J. Mycopathol, Res, ***46(2)*** *: 251-254 (2008)*

Survey of VAM association in common crops grown in the red lateritic soil of south West Bengal

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A survey was conducted on regular crops grown in the area season wise. Collection of rhizospheric soil and roots were made from the crops like jute (*Corchorus olitorius*), groundnut (*Arachis hypogaea*), ladies finger (*Abelmoschus esculentus*) and sweet potato (*Ipomoea batatas*) during summer ; paddy (*Oryza sativa*) and maize (*Zea mays*) during wet season and wheat (*Triticum aestivum*), mustard (*Brassica campestris*), tomato (*Lycopersicon esculentum*) during winter. Depth considered was 0 to 25 cm. The rhizospheric soils were collected for VAMF spore count (wet sieve and decantation method) before sowing and at 15 days after sowing (d.a.s.) 45 d.a.s. and 75 d.a.s. Roots were collected at 7, 15, 30, 45, 60 and 75 d.a.s. for per cent infection study (root clearing and staining method). The crops varied as regard the extent of VAM infection and also initiation of VAM colonization. The initial spore population in the rhizosphere of the summer crops was higher (averaging 62.5 per 100 g. soil) than that of the wet season or winter crops (averaging 42.4 per 100 g. of soil). In general the spore count decreased in the initial stages of plant growth and increased as the crops attained maturity. Highest spore count was observed in the rhizosphere of *T.aestivum* (84 per 100 g soil) and the least in *B. campestris* (12 per 100 g soil) at the end of the crop growing period.

Z mays and *T. aestivum* were colonized as early as 7 d.a.s. ; the others except *B. campestris* at 125 d.a.s. Maximum colonization was observed in *Z. mays* (45%) and the least in *B. campestris* (4%) at 75 d.a.s. The decreasing order of spore count in different crop rhizosphere (at 75 d.a.s.) was *T. aestivum* > *Z. mays* > *L. esculentum* > *I. batatas* > *C. olitorius* > *O. sativa* > *Abelmoscus esculentus* > *Arachis hypogaea* > *B. campestris.* The decreasing order of VAM per cent colonization in different crops at 75 d.a.s. was *Z. mays* > *T. aestivum* > *I. batatas* > *Abelmoschus esculentus* > *C. olitorius* > *Arachis hypogaea* > *L. esculentum* > *O. sativa* > *B. campestis.*

Key words : Vesicular arbuscular mycorrhiza, acid lateritic soil, different crops, different seasons.

INTRODUCTION

The distribution of VAM fungal species in agro-ecosystems varies with changes in soil fertility and cultural practices (Miller *et al*, 1985) A general reduction in the number of predominant VAM species with the change from a native ecosystem to an agro-ecosystem has been reported by Schenck *et al.* (1989). In separate studies made by Mosse (1973) and Padmavathi *et al.* (1991) VAM fungi are mostly found in the top 15—30 cm of soil and their numbers decline markedly below 15 cm of soil (Verma, 1982). Acid soils harbour certain VAM fungi like *Acaulospora, Gigaspora* and *Glomus.* The efficiency of the VAM species *Glomus fasciculatum* in rain fed lateritic soil conditions has been reported (Cliquet *et al.*, 1997 ; Setua *et al.,* 1999). There have been several studies on the ecology of VAMF in native ecosystems (Sylvia, 1986) as well as agro-ecosystems (Schenck and Smith, 1981 ; Schenck and Sequeira, 1987) and efficacy and biological activity of VAMF can be used to characterize soils, edaphic factors and vegetation (Kühn *et al.,* 1987). Study of mycorrhizal dynamics may prove to be an essential step before taking up any mycorrhizal inoculation programme (Allen, 1992).

MATERIALS AND METHODS

A survey was made on vesicular-arbuscular mycorrhizal fungal (VAMF) population in crop fields at the agricultural farms of Midnapore and Kharagpur are situated in the lateritic belt of south Western region of West Bengal, India, located at 22º19´N latitude and 87º19´E longitude at a distance of 115 km from the Bay of Bengal, at an elevation of 44 m above mean seal level. The soil of the experimental site is acid lateritic (Haplystalf) and sandy loam in texture. It is low in organic carbon (0.37%), nitrogen (0.035%) and phosphorus (0.048%) content, and medium in potassium (0.013%) content.

The important crops grown in the area are jute (*Corchorus olitorius*), maize (*Zea mays*), wheat (*Triticum aestivum)*, paddy (*Oryza sativa*), sweet potato (*Ipomoea batatas*) ladies finger (*Abelmoschus esculentus*), tomato (*Lycopersicon esculentum*), groundnut (*Arachis hypogaea)*, and mustard (*Brassica campestris*).

At both the sites, Midnapore and Kharagpur, the collection of VAMF was made from the crop fields. Collection of rhizospheric soil and roots were made from the crops like jute (*Corchorus olitorius*), groundnut (*Arachis hypogaea*), ladies finger (*Abelmoschus esculentus*) and sweet potato (*Ipomoea batatas*) during summer ; paddy (*Oryza sativa*) and maize (*Zea mays*) during wet season and wheat (*Triticum aestivum*), mustard (*Brassica campestris*), tomato (*Lycopersicon esculentum*) during winter. Depth considered was 0 to 25 cm. The rhizospheric soils were collected for VAMF spore count before sowing and at 15 days after sowing (d.a.s.) 45 d.a.s. and 75 d.a.s. Roots were collected at 7, 15, 30, 45, 60 and 75 d.a.s. for per cent infection study. VAM spore count per 100 g of soil was done by wet sieve and decantation method (Gerdemann and Nicolson 1963). Percentage VAM infection study was done by root clearing and staining method (Phillips and Hayman, 1970) and calculated as follows :

% root infection = No. of root pieces with VAM infection/No. of root pieces observed × 100.

RESULTS AND DISCUSSION

The crops varied as regard the extent of VAM infection and also initiation of VAM colonization (Table 1). The initial spore population in the rhizosphere of the summer crops was higher than that of the wet season or winter crops. In general the spore count decreased in the initial stages of plant growth and increased at the crops attained maturity. Highest spore count was observed in the rhizosphere of *T. aestivum* and the least in *B. campestris* at the end of the crop-growing period. *Z. mays* and *T. aestivum* were colonized as early as 7 d.a.s.; the others except *B. campestris* at 15 d.a.s. Maximum colonization was observed in *Z. mays* and the least in *B. campestris* at 75 d.a.s.

The decreasing order of spore count in different crop rhizosphere (at 75 d.a.s.) was *T. aestivum* > *Z. mays* > *L. esculentum* > *I. batatas* > *C. olitorius* > *O. sativa* > *Abelmoscus esculentus* > *Arachis hypogaea* > *B. campestris.*

The decreasing order of VAM per cent colonization in different crops at 75 d.a.s. was *Z. mays* > *T. aestivum* > *I. batatas* > *Abelmoschus esculentus* > *C. olitorius* > *Arachis hypogaea* > *L. esculentum* > *O. sativa* > *B. campestris.*

Intensive agricultural management practice can suppress the population of VAM fungi in the soil (Douds *et al.,* 1993). It was found that the initial spore count ranged from 40 to 68 per 100 g of soil throughout the year, averaging 51.33 per 100 g soil which was considered to be quite poor in mycorrhizal population. However, the soils collected from summer season crop rhizosphere had more spores than winter season crop rhizosphere averaging 62.5 spores per 100 g soil. These could be because the higher soil temperature (above 15ºC) favouring higher VAM spore density (Bhaskaran and Selvaraj, 1997). Wet season crops generally harboured less spores per 100 g soil, which was probably due to over moist situation in the agricultural fields (Bharadwaj *et al.*, 1997).

When the percentage infection in the crops was assessed, it was found that crops varied in response to indigenous VAM and maximum colonization was noted in maize (up to 45%) at

Table 1 : VAM spore count and VAM colonization in different crops at different age

Crops	Family	VAM spore/100 g Soil				VAM % colonization				
		Initial	15 d.a.s.	45 d.a.s.	75 d.a.s.	7 d.a.s.	15 d.a.s.	30 d.a.s.	45 d.a.s.	60 d.a.s.	75 d.a.s.
Summer crops											
Corchorus Olitorius	Tiliaceae	60	20	24	44	0	7	14	19	24	26
Arachis hypogaea	Fabaceae	58	31	20	30	0	5	12	20	22	25
Abelmoschus esculentus	Malvaceae	64	30	12	34	0	4	19	25	29	28
Ipomoea batatas	Convolvulaceae	68	30	21	48	0	2	14	24	30	31
Wet season crops											
Oryza sativa	Poaceae	42	28	26	40	0	5	10	17	23	19
Zea mays	Poaceae	48	34	20	59	2	15	23	35	44	45
Winter crops											
Triticum aestivum	Poaceae	40	30	22	84	5	10	30	39	42	40
Brassica campestris	Brassicaceae	40	24	20	12	0	0	2	5	5	4
Lycopersicon esculentum	Solanaceae	42	32	14	49	0	2	12	20	26	20
LSD at 5%		9.5	5.8	4.8	3.5	0.99	5.2	5.42	3.6	6.2	6.5

maturity with an average of 26.44% for the crops. Better colonization of the two graminaceous members (wheat and maize) compared to other vegetable crops and oil-yielding crops were contrary to the findings of Isobe and Tsuboki (1998). Though VAM is said to have least host specificity yet the difference in percentage infection of hosts, grown under similar soil and climatic conditions indicated a host preference of VAM (Crush, 1974). It might also happen that the indigenous VAM population was campatible to certain crop plants, which in the survey recorded better VAM colonization. Another explanation could be that, crops like maize and wheat were colonized quite early (within 7 days of sowing) which put them at advantage in maximum colonization by native VAM F. Mustard being a member of Brassicaceae (generally non-mycorrhizal) logically recorded a very low per cent infection (Glenn *et al.,* 1988) as well as spore population at maturity.

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(Accepted for publication April 24, 2008)