J. Farm Sci., 30(1): (70-73) 2017

Growth and productivity of *Melia dubia* under different planting densities in Dharwad conditions

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(Received: November, 2016 ; Accepted:March, 2017)

Abstract: The density experiment was conducted to know the effect on growth and productivity of *Melia dubia.* The plantation under different densities (2500 trees/ha with spacing 4×1 m, 1666 trees/ha with spacing 4×1.5 m, 1250 trees/ha with spacing 4×2 m, 1000 trees/ha with spacing 4×2.5 m, 833 trees/ha with spacing 4×3 m, 714 trees/ha with spacing 4×3.5 m and 625 trees/ha with spacing 4×4 m) was established under All India Co-ordinated Research Project on Agroforestry, University of Agricultural Science, Dharwad. The four year old existing block was selected for experiment and laid with 7 Treatments × 3 Replications = 21 plots in Randomized Block Design (RBD). The planting densities of 833 trees/ha and 1000 trees/ha showed optimum performance over the individual tree performance as well as total stand performance. The planting density of 2500 trees / ha exhibited significant stand volume compare to other plant density. These results have greater importance to get maximum productivity under block plantations.

Key words: Girth, Height, Melia dubia, Planting density, Spacing, Volume

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 uses like pulpwood, timber, fuel wood and plywood can fit as a suitable species for plantation 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 stand production, affecting quality and quantity of products throughout the rotation.

Hence, the plantations of fast growing, short rotation woody crop 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 and productivity of the species under different plant densities. (Cassidy *et al.,* 2013, Etigale *et al.,* 2014, James *et al.,* 2006., Paula *et al.,* 2013.). Keeping these points in view present study is made to estimate growth, volume and optimum productivity of the species in relation to different planting densities at different time intervals.

Material and methods

Melia dubia plantation under different densities was established during 2013 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 15^0 29' 16" N Latitude, $74^0$58' 91" E Longitude with altitude of 2268 ft. MSL, Soil is black cotton soil. Observations on growth parameters *viz.,* gbh and height were recorded. The observations were recorded at 3 months interval up to the period of nine months from May-2014 to January-2015.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 x 1m),1666 trees/ha(4 x1.5m), 1250 trees / ha (4 x 2m),1000 trees / ha(4 x 2.5m),833 trees/ha(4x3m), 714 trees/ha(4 x 3m) and 625 trees/ha. in (4x4m) spacing.The tree girth and height was recorded at 3months interval up to the period of 9 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 meters (m). The basal area was determined by the formula.

Basal area = $\pi d^2/4$ or $g^2/4\pi$

Total Volume = Total height x Basal area x Form factor

Finally, total volume was determined by using following formula (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.

Results and discussion

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 32.82cm) at 42,45,48 and 51 months after planting respectively. Height showed significant differences among different planting densities of *Melia dubia.* At Initial reading (42 months after planting) maximum tree height was recorded in case of planting density 714 trees/ha (10.59 m) followed by in planting density of 833 trees/ha (10.12 m) and 625 trees/ha (10.10 m). These planting densities were on par with each other. The minimum height was recorded in case of planting density 2500 trees/ha (7.90 m). Same trend was observed in case of 45, 48 and 51 months after planting.

On the other hand ,the stand volume m^3/ha. under different plant densities showed the 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 m3/ha followed by 1000 trees /ha(107.67 m^3/ ha), 833trees /ha (106.76 m^3/ha) and 1666 trees/ha (102.68 m3/ha), these latters treatments were on par with each other. The lowest volume (69.73) m3/ha) was recorded in plant density of 625 trees/ha. These findings of the experiment revealed significant variation in the growth parameters with respect to different plant densities. (Harris,2007, Forrester *et al.,* 2013).

The variation in the productivity of tree species is mainly depends on the genotype of the species and environment. The present study revealed that varying plant densities significantly affected the tree growth. As the density decreases the individual tree volume gradually increased but total stand volume decreased. The height growth decreased with increasing density, conversely GBH and height are inversely related with changing density. However it is clear that for higher biomass we go for planting in closer spacing (high density) and for individual tree biomass and higher yield in tree size we should go for wider spacing (low density) of *Melia dubia.*

The significant variation in the girth, height and volume of the different tree species which could be due to the competition for limiting factor such as moisture, light and nutrients and also morphology of the species. (Harris *et al.,* 2007). *Eucalaptus globules* at lower densities attained higher diameter as compare to other higher densities (Forrester *et al.,* 2013). In the present study it is evident that optimal density of 714 trees/ha exhibited better results than other planting densities. These results are conformity with the findings of Prasad *et al.,* 2011, the optimum plant stand density of *Leucaena leucocephala* for increasing the girth and volume of the tree.

The total volume in the present experiment was found to higher density of 2500 trees /ha. This could be due to more plants per unit area with efficient utilization of nutrients compare to other densities. Similar results have been reported by Harris *et al.,* 2007 competition on tree stand, growth and structure of different plant densities in subtropical *Eucalyptus grandis* plantations.

Table 1. GBH (cm) of *Melia dubia* as influenced by different densities

Treatments	Girth (cm)			
	Initial reading (42 MAP)	3MAIR (45 MAP)	6 MAIR (48 MAP)	9 MAIR (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
Mean	39.08	41.94	44.23	46.45
S.Em ±	1.79	2.06	2.14	2.33
C.D.(0.05)	5.52	6.34	6.61	7.17

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

Treatments	Height (m)			
	Initial reading (42 MAP)	3MAIR (45 MAP)	6 MAIR (48 MAP)	9 MAIR (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
Mean	9.31	9.70	9.91	10.09
S.Em ±	0.52	0.52	0.53	0.55
C.D.(0.05)	1.60	1.61	1.63	1.69

MAIR – Months After Initial Reading, MAP – Months After Planting

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

Treatments	Volume (m^3/tree)			
	Initial reading (42 MAP)	3MAIR (45 MAP)	6 MAIR (48 MAP)	9 MAIR (51 MAP)
T_1 (2500 trees/ha)	0.050	0.059	0.066	0.076
T_2 (1666 trees/ha)	0.062	0.075	0.086	0.096
T_3 (1250 trees/ha)	0.077	0.094	0.106	0.123
T_4 (1000 trees/ha)	0.108	0.130	0.146	0.163
T_5 (833 trees/ha)	0.128	0.153	0.173	0.192
T_6 (714 trees/ha)	0.110	0.131	0.149	0.167
T_7 (625 trees/ha)	0.112	0.133	0.151	0.171
Mean	0.090	0.110	0.130	0.140
S.Em ±	0.010	0.013	0.014	0.016
C.D. (0.05)	0.022	0.028	0.031	0.035

MAIR – Months After Initial Reading, MAP – Months After Planting

Table 4. Volume (m^3/ha) of *Melia dubia* as influenced by different densities

Treatments	Volume (m^3/ha)			
	Initial reading (42 MAP)	3MAIR (45 MAP)	6 MAIR (48 MAP)	9 MAIR (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
Mean	98.08	117.82	133.10	150.15
S.Em ±	7.41	8.89	9.21	11.13
C.D.(0.05)	22.84	27.39	28.37	34.29

MAIR – Months After Initial Reading, MAP – Months After Planting

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.

The study concluded that varying plant densities significantly affected the tree biomass/growth. As the density decreases the individual tree biomass gradually increased but

total stand biomass decreased. The height growth decreased with increasing density, conversely GBH and height are inversely related with changing density. However it is clear that for higher biomass we go for planting in closer spacing (high density) and for individual tree biomass and higher yield in tree size we should go for wider spacing (low density) of *Melia dubia.* Therefore the *Melia dubia* plays a significant role in increasing the overall growth and productivity at lower planting densities such as 1000, 833, 714 and 625 trees/ha and considered to be better species for block plantations.

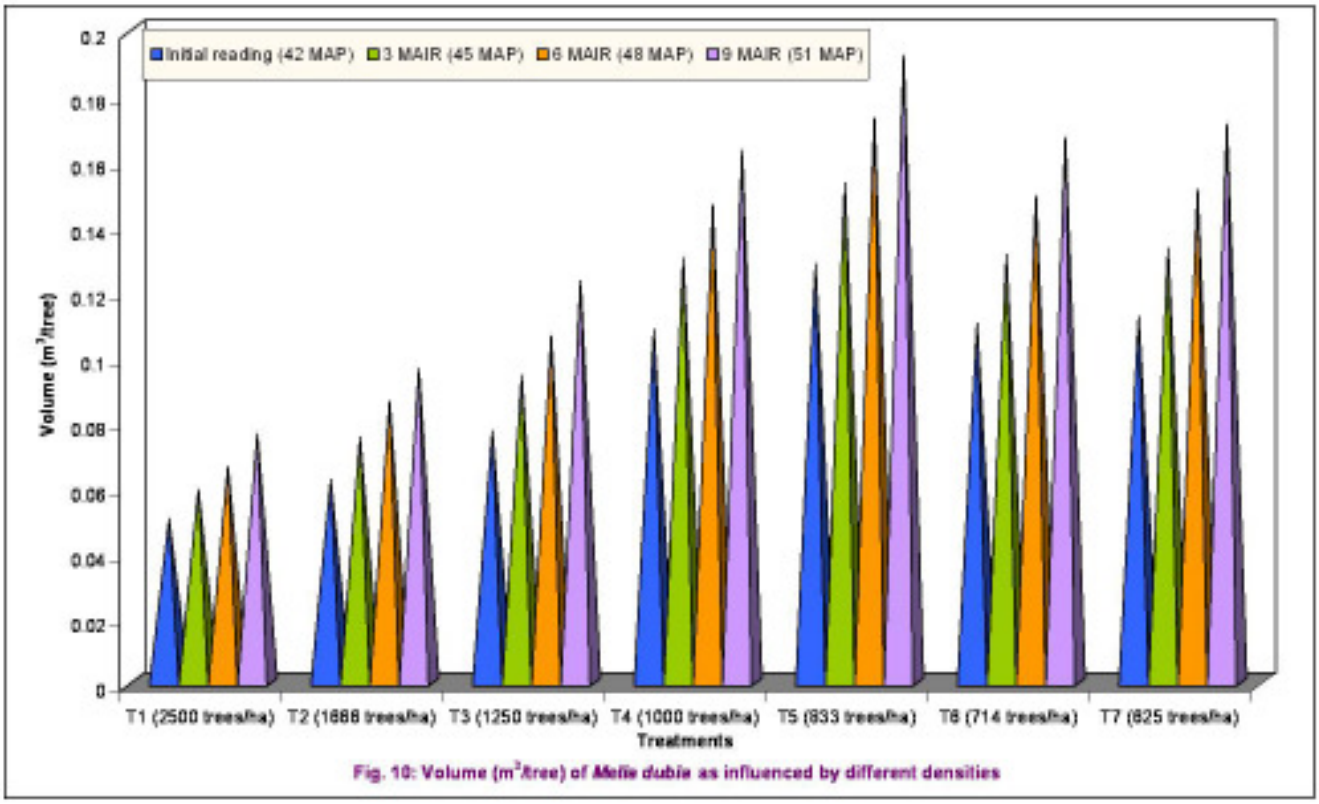

Fig. 10: Volume (m^3/tree) of *Melia dubia* as influenced by different densities

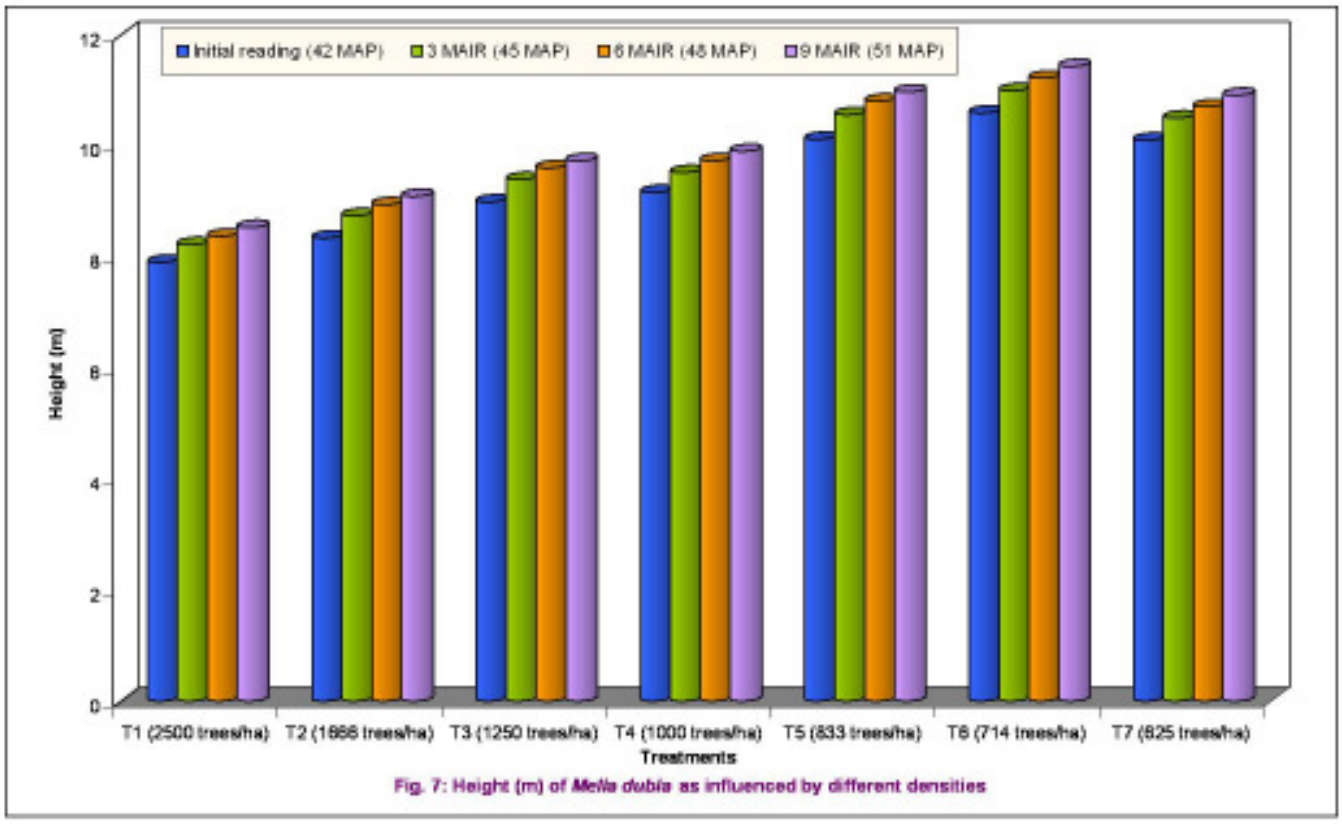

Fig. 7: Height (m) of *Melia dubia* as influenced by different densities

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