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DISTRIBUTION OF ARBUSCULAR MYCORRHIZAL FUNGI ON SOME IMPORTANT MEDICINAL PLANTS OF BANKURA DISTRICT, W.B.

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ABSTRACT : Mycorrhizal fungi are the most significant microbes by virtue of their symbiotic associations with roots of vascular plants and are key components of soil micro biota. Arbuscular mycorrhizal status of forty eight medicinal plants assigned to twenty eight families were studied. The maximum mycorrhization was noted in *Hemidesmus indicus* (92%) followed by *Eclipta alba* (83%). The lowest mycorrhizal percentage was found in *Plumbago zeylanica* (4.2%) followed by *Aerva lanata* (4.8%). Root colonization was found maximum during rainy season. The spore composition varied probably due to their variation in sporulation period. The high moisture and temperature evidently affected sporulation. The study indicated the presence of higher percentage of root colonization among the medicinal plants growing abundantly with wide distribution.

Key words : *Arbuscular mycorrhiza, Medicinal plants, VAM colonization, VAM spore.*

INTRODUCTION

Bankura, the fourth largest district of West Bengal is located in the western part of the state, which is popularly known as 'Rarh' from time immemorial. It forms a part of Bardhaman Division and is situated between 22°38' and 23°38' North latitude and 86°36' and 87°47' East longitude. It has an area of 6881.24 sq km and the total forest area of 1404 sq km is rich in medicinal plants. Medicinal plants have always been a basic resource for human health. Appreciation for the preventative and therapeutic value of herbal remedies, wide accessibility and cultural relevance remains strong in many traditional cultures. Medicinal plants are the potential source for discovery of new products and fine chemicals for drug development and the demand of medicinal plants has been increasing rapidly with the consumption of crude drugs.

Symbiotic association between VAM fungi and higher plants is of great ecological importance in natural and man made biological systems. Vesicular-arbuscular mycorrhizal fungi, form obligate symbiotic associations with the roots and other underground parts of most plants. Mycorrhizal fungal diversity, determining the plant biodiversity, ecosystem viability and productivity and thereby influencing the plant communities by affecting species richness or species evenness have been well documented (Khatun and Chatterjee,2008). The symbiotic association is found to be beneficial to the plants in terms of better nutrient uptake, better water potential and lesser chances of root diseases, which are beneficial to the plants and as such plants with mycorrhizal colonization show more productivity than the non-mycorrhizal plants (Khaliq *et al.*,2001). The role of vesicular arbuscular mycorrhizal (VAM) fungi in enhancing plant growth and improving host resistance against diseases is well documented (Chakraborty and Chatterjee,2007).

There is no study available on the mycorrhizal status of medicinal plants of Bankura district of West Bengal. Keeping this in view, the present study reports the VA mycorrhizal association in some medicinal plants, that grow naturally in and around Bankura town and its adjoining area of Bankura district of West Bengal.

MATERIAL AND METHODS

Roots samples of forty eight medicinal plants were collected from Bankura town and its adjoining area of Bankura district of West Bengal, throughout the three consecutive years from November,2010 to April,2012.

Roots samples were washed thoroughly in water separately to free them of any soil particle. The roots were then cut into 1 cm long pieces. Only fine tertiary roots were taken. The root segments were boiled in 10% KOH and stained by tryphan blue solution following Philips and Hayman (1970). Three observations for each plant species were taken.

Percentage of VAM colonization, presence of vesicle, arbuscle and infected hyphae were recorded in each segment. Percentage colonization of VAM infection of root was calculated as follows.

$$\% \text{ of root colonization} = \frac{\text{No. of mycorrhizal root segments}}{\text{Total No. of root segments observed}} \times 100$$

Rhizosphere soils taken from the roots of different individual's species were used for estimation of spore population. Estimation of spore population was done by wet sieving and decantation technique (Gerdemann and Nicolson,1963). 100 gm of dry soil was mixed in 500 ml of water in large beaker with the help of a brush till all the soil aggregates dispersed to leave a uniform suspension. The heavier particles were allowed to settle for a few minutes and the liquid was decanted through a sieve fine enough to remove larger particles of organic matter, but coarse enough to allow the desired spores to pass through. The suspension that passed through the sieve was stirred well. The heavier particles were allowed to settle for a few seconds and the liquid decanted again through the

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sieves of different sizes process was repeated. Six sieve of different pore sizes (300 µm, 150 µm, 100 µm, 90 µm and 35 µm) were used one after the other, in decreasing order of the pore size. The spores were further filtered with filter paper and observed under stereo microscope. The spore count was taken and the value expressed as number of spore/100 gm of soil.

Table. 1 VAM colonization percentage in roots of medicinal plants and AM fungal spore population in rhizosphere soil.

S.	Family	Plant species	Infection Percentage (VAM)		Vesicle	Arbuscle	Mean spore count per 100g of soil
			Summer	Winter			
1.	Annonaceae	*Annona squamosa*	71±2	48±4	+	+	73
2.	Papaveraceae	*Argemone mexicana*	76±3	59±2	++	+	78
3.	Nyctaginaceae	*Mirabilis jalapa*	61±2	37±5	+	+	70
4.	Amaranthaceae	*Aerva lanata*	13±3	4.8±2	+	-	16
		Alternanthera sessiles	39±2	19±4	+	Rare	44
		Amaranthus spinousus	16±3	5.2±4	+/Rare	Rare/-	26
5.	Plumbaginaceae	*Plumbago zeylanica*	11±2	4.2±5	+	-	18
6.	Tiliaceae	*Corchorus olitorius*	74±2	61±4	+++	+	77
7.	Sterculiaceae	*Abroma augusta*	66±2	42.3±2	+	+	70
8.	Malvaceae	*Abutilon indicum*	71±3	38±3	+	+	80
		Sida cordifolia	79.2±2	41±3	+	+	72
9.	Passifloraceae	*Passiflora foetida*	30.5±4	19.2±1	+	Rare	34
10.	Brassicaceae	*Brassica nigra*	76±4	63.9±2	++	+	76
11.	Fabaceae	*Cassia occidentalis*	79.2±3	66±2	+	+	82
		Crotalaria pallida	66±2	58.2±2	+	+	70
		Desmodium trifoliata	70±2	49.5±3	++	+	73
		Mimosa pudica	60±3	54±2	+	Rare	66
		Tephrosia purpurea	81±4	69±2	++	+	
12.	Lythraceae	*Lawsonia inermis*	51±2	33.1±3	+	-	78
13.	Cornaceae	*Alangium salvifolium*	44±6	31.6±5	+	Rare	56
14.	Euphorbiaceae	*Acalypha indica*	48±2	44±4	+	+	54
		Croton bonplandianum	62.5±3	42±3	+	Rare	68
		Euphorbia hirta	64±2	48±2	+	+	71
15.	Oxalidceae	*Oxalis corniculata*	61±2	53±3	+	+	68
16.	Apiaceae	*Coriandrum sativum*	79±4	61±2	++	+	81
17.	Apocynaceae	*Thevetia nerifolia*	66.5±2	27.4±4	+	-	73
18.	Asclepiadaceae	*Hemidesmus indicus*	92±3	81±2	+++	+	92
19.	Solanaceae	*Solanum nigrum*	71±4	36.6±4	+	+	71
20.	Convolvulaceae	*Evolvulus alsinoides*	79±2	61±3	+	+	84
		Ipomoea obscura	43±4	28±2	+	Rare	39
21.	Verbenaceae	*Lantana camara*	71±2	57.2±5	+	+	78
		Lippia geminata	41±2	30.5±3	+	+	57
		Vitex negundo	61.2±2	48±3	+	+	62
22.	Lamiaceae	*Anisomeles indica*	44.4±4	13.3±4	+	Rare	49
		Ocimum sanctum	58±2	42.2±2	+	+	58
23.	Scrophulariaceae	*Scoparia dulcis*	38.5±4	78±2	+	+	43
24.	Acanthaceae	*Adhatoda vasica*	29.3±2	14±4	+	+	46
		Andrographis paniculata	49.2±4	36±2	+	+	58.2
		Ruelia tuberose	51±2	44.6±6	+	Rare	56
		Rungia pectinata	63±2	44.2±3	+	-	68
25.	Rubiaceae	*Dentella repens*	67±2	35±4	+	+	75
		Oldenlandia corymbosa	47±2	37.2±3	+	+	54
26.	Asteraceae	*Eclipta alba*	83±3	69±2	++	+	89
		Eupatorium odoratum	79±2	49.4±3	+	+	82
		Tridex procumbens	49±3	32.5±4	++	+	70
		Vernonia cinerea	81±2	47.6±5	+	+	83
27.	Commelinaceae	*Commelina benghalensis*	44.2±4	19.5±4	+	Rare	48
28.	Liliaceae	*Asparagus racemosus*	33±2	21±3	+	Rare	38

RESULTS AND DISCUSSION

The percentage of VAM infection, presence or absence of vesicle, arbuscle are presented in Table.1. Among the forty eight medicinal plants studied, all were found to be mycorrhizal. The degree of colonization ranges in between 4.2% to 92%. The lowest mycorrhizal percentage was found in *Plumbago zeylanica* (4.2%), followed by *Aerva lanata* (4.8%). Among the forty eight medicinal plants, significantly highest colonization (92%) was noticed in *Hemidesmus indicus* (92%), followed by *Eclipta alba* (83%). The highest colonization was found in the members of Asclepiadaceae, followed by Fabaceae. Lowest occurrence was observed in Plumbaginaceae, followed by Amaranthaceae and Liliaceae. The distribution and occurrence of VAM fungi differ with change in edaphic factors and type of vegetation. The study revealed that colonization of native VAM fungi was enhanced during late summer months to rainy season, than that of the winter. The type of root system also appeared to influence the degree of colonization. Plants with fibrous root system showed higher degree of infestation, than plants with tap root. Tommerup (1992) stated that the fungi vary in their colonization patterns due to differences in rate of intra-radical growth, amount of hyphae per entry point, and growth of external mycelium along the roots before entry points are formed.

Present study revealed the occurrence of four AM fungal genera *viz.*, *Glomus, Gigaspora, Acaulospora* and *Scutellospora*. The rhizosphere soil of the selected medicinal plants was found to harbour VAM fungi where *Glomus* remains as predominant genus throughout the year followed by Gigaspora. Number of spores of the AM fungi in the soil ranges from 16% to 92%. Highest spore count was recorded in the rhizosphere soil of *Hemidesmus indicus* (92%), while the lowest was recorded in *Aerva lanata* (9%). Host plants have a significant effect on AM colonization, composition and diversity by regulating carbon allocation to roots, producing secondary metabolites or changing soil environmental conditions. Every phase in the life cycle of AM fungi is influenced by plant roots. Actually AM fungi are sensitive to environmental conditions especially soil pH, temperature, soil structure and nutrient level particularly phosphorus concentration plays an important role in the occurrence of AM fungi (Bagyaraj,1991 and Mishra *et al.*,2008). But several reports by different workers showed that there was no relationship between soil type and particular mycorrhizal species (Aggarwal *et al.*,2007). The successful establishment of a VAM infection in a particular soil is dependent on the presence of VAM spores, but is also influenced by factors such as host-plant genetics, endophyte and soil condition (Jakobsen and Heidmann,1989). So VAM fungi may vary with spore germination and root colonization of the host and thus may play an important role in root formation, nutrient cycling, productivity and providing better adjustment to adverse conditions. Higher number of spores in a particular soil also influences the root colonization of the plants growing in that soil.

It is important to note that each fungus represents its own demand for photo-assimilates and the environmental conditions may affect the interactions of these organisms with the roots influencing indirectly the fungal reproductive activity (Lakshman *et al.*,2010). Mycorrhizal fungi may particularly be important for the establishment and early growth of the plants in particular regions where growth and nutrient uptake are seasonal and also dependent on specific mycorrhizal fungi. Mycorrhizal fungi will not prove effective with all plants when the plants have little or no mycorrhizal dependency. Variation in mycorrhizal dependency limits the potentiality of the fungus in improving the plant growth performance (Waddar and Lakshman,2010).

In the present study, the extent of root colonization and spore density showed variations between the plant species. Exploration in root colonization of other medicinal plants of Bankura district is going on. From the survey, it appeared that the species having low level of mycorrhizal association in roots, were less abundant in distribution as observed in nature. The study indicated the presence of higher percentage of root colonization among the medicinal plants growing abundantly with wide distribution. So AM fungal diversity could definitely play a pivotal role in plant biodiversity and ecosystem stability.

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