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GROWTH OF MAIDEN APPLE TREES OF 'GALAXY' AND 'RUBIN' ON ROOTSTOCKS CLONES ORIGINATING FROM CROSSING A.2 × B.9

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Abstract. In the world of orchard science there is a trend of constant limiting the size of fruit trees of almost all species. That is why there is a continuous search for new rootstocks reducing the vigour of growth of the cultivated plants. The experiment was conducted at the Experimental Station of the University of Life Sciences in Poznań, in the years 2008–2009. The aim of this study was to estimate of 15 clones obtained by crossing A2 × B.9 rootstocks to check their usefulness for the production of maiden apple tress of 'Galaxy' and 'Rubin' in a nursery. M.9 and M.26 rootstocks were used as a standard. The strongest growth of maiden apple trees was obtained on M.26 rootstock and on the clone number 15. The growth of trees on clone number 5 was weaker than those on M.9 rootstock. Maiden apple trees of 'Rubin' cultivar did not create lateral shoots for most rootstocks. The biggest number and total number of lateral shoots was found on the trees of 'Galaxy' on rootstocks clones number 1, 3, 6, 7, 10, 13 and 15 and the least on clones number 2, 5 and 9. The biggest number of skeleton roots had trees on M.26 rootstock and the fewest on M.9 one. The biggest number of maiden trees in comparison with the budded rootstocks was obtained for clones number 6, 10 and 13 and the fewest for clones number 2, 7, 8, 9 and 11. For all clones the percentage of trees meeting the requirements of the standards was high and the results did not differ from those on M.9 and M.26 rootstocks.

Key words: new rootstocks, nursery, production of maiden apple trees

INTRODUCTION

In the world of orchard science there is a trend of constant limiting the size of fruit trees of almost all species. That is why there is a continuous search for new rootstocks reducing the vigour of growth of the cultivated species. On the basis of many experiments it has been found that the most efficient method of getting high yield is planting a big number of trees on a unit of a given area [Czynczyk and Olszewska 1990, Silbereisen and Scherr

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1996, Ostrowska and Chełpiński 1997, Wertheim 1998, Engel 1999, Jadczuk and Wlosek-Stangret 1999, Lipecki and Janisz 1999, Webster 1999, Jakubowski and Zagaja 2000].

To get good economical results in orchards well grown and ramified trees with a few lateral shoots and grafted on weakly growing rootstocks are essential [Zagaja et al. 1991, Hrotko and Mozer 1999, Kviklys et al. 1999, Skrzyński and Poniedziałek 1999, Webster and Hollands 1999, Bielicki et al. 2000, Czynczyk et al. 2001, Warmund 2001]. Presently suggested rootstocks for apple trees, however, apart from their advantages have also some disadvantages. M.26 rootstock poorly takes root after being planted into an orchard and M.9 is poorly frost resistant [Webster 1999, Czynczyk et al. 2009]. Rootstock evaluation using special test cultivars is essential for the selection of new candidates for commercial cultivation [Cummins and Aldwinckle 1983, Piestrzeniewicz et al. 2009].

Observations of several clones obtained by crossing A.2 × B.9 rootstocks to check their usefulness for the production of maiden apple tress of 'Galaxy' and 'Rubin' in a nursery were carried out in the Department of Dendrology and Nursery Production of University of Life Sciences in Poznań.

MATERIAL AND METHODS

The studies were carried out in the years 2008–2009 at the Experimental Station in Baranowo near Poznań, belonging to University of Life Sciences in Poznań. A field experiment was established on pseudo-podsolic soil overlaying boulder clay, classified as third class and containing 2,4% of organic matter. The experimental material consisted of 15 clones of rootstocks originating from crossing A.2 × B.9 and standard M.9 and M.26 rootstocks. The author of these new clones is Aleksander Stachowiak. The experiment was set up in a random complete blocks design, with three replications. 50 rootstocks were planted into each plot in early spring 2007 and 2008. The standard rootstocks and new clones originated from a mother field belonging to the Department of Dendrology and Nursery Production of Life Science University in Poznan. All rootstocks were consistent with the present norm for vegetative rootstocks. The rootstocks were planted into a nursery in the spacing of 90 × 25 cm (44.4 thousand rootstocks × ha^{-1}). In the first decade of August the rootstocks were budded with 'Galaxy' and 'Rubin' apple trees cultivars using "T" method. The maiden trees were obtained in two succeeding productive cycles in years 2008–2009. No herbicides were used during the studies and the nursery was weeded mechanically or, if needed, manually. No irrigation was applied, while fertilization and pest and disease control were applied according to the up-to-date recommendations for nursery of fruit trees.

The nursery productivity was presented as the percentage of the maiden trees obtained in relation to budded rootstocks. At the end of October (in 2008 and in 2009) the following features of maiden apple trees were measured: height (cm), diameter of the tree trunk at the level of 10 cm above the ground (mm). The degree of branching of maiden apple trees was estimated measuring the lateral shoots longer than 10 cm. The obtained measurements were the basis to calculate the total length of the lateral shoots and their number. Also all roots of the maiden apple trees were counted. Observations

and measurements were carried out on 15 trees growing in a row, one after another for each combination. The quality of the trees was expressed as the percentage of trees compatible with Polish Norm PN-R-67010.

Statistical analysis of the results was carried out by two-factorial variance analysis (cultivar, rootstock) using Duncan's test for means separation at $p \leq 0.05$. The percentage values were transformed according to ($y = \arcsin\sqrt{x}$). The results presented in tables are mean values from two years because the results obtained in each year (2008, 2009) showed the same tendency in terms of the influence of rootstocks and cultivars on growth of a maiden apple tree.

RESULTS AND DISCUSSION

Both clones of rootstocks and the cultivars used in the experiment affected the differentiation in the results of height of maiden apple trees (tab. 1). Maiden apple trees of 'Galaxy' growing on clones number 5, 9, 12 had lower height compared to M.9 rootstock. Clones 1, 2, 3, 7, 8, 10, 11, 13, 14 of 'Galaxy' maiden trees had a height similar to standard M.9 rootstock, and clone 15 to M.26 rootstock. Maiden apple trees of 'Rubin', cultivated on clones number 4, 6, 11 were characterized by a smaller height compared with M9 rootstock. Height of maiden apple trees of this cultivar on clones 1,

Table 1. Height of maiden apple trees (cm)
Tabela 1. Wysokość okulantów jabłoni (cm)

Rootstocks Podkładki	Cultivars – Odmiany		Mean value for rootstock Średnia dla podkładki
	'Galaxy'	'Rubin'	
Nr 1	150.5 c-f*	155.8 e-g	153.2 de
Nr 2	150.1 c-f	155.5 d-f	152.8 de
Nr 3	157.8 f-g	153.3 d-f	155.6 de
Nr 4	140.2 ab	139.6 ab	139.9 a
Nr 5	135.1 a	146.3 b-e	140.7 a
Nr 6	141.5 a-c	143.6 a-c	142.6 a
Nr 7	150.6 c-f	157.3 fg	154.0 de
Nr 8	156.2 e-g	145.7 b-d	151.0 c-e
Nr 9	135.6 a	150.4 c-f	143.0 ab
Nr 10	157.2 fg	155.6 d-f	156.4 e
Nr 11	155.2 d-f	142.8 a-c	149.0 b-d
Nr 12	140.1 ab	150.2 c-f	145.2 a-c
Nr 13	154.4 d-f	156.4 fg	155.4 de
Nr 14	154.5 d-f	154.2 d-f	154.4 de
Nr 15	165.1 gh	168.7 h	166.9 f
M. 26	169.7 h	171.2 h	170.9 f
M. 9	149.7 c-f	154.3 d-f	152.0 de
Mean value for cultivar Średnia dla oddmiany	150.8 a	153.0 b	

*Means followed by the same letters are not significantly different at the level of $\alpha = 0.05$
* Średnie oznaczone tymi samymi literami w obrębie analizowanych cech nie różnią się istotnie przy poziomie prawdopodobieństwa $\alpha = 0,05$

2, 3, 5, 7, 8, 9, 10, 12, 13, 14 was the same as on M9 rootstock, and on clone 15 the same as on M26. The lowest average height for the two cultivars were obtained for clones number 4, 5, 6, 9 and 12, which differed in height from the remaining clones and control rootstocks. The highest maiden trees were obtained on the dwarf M.26 rootstock and on clone number 15. Maiden trees growing on clones number 1, 2, 3, 7, 8, 10, 13 and 14 did not differ in height from those obtained on the dwarf M.9 rootstock. Independently from the rootstocks used in the experiment the trees of 'Rubin' were higher than of 'Galaxy' (tab. 1).

The diameter of maiden apple trees was differentiated by used rootstocks and cultivars. The smallest value of this parameter of growth for 'Galaxy' and 'Rubin' was found for the trees growing on clone 5. The same diameter of 'Galaxy' maiden trees as for M9 was measured for clones 1, 2, 4, 6, 8, 9, 11, 12, 13, 14. A bigger diameter of 'Galaxy' maiden trees compared with M.26 was fund only for clones 3, 10, 15. A similar diameter of 'Rubin' maiden trees to the diameter of M.9 was obtained for all clones except for clone 15, which value was similar to the standard M.26 rootstock. On average, for the two studied cultivars the smallest diameter was found for the trees growing on rootstocks clones number 5 and 4, which diameter was significantly smaller than for M.9 rootstock (tab. 2). The biggest diameter was measured for maiden trees on clones number 15, 3 and 10. Their values did not differ from the control M.26 rootstock. Independently from the used rootstocks the trees of 'Rubin' had significantly bigger diameter than 'Galaxy'.

Table 2. Diameter of maiden apple trees (mm)
Tabela 2. Średnica okulantów jabłoni (mm)

Rootstocks Podkładki	Cultivars – Odmiany		Mean value for rootstock Średnia dla podkładki
	'Galaxy'	'Rubin'	
Nr 1	12.3 a-d*	14.5 i-m	13.4 c-e
Nr 2	12.3 a-d	13.3 e-h	12.8 a-c
Nr 3	14.9 l-n	14.1 h-l	14.5 gh
Nr 4	12.2 a-c	13.2 d-h	12.7 ab
Nr 5	11.6 a	13.1 c-g	12.4 a
Nr 6	11.9 ab	13.7 g-i	12.8 a-c
Nr 7	13.8 g-j	13.6 f-i	13.7 ef
Nr 8	13.2 d-h	13.3 e-h	13.3 b-e
Nr 9	11.8 ab	13.9 g-k	12.9 a-c
Nr 10	13.9 g-k	14.4 i-m	14.2 fg
Nr 11	13.3 e-h	13.7 g-i	13.5 de
Nr 12	12.7 b-f	14.7 j-n	13.7 ef
Nr 13	12.6 b-e	14.8 k-n	13.7 ef
Nr 14	12.1 ab	14.0 g-l	13.1 b-d
Nr 15	14.0 g-l	15.6 n	14.8 h
M. 26	13.4 e-h	15.3 mn	14.4 gh
M. 9	12.7 b-f	14.1 h-l	13.4 c-e
Mean value for cultivar Średnia dla odmiany	12.9 a	14.1 b	

*For explanation, see table 1
*Wyjaśnienie, patrz tabela 1

Taking into account both the height and the diameter of maiden trees, the clones of apple trees rootstocks used in the experiment had a different growth vigour. The clones diminishing the growth vigour of maiden trees in comparison with the dwarf M.9 rootstock were clones number 4 and 5. The clones with a similar vigour of growth to the one of M.9 were clones number 1, 2, 6, 7, 8, 9, 11, 12, 13 and 14. All those clones are potential dwarf rootstocks. The clones with the vigour of growth similar to the semi-dwarf M.26 rootstock were clones number 3 and 15. A stronger growth of trees on M.26 rootstock than on M.9 obtained in the present experiments confirms the table of classification of vigour of growth of rootstocks elaborated by Jakubowski [1998, 1999]. Also in experiments conducted in an orchard by Czynczyk et al. [2009], 'Gala' grafted on M.26 had stronger vigour than on M.9. Bielicki and Czynczyk [2004] reported, that when grafted on the semi-dwarf M.26 rootstock, two-year-old 'Jonagored' trees were taller and thicker than grafted on the dwarfing M.9. In the nursery production Kviklys et al. [2008] obtained the same growth of maiden apple trees of 'Sampion' cultivars on M.9 and M.26 rootstocks. On the other hand, sometimes not all cultivars had stronger growth on M.26 rootstocks than on M.9 in an orchard [Szczygieł and Czynczyk 2002]. In the present experiment also vigour of growth of maiden trees of 'Rubin' was higher than of 'Galaxy'. It tells about a bigger vigour growth of 'Rubin' in comparison with 'Galaxy'.

Table 3. Average number of lateral shoots of maiden apple trees
Tabela 3. Średnia liczba pędów bocznych

Rootstocks Podkładki	Cultivars – Odmiany		Mean value for rootstock Średnia dla podkładki
	'Galaxy'	'Rubin'	
Nr 1	6.3 ij*	0.4 a	3.4 hi
Nr 2	2.5 b	0.0 a	1.3 a
Nr 3	7.4 k	0.0 a	3.7 i
Nr 4	5.3 e-g	0.0 a	2.7 d-f
Nr 5	2.3 b	0.0 a	1.2 a
Nr 6	6.1 h-j	0.1 a	3.1 f-h
Nr 7	6.5 ij	0.0 a	3.3 g-i
Nr 8	4.6 d	0.0 a	2.3 b-d
Nr 9	2.5 b	0.3 a	1.4 a
Nr 10	5.6 f-h	0.0 a	2.8 e-g
Nr 11	4.7 de	0.0 a	2.4 c-e
Nr 12	5.2 d-f	0.3 a	2.8 e-g
Nr 13	6.6 j	0.0 a	3.3 hi
Nr 14	5.4 fg	0.0 a	2.7 d-f
Nr 15	5.9 g-i	0.2 a	3.0 f-h
M. 26	3.7 c	0.4 a	2.0 bc
M. 9	3.7 c	0.0 a	1.8 b
Mean value for cultivar Średnia dla odmiany	5.0 b	0.1 a	

*For explanation, see table 1
*Wyjaśnienie, patrz tabela 1

The budded cultivar of apple trees influenced a number of lateral shoots much more than the rootstock. There were no differences among rootstocks for 'Rubin' maiden apple trees. Maiden trees of 'Galaxy' growing on clones 2, 5, 9 had a smaller number of lateral shoots than the standard M.9 and M.26 rootstocks which did not differ in results. The remaining clones had more lateral shoots than M.9 and M.26. On average, for the two cultivars the smallest number of lateral shoots was counted for maiden trees on rootstock clones number 5, 2 and 9, which, as far as this feature is concerned, differed from the remaining combinations (tab. 3). The biggest number of lateral shoots was obtained for the trees produced on clones number 1, 3, 7 and 13. Also, trees growing on clones number 4, 6, 10, 12 and 14 had a bigger number of lateral shoots than the control rootstocks. The results obtained for the M.9 and M.26 rootstocks did not differ between one another and in comparison with clone number 8. Independently from the used rootstocks the maiden trees of 'Galaxy' produced significantly more lateral shoots than 'Rubin' (tab. 3).

Table 4. Average total length of lateral shoots of maiden apple trees (cm)
Tabela 4. Suma długości pędów bocznych (cm)

Rootstocks Podkładki	Cultivars – Odmiany		Mean value for rootstock Średnia dla podkładki
	'Galaxy'	'Rubin'	
Nr 1	214.0 d-f*	11.8 a	112.9 c-e
Nr 2	89.5 b	0.0 a	44.8 a
Nr 3	316.1 h	0.0 a	158.1 f
Nr 4	190.8 cd	0.0 a	95.4 bc
Nr 5	65.1 b	0.0 a	32.6 a
Nr 6	267.3 g	6.5 a	136.9 ef
Nr 7	245.6 e-g	0.0 a	122.8 de
Nr 8	177.0 cd	0.0 a	88.5 bc
Nr 9	66.0 b	0.0 a	33.0 a
Nr 10	275.6 g	0.0 a	137.8 ef
Nr 11	208.8 de	0.0 a	104.4 b-d
Nr 12	157.2 c	9.9 a	83.6 b
Nr 13	276.2 g	0.0 a	138.1 ef
Nr 14	185.3 cd	0.0 a	92.7 bc
Nr 15	243.3 e-g	3.7 a	123.6 de
M. 26	250.5 fg	6.7 a	128.6 de
M. 9	164.5 c	0.0 a	82.3 b
Mean value for cultivar Średnia dla odmiany	199.6 b	3.0 a	

*For explanation, see table 1
*Wyjaśnienie, patrz tabela 1

Similarly to the number of lateral shoots, also the sum of their lengths differed depending on the rootstock only for 'Galaxy' maiden trees. Comparing with M.9 a smaller value was obtained for clones 2, 5, 9 and a similar one for 4, 8, 12, 14. The value which did not differ from the one for M.26 rootstock was obtained for clones 7 and 15 and

a bigger for clones 1 and 13. Taking into consideration the mean value for both cultivars the smallest total length of long shoots was obtained for the trees growing on clones number 5, 2 and 9, which did not differ from the remaining combinations (tab. 4). Maiden trees growing on clones number 4, 8, 11 and 14 did not differ in the length of long shoots from the control M.9 rootstock. Significantly the biggest growth in long shoots was observed for clones number 3, 6, 10 and 13, which, with the exception of clone number 3, did not differ from the control M.26 rootstock as well as from clones number 1, 7 and 15. Independently from the rootstocks used in the experiment the trees of 'Galaxy' had a significantly bigger sum of long shoots than 'Rubin' (tab. 4).

Table 5. Average number of roots
Tabela 5. Liczba korzeni

Rootstocks Podkładki	Cultivars – Odmiany		Mean value for rootstock Średnia dla podkładki
	'Galaxy'	'Rubin'	
Nr 1	12.3 d-g*	12.7 f-i	12.5 c
Nr 2	12.5 e-h	12.5 e-h	12.5 c
Nr 3	13.0 g-j	13.7 jk	13.4 de
Nr 4	11.3 bc	11.5 b-d	11.4 b
Nr 5	11.0 b	11.4 b-d	11.2 b
Nr 6	11.4 b-d	11.7 b-e	11.6 b
Nr 7	12.2 c-g	12.7 f-i	12.5 c
Nr 8	13.1 g-j	13.7 jk	13.4 de
Nr 9	12.5 e-h	13.0 g-j	12.8 cd
Nr 10	13.0 g-j	13.3 h-j	13.2 de
Nr 11	12.6 e-i	13.1 g-j	12.9 cd
Nr 12	11.3 bc	11.8 b-f	11.6 b
Nr 13	12.9 g-j	13.0 g-j	13.0 c-e
Nr 14	13.0 g-j	13.5 i-k	13.3 de
Nr 15	13.5 i-k	13.7 j-k	13.6 e
M. 26	14.2 kl	14.8 l	14.5 f
M. 9	8.2 a	8.6 a	8.4 a
Mean value for cultivar Średnia dla odmiany	12.3 a	12.6 b	

* For explanation, see table 1
* Wyjaśnienie, patrz tabela 1

Taking into account the number and the length of lateral shoots of the obtained maiden trees an obvious influence of the budded apple tree cultivar and the used rootstock was found. It is in accordance with Jaumień et al. reports [1992] and those of Słowinski's and Sadowski's [1996] who noticed that a rootstock had a significant influence on the number and length of lateral shoots. In the present experiment the studied clones differed in the tendency of creating lateral shoots. It is particularly seen for the maiden trees of 'Galaxy' cultivar.

The trees of 'Rubin' cultivar produced lateral shoots sporadically. The best ramified trees were obtained on clones number 1, 3, 6, 7, 13 and 15, which in majority cases had

also the longest lateral shoots. The smallest number of lateral shoots and their shortest length was obtained for clones number 2, 5 and 9. In this way the dependence observed by other authors [Jaumień at al. 1992, Słowiński and Sadowski 1996] stating that maiden trees generally ramify poorer on weaker growing rootstocks, found its confirmation also in the present experiment. Maiden trees growing on M.9 rootstock, on one hand, had a similar number of lateral shoots to M.26, but on the other hand, their length was smaller. Also Bielicki and Czynczyk [2004] reported that trees grafted on M.26 rootstock had more dwarf and sylleptic shoots than on M.9.

Table 6. Percentage of obtained maiden apple trees
Tabela 6. Procent otrzymanych drzewek

Rootstocks Podkładki	Cultivars – Odmiany		Mean value for rootstock Średnia dla podkładki
	'Galaxy'	'Rubin'	
Nr 1	71.6 a-g*	73.0 b-i	72.3 b
Nr 2	68.0 a	70.1 a-c	69.1 a
Nr 3	83.3 k	84.2 k	83.8 d
Nr 4	75.7 g-j	75.8 g-j	75.7 c
Nr 5	78.8 j	72.5 b-h	75.7 c
Nr 6	88.8 mn	83.6 k	86.3 e
Nr 7	72.0 a-g	70.1 a-c	71.1 ab
Nr 8	68.7 ab	72.0 a-g	70.4 ab
Nr 9	70.0 a-c	72.3 a-g	71.2 ab
Nr 10	85.4 kl	89.3 n	87.4 e
Nr 11	71.6 a-g	70.3 a-d	71.0 ab
Nr 12	74.6 e-i	75.5 f-j	75.1 c
Nr 13	88.0 l-n	86.4 k-m	87.2 e
Nr 14	76.5 h-j	73.7 c-i	75.1 c
Nr 15	76.5 h-j	74.4 d-i	75.5 c
M. 26	76.8 ij	74.5 d-i	75.7 c
M. 9	70.4 a-e	71.5 a-f	70.9 ab
Mean value for cultivar Średnia dla odmiany	76.6 a	76.2 a	

*For explanation, see table 1
*Wyjaśnienie, patrz tabela 1

Significantly the smallest number of roots had the trees on the control M.9 rootstock and the biggest number of roots was found on the semi-dwarf M.26 rootstock (tab. 5). Among the studied clones the biggest number of roots had clones number 3, 8, 10, 14 and 15. The remaining clones had more roots than M.9. Maiden trees of 'Rubin' cultivar created significantly more roots that 'Galaxy' cultivar, independently form the used rootstocks.

Significantly the lowest percentage of maiden trees of the two considered cultivars, in comparison with the budded rootstocks, was obtained for clones number 2, 7, 8, 9, 11 and 1. The results did not differ from the control M.9 rootstock. The biggest percentage of trees was obtained on rootstocks number 3, 6, 10 and 13. Middle results, that did not differ from the control M.26, were obtained for clones number 4, 5, 12, 14 and 15.

A smaller efficiency of maiden trees was obtained for M.9 rootstock in comparison with M.26. No significant differences in the number of obtained maiden trees were observed between cultivars (tab. 6).

Table 7. Consistency of maiden apple trees with norm PN-R-67011 (%)
Tabela 7. Zgodność otrzymanych drzewek z Normą PN-R-67011 (%)

Rootstocks Podkładki	Cultivars – Odmiany		Mean value for rootstock Średnia dla podkładki
	'Galaxy'	'Rubin'	
Nr 1	95.1 b-d*	96.3 d	95.8 bc
Nr 2	94.0 a-d	95.1 b-d	94.6 a-c
Nr 3	93.9 a-d	95.1 b-d	94.5 a-c
Nr 4	94.7 a-d	95.2 b-d	94.9 a-c
Nr 5	91.1 a-c	93.3 a-d	92.2 a
Nr 6	94.1 a-d	93.5 a-d	93.8 a-c
Nr 7	95.1 b-d	95.1 b-d	95.1 a-c
Nr 8	93.3 a-d	95.1 b-d	94.2 a-c
Nr 9	90.1 ab	93.3 a-d	91.7 a
Nr 10	95.1 b-d	92.6 a-d	93.9 abc
Nr 11	89.6 a	95.1 b-d	92.6 ab
Nr 12	92.8 a-d	95.1 b-d	94.0 a-c
Nr 13	96.8 d	95.5 cd	96.2 c
Nr 14	92.5 a-d	94.1 a-d	93.3 a-c
Nr 15	95.1 b-d	95.2 b-d	95.2 a-c
M. 26	93.9 a-d	93.4 a-d	93.7 a-c
M. 9	94.1 a-d	94.7 a-d	94.4 a-c
Mean value for cultivar Średnia dla odmiany	93.7 a	94.6 a	

*For explanation, see table 1
*Wyjaśnienie, patrz tabela 1

The smallest number of trees compatible with the norm was obtained for clones number 9 and 5. The results of the two clones differed only from clones number 1 and 13. The obtained percentage for the individual clones was similar to M.9 and M.26 rootstocks.

CONCLUSIONS

1. Maiden apple trees obtained on clones number 5 grew weaker than those on M.9 rootstock. The vigour of growth of maiden apple trees on clone 15 was the strongest, similar to standard M26. The vigour of growth of remaining clones was between M.9 and M.26.

2. The best number of lateral shoots of maiden trees 'Galaxy' was obtained on clones number 1, 3, 6, 7, 10, 13 and 15, which in most cases had also the longest lateral shoots. The trees of 'Rubin' cultivar created lateral shoots sporadically.

3. The trees on all studied clones had more roots than on the dwarf M.9 rootstock but fewer than on a semi-dwarf M.26 rootstock.

4. The biggest number of trees, in comparison with the budded rootstocks, was obtained for clones number 3, 6, 10 and 13. The percentage of maiden trees for clones number 2, 7, 8, 9, 11 and 1 was similar to the percentage for M.9 and for clones number 4, 5, 12, 14 and 15 as for M.26.

5. All clones had a high percentage of trees meeting the requirements of the norm and it did not differ from M.9 and M.26 rootstocks.

REFERENCES

Bielicki P., Czynczyk A., Chlebowska D., 2000. Effect of a rootstock and tree location on yield and quality of 'King Jonagold' apples. J. Fruit Ornam. Plant Res., 8(2), 71–78.

Bielicki P., Czynczyk A., 2004. Effect of rootstock quality and height of heading back one-year-old grafts on the quality of two-year-old trees in the nursery. J. Fruit Ornam. Plant Res., 12, 61–67.

Cummins J.N., Aldwinckle H.S., 1983. Breeding apple rootstocks. Plant Breed. Rev., 1, 294–394.

Czynczyk A., Olszewska B., 1990 Growth and yielding of three apple cultivars on rootstocks of Polish and foreign breeds. Fruit Sci. Rep., 17/22, 65–75.

Czynczyk A., Bielicki P., Bartosiewicz B., 2001 Testing new dwarfing apple rootstocks from Polish and foreign breeding programmes. Acta Hort., 557, 83–89.

Czynczyk A., Bielicki P., Bartosiewicz B., 2009. Results of growing three apple cultivars grawted on a number of Polish and English rootstocka and their subclones. J. Fruit Ornam. Plant Res., 17(2), 73–83.

Engel A., 1999. Effect of different M.9 subclones and M.9-cross-breed rootstocks on growth, yield and fruit quality of three apple cultivars. Proc. of the International Seminar 'Apple rootstocks for intensive orchards' (Warsaw-Ursynów, Poland, 18–21.08.1999), 25–26.

Hrotko K., Mozer G., 1999. Effect of dwarfing and semi-dwarfing rootstocks on growth and productivity of 'Idared' apple cultivar. Proc. of the International Seminar 'Apple rootstocks for intensive orchards' (Warsaw-Ursynów, Poland, 18–21.08.1999), 39–40.

Jadczuk E., Wlosek-Stangret C.R., 1999. Cropping and fruit quality of 'Jonagold' apple trees depending on rootstocks. Proceedings of the International Seminar 'Apple rootstocks for intensive orchards' (Warsaw-Ursynów, Poland, 18–21.08.1999), 67–68.

Jakubowski T., 1998. Klasyfikacja siły wzrostu podkładek jabłoni. XXXVII Ogólnopolska naukowa konferencja sadownicza, ISK Skierniewice, 502–507.

Jakubowski T., 1999. Preliminary evaluation of new apple rootstocks clones. Proc. of the Eucarpia, Symp. of Fruit Breeding and Genetics. Acta Hort., 484, 97–100.

Jakubowski T., Zagaja S.W., 2000. 45 years of apple rootstocks breeding in Poland. Acta Hort., 538, 723–727.

Jaumień F., Czarnecki B., Mirtut T., Poniedziałek W., 1992: Very similar effects of a mixture of GA3 and BA(6-benzylaminopurine) and of GA3+7 and BA on branching of some apple cultivars in nursery. Acta Hort., 329, 35–42

Kviklys D., Uselis N., Kvikliene., 1999. Proceedings of the International Seminar 'Apple rootstocks for intensive orchards' (Warsaw-Ursynów, Poland, 18–21.08.1999), 67–68.

Kviklys D., Lanauskas J., Sakalauskaite J., Kvikliene N., Uselis N., 2008. Soil exhaustion and rootstock effect on the growth of apple planting material. Agronomy Research, 6(2), 511–516.

Lipecki J., Janisz A., 1999. Zależności między cechami charakteryzującymi wzrost okulantów jabłoni. Zesz. Nauk, AR Kraków, 351, 67–71.

Ostrowska K., Chełpiński P., 1997. The relationship between growth indices of young apple trees. J. Fruit Ornam. Plant Res., 5 (1), 21–29.

Piestrzeniewicz C., Sadowski A., Dziuban R., 2009. Suitability of different dwarfing rootstocks for 'Rubin' apple trees grown in fertile soil. J. Fruit Ornam. Plant Res., 17(2), 53–62.
Silbereisen R., Scherr F., 1996. Anbauvergleich mit schwachwachsenden Apfel-Unterlagen. Erwerbsobstbaum, 4, 98–106.
Skrzyński J., Poniedziałek W., 1999. Growth and croping of 'Jonagold' apple trees on six different rootstocks M.9, M.26. P 2, P 14, P 22 and P 60. Proceedings of the International Seminar 'Apple rootstocks for intensive orchards' (Warsaw-Ursynów, Poland 18–21.08.1999), 97–98.
Słowiński A., Sadowski A., 1996. Wzrost i rozgałęzianie się drzewek trzech odmian jabłoni w szkółce w zależności od użytej podkładki. II Ogólnop. Symp. AR Poznań, 1, 262–265.
Szczygieł A., Czynczyk A., 2002. Suitability of some semi-dwarf and dwarf rootstocks to three apple cultivars in sub-Carpathica region. J. Fruit Ornam. Plant Res., 10, 85–93.
Warmund M.R., 2001. Early performance of 'Red Fuji' on M.9 clones and other dwarfing rootstocks. J. Am. Pom. Soc., 55(2), 95–100.
Webster A.D., 1999. Dwarfing rootstocks for apple: past, present and future. Proceedings of the International Seminar 'Apple rootstocks for intensive orchards' (Warsaw-Ursynów, Poland, 18–21.08.1999), 15–16.
Webster A.D., Hollands M.S., 1999. Orchard comparisons of Cox's Orange Pepin grown on selections of the apple rootstock M.9. J. Hort. Sci. & Biotech., 74(4), 513–521.
Wertheim S.J., 1998. Rootstock Guide. Fruit research station Wilhelminadorp the Netherlands.
Zagaja S.W., Jakubowski T., Przybyła A., 1991. P 60 a new vegetative apple rootstock. Fruit Sci. Rep., 18(1), 25–30.

WZROST OKULANTÓW JABŁONI ODMIAN 'GALAXY' I 'RUBIN' NA KLONACH POCHODZĄCYCH Z KRZYŻOWANIA PODKŁADEK A.2 × B.9

Streszczenie. W światowym sadownictwie zaznacza się trend stałego limitowania rozmiarów większości gatunków drzew owocowych. Z tego powodu kontynuowane są badania nad nowymi podkładkami ograniczającymi siłę wzrostu uprawianych roślin. Doświadczenie przeprowadzono w Stacji Doświadczalnej Uniwersytetu Przyrodniczego w Poznaniu w latach 2008–2009. Celem doświadczenia była ocena wpływu 15 różnych klonów powstałych z krzyżowania podkładek A.2 × B.9 na wzrost drzewek odmian 'Galaxy' i 'Rubin' w szkółce. Dla porównania jako kontrolę zastosowano podkładki M.9 i M.26. Najsilniejszy wzrost okulantów jabłoni otrzymano na podkładce M.26 i na klonie 15. Wzrost drzewek na klonie 5 był słabszy niż na M.9. Okulanty jabłoni odmiany 'Rubin' nie tworzyły pędów bocznych na większości podkładek. Największą liczbę i sumę pędów bocznych stwierdzono u drzewek odmiany 'Galaxy' rosnących na klonach 1, 3, 6, 7, 10, 13 i 15, a najmniej na 2, 5 i 9. Najwięcej korzeni szkieletowych miały drzewka na podkładce M.26, a najmniej na M.9. Największą wydajność okulantów uzyskano na klonach 6, 10 i 13, a najmniejszą na 2, 7, 8, 9 i 11, które nie różniły się od kontroli M.9. Dla wszystkich klonów uzyskano wysoki procent drzewek zgodnych z normą, a wyniki nie różniły się od kontroli na M.9 i M.26.

Słowa kluczowe: nowe podkładki, szkółka, produkcja okulantów jabłoni

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