

GROWTH PERFORMANCE OF *DALBERGIA SISSOO* IN ABANDONED FALLOW LAND OF CHAPRA, BIHAR

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Abstract

The present study was conducted to evaluate the growth performance of *Dalbergia sissoo* plantations raised in an abandoned fallow land of Jai Prakash University Chapra, Campus during the period August 2015 to July 2017. The parameters studied were height, diameter, height : diameter ratio and tree volume of 3 year old plantations at two sites. The increase in height ranged from 17 to 28%; diameter from 33 to 75%; tree volume 113 to 280% during the period 2016 and 2017 whereas H:D ratios decreased from 11 to 32% with slight increase in 9% at site II in 2017. The per cent monthly increment in height ranged from 23 to 81%; in diameter 5% and the annual increase in height was recorded 23 to 80% and in diameter only 4%. This study indicated that the growth of *Dalbergia sissoo* is satisfactory in the fallow land in the present study sites.

Index terms: *Dalbergia sissoo*, Growth Performance, Fallow land, Tree volume, H: D ratio,

1. Introduction

The genus *Dalbergia* was named after Swedish botanist N.G. Dalberg. This genus consists of 150 species (trees, shrubs and woody climbers) throughout the tropical region. In India and Burma 42 species including 20 tree species occur. *D.sissoo* is the most valuable timber species in India. It is the most multipurpose plantation tree. Due to its fast growth, quality timber, easy propagation and drought resistance *D.sissoo* has been the most valuable plantation species. This species is planted everywhere such as agricultural fields, canal sides, pond's banks, wasteland etc. There is much bigger profit from plantation of this species due to short rotation of timber harvest with comparison to profits from agricultural crops (Troup 1921). This species can attain up to 40m height and 2.4m girth with clear bole up to 15 m under favourable conditions. Chandrasekharaiah and Prabhakar (1987) have evaluated the height growth and dry matter production in *D.sissoo* which produced significantly higher total harvestable biomass per plant as 70.01kg. Dhukia et al (1988) have reported the better yield in four fodder crops under *D.sissoo* plantation than *Albizia lebbek* plantation. Nath et al (1990) have reported good to moderate performance for social forestry under different soil conditions. Sharma et al (1992) have evaluated the growth performance of *D.sissoo* intercrop with wheat and paddy and reported mean height and dbh 10.36 m and 53.45 cm and total timber 1.25 m³ and small timber 7.1 m³ and fuel wood 77.45 q. Singh et al (1998) using *Rhizobium* and VAM fungi, vermicompost, compost, mulch combination with *D.sissoo* indicated better results. Uniyal et al (2003) have evaluated performance of multipurpose trees and reported *D.sissoo* as most suited for restoration of abandoned agricultural and degraded lands. Tiwari et al (1992) have reported tree growth in *D.sissoo* increased linearly with height and diameter growth better up to 4 year old. Height and diameter growth are influenced by a combination of genetic potential and phenological and morphological responses to environmental factors (Vogt et al., 1983; Cole and Newton, 1987; Harrington et al., 1991; Kelty et al., 1992; DeLong, 1991 a, b; Bi and Turvey, 1994; Leiffers and Stadt, 1994; Comeau and Sachs, 1996; Simard and Heineman, 1996; Davis, 1998; Mustard and Harper, 1998; Makinen, 1998; Wang, 1998). Litter depth, slope, aspect, seasonal climate, tree species and age, elevation, site preparation, stock type, provenance and site quality also affect height and diameter ratio (Zimmerman and Brown, 1997; Burton, 1993; MacLsaac and Navratil, 1996; Davis, 1998; Mustard and Harper, 1998). Height : diameter ratio has been involved in the determination of the influence of varied growth variables on height and diameter of trees. Cremer et al (1982) and Nykanen et al (1997) have used height and diameter ratios as gauge for susceptibility to snow and wind damage. Lommanter and Helles (1987) and Nykanen et al (1997) have reported in conifers increased probability of damage with increased height, diameter ratios. It has been reported that for every tree species height and diameter profile and survival varies from site to site, climate factors and other conditions (Plotto 2007). In many studies the performance of different tree plantations have been evaluated. (Makela et al., 2000; Sievanen, 1993; Landsberg and Waring, 1997; Valentine et al., 1997; Bartelink, 1998; Albrektsen and Valinger, 1985; Hashim, 2005; Piotto et al 2003). Rajdeep and Soni (2002) have purposed survival growth index for the performance of the tree plantation stands.

In the present study the main objective was to study the growth performance of *Dalbergia sissoo* plantation raised in fallow land of Jai Prakash University campus Chapra. Further on the basis of this study the suitability of *D.sissoo* for plantation of fallow land will be decided.

2. Materials and methods

Location:

The study site is situated between 25° 36' and 26° 15' N latitude and 84°25' -85°15' E longitude in the southern part of the Saran Division of North Bihar. Total annual rainfall values in 2015, 2016 and 2017 were 946.6 mm, 1018.9 mm and 1134.6 mm, respectively. In rainy season in 2015 81.56% of total rainfall occurred whereas in 2016 it was 75.44% and in 2017 77.30%. The rainfall values in rainy season varied in different years. The maximum temperature during the study period in 2015 ranged from 25.6 to 40.3°C ; in 2016 from 25.5 to 42.0°C and in 2017 from 27.0 to 38.5°C .

The present study was conducted in the three year old plantation of *Dalbergia sissoo* raised in the campus of Jai Prakash University Chapra . The study was conducted during the period August 2015 to July 2017. Three year old 20 plants of *Dalbergia sissoo* was selected .All the selected individuals were marked with paints. The spacing between individuals was 2m×2m.

In the month of August 2015 ,July 2016 and July 2017 growth parameters such as height and diameter were measured. Further the H:D ratio and tree volume of trees were calculated . The height of seedlings was measured by using tape. The diameter at breast height (DBH) for tall seedlings at 1.34 m was measured. Monthly and annual increments in height and diameter were calculated from the difference between two measurements.

H:D ratio:

H:D Ratio was calculated according to the following formula:

$$\text{H:D ratio (cm)} = \frac{\text{Height(cm)}}{\text{Diameter (cm)}}$$

Tree Volume:

Tree volume was calculated in term of M³ according to the following formula

Tree Volume (m³) = D²H (where D represents diameter and H as height). The values obtained in cm³ were converted into m³.

3. Results and discussion

Height:

In case of *Dalbergia sissoo* 3 years old plantation the height values at site I site II were 422.4 cm and 318.8 cm, respectively whereas in 2016 these values were 398.2cm and 378.6 cm. In 2017 the height values were 592.1 cm at site I and 486.8 cm at site II (Table 1). The monthly increment in 2015-2016 was 6.32 cm /mon at site I and 4.98/mon at site II whereas in 2016-2017 these values were 7.83 cm/mon and 9.02 cm/mon .The annual increment in height at site I and site II were recorded 75.8 cm/yr and 59.8 cm/yr whereas in 2016-2017 the height increment were 93.9 cm/yr and 108.2 cm/yr, respectively, at site I and site II. The per cent increase in height at site I and site II in 2016 were 17% and 18%, respectively compared to 2015. During the period 2017 the per cent increase in height at site I was 18% and at site II 28% compared to 2016. The per cent monthly increase in height in 2016 -17 at site I was 23% and 81% at site II compared to 2015-16. The per cent increase annually in height at site I was 23% and 80% at site II compared to 2015-16 (Table 2)

Diameter:

In case of *Dalbergia sissoo* 3 year old plantation the diameter values at site I site II were 18.8 cm and 13.0 cm, respectively whereas in 2016 these values were 27.7 cm and 22.8 cm. In 2017 the diameter value was 37.0 cm site I and 32.3 cm at site II (Table 1). The monthly increment in 2015-2016 was 0.74 cm/mon at site I and 0.82cm/mon at site II, whereas in 2016-2017 these values were 0.78 cm/mon and 0.79 cm/mon. The annual increment in diameter at site I and site II was recorded 8.9 cm/yr and 9.8 cm/yr whereas in 2016-2017 diameter increment was 9.3 cm/yr and 9.5 cm/yr, respectively, at site I and site II. The per cent

increase in diameter at site I was 47% and at site II it was 75% compared to 2015. During 2016- 2017 at site I diameter increased by 33% at site I and 41% at site II compared to 2016. The per cent monthly increase in diameter was 5% at site I but at site II it decreased by 3% compared to 2015-2016. The per cent annual increment in diameter during 2016-2017 was 4% at site I but it decreased by 3% at site II compared to 2015-16 (Table 2).

H: D Ratio:

In 2015 H:D ratio values were recorded 22.5 at site I and 24.5 at site II. However in 2016 the H:D ratio value decreased and it was 17.98 at site I and 16.60 at site II. In 2017 at site I H:D ratio value decreased further and it was 16.0 but at site II it increased to 18.16. Thus it indicates that there was higher rate of growth in diameter than the height in 2016 and 2017 compared to 2015. H:D ratio decreased by 20% and 32.2% at site I and site II, respectively, compared to 11% and increased by 9% at site II compared to 2016 values.

Tree volume (m³):

In 2015 the tree volume values in site I were 0.15 m³ whereas it was 0.05 m³ at site II. In 2016 the tree volume value increased compared to 2015 and it was 0.38 m³ at site I and 0.19 m³ at site II. In 2017 tree volume value further increased to 0.81 m³ at site I and 0.50 m³ at site II. Thus during the period 2016 and 2017 tree volume increased. In 2016 at site I the tree volume increased by 153% and at site II 280%. In 2017 it increased to 113% at site I and 165% at site II compared to 2016.

In the present study the increase in height in 2016 at two sites was 17-18% in 2016 and 18-28% in 2017 whereas the increase in growth in diameter ranged from 47-75% in 2016 and 33 to 41% in 2017. This study indicated that there was more growth in diameter than the height. Thus the H: D ratio decreased. The increase in tree volumes were recorded 113-280%. Earlier workers have reported that the height and diameter growth and H: D ratio are affected by several genetic, phenological, morphological and environmental factors (Comeau and Sachs 1996; Makinen, 1998 Wang 1998). The monthly and annually increase in height and diameter in different years in the present study varied. The increase in height and diameter also varied within sites. At site II there was more growth in height than site I whereas diameter growth was more site I than site II.

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Table -1 Growth Performance in *D.sissoo* during the period 2015-2017

Growth Parameters	2015		2016		2017	
	Site I	Site II	Site I	Site II	Site I	Site II
Height (cm)	422.4	318.8	498.2(+17%)	378.6(+18%)	592.1(+18%)	486.8(+28%)
Diameter (cm)	18.8	13.0	27.7(+47%)	22.8(+75%)	37.0(+33%)	32.3(+41%)
H: D Ratio	22.5	24.5	17.98(-20%)	16.60(-32%)	16(-11%)	18.16(+9.%)
Tree Volume (m ³)	0.15	0.05	0.38(+153%)	0.19(+280%)	0.81(+113%)	0.50(+165%)

Table: 2 Monthly and Annual increment in Height and Diameter in D.sissoo (2015-2017)

Growth Parameters	Site I	Site II	Site I	Site II
	2015-16	2015-16	2016-17	2016-17
Monthly Increment in height (cm/mon)	6.32	4.98	7.83(+23%)	9.02(+81%)
Monthly Increment in diameter (cm/mon)	0.74	0.82	0.78(+5%)	0.79(-3%)
Annual Increment in height (cm/yr)	75.8	59.8	93.9(+23%)	108.2(+80%)
Annual Increment in diameter (cm/yr)	8.9	9.8	9.3(+4%)	9.5(-3%)

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