EFFECT OF FOUR LEGUMINOUS TREE SPECIES ON THE GROWTH OF *E. CAMALDULENSIS*

Chaudhry Abdul Rashid*, Raja Muhammad Omer, Chaudhry Muhammad Faisal**, Waqar Ahmed ***, Zahid Ali*****

Abstract

The study was conducted in irrigated plantation of Chichawatni, Pakistan to measure the effect of four leguminous species *(Parkinsonia aculeata, Albizzia lebbek, Leuceana leucocephala* and *Dalbergia sissoo)* on the growth of fast growing species *(Eucalyptus camaldulensis)*. Eight plants of *E. camaldulensis* were replicated thrice in each treatment with a spacing of 2m x 3m. Plant height (m) and diametre at breast height (DBH) (cm) were measured annually from 1992 to 1998. Soil samples were analysed for pH, organic matter (OM) %, P, K, total soluble salts (TSS) % and soil saturation %. Results indicated that the growth of *E. camaldulensis* was highest in combination with *Leuceana leucocephala* and *Dalhergia sissoo*. Soil factors had no effect on the growth of *E. camaldulensis*.

Introduction

Presence of nitrogen in soil is essential for plant growth (Begon 1996). Introduction of fast growing tree species for fuelwood and fodder have resulted in increasing the up-take of nitrogen from the soil (Chandrasekharaiah 1987 and 1988). The general perception is that fast growing tree species are causing adverse affect on availability of soil nutrients (Byerlee 1992). Since fast growing species are essential for meeting the fuelwood needs of the people their increased planting is also necessary. There are two options available to ameliorate the situation; apply fertilizers to meet the deficiency in soil or plant those tree species that have root nodules and can fix nitrogen in soil. The first option is not cost effective while the second option has potential for further exploration. Therefore present study was initiated with the objective of finding out such tree species that could be most suited to grow with fast growing species. In this regard *Eucalyptus camaldulensis* was chosen since it has fast rate of growth and is most extensively planted throughout Pakistan. Four tree species; *viz.*

* Divisional Forest Officer, Silviculture Research Forest Division, PFRI, Faisalabad
** Sub Divisional Forest Officers, Silviculture Research Forest Division, PFRI, Faisalabad
*** Research Officer, Punjab Forestry Research Institute, Faisalabad
**** Research Assistant, Silviculture Research Forest Division, PFRI, Faisalabad

Parkinsonia aculeata, Albizzia lebbek, Leuceana leucocephala and *Dalbergia sissoo* were selected since they have the potential to fix nitrogen in the soil through root nodules (Parker 1924, Champion, 1965).

Material and Methods

The study was conducted from 1992 to 1998 in Chichawatni Irrigated Plantation, Punjab, Pakistan. *Eucalyptus camaldulensis* (treatment 1 and control) was planted with *Parkinsonia aculeata* (treatment 2), *Albizzia lebbek* (treatment 3), *Leuceana leucocephala* (treatment 4) and *Dalhergia sissoo* (treatment 5). Row to row distance was 2m whereas plant to plant distance was 3m. Each treatment was repeated in alternate rows. Eight plants of *E. camaldulemis* were replicated thrice in each treatment. Plant height (m) and diameter at breast height (DBH) (cm) was measured from 1992 to 1998 of *E. camaldulensis* annually. At the end of study, soil samples were collected from the surface, at one and two metre depths and were analysed for pH, organic matter (OM) %, P, K, total soluble salts (TSS) % and soil saturation %.

Since the data was stratified into strata of unequal sample sizes. Residual Maximum Likelihood (REML) method was used to analyse the data using Genstat 4.2 software (Lawes Agricultural Trust, 2000). The imbalance in sample size was due to missing values of plant height and DBH since few plants died or their tops broken down during the course of study. Plant height and DBH were included as variables whereas replications were used as random factors. Difference between soil variables measured at different depths were analysed for different treatments using the analysis of variance (ANOVA).

Results and Discussions

Plant height differed significantly between different treatments and ages (Table 1). T4 had significantly higher plant height than TI, T2 and T3 but had no difference with T5. It has been reported that growth of *Leuceana leucocephala* is quite gregarious if provided with required quantity of water (Basu 1987, Parker 1924). Since the experiment was laid in an irrigated plantation and water was not a limiting factor, hence its roots might have grown profusely as compared to other tree species. The improvement in soil nitrogen might have started earlier in *L. leucocephala* plots as compared to other tree species, resulting in better height of *E. camaldulensis*. Chandrasekharaiah and prabhakar (1987) concluded that the height and biomass of both *L. leucocephala* and *Dalbergia sissoo* were

higher than other leguminous tree species at Kamataka, India. The lower height of *E. camaldulensis* in T2 was probably due to the slow rate of root growth of *Parkinsonia aculeata* and also the iesser number of nitrogen fixing root nodules per unit area. In the first three years, all the treatments gained considerable height but in later years the height became consistent. The main reason appears to be that the apical tissues of the plants tend to divide profusely at the young age and become rather slow in the later years, hence retarding the plant growth (Dowdeswell 1984).

Table 1. REML adjusted mean heights (m) under different treatments

Age (yr) (A) Treat. (T)	1 (107)	2 (100)	3 (81)	4 (77)	5 (75)	6 (72)	7 (62)	Mean Treat.	Chi-Square P-Value for A
T1 (131)	9.04	11.34	12.99	13.91	14.29	14.61	16.18	13.19^{b}	
T2(93)	8.27	8.44	10.95	11.82	13.41	15.00	15.58	11.92^{a}	
T3(82)	8.45	11.06	12.75	13.73	14.99	14.90	16.67	13.22^{b}	
T4(130)	8.55	10.56	12.71	15.23	14.74	17.07	21.30	14.31^{c}	
T5(138)	9.27	11.90	13.20	14.49	14.93	15.85	15.49	13.59^{bc}	
Mean Age	8.71^{a}	10.66^{b}	12.52^{c}	13.83^{d}	14.47^{d}	15.48^{e}	17.04^{e}		<0.001
Chi-Square P-Value for T								<0.001	T*A 0.331

(TI [control] = *Eucalyptus camaldulensis;* T2 = *Parkinsonia aculeate;* T 3 = *Albizzia lehhek;* T 4 = *Leuceana leucocephala;* T 5 = *Dalhergia sissoo)* and ages (years). Values with similar superscripts are not significantly different at P=0.05. Number of observations are given in parenthesis

Plant diameter also differed significantly between different treatments and ages (Table 2). Diametre was significantly higher in T4 and T5 as compared to TI. Both *L. leucocephala* and *D. sissoo* have extensive root systems (Tewari,1994 and Parker, 1924) that might be improving the soil nitrogen per unit area as compared to other species. Tewari (1994) and Bahuguna (1990) have reported that the extensive root system of both the species improve the soil porosity that eventually increases percolation of water into the soil hence resulting in better plant growth. Since there is no significant difference in the pH, organic matter, Phosphrus, Pottassium and TSS% (Figure 1), therefore, the only factor affecting growth in diameter and height of *E. camaldulensis* in T4 and T5 is the presence of L. *leucocephala* and *D. sissoo*

Table 2. REML adjusted mean diameters (m) under different treatments

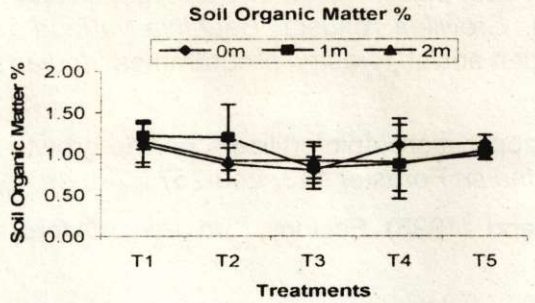
Age (yr) (A) Treat. (T)	1 (107)	2 (100)	3 (81)	4 (77)	5 (75)	6 (72)	7 (62)	Mean Treat.	Chi-Square P-Value for A
T1 (131)	3.52	10.93	12.95	13.96	13.63	15.42	17.33	12.53^{a}	
T2(93)	3.31	8.64	12.92	14.54	17.90	20.40	19.70	13.92^{ab}	
T3(82)	3.86	12.02	13.96	14.65	16.46	17.68	16.84	13.64^{ab}	
T4(130)	3.41	10.53	13.64	16.14	17.06	19.42	22.49	14.67^{b}	
T5(138)	3.79	13.07	15.24	16.95	17.82	18.56	18.82	14.89^{b}	
Mean Age	3.58^{a}	11.04^{b}	13.74^{c}	15.25^{cd}	16.57^{d}	18.30^{e}	19.04^{e}		<0.001
Chi-Square P-Value for T								0.004	T*A 0.474

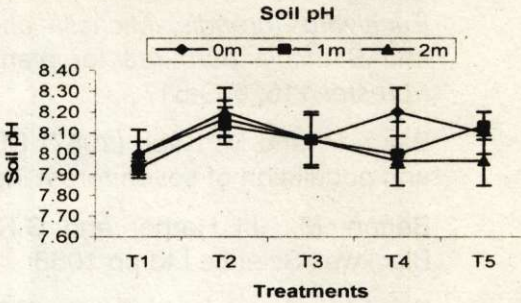
(Tl [control] = *Eucalyptus camaldulensis;* T2 = *Parkinsonia aculeate;* T 3 = *Albizzia lebhek;* T 4 = *Leuceana leucocephala;* T 5 = *Dalherpa sissoo)* and ages (years). Values with similar superscripts are not significantly different at P = 0.05. Number of observations are given in parenthesis.

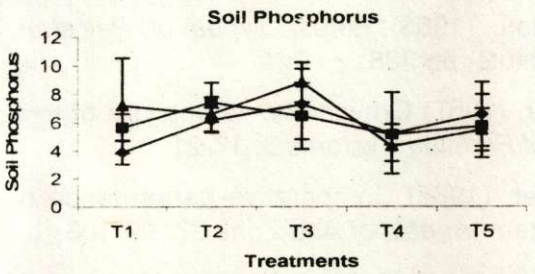
Conclusion

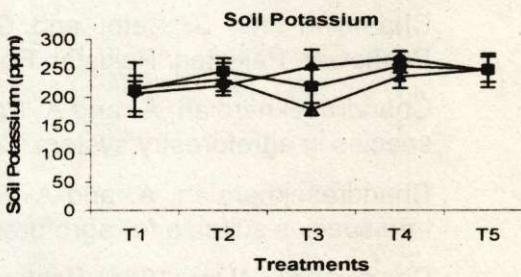
Performance of both *L. leucocephala* and *D. sissoo* was commendable in improving the growth of *E. camaldulensis*, *D. sissoo* is a multipurpose tree species with potential of growing extensively on farmlands and state forests. Although *L. leucocephala* has the potential to encourage growth *of E. camaldulensis* but it grows gregariously and might become a weed. Therefore, any effort to plant *L. leucocephala* should be given consideration only after keeping in view its high growth rate.

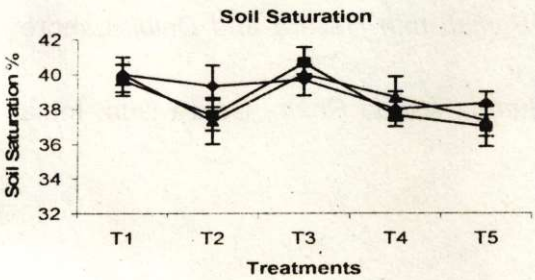
Figure 1: Mean (±SE) values of different soil variables measure at zero m (surface of soil), 1m and 2m depths

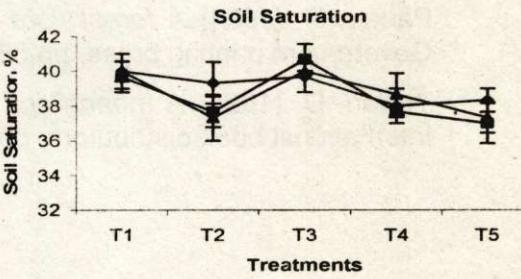


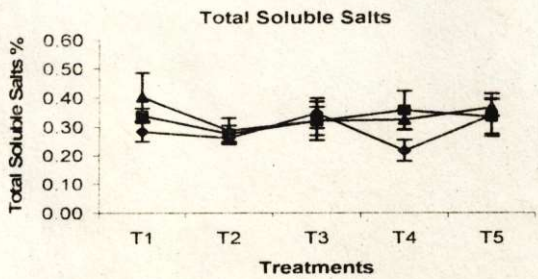












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