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SURVEY OF ARBUSCULAR MYCORRHIZA FUNGI IN PLANTS GROWING IN COASTAL BEACHES AND THEIR EFFECT ON *SOLANUM NIGRAM* L.

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ABSTRACT

Studies were conducted to screen saline tolerant arbuscular mycorrhiza (AM) fungi in coastal beaches of Kumta in Karnataka. Twenty five coastal plants were screened. The varied AM percent of colonization was observed. Thirteen plants; members of families Acanthaceae, Asclepiadaceae, Convolvulaceae, Euphorbiaceae, Fabaceae, Graminae, Lamiaceae, Solanaceae and Verbenaceae had highest percent of colonization, 75-100%. Six plants, belonging to families Rubiaceae, Apocynaceae and Malvaceae had 50-74% colonization and two plants belonging to families Rhamnaceae and Fabaceae had 25-49% colonization with AM fungi. Least percent (below 25%) colonization was recorded in family Amaranthaceae, Cyperaceae, Plumbaginaceae and Typhaceae. No correlation between percent of root colonization and spore number among examined plants was observed. Total thirty different VAM spores have been recorded belonging to five Genera *Glomus, Gigaspora, Acaulospora, Scutellospora* and *Sclerocystis.* Genus *Glomus* was most predominated while the genus *Sclerocystis* was the least.

Green house pot experiments were conducted on *Solanum nigram*. Pots were amended with coastal sand and forest soil in the ratio of 3:1, 2:2 and 1:3. Pots amended with only coastal sand and only forest soil were also maintained. Pots were maintained in triplicate and harvested once in thirty days interval. Plants grown in pots amended with 1:3 (coastal sand : forest soil) exhibited significant increase in plant height, root length, number of leaves, chlorophyll content, biomass production, percent of colonization, spore number-uptake as compared to noninoculated (control) plants. Plants grown in 100% sand with inoculums exhibited moderate growth. The importance of AM fungi in coastal sand dunes (beaches) has been discussed.

INTRODUCTION

The coastal zone represents 18% of earth’s surface providing space for 60% of human population. Salinity is regarded as second most important characteristic of marine ecosystems. Therefore, reclamation of coastal area with ecofriendly restoration of vegetation is need of the hour (Venkatraman 2003).

VAM fungi is known to present in most of the soils and generally not considered to be host specific (Bowen 1987). However, population levels and specific compositions are highly variable, and are influenced by various environmental factors, such as temperature, soil pH, soil moisture and phosphorus levels (Denial & Trappe 1980). VAM have been reported to occur in saline environments (Pond et al. 1984, Sidhu & Behl 1990, Lakshman et al. 2001). Mycorrhiza has a vital role in coastal area development programmes. The role of VAM fungi in stimulating plant growth, enhanced nutrients and water uptake on waste land is widely recognized. Therefore, the present study was undertaken to screen saline tolerant VAM fungi in coastal beaches of Kumta in Karnataka. Greenhouse experiments were carried out on *Solanum nigrum* by using *Glomus fasciculatum* as mixed inoculums.

MATERIALS AND METHODS

Root and rhizospheric soil samples were collected from 25 plants growing in four different coastal beaches namely Aghinashi, Dhareshwer, Gudiangadi and Vanalli. Plants belonged to 17 families, Lamiaceae, Acanthaceae, Graminae, Euphorbiaceae, Fabaceae, Asclepiadaceae, Solanaceae, Verbenaceae, Convolvulaceae, Rubiaceae, Apocynaceae, Malvaceae, Rhamnaceae, Amaranthaceae, Typhaceae, Plumbaginaceae and Cyperaceae. Plants were screened from January to December 2005. For each species five plants were sampled. Plant roots were dug out, washed free of soil and stored in formalin aceto-alcohol (FAA) prior to staining. The rhizospheric soil samples of individual plants within a species were mixed and one part was used for VAM fungal spore enumeration and other for the sand characters. Nine soil variables were measured and nutrients were estimated according to Jackson (1973). Percent of organic matter was determined according to Piper (1950). Electric conductivity was measured using bridge meter and pH by 1:1 soil to water ratio.

Roots were stained with 0.05% traphan blue in lactophenol according to (Phillips & Haymann 1970). Percentage of root length colonization was estimated by magnified intersection method. VA fungal spores were recovered by wet sieving and decanting method (Gedermann & Nicolson 1963). VAM fungal spores were mounted in polyvinyl alcohol lactophenol and identified using Schenck and Perez's manual.

Green house pot experiments were conducted with completely randomized design with three replications. Ten days old seedlings were transplanted in earthen pots measuring 10 × 10 cm diameter. The earthen pots were amended with coastal sand and forest soil in the ratio of 3:1, 2:2, 1:3. Pots amended with only coastal sand and forest soil were also maintained. Before transplantation of seedlings, below one cm of each pot, 10g of mixed inoculum of *Glomus fasciculatum* was provided. Heat killed inoculum was used for control. Thirty days after planting, plants were removed and observations were recorded on dry weight of shoot and root. Chlorophyll content in leaves was estimated according to Arnon (1949) and N, P, K content of shoot was determined according to Jackson (1973). AM infection was assessed as per the procedure of Phillips & Hayman (1970) by employing tryphan blue stain in lactophenol. Plants were harvested once in a 30 days interval.

RESULTS AND DISCUSSION

Twenty five species comprising 17 angiosperms had VAM association with varied percent of root colonization and spore numbers (Table 1). Least colonization (12.50 to 28.6 %) was noted in Amaranthaceae, Typhaceae, Plumbaginaceae, Cyperaceae and Rhamnaceae. These findings are in conformation to early contributions by Harley & Smith (1983) and Read (1996). Roots were colonized with arbuscules and hyphae were prominently observed. On the contrary spore number was interestingly higher than those pants with higher percent of colonization. There is a record of five AMF genera with thirty spores isolated from coastal zones of Kumta. Among these eleven spores have been considered to be new record from this locality.

Experiments were carried out on *Solanum nigram* by using coastal sand with forest soil. Similarly soil : sand mixer containing VAM spores and infected root segments *Sorghum vulgare* was given mixed inoculum of *G. fasciculatum*. Present study suggests that mixed inoculums of indigenous *G. fasciculatum* resulted in higher growth and biomass production (Table 2). There was a significant variation in growth observed, when plants were maintained in varied combination of coastal sand and forest soil. Similar findings were recorded by Daniel & Trappe (1980) and Bowen (1987). Shoot and root dry weights increase in plants grown in 1:3 combination of coastal sand and forest soil (Table 3). There was decreased root biomass of nonmycorrhizal plants by 71% as compared to mycorrhizal plants. Plant height, root length, percent of colonization and spore number was significantly increased

Table 1: Root colonization and spore number in 25 coastal plant associations with AMF Fungi. (mean of four replicates).

Name of the plants	Family	% of VAM colonization	Av. no. of spores
Acacia arabica Willd	Fabaceae	78.38	115.3
Achyranthus aspera L.	Amaranthaceae	12.50	102.3
Algsicarpus belganmensis DC.	Fabaceae	88.91	203.6
Asclepias volubilis L	Asclepiadaceae	80.80	104.2
Borreria hispida Schum.	Rubiaceae	56.50	204.5
Calotropis gigantea R.Br.	Asclepiadaceae	95.24	109.4
Cerbera odollam Gaertn	Apocynaceae	60.62	201.5
Crotalaria juncea Linn.	Fabaceae	92.31	213.2
Cynodon dactylon Pers.	Graminae	91.67	101.1
Cyperus bulbosus Vahl.	Cyperaceae	21.43	107.7
Datura fistuosa Linn.	Solanaceae	88.89	123.8
Euphorbia ligularia Roxb.	Euphorbiaceae	78.73	108.2
Ipomea biloba Linn.	Convolvulaceae	95.83	110.3
Ixora elongata Hyene	Rubiaceae	59.60	116.1
Justicia gendarussa Burm.	Acanthaceae	77.03	208.8
Leucas aspera Spreng.	Lamiaceae	92.10	213.4
Marsdenia volubilis Cook.	Asclepiadaceae	85.30	109.3
Mimosa pudica Linn.	Fabaceae	47.14	117.2
Plumbago coccinea Boiss.	Plumbaginaceae	19.88	114.1
Robus hirtus Roxb.	Rubiaceae	63.87	121.4
Sida acuta Burm.	Malvaceae	73.83	102.2
Sida spinosa Linn.	Malvaceae	70.30	98.1
Typha angustifolia Sibth.	Typhaceae	13.74	101.7
Vitex trifolia Linn.	Verbenaceae	100	111.3
Zizyphus jujuba Lamk	Rhamnaceae	28	126.4

Table 2: Effect of *G. fasciculatum* on dry weight of shoot and root, chlorophyll-*a* and N, P, K contents in *Solanum nigram* for 90 days.

	Dry weight of shoot (g)	Dry weight of root (g)	Chlorophyll-*a* (mg/g) dry leaf wt	N % plant dry weight	P % plant dry weight	K % plant dry weight
Control	0.038	0.005	1.454	0.83	0.05	1.05
	1.504	0.572	1.873	0.88	0.19	1.15
Treated	1.578	0.671	1.984	0.91	0.21	1.17
	4.703	1.535	2.253	0.98	0.24	1.32
L.S.D at 0.05%	0.021	0.018	0.071	0.05	0.02	0.06

in mycorrhizal plants at third harvest. The results obtained in present investigation are encouraging enough to utilize mycorrhizal inoculums for *S. nigram* cultivation. These results are almost similar to the data obtained by Allen (1991) and Srinivasa (1992).

Soil salinity may influence the growth and activity of VAM through several mechanisms, either discretely or interactively (Sidhu & Behl 1990, 1995). It is concluded that use of biofertilizers in reclaimed sodic soils is very important for proper colonization of plant roots with VAM and thereby improving nutrient uptake capacity of plants. The beneficial effects of VAM species adapted to coastal sand should be determined before use. Further, detailed studies are warranted on coastal mycorrhizae studies.

Table 3: Effect of *G. fasciculatum* on plant height, root length, root colonization and spore number in *Solanum nigram* for 90 days.

	Plant height	Root length	% of VAM colonization	Spore no. per 50g of Soil
Control	15.5	22.3	-	-
1	38.2	28.1	50.7	79.6
2	53.8	36.1	59.3	94.2
3	76.4	44.3	66.5	102.2
L.S.D at 0.05%	09.05	06.03	04.00	02.01

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