A Comparative Study on the Occurrence of AMF in Asteraceae Members in Evergreen and Shola Vegetation

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The occurrence of Arbuscular Mycorrhizal Fungal diversity (AMF) of 10 plant species belonging to Asteraceae family was analyzed in two different vegetations, evergreen and deciduous in Anamalai Hills, Western Ghats. The spore population and root colonization of these ten species were observed. The average spore population during winter season was high (470/100gm) in Shola than the evergreen vegetation (454/100gm). The average spore populations were almost equal during summer and rainy seasons in both the vegetations. The average root colonization was slightly high (35%) in Shola vegetation than the evergreen vegetation during winter season but, equal amount in average root colonization was observed in summer and rainy seasons. In general, the spore population and root colonization was comparatively high in Shola vegetation than the evergreen vegetation. Out of four genuses isolated, *Glomus* is found to be dominant in both the vegetations.

Key words: AMF, Spore population, Root colonization percentage, Shola vegetation, *Glomus*.

Soil microorganisms are paramount in the biogeochemical cycling of both inorganic and organic nutrients in the soil and in the maintenance of soil quality. In particular, microbial activity in the rhizosphere is a major factor that determines the availability of nutrients to plants and has a significant influence on plant health and productivity. In terms of ubiquity and partnerships throughout the plant kingdom, mycorrhizal relationships are the most significant plant–microbe symbiosis. Arbuscular Mycorrhizal Fungi (AMF) can be defined in structural terms as associations between symbiotic soil fungi and plant roots. Mycorrhizas are often considered to be classical mutualisms: Many experimental investigations have shown that both plant and fungal symbionts benefit from the reciprocal exchange of mineral and organic resources (Smith and Read, 1997).

Arbuscular mycorrhizal fungi develop intensively inside roots and within the soil by forming an extensive extraradical network and this help plants considerably in exploiting mineral nutrients and water from the soil. Phosphorus is the key element obtained by plants through the symbiosis and the evidence to support this is extensive (Smith and Read 1997). AMF represents a complement to the root system, which allows 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. AM fungi have the potential to increase growth and reproduction of plants. Mycorrhizal infections have been shown to increase seed production in a number of species. This AMF are generally abundant in grasslands, savannas, scrub jungles, open woodlands, dense

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rainforest, semi deserts and sand dunes. They can infect most species of flowering plants in most habitats.

Earlier studies revealed that most woody plants require mycorrhizal association to survive and most herbaceous plants need them to thrive. There are many reports about occurrence of mycorrhizae in natural agricultural soils also (Smith, 1995). No reports are available for comparative analysis on different vegetations hence; in this present study an attempt has been made to compare two different vegetations with respect to spore population, percentage of root colonization and the fungal species in the members of the family Asteraceae.

MATERIAL AND METHODS

Study area

The study area Anamalai hills is a significant segment of the Western Ghats, which lies between 10º 13' to 10º 33' N in latitude and 76º 49' to 77º 21' E. 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 main range of Anamalai hills has a general direction from North West to south east, with an elevation ranging from ca 900 m to 2500 mts.

Collection and analysis of samples

The rhizosphere soil and root samples of 10 Asteraceae members were randomly collected during Jan 2006 to Dec 2006 in a polythene bag and stored in refrigerator in Kongunadu Arts and Science College Laboratory for further analysis. The rhizosphere soil samples were wet-sieved for spores using the method described by (Gerdeman and Nicolson, 1963). Hundred grams of soil from each plant rhizosphere were independently suspended in 150 ml water, stirred with a magnetic stirrer for 10 min, sieved using 40, 70, 100 and 150 mm sieves with tap water, filtered onto a filter paper, and then placed in a 9 cm Petri dish for examination under a binocular stereomicroscope. The intact, healthy AMF spores with shining appearances were considered to be alive and counted in the four sieved samples. The spores were identified using keys adopted by Schenck and Perez (1990) and Raman and Mohankumar (1988).

For the convenience of the study the period has been classified into three seasons namely winter (Jan-Apr), summer (May-Aug) and rainy (Sep-Dec).

RESULTS AND DISCUSSION

The ten plant species belonging to the family Asteraceae were selected and analyzed for spore population (SP), percentage of root colonization (RC) and fungal species (Table 1 & 2) to compare in evergreen and shola vegetation. Variations in spore population and root colonization were observed not only with in the vegetation but also in the same species level. The maximum spore population was observed during winter season in both evergreen and shola vegetation. The average spore population was slightly high in shola forest (470 / 100gm soil) than evergreen vegetation (454 / 100gm soil). The maximum SP (542) was observed in *Sanchus oleracius* during winter season in evergreen forest while in shola forest, the maximum SP (549) was recorded in *Vernonia divergens*. The minimum SP was observed during the rainy season in evergreen as well as shola vegetation in *Eupatorium odoratum* (141) and *Synedrella nodiflora* (127) respectively. This pattern of sporulation leads to the conclusion that spore population increases when the temperature increases and the number of spore reduces where there is a decrease in the temperature. Temperature has been shown to have a significant influence on colonization and sporulation by AM fungi under greenhouse conditions. This present finding is supported by previous reports (Furlan and Fortin, 1973, Suresh and Nagarajan, 2009) that higher temperature generally results in greater root colonization and increased sporulation.

Still it is very hard to conclude that in which season does the spore numbers is high because in contrast to this present findings, Khan (1974) reported that more number of endogone spores were recovered during autumn and winter than in summer. In a case study at Kalakad Reserve forest, it was reported that, the number of mycorrhizal spores was high in summer (Mohankumar and Mahadevan, 1988). So season is not the only factor which determines the

Table 1. The comparative analysis on AMF population and root infection in Asteraceae members in the Evergreen & Shola forest of Anamalai hills, Western Ghats

S. No.	Species Name	Spore population			Root infection		
		Winter	Summer	Rainy	Winter	Summer	Rainy
Evergreen Forest							
1.	Ageratum conyzoides, *L.*	465	362	183	30	51	20
2.	Bidens pilosa *L.*	515	375	159	30	47	19
3.	Eupatorium odaratum, *L.*	460	369	141	28	47	17
4.	Gaenocheto purpuria *(L.)*	463	366	179	27	42	16
5.	Galinsoga parviflora *Cav.*	462	382	184	34	52	18
6.	Mikania cordata *Wight & Arn.*	476	356	165	32	47	18
7.	Notonia grandiflora *DC.*	467	345	187	30	54	19
8.	Sonchus olerasius *L.*	542	354	174	22	39	16
9.	Synedrella nodiflora *Gaertn.*	458	373	190	32	56	17
10.	Vernonia divergens, *Edg.*	235	326	159	31	46	42
	Average	454	360	172	29	48	20
Shola Forest							
1	Ageratum conyzoides, *L.*	499	324	185	38	53	20
2	Bidens pilosa *L.*	510	378	195	38	55	13
3	Eupatorium odaratum, *L.*	428	348	154	31	50	16
4	Gaenocheto purpuria *(L.)*	439	389	153	36	45	19
5	Galinsoga parviflora *Cav.*	458	348	189	33	50	17
6	Mikania cordata *Wight & Arn.*	470	362	192	32	45	20
7	Notonia grandiflora *DC.*	478	374	164	33	48	17
8	Sonchus olerasius *L.*	457	396	179	36	54	20
9	Synedrella nodiflora *Gaertn.*	409	372	127	32	45	16
10	Vernonia divergens, *Edg.*	549	314	179	36	49	19
	Average	470	361	172	35	49	18

Table 2. The AM Fungal genus found associated with the plant species in evergreen and shola vegetation

S. No	Fungal Genus	Evergreen vegetation	Shola vegetation
1	Acaulospora	+	+
2	Gigaspora	+	+
3	Glomus	+	+
4	Sclerocystis	-	+

sporulation or spore abundance. This present finding is in accordance with Zajiceck *et al.*, (1986) who reported that several biotic, edaphic and ecological factors are known to influence the distribution of AM fungi in different soils, temperature, moisture, depth and pH. The decline of spore populations in different seasons could be due to spontaneous germination of spores or death or ingestion by soil fauna or destruction by fungal or other parasites or by stimulation of germination in the presence of living host roots (Gerdemann, 1968; Mosse and Bowen, 1968). However, the present investigation showed that the numbers of VA mycorrhizal spores were high in winter season than in summer but the infection rate is more in summer.

The average percentage of root colonization (RC) was more or less equal in evergreen and shola vegetation but, variation was observed within the species in same vegetation and also in different vegetation. For example, *Synedrella nodiflora recorded* maximum RC (56%) in evergreen vegetation but only 45% was observed in the shola vegetation. This implies that, there are various factors responsible for the root colonization. In general, the root colonization was maximum during the summer season and very minimum during the rainy season. In evergreen vegetation, RC was found to be maximum (56%) during summer season and minimum (16%) in rainy season was observed in *Synedrella nodiflora* and *Sonchus oleracius* respectively. In contrast to this the RC was maximum (55%) and minimum (13%) were recorded in the same species of *Bidens pilosa* but in both the vegetations, the maximum and minimum RC was observed during summer and rainy seasons respectively. The decrease in the RC may be due to the decrease in temperature which in turn reduces the stress (transpiration rate) in the plants. Mahadevan *et al.*, (1988) reported that, during rainy months like August, September and October the heat is reduced and there by the drought stress also which increases the flow of photosynthate to fungal symbiont, thereby increasing the root colonization.

A total of four fungal genuses namely *Acaulospora*, *Gigaspora*, *Glomus* and *Sclerocystis* were found to be associated with Asteraceae members. Among these four genuses, *Glomus* was found to be dominant and present in both the vegetation. *Acaulospra* and *Gigaspora* were isolated in evergreen and shola vegetation but the genus *Sclerocystis* was found to be associated only in the plant species of shola vegetation. Based on the spores the study revealed that the genus *Glomus* is dominating the rhizosphere of all times of sampling. This could attribute to the survival ability of *Glomus* in many agro ecological conditions of Anamalai hills. In aggregating with these present observations, various workers reported the ubiquitous nature of Glomus species in various tropical soils (Gerdemann, 1968).

The overall result revealed that average spore population and percentage root colonization was same in shola and evergreen vegetation. No specific variations have been recognized among the plant species in these vegetations except that variations in SP and RC with in the species in same vegetation. Variation in AM colonization and spore density for the same species and different species at different seasons may be in response to a variety of cases. The climatic variation influences the selection of AMF or regulates the incidence of certain specific strains in the soil (Requena *et al.*, 1996). Throughout the study, a correlation was seen in the spore populations and temperature. This pattern of correlation was reported by Suresh and Nagarajan, (2009). A detailed study with more parameters such as soil characters, soil nutrients, animal and human disturbance levels are required to know exact reasons for these variations.

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