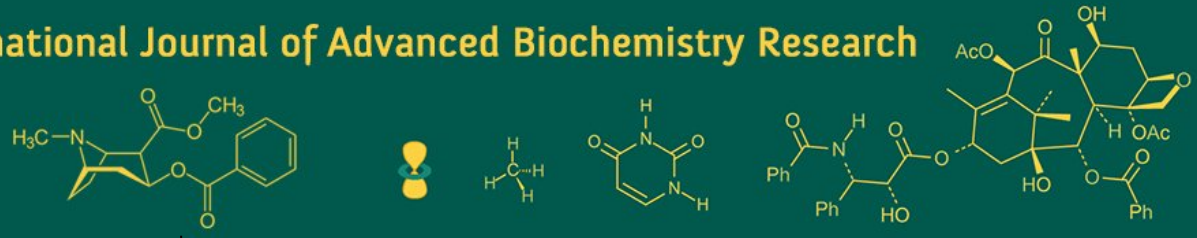
International Journal of Advanced Biochemistry Research



ISSN Print: 2617-4693
ISSN Online: 2617-4707
IJABR 2023; SP-7(2): 478-481
www.biochemjournal.com
Received: 11-09-2023
Accepted: 15-10-2023

Syed Ali
College of Forestry, Ponnampet, South Kodagu, Karnataka, India

Vasudev KL
College of Horticulture, Hiriyur, Karnataka, India

Devagiri GM
College of Forestry, Ponnampet, South Kodagu, Karnataka, India

Ramakrishna Hegde
College of Forestry, Ponnampet, South Kodagu, Karnataka, India

Kumar Naik
Zonal Agricultural and Horticultural Research Station, Hiriyur Karnataka, India

Corresponding Author:
Syed Ali
College of Forestry, Ponnampet, South Kodagu, Karnataka, India

Growth performance of *Melia dubia* in agroforestry in the central dry zone of Karnataka

Syed Ali, Vasudev KL, Devagiri GM, Ramakrishna Hegde and Kumar Naik

DOI: https://doi.org/10.33545/26174693.2023.v7.i2Sg.254

Abstract
Malabar neem (*Melia dubia* Cav.), commonly called as Hebbuvu or Dreak or Gora Neem, is a dry deciduous multipurpose tree belongs to the family Meliaceae. It is an indigenous and multipurpose fast growing tree species, which has a great potential as a plantation species to meet the raw material requirement of the various wood-based industries. The present study was conducted at Zonal Agricultural and Horticultural Research Station, Hiriyur to assess the growth performance of *Melia dubia* planted at a spacing of 4 m × 1 m, 4 m × 2 m and 4 m × 3 m in sole condition without intercrop and with integrating horse gram as intercrop. The experiment was laid out in Randomized Complete Block Design (RCBD) with six treatments and four replications. Tree parameters *viz*., tree height, diameter at breast height (DBH) and crown diameter were recorded and basal area and volume of trees were calculated before sowing as initial readings and after harvest of horse gram as final readings. The study revealed that performance of *Melia dubia* with and without horse gram intercrop was on par and relatively higher in intercropped condition. It was also evident from the present investigation that higher performance of *M. dubia* was recorded under wider spacing of 4 m × 3 m followed by spacing of 4 m × 2 m and least performance was found in the spacing of 4 m × 1 m. In the present study 4 m × 3 m spacing might be most suitable for taking up *M. dubia* based agroforestry in the central dry zone of Karnataka.

Keywords: *Melia dubia*, horsegram, dryland and agroforestry

1. Introduction
Malabar neem (*Melia dubia* Cav.), commonly called as Hebbuvu or Dreak or Gora Neem, is a dry deciduous multipurpose tree belongs to the family Meliaceae. It is indigenous to Western Ghats and Himalayas and grown extensively in upper Assam, West Bengal, Khasi hills of Orissa, Western Ghats and moist deciduous forests of Kerala up to an altitude of 1500-1800 m above mean sea level (Ashok *et al*., 2017) [1]. *Melia dubia* is a light demander and grows to an average height of 35 m and the bark is rough and peeling. Flowering occurs between February–April and fruiting period is usually during November-February in the succeeding year. The fruit is a drupe, ellipsoid in shape with 1-2 seeds, which are black and ovoid with long endocarp (Nair *et al*., 2005) [6]. It is a multipurpose tree species which is extensively used in plywood, package industries, cigar boxes, ceiling planks, construction, agricultural implements, pencils, match boxes, splints, etc. It is utilized for boat outriggers in Sri Lanka. It is also suitable for making musical instruments and tea boxes as it is resistant to termite attack. *Melia dubia* is a fast-growing native tree species with a lot of potential for use as a plantation species to supply the raw materials needed by the many wood-based industries. As a result, this species is being extensively raised by farmers in peninsular India as monoculture plantation. Aiming to address the raw material needs of wood-based sectors, farmers are being encouraged to enhance their economic sustainability in light of the rapid growth. The National Agroforestry Policy (2014) aims to expand the area under agroforestry by introducing fast-growing multifunctional tree species that assist farmers economically and provide a range of ecological services (Dhyani, 2014) [3]. In India, the area under agroforestry is tremendously increased from 4.5 million hectare to 14.5 million hectare in the last two decades. Under such scenario the fast-growing multipurpose tree like *Melia dubia* stands as an option for farmers to incorporate in their fields. Because of the poor productivity and yield as well as the unfavorable climatic circumstances that prevail, farmers in dry zone of Karnataka suffer from economic fragility.

To improve farmers' livelihoods and income, particularly in dry zone of Karnataka, by boosting their extra revenue from tree components and reducing climate change by planting more trees, the present study was carried out to assess the growth performance of *Melia dubia* under different spacing in sole condition without intercrop and with integrating horse gram as intercrop.

2. Materials and Methods

2.1 Site description

The field investigation was carried out at, Zonal Agricultural and Horticultural Research Station (ZAHRS), Hiriyur, Chitradurga district during 2021-2022, Karnataka. The experimental location are situated in central dry zone (Zone-4) of Karnataka and lies in 13°56'57" N and 76°37'13" E at an elevation of 606 m from above Mean Sea Level (MSL). The South-West and North-East monsoons both bring rain to the study region, Hiriyur. In the study region, the average annual rainfall for the past ten years (2012–2021) has been 662.73 mm, with October accounting for a significant amount of that total (295.4 mm). The amount of rainfall in 2021 (953 mm) exceeded the 10-year average (662.73 mm) of annual rainfall during the experimental period. In contrast to the mean temperature of 32.3 and 19.6 °C over the previous ten years, the mean maximum and minimum temperatures for the study period were 31.5 °C and 17.7 °C, respectively. During the experimental period, the rainfall received in 2021 (953 mm) was higher than the 10 years average (662.73 mm) annual rainfall. The mean maximum and minimum temperature during the study period was 31.5 °C and 17.7 °C as compared to 10 years mean (32.3 and 19.6 °C, respectively). During the research period, the annual mean relative humidity observed was 70.5%, which was less than the 10-year normal of 72.80%.

2.2 Details of the experiment

The experiment was carried out in three years old *Melia dubia* planted at a spacing of 4 m × 1 m, 4 m × 2 m and 4 m × 3 m in sole condition without intercrop and with integrating horse gram as intercrop. The experiment was laid out in Randomized Complete Block Design (RCBD) with six treatments and four replications.

2.3 Treatment details

T_1 - 2500 trees ha^{-1} (4 m × 1 m) with horse gram
T_2 - 1250 trees ha^{-1} (4 m × 2 m) with horse gram
T_3 - 833 trees ha^{-1} (4 m × 3 m) with horse gram
T_4 - 2500 trees ha^{-1} (4 m × 1 m) without horse gram
T_5 - 1250 trees ha^{-1} (4 m × 2 m) without horse gram
T_6 - 833 trees ha^{-1} (4 m × 3 m) without horse gram

Tree parameters *viz*., tree height, diameter at breast height (DBH) and crown diameter were recorded and basal area and volume of trees were calculated before sowing of horse gram as initial readings and after harvest of horse gram as final readings. Tree height was measured from ground level to tip of the tree by using measuring pole as per Chaturvedi and Khanna (1982) [2] and expressed in meters (m). The diameter at breast height (DBH) was recorded at 1.37 m with the help of tree caliper as per Chaturvedi and Khanna (1982) [2] and expressed in centimeter (cm). Crown diameter (width) was measured from tree trunk in two (East - West and North - South) directions with the help of properly graduated wooden rod and average was expressed in meters (m) by using the formula.

$$\text{Crown diameter (m)} = \frac{D_1 + D_2}{2}$$

The basal area was determined by adopting the formula suggested by Chaturvedi and Khanna (1982) [2]. The calculated basal was area expressed in m^2 tree^{-1}.

Basal area = $\frac{\pi d^2}{40000}$, Where, d is Diameter at Breast Height (cm)

Total volume of tree was determined by using formula suggested by Chaturvedi and Khanna (1982) [2] and expressed in m^3. The calculated volume expressed in m^3 tree^{-1} and m^3 ha^{-1}. In this study form factor of 0.33 was considered for volume estimation.

Total volume = Total height × Basal area × Form Factor

Relative growth rate for height, diameter at breast height, crown diameter and volume of *Melia dubia* trees were determined by using the formula

$$\text{Relative growth rate (RGR)} = \frac{\text{Final reading} - \text{Initial reading}}{\text{Initial reading}}$$

The Panse and Sukhatme (1978) [8] approach were used to statistically analyze the data collected over the research period using an RCBD design. P = 0.05 was the significance level for the "F" and "t" tests. Whenever the 'F' test was determined to be significant, critical difference values were computed using the SPSS software. An appropriate interpretation of the data was made, and a conclusion was drawn

3. Results and Discussion

Tree growth is essentially a species dependent component that is affected by the agro ecological conditions of the region. The tree productivity or the maximum growth a tree can achieve in a given amount of time is a function of the net rate of photosynthesis. Accordingly spacing and intercrop affect the growth parameters such as tree height, diameter at breast height, crown diameter, basal area and tree volume *etc*., affect the productivity of land.

Diameter at breast height (DBH) of *Melia dubia* before and after the intercropping horse gram varied significantly among treatments. Before intercropping of horse gram, the DBH under different treatments ranged from 6.97 to 9.60 cm. The highest DBH of 9.60 cm was recorded in T_6 (4 m × 3 m) which was superior compared with other treatment combinations (Table 1). Whereas significantly lowest DBH was recorded in T_4 (4 m × 1 m) 6.97 cm. After harvest of horse gram, the DBH ranged from 7.33 to 10.72 cm. The highest DBH of 10.72 cm was recorded in T_6 (4 m × 3 m) which was superior and on par with T_3 (4 m × 3 m) with horse gram (9.86 cm). Next in order was T_5 (4 m × 2 m) without horse gram (9.30 cm) followed by T_2 (4 m × 2 m) with horse gram (9.19 cm) and T_1 (4 m × 1 m) with horse gram (8.15 cm), whereas significantly lowest DBH was recorded in T_4 (4 m × 1 m) without horse gram (7.33 cm) (Table 1). Before intercropping of horse gram, the height of *Melia dubia* under different treatments ranged from 6.56 to 7.94 m. The highest height of 7.94 m was recorded in T_6 (4 m × 3 m) which was superior compared with other treatment combinations (Table 1). Whereas significantly lowest height was recorded in T_4 (4 m × 1 m) 6.56 m. After harvest of horse gram, the height of *Melia dubia* under different treatments ranged from 6.87 to 8.70 m. The highest height of 8.70 m was recorded in T_6 (4 m × 3m) which was superior and on par with T_3 (4 m × 3 m) with horse gram

(8.60 m). Next in order was T_2 (4 m × 2 m) with horse gram (7.83 m) followed by T_5 (4 m × 2 m) without horse gram (7.82 m), T_4 (4 m × 1 m) without horse gram (6.89 m), whereas significantly lowest height was recorded in T_1 (4 m × 1 m) with horse gram (6.87 m) (Table 1).

Crown diameter of *Melia dubia* before and after the intercropping horse gram varied significantly among treatments. Before intercropping of horse gram, the crown diameter of *Melia dubia* under different treatments ranged from 2.63 to 4.03 m. The highest crown diameter of 4.03 m was recorded in T_6 (4 m × 3 m) which was superior compared with other treatment combinations (Table 1). Whereas significantly lowest crown diameter was recorded in T_1 (4 m × 1 m) 2.63 m. After harvest of horse gram, the crown diameter of *Melia dubia* under different treatments ranged from 2.87 to 4.51 m. The highest crown diameter of 4.51 m was recorded in T_6 (4 m × 3 m) which was superior and on par with T_3 (4 m × 3 m) with horse gram (4.20 m). Next in order was T_2 (4 m × 2 m) with horse gram (3.58 m) followed by T_5 (4 m × 2m) without horse gram (3.45 m), T_4 (4 m × 1 m) without horse gram (3.00 m), whereas significantly lowest crown diameter was recorded in T_1 (4 m × 1 m) with horse gram (2.87 m) (Table 1).

Basal area of *Melia dubia* before and after the intercropping horse gram varied significantly among treatments. Before intercropping of horse gram, the basal area of *Melia dubia* under different treatments ranged from 0.004 to 0.008 m^2. The highest basal area of 0.008 m^2 was recorded in T_6 (4 m × 3 m) which was superior compared with other treatment combinations (Table 1). Whereas significantly lowest basal area was recorded in T_4 (4 m × 1 m) 0.004 m^2. After harvest of horse gram, the basal area of *Melia dubia* under different treatments ranged from 0.004 to 0.009 m^2. The highest basal area of 0.009 m^2 was recorded in T_6 (4 m × 3 m) which was superior and on par with T_3 (4 m ×3 m) with horse gram (0.008 m^2). Next in order was T_2 (4 m × 2 m) with horse gram and T_5 (4 m × 2 m) without horse gram with similar basal area of 0.007 m^2 followed by T_1 (4 m × 1 m) with horse gram (0.006 m^2), whereas significantly lowest basal area was recorded in T_4 (4 m × 1 m) without horse gram (0.004 m^2) (Table 1). Volume of *Melia dubia* before and after the intercropping horse gram varied significantly among treatments. Before intercropping of horse gram, the volume of *Melia dubia* under different treatments ranged from 0.008 to 0.020 m^3. The highest volume of 0.020 m^3 was recorded in T_6 (4 m × 3 m) which was superior compared with other treatment combinations (Table 1). Whereas significantly lowest volume was recorded in T_4 (4 m × 1 m) 0.008 m^3. After harvest of horse gram, the volume of *Melia dubia* under different treatments ranged from 0.010 to 0.027 m^3. The highest volume of 0.027 m^3 was recorded in T_6 (4 m × 3 m) which was superior and on par with T_3 (4 m × 3 m) with horse gram (0.022 m^3). Next in order was T_2 (4 m × 2 m) with horse gram and T_5 (4 m × 2 m) without horse gram with similar volume of 0.018 m^3 followed by T_1 (4 m × 1 m) with horse gram (0.013 m^3), whereas significantly lowest volume was recorded in T_4 (4 m × 1 m) without horse gram (0.010 m^3) (Table 1).

Table 1: Growth parameters of *Melia dubia* as influenced by different treatments

Treatment	DBH (cm)		Height (m)		Crown diameter (m)		Basal area (m^2)		Volume (m^3)	
	Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final
T_1 (4 m × 1 m) with horse gram	7.66	8.15	6.58	6.87	2.63	2.87	0.005	0.006	0.011	0.013
T_2 (4 m × 2 m) with horse gram	8.44	9.19	7.30	7.83	3.15	3.58	0.006	0.007	0.014	0.018
T_3 (4 m × 3 m) with horse gram	8.81	9.86	7.91	8.60	3.66	4.20	0.006	0.008	0.016	0.022
T_4 (4 m × 1 m) without horse gram	6.97	7.33	6.56	6.89	2.72	3.00	0.004	0.004	0.008	0.010
T_5 (4 m × 2 m) without horse gram	8.43	9.30	7.29	7.82	2.96	3.45	0.006	0.007	0.014	0.018
T_6 (4 m × 3 m) without horse gram	9.60	10.72	7.94	8.70	4.03	4.51	0.008	0.009	0.020	0.027
S.Em ±	0.43	0.42	0.02	0.02	0.11	0.09	0.001	0.001	0.002	0.002
C. D. (0.05)	1.28	1.27	0.05	0.05	0.32	0.27	0.002	0.002	0.005	0.006

Table 2: Relative growth rate of *Melia dubia* under different treatments

Treatment	RGRD	RGRH	RGRCD	RGRV
T_1 (4 m × 1 m) with horse gram	0.064	0.044	0.090	0.182
T_2 (4 m × 2 m) with horse gram	0.089	0.071	0.139	0.286
T_3 (4 m × 3 m) with horse gram	0.120	0.087	0.149	0.375
T_4 (4 m × 1 m) without horse gram	0.051	0.050	0.105	0.250
T_5 (4 m × 2 m) without horse gram	0.103	0.072	0.166	0.286
T_6 (4 m × 3 m) without horse gram	0.117	0.096	0.120	0.350

RGRD - Relative growth rate of DBH; RGRH - Relative growth rate of height DBH

RGRCD - Relative growth rate of Crown diameter; RGRV - Relative growth rate of volume

Comparatively higher relative growth rate in diameter at breast height was observed in T_3 (4 m × 3 m) with horse gram (0.120) and lower RGR in diameter at breast height was observed in T_1 (4 m × 1 m) with horse gram (0.064). The treatment T_6 (4 m × 3 m) without horse gram attained the higher RGR in height which recorded a value of 0.096 over the least RGR in height (0.044) observed T_1 (4 m × 1 m) with horse gram. Maximum RGR in crown diameter (0.166) was recorded in T_5 (4 m × 2 m) without horse gram and least RGR in crown diameter (0.090) was recorded in T_1 (4 m × 1 m) with horse gram. The treatment T_3 (4 m × 3 m) with horse gram attained the higher RGR in volume which recorded a value of 0.375 over the lower RGR in volume (0.182) observed inT_1 (4 m × 1 m) with horse gram (Table 2). This might be due to effect of various spacing and intercrop cultivation of *Melia dubia* on relative growth rate.

In present study all the growth parameters of *Melia dubia* trees were recorded higher in 4 m × 3 m spacing followed by 4 m × 2 m and lower growth performance was recorded under 4 m × 1 m spacing at before the horse gram intercropping and also after the harvest horse gram, which indicate higher the spacing better the growth performance. This might be due to less competition for various resources in wider spacing compared to closer spacing. As competition for resources with asymmetric distributions develops, the influence of tree position on relative resource acquisition (And relative growth rate) is increased, especially in species like *M. dubia* (Kuppers, 1989) [5]. Similar trend was also found in *M. dubia* by Kirankumar (2015) [4], Pradeep (2015) [9] and Vasudev (2021) [10]. The

mean of DBH, tree height, canopy diameter, basal area and volume of *Melia dubia* trees reveals all these parameters were recorded higher in intercropped conditions as compared to pure stand of *M. dubia* in all three spacing (in absence of horse gram). These results may be attributable to soil management techniques used in intercropping situations that improved root growth conditions by enhancing aeration and reducing soil compaction. Nandal and Kumar (2010) [7] found similar results in *Melia azedarach.*

4. Conclusion

According to the study, *Melia dubia* performed comparably on par with and without horse gram intercropping, However, relatively higher performance was observed in intercropped condition. Thus, integrating intercrops with tree components will have beneficial impact on the growth performance of tree. It was evident from the present investigation that higher performance of *M. dubia* was recorded under wider spacing of 4 m × 3 m followed by spacing of 4 m × 2 m and least performance was found in the spacing of 4 m × 1 m. In the present study 4 m × 3 m spacing might be most suitable for taking up *M. dubia* based agroforestry in the central dry zone of Karnataka.

5. References

1. Ashok K, Savita, Priyanka S, Shruti S, Shivani D, Anchal R, *et al*., Development of high yielding varieties of *Melia dubia* Cav. (Syn. Melia composite Benth.). Ind. For. 2017;143(11):1203-1206.
2. Chaturvedi AN, Khanna LS. Forest Mensuration. Int. Book Distri. Dehra Dun; c1982. p. 406.
3. Dhyani SK. National Agroforestry policy 2014 and the need for area estimation under agroforesry. Current science. 2014;107(1):9-10.
4. Kirankumar GK. Growth and Productivity of *Melia dubia* under different plant densities. M.Sc. (Agri) Thesis, Univ. Agric. Sci., Dharward; c2015.
5. Kuppers M. Ecological significance of above-ground architectural patterns in woody plants: A question of cost-benefit relationships. Trends Ecol. Evol. 1989;4:375-379.
6. Nair KKN, Mohanan C, Mathew G. Plantation technology for selected indigenous trees in the Indian peninsula. Silviculture. 2005;285(3):17-23.
7. Nandal DPS, Kumar R. Influence of *Melia azedarach* based land use systems on economics and reclamation of salt affected soil. Indian J Agrofor. 2010;12(1):23-26.
8. Panse VG, Sukhatme. Statistical methods for agricultural workers 3rd edition. Indian Council of Agricultural Research Publication, New Delhi; c1978. p. 361.
9. Pradeep. Studies on planting geometry of *Melia dubia* and its effect on growth and yield of finger millet in Agroforestry system under rainfed ecosystem. M.Sc. (Agri) Thesis, Univ. Agric. Sci., Bangalore, Karnataka (India); c2015.
10. Vasudev L. Assessment and enhancement of productivity of *Melia dubia* in central dry zone of Karnataka. Ph.D., (Forestry) Thesis, Univ. Agric. Sci., Dharward; c2021.