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INFECTIVITY OF SPORES OF ARBUSCULAR MYCORRRHIZAL FUNGUS *GLOMUS DIMORPHICUM* IN SESAME AFTER LONG-TERM INCUBATION IN DIFFERENT SOIL TYPES

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Infectivity of spores of arbuscular mycorrhizal fungus (AMF) *Glomus dimorphicum* in sesame plants after long-term incubation in four soil types (Coastal Alluvium, Greyish Onattukara, Kuttanad Alluvium and Laterite) in the absence of host plants at two levels of phosphorus (P) availability was studied in pots under glass house conditions. The infectivity of AMF measured as frequency (%F) and intensity (%M) of colonization varied significantly after incubation of spores in different soil types. The %F and %M offered to plants incubated in Laterite and Kuttanad Alluvium was found to be more during infectivity tests. However, the application of phosphorus to soils significantly reduced the AM infectivity in all soil types. Both %F and %M were significantly affected by period of spore incubation in soil. The infectivity was high during early period (1-4 months) of spore incubation in soil and declined greatly after five months of incubation.

Key words: AMF, Phosphorus, Sesame, Soil type

Arbuscular mycorrhizal fungi (AMF) are soil-dwelling microorganisms ubiquitously associated with the large majority of plant families in different ecosystems across the world (Janos 1980; Zhao *et al.* 2001). They are commonly known not only to improve plant fitness through better nutrient acquisition (Smith *et al*. 2011) but may also to provide other benefits including protection from pathogens (Cardoso and Kuyper 2006), improve water relations (Sene *et al*. 2010), contribute to the formation and structural stability of soil aggregates (Bearden and Petersen 2000; Rilling and Mummey 2006) and plant community structure (van der Heijden *et al.* 1998)

AM association in crop plants is being influenced by both host (Menge *et al*. 1978; Harikumar and Potty 2002) and edaphic factors (Gong *et al*. 2012). Several reports indicate the variation in AM population in different soil types (Oehl *et al*. 2010; Verbruggen *et al*. 2013). However, information on the viability of infective propagules in different soil types in the absence of host plants is known just a little.

Sesame (*Sesamum indicum* L., Fam. Pedaliaceae) is cultivated in tropical, subtropical and southern temperate regions of the world for its seeds which is a rich source of edible oil. Incidence of AM colonization in sesame roots and infective propagules in the rhizosphere of the crop has been reported earlier (Selvaraj and Subramanian 1988; Sulochana *et al.* 2000). In Kerala, sesame is cultivated in rice fallows poor in nutrients. Want of suitable host during the fallow period is a major concern as the propagules become senescent with time if deprived of a living host. This often leads to a low level of indigenous AM inoculum in soil. Therefore the identification of soil type/s that supports the survival of AMF without losing their viability in the absence of host plants is essential for planning the inoculation schedule in sesame based cropping system. The present paper reports the infectivity of AMF *G. dimorphicum* in sesame after long-term incubation in different soil types deprived of hosts at two levels of phosphorus (P) availability.

MATERIALS AND METHODS

The experiment was conducted during March 2011at the Department of Botany, Sanatana Dharma College, Alappuzha, Kerala under glass house conditions. Four different soil types (Table 1) used for the study were collected within one week of harvesting the standing crop from fields where sesame was cultivated for several years. Soils were air-dried and sieved through 2-mm mesh sieve. The soils were

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Table- 1. Characteristics of the experimental soils

Soil type	Taxonomy	Soil pH	Organic C ($g\ kg^{-1}$)	Soil P ($mg\ g^{-1}$)
Coastal alluvium (CA)	Entisol	6.4	6.0	0.02
Greyish onattukara (GO)	Entisol	6.3	5.4	0.03
Kuttanad alluvium (KA)	Inceptisol	3.2	7.7	0.01
Laterite (LA)	Oxisol	6.2	4.5	0.05

steam sterilized and filled in plastic pots (10 cm diameter having a holding of 1 kg soil). The AM fungus Glomus dimorphicum which has been reported as the efficient endophyte in sesame (Harikumar 2013) was multiplied using sterilized sand-soil mix (1:1 v/v) as the substrate and Sorghum as the host. After six weeks of growth, shoots of host plants were severed and the substrate containing hyphae, spores and root bits was air dried and used as inoculum. Fifty ml of the inoculum containing approximately 200 spores was uniformly mixed to the soil in all pots. Half of the pots received P application as Rock Phosphate (RP) at 120 mg pot-1. The mouths of pots were covered with nylon mesh which allowed aeration but prevented entry of spores from outside. The experiment consisted of four soil types (CA, GO. KA and LA) and two levels of P (P0 and P1) with a complete 4×2 factorial design with 18 replications per treatment. The 144 pots were incubated at 27^0C in both light and dark in a glass house.

Three pots from each treatment were sown with sesame (variety Tilatara) seeds at one-month interval. After the emergence of seedlings, the number of plants were thinned to one per pot and allowed to grow for a period of two months. The plants were irrigated with equal quantities of deionized water as and when required. The plants were harvested at two months growth to monitor root infectivity by AMF. The experiment was terminated at six months after incubation (MAI) of spores in soil.

Freshly harvested and thoroughly washed root samples were stained with cotton blue (Phillips and Hayman 1970) and examined under a compound microscope (Olympus CX 31) for AM colonization. The frequency of colonization (%F) and intensity of colonization (%M) were evaluated as per Trouvelot et al. (1986). The data were subjected to two-way analysis of variance (ANOVA) suitable for CRD using SYSTAT 9.

RESULTS AND DISCUSSION

The infectivity of AMF *G. dimorphicum* on sesame measured as frequency and intensity of colonization varied significantly on incubation of spores in different soil types in the absence of host (Fig. 1 and 2). Frequency and intensity of colonization offered by spores incubated in Laterite and Kuttanad Alluvium soil tended to be larger than those incubated in other soil types. Survival of AM propagules in soil and infectivity on host plants is affected by a range of biological and non-biological factors (Lee and Koske 1994; Nehl *et al.* 1998). However, in the present study, the influence of biological factors is not crucial as the soils used were steam sterilized and free of other microorganisms. Therefore, the variation in mycorrhiza related measurements could be attributable to the differences in the edaphic factors such as pH, organic carbon and P (Sylvia and Williams 1992; Miranda and Harris 1994).

In general, application of P to soils significantly reduced frequency and intensity of colonization in plant roots irrespective of soil types but the adverse effect was more pronounced in Kuttanad Alluvium soil. The data agree with the general observation that AM levels are lower at high P levels (Dodd and Jeffries 1986; Breuillin *et al.* 2010).

The frequency and intensity of colonization were significantly affected by duration of spore

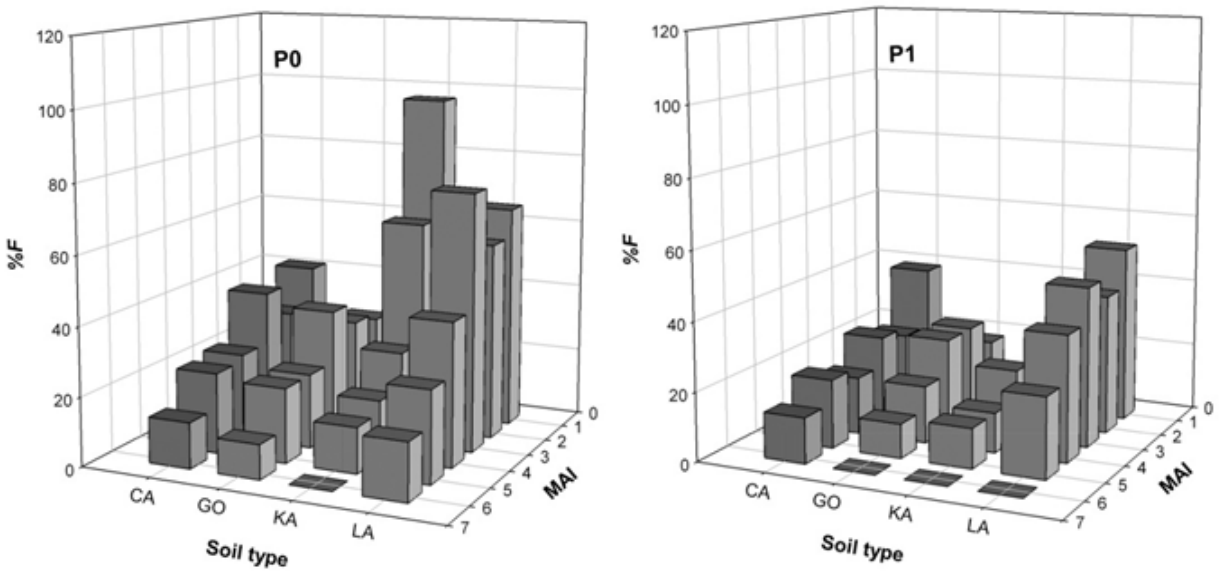

Figure 1. Frequency of colonization (%F) in roots of sesame after long-term incubation of spores of *G. dimorphicum* in different soil types at two levels of P availability

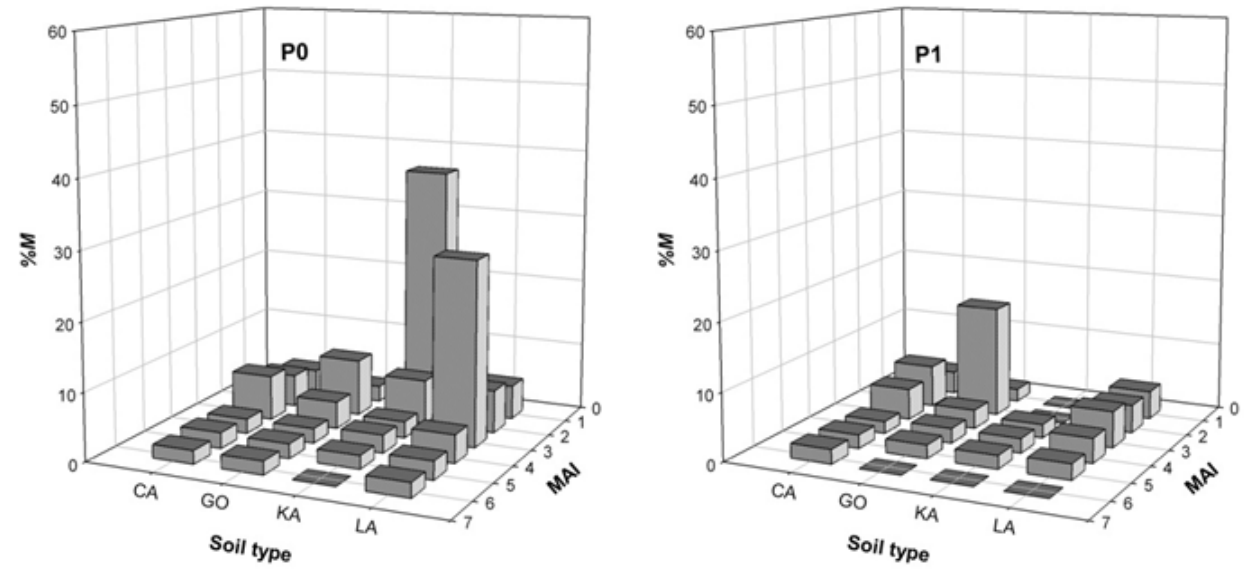

Figure 2. Intensity of colonization (%M) in roots of sesame after long-term incubation of spores of *G. dimorphicum* in different soil types at two levels of P availability

incubation in different soil types in the absence of host. The mycorrhiza related measures recorded a high value during the early period (1-4 months) of incubation irrespective of soil types and declined greatly from 5 MAI which is consistent with the reports of declining viability of AM inoculums over time (Thompson 1994; McGee *et al.* 1997).

The interaction involving soil type, P fertilizer and period of incubation were significant for mycorrhiza related measures (Table 2) indicating the influence of these factors on the infectivity of AMF on sesame. The study warrants the need of AM inoculation in these soil types if the fallow period is extended beyond five months prior to sesame cultivation.

Table - 2. Results of the ANOVA for the effects of soil type, P level and period of spore incubation in soil on mycorrhiza related measures

Source	*%F*	*%M*
Soil type (ST)	***	*
P level (P)	***	***
Period of incubation (PI)	***	***
ST×P	***	***
ST×PI	***	***
ST×P×PI	***	***

*, *** represent significance at P<0.05 and 0.001 respectively (*n*=144)

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