The Andhra Agric. J 58(1):45-49, 2011

Studies on The Influence of Integrated Nutrient Management on Growth and Nutrient Uptake by *Tectona Grandis*.

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ABSTRACT

The present study involves use of biofertilizer (*AM, PSB, Azotobacter*) and chemical fertilizer (NPK) alone and in factorial combination to see the effect on growth, biomass and nutrient uptake by *Tectona grandis*. In all the combinations growth, nutrient content was found significantly higher in comparison to un inoculated seedlings but shown variation with treatments. AM + Azotobacter combination was found to be most effective (3.91 times higher the biomass) than other (effective between 28.18- 302.28 %). Azotobacter alone was found least effective (28.18%) in *T. grandis*. P, Cu, Mn, and Zn uptake was found effective while uptake of N, K, Fe, and Mg was found ineffective.

Key words : *Arb Mycorrhiza, Azotobacter*, Nutrient content and biomass,*PSB, Tectona grandis*.

Biofertilizer often have positive quantitative effect on growth and vigour of plants. (Nagwani *et al.,* 1998). Application of biofertilizer to the soil / seed accelerates the extent of nutrient availability, supplements the demand of chemical fertilizers to some extent and enhances the growth and biomass of plants. Apparent result of microorganisms may not be existing under natural conditions because the naturally occurring microorganisms in soil become insufficient (Powell & Daniel 1978).

Biofertilizers development in soil is influenced by several environmental variables like N, P and K level (Mehrotra M. D 1991).Reports on impact of pH, conductivity and NPK level of soil on morphological changes, growth and biomass of most of the species are well documented but physiological changes that plant may exhibit in response to biofertilizers are few (Koide and Schreiner 1992). *Tectona grandis* is an important forestry species and is largely cultivated as monocrop or in agroforestry system.

The concept of integrated plant nutrient system (IPNS), to use biofertilizers and chemical fertilizers, combinely to reduce the dependency on one fertilizer source. The development of IPNS models for various forest species should given priority to improve the growth of forestry species in nurseries and plantations and to improve the productivity of soil. Therefore, this experiment was undertaken with an aim to study beneficial effects biochemical fertilizers on plant growth and nutrient uptake of *Tectona grandis*.

MATERIAL AND METHODS

The study was conducted in Research & Extension nursery of Social Forestry Division at Jabalpur (M.P.). The rhizospheric soil samples were collected from *Tectona grandis* plantations, as per the procedure adopted by Daniel and Skipper. Examination and identification of ArbusM were made with the help of (Schenck and Peretz 1990) most dominant AM fungi (*Glomus mosseae, G. intraradices & Acaulospora scrobiculata*) were identified. Mass multiplication of AM isolates was done as per Sieverding procedure (1991) by using *Panicum maximum* trap. After six months of intensive care with periodical assessment (Phillips and Hayman 1970 & Gerdemann and Nicolson 1963) trap were harvested and roots were chopped into small pieces. The chopped roots of trap was thoroughly mixed with rhizospheric soil and employed as culture for further inoculation. The culture of *Azotobactor chroococcum* & Phosphate solubilizing bacteria were procured from Regional Biofertilizer Development Centre. Jabalpur (M.P.).

One month old seedlings of *Tectona grandis* were transplanted into polythene bags (13cmx27cm) containing soil & sand (1:1).The seedlings were arranged in randomized block with 5 replicates each having 5 seedlings. The experiment consist of 15 Treatments :To- Control , T_1-*AM*, T_2- PSB, T_3- *Azotobacter*, T_4- *AM* + *PSB*, T_5- *AM* + *Azotobacter,* T_6- *PSB* + *Azotobacter*, T_7-*AM* + *PSB* + *Azotobacter*, T_8- NPK+AM, T_9- NPK+ *PSB*, T_{10}- NPK + *Azotobacter,* T_{11}-*AM* + *PSB* + NPK, T_{12}- *AM* +

Table 1. Effect of Bio-fertilizers and Chemical fertilizers on growth and biomass production of *T. grandis.*

Code	Treatments	Shoot Height (cm)	Root Length (cm)	Collar Diameter (cm)	Biomass (g/pl)
T_O	Control	15.30	22.70	0.63	9.19
T_1	VAM	16.40	31.00	0.67	12.63
T_2	PSB	15.40	39.40	0.83	19.01
T_3	*Azotobacter*	15.40	30.00	1.07	11.78
T_4	VAM + PSB	17.00	36.70	0.83	23.76
T_5	V AM + *Azotobacter*	15.40	37.40	1.35	45.18
T_6	PSB + *Azotobacter*	23.50	42.50	1.25	36.17
T_7	V AM + PSB + Azato.	19.40	40.90	1.35	32.99
T_8	NPK + VAM	15.70	37.60	1.23	22.23
T_9	NPK + PSB	19.70	31.20	0.84	22.60
T_{10}	NPK + Azotobacter	17.10	31.20	0.95	27.97
T_{11}	VAM + PSB + NPK	16:10	27.00	0.85	18.78
T_{12}	VAM + Azoto.+ NPK	21.00	35.0	0.83	21.72
T_{13}	PSB + Azoto + NPK	29.40	27.30	0.84	18.35
T_{14}	VAM + PSB+ Azoto + NPK	15.70	27.40	0.94	23.26
T_{15}	NPK	22.50	33.00	1.25	17.54
	LSD P 0.05	2.35	2.44	0.10	2.47

Azotobacter + NPK, T_{13}- *PSB* + *Azotobacter* + NPK, T_{14}-*AM* + *PSB* + *Azotobacter* + NPK, T_{15} - NPK.

Inoculation of Biofertilizer & NPK was done by making 3-4 holes of size 0-5 cm. depth were made around root zone of each seedling & inoculums of *AM. PSB, Azotobacter*, NPK and also in combination was placed into these holes. Subsequently the holes were filled up with soil and the plants were irrigated quickly.15g inoculum was made available each seeding. Control seedlings were also maintained for the purpose of comparison, weeding was carried out as and when required, daily watering was done as required. After 6 months of inoculation, 10 plants from each treatment were selected randomly (two from each replicate). The seedling height, collar diameter and root length of seedling were measured by Tape and Vernier caliper while fresh weight was recorded separately for each seedlings. The dry biomass was calculated after keeping the plant material in oven at 70°C for 3 days.

The plant material was ground for analysis of total nutrient concentration in plants. Total N content in plant tissue was determined by Auto Kjeltec 2300, as per the prescribed method by Jackson (1973). 1 g ground plant material (20 meshes) was digested with 10 ml of Conc. HNO_3 in a digestion chamber at a temperature of about 225°C. After 3 hours, 5 ml di-acid mixture was added to get clear aliquot of plant material and heated for further 15 minutes. After cooling 25 ml distilled water was added and finally the volume was made up to 50 ml. The aliquot was used for analysis of Fe, Cu, Mn, Zn. Mg and K contents in plants. The pH of soil was estimated by pH meter in 1:2.5 soil water ratio. Organic matter content in soil by prescribed method of Walkey and Black (1934). Estimation of available phosphorus in soil was made by extraction with $NaHCO_3$ (Olsen et al.,1954) and potassium with flame-photometer. Estimation of micro-nutrients was made through Atomic Absorption Spectrophotometer (GBC GZ5 AB). Micro-nutrient content in soil was determined by DTPA extraction technique from Atomic Absorption Spectrophotometer (Liang *et al*., 1993). Statistical analysis of the data was made by using computer package SX for calculation of ANOVA and test of significance)

RESULTS AND DISCUSSION

(i) Growth and Biomass

Biofertilizer inoculation found to improve the growth and biomass significantly (Table-1). Shoot height enhanced maximum of 14.10 cm in seedlings with PSB + *Azotobacter* + NPK inoculation followed by PSB + *Azotobacter* (8.2 cm/pl.) inoculation. Similarly root length was improved maximum (19.80 cm/pl.) in PSB + *Azotobacter* inoculated seedlings. Collar diameter was recorded maximum in VAM + *Azotobacter* inoculated seedlings and minimum in uninoculated seedlings. Biomass improvement was recorded maximum (35.99 g/pl.) with VAM + *Azotobacter* inoculation. Seedlings inoculated with the other combinations of biofertilizer rendered biomass between 11.78 - 36.16 g/pl. while, NPK given seedlings exhibited 17.54g/pl. biomass against uninoculated seedling (9.19 g/pl.).VAM + *Azotobacter* combinations were found to be most effective (3.91 times higher the biomass) than others (effective between 28.18 - 302.28%). *Azotobacter* was found least effective (28.18%) in *T. grandis* (figure-1).Seedlings inoculated with VAM + NPK, PSB + NPK and *Azotobacter* + *NPK* also exhibited higher growth and biomass than individual inoculated Seedlings.

(ii) Nutrient uptake

Seedlings inoculated with PSB + *Azotobacter* was improved maximum nitrogen content (0.815%) over control seedlings but N uptake remained unaffected in seedlings inoculated with PSB, VAM + PSB, VAM + *Azotobacter* and PSB + *Azotobacter.* Phosphorus uptake was improved maximum (15.14 ppm) in VAM + PSB + NPK inoculation followed by PSB + NPK (14.30 ppm) and VAM + NPK (13.68 ppm) inoculation. NPK fertilized seedling shown 7.19 ppm higher P against uninoculated seedlings. Potassium content determined 124.27 ppm higher in VAM + PSB + NPK inoculated seedlings but same time it also found lower (from control) in some cases (Table-2). The uptake of Iron improved maximum (3.10 ppm) in VAM + PSB + NPK inoculated seedlings followed by PSB + *Azotobacter* + NPK (2.81 ppm). Copper content was improved in all the treatment under study and recorded maximum improvement (0.145 ppm) in seedlings inoculated with *Azotobacter* + NPK. Magnesium concentration was more in PSB inoculated seedling and minimum in VAM + NPK inoculated seedlings as compared to control seedlings. Manganese and zinc content was also found higher in seedlings inoculated with different bio-chemical fertilizers and the improvement was noticed maximum upto 0.11 ppm and 0.135 ppm in V AM + PSB + NPK and *Azotobacter* inoculated seedlings respectively.

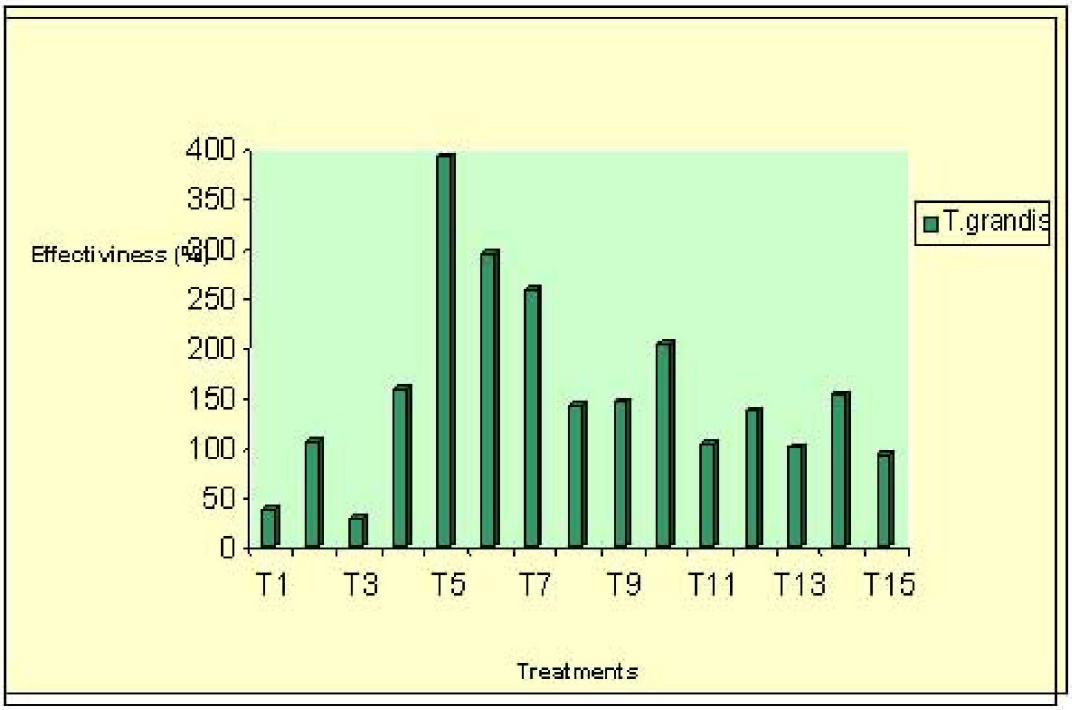

Fig. 1. Growth and biomass of *Tectona gandris*

Table 2. Effect of biofertilizers and chemical fertilizers on nutrient uptake by *Tectona grandis*

Code	Treatments	Nutrient content (ppm)							
		N (%)	P	K	Fe	Cu	Mg	Mn	Zn
T_O	Control	1.719	13.02	77.13	8.73	0.107	16.62	0.65	0.095
T_1	VAM	1.776	20.52	85.7	7.96	0.108	16.97	0.68	0.200
T_2	PSB	1.546	19.70	68.56	10.31	0.144	18.76	0.69	0.210
T_3	*Azotobacter*	2.277	19.68	132.8	8.74	0.134	16.66	0.64	0.230
T_4	VAM + PSB	1 .435	20.34	67.14	8.21	0.182	18.60	0.65	0.200
T_5	VAM + *Azotobacter*	1.708	19.50	81.42	10.66	0.211	17.30	0.62	0.220
T_6	PSB + *Azotobacter*	1.481	19.52	71.42	9.60	0.205	17.51	0.65	0.210
T_7	VAM + PSB + Azoto	1.724	22.30	68.56	9.25	0.211	18.19	0.60	0.215
T_8	NPK + VAM	2.087	26.70	55.71	5.83	0.195	13.59	0.72	0.213
T_9	NPK + PSB	2.354	27.32	98.60	8.60	0.224	15.61	0.73	0.210
T_{10}	NPK + Azotobacter	1.998	25.54	85.70	8.61	0.252	15.30	0.71	0.191
T_{11}	VAM + PSB + NPK	2.111	28.16	201.4	11.83	0.217	14.90	0.76	0.182
T_{12}	VAM + Azoto.+ NPK	2.091	23.24	94.27	8.60	0.207	14.97	0.72	1.950
T_{13}	PSB + Azoto + NPK	2.534	22.18	124.27	10.70	0.134	14.60	0.74	0.190
T_{14}	VAM + PSB + Azoto + NPK	1.833	21.68	72.85	11.54	0.134	16.26	0.72	0.200
T_{15}	NPK	1.798	20.21	90.25	9.13	0.125	16.40	0.69	0.188
	LSD P 0.05	0.28	2.16	9.31	0.92	0.64	1.36	0.049	0.027

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(Received on 30.01.2009 and revised on 22.07.2009)