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PERFORMANCE OF NON-LEGUMINOUS TREE SPECIES IN COMBINATION WITH LEGUMINOUS TREE SPECIES *Albizia lebbeck* AND *Albizia procera* ON COAL MINE SPOIL

Brajesh Kumar Singh and A. K. Jha

Key words : Performance, Non-leguminous trees, Combination, Leguminous trees, Coal mine spoil.

An ecological study of revegetation of mine spoil at Bina Project was initiated in July 1993 but the present study deals with the growth performance of non-leguminous tree species in combination with leguminous tree species in 2009 after sixteen years of plantations at Bina project in Northern Coalfields Limited (NCL), Singrauli. Data on height and diameter growth for tree species planted in mixed culture experimental plots were recorded. Height, diameter, height/ diameter ratio, tree volume, and annual increment in height, diameter, and tree volume were calculated for each species in mixed culture. In mixed culture non-leguminous tree species *Azadirachta indica, Terminalia arjuna, Emblica officinalis* and *Tamarindus indica* showed better performance in terms of height growth than leguminous tree species *Albizia lebbeck* and *Albizia procera*. In general, *Emblica officinalis* and *Azadirachta indica* showed better performance in terms of height, diameter and tree volume growth among non-legume species when planted with *Albizia lebbeck* and *Albizia procera*.

INTRODUCTION

The socio-economic condition is changing. Flora, fauna and the lives of human beings are affected due to open-cast-mining. To restore the vegetation and increase the animal diversity on overburden dumps (mine spoil) is a challenging problem for ecologists. The natural process of ecosystem development, i.e., succession on mine spoils can be accelerated by planting or seeding herbs, shrubs and tree species. Due to mining activities degradation of forests, loss of habitats and biodiversity, piling of overburden dumps and soil erosion, changes in hydrology, disruption of rock-soil-vegetation relationship, and air, water, noise and land pollution can be observed. The 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). During the period 1985-1990 the mechanism of natural recovery of such ecosystem was studied at Jhingurda Project (Jha and Singh, 1990, 1991, 1993a, 1993b, 1994), and during the period 1993-1997 various types of long-term monitoring revegetation models such as tree mono culture 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.

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. 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 characterized by a high degree of inter annual variation (Singh *et al.*,1995). Long-term Monitoring Revegetation Models such as tree mixed culture seeded with the grasses and legumes were set up in 2 ha area on fresh coal mine spoil at Bina Project in July, 1993. The pit size was 40 x 40 x 30cm, spacing between and within rows was 2m x 2m and the plot size was 20m x 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 ten combinations were raised in tree mixed culture revegetation model: *Emblica officinalis* + *Albizia lebbeck*, *Albizia lebbeck* + *Azadirachta indica*, *Tamarindus indica* + *Albizia procera*; *Albizia procera* + *Terminalia arjuna*; *Holoptelia integrifolia* + *Dalbergia sissoo*; *Dalbergia sissoo* + *Tamarindus indica*; *Cassia fistula* + *Madhuca indica*; *Madhuca indica* + *Holoptelia integrifolia*; *Terminalia arjuna* + *Pongamia Pinnata*; *Pongamia pinnata* + *Dendrocalamus strictus*. Ground seeding was done in June 1994 with *Stylosanthes humilis*, a leguminous forb. No grass species was seeded (Singh *et al.*, 1995). In April 2009 after about 16 years of plantations, diameter and height were measured in tree mixed culture experimental plots at Bina Project, NCL, Singrauli.

Deptt. of Botany, J. P. University, Chapra-841 301 (Bihar)
E-mail : brajeshsingh.62@rediffmail.com & ashokjhabotany@gmail.com

RESULTS AND DISCUSSION

The value of height, diameter height/diameter ratio and tree volume after 20 months and after 16 years of plantation are summarized in Tables 1 & 2 and Graph 1. Maximum height was attained by *Emblica officinalis* (380 cm), followed by *Azadirachta indica* (359cm), *Terminalia arjuna* (347cm) and minimum in *Tamarindus indica* (345cm) after 16 years of mixed culture plantations (Tables 1 & 2; Graph 1). Annual increment in height was recorded maximum in *Emblica officinalis* (21.14cm/yr) followed by *Tamarindus indica* (19.21cm/yr), *Terminalia arjuna* (17.86cm/yr) and minimum in *Azadirachta indica* (17.43cm/yr) [Table 3; Graph 2]. Measurements after 16 years indicated that the increase in height of tree species was maximum in *Emblica officinalis* (380 cm) followed by *Azadirachta indica* (359cm), *Terminalia arjuna* (347cm) and minimum in *Tamarindus indica* (345 cm) but after 20 months of plantations the maximum height was recorded in *Azadirachta indica* (115cm) and minimum in *Tamarindus indica* (76 cm). The tree species *Tamarindus indica* (76 cm) was in same position after 16 years of plantation in mixed culture when seeded with the combination of leguminous tree species *Albizia lebbeck* and *Albizia procera* (Tables 1 & 2; Graph 1). Maximum diameter growth was obtained in case of non-leguminous tree species *E.officianalis* (34.11cm) followed by *T. arjuna* (33.86cm) and *T. indica* (31.95cm) and minimum diameter was obtained by *A. indica* (23.16cm) with combination of leguminous tree species *Albizia lebbeck* and *Albizia procera* after 16 years of plantations (Tables 1 & 2; Graph 1). Maximum annual increment in diameter growth was recorded for *E. officinalis* (2.36cm/yr) followed by *T. arjuna* (2.30cm/yr) and *T. indica* (2.21cm/yr) and minimum for *Azadirachta indica* (1.54cm/yr) when seeded with the combination of leguminous tree species *Albizia lebbeck* and *Albizia procera* (Table 3; Graph 2). Height/diameter ratio value was recorded maximum for *Azadirachta indica* (15.50cm/cm) and minimum for *T. arjuna*. (10.25cm/cm) seeded with leguminous species *A. lebbeck* and *A. procera* Tables 1 & 2; Graph 1. Maximum value for tree volume was obtained by *E.officinalis* followed *T.arjuna* and *Tamarindus indica* and minimum value for tree volume was obtained by *Azadirachta indica* with combination of leguminous species *A. lebbeck* and *A. procera* (Tables 1 & 2; Graph 1). Annual increment in tree volume was recorded maximum for *E. officinalis* followed *T. arjuna* and *T. indica* and minimum for *Azadirachta indica* with combination of leguminous species *A. lebbeck* and *A. procera* (Table 3; Graph 2).

The revegetation of mine spoil is difficult because they are deficient in nutrients such as nitrogen, phosphorus, etc. After 16 years of plantation the better performance was shown by *Emblica officinalis*, *Terminalia arjuna* and *Azadirachta indica,* but *Tamarindus indica* showed poor growth performance in early stage and after sixteen years of plantation among non-leguminous tree species with combination of leguminous tree species *Albizia lebbeck* and Albizia *procera* in terms of height growth. Among non leguminous tree species *Emblica officinalis* showed better diameter growth but *Terminalia arjuna* showed minimum growth with the combination of leguminous tree species *Albizia lebbeck* and *Albizia procera* after 16 years of plantations. *Emblica officinalis* showed better performance in terms of annual increment of height, diameter and tree volume growth in mixed culture after 16 years of plantation (Tables 1, 2 & 3; Graphs 1&2).

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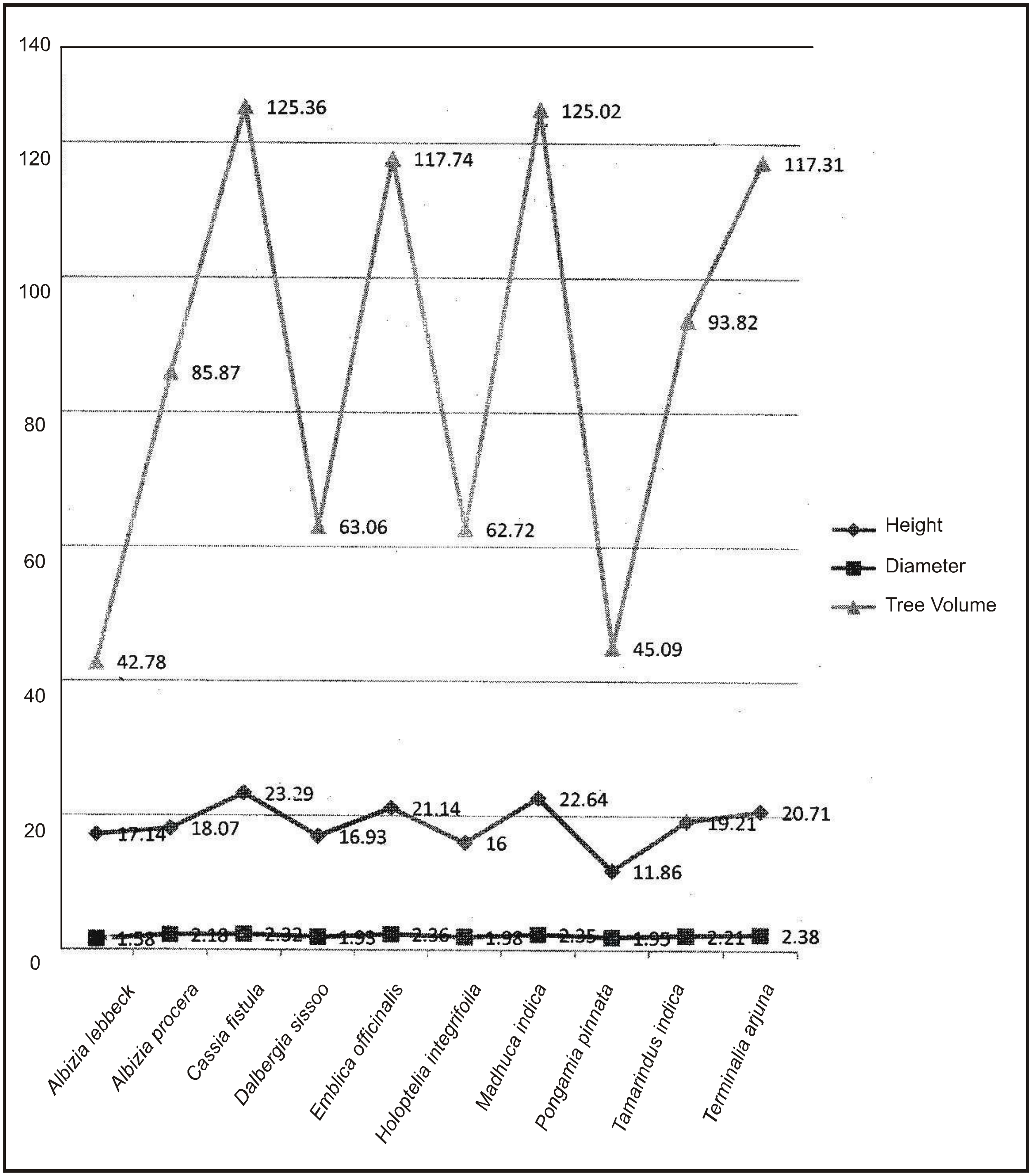
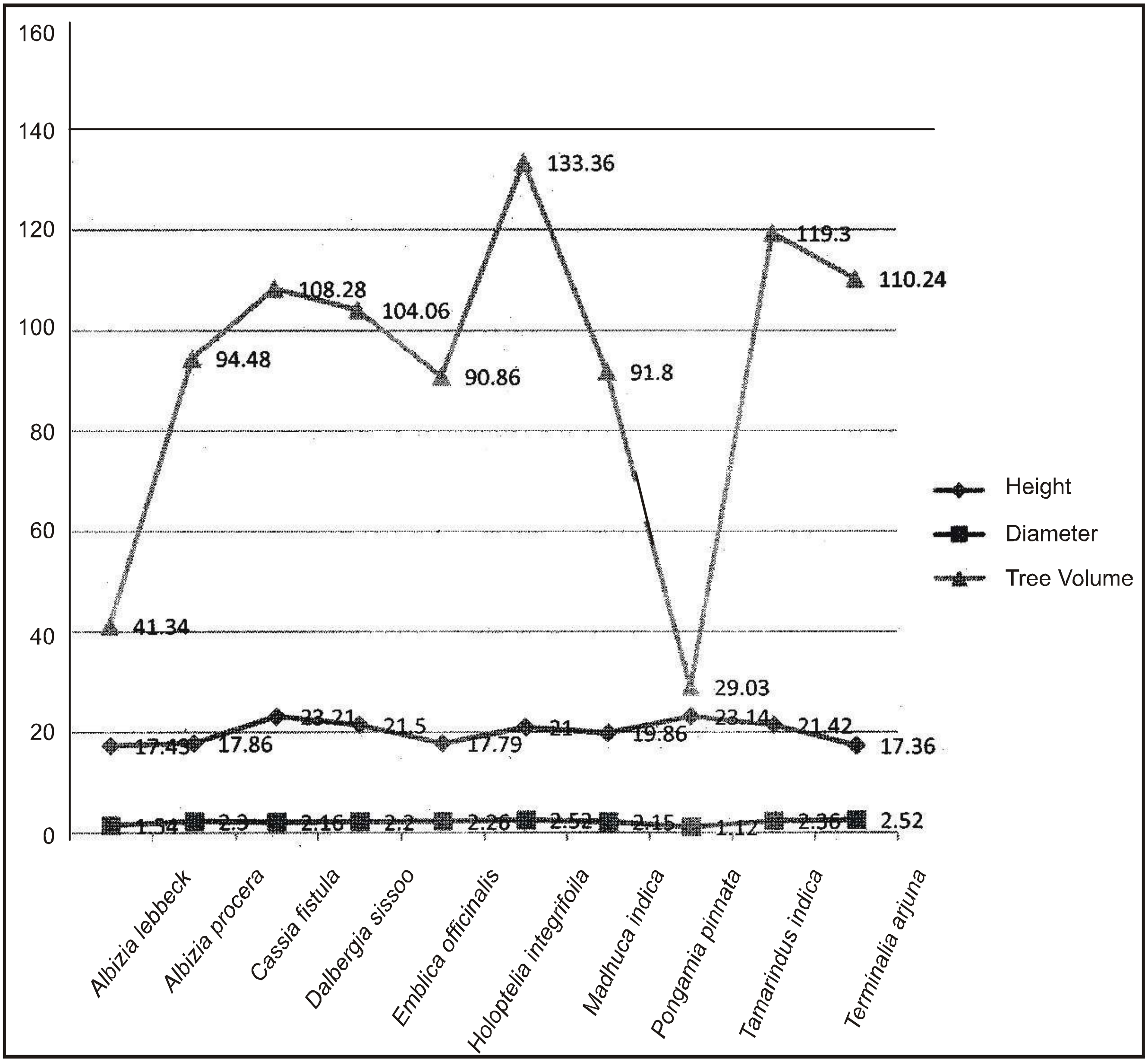


Graph-2 : Mean annual increment in height(cm/yr), diameter (cm/yr) and tree volume (d^2h), (cm^3/yr) about 16 years in comparison to 20 months after plantation (Component 1).



Graph-2 : Mean annual increment in height(cm/yr), diameter (cm/yr) and tree volume (d^2h), (cm^3/yr) about 16 years in comparison to 20 months after plantation (Component 2).