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Diversity of arbuscular mycorrhizal (AM) fungi in the rhizosphere soils of Pandanus tectorius in coastal sand dune ecosystem

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ABSTRACT

Coastal areas accumulated with sand are deficient in organic matter and consequently their fertility is low. Arbuscular mycorrhizal (AM) fungi help in establishment of plant cover, thereby improving the fertility of sand dunes. The present study was carried out to find out the diversity of arbuscular mycorrhizal (AM) fungi in rhizosphere soils of *Pandanus tectorius*. Seven species belonging to 3 genera of arbuscular mycorrhizal (AM) fungi were recorded. The spores were obtained as azygospores and chlamydospores. The spores belonging to the genera *Gigaspora* dominated the rhizosphere soils of *Pandanus tectorius* in distribution. The identified species of arbuscular mycorrhizal (AM) fungi include *Gigaspora albida, G. gregaria, G. heterogama, G. margarita, Glomus monosporum, G. multisubtensum* and *Acaulospora spinosa*. Average spore count obtained was 307 spores/ 100 g of rhizosphere soil.

INTRODUCTION

Sand dunes throughout the world have been recognised for their ecological significance. Vegetation plays an important role in the formation and stabilisation of coastal sand dunes. The dune vegetation helps in keeping the coastal land free from erosion and also prevents internal desertification (Anonymous, 1981).

Water stress and nutrient deficiency are common constraints that a dune system experiences. The fungus-plant mutualistic symbiosis termed as "Mycorrhiza" plays an important role in nutrient deficient sites. They enhance the plant growth by improving uptake of phosphorus and other nutrients, and also by improving the water-soil relation (Koske *et al.*, 1975; Mosse, 1981).

The fragile sand dune ecosystem has deteriorated at many places recently due to urbanisation, development of tourism and hotel industries, sand excavation etc. It has been demonstrated that the AM fungal mycelia help in binding the sand grains thereby arresting their movement and also in the establishment, survival and growth of sand dune colonising plant species (Nicolson, 1960; Koske *et al.*, 1975). Occurrence and distribution of AM fungi have a major role in plant species diversity and survival. There is a need to identify the AM species from existing vegetation so that the same may be used for rebuilding the coastal vegetation under threat. No effort seems to have been directed to isolate and identify the native AM fungi in soils of salinity (Thapar and Kamala, 1990).

Present study represents an attempt to investigate the occurrence of spore types of arbuscular mycorrhizal (AM) fungi in rhizosphere soils of *Pandanus tectorius*, a common inhabitant of the sand dunes along the West Coast. *Pandanus tectorius*, a densly branched shrub dominating the sand dune vegetation, is considered to be good soil binder. Majorda beach located in Salcete, Goa, was selected as the site for the survey. The beach has well-developed sand dunes and rich vegetation, dominated by *Pandanus tectorius*.

MATERIALS AND METHODS

The sample collections were made before the rains in June, 1997. For the soil

analysis, the soil samples were taken from five randomly chosen locations in the beach. Samples were collected from 0-25 cm depth and air dried in the laboratory.

Rhizosphere soil samples collected from the host plants were screened for spores. Hundred grams of sample was assayed for spore count using Wet Sieving and Decanting procedure (Gerdemann and Nicolson, 1963). Fractions collected between 300-45 µm mesh were examined for spores and sporocarps using a stereomicroscope. Spore counting was done as per the procedure given by Gaur and Adoleya (1994) for the estimation of spore density.

Spores were mounted in Polyvinyl alcohol-Lacto-Glycerol (PVGL) and examined for the various characteristics using a compound microscope (100-1000X). Spores were identified using the standard key (Schenck and Perez, 1988).

RESULTS AND DISCUSSION

Physiochemical properties of soil samples indicated that the soil was acidic (pH 6.2). The sandy soil had low available phosphorus (6.73-17.95 Kg/ha).

Present study showed a wide distribution of arbusclar mycorrhizal (AM) fungi in the rhizosphere soils of *Padanus tectorius* (Table 1). The population of AM fungal spore was seemingly very high, average spore count being 307 spores/100g of rhizosphere soil. Seven species of the AM fungi viz., include *Acaulospora spinosa, Gigaspora albida, G. gregaria, G. heterogama, G. margarita, Glomus monosporum and G. multisubtensum* were identified. Occurrence of spores of *Gigaspora margarita and Glomus monosporum* in sand dune vegetation was also reported in earlier studies (Kulkarni *et al.*, 1995; Mohan and Natarajan, 1998). Spores belonging to *Gigaspora* species dominated the soil. Among the four species of *Gigaspora* identified, *Gigaspora gregaria* showed the maximum spore density (15.6%). Mosse (1973), observed that *Gigaspora* and *Acaulospora* are more tolerant to acidity whereas *Glomus* species favour neutral and alkaline soils.

The characteristics of azygospores and chlamydospores identified were as follows:

Table 1. Arbuscular mycorrhizal diversity in the rhizosphere soils of *Pandanus tectorius* Soland

AM fungal species	No. of spores/100g rhizosphere soil	Spore density (%)
Acaulospora spinosa Walker and Trappe	60	19.5
Gigaspora albida Schenck and Smith	12	3.9
Gigaspora gregaria Schenck and Nicol.	48	15.6
Gigaspora heterogama (Nicol. and Gerd.) Gerd. and Trappe	2	0.7
Gigaspora margarita Becker and Hall	20	6.5
Glomus monosporum Gerdemann and Trappe	70	22.8
Glomus multisubtensum	10	3.3
Gigaspora sp. (unidentified)	55	17.9
Glomus sp. (unidentified)	30	9.8

Acaulospora spinosa: Azygospores sessile, globose, 120-140 µm in diameter, dull yellowish brown. Surface of the spore ornamented with crowded blunt spines, 1-4 µm high, 1 µm in diameter at the polygonal base. Spore wall with thickness 4 µm, colour yellowish brown.

Gigaspora albida: Azygospores globose, 162 µm in diameter, hyaline in colour, spore wall 4 µm thick. Suspensor bulbous with 38 µm width, hyaline-yellow in colour, attached to a septate hypha with fine hyphal branches.

Gigaspora gregaria: Azygospores globose, 250-300 µm in diameter, reddish brown in colour. Crowded warts on the spore surface, 2-10 µm in diameter, brown, very conspicuous. Spore wall 10 µm thick. Suspensor bulbous, 42 µm wide.

Gigaspora heterogama: Azygospores dark brown in colour, 240 µm in diameter. Warts on the spore surface closely placed, 0.5-1 µm in diameter. Suspensor width 42 µm.

Gigaspora margarita: Azygospores globose, 260-300 µm in diameter, yellow in colour. Spore wall smooth, composed of 4-8 fused lamination, intact wall with thickness 9 µm. Content of spores composed of oil droplets. Suspensor 35 µm broad, hyaline to light brown, walls 1-5 µm thick.

Glomus monosporum: Chlamydospores 250-350 µm in diameter, globose. Spore wall 6-9 µm thick, dull brown. Inner wall laminate with minute abundant to scattered echinulation that protrude into the outer wall. Subtending hypha 8-12 µm thick. Spore contain oil globules.

Glomus multisubtensum: Chlamydospores 100-150 µm in diameter, spore wall 10 µm thick and subtending hypha 2 in number, attached at one end of the spore, pale yellow, thin walled, 10-15 µm wide at the point of attachment.

Arbuscular mycorrhizal fungi may be of considerable importance in stabilisation of the sand dune ecosystem. The native AM fungi could be isolated and screened for salinity tolerant efficient strains. Mass inoculum production of the selected strains could be used for tailoring roots of plant seedlings suitable for rehabilitation and reclamation of the sandy soil of coastal ecosystem.

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