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ESTIMATION OF 15 NEW CLONES OF APPLE ROOTSTOCKS

Summary. The studies were conducted at the Experimental Station of the Poznań University of Life Sciences in the years 2006-2008. The main target of the experiment carried out in a nursery was the evaluation of the efficiency and quality of stoolings of 15 hybrids obtained by hybridization of A.2 and B.9 rootstocks. The best efficiency of stoolings was observed for clone 1, and next clones 15, 3 and 12. The biggest diameter of the root collar was found for the rootstocks of clones 7 and 5, and the number of places the roots grew for clones 3 and 8. As far as the efficiency of stoolings in a nursery, their diameters and number of places of root growth were concerned, clones 1, 3, 5, 6, 12 and 15 were exceptional. The smallest number of lateral shoots had stoolings of clone 13, and the smallest number of thorns were characteristic for the stoolings of clones 8 and 12.

Key words: hybrids, mother plant, stoolings, efficiency, quality

Introduction

New apple orchards are planted with the use of trees on dwarf or semi-dwarf clonal rootstocks. Among them, M.9 is the most common in Western and Central European countries. At the same time in many countries (WEBSTER et AL. 1986, BESSHO and SOEJIMA 1992, FISCHER 1997, ROBINSON et AL. 1997, WEBSTER and TOBUTT 2001, JOHNSON et AL. 2007), as well as in Poland (PRZYBYŁA and ZAGAJA 1987, ZAGAJA et AL. 1988, JAKUBOWSKI 1993, 1998, JAKUBOWSKI and ZAGAJA 2000, CZYNCZYK and JAKUBOWSKI 2007), various works to obtain new rootstocks for apple trees are conducted. The effect of such works in the Institute of Pomology and Floriculture at Skierniewice, Poland, are, among others, rootstocks: P1, P2, P14, P16, P22, P59 (‘Polan’), P60, P62, P63, P64, P66, P67. Also, in former Agricultural University, and present Poznań University of Life Sciences, Poland, for many years different cultivation and propagation works have been conducted to produce new rootstocks for apple trees. As a result of hybridization of A.2 and B.9 rootstocks several hybrids have been obtained.

As it has been proved, clones of the same rootstock can differ between each other. Numerous experiments performed on stool-beds showed differences in their morphology, propagation, vigour, and other characteristics, for example M.9 rootstock (ENGEL 1986, VAN OOSTEN 1986, KOLASIŃSKI 1996, WERTHEIM 1997, BAAB 1998).

The aim of this study was the estimation of the efficiency and quality of stoolings obtained by hybridization of rootstocks A.2 and B.9.

Material and methods

The studies were conducted at the Experimental Station of Baranowo in the years 2006-2008. A field experiment was established on soil of third valuation class. The object of the studies was 15 hybrids obtained by hybridization between A.2 × B.9 rootstocks. The mother plants were planted in stool-beds at the distance of 220 × 30 cm in early spring of 2004. The experiment was set in random blocks. It comprised 15 combinations in four repetitions. The combinations were different kinds of rootstocks, whereas the repetitions were the plots where three mother plants grew on each of them. The plants were propagated by a stooling method. No herbicides were used during the studies and the mother field was weeded mechanically. No irrigation was applied, while fertilization and control were carried out according to the up-to-date recommendations for the stool-beds. During the second and next years of plantation, when new shoots reached the height of 15 cm a sawdust was used for etiolation. When the shoots grew longer than 20 cm, they were covered with soil two times. A total height of new shoots covered with soil reached 30 cm. In early spring, during the years 2006-2008, the observations and measurements were performed for all obtained stoolings. The height and the diameter of the root collar and the length of lateral shoots in first and the second row of stoolings were measured. The numbers of stoolings from one mother plant, the number of lateral shoots, places of root formation and thorns were counted. The statistical analysis of the data obtained was carried out using a one-factor variance analysis applying Duncan test at the significance level $\alpha = 0.05$. The results presented in tables are the mean values collected in three years.

Result and discussion

The biggest number of stoolings from one mother plant was obtained for clones 1 and 15, which values differed among each other and from other combinations. A good efficiency of the stoolings was observed for clones 3 and 12, and later 2, 6, 5 and 11. The smallest number of stoolings was found for clones 7, 8 and 4 (Table 1). The efficiency of stoolings from one mother plant in a stool-bed is a very important feature that determines the usefulness of a particular rootstock to be used in a nursery production and only rootstocks with a high efficiency of stoolings from a mother plant can be used there. Taking into consideration the efficiency of stoolings from a mother plant, clones 1, 15, 3 and 12 were the most valuable.

Table 1. Average efficiency and quality of rootstocks of the studied clones (average from 2006--2008 years)
Tabela 1. Średnia wydajność i jakość podkładek badanych klonów (średnia z lat 2006-2008)

Number of clone	Number of stoolings from one mother plant	Diameter of root collar (mm)	Average number of places of root formation
1	13.3 j	7.5 de	5.1 de
2	7.7 fg	6.3 a	4.6 bc
3	8.7 h	6.3 a	7.2 i
4	4.7 ab	6.9 bc	4.8 cd
5	7.0 ef	10.3 h	5.4 ef
6	7.7 fg	8.8 g	5.7 f
7	4.0 a	10.7 h	4.2 ab
8	4.0 a	8.2 f	6.8 hi
9	6.0 cd	6.8 bc	6.3 g
10	5.0 b	7.1 cd	6.1 gh
11	7.0 ef	7.0 bc	4.1 a
12	8.0 gh	7.7 e	5.5 ef
13	5.3 bc	6.6 ab	5.8 f
14	6.6 de	8.8 g	4.2 ab
15	10.0 i	8.2 f	4.3 ab

*The means followed by the same letters do not differ at $\alpha = 0.05$.

The biggest diameter of the root collar was noted for stollings of clones 7 and 5. Their diameter differed from other clones. A bit smaller diameter was observed for clones 6 and 14 and clones 8 and 15. The smallest diameter was observed for rootstocks of clones 2 and 3, which values did not differ from clone 13 (Table 1).

The diameter of the root collar of a stooling is one of two parameters determining the use of the rootstock in further stage of a nursery production. According to the present standard (it means since 2004) a minimum thickness of a vegetative rootstock should amount to 3 mm. In the present experiment this requirement was met by all the studied clones. There is an opinion, however, that the thicker the rootstock planted in a nursery, the better quality of the obtained fruit tree in the future (BIELICKI et AL. 1994, GUDAROWSKA 1995, KICZOROWSKI 1998). Taking this opinion into consideration the best clones were 7 and 5. The biggest diameter of clone 7 stoolings, however, was connected with their small number obtained from one mother plant, which excludes this clone from a nursery production. Clone 5 was better. It was characterised by a good efficiency of the rootstocks from a mother plant. Both good parameters of the above mentioned diameters and the efficiency of stoolings were characteristic also for clones 1, 6, 12 and 15 (Table 1).

The number of places of root formation is a second, in the scale of importance, feature of the stoolings. In the present experiment significantly biggest value of this pa-

rameter was obtained for clones 3 and 8 (Table 1). In spite of good rooting of clone 8 stoolings this clone must be excluded due to a very low efficiency of the mother plant. A medium number of places of root formation was observed for clones 13, 6, 12 and 5, the smallest for 11, 7, 14 and 15 (Table 1). The obtained results of the number of places of root formation for every clone met the requirements of the standard (minimum three places of root formation on a rootstock). Taking into consideration all three the most important parameters determining the usefulness of the rootstock, that is: efficiency in a stool-bed, diameter and number of places of root formation (mean values of them) the best were clones: 1 and later 5, 15, 3, 6 and 12.

Significant differences in the height of stoolings of particular clones were found. The highest were the stoolings of clones 15, 1, 6, 3, 14 and 12, which height differed from the rest of the studied ones (Table 2). Also stoolings obtained from clones 7 and 5 were relatively high. Significantly the lowest were stoolings of clone 13.

Table 2. The parameters of growth of rootstocks of the studied clones (average from 2006-2008 years)
Tabela 2. Parametry wzrostu podkładek badanych klonów (średnia z lat 2006-2008)

Number of clone	Height (cm)	Number of lateral shoots	Average length of lateral shoots (cm)
1	84.8 e	3.7 ab	26.9 f
2	82.7 e	3.6 ab	10.0 ab
3	84.0 e	7.7 b	20.3 de
4	63.4 bc	5.9 ab	13.9 b-d
5	76.8 de	6.9 b	13.5 bc
6	84.7 e	5.0 ab	25.7 ef
7	77.5 de	3.6 ab	5.5 a
8	64.7 bc	4.0 ab	17.6 cd
9	69.0 cd	3.2 ab	15.6 b-d
10	66.8 bc	4.3 ab	25.7 ef
11	57.5 ab	4.7 ab	14.5 b-d
12	61.8 a-c	3.1 ab	13.3 bc
13	52.4 a	1.3 a	32.2 f
14	83.2 e	5.2 ab	28.4 f
15	85.1 e	4.0 ab	18.8 cd

*The means followed by the same letters do not differ at $\alpha = 0.05$.

The biggest number of lateral shoots was observed for rootstocks of clones 3 and 5. The results differed among each other and from the remaining combinations (Table 2). Too high number of lateral shoots is not a desired feature as the nurseryman has to remove some of them preparing the rootstock for budding. The lowest load of work con-

nected with this activity would therefore be for rootstock of clone 13, which had the fewest lateral shoots.

The longest lateral shoots of the I row were created by the rootstocks of clone 13, the shortest ones were fund for clone 7 (Table 2). The length of lateral shoots of clone 13 was a result of their small numbers.

Interpreting the results of the remaining studied features of the rootstocks placed in Table 3, significant differences in the length and number of lateral shoots of II row in individual clones were observed. Stoolings of clone 3 produced the longest lateral shoots of II row, and the stoolings of clone 7 were characterized by their biggest number. Clones 4, 5, 8, 13 and 15 were completely deprived of the II row shoots (Table 3).

Table 3. Remaining parameters of growth of rootstocks of the studied clones (average from 2006--2008 years)
Tabela 3. Pozostałe parametry wzrostu podkładek badanych klonów (średnia z lat 2006-2008)

Number of clone	Length of shoots of II row (cm)	Number of shoots of II row	Average number of thorns
1	8.4 e	1.0 b	1.8 d
2	3.2 b	15.0 g	2.3 e
3	12.7 f	1.5 b	2.0 d
4	0.0 a	0.0 a	1.3 c
5	0.0 a	0.0 a	1.5 c
6	4.5 c	1.0 b	1.0 b
7	3.3 b	19.0 h	1.3 c
8	0.0 a	0.0 a	0.3 a
9	5.0 d	8.0 e	5.7 h
10	4.3 c	10.0 f	4.3 g
11	3.4 b	5.0 d	1.3 bc
12	4.8 d	4.0 c	0.3 a
13	0.0 a	0.0 a	1.0 b
14	4.3 c	10.0 f	3.0 f
15	0.0 a	0.0 a	2.4 e

*The means followed by the same letters do not differ at $\alpha = 0.05$.

The biggest number of thorns was observed for the rootstock of clone 9, the smallest for clones 8 and 12 (Table 3). The big number of thorns of the rootstock is not a desired feature as the comfort of nursery work is much reduced.

On the basis of the obtained results six clones were separated. They were characterised by the best efficiency of stoolings, their good rooting, good growth parameters and the lowest number of lateral shoots and thorns. The above mentioned features were observed for clones: 1, 3, 5, 6, 12 and 15.

Conclusions

1. The experiment showed a high variability of the morphological features of the studied clones.

2. The best efficiency of the stoolings in a nursery was observed for clones 1 and 15.

3. The biggest diameter of root collar was noted for the rootstocks of clones 7 and 5, and the biggest number of root formation for clones 3 and 8.

4. The smallest number of lateral shoots was found for stoolings of clone 13 and the smallest number of thorns for clones 8 and 12.

5. Taking into consideration the most important requirements for rootstocks the most valuable clones were 1, 3, 5, 6, 12 and 15.

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OCENA 15 NOWYCH MIESZAŃCÓW UZYSKANYCH Z KRZYŻOWANIA PODKŁADEK JABŁONI

Streszczenie. Badania wykonano w Stacji Doświadczalnej Uniwersytetu Przyrodniczego w Poznaniu w latach 2006-2008. Celem doświadczenia przeprowadzonego w mateczniku była ocena wydajności i jakości odkładów pionowych 15 mieszańców uzyskanych z krzyżowania podkładek A.2 i B.9. Najlepszą wydajnością odkładów charakteryzował się klon 1, a w dalszej kolejności klony 15, 3 i 12. Największą średnicę szyjki korzeniowej odnotowano u podkładek klonów 7 i 5, a największą liczbę miejsc wyrastania korzeni – u klonów 3 i 8. Pod względem wydajności odkładów w mateczniku oraz ich średnicy i liczby miejsc wyrastania korzeni wyróżniły się klony: 1, 3, 5, 6, 12 i 15. Najmniejszą liczbę pędów bocznych miały odkłady klonu 13, a najmniejszą liczbą cierni charakteryzowały się podkładki klonów 8 i 12.

Słowa kluczowe: mieszańce, roślina mateczna, odkłady pionowe, wydajność, jakość

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