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ORIGINAL ARTICLE

Growth Performance of *Melia dubia* Cav. varieties under Agroforestry system in Jabalpur district, Madhya Pradesh

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ABSTRACT
Melia dubia commonly known as 'Malabar neem' is a fast growing tree species, naturally distributed mainly in moist deciduous forest of India. Because of its various utilities, research institutes have developed varieties and clones for uniform growth and higher productivity. The present study was conducted at Tropical Forest Research Institute, Jabalpur during 2019-21, aimed to evaluate growth performance of M. dubia varieties under Agroforestry system with Cajanus cajan as an intercrop. Study revealed that, growth performance of M. dubia (sole plantation) showed maximum height increment in Amar var. (T_4 - 317.33 cm) followed by Kartik var. (T_3 - 200.00 cm), Bahumukhi var. (T_2 - 169.33 cm) while minimum height increment was found in Varsha var. (T_5 - 77.83 cm), similarly under Agroforestry system maximum height increment was found in Amar var. (T_4 - 325.33 cm) followed by Kartik var. (T_3 - 210.00 cm), and Kshitiz var. (T_7 - 162.33 cm) and, the minimum height increment was found in Bahumukhi var. (T_6 - 91.67 cm) and the grain yield of C. cajan was 0.616 t ha^{-1} in intercropping as compared to sole crop (1.51 t ha^{-1}).
Keywords- *Melia dubia, Agroforestry system, Growth performance, Variety, Cajanus cajan*

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INTRODUCTION

Melia dubia Cav. is one of the fast growing tree species commonly known as 'Malabar neem' belongs to family Meliaceae, distributed in moist deciduous forest of Indian states of Tamil Nadu [16], Karnataka and Kerala, [15] etc. *M. dubia* found to be an alternative raw material for pulp and paper industries due to its increased pulp recovery and special vigor of paper [16]. Apart from this, *M. dubia* having mechanical properties, suitable for plywood industry and dendro energy values required for biomass based power generation [20]. Besides an important industrial tree species, it has also having ecological importance like soil enrichment, afforestation and bioremediation [15] and medicinal uses [13 & 23]. It is also verified to be the most attuned agroforestry tree species, compatible with different underneath crops [9] with no allelopathic effect on intercrops [11]. Due to its multiple uses in plywood, pulp wood and other wood based industry and cottage industries along with its fast growth and adaptability to varied agro-climatic conditions of the country, *M. dubia* is also known as the money spinning tree of short rotation [7]. In the first year of plantation green gram, black gram, chilli and turmeric can be successfully raised as intercrop, intercropping with leguminous crop will also enhance the soil nutrient status, the side suckers of *Melia* can be used as Raton crop after harvesting at 5 years of age [6].

Agroforestry is any sustainable land-use system that maintains or increases total yield by combining food crops (annuals) with tree crops (perennials) and/or livestock on the same unit of land, either alternately or at the same time using management practices that suit the social and cultural characteristics of the local people and the economic and ecological conditions of the area [19].

[22], conducted study to evaluate the performance of *M. dubia* with *Cymbopogon* based Agroforestry system and found maximum height of 3.4 m and diameter of 4.06 cm in sole plantation of *M. dubia* planted at 4m x 4m spacing and there was significant effect of *Cymbopogon* spp. on height of *M. dubia.*

[3,9 & 14] reported that *M. dubia* based Agroforestry systems are profitable than that of monocropping systems. Despite the fact that it is being widely adopted as tree component in different types of Agroforestry systems, the effect on growth due to intercropping of underneath crop is still need to be explored in various varieties of *M. dubia* .

Since last decade, India's import of wood logs has substantially increased from 853.36 m^3 to 5530.71 m^3 and sawn wood from 9.14 m^3 to 173.10 m^3 [2]. It is therefore amply important that dependence on wood supplied from natural forests as well as imports is reduced substantially by planting genetically improved planting stocks.

The requirement of wood products has been estimated to about 344 million tons of fuel wood and charcoal, 37 million m^3 of industrial wood, 33 million m^3 sawn timbers, 5.7 million m^3 pulp and paper wood and 1.3 million tones of wood based panels [1 & 12]. The demand is expected to grow further, and therefore short rotation forest tree species like *Melia* and *Eucalyptus* would play an important role in bridging gap between ever increasing demand and supply.

India is under tremendous pressure to meet growing demand for wood and wood products, there is an urgent need to search for alternate species which are required to be evaluated and recommended for commercial cultivation. It is also not out of context to mention that indigenous species would always have better advantages than that of exotics. *Melia dubia* Cav. is one such alternate species with immense potential under ply, timber and pulp industries.

With these aim, Forest Research Institute, Dehradun had worked on its improvement and released genetically improved ten varieties of *M.dubia* which are suitable for Punjab,Haryana and Uttarakhand states and further needs to replicate or domesticate in other regions of India for its suitability .

Hence, present study was undertaken with the hypothesis, how growth of various varieties of *M. dubia* performs under different landuse system as well as in tropical condition of Madhya Pradesh and testing its suitability on different site conditions also.

MATERIAL AND METHODS

The experiment was carried out in the AF demonstration plot at Tropical Forest Research Institute, Jabalpur (M.P.). The study area lies between 23° 6' 0.32" N latitude and 79° 59' 17.72" E longitude. Annual rainfall varies from 1000 mm to 1600 mm, and temperature varies from 7.5°C to 8°C minimum and 35.5°C to 42.5°C maximum. The soil type was sandy loam with pH values ranges from 6.0 to 8.0. One year old Quality Planting material of 7 varieties named Sharad, Bahumukhi, Kartik, Amar, Varsha, Shashi and Kshitiz and these varities were developed by FRI and transported from FRI, Dehradun, UK of *M.dubia* was planted at 3 x 4 m spacing in Randomized Block Design with three replications in 7 treatments viz., T_1= *M. dubia* Sharad var., T_2= *M. dubia* Bahumukhi var., T_3= *M. dubia* Kartik var., T_4= *M. dubia* Amar var., T_5= *M. dubia* Varsha var., T_6= *M. dubia* Shashi var. and T_7= *M. dubia* Kshitiz var. These varieties were procured from Forest Research Institute, Dehradun. The planting was done during July, 2019 and seeds of agriculture crop i.e. *Cajanus cajan* (Arhar) cv Durga was sown in the interspaces of the plantation during kharif season of 2020 at spacing of 60 x 30 cm as an agroforestry component as well as sole crop of *M. dubia.*

The study was initiated during 2019-20 and recorded the growth data of *M. dubia* on annually for two years to evaluate the performance of these seven varieties under agroforestry system and the same was compared with sole Melia. The collected data was tabulated and analysed statistically through ANOVA test and the results are presented for discussion [21]

RESULTS AND DISCUSSION:

Growth performance of *M.dubia* varieties

The growth data (Height) was recorded on annual basis and presented in the Table (1 and 2) and Fig. (2 and 3)., The growth data revealed that, *M. dubia* (sole plantation) showed maximum height increment of 317.33 cm in T_4 Amar var. (317.33 cm) followed by T_3 i.e. Kartik var. (200.00 cm), T_2 i.e. Bahumukhi var. (169.33 cm). The minimum height increment was found in T_5 i.e. Varsha var. (77.83 cm). The sequence for height of *M. dubia* in sole plantation was T_4> T_3> T_2> T_7> T_1> T_6> T_5.

Similarly, Table- 2 and Fig.- 3 depicts the growth performance of *M. dubia* under *C. cajan* based agroforestry system, and found that, maximum height increment in T_4 i.e. Amar var. (325.33 cm) followed by T_3 i.e. Kartik var. (210.00 cm), T_7 i.e. Kshitiz var. (162.33 cm). The minimum height increment was found in T_6 i.e. Shashi var. (91.67 cm). The sequence of height of *M. dubia* in Agroforestry was T_4> T_3> T_7> T_2> T_1> T_5> T_6.

Yield (t ha^{-1}) of Agri-crop

Under the established *Melia* based AFS, 0.616 t ha^{-1} was obtained from the Melia with intercrop compared with 1.51 t ha^{-1} in sole cropping of *C. cajan.*

The result also revealed that the yield of *C. cajan* was reduced under intercrop as compared to pure *C. cajan* while the height of *M. dubia* were improved in intercropping as compared to sole cropping. Similar results were reported by [4], in a study *M.dubia* based agroforestry system and found growth of *M. dubia* (10months old) was highest when intercropped with blackgram and lowest in sesame.

Table- 1: Growth performance of 7 varieties of *M. dubia* in Sole plantation from 2019 - 2021.

Treatments	Mean Height (cm) (Sole crop)			Height increment after two years (cm)
	Planting time (2019)	First year (2020)	Second year (2021)	
T_1 (Sharad var.)	101.00	118.71	185.67	84.67
T_2 (Bahumukhi var.)	124.67	143.65	294.00	169.33
T_3 (Kartik var.)	118.33	132.01	318.33	200.00
T_4 (Amar var.)	122.00	149.43	439.33	317.33
T_5 (Varsha var.)	107.83	135.44	185.67	77.83
T_6 (Shashi var.)	125.67	141.00	209.67	84.00
T_7 (Kshitiz var.)	129.97	147.00	288.67	158.70
SEm (±)	3.84	2.68	4.11	
CD (0.05)	11.95	8.34	12.79	
CV (%)	5.61	3.36	2.59	

Note: CD at 5% level of significance

Table- 2: Growth performance of 7 varieties of *M. dubia* under Agroforestry system from 2019-2021.

Treatments	Mean Height (cm) (Sole crop)			Height increment after two years (cm)
	Planting time (2019)	First year (2020)	Second year (2021)	
T_1 (Sharad var.)	102.00	120.49	209.33	107.33
T_2 (Bahumukhi var.)	123.67	145.33	261.67	138.00
T_3 (Kartik var.)	104.00	113.98	314.00	210.00
T_4 (Amar var.)	120.00	144.00	445.33	325.33
T_5 (Varsha var.)	103.19	131.78	204.00	100.81
T_6 (Shashi var.)	124.00	131.37	215.67	91.67
T_7 (Kshitiz var.)	126.67	157.00	289.00	162.33
SEm (±)	2.57	5.39	11.48	
CD (0.05)	8.01	16.79	35.77	
CV (%)	3.88	6.92	7.18	

Note: CD at 5% level of significance

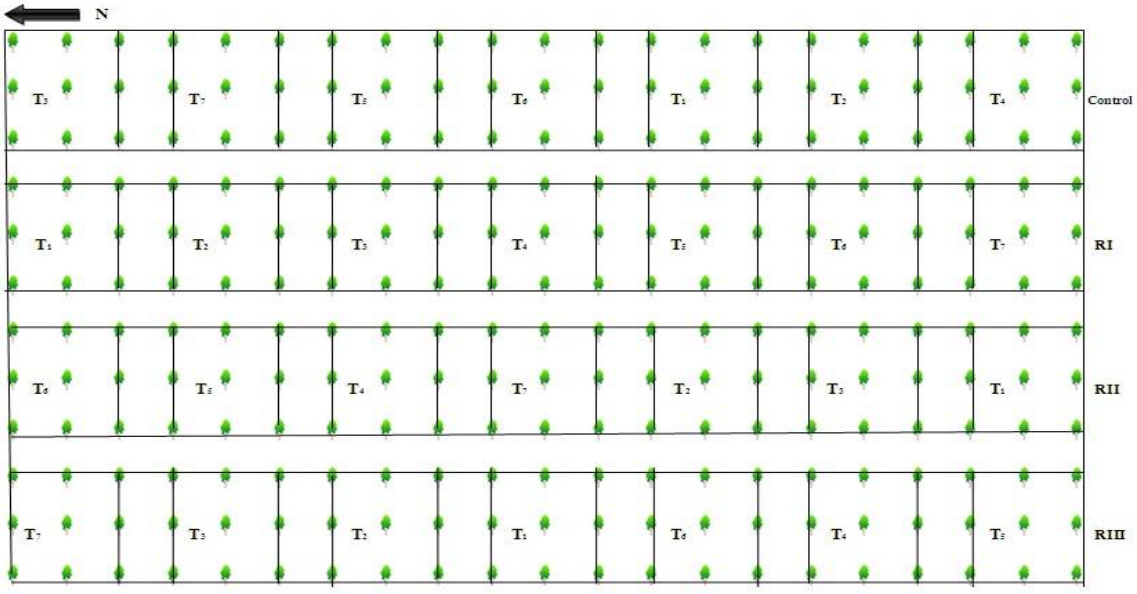

Fig.-1: Layout of demonstration plot of varietal trial of *M. dubia* at TFRI experimental area.

Height Increment of *M.dubia* varieties

The result showed that the height increment in Amar var. was maximum while minimum in Bahumukhi var. in sole and similarly, height increment was maximum in Amar var. while minimum in Shashi var. in Agroforestry system. Results also revealed that on an average growth performance of *M. dubia* was almost certainly significant in both sole as well as in Agroforestry system. Similar findings were reported by [22, 17 & 10].

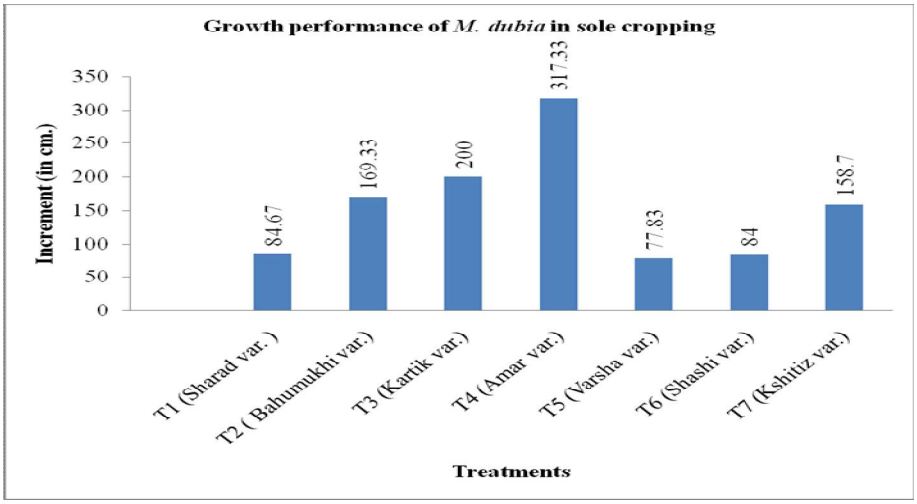

Fig.-2: Increment of *M. dubia* in sole cropping during year 2019 - 21

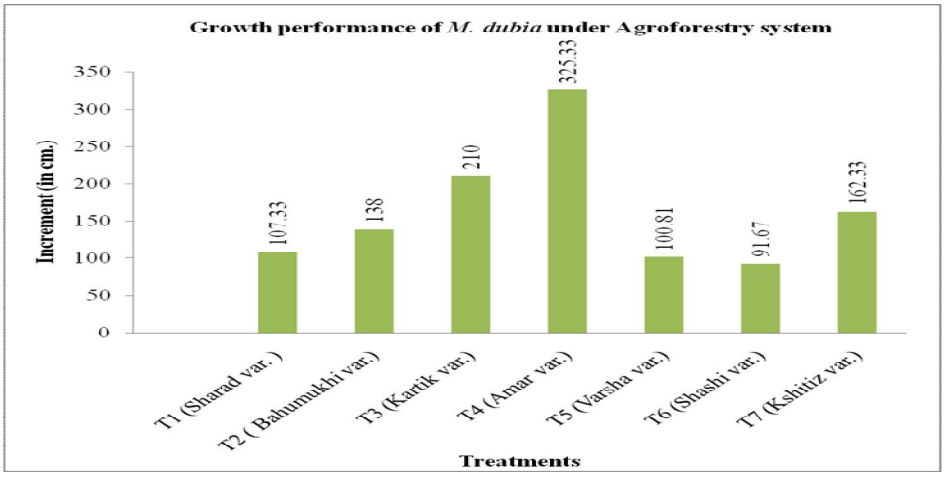

Fig.-3: Increment of *M. dubia* under Agroforestry system during year 2019 - 21.

The growth rate of *M. dubia* is also very good and is 41.54 cubic m ha^{-1} $year^{-1}$ which is better than Eucalyptus and Poplar trees [20]. Also farmers can earn extra income if they plants *M. dubia* trees for 13 - 14 years in their farms bunds (150-170 tree ha^{-1}), they can yield upto Rs. 12,000 to Rs. 15,000 per tree [5] apart from their income from agriculture crops. *Melia* yielded with a minimum value of Rs 1.20 lakhs to Rs 1.50 lakhs per tree from 13-14 years trees [5].

The average market value of timber is Rs. 280 per cu ft and average value per tree having height < 8.5 m is Rs. 4200/-, if the plantation is maintained for 30 years the log value will increased to Rs. 650/- per cu ft as the utility value of wood increased and the log used as veneer for plywood industries [18].

CONCLUSION

Seven varieties of *M. dubia* were tried to assess their suitability in tropical condition of Jabalpur district of Madhya Pradesh and found that the varieties performed significantly at par under monoculture as well as in intercropping. The results showed that out of seven varieties, Amar var. performed best in both the landuse systems. The growth of different plants significantly better under intercropping. It was also noticed that maximum increment was recorded when intercropped. So, based on study, it is concluded that *M. dubia's* varieties like Amar, Kartik, Kshitiz and Bahumukhi cv is recommended for commercial

plantation either on field bunds or as block plantation to get additional income within short rotation period of 6 years along with grain crops in Central India.

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