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Original Research Paper

Survival and Growth Performance of *Albizia procera*: As Influenced By Fertilizers in Degraded Soil

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ABSTRACT

The present investigation deals with the response of fertilizers on the survival and growth of 30 months old *Albizia procera* plantation raised on shallow, murrumy and gravelly soil. The height and radial growth of plant increased significantly with the application of nitrogen and phosphorus fertilizer singly or in combination with each other. Though, the response of phosphorus as a whole was found to be instrumental in enhancing growth of the plant, the nitrogen dose over 75g/plant applied in the form of urea adversely affected survival of the plant. Among 16 treatment combinations (four different phosphorus doses and four different nitrogen doses), the treatment combinations of 75g phosphorus and nitrogen each/plant was found to be best for survival and height of the plant. The maximum radial growth was obtained in the treatment combination receiving 75g/plant phosphorus and 50g/plant nitrogen. The Relative Economic Effectiveness (REE) due to different fertilizer treatments indicated that the REE for the best height growth was 75g/plant phosphorus and nitrogen each, whereas REE for the best radial growth was worked out under the treatment receiving 75g/plant phosphorus and 50g/plant nitrogen.

INTRODUCTION

Albizia procera is a multipurpose tree species. Among many nitrogen fixing tree species *Albizia procera* was identified and selected for the study because of its unique nature and excellent growth performance. Available literature indicates that *A. procera* is a fairly useful nitrogen fixing tree species mostly suited for the semi arid region of the central India. It is popular in agro- forestry practices like planting on bunds of agricultural crop in general and on the bunds of paddy crop in Chhattisgarh region particular. This tree produces good quality of fodder for cattle, however, wood of this tree is used for timber as well as fuel.

Use of fertilizers in the forestry, especially in the forest nurseries and early stage of raising plantation, has become a regular silvicultural practice in many countries Baule & Fricker (1970), Venketesh et al. (2001), Mutnal et al. (2002). The phosphatic fertilizers are known to improve root nodulation in nitrogen fixing tree species (Sharma 1992). The fertilizer trial conducted on forestry species in the past indicated that a balance dose of fertilizers applied in proper time with suitable method had been found to have positive response on survival and growth of plant both at nursery and plantation stage (Prasad et al. 1984a, Sonkar et al. 1993,1994, Pant et al. 1995, Gangoo et al. 1997, Singh 2001).

The efficient and optimum use of fertilizers may be helpful in boosting up the growth of plant and meeting the additional requirement of crop and thereby sustain fertility as well as productive potential of soil ultimately resulting in enhancement of crop production without losing the inherent potential of native soil. In order to enhance the survival and growth of *A. procera* fertilizer has not

been standardized particularly for degraded soils and, thus, the present fertilizer trial has been conducted.

MATERIALS AND METHODS

The fertilizer trial was laid out in the premises of CFR & HRD (Centre for Forestry Research and Human Resource Development) Chhindwara. The area enjoy semiarid type of climate with mean annual rainfall 1161.00 mm and temperature 22.5°C.

An experiment consisting of four different phosphorus and nitrogen doses i.e., 0.0, 25.0, 50.0 and 75.0 g/plant each was laid out in randomised block design with three replications and, thus, there are sixteen treatment combinations. Plantation pits of the size of 45 × 455 × 45 cm were dug in the month of April 2003. The plantation pits were filled with 250g farm yard manure + 500 g clayey soil + full recommended dose of phosphorus in the form of single super phosphate in the month of May. Ten months old healthy seedlings of *A. procera* were planted in July 2003. One-fourth (1/4) recommended dose of nitrogen in the form of urea was applied during planting time and half (1/2) recommended dose of nitrogen in the form of urea was applied during 1st weeding in the month of August 2003. Rest one fourth (1/4) recommended dose of nitrogen in the form of urea was applied during 2nd weeding in month of October 2003. Final observation on the survival and growth (height and collar diameter) was recorded in the 1st week of October 2005. Data were statistically analysed and interpreted. Relative treatment effectiveness for survival, height and collar diameter were worked out as under :

$$\text{RTE for height } \% = \frac{\text{Height in the treatment} - \text{height in control}}{\text{Height in control}} \times 100$$

$$\text{REE for height} = \frac{\text{Cost in control}}{\text{Cost in treatment}} \times \text{RTE}$$

$$\text{RTE for collar diameter } \% = \frac{\text{Collar girth in the treatment} - \text{collar girth in control}}{\text{Collar girth in control}} \times 100$$

$$\text{REE for collar girth} = \frac{\text{Cost in control}}{\text{Cost in treatment}} \times \text{RTE}$$

RESULTS AND DISCUSSION

The soil of plantation site is well drained, gravelly clay loam with slight to moderate erosion. The soil depth is very shallow to moderately deep and physiographically situated on upland with 1-3 % slope gradient. Basaltic stones varies from 5-10%. Morphological features and physico-chemical properties as shown in Table 1 give an indication of poor and degraded soil. Survival of plants under different fertilizer treatment shows that survival of plants increased on combined application of phosphorus and nitrogen (Table 2). Application of nitrogen over 75g/plant in the form of urea has been found to have maximum mortality (33.67 %) followed by 22.44% on application of 50.00 g/plant nitrogen in the form of urea. The adverse effect of nitrogen > 50g/plant on survival may be due to toxic effect of higher concentration of ammonium ion (Brady 1996). The adverse effect of nitrogen over 50g/plant on survival of *Cassia siamea* has been reported by Pant et al. (1995). Quresi & Yadav (1967) also reported the adverse effect of higher dose of nitrogen on survival of *Tectona grandis.*

The application of phosphatic fertilizer in combination of nitrogenous fertilizer has always been

found to have positive effect on the survival of plant. Increase in survival of *Eucalyptus tereticornis* has been reported by Prasad et al. (1984a) on application of 120g/pit single super phosphate in combination of 40g/pit urea.

Increase in radial growth of plant seems to be very much dependent on both nitrogen and phosphorus. A significant ($P < 0.01$) increase in collar girth was observed either due to application of phosphorus alone or in combination with nitrogen. The maximum collar girth (18.33cm) was obtained on application of 75g/plant phosphorus and 50g/plant nitrogen followed by 15.96 cm girth at collar on application 75g/plant phosphorus and 75g/plant nitrogen, which are 2.53 and 2.20 times more as compared to collar girth in control (7.24cm). It was also noticed that when amount of phosphorus was constant and doses of nitrogen increased, there is further decrease in collar girth (0.33cm) in radial growth (Table 2). Phosphorus, being the basic constituent of cell membrane of plant tissue, is directly involved in photosynthetic process, energy transformation and metabolic processes in

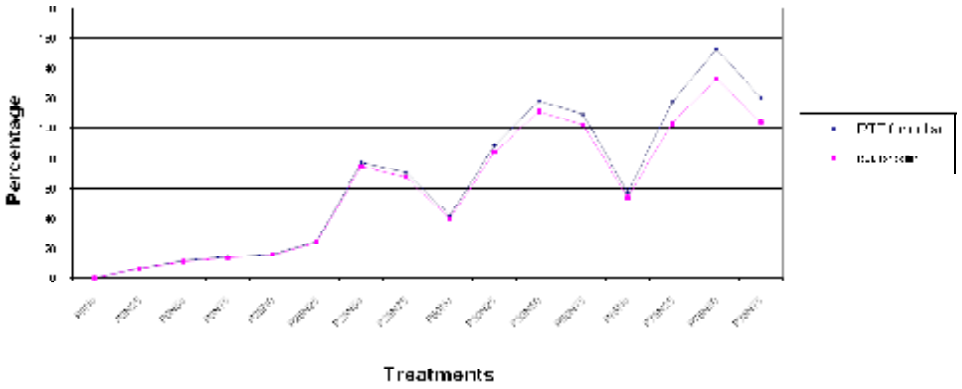

Fig. 1: RelativeTreatment Effectiveness (RTE %) and Relative Economic Effectiveness (REE %) in relation to collar girth.

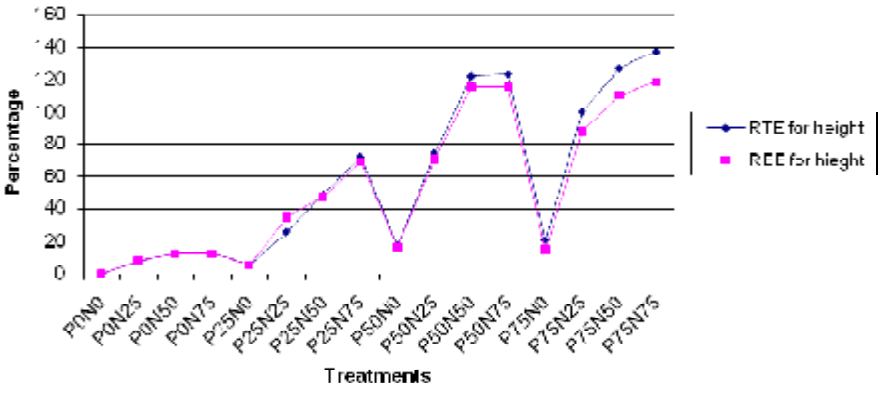

Fig. 2: RelativeTreatment Effectiveness (RTE %) and Relative Economic Effectiveness (REE %) in relation to height of plants.

Table 1: Morphological features and physico-chemical properties of soil of plantation site.

Horizon	Soil depth (cm)	Colour	Texture	Structure	Consistency	Concretions	Gravelliness	Soil pH	Org. matter %	Available nutrients (ppm)		
										N	P	K
A	0-11	Yellowish brown	Clay loam	Moderate medium subangular blocky	Hard on dry sticky and plastic when wet	< 10%	5%	6.9	1.04	84	3.4	110.40
B1	11-18	Yellowish brown	Gravelly clay loam	Moderate medium subangular blocky	Hard on dry sticky and plastic when wet	10-30% Ferro magnesium	5-15%	7.0	0.86	90	4.3	160.18
Bc	18-29	Dark yellowish brown	Gravelly clay loam with murrum	Moderate medium granular	Hard on dry sticky and plastic when wet	>30% Coarse Ferro magnesium	>15%	7.0	0.66	46	4.1	80.20
C	29+	Dark yellowish brown	Murrum	-	-	-	-	-	-	-	-	-

Table 2 : Survival, collar girth and height of 27 months *Albizia procera* : as influenced by nitrogen and phosphorus fertilizers.

S.No.	Treatments (nitrogen and phosphorus g/plant)	Survival (%)	Collar girth (cm)	Height (m)
1.	P_0N_0	88.89	7.24	0.86
2.	P_0N_{25}	100.00	7.7	0.93
3.	P_0N_{50}	22.22	8.06	0.97
4.	P_0N_{75}	66.67	8.26	0.97
5.	$P_{25}N_0$	100	8.40	0.91
6.	$P_{25}N_{25}$	100	9.00	1.17
7.	$P_{25}N_{50}$	100	12.84	1.28
8.	$P_{25}N_{75}$	88.89	12.35	1.46
9.	$P_{50}N_0$	100	10.25	1.01
10.	$P_{50}N_{25}$	100	13.67	1.50
11.	$P_{50}N_{50}$	100	15.81	1.91
12.	$P_{50}N_{75}$	100	15.16	1.92
13.	$P_{75}N_0$	88.89	11.40	1.04
14.	$P_{75}N_{25}$	100	15.79	1.72
15.	$P_{75}N_{50}$	100	18.33	1.95
16.	$P_{75}N_{75}$	100	15.96	2.04
	CD 0.05	-	2.6483	3.0607
	CD 0.01	-	3.566	4.1214
	SE$\pm$	9.949	1.2967	1.4987

P-Phosphorus; N-Nitrogen

plants (Brady 1976). As such, effect of phosphorus and its added doses enhance the radical growth of plant. The collar diameter in *Lagerstroemia perviflora* increases 0.9cm due to application of 50ppm phosphorus and 50ppm nitrogen in combination against the collar diameter (0.38cm) in control (Sonkar et al. 1994). The results of this experiment are in agreement with Kishore (1987) who observed maximum collar diameter due to application of phosphatic fertilizers in two years old plantation of

Tectona grandis.

The application of nitrogen and its increasing level up to 75g/plant was found to increase the plant height. On application of 25 g/plant nitrogen 0.93m plant height was observed as against 0.86 m height in control. There is further increase in plant height on increasing the doses of nitrogen. On application of 50 g/plant nitrogen, plant height increases from 0.93 m to 0.97 m and, thus, there is increase of 0.04 m in plant height due to addition of 25g/plant additional nitrogen. The vegetative growth of plant is boosted up due to nitrogenous fertilizer because of more carbohydrate utilization by plant (Tisdale & Nelson 1986). Sonkar et al. (1993) observed 109.62cm height on application of 150ppm nitrogen against 78.42 cm height in without fertilizer treated (control) plant of *Eucalyptus tereticornis*.

The application of phosphorus and its increasing level up to 75g/plant was found to increase the plant height. On application of 25 g/plant phosphorus 00.91m plant height was observed as against 00.86 m height in control (without phosphorus application). There is further increase in plant height on increasing the doses of phosphorus. On application of 50 g/plant phosphorus, plant height increases from 00.91m to 1.01 m and, thus, there is increase of 00.10 m in plant height due to addition of 25g/plant additional phosphorus. This result indicates that as a whole, phosphorus was found to be more effective in enhancing the plant growth than application of nitrogen alone. Better height of 5 months old *Tectona grandis* seedlings has been reported by Sonkar et al. (1993) on application of 100 kg/ha phosphorus in phosphorus deficient nursery soil.

The critical perusal of data presented in Table 2 indicates that the application of nitrogen accompanied with phosphorus boosts up more plant growth than that of nitrogen and phosphorus separately. Height of plant significantly increased when phosphorus was applied with nitrogen (CD at 0.01-4.1214 and SEm 1.4987). Average 1.17m height of the plant was observed on combined application of 25 g/plant phosphorus and nitrogen each which is 00.31m higher than the height noted in control (without fertilizer treatment). When the application of combined doses of phosphorus and nitrogen increases, the height of the plant increases respectively (Table 2). The highest value (2.04m) with respect to height of plant was noted on application of 75.00g/plant nitrogen and phosphorus each followed by 1.95 m height on application of 75 g/plant phosphorus and 50 g/plant nitrogen. Ammonical form of nitrogenous fertilizer is known to stimulate phosphorus uptake and phosphorus becomes more available to the plants, particularly in phosphorus deficient soils (Nayyer & Sawarkar 1980, Biswash & Mukharjee 1994). The maximum shoot height of *Lagerstroemea parviflora* has been reported by Sonkar et al. (1994) on application of 50 ppm phosphorus with 50 ppm nitrogen. Similarly, positive response of combined application of N and P has been reported by Pant et al. (1995) for *Casia siamea* and Prasad et al. (1984) for *Eucalyptus tereticornis.*

It is reflected from the calculation of Relative Treatment Effectiveness and Relative Economic Effectiveness for radial growth and height of 30 months old plants of *A. procera* as illustrated in Figs. 1 and 2, which show that the 75 g/plant phosphorus with 50 g/plant nitrogen are the most effective and economic doses for better radial growth of plants. 75 g/plant phosphorus with 75 g/plant nitrogen are the most effective and economic doses for best height of the plants. Almost similar finding has been reported by Pant et al. (1995) with respect to RTE and REE for *Casia simea*.

From the findings of the present study, it may be inferred that in order to rehabilitate and increase the forest productivity of degraded site, a multipurpose and nitrogen fixing tree species like *A. procera* should preferably be selected for plantation. The plantation pit of the size of 45 × 45 × 45cm should

be dug well in advance. Full recommended dose of phosphorus should be mixed with the native soil to be filled in the pits before planting. A booster dose of nitrogen during planting time and rest recommended dose should be given during 1st and 2nd weeding by ring method.

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