International Journal of Research
Available at https://journals.pen2print.org/index.php/ijr/
e-ISSN: 2348-6848
p-ISSN: 2348-795X
Volume 06 Issue 08
July 2019

The significance of mycorrhizal fungi for crop productivity and ecosystem sustainability in organic farming systems

Basant Narain Singh
Research Scholar, Jai Prakash University, Chapra (Bihar)
Email ID: bnsinghbotany@gmail.com

Abstract
Mycorrhizal fungi are especially relevant for organic agriculture because they can act as natural fertilizers to enhancing plant yield. The mycorrhizal fungi play major role in sustainable farming systems with their contribution to crop productivity and ecosystem functioning. This paper evaluate a number of mechanisms and processes by which mycorrhizal fungi can play its role in agro system, and results showing its role can also be used to suppress several problematic agricultural weeds.

There results give insight for the significance of mycorrhizal fungi for sustainable farming systems. It also suggests the need to develop farming systems in which the positive effect of these beneficial soil fungi is optimally being utilized.

Key words: organic agriculture, plant-soil interactions, crop productivity, mycorrhizal symbiosis

Introduction

The most ancient and abundant mutualism existed between the majority of land plants and arbuscular mycorrhizal (AM) fungi is example of symbiosis in agricultural ecosystem. AM fungi form extensive hyphal networks in soil and provide nutrients to plants and in turn assimilates for its energy demands (Smith & Read 1997). AM fungi can act as support systems for seedling growth, resist against drought and some pathogens and can enhance biological diversity in grassland (Van der Heijden et al. 1998). There are also studies that have shown its contribution for 90% phosphorus demand of plants (Jakobsen et al. 1992; van der Heijden et al. 2006).

AM fungi are especially important for sustainable farming systems as they are efficient in the case of low nutrient in soil and also when nutrients are bound to organic matter and soil particles. Many important agricultural crops can benefit from AM fungi, including maize, potato, sunflower, wheat, onion, leek and soybean, especially under condition of low nutrient availability as limiting plant growth. Moreover, These fungi also have indirect effects such as stimulation of soil quality and the suppression of organisms that reduce crop productivity.

There most studies are available which investigated the effects of AM fungi on plant growth in single planting condition. However, in the field crops co-occur with weeds and some crops are grown together with other crops in mixtures. Hence, it is necessary to use a systematic approach to assess the significance of AM fungi for the functioning of agricultural ecosystems. In this study, a system approach was explored whether AM fungi can suppress growth of several highly problematic agricultural weeds that coexist with crops.

Methods and Materials

The wheat cropping system was established in the greenhouse under controlled conditions with thirty microcosms for simulation. Wheat and six weed species were grown together in microcosms or weed and sunflower monocultures respectively. Half of the microcosms of each treatment were inoculated with a mixture of three AM fungal species and the other half of the microcosms received sterilized inoculum as a control. The microcosms were harvested after 14 weeks. Than dry weights of wheat and weeds were determined in each treatment and used to calculate the competitive balance index according to Wilson (1988). It was tested whether AM fungi reduce weed growth and alter competitive interactions between weeds and wheat crop.

Results & Discussion

It is presently widely accepted that AM fungi enhance plant growth. However, AM fungi interacts with plants can range from mutualistic to parasitic (Van der Heijden 2002; Klironomos 2003). Francis & Read (1995) performed studies with plants from natural communities and showed that AM fungi have a negative impact on several plants. The important weeds have a ruderal lifestyle, suggesting that AM fungi have the potential to suppress weed growth. This hypothesis was tested through establishment of microcosms in which wheat was grown together with weeds, and, observed a reduction in weed biomass when AM fungi were present in the microcosms supporting our expectations. Moreover, the presence of AM fungi significantly enhanced the competitive ability of wheat relative to the weeds (Figure 1).

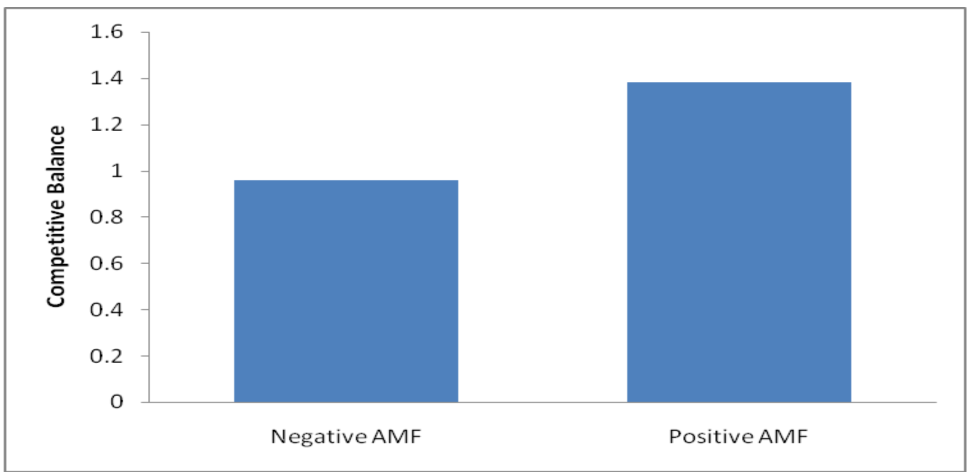

Figure 1: Competitive balance between Wheat and weeds in microcosms with AM fungi (+AMF) or without AM fungi (-AMF).

Thus, the present results showed that AM fungi alter the interaction between weeds and wheat, promoting wheat and suppressing weeds.

Conclusions

There results showed that mycorrhizal fungi can contribute to weed control because they suppress the competitive ability of weeds relative to wheat crop. Moreover, mycorrhizal fungi can directly and indirectly contribute to plant productivity in organic farming systems. The AM fungi effects include enhanced nutrient uptake, enhanced seedling establishment and stimulation of soil structure. Additional research is needed to develop farming systems that optimize the use of natural resources for sustainable agricultural production.

References

1. Jakobsen I, Abbott LK, Robson AD (1992): External hyphae of vesicular-arbuscular mycorrhizal fungi associated with *Trifolium subterraneum* L. I: Spread of hyphae and phosphorus inflow into roots. New Phytol., 120, 371-380.
2. Francis R, Read DJ (1995): Mutualism and antagonism in the mycorrhizal symbiosis, with special reference to impacts on plant community structure. *Can. J.Bot.* 73, S1301-S1309.
3. Klironomos JN (2003): Variation in plant response to native and exotic arbuscular mycorrhizal fungi. Ecology, 84: 2292-2301.
4. Smith S.E., Read D.J. (1997): Mycorrhizal symbiosis, 2nd ed. Academic Press, London, UK.
5. Van der Heijden MGA. 2002. Arbuscular mycorrhizal fungi as a determinant of plant diversity: in search for underlying mechanisms and general principles. (In: Van der Heijden MGA, Sanders IR ed. *Mycorrhizal Ecology*).
6. Van der Heijden MGA, Streitwolf-Engel R, Riedl R, Siegrist S, Neudecker A, Ineichen K, Boller T, Wiemken A, Sanders IR (2006): The mycorrhizal contribution to plant productivity, plant nutrition and soil structure in experimental grassland. New Phytol, 172: 739-752.
7. Wilson JB (1988) Shoot competition and root competition. J Appl Ecol, 25: 279-296.