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Results of cherry rootstock evaluations in Hungary

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Summary: The paper gives a review on the results of the latest rootstock evaluation projects in Hungary. Several cherry rootstock evaluation projects were carried out in Hungary during the last two decades. The evaluated rootstocks are partly mahalebs selected in Hungary, but more or less all the most important new rootstocks from different countries are involved. The aim of these evaluation projects was to find appropriate rootstocks in a wide range of vigour for our climate and soil conditions. The conclusion of the last 20 years of research in Hungary proved just the opposite of believes, that high density orchard can only be planted with dwarfing rootstocks. Before choosing the right rootstock the most important is to consider adaptability, precocity and productivity. Dwarfing and semi-dwarfing rootstocks showed proper results only with irrigation or very good site conditions. These rootstocks are very precocious, but branches form easily blindwood. This must be corrected by severe pruning in the first years. The relatively small leaf surface area can also be disadvantageous, but it can be controlled by pruning, fruit-thinning, irrigation and fertilization. After studying different rootstocks semi-vigorous rootstocks seem to be the most adequate for different site conditions in Hungary. Fast initial growing and competent precocity are their favourable characters. From the vigorous group of clonal mahalebs or seedlings are highly recommended first of all for poor site condition (sandy, lime soils with high pH). They turn to bearing early and easy to find them in the Hungarian nurseries. But on vigorous rootstocks trees might need stronger summer pruning.

Key words: climate and soil adaptability, GiSelA-series, precocity, productivity, *Prunus mahaleb*, Weiroot-series

Introduction

Sweet and sour cherry production in Hungary dramatically has decreased in the last 20 years because of the lack of intensive orchard system. Fruit quality, reduced usage of chemicals and ecological growing technology are all worldwide increasing demand. Thus it is necessary to pay more attention to high density orchard systems and environmental safe sustainable growing practice. Both ecologically and economically only high density orchards can provide handpicked, good quality fruits (*Hrotkó* et al., 1997, 1999, 2007).

Choosing the right rootstocks is one of the most important factors, apart from choosing good variety, training and pruning system. Right rootstocks not only influence graft-quality, but also the long term efficiency of the orchard. It has been two decades since the Department of Fruit growing (Corvinus University of Budapest) worked on the development of cultivation systems. During the last two decade of our research work we have developed a special training system for cherry orchards, the so-called central leader with basal branches and so the adequate pruning technique of it (*Bujdosó* et al., 2004; *Hrotkó and Magyar*, 2005; *Bujdosó and Hrotkó*, 2005; *Hrotkó*, 1997, 2007; *Hrotkó* et al., 1997, 1999, 2006,2007). However, for maintaining high density orchard, it is essential to analyze rootstock's effect and thus to use only appropriate rootstocks for our environmental and site conditions.

This paper gives a review on the results of the latest rootstock evaluation projects in Hungary.

Table 1 Review of cherry rootstock evaluation projects in Hungary

Planting	Cultivars	Rootstocks	Spacing	References
1989, 1992	Germersdorfi, Van	SL 64, Colt, MaxMa 14, MaxMa 97, Bogdány, MaxMa 14, Gisela 5, Prob	7m x 4m	[3,4,5,6,8]
1996 – 97	Linda, Katalin	Magyar, Bogdány, MaxMa 97, Pi-Ku 1, 2, 3, Weiroot 13, 154, 158, PH-L-A, Gisela 5, Prob	4m x 2m	[3,4,5]
1997	Linda, Katalin	Cema, C 2493, Weiroot 13, 154, 158, 72, PH-L-A, Gisela 5	6m x 3m	[1,2,4]
1999	Lapins	MaxMa 14, 97, 60, Damil, Colt, Hexaploid Colt, Weiroot 10, 53,158, Edabriz, Gisela 3, 4, 5, 6, 7, 11, and six further clone	6m x 4m	[9]
2000	Axel, Vera	SL 64, Bogdány, Magyar, Pi-Ku 1, Gisela 5, Edabriz, Probm x	4m x 2m	[7]
2002	Carmen	Egervár, CEMA, SL 64, MAKLA, Magyar, Bogdány, Ks 24/31, Colt, Korponay, CAB 11/E, Brokgrow	4m x 2m	
2004	Rita, Vera, Petrus	Egervár, Bogdány, Korponay, Magyar, SL 64, SM 11/14, Mazzard, Prob, Gisela 6	4m x 2m	

Rootstock evaluation projects

Several cherry rootstock evaluation projects were carried out in Hungary during the last two decades (*Table 1*). The evaluated rootstocks are partly mahalebs selected in Hungary, but more or less all the most important new rootstocks from different countries are involved. The aim of these evaluation projects was to find appropriate rootstocks in a wide range of vigour for our climate and soil conditions.

International rootstock trial in Ceglédbercel

Rootstock evaluations in orchard conditions are carried out more and more in international cooperation. Such an international cherry rootstock trial started in 1999 between fourteen EU countries – which inspired to test the numerous new cherry rootstocks in different ecological conditions. The project was coordinated by the Danish Agricultural Institute of Fruit Growing (Aarslev). Hungary (Corvinus University of Budapest) joined the project in 1999, and planted nearly four hundred cherry grafts in Ceglédbercel. All the grafts were uniformly raised, two-years-old branched trees of 'Lapins', grafted by the nursery Planteskolen Vester Skovgard, in Denmark. The type of the training is modified Brunner-spindle.

Trunk circumference (60 cm height), number of shoots, prunings' weight, canopy spread, blooming, crop quality and quantity were measured or observed. Based on the results we can classify the rootstocks by growing and productivity (*Figure 1*). We used trunk cross-section range (cm^2) for referring to growth vigour of trees, and yield volume apply to trunk cross-section (kg/cm^2) for referring to productivity compared to trees on Weiroot 10 as the 100%.

Based on the results of the six year researches can be stated, that there are important differences between growing, blooming, winter frost damage of buds, and productivity of trees on vigorous and dwarfing rootstocks. We classified all the rootstocks into four groups by their vigour. G107/1, Colt, MaxMa 60 and Weiroot 10 are vigorous (standard) rootstocks, MaxMa 14, MaxMa 97, Gisela 7, G 497/8, HexColt and G 318/17 are semi-vigoorus, Weiroot 158, Gisela 6, Gisela 11, Damil, G 148/13, G 154/7, Weiroot 53 are semi-dwarfs, and G 195/20, Gisela 4, Gisela, Edabriz are dwarf rootstocks.

From the *Figure 1* it is demonstrable that there are also important differences between the productivity of the four growing group. We can tell that the most productive dwarfing rootstocks are Gisela 4, Gisela 3, G 195/20 and Edabriz, G 148/13 semi-dwarf, and Gisela 7 semi-strong rootstocks also showed promising results. Blooming and yielding of trees on dwarfing rootstocks were much earlier than the ones on vigorous rootstocks, but in contrast to these promising results, the sensitivity of buds and flowers was worst on dwarfing rootstocks. It is also shown, that dwarfing and semi-dwarfing rootstocks produced smaller fruit size than the trees on vigorous rootstocks. There was on G 154/7 and Gisela 4 rootstocks intolerable sucker formation, all the rest showed average results, apart from G 148/1, G 148/8, G 148/13, G 318/17 and G 209/1 rootstocks, which has insignificant suckering.

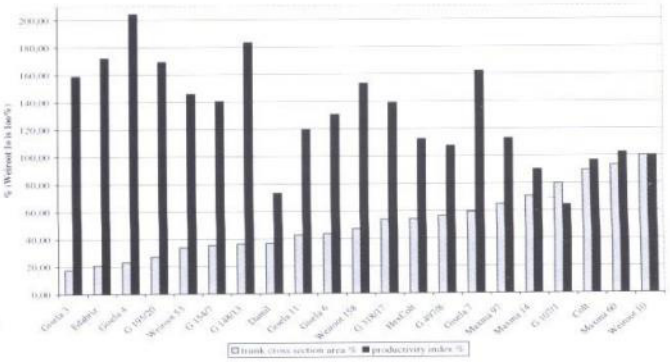

Figure 1 Productivity and vigour of 'Lapins' cherry trees in Ceglédbercel (2006)

Comperative rootstock trial in Érd

In 1997 in cooperation with the Reserach Institute of Fruitgrowing and Ornamentals in Érd a comparative rootstock trial was set up to study foreign bred dwarfing rootstocks under Hungarian climate. Six German bred dwarfing rootstocks (Weiroot 13, Weiroot 53, Weiroot 72, Weiroot 154, Weiroot 158, GiSelA 5), one Czech bred ('P-HL-A') were compared to a Hungarian bred Mazzard seedling (*Cerasus avium* L. 'C. 2493') and as control we used the mahaleb seedling 'Cema' which is one of the most often used (70%) sweet cherry rootstock in Hungary. Based upon their effect on trunk and canopy growth rootstocks can be classified into 3 groups, the very vigorous (*Prunus mahaleb* L. 'Cema', *Prunus avium* L. 'C. 2493', Weiroot 13), medium vigorous (Weiroot 158, Weiroot 154, P-HL-A) and dwarfing rootstocks (Weiroot 72, Weiroot 53, GiSelA 5). The control 'Cema', Mazzard stock and Weiroot 13 were planted to 6 x 6 m, the other combinations to 3 m in the row and 6 m between the rows. The trial design consists of 3 trees per treatment in 2 replications. The trees were trained to central leader. Winter pruning was usual, but after 2001 replaced with summer pruning.

The effect of the rootstocks on scion cultivars was studied on three sweet cherries ('Germersdorfi 3', 'Linda', 'Katalin') and a sour cherry cultivar ('Piramis'). Differences between the blooming and ripening times of rootstocks/scion combinations were also observed. The largest cumulative yield produced 'Linda' followed by 'Katalin', 'Germersdorfi 3' and 'Piramis'. The biggest fruit diameter was measured on 'Germersdorfi 3' among the sweet cherry cultivars, the highest ratio of the fruits bigger than 26 mm on Weiroot 72, the lowest on GiSelA 5. The biggest fruit diameter of the 'Piramis' combinations was measured on trees on *Cerasus avium* 'C. 2493'.

Cherry rootstock evaluation in Szigetcsép

In 2000 we planted a high density cherry orchard in Szigetcsép with Vera® and Axel® to 4 x 2 meter row and

plant distance, on purpose to examine different rootstocks. Trees are trained to central leader with permanent basal branches; in the alley way naturally grown grass is managed by mowing. The first considerable fruiting was in 2004. Every year we measured trunk and crown parameters of the trees, productivity and fruit size. According to our results we classified rootstocks into three groups. Cema, SL 64, and Bogdány are vigorous rootstocks, moderate vigorous are MaxMa 97, Pi-Ku 1, and Tabel® Edabriz, Gisela® 5 and Prob are dwarfing rootstocks (*Table 2 and 3*).

Table 2: Productivity and growing of trees Vera® in Szigetcsép

Rootstock	Trunk cross section cm²	Cumulative yield kg/tree	Fruit weight (g/piece	Average crop t/ha/year (1250 tree/ha)	Average crop t/ha/year (1666 tree/ha)
Gisela 5	52,95 a	66,17, ab	8,72 a	20,6	27,5
Edabriz	64,01 a	51,10 a	8,98 ab	16,0	21,3
Prob	77,13 a	53,31 a	8,65 a	16,6	22,2
Pi-Ku 1	86,31 a	89,14 c	9,71 abc	27,9	37,2
Brokgrow	123,23 b	67,09 ab	9,38 abc	21,0	28,0
Cema	143,36 bc	88,99 c	9,88 abc	27,8	–
SL 64	147,63 bc	91,62 c	10,18 bc	28,6	–
Bogdány	166,37 c	83,58 bc	10,40 c	26,1	–

Table 3. Recommended sweet- and sour cherry rootstocks for Hungarian site conditions

Vigorous	**Semi-vigorous**	**Semi-dwarf**	**Dwarf**
Cema Cemany	Korpona, Magyar	Weiroot 154, 158	Tabel®Edabriz
Bogdány SL 64	MaxMa 97 ('Brokgrow')	Gisela 6	Gisela 5
Weiroot 10 Weiroot 13 Colt	MaxMa 14 ('Brokforest')	Pi-Ku 1	

We measured significant differences in cumulative yield between rootstocks. Cumulative yield of Axel® was the highest on Bogdány and on Cema, contrary to Gisela 5®, which produced only 50% of the previous ones. The productivity results of the two other dwarfing rootstocks were not even 50% of Gisela 5®. Cumulative yield of Vera® was the highest on SL 64, and no significant difference was found, compared to trees on rootstocks Cema, Bogdány and Pi-Ku 1. Cumulative yield production of trees was smaller on Gisela® 5, Prob, MaxMa 97 and Tabel® Edabriz rootstocks. According to the average yield/year production of the measured four years, SL 64, Bogdány, Cema and Pi-Ku 1 were the most effective rootstocks. The same results can be achieved on Gisela 5® with higher densities (row-plant distance 4 x 1.5 m). With this increased density Pi-Ku 1 rootstocks proved to be the most effective ones. Rootstocks also affect fruit size. We measured the largest fruits on trees on Bogdány. According to our results we can highly recommend SL 64, Bogdány, Cema and Pi-Ku 1 for high density orchard plantation under our site conditions (*Figure 2 and 3*).

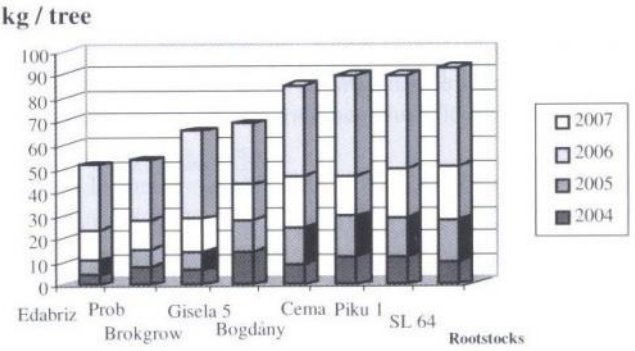

Figure 2 Yields of Vera® trees on different rootstocks (2004–2007)

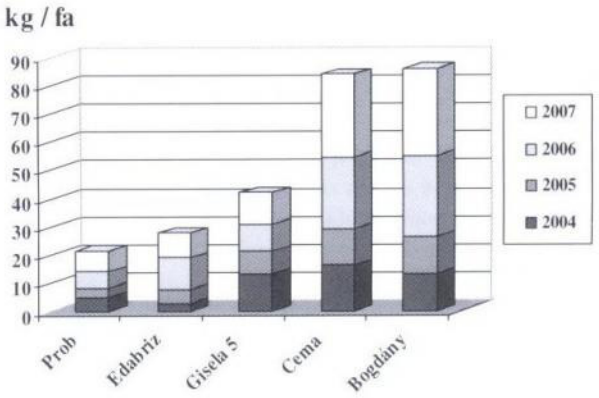

Figure 3 Yields of Axel® trees on different rootstocks (2004–2007)

Results and discussion

The conclusion of the last 20 years of research in Hungary proved just the opposite of believes, that high density orchard can only be planted with dwarfing rootstocks. Moreover in certain situations vigorous or semi-vigorous rootstocks can be more favorable than dwarfing rootstocks. Before choosing the right rootstock the most important is to consider adaptability, precocity and productivity.

Dwarfing and semi-dwarfing rootstocks showed proper results only with irrigation or very good site conditions. These rootstocks are very precocious, but branches form easily barewood. This must be corrected by severe pruning in the first years.

Support system is definitely necessary in case of using dwarfing rootstocks. The relatively small leaf surface area can also be disadvantageous, but it can be controlled by pruning, fruit-thinning, irrigation and fertilization.

After studying different rootstocks semi-vigorous rootstocks seem to be the most adequate for different site conditions in Hungary. Fast initial growing and competent precocity are their favourable characters. The main problem with them is availability difficulties, most of them can only be found in nurseries from abroad.

From the vigorous group of clonal mahalebs or seedlings are highly recommended first of all for poor site condition (sandy, lime soils with high pH). They turn to bearing early and easy to find them in the Hungarian nurseries. But on vigorous rootstocks trees might need stronger summer pruning.

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