Environment and Ecology 40 (2A) : 470—475, April—June 2022
ISSN 0970-0420

Arbuscular Mycorrhizal Fungal (AMF) Studies on Some Forest Plants of West Bengal

Pampi Ghosh

Received 15 January 2022, Accepted 10 March 2022, Published on 20 May 2022

ABSTRACT

Southwest Bengal forest is rich in floral composition during monsoon but during summer ground vegetation was recorded as minimum due to forest fire even scarcity of water as seasonally it is dry deciduous forest. During monsoon decomposition of leaf litter and twigs show good organic matter production and macro-fungi grow there is a huge number. Similarly underneath of the forest floor, rhizosphere soil shows good and vivid arbuscular mycorrhizal spore. Roots of various plants exhibit colonization by a large no of AM species. In this paper a general study report of some herbaceous plants and shrubs has been presented with Am colonization. Here 32 plant species have been enumerated in which 4 species are shrubs. Study revealed that highest spore density was recorded in case of *Aristolochia indica* (350) during winter and highest colonization was recorded in case of *Costus speciousus, Flemingia strobilifera* and *Phyllanthus amarus* (99%) during monsoon.

Keywords Southwest Bengal, AM colonization, spore density, Forest floor.

Pampi Ghosh
Assistant Professor
Department of Botany,
Seva Bharati Mahavidyalaya, Kapgari, Jhargram 721505, West Bengal, India
Email : pampikapgari@gmail.com

INTRODUCTION

Southwest Bengal is a part of West Bengal which is famous as sal (*Shorea robusta*) dominated forest land with tribal populations. The people of this land are dependent on forest and agriculture. In the forest people use many non-timber forest produces (NTFPs) from time to time round the year. In this area forest are more or less similar due to composition and physiognomic characters but depending upon the degree of dominancy of forest tree species, ground layer composition like herbs and shrubs differ from one site to another site. People use these medicinal herbs and climbers in this region for their own purpose but some time they collect all these medicinal plants and sale these in the nodal markets to earn money. The cover of herbaceous vegetation is a resource though their growth and development depends upon the nutrient structure of ground and microorganisms which play a crucial role for them. The Vesicular Arbuscular mycorrhizae are unique in roots of vascular plants in nature (Harley and Smith 1983, Powel and Bagyaraj 1984, Gabor 1992) and are common soil fungi (Gerdemann 1968). In this forest, rhizosphere soil shows good arbuscular mycorrhizae that play a vital role for their growth and development of herbaceous vegetation. The spore densities in soil and colonization percentage of host plants vary from site to site even season to season. Generally, during monsoon lowest number of spore density have been recorded in compare to winter or summer but colonization percentage was highest in monsoon and lowest during winter followed by summer (Ghosh 2017). But in different sites a single host species shows different colonization and it varies due to growth behavior of

species. It depends on the onset of propagules of plant in the ground layer and thereby shows good growth and development of roots. This is due to presence of a diverse type of characteristic features. In this case root colonization of species is common in terms of various structures found in the root cortical cells of AM species. Arbuscular Mycorrhizal Fungi (AMF) are cosmopolitan in distribution though their density become lowers due to conversion of land to degraded kind and huge application of chemical fertilizer with varied applications of chemical pesticides, insecticides and foliar spray of chemicals unscientifically in agricultural lands. Another fact is that, high tillage and creation of water logged condition rapidly diminishes the growth of the AM fungi in and around the cultivated land. Forest is a natural land as well as repository that protects its biodiversity obviously the soil microorganisms and therefore keep the number of AM fungal spores constant during winter in compare to the land of degraded and cultivated one which have altered the conditions in the same area in same season. The present study is therefore a study of AM fungi in natural forest of southwest Bengal under various microclimatic conditions.

Study area

Study area was taken in Bandarbhula forest of Jhargram district in West Bengal. It is a part of southwest Bengal.(Fig. 1). It is very close to Jhargram town under Jhargram forest division. The area is sal (*Shorea robusta*) dominated forest. It is a dry deciduous forest but green and clean in monsoon. Many underground floral members have been found that show flowering during post monsoon. Forest fire is restricted in this site due to good forest management strategy taken by FPC. Lateritic soil is very dry and moisture content is low during summer.

Fig. 1, Author collecting twigs of plants.

MATERIALS AND METHODS

The present study was carried out in three study sites in three seasons from 2019 to 2020 at Bandarbhula forest. Samples were collected from field in monsoon, summer and in winter season with a gap interval of 15 days. The winter temperature goes from 7˚C to 13˚C. Roots of selected plants were collected and washed it thoroughly by tap water (Figs 2–5). All the samples were treated with KOH and after that treated with dilute Hcl. It was stained by camel ink and cold treatment was used (Utobo *et al.* 2017). One 1cm rootlets were studied for each sample and in every season collected materials were studied. The VAM percentage infection in root was assessed as per Phillips and Hayman (1970). Rhizosphere soils of 3 fields and 3 stations each were collected from randomly designed selected sites. Three rhizosphere soil samples were collected from each site. These rhizosphere soils collected at the middle and end of each month were pooled together to form a composite sample and stored in polyethylene bags at 4˚C for further analysis. From each composite sample, three replicates were taken for further analysis. The physico-chemical characteristics of soils such

Fig. 2. .Author collecting rhizosphere soil and roots of selected plants.

Table 1. Seasonal root colonization and spore density of some forest plants of Jhargram district in Southwest Bengal.

Sl. No.	Name of plant	Season wise root Colonization %			Spore density in 100g rhizospheric soil		
		Monsoon season	Winter season	Summer season	Monsoon season	Winter season	Summer season
1	*Allophyllus cobbe* (L.) Reausch. (Beng.-Rakhal phool)	46	30	17	55	218	86
2	*Andrographis paniculata* Nees. (Beng.-Kalmegh)	55	16	12	82	280	140
3.	*Aristolochia indica* L. (Beng.-Iswarmul)	96	90	40	140	350	210
4.	*Bonnaya brachiata* Link. & Otto. (Beng.-Nil)	86	NIL	NIL	50	211	112
5.	*Carissa spinarum* L. (Beng.-Bon Karmacha)	10	6	6	9	208	18
6.	*Chrysopogon aciculatus* (Retz.) Trin. (Beng.-Chorkanta)	10	8	7	05	17	06
7.	*Clerodendrum viscosum* Vent. (Beng.-Ghetu)	96	60	52	50	220	107
8.	*Commelina obliqua* Vahl. (Beng.-Kanshirna)	55	44	20	65	188	120
9.	*Costus speciosus* (Koenig ex Retz.) J. E. Smith (Beng.-Kemuk/Keu)	99	74	NIL	106	310	170
10.	*Curculigo orchioides* Gaertn. (Beng.-Talamuli)	72	40	NIL	88	100	NIL
11.	*Cyperus kyllinga* Endl. (Beng.-Banmutha)	20	12	12	24	152	50
12.	*Desmodium motorianum* (Houtt.) Merr. (Beng.-Gorachand)	80	70	55	54	240	76
13.	*Desmodium triflorum* (L.) DC. (Beng.-Kudali)	52	50	46	54	240	180
14.	*Dicliptera bupleuroides* Nees. (Beng.-Pota Potka)	72	65	44	88	252	140
15.	*Dioscorea bulbifera* L. (Beng.-Ratalu)	92	NIL	NIL	92	270	140
16.	*Dioscorea pentaphylla* L (Beng.-Kantaalu)	98	NIL	NIL	110	312	150
17.	*Elephantopus scaber* L. (Beng.-Hastipada)	55	47	NIL	165	220	172
18.	*Evolvulus nummularius* (L.) L. (Beng.-Bhuinankra)	98	45	30	80	224	122
19.	*Flacourtia indica* (Burm.f.) Merr. (Beng.-Boichi)	40	17	12	42	89	52
20.	*Flemingia chapper* Buch.-Ham. ex Bnth. (Beng.-Mot chapta)	55	32	NIL	62	180	NIL
21.	*Flemingia strobilifera* R. Br. (Beng.-Chapta)	99	62	NIL	85	210	NIL
22.	*Gardenia gummifera* L. f. (Beng.-Lohajung)	59	32	10	48	140	65
23.	*Hemidesmus indicus* R. Br. (Beng.-Anantamul)	40	30	22	12	111	42
24.	*Holarrhena pubescens* Wall. ex G. Don. (Beng.-Kurchi/Heart)	50	40	24	26	84	55
25.	*Icnocarpus fruticens* (L.) R. Br. (Beng.-Kalilata)	79	40	33	50	244	84
26.	*Indigofera cassioides* Rott. ex DC. (Beng.-Ban nil)	66	28	22	52	240	62
27.	*Meyna spinosa* Roxb. (Beng.-Mantukanta/Moyna)	15	08	06	53	289	155

Table 1. Continued.

Sl. No.	Name of plant	Season wise root Colonization %			Spore density in 100g rhizospheric soil		
		Monsoon season	Winter season	Summer season	Monsoon season	Winter season	Summer season
28.	*Phaseolus adenanthus* G. Mey. (Beng.-Nil)	65	52	NIL	96	284	110
29.	*Phyllanthus amarus* Schum & Thonn. (Beng.-Bhuiamla)	99	56	NIL	154	298	160
30.	*Scoparia dulcis* L. (Beng.-Mithapata)	54	51	40	42	186	102
31	*Smilax ovalifolia* Roxb. ex D. Don. (Beng.-Ramdantun)	60	35	NIL	95	220	109
32.	*Vernonia cinerera* Less. (Beng.-Sahadevi)	55	33	12	52	188	89

as soil moisture content (%) and soil reaction (pH) were done using dry weight method and electrode pH meter. Arbuscular Mycorrhizal Fungal (AMF) spore density was calculated from the rhizosphere soil samples using 100 g soil samples for each sample. Three replicas were used and then mean was taken to determine the number month wise. Wet sieving and decanting technique was used (Gerdemann and Nicolson 1963) and direct count was used for quantification using the "stereomicroscope". Results were expressed as mean of three replicates for each sample. The abundance of spores determined for each sample was expressed as the number of AM fungal spores per 10 g of soil for all the samples studied after that it was multiplied by 10 to get 100 g soil sample because a large number get so many number of spores might be problematic during counting. Intact spores and sporocarps were mounted in lacto-phenol glycerol and identified according to their spore morphology by using taxonomic key. The qualitative estimation was expressed as percentage frequency occurrence of AM fungal species. Other literatures used were published time to time in various journals. Authors delivered lectures on the same topics also put forth for reference to support the same but these were not quoted a published one (Ghosh,2021).

RESULTS AND DISCUSSION

The data on rhizosphere soil analysis showed that the soil pH varied from 6.5 to 6.9. This variation thereby, indicating a major soil pH from one site to another as there were different forest species composition. These soils obviously affect the plant growth. Mois-

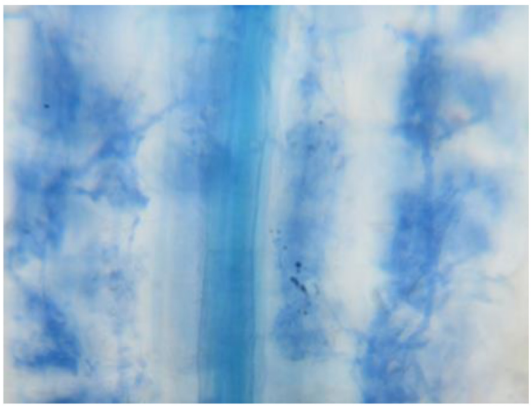

Fig. 3. Arbuscule of AM fungi.

Fig. 4. Vasicle of VAM fungi.

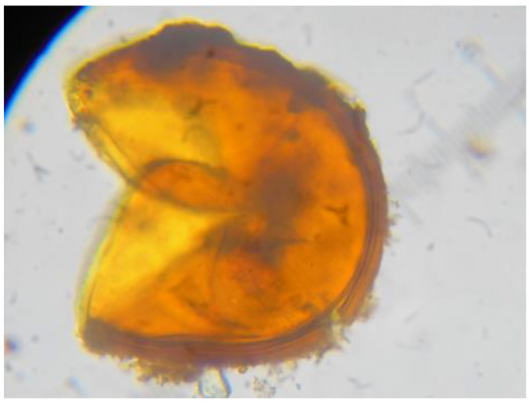

Fig. 5. AM spore in rhizosphere soil.

ture content varied from 6-28% in different types of study soil round the year. Colonization % was recorded highest in case of four species namely *Costus speciousus, Flemingia strobilifera* and *Phyllanthus amarus* (99%) during monsoon (Table 1). The AM fungal spores isolated from the present soils during the seasonal survey exhibited the association of many species under 4 genera of fungi. There was no *Sclerocystis* species recorded during study. Among the isolated AMF genera, *Glomus* represented higher density over other species under 4 genera, whereas genus, *Acaulospora* represented second dominated species. Other genera found were *Gigaspora* spp. and *Scutellospora* spp. in the same study sites. The present study showed that there is a wide range of variation in spore number at different study sites under different management regimes in a season. Highest AMF spore density was observed in case of *Aristolochia indica* (350) during winter (Table 1).

CONCLUSION

Natural forest soils are good source of repository for AM spores. Good colonization found in fine rootlets of ground vegetation and these also found hidden in soil. So, forest soil may be used for AM culture to inoculate degraded land mass during plantation program that may be successfully raised after inoculation in nursery through local AM fungi. In agricultural practice, bio-fertilizers like AM fungi may be used with other bio-fertilizers as well as manures that can restore the soil health in near future. This is supported by many workers (Basiru *et al.* 2021). They argued that a variety of plant symbionts, most notably the arbuscular mycorrhizal fungi, nitrogen fixing bacteria and phosphate-potassium solubilizing microorganisms entered the era of large scale applications in agriculture, horticulture and forestry. It may be used in forest nursery to raise the healthy seedlings. Farmer and other plant growers can use directly the forest soil for AM inoculums and can upgrade the application in field for better yield, though the lack of knowledge about AM bio-fertilizer production practice and application is the main hindrance behind it. Forest stock and forest floor must be conserved from forest fire even from any kind of degradation because of high abundance of AM spore number and mycelia which could be a boon for scientists in near future.

ACKNOWLEDGEMENT

I acknowledge my sincere thanks to Prof. (Dr.) N.K. Verma, Retired Prof. and Ex-Head, Department of Botany and Forestry, Vidyasagar University, Midnapore, WB for his continuous help and suggestions as and when required. I thank to local people of Bandarbhula area who helped me in field.

REFERENCES

Bagyaraj DJ (1984) Biological interaction with VA mycorrhizal fungi. In: VA mycorrhiza (eds.), Powel CL , Bagyaraj DJ, CRC Press, Boca Raton, pp 131-154.

Basiru S; Mwanza HP, Hijri M (2021) Analysis of Arbuscular Mycorrhizal Fungal Inoculant Benchmarks, Microorgani isms, 9(1):1-18, doi.: https://www.mdpi.com/journal /10.3390/microorganisms9010081.

Gabor JB (1992) Mycorrhizae and crop productivity, In: My corrhizae in Sustainable Agriculture, eds. GJ Bethlenfalvay RG Linderrhan, Am Soc Agron Madison, Wisconsin, USA:1-28.

Gerdemann JW (1968) Vesicular Arbuscular Mycorrhiza and Plant Growth, Ann. Rev. of Phytopathol, 6: 397-418.

Gerdemann JW, Nicolson TH (1963) Spores of mycorrhizal Endogone species extracted from soil by wet-sieving and decanting, Trans. Br. Mycol. Sos. 46: 235-244.

Ghosh P (2017) Vesicular-arbuscular Mycorrhizal studies of select ed Medicinal Plants of Southwest Bengal and its impact on yield, Ph.D. Thesis (Unpublished), V.U., Midnapore, W.B.

Ghosh P (2021) Eco-friendly AM fungal bio-fertilizer production and Application in Your Home or Kitchen Garden with organic farming, Environment and Development Webinar Lecture 2(2), Organised by-Dept. of Botany, GGDC Lalgarh, Jhargram & Dept. of Botany, SBM, Kapgari, Jhargram, 28th August, 2021, 7:00 p.m to 8:45 p.m (Online).

Harley JL, Smith SE (1983) Mycorrhizal Symbiosis, Academic Pres London, 483.

Phillips JM; Hayman DS (1970) Improved pro**cedures for** clearing roots and staining parasitic and VAM fungi for rapid assess ment of infection. Trans Brit.Mycol. Soc. 55: 158-161.

Utobo EB, Ogbodo EN, Nwogbaga AC (2017) Techniques for Extraction and Quantification of Arbuscular Mycorrhizal Fungi, Libyan Agriculture Research Centre Journal International, 2(2): 68-78.