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Effect of three indigenous and one exotic AM-fungi on growth of *Acacia auriculiformis* and *Eucalyptus tereticornis* grown in red lateritic soil

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Acacia auriculiformis and *Eucalyptus tereticornis* are two common species used for plantaion of afforestation in the red lateritic soil of south West Bengal. Three arbuscular mycorrhizal species isolated from indigenous soil, *Glomus aggregatum, G. occultum and Acaulospora delicata* and one exotic *G. mosseae* were inoculated in sterilized soil with the two above plants. All inoculated seedlings showed higher growth in shoot height, root collar diameter, leaf area, biomass etc. compared to non-inoculated control. *A. delicata* was found to be most effective AM fungus for both the plant species. Both plant species showed high mycorrhizal dependency. *E. tereticornis* showed maximum dependency on *A. delicata* (65%) followed by on *G. aggregatum* (60.5%), whereas *A. auriculiformis* showed 69% dependency on *A. delicata* followed by 65% on *G. aggregatum* and 64% on *G. mosseae.*

Key words : AM fungi, *Glomus aggregatum, G. occultum, G. mosseae, Acaulospora delicata, growth, Acacia auriculiformis, Eucalyptus tereticornis*

INTRODUCTION

The unique role of arbuscular mycorrhizal (AM) fungi in nutrient absorption, especially P along with N, K. and other less mobile micronutrients (Miller and Jasrow, 1994 ; Marschner and Dell, 1994) is now widely accepted. AM fungi are more effective in nutrient poor particularly P deficient soil (Powell and Daniel, 1978). AM Fungi can absorb water form lower water potential soil from which roots cannot absorb (Aúge *et al.*, 1994). The extra-radical mycelia also increse absorptive surface are and retain moisture (Hamp *et al.*, 2000).

The acid lateritic soil of south West Bengal have a low phosphorous and high aluminum and iron content which decrease the mobility of nutrients. *Acacia auriculiformis* and *Eucalyptus tereticornis* are two major exotic species used for plantation in this zone. In this dry and nutrient poor soil, the survival and growth rate of seedlings are low. As AM fungi are obligate symbionts, in the denuded land, natural AM fungal population is very low. Pre-inoculation of seedlings with effective AM fungi in nursery may be beneficial for better aclimatization and performance in stressed condition (Sylvia and Williams, 1992).

Three indigenously isolated AM species, *Acaulospora delicata, Glomus aggregatum, G. occultum* and one exotic species, *G. mosseae* collected from Mycorrhiza laboratory, University of Agricultural Sciences, Bangalore (courtesy, Prof. D. J. Bagyaraj) were used to find out effective AM fungi for the two tree species.

MATERIALS AND METHODS

The study was conducted in net-house at Vidyasagar University, Midnapur, West Bengal, India (22°19′ latitude and 87°19' longitude). Three indigenously isolated AM species, *Acaulospora delicata, Glomus aggregatum* and *G. occultum* were

mass cultured in sterilized sand-soil (1:1, v/v) mixture on *Sorghum vulgare* host. The soil inocula contained 63, 62 and 60 spore g^{-1} of *Acaulospora delicata, Glomus aggregatum* and *G. occultum* respectively. One exotic species, *G. mosseae* obtained from Mycorrhiza Laboratory University of Agricultural Sciences, Bangalore. The species was mass cultured in similar way and the sucessive soil inoculum contained 56 spore g^{-1}.

Viable seed of *Acacia auriculiformis* and *Eucalyptus tereticornis* were surface sterilized with 5% sodium hypochloride solution and germinated in aseptic condition. Soil used for the pot experiment was denuded top soil collected from upon 30 cm depth. The soil was sterilized with formalin water (1 : 4, v/v) and kept airtight for 3 days. After then left open for 15 days to evaporate. The soil was filled in polypots (20 × 10 cm). Soil inocula of the above AM species were used as different treatments and placed at 5 cm below soil surface. Germinated seeds were placed at 2 cm below soil surface. One uninoculated control was maintained in sterilized soil. The pots were placed on racks, and foots of which were placed on water filled containers to prevent contamination by crawling insects. Thinning was done after 10 days to maintain single seedling in each pot. Post were watered as required. The experiment continued for 6 months. The growth of seedlings were measured for the following parameters : Shoot height, root collar diameter, leaf area at 30 days intervals. Root colonization was measured following the method of Philips and Hayman (1970). The data on root, shoot and total biomass yield were taken at 240th day by oven drying at 80°C to constant weight. Mycorrhizal dependency was calculated by the formula (Plenchette *et al.*,1983) which is as follows :

$$\frac{\text{Dry weight of mycorrhizal plant} - \text{Dry weight of non-mycorrhizal plant}}{\text{Dry weight of mycorrhizal plant}} \times 100$$

Statistical analysis was done by 'Statistica'.

RESULTS AND DISCUSSION

All inoculated seedlings of the two tree species showed enhancement in growth over control from 60 days onward. In *A. auriculiformis,* shoot height of inoculated plants showed continuous and steady increase and was maximum in *A. delicata* and minimum in *G. occultum* treatments (Fig. 1). The leaf area almost ceased to increase in control plants after 180 days, whereas in inoculated plants it continued to increase upto 210 days, after then it decreased slightly probably due to nutrient depletion in pots (Fig. 2). Root infection percentage increased with time and was poor in *G. occultum* (Fig. 3). At 240th day, shoot height was found significantly higher in *A. delicata* treatment followed by *G. aggregatum* and *G. mosseae* (Table 1). Root collar diameter was maximum by *G. aggregatum.* Leaf area, biomass and mycorrhizal dependency were higher in *A. delicata* treatment followed by *G. aggregatum* and *G. mosseae.*

Table 1 : Growth parameters, mycorrizal dependency, spore population and root colonization percentage of *A. auriculiforimis* at 240th day

Treatment	Shoot height (cm)	Collar diameter (mm)	Leaf area (cm^2)	Root infection(%)	Total Biomass (g)	Mycorrhizal dependency (%)
Control	14.0 ± 1.6	3.6 ± 0.7	6.0 ± 0.5	1.5	1.84	—
G. occultum	22.0 ± 1.2	6.1 ± 0.8	9.8 ± 1.4	39	4.64	60.3
G. aggregatum	28.2 ± 2.2	6.6 ± 0.4	10.5 ± 0.8	62	5.32	65.4
G. mosseae	28.0 ± 1.3	6.4 ± 0.3	9.6 ± 0.8	55	0.08	64.0
A. delicata	34.2 ± 1.4	6.3 ± 0.2	12.5 ± 1.2	56	5.96	69.0
L.S.D (P < 0.05)	5.6	2.4	4.1	9.3	1.1	6.6

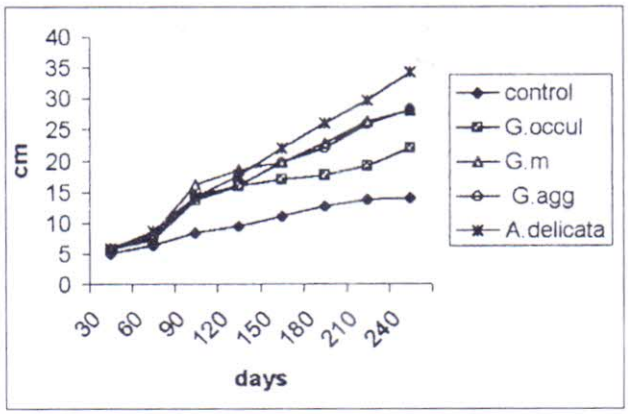

Fig. 1 : Shoot height of *A. auriculiformis.*

In *E. tereticornis* also the seedlings showed inoculation effects from 60 days onward (Table 2). The shoot height increased rapidly in inoculated

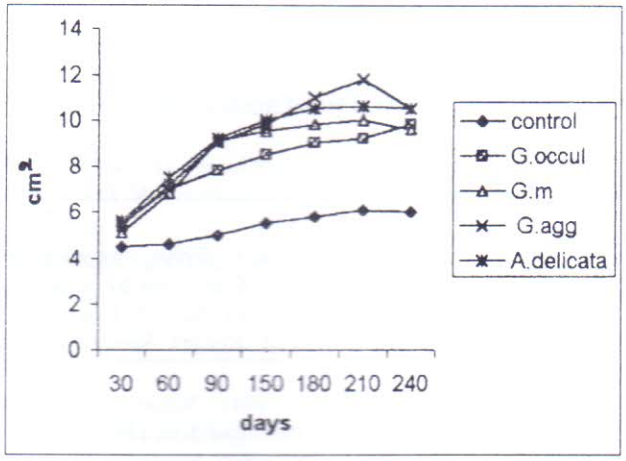

Fig. 2 : Leaf area of *A. auriculiformis.*

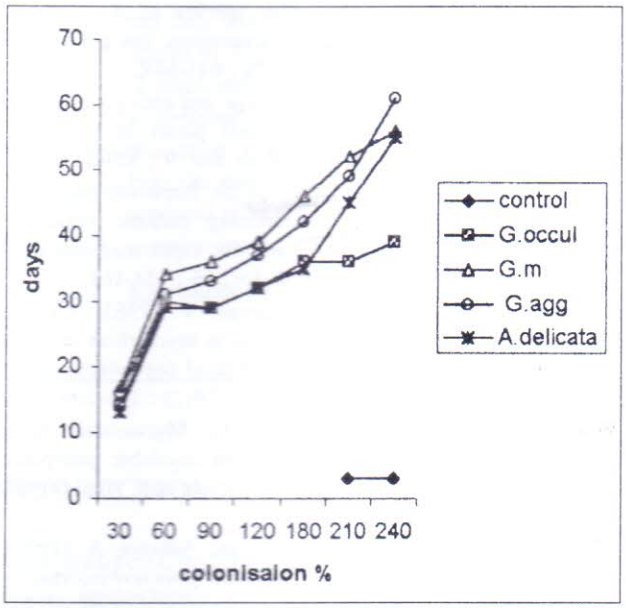

Fig. 3 : Root colonization percentage of *A. auriculiformis.*

plants (Fig. 4). Increase in leaf area was observed upto the last harvest at 240 day, though it decreased in control plants after 150 days (Fig. 5). At 240th day, the shoot height, leaf area, and total biomass were found to be maximum in *A. delicata* treatment. Root collar diameter and leaf area was found to be maximum in *G. aggregatum* treatment (Fig. 6). Mycorrhizal dependency was maximum in *A. delicata* followed by *G. aggregatum* and was significantly higher than other treatments.

Table 2 : Effect of three indigenous and one exotic AM fungi on growth of *E. tereticornis* at 240th day

Treatment	Shoot height (cm)	Collar diameter (mm)	Leaf area (cm^2)	Root infection(%)	Total Biomass (g)	Mycorrhizal dependency (%)
Control	14.2 ± 0.8	2.0 ± 0.4	3.0 ± 0.3	2	1.66	—
G. occultum	22.5 ± 0.8	5.2 ± 0.5	5.4 ± 0.4	36	4.04	59
G. aggregatum	21.8 ± 0.6	6.9 ± 0.5	6.0 ± 0.6	62	4.20	60.5
G. mosseae	22.3 ± 1.2	5.3 ± 0.4	6.2 ± 0.4	50	3.89	57
A. delicata	28.6 ± 0.9	5.4 ± 0.6	7.0 ± 0.7	52	4.69	65
L.S.D ($P < 0.05$)	6.8	2.1	4.1	6.7	1.32	6.7

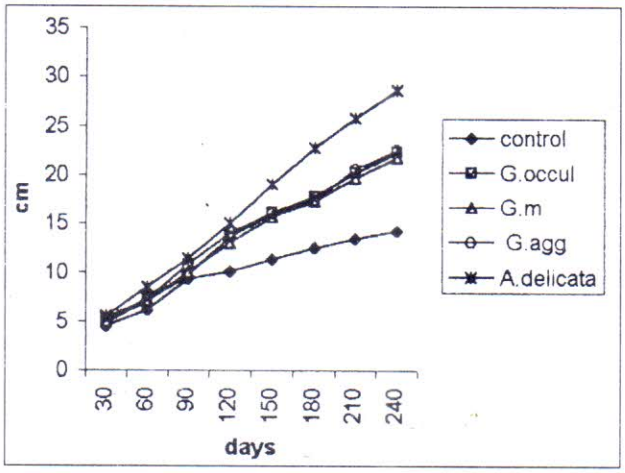

Fig. 4 : Shoot height of *E. tereticornis* at 30 days interval.

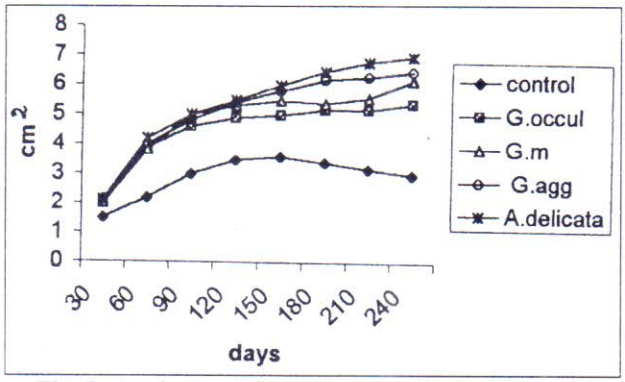

Fig. 5 : Leaf area of *E. tereticornis* at 30 days interval.

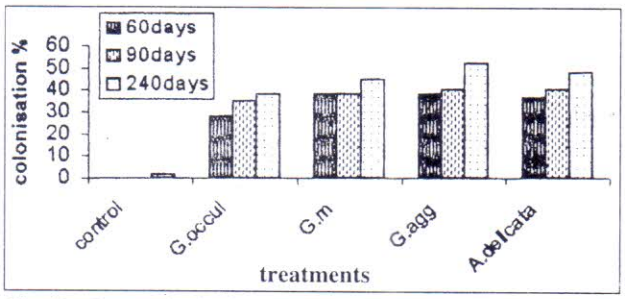

Fig. 6 : Root colonization percentage of *E. tereticornis* at 60, 90 and 240th days.

These results reflected that the two plant species are highly dependent on AM fungi in this soil condition. Two indigenous AM fungi, *A. delicata* and *G. aggregatum* are most effective followed by the exotic species *G. mosseae*. The other indigenous species *G. occultum* showed poor result than other AM fungi though it ws much better than control. *G. occultum* showed poor colonization. The positive relationship between root colonization and biomass may be an indication of effective symbiosis.

As species beloning to *Acaulospora* favour the acidic (Morton, 1986) and *Glomus* neutral to alkaline soil condition (Daft and Haeskaylo, 1976), high effectivity of *A. delicata* may be related to acidic pH of lateritic soil. Mycorrhizal dependency may be a direct measurement of the effciency of AM fungi as degree to which a plant is dependent on AM to produce its maximum growth at a given level of soil fertility may be measured by it (Gerdeman, 1975). All plants were not dependent on AM (Hall, 1975) and dependency varied according to AM species (Mosse, 1972) and soil fertility (Baylis, 1974). Plant rely more on AM in P deficient soil. In a phosphorus amended alfisol mycorrhizal dependency and colonization were found to decrease with increased P concentration (Sharma *et al.*, 1999). High mycorrhizal dependency and effectivity in this soil provided initial size advantage particularly in leaf area and shoot height which were significant for growth in stressed condition.

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