



***Melia dubia*: A Promising Agroforestry Tree in India**

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INTRODUCTION

Agroforestry is a method of land use that involves intentionally incorporating woody perennial plants alongside agricultural crops and/or animals in a certain spatial arrangement or temporal sequence. Agroforestry systems involve ecological and economic interactions among different components. This system integrates the production of several outputs while safeguarding the resource base. It focuses on utilizing multiple native trees, especially in low-input and delicate situations, and involves the interaction of socio-cultural values more than many other land-use systems.

India's current raw material production for pulp and paper is 2.76 million tonnes, while the demand is 5.04 million tonnes, resulting in a 45% shortage. Wood-based companies have had to become self-sufficient in sourcing their own raw materials due to insufficient resources and strict forest regulations. Paper businesses have created farm and agroforestry plantations using contract farming. *Eucalyptus spp.* and *Casuarina spp.* are the primary tree species utilized as raw material for pulp and paper production. Poor production and an increase in pests and diseases are the constraints in these two tree species. *Melia dubia* is now being considered as a substitute raw material for the pulp and paper sectors because of its enhanced pulp recovery and outstanding paper strength.

Malabar neem, scientifically known as *Melia dubia*, is a rapidly growing tree species valued for its high-quality timber and fuelwood characteristics. Wood is mostly utilized in plywood industries, matchbox production, packaging materials, musical instrument crafting, and furniture manufacturing.

Melia has been evaluated as a potential tree species for pulpwood production. It is well-suited for agroforestry with a life cycle ranging from 8 to 12 years. The Malabar neem is becoming increasingly popular in both local and global markets due to its economic significance and unique tree characteristics, such as fast growth, straight stems with minimal branching, and low shade impact. The species requires minimal upkeep, providing a reliable income while also aiding in carbon sequestration and mitigating the effects of climate change. Intercrops can be successfully grown in block plantations of Melia for the first several years depending on the canopy coverage and closure. Identifying appropriate intercrops for block plants is crucial for promoting the Melia-based agroforestry system.

Botanical Characters: The tree is deciduous to semi-evergreen, reaching heights of up to 25 meters, with broad spreading branches and attractive leaves. The bark is dark brown, fibrous, and peels off in large rectangular pieces. It thrives in deciduous forests and rural areas, including wastelands. The leaves are compound, containing essential oils, and are bipinnate to tripinnate. They are arranged alternately on the stem, with a terete rachis up to 30 cm long. The petiole measures 0.3-1.2 cm, with 3-8 pairs of pinnae and 2-11 leaflets on each pinnate. The leaflets are opposite, ovate or elliptic, with an acuminate apex and cuneate or attenuate base. They are asymmetric with a crenate margin, coriaceous texture, and become glabrous when mature. The midrib is raised above, with 10 pairs of

gradually curved secondary nerves and broadly reticulate tertiary nerves. The inflorescence is an auxiliary panicle, measuring 12-20 cm in length. The flowers are small, greenish white, and emit a honey aroma. They appear in bunches alongside new leaves from January to March. The fruit is a drupe that is ovoid or ellipsoid in shape, with longitudinal ridges. It becomes pulpy and yellowish when ripe, emitting a fragrant fragrance. Each fruit contains 3-4 seeds. Fruits possess a tough endocarp. Thus, germination is fairly challenging.

Distribution: Melia is native to the Western Ghats in Southern India and is frequently found in moist deciduous forests in Kerala. It is found in the Sikkim Himalayas, North Bengal, higher Assam, Khasi hills of Orissa, Deccan Plateau, and Western Ghats at elevations ranging from 1500 to 1800 meters. It grows quickly and is utilized for reforestation.

Silvicultural Characters: The shade temperature in Melia's native habitat ranges from 27.5 to 37.5 °C at its highest and 0 to 15 °C at its lowest. It thrives in humid areas with an average yearly rainfall of around 1000 mm. It is typically located in the hills at elevations between 600 and 1800 meters. The tree requires sunshine, but the seedling is inhibited by shade. Seedlings can withstand mild frost, but they are unable to survive severe frost. It is vulnerable to fire damage and young trees are affected by browsing. It thrives on a diverse range of soils. Deep fertile sandy loam soils provide optimal growth, but shallow gravelly soils result in limited growth.



Fig. Block Plantation of 3-year-old Melia dubia at different spacing's at RLBCAU, Jhansi

Phenology: The tree is devoid of leaves for a period from December to February. New foliage emerges in February and March simultaneously with the flowers. Fruits ripen in the cold season from October to February.

Propagation Technology:

Through Seeds: Seeds are harvested from mature fruits between January and February through rubbing, then cleaned, dried, and stored in airtight containers. The seeds have a germination capacity of less than 25%. Seeds are planted in elevated beds at the nursery. The optimal seed pre-treatment is soaking the seeds in a cow dung solution for one day. Research conducted at IFGTB in Coimbatore, India shows that germination rates can reach up to 60% without any pre-treatment. Seeds are planted in March-April in rows spaced 5 cm apart, using a mixture of farm-yard manure in a 2:1 ratio. One regular nursery bed requires approximately 6-7 kg of dried drupes containing around 1500 seeds. Water the seeds twice daily. In areas with moderate daytime temperatures or shaded nursery beds, cover the bed with a tarpaulin sheet to maintain the temperature within the soil. Germination takes place within a period of 90 days. The seedlings require 6 months to finish their nursery phase.

Vegetative Propagation: Young stem cuttings and new growth from cut trees show positive reactions to 1000-2000 ppm of IBA in liquid form. Older trees' coppice shows improved response to roots. Propagation should be done using cuttings that are as thick as a pencil. Delicate sprouts are prone to root rot. Place the shoots on a sand medium and water them twice daily. Proper drainage is essential to prevent waterlogging, which can damage the shoots. Season significantly influences the rooting of cuttings. Dry seasons are favourable for root growth. A success rate of approximately 75% can be achieved through rooting. Handle the species with care during transplantation to avoid any damage, whether pricking seedlings from the bed or transplanting rooted shoots into bags.

Mini clonal Technology: FC&RI in Mettupalayam, India has developed a miniature clonal technology for *Melia dubia*. Superior clonal plants were cultivated in a small clonal garden using advanced technology, receiving consistent watering and fertilizer to enhance the growth of shoots. The mother plants are planted with a spacing of 10 cm x 10 cm in this approach, and cuttings can be collected from plants that are 30-45 days old. The recently grown shoots were isolated from the plants, exposed to 1500 ppm IBA (liquid formulation), and then placed in 90 cc root trainers containing decomposed coir pith. The rooting process began after 15 days, and the rooted plants were ready for hardening at 25 days old. Using this strategy enhances rooting efficiency and uniformity, resulting in consistent establishment, growth, and development. The small clonal garden can be sustained for a maximum of 5 years, yielding an average of 0.1 million plants annually.

Cultural Operations: Seedlings in plantations benefit from rough tillage, while cultivated fields see less weed issues with thorough tillage. The spacing between crops depends on factors such as the size of the field, the type of intercropping, water availability, and the farmer's needs. Typically, when setting up plantations, 6-month-old seedlings are planted in 45 cubic centimetre pits. An optimal spacing of 5 m x 5 m is recommended, while an ideal spacing of 8 m x 8 m is preferred. Farmers typically plant crops with a spacing of either 3 m x 3 m or 3 m x 4 m. Yearly pruning is performed to achieve straight cylindrical trunks. Early development is accelerated by daily watering and fertilizers applied every three months during the initial three years. The tree thrives with irrigation every 10-15 days in the dry season. Applying a mixture of 25-50 grams of N, P, K per tree twice a year enhances growth. Fertilizer needs can be adjusted based on the tree's growth and development.

Tending Operations: Tending operations including ploughing, weeding, and cleaning

are conducted in *Melia dubia* plantations. However, when intercropping is practiced, these operations are specifically targeted towards agricultural or horticultural crops. Thinning, pruning, and enhancement felling's are conducted in monocultures and bund-planted regions, especially in cases where shade affects agricultural crops and there is a

need for fodder and fuelwood. Pruning every 6 months helps control branches.

Suitable Agroforestry Systems: *Melia* is a beneficial agroforestry species that is cultivated alongside various crops like groundnut, chili, turmeric, black gram, papaya, banana, melon, foxtail millet, and sugarcane with successful results.



Fig. Intercropping of different legume crops in 2-year-old *Melia dubia* plantation at RLBCAU, Jhansi

Yield: The tree reaches a volume of 15 cubic feet at 15 years and generates a revenue of Rs 350 per cubic foot from the 5th year onwards. Under intensive management, the growth rate varies from 20 to 25 cm per year, while in unmanaged plantations, it ranges from 6 to 8 cm per year. It is projected to yield 12 to 15 cubic feet (0.4 - 0.5 cubic meters) of timber in 5 years. Currently, *Melia* trees are sold for Rs. 7300 per tonne for billets with a girth of 50-120 cm and above Rs 370 per cubic foot for trees with a girth exceeding 120 cm.

Utilization: The sapwood is greyish white, while the heartwood ranges from light pink to light red, eventually turning pale russet brown

as it ages. The material is shiny with a dry touch, extremely lightweight (specific gravity 0.33; weight 21 kg/cubic foot), has a straight grain, coarse texture, and somewhat uneven surface. The lumber is not durable when exposed to the elements but shows considerable durability when kept under protection. It is less robust and long-lasting compared to Neem. The wood is utilized for various uses such as packing cases, ceiling boards, building materials, agricultural equipment, pencils, match boxes, splints, musical instruments, and tea boxes. The species has a secure and guaranteed market because of its versatile uses.