

GROWTH PERFORMANCE OF TREE SPECIES AFTER SIXTEEN YEARS OF PLANTATIONS IN MONOCULTURE ON COAL MINE SPOIL

Brajesh Kumar Singh and A. K. Jha

Key words : Growth performance, Tree species, Monoculture, Coal mine spoil.

The tree growth performance study was conducted on coal mine spoil at Bina project, NCL, Singrauli in 2009. Data on height and diameter growth for tree species planted in monoculture experimental plots were recorded. Height/ Diameter ratio, tree volume, annual increment in height and diameter were calculated for each species in monoculture. In monoculture leguminous tree species, *L. leucocephala* and *D. sissoo* showed better performance in terms of height growth than other tree species. In general, *T. arjuna* and *E. officinalis* showed better performance in terms of height, diameter and tree volume growth among non-legume species.

INTRODUCTION

Open-cast coal mining in Northern Coal Fields Limited (NCL), Singrauli since 1965 has caused piling of overburden dumps on unmined lands which have affected drastically the flora, fauna, hydrological relations and soil biological systems (Jha and Singh, 1990). Due to drastic disturbances in the ecosystem there is loss of biological diversity. Such disturbed ecosystems are expected to be extremely vulnerable to future anthropogenic global changes (Peter, 1985). To restore such disturbed ecosystem is a challenging problem to the ecologists. During the period 1985-1990 the mechanism of natural recovery of such ecosystem was studied at Jhingurda Project. (Jha and Singh, 1990, 1991, 1993, 1994); and during the period 1993-1997 various types of long-term monitoring revegetation models such as tree monoculture seeded with grasses and legumes; tree monoculture seeded with crop plants; tree mixed culture seeded with grasses and legumes; and tree monoculture with ground seeding and fertilizer applications were set up on coal mine spoils at Bina and Jayant Projects, NCL, Singrauli (Singh *et al.*, 1993, 1997).

The main purpose of the long-term monitoring revegetation models was to raise plantations of suitable tree species of different potential heights, and ground seeding with grasses and leguminous forbs for developing a multistratal canopy on the mine spoils (Singh *et al.*, 1995). This will accelerate the natural recovery process and will also enrich the habitat with soil organic matter and nutrient cycling will be speeded up. The ground cover will check soil erosion. Thus the ecosystem will be self sufficient in the long run. The present study was conducted at Bina Project, NCL, Singrauli in April, 2009 to evaluate the present status of the tree monoculture plantations.

MATERIAL AND METHODS

NCL, Singrauli extends over 2200 sq km, Lat. 30° 47' - 24° 12'; Long 81° 48' - 82° 52' E and elevation 280-519m above msl of which 80 square kilometer lies in U.P. and rest

in M.P. There are eleven mining blocks : Kakri, Bina, Marrak, Part of Khadia and Dudhichua, Krishnasila are in U.P. while Jhingurda, Gorbi, Mohar, Amlori, Nigahi, Jayant and Part of Khadia and Dudhichua are in M.P. The rocks are fine to coarse grained sandstones white and grey clays with ferruginous bands, carbonaceous shales and coalseams. The coalseam formation belongs to the Paleozoic Epoch and Falls in the Damuda series of Lower Gondwana field forming the Raniganj (Upper Permian age) and Baraker Measures (Middle Permian age). The Jhingurda 'Top' and 'Bottom' seams belonging to Raniganj measure about 230 million years ago; and Pani Pahari Seam, Khadia Seam, Purewa Top, Purewa Bottom, Tura seam and Kota seam belonging to the Baraker measure about 250 million years old (Tripathi and Dutta, 1967).

The climate is tropical monsoonal and the year is divisible into a mild winter (Nov.-Feb.), a hot summer (April-June), and a warm rainy season (July-Sept.). Other months of the year are transitory periods between these seasons. The rainfall is characterised by a high degree of inter annual variation; (Singh *et al.*, 1995).

Long-term Monitoring Revegetation Models such as tree monoculture seeded with the grasses and legumes were set up in 2ha area on fresh coal mine spoil at Bina Project in July, 1993. The pit size was 40 × 40 × 30cm, spacing between and within rows was 2m × 2m and the plot size was 20m × 20m, the tree density was 100 stem/plot and the number of plots per species/combination varied from 3 to 5. Nursery raised seedlings of the following eleven species were grown in tree monoculture : *Albizia procera*, *Azadirachta indica*, *Dalbergia sissoo*, *Dendrocalamus strictus*, *Holoptelia integrifolia*, *Embllica officinalis*, *Leucaena leucocephala*, *Madhuca indica*, *Pongamia pinnata*, *Tamarindus indica* and *Terminalia arjuna*. Ground seeding was done with *Stylosanthes humilis*, leguminous forbs in June, 1994. No fertilizer was added in pits. No grasses were seeded (Singh *et al.*, 1995).

In April 2009 after about 16 years of plantations, diameter and height were measured in tree monoculture experimental plots at Bina Project, NCL, Singrauli.

RESULTS

Tree Monoculture

Height growth : Data on the height, diameter, height/diameter ratio and tree volume (d^2h) (cm^3) after 16 years of plantations are summarized in Table 1. Maximum height was attained by *D. strictus* (534 cm) followed by *T. arjuna* (393 cm) and *L. leucocephala* (375 cm); and minimum height was attained by *Holoptelia integrifolia* (193cm) (Table 1) after 16 years of plantation. Maximum annual increment in height was recorded for *D. strictus* followed by *M indica*, *L. leucocephala*, *D. sissoo* and *T. arjuna*, and minimum in case of *H. integrifolia* and *P.pinnata* (Table 2).

Diameter Growth : Maximum diameter was obtained in case of *A. lebbeck* (14.6 cm) followed by *D. sissoo* (13.73 cm) and *T. arjuna* (12.06 cm); and minimum diameter was obtained by *H. integrifolia* (5.57 cm) after 16 years of plantations (Table 1). Five tree species namely *A. lebbeck*, *D. sissoo*, *T. arjuna*, *L. leucocephala* and *A. indica* showed

diameter more than 10 cm; and other six species viz. *P. pinnata*, *M indica*, *E. officinalis*, *T. indica*, *D. strictus* and *H. integrifolia* obtained less than 10 cm diameter in 16 years (Table 1). Maximum annual increment in diameter growth was recorded for *A. lebbeck* followed by *D. sissoo* and *T. arjuna*, and minimum for *D. strictus* (Table 2).

Height/Diameter ratio : This value was maximum for *D. strictus* and minimum for *A. lebbeck* (Table 1).

Tree Volume: Maximum tree volume was attained by *A. lebbeck* followed by *D. sissoo* and *T. arjuna*. (Table 1). Annual increment in tree volume was recorded maximum for *D. sissoo* followed by *A. lebbeck* and *T. arjuna*, and minimum for *H. integrifolia* and *D. strictus* (Table 2).

CONCLUSION

Among the leguminous species, *Leucaena leucocephala* and *Dalbergia sissoo* and among non-leguminous species *Terminalia arjuna* and *Emblca officinalis* showed better growth performance than other species. Thus these tree species should be considered in revegetation of coal mine spoil.

TABLE-1: Growth performance in Height (cm), Diameter (cm), Height/Diameter Ratio (cm/cm) and Tree Volume (d^2h) (cm^3) about after 16 years plantation in monoculture.

No.	Species	Height (cm)	Diameter (cm)	Height/Dia. Ratio (cm/cm)	Tree Volume
1.	<i>Albizia lebbeck</i>	346	37.08	9.30	475725
2.	<i>Azadirachta indica</i>	354	25.90	13.67	237467
3.	<i>Dalbergia sissoo</i>	366	34.87	10.50	445026
4.	<i>Dendrocalamus strictus</i>	534	14.27	37.42	108740
5.	<i>Emblca officinalis</i>	319	23.60	13.52	177670
6.	<i>Holoptelia integrifolia</i>	193	14.15	13.64	38642
7.	<i>Leucaena leucocephala</i>	375	26.00	14.43	253500
8.	<i>Madhuca indica</i>	371	24.62	15.07	224880
9.	<i>Pongamia pinnata</i>	265	18.95	13.98	95162
10.	<i>Tamarindus indica</i>	352	24.87	14.15	217718
11.	<i>Terminalia arjuna</i>	393	30.63	12.83	368711

TABLE-2 : Mean annual increment in Height (cm/yr), Diameter (cm/yr) and Tree Volume (d^2h) (cm^3/yr) after about 16 years of plantation in tree monoculture.

No.	Species	Height	Diameter	Height/
1.	<i>Albizia lebbeck</i>	14.78	0.94	13.00
2.	<i>Azadirachta indica</i>	18.00	0.62	6.91
3.	<i>Dalbergia sissoo</i>	19.00	0.90	15.39
4.	<i>Dendrocalamus strictus</i>	26.70	0.33	2.90
5.	<i>Emblca officinalis</i>	14.00	0.55	4.24
6.	<i>Holoptelia integrifolia</i>	10.42	0.34	1.20
7.	<i>Leucaena leucocephala</i>	19.14	0.66	8.33
8.	<i>Madhuca indica</i>	23.78	0.61	8.85
9.	<i>Pongamia pinnata</i>	10.57	0.41	1.78
10.	<i>Tamarindus indica</i>	18.14	0.58	6.10
11.	<i>Terminalia arjuna</i>	18.86	0.69	8.98

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