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EFFECT OF MYCORRHIZAL COLONIZATION AND NUTRIENT SOLUTIONS CONCENTRATION ON THE YIELDING AND CHEMICAL COMPOSITION OF TOMATO GROWN IN ROCKWOOL AND STRAW MEDIUM

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Abstract. Efficiency of arbuscular mycorrhizal fungi (AMF) to host plants depends mainly on the chemical composition and properties of the rhizosphere. This is especially important in soilless cultures, in which the amount of nutrients supplied to the rhizosphere has to be strictly controlled. The effect of AMF and two nutrient solution concentrations: standard (S) with average EC 2.6 $mS \cdot cm^{-1}$ and reduced (R) with average EC 1.9 $mS \cdot cm^{-1}$, on the yielding and chemical composition of fruit and leaves of tomato, was investigated. Tomato plants cultivar 'Admiro F_1' were cultivated in greenhouse with fertigation system in rockwool and straw medium in 2012–2013 years. In the research, no effect of AMF on the total and marketable yield as well as on number of fruit per plant, was detected. A significant lower marketable yield in treatments fertigated with standard nutrient solution (S), compared to reduced solution (R) was detected, which was the effect of smaller number of fruits. Fruits of tomato inoculated with AMF contained significantly more sugars as compared to plants growing without mycorrhization. Significant higher dry matter content was detected in fruit of tomato fertigated with standard nutrient solution (S), compared to reduced solution (R). More total nitrogen was recorded in leaves of plants mycorrhized with AMF, although this increase was not statistically confirmed in every treatments. More calcium was determined in fruits of tomato inoculated with AMF as compared to those harvested from non-mycorrhized plants.

Key words: soilless culture, dry matter, nitrogen, potassium, total sugars, ascorbic acid

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INTRODUCTION

Numerous reports indicate that inoculation of arbuscular mycorrhizal fungi (AMF) in a soilless tomato cultivation improves plant growth and vegetative development, as well as increases the fruit yields [Demir 2004, Utkhede 2006, Dasgan et al. 2008, Tünenkçi et al. 2012]. Dasgan et al. [2008] and Salvioli et al. [2012] claim that better utilization of nutrients, in particular nitrogen, phosphorus, and microelements, from rhizosphere is the main benefit due to root settlement by AMF. In opinion of Mwangi et al. [2011], a positive influence of AMF on plant growth and development is enhanced along with the decrease of rhizosphere abundance. Salvioli et al. [2012] and Candido et al. [2013] convince that utilization of artificial fertilizers can be reduced by means of AMF inoculation, which is crucial for sustainable plant production. Such solution, however, is not so obvious in the case of soilless cultivation, where nutrients are added regularly along with the fertigation in concentrations adjusted to current nutritional requirements of plants [Sonneveld and Voogt 2009, Nurzyński and Jarosz 2012]. Up-to-date studies indicate that decreasing the medium composition – as compared to levels recommended for non-AMF inoculation – can contribute to lower yields and worse main parameters of yield quality [Brañas et al. 2001, Fandi et al. 2010]. In turn Abdel Latef and Chaoxing [2011] claim that forming and functioning the mycorrhizal symbioses is more effective at lower ionic concentrations within the rhizosphere. According to Dasgan et al. [2008] and Hajiboland et al. [2010], the AMF inoculation during soilless tomato growth allows for mitigating periodical oscillations of ion concentrations in plant rhizosphere as well as soothing abrupt changes in the rhizosphere EC values.

The rockwool is nowadays a dominating medium for soilless tomato cultivation, mainly due to its very good air-water properties [Kleiber et al. 2012, Nurzyński et al. 2012]. Despite the enormous interest in many countries, the problem of a proper utilization of post-production wastes after cultivation on that material, has not been solved yet. This situation raises a growing opposition among environmentalists [Kleiber et al. 2012].

In accordance to Nurzyński et al. [2012], selection of the medium – besides its properties and usefulness for cultivation of a given plant species – is determined by its purchase costs and possibility to easy utilize the post-production wastes generated after the cultivation complete. The cereal straw is a cheap and readily bio-degradable medium. Numerous studies reveal that both yield and qualitative parameters of fruits produced on the straw medium do not significantly differ as compared to rockwool cultivation [Piróg et al. 2010, Kowalczyk and Gajc-Wolska 2011, Nurzyński and Jarosz 2012]. Nurzyński and Jarosz [2012] reported that during the tomato cultivation in prolonged cycle on straw medium, this material is mineralized in about 70%. In opinion of Hodge and Storer [2014], application of AMF can additionally accelerate the decomposition of organic matter that plays the role of medium. This phenomenon can lead to the situation, when periodically symbiotic organisms begin to compete for nutrients, in particular for nitrogen, that is strongly sorbed biologically during the degradation of organic matter with wide C:N ratio. Competition for nutrients between a plant and fungus will be escalated at lower EC values of the nutrient solution. Application of AMF for tomato cultivations on mineral and organic mediums, therefore requires to determine the impact of mycelium inoculation on the status of plant nutrition and to determine the optimum composition of nutrient solution, which would provide a proper development of both the host plant and the fungus.

The aim of presented study was to determine the influence of arbuscular mycorrhizal fungi inoculation on chemical composition of fruits and leaves of tomato grown on rockwool and straw medium applying fertigation using standard solution (average EC 2.6 $mS \cdot cm^{-1}$) and reduced solution with decreased, by 30%, contents of nutrients (average EC 1.9 $mS \cdot cm^{-1}$).

MATERIALS AND METHODS

The study was carried out in the period 2012–2013 in heated greenhouse localized near Lublin, Poland (51°21'N, 22°56'E). Tomato plants cultivar 'Admiro F_1' were grown in rockwool or triticale straw. Straw cut into 2 cm pieces was placed in plastic containers, corresponding in their shape and volume to a rockwool slab (12 dm^3). The experiment was set up as a completely randomized design with eight replicates. A slab/container in which two plants were grown was one replicate. Tomato plants were planted in their permanent place in the third 10-days period of February (23 February 2012 and 26 February 2013) in the initial phase of blossom first cluster. They were grown in an extended growth cycle (22 clusters) at a density of 2.3 $plant \cdot m^{-2}$ until the beginning of November (5 November 2012 and 6 November 2013), using a drip irrigation and fertilization system with closed nutrient solution circulation. Inoculation of arbuscular myccorhizal fungi was performed at the moment of setting the plants on a permanent medium (rockwool slabs or containers with straw) by Eudomix inocula (Mykoflor, Poland), containing spores of Glomus mosseae, Glomus intraradices, Glomus etunicatum and Glomus clarum.

In the study two different nutrient solutions were tested: standard solution with average EC 2.60 $mS \cdot cm^{-1}$ and reduced solution with average EC 1.90 $mS \cdot cm^{-1}$. The composition and proportions of particular elements in the nutrient solution were changed during plant growth and adjusted to plant development stages in accordance with the latest of recommendations [Sonneveld and Voogt 2009, Nurzyński and Jarosz 2012, Nurzyński 2013]. The average values of nutrients in the tested solutions and in the water used to their preparation are reported in Table 1. The solution was supplied to all plants in the same amount with an excess of about 25% as a drainage water. The frequency of nutrient solution supply, controlled by a solar timer, depended on solar radiation intensity. The flowers were pollinated by the large earth bumblebee (*Bombus terrestris*). Plant protection treatments were carried out using biological agents (*Encarsia formosa*, En-Strip, Koppert). All tending treatments were performed in accordance with the applicable praxis recommendations.

Fruit harvest started on 4 May 2012 and 2 May 2013, respectively, and fruits were picked twice a week in the harvesting maturity stage. They were counted and sorted out; subsequently, total fruit yield, marketable fruit yield and number fruits per plant were determined in accordance with EU standards [Commission Regulation (EC) No. 790/2000].Fruits were sampled for analysis from the 11th cluster at the harvest maturity stage. Dry weight was determined in fresh material by the gravimetric method [PN-90/A-75101/03], ascorbic acid by Tillman`s method [PN-A-04019], and total sugars by

Schoorl-Rogenhausen's method [Rutkowska 1981]. Following mineralization of the material in a mixture of nitric and perchloric acids at a ratio of 3:1 (v:v) [Ostrowska et al. 1991], calcium was determined by AAS method (Perkin-Elmer, AAnalyst 300). Leaves were sampled for analysis (the 9^{th} leaf from the top) four times in during the growing season (every two mounts). After the material was dried (8 hours at 105°C), total nitrogen was determined using Kjeldahl's method [Ostrowska et al. 1991]. Following mineralization of the material in a mixture of nitric and perchloric acids at a ratio of 3:1 (v:v) [Ostrowska et al. 1991], potassium was determined by AAS method (Perkin-Elmer, AAnalyst 300).

The results were statistically analysed by analysis of variance using the employing Tukey's test to evaluate the significance of differences at the $\alpha = 0.05$ level of significance. For the statistical analysis all percentages were transformed according to Bliss's formula [Büchse et al. 2007]. The presented results are two-year means.

RESULTS AND DISCUSSION

Applying of nutrient solution that provides with optimum plant nutrition is fundamental for achieving high yields with desirable qualitative parameters of fruits in soilless tomato cultivation [Nurzyński and Jarosz 2012, Nurzyński 2013, Rosadi et al. 2014]. In opinion of Nurzyński [2013], high yield of tomato fruits grown on straw medium ensures constant levels of the following ions in the rhizosphere (mg dm^{-3}): 28 $N\text{-}NH_4$, 246 $N\text{-}NO_3$, 75 $P\text{-}PO_4$, 328 K, 320 Ca, 107 Mg. Studies performed by this author revealed that recommended concentration of components in rhizosphere can be guaranteed by use of nutrient solution with composition corresponded to standard solution (S) applied in presented study (tab. 1), which during vegetation season is dosed for plants at

Table 1. Nutrient content ($mg \cdot dm^{-3}$) and pH of water and nutrient solutions used in experiment

Solution	$N\text{-}NH_4$	$N\text{-}NO_3$	$P\text{-}PO_4$	K	Ca	Mg	$S\text{-}SO_4$	B	Fe	Mn	Zn	Cu	pH
Water	0.02	5.00	4.00	1.40	111.0	13.80	32.00	0.02	0.24	0.03	0.04	–	7.44
Standard (EC 2.6)	10.0	210.0	55.0	340.0	250.0	80.0	150.0	0.54	2.00	0.95	0.56	0.09	5.60
Reduced (EC 1.9)	7.0	147.0	38.5	238.0	175.0	56.0	105.0	0.39	1.40	0.66	0.39	0.06	5.60

EC 2.0–3.0 mS cm^{-1} (2.60 mS cm^{-1}, on average). Much lower nutrient contents in nutrient solution are recommended by Fandi et al. [2010]. According to them, standard nutrient solution for tomato grown in the soilless system should contain 150–200 ppm N, 30–40 ppm P, 200–300 ppm K, 40–50 ppm Mg, as well as 150–200 ppm Ca. In turn, Rosadi et al. [2014] report that during soilless tomato cultivation, nutrient solution containing 7.0 mM K^+, 4.0 mM Ca^{2+}, 2.5 mM Mg^{2+}, 1.5 mM NH_4^+, 12.0 mM NO_3^-, 1.5 mM $H_2PO_4^-$, and 4.0 mM SO_4^{2-} should be used for plants at EC values from 2.0 to 2.5 $dS \cdot m^{-1}$. Composition of nutrient solution with reduced levels of nutrients (R) used for plants in present study at average EC 1.9 mS cm^{-1}, was consistent with recommendations by Fandi et al. [2010] and similar to those by Rosadi et al. [2014].

Analysis of results achieved in present study did not reveal any significant influence of AMF inoculation on the total and marketable yields of tomato fruits cultivated on tested mediums (tabs 2 and 3). However, different results were reported by Candido et al. [2013] and Colella et al. [2014], who recorded a positive impact of mycorrhization on tomato yielding. It should be underlined that quoted studies were carried out under field conditions and improvement of water and nutrients supply to plants accounts for

Table 2. Effect of AMF and nutrient solution concentration on the yielding and selected parameters of tomato fruits grown in rockwool (mean from 2012–2013)

Arbuscular Mycorrhizal Fungi (AMF)	Nutrient solution	Total yield ($kg \cdot m^{-2}$)	Marketable yield ($kg \cdot m^{-2}$)	Number of fruits ($No \cdot m^{-2}$)	Dry matter (%)	Ascorbic acid ($mg \cdot 100\ g^{-1}$ FW)	Total sugars (% FW)
With AMF	S	38.8	32.6	272.6	5.68	18.05	2.33
	R	40.2	36.3	269.8	5.48	17.69	2.81
Mean		39.5	34.4	271.2	5.58	17.90	2.57
Without AMF	S	38.0	33.5	277.7	5.47	18.33	2.25
	R	40.4	36.8	268.3	5.10	17.41	2.15
Mean		39.2	35.2	273.2	5.28	17.67	2.20
Mean for nutrient solution	S	38.4	33.1	275.1	5.57	18.19	2.29
	R	40.3	36.6	269.2	5.29	17.55	2.48
$LSD_{0.05}$ for	AMF	NS	NS	NS	0.18	NS	0.32
	solution	1.36	1.40	5.27	0.18	NS	NS

With AMF – mycorrhizal plants, Without AMF – nonmicorrhizal plants, S – standard solution (EC 2.6), R – reduced solution (EC 1.9), NS – nonsignificant

Table 3. Effect of AMF and nutrient solution concentration on the yielding and selected parameters of tomato fruits grown in straw medium (mean from 2012–2013)

Arbuscular Mycorrhizal Fungi (AMF)	Nutrient solution	Total yield ($kg \cdot m^{-2}$)	Marketable yield ($kg \cdot m^{-2}$)	Number of fruits ($No \cdot m^{-2}$)	Dry matter (%)	Ascorbic acid ($mg \cdot 100\ g^{-1}$ FW)	Total sugars (% FW)
With AMF	S	39.4	33.8	289.7	6.29	18.98	3.18
	R	38.1	34.7	269.7	5.59	17.06	2.86
Mean		38.8	34.3	279.7	5.94	18.02	3.02
Without AMF	S	37.8	33.2	273.6	5.77	18.32	2.51
	R	40.1	36.2	274.6	5.13	18.07	2.20
Mean		38.9	34.7	273.9	5.45	18.20	2.35
Mean for nutrient solution	S	38.6	33.5	281.7	6.03	18.66	2.84
	R	39.1	35.5	272.0	5.36	17.57	2.53
$LSD_{0.05}$ for	AMF	NS	NS	NS	NS	NS	0.42
	solution	NS	1.78	7.28	0.55	0.87	NS

With AMF – mycorrhizal plants, Without AMF – nonmicorrhizal plants, S – standard solution (EC 2.6), R – reduced solution (EC 1.9), NS – nonsignificant

the mycorrhization efficiency. Therefore, our own results indicate that influence of mycorrhization on the amount of yield can be of less importance at precise fertilization and strictly controlled moisture during the soilless cultivation of tomato applying fertigation. Dasgan et al. [2008] reported different results of tomato mycorrhization efficiency for plants growing on perlite at open and closed medium circulation. Those studies revealed considerable yield increase in mycorrhized objects, although with no effects on vegetative growth of plants and nutrients uptake. The results allowed for concluding that tomato plants inoculated with AMF use the assimilates more effectively for the fruit development than for vegetative matter.

A significant decrease in the marketable yield is noteworthy in treatments, where nutrient solution fertigation using standard concentration (EC 2.6 $mS \cdot cm^{-1}$) was applied, as compared to reduced medium (EC 1.9 $mS \cdot cm^{-1}$), which was the effect of smaller number of fruits (tabs 2 and 3). This decrease amounted to 3.5 $kg \cdot m^{-2}$ (i.e. 9.56%) when cultivating on rockwool and 2.0 $kg \cdot m^{-2}$ (i.e. 5.63%) when grown on the straw medium. According to Tüzel et al. [2001] and Magán et al. [2008], temporal uncontrolled EC increase in the rhizosphere is the most frequent cause of the yield decrease in the soilless tomato cultivation. Achieved results clearly show that nutrient solution composition recommended by literature references for soilless tomato cultivation requires some modifications taking into account current weather conditions and differences in applied technology, e.g. type and properties of the medium or specific varietal requirements. In opinion of Dasgan et al. [2008] and Nzanza et al. [2012], root colonization by AMF improves the plant's productivity through enhancing their resistance to abiotic stress, including that invoked by abrupt changes in rhizosphere EC. Results recorded in here presented study did not confirm that dependence.

It is interesting to compare the yielding effects for tomato grown on rockwool and the straw medium. In the evaluation independent of mycorrhization and the level of nutrient solution EC total and marketable yields of tomato fruits cultivated on straw medium was slightly lower (by 0.5 $kg \cdot m^{-2}$ and 0.32 kg $\cdot m^{-2}$, respectively) than those of fruits harvested from rockwool. The differences were not statistically significant. Such results confirm previous studies, in which the usefulness of cereal straw as the medium for soilless tomato cultivation, was proved [Kowalczyk and Gajc-Wolska 2011, Nurzyński et al. 2012].

Candido et al. [2013], when studying the effectiveness of mycorrhization in the field tomato cultivation, recorded remarkable acceleration of fruiting, which resulted from sooner flowering and shortening the mean harvest period at mycorrhized plants. Similar results were achieved by Salvioli et al. [2012], who tested the AMF inoculation in the soilless tomato cultivation. Those authors concluded that application of AMF accelerated the flowering stage and development of the first cluster fruits, which was the result of positive effect of mycorrhization on transcription of genes responsible for nitrogen and carbohydrates metabolism. Positive influence of AMF inoculation on acceleration of fruit yield was also recorded in own studies (fig. 1). In the evaluation independent of the EC and the substrate Average commercial yield from mycorrhized plants achieved in May was higher by 44.1%, while in June by 11.2% as compared to control plants grown without AMF inoculation. In September and October, mean marketable yield from mycorrhized plants was lower respectively by 21.2% and 23.8% as compared to non-mycorrhized plants. These results are very important for commercial production of tomato, because the earliest yields reach the best prices.

Significant higher dry matter content in fruit of tomato grown in rockwool with AMF was detected, comparing to treatment without AMF. These results have not been

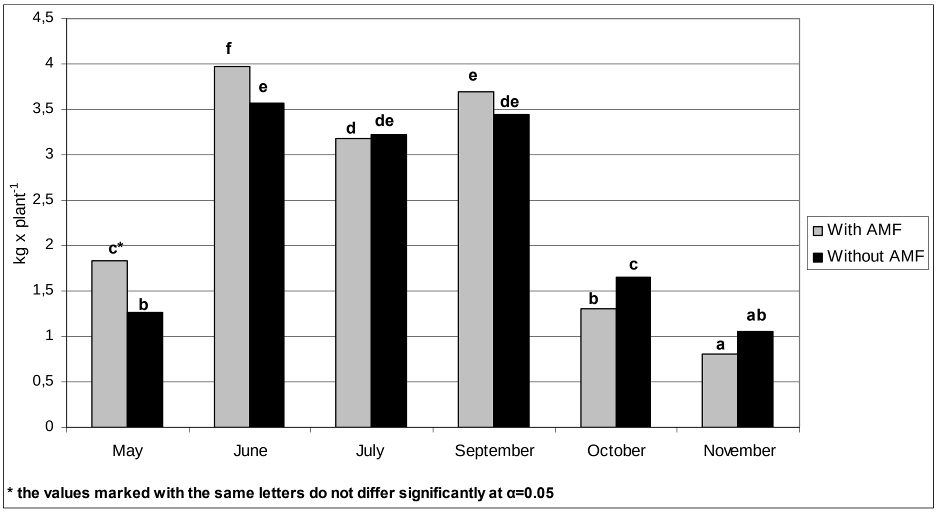

Fig. 1. Effect of AMF on the marketable yield of tomato (kg·plant^{-1}) in the following months of cultivation (mean from 2012–2013, independently of the EC level and the type of substrate)

recorded in the cultivation of tomato in the straw. In the evaluation independent of AMF treatment significant higher dry matter content was detected in fruit of tomato fertigated with standard nutrient solution (S), compared to reduced solution (R). These results were found both in rockwool and straw cultivation. The conducting research showed no significant effect of mycorrhiza application on ascorbic acid content in fruit of tomato. Analysis of results achieved in present study revealed significant increase in total sugars content in fruits of plants inoculated with AMF. Such results should be linked to the hypothesis by Salvioli et al. [2012] that applying of mycorrhization has positive impact on carbohydrate metabolism. Literature references related to the influence of AMF inoculation on chemical composition of fruits are divergent. In opinion of Copetta et al. [2011], tomato mycorrhization has positive effects on fruits quality. Studies performed by Candido et al. [2013] did not show any influence of mycorrhization on dry matter and soluble solids contents in fruits.

Salvioli et al. [2012] and Colella et al. [2014] proved that application of mycorrhization remarkably improved the plant nutrition, mainly with nitrogen and phosphorus. In opinion of these authors, mycorrhizal mycelium actively uptakes the nutrients and transfers them directly to the roots of a host plant. This dependence seems to be confirmed by results of own studies, in which from 0.01 to 0.19% DW more nitrogen was determined in leaves of mycorrhized tomato as compared to plants grown without AMF inoculation (fig. 2). Hodge and Storer [2014] report results indicating that mycorrhizal mycelium transfers nitrogen in ammonia form (NH_4^+) much more effectively than nitrates (NO_3^-) to the host plant. It is worth emphasizing that in presented own study, content of ammonia nitrogen in the total amount of that element supplied under the plants along with the nutrient solution did not exceed 5% (tab. 1), which is consistent with current recommendations for tomato fertilization [Nurzyński and Jarosz, 2012]. Achieved results seem to indicate that at low ammonia cations content in the rhizosphere, mycorrhizal mycelium, having no choice, begins to uptake the nitrates. Hodge and Storer [2014] also suppose that different AMF species have different preferences towards the form of nitrogen they can uptake.

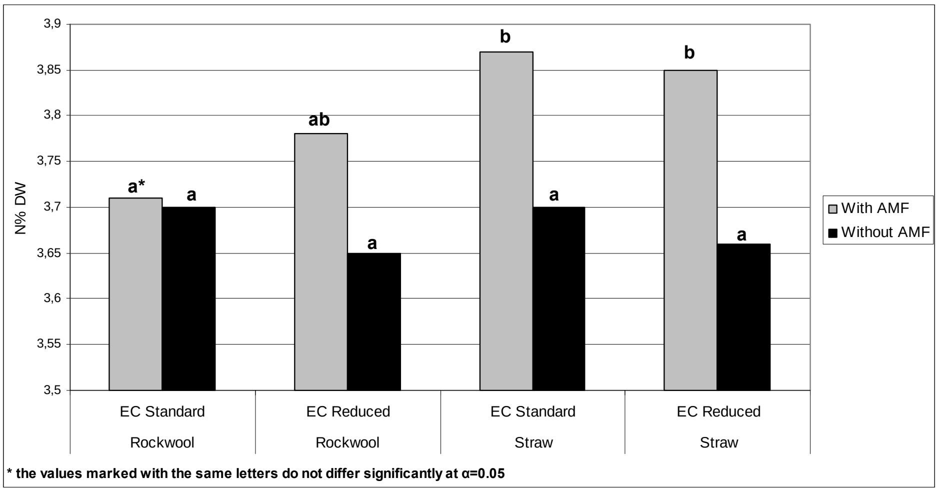

Fig. 2. Effect of AMF and nutrient solution concentration on the nitrogen content (% DW) in leaves of tomato grown in rockwool and straw medium (mean from 2012–2013)

The largest difference in nitrogen content in leaves (0.19% DW) was found between mycorrhized plants and those growing without mycorrhization on straw medium using fertigation with nutrient solution with reduced composition (EC 1.9 $mS \cdot cm^{-1}$). Achieved results also show that mycelium developing in the rhizosphere is not competitor for tomato as a host plant for the uptake and utilization of nitrogen even reduced nutrient solution by 30% content of nitrogen, is used.

In opinion of Candido et al. [2013], cooperation with mycorrhizal mycelium also improves the nutrition of a host plant with potassium. In present study, significant influence of mycorrhization on improved potassium supply was confirmed only for tomato grown on straw along with fertigation using reduced nutrients concentrations (fig. 3). In this object, leaves of mycorrhized plants contained by 0.27% DW more potassium than those growing with no AMF inoculation. Statistically confirmed differences of this element were not recorded in other objects. Despite of considerable differentiation in nitrogen and potassium contents in leaves of tomato grown in particular objects, achieved results should be considered as optimum [Chohura and Komosa 2003, Nurzyński and Jarosz 2012]. The optimum concentrations of these two nutrients and their proper ratio seem to be crucial factors determining the appropriate quality of tomato fruits grown in the soilless system [Nurzyński and Jarosz 2012].

Impact of tested factors on calcium content in tomato fruits is very interesting (fig. 4). In the case of tomato, a proper nutrition with calcium is extremely important, because decrease in its level in fruits enhances the risk of the blossom-end rot occurrence

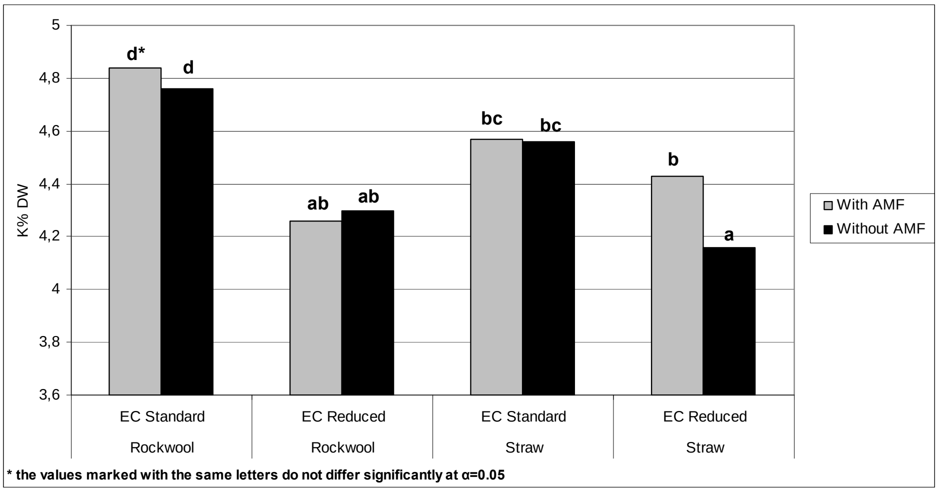

Fig. 3. Effect of AMF and nutrient solution concentration on the potassium content (% DW) in leaves of tomato grown in rockwool and straw medium (mean from 2012–2013)

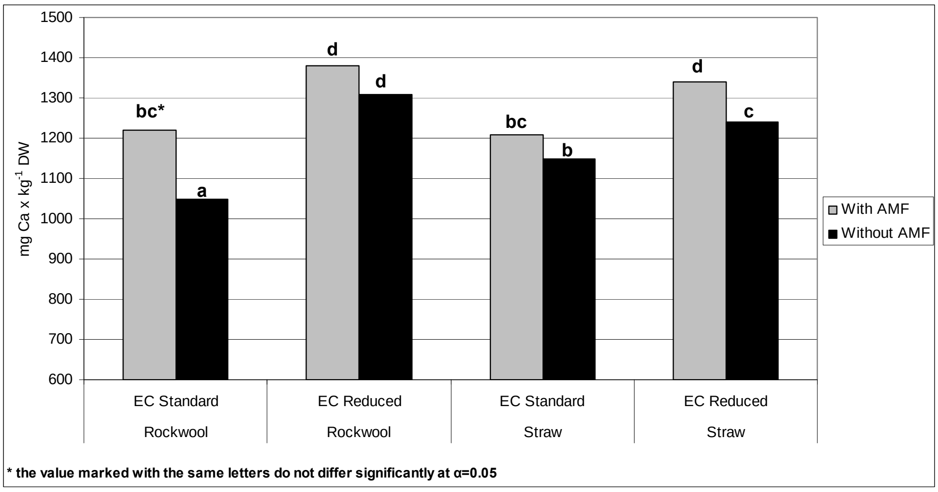

Fig. 4. Effect of AMF and nutrient solution concentration on the calcium content (mg·kg^{-1} DW) in fruit of tomato grown in rockwool and straw medium (mean from 2012–2013)

[Michałojć and Horodko 2006, Nurzyński and Jarosz 2012]. In all objects, fruits of mycorrhized plants contained more calcium, although not every difference was statistically significant. Tüfenkçi et al. [2012] reported different results – they did not found any influence of AMF inoculation on calcium concentration in cucumber seedlings. Definitely less calcium was determined in fruits of tomato treated with standard nutrient solution fertigation with higher EC (2.6 mS·cm^{-1}) as compared to those fertilized with reduced solution (EC 1.9 mS·cm^{-1}). These results are consistent with numerous earlier reports. Calcium is transported within a plant almost exclusively through xylem, thus its uptake and distribution both depend on water intake intensity [Michałojć and Horodko 2006, Kowalska and Sady 2012]. Increase in the total concentration of ions in the rhizosphere, that makes water intake through the roots difficult, causes decrease in the calcium concentration in leaves and fruits of tomato plants. As a consequence, the increase in EC value of the rhizosphere elevates the risk of BER occurrence [Tüzel et al. 2001]. In presented study, BER presence on fruits was incidental, which made impossible for precise determination of a dependence between tested factors and this unfavorable phenomenon.

CONCLUSIONS

Present study did not reveal any significant impact of AMF inoculation on the total and marketable yields, nor on the average number of fruits per plant. Application of AMF positively accelerated the plant yielding and remarkably enhanced the yield during the first months of growing (May and June), which is very desirable due to economic reasons. A significant lower marketable yield in treatments fertigated with standard nutrient solution (S), compared to reduced solution (R) was detected, which was the effect of smaller number of fruits. Fruits of tomato inoculated with AMF contained significantly more sugars as compared to plants growing without mycorrhization. Higher dry matter content was detected in fruit of tomato fertigated with standard nutrient solution (S), compared to reduced solution (R). More total nitrogen was recorded in leaves of plants mycorrhized with AMF, although this increase was not statistically confirmed in every object. The study showed that the mycelium developing in the rhizosphere is not competitor for tomato as a host plant for the uptake and utilization of nitrogen even reduced nutrient solution by 30% content of nitrogen, is used. More calcium was determined in fruits of tomato inoculated with AMF as compared to those harvested from non-mycorrhized plants.

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WPŁYW MIKORYZYACJI ORAZ KONCENTRACJI POŻYWKI NA PLONOWNIE I SKŁAD CHEMICZNY POMIDORA UPRAWIANEGO W WEŁNIE MINERALNEJ I SŁOMIE

Streszczenie. Skuteczność mikoryzacji (AMF) roślin uprawnych zależy w głównej mierze od składu i właściwości ryzosfery. Ma to szczególne znaczenie w uprawach bezglebowych, w których ilość składników pokarmowych dostarczanych do środowiska korzeniowego musi być ściśle kontrolowana. W przeprowadzonych doświadczeniach badano wpływ mikoryzacji (AMF) oraz dwu koncentracji pożywek: standardowej (S) o średnim EC 2,6 $mS \cdot cm^{-1}$ oraz zredukowanej (R) o średnim EC 1,9 $mS \cdot cm^{-1}$ na plonowanie oraz skład chemiczny owoców i liści pomidora. Badania przeprowadzono w latach 2012–2013 z pomidorem odm. 'Admiro F_1' uprawianym w wełnie mineralnej i słomie. W badaniach nie stwierdzono wpływu mikoryzacji (AMF) na wielkość plonu ogólnego i handlowego owoców pomidora, jak również na średnią liczbę owoców z rośliny. Istotnie mniejszy plon handlowy owoców odnotowano w obiektach fertygowanych pożywką standardową (S) w porównaniu ze stosowaniem pożywki zubożonej (R), co było efektem mniejszej liczby owoców. Owoce pomidora mikoryzowanego zawierały istotnie więcej cukrów w porównaniu z roślinami kontrolnymi. Istotnie większą zawartość suchej masy odnotowano w owocach roślin nawożonych pożywką standardową w porównaniu z roztworem pokarmowym o obniżonej koncentracji. W liściach roślin mikoryzowanych stwierdzono więcej azotu ogółem, jakkolwiek nie we wszystkich obiektach wyniki te potwierdzono statystycznie. Owoce pomidora mikoryzowanego zawierały istotnie więcej wapnia w porównaniu z roślinami niemikoryzowanymi.

Słowa kluczowe: uprawy bezglebowe, sucha masa, azot, potas, cukry ogółem, witamina C

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