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Arbuscular Mycorrhizal Fungal Association in Tuberous Plants

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The arbuscular mycorrhizal fungal (AMF) biodiversity of 11 tuberous plants species has been assessed with respect to spore population and root colonization. The study area, Anamalai Hills of Western Ghats is known for its rich endemism and diversity of flora and fauna population with divergent climatic factors. A total of 11 plant species of 8 families were assessed, out of this *Curculigo orchioides* of Amaryllidaceae showed the maximum number of spore population (SP) (548 sp/100g) in the months of winter and minimum was observed in *Sansviera roxburghiana* a Liliaceae member (180 sp/100g) during months of rainy season. A slight variation in the pattern of spore population and root colonization was observed in the tuberous plants. The maximum root colonization (RC) was observed in *Gloriosa superba* of Liliaceae (69%) during summer season and minimum was recorded in *Curculigo orchioides* of Amaryllidaceae (16%) during the rainy season. Five genus of AMF has been found to be associated with the plant species in the study area. Among the five genuses the *Glomus* is found to be dominant.

Key words: AMF, Anamalai Hills, Spore population, Root colonization.

Microorganisms are present in great number near the feeder roots of plants, and they play vital role in numerous physiological processes. These dynamic microbial processes include saprophytism, pathogenecity and symbiosis. The most wide spread symbiosis of trees is the mycorrhizal association between root-inhabiting fungi and the feeder roots of the trees (Marx, 1997). AMF are known to form mutualistic symbiotic association with many plants of economic importance and found to improve plant growth mainly through increased uptake of diffusion, limited plant nutrients particularly phosphorous and by producing growth promoting substances. AMF represent a complement to the root system, which allow plants to acquire resources under acute stress. They also provide protection to host plants from the detrimental effect of unfavorable pH, toxic metals and plant pathogens.

The mycorrhizal fungi are associated with tertiary roots which are mainly responsible for the absorption of nutrients from soil. The importance of fungal symbiont is very much understood as a number of plant species in nature fail to survive without mycorrhizal fungi. It has been estimated that about 95% of the world's present plant species of vascular plants that are characteristically mycorrhizae (Trappe, 1977). Now-a-days there is an increasing demand for natural herbs. This is mainly because of the hazardous side effects of many of the chemical substitutes. A massive effort is needed to ensure the survival of several endangered medicinal plants and to develop the most important ones as 'Commercial Crops.

It is difficult to distinguish the relative contributions of the different types of propagules to colonization of the root systems of plants growing in any particular field situation that is to

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the 'infectivity' of the soil. The density of the spores in soil can be determined, but although this sometimes shows a correlation to the extent of root colonization. Though there are various benefits by the AMF to the plants the work on the association is only carried out very little especially in tuberous plants. Hence an attempt has been made to study the AMF association in the tuberous plants.

MATERIAL AND METHODS

The study area Anamalai hills is a significant segment of the Western Ghats, the vegetation of this region, harbor many endemic species and is a unique ecological tract rich in biodiversity. The forest tract of Anamalais exhibiting a wide diversity in terrain, elevation and climate supports diverse vegetations of striking differences. The present study was carried over a period of one year from Jan 2007 to Dec 2007. For the convenience of the study the study period is classified as three seasons namely winter (Jan-April), summer (May-August) and Rainy (Sep-Dec).

Root samples and rhizosphere soil samples were collected in the polythene bags and stored in refrigerator for further analysis. The roots were cleaned for assessment of AM infection following the method of Phillips and Hayman (1970). The AM fungal spores were separated out by wet sieving and decanting method (Gerdeman and Nicolson, 1963) and spores were identified using keys adopted by Schenck and Perez (1987) and Raman and Mohankumar (1988). Soil pH, micro and macronutrients were estimated following the method laid down by Sharma *et al*., 1984.

The percentage root colonization was measured by the following formulae

$$\text{Percentage of infection} = \frac{\text{No. of root segments infected}}{\text{Total no. of root segments observed}} \quad 100$$

RESULTS AND DISCUSSION

A total of 11 plant species belonging to 8 different families were analyzed (Table-1) for spore population and percentage of root colonization in the study area. The maximum and minimum spore population was observed in *Curculigo orchioides* of Amaryllidaceae (548 sp/100g) and *Sansviera roxburghiana* a Liliaceae member (180 sp/100g) respectively. The maximum SP (Spore Population) was observed during the months of winter season (Jan-April) and minimum SP was recorded during the rainy season (Sep-Dec). This may be due to the excess activity/stress of the plant species during the summer season and gradual decrease in SP was due to the inactiveness / less stress of the plant species during the rainy seasons. The similar results have been observed by various early workers (Suresh and Nagarajan, 2009).

Spores are the best defined source of inoculums and are the only propagules that can be identified to species with any degree of certainty. Consequently, they are of central importance in isolating these species, determining their distribution and establishing them in pot cultures for experimental or identification purposes. The relationship is complex, because the extent of colonization may be related both to the availability of spores as inoculums and to the capacity of the mycorrhizal root system to produce new spores. Furthermore, the spore population is varied, with respect to species composition, viability, dormancy, etc., and other sources of inoculum may play a significant role in the colonization of roots.

The percentage of root colonization was, maximum during the summer season which was observed in *Gloriosa superba* of Liliaceae (69%) and minimum (16%) was observed during the rainy season in *Curculigo orchioides* of Amaryllidiaceae. This may be due to the excess loss of water through transpiration or may be indirectly affected by increase in temperature. Since the sporulation and colonization was not determined by single factor, it is hard to conclude that increase in temperature alone will be the reason for increased colonization. The early reports suggests that, the factors such as soil characters, soil nutrients, rainfall, temperature and disturbances by humans and animals have collective effect in the determination of the spore population and colonization (Suresh, 2008). Hence, a detailed study is required to conclude the exact reason for increase in the colonization during various seasons.

The widely accepted concept of increased sporulation and colonization in winter and summer and declining towards the rainy season was observed in the present study. Again, we are not able to conclude the exact reason for the increase in SP during summer and found very less during rainy season may be due to inactiveness of the plant or less stress conditions of the plants during these seasons.

The degree of variations in root colonization was varied from species to species and even within the species of same family. This shows the host specificity of the AMF and impact of abiotic factors such as climate, soil and disturbance by animals. However, these potential seasonal patterns in spore numbers may also be created by the formation of new spores in association with root growth at these times. Through out the study the climatic influence is seen in all the seasons, this status may in accordance with the previous findings of the various workers. The influence of climatic factors on AMF colonization and spore numbers corroborates studies (Michelini *et al.*, 1993; Saito and Kato, 1994; Udaiyan *et al.*, 1996) that indicate the influence of climatic factors on mycorrhizal formation and function.

In situations where density of spores is positively correlated with the extent of root colonization, both may increase during the growing season of annual plants. Decreases in density with depth of soil could well be associated with the decline in density of roots and mycorrhizas (Hayman, 1970). However, this relationship does not always hold: an inverse relationship between spore density and colonization in four perennial trees from lowland tropical rainforest and in some investigations no correlation at all has been found between spore populations and infectivity.

Table 1. The VAM spore population and root infection of the tuber plant species collected in 2007 in Anamalai, hills

S. No.	Name of the plant species	Family	Spore population (SP) / 100 g soil			Root colonization (%) (RC)		
			Winter	Summer	Rainy	Winter	Summer	Rainy
1	*Bulbophyllum tremulum*, W.	Orchidaceae	436	325	259	34	68	29
2	*Burmannia coelistis*, Don	Burmanniaceae	517	365	285	37	58	30
3	*Geodorum densiflorum* Lam.	Orchidaceae	536	419	258	24	14	21
4	*Scilla indica*, Bak.	Liliaceae	523	160	472	30	37	26
5	*Corallocarpus epigaeus* Hk. f.	Cucurbitaceae	425	328	236	34	58	48
6	*Curculigo orchioides* Gaertn.	Amaryllidaceae	548	402	328	35	66	16
7	*Dioscorea bulbifera* L.	Dioscoriaceae	205	325	268	30	36	24
8	*Gloriosa superba* Linn.	Liliaceae	485	397	247	45	69	33
9	*Portulaca tuberosa* Roxb.	Portulacaceae	485	373	236	37	58	24
10	*Sansviera roxburghiana*, Schult.f.	Liliaceae	370	235	180	15	47	22
11	*Scutellaria colebrookiana*, Benth.	Lamiaceae	475	385	214	38	41	27

The relationship between the SP and RC was quite interesting. The plant species *Curculigo orchioides* showed maximum number of SP during winter at the same time RC is remarkably less compared to other plants at the time of rainy season. This present situation suggests that, there is no correlation between the occurrence and colonization of the plant species. The similar results have been reported by earlier workers (Suresh, 2008).

The results of the present study indicate that AM are a common and important component of ecosystems and small-spored AM fungi may be better adapted to these ecosystems. This suggests that AM may play an important role in the development and maintenance of plant communities.

CONCLUSION

Since the present study is carried out only on the aspect of climatic factors on tuberous plants, further detailed study in future with broad aspects such as soil nutrients, soil characters, animal and human disturbances will reveal the exact role of this AMF and impact on the tuberous plant species in the study area.

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