Impacts of arbuscular mycorrhizal fungi on plant growth and yield of three pepper genotypes

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Abstract: Field study was implemented at the experiment station of Szent Istvan University, Godollo, Hungary to investigate the effects of arbuscular mycorrhizal (AM) fungi on plant growth, yield of three pepper cultivars during the plant growth. The experiment was arranged in randomized complete block design with two factors of pepper cultivars and AM applications. Three pepper varieties were Karpia, Karpex, Kaptur while AM applications consisted of AM mixture with 6 different AM species and non-inoculated treatment. Greater shoot fresh weight in AM plants were observed while values of root fresh weight, shoot and root dry weight remained unchanged in inoculated plants, except the increases recorded in Karpex cultivar. AM application also enhanced significantly fruit yield in Karpia and Kaptur but not in Karpex cv. In addition, AM treated plants showed improved root colonization of AM fungi.

Keywords: Arbuscular mycorrhizal fungi, pepper, growth, fruit yield.

Introduction

Pepper (*Capsicum annuum* L.) is one of the main horticultural vegetables and cultivated worldwide due to important nutritional and economic values. In addition to pepper cultivars, pepper production and quality are diversed owing to various stress conditions that which often loses 70 % of yield forming a barrier in pepper cultivation (Gajanayake et al., 2011). The exploitation of symbiotic feature of AM fungi is one of the efficient approaches to improve crop tolerance to unfavored environment (Birhane et al., 2012). In fact, AM fungi are probably the most ubiquitous soil microbe that can colonize 80% of terrestrial plant species consisted of many important crops (Smith and Read, 2008). Many beneficial effects from mycorrhizal colonization including increased seedling survival, enhanced growth, fruit yield and quality, uniformity of horticultural crops, and earlier and increased flowering as well as induced resistance to abiotic and biotic stresses have been reported (Estrada-Luna et al., 2000; Estrada-Luna & Davies, 2003; Garmendia et al., 2004; Alejo-Iturvide et al., 2008; Mena-Violante et al., 2006; Kaya et al., 2009; Ruscitti et al., 2011; Ortas et al., 2011; Franco et al., 2013).

Although use of the AMF is widely investigated in many plants, little attention has been paid to use different cultivars as target plants for inoculation. Therefore, the aim of this study was to examine the potential of AM mixture for growth, fruit yield in different pepper genotypes under field conditions.

Materials and methods

Three sweet pepper (*Capsicum annuum* L.) hybrids, Karpia, Karpex and Kaptur were used for this study at experimental station of Szent István University, Gödöllő, Hungary. Under field, treatments including inoculation of AM mixture or no inoculation (control) and three cultivars were arranged in randomized complete block design with 30 replications each treatment. Pepper seedlings were grown in greenhouse in 7 weeks before planting in field. Mycorrhizal Inoculation with commercial product Symbivit® (mixture of *Glomus intraradices, G. mosseae, G. etunicatum, G. claroideum, G. microaggregatum,*

G. geosporum) (Symbiom Ltd., Lanskroun, Czech Republic; www.symbiom.cz), was utilized at 25 g of inoculum per pepper seedling at planting. **Assessment of mycorrhizal colonization** by gridline intersect method (Giovannetti & Mosse, 1980) after staining roots (Vierheilig et al.; 1998) with five plants per treatment. **Plant biomass and fruit yield**: The pepper harvesting was performed randomly by hand at the biological maturity stage and evaluated for each treatment. All data were evaluated by two-way factorial analysis of variance (ANOVA) and Tukey's Post hoc test at $P < 0.05$ by SAS 9.1 software.

Results and discussion

Pepper cultivar Karpex inoculated with AM mixture exhibited higher root fresh and dry weight than the counterpart while conversely, in Karpia and Kaptur root fresh and dry weight in AM plants were reduced and remained unchanged, respectively in relation to non-inoculated plants (Figure 1). Noticeably, all varieties pretreated with AM showed higher shoot fresh weight than their counterparts, however, the increase in dry shoot weight was only observed in Karpex cultivar applied by AM, not Karpia and Kaptur.

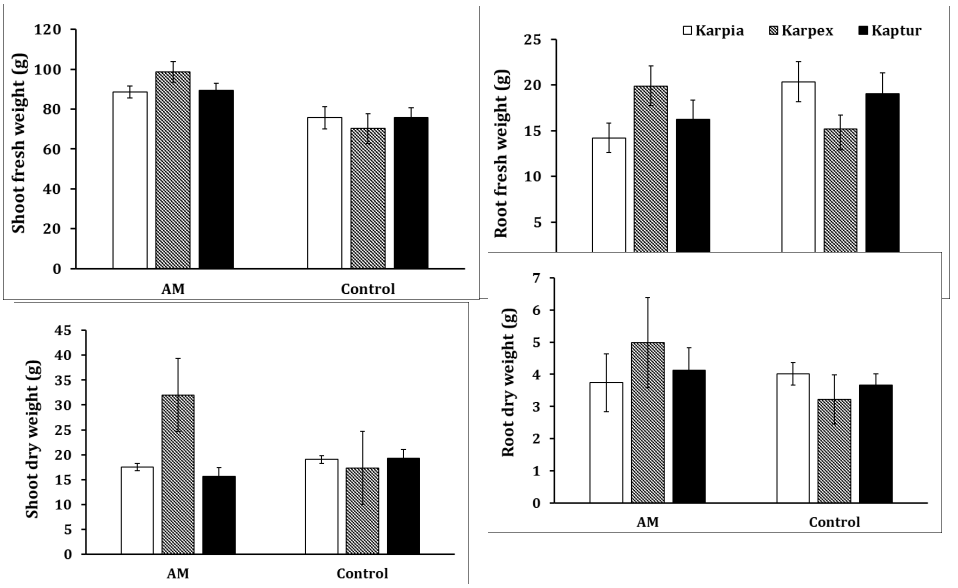

Figure 1. Effect of AM inoculation on root fresh weight (A - upper left), root dry weight (B - upper right), shoot fresh weight (C - lower left) and shoot dry weight (D - lower right) of three pepper cultivars, Karpia, Karpex, Kaptur. Each bar presents mean ± standard deviation

AM inoculated plants in all pepper cultivars showed the greater AM colonization rate in roots than non-inoculated controls (Figure 2). Interestingly, fruit yield in cultivars inoculated with AM improved significantly than non-inoculated plants, nevertheless, Karpex cv. has the similar fruit yield to their control. The results of inclined biomass production, fruit yield are accordance to numerous reports showing that AM inoculation enhanced root and shoot dry weight, fruit yield in pepper plants (Abdel Latef & Chaoxing, 2014; Abdel Latef, 2013; Boonlue et al., 2012; Tanwar et al., 2013). The most common explanation is that AM symbiosis enhance absorption of soil mineral nutrients, water through the AM hyphae network (Smith & Read, 2008), induced resistance or tolerance

 DOI: 10.18380/SZIE.COLUM.2017.4.1.suppl

to various stresses (Garmendia et al., 2004; Alejo-Iturvide el al., 2008; Mena-Violante et al., 2006; Kaya et al., 2009; Ruscitti el al., 2011). However, no beneficial effect from AM inoculation on pepper plants were also found in other reports (Russo, 2006; Russo & Perkins-Veazie, 2010).

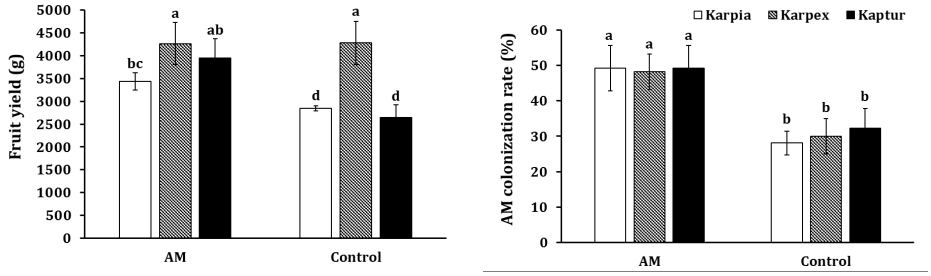

Figure 2. Arbuscular mycorrhizal colonization rate (A) and fruit yield (B) of AM inoculated and control plants of three pepper cultivars, Karpia, Karpex, Kaptur. AM, Arbuscular mycorrhizal fungi; Each bar presents mean ± standard deviation. Different letters denote significant differences among treatments according to Tukey's post hoc test (P < 0.05) among treatments.

Conclusions

This study showed that application of AM mixture generally enhanced the growth, fruit yield of pepper plants but not in all cultivars tested under field conditions.

Acknowledgement

Authors thank to Stipendium Hungaricum fellowship for supporting this study and to Institute of Horticultural Technology at Szent Istvan University.

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 DOI: 10.18380/SZIE.COLUM.2017.4.1.suppl