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EFFECT OF SHADE ON GROWTH PERFORMANCE OF FOUR TREE SPECIES: POST FIELD PLANTING

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In this study seedlings of four species raised under four shading levels were planted in field to determine the effect of nursery level shade intensities on the growth performance. The results indicated that none of the nursery level shading treatments had any effect on growth performance of species under trial at field level.

Key words: growth performance, post field planting, shade effect

INTRODUCTION

The quality planting stock plays an important role in the establishment of tree plantations in public or private sector. A healthy seedling must have maximum potential for adjustment in its new home and withstand postplanting environmental stresses such as desiccation and high temperatures. Due to arid and semi-arid environmental conditions generally some shading is provided during seedling development at nursery stage. This is one of the nursery cultural practices common in Pakistan. Shading definitely influences seedling quality through morphological and physiological changes in the developing plants. Shaded plant leaves might have fewer carbohydrate reserves, which could be used to fuel root generation immediately after out planting when the seedling's photosynthetic mechanism is less active due to shifting into new home. On one hand shading at initial stages of development enhances shoot growth at the expense of root growth, hence disturbs root/shoot ratio (Kramer and Kozlowski, 1979), while on the other, heavy and prolonged shading reduces seedling ability to withstand high temperature and water stress, thereby decreasing survival rate in the field. The question therefore arises: what level of nursery shading is necessary to keep the seedling healthy so that maximum survival and growth rates are ensured in the field. Thus the present study was carried out to determine the effect of nursery level shading on post field planting performance of four tree species.

MATERIALS AND METHODS

This study was conducted at the Punjab Forestry Research Institute, Faisalabad (PFRI). Seedlings of the four species viz. *Acacia nilotica, Prosopis cineraria, Leucaena leucocephala* and *Eucalyptus camaldulensis* raised at research nursery PFRI under prescribed shading levels were out planted in the field. Seedlings were raised in polythene tubes of size 5 x 15 cm with 40 perforations and filled with thoroughly mixed medium of 33% sand and 66% soil. They were out planted in 30 cm wide and 45 cm deep pits under barani conditions. Lower 20 cm of the pits was refilled with the same soil leaving upper 25 cm for water.

The study was laid out using split plot design under four replications. Shading levels were treated as whole plots and species as subplots. From each nursery plot, 20 seedlings were selected at random (five seedlings per species) and planted in a row at a spacing of 1m within row and 2m between the rows. Five seedlings of each species made one subplot and each row of 20 seedlings constituted one whole plot. Four such rows formed one replication and for four replications, a total of 16 rows were established having 320 plants. Four times hand watering was done during initial stages of seedling establishment at an interval of one week, at the rate of 10 litres per irrigation. Afterwards the plants were left on natural precipitation. In the field, plants were protected from animals and people through fencing with barbed wire. Weeding and reopening of pits was carried out as per requirements of plants. Survival percentage of plants was recorded at the age of 3, 6, 12 and 24 months. Height gain by plants was measured at the age of 12 and 24 months. Stem diameter was recorded at the age of 24 months. The data were analysed using "Sigma Stat" statistical package.

RESUL TS AND DISCUSSION

Analysis of data revealed that different levels of shade applied at nursery stage had no significant effect on survival, height and diameter growth of all the four tree species at 5% probability level. The interaction between shade and species was also non-significant. However, in case of diameter (dia.) growth, shade and species interaction was significant (P=0.05). *Eucalyptus camaldulensis* showed overall better dia. growth as compared to *Acacia nilotica* and *Leucaena leucocephala* (Table 3). The LSD test of means revealed that only *E. camaldulensis* showed significantly better dia. growth under full shade and full shade-2 treatment as compared to single shade. However, no shade (control) treatment did not differ significantly from these. In case of *A. nilotica* and *L. leucocephala* shading levels did not have significant effect on species dia. growth.

All the four species were significantly different from each other with respect to survival, height gain and diameter growth (P=0.05). This may be attributed to the nature or pattern of growth of the species. It was observed that at the time of field planting, all the four species grown under full shade and full shade-2 treatments were physically weak. Their good survival and growth performance in the field may be attributed to their better genetic make up, which after removal of shade at field level established themselves very quickly and neutralized the shade effect at nursery

stage. These results are in line with the findings of Kramer and Kozlowski (1979) who said that amongst several factors influencing species shade tolerance, important are genetic control of anatomical changes in leaves, changes in chlorophyll, respiration rates, photosynthesis rates and various metabolic changes in competitive situations. Each species has got different growth pattern thus their performance in field differs significantly from one another. Groninger et al. (1996) concluded that differences in shade tolerance among different tree species are not the result of changes in photosynthetic mechanism in response to shade. Survival percentage was recorded at different time intervals. There was a declining trend in all the species. However, overall decrease in survival was very low as given in Table I. Such a nominal decrease in survival rate may be due to strict protection measures and initial irrigations at weekly intervals given after field plantings. In case of height and dia. growth, *P. cineraria* put on minimum growth up to 24 months of age, while *E. camaldulensis* put on maximum height and dia. growth followed by *A. nilotica* and *L. leucocephala* as given in Tables 2 and 3. This may be attributed to the nature of growth of the species. *P. cineraria* is slow growing while *E. camaldulensis, A. nilotica* and *L. leucocephala* are fast growing in nature as reported by Troup (1921), Singh (1982) and Hocking (1993). According to Jisheng (1986), 90% of tree biomass comes from photosynthesis products. The yield and biomass production of the plants correlate positively with the net photosynthetic capaeity, The yields can be increased by improved photosynthesis. In other words the net photosynthesis may be one of the causes for the difference in growth (Driscoll, 1990).

Table I. Mean survival rate in four tree species at different ages under various shading treatments of nursery level

Nursery level shade treatments	Survival rate at various ages (months)															
	Acacia nilotica				*Prosopis cineraria*				*Leucaenaleucocephala*				*Eucalyptus camaldulensis*			
	3	6	12	24	3	6	12	24	3	6	12	24	3	6	12	24
Full shade	95	85	70	65	100	100	90	90	100	100	90	90	95	95	75	75
Full shade-2	95	85	80	75	100	100	100	100	100	100	90	85	100	100	90	90
~/ shade	100	90	80	80	100	90	85	85	95	90	80	80	95	85	70	70
No shade	95	95	85	85	100	100	85	85	100	95	95	95	95	90	7fJ	70

Table 2. Mean height (m) of four tree species at different ages (months) under various shading treatments of nursery level

Nursery level shade treatments	*Acacia ni/otica*		*Prosopis cineraria*		*Leucaena leucocephala*		*Eucalyptus camaldulensis*	
	12	24	12	24	12	24	12	24
Full shade	1.5	3.4	0.5	1.1	2.2	2.8	3.1	6.2
Full shade-2	1.3	2.8	0.5	1.0	2.1	3.1	2.8	5.1
y, shade	1.7	3.9	0.6	1.2	2.5	3.3	1.9	3.4
No shade	1.6	3.5	0.8	1.4	2.3	2.8	2.4	4.2

Table 3. Mean diameter (cm) offour tree species at the age of24 months, under various shading treatments of nursery level

Nursery level shade treatments	*Acacia nilotica*	*Prosopis cineraria*	*Leucaenaleucocephala*	*Eucalyptus camaldulensis*
Full shade	3.5	–	2.3	5.9
Full shade-2	2.7	–	1.9	5.2
~ shade	4.2	–	2.4	2.8
No shade	3.9	–	2.3	4.6

It appears that the species having higher content of chlorophyll has a higher rate of photosynthesis and growth, indicating that a relationship exists between chlorophyll content, photosynthesis and growth. According to Troup (1921), Singh (1982) and Champion (1987), all the four species under study have a considerable demand for light. The results of nursery level study also supported these findings. Thus it may be concluded that shading of all the four species at nursery level did not affect the growth of plants in the field. The growth of species depends upon several factors such as water, temperature, light, mineral deficiency, genetic control of anatomical changes in leaves, changes in chlorophyll, respiration rate, photosynthesis rate and various metabolic changes in competitive situations.

Conclusions: The growth in all the four species is not affected by nursery level shading in the field. These species are strong light demander and put the best growth under no shade situations. The survival rate, height and diameter

growth patterns of all the four species differ from each other by their nature. The growth of species depends upon several factors such as water stress, temperature, mineral deficiency, genetic control of anatomical changes in chlorophyll, respiration rates, photosynthesis rates and various metabolic changes in the plants.

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