INFLUENCE OF TREE CANOPY ON DRY MATTER YIELD OF SEEDLINGS OF *LEUCAENA LEUCOCEPHALA* ON MINE SPOIL IN A DRY TROPICAL ENVIRONMENT

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INTRODUCTION

Mine spoils consist of overburdened dumps of haphazardly, mixed consolidated and unconsolidated material. Mine spoils are nutritionally and microbiologically impoverished habitats (Singh and Jha,1993). Natural restoration of mine spoil is a slow process. Afforestation of mine spoils with fast growing tree species accelerates the revegetation process and fulfils the restoration goal. Trees can either diminish or enlarge plant biomass by modifying the resource availability to understorey plants. *Leucaena leucocephala* is evergreen tree species native to Central America. The tree species produces large number of seeds which germinate and colonize the ground surface eliminating the other ground flora. This tree species was chosen for the afforestation of mine spoil owing to its N_2 fixing property, fast growth and wide range of adaptibility. The study was undertaken to assess that up to what extent the developing tree canopy affects the yield of seedlings, which checks the growth of other ground flora in *Leucaena* plantations. The main objective of this study was to analyze the impact of tree canopy on the dry matter yield of (naturally grown) seedlings of *L. leucocephala* on mine spoil.

MATERIALS AND METHODS

The study was conducted at the Jayant coal mine in the Singrauli coalfields, extending over 2200 km^2, out of which 80 km^2 lie in Uttar Pradesh and rest in Madhya Pradesh. The climate was dry tropical with temperature reaching up to a maximum of 48°C during June and going down to a minimum of 5°C in January. Annual rainfall varies from 90 -100 cm and is mainly confined during monsoon months from June to September. The potential natural vegetation constitutes tropical dry deciduous forest (Champion and Seth, 1968).

Monoculture of *Leucaena leucocephala* was planted in 20 x 20 m plots with 2 x 2 m spacing in July 1993. At the time of plantations the mine spoils were fresh and without any natural vegetation. Flowering and fruiting in the tree species first time occurred during the year 1995-1996. The large number of seeds shed from ripened fruits, started germinating from June 1996 after first shower of rain. Three plantation plots were chosen for the study. Two locations were identified in each plot of the planted tree *Leucaena leucocephala*, (1) Below-canopy : directly under the tree canopy near the bole i.e. 30 cm away from the tree stem (2) in the open : the area exposed to full sunlight without any canopy interference.

The density and biomass of seedlings was measured in November 1996. One sampling was done in each plot from the two locations for density as well as biomass measurement. Density was estimated as total number of seedlings per m^2. The shoot biomass was harvested from two locations using 1 x 1m quadrat. Root biomass was estimated by using 25 x 25 x 30 cm monoliths. Monoliths were washed with a fine jet of water using 2.0 and 0.5 mm mesh screens. The shoot and root biomass was oven-dried at 80° C to constant weight. Significant difference between location means were tested using two-tailed Student's *t*-test.

RESULTS AND DISCUSSION

The total Carbon (C), total Nitrogen (N) and total Phosphorus (P) under below-canopy spoil to a depth of 10 cm was recorded as 0.35%, 0.045% and

Table-1: Density, shoot biomass, root biomass, total biomass and root/shoot ratio of naturally grown seedlings of *L. leucocephala* at two locations in monoculture plantation plot on coal mine spoil (n = 3)

Location	Seedlings (m^{-2})	(Mean ± 1 S E) Biomass (g m^{-2})			Root/Shoot ratio
		Shoot	Root	Total	
Below-canopy	66	256 ± 8[a]	93 ± 5[a]	349 ± 12[a]	0.36 ± 0.005[a]
Open	49	383 ± 10[b]	152 ± 8[b]	534 ± 18[b]	0.39 ± 0.01[b]

Values in a column suffixed with different letters are significantly different from each other at $P<0.05$.

0.010%, respectively. While in the open area spoil to a depth of 10 cm the total C, N and P was recorded as 0.22%, 0.018% and 0.0087%, respectively. Thus the below-canopy area had greater fertility than the open area. The greater fertility under below-canopy area is due to accumulation and decomposition of large quantity of leaf litter. Tree canopy tend to improve the below-canopy physical and soil fertility conditions (Weltzin and Coughenour, 1990).

The shoot biomass, root biomass and total biomass yield was significantly greater in the open area than the below-canopy area (Table -1). One major process through which tree modify the sub-canopy environment, however, is interception of direct solar radiation, which could also result in lower temperatures, and evapotranspiration influencing the below-canopy soil moisture regime (Vetaas, 1992).

Though the density of seedlings was greater in the below-canopy area than the open area, the shoot and root biomass yield was greater in the open area. The soil nutrient content was also found greater in below-canopy area than the open area. This vividly suggests that light probably has been the major factor governing the productivity of the seedlings. In the open area, plenty of light was available while below-canopy area was shaded due to the overhead tree canopy. This may be the reason for lower dry matter yield under below-canopy area than the open area. The assimilation rate in continuously shaded leaves under canopies can be five to six times lower than in leaves in open conditions in full sunshine (Mordelet and Menaut, 1995).

The root/shoot ratio was also significantly greater in the open area than the below-canopy area suggesting that compared to shade, light favours more allocation to root biomass than shoot biomass in plants. The allocation to root part is generally found to increase in light than shade (Hunt, 1975).

CONCLUSION

The study suggests that the dry matter yield of seedlings was significantly affected by the overhead tree canopy. The light seems the principal factor governing the seedling biomass yield of *L. leucocephala* than nutrients on mine spoil.

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