4					
Total	0.07	0.3	1.4	5.8	1.9	0.1	0.5	2.7	7.0	2.6
LSD (P = 0.05)	0.1	0.3	0.4	0.6	0.4	0.2	0.5	0.7	1.2	0.9

Table 2. Development of tree mean trunk cross-section area (cm^2) of Lapins and Regina cvs. according to rootstocks

Rootstock	Lapins						Regina					
	1999	2000	2001	2002	2003	Mean	1999	2000	2001	2002	2003	Mean
G 154/7	0.9	1.7	4.2	8.0	15.1	6.0						
G 195/20	1.5	2.6	4.2	6.8	11.0	5.2						
G 209/1	1.6	2.7	4.8	8.2	13.9	6.2						
G 497/8	1.8	2.7	4.8	9.2	18.0	7.3	2.4	4.1	8.7	15.9	28.8	12.0
Gisela 4	1.4	2.3	5.4	9.6	17.9	7.3	1.9	3.2	9.0	16.6	28.7	11.9
Gisela 7	0.9	2.6	6.8	12.6	20.9	8.8	1.2	3.3	10.0	17.4	29.9	12.4
P-HL-A	1.3	2.0	4.3	7.6	14.1	5.9						
Tabel (Edabriz)	1.8	2.8	5.3	8.8	14.7	6.7	1.8	3.4	6.7	12.0	20.2	8.8
Weiroot 158	1.3	1.9	3.6	6.9	13.3	5.4	2.0	3.7	8.4	15.7	24.8	10.9
Weiroot 53	0.2	1.0	2.0	4.7	9.7	3.5						
Total	1.3	2.3	4.7	8.5	15.3	6.4	1.9	3.5	8.6	15.5	26.5	11.2
LSD (P = 0.05)	0.9	1.2	2.5	3.2	4.3	2.9	1.0	1.8	3.4	3.9	5.6	3.7

differ from Tabel (Edabriz) in this characteristic. Trees of Regina had much larger TCA than those of Lapins. Within this group trees on Gisela 7 had the largest values of TCA again, whereas trees on Tabel (Edabriz) had the smallest.

A joint evaluation of tree vigour that takes into consideration canopy value, trunk cross-section area and mean shoot length (2001–2003) is presented for Lapins cv. in Fig. 1. According to this complex measure, trees of Lapins cv. grew the most vigorously on Gisela 7. After it, G 154/7, G 497/8 and Gisela 4 followed with diminishing vigour. The most dwarfing effect on Lapins cv. was generated by G 195/20. These trees were by more than a half smaller in comparison with the most vigorous ones on Gisela 7. A dwarfing effect quite similar to G 195/20 was further observed with Weiroot 53 and Weiroot 158. A majority of dwarf rootstocks (with the exception of Weiroot 53) generated relatively higher values of TCA than CA, whereas the opposite relationship between TCA and CA was typical of G 154/7 rootstock.

An analogical view of rootstocks evaluated with respect to Regina cv. is given in Fig. 2. A higher vigour was observed in trees on Gisela 7, G 497/8 and Gisela 4 (practically without any difference between each other), whereas Tabel (Edabriz) induced the highest reduction of vigour. Trees on Weiroot 158 were classified intermediate in their vigour between both categories.

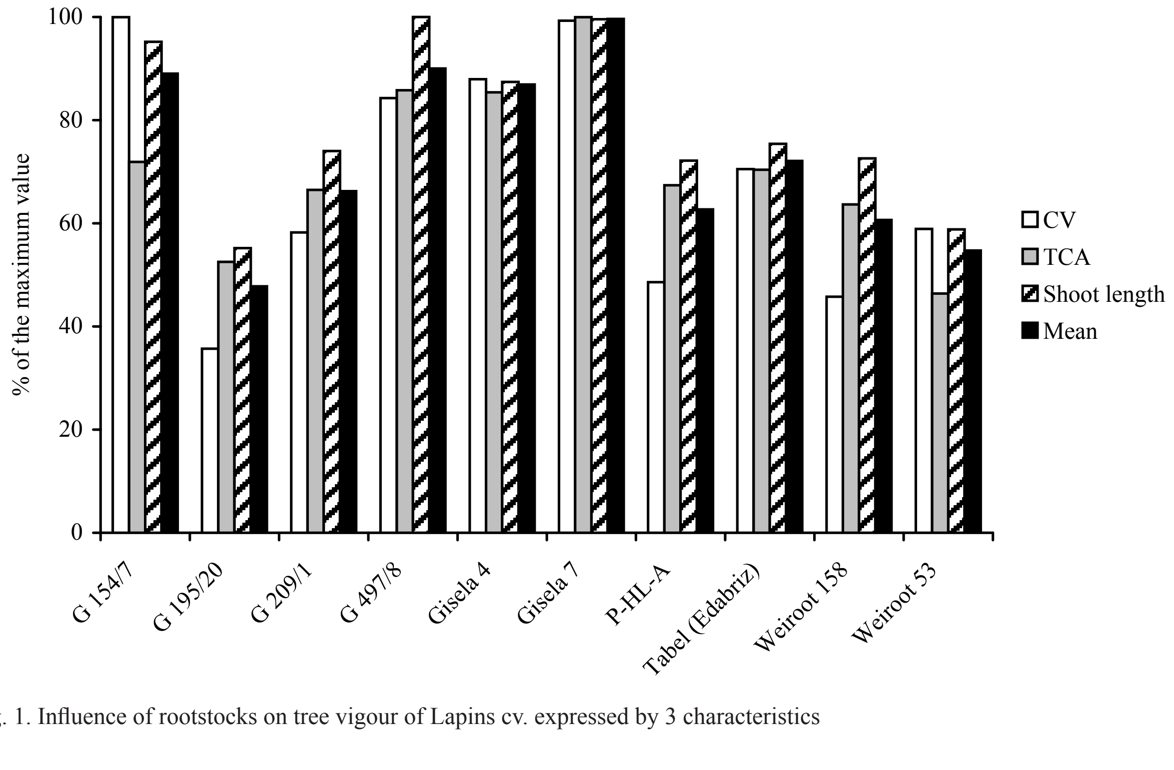

Fig. 1. Influence of rootstocks on tree vigour of Lapins cv. expressed by 3 characteristics

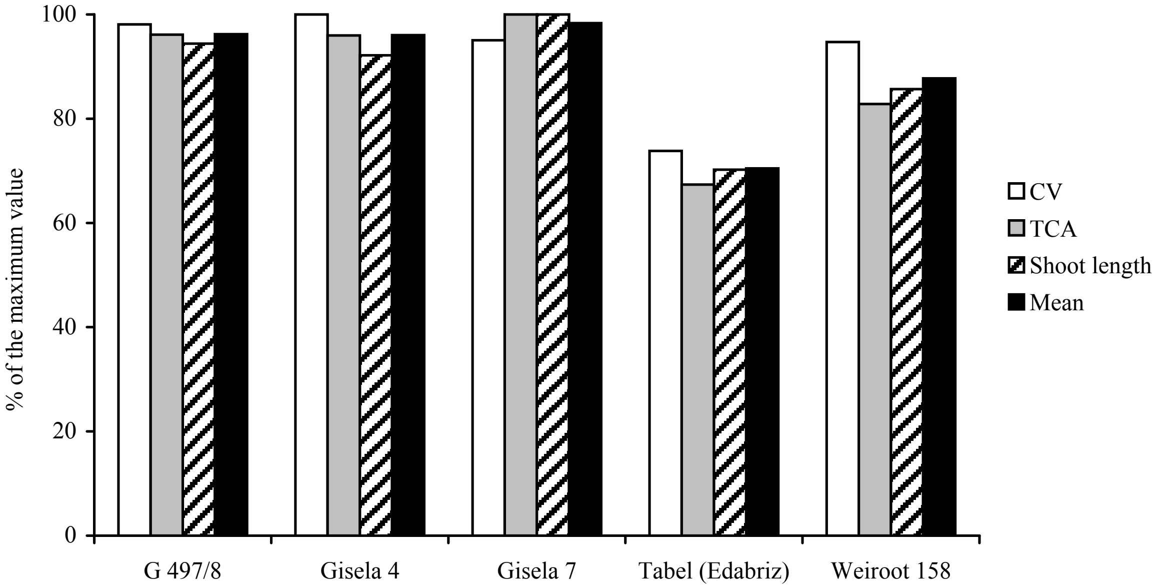

Fig. 2. Influence of rootstocks on tree vigour of Regina cv. expressed by 3 characteristics

Flower set

The influence of the studied rootstocks on flower set of Lapins and Regina cvs. during the first 5 years after planting in the orchard is surveyed in Table 3. All rootstocks generated abundant flowering of trees as soon as in the second year after planting. Differences between rootstocks with both cultivars were generally relatively small and mostly insignificant. With Lapins cv. the highest values of flower set were observed on rootstocks G 195/20 and Gisela 4. On the other hand, the lowest flower set was observed among the trees on Gisela 7 that were also somewhat less precocious than trees on other rootstocks. Inferior flowering of Lapins cv. trees on all rootstocks occurred in 2002 as a response to the infection of these trees by cherry leaf spot in the previous year. In Regina cv. relatively the most abundant flowering was recorded with trees on Weiroot 158 that significantly differed in this characteristic from trees on Gisela 7.

Yields

The first marked yields of trees of Regina cv. were recorded in 2000, in the second year after planting. Trees of Lapins cv., which were in the third year after their planting, produced similar yields in 2001 (Table 4). Much lower yields of these trees, however, were recorded in the subsequent year (2002) in connection with a low flower set, as mentioned above. An ordinary level of bearing of the cultivar was again achieved in 2003. Cropping of Regina cv. was rather poor during 2001–2003, partly because of frost damage to flower buds and probably also for insufficient cross-pollination of the cultivar in the orchard.

The highest yields per tree in the case of Lapins cv. were recorded from trees on G 154/7 and Gisela 7 rootstocks, followed by Tabel (Edabriz). On the contrary, the lowest yields per tree of the cultivar were harvested on Weiroot 158 and Weiroot 53. Trees of Regina cv.

Table 3. Flower set (1–9) of Lapins and Regina cvs. on tested rootstocks

Rootstock	Lapins						Regina					
	1999	2000	2001	2002	2003	Mean	1999	2000	2001	2002	2003	Mean
G 154/7	1.0	6.9	7.3	4.1	6.9	5.2						
G 195/20	1.2	7.3	8.3	4.9	7.1	5.8						
G 209/1	1.2	6.9	7.7	3.2	6.8	5.2						
G 497/8	1.0	7.1	7.7	4.5	5.8	5.2	1.0	7.7	8.7	5.3	8.0	6.1
Gisela 4	1.0	7.1	8.3	4.6	7.6	5.7	1.0	7.7	7.0	6.0	8.0	5.9
Gisela 7	1.0	5.9	7.4	4.2	7.1	5.1	1.0	5.3	7.7	7.0	8.0	5.8
P-HL-A	1.0	6.7	6.9	4.8	7.2	5.3						
Tabel (Edabriz)	1.1	7.0	7.6	4.5	7.3	5.5	1.0	7.3	7.7	6.0	7.7	5.9
Weiroot 158	1.0	7.3	8.4	4.3	6.6	5.5	1.3	7.7	8.0	7.0	8.8	6.4
Weiroot 53	1.3	6.9	8.8	4.0	5.9	5.4						
Total	1.1	6.9	7.9	4.3	6.8	5.4	1.1	7.1	7.8	6.3	7.9	6.0
LSD (P = 0.05)	0.4	0.6	0.4	0.7	0.5	0.4	0.6	1.1	0.9	1.0	0.6	0.5

Table 4. Mean yield (kg per tree) of Lapins and Regina cvs. on tested rootstocks

Rootstock	Lapins					Regina				
	2000	2001	2002	2003	Mean	2000	2001	2002	2003	Mean
G 154/7	0	0.8	0.5	4.3	1.4					
G 195/20	0.01	1.2	0.2	2.0	0.8					
G 209/1	0.02	1.0	0.2	2.5	0.9					
G 497/8	0	1.1	0.3	1.5	0.7	0.7	0.5	0.4	0.7	0.6
Gisela 4	0	1.3	0.3	3.0	1.1	1.0	0.3	0.5	1.0	0.8
Gisela 7	0	1.0	0.3	4.2	1.4	1.5	0.6	0.6	1.5	1.1
P-HL-A	0	1.0	0.8	2.5	1.1					
Tabel (Edabriz)	0.01	1.6	0.5	2.8	1.2	0.5	0.3	0.4	0.5	0.6
Weiroot 158	0	0.5	0.2	0.8	0.4	0.8	0.6	1.0	0.8	0.7
Weiroot 53	0	0.6	0.1	0.9	0.4					
Total	0	1.0	0.3	2.4	0.9	0.9	0.5	0.6	0.9	0.8
LSD (P = 0.05)		0.4	0.2	0.6	0.4	0.3	0.2	0.3	0.4	0.3

produced the highest yields per tree on Gisela 7, but the lowest yields were harvested from trees on G 497/8 and Tabel (Edabriz) rootstocks.

Yields calculated for one hectare are presented in Table 5. The mean hectare yield of Lapins cv. was increased from 1.3 ton in 2001 to 3.2 ton/ha in 2003. The highest yield 5.7 ton/ha in that year was achieved on trees on G 154/7 rootstock, followed by Gisela 7. The poorest cropping with Lapins cv. was recorded on Weiroot 158 rootstock. Hectare yields of Regina cv. were more than twice lower in recent years than those of Lapins. The span of the yield ranged there in 2003 from 0.7 ton/ha (Tabel (Edabriz)) to 2.0 ton/ha (Gisela 7).

Yield efficiency

The mean yield efficiency for all trees of Lapins cv. was 1.2 kg per m^3 of canopy volume, whereas for Regina it was only 0.5 kg (Table 6). The span of this yield efficiency for Lapins cv. fluctuated from 0.8 kg per m^3 of canopy volume (G 154/7 and Gisela 7) to 2.9 kg per m^3 of canopy volume (P-HL-A). The corresponding span for Regina cv. ranged from 0.3 kg (Gisela 4) to 0.8 kg (Weiroot 158). This yield efficiency generally decreased with the ageing of trees in proportion to the increase of their canopy. Therefore, in 2003 the span for Lapins cv. ranged only from 0.2 (Weiroot 158) to 0.7 (P.HL-A) kg per m^3 of canopy volume.

Yield efficiencies calculated per 100 cm^2 of trunk cross-section area differed somehow from the previous parameter (Table 7). The mean yield efficiency for all trees of Lapins cv. was 13.6 kg per 100 cm^2 of TCA, and for those of Regina cv. it was 8.3 kg. The span of the yield efficiency calculated per 100 cm^2 of TCA for Lapins cv. varied from 8.0 kg (Weiroot 158) to 18.0 kg (G 154/7 and Tabel (Edabriz)). The corresponding span for Regina cv. ranged from 6.5 kg [Tabel (Edabriz)] to 11.0 kg (Weiroot 158).

Yield efficiencies were related closely with fruit set, and while they were also monitored in this study, they were

Table 5. Yield in tons per hectare of Lapins and Regina cvs. on tested rootstocks

Rootstock	Lapins					Regina				
	2000	2001	2002	2003	Mean	2000	2001	2002	2003	Mean
G 154/7	0	1.1	0.7	5.7	1.9					
G 195/20	0.01	1.6	0.2	2.6	1.1					
G 209/1	0.02	1.3	0.2	3.3	1.2					
G 497/8	0	1.4	0.4	1.9	0.9	0.9	0.7	0.5	0.9	0.8
Gisela 4	0	1.7	0.4	4.0	1.5	1.3	0.4	0.7	1.3	1.1
Gisela 7	0	1.4	0.4	5.6	1.8	2.0	0.8	0.8	2.0	1.5
P-HL-A	0	1.3	1.0	3.3	1.4					
Tabel (Edabriz)	0.02	2.1	0.6	3.7	1.6	0.7	0.4	0.5	0.7	0.8
Weiroot 158	0	0.7	0.2	1.1	0.5	1.1	0.8	1.3	1.1	1.0
Weiroot 53	0	0.7	0.1	1.2	0.5					
Total	0	1.3	0.4	3.2	1.3	1.2	0.6	0.8	1.2	1.0
LSD (P = 0.05)		0.5	0.3	0.8	0.5	0.4	0.3	0.4	0.5	0.4

Table 6. Yield efficiency in kg per m^3 of canopy volume for Lapins and Regina cvs. on tested rootstocks

Rootstock	Lapins				Regina			
	2001	2002	2003	Mean	2001	2002	2003	Mean
G 154/7	1.4	0.2	0.6	0.8				
G 195/20	5.5	0.4	0.7	2.2				
G 209/1	3.6	0.2	0.6	1.5				
G 497/8	5.5	0.2	0.2	2.0	1.2	0.1	0.1	0.5
Gisela 4	3.0	0.2	0.5	1.2	0.5	0.2	0.1	0.3
Gisela 7	1.7	0.1	0.6	0.8	1.4	0.2	0.2	0.6
P-HL-A	7.1	0.9	0.7	2.9				
Tabel (Edabriz)	4.4	0.4	0.5	1.8	1.0	0.2	0.1	0.4
Weiroot 158	2.6	0.2	0.2	1.0	1.8	0.3	0.1	0.8
Weiroot 53	6.0	0.1	0.2	2.1				
Total	3.0	0.2	0.4	1.2	1.0	0.2	0.1	0.5
LSD (P = 0.05)	0.9	0.5	0.3	0.5	0.6	0.4	0.1	0.3

Table 7. Yield efficiency in kg per 100 cm^2 of TCA for Lapins and Regina cvs. on tested rootstocks

Rootstock	Lapins				Regina			
	2001	2002	2003	Mean	2001	2002	2003	Mean
G 154/7	19.3	6.2	28.6	18.0				
G 195/20	27.8	2.4	17.7	16.0				
G 209/1	20.4	1.9	18.0	13.4				
G 497/8	21.8	2.9	8.1	10.9	12.2	4.2	4.2	6.9
Gisela 4	23.8	2.9	16.8	14.5	10.3	5.6	6.0	7.3
Gisela 7	15.1	2.2	19.9	12.4	17.9	6.0	8.6	10.8
P-HL-A	23.2	9.9	17.7	16.9				
Tabel (Edabriz)	29.7	5.3	19.0	18.0	9.9	5.5	4.2	6.5
Weiroot 158	15.0	2.7	6.2	8.0	15.7	12.0	5.3	11.0
Weiroot 53	27.0	1.4	8.9	12.5				
Total	21.1	3.6	15.9	13.6	13.2	6.6	5.8	8.5
LSD (P = 0.05)	6.3	2.9	7.9	4.6	5.0	4.3	2.5	3.5

not finally presented here in any table. Within the trees of Lapins cv. a close relationship (r = 0.92) was found between flower set and fruit set (Fig. 3), leading to the conclusion that yield efficiency of Lapins cv. was mostly a function of flower set in this study. No similar relationship was, however, found within the trees of Regina cv.

Time of flowering

The tested rootstocks had a significant influence on the beginning of flowering of Lapins cv. (Table 8). In the case of Regina cv., with which only 5 rootstocks were tested, this influence was barely significant. Trees

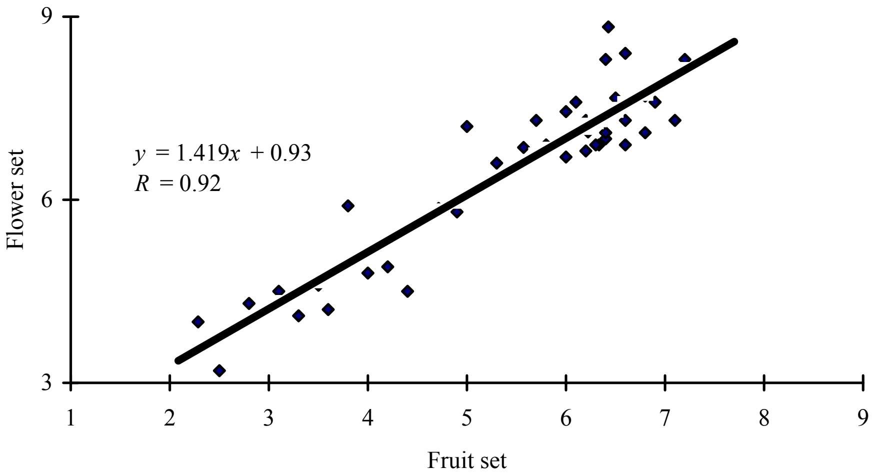

Fig. 3. Regression of fruit set on flower set with Lapins cv.

Table 8. Beginning of flowering (in calendar days) for Lapins and Regina cvs. on tested rootstocks

Rootstock	Lapins					Regina				
	2000	2001	2002	2003	Mean	2000	2001	2002	2003	Mean
G 154/7	111.9	120.3	113.0	116.7	115.5					
G 195/20	111.5	118.8	112.5	116.3	114.8					
G 209/1	109.7	117.1	111.7	116.0	113.6					
G 497/8	111.8	119.0	114.6	116.3	115.4	112.3		119.0	119.0	116.8
Gisela 4	111.9	119.2	114.5	117.0	115.7	112.3	123.0	117.3	119.0	118.0
Gisela 7	111.6	118.0	113.0	116.9	114.9	112.0	122.0	119.0	119.0	118.0
P-HL-A	112.0	121.3	114.0	116.0	115.8					
Tabel (Edabriz)	111.6	118.4	113.3	116.7	115.0	112.0	121.0	119.0	118.0	117.5
Weiroot 158	111.3	118.7	111.8	116.4	114.6	112.3	121.0	118.0	119.0	117.6
Weiroot 53	111.3	117.8	113.9	116.1	114.8					
Total	111.4	118.7	113.2	116.5	115.0	112.3	121.8	118.8	118.8	117.6
LSD (P = 0.05)	1.5	1.1	1.6	0.9	1.2	1.2	0.9	1.4	0.5	1.0

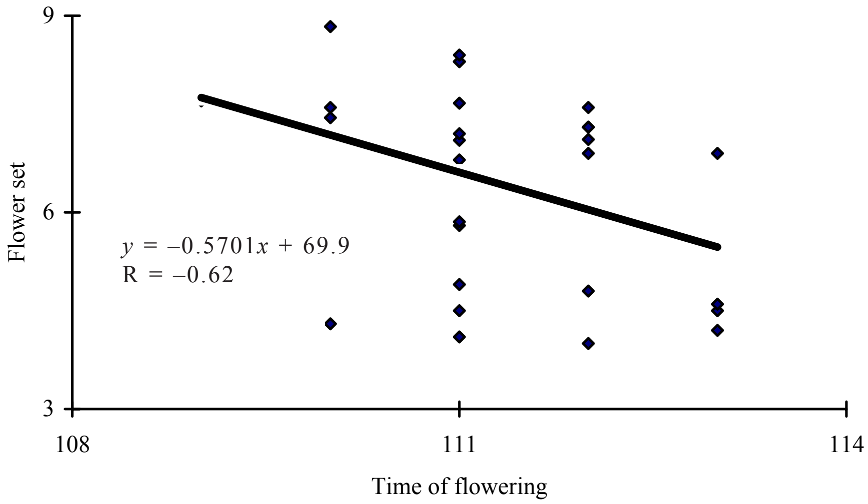

Fig. 4. Regression for time of flowering on flower set

of Lapins cv. on G 209/1 started their flowering earlier, and those on P-HL-A and Gisela 4 later than most of the others. In the search for factors that could be behind these differences, a slightly negative relationship (r = –0.62) was found between the flower set of trees and the time of their flowering (Fig. 4). According to these relationships, trees with a higher flower set had a tendency to start flowering earlier than trees with a lower flower density. This factor, however, could not certainly influence the time of flowering for trees on

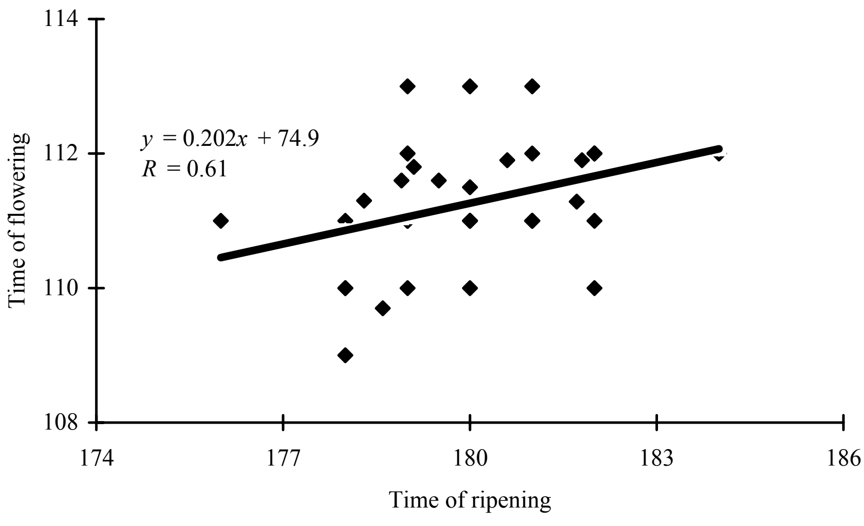

Fig. 5. Regression for time of ripening on time of flowering with Lapins cv.

Table 9. Beginning of fruit ripening (in calendar days) for Lapins and Regina cvs. on tested rootstocks

Rootstock	Lapins					Regina				
	2000	2001	2002	2003	Mean	2000	2001	2002	2003	Mean
G 154/7	180.6	197.0	188.2	186.1	188.0					
G 195/20	180.0	196.6	189.0	181.9	186.9					
G 209/1	178.6	194.1	189.0	181.4	185.8					
G 497/8	179.1	195.2	186.2	180.1	185.2	178.0	194.0	184.0	179.0	183.8
Gisela 4	181.8	197.4	188.2	183.5	187.7	180.0	195.7	185.0	179.0	185.0
Gisela 7	179.5	196.0	188.0	181.0	186.1	178.0	193.0	183.0	179.0	183.3
P-HL-A	182.0	196.0	189.0	178.0	186.3					
Tabel (Edabriz)	178.9	193.8	187.0	183.5	185.8	178.0	193.0	183.0	180.0	183.5
Weiroot 158	178.3	195.7	185.0	181.4	185.1	179.0	193.0	183.0	179.0	183.5
Weiroot 53	181.7	195.4	186.1	182.0	186.3					
Total	179.8	195.7	187.5	182.2	186.3	178.6	193.7	183.6	179.2	183.8
LSD (P = 0.05)	1.4	1.8	1.0	2.1	1.5	1.5	1.9	1.5	1.0	1.3

Table 10. Mean fruit weight (g) for Lapins and Regina cvs. on tested rootstocks

Rootstock	Lapins				Regina			
	2001	2002	2003	Mean	2001	2002	2003	Mean
G 154/7	8.7	9.7	7.8	8.7				
G 195/20	9.2	9.9	7.6	8.9				
G 209/1	8.1	9.7	7.4	8.4				
G 497/8	7.9	9.7	7.7	8.4	9.6	9.9	7.5	9.0
Gisela 4	8.9	10.1	7.7	8.9	9.4	9.9	8.1	9.1
Gisela 7	8.0	9.7	7.0	8.2	9.1	10.2	7.9	9.1
P-HL-A	7.4	9.6	7.4	8.1				
Tabel (Edabriz)	7.7	9.7	7.2	8.2	9.2	10.6	7.9	9.2
Weiroot 158	7.0	8.7	8.2	8.0	9.6	9.7	8.0	9.1
Weiroot 53	6.8	8.8	7.0	7.5				
Total	8.1	9.6	7.5	8.4	9.4	10.1	7.9	9.1
LSD (P = 0.05)	0.4	0.3	0.2	0.3	0.5	0.4	0.6	0.5

G 209/1 and Gisela 4 because their flower sets were at opposite positions.

Time of ripening

Similarly like the time of flowering, the time of fruit ripening was significantly influenced by the tested rootstocks, especially with Lapins cv. (Table 9). The range of this variation, however, differed in particular years. The greatest span in the beginning of fruit ripening was recorded with Lapins cv. in 2003 – 8 days. There was a difference between P-HL-A and G 154/7 rootstocks. On the average, the earliest ripening was observed on Weiroot 158 and the latest on G 154/7. Significantly later ripening further occurred on Gisela 4, also in the case of Regina cv.

A slight relationship (r = 0.61) was revealed within the trees of Lapins cv. between the time of fruit ripening and the time of flowering (Fig. 5). This dependence, however, could explain only a small part of the above-mentioned variability. No relationship between fruit ripening and time of flowering existed within the trees of Regina cv. that generally cropped poorly in this study. In both cultivars, no further relationship existed between fruit set and time of fruit ripening.

Weight of fruits

The tested rootstocks significantly influenced the weight of the fruits of Lapins cv. (Table 10). In the case of Regina cv. these differences were on average negligible. The mean fruit weight of Lapins cv. spanned from 7.5 g (Weiroot 53) to 8.9 g (G 195/20 and Gisela 4). The span was the greatest in 2001, when the mean difference in fruit size between Weiroot 53 and G 195/20 rootstocks reached 2.4 g. The fruit weight of Lapins was mostly negatively dependent on the fruit set (Fig. 6). This relationship was, however, completely opposite in the case of Regina cv. (Fig. 7). In this case, variants with the lowest fruit set brought fruits of smaller size.

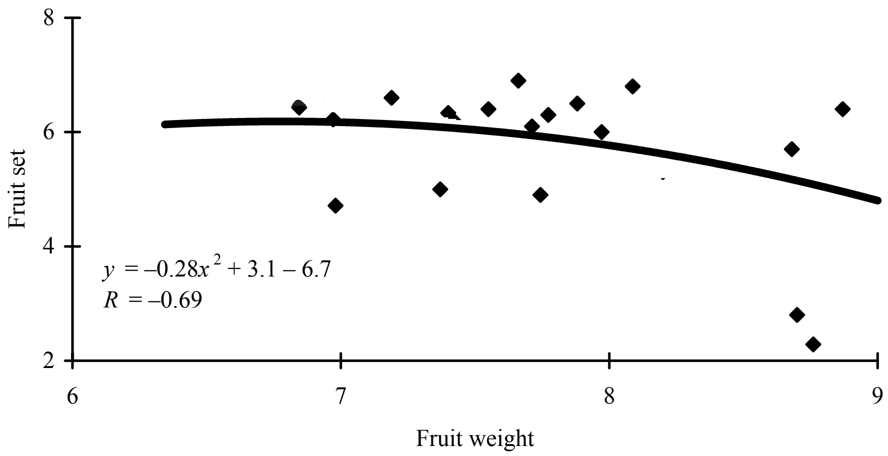

Fig. 6. Regression for weight of fruits on fruit set with Lapins cv.

DISCUSSION

Tree vigour

In comparison with previous experiments with sweet cherries on dwarf rootstocks at Holovousy that were run without tree pruning and training, in this trial the development of canopy volume and trunk cross-section area were about one year behind (BLAŽKOVÁ 1998, 1999). This is a confirmation of the well-known experience that training of sweet cherry trees, even as spindles, delays total canopy development of the orchards and the level of the first yields. Poor bearing of Regina cv. trees stimulated the vigour of tested rootstocks and could also explain the different behaviour of Weiroot 158 in combinations with both cultivar testers.

Yields

Practically all rootstocks that were included in this study were very precocious, and their yields during the first years in Lapins cv. were comparable with results from the latest sweet cherry experiments established at Holovousy in which similar tree training was used (BLAŽKOVÁ 2001; BLAŽKOVÁ, HLUŠIČKOVÁ 2001, 2003). Regina cv. trees started bearing extremely early (practically one year earlier than Lapins), and in 2000 they already produced yields comparable to trees of Lapins in 2001. Unfortunately, in the next three years, yields of Regina cv. trees were poor, partly because of flower bud damage by spring frosts and probably mainly due to insufficient cross-pollination. Regina cv. flowers very late and the time of flowering of other cultivars in some years need not have been late enough for sufficient over-lapping. This poor cropping of Regina cv. during the three decisive years of this study influenced adversely the total performance of the tested rootstocks.

Time of flowering

In this study, sweet cherry trees of Lapins cv. on G 209/1 and Gisela 4 rootstocks differed significantly from each other in the time of their flowering. Rootstock G 209/1 promoted the start of flowering about two days earlier than Gisela 4. Similar differences in the time of flowering within other rootstocks of the Gießen series were reported previously from Germany (FRANKEN-BEMBENEK 1995). As it was also found in this study, the time of flowering can be further slightly influenced by the flower set. Trees of higher flower density started

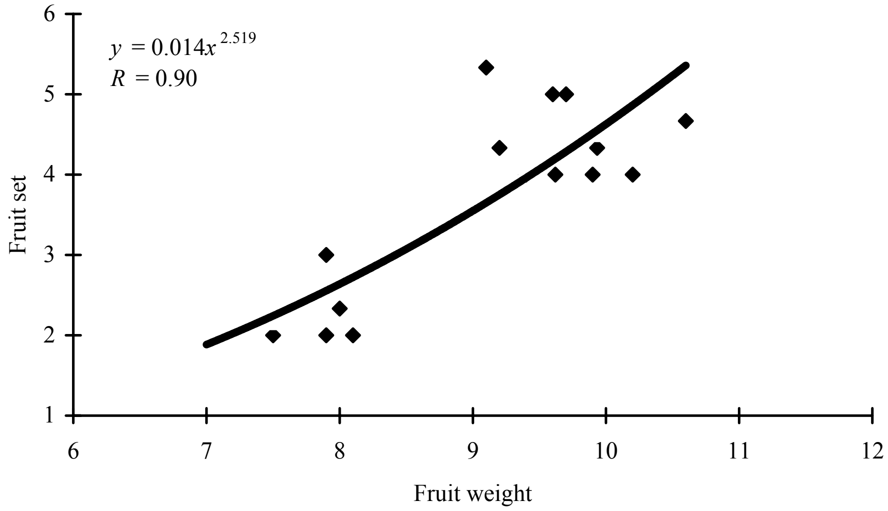

Fig. 7. Regression for weight of fruits on fruit set with Regina cv.

their flowering somewhat earlier than those of lower flower density.

Time of ripening

Significant differences between rootstocks studied in this trial were also observed in the time of fruit ripening. The greatest span in this respect was found between trees on Weiroot 158 and G 154/7 rootstock. Fruits on the former ripened on average about three days earlier than those on the later. Besides this rootstock influence, a certain modifying effect on this character could have further inflicted differences in the time of flowering. A significant influence of some rootstocks on the time of fruit ripening of the sweet cherry was also observed in our previous study (BLAŽKOVÁ, HLUŠIČKOVÁ 2001).

Weight of fruits

Dwarf sweet cherry rootstocks affect the size of fruits very distinctly. Some of them have an intrinsic potential for smaller fruit due to the high number of fruits per spur and total fruit set (WEBSTER, SCHMIDT 1996; MÖLLER 1999). Therefore, more severe pruning and a higher level of fertilising are recommended for them to promote a sufficient length of new shoots, and the relationship between vegetative and generative growth. In this study, the fruit weight of Lapins cv. was closely negatively dependent on the fruit set, which is in agreement with the above-mentioned findings. Fruits from trees on Weiroot 53, which were the smallest in this trial, exceed, however, the scope of this relationship. This reduction was much greater than it should be. Then, it is obvious that in the case of this rootstock other factors influencing the fruit size have to be involved.

With trees of Regina cv. that yielded poorly in this study, the completely opposite relationship between fruit set and fruit weight was found. Here, surprisingly, the weight of fruits was increased with increasing fruit set. An explanation of the phenomenon could be that fruit sets of Regina cv. trees in this study did not achieve mostly a boundary for competitiveness of fruit set for their size. On the other hand, too few fruits in low fruit sets developed under greater competition from the excessive vegetative growth that was promoted by this situation.

CONCLUSIONS ON ROOTSTOCKS

From a complex evaluation of the rootstocks that were included in the present study, the following conclusions could be drawn for the time being:

Rootstock G 195/5 looks like the most promising of these new series as it produces trees with Lapins cv. It produces trees even smaller than P-HL-A or Tabel (Edabriz), with better yield efficiency and good fruit size.

Both P-HL-A and Tabel (Edabriz) proved to be quite reliable rootstocks for modern sweet cherry orchards established in domestic soil and climatic conditions.

For more vigorous trees, rootstock G 154/7 also seems to be interesting because of its high yields and unreduced fruit size. This rootstock is, however, less precocious than those previously mentioned.

With Regina cv., the relatively best results at present were achieved on Weiroot 158. This scion-rootstock combination should be recommended for further testing.

Rootstock Weiroot 53 should be withdrawn from testing in the Czech Republic because of its inferior graft compatibility and its negative influence on the fruit size. This conclusion is also supported by similar results from northern Germany (STEHR 2001).

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Received for publication February 10, 2004
Accepted after corrections March 22, 2004

První výsledky hodnocení nových vegetativních podnoží třešní z pokusné výsadby založené v Holovousích

ABSTRAKT: Deset vegetativních zakrslých a polozakrslých třešňových podnoží bylo po pět vegetačních období hodnoceno v pokusu založeném v Holovousích na jaře 1999 v rámci programu mezinárodních pokusů s podnožemi třešní, který je v Evropě koordinován Výzkumným ústavem pro rostliny a půdu v Aarslevu v Dánsku. Všechny podnože byly zkoušeny naštěpováním odrůdy Lapins. Na pěti z nich byla dále naštěpována odrůda Regina. Z nových podnoží byla jako nejvíce perspektivní pro odrůdu Lapins vybrána G 195/5. Stromy na této podnoži byly menší než na podnožích P-HL-A nebo Tabel (Edabriz), měly vyšší specifickou plodnost a větší hmotnost plodů. V souhlasu s výsledky z předcházejících pokusů se potvrdila vhodnost podnoží P-HL-A a Tabel (Edabriz) pro moderní husté výsadby nízkých tvarů v České republice. Z polozakrslých podnoží je nejzajímavější G 154/7, protože stromy na této podnoži dosáhly nejvyšších výnosů a měly vyšší hmotnost plodů. Z podnoží, na kterých byla zkoušena odrůda Regina, se jako relativně nejlepší projevila podnož Weiroot 158. Naproti tomu zklamáním byly výsledky hodnocení podnože Weiroot 53, protože měla špatnou roubovou afinitu a negativně ovlivňovala velikost plodů. Některé ze zkoušených podnoží významně ovlivňovaly dobu kvetení a dobu zrání plodů. Mezi hodnocenými znaky bylo nalezeno několik regresních vztahů, které jsou v příspěvku podrobněji diskutovány.

Klíčová slova: třešeň; podnože; odrůdy; růst stromů; výnos; specifická plodnost; období květu; období zrání; hmotnost plodu

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