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Association of arbuscular mycorrhizal fungi with plants of coastal sand dunes of west coast of India

K.R. BEENA, A.B. ARUN, N.S. RAVIRAJA & K.R. SRIDHAR[1]

Department of Biosciences, Mangalore University, Mangalagangotri - 574 199, Mangalore, Karnataka, India

Abstract: An inventory of arbuscular mycorrhizal (AM) fungal status of 28 plant species belonging to 14 families established on the coastal sand dunes of southwest coast of India was performed. Roots of 23 plant species were colonized by AM fungi, whereas the rhizosphere of only 20 plant species possessed AM fungal spores. *Canavalia cathartica* had the highest root colonization (83%) by AM, while the rhizosphere of *Borreria articularis* had the highest number of AM spores (1.6 g^{-1}). Among 30 AM fungi recovered, *Scutellospora erythropa* showed a wide host range (colonized 13 plant species), while *Scutellospora gregaria* had high spore abundance per plant species (12.75). The mean species richness on the west coast dunes was 4.4, highest being in *Ipomoea pes-caprae* (11). Among the mat-forming creepers, the AM fungal diversity was highest in *Alysicarpus rugosus*.

Resumen: Se realizó un inventario de la condición respecto a hongos micorrízicos arbusculares (MA) para 28 especies pertenecientes a 14 familias establecidas en las dunas costeras arenosas de la costa sudoccidental de la India. Las raíces de 23 especies vegetales estuvieron colonizadas por hongos MA, mientras que la rizosfera de sólo 20 especies de plantas contuvo esporas de hongos MA. *Canavalia cathartica* tuvo la mayor colonización en su raíz (83%), mientras que la rizosfera de *Borreria articularis* tuvo el mayor número de esporas MA (1.6 g^{-1}). Entre los 30 hongos MA recuperados, *Scutellospora erythropa* mostró una amplia variedad de hospederos (colonizó 13 especies de plantas), mientras que *Scutellospora gregaria* presentó una gran abundancia de esporas por especie vegetal (12.75). La riqueza promedio de especies en las dunas de la costa occidental fue de 4.4; la mayor correspondió a *Ipomoea pes-caprae* (11). Entre las reptantes que forman tapetes, la diversidad de hongos MA fue mayor en *Alysicarpus rugosus*.

Resumo: Um inventário sobre o status das micorrízas arbusculares em 28 espécies de plantas pertencentes a 14 famílias vegetando nas dunas costeiras na costa sudeste da Índia, foi efectuado. As raízes de 23 espécies vegetais foram colonizadas por fungos AM, enquanto só a rizosfera de 20 espécies de plantas continham esporos de fungos AM. A *Canavalia cathartica* apresentava a mais elevada colonização radicular (83%) por fungos micorrizícos AM, enquanto a rizosfera da *Borreria articulares* apresentava o mais elevado número de esporos AM (1,6 g^{-1}). Entre os 30 fungos AM recuperados, a *Scutellospora erythropa* mostrou uma conjunto de hospedeiros alargados (colonizava 13 espécies de plantas), enquanto a *Scutellospora gregaria* apresentava a maior percentagem de esporos por espécies de plantas (12,75). A riqueza específica nas dunas da costa ocidental foi de 4,4, sendo a mais alta na *Ipomoea pes-caprae* (11). Entre as trepadeiras formando tapete, a diversidade dos fungos AM foi mais elevada na *Alysicarpus rugosus*.

Key words: AM fungi, mat-forming creepers, microbial diversity, non-mycorrhizal plants, vegetation.

[1]*Corresponding Author*; Fax: 0091 824 742 367; E-mail: sirikr@yahoo.com

Introduction

The coastal sand dunes exhibit favourable conditions for the association and development of arbuscular mycorrhizal (AM) fungi with plants since they are deficient in phosphorus (Koske & Halvorson 1981; Ranwell 1972). The importance of AM fungi for the growth and succession of plant species in coastal sand dunes was first recognized by Nicolson (1959). Aggregation of sand grains and colonization of AM fungi with dune plants significantly stabilize the sand dunes (Koske & Polson 1984; Sutton & Sheppard 1976). Several temperate coastal sand dunes: northeastern United States (Koske 1987; Koske & Halvorson 1981), Italy (Giovannetti 1985; Giovannetti & Nicolson 1983), Poland (Blaszkowski 1997) and Scotland (Nicolson 1960; Nicolson & Johnston 1979) have been surveyed for the occurrence of AM fungi. Inventory in subtropical locations are quite recent: Southeastern United States (Sylvia 1986), Gulf of Mexico (Corkidi & Rincon 1997a, 1997b), Baja California (Siguenza *et al.* 1996), Brazil (Sturmer & Bellei 1994), Japan (Abe *et al.* 1994) and Australia (Koske 1975; Logan *et al.* 1989). Hawaiian Islands (Koske 1988; Koske & Gemma 1996), India (Beena *et al.* 1997; 2000; Kulkarni *et al.* 1997; Mohankumar *et al.* 1988) and Singapore (Louis 1990) are the only three tropical locations surveyed for sand dune AM fungi.

The members of the family Poaceae are the main coastal sand dune stabilizing plants in temperate dunes (Read 1989), while in tropical locations plant species belonging to Asteraceae, Convolvulaceae, Fabaceae and Poaceae contribute towards the stabilization of coastal sand dunes (Devall 1992; Koske & Gemma 1990; Kulkarni *et al.* 1997; Moreno-Casasola & Espejel 1986). West coast of India supports a wide variety of coastal sand dune vegetation (Rao & Meher-Homji 1985). The objective of the present study was to examine the colonization, abundance, species richness and diversity of AM fungi associated with plant species established on the coastal sand dunes of southwest coast of India.

Materials and methods

Study site

The survey was conducted during post-monsoon season (October-January) on four maritime sand dune locations of Karnataka (Fig. 1, Table 1). Although a variety of herbaceous plant species exist on the dunes, the extent of establishment is dependent on the severity of disturbance on the dunes. The dunes at Someshwara and Padubidri are relatively less disturbed than the dunes at Ullal and Bengre. Erosion and human interference are quite high at Ullal. Granite wall constructed against sea erosion has severely affected the Ullal dune vegetation. Bengre dunes are more prone to heavy accretion, which has resulted in decreased vegetation cover. Altogether 28 plant species belonging to 14 families were screened for their association with AM fungi. Almost all plant species were at flowering or post flowering or seed setting stage. Members of the family Fabaceae were showing profuse root nodulation.

Ipomoea pes-caprae showed highest relative plant cover (>65%), while *Borreria articularis, Launaea sarmentosa, Scaevola sericea* and *Wedelia biflora* had 10-20% relative plant cover. Rest of the plants had <10% cover (Table 2). Only five plant species showed wide distribution across the dune and occupies foredunes, mid dunes and hind dunes. Eighteen plant species were found to grow on mid dunes.

Sampling

Roots and rhizosphere soil samples were collected to assess the AM fungal colonization and presence of spores of AM fungi. Ten plants of each species growing 10-50 m apart were selected for

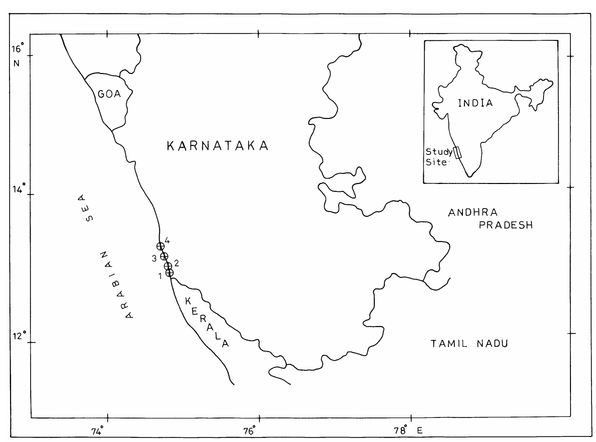

Fig. 1. Map showing the coastal sand dune sampling locations along the west coast of India: Someshwara (1), Ullal (2), Bengre (3) and Padubidri (4).

Table 2. Arbuscular mycorrhizal fungal status of plant species from four coastal sand dunes of west coast of India.

Plant species	Collection site	AM fungal colonization (%)	AM spores 100 g^{-1} soil	Distribution*
Aizoaceae				
Sesuvium portulacastrum L.	Padubidri	0	0	FM
Asteraceae				
Ageratum conyzoides L.	Someshwara	70	100	MH
Emelia sonchifolia (L.) DC.	Someshwara	80	63	MH
Launaea sarmentosa (Willd.) Alston	Someshwara	45	10	FMH
Tridax procumbens L.	Someshwara	60	89	M
Wedelia biflora DC.	Padubidri	43	0	M
Caryophyllaceae				
Polycarpaea corymbosa (L.) Lam.	Someshwara	55	67	H
Convolvulaceae				
Ipomoea pes-caprae (L.) R. Br.	Someshwara	65	87	FMH
Cyperaceae				
Cyperus arenarius Retz.	Someshwara	60	16	MH
Cyperus pedunculatus (R. Br.) Kern	Padubidri	0	0	M
Fimbristylis argentea (Rottb.) Vahl	Ullal	22	5	H
Euphorbiaceae				
Euphorbia articulata Dennst.	Padubidri	47	6	H
Fabaceae				
Alysicarpus rugosus (Willd.) DC.	Someshwara	45	93	MH
Canavalia cathartica Thouars	Padubidri	83	63	FMH
Canavalia maritima (Aubl.) Thours	Padubidri	24	133	MH
Tephrosia purpurea (L.) Pers.	Bengre	53	23	FMH
Goodeniaceae				
Scaevola plumieri Vahl	Padubidri	0	0	H
Scaevola sericea Vahl	Padubidri	11	0	H
Lamiaceae				
Leucas aspera (Willd.) Link	Someshwara	75	121	H
Molluginaceae				
Glinus oppositifolius (L.) A. DC.	Ullal	0	0	H
Mollugo pentaphylla L.	Ullal	67	12	H
Poaceae				
Spinifex littoreus (Burm. f.) Merr.	Bengre	41	6	MH
Rubiaceae				
Borreria articularis (L. f.) F.N. Will.	Someshwara	75	160	MH
Borreria pusilla (Wallich) DC.	Someshwara	55	83	MH
Hydrophylax maritima L. f.	Padubidri	3	0	M
Oldenlandia aspera (Roth) DC.	Someshwara	65	81	H
Solanaceae				
Solanum xanthocarpum Schrader & Wendl.	Bengre	75	68	FMH
Verbenaceae				
Phyla nodiflora (L.) Greene	Padubidri	0	0	H

*Distribution: F-Foredune; M-Mid dune; H-Hind dune.

corrhizal structures. *Canavalia cathartica* showed highest colonization (83%) which was followed by *Emelia sonchifolia* (80%), *Borreria articularis, Leucas aspera* and *Solanum xanthocarpum* (75%). Except for *Scaevola sericea*, all the plant species possess arbuscules indicates the active functioning of AM fungi in the coastal dune ecosystem.

Spore abundance and host range

Among 28 plant species, 20 showed AM fungal spores in the rhizosphere (Table 2). Rhizosphere of eight plant species namely, *Cyperus pedunculatus, Glinus oppositifolius, Hydrophylax maritima, Phyla nodiflora, Scaevola plumieri, S. sericea, Sesuvium portulacastrum* and *Wedelia biflora* were devoid of AM fungal spores. The spore abundance was highest in *Borreria articularis* (1.6 g^{-1}) followed by *Canavalia maritima* (1.3 g^{-1}), *Leucas aspera* (1.2 g^{-1}) and *Ageratum conyzoides* (l g^{-1}).

Spores of 30 AM fungal species were recovered from the rhizosphere of 20 plant species (Table 3). Except for the genus *Entrophospora*, rest of the five genera of AM fungi were encountered during the present study. The species belonging to the family Glomaceae were dominant (66.6%), the genus *Glomus* was recorded more frequently (53.3%). *Scutellospora erythropa* had widest host range (13 plant species) followed by *Glomus albidum* (12), *Gigaspora margarita* (10), *Scutellospora gregaria* (10), *Glomus lacteum* (9), *Gigaspora gigantea* (8) and *Glomus mosseae* (8). Rest of the species were associated with 1-6 plant species. The mean spore abundance per plant was higher in case of *Scutellospora gregaria* (12.75) followed by *Gigaspora margarita* (7.55), *Glomus albidum* (7.25), *Scutellospora erythropa* (6.55) and *Glomus lacteum* (4.85).

Species richness and diversity

The species richness of AM fungi ranged between 0 and 11 (mean, 4.4) (Table 3). It was higher in *Ipomoea pes-caprae* (11) followed by *Alysicarpus rugosus, Borreria articularis, Leucas aspera* (10) and *Polycarpaea corymbosa* (9). *Leucas aspera, Alysicarpus rugosus* and *Ipomoea pes-caprae* showed higher AM fungal diversity than other plant species. Among 30 species of AM fungi reported, two species of *Glomus*, one species each of *Sclerocystis* and *Scutellospora* are likely to be new species since they do not fit into any described species.

Discussion

Knowledge of the plant diversity and their association with AM fungi on maritime sand dunes is of crucial importance for their efficient use in the conservation and management of strand ecosystem. Inventory of maritime sand dune AM fungi of Indian Subcontinent are scanty (Kulkarni *et al.* 1997; Mohankumar *et al.* 1988). The high diversity of AM fungal flora recorded in the present study is consistent with that found in other tropical (Beena *et al.* 1997, 2000; Kulkarni *et al.* 1997; Mohankumar *et al.* 1988) and subtropical sand dunes (Koske 1988; Koske & Gemma 1996; Sturmer & Bellei 1994). The mean AM fungal species richness (number of AM fungi per plant) for 28 plant species was 4.4 (range, 0-11) which is higher than the richness in other tropical sand dunes: Australia (1.5-2.4; Koske 1975), Hawaiian Islands (2 and 2.4; Koske 1988; Koske & Gemma 1996) and Brazil (5.9; Sturmer & Bellei 1994).

Among 30 species of AM fungi reported in the present study, 14 species are known from the coastal dunes of the India (Kulkarni *et al.* 1997; Mohankumar *et al.* 1988). All the four frequently occurring AM fungi in this study (*Scutellospora erythropa, S. gregaria, Gigaspora margarita* and *Glomus albidum*) were also frequent in an earlier survey of west coast dunes of India (Kulkarni *et al.* 1997). Except for *Scutellospora erythropa* these species were also abundant. *Scutellospora gregaria* was found to be common on the dunes of Florida (Nicolson & Schenck 1979), Hawaii (Koske & Gemma 1996) and Brazil (Sturmer & Bellei 1994). In the present study the spores of *Scutellospora gregaria* were most abundant and also had wide host range of 10 plant species including *Ipomoea pes-caprae.* *Scutellospora gregaria* was found to be associated with *Ipomoea pes-caprae* in Hawaiian dunes (Koske & Gemma 1996). *Glomus intraradices* was isolated frequently in the dunes of Hawaii (Koske & Gemma 1996). In the present study it was exclusively associated with *Canavalia maritima.* *Glomus aggregatum* is a common inhabitant of sand dunes in Hawaii (Koske 1988), but is a minor species on the west coast dunes of India.

A wide variety of plant species have been established on the west coast of India (sedges, scrubs, herbs, climbers and creepers) (Rao & Meher-Homji 1985). In the present study five plant

Table 3. Spore abundance of AM fungi in the rhizosphere of sand dune plants species of west coast of India.

AM fungus	Plant species* (spores 100 g-1 in parenthesis	MSPS**
Scutellospora gregerea (Schenck & Nicolson) Walker & Sanders	Ac(49), Ar(25), Ba(64), Bp(24), Es(21), Ip(5), La(24), Oa(20), Pc(10), Tpr(33)	12.75
Gigaspora margarita Becker & Hall	Ac(21), Ar(8), Ba(18), Bp(13), Es(17), Ip(7), La(16), Oa(12), Pc(17), Tpr(22)	7.55
Glomus albidum Walker & Rhodes	Ac(9), Ar(18), Ba(24), Bp(22), Ca(3), Es(13), Ip(5), La(7), Ls(3), Oa(20), Pc(11), Tpr(10)	7.25
Scutellospora erythropa (Koske & Walker) Walker & Sanders	Ac(3), Ar(9), Ba(7), Bp(2), Cm(36), Ea(7), Es(3), Oa(4), Pc(1), Sl(4), Sx(41), Tp(4), Tpr(10)	6.55
Glomus lacteum Rose & Trappe	Ac(13), Ar(12), Ba(16), Bp(7), Es(4), La(11), Oa(9), Pc(16), Tpr(9)	4.85
Acaulospora spinosa Walker & Trappe	Ca(3), Cm(29), Ea(11), Sl(2), Sx(4), Tp(7)	2.8
Glomus mosseae (Nicolson & Gerdemann) Gerdemann & Trappe	Ar(4), Ca(7), Ea(3), Fa(2), Ip(12), La(15), Mp(5), Tp(7)	2.75
Glomus occultum Walker	Ar(15), Ba(4), La(24), Oa(2), Pc(5)	2.5
Glomus tortuosum Schenck & Smith	Cc(7), Cm(17), Ea(4), Sx(20)	2.4
Gigaspora albida Schenck & Smith	Ca(25), Cm(15)	2
Glomus dimorphicum Boyetchko & Tewari	Ar(9), Ba(10), Bp(3), La(17)	1.95
Glomus fasciculatum (Thaxter) Gerdemann & Trappe emend. Walker & Koske	Ar(2), Ba(16), Bp(8), Ip(7), La(11), Pc(2)	1.95
Glomus sp. 10 DM	Ip(31), Sx(3)	1.7
Gigaspora gigantea (Nicolson & Gerdemann) Gerdemann & Trappe	Ac(1), Ar(1), Ca(3), Ea(7), Es(3), Ip(3), La(3), Tpr(2)	1.15
Glomus sp. 07 DM	Ac(2), Ba(3), Es(2), Ls(5), Oa(5), Tpr(3)	1
Glomus deserticola Trappe, Bloss & Menge	Cc(5), Cm(13)	0.9
Acaulospora sp. 22 KS	Cc(15), CM(2)	0.85
Scutellospora arenicola Koske & Halvorson	Cc(11), Ip(6)	0.85
Glomus intraradices Schenck & Smith	Cm(10), Tp(5)	0.75
Scutellospora sp. 43 SS	Ac(2), Ba(1), Oa(9), Pc(2)	0.7
Glomus albidum Walker & Rhodes	Fa(3)	0.5
Acaulospora denticulata Sieverding & Toro	Cm(9)	0.45
Glomus aggregatum Schenck & Smith emend. Koske	Ip(7)	0.35
Glomus microaggregatum Koske, Gemma & Olexia	Ls(1), Pc(3)	0.2

Contd...

AM fungus	Plant species* (spores 100 g-1 in parenthesis	MSPS**
Acaulospora sp. 19 PS	Cc(2), Ea(1)	0.15
Glomus globiferum Koske & Walker	Ip(3)	0.15
Scutellospora nigra (Red Head) Walker & Sanders	Tp(3)	0.15
Sclerocystis pachycaulis Wu & Chen	Ba(1)	0.05
Glomus constrictum Trappe	Ar(7), Ls(1)	0.05
Sclerocystis sp. 32 SS	Ip(1)	0.05

* Plant species: Ac, *Ageratum conyzoides*; Ar, *Alysicarpus rugosus*; Ba, *Borreria articularis*; Bp, *Borreria pusilla*; Ca, *Cyperus arenarius*; Cc, *Canavalia cathartica*; Cm, *Canavalia matitima*; Ea, *Euphorbia articulata*; Es, *Emeia sonchifolia*; Fa, *Fimbristylis argentea*; Ip, *Ipomoea pes-caprae*; La, *Leucas aspera*; Ls, *Launaea sarmentosa*; Mp, *Mollugo pentaphylla*; Oa, *Oldenlandia aspera*; Pc, *Polycarpaea corymbosa*; Sl, *Spinifex littoreus*; Sx, *Solanum xanthocarpum*; Tp, *Tephrosia purpurea*; Tpr, *Tridax procumbens*.
**MSPS: Mean number of AM spores per plant species (out of 20 plant species)

species belonging to the so called non-mycorrhizal family (Aizoaceae, Caryophyllaceae and Cyperaceae) were screened for AM fungal association. *Sesuvium portulacastrum* (Aizoaceae) a matforming creeper helps in the stabilization of dunes (Rao & Meher-Homji 1985). It was neither colonized by AM fungi, nor did possess spores in the rhizosphere. This plant species was also not found to be colonized at the dunes of Hawaii (Koske & Gemma 1990) and Singapore (Louis 1990). However, on the dunes of Gulf of Mexico and Australia it was colonized up to 19 and 41%, respectively (Corkidi & Rincon 1997a; Logan *et al.* 1989). *Polycarpaea corymbosa* (Caryophyllaceae) believed hitherto was established mainly on the hind dunes showed 55% root colonization (consists of arbuscules and vesicles) and the rhizosphere had 0.67 spores g^{-1}. The results were found to be similar in an earlier study too (Kulkarni *et al.* 1997). Among the three plant species belonging to family Cyperaceae, *Cyperus peduncuIatus* was not colonized and had no AM spores in the rhizosphere. Roots of *Cyperus arenarius* and *Fimbristylis argentea* were colonized and their rhizosphere had spores. The rhizomatous plant species, *Sporobolus virginicus* and *Jacquemontia sandwicensis* served as good inoculum of AM fungi on Hawaiian dunes (Koske & Gemma 1990). The AM vegetative fragments and the spores in the roots of the former plant species retained viability and became potential inoculum in spite of sea water treatment, suggests the oceanic dispersal of AM fungi (Koske & Gemma 1990). Being rhizomatous the members of Cyperaceae stabilize the dune and its colonized rhizomes may serve as a source of inoculum on the west coast sand dunes.

Ipomoea pes-caprae shows wide distribution in tropics and being a sand creeper it contributes substantially towards dune stabilization (Devall 1992; Rao & Meher-Homji 1985). The relative plant cover of *Ipomoea* at Someshwara dunes exceeds 65% and is well colonized by AM fungi. In addition to the dune stabilization, it helps in the accumulation of organic debris. On the dunes of Someshwara its rhizosphere showed highest number of AM fungal species which encompass both common and rare species (Table 4). *Spinifex littoreus* (Poaceae) is dominant at Bengre dunes in spite of heavy sand accretion. This plant species has been profusely colonized by AM fungi and distributed widely on the dunes under heavy accretion (Sridhar *et al.* unpub. obs.). *Borreria articularis* is codominant with *Spinifex littoreus* in Someshwara and has the highest spore density (1.6 g^{-1}). Among the members of the family Asteraceae, *Launaea sarmentosa* as a matforming creeper is of considerable interest in view of stabilization of coastal sand dunes of west coast of India (Rao & Meher-Homji 1985). This deep-rooted plant also possesses AM fungal association (Kulkarni *et al.* 1997; Mohankumar *et al.* 1988).

Among the nitrogen fixing plant species on the dunes, the stoloniferous creepers, *Canavalia cathartica* and *Canavalia maritima*, show wide distribution on the west coast (Arun *et al.* 1999). *Canavalia cathartica* and *Canavalia maritima* grows

Table 4. Species richness and diversity of AM fungi associated with plant species of west coast sand dunes of India.

Plant species	AM Species Richness	AM Diversity Index		Shannon Evenness
		Simpson	Shannon	
Asteraceae				
Ageratum conyzoides L.	8	0.696	2.116	0.705
Emelia sonchifolia (L.) DC.	7	0.776	2.337	0.832
Launaea sarmentosa (Willd.) Alston	4	0.711	1.685	0.843
Tridax procumbens L.	7	0.773	2.360	0.841
Caryophyllaceae				
Polycarpaea corymbosa (L.) Lam.	9	0.832	2.706	0.854
Convolvulaceae				
Ipomoea pes-caprae (L.) R. Br.	11	0.830	2.951	0.853
Cyperaceae				
Cyperus arenarius Retz.	4	0.750	1.880	0.940
Fimbristylis argentea (Rottb.) Vahl	2	0.600	0.971	0.971
Euphorbiaceae				
Euphorbia articulata Dennst.	6	0.799	2.314	0.895
Fabaceae				
Alysicarpus rugosus (Willd.) DC.	10	0.875	3.030	0.912
Canavalia cathartica Thouars	5	0.749	2.104	0.906
Canavalia maritima (Aubl.) Thours	9	0.836	2.778	0.876
Tephrosia purpurea (L.) Pers.	4	0.771	1.962	0.981
Lamiaceae				
Leucas aspera (Willd.) Link	10	0.881	3.111	0.937
Molluginaceae				
Mollugo pentaphylla L.	2	0.530	0.980	0.980
Poaceae				
Spinifex littoreus (Burm. f.) Merr.	2	0.533	0.918	0.918
Rubiaceae				
Borreria articularis (L. f.) F.N. Will.	10	0.783	2.605	0.874
Borreria pusilla (Wallich) DC.	8	0.811	2.854	0.861
Oldenlandia aspera (Roth) DC.	8	0.835	2.703	0.901
Solanaceae				
Solanum xanthocarpum Schrader & Wendl.	4	0.553	1.398	0.699

profusely across the dune along with *Ipomoea-pes-caprae*, while *Canavalia cathartica* establishes independently on fore dunes during post-monsoon season. Roots of *Canavalia maritima* had shown 35% and 46% colonization by AM fungi on the dunes of Australia (Logan *et al.* 1989) and Gulf of Mexico, respectively (Corkidi & Rincon 1997a). *Alysicarpus rugosus* found sparsely on the west coast dunes in mixed vegetation (Arun *et al.* 1999) which has good sand binding ability owing to its fine fibrous roots. Among the members of Fabaceae the species richness and diversity of AM fungi were highest in *Alysicarpus rugosus* (Table 4).

Sand movement is an important factor affecting the distribution and composition of coastal plant communities (Martinez & Moreno-Casasola 1996; Moreno-Casasola 1986). Stabilization of disturbed coastal ecosystem is dependent upon successful re-establishment of most effective plant communities (Louis 1990; Skujins & Allen 1986). Based on the ecological amplitude, Rao (1977) suggested that mat-forming strand creepers might be used for the fixation of mobile dunes and moving sand. The present study also revealed that these mat-forming strand communities (*Alysicarpus rugosus, Canavalia maritima, Canavalia cathartica, Ipomoea pes-caprae* and *Launaea sarmentosa*) are highly mycorrhizal and some of them are nitrogen fixers. Results from this study shows that in addition to mat-forming creepers, *Spinifex littoreus* could be successfully used at places of heavy accretion. For primary succession in sand dunes, the restoration of above ground plant communities must include restoration of below ground AM fungal communities (Koske & Gemma 1997; Miller 1985).

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