VAMF spore diversity of Jhitka Forest floor under proposed Jhargram District in West Bengal, India

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Abstract- *Vesicular Arbuscular Mycorrhizal Fungi (VAMF) are ubiquitous in distribution though their density become lowers due to conversion of land to degraded kind and havoc use of chemical fertilizer with huge applications of chemical pesticides and insecticides in field. Another fact is that high tillage and creation of water logged condition that diminishes the growth of the same fungi in and around the cultivated land. Forest is a natural land that protects its biodiversity obviously the soil microorganisms and therefore showed heavy number of VAM fungal spores during winter in compare to the land of degraded and cultivated one in the study. The present study is therefore a study of VAM fungal spore density in natural forest, degraded land and cultivated land in Lalgarh of Paschim Medinipur District. Some species under 5 genera of VAMF have been isolated from the Lalgarh areas of Proposed Jhargram District in West Bengal, India. Here Glomus is dominat genus over the other 4 genera.*

Keywords- VAM Fungal spore density, Lalgarh Forest, Degraded land, Cultivated land.

I. INTRODUCTION

Vesicular Arbuscular Mycorrhizal (VAM) fungi are the most common type of beneficial fungi and most ubiquitous in their distribution over the globe [1, 2]. They are associated with almost all land plants in an ecosystem [3-5]. Over the last decades, there has been growing appreciation of the importance of VAM fungi on terrestrial ecosystems [6-8] as they showed natural infection over 80% of vascular plants. Vesicular Arbuscular Mycorrhizal (VAM) fungi play a major role in soil fertility, nutrient acquisition and transport [7] especially uptake of phosphorus from the soil and thereby enhancing plant vigour [8], enhance growth, yield, provide greater resistance to plant diseases [9] and increase tolerance to drought, salinity and unnatural stress imposed by several factors [10]. The soil rhizosphere is a habitat of complex interactions between plants and microbionts in which environmental factors such as soil physico-chemical parameters as well as fertilizers or cultivation practices may have large effect on microbial communities. The rhizosphere, where VAM fungi and soil organisms coexist side by side and constantly change the non linear environ because of several altered factors. The activity of rhizosphere-inhabiting microorganisms exerts a significant effect on plant health and give support better to work more. Depending on the type of interaction between two different symbionts and the environment, the degree of spore production by VAM fungi varies.

In general variation of spore density in rhizosphere soil varies with the variation of seasons. Seasonal influence affects the spore production and even colonization in different host plants under field conditions, depending on the efficacy of indigenous fungi. Therefore, there is a need to take a close look at the nature of natural processes that help to increase the forest crop yield and quality with more efficient use of nutrient inputs, reduced need for pesticides and insecticides under nursery condition followed by field including horticultural and agricultural crops. Vesicular Arbuscular mycorrhizal fungi, the “hidden heroes” of nutrient deficient soils especially phosphorus can provide support for management of nutrients and maintenance of better crop growth. Because of the public concerns about the side effects of agrochemicals, more attention is now being given to research areas concerning biological balance in soil, microbial diversity or microbial dynamics in soil, health support and better adaptability through the change of the soil greedily from microhabitat to macro-habitat. Therefore, the study of spore interactions in the mycorrhizosphere is an interest topic of current concern. Despite the importance of mycorrhiza in agriculture and floriculture, little work has been done regarding their distribution and diversity in the rhizosphere soil associated with the forest crop plants and horticultural plants so the present study have been taken in to consideration. It will be helpful to the researchers working in this field and may be a first time study as preliminary one to give better understanding between two different ecosystems side by side. Hope that future study and research will take the creamy part to isolate VAM fungi and spores from soil to make bio-fertilizer in a global basis and solve a crucial problem to produce eco-friendly procured crops in different field of biology.

II. STUDY AREA

Study area was taken as Natural forest in Jhitka under Binpur-I community development block of Jhargram sub-Division in Paschim Medinipur District which will come very soon under Jhargram District of West Bengal State in India. Other sites were degraded land and paddy field from the nearby forest. It was a lower tract of Chotanagpur plateau with lateritic red soil along with alluvial substances in a high and low ridge stratum [11, 16].

III. MATERIAL AND METHODS

The present study was carried out in three eco-climatic fields like natural forest Jhitka, agricultural crop land and degraded land nearer to crop land in Binpur-I community Development Block of Paschim Medinipur District. The site of the forest was Jhitka under Medinipur Forest Division [11-13, 16] and degraded land was taken from river side along with crop filed like paddy field produced single time crop in a ridge of a river Bank Kansai (Kanswabati) flows towards Dherua of Paschim Medinipur District in West Bengal. Samples were collected at different months during winter starting from December 2016 to February 2017 with 15 days intervals. The winter temperature goes from 9˚C to 10˚C. Rhizosphere soils of three fields and 4 stations each were collected from randomly designed selected sites. Four 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 as soil moisture content (%) and soil reaction (pH) were done using dry weight method and pH meter.

Vesicular Arbuscular Mycorrhizal (VAM) spore density was calculated from the rhizosphere soil samples using 100 grams soil samples for each sample. Three replicas were used and then mean was taken to determine the number month wise. From the month wise data mean was calculated to draw a final conclusion following multiplication by 10 as the soil was 100gm. Wet sieving and decanting technique was used [15] 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 VAM fungal spores per 10 grams 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 and identified according to their spore morphology by using taxonomic key [17, 18]. The qualitative estimation was expressed as percentage frequency occurrence of VAM fungal species. Other literatures used were 19-35 published time to time.

IV. RESULTS AND DISCUSSION

The data on rhizosphere soil analysis shows that the soil pH was acidic in nature (6.8) and range varied from 6.8 to 6.9 i.e. little variation thereby, indicating no major variation from degraded to natural sites via agricultural land to affect the plant growth (Table 1). Moisture content varied from 4-14% in different types of study soil.

The VAM fungal spores isolated from the present soils during the seasonal survey exhibited the association of many species under 5 genera. Among them isolated Glomus represented higher density over other species under 4 genera, whereas genus, Acaulospora represented second dominated species. Other genera found were Gigaspora, Sclerocystis and Scutellospora 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 VAMF spore density was observed in forest rhizosphere soil than degraded than paddy field (Table 2).

Table No 1.Soil pH of study sites at Lalgarh of Paschim Medinipur, West Bengal

Types of Study Soil	Moisture Content % (range)	Mean Soil p^H
1. Natural Forest	7% to 14%	6.8
2. Degraded Land	4% to 12%	6.9
3. Paddy Field	5%-12%	6.8

Table No 2.Vesicular Arbuscular Mycorrhizal Fungal (VAMF) Spore density in Rhizosphere soil

Type	Sample No.	100 BSS Mess Sieve	<100 BSS Mess Sieve	VAM Spore in 10 gm Rhizosphere soil	
				Spore no. in samples	Mean spore number
Forest (Jhitka)	1.	6	124	130	128.75
	2.	6	98	104	
	3.	3	253	256	
	4.	2	23	25	
Rice field	1.	6	17	23	22
	2.	5	14	19	
	3.	6	19	25	
	4.	5	16	21	
Degraded	1.	2	3	5	7
	2.	2	5	7	
	3.	3	5	8	
	4.	2	6	8	

N.B.: Per 100 gram rhizosphere soil therefore contains 1280, 220 and 70 number of VAMF spores during monsoon. This indicates forest soil having maximum spore density than rice field than degraded land.

V. CONCLUSIONS

The present study shows good association of VAMF spores in natural forest soils during monsoon. The other two types of soil show less to lesser number as the soil was amended by chemical fertilizers as well as rapid applications of chemical insecticides and pesticides successively during cultivation. This indicates forest soil is a good repository of VAMF species which exhibit rapid function of the natural ecosystem and get good yield at the end. Agro-ecosystem of the same area has less to lesser number of VAMF spores which could be the cause for less productivity of agricultural soil. Higher spore density means higher fungal seeds which could be a boon to develop the level of nutrient richness. Not only that it indicates better fungal root contact during monsoon which is a prerequisite for increased benefits of AM symbiosis and better adaptation in the present soils. Seasonal studies round the year or successive years under different management regimes should be incorporated in our research to know the standard of infectivity in different microclimatic sites in the same forest, degraded land and cultivated field. Pot experiment and specific studies should be conducted immediately to isolate the VAMF spore to prepare the VAM Bio-fertilizer in near future.

Fig. Diversity Of Arbuscular Mycorrhizal Fungal Spores (Amfs) Of Lalgah Forest (A Conservatory Of Potent Biofertilizer Producing Organisms For Future Use)

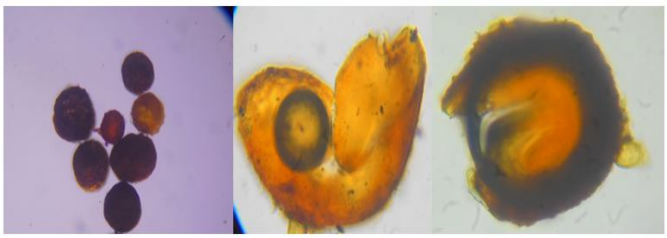

Fig. 1. Glomalean spores as Bio-fertilizer Fig. 2. Gigaspora sp. Fig. 3.Gigaspora sp.

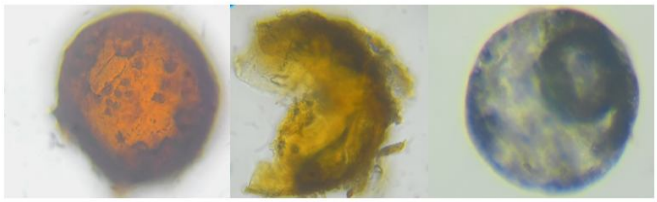

Fig. 4 Acaulospora sp. Fig. 5 Acaulospora sp. Fig. 6 Scutellospora scutata

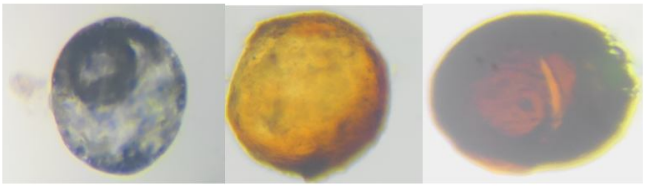

Fig. 7.Scutellospora scutata Fig. 8.Gigaspora margarita Fig. 9. Gigaspora sp.

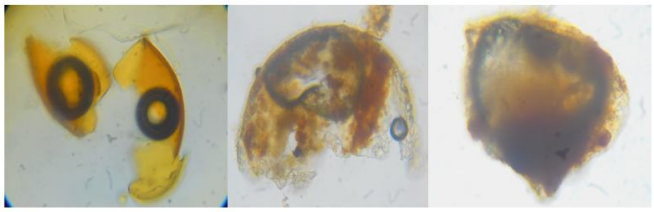

Fig. 10.Gigaspora margarita Fig. 11.Scutellospora sp. Fig. 12.Scutellospora sp.

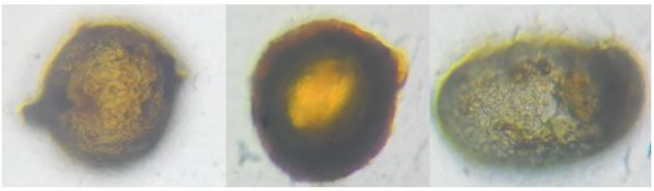

Fig. 13.*Scutellospora* sp. Fig. 14.*Glomus* sp. Fig. 15.*Scutellospora* sp.

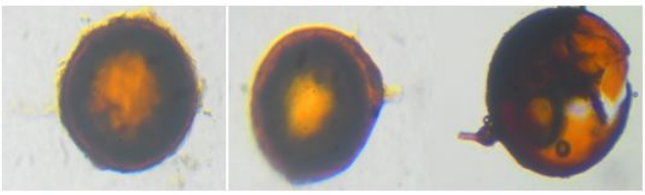

Fig. 16.Glomus sp. Fig. 17.Glomus sp. Fig. 18.Gigaspora albida

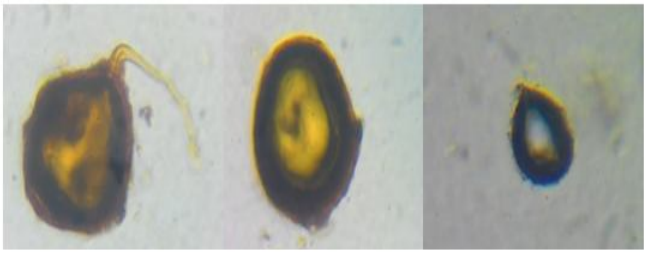

Fig. 19.*Glomus* sp. Fig. 20.*Glomus* sp. Fig. 21.*Glomus* sp.

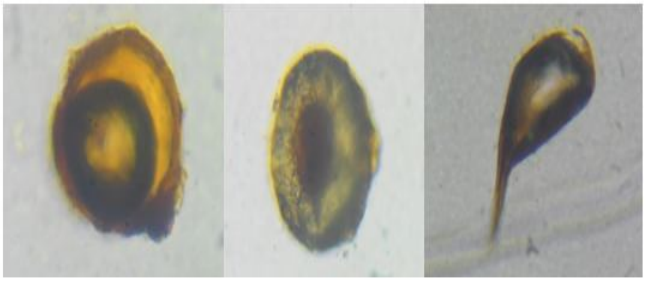

Fig. 22.Glomus sp. Fig. 23.Scutellospora sp. Fig. 24.Sclerocystis sp.

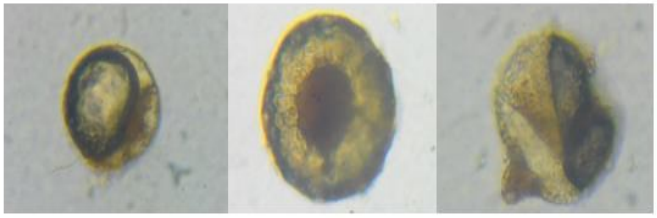

Fig. 25.Scutellospora sp. Fig. 26.Scutellospora sp. Fig. 27.Scutellospora sp.

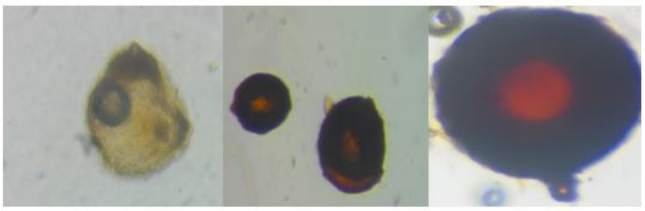

Fig. 28.Scutellospora sp. Fig. 29 .Gigaspora spp. Fig. 30.Gigaspora sp.

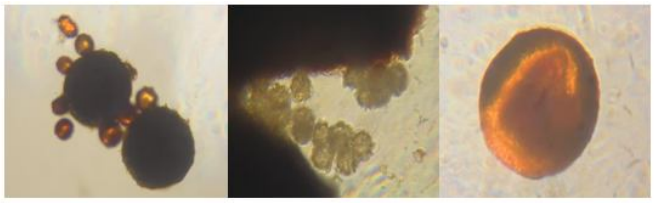

Fig. 31.Scutellospora nigra (Large) Fig. 32.Sporocarp with spores Fig. 33.Glomus sp.

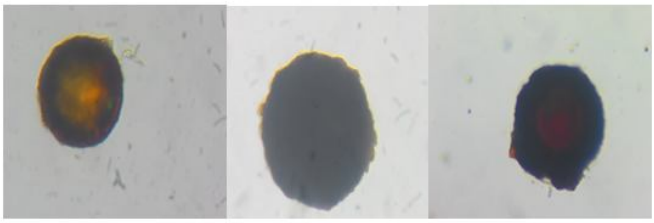

Fig. 34.Glomus sp. Fig. 35.Scutellospora nigra Fig. 36. Glomus sp.

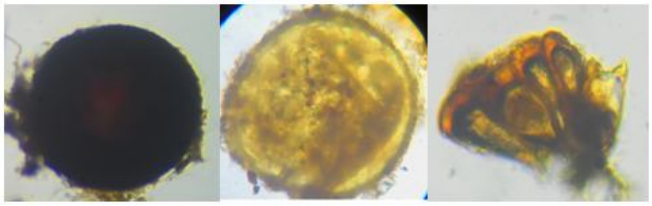

Fig. 37 *Scutellospora* sp. Fig. 38.*Acaulospora* sp. Fig. 39.*Sclerocystis* sp.

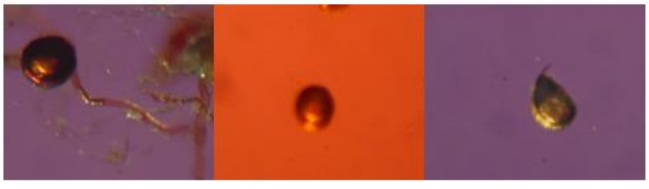

Fig. 40.*Glomus aggregatum* Fig. 41.*Glomus* sp. Fig. 42.*Glomus* sp.

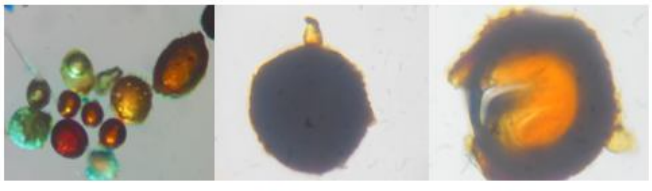

Fig. 43.Potent bio-fertilizer Fig. 44.*Gigaspora* sp. Fig. 45.*Gigaspora* sp.

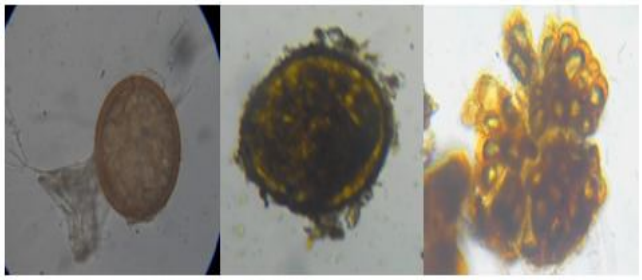

Fig. 46.*Acaulospora* laevis Fig. 47.*Acaulospora* sp. Fig. 48.*Sporocarp* of Sclerocystis

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