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RESEARCH ARTICLE

AM FUNGAL DIVERSITY IN THE PLANT COMMUNITY OF VELLIANGIRI HILLS, WESTERN GHATS, COIMBATORE

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ABSTRACT

The ecological mechanisms of AM fungal diversity ensure successful management for conservation and restoration of natural ecosystems. Here the study contacted to estimate the diversity of AM fungal and their function in Velliangiri hills, Western Ghats, Coimbatore. The community structure of AM fungi, as determined by number of spores present in 100g of soil, varied with sampling time in plant community. And all so the morphological identification was done by microscopic characters. Soil properties like pH, macro and micro nutrient and the climate data were collected for all tree years to know their impact on fungal community. The overall result conform the root colonization and spore population were higher in winter season and also lower in rainy. Totally 30 AM fungal species from 10 genera were identified the important genera *were Acaulospora, Ambispora, Claroideoglomus, Funneliformis, Gigaspora, Glomus, Racocetra, Redeckera, Rhizophagus* and *Scutellospora*. Among these five genera, *Glomus* occurred most frequently. In general, *Rhizophagus fasciculatus* was found to be most abundant species. Consequently, this result conform the rich diversity in the study area. This symbiotic relationship had important roles in establishment of plant community of this area.

Keywords: Arbuscular Mycorrhizal Fungi, Diversity, Velliangiri hills.

1. INTRODUTION

There are many groups of fungi can establish associations with roots for facilitate plant growth and increase stress tolerance. Plants associated with mycobiota comprise taxonomically diverse, particularly mycorrhizal symbioses are extensively described due to the important role in improving plant nutrition and stress tolerance (1). AM fungi are integral components of most terrestrial ecosystems, with complex interactions between plants and production of glomalin (AM Fungal hyphal glycoprotein) may play a vital role in soil aggregation (2). The AM Fungal are essential for the function of ecosystems by the influence in plant diversity patterns in a variety of ecosystems. Where the mycelial network of AM fungi extends greatly increases the surface area for the uptake of immobile nutrients and they build up the macroporous structure in soil that allows penetration of water and air and thereby prevents erosion. They have great potential in the restoration of disturbed land and low fertility soil (3).

Mycorrhizal fungi usually enhance overall plant performance such as seed germination, early plant establishment, crucial steps in plant cycles and increased reproductive output (4). Moreover, the importance of mycorrhiza and the possibilities of its practical application strengthen the need for identification and cultivation of mycorrhizal fungi of natural plants (5). There is not enough focus on the mycorrhizal association with medicinal plants. Their species in different ecosystems are affected by edaphic factors, so it is necessary to investigate the spatial distribution and colonization of AM fungi in medicinal plants (6). Hence, in the present study contacted to estimate the diversity of AM fungal and their function in Velliangiri hills of Western Ghats.

2. MATERIALS AND METHODS

2.1. Study area

The Velliangiri hills from a major hill range in Western Ghats and a part of Nilgriri Biosphere Reserve of southern Western Ghats of Coimbatore district at a distance of 40 km. The geographical position between the longitude 6°-40' and 7°-10' and E latitude 10°-55' and 11°N with the altitudinal range having the altitude 1840 ms above msl. The boundary of Velliangiri hills is Palghat district of Kerala at western side, Nilgiri mountains at northern side, Siruvani hills at the south and plains of Coimbatore district of eastern side (Fig. 1 & 2).

2.2. Sample collection

Root samples and rhizosphere soil samples of 25 plant species growing in area of Velliangiri hills were collected in all three different seasons in the period of January, 2013 to December, 2015. For identification and nomenclature of the plant species

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the following manual was used (7). The root and soil samples were transported to the laboratory immediately after collection. The roots were fixed in formaldehyde-acetic acidethanol (FAA) solution for further process (8). The soil sample was air dried and stored at 40 C until processed. Each soil samples was used for chemical analysis, spore counts and classification in to various types and multiplication, concentration and separation of AM fungal spore for identification.

2.3. Soil analysis and climate data

The soil factors, texture, macro and micro nutrients were estimated by the following methods such as soil pH, EC (9), OC (10), available N, available P (11) and available K and the micro nutrient (Zu, Cu, Fe and Mn) (12). The climate date of the study area was collected from the Tamil Nadu Agricultural University, Coimbatore, India.

2.4. Evaluation of AM infection

The root samples were cleared and stained in tryphan blue with a modified version of the Phillips and Hayman's (8) method, in some cases, the modified method of Merryweather and Fitter (13) and Arias *et al.* (14). Arbuscular mycorrhizal infection in the roots was assessed following the grid line-intersect and the slide methods of Giovannetti and Mosse (15).

2.5. Isolation of Arbuscular Mycorrhizal Spores from the soil samples

Spores were recovered from the soil samples by the wet sieving and decanting method (16). Identification of AM fungi based upon microscopic characters, the AM fungal spores were identified. For identification and nomenclature, keys of the following manual authors were used: Raman and Mohankumar (17), Schenk and Perez (18), Redecker *et al.* (19) and Schubler and Walker (20). Classification on based on color, size, shape, surface, structure, general nature of the spore contents and hyphal attachment. Photomicrographs were taken with the help of a Magnus Olympus Microscope.

3. RESULTS

The study purpose was to isolate the diversity and function of AM Fungi associated with some medicinal plants located in Velliangiri hills. The infection and spread of AM fungal genera as influenced by as climatic and edaphic factors. The results relate to influence of soil properties and climatic variations on the AM fungal associations in medicinal plant. As well as the monthly rain fall, temperature and relative humidity of Velliangiri hills from January, 2013 to December, 2015 were presenting in Table 1. The soils were sandy loam, non-calcareous and black in nature (Table 2). The soil physical factors such as soil pH, electric conductivity and organic carbon were reported in the Table 2. The soil pH was recorded 7.19 to 7.1 in the all seasons of three years, whereas electric conductivity was recorded in between 0.39 to 0.34 d sm-2. Likely, the organic carbon was noted in between 0.86 to 0.81 % in the vegetation zones in all seasons of tree years. Whereas, the detailed records of the macro and micro nutrients were given in the Table 3.

Totally in Velliangiri hills, 30 AM fungal species in the 10 genera were isolated and identified (Table 4). The important genera were identified as *Acaulospora, Ambispora, Claroideoglomus, Funneliformis, Gigaspora, Glomus, Racocetra, Redeckera, Rhizophagus*, and *Scutellospora*. Among these five genera, *Glomus* occurred most frequently. In general, Rhizophagus fasciculatus was found to be most abundant species. In winter season, *Crotalaria barbata* (47%), *Plectranthus fruticosus* (88%) and *Crotalaria albida* (66%) were noted higher percentage of root colonization and *Begonia malabarica* (12%), *Abutilon hirtum* (8%) *Piper longum* and *Begonia malabarica* (8%) were found as lower infected plant roots. In summer, the higher root infection were found in *Crotalaria albida* (63%), *Plectranthus fruticosus* (91%), *Abutilon hirtum* and *Corchorus trilocularis* (73%), and also the lower colonization were found in *Impatiens goughi* (6%) and *Piper longum* (7%). Where in rainy season, the high colonization were found in *Pogostemon mollis* (51%), *Anaphalis aristata* (11%) and *Plectranthus fruticosus* (57%) where the lower infection found in *Biophytum polyphyllum* and *Begonia malabarica* (6%), and *Andrographis alata* (5%). In the study period (2013 to 2015) some plant species were not have any infection or may have very poor percentage of infection such as *Anaphalis aristata*, *Andrographis affinis*, *Cleome gynandra*, *Cleome monophylla*, *Begonia trichocarpa*, *Impatiens crenata*, *Impatiens goughii, Biophytum polyphyllum, Andrographis alata, Piper longum, Begonia malabarica*, *Cleome gynandra, Biophytum sensitivum, Begonia trichocarpa* and *Anaphalis aristata* (Table 5-7).

In winter season, the highest spore populations were found in *Crotalaria barbata* (647), *Sida acuta* (784) and *Plectranthus fruticosus* (795), of the examined years 2013 to 2015, whereas also the lower spore population in *Impatiens goughii* (145), *Cleome gynandra* (189) and *Piper longum* (184). In summer, the higher population noted in *Crotalaria barbata* (758), *Pogostemon speciosus* (498) and *Impatiens goughii* (637) as well as the lowest population found in *Impatiens goughii* (128), *Anaphalis aristata* (120) and *Piper longum* (159).

Table 1. Climatic factor of Velliangiri hills, Western Ghats during 2013 to 2015.

Month	Rain fall (mm)			Temperature °C						Relative humidity (%)		
	2013	2014	2015	2013		2014		2015		2013	2014	2015
				MAX	MIN	MAX	MIN	MAX	MIN	7.22 HOURS	7.22 HOURS	7.22 HOURS
JANUARY	0	14	0	31.6	19.0	29.4	17.9	30.1	19.5	86	61	86
FEBRUARY	99.8	9.2	0	31.9	20.7	31.4	18.5	32.2	20	82	55	80
MARCH	0	17.0	3.7	34.2	22.8	34.5	20.5	34.5	23.1	80	50	80
APRIL	46.8	52.7	62.7	35.9	24.5	35.2	23.8	32.7	24	86	54	83
MAY	14.8	66.5	**195.8**	33.4	24.5	34.0	23.2	32.3	23.5	82	55	91
JUNE	54.5	42.8	46.9	30.6	23.3	31.6	22.9	32.3	23.7	80	56	82
JULY	21.9	68.5	5.1	30.1	23.2	30.1	22.2	32.2	22.9	79	55	85
AUGUST	27.3	30.1	28.1	31.3	22.6	30.1	22.2	32.3	23.2	86	62	86
SEPTEMBER	46.5	68.0	66.2	31.2	22.6	31.6	21.8	33	23.8	85	63	83
OCTOBER	**140.12**	**146.0**	65.2	31.5	21.7	30.6	21.4	31.6	23.3	88	72	87
NOVEMBER	57.9	118.0	191.3	29.8	22.3	29.2	20.2	28.6	22	89	73	93
DECEMBER	24.8	41.4	24.1	29.2	19.8	29.4	17.9	29.0	21.5	88	77	90

Table 2. Soil type, texture and Physical factor of Velliangiri hills, Western Ghats during 2013 to 2015.

Years	Seasons	PH	EC	OC	Soil type	laim
	Winter	7.14	0.38	0.85	Sandy loam	Non-calcareous, Black
2013	**Summer**	7.11	0.38	0.85	Sandy loam	Non-calcareous, Black
	Rainy	7.19	0.39	0.84	Sandy loam	Non-calcareous, Black
	Winter	7.13	0.38	0.86	Sandy loam	Non-calcareous, Black
2014	**Summer**	7.12	0.38	0.85	Sandy loam	Non-calcareous, Black
	Rainy	7.18	0.39	0.83	Sandy loam	Non-calcareous, Black
	Winter	7.12	0.36	0.82	Sandy loam	Non-calcareous, Black
2015	**Summer**	7.1	0.34	0.81	Sandy loam	Non-calcareous, Black
	Rainy	7.17	0.39	0.83	Sandy loam	Non-calcareous, Black

Table 3. Soil macro and micro nutrients of Velliangiri hills, Western Ghats during 2013 to 2015.

Years	Seasons	Available N (kg ha^{-1})	Available P (kg ha^{-1})	Available K (kg ha^{-1})	DTPA-Zn (pmm)	DTPA-Cu (pmm)	DTPA-Fe (pmm)	DTPA-Mn (pmm)
	Winter	224	16.1	555	0.98	1.26	7.58	13.37
2013	**Summer**	225	16.0	553	0.97	1.23	7.55	13.30
	Rainy	222	16.1	551	0.97	1.20	7.46	13.24
	Winter	234	16.2	544	0.92	1.39	7.91	12.48
2014	**Summer**	232	16.3	524	0.91	1.37	7.90	12.45
	Rainy	230	16.2	510	0.92	1.37	7.90	12.23
	Winter	226	16.2	536	1.1	1.40	7.52	14.96
2015	**Summer**	226	15.3	531	1.09	1.47	7.50	14.95
	Rainy	223	15.2	528	1.12	1.35	7.46	14.93

Table 4. AM fungal Species from Velliangiri hills Western Ghats with species code.

S. No.	AM fungal Species		Species code
	New name	Synonym	
1.	*Acaulospora denticulate*	*Acaulospora denticulate*	ADTC
2.	*Acaulospora foveata*	*Acaulospora foveata*	AFVT
3.	*Acaulospora mellea*	*Acaulospora mellea*	AMLL
4.	*Acaulospora nicolsonii*	*Acaulospora nicolsonii*	ANCS
5.	*Acaulospora sporocarpia*	*Acaulospora sporocarpa*	ASPC
6.	*Ambispora appendicula*	*Acaulospora appendicula*	AAPD

7.	*Claroideoglomus claroideum*	*Gloums claroides*	LCRD
8.	*Funneliformis caledonium*	*Glomus caledonium*	LCLD
9.	*Funneliformis constrictum*	*Glomus constrictum*	LCST
10.	*Gigaspora candida*	*Gigaspora candida*	GCDD
11.	*Gigaspora rosea*	*Gigaspora rosea*	GRSA
12.	*Glomus aggregatum*	*Glomus aggregatum*	LAGR
13.	*Glomus albidum*	*Glomus albidum*	LABD
14.	*Glomus ambisporum*	*Glomus ambisporum*	LABS
15.	*Glomus arborense*	*Glomus arborense*	LABR
16.	*Glomus austral*	*Glomus austral*	LAST
17.	*Glomus halonatum*	*Glomus halon*	LHLN
18.	*Glomus heterosporum*	*Glomus heterosporum*	LHTS
19.	*Glomus hoi*	*Glomus hoi*	LHOI
20.	*Glomus muticaule*	*Glomus muticaule*	LMTC
21.	*Glomus nanolumen*	*Glomus nanolumen*	LNNL
22.	*Glomus reticulatum*	*Glomus reticulatum*	LRTC
23.	*Racocetra coralloidea*	*Scutellospora coralloidea*	CCRL
24.	*Racocetra gregaria*	*Scutellospora gregaria*	CGRG
25.	*Racocetra verrucosa*	*Scutellospora verrucosa*	CVRC
26.	*Redeckera fulvum*	*Gloums fulum*	LFLV
27.	*Rhizophagus clarus*	*Glomus clarum*	LCLR
28.	*Rhizophagus fasciculatus*	*Glomus faciculatum*	LFSC
29.	*Scutellospora arenicola*	*Scutellospora arenicola*	CARC
30.	*Scutellospora savannicola*	*Scutellospora savannicola*	CSVN

Table 5. AM fungal root colonization and spore population in the plant species of Velliangiri hills Western Ghats during 2013.

S. No.	Plant name	Family	Type of Colonization			% Root colonization			Spore population/100g of soil		
			H	V	A	W	S	R	W	S	R
1	*Abutilon hirtum* (Lam.) Sweet.	Malvaceae	+	+	-	47	62	23	376	312	189
2	*Anaphalis aristata* (DC.) DC.	Compositae	+	+	+	12	36	11	271	189	123
3	*Andrographis alata* (Vahl) Nees.	Acanthaceae	+	+	-	12	24	-	274	253	132
4	*Andrographis affinis* Nees.	Acanthaceae	+	-	-	-	27	-	210	168	115
5	*Begonia malabarica* Lam.	Begoniaceae	+	+	+	12	20	-	183	138	110
6	*Begonia trichocarpa* Dalzell	Begoniaceae	+	-	-	-	10	-	234	172	121
7	*Biophytum polyphyllum* Munro	Oxalidaceae	+	-	+	23	-	-	222	332	129
8	*Biophytum sensitivum* (L.) DC.	Oxalidaceae	+	+	-	16	12	-	321	214	164
9	*Cleome gynandra* L.	Cleomaceae	+	+	+	-	17	-	241	254	130
10	*Cleome monophylla* L.	Cleomaceae	+	+	-	-	14	-	256	189	112
11	*Corchorus trilocularis* L.	Malvaceae	+	-	+	36	53	25	473	481	243
12	*Crotalaria albida* Roth	Leguminosae	+	+	-	42	63	32	564	742	184
13	*Crotalaria barbata* Wight & Arn.	Leguminosae	+	-	-	53	57	28	647	758	213
14	*Hibiscus calyphyllus* Cav.	Malvaceae	+	-	+	47	62	32	474	529	143
15	*Hibiscus hispidissimus* Griff.	Malvaceae	+	+	-	38	46	29	546	435	179
16	*Impatiens crenata* Bedd.	Balsaminaceae	+	+	-	-	10	-	243	156	124

17	*Impatiens goughii* Wight	Balsaminaceae	+		+	-	6	-	145	128	112
18	*Piper longum* L.	Piperaceae	+	+	-	12	22	-	238	231	167
19	*Plectranthus bishopianus* Gamble	Lamiaceae	+	+	+	37	41	22	432	376	210
20	*Plectranthus fruticosus* L'Hér.	Lamiaceae	+	+	-	28	36	12	467	586	189
21	*Pogostemon benghalensis* Kuntze	Lamiaceae	+	+	-	47	56	32	546	487	129
22	*Pogostemon mollis* Benth.	Lamiaceae	+	+	+	32	44	51	466	378	121
23	*Pogostemon speciosus* Benth.	Lamiaceae	+	-	+	52	42	27	389	527	186
24	*Pogostemon vestitus* Benth.	Lamiaceae	+	+	+	39	40	18	425	253	130
25	*Sida acuta* Burm.f.	Malvaceae	+	-	+	44	56	23	274	738	180

H- Hyphal, V- Vesicles, A- Arbuscules; W-Winter; S – Summer; R – Rainy

Table 6. AM fungal root colonization and spore population in the plant species of Velliangiri hills Western Ghats during 2014.

S. No.	Plant name	Family	Type of Colonization			% Root colonization			Spore population/100g of soil		
			H	V	A	W	S	R	W	S	R
1	*Abutilon hirtum* (Lam.) Sweet.	Malvaceae	+	+	+	32	46	18	265	483	192
2	*Anaphalis aristata* (DC.) DC.	Compositae	+	+	-	12	24	19	325	271	163
3	*Andrographis alata* (Vahl) Nees.	Acanthaceae	+	+	+	16	27	12	271	234	123
4	*Andrographis affinis* Nees.	Acanthaceae	+	-	-	18	22	20	292	189	136
5	*Begonia malabarica* Lam.	Begoniaceae	+	+	-	17	13	14	324	214	222
6	*Begonia trichocarpa* Dalzell	Begoniaceae	+	-	+	24	22	21	345	258	140
7	*Biophytum polyphyllum* Munro	Oxalidaceae	+	-	-	12	7	5	281	178	124
8	*Biophytum sensitivum* (L.) DC.	Oxalidaceae	+	+	-	8	9	-	299	189	142
9	*Cleome gynandra* L.	Cleomaceae	+	+	+	14	12	8	189	256	182
10	*Cleome monophylla* L.	Cleomaceae	+	+	-	12	7	-	201	173	122
11	*Corchorus trilocularis* L.	Malvaceae	+	-	+	45	84	22	372	478	123
12	*Crotalaria albida* Roth	Leguminosae	+	+	-	78	89	49	760	485	270
13	*Crotalaria barbata* Wight & Arn.	Leguminosae	+	-	-	88	91	57	768	389	213
14	*Hibiscus calyphyllus* Cav.	Malvaceae	+	-	+	56	62	39	580	482	294
15	*Hibiscus hispidissimus* Griff.	Malvaceae	+	+	+	63	41	29	440	341	289
16	*Impatiens crenata* Bedd.	Balsaminaceae	+	+	+	12	15	10	264	189	134
17	*Impatiens goughii* Wight	Balsaminaceae	+		+	11	8	5	284	149	111
18	*Piper longum* L.	Piperaceae	+	+	-	10	11	-	210	120	115
19	*Plectranthus bishopianus* Gamble	Lamiaceae	+	+	+	43	29	17	243	178	142
20	*Plectranthus fruticosus* L'Hér.	Lamiaceae	+	+	-	52	37	26	273	159	123
21	*Pogostemon benghalensis* Kuntze	Lamiaceae	+	+	-	67	48	29	658	493	184
22	*Pogostemon mollis* Benth.	Lamiaceae	+	-	+	58	39	22	597	498	281
23	*Pogostemon speciosus*	Lamiaceae	+	+	+	66	38	22	784	479	260

	Benth.										
24	*Pogostemon vestitus* Benth.	Lamiaceae	+	-	+	48	53	32	583	276	185
25	*Sida acuta* Burm.f.	Malvaceae	+	-	+	39	47	29	475	351	169

H- Hyphal, V- Vesicles, A- Arbuscules; W-Winter; S – Summer; R – Rainy

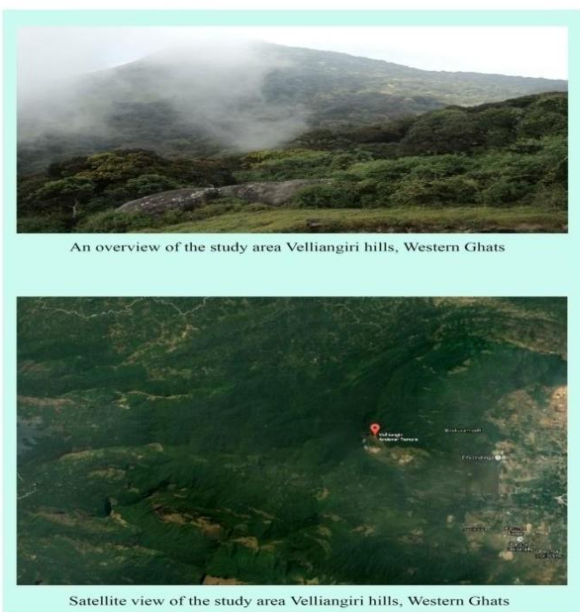
Table 7. AM fungal root colonization and spore population in the plant species of Velliangiri hills Western Ghats during 2015.

S. No.	Plant name	Family	Type of Colonization			% Root colonization			Spore population/100g of soil		
			H	V	A	W	S	R	W	S	R
1	*Abutilon hirtum* (Lam.) Sweet.	Malvaceae	+	+	+	64	73	39	584	396	259
2	*Anaphalis aristata* (DC.) DC.	Compositae	+	+	+	12	15	-	395	275	142
3	*Andrographis alata* (Vahl) Nees.	Acanthaceae	+	+	+	24	28	17	369	240	189
4	*Andrographis affinis* Nees.	Acanthaceae	+	-	-	32	25	15	463	273	168
5	*Begonia malabarica* Lam.	Begoniaceae	+	+	+	10	8	-	231	169	123
6	*Begonia trichocarpa* Dalzell	Begoniaceae	+	-	-	-	5	-	184	159	133
7	*Biophytum polyphyllum* Munro	Oxalidaceae	+	-	-	8	14	6	213	159	112
8	*Biophytum sensitivum* (L.) DC.	Oxalidaceae	+	+	+	12	14	8	243	260	127
9	*Cleome gynandra* L.	Cleomaceae	+	+	+	23	12	11	372	231	157
10	*Cleome monophylla* L.	Cleomaceae	+	+	-	21	22	13	543	274	189
11	*Corchorus trilocularis* L.	Malvaceae	+	-	+	47	52	25	473	243	163
12	*Crotalaria albida* Roth	Leguminosae	+	+	-	64	59	23	537	498	362
13	*Crotalaria barbata* Wight & Arn.	Leguminosae	+	-	-	87	91	46	758	637	341
14	*Hibiscus calyphyllus* Cav.	Malvaceae	+	+	+	53	42	28	576	453	236
15	*Hibiscus hispidissimus* Griff.	Malvaceae	+	-	-	66	43	35	564	376	132
16	*Impatiens crenata* Bedd.	Balsaminaceae	+	+	-	14	12	10	321	243	124
17	*Impatiens goughii* Wight	Balsaminaceae	+	-	+	11	9	-	246	194	153
18	*Piper longum* L.	Piperaceae	+	+	-	9	8	9	233	179	145
19	*Plectranthus bishopianus* Gamble	Lamiaceae	+	-	+	48	51	37	597	463	251
20	*Plectranthus fruticosus* L'Hér.	Lamiaceae	+	+	-	61	59	24	574	632	220
21	*Pogostemon benghalensis* Kuntze	Lamiaceae	+	-	-	41	73	28	689	473	197
22	*Pogostemon mollis* Benth.	Lamiaceae	+	+	+	52	63	31	489	372	186
23	*Pogostemon speciosus* Benth.	Lamiaceae	+	-	+	62	53	36	754	359	190
24	*Pogostemon vestitus* Benth.	Lamiaceae	+	+	+	42	49	21	479	352	189
25	*Sida acuta* Burm.f.	Malvaceae	+	-	+	57	62	70	795	473	255

H- Hyphal, V- Vesicles, A- Arbuscules; W-Winter; S – Summer; R – Rainy

Figure 1 Study area of Velliangiri hills, the Westrn ghats, Coimbatore district

Figure 2 An overview and satellite view of study area

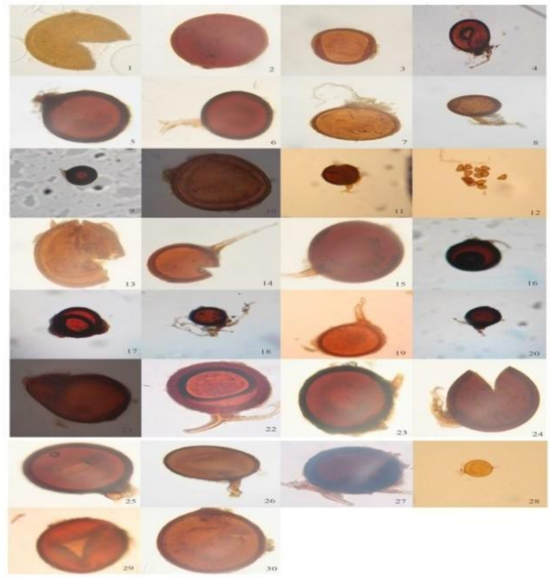


An overview of the study area Velliangiri hills, Western Ghats

Satellite view of the study area Velliangiri hills, Western Ghats

In rainy season, *Corchorus trilocularis* (243), *Crotalaria barbata* (294) and *Impatiens crenata* (362) were found higher spore population, at the same time *Begonia malabarica* (110), *Biophytum polyphyllum* (111) and *Begonia malabarica*, (112) were have minimum population in the study period. The overall aspirations the rainy season were influenced the spore population due to the lagging of rain water. Where, in the winter and summer seasons have more favor for the AM fungal. In Velliangiri hills, highest AM diversity was recorded which may be due to its location, which experiences optimum rainfall and temperature that are conducive for AM population (Table 5-7).

Figure 3 AM fungal Species from Velliangiri hills Western Ghats



1. *Acaulospora denticulate*, 2. *A. foveata*, 3. *A. mellea*, 4. *A. nicolsonii* 5. *A. sporocarpia*, 6. *Ambispora appendicula*, 7. *Claroideoglomus claroideum*, 8. *Funneliformis caledonium*, 9. *F. constrictum*, 10. *Gigaspora candida*, 11. *G. rosea*, 12. *Glomus aggregatum*, 13. *Gl. albidum*, 14. *Gl. ambisporum*, 15. *Gl. arborense*, 16. *Gl. austral*, 17. *Gl. halonatum*, 18. *Gl. heterosporum*, 19. *Gl. hoi*, 20. *Gl. muticaule*, 21. *Gl. nanolumen*, 22. *Gl. reticulatum*, 23. *Racocetra coralloidea*, 24. *Ra. gregaria*, 25. *Ra. verrucosa*, 26.*Redeckera fulvum*, 27. *Rhizophagus clarus*, 28. *Rh. fasciculatus*, 29. *Scutellospora arenicola*, 30.*Sc. savannicola*.

Figure 4 The average spore population in the plant species of Velliangiri hills Western Ghats during 2013 to 2015

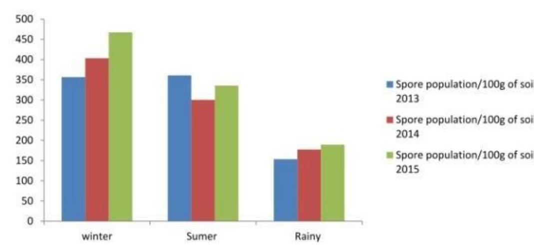
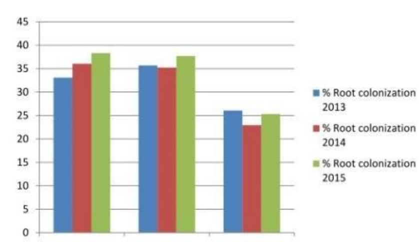


Figure 5 The average root infection in the plant species of Velliangiri hills Western Ghats during 2013 to 2015



4. DISCUSSION

The AM fungi are major components of soil biota that can determine the productivity of ecosystems (21). The rhizosphere of the mycorrhizal plant can be referred to as the mycorrhizosphere. Mycorrhizosphere comprises both the root and hyphae influence zones. Hence, the mycorrhizosphere provide a critical link between plants, other microorganisms and the soil (22). The number of mycorrhizal fungal individuals found in a given habitat is likely to depend on a range of factors that includes plant community composition and age, soil chemical, physical and biological properties, and climate, meaning that considerable variability can be expected this requires more effort to quantify intra specific diversity of mycorrhizal fungi (23). The present study contacts an experiment on mycorrhizal fungal community from the Velliangiri hills. In the study site 10 AM fungal genera were identified, among these *Glomus* has been the most dominant genus in this region, where also the Rhizophagus fasciculatus was the most dominant AM fungal species. Some other finding supported that the relatively higher frequency of *Glomus* species (24, 25). These species have good relation with edaphoclimatic factors of this area.

The present study clearly demonstrated for the first time that plant species from Velliangiri hills are revealed that both AM fungal spore population and percentage of root colonization, which may affected by edaphoclimatic factors such as effect of various climatic, physical and chemical properties of soils. The huge distinction takes place in the spore population within the plant species have in this study, this may be attributed to the variation in edaphic and climatic factors. Numerous biotic and abiotic factors influence into the structure of mycorrhizal fungal communities. . Similarly, Kulkarni (26) also proposed by the influence of edaphic factors and host compatibility, climate and soil microorganisms on mycorrhization. The soil study revealed that AM Fungal communities are influence by habitat and soil type. In addition, the soil properties are related to microbiological activity and triggering the distribution of AM Fungi. These results contribute to a better understanding of the ecological factors that can shape AM fungal communities, an important soil microbial group that affects multiple ecosystem functions. The pH of study area was very fine (7.19 to 7.1) and this got good relationship of AM population of the study area. The other factors like organic carbon, electric conductivity and micro and macro nutrients.

The present study have higher spore population in winter followed by summer, where rainy season got lower spore population, this may be a variation in moisture and temperature. There is an optimum soil and environmental conditions are required for the AM fungi development and infectiveness (27). Here, many species were recorded in lower colonization of the samplings in the test sites. This has been influenced on plant growth and community structure, due to the important relationship between biodiversity and their potential to control on plant diversity and productivity (28). Where also AM fungal colonization increase intra specific plant competition by different magnification among them. There the influence of mycorrhizal community appears to extant level of plant populations and communities. Fungal may profit from additional nutrient and water availability at relatively low energy cost compared to non-mycorrhizal. Mycorrhizal alien plant species may obtain a competitive advantage compared to non-mycorrhizal alien plant species (24).

5. CONCLUSION

However, despite the importance of AMF to terrestrial ecosystems, little is known about the effects of environmental changes on AMF abundance, activity and the impact of these changes on the ecosystem services. Therefore, it is important to gain a clearer understanding of the effects of environmental changes on the AM fungal species to guide conservation and restoration efforts. The symbiosis has long been a focus for invasion biologists, we do not know of any study combining plant mycorrhizal status with other plant functional traits. Therefore, we encourage the consideration of mycorrhizal status and related mycorrhizal plant traits in future analyses of alien plant invasion success.

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