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RESEARCH ARTICLE

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Growth and productivity of *Melia dubia* under different plant density

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ABSTRACT : Different density experiment was conducted to know the effect on growth and productivity of *Melia dubia*. The trial was laid out with different spacing regimen as per statistical design. The growth observations were recorded at different intervals of time *viz.*, 42, 45, 48 and 51 months after planting. The results revealed significant difference among different planting densities and maximum was recorded in planting density of 714 trees/ha (46.85 cm, 10.59 m; 50.14 cm, 10.99 m; 52.99 cm,11.22 m and 55.76 cm,11.43 m) for both girth (cm) and height (m), respectively for all the time interval. However, the total stand volume (m^3/ha) in all the time interval was significantly superior in case of planting density of 2500 trees/ha (125.00 m^3/ha, 148.33 m^3/ha, 165.83 m^3/ha and 189.25 m^3/ha). Based on the results of the present experiment it is concluded that, the planting density of 2500 trees/ha exhibited significant stand volume compare to other planting density. These findings have significant relevance to get maximum productivity under monoculture block plantation system.

KEY WORDS : Girth, Height, Volume, Spacing, Planting density

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INTRODUCTION

Melia dubia belongs to the family meliaceae has its trade name as Malabar neem and locally called as hebbevu. It's an indigenous fast growing tree species with multipurpose benefits such as plywood pulpwood, timber and fuel wood. The species is suitable for plantation programme under various agroclimatic conditions, Thus, in the recent scenario the species has greater attraction by farmers, foresters and plantation growers. The growing demand for timber can be met to some extent by utilizing alternate species and increasing the timber production through intensive silviculture management. The choice of planting density is a primary silvicultural decision which considers the tradeoff between individual tree size and total stand production, affecting type of quality and quantity of products throughout the rotation. Hence, the plantations of fast growing, short rotation woody crops like *Melia dubia* gained more importance also in Carbon sequestration while providing income from wood products. In spite its multifarious benefits; there are hardly few studies on evaluating the growth productivity of the

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species under different plant densities. Keeping these points in view, the fundamental hypothesis of the present experiment is that, do the plant densities influence the productivity of *M. dubia*? Thus primary aim of the present study is to estimate growth, volume and optimum productivity of the species in relation to different planting densities at different time intervals.

EXPERIMENTAL METHODS

Melia dubia plantation under different densities was established under All India Co-ordinated Research Project on Agroforestry, University of Agricultural Science, Dharwad. The study area fall under the Northern Transitional Zone of Karnataka between 15º 29' 16" N Latitude, 74º 58' 91" E Longitude with altitude of 2268 ft amsl and the soil type was black cotton soil. The experiment was laid with 7 Treatments × 3 Replications = 21 plots in Randomized Block Design (RBD). The different plant densities such as 2500 trees/ha (4×1m), 1666 trees/ha (4×1.5m), 1250 trees/ha (4×2m), 1000 trees/ha (4×2.5m), 833 trees/ha (4×3m), 714 trees/ha (4×3.5m) and 625 trees/ha (4×4m). Observations on growth parameters *viz*., girth and height was recorded at 3 months interval upto the period of nine months from May, 2014 to January, 2015. The girth at breast height was recorded with the help of girth tape at 1.37 m above the ground level and expressed in centimeters. The total height from base to its tip of the main stem by using marked pole and expressed in m. The basal area was determined by the formula; Basal area = $\pi d2/4$ or $g2/4\pi$ (Chaturvedi and Khanna, 1984). Finally total volume was determined by using following formula; Total Volume = Total height x Basal area x Form factor (Chaturvedi and Khanna, 1984) and expressed in m^3. All the growth observations were subjected one way analysis of variance to estimate the significance of the treatments.

EXPERIMENTAL RESULTS AND ANALYSIS

The result revealed significant difference among different planting densities for all the growth parameters at different time intervals. The results on girth was significantly superior at planting density of 714 trees/ha (46.85, 50.14, 52.99 and 55.76 cm) and the lowest girth was recorded in density of 2500 trees/ha (27.50, 29.40, 30.92 and 32.82 cm) at 42, 45, 48 and 51 months after planting, respectively. The results on height parameter showed similar trend of significant differences with maximum height was found in planting density of 714 trees/ha (10.59, 10.99, 11.22 and 11.43 m) and the minimum was in density of 2500 trees/ha (7.90, 8.22, 8.37 and 8.53 m) in all the observation periods.

On the other hand, the stand volume (m^3/ha) under different planting densities showed contrary results with significant differences among different densities. At Initial reading (42 months after planting) the maximum volume was noticed in plant density of 2500 trees/ha (125.00 m^3/ha) followed by 1000 trees/ha (107.67 m^3/ha), 833 trees/ha (106.76 m^3/ha) and 1666 trees/ha (102.68 m^3/ha), these latter treatments were at par with each other. The lowest volume (69.73 m^3/ha) was recorded in plant density of 625 trees/ha. Similar pattern of significance was observed in rest of the observations period. Overall findings of the experiment revealed significant variation in the growth parameters with respect to different plant densities.

The variation in the productivity of tree species is mainly depends on the genotype of the species. In addition, the species grows in different climatic conditions

Table 1 : Girth (cm) of *Melia dubia* as influenced by different densities

Treatments	Initial reading (42 MAP)	45 MAP	48 MAP	51 MAP
T_1 (2500 trees/ha)	27.50	29.40	30.92	32.82
T_2 (1666 trees/ha)	31.26	33.71	35.61	36.04
T_3 (1250 trees/ha)	36.17	38.96	41.15	43.93
T_4 (1000 trees/ha)	40.11	43.26	45.44	47.74
T_5 (833 trees/ha)	46.00	49.24	51.85	54.25
T_6 (714 trees/ha)	46.85	50.14	52.99	55.76
T_7 (625 trees/ha)	45.68	48.86	51.68	54.58
S.E. ±	1.79	2.06	2.14	2.33
C.D. (P=0.05)	5.52	6.34	6.61	7.17

Table 2 : Height (m) of *Melia dubia* as influenced by different densities

Treatments	Initial reading (42 MAP)	45 MAP	48 MAP	51 MAP
T_1 (2500 trees/ha)	7.90	8.22	8.37	8.53
T_2 (1666 trees/ha)	8.34	8.74	8.94	9.09
T_3 (1250 trees/ha)	8.99	9.39	9.60	9.73
T_4 (1000 trees/ha)	9.16	9.52	9.73	9.90
T_5 (833 trees/ha)	10.12	10.56	10.80	10.97
T_6 (714 trees/ha)	10.59	10.99	11.22	11.43
T_7 (625 trees/ha)	10.10	10.50	10.70	10.91
S.E. ±	0.52	0.52	0.53	0.55
C.D. (P=0.05)	1.60	1.61	1.63	1.69

Table 3 : Volume (m^3/ha) of *Melia dubia* as influenced by different densities

Treatments	Initial reading (42 MAP)	45 MAP	48 MAP	51 MAP
T_1 (2500 trees/ha)	125.00	148.33	165.83	189.25
T_2 (1666 trees/ha)	102.68	124.84	143.00	159.21
T_3 (1250 trees/ha)	96.29	117.00	132.62	153.71
T_4 (1000 trees/ha)	107.67	130.33	145.77	163.03
T_5 (833 trees/ha)	106.76	127.45	143.78	159.69
T_6 (714 trees/ha)	78.40	93.49	106.15	119.43
T_7 (625 trees/ha)	69.73	83.31	94.50	106.71
S.E. ±	7.41	8.89	9.21	11.13
C.D. (P=0.05)	22.84	27.39	28.37	34.29

MAP – Months after planting

which ultimately reflect on species performance, hence, environment also has significant influence on the productivity. In the present study also there is significant variation in the girth, height and volume of the species which could be due to the competition for limiting factors such as moisture, light and nutrients (Kuppers, 1989) and also morphology of the species (crown width, height) (Harris, 2007). Forrester *et al*. (2013) also observed that *Eucalyptus globulas* at six densities attained higher diameter at breast height at lower planting densities over the other planting densities. As far height parameter has significantly influenced by optimal density of the plants. In the present study it is evident that optimal density of 714 trees/ha exhibited better results than other planting density. This could be due to competition mainly for light and available resources. The results are conformity with the findings of Prasad *et al*. (2011) on *Leucaena leucocephala*.

The total volume in the present experiment was found in higher density of 2500 trees/ha. This could be due to more plants per unit area with efficient utilization of nutrients compare other densities. Similar findings have been reported by Harris (2007) in *Eucalyptus grandis* trial planted with different densities. The results revealed high stocking densities led to greater stand growth and also greater inequality in tree size, the largest trees in high stocking densities were smaller than those in low stocking densities. Jayaraman and Rajan (1991) also observed similar pattern in *Acacia auriculiformis* plantations.

The study revealed that varying plant densities has significantly influenced the tree growth and productivity. In the present experiment though there is limited number of treatments at only one climatic condition. But the findings needs to be emphasized before taking up plantation programme at larger scale to get maximum productivity at shorter period to full fill the demands for various wood based industries.

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