

Effect of Tree Spacing on Growth Performance of *Melia composita* Willd in Punjab Region of North India

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Abstract—*Melia composita* Willd. which is an indigenous, multipurpose, fast growing and valuable timber species emerged as one of the most suitable tree species for agrisilviculture system. The present study was conducted in the Punjab region in Northern India. The study was conducted at two sites site-1 (Site1- Handesra, Mohali (30 25 28.94 N, 076 53 36.43E) and site-2(Site-2 Bhera Village, Hoshiarpur(31 34 15.8 N, 075 56 15.8 E) with the spaces 2×2, 3×3 and 4×4 in the year of 2014, 2015 and 2016. The growth parameters both height and diameter were measured continuously for three consecutive years. The maximum increase in height was recorded at Site-2 in spacing of 3×3(9.38 m) in 2016 and minimum was recorded in spacing of 4×4 in 2014 initial stage of year plant. In case of diameter the maximum diameter were recorded at site-2 in spacing of 3×3(51.20 cm) in year 2016. This data clearly shows the significant increase in growth of tree species at both the sites. But it was recorded best growth performances in 3×3 after several years of plantation. The higher growth were observed in spacing of 3×3 may be due it allow the tree to have minimum branches and higher wood in stem of the *Melia* sp. The study reveals that the appropriate spacing plays a significant role in amount of bole height and wood stock for the industries as well in minimum space on the ground.

Keywords: *Melia composite*, Tree Spacing, Growth, Punjab, Agroforestry.

1. INTRODUCTION

In India, as a result of restrictions on felling in natural forests, fast growing, and short rotation forest plantations are emerging as a major source of raw material for Indian wood based industries. Under high density short rotation plantations, trees are grown with a rotation period less than 6 to 12 years and with high productivity at least 10 to 30 m³ ha⁻¹ yr⁻¹. There is a substantial gap (14 Million Tonnes) in the demand (55 Million Tonnes) and supply (41 Million Tonnes) of timber (TERI, 2009). So, there is a need for plantation of short rotation species, to meet out the growing demand of raw material for wood based industries. A large number of fast growing exotic as well as local species are available for this purpose, however, there, is need for selection of appropriate tree for optimizing biomass production and improving the

yield of intercrops. *Melia composita* Willd. which is an indigenous, multipurpose, fast growing and valuable timber species emerged as one of the most suitable tree species for agrisilviculture system. It occurs mostly in tropical moist deciduous forest of the Sikkim, Himalayas, North Bengal and Upper Assam, Khasi hills, North Circle, Deccan and the Western Ghats at an altitude of 1200 to 1800 meters. It is known to yield multi utility timber and its wood can be used as packing cases cigar boxes, pencil, match boxes, splints, and ply boards. *Melia* wood has huge demand in wood based industries. It is also source of firewood with the calorific value more than 5000 kcal/kg and above all these, the species is leaflessness during winter and hence incorporated in many agro forestry systems. The flowers are said to provide excellent bee forage. The tree tends to develop heavy lateral branching; therefore it is advised to prune *M. composita* from the 1st year onwards to maintain a clean straight bole. *Melia* is very suitable for the agroforestry system. This, however, is dependent upon good silvicultural practice in reducing the shade effect of canopies, which would otherwise adversely affect light-demanding crops during summer season. The species has been identified as a potential alternate pulpwood species (Chauhan et al., 2008). Its bark, fruits, leaves, and wood have insecticidal properties (Alché et al., 2003). This species with multifarious uses has gained only limited research attention, especially regarding tree improvement. As the species is of immense importance, a study to select and analyze potential open-pollinated progenies by assessing the existing variability was conducted so that the same is used in future improvement and plantation programs. The present study is a step towards impact of spacing on *Melia* species on their growth, which can be identify for optimal utilization for space in agroforestry system.

2. METHOD AND METHODOLOGY

The study was conducted in the district of Mohali and Hoshiarpur in the state of Punjab with reference to *Melia*. For

the establishment of experimental plots at selected sites of Handesra, Mohali (30° 25' 28.94 N, 076° 53' 36.43E) and Bhera Village, Hoshiyarpur (31° 34' 15.8 N, 075° 56' 15.8 E). The topography of the area was marked by plain or moderate slope. The area fall under the subtropical climate with three distinct seasons viz rainy, winter and summer. The annual rainfall during the study period was approx. 1200 mm and mean monthly temperature ranged from 7.7 °C in January to 41 °C maximum in June. Most of the rainfall is received from July to September. Spacing under plantation block plantation was with the spaces 2m×2m, 3m×3m and 4m×4m design of layout at both the sites in RBD with six replications at each site. There were six samples of each spacing for three years at both the sites were recorded.

The height of standing tree is measured from the tip of the leading shoot (from the highest point of the crown where there is no leader) to the ground level. The height of the tree is measured with the help of measuring tape (Chaturvedi and Khanna, 1982). The diameter was collected at DBH using tree caliper (Chaturvedi and Khanna, 1982). On sloping ground, the diameter at breast - height measured on the uphill side, after removing any dead leaves or needles lodged there (Chaturvedi and Khanna, 1982).

3. RESULTS AND DISCUSSIONS:

The maximum increase in height was recorded at Site-2 in spacing of 3×3 (9.38 m) in 2016 and minimum was recorded in spacing of 4m×4m in 2014 initial stage of year plant. In case of diameter the maximum diameter were recorded at site-2 in spacing of 3×3 (51.20 cm) in year 2016 (Table 1).

Table 1: The diameter and height in at two sites of study area in Punjab

Site-1- Handesra, Mohali (Location: 30° 25' 28.94 N, 076° 53' 36.43E)							Site-2 Bhera Village, Hoshiyarpur (Location: 31° 34' 15.8 N, 075° 56' 15.8 E)						
Sit e-1	Diameter			Height			Sit e-2	Diameter			Height		
	2X 2	3X 3	4X 4	2 X 2	3 X 3	4X 4		2X 2	3X 3	4X 4	2 X 2	3 X 3	4 X 4
2014	36.23	37.95	35.42	6.22	6.85	6.17	2014	38.58	40.72	35.95	6.92	7.37	6.15
2015	39.17	43.88	40.20	7.17	7.65	7.22	2015	44.05	46.77	38.32	7.88	8.10	6.82
2016	46.37	50.32	44.33	9.12	9.32	7.98	2016	48.57	51.20	41.60	9.08	9.38	7.45

Data mean of 6 six replicate at each year

This data clearly shows the significant increase in growth of tree species at both the sites. But it was recorded best growth performances in 3×3 after several years of plantation. The higher growth were observed in spacing of 3×3 may be due it allow the tree to have minimum branches and higher wood in

stem of the *Melia sp.* The study reveals that the appropriate spacing plays a significant role in amount of bole height and wood stock for the industries as well in minimum space on the ground. The study conducted by Sheikh (1984) conducted an experiment to know the effect of spacing on growth parameter in 6 years and 9 years old *Dalbergia sissoo* planted at spacing of 2m×2m. He observed the 2m x 2m spacing produced fewer branches and more fuelwood. The height and diameter were 8.7m and 8.6cm, respectively, at 6 year and 13.9m and 14.2cm respectively, at the age of 9 years old plantation.

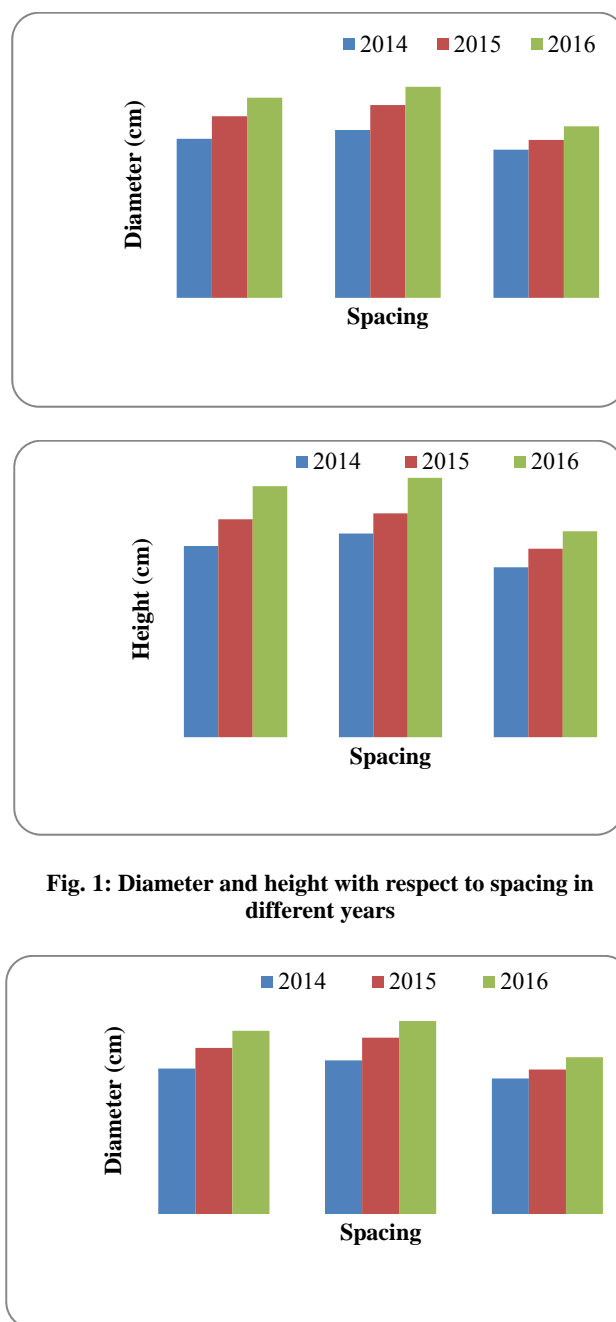


Fig. 1: Diameter and height with respect to spacing in different years



Fig. 2: Diameter and height with respect to spacing in different years

Sheikh (1988) carried out a study to find out the biomass production planted at 2 m x 2m and in 10 years old *Dalbergia sissoo* plantation in Peshawar, Pakistan. He reported that there was no significant difference among spacing for the biomass production. The produced biomass of *Dalbergia sissoo* (main stem, branches, leaves and roots) were 510, tones/ha, respectively. In India Singh and Puri (1990) studied 9 years old *Populus deltoides* stand planted 2mx2m spacing in semi-arid region of Haryana. The maximum above-ground biomass and net primary productivity in the plantation of 2m x 2m spacing were 206 t ha⁻¹. Sharma *et al.*, (1996) studied growth and biomass of 5 years old plantation with *Amoora walichii*, *Callicarpa arborea*, *Ficus fistulosa*, *Gmelina arborea* and *Vatica lunceaefolia* at five different spacing. Among these species minimum palpable dry biomass was recorded in *F. fistulosa* (80.1t ha⁻¹ in case of 2 m x 2 m. It was maximum in *G. arborea* (40.4 t ha⁻¹) and minimum in *A. walichii* (21.8 t ha⁻¹). In these studies, the mean height of trees increased from 16.6m to 19.6 m between 4 to 7 year. Similarly the tree dimensions were also increased in respect to volume and dry matter content from 200 to 274 m³ t ha⁻¹ and 68 to 11.9 t ha⁻¹, respectively. The study by Pacholi and Pandey (1998) studied the impact of plantation density on biomass production in *Dalbergia sissoo*. The above ground biomass was maximum (104.6 t ha⁻¹) in 2 m x 2 m spacing plantation while the above ground biomass decreased as spacing increased. Singh (1994) analyze the growth performance of tropical leguminous tree *Leucaena leucocephala* planted at 2mx2m spacing on coal mine spoil in Jayant coal mine. It was evident from the study that row spacing distance had does not marked impact on the growth performance of *Leucaena leucocephala*. The study conducted by Singh and Toky (2005) estimated above ground biomass and net primary productivity in high density (energy) plantations of three important species raised at Hisar in arid India. In 4-year old plantations, The standing biomass after 4 years was 112 t ha⁻¹ in *Leucaena leucocephala*, 96 t ha⁻¹ in *Eucalyptus tereticornis* and 52 t ha⁻¹ in *Acacia nilotica*. In 8-years old plantations with initial spacing of 2m x 2m, the net primary productivity was 25 t ha⁻¹ year⁻¹ in *Leucaena leucocephala*, 21 t ha⁻¹ year⁻¹ in *Eucalyptus tereticornis* and 14

t ha⁻¹ year⁻¹ in *Acacia nilotica* and 38 to 45% of it was returned to the soil through litter fall. After 8 years of growth, biomass was 126 t ha⁻¹ in *Leucaena leucocephala*, 102 t ha⁻¹ in *Eucalyptus tereticornis* and 77 t ha⁻¹ in *Acacia nilotica*. Roy *et al.*, (2006) studied tree growth and biomass production in eight years old plantation in single line (2m apart) of *Melia azedarach* tree on farm boundaries in a semi arid region (IGFRI, Jhansi, and U.P). They observed that maximum number of trees were recorded in the diameter range of more than 22 cm. The trees contributed a total biomass production of 2101 t ha⁻¹ of which 66, 24 and 10 % were contributed by minor timber, fire wood and fodder respectively. Shinde and Gowade, (2007) considered three species *Acacia auriculiformis*, *Casuarina equisetifolia* and *Leucaena leucocephala* in different 2mx2m to evaluate DBH, height and maximum biomass production and revealed that there was significant difference between them. Loutfy.I.El- Juhany and Ibrahim M.Aref (2008) carried out an experiment to know the growth performance of *Leucaena leucocephala* (Lam.) planted in the field of College of Agriculture. The spacing between rows or trees within row was either 2.10 meter. They observed the relative growth rates of both diameter and height increased with increasing the distance between trees but decreased with age. The effects of both diameter and height growth on total above-ground biomass before pruning were similar for all spacing regimes. After pruning the height had the remarkable effect on above-ground biomass in the spacing of 2.1m. The study done by Singh (2012) analyze the growth performance of tropical leguminous tree *Leucaena leucocephala* planted with two different row spacing distance on coal mine spoil in Jayant coal mine of Singrauli coalfields, India. It was evident from the study that row spacing distance had marked impact on the growth performance of *Leucaena leucocephala*. Saplings planted at a distance of 2 m x 4 m exhibited better growth. The study reveals that the appropriate spacing plays a significant role in amount of bole height and wood stock for the industries as well in minimum space on the ground. This species in optimum growth could be used for the agroforestry purposes.

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