



OCCURRENCE OF VAM FUNGI IN RHIZOSPHERE OF *LASIURUS SINDICUS*

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ABSTRACT

Soil samples were collected from rhizosphere of *Lasiurus indicus* growing at ten different localities of Rajasthan state and screened for VAM propagules. *Glomus fasciculatum* and *Glomus mosseae* were isolated from these rhizosphere soil samples. Soil type and plant distribution were found to be more and less equally important factors contributing to such a predominance of *Glomus* spp.

INTRODUCTION

Mycorrhiza is the mutualistic symbiosis (non-pathogenic association) between soil-borne fungi with the roots of higher plants. Two types of mycorrhiza are known: ectomycorrhizas and endomycorrhizas. Three main components involved in VAM association are: A) the soil, B) the fungus and C) the plant.

Versicular arbuscular mycorrhizae are geographically ubiquitous and occur over a wide ecological range from aquatic to desert environments (Mosse et al. 1981). More than 80% of land plants form mutual association with VAM fungi (Smith et al. 2003). Mycorrhizal inoculation would have practical significance in low phosphate soils containing either few indigenous mycorrhizal fungi or ineffective strains (Mosse and Hayman 1971). Mycorrhizal plants removed more phosphorus from the soil and had greater dry matter and phosphorus. There were positive correlations between spore number and mycorrhizal development and between extent of root infection and increased growth. It was also observed that the growth of mycorrhizal seedlings improved in comparison with non-mycorrhizal controls (Khan 1972).

Bagyaraj and Manjunath (1980) carried out study on selection of a suitable host (grasses) for mass production of VAM inoculum. They observed that of the eight grasses tested, guinea grass recorded higher infection and higher spore production by VAM fungus, *Glomus fasciculatum*.

Ollivier et al. (1982) studied percentage infection by VAM fungi in *Vigna unguiculata* on Deck soil and demonstrated that the intensity of mycorrhizal infection and P and Zn concentration in aboveground parts were significantly higher in the presence of *Glomus* spp.

Pope et al. (1983) reported dependency of four hard wood tree species on six species of VAM fungi (*Glomus mosseae*, *G. fasciculatum*, *G. etunicatum*, *G. macrocarpum*, *G. epigaeum* and *Gigaspora margarita*) for 16 weeks in soil with low available phosphorus and reported that for all the tree species inoculated with *Glomus macrocarpum* resulted in highest mycorrhizal dependency values.

Krishna and Dart (1984) tested six mycorrhizal fungi as inoculants for pearl millet grown in pots in a greenhouse and reported that VAM fungi varied in their ability to stimulate plant growth and phosphorus uptake. Pennington (1986) reported that by stimulating the development of beneficial microorganisms in the rhizosphere, the use of VAM-infected plants could reduce the amount of fertilizer needed for the establishment of vegetation and could also increase the rate at which the desired vegetation becomes established. Tarafdar and Rao (1990) made a survey of Indian arid zone tree species for the occurrence of VAM infections. Twelve plant species from nine environmentally harsh sites in Rajasthan were found for the presence of VAM infections. Of the 10 different VAM fungi inoculated, *Casuarina* seedlings responded best (in biomass) to inoculation with *Glomus mosseae* closely followed by *Acaulospora laevis* and *Glomus fasciculatum*. Troeh and Loynachan (2003) have reviewed the integration of VAM into cropping systems to maintain high yields and to reduce phosphorus input. Surendran and Vani (2013) reported that AMF applied plots showed significant difference in germination percentage, tiller number, inter-node thickness and sugarcane yield. It is evident that VAM association is important for plant growth. An attempt has been made to investigate VAM association in *Lasiurus indicus* which is an important fodder grass in arid and semi-arid region of Rajasthan.

MATERIALS AND METHODS

VAM fungi were isolated from rhizosphere soil of *Lasiurus indicus* of different localities following the wet sieving and decanting technique of Gerdemann and Nicolson (1963). Identification of various isolated species was done with the help of synoptic key of Schenck and Perez (1980) and Trappe's (1982).

RESULTS AND DISCUSSION

Nine different types of spores were isolated and identified with the help of the synoptic key of Trappe's (1982) and manual of Schenck and Perez (1990). These belonged to the following four genera of family Endogonaceae viz., *Acaulospora*, *Glomus*, *Gigaspora* and *Sclerocystis* comprising of the following species (Plate 1).

1. *Acaulospora laevis* (Gerd. & Trappe)

Spores smooth, 119-300 x 119-520µm, globose to sub-globose, ellipsoid or occasionally reniform to irregular, dull yellow in youth becoming deep yellow - brown to red-brown or dark olive brown at maturity.

(2) *Gigaspora calospora* (Nicol. & Gerd.)

Spore globose, spore dimension at maturity 200 - 478µm. Surface ornamentation at maturity smooth to dull roughened, two distinct walls, outer brownish and inner hyaline in tungsten illumination. The diameter of bulbous attachment was 30-45 µm. Spore borne singly.

(3) *Gigaspora gigantea* (Nicol. & Gerd.) Gerd. & Trappe

Azygospores formed singly in soil, 353-368 x 345-398µm, globose to ellipsoid, greenish yellow, with a thin, outer wall tightly covering an inner wall, the inner wall 5-7µm thick and continuous except for an occluded pore at the attachment. Suspensor like bulbous cell giving rise to a slender hypha that project into the spore. Spherical to clavate vesicles formed in soil, 22 x 37 x 20-34µm, in clusters of 1-16 on complex system on intercoiled hyphae, septate echinulations at apex of vesicles. Vesicles lacking in roots.

(4) *Gigaspora margarita* (Becker & Hall)

Spore globose, spore dimension at maturity 240 to 480µm, surface ornamentation at maturity smooth to dull roughened, single walled, wall colour light brown to sub-hyaline at maturity in tungsten illumination and yellowish hyaline when young. The diameter of the bulbous attachment was 25 to 50µm. Vesicles contain more than one oil globules.

(5) *Glomus fasciculatum* (Thaxter sensu Gerd.) Gerd. & Trappe

Spores globose, often mixed with sub-globose ovate, ellipsoid or irregular spores, longest dimension at maturity 50-125µm; surface smooth to dull roughened, double walled, outer thinner; wall colour at maturity in tungsten illumination, yellow, sporogenous hypha, thickened at the point of attachment with a diameter 5 to 20µm.

(6) *Glomus intraradices* (Schenck & Smith)

Chlamydospores formed singly or in cluster in the root, rarely formed outside the root; chlamydospores predominantly globose (40.5-) 98.5 (-190.5)µm diameter but frequently sub-globose 93-119 x 112-131µm diameter; yellow to gray-brown, appearing greenish brown with transmitted light; spores with 1 or 2, occasionally up to 4 laminated walls on larger spores: inner walls darker than outer walls. Spore contents globular, yellow to light brown. Walls of the spore extending into the hyphal attachment forming an apparent tubiform flare at the juncture with the hyphal attachment.

(7) *Glomus macrocarpum* (Tul. & Tul.)

Sporocarps are fragmentary. Spores are usually slightly longer than wide, sub-globose or globose to irregular, 120 x 110µm. Spore wall composed of two distinct layers. Spores taper at the point of attachment of the single persistent hypha. The average diameter of the hypha is 16µm. Spores characteristically bear a straight, long subtending hypha which may extend up to 100µm before branching or breaking.

(8) *Glomus mosseae* (Nicol. & Gerd.) Gerd. & Trappe

Chlamydospores yellow to brown in colour, globose to ovoid, sometimes ellipsoid to irregular; spore size ranging from 120-300µm. Spore surface smooth to dull roughened; spore wall one, yellow brown in colour; content of spore white to hyaline globules at maturity. Spores with typical funnel shaped base of 20-30µm thickness derived from the subtending hypha.

(9) *Sclerocystis microcarpus* (Iqbal and Bushra)

Sporocarps dark brown, 100-420 µm in diameter, globose to subglobose, minutely verrucose, spores formed radially in a single, tightly packed layer around a central plexus of hyphae; peridium lacking. Chlamydospores 95-115 x 40-60µm, clavate, cylindric-clavate with a small pore opening into the thick-walled subtending hyphae. Chlamydospore walls laminate, brown, (9.5-) 17-26µm thick at the apex, 3.5µm thick at the sides, generally thickest at the apex.

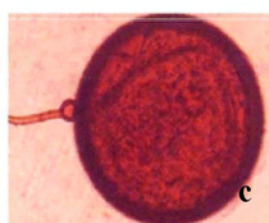
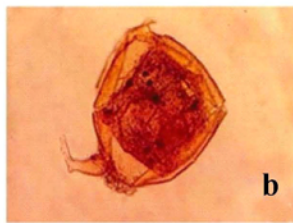
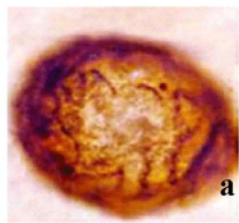
The results of the survey showed that the distribution of these VAM fungi had no definite pattern or specificity with regard to different districts of Rajasthan. The survey also shows that VAM fungi are well distributed in the rhizosphere soil of the test fodder grasses in all the localities studied (Table 1). Of all species *Glomus fasciculatum* and *Glomus mosseae* have been isolated from the rhizosphere soil of *Lasiurus sindicus* grass from all the localities. Soil type and plant distribution were found to be more and less equally important factors contributing to such a predominance of *Glomus* spp. Our findings agree with those of Schenk and Kinloch (1980),

Vyas and Srivastava (1988), and Rao and Gupta (1999, 2000). Another interesting fact emerging out from this study was a hundred percent occurrence of *Glomus fasciculatum* in the rhizosphere soils of the test plant (Table 1). This indicates a definite specificity between the host and fungal symbiont based upon a mutual interaction of excretions of the host roots and fungal hyphae.

Gigaspora gigantea was also isolated from the rhizosphere soil of test plant from all the localities, except Sikar (Table 1). *Gigaspora margarita* and *Glomus interradices* were isolated from seven different rhizosphere while *Acaulospora*

Table 1. Occurrence of VAM fungi in the rhizosphere soil of *Lasiurus sindicus* from different localities of Rajasthan.

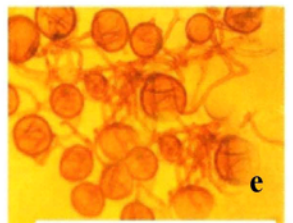
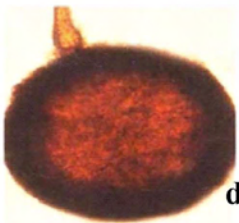
Localities	<i>Acaulospora laevis</i>	<i>Gigaspora calospora</i>	<i>Gigaspora gigantea</i>	<i>Gigaspora margarita</i>	<i>Glomus fasciculatum</i>	<i>Glomus interradices</i>	<i>Glomus macrocarpum</i>	<i>Glomus mosseae</i>	<i>Sclerocystis microcarpum</i>
Ajmer	+	-	+	+	+	+	+	+	-
Alwar	+	+	+	+	+	+	+	+	-
Bhilwara	-	-	+	+	+	+	+	+	-
Bikaner	-	+	+	-	+	+	+	+	+
Hanumangarh	+	+	+	-	+	+	+	+	-
Jaipur	-	-	+	-	+	+	-	+	+
Jaisalmer	+	+	+	+	+	-	+	+	+
Jodhpur	-	-	+	+	+	+	+	+	+
Pali	-	+	+	+	+	-	-	+	-
Sikar	+	-	-	+	+	-	+	+	+
Total occurrence (%)	50	50	90	70	100	70	80	100	50



(a) Chlamydospore of *Acaulospora laevis* (x 450)

(b) A single azygospore of *Gigaspora calospora* (x 450)

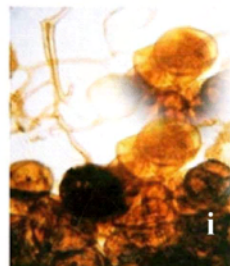
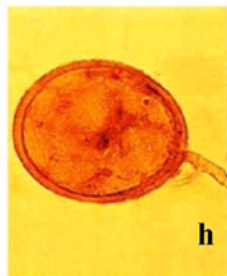
(c) A single azygospore of *Gigaspora gigantea* (x 1100)



(d) A single azygospore of *Gigaspora margarita* (x 1100)

(e) Chlamydospores of *Glomus fasciculatum* (x 1100)

(f) Chlamydospores of *Glomus mosseae* (x 1100)



(g) A sporocarp of *Sclerocystis microcarpum* (x 1100)

(h) Chlamydospore *Glomus intraradices* (x 450)

(i) Chlamydospores of *Glomus macrocarpum* (x 1100)

laevis, *Gigaspora calospora* and *Sclerocystis microcarpus* were recorded in five rhizosphere soil samples of *Lasiurus syndicus*. The association of *Lasiurus syndicus* with VAM fungi explains its good growth even in xeric environ.

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