Vesicular Arbuscular Mycorrhizal Status on Some Medicinal Plants At Kaluasarh of Nayagram Block Under Jhargram District of West Bengal, India

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Abstract- *The present study was done with the aim to represent data on Vesicular Arbuscular Mcorrhizal (VAM) status of different medicinal plants available in the forest of Kaluasarh areas of Nayagram under Southwest Bengal. Kaluasarh is a sacred grove; within Nayagram area of Jhargram District which is coppice sal (Shorea robusta) dominated dry deciduous forest. Medicinal plants of 41 species studied well after critical analyses. All 41 root samples of different medicinal plants showed intercellular hyphae, arbuscule, and vesicles round the year. Some of these showed coiled hyphae also. Spores isolated from rhizospheric soil of studied samples showed spores of Glomus, Acaulospora, Gigaspora, Paraglomus and Scutellospora, in which Glomus sp was found most common. The VA-mycorrozal root colonization, spore population, species richness and species diversity altered with seasons as well as with plant species. Highest root colonization percentage was found during monsoon and highest rhizospheric spore population was found during winter. As there are 7 types of mycorrhizal fungi currently recognised but the present study focused on vesicular arbuscular mycorrhizal fungi and its association with some important forest living medicinal plants.*

Keywords- Arbuscular mycorrhizal status, colonization, medicinal plants, spore diversity.

I. INTRODUCTION

Lateritic South west Bengal has a vast tract of s*al* (*Shorea robusta)* dominated dry deciduous forest area. Its ground area is covered with variety of important herbaceous medicinal plants. Some plants are annual and some are present throughout the year. Medicinally important trees are also there. These medicinal plants have great importance due to their tremendous potential in modern and traditional medicines. Indian system of medicine uses 25,000 plant species belonging to more than 1000 genera [1] among them about 25% species are used by the industries. Herbal drugs obtained from plant parts are believed to be much safer than chemical drugs [2] and has been proved in the treatments of various ailments .According to WHO nearly 80% of population in developing countries like India consume traditional medicines for sustaining health and vitality. Medicinal plants have been identified as one of the thrust areas by the Ministry and different programmes have been initiated for conservation of medicinal plants found in the forests and protected areas as well as cultivation of these plants in the degraded forest areas.

To improve the quality of plant drugs and increase production of active principles it is necessary to improve the health of plants. Fertilizer is the only way to cultivate medicinal plants in proper way. Chemical fertilizers are costly and hazardous to health and environment. So, the time comes to apply bio fertilizer to improve the plant health and productivity and at the same time improve the quality of production. Since few decades arbuscular mycorrhizal (AM) fungi has emerged as potential bio fertilizer (3, 35). It is cheap, environmental friendly and alternative of costly, hazardous chemical fertilizer [4]. Mycorrhiza is the mutualistic symbiotic association (non-pathogenic) between soil-born fungi with the roots of higher plants [5]. Mycorrhizae are found in a wide range of habitats usually in the roots of angiosperm, gymnosperms and pteridophytes. About 80% of all terrestrial plant species form this type of symbiosis [6] and 95% of the world's present species of vascular plants belong to families that are characteristically mycorrhizal [7]. VA-mycorrhizae increase tolerance to adverse soil conditions, influence response to several climatic conditions and increase plant productivity and are important for natural and managed ecosystems [8]. Mycorrhiza plays a very important role on enhancing plant growth and yield due to increase in supply of phosphorus to the host plant from the residing soil.

Mycorrhizal plants can absorb and accumulate several times more phosphate from the soil than non-mycorrhizal plants [9,40].

Mycorrhiza increase root surface area for water & nutrient uptake and same time give resistance against some root diseases. Arbuscular Mycorrhizal fungi are one of the important components of rhizospheric ecosystem, because they play an important role in establishing of plant community [36]. Vesicular Arbuscular Mycorrhizal fungi (VAMF) acts as bio-fertilizer and have the unique ability to convert nutritionally important elements from unavailable to available form through biological processes [10]. Plants with VA-myccorrizal association will have higher efficiency for nutrient absorption, such as nitrogen, phosphorus, potassium, calcium, magnesium, zinc and copper [11, 4]. At the same time VAM increases plant resistance to draught [12].There are so many reports of Vamyccorrhizal association with medicinal plants [(10, 11, 12, 16, 17, 18, 19, 31, 32, 33, 34and 40)]. Associated VAM funguses with the medicinal plants not only enhance the growth of those medicinal plants but also improve the active principle contents of plants or plant parts [(13, 14, 15 and 16, 36)].

The study site is situated on the bank of river Subarnarekha which is *Sal* dominated with potential natural medicinal plants. Present study is important one since literature perusal did not show any authentic study regarding VAM status of this unique geographical area. Once inventoried, the same can be used for improvement of cultivated medicinal plants and their active principle in Lateritic South West Bengal, India.

II. MATERIALS AND METHODS

Study area:

The study site was Nayagram which is situated aside the bank of the river Subarnarekha and a Plain area with lateritic *Sal* dominated dry deciduous forest. The altitude is above mean sea level. The study Spot was Kaluashar area of Nayagram which is situated in between 22 º 01´ 55´´ N and 87 º 10´ 41´´ E. The spot is 6 km away from Nayagram forest range office. The temperature is in between 12 to 38 degree centigrade and the average annual precipitation is 2120 mm.

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Sampling of roots and rhizospheric soils:

Available and easy to uprooting medicinal plants with their intact roots and rhizospheric soil up to 10 cm depth was collected. Periodic survey was undertaken to study the seasonal variations of mycorrhizal fungi and status of the same. Based on the climate three seasons were recognised. Monsoon (July, August, September and October), winter (November, December, January and February) and summer (March, April, May and June).

Fine feeder roots of the medicinal plants were collected and cut into approx. 1cm. Fragments was washed under tap water properly. Root samples were taken into labelled glass test tubes and 20% KOH solution added to them so that samples were immersed into the solution properly. The test tubes were kept in the laboratory for three days. The cold treatment is though time consuming at the same time labour saving and easy [20, 21]. After three days roots were taken in nylon tea-sieves and washed under tap water. Then these pieces were soaked in dilute HCl sol (1% to 3.5%) for 3-4 minutes and again washed in tap water. Cleared root segments were stained by writing ink (Camel, Royal Blue) as a dye. The staining solution consists of 5% ink diluted in vinegar (5% acetic acid) solvent [21, 22 and 23]. The samples with stain may be kept in the same condition for one day or can be observed after 30 minutes after rinsing with acidified water. Root segments if still remain pigmented after cold treatment then it is necessary to place the root segments in freshly prepared alkaline H_2O_2 Solution at room temperature for 10 to 20 minutes or until roots are bleached [21]. Alkaline H_2O_2 is made by adding 3 ml of NH_4OH to 30 ml of 10% H_20_2 and 567 ml of fresh tap water [21]. Staining of VA mycorrhizae with Ink and vinegar is a low- budget, non toxic, non hazardous technique which gives excellent staining results [21, 24].

Rhizospheric soil samples were collected in clean plastic carry bags with tag. Each soil sample was spread on clean news paper and was allowed to dry in air under shade of net house of Vidyasagar University. Pebbles and other unwanted matters were removed. Large lumps were broken with wooden roller or hand. After grinding soil samples were sieved through flower sieves and fine soils were stored in clean plastic carry bag with tag /Labelle for spore estimation and soil analysis in room temperature.

Estimation of root colonization:

VA-mycorrizae colonization in roots was assessed following slide method [(25, 26)] stained root pieces of app. 1cm length were randomly placed on slide in groups of 5.to.observe hyphae, vesicles, arbuscule and other related structures under light microscope (15×10), the root pieces were mounted in lacto phenol or 50% glycerine. It is necessary to press gently the cover slip to flatten the root pieces.

The percentage of AM infection was calculated using the formula:

Percent of root colonization= Number of root segments colonized/Number of root segments observed x 100

Spore separation and quantification:

Quantification and separation of VAmycorrhizal spores from each medicinal plant rhizospheric soil sample was done by using wet sieving and decanting method [27,39]. From each soil sample 100 gm soil was taken and mixed with 1L normal tap water in large beaker and stirred by glass rod until all the aggregates dispersed to leave a uniform suspension. Heavier particles were allowed to settle down. The suspension was passed through stack of sieves, 710µm, 150µm, 75µm, 45µm and 32µm consecutively for several times repeats. The residues of respective sieves were collected in separate beaker. Then the aliquots were passed through filter paper placed in a glass funnel. To accumulate spores in a single circle clear water drops should be tickled through dropper. Now the filter papers placed in wet Petridis and spores were counted and observed through stereomicroscope (×40). Total spores were counted by adding the spore numbers of each respective filter paper spores. Spore density was calculated by counting the spores in the 100gm of soil. Spores were separated wooden dowel and mounted in lacto phenol for temporary work. For permanent slide preparation for further work spores were mounted in Polyvinyl –alcohol-lacto-glycerol. Sometimes glue was used for the same purpose in absence of PVLG.

Identification of VA-mycorrhizal spore:

Based upon hyphal attachment colour, size, shape, structure and compound microscopic character spores were identified. For identification and nomenclature INVAM's World Wide Web site at http:/invam.caf.edu was used. In this present study unexplored lateritic Sal dominated forest floor near Kaluasarh was taken. Plant samples and rhizospheric soils of the study site were collected every month's interval for two years.

III. RESULTS AND DISCUSSION

A total 41 medicinal plant species were screened for VA-mycorrhizal colonization in Kaluasarh sacred grove area. Among them 41 host species belong to 39 genera under 30 different families (Table 1). All the plants were found myccorizal. VA-mycorrhizal colonization was indicated by the presence of hyphal networks, arbuscules, vesicles, interradicular vesicles (IRVs) and coiled hyphae. Highest percentage of colonization showed in rainy season and lowest in summer as the result is similar to the result of Bouamari *et al.* [28]. Spore density increased to its peak in winter and least in rainy seasons followed by Sambandan [29]. Plants like *Cissampelos pareira, Rungia pectinata, and Smilax zeylanica* showed high % of infection (99%) during monsoon and *Blumea lacera* showed highest % of spore density (280) per 100 gm rhizospheric soil during winter (Table 2). Temperature and moisture fluctuations with different seasons influence the AM spore population and root colonization directly or indirectly [13]. The VA-mycorrhizal spore count has showed no significant or positive correlation with the root colonization percentage [12].

The spore density was in between 74 to 280/100gm soil. The major population of VAM fungi was *Glomus* sp followed by *Scutellospora*, *Aculospora* and *Gigaspora*. The predominance of various *Glomus* spp. seems to be general observation reported under curtained ecosystem by others also and at the same time in case of medicinal plants also [12,19, 29 and 30]. *Glomus* has high adaptive mechanism for associations with various medicinal plants of deciduous lateritic *sal* dominated Southwest Bengal forest floor as well as in agricultural land of the same site [37, 38].

Table 1 Important Medicinal Plants of Kaluasarh at Nayagram, Jhargram, West Bengal, India

Sl. No.	Name of plant	Family	Parts used	Uses	Active principle
1.	*Aegle marmeolos* Corr. (Beng.-Bel)	Rutaceae	Fruit pulp and Leaves.	Fruit pulp is usedin Chronic diarrhea, dysentery, Half ripe fruit is used as an astringent, digestive, stomachic and in diarrhea.	Furoquinolin, furo-coumarins.
2.	*Amorphophalus sylvaticus* (Roxb.) Kunth. Syn.: *Synantherias sylvatica* Schott. (Beng. -Ban oal)	Araceae	Corm	Used as chemical medicine called madanmast	Phenolic compounds, glycyrrhizin

3.	*Aristolochia indica* L. (Beng.-Iswarmul)	Aristolochiaceae	Leaves,bark,stem and root	Juice with honey used against leucoderma,used against fever,arthritis and bowel complaints	Alkaloid aristolochine
4.	*Azadirachta indica* Adr. Juss.(Beng.-Neem)	Meliaceae	All parts	Anthelmintic,carminative expectorant, leaves used in skin diseases,seed oil used for killing lice	Alkaloid azadirachtin
5.	*Blumea lacera* DC. (Beng.-Kuksima)	Compositae/Asteraceae	Leaves	Juice of leaves is anthelmintic, diuretic, stimulant, and febrifuge	Apinene, Humulene, E-b-farnesene
6.	*Chlorophytum tuberosum* (Roxb.) Baker (Beng.-Musli)	Antheriaceae	Tubers	Used as aphrodisiac and tonic, to treat physical illness.	Steroids, saponin, triterpinoids, glycosides and alakloids.
7.	*Cissampelos pareira* L. (Beng.-Padh)	Menispermaceae	Dried roots leaves	Used in diarrhea, dysentery, colic pains, cough and urinary troubles.	Alkaloid bebeerines or pelosine: Hayatine.
8.	*Cissus quadrangularis* L. (Beng.-Harjora)	Vitaceae	Stem.	Plant pest used to join broken bone	Phytosterols, flavonoids
9.	*Clerodendrum viscosum* Vent. (Beng.-Ghentu)	Verbenaceae	Leaves roots	Locally used over boils and certain skin diseases, also anthelmintic, antiperiodic	Steroids, flavonoids, saponins
10.	*Commelina obliqua* Vahl.	Commelinaceae	Leaves	Juice of leaves used to treat insect bites.	-`
11.	*Croton bonplandianum* Baill. (Beng.-Banlanka/Churchri)	Euphorbiaceae	Whole plant	Extract is useful as hypotensive and spasmolytic	Pyrrolizidene alkaloids such as mucronatin, monocrotaline
12.	*Curculigo orchioides* Gaertn. (Beng.-Talamuli)	Hypoxidaceae	Rhizome.	Alterative, appetizer aphrodisliac,carminative,demulcent, diuretic.	phenolic compound Curculigoside
13.	*Desmodium gangeticum* DC. (Beng.-Salpani)	Fabaceae	Roots and Seeds.	Used in febrifuse and anti-catarrhalic medicine. It has also antipyretic property.	Alkaloids, terpenopids, phenols, steroids and tannin.
14.	*Dioscorea bulbifera* L. (Beng.-Banalu)	Dioscoreaceae	Tuberous roots	Used o treat ulcers, piles and syphilis, anti-tumour, anticancer suppressing activity.	Stigmasterol, mono-arachidin, dioscorin, diosbulbin-B, D.
15.	*Dioscorea triphylla* (L.) Amoen. (Beng.-Churka alu)	Dioscoreaceae	Tuber	Used to treat indigestion, having anticancer suppressing activity.	Steroids, alakaloids and glycosides.
16.	*Elephantopus scaber* L. (Beng.-	Asteraceae	Leaves and roots	Decoction used for diarrhoea, dysentery and pains in stomach. It	Terpenoids, flavonoids,

	Hatikan/Gobhi)			has anti-bacterial, anti-viral, anti-tumour and hepatoprotective properties. It balances the blood pressure also.	glycosides, alkaloids, quinines, phenols, tannin and saponins. elephantopin
17.	*Elsholtzia patrini* Garcke. (Beng.-Sedok)	Lamiaceae	Leave	Oil of leaves is used in medicine which is aromatic.	beta-dehydroelsholizione, Elghotlzia ketone, d-carvone.
18.	*Fimbristylis cymosa* R. Br.	Cyperaceae	Whole plant	Used against snake bites, antimicrobial, anti-diarrhoeal.	Alakaloids, glycosides and saponins
19.	*Flacourtia vulgare* Mill. (Beng.-Baichi)	Flacourtiaceae	Leaves.	Leaf juice having anti-diabetic effect	Alkaloids, tannins, saponins, flavonoids, glycosides, phenolic compounds, triterpenoids and steroids.
20.	*Gardenia gummifera* L. (Beng.-Bon Gandharaj)	Rubiaceae	Bark and gum-resin.	antispasmodic, carminative, anthelmintic and antibacterial Gum-resin is used as carminative, stimulant and in dyspepsia.	Gardemin, Oleanomic aldehyde and nevadensin
21.	*Hemisdesmus indicus* L. (Beng.-Anantamul)	Asclepiadaceae.	Roots	Roots are used as substitute of Sarsaparilla; as tonic, diuretic, diaphoretic and demulcent	p-methoxy salisylic aldehyde, coumarins, flavonoids, triterpenes, pregnane glycoside, polyphenols, and sterols
22.	*Holarrhena antidysenterica* (L.) Wall. Ex Dc. (Beng.-Kurchi)	Apocynaceae.	Leaves, bark, seeds, root (Bark).	Used to cure dysentery, and diarrhoea.	Bark contains Conessine, Kurchine, Kurchicine, holarrhimine, conarrhimine, iso-conessimine, conimine, holacetin and conkurchin
23.	*Ichnocarpus frutescens* Ait. & Ait. (Beng.-Dudhilata)	Apocynaceae.	Roots, leaves	Used to treat cough, thirst,vomiting,fever,biliousness , decoction used as nervous	Alkaloids, glycosides, steroids,

				debility. Leaf paste used against skin diseases. Plant paste used on fractured bones.	flavonoids and tannins
24.	*Lygodium japonicum* (Thunb.)Sw. (Beng.-Berajal)	Lygodiaceae-A fern.	Whole plant	Decoction of plant parts (vegetative and spores) is used as diuretic and cathartic.	Quercetin
25.	*Meyna laxiflora* Robys. Syn.: *Vanguiria spinosa* Roxb. (Beng.-Maynakanta)	Rubiaceae.	Fruits.	Dry fruits is used for boils and dysentery	Glycosides, alkaloids, steroids, tannins, saponins, gums, terpenoids, mucilage etc.
26.	*Mimosa pudica* L. (Beng.-Lajjwati)	Mimosaceae.	Leaves, Seeds.	Used as sedative and laxative	Alkaloisds, mimosin, flavonoid, C-glycosides, sterols, terpenoids, tannins and fatty acids.
27.	*Mitrcarpus verticillatus* (Schumach. & Thonn.) Vatke. (Beng.-Papra)/Rubiaceae	Rubiaceae	Whole plant	Whole plant used to treat nausea and vomiting, antimicrobial, antileashmanial.	Phenolics and flavonoids
28.	*Mollugo lotoides* (L.) O. Kuntze (Beng.-Gimesak)	Molluginaceae.	Whole plant.	Dried plant is used in diarrhoea; cure for boils, bilious attacks and for wounds and pains in the limbs.	Saponin, flavonoids
29.	*Mollugo pentaphylla* L. (Beng.-Ghoragime)	Molluginaceae	Whole plant	Stomachic, aperients, antiseptic and emmenagogue, and is used in poultice for sore legs.	Saponin, carotine
30.	*Ocimum americanum* L. (Beng.-Bantulsi)	Lamiaceae.	Seeds, leaves.	Seeds are used in dysentery and chronic diarrhea, leaves are aromatic expectorant, stomachic and carminative	Methyl havicol, eugenol, limonene
31.	*Olax scandens* Roxb. (Beng.-Vaduriara)	Olacaceae.	Bark.	Used in anaemia, stem bark also used to cure fever and cough.	henolics and alakaloids
32.	*Pedalium murex* L. (Beng.-Baragokhur/Baghnak)	Pedaliaceae.	Fruits.	Seeds used to treat urinary troubles.	Alkaloids, flavonoids, steroids, fixed oils and fats, glycosides in bark
33.	*Phyllanthus fraternus* Webster (Beng.-Bhuiamlaki)	Euphorbiaceae	Whole plant, roots.	Whole plant used to treat jaundice, ulcers and skin diseases.	Alkaloids, cyanogenic glycosides,

					saponins, tannins and oxalates
34.	*Rungia pectinata* (L.) Nees (Beng.-Nilful)	Acanthaceae	Leaves	Juice of the leaves is given in small pox and has cooling effect, considered cooling and aperients, and is given to relief pain and swellings.	Flavonoids and terpinoids
35.	*Sagittaria sagittifolia* L. (Beng.-Tirusak)	Alismataceae	Whole plant	Corm paste used to treat swellings and to reduce joint pain, having antibacterial activity, rheumatism and in oral diseases.	Sagittine A-D
36.	*Shorea robusta* Gaertn. f. (Beng.- Sal) Fig. 1, 3.	Dipterocarpaceae	Resin	Used in diarrhea and dysentery, and also in ointments for skin diseases.	Alkaloids and flavonoids
37.	*Smilax zeylanica* L. (Beng.- Ramdantan)	Smilacaceae	Roots	Roots are substitute for India Sarsaparila in treatment of veneral diseases, also applied for rheumatism and bloodless dysentery.	Catechin
38.	*Stephania japonica* (Thunb.) Miers. (Beng.-Tejomala)	Menispermaceae	Tuber	Tubers are used for fever, diarrhoea and to stop stomachic	Phenols, flavonoids, alakaloids, saponins and glycosides
39.	*Tamarindus indica* L. (Beng.-Tentul)	Caesalpiniaceae	Leaves and seeds, Flowers.	Fruit pulp is refrigerant, carminative and laxative,infusion of leaves is reported to be cooling and useful in bilious fever, poultice of fresh leaves is useful in swellings and boils, and for relieving pain.	Phenolic compound, cardiac glycosides.
40.	*Vernonea cineria* (L.) Less. (Beng.-Sahadevi)	Asteraceae	Whole plant	Antifilarial, anthelmintic, diaphoretic, diuretic seeds Paste used locally in skin diseases and destroying head lice.	Triterpene, luteolin
41.	*Xeromphis spinosa* (Thunb.) Keay (Beng.- Mainphal/Madan)	Rubiaceae	Fruits	Used as refrigerant, cholagogue.	Glycosides, alakaloids, steroids, saponins

Table 2. VAM Root Colonization % and spore Density/100 gm rhizospheric soils of medicinal Plants available at Nayagram, India

Sl. No.	Name of plant	Season wise root Colonization %			Spore density in 100g rhizospheric soil		
		Rainy season	Winter season	Summer season	Rainy season	Winter season	Summer season
1.	*Aegle marmeolos* Corr. (Beng.-Bel)	72 (72:0)	46	40	100	210	170
2.	*Amorphophalus sylvaticus* (Roxb.) Kunth. (Beng. -Ban oal)	22 (11:1)	Dead plant	Dead Plant	80	75	74
3.	*Aristolochia indica* L. (Beng.-Iswarmul)	50 (19:2)	46	40	80	170	120
4.	*Azadirachta indica* Adr. Juss. (Beng.-Neem)	75 (75:0)	65	60	135	200	170
5.	*Blumea lacera* DC. (Kuksima - Beng.)	92 (92:0)	88	60	135	280	160
6.	*Chlorophytum tuberosum* (Roxb.) Baker (Beng.-Musli)	76 (76:0)	52	40	120	260	155
7.	*Cissampelos pareira* L. (Beng.-Padh)	99 (19:15)	40	32	140	240	190
8.	*Cissus quadrangularis* L. (Beng.-Harjora)	40 (4:1)	34	24	90	200	140
9.	*Clerodendrum viscosum* Vent. (Beng.-Ghentu)	82 (12:1)	72	60	120	220	150
10.	*Commelina oblique* Vahl.	70 (5:1)	PNV	PNV	90	-	-
11.	*Croton bonplandianum* Baill. (Beng.-Banlanka/Churchri)	84 (84:0)	72	68	135	220	170
12.	*Curculigo orchioides* Gaertn. (Beng.-Talamuli)	62 (31:8)	Dead Plant	PNV	120	180	-
13.	*Desmodium gangeticum* DC. (Beng.-Salpani)	47 (45:12)	36	30	90	200	160
14.	*Dioscorea bulbifera* L. (Beng.-Banalu)	98 (49:1)	PNV	PNV	140	-	-
15.	*Dioscorea triphylla* (L.) Amoen. (Beng.-Tinpataalu)	74 (37:2)	PNV	PNV	120	-	-
16.	*Elephantopus scaber* L. (Beng.-Hatikan/Gobhi)	91 (13:10)	48	PNV	131	200	-

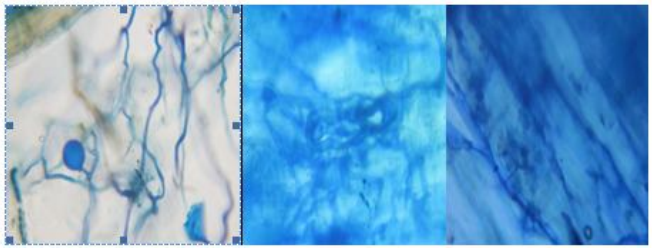
17.	*Elsholtzia patrini* Garcke. (Beng.-Sedok)	96 (46:3)	PNV	PNV	120	-	-
18.	*Fimbristylis cymosa* R. Br. (Beng.-Sulughas)	10 (1:1)	PNV	PNV	70	-	-
19.	*Flacourtia vulgare* Mill. (Baichi -Beng.)	65 (65:0)	30	20	123	176	150
20.	*Gardenia gummifera* L. (Beng.-Bon Gandharaj)	76 (76:0)	68	50	130	210	170
21.	*Hemisdesmus indicus* L. (Beng.-Anantamul)	84 (4:3)	82	71	132	240	200
22.	*Holarrhena antidysenterica* (L.) Wall. Ex Dc. (Beng.-Kurchi)	75 (75:0)	64	60	131	256	189
23.	*Ichnocarpus frutescens* Ait. & Ait. (Beng.-Dudhilata)	58 (58:0)	50	45	122	242	170
24.	*Lygodium japonicum* (Thunb.)Sw. (Beng.-Berajal)	20 (35:1)	12	10	60	150	130
25.	*Meyna laxiflora* Robys. (Beng.-Mynaphal/Mynakanta)	78 (78:0)	70	60	80	180	170
26.	*Mimosa pudica* L. (Beng.-Lajjwati)	70 (7:1)	56	30	130	215	160
27.	*Mitrcarpus verticillatus* (Schumach. & Thonn.) Vatke. (Beng.-papra)/Rubiaceae	91 (42:7)	PNV	PNV	140	-	-
28.	*Mollugo lotoides* (L.) O. Kuntze (Beng.-Gimesak)	12 (12:0)	PNV	PNV	80	-	-
29.	*Mollugo pentaphylla* L. (Beng.-Ghoragime)	10 (10:0)	PNV	PNV	70	-	-
30.	*Ocimum americanum* L. (Beng.-Ban tulsi)	54 (17:5)	PNV	PNV	120	-	-
31.	*Olax scandens* Roxb. (Beng.-Vaduriara)	51 (51:0)	40	24	131	199	156
32.	*Pedalium murex* L. (Beng.-Baragokhur/Baghnak)	92 (41:19)	72	42	140	205	160
33.	*Phyllanthus fraternus* Webster (Beng.-Bhuiamlaki)	34 (34:0)	30	24	70	180	120
34.	*Rungia pectinata* (L.) Nees (Beng.-Nilphul)	99 (99:0)	98	PNV	145	240	-
35.	*Sagittaria sagittifolia* L. (Beng.-Tirusak)	98 (10:3)	PNV	PNV	90	-	-
36.	*Shorea robusta* Gaertn. f. (Beng.- Sal)	40 (7:3)	32	21	70	180	140
37.	*Smilax zeylanica* L. (Beng.- Ramdantan)	99 (99:0)	62	40	145	225	170
38.	*Stephania japonica* (Thunb.) Miers.	62 (62:0)	46	32	97	160	125

	(Beng.-Tejomala)						
39.	*Tamarindus indica* L. (Beng.-Tentul)	78 (78:0)	60	28	80	120	114
40.	*Vernonea cineria* Less. (Beng.-Sahadevi)	75 (75:0)	68	48	130	200	168
41.	*Xeromphis spinosa* (Thunb.) Keay (Beng.-Mainphal/Madan)	68 (68:0)	50	42	120	198	160

N.B: PNV =Plant physically not visible during the season. Value in parenthesis indicates arbuscle and vesicle ratio. As monsoon shows all available plant species, hence arbuscles and vesicles ratio has been done on the basis of common occurrence of species at study site.

IV. PHOTO PLATE

Fig 1 Forest official and 1st author during field,
2. Kaluasarh sacred grove,
3. Forest floor of dry deciduous coppice sal



\ Fig 4. Vesicle in *Aristolichia* root ,
5. Coiled hyphae in *Aristolichia* root,
6. Arbuscles in roots of *Aristolichia* sp.

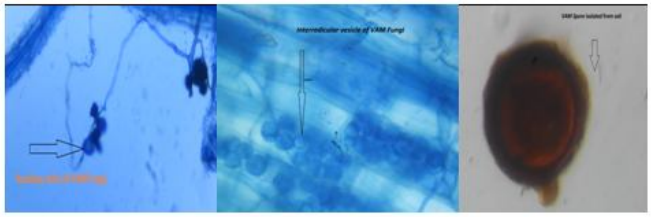


Fig 7. Auxiliary cells of VAM fungi,
8. IRV of VAM fungi,
9. VAM spore isolated from soil of Nayagarm forest.

V. CONCLUSION

Based on this study and investigation, it was not possible to access the host specificity in details of medicinal plants of forests for VAM fungal colonization. So, there is a true scope for further detailed study to compromise the understanding between the AM fungi and host for the specificity of colonization. Not only that there are scopes to study more to know about the VAMF interaction to the medicinal plants along with the effect on enhancements of secondary metabolites particularly the production of active principles. This may be made in a trial basis under controlled condition in pot culture under net house to know the actual deviation found in field under natural condition.

VI. CONFLICT OF INTEREST

Conflict of interest is none.

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REFERENCES

[1] Kartikeyan, B; Joe, M. M and Jaleel, C.A. 2009. Response of Some Medicinal Plants to Vesicular Arbuscular Mycorrhizal Inoculations, *Journal of Scientific Research*, **1**(1), 381-386.
[2] Mitalaya, K.D; Bhatt, D.C; Patet, N.K and Didia, S. K.2003. Herbal remedies used for hair disorders by tribes and rural folk in Gujarat, *Indian journal of Traditional Knowledge*, **2**: 389-392
[3] Dalpe, Y and Monreal, M. 2004. Arbuscular Mycorrhiza Inoculum to Support Sustainable Cropping Systems, Online Crop Management, doi:10.1094/CM-2004-0301-

09-RV.2004

[4] Stivastava D; Kapoor R; Srivastava, A.K. and Mukerji, K.G. 1996. Vesicular Arbuscular Mycorrhiza, an overview, In Mukerji KG (Edn.), Concepts in mycorrhizal research, Kluwer, Dordrecht, pp.1-34.

[5] Sieverding, E. 1991. Vesicular Arbuscular Mycorrhizal Management in Tropical Agrosystems. Technical Co-operation, Federal Republic of Germany Eschborn, ISBN 3-88085-462.

[6] Smith, S E and Read, D. J. 1997. Mycorrhizal Symbiosis, Academic Press, Inc San Diego California.

[7] Quilimbo, O. A. 2002. Functioning of Peanut (*Arachis hypogea* L) under nutrient deficiency and drought stress in relation to symbiotic associations, Ph. D thesis, University of Groningen, The Netherlands, Van Denderen B.V., Groningen.

[8] Brundrett, M; Beegher, N; Dell, B; Groove, and Malajczuk, N. T. 1996. Working with Myccorizas in Forestry and Agriculture, ACIAR monograph 32.374+xp ISBN 1863201815

[9] Verma, N. K. 1998. Effect of VA mycorrhiza on the growth and P uptake in *Eupatorium adenophorum* Spreng. (Asteraceae) grown in soil amended with soluble phosphate, *J. Nat. Bot. Soc.* **52**: 41-45 (printed in India).

[10] Hedge, D.M; Dwived,B. S and Sudhakara, S. N. 1999. Biofertilizers for cereal production in India Review, *Indian J. Agri Sci*, **69**; 73-83

[11] Achakzoi, A. K.K; Liasu, M.O and Popwla, O.J. 2012. Effect of mycorrhizal inoculation on the growth and phytoextraction of heavy metals by maize grow in oil contaminated soil, *Pakisthan Journal of Botany*,**44** (1): 221-230.

[12] Koul,K; Agarwal, S and Rafiq, L. 2012. Diversity of Arbuscular Mycorrhizal Fungi Associated with the Medicinal plants from Gwalior-Chambal region of Madhya Pradesh, India; *American-Eurasian J. Agric.* and *Environ, Sci.*, **12** (8): 1004-1011

[13] Pawaar, J. S. and Kakde, U. B. 2013. Screening of some important medicinal plants and Rhizosphere for arbuscular mycorrhiza of Mumbai Region, *Life Science leaflets*, **8** : 08-18.

[14] Sing, M. Sing, P and Vyas, D.D. 2011.Mycorrhozation in Medicinal Plants, *Mycorrhizal News*, **23**:14-21.

[15] Baylin, G.T.S. 1967. Experiments on the ecological significance of phycomycetous mycorrhizas. *New Phytol.*, **66**: 231-243.

[16] Zubek, S. and Blaszkowski, J. 2009. Medicinal plants as hosts of arbuscular mycorrhizal fungi and dark septate endophytes, *Phytochem.Rev.*, **8**: 571-580.

[17] Hassan, M; Sadaghiani, R; Hossani, A; Mohsen, B; Youness Rezaee, D and Sefidkon, F. 2010. Effect of arbuscular mycorrhizal (AM) fungi on growth, essential oil production and nutrient uptake in basil, *Jopurnal of Medicinal Plants Research* **4** (21): 2222-2228.

[18] Aparna, J and Bagyaraj, D.J. 2007. Response of Kalmegh to an Arbuscular Mycorrhizal Fungus and a Plant Growth Promoting Rhizomicro organism at two Levels of Phosphorus Fertilizer, *American-Eurasian J. Agricu. & Envioron Sci.*, **2** (1): 33-38.

[19] Muthuraj, K, Prasad Joseph, V. J and Nagarajan, N. 2014. Arbuscular Mycorrhizal Fungal Diversity and root colonization of some Medicinal plants Rhizospheric soil of Madayipara Hills, Kannur, Western Ghat Kerala, *World Journal of Pharmacy and Pharmaceutical Science*, **3** (6): 1114-1122.

[20] Zubek, S; Blaszkowski, J; Seidler-Lozykowska, K; Baba, W and Mleczko, P. 2013. Arbuscular Mycorrhizal Fungi Abundance Species Richness and Composition under the monocultures of five Medicinal Plants, *Acta Sci.Pol.,Hortorum Cultus*, **12**(5): 127-141

[21] Utobo,E.B; Ogbodo, E. N and Nwogbaga, A.C. 2011. Techniques for Extraction and Quantification of Arbuscular Mycorrhizal Fungi , *Libyan Agriculture Research Centre journal International* , **2**(2): 68-78.

[22] Mycorrhiza-AM Mannual, INVAM Pdf 17/8/13

[23] Vierheilig, H., Coughhlan, A.P; Wyss and Picge, Y. 1998. Ink and vinegar, a simple staining technique for arbuscular mycorrhizal fungi, *Appl. Environ. Microbial.*, **64**: 5004-5007.

[24] Vierheilig,H.,Schweiger and Brundrett, M. 2005. An overview of methods for the detection and observation of arbuscular mycorrhizal fungi in roots, *Physiologia Plantarum*, **125**: 393-404.

[25] Giovannetti,M and B. Mosse. 1980. An evaluation of techniques for measuring Vesicular Arbuscular Mycorrhizal infection in root, *New Phytologist.* **84:** 489-500.

[26] McGonigle,T.P; Miller, M.H; Evans, D.G.; Fairchild, G.L and Swan, J.A. 1990. A new method Which gives an objective measure of colonization of roots by Vesicular Arbuscular Mycorrhizal fungi, *New Phytol.***115**: 495-501.

[27] Gerdemann, J.W. and Nicolson, T.H. 1963. Spores of Mycorrhizal Endogone Species extracted from soil by wet sieving and decanting, *Transaction of British Mycological society*, **46**: 235-244.

[28] Bouamri, R; Dalpe, Y and Serrhini, M.N. 2014. Effect of seasonal variation on arbuscular mycorrhizal fungi associated with date palm, *Emir. J. Food Agric.* **26** (11): 977-986.

[29] Sambandan, K. 2014. Studies on Arbuscular Mycorrhizal (AM) profiles of costal soils in Karaikal district, U.T of Puducherry, India. *International Journal of Multidisciplinary and Current Research*, **2**: 307-312.

[30] Ram, U. and Bhadauria, S. 2009. Vesicular-arbuscular

mycorrhizal association with some medicinal plants growing on alkaline soils of Manipuri District, Uttar Pradesh, *Mycorrhiza News*, **13**: 12-14.

[31] Gupta, M. L; Khalig, A; Pandey, R; Shukla, R.S; Sing, H. N and Kumar, S. 2000. Vesicular-Arbuscular Mycorrhizal fungi associated with *Ocimum* Spp., *J. Herbs Species Med. Plants*, **7**: 57-63.

[32] Gupta , A. K; Chaturvedi, S and Sharma, A.K 2009. Arbuscular mycorrhizal fungal diversity in some medicinal plants, *Mycorrhiza News*, **20**: 10-13.

[33] Panwara, J and Tarafdar, J. C. 2006. Distribution of the endangered medicinal plant species and their colonization with arbuscular mycorrhiza, *J. of Arid Environ*., **65**(3): 337-350.

[34] Gaur, S. and Kausik, P. 2011b. Influence of Edaphic Factors on Distribution of Mycorrhiza Associated with Medicinal Plants in Indian Central Himalayas, *Journal of Biological Sciences*, **11**(5): 349-358.

[35] Mahmood, I and Rizvi, R. 2010. Mycorrhiza and organic farming, *Asian Journal of Plant Sciences*, **9**(5): 241-248.

[36] Kulkarni, A. 2015. Studies on AM fungal association with certain medicinal plants, *Flora and Fauna*, **21**(1): 103-106

[37] Ghosh, P and Das, D. 2017a. VAMF spore diversity of Jhitka Forest floor under proposed Jhargram District in West Bengal, India, *IJSART*, 3(2): 227-232.

[38] Ghosh, P and Das, D. 2017b. AMF spore density in three agricultural sites in two districts of West Bengal, *IJSART*, 3(5):140-146.

[39] Ghosh, P and Das, D. 2018. Anthill soil is a good repository of VA mycorrhizal spores in Southwest Bengal, Indian Journal of Applied and Pure Biology, 33(2):119-123.

[40] Ghosh, P. 2017. Vesicular-Arbuscular Mycorrhizal studies of selected Medicinal plants of Southwest Bengal and its impact on Yield. Ph. D. Theis Awarded from Vidyasagar University, Midnapore.