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NUTRITIONAL REQUIREMENT AND FERTILIZER APPLICATION ON SEEDLING GROWTH OF *TECTONA GRANDIS*

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ABSTRACT
Growth performance and biomass of teak (*Tectona grandis*) seedlings were examined under three different doses of Nitrogen (50, 100 and 150 mg) and Phosphorous (25, 50 and 75 mg) individually as well as in combination with 300g of Farm Yard Manure on sodic soil in Eastern U P in Northern India. Results reveal that a dose of 100mg Nitrogen was required to achieve maximum growth when Teak seedlings were treated with individual doses of Nitrogen and Phosphorous. However, the required dose of Nitrogen was only 50mg when combined with 50 mg of Phosphorous and300g of Farm Yard Manure.

KEY WORDS: Farm Yard Manure, Seedling growth, *Tectona grandis*, Fertilizer, Biomass

INTRODUCTION

Standardization of nursery techniques is the first step for raising successful plantations, as the expenditure on nursery alone takes a major portion of plantation cost. The cost can therefore, be reduced by developing suitable and desired nursery practices on scientific lines (Bahuguna and Lal,1992).

Large-scale afforestation in India has brought into prominence the need for a more comprehensive knowledge of the mineral requirements of forest tree species and for a reliable method for the diagnosis of nutritional disturbance limiting their growth. Mineral nutrition of plants is a subject of great interest and importance for the intensive management of forestland. Much attention has been paid on this subject in other countries, particularly in studying and solving problems of soil fertility, nutritional requirements, mineral deficiencies and in the application of mineral fertilizers in nurseries, as well as in the field. Fertilizers of various kinds play a key role in maintaining the proper level of nutrients in the nursery to produce vigorous planting stocks. In the present work, fertilizer use efficiency of teak seedlings under nursery conditions has been studied. Indices of growth, i.e. height increment, dry matter, etc., have been used in the present study to determine the nitrogen, phosphorus and Farm Yard Manure requirements of *Tectona grandis* seedlings.

MATERIAL & METHODS

In order to see the effect of different levels of fertilizers on teak seedling, raised in the nursery, the present study was carried out using randomized block design, with 5 replications of 16 treatments. Each replication was a unit of 5 seedlings and treatments were three individual dose of Nitrogen and Phosphorous and nine doses involving various combinations of Nitrogen and Phosphorous, including a control. The treatments were: three levels of nitrogen viz., 50, 100 and 150 mg per plant, three levels of phosphorus viz., 25, 50 and 75 mg per plant (elemental dose of fertilizer) separately, as well as in different combinations. Apart from this treatments of Farm Yard Manure (300 g per plant)

and its different combinations with chemical fertilizers i.e. Nitrogen and Phosphorous were also given to the seedlings. Basal dose of urea and single super phosphate per plant was given to similar sized well-established one month old seedlings in first week of April, 1999. The quantity of fertilizer was weighed in an electronic balance. Urea was given in two installments i.e., first in the beginning and second after one month. The bags containing seedlings were weeded and irrigated as and when required. Observations on growth i.e. shoot height and collar diameters were recorded at monthly interval, whereas seedling dry weight of leaves, stem and root was taken at three months interval.

Measurements on seedling growth (height and collar diameter) were taken at monthly interval and dry weight yield of seedlings at three months interval, after the roots were carefully washed. Different parts of the plant i.e., leaves, stem and root were separated and oven dried at 80^0C to constant weight. The experiment was continued till six months as after this period seedling raised from root-shoot cuttings assume sapling stage. Leaf weight ratio (LWR), relative growth rate (PGR) and net assimilatory rate (NAR) were determined following Evans (1972). Sturdiness Quotient (S.Q.) (Thomson, 1985) and Quality Index (Q.I.) (Dickson *et al.*,1960) were also determined under present investigation.

RESULT & DISCUSSION

Table 1a indicate seedling growth in terms of seedling height, collar diameter and dry weight due to individual application of Farm Yard Manure (control), Nitrogen and Phosphorous (fertilizer supplements) as well as their coupled effect under nursery condition. On application of varied levels of nitrogen viz, 50,100 & 150 mg seedling; it was observed that seedling growth increased upto 100 mg N seedling. Maximum seedling

height, collar diameter and seedling dry weight at this level of input were 36.30 cm seedling, 9.94 mm and 36.32 g per seedling respectively. Nitrogen beyond this level caused an adverse effect on growth. Lack of.

Table 1a. Combined effect of FYM and chemical nutrients (fertilizer) on seedling growth of teak

Treatment	Elemental proportion of fertilizer (mg plant^{-1})	Seedling growth after 6 months		Dry weight/seedling (g) after 6 months			
		Height (cm)	Collar diameter (mm)	Leaf weight	Stem weight	Root weight	Total weight
Control	**0.00**	20.24	7.05	6.28	3.27	8.55	18.10
FN1	**50**	31.14	8.72	11.15	7.22	11.12	29.49
FN2	**100**	36.30	9.94	14.60	8.16	13.56	36.32
FN3	**150**	27.96	8.21	11.70	6.28	13.54	31.52
FP1	**25**	27.20	8.38	7.51	4.83	9.00	21.34
FP2	**50**	29.98	9.06	9.68	5.38	10.49	25.55
FP3	**75**	33.00	9.55	12.38	6.56	12.50	31.44
FN1P1	**50:25**	45.40	12.18	21.90	12.84	21.94	56.68
FN1P2	**50:50**	65.70	14.78	31.42	16.14	25.00	72.56
FN1P3	**50:75**	52.70	13.24	27.08	13.64	23.80	64.52
FN2P1	**100:25**	46.44	11.88	20.80	9.84	21.42	52.06
FN2P2	**100:50**	40.10	11.29	20.30	8.40	19.44	48.14
FN2P3	**100:75**	34.10	9.99	17.80	7.30	17.80	42.90
FN3P1	**150:25**	30.80	9.87	15.42	6.70	16.20	38.32
FN3P2	**150:50**	29.19	9.79	13.44	6.68	14.86	34.98
FN3P3	**150:75**	25.00	8.62	11.34	5.56	13.35	30.25
		**	**	**	**	**	**
	sem	**3.06**	**5**	**0.24**	**0.28**	**0.46**	**3.06**
	CD 1%	11.52	3.18	0.89	1.05	1.72	11.52
	CD 5%	8.67	2.39	0.67	0.79	1.29	8.67

*** F=300g FYM**

Table - 1b. Combined effect of FYM and chemical nutrients (fertilizer) on growth indices of teak seedling.

Treatment	Elemental proportion of fertilizer (mg plant^{-1})	Root : shoot ratio	RGR	LWR	NAR	RWR	SQ	QI
Control	**0.00**	0.89	0.005	0.35	0.016	0.47	2.87	4.54
FN1	**50**	0.60	0.005	0.38	0.017	0.38	3.57	5.65
FN2	**100**	0.59	0.006	0.40	0.019	0.37	3.65	6.82
FN3	**150**	0.75	0.005	0.37	0.018	0.43	3.40	6.67
FP1	**25**	0.73	0.005	0.35	0.017	0.42	3.24	4.64
FP2	**50**	0.69	0.005	0.38	0.018	0.41	3.31	5.38
FP3	**75**	0.66	0.005	0.39	0.018	0.40	3.45	6.33
FN1P1	**50:25**	0.63	0.006	0.39	0.019	0.39	3.73	10.67
FN1P2	**50:50**	0.52	0.007	0.43	0.020	0.34	4.44	11.44
FN1P3	**50:75**	0.58	0.007	0.42	0.019	0.37	3.98	11.34
FN2P1	**100:25**	0.70	0.006	0.40	0.019	0.41	3.91	9.75
FN2P2	**100:50**	0.68	0.006	0.42	0.018	0.40	3.55	9.58
FN2P3	**100:75**	0.71	0.006	0.41	0.018	0.41	3.41	8.90
FN3P1	**150:25**	0.73	0.006	0.40	0.018	0.42	3.12	8.54
FN3P2	**150:50**	0.74	0.006	0.38	0.016	0.42	2.97	8.09
FN3P3	**150:75**	0.79	0.005	0.37	0.016	0.44	2.90	7.26

positive response to higher dose of nitrogen (150 mg) can be attributed to the initial medium status of available nitrogen in experimental soil which when supplemented with 150 mg Nitrogen per seedling reached supra-optimal level of plant nitrogen requirements. The finding of this study is similar to the reports of Kaul (1989) for *Bahunia variegata* and Bhardwaj et al. (1996) for *Acer oblungum*In case of individual Phosphorous application, seedling growth increased along treatment and maximum growth was recorded at maximum level of P applied (75 mg per seedling). The seedling height ranged from 27.20 to 33.0cm per seedling, collar diameter from 8.38 to 9.55 mm per seedling and seedling dry weight from 21.34 to 31.44 g per seedling. On comparison of seedling growth under individual application, the former

indicated superiority over the latter. However, the sturdiness quotient showed that, P application favoured better collar diameter growth than that of N application. As regards effect of N application, generally its dominance over P application prevailed. Increase in growth due to N and P application is in conformity to Brar and Katoch, 1980; Dutt and Pathania, 1984;

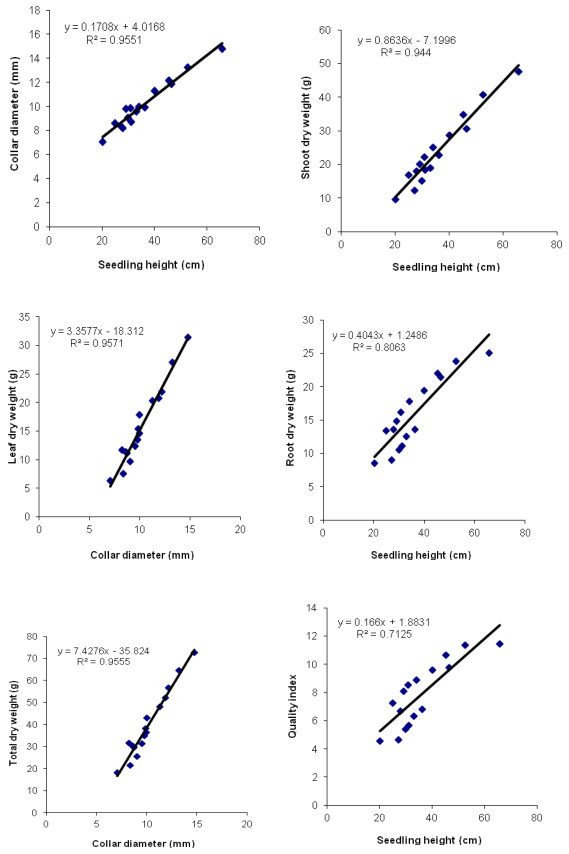

Fig.1: Correlations and regression analyses for certain seedling parameters under conditions of varied combinations of FYM and chemical fertilizer levels in the nursery.

Interestingly, the root shoot ratio and RWR exhibited reverse order (*Table 1b*). Significant positive correlations (r^2=0.71 to 0.95; p<0.01) were indicated for relationships between different parameters (Fig.1). As revealed by the results of this study, better growth performance of seedlings was reflected when Farm Yard Manure was applied in combination with chemical fertilizers. This is perhaps due to direct as well as indirect effects of Farm Yard Manure on soil and plant growth. The indirect effects include augmentation of beneficial microbial population and their activities such as organic matter decomposition (Gaur et at., 1971, 1973; Gaur and Pareek, 1974), solubilisation of insoluble phosphates (Gaur, 1972) and availability of plants.

In addition to substantial content of nitrogen (0.5%), phosphorus (0.2%) and potassium (0.5%), a fair amount of micro-nutrients (e.g., manganese, zinc, copper and iron) are also present in FYM, which are added to the soil (Yawalkar et al., 1996). Organic manures have an improving effect on structure, water holding capacity and base exchange capacity of soil (Gaur et at., 1972). The direct effect relates to the uptake of humic substances or its decomposition products affecting favourably the growth and the metabolism of plants (Gaur, 1971; Gaur and Bhardwaj, 1971; Mathur and Gaur, 1977). Besides these, humic substances increase the efficiency of bio and chemical fertilizer to a great extent. The result of this study shows that 300 g of Farm Yard Manure in combination with 50 g of N & 50 g of P proves to be the optimum dose for teak seedlings.

While decline in seedling growth due to higher doses of Nitrogen and Phosphorous may be due to the antagonistic effect, as higher nutrient doses combined with Farm Yard Manure are available to the trees above the critical level supporting seedling growth. Our study, therefore, concludes that combined application of Farm Yard Manure and fertilizer proves better by making all essential nutrients available to the seedlings in the growth medium.

For Nitrogen and Phosphorous trial, when minimum level of nitrogen (50 mg Nitrogen per seedling), was combined with different phosphorus levels (25, 50 & 75 mg P per seeding), seedling growth increased upto 50:50 mg Nitrogen and Phosphorous per seedling. Seedling height, collar diameter and seedling dry weight at this level was 65.70mm; 14.78 mm and 72.56 g per seedling, respectively. Growth recorded at aforesaid level, was also maximum for all the treatments under present study. In combinations, where intermediate and maximum Nitrogen level (150 mg Nitrogen per seedling) was combined with different phosphorus levels, seedling growth however showed a quite reverse trend along treatments (*Table 1a*). The value of RGR, LWR, NAR, S.Q. and Q.I. exhibited almost similar patter as that of seedling growth. Interestingly, the root shoot ratio and RWR exhibited reverse order (*Table 1b*). Significant positive correlations (r^2=0.71 to 0.95; p<0.01) were indicated for relationships between different parameters (Fig.1). As revealed by the results of this study, better growth performance of seedlings was reflected when Farm Yard Manure was applied in combination with chemical fertilizers. This is perhaps due to direct as well as indirect effects of Farm Yard Manure on soil and plant growth. The indirect effects include augmentation of beneficial microbial population and their activities such as organic matter decomposition (Gaur et at., 1971, 1973; Gaur and Pareek, 1974), solubilisation of insoluble phosphates (Gaur, 1972) and availability of plants.

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REFERENCES

1. Bahuguna, V.K., and Lal Pyare, 1992. Standardization of Nursery Techniques of *Acacia auriculiformis* A. Cum Ex Benth under North Indian mist climatic conditions. Part-I Method of seed sowing and irrigation schedule. ***Indian Forester***. Vol. 118 No.9 616-622.
2. Bhardwaj, S.D., Shamet, G.S. and Masoodi, T.H. 1996. Studies on the effect of spacing and nitrogen fertilization on growth of *Acer oblongum* seedlings in the nursery. ***Ind. J. For***. Vol. 19 (2) : 145-147.
3. Brar, H.S. and Kotoch, P.C. 1980. Effect of different levels of nitrogen, on growth characteristics of *Populus deltoides* Marsh under nursery conditions. In : Khosla, P.K. (ed.), Proc. National Symp. on Improvement of Forest Biomass, H.P.K.V.V. Solan, pp. 299-303.
4. Dutt, A.K. and Pathania, U. 1984. Effect of different doses of phosphorus on the growth of *Sesbania sesban* Nitr. Fix. Tree Res. Rep., 2 : 3.
5. Gaur, A.C. 1971. Humus aids in raising healthier and better crops***. Indian Fmg*** 20 : 17.
6. Gaur, A.C. 1972. Role of phosphate solubilising micro-organisms and organic matter in soil productivity. Proc. Symposium on soil productivity. ***Nat. Acad. Sci. India***, pp. 259.
7. Gaur, A.C. and Bhardwaj, K.K.R. 1971. Influence of humate on the crop plants inoculated with bacteria of agricultural importance. Pl. Soil 35 : 613.
8. Gaur, A.C. and Pareek, R.P. 1974. Organic acids in soil during decomposition of organic residues. ***Indian Nat. Sci. Acad***. 40 : B : 68.
9. Gaur, A.C., Sadasivam, K.V., Vimal, O.P. Mathur, R.S. and Kavinandan, S.K. 1973. Studies on the humification of organic matter in a red rakar soil. Zbl. Bakt. II Bd. 128-149.
10. Kaul, V.K. 1989. Effect of different doses of nitrogen and phosphorus on selected growth parameters of *Bauhinia variegata* Linn. during nursery stage M. Sc. Thesis, Dr. Y.S. Parmar University of Horticulture and Forestry, Solan.
11. Koul, V.K., Bhardwaj, S.D. and Kaushal, A.N. 1995. Effect of N and P application on nutrient uptake and biomass production in *Bauhinia variegata* Linn. seedlings. ***Indian Forester***. 121 : 14-22.
12. Mathur, R.S. and Gaur, A.C. 1977. Effect of humus and microbial inoculants on crop yields and uptake of nutrients. Microbiologia. 36 : 149.
13. Moloney, R.A.; Aitken, R.L. and Gutteridge, R.C. 1986. The effect of phosphorus and nitrogen on the early growth of *Adenanthera pavonina, Albizia falcatari* and *Schleinitzia insularum* Nitr. Fix. Tree Res. Rep., 4 : 3-6.
14. Qureshi, I.M. and Yadav, J.S.P. 1967. Use of fertilizers and manures in forestry. ***Indian For***., 93 (12) : 777-792.
15. Qureshi, I.M. and Yadav, J.S.P. 1967. Use of fertilizers and manures in forestry. ***Indian For***., 93 (12) : 777-792.
16. Raina, A.K., Pharasi, S.C. and Prasad, K.G. 1990. Application of nutrients on growth of *Acacia catech* in nursery bed. ***Indian Forester***. 116 (8) : 655-662.
17. Reinsvold, R.J. and Pope, P.E. 1987. Combined effect of soil nitrogen and phosphorus on nodulation and growth of *Robinia pseudoacacia*. ***Can. J. For***. 7 : 964-969.
18. Singh, Jasbir, Gupta, G.N. and George, M. 1989. Response of *Acacia nilotica* seedling to varying doses and forms of NPK in different soil types. Van Vigyan, 27 (2: 84-94).
19. Yawalkar, K.S., Agarwal J.P. and Bokde, S. 1996. Manures and fertilizers. Eight Edison. Agri Horticultural Publishing House. Nagpur.
20. ickson, A., Leaf, A.L. and Hosner, J.F. 1960. Quality appraisal of white spruce and white pine seedling stock in nurseries. For. Chron. 36 : 10-13.
21. vans, J. 1983. Plantation Forestry in the Tropics ELBS and Clarendon Press. Oxford.
22. Hunt, R. 1982. Plant Grwoth Curves : The Functional Approach to Plant Grwoth Analysis. University Park Press, Baltimore, Moryland. 248 p.
23. Thompson, B.E. 1985. Seedling morphological evaluation : What you can tell by looking, pp. 59-71. In : Duryea, M.L. (Ed.) Evaluating seedling quality : Principles, procedures and predictive Abilities of Major Tests. Forest Res. Lab., Oregon State Univ., Corvallis.