Research Paper :

Status of AM fungi on some important leguminous plants of Mercara in Karnataka

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SUMMARY

Legumes are important members belonging to the family Fabacae. In the present study fifteen important leguminous plants were selected in Mercara to assess the per cent of mycorrhizal colonization. The results revealed that both per cent colonization or spore number could not be correlated with each other.Higher per cent of root colonization was recorded in *Vigna mungo* and least colonization was observed in *Vicia faba*. Similarly, highest numbers of spores were recovered in *Macutyloma uniflorum*, least number was in *Acacia planiformis*. AM Fungi are imporatnt root symboints which play an important role in phosphorus absorption. Therefore it can be concluded that presence of mycorrhizal fungi on these legumes could sustain in drier or tropical soils with low phosphorus.

Key words : AM fungi, Legumes, Colonization, Spore number

AM Fungi interact with the wide range of other micro flora present in the roots, the rhizosphere and bulk soil. The interactions that occur between mycorrhizal fungi and soil micoflora would be largely restricted to that of soil bacteria, actinomycetes fungi, those involving nitrogen fixing organisms and plant pathogens (Filter and Garbaye, 1994). Arbuscular mycorrhizal fungi occur in nearly all soils on earth and form a symbiotic association with roots of most terrestrial plants. (Lakshman, 2009).The AM fungal microbial interactions takes place at all stages of AM life cycle, *i.e.* spore population, root colonization and internal extension and hyphal growth and root noodle formation. They effect the host plant physiology that could change root morphology, physiology and thus patterns of exudation into the mycorrhizosphere. AM fungi help in the growth of plants under adverse physical soil conditions such as extremely low soil pH, alkalinity, salinity and high concentration of toxic elements such as Al, Fe and Mn.

Legumes are flowering plants that produce pods with two distinct halves. The legume family contains more than 20,000 species making it the third most populous family of flowering plants. Legume plants are notable for ability to fix atmospheric nitrogen. Growing legumes can help to restore nitrogen to the surrounding soil which is used up by other crops. Legumes are used by drug companies in many pharmaceuticals applications and are finding new uses continuously. Legumes are rich sources of fibre, protein, essential micronutrients and low glycemic index carbohydrates. They also contain other beneficial compounds, including essentials fatty acids, folate, magnesium,potassium. By replacing food in ones diet that is high in saturated fats with legumes, one can lower the risk of developing type 2 diabetes and cardiovascular disease. Since the legumes are good income generation source for farmers and also help in maintaining good health, they are being cultivated in many parts of India. Therefore, in the present study, screening of AM fungi were documented and the importance of AM fungi on legumes have been discussed.

MATERIALS AND METHODS

Collection of sample:

Rhizospheric soil and roots were collected from fifteen leguminous plants growing in natural conditions of Mercara in Karnataka.

Experimental site:

Mercara is located at 12.42^0 N and 75.73^0E. It has an elevation of 1525 meters (5003ft) above sea level. Mercara lies in western ghat region of Karnataka. The temperature ranges from 8.6^0 C in December

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to 35^0 C in May. The humidity ranges from 20% - 97%, the town has an average annual rainfall of 2840.2mm and the wind speed ranges from 1m-60m/sec.

Isolation and identification of mycorrhizal fungal spores:

50g of soil was mixed with100ml of water and stirred slowly, then allowed to settle for few seconds. The supernatant was poured through a course of soil sieve (45-800nm) to remove large pieces of organic matter. The liquid that passed through this sieve was collected. Later, this suspension was passed through a fine sieve to retain the spores. This washing and decanting process was repeated twice in order to increase likelihood and majority of spores were removed. After ensuring that all colloidal particles have passed through the sieve, the remains on each sieve were washed and collected separately in beakers. Estimation of spores was carried out by modified method of (Asghari,2008).Spores were transferred to the Petri plate and counted under stereo zoom microscope. The spores were then mounted on glass slide with poly vinyl lacto-phenol and cover slip was placed. Subsequently recovered spores were identified with the help standard manuals and monographs.

Estimation of arbuscular mycorrhizal infection:

The cleaned roots were cut into 1cm long pieces and stained with tryphan blue, according to the procedure of Phillips and Hayman (1970). The roots were boiled in 10%KOH for 1hr, acidified with 5N HCl and stained over night with 0.5% tryphan blue. The roots were then destained with 70% glycerol. The mycorrhizal infection (mycelium, vesicles, arbuscles) were observed in each segment. The per cent of root colonization was calculated by the following formula:

$$\text{Per cent of root colonization} = \frac{\text{Number of root bits showing colonized}}{\text{Total number of root bits observed}} \times 100$$

RESULTS AND DISCUSSION

The study revealed differences in the number of spores in different samples of plant soils. The plants were infected with a number of arbuscular mycorrhizal spores. The maximum number of AM fungi spores were recovered from rhizospheric soil of *Vigna mungo* followed by *Macrotyloma uniflorum*. The lowest numbers of spores were seen in the soils of *Acacia planiformis* followed by *Cyamopsis tetragonoloba* and *Clitorea ternatea* (Table 1).Data on root colonization by AM Fungi revealed that the root infection per cent varied from plant to plant (Fig. 1). The per cent root colonization was highest in *Vigna mungo* (65.19%) and *Macrotyloma uniflorum* (62.19%). It was lowest in *Cyamopsis tetragonoloba* (20.18%) and *Glyricidia maculata* (22.46%).

Table 1 : Leguminous plants with number of AM Fungal spores and per cent root colonization per plant

Plant species	Spore number per 50g soil	Per cent of root colonization
Acacia planiformis L.	39	41.26
Abrus precatorius L.	95	42.72
Cajanus cajana (L.) Millsp	98	49.1
Clitorea ternatea L.	82	41.12
Cyamopsis tetragonoloba (L.)Taub.	60	20.18
Cicer arictinum L.	96	52.16
Glyricidia maculata L.	70	22.46
Glycine max (L.)Merr.	110	45.26
Lens culinaris Medik.	95	37.13
Macrotyloma uniflorum (Lam.)Verdc.	170	62.19
Mimosa pudica L.	104	35.16
Pongamia pinnata (L.) Pierre	120	39.25
Tamarindus indica L.	150	61.25
Vicia faba L.	99	33.12
Vigna mungo (L.) Hepper	182	65.19

Distribution of AM fungal spores in fifteen plants at 8 selected places of Mercara has been presented in Table 2 and AM fungal components in macerated roots of some selected legumes have been depicted in Plate 1.

Arbuscular mycorrhizal fungi are the most promising obligate symboints with plant roots. Approximately 80% of plants were found infected with AM fungi. Similarly, most of the Leguminous plants growing in tropical soils with low phosphorus content in the soil could contribute the association of AM fungi in these Leguminous plants (Douds and Millner, 1999; Asghari, 2008).Per cent of root colonization and spore number varied in the examined plants, however this process is not necessarily dependent on each other and previously published data are ambiguous (Abbott, 1982; Douds, 1994 and Millner, 1999). *Tamarindus indica, Macrotyloma uniflorum* and *Vigna mungo* contained higher number of spore population. Other research findings have shown that plants with finer roots favoured the sporulation of AM fungi (Black and Tinker, 1979) and yet others correlated the increased

Table 2 : Distribution of AM Fungal spores on examined plants in eight selected places of Mercara

Plant species AM species	A,D,G,H,I	A,B,D,E	B,E,H,K	A,D,G,H,K	B,C,E,G,J	A,B,C,D,E	E,F,G,K	D,E,H,G,J
Acacia planiformis L.	+	+	+	-	+	+	+	-
Abrus precatorius L.	-	+	+	+	+	-	-	-
Cajanus cajana (L.) Millsp	-	+	+	-	+	+	-	-
Clitorea ternatea L.	-	+	+	-	+	+	-	+
Cyamopsis tetragonoloba (L.)Taub	+	+	-	+	+	+	-	-
Cicer arictinum L.	-	+	+	+	+	+	-	-
Glyricidia maculata L,	-	+	+	+	+	+	-	-
Glycine max (L.)Merr	-	+	+	+	+	+	-	-
Lens culinaris Medik	+	+	+	+	+	+	+	-
Macrotyloma uniflorum (Lam.) Verdc	+	+	-	-	+	+	-	+
Mimosa pudica L.	-	-	+	+	-	+	+	+
Pongamia pinnata (L.) Pierre	+	+	+	+	-	-	-	-
Tmarindus indica L.	+	+	+	+	+	+	+	-
Vicia faba L.	+	+	+	+	-	+	-	+
Vigna mungo (L.) Hepper	+	+	+	+	+	-	-	-

1. Talakaveri, 2. Bhagamandala, 3. Shuntikoppa, 4. Virajpet, 5 .Gonikoppa, 6. Galibeedu, 7. Ponnampet, 8. Mercara
A. *Acualospora Trappei,* B. *Acaulospora spinosa,* C. *Acaulospora scrobiculata,* D. *Glomus aggregatum,* E. *Glomus fasciculatum*
F. *Glomus macrocarpum,* G. *Glomus mossae,* H. *Glomus etinicatum,* I. *Glomus intraradices,* J. *Gigaspora margarita,*
K. *Gigaspora gigantia*

number of spores with the improved nutritional state of the plants. Per cent of root infection was found to be higher in *Vigna mungo* and *Macotyloma uniflorum*. Higher number of spores indicate the possibility of higher root colonization. This kind of results have been documented in many other terrestrial plants (Harley and Smith,1983;Brundrett,2004). Arbuscular mycorrhiza fungal association helps in increased nutrient and water uptake, absorption through improved absorptive area and translocation of elements to host tissues and their accumulation. The fungus improves the host nutrition by increasing the delivery of phosphorus and other minerals to roots. At the same time, mycorrhizal fungi contribute to organic matter turn over and nutrient cycle in forest and crop plant ecosystem. The helps soil aggregation, soil stabilization and increased soil fertility. The present preliminary observations clearly suggest that similar benefits may be contributed by AM fungi to these legumes growing in moist forest of Mercara (Abbott, 1982; Bagyaraj *et al*., 1997; Lakshman, 2009).

Among the five genera of AM fungi the spores of *Gigaspora,Acaulospora, Glomus macrocarpum, Glomus intraradices,Glomus etinicatum* and *Glomus mossae* were found more frequently in all rhizospheric

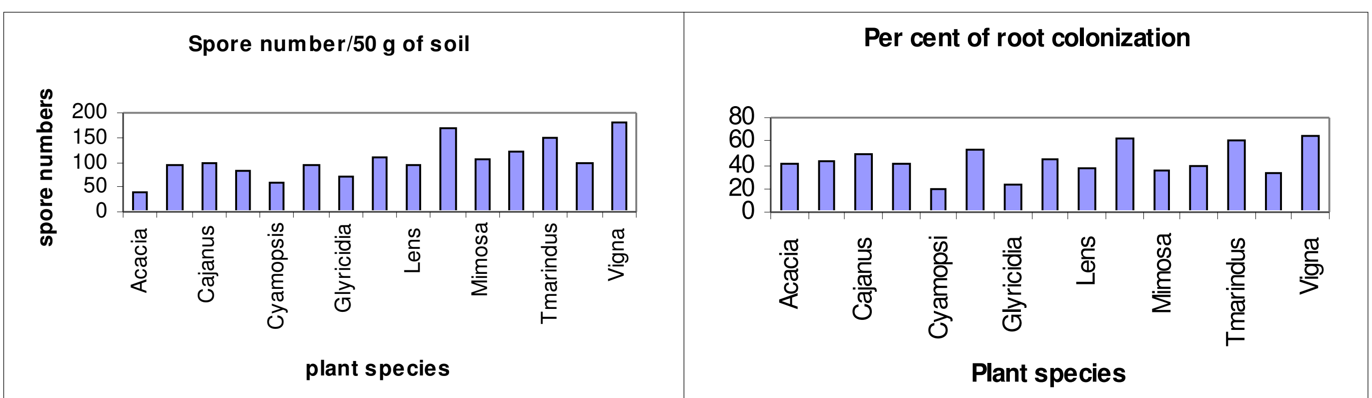

Fig 1: Leguminous plants with number of AM fungal spores and per cent root colonization per plant

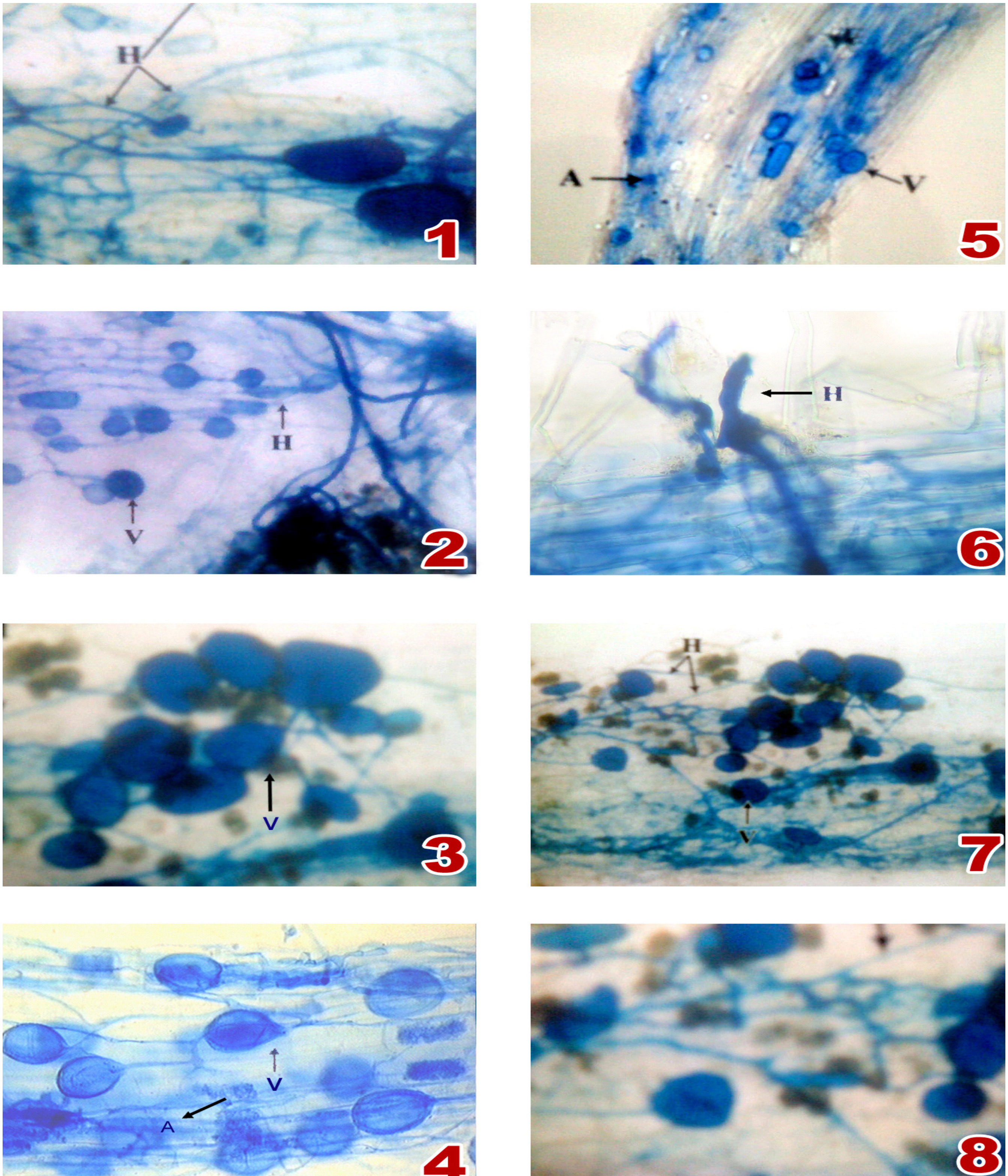

Plate 1 : AM fungal components in the macerated roots of selected legumes. A- Arbuscules, H-Hyphae, V-Vescicle
1. Running hyphae with vescicle of *Mimosa pudica* L.
2. Irregularly distributed vescicles in root sample of *Cajanus cajana* L.
3. Macerated root sample of *Clitorea ternatea* L.
4. Macerated root sample of *Pongamia pinnata* (L.)Pierre
5-6 Arbuscules and Hyphae in root sample of *Tamarindus indica* L.
7-8 Vescicles in macerated root sample of *Vigna mungo* (L.)Hepper

soil of plants used in this study. Among the recovered AM fungal spores *Glomus* species have been reported to have higher frequency. Similar observation was made by (Lakshman, 1996 and Linderman, 1998). With regard to diversity of species, only two species in *Gigaspora* were detected. It is important to note that each fungus represents its own demand for photo-assimilates and the environmental conditions may affect the interactions of these organisms with the roots influencing indirectly the fungal reproductive activity.

It may be concluded that most of the Indian agricultural and forest soils have predominant *Glomus* species along with other AM fungal species and play vital role by harboring legume roots other than root nodules of legumes. Therefore this present work warrants to understand physico-chemical characteristics of soil, root nodules of legumes and their interaction with AM fungi.

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