Results of an orchard trial with new clonal sweet cherry rootstocks established at Holovousy and evaluated in the stage of full cropping

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ABSTRACT: Ten clonal dwarf or semi-dwarf rootstocks were evaluated in a trial that was established in the spring of 1999 at Holovousy. Lapins cv. was used as a scion tester for all these rootstocks; five of them were tested also by Regina cv. Among the new rootstocks G 195/5 was evaluated as the most promising for Lapins cv. The highest rate of mortality and symptoms of poor scion compatibility with Lapins cv. were observed on Weiroot 53 and Weiroot 158. The most vigorous of the tested rootstock was G 497/8 followed by Gisela 7 and Gisela 4. Intermediate vigour was recorded on trees on G 154/7, P-HL-A, Gisela 3 and Tabel Edabriz. The least vigorous were G 195/20, Weiroot 158 and Weiroot 53. The highest accumulated yield per hectare of the Lapins cv. (21.2 tons) was harvested from Gisela 7 rootstock. With Lapins cv. higher yield efficiencies were calculated for P-HL-A, G 195/20 and Tabel Edabriz. In the case of the Regina cv. the highest yield efficiency was on Gisela 7. The mean fruit weight of the Lapins cv. had a span from 8.2 g (Weiroot 53) to 9.7 g (G 195/20). With the Lapins cv. less fruit cracking was observed on fruits from Tabel Edabriz and Gisela 7. Significant differences between tested rootstocks were found also at the time of tree flowering and ripening.

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

Several series of dwarfing rootstocks were bred in research institutes and universities all over the world in the 1960s and 1970s. These series were reviewed by Bujdosó and Hrotkó (2005). Since 1994 international cherry rootstock trials in Europe were co-ordinated by the Danish Institute of Plant and Soil Science at Aarslev, Denmark. The Research and Breeding Institute of Pomology Holovousy Ltd. has jointed these trials as one of their partners and established an experimental orchard with a range of selected cherry rootstocks in the spring of 1999 using nursery stock material that had been propagated in Aarslev. Preliminary results from the orchard study based upon the first five years of observations have been previously published (Blažková, Hlušičková 2004). This paper deals with more comprehensive results that include a stage of the full cropping of the orchard.

MATERIAL AND METHODS

For this study, ten sweet cherry rootstocks (G 154/7, G 195/20, G 497/8, Gisela 3, Gisela 4, Gisela 7, P-HL-A, Tabel Edabriz, Weiroot 158 and Weiroot 53) were used. 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, the cultivar Regina from Germany was grafted as another tester. Nursery stock of the material was grown from bench-grafted rootstocks at the Danish Institute of Plant and Soil Science at Aarslev, Denmark. It mostly consisted of two-year-old trees without ramification.

The experimental orchard was established in the spring of 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 of Regina, only one tree per replication was planted on each tested rootstock. Climatic conditions at Holovousy are characterised by the average annual temperature of 8.1°C and the 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.

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Experimental trees were cut back just after planting to induce side branching at the height of 0.7 m above ground level. Then they were trained as spindles using strong wooden stakes as supports and using shoot binding and pegging to achieve more horizontal positions of the side branches. No irrigation was applied in the orchard. Clean strips were kept under trees by contact herbicides whereas 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 the prolonging shoots and characteristics necessary for calculations of canopy volume and trunk cross-section area were measured on all experimental trees. From the second year, the begin date of flowering (when 25 flowers were open), flower set, fruit set, begin date of fruit ripening, percentage of cracked fruits, weight of yield, mean fruit weight and soluble solids content in the fruit were further recorded. Besides these characteristics, the health status of every tree was regularly monitored during the run of this experiment.

Phenological data were recorded as successive calendar dates starting January 1^{st}. The 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 of a randomly gathered sample of 50 fruits. In the case of 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

Mortality of trees

Tree dieback was recorded only on trees grafted by Lapins cv. (Table 1). The highest rate of mortality occurred on the rootstock Weiroot 53 where 4 trees among 9 that were planted died before the end of 2006. Half of the loss was further observed with trees on Weiroot 158 and an additional tree died on Tabel Edabriz rootstock. Nearly all cases of the tree dieback were clearly bound with poor scion compatibility expressed by yellowing of leaves and trunk gummosis. These symptoms are the most severe on all trees on Weiroot 53 and probably all of them will die during the next few years.

No symptoms indicating any problems with scion compatibility have been observed till the present on trees grafted by Regina cv. Unfortunately, the rootstock Weiroot 53, which was the most involved concerning these problems with Lapins cv., was not used in the combination.

Tree vigour

The most vigorous of the tested rootstock was G 497/8 followed by Gisela 7 and Gisela 4 (Fig. 1). Intermediate vigour was observed on trees on G 154/7, P-HL-A, Gisela 3 and Tabel Edabriz. The least vigorous were G 195/20, Weiroot 158 and Weiroot 53. The weak vigour of Lapins trees on Weiroot 158 and especially on Weiroot 53, however, might be partly connected to the poor scion compatibility of these combinations.

Table 1. Mortality of trees (%) of Lapins cv. in the orchard 2000–2006

Rootstock	2000	2001	2002	2003	2004	2005	2006	Total
G 154/7	0	0	0	0	0	0	0	0
G 195/20	0	0	0	0	0	0	0	0
G 497/8	0	0	0	0	0	0	0	0
Gisela 3	0	0	0	0	0	0	0	0
Gisela 4	0	0	0	0	0	0	0	0
Gisela 7	0	0	0	0	0	0	0	0
P-HL-A	0	0	0	0	0	0	0	0
Tabel Edabriz	0	0	0	11	0	0	0	11
Weiroot 158	0	0	0	0	11	0	11	22
Weiroot 53	11	22	0	0	0	11	0	44
Total	1.1	2.2	0	1.1	1.1	1.1	1.1	7.8

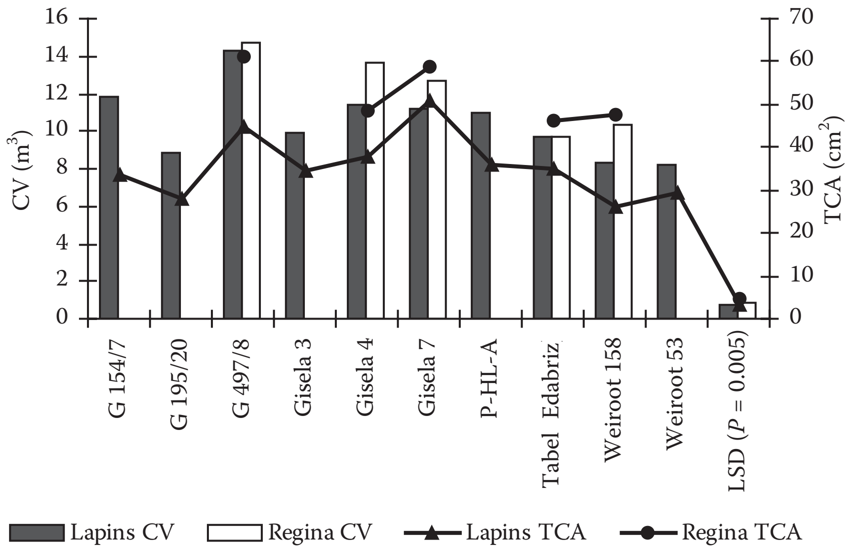

Fig. 1. Tree vigour expressed by canopy volume (CV) and trunk-cross-section area (TCA) in 2006

Trees of Regina cv. on the same rootstock grew mostly about 10–20% more vigorously than trees of Lapins. The weakest growth of Regina cv. was observed on Tabel Edabriz.

Flower set

All rootstocks generated abundant flowering of trees as soon as the second year after planting (Table 2). Differences between rootstocks with both cultivars were generally relatively small and mostly insignificant. With Lapins cv. the highest values of the mean flower set were observed on the rootstocks Gisela 4, G 195/20 and Weiroot 158. On the other hand, the lowest mean flower set was observed in trees on Gisela 7, which were also somewhat less precocious than trees on other rootstocks. Inferior flowering of Lapins cv. trees on all rootstocks took place in 2002 as a response to the infestation of these trees by cherry leaf spot in the previous year. With Regina cv., relatively the most abundant flowering was recorded with trees on Weiroot 158, which significantly differed in this characteristic from trees on Gisela 4 and Gisela 7.

Trees of Regina cv. had generally somewhat a higher flower set than trees of Lapins. This phenomenon is probably related to poor cropping of the cultivar in this trial.

Fruit set

Also in this characteristic the differences in the total means between rootstocks with both cultivars were relatively small and mostly insignificant (Table 3). With Lapins cv. the highest value of the mean fruit set was recorded on the rootstock G 195/20 followed

Table 2. Flower set (1–9) of Lapins and Regina cvs. on tested rootstocks in 2000–2006

Rootstock	Lapins								Regina							
	00	01	02	03	04	05	06	Ø	00	01	02	03	04	05	06	Ø
G 154/7	6.9	7.3	4.1	6.9	6.3	8.2	7.9	6.8								
G 195/20	7.3	8.3	4.9	7.1	5.3	8.2	7.8	7.0								
G 497/8	7.1	7.7	4.5	5.8	4.6	8.9	7.9	6.6	7.7	8.7	5.3	8.0	8.0	8.0	8.0	7.7
Gisela 3	6.9	7.7	3.2	6.8	4.6	8.3	7.7	6.5								
Gisela 4	7.1	8.3	4.6	7.6	5.6	8.8	8.4	7.2	7.7	7.0	6.0	8.0	8.0	7.0	7.7	7.3
Gisela 7	5.9	7.4	4.2	7.1	5.0	7.7	7.6	6.4	5.3	7.7	7.0	8.0	7.5	8.0	8.0	7.4
P-HL-A	6.7	6.9	4.8	7.2	4.3	8.3	7.7	6.6								
Tabel Edabriz	7.0	7.6	4.5	7.3	4.7	8.8	7.7	6.8	7.3	7.7	6.0	7.7	7.7	8.0	8.0	7.5
Weiroot 158	7.3	8.4	4.3	6.6	6.0	8.5	8.2	7.0	7.7	8.0	7.0	8.8	7.7	8.0	8.5	8.0
Weiroot 53	6.9	8.8	4.0	5.9	5.0	8.6	7.7	6.7								
Total	6.9	7.8	4.3	6.8	5.1	8.4	7.9	6.8	7.1	7.8	6.3	8.1	7.8	7.8	8.0	7.6
LSD (P = 0.05)	0.6	0.4	0.7	0.5	0.4	0.3	0.5	0.4	1.1	0.9	1.0	0.6	0.6	0.8	0.5	0.5

Table 3. Fruit set (1–9) of Lapins and Regina cvs. on tested rootstocks in 2000–2006

Rootstock	Lapins								Regina							
	00	01	02	03	04	05	06	Ø	00	01	02	03	04	05	06	Ø
G 154/7	6.9	5.7	3.3	6.3	4.7	6.4	4.1	4.8								
G 195/20	7.3	7.2	4.2	6.4	4.6	5.8	6.1	5.4								
G 497/8	7.1	6.5	3.1	4.9	3.8	6.8	4.9	4.8	7.7	4.0	4.0	2.0	4.7	2.3	3.3	4.0
Gisela 3	6.9	6.7	2.5	6.2	3.8	5.0	5.1	4.7								
Gisela 4	7.1	6.4	3.5	6.1	4.2	6.4	5.6	5.0	7.7	4.0	4.3	2.0	4.3	2.0	5.0	4.2
Gisela 7	5.9	6.0	3.6	6.2	4.7	6.6	5.4	4.9	5.3	5.5	4.0	3.0	5.0	3.0	4.0	4.3
P-HL-A	6.7	6.3	4.0	5.8	3.9	6.0	5.0	4.8								
Tabel Edabriz	7.0	6.9	4.4	6.6	4.0	6.2	5.7	5.2	7.3	4.3	4.7	2.0	4.0	2.3	4.0	4.1
Weiroot 158	7.3	5.8	2.8	5.3	4.7	4.4	6.7	4.7	7.7	5.0	5.0	2.3	4.0	2.0	3.0	4.1
Weiroot 53	6.9	6.8	2.3	4.7	4.5	5.7	5.0	4.7								
Total	6.9	6.4	3.4	5.9	4.3	5.9	5.4	4.9	7.1	4.6	4.4	2.3	4.4	2.3	3.9	4.1
LSD (*P* = 0.05)	0.6	0.5	0.6	0.6	0.4	0.6	0.5	0.5	1.1	0.7	0.3	0.4	0.5	0.3	0.4	0.4

by Tabel Edabriz. The lowest values of the fruit set with the cultivar were observed on Gisela 3, Weiroot 158 and Weiroot 53. With Regina cv. no significant differences in total means could be determined within the tested rootstocks.

Yields

With Lapins cv. the highest yields in kg per tree were recorded on the rootstock Gisela 7 (Table 4). The mean value in this rootstock-cultivar combination reached 2.6 kg, whereas in 3 different years this yield was equal to or close to over 4 kg. Yields in kg per tree of Lapins on G154/7 and Tabel Edabriz were also not significantly lower. On the contrary, the lowest yields were harvested from trees on the rootstocks Weiroot 53 and Weiroot 158.

In the case of Regina cv. the yields were significantly lower because of frost damage of flower buds in 2002, 2003 and 2005. The other reason for the poor yield of the cultivar was probably insufficient cross-pollination in the orchard. Trees of the Regina cv. brought relatively the highest yields per tree on Gisela 7 but the least yields were harvested, on the other hand, from trees of the cultivar on G 497/8 and Tabel Edabriz rootstocks.

Accumulated yields for 2000–2006 calculated for one hectare are presented in Fig. 2. The highest accumulated yield per tree in the case of the Lapins cv. was equal to 21.2 tons, which was harvested from trees on Gisela 7 rootstock. Then, the second rank (18.7 t) in comparison belonged to the rootstock G 154/7 and the third (18.1 t) to Tabel Edabriz. On the other hand, the lowest accumulated yield (7.7 t) of the Lapins was

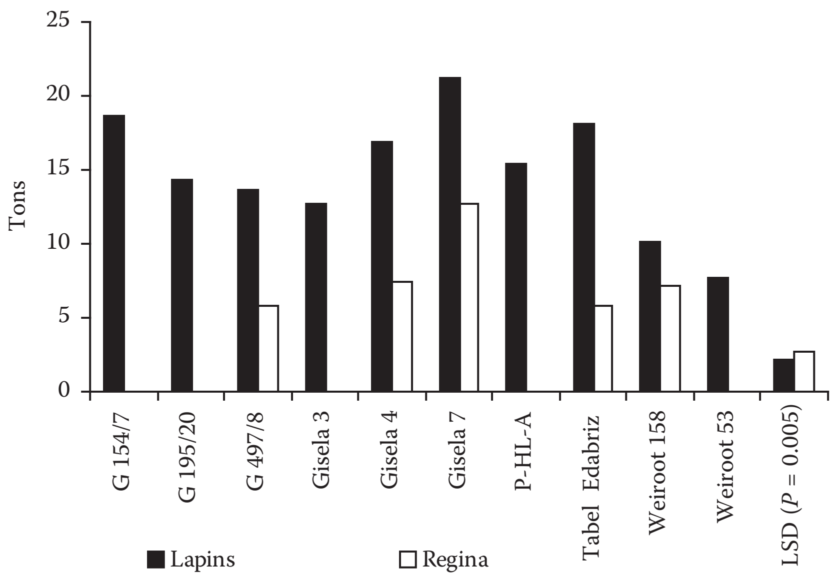

Fig. 2. Accumulated yield (t/ha) from 2000–2006

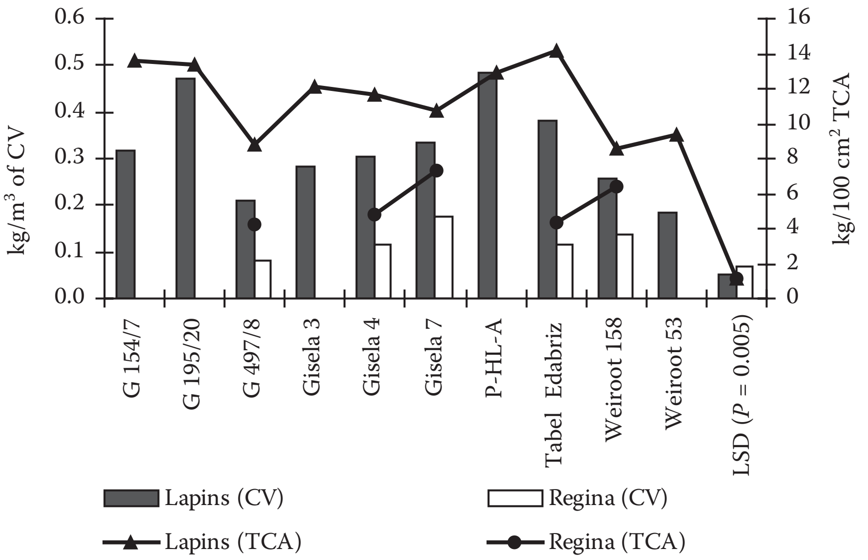

Fig. 3. Mean yield efficiency (kg/m^3) of CV and 100 cm^2 of TCA for 2002–2006

recorded on Weiroot 53. Not much higher (10.1 t) was the yield of the cultivar on Weiroot 158.

Hectare yields of the Regina cv. were about half of the values recorded with Lapins. The highest accumulated yield (12.7 t) for 2000–2006, even with this cultivar, was harvested from trees on Gisela 7 rootstock. On the contrary, with the Regina cultivar the lowest accumulated yields (5.8 t) were harvested on G 497/8 and Tabel Edabriz rootstocks.

Yield efficiency

With the Lapins cv. higher yield efficiencies were calculated for P-HL-A, G 195/20, Tabel Edabriz and G 154/7 rootstocks (Fig. 3). Intermediate levels of yield efficiencies of the cultivar were recorded in trees on rootstocks Gisela 7, Gisela 4 and Gisela 3. The lowest levels of yield efficiency were found on Weiroot 53, G 497/8 and Weiroot 158.

In the case of the Regina cv., the highest yield efficiency was observed on trees grafted on Gisela 7, whereas the lowest levels of the parameter were on G 497/8 and Tabel Edabriz.

Weight of fruits

The mean fruit weight of Lapins cv. had a span from 8.2 g, found in the case of the rootstock Weiroot 53, to 9.7 g from trees on G 195/20, which was the most outstanding in this respect (Fig. 4). The majority of the tested rootstocks, however, did not differ significantly from one to the other in the characteristic. In the case of the Regina cv. the differences between tested rootstocks were negligible on average. The relatively largest fruits of the cultivar were harvested from trees on Gisela 7 and Tabel Edabriz.

Soluble solids content

The content of soluble solids in fruits varied in the total means even less than the weight of fruits, and the great majority of differences among tested

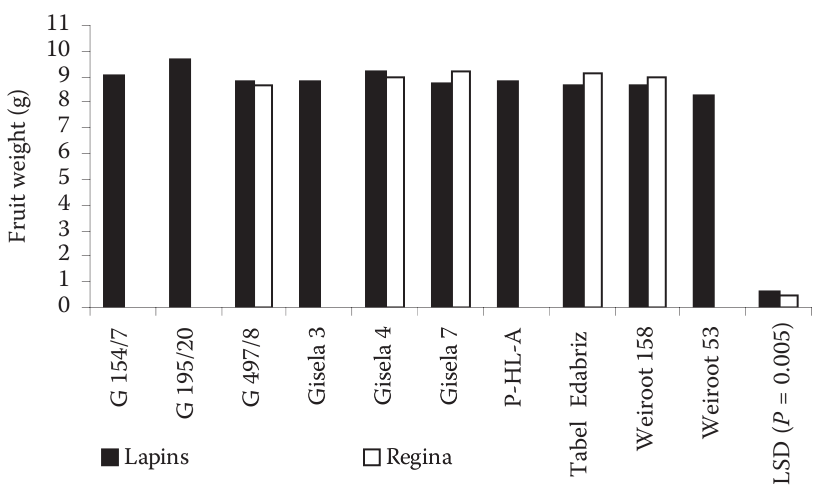

Fig. 4. Mean fruit weight (g) from 2001–2006

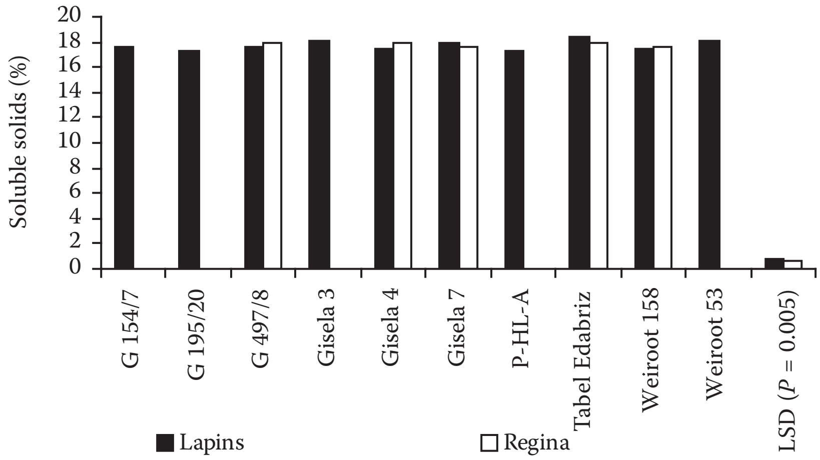

Fig. 5. Mean soluble solids content (%) in fruits from 2001–2006

rootstocks were insignificant (Fig. 5). The highest mean percentage of soluble solids was recorded with fruits of Lapins cv. on Tabel Edabriz rootstock (18.4%), whereas the lowest percentage of soluble solids (17.3%) was found in fruits of the cultivars from trees on the rootstock G 195/20. The data indicate some reverse relationship between the weight of fruits and the content of soluble solids in them, but it was not possible to calculate any significant regression within these complete sets. With the Regina cv. no significant differences between rootstocks in the total percentage of soluble solids were found.

Greater differences in the content of soluble solids in fruits were observed between particular years of the study. With the Lapins cv. the total mean of the soluble solids (from all tested rootstocks) in 2002 amounted to 16.9%, but in the next year 2003, it reached 19.5%. In the case of the Regina cv. the total mean of the soluble solids in 2004 was only 15.9%, whereas in 2006 it was 19.6%.

Cracking of fruits

Except for the years 2002 and 2003, fruit cracking was a serious problem of the Lapins cv. in all years of the testing. In the total means of the cultivar the highest rate (50.1%) of fruit cracking was recorded on Gisela 4 rootstock (Fig. 6). Nearly the same rate of fruit cracking (49.0%) was recorded on G 154/7 rootstock. On the other hand, the lowest level of cracking (36.2%) was observed in fruits of the cultivar from Tabel Edabriz. A low percentage of fruit cracking (37.2%) was found also on Gisela 7.

Fruits of the second cultivar, Regina, cracked on the average about 5 times less. Despite this different level of fruit cracking, differences between rootstocks were obvious as well. The highest percentage of fruit cracking (11.9%) was recorded on fruits of the Regina cv. harvested from trees on the rootstock Gisela 4, whereas the lowest percentage of cracking (6.0%) was found on Tabel Edabriz.

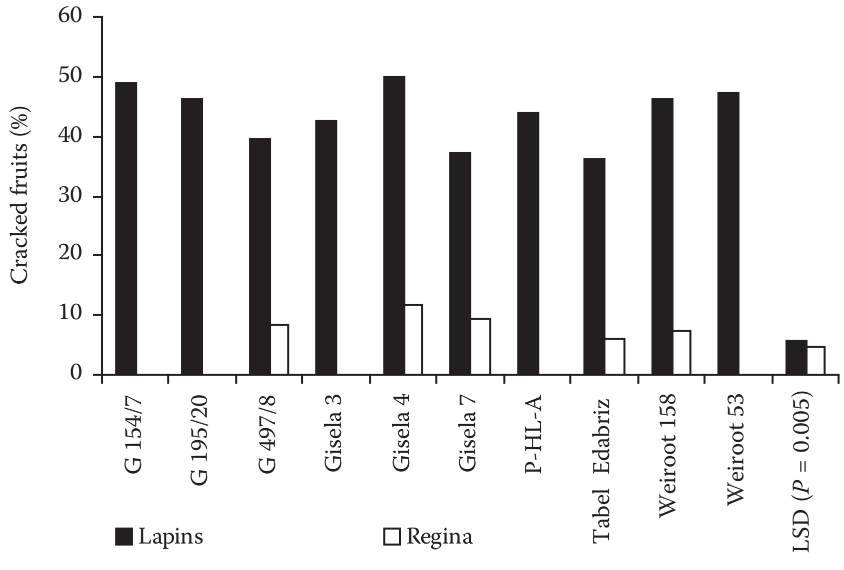

Fig. 6. Mean cracking of fruits (%) from 2001–2006

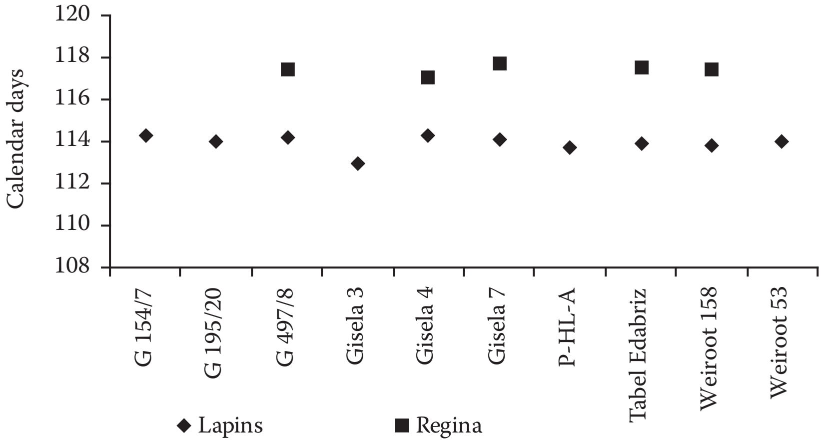

Fig. 7. Mean beginning of flowering in calendar days in 2001–2006

In some years (e.g. 2005) a positive regression of fruit cracking rate on fruit weight was found with the Lapins cv. using a complete set of data (Fig. 9) but in other years this relationship was negligible.

Time of flowering

The tested rootstocks had slightly different but significant influence on the beginning of flowering of the Lapins cv. (Fig. 7). Trees of the cultivar on Gisela 3 rootstock started flowering on average about one day earlier than those on the majority of other rootstocks. On the contrary, trees of the Lapins cv. on the rootstocks G 154/7 and Gisela 4 started flowering about a half day later than the others. In the case of the Regina cv., on which only 5 rootstocks were tested, these differences in the time of flowering were not significant.

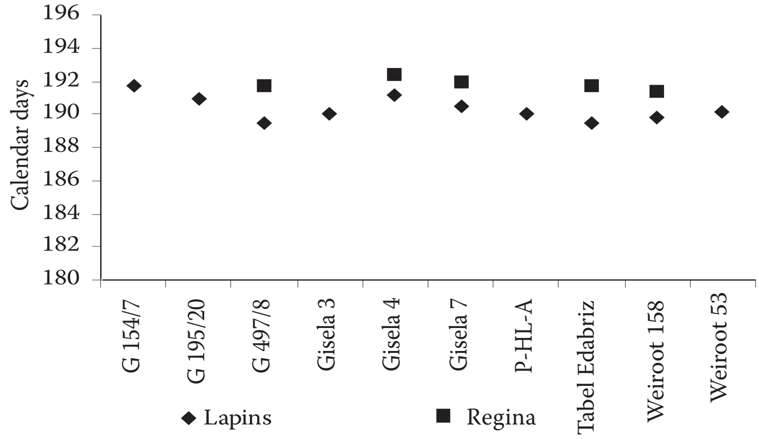

Fig. 8. Mean beginning of fruit ripening in calendar days in 2001–2006

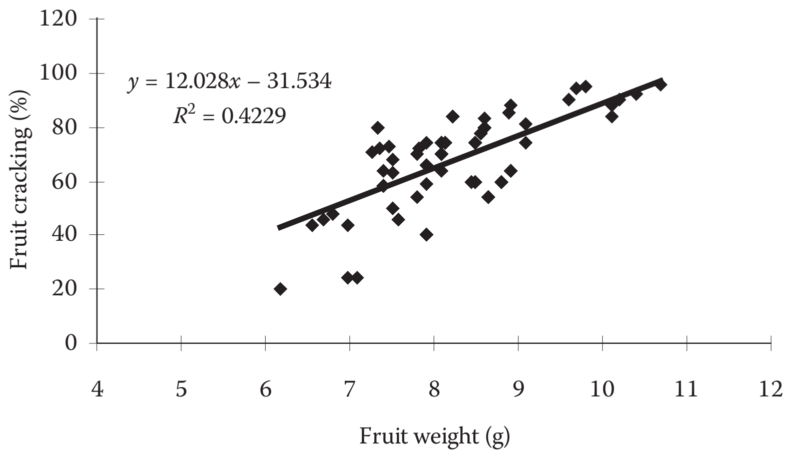

Fig. 9. Regression of fruit cracking on fruit weight with Lapins cv. 2005

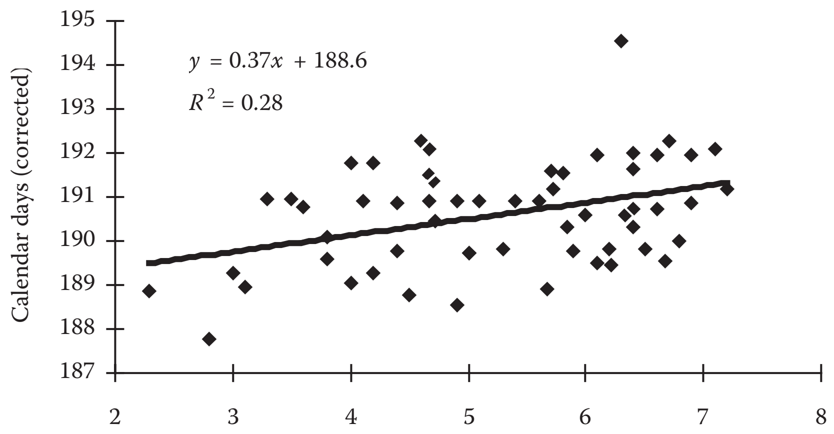

Fig. 10. Regression of fruit ripening on fruit set with Lapins cv. 2000–2006

Time of ripening

Similar to the time of flowering, the time of fruit ripening was also significantly influenced by the tested rootstocks, especially with the Lapins cv. (Fig. 8). The span of the mean time of fruit ripening of the cultivar on tested rootstocks was equal to 2.3 days. The earliest ripening was recorded on the rootstock Tabel Edabriz and the latest ripening on the rootstock G 154/7. In the case of Regina the span in time of ripening among different rootstock was shorter – 1.2 days. The earliest ripening was observed on the rootstock Weiroot 158 and the latest on Gisela 4.

A slightly positive relationship was revealed within the trees of the Lapins cv. between fruit set and time of fruit ripening (Fig. 10). This association, however, could explain only a small part of the above-mentioned variability in this characteristic. For example, trees of the Lapins cv. on the rootstock Tabel Edabriz, which were distinguished by the earliest fruit ripening, had on average a rather high fruit set.

DISCUSSION

Scion compatibility

Two rootstocks – Weiroot 53 and Weiroot 158 should not be recommended for growing of the Lapins cv. in the Czech Republic because of poor scion compatibility and a high rate of tree mortality. Lapins on Tabel Edabriz also does not seem to be quite trouble-free in this respect. On the other hand, the Regina cv. had no problems on these rootstocks either with symptoms of poor scion compatibility or with tree dieback.

In the case of Weiroot 53, tree losses reported from trials in Germany excluded this rootstock from commercial growing (Stehr 2001, 2005). This author further mentioned that several cultivars had health

Table 4. Mean yield (kg per tree) of Lapins and Regina cvs. on tested rootstocks in 2001–2006

Rootstock	Lapins							Regina						
	01	02	03	04	05	06	Ø	01	02	03	04	05	06	Ø
G 154/7	0.8	0.5	4.3	2.7	2.9	2.8	2.3							
G 195/20	1.2	0.2	2.0	1.6	1.6	4.2	1.8							
G 497/8	1.1	0.3	1.5	1.5	2.1	3.9	1.7	0.5	0.4	0.7	1.4	0.1	0.7	0.6
Gisela 3	1.0	0.2	2.5	1.6	0.9	3.4	1.6							
Gisela 4	1.3	0.3	3.0	2.5	1.8	3.8	2.1	0.3	0.5	1.0	1.7	0.1	1.0	0.8
Gisela 7	1.0	0.3	4.2	2.3	4.1	4.0	2.6	0.6	0.6	1.5	3.1	0.2	2.0	1.3
P-HL-A	1.0	0.8	2.5	1.9	2.8	2.7	2.0							
Tabel Edabriz	1.6	0.5	2.8	2.3	2.2	4.2	2.3	0.3	0.4	0.5	0.8	0.2	1.7	0.6
Weiroot 158	0.5	0.2	0.8	1.0	1.0	4.1	1.3	0.6	1.0	0.8	1.4	0	0.7	0.8
Weiroot 53	0.6	0.1	0.9	1.0	0.9	2.4	1.0							
Total	1.0	0.3	2.5	1.8	2.0	3.5	1.9	0.5	0.6	0.9	1.7	0.1	1.2	0.8
LSD (P = 0.05)	0.4	0.2	0.6	0.3	0.5	0.4	0.4	0.2	0.3	0.4	0.5	0.2	0.3	0.3

problems on Weiroot 158. Mortality of trees on this rootstock was reported also from Slovenia (Usenik et al. 2006). On the contrary, Weiroot 158 proved to be the best adapted clonal rootstock for the Hungarian climate (Bujdosó, Hrotkó 2005). Also in Utah, USA Weiroot 158 had the highest survival rate, whereas the greatest tree mortality was recorded on Gisela 3 and Gisela 4 (Kappel et al. 2005).

Tree vigour

This study confirmed considerable differences in tree vigour among tested rootstocks. It makes possible for the grower a method to choose the proper rootstock according to soil quality and the tree spacing used in the orchard (Blažková 2001).

A prolonged period of observation contributed to more precise classification of the rootstocks in this characteristic. The rootstock G 154/7, which developed the largest tree canopy in the first few years (Blažková, Hlušičková 2004), should be finally classified as medium vigorous only. The rootstock G 195/20 could be classified as the most dwarfing based upon this study. On the contrary, trees of Weiroot 53 and Weiroot 158 grafted by the Lapins cv., which grew very weak, did not probably indicate strong dwarfing potential of the rootstocks but rather poor scion compatibility of these combinations.

In the western part of North America the most dwarfing rootstocks were Weiroot 53, Gisela 3 and Tabel Edabriz (Kappel et al. 2005). Also in Germany Gisela 3 was considered as a more dwarfing rootstock (Franken-Bembenek 2004), which was not fully confirmed in this study.

In a rootstock trial in Slovenia, G 195/20 and Weiroot 158 were ranged as semi-dwarfing rootstocks, whereas Tabel Edabriz was classified as the least vigorous (Usenik et al. 2006). The most dwarfing potential of Tabel Edabriz was also found in the first sweet cherry rootstock trial in Holovousy (Blažková, Hlušičková 2003). Rather contradictory results regarding tree vigour of Weiroot 158 came from Germany. Upon the conclusion of German national trials it was ranged as vigorous, but according to results from northern Germany it seems to be more dwarfing (Stehr 2005).

This study also disclosed certain limitations of tree vigour evaluation in a dense planting. As soon as the tested trees fill up the allotted space in the planting their next growth have to be regulated by restricted pruning. Therefore, measuring the canopy volume with advanced tree aging becomes less accurate as indices of natural tree vigour. Similarly, the development of trunk-cross-section area can be negatively influenced by the increasing competition of adjacent trees. For these reasons, the nature of tree vigour should preferably be evaluated in plantings with sufficiently free spacing.

Yields

Yields in this study were to a great extent reduced by the damage of flowers from late spring frosts. This was especially the case of the Regina cv. where severe frost damage of flower buds took place in the years 2002, 2003 and 2005. Poor cropping of the Regina cv. in this orchard was probably also due to insufficient cross-pollination. The Regina cv. flowers very late and the time of flowering of other cultivars in some years might not be late enough for sufficient over-lapping.

The tested rootstocks influenced actual yields mostly by the different size of canopy volume. Otherwise differences in flower set and in fruit set among the tested rootstocks were very small and mostly statistically insignificant. Inferior cropping of the Lapins cv. on Weiroot 53 and Weiroot 158 was obviously connected to their poor scion compatibility. In addition to these two, Gisela 3 rootstock was only slightly under the average in this respect.

Yield efficiency

With the Lapins cv., yield efficiency in this study was generally adversely related to the tree vigour. The most productive in relation to tree size was the rootstock G 195/20, followed by P-HL-A and Tabel Edabriz, whereas the least productive in this relation was the most vigorous rootstock G 497/8. The above-mentioned rule, however, did not fully hold for rootstocks evaluated after grafting the Regina cv. With this set of data the most productive was Gisela 7, which was classified as being vigorous.

In Hungarian conditions, where the tolerance to drought is important, the most productive was Weiroot 158 and the least productive was P-HL-A (Bujdosó, Hrotkó 2005). On the contrary, in trials in Poland P-HL-A was distinguished by the highest yield efficiency (Grzyb et al. 2005). In a rootstock trial in Slovenia, Tabel Edabriz was evaluated as the rootstock with the highest yield efficiency (Usenik et al. 2006). In Germany, the highest productivity was achieved with Tabel Edabriz, Gisela 5 and G 195/20 (Hilsendegen 2005).

Weight of fruits

The fruit weight of the Lapins cv. was mostly negatively dependent on fruit set as it was already found in the first stage of the study (Blažková, Hlušičková 2004). Therefore, the largest fruit size recorded in the case of the rootstock G 195/20 (which was also distinguished by a higher fruit set) should be considered as an interesting exception of the rule. The completely opposite relationship between fruit set and fruit weight that was found in the first years of the study with the Regina cv. did not occur any more in the latter years.

Soluble solids content

As the results of this study showed, the content of soluble solids in sweet cherry fruits is mostly dependent on conditions during the year. Weather conditions a few days prior to harvest are in all probability the most important. The question arises by how much, if any, these values could be directly modified by the rootstock itself. Hitherto data from the study indicate that fruit size could be another factor worth consideration and that the total effect of the rootstock on the characteristic is rather small.

Cracking of fruits

This study also supplied numerous data on fruit cracking, especially in the case of the susceptible cultivar Lapins. Differences in fruit cracking of the cultivar among different rootstocks were highly significant. Gisela 7 had especially a positive effect on the characteristic. At present, only the size of the fruit was correlated in some years with the rate of cracking. In Hungary, a different influence of particular rootstocks on fruit cracking was also observed (Bujdosó, Hrotkó 2005).

Time of flowering

Several rootstocks tested in this study differed significantly from each other in the time of flowering of the Lapins cv. Analogous variation in the time of flowering within rootstocks of the Gießen series was reported previously from Germany (Franken-Bembenek 1995). Also in Hungary, all scion cultivars budded on Gisela 5 started blooming 1 or 2 days earlier than on the control Mazzard (Bujdosó, Hrotkó 2005). The differences might be important in orchard planning regarding pollination.

Time of ripening

Some of the tested rootstocks changed somewhat the normal time of fruit ripening. The greatest difference was found in the comparison between Tabel Edabriz and G 154/7 with the Lapins cv. In Hungary, the Germersdorfi 3 cv. on Gisela 5 ripened 1 or 2 days earlier than on other rootstocks (Bujdosó, Hrotkó 2005). In Poland, three sweet cherry cultivars ripened on P-HL-A rootstock 3or 4 days earlier than on Mazzard (Rozpara et al. 2004).

In the search for factors that are behind the phenomenon, a slight positive relationship was calculated within the trees of the Lapins cv. between fruit set and the time of fruit ripening. This correlation, however, could explain only a small part of the variability in the time of fruit ripening. Significant influence of certain rootstocks on the time of fruit ripening of the sweet cherry was also observed in our earlier study in which other sweet cherry rootstocks were included (Blažková, Hlušičková 2001).

CONCLUSIONS

From a complex evaluation of these rootstocks in the trial the following conclusions could be drawn:

– G 195/5 appears as the most promising among the new rootstocks tested with the Lapins cv. regarding smaller tree size, higher yield efficiency and better quality of fruits.
– Both P-HL-A and Tabel Edabriz proved to be reliable rootstocks for modern sweet cherry orchards established in domestic soil and climatic conditions.
– The highest rate of mortality and symptoms of poor scion compatibility with the Lapins cv. were observed on Weiroot 53 and Weiroot 158.
– The most vigorous of the tested rootstocks was G 497/8 followed by Gisela 7 and Gisela 4. An intermediate vigour was recorded on trees on G 154/7, P-HL-A, Gisela 3 and Tabel Edabriz. The least vigorous rootstocks were G 195/20, Weiroot 158 and Weiroot 53.
– The highest accumulated yield per tree of the Lapins cv. (21.2 tons) was harvested from trees on Gisela 7 rootstock.
– With the Lapins cv. higher yield efficiencies were calculated for P-HL-A, G 195/20 and, Tabel Edabriz rootstocks. In the case of the Regina cv. the highest yield efficiency was on Gisela 7.
– The mean fruit weight of the Lapins cv. had a span from 8.2 g (Weiroot 53) to 9.7 g (G 195/20).
– Significant differences between the tested rootstocks were found also in the time of tree flowering and ripening.
– With the Lapins cv. the lowest fruit cracking was observed on fruits from Tabel Edabriz and Gisela 7.

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Výsledky studia nových vegetativních podnoží třešní v pokusné výsadbě založené v Holovousích a hodnocené ve fázi plné plodnosti

ABSTRAKT: V pokusu založeném v r. 1999 v Holovousích bylo hodnoceno deset zakrslých a polozakrslých podnoží třešní. Kultivar Lapins byl použit jako testovací odrůda pro všechny podnože, avšak pět podnoží bylo zkoušeno také při použití odrůdy Regina. Pro odrůdu Lapins se z nových podnoží jako nejperspektivnější jeví G 195/5. Nejvyšší úhyny stromů a příznaky špatné afinity byly pozorovány u odrůdy Lapins na podnožích Weiroot 53 a Weiroot 158. Jinak nejvzrůstnější byla podnož G 497/8 následovaná podnožemi Gisela 7 a Gisela 4. Jako středně vzrůstné byly vyhodnoceny podnože G 154/7, P-HL-A, Gisela 3 a Tabel Edabriz. Nejslaběji rostly podnože G 195/20, Weiroot 158 a Weiroot 53. Nejvyššího sumarizovaného výnosu po přepočtu na 1 ha dosáhla odrůda Lapins na podnoži Gisela 7 (21,2 t). Vypočítaná specifická plodnost u této odrůdy byla nejvyšší u podnoží P-HL-A, G 195/20 a Tabel Edabriz. V případě odrůdy Regina bylo nejvyšší specifické plodnosti dosaženo na podnoži Gisela 7. Průměrná hmotnost plodů u odrůdy Lapins kolísala od 8,2 g (Weiroot 53) do 9,7 g (G 195/20). U této odrůdy nejméně praskaly plody na podnožích Tabel Edabriz a Gisela 7. Významné rozdíly mezi zkoušenými podnožemi byly zjištěny také v době kvetení a v době zrání plodů.

Klíčová slova: třešeň; podnože; odrůdy; vzrůstnost stromů; úhyn stromů; výnosy; specifická plodnost; doba kvetení; doba zrání; hmotnost plodů; praskání plodů

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