

EFFECT OF BENEFICIAL BIOINOCULANTS ON THE GROWTH OF MONKEY POD TREE (*SAMANEASAMAN*) IN NURSERY CONDITION

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Abstract : Nursery experiments were conducted to assess suitable bioinoculants and their combinations to improve the seedling quality of *Samaneasaman*. Seeds were germinated in polythene bag with a potting mixture of unsterilized soil, sand and Farm yard manure in the ratio of 1:2:1 and inoculated individually and in combinations with *Azospirillum*, AM fungi and *Pseudomonas*. Shoot and root length, basal diameter and biomass were recorded at six months after inoculation. Results showed that the bioinoculants increase the growth and biomass of *S. saman* seedlings. Bioinoculants caused the significant increase in the growth, biomass, chlorophyll, protein and soluble sugar content of *S. saman* when compared to control plants. The maximum total biomass was observed in *Azospirillum* + AM fungi + *Pseudomonas* inoculated seedlings, followed by seedlings inoculated with *Azospirillum* + AM fungi and then by *Azospirillum* alone.

Key words: Biomass, Bio-inoculants, Biochemical content and *Samaneasaman*

INTRODUCTION

Bioinoculants play a key role in fixing the atmospheric nitrogen and mobilization of phosphorous, sulphur, manganese, Copper and Iron in the soil (Tinker, 1984). Many root colonizing bacteria including the nitrogen fixing *Azospirillum* and phosphorus solubilizing *Pseudomonas spp.*, are known to produce growth hormones which often lead to the increased root and shoot growth (Govindarajan and Thangaraju, 2001). *Azospirillum* is an important non-symbiotic associative and fixes atmospheric nitrogen in soil (Krishnamoorthy, 2002). Similarly, *Azospirillum* promote seedling growth, biomass and nutrient uptake (Sekaret al., 1995; Rajendran et al., 2003; Kasthuri Rengamaniet al., 2006).

The importance of nutrient uptake by plants is commonly attributed to the activity of mycorrhizae. AM fungus especially *Glomus fasciculatum* treated *Acacia nilotica* seedlings recorded an increase in shoot and root biomass (Priya Rani et al., 1998). Barrow et al (1977) reported that when phosphate is added to soil, it slowly becomes more firmly bound and less available to plants and firmly held phosphate is made available to plants by AM fungi inoculation. Plant growth promoting rhizobacteria are a group of bacteria that actively colonize plant roots and increase plant growth and yield (Cheung et al., 2005). Strains of *Pseudomonas putida* and *P. fluorescens* could increase root and shoot elongation in canola (Glick et al., 1997) as well as wheat and potato (Freitas and Germida., 1992; Frommelet al., 1993).

Samaneasaman or monkey pod tree is a large canopied tree with symmetrical crown. Although globally distributed, it is of tropical American origin and belongs to the family leguminosae (pulse family). Parts of the tree were used in the traditional medical practice for the mitigation of different

diseases including cold, headache, intestinal ailments and stomach ache (Staples and Elevitch, 2006). *Samaneasaman* is widely planted in tropics and subtropics. Forest departments as well as common private nurseries are producing large quantity of seedlings for planting. The seedlings produced both of them are poor quality due to insufficiency of necessary beneficial microbes and the rate of mineralization and nitrogen fixation.

This problem can be overcome by providing suitable bio inoculants to improve the growth and nutrient uptake in *Samaneasaman* seedlings. Hence the present study was made an attempt to evaluate the growth response and assess the biochemical changes inoculated with selected bioinoculants on *Samaneasaman* tree seedlings in the nursery conditions.

MATERIAL AND METHOD

A nursery experiment was conducted at Forest Department nursery, Madurai, which is located in the southern part of Tamil Nadu. The experiment was set up in a completely randomized design with 8 treatments and 12 replicates. Seedlings were maintained for six months with proper watering. Bio-inoculants such as *Azospirillum brasilensis*, *Glomus fasciculatum* fungi and *Pseudomonas fluorescens* were obtained from the Department of Agricultural Microbiology, Agriculture College, Madurai. One month old *samaneasaman* seedlings were selected for treatment. Potting mixtures were prepared by mixing sand, soil and FYM at 1; 2:1 ratio and one Kg of the potting mixture were filled in 96 polythene bags.

Treatments

T₁ – *Azospirillum*, T₂ – Arbuscular mycorrhizal (AM) fungi, T₃ – *Pseudomonas*, T₄ – *Azospirillum* + AM fungi, T₅ – *Pseudomonas* + *Azospirillum*, T₆ – AM

fungi + *Pseudomonas*, T₇ – *Azospirillum* + AM fungi + *Pseudomonas* and T₈ – Control.

Harvesting and Measurement:

180 days after inoculation a total of 12 seedlings were selected for each treatment, height, basal diameter were recorded. Seedlings were uprooted carefully and washed in the running tap water. The seedlings were cut at collar region, dried separately at 70°C in paper bags in hot air oven and biomass estimation was carried out using top pan electronic balance.

Biochemical analysis

Estimation of Chlorophyll: Extraction and estimation of chlorophyll pigments was done using acetone. The concentration of chlorophyll was calculated using the formula of Arnon (1949).

Estimation of Protein: Proteins in crude extract were estimated using the method used by Lowry et al (1951).

Estimation of soluble Sugar: Total soluble sugars were estimated following the method of Dubois et al (1956).

Statistical analysis

The data were statistically analysed by analysis of variance (ANOVA) and treatment means were separated using Duncan's Multiple Range Test (Duncan, 1955)

RESULT

Microbial inoculants have been advocated to provide benefits to growing plants in terms of direct promotion of vegetative growth through atmospheric N fixation, P solubilization and release of growth promoting substances in rhizosphere which alter the root physiology. The present study was aimed to assess the effects of beneficial microbes such as *Azospirillum*, AM fungi and *Pseudomonas* on plant growth of *Samanea saman* in the nursery condition.

The physico-chemical property of the nursery soil was determined and it was found to be sandy clay loam with a pH of 7.9. The soil showed total N (0.40%), P (0.18%), K (0.04%), Mn (0.08%) and Zn (0.05%).

The results were presented in Table-1 showed shoot; root and total biomass accumulation indicated that significant responses were observed among the treatments evaluated at 180 days after bioinoculants inoculated. The maximum biomass in the shoot was recorded in triple inoculation (*Azospirillum* + AM fungi + *Pseudomonas*), followed by inoculation with AM fungi + *Azospirillum*. Among individual inoculation *Azospirillum* was the more effective than others. The collar diameter was maximum in plants inoculated with *Azospirillum* + AM fungi + *Pseudomonas* followed by *Azospirillum* + AM fungi and AM fungi alone inoculated seedlings.

A change in a number of biochemical parameters has been observed in bio-inoculants treated *Samanea saman* seedlings. In general bioinoculants treated plants enhanced the biochemical aspects. Among the treatments triple inoculation had increase of chlorophyll, protein and sugar content than other treatments and non-inoculated plants. Among single inoculation, *Azospirillum* inoculated seedlings has more sugar content and AM fungi inoculated seedlings have been more chlorophyll and protein content but in less sugar content where as in *Pseudomonas* inoculated seedlings had no significant results (Fig:1).

DISCUSSION

Bio-inoculants such as *Azospirillum*, AM fungi and *Pseudomonas* either individually or in combinations, help the plant growth development through nitrogen fixation, phosphate solubilisation and phosphate uptake. In the present study, the height, diameter and dry matter production of the *Samanea saman* was higher in the seedlings treated with bio-inoculants. Growth promoting effect of inoculation with *Azospirillum* individually or in combination with other biofertilizers in other tree species already reported by Rajendran et al., (2003) in *Casuarina equisetifolia* and Kasthuri Rengamaniet al., (2006) in *Moringa oleifera*. Similarly in the present study *Azospirillum* inoculated seedlings showed better growth and root biomass as compared to control.

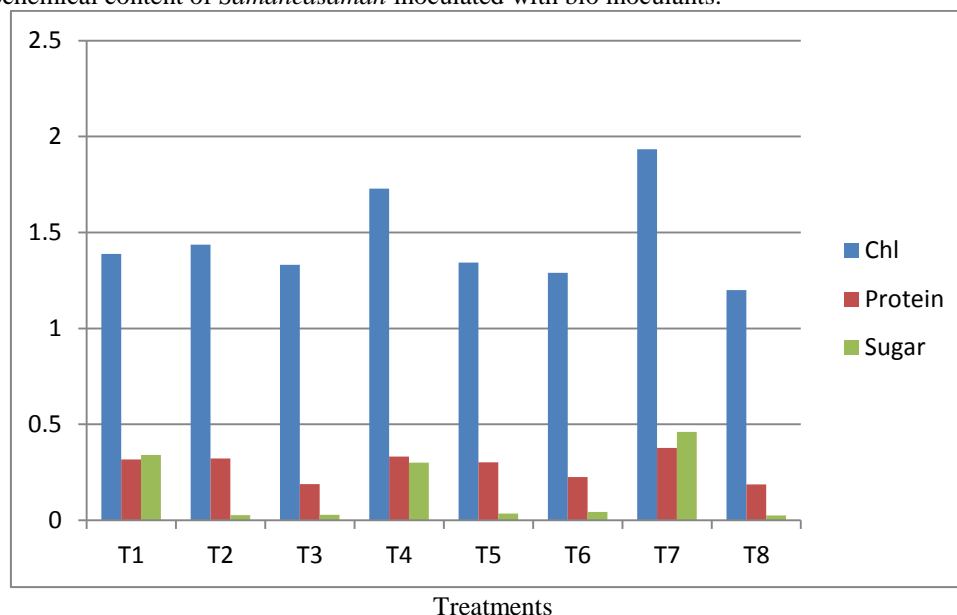
In the present study AM fungi inoculation enhanced the plant growth and also improved the biochemical content of *Samanea saman* this can be attributed due to extensive external network of mycelium produced by the AM fungi in association with the host root system (Howeler et al., 1981). Mycorrhizal plants have higher total chlorophyll and protein content than the non-mycorrhizal plants (Morte et al., 2000; Mathur and Vyas, 1995). But in sugar contents in the leaves showed decrease in AM inoculated seedlings. This decrease in sugar content may be due to the translocation of carbohydrate produced by the host to the fungal partner (Fitter, 1991).

Pseudomonas treated seedlings were not different in growth and biochemical content because it produces secondary metabolites (siderophores). Siderophores are phenolic compounds which are antimicrobial in nature (Guang, 1998) and may be more responsible for antimicrobial activity than the growth promotor.

It is concluded that proper utilization the use of efficient bio-inoculants lead to an increased growth, biomass and chemical content of *Samanea saman*. The present study clearly shown that the combined inoculation of bio-inoculants (*Azospirillum* + AM fungi + *Pseudomonas*) might improve the growth and biochemical content of *Samanea saman* seedlings.

Table1: Effect of different bio inoculants on the growth and biomass of *Samaneasaman* seedlings

Treatments	Shootlength (cm)	Root length (cm)	Collar diameter (mm)	Shoot dry wt (g/plant)	Root dry wt (g/plant)
T ₁	27.42 ^e ± 0.190	66.14 ^c ± 1.599	0.56 ^b ± 0.015	24.08 ^e ± 0.035	43.83 ^c ± 1.175
T ₂	26.60 ^{cd} ± 0.620	54.76 ^b ± 1.192	0.64 ^c ± 0.017	24.01 ^e ± 0.001	41.43 ^c ± 1.175
T ₃	24.26 ^{ab} ± 1.001	44.90 ^a ± 1.307	0.54 ^b ± 0.012	22.87 ^e ± 0.020	30.89 ^{ab} ± 0.665
T ₄	32.72 ^e ± 0.442	74.32 ^d ± 1.511	0.66 ^c ± 0.013	30.24 ^f ± 0.035	46.01 ^c ± 4.010
T ₅	25.42 ^{bcd} ± 0.815	54.60 ^b ± 1.756	0.54 ^b ± 0.016	23.04 ^d ± 0.020	38.14 ^{bc} ± 2.120
T ₆	24.80 ^{abc} ± 1.215	45.84 ^a ± 0.761	0.55 ^b ± 0.013	22.87 ^c ± 0.020	33.27 ^{ab} ± 1.960
T ₇	33.42 ^e ± 1.215	75.44 ^d ± 1.132	0.73 ^d ± 0.013	33.01 ^g ± 0.010	54.43 ^d ± 2.455
T ₈	22.74 ^a ± 1.215	44.40 ^a ± 1.307	0.35 ^a ± 0.014	18.60 ^b ± 0.005	27.19 ^a ± 1.380

Fig 1: Biochemical content of *Samaneasaman* inoculated with bio inoculants.

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