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Diversity of Arbuscular Mycorrhizal (AM) fungi in Some Medicinal Plants of Malshej Ghat Region in Western Ghats

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ABSTRACT

Arbuscular mycorrhizal (AM) fungal symbiosis is considered as one of the primary determinants of plant health and soil fertility in terrestrial ecosystems. The fine hyphae extending out into soil exploit minerals more efficiently than plant roots alone, and presence of fungi consistently reduces soil-borne fungal and nematode attacks on roots. These different attributes of AM fungi contribute to their role in protecting endangered plants. Medicinal plants from Malshej Ghat are endangered due to over exploitation and are facing the threat of habitat destruction. In present study, medicinal plants viz. Tectona grandis, Butea monosperma, Terminalia cuneata and Hemidesmus indicus showed presence of arbuscular mycorrhizal fungi. AM fungi viz. Acaulospora and Sclerocystis have wide occurrence in rhizosphere soil of all four medicinal plants, while Scutellispora was restricted to Terminalia cuneata and Hemidesmus indicus only.

Keywords: Arbuscular mycorrhizal (AM) fungi, medicinal plants, endangered plants, Malshej ghat.

I. INTRODUCTION

Forests of the Western Ghats region are source of nearly 5000 medicinal plants; of which some are used in traditional and folk medicinal practices [7]. Medicinal plants are important for pharmacological research and drug development, not only as plant constituents used directly as therapeutic agents, but also as starting materials for the synthesis of drugs or as models for pharmacologically active compounds [9]. Western Maharashtra is composed of tall steep hills which constitute the northern part of the Western Ghats. Malshej Ghat region ($19^0$00'N and $73^0$17'E) is a part of Western Ghats located in Western Maharashtra and is on the way from Kalyan to Ahmednagar (National Highway 61). A major portion of the Malshej Ghat is included under Thane district whereas the small portion is under Pune district. It is situated at an altitude of about 900m. Due to high rainfall and humidity it is one of the richest spot of angiosperm vegetation diversity [1]. Malshej Ghat is facing threat of habitat destruction due to developmental activities and tourism. Due to an increasing demand for medicinal plants and loss and fragmentation of natural habitats around 1,000 species are estimated to be facing various degrees of threat across different bio geographic regions in the country [13].

Mycorrhizae are non – pathogenic symbiotic soil fungi which invade the root system of plants. Arbuscular mycorrhizal (AM) fungi are associated with about 80% of the plant families in the world [5]. The arbuscular mycorrhizal (AM) fungal symbiosis is considered to be

the primary determinant of plant health and soil fertility in terrestrial ecosystems [6]. The fine hyphae extending out into the soil exploit minerals more efficiently than plant roots alone, and the presence of the fungi consistently reduces soil-borne fungal and nematode attacks on roots [16]. These different attributes of AM fungi will contribute to their role in protecting endangered plants.

Diversity characterization of AMF association with the medicinal plants from Malshej Ghats is not available till date. The present study was aimed to explore the arbuscular mycorrhizal fungal diversity in some commonly occurring medicinal plants of Malshej Ghats.

II. METHODS AND MATERIALS

Description of study site:

The association of AM fungi with four selected medicinal plants was carried by collecting plant roots and rhizosphere soil from locality Naneghat present in Malshej Ghats near National highway 61, Maharashtra, India.

Sample Collection:

Roots and rhizosphere soil from four medicinal plants viz. Tectona grandis, Butea monosperma, Terminalia cuneata and Hemidesmus indicus was collected from study site in month of January. Roots and soil sample from each plant at the depth of 20-30 cm were collected in polythene bags. Roots were preserved in formalin for study of AM colonization. Medicinal plants are identified by using Flora of Maharashtra [14, 15].

Estimation of root colonization:

Preserved roots in formalin were washed and cut into 1 cm length for percentage of root colonization. Roots were washed and boiled in 10 % KOH until roots became transparent, acidified with 2 N HCl and stained with 0.05 % Trypan blue. The percentage root colonization was estimated by slide technique [10]. Thirty segments were mounted on a slide (five segments each slide) and examined under binocular microscope at 10×10 magnification. A root segment was considered as positively infected if it showed mycelium, vesicle and arbuscules or any other combination of these structural characteristics of AM colonization. The presence or absence of colonization in the root pieces was recorded and the percentage of colonization was calculated by the following formula:

$$\% \text{ root colonization} = \frac{\text{Number of AM positive segments}}{\text{Total number of segments studied}} \times 100$$

Isolation and estimation of Arbuscular mycorrhizal fungal spores:

Arbuscular mycorrhizal fungal spores were identified by wet sieving and decanting method [4]. From each sample, 100 gm soil was taken in a 1000 ml capacity glass beaker and 500 ml of water was mixed with the soil to make slurry. After soil settled down, the suspension was passed through the 250µm and 75µm sieves gradually to extract the spores. The residues of the sieves were collected in beaker along with water and filtered through Whatman filter paper No-1. Squares of intersecting gridlines were drawn earlier on the filter paper for easy counting of spores. Spore number from each sample was counted and the result was expressed as number of spores per 100 gm of dry soil.

Identification of AMF spores:

Different AMF spores were separated based on morphological characters and mounted in polyvinyl lactoglycerol (PVLG) mounting media and identified on the basis of spore shape, size, colour, and hyphal attachment by using manual [12].

III. RESULTS AND DISCUSSION

In present study, medicinal plants viz. Tectona grandis, Butea monosperma, Terminalia cuneata and

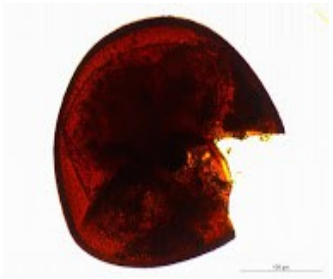
Hemidesmus indicus shows presence of arbuscular mycorrhizal fungi. Arbuscular mycorrhizal fungi belonging to five genera were identified in four medicinal plants figure 1.

Occurrence of AMF spores in every host and their detailed morphological description is described in table 1.

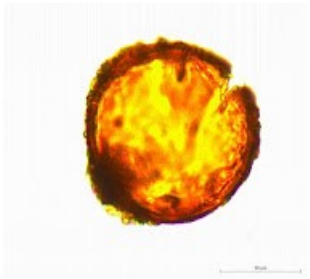
Results of root colonization, spore population and AM fungi associated with medicinal plants are shown in table 2.

Percentage AM colonization ranged from 30.00% to 93.33%. Maximum AM colonization was recorded in Butea monosperma (93.33%) followed by Tectona grandis (80.00%). Less AM colonization was observed in Terminalia cuneata (30.00%) and Hemidesmus indicus (33.33%).

Spore number per 100gm of rhizosphere soil of four medicinal plants varied from 207 to 453. Rhizosphere soil of Terminalia cuneata exhibited more spore number (453) followed by Tectona grandis (311). Comparatively less spore number was observed in Butea monosperma (210) followed by Hemidesmus indicus (207).



Acaulospora spp.



Gigaspora decipiens

Glomus tenebrosum

Scutellispora nigra

Figure 1. Photomicrograph of AM fungal spores isolated

Table 1. Morphological identification of spores

Sr.No.	Name of the species	Colour	Size (µm)	Shape	Hyphal Attach-ment
Tectona grandis L.					
1	Acaulospora spp.	Y-Br	165	Globose	Absent
2	Gigaspora decipiens Hall & Abbott.	Y-Gold	215	Globose	Absent
3	Sclerocystis spp.	Br-Bl	433	Globose	Present
Butea monosperma (Lam.) Taub.					
1	Acaulospora spp.	Y-Br	165	Globose	Absent
2	Glomus tenebrosum (Thaxter) Berch.	Br-Bl	132	Globose	Present
3	Sclerocystis spp.	Br-Bl	433	Globose	Present
Terminalia cuneata Roth.					
1	Acaulospora spp.	Y-Br	165	Globose	Absent
2	Gigaspora decipiens Hall & Abbott.	Y-Gold	215	Globose	Absent
3	Glomus tenebrosum (Thaxter) Berch.	Br-Bl	132	Globose	Present

4	Sclerocystis spp.	Br-Bl	433	Globose	Present
5	Scutellispora nigra (Readhead) Walker & Sanders	Bl	489	Globose	Present
Hemidesmus indicus (L.) Schult.					
1	Acaulospora spp.	Y-Br	165	Globose	Absent
2	Gigaspora decipiens Hall & Abbott.	Y-Gold	215	Globose	Absent
3	Glomus tenebrosum (Thaxter) Berch.	Br-Bl	132	Globose	Present
4	Sclerocystis spp.	Br-Bl	433	Globose	Present
5	Scutellispora nigra (Readhead) Walker & Sanders	Bl	489	Globose	Present
H-W: hyaline to white, Y-Br: Yellow to Brown, Br-Bl: Brown to Black, YBr-Br: Yellow brown to Brown, H-Y: Hyaline to white, Bl: Black.					

Table 2. Root colonization and spore count

Sr. No.	Plant Species	Percentage AM colonization (%)	Spore count/ 100 gm of soil
1	*Tectona grandis* L.	80.00	311
2	*Butea monosperma* (Lam.) Taub.	93.33	210
3	*Terminalia cuneata* Roth.	30.00	453
4	*Hemidesmus indicus* (L.) Schult.	33.33	207

IV. CONCLUSION

The present work was undertaken to reveal AM fungi diversity in important medicinal plants from Malshej Ghat. The mycorrhizal colonization differed among medicinal plant species and there was a considerable variation in percentage of root colonization and number of different Arbuscular mycorrhizal fungal spores associated with rhizosphere soil but no definite correlation could be established between them, which are in agreement with the previous findings [8, 11]. This could be due to the fact that Arbuscular mycorrhizal fungal sporulation is dependent on a wide range of host fungal and environmental factors, and their germination potential varies at different times of the year [3, 17]. AM fungi viz. Acaulospora and Sclerocystis have wide occurrence in rhizosphere soil of all four medicinal plants under study, while Scutellispora is restricted to Terminalia cuneata and Hemidesmus indicus.

The study will provide basis for use of AM fungi in enhancing the important medicinal compounds from the AM inoculated medicinal plants, which are endangered in study areas.

The study will be beneficial for enhancing the growth of plant and amount of medicinally important compounds in AM inoculated medicinal plants. Further if in future the studied medicinal plants face threat of extinction, colonization of those endangered medicinal plants with arbuscular mycorrhizal fungi will increase their sustainability in the field.

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