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THE INFLUENCE OF FOLIAR FERTILIZATION OF MAIDEN PEAR TREES AND SOAKING THE ROOT SYSTEM OF THE ROOTSTOCKS IN HYDROGEL WITH THE ADDITION OF TRIFENDER WP PREPARATION ON THE GROWTH OF MAIDEN QUINCE TREES IN A NURSERY

Sławomir Świerczyński ✉[1], Krzysztof Rutkowski [1], Ilona Świerczyńska [2]

[1] Department of Ornamental Plants, Dendrology and Pomology, Poznan University of Life Science
[2] Institute od Plant Protection – National Research Institute, Poznań

ABSTRACT

The comparison of the influence of foliar fertilization with four preparations on the growth of 'Conference' maiden pear trees growing on MA quince rootstock was conducted in a nursery in a three-year period. The evaluation was conducted on the basis of maidens growth parameters and the state of their leaf minerals content as well as on photosynthetic activity of the maiden trees. The preparations used in the experiment affected the improvement of some growth parameters studied, especially the stem diameter and fresh mass of the maidens. Biopuls Original turned out to be the best preparation as it improved significantly three out of five studied growth parameters. A varied impact of the preparations used on the content of micro and macro-elements in leaves was detected. All tested preparations positively influenced the leaves area index of maiden trees except for Blackjak preparation. Photosynthetic intensity of maiden pear trees nourished through leaves was significantly smaller in comparison with the control. Only plants treated with Biopulus Original were characterized by a higher concentration of CO_2 and its level in intercellular space. The aim of the second experiment was to check the influence of the application of Trifender WP preparation with hydrogel on the growth of 'Champion' maiden quince trees at the stage of planting the rootstocks into a nursery. A better branching of the rootstocks was obtained after the use of the preparation with hydrogel and the hydrogel alone. The trees in these combinations were also characterized by bigger fresh and dry mass of the leaves. The influence of Trifinder WP applied in connection with hydrogel was the best.

Key words: leaf minerals content, leaf area index, photosynthetic activity parameters

INTRODUCTION

So far there have been very few publications on the improvement of poor growth of maiden pear trees in a nursery [Jacyna 2004, Lewko et al. 2006, Milosevic and Milosevic 2010]. Also the influence of foliar fertilization on the content of macro and microelements in maiden pear trees' leaves has been analyzed in a quite narrow scope [Lewko et al. 2004, Wójcik 2007]. What is more, there has been no research on the influence of that treatment on photosynthetic activity of maiden pear trees.

A some kind of disadvantage in the production of pear fruits is late entering the trees into bearing fruits period, especially if they are produced on Caucasian pear [*Pyrus caucasica* L.] rootstock. It lengthens the

✉ slawomir.swierczynski@up.poznan.pl

investment period significantly. A requirement for the intensification of orchard cultivation is the ability to obtain trees with a big number of fruit bearing shoots and also a big impact is placed on environmental protection by limiting mineral fertilizers and plant protection preparations.

Biofertilization is now a very important method for providing the plants with their nutritional requirements without having an undesirable impact on the environment [Abou El-Yazied and Sellim 2007]. Raghuwanshi [2012] stated that biofertilizers have a great potential as supplementary, renewable and environmental friendly sources of plant nutrients. The application of biostimulants allowed a reduction in fertilizers without affecting yield and quality [Bulgari et al. 2015]. In the scientific literature, there are several definitions of biostimulants. According to Vernieri et al [2006], biostimulants are environmental friendly, natural substances which are able to promote vegetative growth, mineral nutrient uptake, plant response to different pedoclimatic conditions and tolerance to abiotic stresses

Diverse preparations were tested in the cultivation of different orchard species: strawberry [Masny et al. 2004, Laugale et al. 2006], grapevine [El-Sabagh et al. 2011, Mohamed et al. 2013], apple [Thalheimer and Paoli 2002, Bennewitz et al. 2008, Marzuoka and Kassem 2011, Bradshaw et al. 2013, Grzyb et al. 2015, Derkowska et al. 2017], chokeberry [Krawiec 2008], raspberry [Krok and Wieniarska 2008]. In a nursery biopreparations were soil-applied in the cultivation of apple and cherry maiden trees [Grzyb et al. 2014, 2015]. As some authors say [Thalheimer and Paoli 2002, Masny et al. 2004, Michalski 2004, Basak 2008, Basak and Mikos-Bielak 2008, Błaszczyk 2008, Krok and Wieniarska 2008, Wrona and Msiura 2008, Marjańska-Cichoń and Sapieha-Waszkiewicz 2011, Rosłon et al. 2011, Michalak and Chojnacka 2016] biopreparations do not always have a positive impact on the plants' growth.

It was proved that foliar application of extracts from various plants or application of different humous compounds by soil are treatments improving the nutrition state of the plants [Sas et al. 1999, Malusa et al. 2006].

Also fungi of Trichoderma species are capable of utilization of various nutrients, and also of modification of plants' rhizosphere micro-flora by intensive colonization of the roots, they are also aggressive to pathogenic fungi. Trichoderma develops rapidly in new environment as they are the fungi resistant to many toxic compounds such as herbicides, fungicides, pesticides and phenols [Benìtez 2004]. Application of these microorganisms elevates the level of plants' health, which is comparable to the protection obtained with the use of a full dose of fungicides [Monte 2001].

Mineral plant nutrition is crucial to functioning of plants at photosynthesis level. As it was previously found lower nutrition can cause decrease in net photosynthesis rate due to stomatal closure [Longstreth and Nobel 1980]. As it was previously mentioned environmental aspects of plant nutrition are highly important, hence the effect of biostimulants without mineral fertilizers were also analyzed. Similarly, as for mineral nutrition an increase of net photosynthesis rate, stomatal conductance and transpiration rate was also found [Anjum et. al. 2011, Díaz-Leguizamón et al. 2016].

In the experiment considered it was studied the influence of foliar fertilization on the growth of maiden pear trees of 'Conference' cultivar, and their leaf minerals content as well as photosynthetic activity. The aim of the second experiment was to determine the influence of the use of hydrogel and Trifender WP preparation on the growth of maiden quince trees of 'Champion' cultivar growing on quince MA rootstock.

MATERIAL AND METHODS

The two experiments were conducted in years 2016–2018 at Marcelin Experimental Station, belonging to Poznań University of Life Sciences. They were prepared in the set of random blocks with 25 plants in each field with four repetitions. In the first experiment, maiden pear trees of 'Conference' cultivar were cultivated, and in the second one those of big size of fruit 'Champion' quince cultivar growing on quince MA rootstock. The experiments were carried out twice and the results in the tables are mean values of the two series.

In 2016–2017 the quince MA rootstocks were budded with 'Conference' pear cultivar. In the second year of the nursery from the end of May till the middle of July in the growth period the maiden trees were treated with foliar preparations four times every third week. Maiden pear trees were treated with foliar sprays with

three biostimulants: Blackjak 0.25%, Biopuls Original 1.0%, Biopuls Forte 1.0 % and one foliar fertilizer Maxi-Grow Excel 0.1%. The plants in the control combination were sprayed only with distilled water. Blackjak contains humins, fulvic acids and other mineral components, Maxi-Grow Excel has Cu 1.1%, Fe 1.1%, Mn 1.3%, Zn 2.5% in its composition, Biopuls Original contains *Yarrowia lipolytica* yeasts, yeasts metabolites, rhizobacteria, actinomycetes, vitamins from B group, bioactive substances and natural antybiotics, Biopuls Forte: vitamins from B group, bioactive substances, natural antybiotics and microelements Cu, Fe, Mn, Zn and B.

In the second experiment the plants were divided into three parts. The first of the three parts of MA quince rootstocks was treated only with hydrogel by soaking the root system in it before planting the rootstocks into the nursery. The second part of the plants was soaked in hydrogel with the addition of Trifender WP in the amount of 10 g per liter of water. The mixture was delicately stirred to get a jelly-like substance. The control combination – the third part of the plants was soaked in distilled water only. Trifender WP preparation whose producer is Bioved company contains *Trichoderma asperellum* (5×10^8 spores in g), RhizoVital 42 (cillus amyloliquefaciens $>2.5 \times 10^{10}$ CFU/ml) – all in the dose of 0.05%. It is a microbiological preparation contributing to plants cultivation, containing conidia of antagonist fungus *Trichoderma asperellum* and the selected strain T12 *Trichoderma viride* isolated from the soil. In the next step the 'Champion' quince cultivar was budded on these rootstocks.

Podzolic soil in the nursery developed from dusty medium loam contained 2.0% of organic matter and its pH was 7.1. Following content of assimilable forms of three macro-elements was observed in the soil arable layer (in mg·100 g soil^{-1}) in the middle of August 2016: phosphorus (P) – 8.1, potassium (K) – 12.8 and magnesium (Mg) – 13.2. Average sums of rainfalls in 2016 were 500 mm, in 2017 – 338 mm, in 2018 – 227 mm. Meteorological data were obtained from the nearest Agrometeorological Station of the Life Sciences University in Poznań located in Marcelin near the nursery.

Manual weeding was a major caring treatment. The plants were sprayed with Discus 50WG, Topsin 500SC, Syllit 80WP against diseases. Also aphids was fought by preparation Pirimor 80WG. The nursery was not irrigated. In autumn of 2017–2018 years the following measurements of the maiden trees and observations were conducted: height (cm), diameter (mm) measured at the height of 10 cm above the budding place, number of lateral shoots and their length (cm). Also the fresh mass of the maiden trees and the fresh and dry mass of the maiden trees' leaves were weighed. Measurement of total leaf area (cm^2) was taken as well by means of 'Squer' program. The leaf mineral content of the maiden trees was evaluated too checking the content of macro- and microelements and sodium in leaves. The samples of the leaves were taken in the middle of August from the middle part of long shoots – 5 leaves from the sample of 20 maiden trees in each combination.

The leaves were dried at 60°C for 48 h and later they were ground and the content of macroelements, microelements and sodium was evaluated. In order to measure the content of general forms of nitrogen, the plant material was subjected to mineralization in sulfosalicylic acid, where sodium thiosulfate was applied as a reducing agent and a selenium mixture as a catalyst. Next, the material was measured in a Parnas and Wagner apparatus by distillation according to the Kjeldahl method [Kozik and Golcz 2011]. To measure general forms of phosphorus, potassium, calcium, magnesium and sodium the plant material was mineralized in concentrated sulfuric acid. After the mineralization process the colourimetric method was applied to measure the phosphorus content by means of a Spekol 210 apparatus with ammonium molybdate. The content of potassium, calcium and sodium was measured by means of flame photometry with a Zeiss AAS 3 apparatus, whereas the content of magnesium was measured by means of flame atomic absorption spectroscopy (FAAS) with a Zeiss AAS 3 apparatus [Kozik and Golcz 2011]. The same plant material was dry-mineralized at the temperature of 450°C in a Linn Elektro Therm furnace. The content of copper, zinc, manganese and iron in the plant material was measured by means of flame atomic absorption spectroscopy (FAAS) with an AAS-3 spectrophotometer (Zeiss). The accuracy and precision of analytic measurements were checked by analyzing Rye Grass ERM®-CD281 reference material, (certi-

fied by European Commission, Joint Research Centre, Institute for Reference Materials and Measurements / IRMM, Geel BE/).

The photosynthetic activity parameters were measured with the aid of handheld photosynthesis system Ci 340aa (CID BioScience Inc., Camas, USA). The following parameters were analysed: net photosynthetic rate (P_N), transpiration rate (E), intercellular CO_2 concentration (C_i) and intensity of CO_2 (Int. CO_2). To achieve comparable results constant conditions of measurements in the leaf chamber were maintained: CO_2 inflow concentration [390 µmol $(CO_2)mol^{-1}$], photosynthetic photon flux density (PPFD) 1000 µmol (photon) m^{-2} s^{-1}, chamber temperature 23°C, relative humidity 40 ±3%. Four replications were performed for each treatment, mature and intact leaves were selected for this purpose.

In order to confirm the presence of *Trichoderma* species fungi in the rhizosphere of the examined rootstocks, the samples of roots were taken for mycological analysis. Healthy roots were surface disinfected for 0.5 min in 5% sodium hypochlorite and next they were rinsed with sterile distilled water. After drying on filtration paper the roots were cut with a sterile lancet into a few-millimeter pieces. The material prepared in this way was placed on earlier prepared PDA (Potato Dextrose Agar) culture medium on a Petri dish (90 mm). The incubation process was conducted at 21°C. After 6 days of cultivation the presence of many *Trichoderma* spp. colonies was detected as well as the colonies of other filamentous fungi and yeasts (Fig. 1). Fungi from *Trichoderma* species were identified on the basis of the evaluation of macroscopic and microscopic features by means of mycological keys.

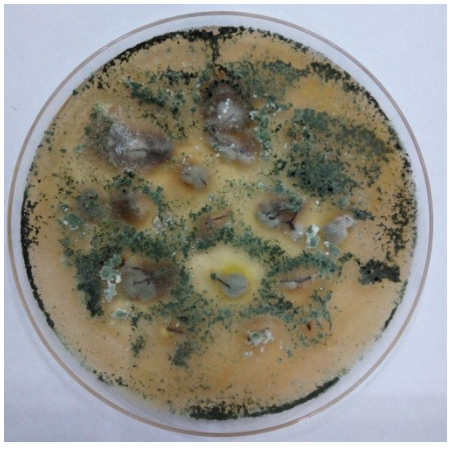

Fig. 1. *Trichoderma* spp. fungus colonies after 15 days of incubation [phot. by I. Świerczyńska]

Results of combination in one-way analyses of variance were separated by Duncan's Multiple Range test at $P \leq 0.05$. In the tables are the average results for two years.

RESULTS

Foliar preparations used in the experiments had a positive impact on the growth of 'Conference' cultivar maiden pear trees. The plants treated with Biopuls Original and Maxi-Grow Excel were significantly higher in comparison with the control combination. The trees treated with Blackjak produced significantly more lateral shoots than the control plants. A bigger diameter of the stem was observed in trees in the combination Biopuls Forte, Blackjak and Biopuls Original and a bigger fresh mass of the trees was found in the combination Maxi-Grow Exel, Biopuls Original and Biopuls Forte in comparison with the control. Only in case of the sum of the lengths of lateral shoots no significant difference between the used combinations of foliar fertilization and the control was observed (Tab. 1).

The fresh and dry mass of the collected leaves from pear trees was significantly bigger for plants treated with Biopuls Forte in comparison with the Maxi Grow Exel and control combinations. The leaves of the trees treated with preparations: Biopuls Original, Biopuls Forte and Maxi-Grow Exel were characterized by a bigger foliar area index than those collected in the control combination (Tab. 2).

Foliar preparations used in the experiment differentiated the level of macro-elements in the leaves of 'Conference' pear cultivar only in a few cases. In case of the content of nitrogen no differences were observed. Maxi-Grow Exel preparation lowered the content of phosphorus significantly compared with other combinations. The smallest amount of potassium was present in the leaves collected from the control combination, which differed much from those treated with Blackjak preparation. The highest level of calcium was detected in the leaves of maiden pear trees treated with Biopuls Forte and in the control. Significantly

Table 1. Results of the growth of 'Conference' cultivar of maiden pear trees

Combination	Height (cm)	Sum of lenghts of lateral shoots (cm)	Number of lateral shoots	Diameter of stem (mm)	Fresh mass of a tree (kg)
Control	131.2 a*	19.2 a	9.3 a	10.8 a	0.29 a
Maxi-Grow Excel	148.8 b	26.3 a	15.3 ab	12.3 ab	0.39 b
Blackjak	133.4 ab	25.1 a	22.0 b	12.9 b	0.34 ab
Biopuls Original	150.0 b	20.1 a	19.0 ab	12.9 b	0.36 b
Biopuls Forte	144.8 ab	24.4 a	19.3 ab	13.4 b	0.36 b
Femp.	3.03	0.64	1.87	3.1	1.42

* One-way analyses of variance; data marked with the same letter within the given feature are not significantly different at α = 0.05 (Duncan's test)

Table 2. Fresh and dry mass and the surface of the leaves of 'Conference' cultivar maiden pear trees

Combination	Fresh mass of the leaves (g)	Dry mass of the leaves (g)	Surface of the leaves (cm^2)
Control	54.7 a*	31.0 a	171.4 a
Maxi-Grow Excel	56.7 a	30.5 a	207.3 b
Blackjak	71.0 ab	35.7 ab	197.5 ab
Biopuls Original	72.3 ab	35.5 ab	214.7 b
Biopuls Forte	85.5 b	41.7 b	213.6 b
F emp.	2.06	0.87	3.29

* One-way analyses of variance; data marked with the same letter within the given feature are not significantly different at α = 0.05 (Duncan's test)

Table 3. Content of macro-elements in the leaves of 'Conference' cultivar maiden pear trees

Combination	Macroelements					
	N	P	K	Ca	Mg	Na
Control	2.24 a*	0.16 b	1.75 a	1.93 c	0.22 c	0.007 ab
Maxi-Grow Excel	2.05 a	0.13 a	1.77 ab	1.61 a	0.19 a	0.006 a
Blackjak	2.21 a	0.16 b	1.95 b	1.83 bc	0.21 bc	0.008 bc
Biopuls Original	2.21 a	0.16 b	1.84 ab	1.68 ab	0.20 ab	0.009 c
Biopuls Forte	2.24 a	0.16 b	1.76 ab	1.95 c	0.28 d	0.013 d
F emp.	0.61	1.09	0.93	1.02	2.15	2.51

* One-way analyses of variance; data marked with the same letter within the given feature are not significantly different at α = 0.05 (Duncan's test)

lowest content of this element was found in the combination with Maxi-Grow Excel. Foliar fertilization with Biopuls Forte had a significant impact on the highest content of magnesium and sodium, the lowest content of these elements was observed when Maxi-Grow Exel was used (Tab. 3).

Significantly higher level of iron in the leaves of maiden pear trees, compared with the control, was detected after the use of Blackjak and Biopuls Forte preparations. The level of manganese and zink was significantly higher after the use of all the preparations comparing with the control. The highest content of manga-

Table 4. Content of micro-elements in the leaves of 'Conference' cultivar of maiden pear trees

Combination	Microelements			
	Fe	Mn	Zn	Cu
Control	145.3 a*	29.7 a	52.9 a	4.9 a
Maxi-Grow Excel	159.1 a	51.0 d	81.1 d	13.7 e
Blackjak	290.6 c	58.5 e	56.8 b	7.6 c
Biopuls Original	151.8 a	37.0 b	90.4 e	7.2 b
Biopuls Forte	214.6 b	40.6 c	66.8 c	8.7d
F emp.	1.2	2.78	0.99	1.44

* One-way analyses of variance; data marked with the same letter within the given feature are not significantly different at α = 0.05 (Duncan's test)

Table 5. Photosynthetic activity of the leaves of 'Conference' cultivar of maiden pear trees

Combination	P_N	E	Ci	Int. CO_2
Control	28.95 d*	2.35 a	225.63 d	334.83 c
Maxi-Grow Exel	24.74 b	2.53 a	207.82 c	341.43 c
Blackjak	26.51 c	2.29 a	133.94 b	215.23 b
Biopuls Original	22.70 a	9.63 a	322.94 e	429.53 d
Biopuls Forte	25.30 b	1.44 a	96.78 a	126.10 a
F emp.	73.5	1.41	1203.71	530.64

* One-way analyses of variance; data marked with the same letter within the given feature are not significantly different at α = 0.05 (Duncan's test)

Table 6. Biometric measurements of 'Champion' cultivar of maiden quince trees

Combination	Height (cm)	Sum of lenghts of lateral shoots (cm)	Number of lateral shoots	Diameter of stem (mm)	Fresh mass of a tree (kg)
Control	134.7 a*	10.0 a	0.0 a	9.0 a	0.27 a
Hydrogel	142.6 a	11.0 b	2.0 b	9.0 a	0.23 a
Trifender WP + hydrogel	146.8 a	13.7 b	1.7 b	9.4 a	0.26 a
F emp.	0,7	17.7	45.8	0.3	0.2

* One-way analyses of variance; data marked with the same letter within the given feature are not significantly different at α = 0.05 (Duncan's test)

Table 7. Fresh and dry mass of the leaves and their total surface 'Champion' cultivar of maiden quince trees

Combination	Fresh mass of the leaves (g)	Dry mass of the leaves (g)	Surface of the leaves (cm^2)
Control	22.5 a*	9.6 a	164.3 a
Hydrogel	32.5 b	13.7 b	176.5 ab
Trifender WPv + hydrogel	49.0 c	18.7 c	190.5 b
F emp.	537.3	312.0	3.6

* One-way analyses of variance; data marked with the same letter within the given feature are not significantly different at α = 0.05 (Duncan's test)

nese was observed in plants treated with Blackjak and zink treated with Biopuls Original. The lowest content of these elements in leaves had trees in the control. Also the content of copper was varied and higher in combinations after the use of foliar preparations. The highest content of this element was characteristic for trees in the combination with Maxi-Grow Exel (Tab. 4).

The plants in the control combination were characterized with a bigger intensity of photosynthesis netto (P_N). The intensity of transpiration (E) was not affected by the use of the preparations used in comparison with the control. The highest concentration of CO_2 in intercellular spaces (Ci) and the highest intensity of CO_2 (Int. CO_2) was detected in the combination with Biopuls Original preparation (Tab. 5).

Hydrogel alone and in the combination with Trifender WP preparation used in the experiment had a significantly positive impact on the sum of the lengths of lateral shoots and their number. However, the effect of these two combinations on the height, diameter and fresh mass of a tree turned out to be insignificant (Tab. 6).

Hydrogel with Trifender WP preparation had a significantly positive impact on the fresh and dry mass of the leaves and on their total surface in comparison with the control. Only the surface of the leaves was not positively influenced by the use of hydrogel alone (Tab. 7).

Trichoderma spp. colonies from the combination treated with this fungus were characterized by a fast rate of growth and abundant sporulation. The colour of the colonies was usually a hue of green – from white-green to dark green, sometimes with some yellow or gray coating (Fig. 1).

DISCUSSION

Foliar preparations used in the experiment to treat 'Conference' cultivar of maiden pear trees showed a positive impact in case of majority of examined growth features. Results obtained in the experiment are also confirmed by other authors. They also generally obtained positive results of growth of orchard plants after the use of different foliar fertilizers. Bennewitz and Hlusek [2006] reported that biofertilization is beneficial in stimulating the growth and fruiting of pome and stone fruits. Besides, Rozpara et al. [2014] and Mosa et al. [2016] found also that biopreparation had a positive influence on the growth and development of apple trees growing. Also Tomala et al. [2006] showed that multiple use of Goëmar BM 86 preparation on 'Gala' apple tree cultivar supported the growth of fruits. It is confirmed by other researchers in both apple trees' [Szwonek 2003, Basak 2008] and pear trees' cultivation [Błaszczyk 2008].

In the production of small bushes the influence of biostimulators was varied depending on the preparation used. Conducting studies on chokeberry Krawiec [2008] concluded that the combination of Goëmar BM 86 and Asahi SL preparations, even in stress condi-tions did not cause any significant growth of the mass of 100 fruits. A similar phenomenon was observed by Masny et al. [2004], who used Goëmar BM 86 preparation for spraying strawberry plantation and Krok and Wieniarska [2008] in raspberry cultivation. In the experiment of the last mentioned authors the impact of biopreparations depended on the year of the experiment and on the discussed cultivar. As Krawiec [2008] states the application of biostimulators is especially beneficial in a year of long-lasting drought. On the other hand, its use did not give any positive effect in case of lack of any stress factor, such as, for example, drought or spring frost.

Most of the examined foliar preparations increased the content of macro- and micro-elements in leaves. Biopuls Forte affected a higher content of Ca, Mg and Na, and Biopuls Original also of Na. Also the varied impact of the preparations on the level of macroelements was observed. Blackjak increased the content of Mn and Fe, Biopuls Original Zn, and Maxi-Grow Excel Cu, Mn and Zn. Other researchers as Hassan et al. [2010] who used Aminofert preparation in the cultivation of plum trees obtained a growth in the content of N, K, Zn, Mn and a drop in P content. However, after the use of biofertilizers, Fawzi et al. [2010] found a higher content of N, P, K, and Mg in the leaves of pear trees. On the other hand, the experiment of Chitu et al. [2010] did not confirm a positive impact of foliar treatment of apple trees with ecological products on the content of macro-elements in their leaves. But results of such studies depend on many factors, among others, on the content of examined preparations, course of climatic conditions, soil richness in various elements, a rootstock used and the cultivar. That is why there are difficulties in comparing the results obtained.

In the discussed experiment the used foliar preparations affected photosynthetic activity of maiden pear tree leaves in a different degree. As Veberic et al. [2002] report apple trees sprayed with phosphorus and potassium (Hascon M) showed the lowest photosynthesis rate, which does not find its confirmation in the discussed experiment. However, in the study by Swietlik et al. [1982] potassium foliar fertilizer did not influence stomatal conductance and photosynthesis in non-stressed apple trees.

In the second experiment the use of Trichoderma species fungi present in Trifender WP preparation in a combination with hydrogel, and hydrogel alone improved the process of branching of 'Champion' maiden quince trees not affecting their height and trunk diameter in a significant way. A positive impact of fungi of Trichoderma species used in the form of soil and foliar preparations was also found by [Etebarian et al. 2000, Hỳsek et al. 2002, Kowalska and Remlein-Starosta 2012]. Bandurska et al. [2015] observed an improvement in mass of the roots of tomato plants after the use of Trichoderma species fungi. In their opinion, it could result from increased intake of nutrients which was shown by Chet et all [1997], Benìtez et al. [2004], or it could be connected with a better availability of microelements found by Yedidia et al. [2001] where treating cucumbers with *T. harzianum* T-203 increased mass of the roots and above-ground parts of the plants. Harman et al. [2004], in turn, point out one mechanism leading to an increase in the bioavailability of elements. On the basis of the obtained results one can observe a small usefulness of using hydrogel and Trifender WP preparation for obtaining better quality big size fruit quince cultivar of maiden trees.

CONCLUSIONS

All the preparations used in foliar fertilization of maiden pear trees affected their growth, most often Biopuls Original, especially the stem diameter and fresh mass of the plants.

Maiden trees treated with Biopuls Forte were characterized by a bigger fresh and dry mass of the leaves and all the testes preparations influenced significantly the surface area of the leaves of maiden pear trees, except for Blackjak in comparison with the control combination.

Among foliar preparations used Maxi-Grow Excel increased significantly the content of the follow-ing minerals in maiden pear leaves: Cu, Mn and Zn; Biopuls Forte – Ca, Mg and Na; Blackjak – Mn and Fe, and Biopuls Original preparation – Na and Zn.

Intensity of netto photosyntheses under the influence of the tested preparations was smaller in comparison with the control, and their impact on the transpiration level was insignificant. The highest concentration of CO_2 in intercellular spaces and the highest level of CO_2 was found in the combination with Biopuls Original preparation.

Quince maiden trees 'Champion' cultivar of whose rootstocks were treated with hydrogel alone and hydrogel together with Trifender WP preparation created only significantly more lateral shoots and were char-acterized by a bigger fresh and dry mass of the leaves.

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