Biological Forum – An International Journal **14(1): 313-316(2022)**

ISSN No. (Print): 0975-1130
ISSN No. (Online): 2249-3239

Studies on Morphological Characteristics of Arbuscular Mycorrhiza Associated with Forest spp.

Dipake Shital[1*], Ekta D. Bagde[2] and Tini Pillai[3]
[1]M.Sc. Scholar, Plant Pathology Section,
College of Agriculture, Nagpur Dr. PDKV, Akola, (Maharashtra), India.
[2]Assistant Professor (Plant Pathology),
Regional Fruit Research Station, Katol, (Maharashtra), India.
[3]Assistant Professor, Plant Pathology Section,
College of Agriculture, Nagpur Dr. PDKV, Akola, (Maharashtra), India.

(Corresponding author: Dipake Shital)*
(Received 16 October 2021, Accepted 14 December, 2021)
(Published by Research Trend, Website: www.researchtrend.net)

ABSTRACT: Five forest species *viz.* Bamboo, Teak, Eucalyptus, Acacia and Neem were investigated for arbuscular mycorrhizal association and its morphological characteristics isolated AM spore from three different locations *viz.* Nagpur, Ramtek and Umred region. AM spore isolated by using wet-sieving and decanting method. Only one type of AM spore *i.e. Glomus* was associated with all the forest species of three different locations of Nagpur. The shape of *Glomus* sp. was Globose to sub-globose elongated, irregular sometime and colour of *Glomus* sp. was light yellow to bright orange and brown black to dark black at maturity observed. Bamboo showed maximum number of spores in the rhizosphere at three different locations viz. Nagpur, Ramtek and Umred i.e., 18, 20, 23 per 100g soil respectively and maximum per cent root colonization and Neem showed minimum number of spores in the rhizosphere i.e., 8, 5, 7 per 100g soil of Nagpur, Ramtek and Umred, respectively and minimum per cent root colonization. Arbuscular Mycorrhiza colonization varied from 11% to 32%.

Keywords: Forest sp., Arbuscular mycorrhiza, *Glomus*, Rhizosphere, Physico-chemical properties of soil.

INTRODUCTION

Forest trees play vital role in ameliorating the deteriorating environment. They act as dust collectors, air purifiers and noise reducer. They conserve soil moisture, improve general environmental condition, prevent soil erosions and provides wind break and shelter belt and create aesthetic value. In India, area under forest species are 76.5 million ha and Maharashtra 63842 sq. km i.e., 23.3% and 20.75%, respectively. India is placed 8th in the list of top ten forest area (Anonymous, 2017). One of the key players that can help in the conservation of agroforestry is the arbuscular mycorrhiza. Mycorrhiza are species of fungi that associated with plant roots forming a symbiotic relationship with the plants providing sugars for the fungi and the fungi providing nutrients such as phosphorus to the plants. In natural communities approximately 80% of higher plants are obligatorily dependent on fungal association and 18% typically non-mycorrhizal (Trappe, 1987). Vesicular arbuscular mycorrhiza extracts a greater amount of nutrients from the soil such as phosphorous, nitrogen, zinc, boron and increased disease resistance, enhanced water relations and increased soil aggregation (Gerdman 1975, Hayman 1982; Newsham *et al*., 1994).

Mycorrhiza provide wide range of services viz. nutrient uptake, leaching, contribution to soil structure and mycorrhizal fungal networks acting as hyphal highways for bacterial dispersion (Marcel *et al*., 2009). Mycorrhiza able to retard pathogen development in root system due to high chitinolytic activities (Dehne, 1982). About 95% of the species in tropical forest are mycorrhizal in which genus Glomus is dominant. These association is very important from point of survival and growth of forest trees. Mycorrhizal fungi retard the pathogen growth. Mycorrhizal root tissue is more lignified restricts the endophyte to cortex. Vesicular arbuscular mycorrhiza used as biofertilizer for development and growth of plants. Vesicular arbuscular mycorrhiza seems to be effective in overcoming the stress conditions like draught, disease incidences and deficiency of nutrients. Mycorrhiza have extensive host

range benefited from symbiotic fungal association which enhanced plant growth by augmenting nutrient uptake especially phosphorous and provide better condition for the survival of plants under stress condition by uptake of nutrients such as P, Zn, Cu and water. Thus, the present study aimed to know the association and its morphology of such advantageous mycorrhiza with forest species.

MATERIAL AND METHODS

The present investigation was carried out in the Section of Plant Pathology, college of Agriculture, Nagpur, during the year 2019-20. The study was conducted in natural and planted stands of forest sp. located in Nagpur, Ramtek and Umred under Nagpur District of Maharashtra. Roving survey for Bamboo, Teak, Eucalyptus, Acacia and Neem were undertaken to collect 30cm deep rhizosphere soil samples. The roots were collected by digging and tearing the roots up to the base of main stem. Collected root samples from different host were thoroughly washed in tap water to remove soil particles. Selected and cleaned roots were fixed in 4% formaldehyde/acetic acid solution (Johansen, 1940). To observe AM fungus structures within the root, the cortical cells of cytoplasm and phenolic compounds which usually hide them was clear and then differentially stain the fungus tissue. Clearing procedures which use chemical agents to remove cell contents and cell wall pigments are routinely used to view internal features in plant tissues (Gardner, 1975). The roots were cleared for assessment of VAM infection following the method of staining in Trypan blue as described by Phillips and Hayman (1970). Colonization of vesicular arbuscular mycorrhizal infection calculated by given formula:

Root colonization % =

$$\frac{\text{No. of root segment colonized}}{\text{Total no. of root segments observed}} \times 100$$

The VAM spores were separated out by wet- sieving and decanting method given by Gerdmann and Nicolson in 1963 and spores were identified by using as given in description of INVAM (2019) and using keys adopted by Schenck and Perez (1987). The spore was counted by given formula:

Number of spore in 1g soil = Number of spore counted / Weight of soil

RESULTS AND DISCUSSION

The morphological characterization of arbuscular mycorrhiza in rhizosphere soil of forest sp. was presented in Table 1. The observation regarding colour of spore, orange brown colour was observed in the isolate collected from Bamboo (Nagpur, Ramtek), Eucalyptus (Umred) and Acacia (Nagpur). Black colour spore seen at maturity of *Glomus* was only observed in Bamboo of Umred location. Dark orange yellow in Teak of Nagpur location. Dark orange brown colour were observed in Teak (Ramtek, Umred), Eucalyptus and Neem of Nagpur location. Brown colour was found in Eucalyptus (Ramtek) and Acacia (Umred). Black brown or greyish brown colour spore was observed in Acacia (Ramtek) and Neem (Umred). Mycorrhizal soil collected from Neem of Ramtek location showed Light yellow brown colour spore. Spore was also found with one straight to recovered funnel shape subtending hyphae. The colour of hyphae was observed as yellow to brown. Regarding shape of spore, it was globuse to sub-globuse in maximum isolates of forest sp. while oval or round shape spore was found in Acacia and Neem of Ramtek location. Irregular shape was observed in Teak and Neem of Umred location. And typical globose to sub-globose, elongated vesicles were observed in the roots of forest species of Nagpur District.

Table 1: Morphological characteristics of arbuscular mycorrhiza from rhizosphere soil of different forest spp. collected from different location of Vidarbha region of Maharashtra.

Sr. No.	Forest Plant	Location	Morphological Characteristics		
			Types of Spore	Colour	Shape
1.	Bamboo	Nagpur	Glomus sp.	Orange brown	Globuse
		Ramtek	Glomus sp.	Orange brown	Globuse
		Umred	Glomus sp.	Black	Globuse
2.	Teak	Nagpur	Glomus sp.	Dark orange yellow	Globuse
		Ramtek	Glomus sp.	Dark orange brown	Sub-globuse
		Umred	Glomus sp.	Dark orange brown	Irregular
3.	Eucalyptus	Nagpur	Glomus sp.	Dark orange brown	Globuse
		Ramtek	Glomus sp.	Brown	Sub-globuse
		Umred	Glomus sp.	Orange brown	Globuse
4.	Acacia	Nagpur	Glomus sp.	Orange brown	Sub-globuse
		Ramtek	Glomus sp.	Black brown	Oval
		Umred	Glomus sp.	Brown	Globuse
5.	Neem	Nagpur	Glomus sp.	Dark orange brown	Sub-globuse
		Ramtek	Glomus sp.	Light yellow brown	Oval
		Umred	Glomus sp.	Black brown	Irregular

Based on above morphological characters of arbuscular mycorrhizal spore was identified to be *Glomus* sp. as given in descriptions of INVAM, 2019. The spore colour were determined according to INVAM color chart showed spore was light yellow brown or bright yellow and transparent to translucent when young and became black brown to black at maturity. Similar result found in Trappe (1987) and Schenck and Perez (1987) reported that spore colour, size, shape, wall characteristics and nature of spores. Raman *et al.* (1992) also observed *Glomus* as the most dominant genus in trees of Mamandur forest.

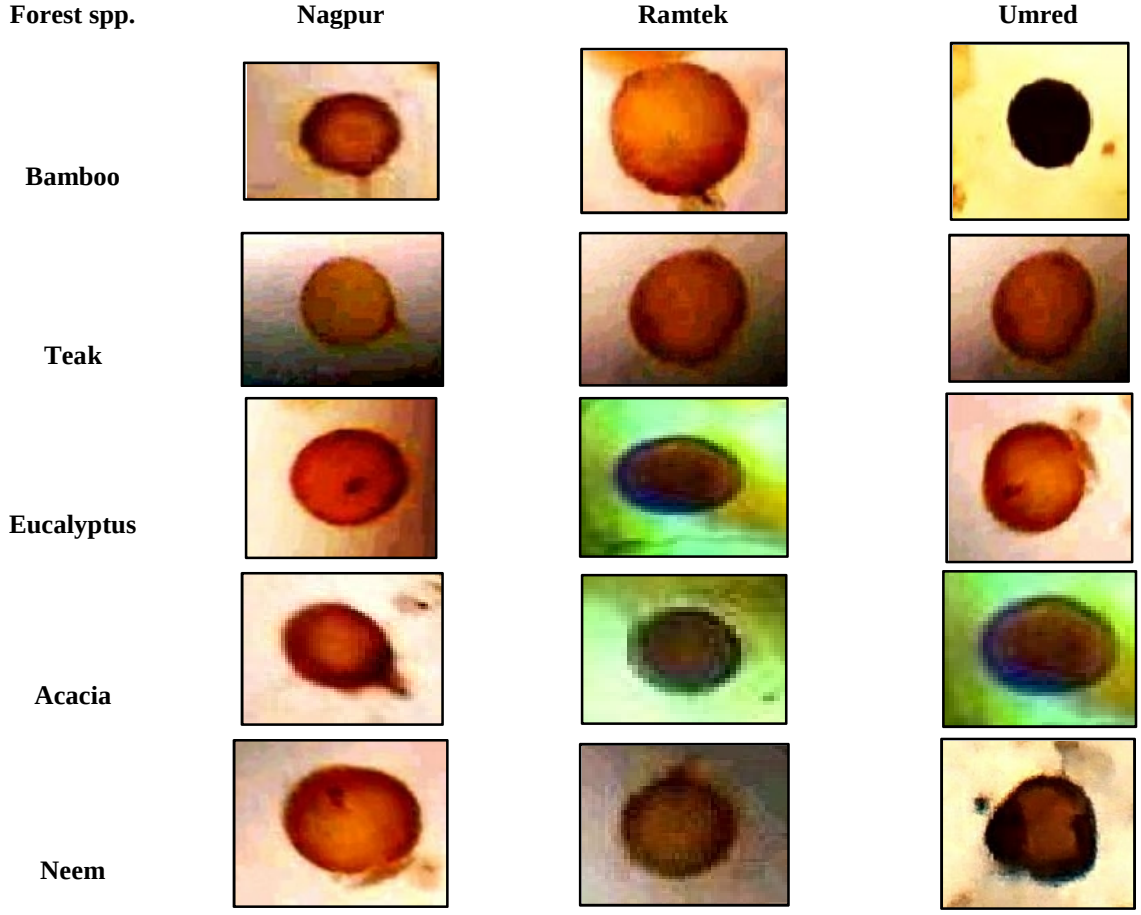

Plate 1. Isolation of *Glomus* sp. from roots of different forest spp. collected from different locations of Vidarbha region of Maharashtra.

Table 2: Percent root colonization and spore density of Arbuscular Mycorrhiza in different forest spp. collected from different location of Vidarbha region of Maharashtra

Sr. No.	Name of Tree	Location	Spore Density (No. of spore/100g soil)	Root colonization %
1.	Bamboo	Nagpur	18	24
		Ramtek	20	28
		Umred	23	32
2.	Teak	Nagpur	10	17
		Ramtek	12	12
		Umred	16	26
3.	Eucalyptus	Nagpur	12	20
		Ramtek	15	21
		Umred	20	22
4.	Acacia	Nagpur	14	22
		Ramtek	17	25
		Umred	22	28
5.	Neem	Nagpur	08	11
		Ramtek	05	12
		Umred	07	14

The data obtained on AM spore count and root colonization % of forest species are in Table 2 as Number of spores/100g soil occurred in Bamboo sp. in the range of 18 to 23 with percentage root colonization between 24 to 32 %. In Teak, it was 10 to 16 with percentage root colonization observed was 17%; 12% and 26% in Nagpur, Ramtek and Umred location, respectively. In Eucalyptus sp., the spore count was 12, 15 and 20 whereas percentage root colonization observed in the range of 20%; 21% and 22% in Nagpur, Ramtek and Umred location, respectively. In Acacia sp., the spore count was 14, 17 and 22 whereas percentage root colonization observed in the range of 22%; 25% and 28% in Nagpur, Ramtek and Umred location. Number of spores/100g soil was observed minimum in Neem sp. *i.e*., 8, 5 and 7 whereas percentage root colonization observed was 11%; 12% and 14% in Nagpur, Ramtek and Umred location. Although maximum number of spore was found in the rhizosphere of Bamboo *i.e*., 23/100g and minimum number of spores were observed in rhizosphere of Neem *i.e*., 5/100 of soil and the maximum root colonization in the Bamboo *i.e*., 32% and minimum root colonization in Neem *i.e*. 11%. The results are in conformity with the findings of Rahangdale and Gupta (1999) that VAM colonization in roots of forest species varied from 10% to 94% and by Dhar and Mridha (2012) found that AM colonization varied significantly from 10% to 73% in forest trees.

FUTURE SCOPE

Mycorrhiza play crucial role in native ecosystems such as forest where fertigation of extensive land area with large quantities of phosphorous is not practical (Habte, 2000). Mycorrhiza provide wide range of services viz. nutrient uptake, leaching, contribution to soil structure and mycorrhizal fungal networks acting as hyphal highways for bacterial dispersion (Marcel *et al*., 2009) also, mycorrhiza able to retard pathogen development in root system due to high chitinolytic activities (Dehne,1982). Mycorrhiza play crucial role in natural forest ecosystem and also in agriculture system. The status of mycorrhizal colonization in forest species of Nagpur region had not been studied so far and hence there is urgent need to know the different mycorrhizal species associated with forest species of Nagpur region and their role for disease management in agriculture ecosystem.

Acknowledgement. Authors acknowledged Section of Plant Pathology, College of Agriculture, Nagpur for providing all laboratory facilities with financial support for the research.

Conflict of Interest: None.

REFERENCES

Anonymous (2017). India state of forest report. Forest survey of India.

Dehne, H. W. (1982). Interaction between vesicular arbuscular mycorrhizal fungi and plant pathogens. *Phytopath. 72*(8): 115-118.

Dhar, P. P. and Mridha M. A. U. (2012). Arbuscular mycorrhizal associations in different forest tree species of Hazarikhil forest of Chittagong, Bangladesh. *J. forestry Res., 23*(1): 115-122.

Gardner, R. O. (1975). An overview of botanical clearing technique. *Stain Technol., 50*(2): 99-105.

Gerdmann, J. W. and Nicolson, T. H. (1963). Spores of mycorrhizal endogone species extracted from soil by wet sieving and decanting method. *Trans. Br. Mycol. Soc., 46*(2): 235-244.

Gerdmann, J. W. (1975). VAM Fungi in: The development and functions of roots. *Academic press, London*, 541-575.

Habte, M. (2000). Mycorrhiza fungi and plant nutrition. *Plant Soil, 106*: 127-131.

Hayman, D. S. (1982). Practical aspect of VAM. Advances in agricultural Microbiology, Oxford and IBH publishing Co. Pvt. Ltd. New Delhi: 325-373.

IMVAM (2019). International culture collection of vesicular arbuscular mycorrhizal fungi. http://invam.wvu.edu

Johansen, D. A. (1940). Plant Micro technique. Mc Graw-Hill book company, New York and London, 530.

Marcel, G. A., Heijden, V. and Horton, T. R. (2009). Socialism in soil? The importance of mycorrhizal fungal networks for facilitation in natural ecosystems. *J. Ecology, 97*: 1139-1150.

Newsham, K. K., Filter, A. H. and Watkinson, A. R. (1994). Root pathogenic and arbuscular mycorrhizal fungi determine- fecundity of asymptomatic plants in the field. *J. Ecol.,* : 805-814.

Phillips, J. M. and Hayman, D. S. (1970). Improved procedures for clearing roots and staining parasitic and VAM fungi assessment of infection. *Trans. Br. Mycol. Soc., 55*: 158-161.

Raman, N., Nagarajan, N. and Sambandan, K. (1992). Vesicular-arbuscular mycorrhizae of tree species of Mamandur forest of Tamil Nadu. *J. Tree Sci., 11*(2):135-139.

Rahangdale, R. and Gupta, N. (1999). Vesicular arbuscular mycorrhizal association of biomass tree species in tropical forest of Madhya Pradesh. *Ind. J. Forestry, 22*(1/2): 62-65.

Schenck, N. C. and Perez, Y. (1987). Manual for the identification of VAM fungi. Univ. of Florida, Gainesville, Florida. 244 p.

Trappe, J. M. (1987). Phylogenic and ecological aspects of mycotrophy in the angiosperm from an evolutionary stand point. *Ecophysiol. VAM plants*, 5-25.

How to cite this article: Dipake Shital, Ekta D. Bagde and Tini Pillai (2022). Studies on Morphological Characteristics of Arbuscular Mycorrhiza Associated with Forest spp. *Biological Forum – An International Journal, 14*(1): 313-316.