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## **APPLICATION OF DOUBLE ROOT SYSTEM IN A MOTHER FIELD OF ROOTSTOCKS FOR APPLE TREES**

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**ABSTRACT.** The influence of a double root system of mother plants on the efficiency and quality of stool layers of vegetative rootstocks for apple trees was evaluated in the study. The following rootstocks were examined: M.9, M.26, MM.106. Mother plants on their own roots constituted a control group. The application of a double root system increased significantly the efficiency of mother plants and the quality of layers in the case of M.26 and MM.106 rootstocks, but no positive changes were observed for M.9 rootstock.

**Key words:** double root system, growth and efficiency of mother plants, propagation by stool layers, quality of stool layers, rootstocks for apple

### **Introduction**

In an orchard nursery vegetative rootstocks play an important role. The demand for such rootstocks makes researchers try to increase the efficiency of a nursery and improve the quality of the obtained rootstocks (**Rusnak** 1976 a, b, **Grzyb** 1978). The most frequently, from one mother plant one can get from some to anywhere from ten to twenty stool layers. It mainly depends on the type of a rootstock and the soil and climate conditions. One of the reasons of such low efficiency is a weak root system of mother plants. That is why in the presented experiment its size was increased by the use of additional root system of Antonówka seedling. It is a generative rootstock characterized by a deep and well developed root system better absorbing water and nutrients, especially in dry periods, which may affect the efficiency and the quality of the obtained layers (**Czynczyk** 1973).

## Material and methods

The experiment was carried out in 2001-2005. In the middle of February 2001 a winter grafting in a hand was executed on Antonówka seedlings using bud sticks with three buds of vegetative rootstocks M.9, M.26 and MM.106. At the end of March, after a proper storage period, the inoculated rootstocks were planted into a nursery, leaving only one – upper bud of the scion, above the ground. The inoculated plants were planted deep enough to enable the growth of a double root system (of Antonówka seedling and the vegetative rootstock). The same rootstocks but on their own roots constituted a control group. The experiment was carried out in complete random blocks with three replication, three mother plants in each replication.

In the early spring of 2003 the above-ground part of mother plants was trimmed on the height of 5 cm above the ground to make them develop. During the growth of young shoots, when they reached the height of respectively 15, 30 and 45 cm, they were strewed with sawdust and later with the intercrop soil.

In late autumn, every year of the nursery exploitation all stool layers were taken off and measured – the thickness of the root neck (mm) and the height of the rootstocks (cm). On the basis of the above mentioned measurements and the number of places of roots rise, the number of rootstocks meeting the requirements of the Polish Standard PN-R-67010 was stated. The efficiency of mother plants was evaluated as well. Statistical analysis of the results was carried out with STAT programme using two-factor variance analysis (rootstocks, the type of a root system). Significance of differences among combinations was evaluated on the basis of confidence intervals calculated from Duncan's test for a confidence level  $\alpha = 0.05$ . The results presented in tables are average values of the three years.

## Results

The application of a double root system of mother plants encouraged the growth of all types of rootstocks, although no significant differences in the height and thickness of the individual plants were detected. Independently from the examined combinations the highest and the thickest were the rootstocks originating from mother plants M.26 (Table 1).

A double root system significantly increased the efficiency of mother plants of M.26 and MM.106 rootstocks, compared with the control group. M.9 rootstock constituted the only exception, for which no significant difference in mother plants efficiency was detected (Table 2). Independently from the root system type a better efficiency from one mother plant was obtained for M.26 and MM.106 rootstocks than for M.9.

An average number of M.26 and MM.106 rootstocks consistent with the Polish Standard PN-R-67010 from a double root system was bigger, compared with the controlled group. For M.9 rootstock, however, similar results for both combinations were obtained (Table 2). This rootstock was characterized by the smallest number of layers consistent with the above mentioned Standard.

The double root system did not affect any important differentiation of the percent number of rootstocks consistent with Polish Standard PN-R-67010. Only the percent for the MM.106 rootstock on a double root was higher than for the remaining combinations. (Table 2).

**Table 1**  
**Height and thickness of rootstocks for apple trees depend on the kind of the root system of mother plants (in 2003-2005)**  
**Wysokość i grubość podkładek dla jabłoni w zależności do rodzaju systemu korzeniowego karp matecznych (w latach 2003-2005)**

Combination Kombinacja	Rootstock Podkładka	Height Wysokość (cm)	Thickness Grubość (mm)
Control Kontrola	M.9	53,7 a *	6,5 a
	M.26	69,1 ab	7,8 a
	MM.106	65,6 ab	7,3 a
Double root system Podwójny system korzeniowy	M.9	60,8 ab	6,9 a
	M.26	77,2 b	7,6 a
	MM.106	68,8 ab	7,4 a

\*Means followed by the same letters in columns are not significant at the level of  $\alpha = 0.05$ .

\*Średnie oznaczone tymi samymi literami w kolumnach nie różnią się istotnie na poziomie  $\alpha = 0,05$ .

**Table 2**  
**Efficiency and quality of rootstocks for apple trees depend on the kind of the root system of mother plants (in 2003-2005)**  
**Wydajność i jakość podkładek dla jabłoni w zależności do rodzaju systemu korzeniowego karp matecznych (w latach 2003-2005)**

Combination Kombinacja	Rootstock Podkładka	Efficiency of rootstocks from one mother plant Wydajność pod- kładek z 1 karp- matecznej	Number of rootstocks that meet the re- quirements of Polish Standard PN-R-67010 Liczba podkładek spełniających wyma- gania Polskiej Normy PN-R-67010	Percentage of root- stocks that meet the requirements of Polish Standard PN-R-67010 Procent podkładek spełniających wyma- gania Polskiej Normy PN-R-67010
Control Kontrola	M.9	11.5 a *	8.5 a	73.9 a
	M.26	13.6 b	10.1 a	74.3 a
	MM.106	14.7 b	12.2 b	83.0 b
Double root system Podwójny system ko- rzeniowy	M.9	11.7 a	8.9 a	76.1 a
	M.26	20.5 c	16.4 c	80.0 ab
	MM.106	20.3 c	16.3 c	80.3 ab

\*Means followed by the same letters in columns are not significant at the level of  $\alpha = 0.05$ .

\*Średnie oznaczone tymi samymi literami w kolumnach nie różnią się istotnie na poziomie  $\alpha = 0,05$ .

## Discussion

In orchard nursery researchers are constantly looking for such propagation methods which would enable the increase in the efficiency of mother plants as well as the quality of rootstocks. Decrease in mother plants spacing to 20 cm in a row (**Grzyb** 1978) enables the increase in rootstocks' efficiency from one unit of the ground. However, mother plants are so close to one another in a full fructification period that the growing sprouts do not have enough space for their growth. Besides, a limited access to water and nutrients worsens the quality of the obtained layers. A higher cut of the rootstocks (10 cm), in the second year after the mother plants plantation establishment, suggested by **Grzyb** (1978), seems effective only through the first two years of a nursery. Later the mother plants are placed higher and more difficult to heap up banks. Later a hard cut lowering mother plants is also necessary.

**Rusnak** (1976 a) in his experiments observed the dependance between the nursery efficiency and its demand for water and nutrients. This dependance is important if one wants to improve the efficiency of a mother field. The use of sawdust for plants strewing, suggested by **Rusnak** (1976 b), together with peat application, gave a positive effect in the form of rootstocks with bigger number of roots.

Propagation of rootstocks from cuttings suggested by **Slaski** (1978), is possible on the condition of keeping appropriate humidity with the use of automatic fogging.

Some authors (**Wertheim** 1988, **Czynczyk et al.** 1994) suggest the propagation of the rootstocks using in vitro method. This method enables the obtaining of many healthy rootstocks in a short period of time. However this method arises controversies among other authors (**Rosati and Gaggioli** 1987, **Poniedziałek** 1993) because of the possibility of appearing the forms which differ with morphological and genetic features from the origin genotype. Considering present trends in nursery development that aim at the increase in the efficiency of mother plants, one can observe that the propagation of rootstocks through stool layers is and will be widely applied by nurserymen. Modification of this method of propagation may enable the increase of a nursery efficiency. **Czynczyk** (1973) states that budding of Antonówka seedlings with the vegetative rootstocks buds, as well as the grafting of seedlings with scions of these rootstocks are the methods of obtaining quick and cheap mother plants. Results obtained in this paper are consistent with the above mentioned opinion. However it is necessary to observe a nursery and repeat the experiment with other known types of vegetative rootstocks for apple trees to confirm the usefulness of this method. On the basis of the so far obtained results one can state that this method does not seem to be useful for all types of rootstocks. Stronger growing rootstocks react with a big improvement in the quality and efficiency of layers, compared with dwarf ones e.g. M.9.

## Conclusions

1. A double root system increased significantly the efficiency of a nursery and improved the quality of vegetative rootstocks M.26 and MM.106 for apple trees.
2. M.9 rootstock on a double root system in a nursery did not show any significant increase in mother plants efficiency and in the quality of stool layers.

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### ZASTOSOWANIE PODWÓJNEGO SYSTEMU KORZENIOWEGO W MATECZNIKU PODKŁADEK DLA JABŁONI

#### S t r e s z c z e n i e

W latach 2001-2005 w mateczniku oceniono wzrost, wydajność i jakość odkładów pionowych trzech podkładek wegetatywnych dla jabłoni: M.9, M.26, MM.106 na dodatkowym systemie korzeniowym pochodzącym od siewki 'Antonówki'. Kombinacją kontrolną były rośliny mateczne na własnym korzeniu. U podkładek M.26 i MM.106 zastosowanie podwójnego systemu korzeniowego istotnie zwiększyło wydajność karp matecznych i polepszyło jakość odkładów. Pozytywnego wpływu dodatkowego systemu korzeniowego nie stwierdzono dla podkładki M.9.