International Journal of Agricultural and Applied Sciences, December 2024, 5(2): 11-15
https://www.agetds.com/ijaas
ISSN: 2582-8053
https://doi.org/10.52804/ijaas2024.522

Research Article

OPEN ACCESS

Suitability of *Melia dubia* Based Agroforestry in Eastern Uttar Pradesh, India

Anubha Srivastav[1], Devendra Kumar[2] and Pritam Kumar Barman[1]
[1]*ICFRE-Eco-rehabilitation Centre, Prayagraj, Uttar Pradesh (211002), India*
[2]*ICFRE-Forest Research Institute, Dehradun, Uttarakhand, India*
**Corresponding author e-mail: anubhasri_csfer@icfre.org*
(Received: 20/07/2024; Revised: 10/09/2024; Accepted: 30/10/2024; Published: 10/12/2024)

ABSTRACT
Agroforestry is being promoted commercially due to the growing need for wood and wood products. However, the progress made in structured agroforestry promotion is limited due to the lack of suitable fast-growing species with improved productivity. *Melia dubia* has been identified as a promising fast-growing tree species that can be incorporated into different agroforestry systems under appropriate circumstances. Given the wide demand for this species, a demonstration plot of *Melia dubia* with intercrops (paddy, wheat and maize) was established at a spacing of 5 m × 5 m, 4 m × 5 m and 4 m × 4 m in the Karchana block of Prayagraj district in Uttar Pradesh in the year 2023. The annual assessment of early growth performance of *Melia dubia* trees after one year depicted that *height increment was in* the *range of 6.54–7.02 m and* girth at breast height (GBH) *increment was* in between 13.06–13.86cm respectively for T_1 (tree + agriculture), T_2 (sole trees), T_3 (tree + agriculture), T_4 (sole trees), T_5 (tree + agriculture), T_6 (sole trees), T_7 (sole agriculture). The growth performance of trees was inferior in control plots (without intercrop) as compared to intercropped plots. The agriculture crops yield for the paddy, wheat and maize crops were 37.8-38.3 qt/ha, 32.9-33.5 qt/ha and 18.7-19.6 qt/ha respectively. There was no substantial difference in agricultural crop yield after one year of tree planting. *Melia dubia* tree typically yields four quintals of wood after harvesting for five years. The present market value of a *Melia dubia* tree is Rs. 0.03-0.04 lakh. Thus, on average, from 400 trees at a spacing of 5 m x5 m, Rs. 14.0 lakh may be gained per hectare after 5-6 years. Thus, the agroforestry system based on *Melia dubia* is a good choice of species for farmers of eastern Uttar Pradesh.
Keywords: *Melia dubia*, agroforestry, intercrops, growth performance, economics of tree.

INTRODUCTION

Agroforestry is an effective approach to addressing environmental concerns and meeting the needs of a rapidly growing human population in a sustainable manner. Sustainability depends on fertile soils, which can be effectively preserved and improved through agroforestry practices. Including trees on agricultural lands can help address various agricultural issues such as sustainable biological production, deforestation, declining soil fertility, droughts and excessive use of harmful chemicals (Arya *et al.,* 2018). Trees in agroforestry systems contribute to improved soil organic matter, nitrogen retention, water-holding capacity and soil infiltration rates. They also aid in preserving soil fertility through nitrogen fixation and the return of organic matter through leaf fall (Rosenstock *et al.,* 2014). Agroforestry is a highly sustainable agricultural practice that not only fulfils our basic needs for food, fuel and fodder but also contributes to the creation of healthier ecosystems for all living beings. Agroforestry is a low-input system that involves integrating trees with crops in different combinations or sequences (Upadhyay *et al.,* 2021). Therefore, researchers, policymakers and others in India have been focusing on agroforestry because of its perceived potential to significantly boost economic growth, reduce poverty, improve the environment and preserve biological diversity. Thus, agroforestry is a crucial tool for integrated and sustainable development (Pal *et al.,* 2011).

In addition to helping to improve soil quality, increase farm earnings, reduce deforestation, and act as carbon sinks, agroforestry systems also benefit food security (Nanda *et al.,* 2021). Asia has seen a sharp rise in the amount of agroforestry-related research; India and China, with their supportive institutions and policies, are hotspots for agroforestry studies, which may have contributed to both nations' increased forest cover shares worldwide (Shin *et al.,* 2020). Traditional agroforestry practices promote species diversity and demonstrate biodiversity reserves that require more investigation and management (Saikia *et al.,* 2017). Agroforestry practices have demonstrated great potential in the current climate change scenario as an approach to reducing the negative impacts of the phenomenon.

Among the most significant problems facing farmers nowadays is a yearly income decline per acre compared to a sudden increase in the value of agricultural land. Planting specific tree kinds, like *Melia dubia*, which are highly valued in the market, have a guaranteed repurchase and require minimal maintenance, can be beneficial in this regard. Furthermore, the trees benefit the plant by limiting the increase in temperature and regulating the release of gases into the atmosphere. *Melia dubia* is a fast-growing, native, multipurpose tree species with significant economic value. At a young stage, it develops quickly in the damp deciduous forest and is a moderately light demander (Kumar *et al.*, 2013). In comparison to traditional *Eucalyptus* species, new and alternative industrial wood species like *Melia dubia*, *Dalbergia sisso* and *Leucaena leucocephala* have been identified as superior sources of pulp wood. These species were developed by Tamil Nadu Agricultural University (TNAU) under National Agricultural Innovation Project (NAIP) on industrial agroforestry (Ramasamy, 2014). To investigate the suitability of *Melia dubia* tree in various cropping systems and promote this agroforestry system through farmer's participation, a demonstration plot was established on a farmer's field in Trans-Yamuna region of Prayagraj, Uttar Pradesh.

MATERIALS AND METHODS

Study area description

Prayagraj, which was formerly known as Allahabad, is among India's oldest cities located at the confluence of the Ganga, Yamuna and Saraswati rivers. The city is situated in the southern region of Uttar Pradesh, spanning over an area of 5482 square kilometres, lying between 24°50′ and 25°40′ North latitudes and 81° 30′ to 82°20′ East longitudes, with an elevation of 322 feet (98 meters). The climate of Prayagraj is temperate. On average, Prayagraj receives 928.79 millimetres of rainfall annually. There are twenty-three development blocks and seven tehsils in the district (Fig. 1).

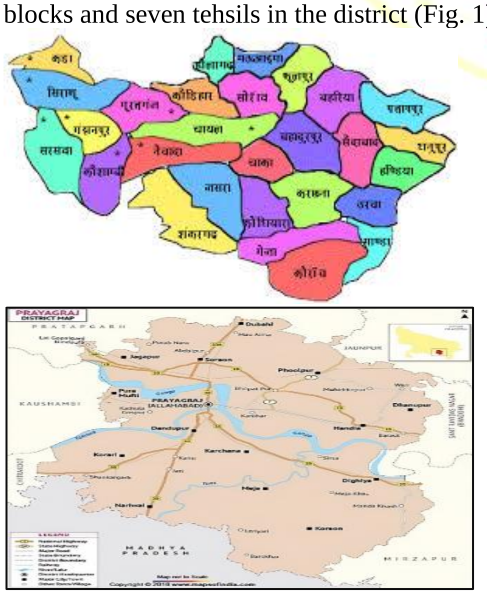

Fig. 1: Maps of Prayagraj district

Establishment of experimental trial

A demonstration plot of *Melia dubia* (Dev variety) was established in the Karchana block of Prayagraj district in the year 2023. The trial consisted of three replications with a spacing of 5 m × 5 m, 4 m × 5 m and 4 m × 4 m respectively (Table. 1 & Fig. 2) and was carried out under a randomized block design (RBD). At the beginning of the monsoon season, a mixture of 100 grams of NPK (3:2:1) fertilizer and 1.0 kilogram of farmyard manure (FYM) was applied to each plant to aid in growth establishment. Irrigation was carried out once a week during hot summer months and twice a month during other times. The growth parameters, including height and gbh were measured annually to calculate the increment.

Table 1. Details of treatments used for the study

Treatment No.	Treatments
T_1	Tree (5 m × 5 m) + Agriculture
T_2	Tree (5 m × 5 m) sole
T_3	Tree (4 m × 5 m) + Agriculture
T_4	Tree (4 m × 5 m) sole
T_5	Tree (4 m × 4 m) + Agriculture
T_6	Tree (4 m × 4 m) sole
T_7	Agriculture sole

Fig. 2. Intercropping of *Melia dubia* with Maize

Data analysis

RBD and the traditional Analysis of Variance (ANOVA) method were used for the statistical analysis of the data. The statistical analysis was carried out using the OPSTAT data analysis tool package, which was developed by the Statistical Software Package for Agricultural Research Workers, CCS HAU, Hisar, Haryana (Sheoran *et al.*, 1998).

RESULTS AND DISCUSSIONS

The research was conducted in the Karchana block of Prayagraj district in 2023-24, focusing on farmers' fields. One-year-old *Melia dubia* plantation was taken into account for the study. Observations on the height and gbh of the *Melia dubia* plants were made at the time of plantation and one year of age. The plant height ranged from 0.26 to 0.35 m at the initial stage and from 6.54 to 7.02 m at one year, indicating rapid growth. The plant gbh ranged from 0.3 to 0.45cm at the initial stage and at one year, gbh ranged from 13.06 to 13.86 cm, showing increase in stem girth.

After a year of planting, it was found that T_1 (tree + agriculture) had the highest increment in girth (13.86 cm), followed by other varieties, with T_6 (control) having the lowest value (13.06 cm). Based on the statistics on height, treatment T_1 performed better than other treatments, followed by T_3 and T_5, while treatment T_6 has the lowest values. After a year of planting, T_1 performed well based on trends in both height and girth data (Table 2 & Fig. 3).

Table 2. Growth performance of *Melia dubia* after one year

Treatments	Height increment (m)	Girth increment (cm)
T_1	7.02	13.86
T_2	6.56	13.39
T_3	6.79	13.75
T_4	6.69	13.31
T_5	6.71	13.47
T_6	6.54	13.06
CD (5%)	N/A	0.34
SE(m)	0.097	0.107
SE(m)	0.138	0.151
C. V.	2.507	1.371

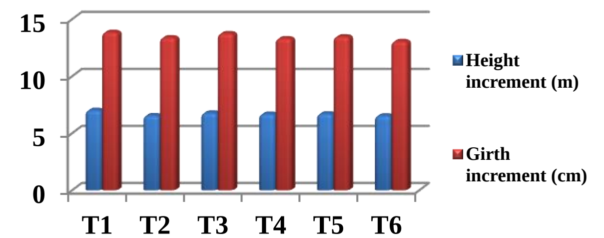

Figure 3. Growth performance (height & girth) of *Melia dubia* after one year

Intercropping yield

The results of the intercropping of paddy in T_1 (*Melia dubia*-based agroforestry) showed highest crop yield of 37.8qt/ha, whereas T_7 (sole agriculture) recorded higher with 38.3 qt/ha (Table 3 and Fig. 4).

Table 3. Paddy yield (qt/ha)

Treatments	Paddy yield (qt/ha)
T_1	37.8
T_3	37.5
T_5	36.7
T_7	38.3

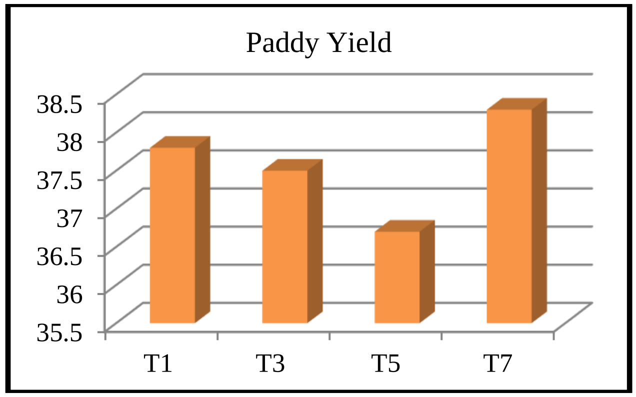

Fig. 4. Paddy yield (qt/ha)

The results of the intercropping of paddy in T_1 (*Melia dubia* based agroforestry) showed the highest crop yield of 32.9 qt/ha, whereas T_7 (sole agriculture) recorded higher with 33.5 qt/ha (Table 4 and Fig. 5).

Table 4. Wheat yield (qt/ha)

Treatments	Wheat yield (qt/ha)
T_1	32.9
T_3	32.6
T_5	31.8
T_7	33.5

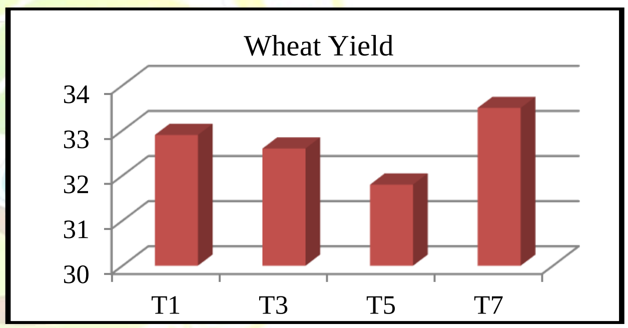

Fig. 5. Wheat yield (qt/ha)

The results of the intercropping of paddy in T_1 (*Melia dubia* based agroforestry) showed highest crop yield of 18.7 qt/ha, whereas T_7 (sole agriculture) recorded higher with 19.6 qt/ha (Table 5 and Fig. 6).

Table 5. Maize yield (qt/ha)

Treatments	Maize yield (qt/ha)
T_1	18.7
T_3	18.4
T_5	18.2
T_7	19.6

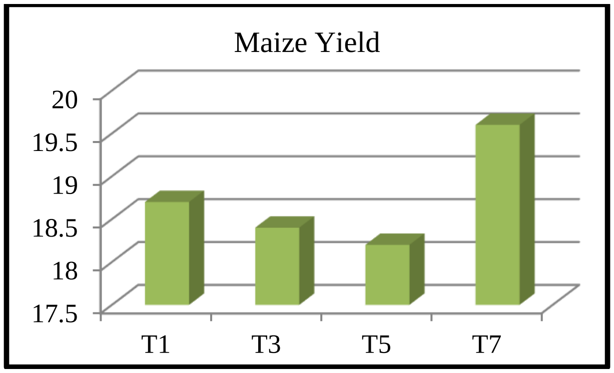

Fig. 6. Maize yield (qt/ha)

The benefits of planting *Melia dubia* in an agroforestry system have been reported by Dhiman and Gandhi (2017) and Goswami *et al.*, (2020). Kulkarni (2017) also reported that *Melia dubia* did not have any negative effects on the growth and yield of crops in the agroforestry system. Narender *et al.*, (2023) found that in intercropped conditions, the tree parameters of *Melia dubia*, such as tree diameter at breast height (DBH), tree height and canopy spread, were higher than those without intercrops. Trees with intercrops exhibited more canopy spread, tree height and DBH (6.9 m, 16.3 m and 56.6 m) compared to pure stands (6.6 m, 16.2 m and 55.6 m) of *Melia dubia* trees. Ajaykumar *et al.*, (2022) studied intercropping with *Melia dubia* in three different spacings: S_1 (3 m × 1.5 m), S_2 (3 m × 3 m) and S_3 (4 m × 4 m), while S_0 represented open field (sole crop) for both seasons. They found that wider spacing of S_3 (4 m × 4 m) could be recommended for intercropping under *Melia dubia* plantations for up to 4 years. In comparison to other medicinal agroforestry systems, Meshram *et al.*, (2024) reported that the *Melia dubia* + *Clerodendrum phlomidis* agroforestry system had the highest overall gross returns, net returns and benefit-cost ratio. To support farmers, the marketing of end products should be strengthened through collaboration with project planners and wood-based industries (Srivastav *et al.*, 2019).

CONCLUSION

Melia dubia did not adversely affect the growth of trees and yield of crops grown in the agroforestry system. Based on the results of the current study, it can be concluded that sole agriculture performed a little superior than the intercrops, but in view of anticipation of sale of trees and intercrops after harvesting period may definitely give more returns compared to sole crop system to agroforestry system, as from sale of a *Melia dubia* tree, Rs. 0.03-0.04 lakh or from 400 trees per ha at a spacing of 5 m × 5 m, Rs.14.0 lakh may be gained. The successful implementation of *Melia dubia* based agroforestry systems can bring multiple benefits for farmers and the environment. These systems can generate additional income through diverse revenue streams while also improving soil health and productivity. By integrating *Melia dubia* into their practices, farmers can achieve sustainable land management, increase crop yields and contribute to environmental conservation efforts. Future research and development efforts should be prioritized for optimizing cultivation practices, enhancing genetic varieties and exploring new applications of *Melia dubia*. By unlocking its full potential, *Melia dubia* can play an important role in advancing agroforestry as a viable solution for sustainable development and mitigating the impacts of climate change.

CONFLICT OF INTEREST

The author here declares that there is no conflict of interest in the publication of this article.

ACKNOWLEDGMENT

The authors are grateful to the Compensatory Afforestation Fund Management and Planning Authority (CAMPA) scheme of MoEFCC, New Delhi for providing financial assistance to carry out this research work.

REFERENCES

Ajaykumar, R., Prabakaran, P., and Sivasabari, K. 2022. Growth and Yield Performance of Black Gram (*Vigna mungo* L.) under Malabar Neem (*Melia dubia*) Plantations in Western Zone of Tamil Nadu. *Legume Research*. **45**(2): 182-188.

Arya, S., Toky, O., P., and Singh, K. 2018. Mitigation of climate changes through agroforestry for sustainable agriculture in India. *Journal of Agrometeorology*, **20**: 172-177.

Dhiman, R. and Gandhi, J. 2017. Comparative performance of Poplar, Melia and Eucalyptus based agroforestry systems. *Indian Journal of Agroforestry*, **19**(2): 1-7.

Goswami, M., Bhagta, S., and Sharma, D. 2020. *Melia dubia* and its Importance: A Review, *International Journal of Economic Plants*, 7(1): 029-033.

Kulkarni, S. 2017. Suitability study on *Melia Dubia* based Agroforestry System in North Karnataka. *Bulletin of Environment, Pharmacology and Life Sciences*, **6**(12): 49-52.

Kumar, P., Parthiban, K., T., and Saravanan, V. 2013. Genetic Variations among Open Pollinated Families of Selected Better Trees in *Melia dubia*. *Research Journal of Recent Sciences*, **2**:189-194.

Meshram, N., Desai, S., Sawant, S., and Dalvi, V. 2024. Doubling the farmer's income through *Melia dubia* based medicinal agroforestry system in Konkan region of Maharashtra. *Indian Journal of Agroforestry*, **26**(1). 47-52.

Nanda, K., Arya, S., Kaushik, N., Beniwal, R., S., and Kumar, A. 2021. Agroforestry in semi-arid regions of North-western India with *Melia dubia*. Recent advances in *Melia dubia* Cav. ISBN: 978-81-943323-5-0: 267-272.

Narender, Arya, S., Nanda, K., Yadav, S., Singh, T., and Ranawat, J., S. 2023. The potential of *Melia* *dubia*-wheat based agroforestry system to cope up with climate change. *Environment Conservation Journal*, **24**(2): 162-169.

Pal, R., S., Hymavathi, H., N., and Kakker, R. 2011. Agroforestry: Sustainability Issues and FutureProspects, *My Forest*, **47**(4): 273-284.

Ramasamy, K. 2014. Industrial Agroforestry: a successful value chain approach in Tamil Nadu. *Indian Farming*, **63**(11): 30-32.

Rosenstock, T., S., Tully, K., L., Arias-Navarro, C., Neufeldt, H., Butterbach-Bahl, K., and Verchot, L., V. 2014. Agroforestry with N2-fixing trees: sustainable development's friend or foe? *Current Opinion in Environmental Sustainability*, **6**: 15–21.

Saikia, P., Kumar, A., and Khan, M., L. 2017. Agroforestry: A sustainable land use system for livelihood security and climate change mitigation. Climate Change and Agroforestry: Adaptation, Mitigation and Livelihood security. New Delhi, India, *New India Publishing Agency*: 61-70.

Sheoran, O., P., Tonk, D., S., Kaushik, L., S., Hasija, R., C., and Pannu, R., S. 1998. Statistical Software Package for Agricultural Research Workers. Recent Advances in Information Theory, Statistics & Computer Applications (eds. D.S. Hooda and R.C. Hasija). Department of Mathematics Statistics, CCS HAU, Hisar: 139-143.

Shin, S., Soe, K., T., Lee, H., Kim, T., H., Lee, S., and Park, M., S. 2020. A systematic map of agroforestry research focusing on ecosystem services in the Asia-Pacific Region. *Forests*, **11**(4): 368.

Srivastav, A., Tomar, A., and Shukla, H., O. 2019. Status of agroforestry practices in Varanasi district of Eastern plain region of Uttar Pradesh, India. *International Journal of Forestry and Crop Improvement*, **10**(1): 1-8.

Upadhyaya. K., Ram, A., Dev, I., Kumar, N., Upadhyay, S., Gautam, K. and Arunachalam, A. 2021. Above and belowground interactions in teak-barley agroforestry system in the Bundelkhand region of Central India, *Indian Journal of Agroforestry*, **23**(1): 1-7.

Citation: Srivastav Anubha; Kumar Devendra and Barman Pritam Kumar 2024. Suitability of *Melia dubia* Based Agroforestry in Eastern Uttar Pradesh, India. *International Journal of Agricultural and Applied Sciences*, 5(2): 11-15.