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Research Article

Arbuscular Mycorrhizal Fungi in Mizo Bird's Eye Chilli (*Capsicum frutescens* L.) from Home Gardens in Aizawl

R. Vanlalmalsawmi[1], John Zothanzama[2]*

[1]Department of Environmental Science, Mizoram University, Tanhril, 796004 (India)

[2]Department of Biotechnology, Mizoram University, Tanrhil, 796004 (India)

E- mail: john_zza@yahoo.co.in

Abstract

A study was conducted on the colonization and the diversity of Arbuscular Mycorrhizal Fungi on the roots of the Mizo Bird's eye chilli *Capsicum frutescens* L. The study was carried out at three home gardens within Aizawl, Mizoram during the year 2018 - 2019. The study was conducted for different stages of the plant, namely – Juvenile stage, Fruiting stage and Senescence stage. The highest colonization of Arbuscular Mycorrhizal Fungi was found in the roots of the plant in the juvenile stage and the lowest was found in the roots of the plant in the senescence stage. Seven Arbuscular Mycorrhizal fungal taxa belonging to the genera *Acaulospora* (3 spp.), *Glomus* (2 spp.), *Pacispora* (1 sp.) and *Funneliformis* (1 sp.) were found. Among these, *Acaulospora* was the dominant genus found at all sites, followed by Glomus. The spore density and root colonization of AMF on Mizo Bird's Eye Chilli varied significantly among the different stages of the plant.

Keywords: Mizo bird's eye chilli, Colonization, Juvenile, Fruiting, Senescence, Spore.

INTRODUCTION

The Mizo Bird's Eye Chilli (*Capsicum frutescens* L.) is located at various places of the world; one of such center of domestication is the Mizoram State of India. In Mizoram, they are locally called 'Mizo hmarchate' or Mizo Bird's eye chilli which belongs to the species *C. frutescens* and is widely grown in the state of Mizoram. It is mainly used for spicy cuisines, in pickles, chutneys, hot sauces and local medicines and has a very high demand in neighboring state like Assam, Tripura, Manipur and countries like China, Thailand, and Vietnam. The Bird's Eye Chilli has recently been registered as the rightful Mizo Property under the Geographical Indication (GI) with the name Mizo Chilli or Mizo Bird's Eye Chilli. Mizoram is known for the presence of considerable diversity of Bird's eye chilli with respect to fruit shape, size, colour, pungency, plant type, physiological characteristics, reactions to diseases and pests, adaptability and distribution. Three different varieties/qualities – Grade A, Grade B and Grade C of Mizo Hmarchate are being cultivated in the eight districts of Mizoram (Alarcón et al., 2012).

Mycorrhiza is the symbiotic association between plant roots and fungus localized in root-like structure in energy which moves primarily from plants to fungus and inorganic plants to resources from fungus to plant (Lewis, 1973). The term mycorrhiiza was first used by (Francke, 1934) to describe the long - lived

association between plant roots and fungal mycelium (Harley, 1969). They are formed between members of the zygomycetes (order, glomales) and the majority of angiosperm species, which includes most agriculturally important crops (Alguacil et al., 2014). AMF are a key functional group for agroecosystems due to their widespread geographical distribution and because they are commonly

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associated with many important crops (Brundrett, 2009; Alarcon et al., 2012).

AMF are associated with different species and varieties of chili pepper (Capsicum spp.), whose AMF colonization have ranged from 38% to 68% (Castillo et al., 2010; Boonlue et al., 2012; Chen et al., 2012; Vays and Vays, 2012). In addition, some reports have demonstrated significant variations in the composition and in the number of AM fungal spores among Capsicum species (Boonlue et al., 2012; Vays and Vays, 2012).

MATERIALS AND METHODS

Study Sites

Three study areas, namely Garden 1, Garden 2 and Garden 3 were randomly selected in Aizawl, Mizoram which lies at latitude 23° 44' 16" N and longitude 92° 39' 31" E (Garden 1), latitude 23° 43' 10" N and longitude 92° 43' 1" E (Garden 2) and latitude 23º 42' 50" N and longitude 92º 42' 49" E (Garden 3).

Collection of Samples

The roots and soil samples were taken from a depth of 5 – 15 cm of the rhizosphere portion from three different sites. The soils from the upper layer were scrapped off to remove litter layer. Approximately, 200 grams of rhizospheric soils along with fine roots were collected in a clean plastic box with a tight lid. The soil shaken from the roots were collected, shade dried and stored at room temperature until the soil got dried.

Analysis of Root Colonization

The root samples were washed free of soil and fine roots were cut into segments of 1 cm in length. The root segments were treated in 10% KOH solution and heated for around 15 - 20 minutes after which it was washed again with water and stained using Trypan blue stain. The root segmens were then observed under the microscope and colonization was calculated using the formula given by Giovanetti and Rosse (1980):

$$\% \text{ colonization} = \frac{\text{No. of root segments colonized}}{\text{Total no. of root segments observed}} \times 100$$

Isolation and Identification of Spores

The spores were isolated from the soil samples of 100 g by wet sieving and decanting technique according to Gendermann and Nicholson (1963). The clean and intact spores were isolated using a needle and were mounted on a glass slide with a drop of Melzer's reagent. All the spores were examined under the microscope for their morphological characteristics. Spore characterization was mainly done with the help of spore characteristics given by INVAM, 1997.

RESULT AND DISCUSSION

The analysis of mycorrhizal colonization in roots was done using collection of samples from nine plants and grouped into three plant stages, namely - Juvenile stage, Fuiting stage and Senescence stage. The analysis was done on 450 stained segments of fine roots which showed a significant variation between the three stages (**Figure 1**). The mycorrhizal colonizattion ranged between 30% - 68%. The highest colonization was found in the Juvenile stage,i.e., 57% (± 9.45 SD), followed by the Fruiting stage 38% (± 4.0 SD) and least colonization was found in the Senescence stage 35% (± 5.03 SD).

Seven mycorrhizal spores were identified from the soil samples collected, they are - *Acaulospora foveata*1*, Acaulospora lacunosa*2*, Acaulospora scrobiculata*3*, Glomus aggregatum*4*, Glomus aureum*5*, Pacispora scintillans*6 *and Funneliformis geosporum*7 (**Figure 2**)

The highest colonization of roots was collected from the juvenile stage. Proper addition of natural manures was observed with proper irrigation and proper tillage for air circulation which have increased the plant production thereby facilitating production of new young and fine roots. According to (Oehl, 2004) and Alquacil et al. (2014), intensive agriculture management practices including cultural practices like chemical fertilization, pest control, continuous monoculture, soil tillage, may have significant impacts on the interactions between AMF and plants.

Capsicum frutescens L. is an annual plant which completes its life cycle in one growing season, and then dies. This character of the plant could contribute to the population of AMF communities during the various stages of the plant life cycle. Population of AMF declined during the fruiting stage and least population or colonization was found during senescence period. The senescence period is marked by the gradual deterioration of the functional characteristics of the plants. As the plant reaches maturity or senescence stage, the number of fine roots produced lessens or declines which contributes to the less number of AMF population as AMF infests only the young and fine roots. These findings agree to that of Pawar, J. and Trafdar, J.C. (2006) who attributes the differences to the length of the growing season and the type of root systems of trees, which make the rhizosphere more favourable to spore propagation and AMF colonization (Mohnish Vyas and Anil Vyas, 2012).

(Gashua, et al. 2015) also identified spores belonging to *Glomus sp* and Gigaspora spp. which were associated with chilli plant. Sánchez-Roque, et al. (2016) also found *Glomus spp*. and *Acaulospora sp* associated with chilli plant. Wagner et al., (2019) identified spores belonging to the genera *Acaulospora*, *Glomus*, *Gigaspora* and *Funneliformis* in association with the rhizosphere of *Capsicum* frutescens.

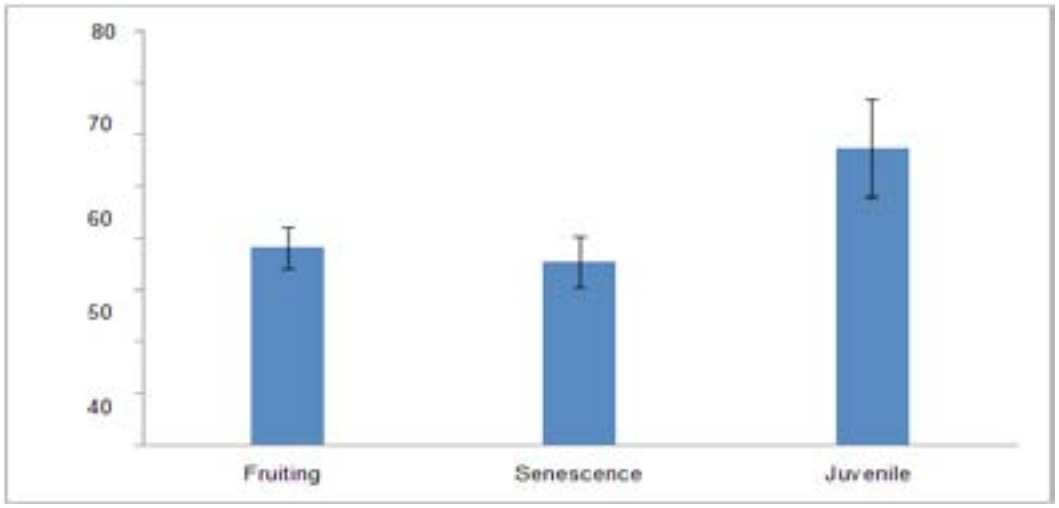

Figure 1. Percentage AMF Colonization with SD (±) values at ± 4.0, ± 5.03 and ± 9.45 for Fruiting stage, Senescence stage and Juvenile stage respectively.

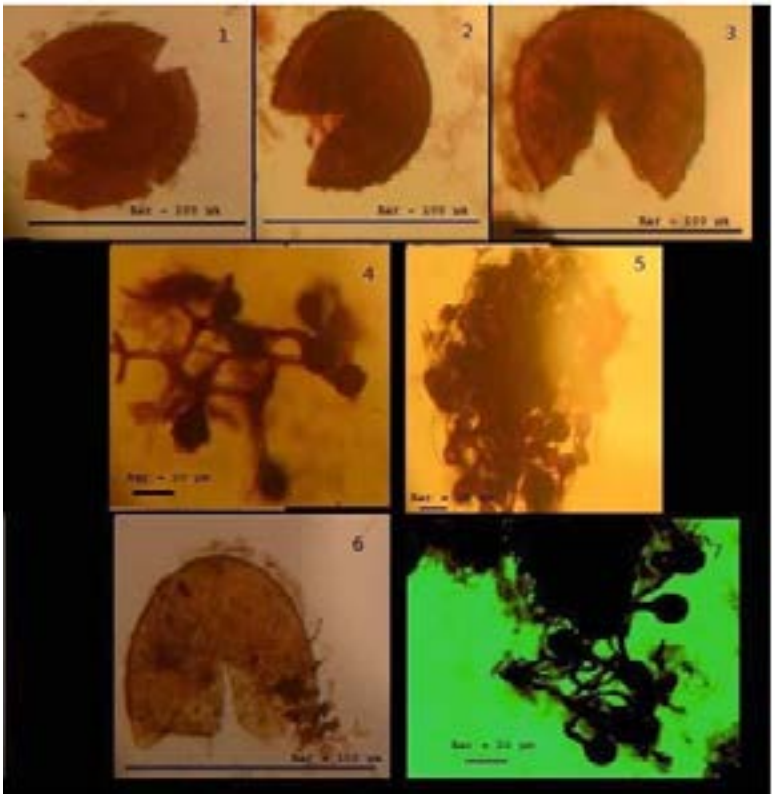

Figure 2. Mycorrhizal spores found in the soil sample.

However, the association of chilli plant with *Pascispora scintillans* has not been recorded so far in literature (Gerdemann, 1963), (Giovannetti, 1980), (Caputti, 2009). The present record is the first report of the species in chilli plant i.e., the Mizo Bird's eye chilli.

It may be concluded that the study is significant since it has revealed the AMF association in the Mizo Bird's Eye Chilli plant as well as a new record of the species *Pascispora scintillans* from the chilli plant. However, since the work done is not conducted from a larger assemblage of samples with more variation of geographical location, further intensive studies may be conducted to identify more AMF species as well as to find out exact nature and level of the AMF association in the Mizo Bird's Eye Chilli plant.

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