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Biodiversity of Arbuscular Mycorrhizal Fungi in Evergreen Vegetation of Westernghats

S.N. Suresh* and N. Nagarajan

PG & Research Department of Botany, Kongunadu Arts and Science College, Coimbatore - 29, India.

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The present study is undertaken to asses the mycorrhizal biodiversity in the evergreen vegetation of Anamalai Hills, Western Ghats. A total of 32 plant species belonging to 14 families were selected for the study. The rhizosphere soil and root samples were collected from the study area and examined in laboratory. The results showed varied spore count and colonization from species to species and even with in the family. Five fungal genera *Acaulospra, Glomus, Gigaspora, Sclerocystis* and *Scutellispora* has been isolated, among these five genera *Glomus* was found to be dominant. In this present study an attempt has been made to study the impact of climatic factors- temperature and rainfall on the mycorrhizal community in the evergreen vegetation of Anamalai Hills, Western Ghats.

Key words: Biodiversity, Arbuscular Mycorrhizal Fungi, Rhizosphere.

Arbuscular Mycorrhiza (AM) are widespread among terrestrial plants where mycorrhiza occur in all gymnosperms, in 83% of the dicotyledonous and 79% of the monocotyledonous species tested so far (Trappe, 1987; Wilcox, 1991). These AM fungi are obligately symbiotic soil fungi which colonize the roots of the majority of plants. These fungi are so named because they produce characteristic finely branched hyphal structures, termed arbuscules, inside cortical cells of plant roots. While plant–AM symbiotic relationships are undoubtedly important in nutrient cycling in natural undisturbed ecosystems, their overall importance in intensive agricultural systems is not as well understood.

AMF are believed to be dependent upon the host plant for fixed carbon. The plant receives a variety of benefits which may result in increased growth: improved water relations (Davies *et al.,* 1993), pest and disease resistance (Hooker *et al.,* 1994), enhanced nutrient uptake over non-mycorrhizal controls (George *et al.,* 1995), and modification of root morphology (Berta *et al.,* 1990). The most important of these benefits is increased nutrient uptake, notably of immobile nutrients such as P and Zn (Bolan, 1991; Bürkert

* To whom all correspondence should be addressed.

and Robson, 1994). Extra-radical hyphae of the AMF extend up to 8 cm beyond the root (Rhodes and Gerdemann, 1975) and act, in effect, as extensions of the root system in acquiring nutrients from the soil. The below-ground ecosystem as a whole is affected by AMF. These fungi are important in maintaining and enhancing the stability of soil aggregates (Miller and Jastrow, 1992). Soil aggregation is an important aspect of soil structure, which determines characteristics such as water inflow rate, pore space, and resistance to erosion. In the present study, we have examined the presence of AM in evergreen vegetation from Anamalai Hills Western Ghats, Tamilnadu.

MATERIAL AND METHODS

A total of fifteen species belongs to 14 families were analyzed for AM fungal isolation. (Table 1). Root samples and rhizosphere soil samples were collected from the study area from January 2005 to December 2005 with successive intervals at random sampling with respect to three different seasons namely winter, summer and rainy. The collected soil and root samples were packed in air tight polythene bags and carried to the laboratory and root samples were stored in refrigerator in Kongunadu Arts and Science College, Coimbatore 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.

RESULTS AND DISCUSSION

A total of 32 species belonging to 14 families were tested for AM fungal spore population and root colonization. Variations in the extent of colonization of the root systems have been observed in the plant species studied (Table 1). Out of these 32 species the family Asteraceae contributed 10, Lamiaceae 5, Poaceae 4, Balsaminaceae 3, Gesneriaceae 2 and rests of the species each 1. All the species were found to be mycorrhizal and showed either arbuscules of vesicles as evidence for the infection by AMF. The overall maximum spore population (534) was observed in the *Cyrtococcum trigonum* of Poaceae during the summer season while the minimum (125) was observed in the rainy season in *Galinsoga parviflora* of Asteraceae. The root colonization was maximum (67%) in *Bidens pilosa* during the winter season and the minimum (14%) *Salvia officinalis* in the rainy season. In general the plants were found to be infected heavily during the summer season, where the plant activity during this season may be high due to excess water loss through transpiration. Hence, the root colonization was found to be high among all the plant species studied during summer season. The less activity of the plant during the winter and rainy season may be the reason for the occurrence of low spore populations.

The association of fungal species with plants varied from species to species and even with in the same family. The genus *Glomus* was found to be associated with almost all the species studied followed by *Acaulospora, Gigaspora, Scelerocystis and Scutellispora* respectively. This shows the dominant character of the genus *Glomus*. Not all the species were found to be associated with same plant in the study, this shows the host specificity of the fungal species.

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). The same observations have been reported by earlier workers. Mason (1964) reported that the number of AM mycorrhizal spores increased in summer. In contrast, more number of endogone spores was recovered during autumn and winter than in summer (Khan, 1974). 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). However, the present investigation showed that the number of VA mycorrhizal spores have distributed in winter season than in summer but the infection rate is more in summer.

Table 1. The Spore population, Root infection and AM fungal species in the plant species of Evergreen vegetation of Anamalai Hills, Western Ghats during the study

S. No.	Species Name	Family	AM Fungal species	Spore Population/ 100 gm soil			Root Colonization %		
				Winter	Summer	Rainy	Winter	Summer	Rainy
1.	*Ageratum conyzoides,* L.	Asteraceae	1,2	463	328	210	34	52	21
2.	*Bidens pilosa* L.	Asteraceae	1, 4, 5	489	387	185	42	67	23
3.	*Eupatorium odaratum,* L.	Asteraceae	1,3	427	369	182	34	51	17
4.	*Gaenocheto purpuria* (L.)	Asteraceae	1	476	386	192	33	47	21
5.	*Galinsoga parviflora* Cav.	Asteraceae	1,2	451	370	125	30	50	19
6.	*Mikania cordata* Wight & Arn.	Asteraceae	1,5	532	361	216	32	51	18
7.	*Notonia grandiflora* DC.	Asteraceae	1,	463	382	184	34	52	18
8.	*Sonchus olerasius* L.	Asteraceae	1,2	420	345	156	32	50	21
9.	*Synedrella nodiflora* Gaertn.	Asteraceae	1,5	496	382	168	30	50	17
10.	*Vernonia divergens,* Edg.	Asteraceae	1,2,3	463	366	179	27	22	16
11.	*Impatiens campanulata,* W.	Balsaminaceae	1,2	213	316	157	29	50	17
12.	*Impatiens parvifolia,* Bedd.	Balsaminaceae	1,3	416	325	174	26	49	19
13.	*Impatiens phoenicea,* Bedd.	Balsaminaceae	1,2	425	345	183	29	43	18
14.	*Kalanchoe laciniata* DC.	Crassulaceae	1, 4, 5	432	358	180	32	53	20
15.	*Carex baccans* Nees.	Cyperaceae	1,3	512	306	184	34	60	21
16.	*Euphorbia rothiana,* Spr.	Euphorbiaceae	1,4	486	323	197	30	46	19
17.	*Crotalaria pallida* Aiton.	Fabaceae	1,5	522	354	169	38	61	44
18.	*Exacum wightianum,* Arn.	Gentianaceae	1,2	483	320	321	31	43	22
19.	*Biophytum reinwardtii,* Edgw & Hook	Geraniaceae	1,4	469	350	219	25	43	17
20.	*Rhyncoglossum obliquum,* Bl.	Gesnariaceae	1,3	487	376	164	31	50	18
21.	*Didymocarpus tomentosa,* Wight.	Gesneriaceae	1,4	486	392	219	40	54	21
22.	*Anisochilus paniculatus* Benth.	Lamiaceae	1,2	473	391	197	36	57	20
23.	*Plectranthus wightii,* Benth.	Lamiaceae	1,2	415	329	134	30	48	18
24.	*Pogostemon paniculatus,* Benth	Lamiaceae	1,3,5	515	421	274	29	52	16
25.	*Salvia officinalis* L.	Lamiaceae	1, 4, 5	421	318	197	30	43	14
26.	*Neolitsea scrobiculata,* Gamb.	Lauraceae	1,2	436	375	132	31	48	19
27.	*Oberonia verticillata,* W.	Orchidaceae	1,5	465	362	183	34	54	20
28.	*Plantago pherosa,* L.	Plentaginaceae	1,3	485	318	208	34	58	22
29.	*Arundinella pumila,* Steud.	Poaceae	1,2	526	328	148	39	53	22
30.	*Cyrtococcum patens,* A. Cam.	Poaceae	1,3	541	486	173	41	55	20
31.	*Cyrtococcum trigonum,* A. Cam.	Poaceae	1,2,5	534	397	206	40	52	21
32.	*Eragrostis riparia* Nees	Poaceae	1,3,4	415	294	167	55	54	20

* 1= Glomus, 2= Acaulospora, 3= Gigaspora, 4= Sclerocystis, 5= Scutellispora.

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). Mohankumar and Mahadevan (1987) studied ecological distribution of AM fungi in a tropical forest of south India, and pointed out the reasons for the decrease of spores in soil. In contrast to the present results Sangeeta and Kaushal., (2000) and Alpana Kaushik *et al.,* (1992) reported that maximum spore population was found with the commencement of rainy season and they observed that the number of chlamydospores were significantly high during the rainy season.

Earlier Gerdemann, (1968) has reported that the family Cyperaceae as non mycorrhizal but in contrast to this in our present study the *Carex baccans* a Cyperaceae member was found to be mycorrhizal and shown high spore population (512) as well as root colonization (60) during the study. Similarly, Michael Miller *et al*. (1999) reported the occurrence of mycorrhizal association in 16 plant species of Cyperaceae, Pawlowska *et al*. (1996) reported 5% of infection in 3 species of Cyperaceae members. Similar kinds of results were observed in Cyperaceae member, *Cyperus articularis* (8%) by Lea corkidi and Emmanuel Rincon (1997). The family Asteraceae was reported as non-mycorrhizal (Khan, 1974) in support to this Ragupathy *et al.* (1988) reported the absence of mycorrhizal infection in the two species *Colocasia esculenta* and *Boreria hispida* collected from aquatic / semi aquatic and coastal evergreen forests respectively. But all the 10 species of family Asteraceae collected at the time of study found to be mycorrhizal. In relevant to this Narayana Bhat *et al.,* (1993) reported that majority of the plant species showed mycorrhizal association indicate wide spread occurrence of AM fungi in the forest species. In the broad study where it is known that almost all forest tree species were recorded with VAM colonization in the roots.

There are numerous reports available regarding the association of the fungal species with plants in varied climatic and environmental conditions. The present study also confirms the concept that genus *Glomus* was dominant and occurs almost in all the season and environment. Narayana Bhat *et al* (1993) observed that among VAMF genera, *Glomus* was encountered very frequently than the other genera. The wide occurrence of *Glomus* in the root zone indicates its adaptability to different plants and environmental conditions as observed by Schenck and Kinloch (1980).

Throughout the study a definite correlation was observed in spore population and root colonization as mentioned above, this may be due to the influence the climatic factors but temperature and rainfall not the only parameters it is s hard to leave other parameters such as humidity, edaphic factors and physical disturbances by animals may also be the reasons for the present observations. Since there are many factors associated with this an extensive study should be undertaken to conclude the role of these parameters in the influence over the plant community.

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