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Diversity of Arbuscular-Mycorrhizal fungi in the medicinal plants of Ramdevpur village, District Jaunpur, Uttar Pradesh, India

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The diversity of Arbuscular Mycorrhizal Fungi was examined in five different medicinal plants from the fields of Ramdevpur village, Taluka Kerakat, District Jaunpur, Uttar Pradesh. In the month of April 2022, the rhizospheric soil and roots of the plants (*Hibiscus rosa-sinensis, Carica papaya*, *Ricinus communis, Calotropis gigantea, and Achyranthes aspera)* were collected. The rhizospheric soil of plants was checked for the presence of Arbuscular Mycorrhizal Fungal spores. Based on morphological characters of spores, 15 species belonging to six genera (*Acaulospora, Glomus, Dentisculata, Funneliformis, Racocetra* and *Rhizophagus*) were identified. Root colonization in the plants was in the form of hyphae, arbuscules, vesicles and spores. Root colonization ranged from 40% to 100 %. AM spore density ranged from 46.33 to 91.67 in the rhizospheric soils. Maximum spore density, species richness & root colonization were observed in *Achyranthes aspera* and *Hibiscus rosa-sinensis*. *Rhizophagus, Funneliformis* and *Acaulospora* were the dominant genera and *Rhizophagus irregularis* had the highest isolation frequency. The soils are sandy loam with a pH of 6.35, total Nitrogen 0.28%, available phosphorus 20.2 Kg/hectare, Potassium 21ppm.

Keywords: *A. rehmii*, Mycorrhization, Soil analysis, Stereozoom microscope

INTRODUCTION

AM fungi are among the most helpful organisms since they symbiotically associate with the roots of plants to supply all of the plant's required nutrients. In stressful environments including drought, salt, and heavy metals, AM fungus also aids plant survival. Nearly 90% of plant species establish associations with AM fungi, which not only improve the plant's capacity for water and mineral absorption but also help it fight against pathogen attack. (Smith and Read, 2008; Kaya *et al.* 2009; and Jung *et al*. 2012). India is one of the world's herb treasure troves. Many herbal medicinal plants are often treated as weeds because of their undesirable habitats. Jaunpur is a district in the Varanasi Division of the Indian state of Uttar Pradesh, which covers an area of 4,038 square kilometres and has a rich diversity of medicinal plants. There is no published data on AM fungal association in the medicinal plants of Ramdevpur village, District Jaunpur, to date. Hence, in the present study, five different medicinal plants, namely *Achyranthes aspera, Ricinus communis, Calotropis gigantea, Carica papaya, and Hibiscus rosa-sinensis*, were collected to study the diversity of AM fungi.

MATERIALS AND METHODS

Sampling

Samples (i.e roots and rhizosphere soils) were collected in plastic bag with proper labeling, during the month of April, 2022 from the village Ramdevpur, Taluka Kerakat, District Jaunpur, Uttar Pradesh.

Spore extraction and density

The spores were extracted by Gerdeman and Nicolson method (1963). 50 g of rhizospheric soil were taken and mixed properly with 250 ml of water.

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The mixture was passed through 210 µm,75 µm, 45 µm and 25µm sieves under continuous running water and the residue in the respective sieve were collected along with some amount of water (100 ml) in a beaker. The water containing spores were filtered through Whatman filter paper and the residue was observed under stereozoom microscope, counting of spore were done by Gaur and Adholeya (1994) method.

Identification of Arbuscular Mycorrhizal spore

Taxonomic identification of AM spores up to species level was done with the help of INVAM and ZORZUT Websites.

Root Colonization of AM Fungi

Root colonization of AMF was done by Philips and Hayman method (1970). The collected root samples were washed with tap water then cut it into 1cm pieces. The root pieces were treated with 10% KOH and kept in oven at 90º C for 60 minutes. After removing KOH solution, the roots were washed with tap water for 4-5 times and kept in 5%HCl for 5 minutes. Then the root segments were stained by 0.05% trypan blue and kept it for 48 hr. Roots were mounted on glass slide with drop of polyvinyl lacto Glycerol and observed under trinocular microscope. Percentage root colonization was calculated by following Read *et al*. 1976.

Percentage of root colonization was calculated using the following formula :

$$\% \text{ of root colonization} = \frac{\text{Number of Root Segment Infected By AMF}}{\text{Total Number Segments}} \times 100$$

Diversity measures used to describe AM Fungi

- Spore density: Number of spores in 50 gm of soil sample.
- Species richness: Number of identified Arbuscular Mycorrhizal Fungal species per soil sample.
- Isolation frequency was calculated as follows :

$$\text{Isolation frequency (\%)} = \frac{\text{Number of soil samples in which AMF sps occured}}{\text{Total Number of soil samples studied}} \times 100$$

- Soil analysis

Total nitrogen, Phosphorous and Potassium of soil sample was determined by modified Kjeldahl method (Jackson, 1973), Ammonium molybdate spectrophotometric method (Bray's method, 1945) and flame photometer respectively. Soil pH was checked using pH meter.

RESULTS AND DISCUSSION

The following study confirms the mycorrhizal colonization in the selected medicinal plants which were collected from the village Ramdevpur. The agricultural soil of ramdevpur is sandy loam and the pH of the soil is 6.35 as mentioned in Table 1.

Table 1: Characteristics of the Soil

S. No	Soil parameter	Valu e
1	Texture of soil	Sandy Loam
2	pH of soil	6.35
3	Total Nitrogen present in soil	0.28%
4	Total Phosphorus present in soil	20.2 Kg/hectare
5	Potassium in soil	21%
6	Organic matter of soil	2.54%

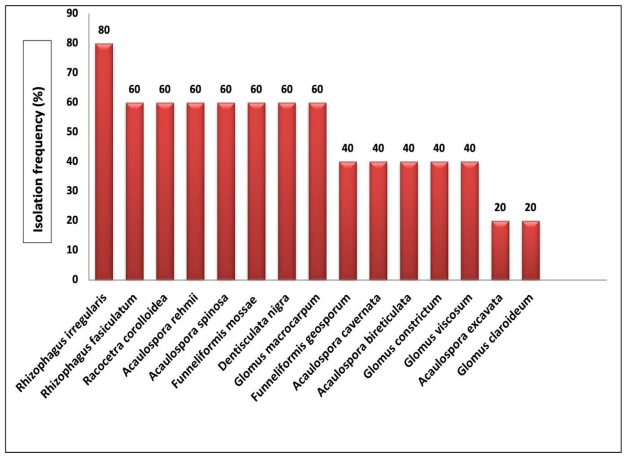

Fig.1 : Isolation frequency of mycorrhizal species.

The major crops cultivated in this soil are wheat, sugarcane, rice, peas. Some farmers grow vegetables like onion, cucumber, brinjal, tomatoes, spinach, fenugreek, bottle gourd, bitter gourd and other vegetables. Some medicinal plants i.e. Amla, Tulsi, curry leaves, Periwinkle, lemon grass etc were also grow in Ramdevpur village. In the present study five medicinal plants i.e., *Carica papaya, Ricinus communis, Calotropis gigantea, Achyranthes aspera* and *Hibiscus rosa-sinensis* were collected in the month of April 2022 and spore

Table 2: Spore density, Species richness, Root colonization &Mycorrhizal Spore types

Name of the Plant	Spore Density/50gm soil	Species Richness	Root colonization %				Mycorrhizal Spore types
			H	A	V	%	
Hibiscus rosa-sinensis	87.67±2.52	10	++	++	+++	90	*Acaulospora rehmii, Acaulospora bireticulata, Acaulospora spinosa,Racocetra corolloidea, Funneliformis mossae, Dentisculatanigra, Funneliformis geosporum, Rhizophagus irregularis, Glomus viscosum, Glomus constrictum.*
Carica papaya	69.33±3.51	05	++	++	++	60	*Acaulospora cavernata, Glomus viscosum, Glomus constrictum, Funneliformis mossae, Rhizophagus irregularis.*
Ricinus communis	46.33±3.06	04	++	--	++	40	*Rhizophagus irregularis, Rhizophagus fasiculatum,Racocetra corolloidea, Glomus macrocarpum.*
Calotropis gigantea	59.0±3.61	06	++	++	+++	80	*Acaulospora rehmii, Acaulospora spinosa, Acaulospora cavernata Dentisculata nigra, Rhizophagus fasiculatum, Glomus macrocarpum.*
Achyranthes aspera	91.67±2.52	12	++	++	+++	100	*Acaulospora excavata, Acaulospora bireticulata, Acaulospora rehmii,Acaulospora spinosa, Dentisculatanigra, Glomus claroideum,Racocetra corolloidea, Funneliformis mossae, Glomusmacrocarpum, Funneliformis geosporum, Rhizophagus irregularis, Rhizophagusfasiculatum.*

density of AMF were checked. Based on morphological characters of spores, 15 species belonging to six genera were recovered from the rhizospheric soil of the plants as shown in Table 2**.** The six genera were *Acaulospora, Glomus, Dentisculata, Funneliformis, Racocetra* and *Rhizophagus*. Species richness varied from 4 to 12 in the collected medicinal plants. According to our study the *Achyranthes aspera* and *Hibiscus rosa-sinensis*, showed highest spore density i.e 91.67±2.52 and 87.67±2.52 spores /50g of soil and root colonization were 100% and 90% respectively. Whereas *Calotropis gigantea* and *Carica papaya* showed moderate spore density i.e 59.0±3.61and 69.33±3.51spores /50g of soil and root colonization were 80% and 60% respectively. *Ricinus communis* showed least spore density i.e 46.33±3.06 spore density and 40% root colonization was observed. *Rhizophagus irregularis* had the highest isolation frequency of 80% as shown in Fig. 1. This genus was found in the rhizospheric soil of almost all the plants. The most common spores discovered in tropical climates, as described in our study, are from the Glomeraceae and Acaulosporaceae (Parihar *et al.* 2019; Belay *et al.* 2013; and Dobo *et al*. 2018).

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