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Research Article

GROWTH PERFORMANCE OF *LEUCAENA LEUCOCEPHALA* ON A COAL MINE SPOIL

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ABSTRACT
A study was conducted to assess the growth performance of *Leucaena leucocephala* planted on a coal mine spoil. The study indicated marked growth in height, diameter and volume of tree species. In one year the tree species has attained the height growth rate of about 1 m, diameter growth rate of about 1 cm and volume growth rate of about 2300 cm^3.

Keywords: *Leucaena leucocephala, Coal Mine Spoil, Annual Growth Rate, Singrauli Coalfields*

INTRODUCTION
Opencast mining activities though inevitable for economic development is environmentally hazardous and results in huge dumps of overburden material as mine spoil. These dumps are drastically disturbed and are physically, nutritionally and microbiologically impoverished habitats (Wali, 1975; Singh and Jha, 1993). Nitrogen (N) and phosphorus (P) are the two major limiting nutrients in mine spoil (Mays and Bengston, 1978; Jha and Singh, 1993; Singh and Singh, 2001) thwarting the establishment and growth of plant species. Mine spoils are highly prone to erosion, and could cause contamination of rivers and adjoining agricultural lands with harmful substances leached out from it through rain water. Hence stabilization of mine spoil becomes inevitable. Natural restoration of mine spoil is a slow process (Iverson and Wali, 1982; Jha and Singh, 1991, 1992) but can be accelerated by planting leguminous tree species due to their autonomy of fixing nitrogen. The leguminous tree *Leucaena leucocephala* was chosen for the afforestation of mine spoil due to its high nitrogen fixing ability and wide range of adaptability. It is a fast growing tree species native to Central America and Pacific islands. Studies have been conducted to assess the growth performance of *Leucaena leucocephala* on mine spoil (Jha *et al*., 2000), influence of spacing distance on performance of *L. leucocephala* on mine spoil (Singh, 2012), and effect of compost and limestone amendment on growth performance of *L. leucocephala* on tin mine tailings (Ssenku *et al.*, 2014). However, the main objective of the present study was to evaluate the growth performance of *L. leucocephala* planted on a coal mine spoil in monoculture plantation.

MATERIALS AND METHODS
Site Description
The study was conducted at the Bina coal mine of Singrauli Coalfields, India. The Singrauli coalfields extends, over an area of 2202 km^2 (23°47'-24° 12' N; 81° 48' - 82° 52' E and elevation of 280-519 m above mean sea level), of which 80 km^2 lie in the state of Uttar Pradesh and rest in the state of Madhya Pradesh. Bina coal mine is located in Uttar Pradesh. The climate is tropical monsoonal with temperature reaching up to 48°C during June in summer season and lowering down to 5°C in January in winter season. Rainfall varies from 90-100 cm during monsoon months of June to September. The potential natural vegetation is a tropical dry deciduous forest (Champion and Seth, 1968).

Experimental Design and Methods
Nursery raised individuals of *L. leucocephala* were planted on fresh and flat coal mine spoil in July 1993. The seedlings were planted in 20 m × 20 m plots with a spacing distance of 2 m × 2 m. Three replicate plots were maintained for the species.

A total of 15 individuals distributed equally between the three replicate plots selected at random for growth measurements. Height and diameter measurements were made in April 1996 (33 months after plantation) and in April 1997 (45 months after plantation). Diameter (*d*) was measured at 20 cm above the

ground surface. Height (*h*) was measured using a scaled bamboo stick. Tree volume (V) was calculated as a cone ($V=d^2h$). Annual growth rate was assessed as increments in height, diameter and volume from the values measured in April 1996 and April 1997.

RESULTS AND DISCUSSION

The data on height, diameter and volume for both the sampling dates are summarized in Table 1 while data on annual height, diameter and volume are presented in Table 2.

Table 1: Height, diameter and volume of *Leucaena leucocephala* at two different ages planted on a coal mine spoil (Mean ± 1 SE)

33 months after plantation			45 months after plantation		
Height (m)	**Diameter (cm)**	**Tree volume (d^2h) (cm^3)**	**Height (m)**	**Diameter (cm)**	**Tree volume (d^2h) (cm^3)**
1.85 ± 0.15	1.91 ± 0.15	814 ± 161	2.83 ± 0.21	3.02 ± 0.23	3088 ± 591

Table 2: Annual height, diameter and volume increments in *Leucaena leucocephala* planted on a coal mine spoil (Mean ± 1 SE)

Height (m)	Diameter (cm)	Volume (cm^3)
0.97 ± 0.07	1.10 ± 0.08	2274 ± 432

The result of the study reveals that, 33 months old planted trees of *L. leucocephala* were about 2 m tall having diameter of about 2 cm. However, 45 months old trees attained the height of about 3 m and diameter of about 3 cm.

The trees of *L. leucocephala* on the second sampling date were 52.97% taller compared to first sampling date. Similarly diameter and volume were 58.11% and 273.36%, respectively greater on second sampling date compared to first sampling date indicating marked growth in height, diameter and volume of *L. leucocephala* growing on nutritionally impoverished coal mine spoil. Thus the tree volume which frequently figures as proxy variable for biomass (Zavitkovski and Stevens, 1972; DeBell *et al.*, 1989; Singh and Singh, 2001) has exhibited more than four times greater growth compared to height and diameter. The growth rate i.e. annual height, diameter and volume increments reveals that species seems a good performer on coal mine spoil. In one year the tree has attained height growth rate of about 1 m, diameter growth rate of about 1 cm and volume growth rate of about 2300 cm^3.

Conclusion

It can be concluded from the study that *L. leucocephala* is a good performer on mine spoil, however in early years the growth performance of the tree species is poor

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