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GROWTH OF THREE GENERATIVE ROOTSTOCKS IN A "REPLANT DISEASE SOIL" NURSERY AFTER THE USE OF DIFFERENT ORGANIC FERTILIZERS

Summary. In the years 2007-2008 a special experiment was carried out. Its aim was the evaluation of growth of three generative rootstocks: 'Antonówka' seedling, *Pyrus communis* var. *caucasica* seedling and 'Wangenheim Prune' seedling in a nursery in "replant disease soil" enriched with organic matter coming from the leaves of *Beta vulgaris* var. *saccharifera*, leaves of *Ginkgo biloba* and straw of *Sinapis alba*. One of the combinations were the seedlings, which were growing on the place where there had not been a nursery before. The rootstocks of 'Antonówka' seedling grew the best on the stand where the leaves of *G. biloba* were the organic matter. The best growth of 'Wangenheim Prune' and *P. communis* var. *caucasica* rootstocks was observed in the combination with no "replant disease soil" stand, and in next turn after the use of *B. vulgaris* var. *saccharifera* leaves and *G. biloba.* The smallest percentage of rootstocks of *P. communis* var. *caucasica* with traces of *Agrobacterium tumefaciens* was noted for the combination with no "replant disease soil" stand and after the use of straw of *S. alba.*

Key words: seedlings, nursery, "replant disease soil", organic matter

Introduction

Intensification of many agricultural cultivations causes that the same species appears on the same plots in the crop rotation cycles in much shorter periods of time. The consequence of such activities can be a "replant disease soil" phenomenon, which is more and more popular, especially in orchards and nurseries. A lot of research has been carried out to limit the consequences of this phenomenon in orchards (KOWALIK et AL. 1998, SZCZYGIEŁ and ZEPP 1998, MERWIN and BYARD 2001, BECHMER et AL. 2003, ZYDLIK 2004, REGINATO et AL. 2008, TUSTIN et AL. 2008), less studies come from nurseries (PORĘBSKI et AL. 2003, SIMEONE et AL. 2006). The best method to avoid the "replant disease soil" phenomenon is a production of trees in a place where there has not been a nursery so far, however, it is not always possible due to e.g. a price of the ground or difficult renting procedures. In the search for non chemical methods of fighting with "replant disease soil" phenomenon the introduction of organic substances such as peat or compost into the soil of new orchards is popularised (ENGEL 1988, KOWALIK 1994, KOWALIK et AL. 1998, TRAVIS et AL. 2006). In the last years studies on the use of mycorrhizal fungi to limit the "replant disease soil" have been also carried out (MONTICELLI et AL. 2000, RUTTO and MIZUTANI 2006, DRUZIC-ORLIC et AL. 2008).

The aim of the present studies was the evaluation of the growth of three generative rootstocks cultivated in a "replant disease soil" nursery after introduction of different organic fertilizers.

Material and methods

The studies were carried out in Agricultural Experimental Station in Baranowo, belonging to Poznań University of Life Sciences, in the years 2007-2008. The following organic matter was introduced into the soil which had been planted first with rootstocks and later with fruit trees: with sugar beet (*Beta vulgaris* var. *saccharifera* L.) leaves – 30 $t \cdot ha^{-1}$, with maidenhair (*Ginkgo biloba* L.): leaves – 2 $t \cdot ha^{-1}$ and straw of white mustard (*Sinapis alba* L.) – 10 $t \cdot ha^{-1}$. Rootstocks growing on a plot with no previous nursery record were a control combination. Seedlings of 'Antonówka' and *Pyrus communis* var. *caucasica* (Fed.) and 'Wangenheim Prune' rootstocks pricked out 100 on each plot in four replications. Protection and care of growing plants was carried out in accordance with the latest recommendations for a rootstock nursery. Rootstock plots were not watered. After a vegetation period, at the end of November, all obtained rootstocks were measured. The measurements of height (cm) and root neck diameter (mm) were carried out and the number of skeleton roots was calculated as well. Additionally for *P. communis* var. *caucasica* the percentage of rootstocks with visible symptoms of *Agrobacterium tumefaciens* (Smith et Town; Conn) was defined. The statistical analysis of the obtained data was carried out with the help of STAT programme, with the application of one-factor variance analysis using Duncan's test, with probability level $\alpha = 0.05$. Results shown in tables are mean values of two following years of studies.

Results and discussion

The height of 'Antonówka' seedling was differentiated and depended on the used combination. The highest trees were obtained on a plot with *G. biloba* leaves. Lower rootstocks than the above mentioned ones grew on no "replant disease soil". Medium height, but also different from the remaining combinations, was noted for plants growing in a soil after the use of *S. alba* straw. Significantly the lowest plants were obtained after the use of sugar beet leaves (Table 1).

Significantly the biggest diameter of the root neck had the trees of 'Antonówka' rootstock in a combination with *G. biloba* leaves. Remaining results did not differ among each other (Table 1).

Table 1. The parameters of growth of 'Antonówka' rootstock
Tabela 1. Parametry wzrostu podkładki 'Antonówki'

Combination	Height (cm)	Diameter of root collar (mm)	Number of roots
Leaves of *Beta vulgaris* var. *saccharifera*	39.8 a	5.4 a	4.3 b
Leaves of *Ginkgo biloba*	55.2 d	5.9 b	5.5 c
Straw of *Sinapis alba*	45.8 b	5.2 a	3.9 a
No replant soil	51.4 c	5.1 a	5.5 c

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

The biggest number of roots was noted for plants of 'Antonówka' rootstock growing in the soil with *G. biloba* leaves and in no "replant disease soil". Significantly the lowest number of roots had seedlings grown in the soil with the addition of *S. alba* straw (Table 1).

Plants of 'Wangenheim Prune' rootstock grew best in no "replant disease soil". Significantly, the lowest height was characteristic for rootstocks growing in a soil where straw of *S. alba* was used (Table 2).

Table 2. The parameters of growth of 'Wagenheim Prune' rootstock
Tabela 2. Parametry wzrostu podkładki 'Węgierki Wangenheima'

Combination	Height (cm)	Diameter of root collar (mm)	Number of roots
Leaves of *Beta vulgaris* var. *saccharifera*	40.8 b	6.8 c	6.7 c
Leaves of *Ginkgo biloba*	4.2 b	6.0 b	5.3 b
Straw of *Sinapis alba*	3.0 a	5.4 a	4.3 a
No replant soil	45.6 c	6.9 c	7.7 d

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

Significantly the biggest diameter of the root neck of 'Wangenheim Prune' rootstock was found in no "replant disease soil" and with sugar beet leaves. On the plot with *S. alba* straw the rootstocks had significantly lowest diameter (Table 2).

The number of roots of 'Wangenheim Prune' rootstock was significantly differentiated. The best result was noted for trees growing on plots with no "replant disease soil", later on the soil with sugar beet leaves. These results differed among one another and were different from the remaining combinations. Statistically the lowest number of roots had trees growing in the soil with *S. alba* straw (Table 2).

The plants of *P. communis* var. *caucasica* rootstock growing on a plot which had not been occupied by a nursery obtained the biggest height. Significantly the lowest were rootstocks in a soil with sugar beet leaves and *S. alba* straw (Table 3).

Table 3. The parameters of growth of *Pyrus communis* var. *caucasica* rootstock
Tabela 3. Parametry wzrostu podkładki gruszy kaukaskiej

Combination	Height (cm)	Diameter of root collar (mm)	Number of roots	Seedlings of visual symptoms of *Agrobacterium tumefaciens* (%)
Leaves of *Beta vulgaris* var. *saccharifera*	42.0 a	6.3 a	4.6 b	14.4 d
Leaves of *Ginkgo biloba*	44.7 b	6.5 ab	4.0 a	10.1 c
Straw of *Sinapis alba*	42.3 a	6.3 a	3.9 a	2.6 b
No replant soil	47.8 c	6.7 b	5.5 c	1.1 a

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

Significantly the biggest diameter had trees of *P. communis* var. *caucasica* growing in no "replant disease soil", which did not differ only from the ones grown in a soil with *G. biloba* leaves. *Pyrus communis* var. *caucasica* rootstocks coming from the plot with sugar beet leaves and *S. alba* straw had the smallest diameter (Table 3).

Statistically the highest number of roots had trees of *P. communis* var. *caucasica* rootstock grown in no "replant disease soil", the least those grown in the soil with *S. alba* straw and *G. biloba* leaves (Table 3).

Organic fertilizers that were used in the experiment had a significant impact on the percentage of plants of *P. communis* var. *caucasica* rootstock with visual symptoms of *A. tumefaciens* (Table 3). The highest percentage of plants with the symptoms of this disease was observed in a combination with sugar beet leaves. A little lower one, but also significantly different from the remaining ones, was noted after the use of *G. biloba* leaves. Much smaller percentage of plants with *A. tumefaciens* was obtained for *S. alba* straw. Significantly the smallest percentage of rootstocks with *A. tumefaciens* was obtained in no "replant disease soil" (Table 3).

In a search for biological factors in a protection of seedlings against the effects of "replant disease soil" attention should be paid to a possibility of practical stimulation of number of antagonistic microorganisms in the soil environment. As it was proved earlier the use of peat gives such possibilities (Kowalik 1994, Kowalik et al. 1998). Also the use of compost gave good results in replant disease soil in orchards (Travis et al. 2006). In the experiment carried out by Porębski et al. (2003) in a nursery of maiden apple trees the influence of the use of peat, humus and dry cow dung was studied. All three used organic fertilizers significantly increased the diameter of trees, number of long shoots and the sum of their lengths, not changing significantly the results of the height of maiden trees. In the present experiment no univocal results supporting the idea that the use of any of the organic fertilizers increased growth parameters of all three rootstocks were found.

Conclusions

1. The best growth of 'Antonówka' rootstock was obtained after the use of *Ginkgo biloba* leaves as an organic matter.
2. The strongest growth of *Pyrus communis* var. *caucasica* and 'Wangenheim Prune' rootstock was obtained in no "replant disease soil".
3. The use of *Sinapis alba* straw and cultivation in no "replant disease soil" diminished the percentage of *P. communis* var. *caucasica* rootstocks with visual symptoms of *Agrobacterium tumefaciens*

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WZROST TRZECH PODKŁADEK GENERATYWNYCH W SZKÓŁCE O „ZMĘCZONEJ" GLEBIE PO ZASTOSOWANIU RÓŻNYCH NAWOZÓW ORGANICZNYCH

Streszczenie. W latach 2007-2008 przeprowadzono doświadczenie, którego celem była ocena wzrostu trzech podkładek generatywnych: siewki 'Antonówki', gruszy kaukaskiej i 'Węgierki Wangenheima' w szkółce o „zmęczonej" glebie wzbogaconej w materię organiczną pochodzącą z: liści buraczanych, liści miłorzębu dwuklapowego i słomy z gorczycy. Jedną z kombinacji były siewki rosnące na stanowisku, gdzie szkółki wcześniej nie było. Podkładki siewki 'Antonówki' najlepiej rosły na stanowisku, gdzie materię organiczną stanowiły liście miłorzębu. Najlepszy wzrost podkładek 'Węgierki Wangenheima' i gruszy kaukaskiej uzyskano w „niezmęczonej" glebie, a w dalszej kolejności po zastosowaniu liści buraczanych i liści miłorzębu. Najmniejszy procent podkładek gruszy kaukaskiej z objawami guzowatości korzeni odnotowano w glebie „niezmęczonej" oraz po zastosowaniu słomy z gorczycy.

Słowa kluczowe: siewki, szkółka, „zmęczenie" gleby, materia organiczna

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