Rootstocks for Cherries from the Department of Fruit Science Budapest

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Summary: Cherry rootstock breeding started at the Department of Fruit Science, SSU Budapest by the late 50-s and the activity can be divided into three main groups. In the first stage the activity was focused on collection of native mahaleb cherry *(Prunus mahaleb L.)* varieties lead by L. Sebők. After evaluation in the nursery and orchard tests there are four promising rootstock cultivars selected from this material: 'Korponay' used as self fertile seed tree, its seedlings are recommended for sour cherries. The mahaleb varieties 'Bogdány' (vigorous), 'Egervár' and 'Magyar' (medium vigour) are propagated by cuttings. The next project has started in 1979 with the aim to select self fertile mahaleb seed trees producing homogeneous seedling populations with reduced vigour. Inbred populations from isolated flowering self fertile trees were produced and planted out in 1980. The inbreeding of 'Korponay' self fertile *P. mahaleb* variety resulted in specimens with different fruit colour (yellow, red, black), fruit shape and size. From among them self fertile trees were selected with various growth characteristics. Seedlings of that self fertile mother trees (S2 population) were tested in seedbed, they showed homogeneous phenotype characteristics as liners in the nursery. As rootstock of 'Érdi bőtermő' sour cherry in the orchard most of the S2 lines proved to be less vigorous in comparison to S1 popuplations. 'Érdi bőtermő' trees budded on certain S2 lines in the orchard are more productive than those on S1 ('Korponay' seedling). Characteristics of the S2 generation as seed tree were studied as well. We expect to get morphologically homogeneous seedling populations with different growth vigour and good productivity in the later inbred generations. In the last couple of decades the research activity concerning ground-cherry and its hybrids resulted in dwarfing rootstocks. *Prunus fruticosa Pall.* hybrids from the natural flora of Hungary were collected and artificial hybrids were created between *P. fruticosa* and mahaleb cherry. Most of them are in the initial tests, only one of them is before registration, named 'Prob', which is a dwarf rootstock for sweet cherry. By the screening of new hybrids medium vigorous or semi dwarfing and precocious rootstocks seem to be promising for the cherry industry.

Key words: breeding method, cherry rootstocks, clonal rootstock, ground cherry, growth vigour, inbreeding, mahaleb cherry, productivity, rootstock effect, seed tree, seedling

Introduction

Sweet and sour cherries are important fruit crops in Hungary and in their production growth and development is expected. For modern orchards growth reducing rootstocks are needed with good compatibility, yield efficiency and adaptability to local ecological conditions. Sweet and sour cherry growing in Hungary is located partly in a region with continental climatic influence and on soils with high calcium content and pH level, partly light sandy soils. The adaptability of cherry rootstock *Prunus mahaleb L.* is good to the ecological conditions in Hungary, thus in the last ten years about 65–70% of the sweet cherry varieties and 95% of tart cherries were budded on mahaleb rootstocks in the nurseries. Because the nursery results and orchard features of the commercial mahaleb seedlings were not satisfying, a research program started at the Department of Fruit Science with the aim of selection the optimal rootstock and improving the characteristics of rootstock based on native mahaleb and spontaneous cherry hybrids.

Rootstock selection in native mahaleb cherry

Cherry rootstock breeding started at the Department of Fruit Science in Budapest by the late 50-s. In the first decades the activity was focused on collection and selection of native mahaleb cherry (*Prunus mahaleb L.*) varieties lead by Livia Sebők. Investigations on flower biology of varieties showed out that two varieties are self fertile, one is pollen-sterile and the others are self-incompatible. Based upon the blossom time the varieties could be divided into four groups (*Hrotkó* 1985; *Hrotkó* 1986). The rooting ability of leafy cuttings was tested in 1978–82 of the varieties (*Hrotkó* 1982).

Based upon the results of nursery and orchard trials (*Sebők* 1968; *Hrotkó* 1990, 1993), from among the tested varieties one self fertile and some vegetatively propagated clones with definitely basitonial and flat branching were selected as candidates for state agricultural quality control and release. After evaluation in the nursery and orchard tests there are three promising rootstock cultivars selected from this material: 'Korponay' used as self fertile seed tree,

Table 1 Nursery value of mahaleb seedlings in average of five years in (Hrotkó 1988)

Rootstocks	Budded	Bud take (trees in %of budded rootstocks)			First quality trees in the nursery (%)		
	in % of planted rootstocks	Újfehértói fürtös	Érdi bőtermő	Germersdorfi óriás*	Újfehértói fürtös	Érdi bőtermő	Germersdorfi óriás*
Korponay sdlg	87.0	85.8	71.6	70.9	72.7	58.6	53.1
Cema (CT 2753 sdlg)**	92.2	75.3	60.6	–	70.9	57.7	–
Mahaleb V/35 sdlg	84.0	82.6	61.4	50.7	67.4	49.7	34.5
Mahaleb IV/3 sdlg	81.1	53.0	59.6	56.6	51.2	49.9	42.3
LSD 5%	NS	11.12	NS	NS	9.11	NS	NS

* only three years; ** only four years; - no data

seedlings are recommended for sour cherries, and the vegetatively propagated 'Bogdány' and 'Magyar' for sweet cherries *(Table 1, 2, 3, 4.)*.

Inbreeding of mahaleb

The seed tree selection from among inbred populations started in 1979 with the aim to select self fertile seed trees producing homogeneous seedling populations with reduced vigour. Inbred populations from flowering of isolated self fertile trees were produced and planted out in 1980. The inbreeding of 'Korponay' self fertile variety resulted in specimens with different fruit colour (yellow, red, black), fruit shape and size. From among them self fertile trees were selected with various growth characteristics. Seedlings of that self fertile mother trees (S_2 population) were tested in seedbed, they showed homogeneous phenotype characteristics as liners in the nursery. As rootstock of 'Érdi bőtermő' sour cherry in the orchard most of the S_2 lines proved to be less vigorous in comparison to S_1 popuplation. 'Érdi bőtermő' trees budded on certain S_2 lines in the orchard are more productive than those on S_1 ('Korponay' seedling) *(Table 5 and 6)*. Characteristics of the S_2 generation as seed tree was studied as well. Tree size is smaller and their seedlings (S_3) in the nursery are less vigorous than those of S_2 populations.

Table 2 Orchard value of 'Meteor korai' sour cherry on various rootstocks in Szigetcsep (1968–1985)

Rootstocks	Survival % in 18th year	TCSA cm?	Canopy volume (ml)	Yield efficiency kg/year/cm? TCSA	Coeffi cient of variance in yield (cv%)
Korponay sdlg.	87.5	381	100.4	0.121	46.6
Mahaleb V/35	53.8	393	92.0	0.117	58.1
Mahaleb V/19	83.3	446	136.3	0.105	60.5
Mahaleb IV/3	70.0	512	133.7	0.104	48.5
Mazzard sdlg.	78.0	409	81.4	0.097	66.6
Sour cherry sdlg	100.0	230	70.3	0.079	32.4
LSD 5%	–	92.3	55.2	0.023	–

Table 3 Effect of rootstocks on growth of 'Alex' sweet cherry trees in fourth leaf (Szigetcsép. 2003)

Rootstock	TCSA (cm?)	Shot growth (cm)	Shoot number (db/fa)	Average length of internodes cm
Cema	34.7 b	2848 b	58 a	2.5 ab
Bogdány	30.1 ab	2230 ab	76 a	3.2 b
Gisela5	20.0 a	1657 a	81 a	2.1 a

Table 4 Effect of rootstocks on fruiting wood and burse shoot development of 'Alex' sweet cherry trees in fourth leaf (Szigetcsép 2003)

Rootstock	Two-years old wood		Burse shoots	
	Number/ tree	Length/ tree (cm)	Number/ tree	Number/ cm? TCSA
Cema	*31.0 a*	*1151 a*	*352 a*	*10.4 a*
Bogdány	35.4 a	1342 a	307 a	11.3 ab
Gisela5	35.4 a	1176 a	308 a	15.7 b

Our data confirm the former hypothesis that considerable tree size reduction can be achieved even in the second or third inbred generation. It is in contradiction to Fischer's (1985) results although in contrary to his opinion it was possible to achieve progress in yield efficiency. May be the larger number of S_1 seed trees in our trial contributed to success.

Since the resources in genetics and breeding method of traditional cherry rootstocks like mahaleb and mazzard are still hardly utilized, inbreeding of self-fertile seed trees could provide a useful tool for rootstock breeding.

Many of the new dwarfing hybrid rootstocks involve propagation problems the too thin shoots create difficulties in nursery raising and certain virus-sensitivity limit rootstock use. In turn some promising mahaleb S_2 seedlings are cheap, easy to propagate and aftercare in the nursery and may provide about 50% reduction in tree size with an increased yield efficiency.

Our sour cherry trees are relatively young and tests with sweet cherries started later, thus the evaluation of our trials needs longer time. However, the early cropping and high yield efficiency of some progenies are promising. We expect to get homogeneous seedling populations in morphology

Table 5 Effect of rootsctocks on tree size of 'Érdi bőtermő' sour cherry in the 10th year (Ráckeve 1999)

Rootstock	TCSA cm^2	Projected canopy area m^2	Canopy volume m^3
Korponay seedling	113.18 b	46.51 a	83.10 a
Egervár (clonal rootstock)	130.62 b	54.53 b	105.37 b
Average of Korponay S_2 seedlings	88.98 a	42.90 a	73.57 a

Note: significantly not different values are marked with the same letters

with different growth vigour and good productivity in the later inbred generations *(Table 3 and 4)*.

Prunus fruticosa crosses and selection

In Hungary *Kárpáti* (1944) reported about various spontaneous hybrids of *Prunus fruticosa* Pall., but this plant material hasn't been utilized yet in plant breeding. With the aim to collect individuals as crossing partners in rootstock breeding *Prunus fruticosa* Pall. populations in several locations of Hungary were studied in situ. Promising individuals were budded for breeding use and tests. Compared this plant material with *Prunus fruticosa* clones used in west-european breeding projects it turned out that most of the plants known as *P. fruticosa* are hybrids but not the *P. fruticosa f. typica*. This fact and our observations are in correspondence with *Wojcicki* (1991), who showed out, that the frequency of *Prunus fruticosa* hybrids increases gradually westwards in Europe. The exact identification of the taxon is of great importance before horticultural use in the breeding, and the spontaneous hybrids could provide advantages too.

Our attention is attracted by that together with *f. fruticosa* three well defined groups of hybrids could be spotted on every location. The first group of hybrids can partly be identified with *Prunus x mohacsyana* Kárp. even if not all the characteristics are in correspondence with the original description of the author made sixty years ago using only one of the colony of the hybrid population. It is supposed by the cited author, that it was a hybrid of *Prunus fruticosa* x *Prunus avium*.

The second group of hybrids showed morphological resemblance to *P.cerasus ssp. acida*. Considering its morphological characteristics it is very similar to *Prunus x stacei (P. fruticosa* Pall. *x P. cerasus L. x P. avium L.*, 2n=24) hybrid described by *Wojcicki* (1991). The possible cross pollination partner in the locations could be only *Prunus avium*. The relationship between this hybrid group and *P. fruticosa x P. cerasus ssp. acida* (Syn. *Prunus eminens* Beck.) could not be clearly explored.

On every location *P. fruticosa f. aucta* Borb. was found as a third hybrid group. Some individuals of this hybrid group could be clearly identified as *Prunus x javorkae* Kárp. *(=Prunus fruticosa x P. mahaleb)*. On every location there are many trees of *Prunus mahaleb* L., thus the conditions for the crossing were given. Based upon its morphological characteristics the previously selected *P. fruticosa* 'Prob' could be identified as *f. aucta*.

Table 6 Important characteristics of promising inbred lines compared to the control

	Number of trees	TCSA in %	Yield efficiency	Survival rate %	Homogeneity
Egervár (clonal)	29	115	89.0	97	clonal rootstock
Korponay	36	100	100.0	88	less uniform than clonal rootstock
22/24	4	125	102.4	100	similar to clonal rootstock
24/29	31	89	100.8	84	similar to clonal rootstock
22/20	10	86	102.4	85	similar to clonal rootstock
26/11	12	73	103.9	87	similar to clonal rootstock
24/41	34	68	107.9	92	similar to clonal rootstock
26/8	3	64	125.2	100	Not tested

The seeds of hybrids were sowed and the seedling populations are studied in order to get more information about the horticultural value and use of the hybrids. Most of them are in the initial tests. A test orchard is planted in 2000 for screening in clonal plant meterial collected as spontaneous hybrids.

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