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Incidence of Arbuscular Mycorrhizal and Dark Septate Fungal association in *Dioscorea* species

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ABSTRACT

Dioscorea (Yam) is a tuber crop belonging to the family Dioscoreaceae. It is among the oldest food crop and valuable source of carbohydrate in the diet. A number of *Dioscorea* species are also cultivated to provide a source of diosgenin, some sapogenins, alkaloids, steroid derivatives and phenolic compounds used in the pharmaceutical industry. As soil microorganisms are crucial for natural soil fertility, two species of *Dioscorea* from three different sites were investigated for the presence of mycorrhizal and dark septate endophytic (DSE) association. *Dioscorea hispida* (Dennst.) and *D.bulbifera* (L.) were collected from June-Nov 2011 along with their fibrous roots and rhizosphere soils. Soil physico-chemical analyses of collected samples were carried out with standard methods. All the samples were found to be colonized with arbuscular mycorrhizal and Dark Septate Endopytic fungi. The percent root colonization was in between 75 to 90.32%. AM fungal spore density was in between 185 to 296 / 100g and spores belonging to *Glomus* species and *Acaulospora sporocarpa* were identified. By inoculating the proper indigenous AMF and DSE with *Dioscorea* species, can produce high yield of crops in future.

KEYWORDS

AM fungi,
DSE,
Dioscorea (Yam)

INTRODUCTION

Soil, an underground terrestrial ecosystem shows the greatest diversity of organism. Especially rhizospheric region is the most dynamic environment that harbors Arbuscular Mycorrhizae the most dominant fungal associations. Of the several mycorrhizal symbiosis arbuscular mycorrhizas are the most abundant. These are formed by a very wide variety of host plant, including angiosperms, gymnosperms, pteridophytes and some mosses, lycopods and psilotales and a comparatively small group of aseptate filamentous fungi, the Glomales. More than 90% of all plant families studied, agricultural and natural environments form mycorrhizal associations and they can be essential for plant nutrition. In tuber crops, many studies have demonstrated the enhancement of growth and yield by AMF. Recently a high AMF species richness was determined for soils in the 'Yam belt' of Benin (Tchabi *et al*., 2008).

Yam is a tuber crop belonging to the family Dioscoreaceae. Yam are among the oldest food crops recorded and are defined as "an economically useful plant the botanical genus *Dioscorea* for the tuberous or rhizomes of these plants". Major constraints for Yam production are presumed to be low soil fertility, e.g. due to macro and micronutrient deficiency. In terms of nutrient use, Yam is a demanding crop and, consequently, it is planted traditionally at the beginning of the rotation cycle following forest clearing. It is widely cultivated in West and Central Africa, in Asia and in many tropical Central and South American countries (Ravi *et al*., 1996; Sotomayor-Ramirez *et al*., 2003; Suja *et al*., 2003; FAOSTAT, 2007).

A number of *Dioscorea* species are also cultivated to provide a source of diosgenin, which is used in the manufacture of oral contraceptives and sex hormones. Also, some sapogenins, alkaloids, steroid derivatives and phenolic compounds are found in yam and are used in the pharmaceutical industry.

To increase the production of this tuber species, there is a need to develop quality of tuber for plantation and also boost the growth through the

inoculation of AM fungi and DSE. Taking into consideration the beneficial effect of AM fungi the *Dioscorea species* have been investigated from their sites.

Present work would confirm the occurrence of mycorrhizal fungi and its association with *Dioscorea species.* It will describe new ideas in fascinating field of mycorrhiza.

MATERIALS AND METHODS

Tuberous plant species, distributed in undisturbed soils of Amravati district at different places Semadoh (S_1), Chikhaldara (S_2), and Narnala Fort (S_3) were collected from June- Nov 2011 along with their tubers, fibrous roots and rhizosphere soils. Rhizosphere soils from each plant area was dug out up to the depth of 15 -20 cm and about 500g soil samples were collected in sterile polythene bags. Prior to spore enumeration from the soil, composite samples were used for analysis of soil characteristics by the standard analytical methods (Jackson 1973). The isolation of AM spores was carried out by the method of Gerdemann and Nicolson (1963). The procedure described by Gaur and Adholeya (1994) was used for counting the AM spores. For assessing the AM infection and % colonization, roots from preserved samples were processed.

The Grid line intersect method (Giovannetti and Mosse, 1980) was used for quantifying the AM colonization. The AM Fungi were identified by using the manual of Schenck and Perez (1990). The peels of tubers along with fine roots were screened for presence of septate hyphae and the intracellular microsclerotia.

RESULTS AND DISCUSSION

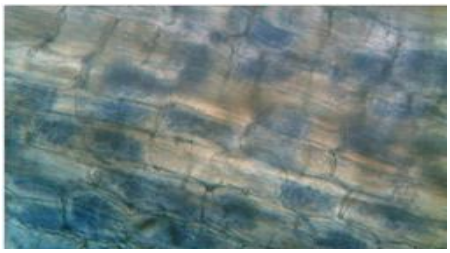
The results of rhizosphere soils physico-chemical analysis of three sites have been projected in table 1. All the samples studied exhibited AM fungal association. The root association was characterized by the presence of hyphal, arbuscular and vesicular characteristic features (photo plate-I). The root % colonization from the site S_1 was found to be 90.32%, S_2 site 77.27% and from S_3 site 75%. The spore count of 296 at S_1, 214 at S_2 and 185 at S_3 site was recorded in the present investigation. Seven species of arbuscular mycorrhizal fungi belonging to *Glomus* namely *Glomus aggregatum, G. ambisporum, G. leptotichum, G. multicaule, G. fasciculatum, G. maculosum, G. fistulosum* and *Acaulospora sporocarpa* were recorded from rhizosphere soils of tuberous plants.

Table 1:Physico-Chemical Analysis of Soil Samples , AMF %colonization and spore count

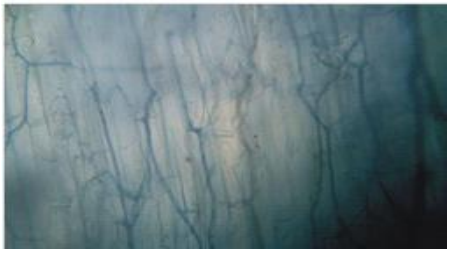
Sr. No.	Site	pH	EC	N (kg/ha)	P (kg/ha)	K (kg/ha)	Free Lime (%)	Org. C (%)	% Colonization	Spore/100g
1	S_1	6.75	1.65	679.44	6.43	875.84	1.25	1.52	90.32	296
2	S_2	7.82	1.25	308.89	6.93	865.76	13.12	0.87	77.27	214
3	S_3	8.23	0.24	362.8	37.38	528.64	6.87	6.87	75	185

Table 2: AMF and DSE Status in the Study area.

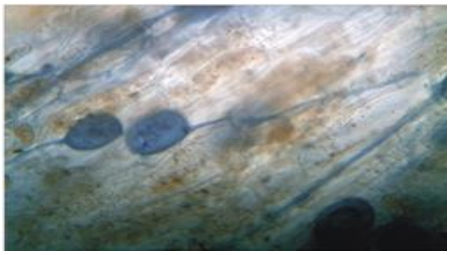
Sr. No	Site	Septate Hyphae	Microsclerotia	AM Hyphae	Vesicle	Arbuscules	AMF species
1	S_1	+ + +	+ +	++	++	+	*G.aggregatum, G.ambisporum, G.leptotichum*
2	S_2	+ +	+	++	+++	-	*G.fasciculatum, A.sporocarpa, G.maculosum G.multicaule*
3	S_3	+	+	+++	++	+	*G.aggregatum, G.ambisporum G.fistulosum G.multicaule*



Arbuscule

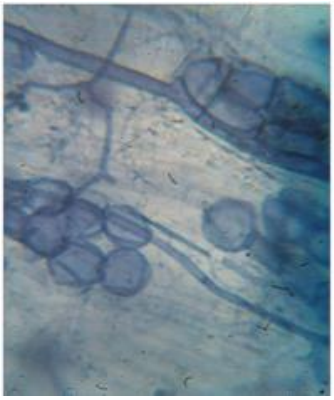


Hyphae

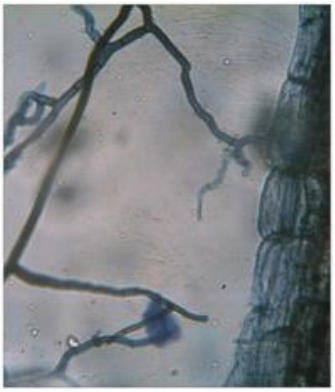


Vesicle

Photo plate 1



Microsclerotia



Dark Septale Endophyte

Intraradicle Spores

Photo plate 2

The current study showed that AMF and DSE (Photo plate-II) had a good symbiotic association with the tuberous roots of *Dioscorea* species. Co-occurrence of these two association was detected microscopically. The present study confirm the earlier findings that the AM fungi colonize tubers of medicinal plants (Rodrigues,1996; Bhat and Kaveriappa,1997a). The incidence of AMF association has been documented in the tubers of *Pueraria tuberose* (Rodrigues,1996); *Colocasia esculenta* (Bhat and Kaveriappa,1997b); *Gloriosa superb*a (Khade and Rodrigues, 2003); *Dioscorea* species (Khade and Rodrigues, 2007); *Gloriosa superba* and *Dioscorea bulbifera* (Nisha *et al*., 2010).

CONCLUSION

Both the species of *Dioscorea* were found to be associated with AM fungi and Dark Septate Endophyte. Proper selection of efficient AM fungi and DSE is an important step for developing any mycorrhizal inoculation programme.

Further research is needed to clarify the basic physiology of this symbiotic relationship intuber plant like *Dioscorea*, to realize the full potential of AMF and DSE in agroforestry or forestry.

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