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Editors:
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S. Sureshkumar Singh

Assistant Editors
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Department of Forestry
North Eastern Regional Institute of Science and Technology
Nirjuli – 791109, Arunachal Predesh

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OCCURRENCE OF ARBUSCULAR MYCORRHIZAL FUNGI IN NATURAL FOREST AND ARABLE LAND OF MEGHALAYA, NORTHEAST INDIA

Panna Das[1]& Highland Kayang[1*]

[1]Microbial Ecology Laboratory, Department of Botany, North Eastern Hill University, Shillong- 793 022, India.

(*Author for Correspondence: Email: hkayang@nehu.ac.in)

ABSTRACT

Arbuscular mycorrhizal fungi (AMF) are ubiquitous and worldwide in distribution. Nevertheless, AMF are lesser known from northeast India. In this connection, *Pinus kesiya* which dominates the major portion of forests in Meghalaya is ectomycorrhizal in nature. Hence, the study was undertaken to asses the composition of arbuscular mycorrhizal fungi from natural pine forest and compared with the arable land of *Solanum tuberosum*. The spores were isolated using the modified method of wet sieving and decanting. The spore density differ significantly ($p < 0.05$) with moisture content and soil chemical properties. However, spore density does not differ significantly between the sites. Species richness is more in potato field than in pine forest. Eleven morphotypes types were isolated from potato field and only six from pine forest. Sorenson co-efficient analysis reveals a low value of species similarity of 0.18. The study indicates that pine forest is relatively poor in species richness of arbuscular mycorrhizal fungi.

Keywords: Arbuscular mycorrhizal fungi, Meghalaya, morphotypes, *Pinus kesiya,* species richness, *Solanum tuberosum*

INTRODUCTION

Arbuscular mycorrhizal (AM) fungi are extremely common symbioses in terrestrial ecosystems, associating with about 80% of plant families worldwide. They are recognized as an important, widespread component of most terrestrial ecosystems, benefiting plant establishment by enhancing plant nutrient acquisition, improving soil quality, and increasing resistance to environmental stresses (Smith and Read, 1997). In recent years, the importance of AM fungal diversity for plant diversity, productivity and ecosystem processes has been recognised (van der Heijden *et al.*, 1998; Bever, 2002; Burrows and Pfleger, 2002). Numerous studies have focused on the diversity of AMF in grasslands and their role in the restoration of highly disturbed areas (Smith *et al.*, 1998; Anken *et al.*, 2004). These studies have shown that AM fungi exert a significant influence on plant community structure and dynamics in grasslands and other terrestrial ecosystems (Koide and Dickie, 2002; Ferrol *et al.*, 2004). The work of van der Heijden *et al.*, (1998) in the grasslands of Europe and North America has indicated that increasing the diversity of AM fungi might directly increase the diversity of plants.

Pinus kesiya Royle ex. Gord. (Khasi pine), an economically important timber yielding tree is found in northeast India (Choudhury *et al.*, 2008). *Pinus kesiya* forests are found almost as pure

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North Eastern Regional Institute of Science & Technology,
Nirjuli 791109, Arunachal Pradesh

stands over a vast area in north-east India between 800 and 2,000 m altitude. These forests have developed as a result of degradation of primary broadleaved forests by clear felling or selective cutting of trees for shifting cultivation widely practiced throughout north-eastern India (John *et al.*, 2002).

The present study is undertaken to assess the spore density and species richness of AMF in pine forest soil, which is ectomycorrhizal in nature (Rao *et al.*, 1996; Jha *et al.*, 2007) and compare it with the arable soils of *Solanum tuberosum* Linn.

MATERIALS AND METHODS

In September 2007, A sub-tropical pine forest was selected having 1537 m, a.s.l. altitude and with location of 25°36'.735 N & 091°53'.880 E. An arable land of potato was also selected in Swer village located 25°25.01'N and 091°47 47'E with an altitude of 1960 m, a.s.l.

Five replicates of soil samples were collected from each site and composite samples were prepared. The soil samples were dried under sun after analysis of soil moisture content and pH. Spores were extracted by modified wet sieving and decanting method (Muthukumar *et al.*, 2006). 100 g of soil was dispersed in 1 l water and decanted through a series of 710 to 38 µ sieves. The residues were filtered through gridded filter papers and all whole spores were counted using a compound microscope at 40X magnification. Sporocarps and spore clusters were considered as one unit. AMF spores were mounted in polyvinyl alcohol–lactoglycerol with or without Meltzer's reagent for identification using keys from (Oehl and Sieverding, 2004; Wu *et al.*, 1995; http://www.invam.caf.wvu.edu). The photography of the spores was done with the help of Leica EC 3 camera attached in Leica dm 1000 microscope. Spore density was expressed as number of AM fungal spores per soil sample. Species richness is calculated as the number of AMF species in each site. To evaluate the degree of community similarity of AM fungi between the sites, Sorenson's coefficient (CS) was employed and calculated according to the following formula:

$$CS = 2j/\ (a + b)$$

where j is the number of AM fungus species co-existing in any two sites, a is the total number of AM fungus species in any one, and b is the total number of AM fungus species in any other sites.

The soil physical characteristics such as texture and moisture content (%) was analysed. Soil texture was analyzed using sodium hexametaphosphate method (Allen, 1974). For moisture content (%), 10 g sub sample was oven dried to constant weight and was determined by using the following formula:

$$\text{Moisture content (\%)} = [(\text{Wfms}-\text{Wods})/\ \text{Wfms}] \times 100\%$$

where; Wfms is the weight (g) of field moist sample and Wods is the weight (g) of oven-dried sample. The soil was analyzed for soil chemical parameters such as pH, organic Carbon and available Phosphorus. Measurement of pH was done using Microprocessor – based Pocket pH testr 2 (Eutech Instruments) Available phosphorus of soil was determined following standard methods molybdenum-blue method (Allen, 1974). The soil organic carbon was estimated using colorimetric method (Anderson and Ingram, 1993).

Table 1: Spore density and some selected soil physico-chemical properties

	Spore density/25g	Moisture (%)	Sand (%)	Silt (%)	Clay (%)	pH	Organic C (%)	Phosphorus (mg/kg)
Pine forest	134.00	23.13	75.36	2.56	22.08	5.4	1.0	2.38
Potato field	102.33	28.21	82. 36	3. 56	14. 08	6.4	11.45	5.94

Table2: AMF species composition of two sites

AMF species	Pine forest	Potato field
Acaulospora scrobiculata **Trappe**	+	-
A. sp 1	+	-
A. sp 2	-	+
Gigaspora sp 1	-	+
G. sp 2	-	+
Glomus sp1	+	+
G. sp 2	+	-
G.aggregatum **Schenck & Smith**	-	+
G. clavispora **(Trappe) Almeida & Schenck**	+	+
G. rubiformis **(Gerd. & Trappe) R.T. Almeida & N.C. Schenck**	+	+
G. tortuosum **Schenck & Smith**	-	+
Pacispora sp1	-	+
P. sp 2	-	+
Scutellospora sp 1	-	+
No. of species at sites	6	11

RESULTS

The mean values of soil physico-chemical characteristics are presented in Table 1. The moisture content, sand, silt pH, organic carbon and available 0.05, respectively). However, there is no statistical difference between the spore Two sample t-test was conducted to analyse the variation in the soil physico-chemical properties and spore density. phosphorus is found to be higher in potato field, apart from clay content which is more in pine forest. The spore density is higher in pine forest (Table 1 & Figure 1). There is significant difference between spore density and moisture content (%), ph, organic carbon (%), available phosphorus mg/kg (t = 5.76; df = 2; $p <$ 0.05, t = 7.08; df = 2; $p <$ 0.05, t = 6.71; df = 2; $p <$ 0.05, t = 7.15; df = 2; $p <$ densities of two sites. Fourteen morphotypes were extracted from the soils of both the sites. Few identified species are shown in Figure 2. Eleven were

recovered from potato field and only six from pine forest. Consequently, species richness was more to be in potato field (Figure 3). Hence, an inverse tendency of spore density and species richness is observed (Figure 4). *Glomus* was the most dominant in pine forest as well as in potato field. Three morphotypes were isolated from Acaulospora, two from *Gigaspora*, six from *Glomus*, two from *Pacispora* and only one from *Scutellospora* (Table 2). Sorenson's coefficient (Cs) revealed that both sites have low similarity with the value of 0.18.

DISCUSSION

The soil chemical properties are comparatively higher in potato field which may be due to the fertilizer application. The moisture content also is high which may be due to regular watering to the arable fields. The characteristics of conifer forest are lower pH (Berg and Verhoef, 1998; Marcos *et al.*, 2007) which is in accord with this study. However, no significant difference in the spore density could be observed in both the sites. This possibly might be due to production of AMF spores in the rhizosphere vicinity of surrounding weeds in case of potato plant and herbaceous species in the pine forest. Therefore, spore population normally cannot establish correlation with host species alone in nature as also supported by Kruckelmann, 1975. The spore population of AMF and species richness that is encountered may be due to presence of successional plants such as grasses (Gramineae), herbs (Compositae) and shrubs.

Current agricultural sites were associated with decreased spore densities are in accord with the study of Cousins *et al.*, 2003. Historically agricultural sites with decreased species richness are also reported (Cousins *et al.*, 2003), however, in the present study, species richness is high which may be explained in the view that shifting agriculture is a prevalent form of cultivation of this region. AMF species composition was substantially either influenced in the pine forest by disturbance such as slash and burn activity in the pine forest (Ramakrishnan and Mishra, 1981) or ectomycorrhizal nature of pine.

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