

GROWTH INTENSITY OF APPLE-TREES ON CLONAL ROOTSTOCKS BEFORE THE BEGINNING OF FRUIT BEARING ĀBEĻU AUGŠANAS INTENSITĀTE UZ KLONA POTCELMIEM PIRMS RAŽOŠANAS SĀKUMA

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Kopsavilkums

Četrus Baltijas valstu sadarbības projekta ietvaros no 2001. līdz 2004. gadam tika pētīta dažādu potcelmu piemērotība audzēšanai Igaunijas apstākļos. Divas šķirnes 'Belorusskoje Malinovoje' un 'Auksis' tika audzētas uz 11 puspondura un pundura klona potcelmiem. Potcelms M 9 tika izmantots kā kontrole. Koki tika stādīti Polli Dārzkopības Institutā, Igaunijas dienvidrietumos 2001. gada pavasarī. Rakstā ir sniegts ieskats koku augšanas spara izvērtējuma rezultātos Igaunijas klimatiskajos apstākļos pirmajos četros gados dārzā. Pirmajos gados augiem spēcīgākais augums bija uz 'Bulboga', M 26 un B146 potcelmiem.

Abstract

In the years 2001-2004, the trial was carried out, within the collaborative project of four countries „Baltic Fruit Rootstock Studies“, aimed at the evaluation of the suitability of different rootstocks for Estonian conditions. Performance of two apple cultivars, 'Belorusskoje Malinovoje' and 'Auksis', was compared on 11 dwarfing or semi-dwarfing clonal rootstocks. M.9 served as control. The trees were planted at the Polli Horticultural Institute, southwest Estonia, in the spring 2001. Preliminary results, concerning initial tree vigour on different rootstocks and their resistance to Estonian climatic conditions during the first four years in the orchard, are given in this paper. In the first years after planting apple trees showed the strongest growth on the rootstocks 'Bulboga', M.26 and B146.

Key words: apple tree, clonal rootstocks, growth, vigour, Estonia

Introduction

Dwarfing and semi-dwarfing clonal rootstocks are lately widely used in apple growing worldwide, due to providing early and abundant bearing as well as high fruit quality. These intensive orchards are relatively less common in places with colder climates, like the Baltic region of Europe, where clonal rootstocks, originated from a warmer climate, show insufficient winter hardiness. In recent decades, many cold-resistant dwarfing and semi-dwarfing apple clonal rootstocks have been bred in Central-Russia, Poland, Germany and Baltic States. Their suitability for the Baltic region is still unclear, however. In 1998, a collaborative project, called „Baltic Fruit Rootstock Studies“ was initiated at Pure Research Station, Latvia, aimed at the evaluation of various dwarfing or semi-dwarfing rootstocks for apple, pear, plum and cherry, simultaneously in Estonia, Latvia, Lithuania and in the Brest oblast' of Belorussia. Twelve types of dwarfing and semi-dwarfing apple rootstocks were included in the project (Bite *et al.*, 1999). The objective of the project was to assess the resistance of these rootstocks to the climate of the Baltic region as well as their effect on tree vigour, early bearing, yield and fruit quality.

Materials and Methods

The test material for all participants of the project was gathered at the Pure Experimental Station in the years 1998-2000. In Estonia, the apple rootstock trial was established in the southwester part of the country, at the Polli Horticultural Centre. In the Polli region the sum of temperatures over 5° C is 1800-1900° C, average minimal temperature varies in the range from -26 to -28° C. Average yearly precipitation ranges from 600 to-700 mm. The soil of the experimental plots was sandy loam of moderate fertility. The experiment area is situated on nearly flat land, with a west and west-north aspect, aside of valley. White mustard was grown as a pre-planting green manure on the experiment

area. Farmyard manure, at the dose of 100 tons per hectare, as well as phosphorous-and potassium fertilisers (500 kg P₂O₅ and 500 kg K₂O per ha) were also applied before planting. Ammonium nitrate was then applied in the orchard, at the rate of 80 kg N per ha every year.

One- and two-year-old trees of 'Belorusskoje Malinovoje' on 8 different apple rootstocks and of 'Auksis' on 11 rootstocks, were planted in spring 2001. Out of the studied rootstocks, two (M.9 and M.26) were bred in East Malling, England; four (B9, B396, B146 and B491) in Michurinsk, Central Russia; two (P60 and P22) in Poland; one (Jork 9) in Germany; one (Püre 1) in Latvia; and one (Bulboga) in Moldova. The control rootstock was M.9. Planting distance was 4 × 1.5 m. The trial was established in a randomised block design, in four replications, with 3 trees per plot. Trees were trained as spindle-bush. The soil beneath the fruit trees was treated with contact herbicides, and the grass between alleys was frequently mown. In every autumn the trunk diameter (at 30 cm above the ground), tree height and crown width were measured. Basing on these measurements, trunk cross-sectional area (TCSA) and canopy volume were calculated every year. The results were elaborated by the one-way analysis of variance. Significance of differences between treatment means was estimated using the Student's test at the probability of error $\alpha=0.05$.

Results and Discussion

Estonia is the one of the Baltic States, which is situated in the north and has a relatively severe climate. The winters of 2001-2004 were characteristic for this area – cold days alternated with periods of thaw. The coldest was the winter 2002/2003, when in January the air temperature dropped to -29° and -32° C. The studied trees were not greatly damaged, but close to the trial orchard, on a site, which was approximately 1 m lower, apple trees on M.9, planted in 2002, were destroyed. From this observation and from some earlier experiments (Palk, 1972; Veidenberg, 1981) it can be concluded that growing trees on M.9 is quite risky in Estonian conditions, due to poor winter hardiness of this rootstock. Tatarinov (1984) stated that "although roots of M.9 can survive only -10° C, it still is well-known dwarfing rootstock, which can grow well on any soil and trees grafted on M.9 bear fruit early and are productive with fruits of high quality". M.9 certainly is one of the most popular apple clonal rootstocks in the southern areas of apple growing, but under Estonian, relatively, cold conditions it suits well only as reference for estimation of vigour of other dwarfing rootstocks.

Trunk diameter, tree height and canopy volume of the young 4-year-old apple trees grown on different rootstocks differed to a great extent. For both studied cultivars, the indices of tree size were significantly larger on M.26, Bulboga and B146, except for canopy volume of 'Auksis' on M.26 or on B146 (Table 1).

Table 1. Trunk cross sectional area (TCSA), tree height and canopy volume of 4-year-old apple trees on different rootstocks

Rootstock	'Belorusskoje Malinovoje'			'Auksis'		
	TCSA cm ²	Height m	Canopy volume, m ³	TCSA cm ²	Height m	Canopy volume, m ³
M.9 (control)	4.7	1.65	0.45	4.7	1.68	0.77
M.26	9.1*	2.00*	1.46*	7.7*	1.88*	0.77
B.146	10.0*	2.05*	1.40*	9.9*	1.85*	0.87
Püre 1	4.6	1.53	0.37	6.1	1.78	0.69
B.396	6.1	1.68	0.82	5.2	1.73	0.71
Jork 9	6.4	1.93*	1.07*	5.4	1.83*	0.71
P.60	5.0	1.63	0.70	4.5	1.63	0.70
Bulboga	9.3*	2.20*	1.52*	11.3*	2.18*	1.80*
B.9	-	-	-	4.7	1.58	0.41
B.491	-	-	-	5.7	1.83	0.73
P.22	-	-	-	4.2	1.68	0.47
LSD _{.05}	2.2	0.24	0.49	1.6	0.18	0.42

* Values significantly different from the control, M.9 rootstock

The tree height of both cultivars and also the canopy volume of 'Belorusskoe Malinovoe' were relatively larger on Jork 9. The vigour of trees on other rootstocks did not significantly differ from that of trees on the control stock.

The annual increase of the trunk diameter describes the most objectively the rootstock effect on tree growth. It was noted that trunk diameter of trees increased in the year of planting only by 1-3 mm and was not affected by rootstock (Fig. 1).

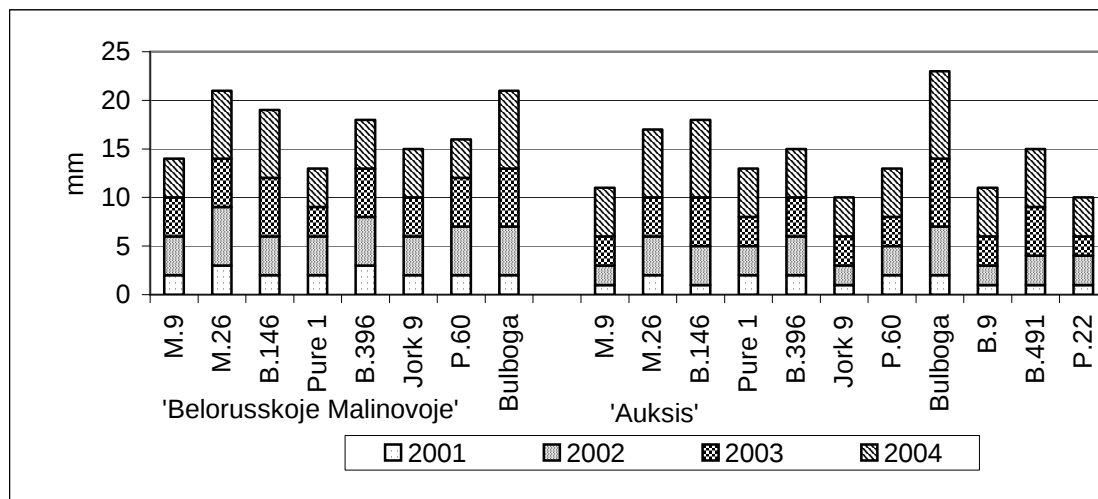


Figure 1. Increase of trunk diameter of apple trees in the years 2001-2004

In the next two years the trunk diameters increased by 2-6 mm per year and on the fourth year after planting it increased 4-9 mm. The effect of rootstock on trunk diameter started to show already from the second year after planting and was most noticeable in the fourth year. In 2004 the increase of the trunk diameter of the cultivar 'Belorusskoje Malinovoje' on the rootstocks M.26, B146 and Bulboga was 3-4 mm larger and of cultivar 'Auksis' 2-4 mm larger than on the M.9 rootstock. During the four-year period, the trunk diameter of 'Belorusskoje Malinovoje' on the reference M.9 rootstock increased 14 mm, whereas on M.26, B146 and Bulboga 21, 19 and 21 mm, respectively. Trunk diameter of 'Auksis' on M.9 increased 11 mm and on M.26, B146 and Bulboga 17, 18 and 23 mm. 'Belorusskoe Malinovoe' and 'Auksis' showed the overall trunk diameter increase 4 and 5 mm greater on B396 than on M.9. In case of the cultivar 'Auksis', the increment of trunk diameter was 4 mm larger on B491 than on M.9. Trunk diameter increase of the studied cultivars on other rootstocks did not differ significantly from that on the control rootstock.

So, the rootstocks M.26, B146 and Bulboga may be considered as semi-dwarfing, B396, B491 and Jork 9 intermediate between dwarfing and semi-dwarfing, while M9, Püre 1, B9, P60 and P22 as dwarfing – in Estonian conditions. Depending on site, scion/rootstock combination or some other factors, opinions about the vigour of any clonal rootstock may be quite diverse. M.26, however, is regarded as semi-dwarfing also elsewhere, including the Baltic region. According to Tatarinov (1984), during the first five years, it performs as semi-dwarfing only when grown on a fertile soil; on a less fertile soil it is dwarfing. Little information is available about performance of the rootstocks Bulboga and B146 in the Baltic region. In Latvia, Bulboga is considered as semi-dwarfing (Bite, 1999). In Poland, trees on B146 showed even weaker growth than trees on M.9 (Sadowski *et al.*, 1999). In Lithuania, P60 and B396 have been considered as semi-dwarfing (Kviklys, 2002) and in Latvia the Püre 1, B9 and B396 have been classified as dwarfing rootstocks (Bite, 1999). Püre 1 should be more vigorous than B9, but trees on these rootstocks have shown the same vigour (Lepsis, 1999; Lepsis and Bite, 2000). In Belorussia, B396 is considered as dwarfing or semi-dwarfing rootstock (Kapichnikova, 1999) and it is in line with our results.

Conclusions

The vigour of apple trees on different clonal rootstocks depends not only on rootstock, weather conditions or location, but also on the scion/rootstock combination. The complex analysis based on the results of the international project, carried out simultaneously in four Baltic countries,

enables an objective evaluation of the rootstock effect on tree vigour to be made. Out of 11 apple rootstocks, studied during four years, M.26, B146 and Bulboga can be regarded as semi-dwarfing; M.9, Püre 1, B9, P60 and P22 as dwarfing and B396, B491 and Jork 9 as intermediate between dwarfing and semi-dwarfing, in South Estonian conditions.

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