Farming Increases the Spore Population of AM Fungi in Central Deserts of Iran

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Abstract:

Mycorrhizal symbiosis is a key component of natural and agricultural ecosystems. It enhances the mineral nutrition and increase tolerance of host plants to environmental and biological stress particularly in extreme environments. In this study, the changes in spore abundance of AM fungus *Paraglomus occultum* was compared in two neighbouring habitat in central deserts of Iran. Farming practice applied over 12 years sharply increased *P. occultum* spore population in this region.

Introduction:

The arbuscular mycorrhizal (AM) symbiosis is one of the most widespread plant symbioses. It is a mutualistic relationship that improves mineral nutrition in host plants and increases the tolerance of host plants to biological and environmental stresses (Smith and Read 1997). The production of AM fungal inoculant is very costly, and the management of this symbiosis in agricultural systems is mainly restricted to the management of the inoculum occurring naturally in soils (Robson, Abbott et al. 1994). Changes in the quantity of AM fungal propagules in soil could change the intensity of AM fungal colonization in host plants. In this project, we studied the long-term influence of cropping on the density of AM fungal spores in rhizosphere soil and the extent of AM root colonization levels, in central deserts of Iran (Fig. 1).

Methods and Materials:

The study area is located in the north of Kashan (Central Iran 51° 19' - 51° 32' and 33° 40' - 34° 13'). Average annual temperature is 35°C and average annual rainfall is 105.5 mm. The abundance of AM fungal spores and the level of AM root colonization in one soil patch under cultivation for 12 years and in the adjacent uncultivated soil were determined.

In June 1999, the roots of 15 individuals of each of the four species under study (Table 1) were taken and transported to the laboratory in 48 hours. Roots were fixed in FAA and stained with 0.05% Aniline blue according to Miller (1992). Stained roots were observed under a light microscope for the assessment of their AM colonization level. One hundred 1-cm pieces of stained roots were examined.

Samples of rhizosphere soil were collected within the top 5-30 cm soil layer, placed in plastic bags, dried and stored in the laboratory after homogenization. Spores from 200 g of rhizosphere soil were extracted according to Daniels and Skiper (1982) and counted under a stereo microscope. Determination was done at the Plant Pest & Diseases Research Institute, Teheran, Iran.

Results:

The only AM fungus found in cultivated and non- cultivated site was *Paraglomus occultum* (Fig. 3). Farming had a clear influence on the density of spores in cultivated site as there was 32 times more spore per 1 g dry rhizosphere soil in the cultivated site compared to the non cultivated site (Fig. 2). The average root colonization level was also increased by more than two times in the cultivated site (Tab1).

Table 1. The Colonization Level of Plants in Cultivated Soil was Higher than that Found in Uncultivated Soil.

Plant Name	Site	Colonization %
S. Carelini	Uncultivated	10
S. Plumosa	Uncultivated	7
Hordeum vulgare	Cultivated	16
Pistacia vera	Cultivated	22

Fig. 1. A View of Study Site.

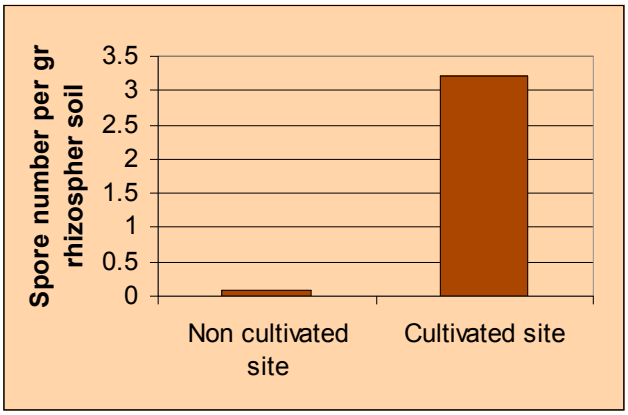

Fig. 2. Farming During 12 Years Increased Spore Density in Rhizosphere Soil.

Fig. 3. *Paraglomus occultum* was the Only AM Fungal Species Found in our Survey. Here, Spores are Seen at 70x through the Light Microscope.

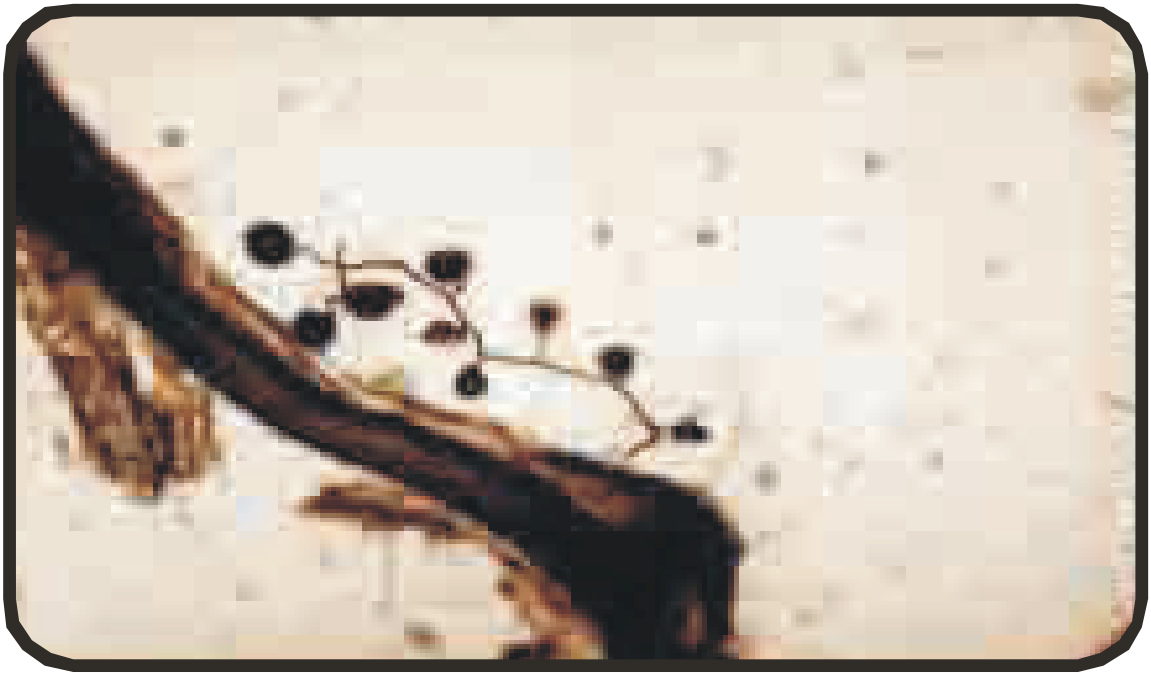

Fig. 4. AM root of *S. plumosa* Seen at 40x Through the Stereo Microscope.

Discussion:

The results of this study shows farming practices can sharply increase the spore population of *Paraglomus occultum* in central desert systems of Iran. Abbott and Robson (1977) also found that farming increases the AM fungal density in host plant, which supports our results, however, Kucey and Paul (1983) observed a decrease in the population of AMF spore in cultivated soils compare to non- cultivated soils in Saskatchewan, Canada. The difference between the plant community structures in our study site and Kucey and Paul's study site could be a main reason for the differences in results as native habitats of Saskatchewan are mostly dense grasslands which can support high populating of AM fungi.

The drastically increase in spore population of AM fungi in non- cultivated site could be due to clear increase in the density of host plants comparing to native habitat. The longer growing season for cultivated plant (*Hordeum*) comparing to *Stipagrostis* spp. (The dominant component of non- cultivated site) could also has effect on increase of AMF spore density. The average colonisation rate in cultivated site is 18% comparing to 8.5% for non cultivated site which could be another reason for increase in spore population in cultivated site.
The mycorrhizal dependency of *Stipagrostis* spp. needs to be evaluated. The root density and structure in the soil of native and cropped ecosystems should be compared to better understand how the proliferation of AM fungi in cropped soil is encouraged.

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