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Effect of combined AM fungal inoculation on the growth response and N, P and K uptake in important tree species

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ABSTRACT

The influence of single and combined Am fungal inoculation and without inoculation was studied on three hard wood trees namely; *Artocarpus heterophyllus* Lam., *Eugenia bracteata* (Willd) Roxb. ex DC, *Lagerstroemia lanceolata* Wall. ex C.B.Clarke. It was observed that single inoculation neither influenced nor showed higher growth response. But the combined inoculation of AM fungi *G.bagarajii* and *G.geosporum* significantly has improved the plant growth and biomass yield and N, P, K and Zn uptake in all the bioinoculated plants over the control/noninoculated plants. The importance of mycorrhizal inoculation for tree seedlings before, they transplantation to agro forestry programmes has been discussed.

Keywords: *Artocarpus heterophyllus*, *Eugenia bracteata*, *Lagerstroemia lanceolata*. AMF (Arbuscular mycorrhizal fungi), Rhizosphere, Per cent root colonization.

1. Introduction

In the process of deforestation soil becomes infertile and it becomes different for plants to establish themselves without appropriate mycosymbiont^[10, 11, 12]. Many hardwood trees are associated with countless microorganisms in their rhizosphere. Most of the microorganisms are beneficial to plant and its health^[3, 9]. Among the beneficial microorganisms, AM fungi of the phylum Glomeromycota are important symbiotic fungi in higher plant root. They colonize 90% of the terrestrial plants^[9, 13]. These fungi benefit their hosts by increasing uptake of nutrients, especially P and enhancing resistance to biotic and abiotic stress. Preferential application of mycorrhizae too many horticultural/ forest seedlings is significant and realistic for their low cost and high economic output^[6]. Information about the influence of AM fungi on these three wood tree seedlings is very scanty. Therefore, the present study was undertaken to conduct the experiments under greenhouse conditions.

2. Materials and methods

Sandy loam soil and pure sand 3:1 in ratio was fumigated in 5 % methyl bromide that was used for pot experiments. Each pot measuring 20x25 cm (Length x breadth), filled with 6 kg of sterilized soil. AM fungal culture was prepared by multiplying AM fungi in separate pots by using *Sorghum* as a host plant. Inoculum of AM fungi *Glomus bagyarajii* and *Glomus geosporum* was mass cultured in *Sorghum*. Rhizosphere soil with AM fungal spores and chopped root bits of *Sorghum* roots 15 g dried inoculums was placed 4 cm below the surface of the soil in experimental pots. Before sowing the seeds of *Artocarpus heterophyllus* Lam., *Eugenia bracteata* (Willd.) Roxb ex DC. and *Lagerstroemia lanceolata* Wall. ex C.B.Clerke were surface sterilized in 2% sodium hypochlorite and washed 2-3 times in distilled water and sowed in each experimental pots. Four replicates for each treatment and a control without AM fungi were maintained. After 180 days the seedlings were removed to record the growth parameters. Shoot and root biomass was determined after drying the plant samples to a constant weight at 70 °C in a hot air oven. The AM fungal colonization in roots was recorded after clearing and staining the roots with 0.05% typhan blue in lactophenol^[15]. Phosphorous was determined by employing vanado/molybdate phosphoric acid yellow colour method^[8]. The nitrogen content was estimated following Microkjeldahl method^[8]. Potassium was determined by flame photometric method^[8], Zn was determined by GBS-902 atomic absorption spectrometer.

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3. Results and Discussion

The data on growth and percent root colonization and spore number/50 g soil of three hard wood tree seedlings shown in (Table 1). Response of three tree seedlings brought considerable improvement of growth, dry matter, N, P, K and Zn uptake when, the plants are inoculated with *Glomus bagyarajii* and *Glomus geosporum* in *Artocarpus heterophyllus* Lam., *Eugenia bracteata* (Willd) Roxb ex DC. and *Lagerstroemia lanceolata* ex C.B.Clarke (Table 2). Single inoculation (*G. bagyarajii*) brought favorable growth, plants biomass, percent root colonization, spore number and nutrients uptake in *Lagerstroemia lanceolata* Wall.Ex.C.B compare to *Artocarpus heterophyllus* Lam. and *Eugenia bracteata* (Willd) Roxb ex DC. But optimum growth responses were recovering in combined inoculation especially in *Eugenia bracteata* (Willd) Roxb. ex DC. Similarly, growth response of all the three trees seedling is depicted in (Fig 1). The results revealed that single inoculation of *Glomus bagyarajii* or *Glomus*

geosporum resulted in improvement of plants height, stem diameter, dry weight of stem, root and leaves with root colonization compared to uninoculated plants of *Artocarpus heterophyllus* Lam. and *Eugenia bracteata* (Willd) Roxb ex DC. But this kind of trend was not observed in *Lagerstroemia lanceolata* Wall. ex C.B.Clarke. *Glomus bagyarajii* influenced significantly than *G. geosporum*. Overall the, combined inoculation of *Glomus bagyarajii* and *G. geosporum* brought optimum growth as compared to the uninoculated control plants. The present findings are for with the early workers reported documents on olive tree by Victoria E [16], Giri B [4] had reported the positive response on *Cassia siamea* with the inoculation of *Rhizophagus fasciculatus* and *Glomus macrocarpum*. Single AM fungal inoculation may not be recommended for hard wood trees. The present findings are in accordance with earlier observations of [2], who have reported that mycorrhizal fungi differed in their efficacy on particular host.

Table 1: Percent root colonization and spore number in three hard wood tree seedlings at 180 days.

Tree species	Treatments	Per cent root colonization (%)	Spore number/50 g soil
1. <i>Artocarpus heterophyllus</i> Lam.	C	-	-
	Gb	51.7a	98c
	Gg	45.3d	83b
	Gb+Gg	59.4b	126d
2. <i>Eugenia bracteata</i> (Willd) Roxb ex DC.	C	-	-
	Gb	47.3a	87b
	Gg	52.8c	101a
	Gb+Gg	57.2d	114c
3. <i>Lagerstroemia lanceolata</i> Wall.ex C.B.Clarke	C	-	-
	Gb	44.5d	71b
	Gg	41.3c	78a
	Gb+Gg	49.8b	83c

Gb- *Glomus bagyarajii*; Gm- *Glomus geosporum*; C- Control. The values followed by the same letter within species are not significantly (P=0.05) according to Duncun’s range test.

Table 2: Growth response for three hard wood trees species, grown in a mixture of AM fungi at 180 days.

Tree species	Treatments	Plant height shoot	stem diameter root	dry weight leaves	dry weight	dry weight	P uptake	N uptake	K uptake	Zn uptake
1. <i>Artocarpus heterophyllus</i> Lam.	C	14.8a	0.43a	0.84a	0.1a	0.1a	0.05c	0.04c	0.02d	0.06d
	Gb	28.4a	0.64c	2.32b	1.2e	1.7b	0.11b	0.08b	0.04c	0.10c
	Gg	22.3c	0.71d	4.4b	2.2c	4.3a	0.13b	0.11b	0.05b	0.07b
	Gb+Gg	68.5a	0.78b	10.2d	3.1d	6.1b	0.19a	0.13a	0.08a	0.09a
2. <i>Eugenia Bracteata</i> (Willd) Roxb	C	13.3a	0.48a	0.76a	0.1a	0.1b	0.06d	0.05c	0.03c	0.04d
	Gb	28.5a	0.63c	3.3a	2.0c	3.6b	0.12c	0.10d	0.07b	0.06c
	Gg	36.7d	0.71c	5.8b	2.5c	3.8a	0.15b	0.12b	0.08d	0.07b
	Gb+Gg	73.4e	0.75b	11d	3.3b	0.5.2b	0.23a	0.20a	0.09a	0.10a
3. <i>Lagerstroemia lanceolata</i> Wall.ex.C.B	C	14.7a	0.46a	0.86c	1.1a	0.1c	0.05	0.06	0.05	0.02
	Gb	34.2c	0.69c	7.4c	3.1b	4.3a	0.15	0.12	0.09	0.06
	Gb	31.4d	0.59c	6.3d	2.4d	3.7b	0.12	0.11	0.06	0.04
	Gb+Gg	63.4e	0.75b	9.9d	3.3b	5.2b	0.24	0.23	0.10	0.11

Gb- *Glomus bagyarajii*; Gm- *Glomus geosporum*; C- Control. The values followed by the same letter within species are not significantly (P=0.05) according to Duncun’s multiple range test.

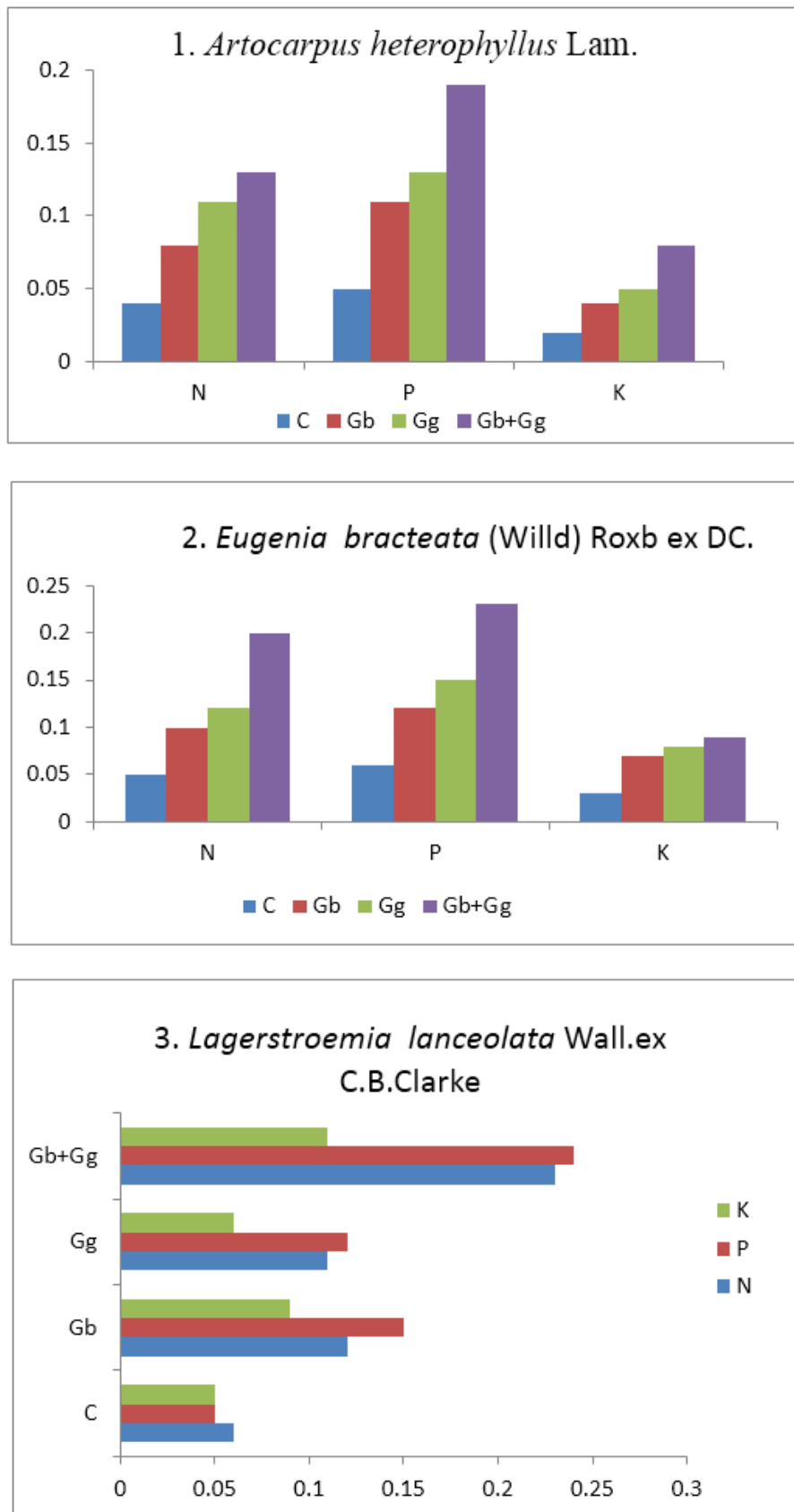


Fig 1: Showing the Growth response for three hard wood trees species, grown in a mixture of AM fungi on 1. *Artocarpus heterophyllus* Lam., 2. *Eugenia bracteata* (Willd) Roxb ex DC., 3. *Lagerstroemia lanceolata* Wall. ex C.B. Clarke

4. Conclusion

AM fungal inoculation on hard wood trees established significant root colonization in combined inoculation. Expect increase of *Artocarpus heterophyllus* Lam. may be useful as single inoculation of *G. bagyarajii*. Therefore, co-inoculation of AM fungi needs to be considered as valuable technology for the establishment of *Artocarpus heterophyllus* Lam., *Eugenia bracteata* (Willd) Roxb ex DC. and *Lagerstroemia lanceolata* Wall. ex C.B. Clarke of all these hard wood seedling at nursery stage, before, they are transplanted to bare area or in the agroforestry programmes. In future, the research programme on mycorrhiza must embrace multidisciplinary approach and should include all aspects of plant growth including the beneficial role of mycorrhiza and their possible manipulation to improve production. Reforestation of arid, semi-arid and wastelands pose serious challenges and this can be achieved by proper selection of mycorrhizal fungi.

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