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RESEARCH ARTICLE :

Effect of integrated plant nutrition system on nutrient uptake of *Dalbergia latifolia* (Rose wood) seedlings

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SUMMARY : The study was conducted at Forest College and Research Institute, Mettupalayam, to know the effect of organic manures and inorganic fertilizers on nutrient uptake of the *Dalbergia latifolia* seedlings. Among the fourteen different treatments, the treatment with 100 mg of N, 200 mg of P_2O_5 and 100 mg of K_2O along with vermicompost (5g), Azophos (10g) and VAM (5g) per seedlings showed significantly maximum shoot and root N, P and K uptake (nitrogen shoot uptake 0.81 mg per seedling and root uptake 0.48 mg per seedling, phosphorus shoot uptake 0.24 mg per seedling and root uptake 0.276 mg per seedling, potassium shoot uptake 0.93 mg per seedling and root uptake 0.69 mg per seedling). Nutrient uptake values in control were remarkably low throughout the seedling growth.

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KEY WORDS :
Dalbergia latifolia, Uptake, Fertilizers, Nitrogen, Phosphorus, Potassium

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BACKGROUND AND OBJECTIVES

Dalbergia latifolia (Leguminosae, subfamily Papilionoideae) is predominantly a single-stem deciduous tree with a dome shaped crown of lush green foliage. On wet sites, it may remain evergreen. The trees reach a height of 20-40 meters with a girth of 1.5 - 2.0 meters (Prasad *et al.*, 1993). East Indian Rosewood is considered a "tone wood" due to its consistent acoustic qualities and came into wide use in the mid 1960 as a substitute for Brazilian Rosewood (which was over harvested and became an endangered species) in making guitar backs and sides. It is used to make premium-grade furniture, panelling, veneers and interior and exterior joinery. Secondary uses of the wood include knife handles, musical instrument, calico-printing blocks, mathematical instruments, agricultural implements and boat keels and screws. Tannins from the bark is used to produce medicines for the treatment of diarrhoea, worms, indigestion and leprosy. Tannin is also used to produce an appetizer.

As pure stands, *D. latifolia* is planted at a spacing of 1.2 x 1.2 to 1.8 x 1.8 m (Deshmukh, 1975) or 1 to 2.5 x 1 m (Japing, 1936 in Kadambi, 1954). Wider spacing may produce crooked stems. For agro forestry

systems, trees are planted at a spacing of 3 x 1 to 6 x 2 m (Sukandi, 1993). Trees are usually harvested in 30-40 years. To obtain 30 cm of heartwood a 50 year cutting cycle is recommended (DMI, 1980). *Dalbergia latifolia* is generally managed by clear felling followed by artificial regeneration. After planting or direct sowing, regular weeding is necessary until trees dominate weed competition. Loosening soil around seedlings also improves growth. Weeding and soil loosening should be done before weeds become dense. The sudden removal of heavy weed growth from around seedlings may cause death from exposure (Kadambi, 1954).

Fresh seed germinates at 50-75% within 7-21 days of sowing. Stored in gunny sacks or earthen pots, seed remains viable for six months (Kadambi, 1954). Seed viability can be extended to 9-12 months by drying seeds to 8% moisture content and storing them in airtight containers, however, germination will decrease to 30-40%. One kilogram contains 21,000 seeds. The annual rainfall in *D. latifolia's* native habitat ranges from 750-5000 mm. As a seedling, *D. latifolia* is shade tolerant but sensitive to drought and fire. In maturity, it is tolerant of drought and ground fire, but susceptible to crown fire. It is classified as a moderate light demander (Troup, 1921).

RESOURCES AND METHODS

The study was conducted at Forest College and Research Institute, Mettupalayam, during November, 2011 to March, 2012. The aim of the study was to find the effect of organic manures and inorganic fertilizers on nutrient uptake of *Dalbergia latifolia* seedlings. For this purpose, 45 days old seedlings raised in nursery beds were planted in polybags (25 cm X 15 cm) size containing nursery medium soil and FYM in the ratio of 3:1. The calculated quantity of organic and biofertilizers (*Azospirillum* and *Phosphobacteria*) were added to the respective poly bags as per the treatment schedule at transplanting. The inorganic fertilizers were added as aqueous solution to each poly bags seven days after transplanting. Fourteen different treatment combinations were tried for the study:

The experiment was laid out in Completely Randomized Design (CRD). Thirty seedlings were maintained in each treatment with three replication. For these seedlings, watering was done daily and also the seedlings were kept as weed free. Plant samples were collected at 30,60 and 90 days after transplanting, dried and processed and analysed for nutrient contents. The following analytical methods were used for the study *viz.*, microkjeldhal method for nitrogen content (Humphries 1973), vanadomolybdate yellow colour method for phosphorus content (Jackson 1973) and flame photometry for potassium content (Piper 1966). Nutrient uptake was computed by using the nutrient content values and dry matter production.

OBSERVATIONS AND ANALYSIS

Nutrient uptake by shoot and root of *Dalbergia latifolia* seedlings varied significantly due to influence of organic manures and inorganic fertilizers over control are presented in Table 1. The beneficial effect of various IPNS treatments in influencing the N uptake in shoot and root of Dalbergia latifolia seedlings was well established in the present investigation.

With regard N uptake, the application of 100 mg of N, 200 mg of P_2O_5 and 100 mg of K_2O along with vermicompost (5g), Azophos (10g) and VAM (5g) per seedling (T_{11}) recorded the highest shoot N uptake of 0.81 mg per seedling at 90 DAT. The same treatment registered maximum root N uptake of 0.48 mg per seedling at 90 DAT. The probable reason for higher nitrogen uptake might be due to optimal concentration of the nutrients in that particular treatment combination. The above results were in accordance with David Camus (2008) who reported that combined application of NPK (150:200:100 mg) along with vermicompost (5 g) and *Phosphobacteria* (10 g) significantly increased the uptake of N and K in *Melia dubia* seedlings. The present finding was in consonance with Karthikeyan and Pandiyarajan (1995) who have reported that dual inoculation of *Phosphobacteria* and AM fungi resulted in significant increase in total dry weight and NPK uptake over individual inoculation in neem. Application of 100 mg of N, 200 mg of P_2O_5 and 100 mg of K_2O along with vermicompost (5g), Azophos (10g) and VAM (5g) per seedling (T_{11}) registered the highest P uptake of shoot (0.24 mg) and root (0.28 mg) at 90 DAT, respectively. The enhanced P uptake due to bioinoculants is attributable to the presence of *Phosphobacteria* which solubilize the immobile organic phosphates to inorganic phosphates through organic acids released by *Phosphobacteria*. Similar finding was also observed by Kalavathi *et al.* (2000) who reported that the combined inoculation of

Phosphobacteria and VAM significantly increased the growth, P uptake and VAM colonization over VAM or *Phosphobacteria* alone in neem. The finding was in consonance with Amol (2009) who reported that the application of *VAM*, *Phosphobacteria*, and *Azospirillum* along with NPK recorded the maximum P content and P uptake of *Bambusa vulgaris* seedlings. Potassium uptake by seedling applied with 100 mg of N, 200 mg of P_2O_5 and 100 mg of K_2O along with vermicompost (5g), Azophos (10g) and VAM (5g) per seedling (T_{11}) registered the highest shoot 0.93 mg per seedling and root 0.69 mg per seedling at 90 DAT. The result from the present investigation corroborated with the finding of Sekar *et al*. (1995) who observed that combined

Table 1 : Nutrient uptake (mg seedling^{-1}) shoot by *Dalbergia latifolia* as influenced by organic manures and inorganic fertilizers at different growth stages

Treatments	Nitrogen (mg seedling^{-1})			Phosphorus (mg seedling^{-1})			Potassium (mg seedling^{-1})		
	30 DAT	60 DAT	90 DAT	30 DAT	60 DAT	90 DAT	30 DAT	60 DAT	90 DAT
T_1 - Control	0.01	0.02	0.03	0.01	0.01	0.01	0.01	0.02	0.03
T_2 - Vermicompost (5g)	0.04	0.07	0.12	0.02	0.02	0.03	0.04	0.08	0.15
T_3 - Azophos (10g)	0.04	0.07	0.12	0.02	0.02	0.03	0.05	0.08	0.14
T_4 - VAM (5g)	0.04	0.07	0.11	0.01	0.02	0.04	0.05	0.08	0.15
T_5 - T_3 + T_4	0.04	0.07	0.13	0.02	0.02	0.03	0.05	0.08	0.15
T_6 - 50:100:50 mg NPK	0.05	0.07	0.13	0.02	0.03	0.04	0.05	0.09	0.16
T_7 - T_6+ T_3	0.04	0.07	0.13	0.02	0.03	0.05	0.05	0.10	0.17
T_8 - T_6 + T_5	0.05	0.12	0.17	0.02	0.04	0.05	0.05	0.14	0.21
T_9 - 100:200:100 mg NPK	0.06	0.12	0.21	0.03	0.04	0.07	0.07	0.14	0.24
T_{10} - T_9 + T_3	0.17	0.32	0.39	0.08	0.12	0.15	0.19	0.36	0.51
T_{11} - T_9 + T_5	0.31	0.62	0.81	0.11	0.18	0.24	0.35	0.69	0.93
T_{12} - 200:400:200 mg NPK	0.08	0.18	0.25	0.05	0.08	0.09	0.10	0.23	0.33
T_{13} - T_{12} + T_3	0.11	0.17	0.25	0.06	0.08	0.11	0.12	0.20	0.34
T_{14} - T_{12} + T_5	0.06	0.14	0.29	0.03	0.05	0.09	0.07	0.16	0.35
S.E. ±	0.013	0.021	0.038	0.005	0.008	0.012	0.016	0.025	0.051
C.D. (P=0.05)	0.026	0.043	0.079	0.010	0.016	0.026	0.032	0.051	0.105

Table 2 : Nutrient uptake (mg seedling^{-1}) of root by *Dalbergia latifolia* as influenced by inorganic manures and inorganic fertilizers at different growth stages

Treatments	Nitrogen (mg seedling^{-1})			Phosphorus (mg seedling^{-1})			Potassium (mg seedling^{-1})		
	30 DAT	60 DAT	90 DAT	30 DAT	60 DAT	90 DAT	30 DAT	60 DAT	90 DAT
T_1 - Control	0.02	0.03	0.03	0.003	0.004	0.005	0.03	0.04	0.04
T_2 - Vermicompost (5g)	0.04	0.06	0.10	0.009	0.015	0.026	0.06	0.08	0.15
T_3 - Azophos (10g)	0.04	0.06	0.10	0.010	0.016	0.027	0.06	0.09	0.15
T_4 - VAM (5g)	0.04	0.06	0.09	0.009	0.017	0.033	0.06	0.09	0.16
T_5 - T_3 + T_4	0.04	0.07	0.11	0.010	0.018	0.029	0.06	0.09	0.16
T_6 - 50:100:50 mg NPK	0.05	0.07	0.11	0.012	0.019	0.035	0.07	0.10	0.17
T_7 - T_6+ T_3	0.04	0.07	0.12	0.011	0.020	0.035	0.06	0.11	0.19
T_8 - T_6 + T_5	0.05	0.11	0.14	0.013	0.031	0.043	0.07	0.16	0.21
T_9 - 100:200:100 mg NPK	0.06	0.12	0.18	0.017	0.032	0.054	0.08	0.17	0.25
T_{10} - T_9 + T_3	0.16	0.25	0.30	0.054	0.101	0.135	0.22	0.35	0.47
T_{11} - T_9 + T_5	0.22	0.37	0.48	0.108	0.209	0.276	0.30	0.52	0.69
T_{12} - 200:400:200 mg NPK	0.11	0.17	0.20	0.024	0.056	0.080	0.16	0.27	0.33
T_{13} - T_{12} + T_3	0.13	0.17	0.22	0.033	0.055	0.086	0.17	0.24	0.37
T_{14} - T_{12} + T_5	0.08	0.13	0.23	0.017	0.036	0.073	0.10	0.19	0.35
S.E.±	0.012	0.012	0.027	0.004	0.010	0.010	0.019	0.020	0.046
C.D. (P=0.05)	0.025	0.025	0.056	0.009	0.020	0.022	0.038	0.041	0.094

inoculation of *Azospirillum*, *Phosphobacteria* and AM fungi significantly increased the uptake of N, P, K and micronutrients in shola tree species *viz*., *Syzygium montanum* and *Eleocarpus oblanga*. Similar trend was observed by Heeralal (1999) in *Albizia lebbeck* and *Ceiba pentandra*.

From this study, it was concluded that soil incorporation of 100 mg of N, 200 mg of P_2O_5 and 100 mg of K_2O along with vermicompost (5g), Azophos (10g) and VAM (5g) per seedling (T_{11}) significantly enhanced the nutrient uptake of shoot and root during all stages of seedling growth.

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