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GENUINE MAHOGANY

Cultivation, Management & Uses





M.V. Durai & S.K. Sharma

INSTITUTE OF WOOD SCIENCE AND TECHNOLOGY
(Indian Council of Forestry Research and Education)
BENGALURU - 560 003

काष्ठ विज्ञान एवं प्रौद्योगिकी संस्थान
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FOREWORD

More than half-a-dozen of timber species are being traded as "mahogany" in the market as their wood quality is similar to that of genuine mahogany. Mahogany trees are grouped into three classes, viz., Genuine (*Swietenia* spp.), True (*Khaya* spp.) and mixed mahogany (*Toona* spp., *Entandrophragma* etc.). Genuine mahogany is one of the highly priced and popular fast growing tropical timbers in the world. It is grown in farm lands, roads, parks and gardens and waste lands in all agro-climatic zones in India. Genuine mahogany species viz., *Swietenia macrophylla* and *S. microphylla* are suitable for raising commercial plantations. Even now, it is the most preferred timber in USA and UK. Now-a-days, it is very popular among farmers and plywood industries in India due to its fast growth, short rotation and high price.

This technical bulletin presents an overview of the distribution, seed handling technique, nursery practices, establishment and management of plantation, yield and economics and wood properties and uses of Genuine mahogany species. This is an effort by the IWST to acquaint the stakeholders about mahogany, its cultivation and wood properties. It is anticipated that the information provided in the bulletin will be useful to students, farmers, academicians, wood industrialists and tree growers.

(Dr. M.P. Singh, IFS)
Director

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GENUINE MAHOGANY

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1. Introduction

The mahogany wood has unique reputation in the international market due to its desirable characteristics such as attractive appearance, good dimensional stability, ease of working with both hand and machine tools, excellent finishing qualities and a high degree of natural durability. More than 200 species belonging to 35 families have been called as "mahogany" in one time or another. However, mahogany trees are generally grouped into three groups viz., Genuine (*Swietenia* sp.), True (*Khaya* sp.) and Mixed mahogany (Toona sp., *Entandrophragma* sp., etc.) for the purpose of trade. The genuine mahoganies are valuable tropical timber species that are of great economic importance to the economy of their native countries. As most of the mahogany resource base has dwindled, the establishment of plantations with these species offers a viable way to enhance the regular supply of mahogany wood for wood industries. Further, plantations play an important role in economy of the nation and improvement of livelihood of farmers in rural communities. Both genuine and true mahogany species are suitable for commercial plantation.

The genuine mahogany species were introduced from Jamaica and Honduras in the Royal Botanic Garden, Kolkata in 1795 and 1872, respectively as ornamental. Later, it has been introduced as an avenue tree as well as timber species in many other parts of India. The state Kerala has the largest area of mahogany plantations in India. Now–a-days, farmers and tree growers are cultivating Honduran mahogany in the farm lands and forest lands in large scale in the form of block plantation, agroforestry and avenue tree in Kerala, Tamil Nadu, Karnataka and Maharashtra due to its fast growth, short rotation, and high price. The Government has included mahogany species in the list of exempted trees to promote its cultivation as Tree-outside-Forests (ToFs) areas.

2. Description of tree

Honduran mahogany (*Swietenia macrophylla*) is a beautiful, lofty, evergreen tree and leafless for brief period during summer. The leaves shed and new flush shoot growth happens simultaneously in dry sites. It usually grows 30-40 m in height and 3-4 m in girth, but in very favorable localities it may attain a height up to 60 m and 9 m girth. The trunk is straight and cylindrical, with a clear bole height of 20-25 m and buttressed at base. The bark is greyish brown, fairly smooth to some-what rough, flaking off in patches. Leaves are paripinnate, green or reddish when young, dark green and shining when mature, up to 20 cm long. The inconspicuous flowers are borne in small open clusters among the leaves; these appear during February-March, nearly a year later. The flowers are greenish cream color, 0.8-1.0 cm across, sweet-scented, in narrow supra-axillary panicles. The capsules (fruits) are like a large, inverted club, 12.5 × 7.5 cm and very woody. Cuban mahogany (S. mahagoni) looks similar to Honduran mahogany in all aspects, except size of leaf and fruit and branching pattern. In Cuban mahogany, size of leaf and fruit is small and number of branches is more, when it is grown in wider spacing.


Mahogany in wet site


Mahogany in dry site


Honey bees in Flowers

3. Environmental conditions

Mahogany grows in a variety of soils and the best growth is found in deep, fertile soil on well drained slopes in regions where rainfall is abundant. However, timber from the less moist region is reported to be more valuable. It grows well at elevations up to 1300 m but best growth is found up to 900 m. Further, the Honduran mahogany is less exacting than the true mahogany. The Cuban mahogany regards both soil and climate for best growth. Mahogany tree appears to thrive best in a warm moist climate with the temperature ranging from 21 to 350C and mean annual rainfall from 1000–2000mm. It is a moderate shade-bearer and can be grown as an under storey in Teak plantation. It is very sensitive to frost and plants raised in the open in Dehra Dun are most often killed due to frost.

4. Fruiting and seed collection

The quality of seeds plays a vital role in the production of high quality seedlings for planting. Good quality seeds are collected from the identified seed trees or seed production areas or seed orchards. Mahogany trees flower annually in the month of February. Seeds ripen from February to March and fruit attains maturity in 11-12 months after flowering. Mature fruits are collected during November - April when fruit become whitish brown in colour and they begin to dehisce. The mature pods dry for 2-3 days in the sun to dehisce longitudinally to release seeds. A fruit contains 25-30 viable seeds and 1kg has 2000-2200 seeds. The seeds lose their viability after two or three months, if exposed to the open air; but it may be viable for a year, if it is kept in saw dust in closed containers.


Immature fruit


Mature fruit


Drying fruits


Seeds arrangement in fruit


Processed seeds

5. Nursery and seedling production

Mahogany is easily propagated through direct seed sowing, transplanting and stump-planting, of which transplanting gives best results. Freshly collected seeds are subjected to over-night soaking in cold water and are dried in shade for 15 minutes after decanting the water before sowing. Then, seeds are spread on sand-beds uniformly and fine sand/soil is broadcasted over the seeds for about 1 cm thickness to cover. After regular watering, seed germination starts on 15th day from date of sowing. The speed of seed germination and germination percentage varied between seed source and site conditions. The seed

germination percentage varies with age and location of seed source. Peak time of germination is observed after 15-20 days from the date of seed sown. At 2nd leaf stage, seedlings are transplanted from nursery bed into polybags. The container seedlings are maintained for about 6-months for out-planting. Seed treatment with 10% BHC or 10% methoxychlor by 3 hours cold water soaking is most effective against soil-borne insects and considerably increases the germination percentage.



Mother bed





Seedlings in mother bed



Container filling with media





Transplanting seedling from bed to polybags



Seedling transplantation



Seedlings in green house



Seedling hardening

6. Vegetative propagation

The desirable traits of mother tree would be transferred fully to its progenies through vegetative propagation. Stem cuttings and grafting may be employed for production of clonal seedlings. Maximum rooting percentage and root length of the cuttings is achieved in 2000 ppm IBA treatment. Cleft grafting has also shown promising results.



Cuttings at poly-tunnel



Sprouted cutting



Rooted cutting



Grafted seedling

7. Establishment of plantation

Honduran mahogany is being cultivated for timber, shade, as avenue tree, and border trees in forest and farm lands. In mahogany based agroforestry, pumpkin, maize, sugarcane, banana, fodder grasses, chilli and leafy vegetables are common intercrops. The recommended spacing is 2×3 m or 3×3 m or 3×4m for block plantation for timber production. For agroforestry, the recommended spacing is 4×4 m. The Honduran mahogany grows rapidly and thrives better than Cuban mahogany in India. Under favourable conditions, the rate of growth is very fast.



Agroforestry model (mahogany + rainfed crops)



Block plantation

8. Management of plantation

Weeding and hoeing are required 4 times at every 6 months interval during the first 2 years after planting. Either line weeding or ring weeding (in 1m diameter around the seedling) is recommended. It is reported that fertilising seedlings may reduce susceptibility to shoot borer damage by altering the chemical composition of shoots and enhancing tolerance. Usually, a dose of 75-100 g NPK per plant in a ring around the seedlings is applied after planting. As Honduran mahogany grows straight with narrow crown, pruning normally is not required. However, pruning may be required to remove any dead and diseased branches, and it also reduces the risk of disease and pest infestations by reducing relative humidity. Pruning is usually done for the first 3 years. Best time for pruning is just before the rainy season preferably during dormant season (winter). Thinning is normally done to improve the growth of remaining trees with an acceptable form. First thinning is applied in around 5-10 years, depending on site quality and initial stand density. The number of thinning required depends on initial stand density and site quality. Multiple thinning is suggested for closer spaced stands (3×3 m; 2×3 m) at interval of 5-10 years. For stands with high initial planting density (2×3 m), four thinning in a rotation is recommended. For 3×3 m spacing, 2 - 3 thinning appears to be essential whereas in a wider spacing (4×4 m), one thinning is recommended.

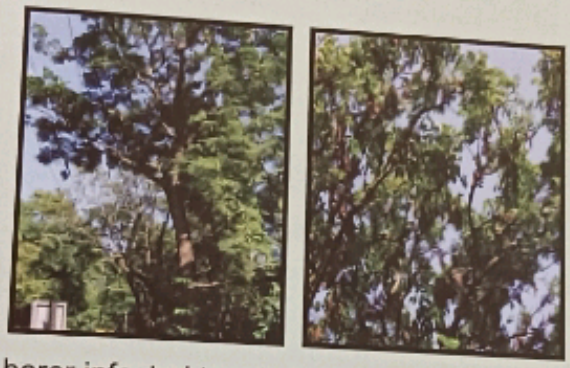
9. Growth statistics and timber yield

The rate of growth varies with site conditions, initial spacing and age. The annual height growth and diameter of 11-year-old plantation is 1.5 m and 1.3 cm, whereas in 17-year-old plantation, the mean diameter growth is same as in 11-year-old plantations. In Palakkad (Kerala), maximum timber yield/ha was recorded in wide spacing. The density, site and age of plantation has an important role in enhancing timber yield. Mahogany plantations are predicted to reach maximum mean annual increment (MAI) and volume of 38.1 m3/ha/year and up to 572 m3/ha in 15 years in the best sites, respectively, and the medium-quality sites

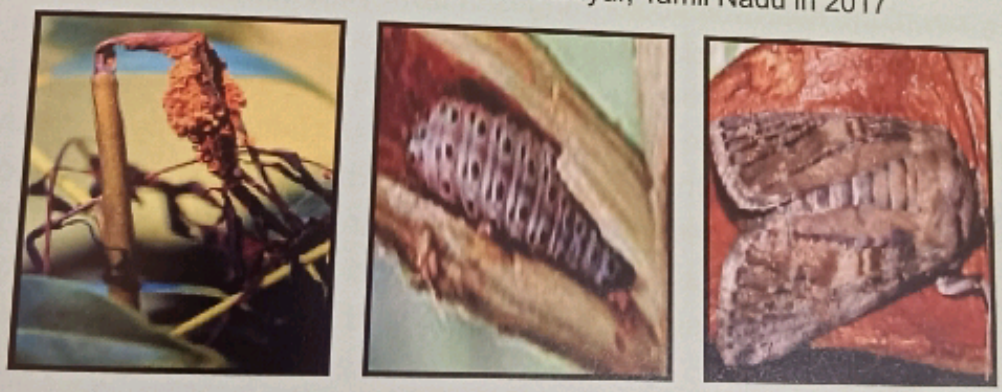
produce MAI of 19.7 m3/ha/year with volume up to 493 m3/ha in 25 years. If the rotation is set to 30 years, stands can attain a mean height of 24.4 m and a mean diameter of 35.4 cm and produce total volume 583 m3/ha including thinning in moderate sites. Thus, the estimated total timber volume is between 200.5-501.6 m3/ ha with MAI of 7.7–19.3m3/ha/year in rotation age of 15-30 years (Mayhew and Newton, 2000).

10. Insects

Of the reported 23 insect-pests of mahogany, defoliators, borers and sap-suckers are major pests. The sapwood is more susceptible to the attack of powder post beetles (*Lyctus* sp.). The shoot-borer (*Hypsipyla robusta)* is the only serious pest of mahogany in the sub-tropical and tropical regions. The larvae attack the leading shoots of plants, causing multiple branching and stunting of the saplings and retarding their development, but seldom cause their death. Shoot borer is generally high on the poor soils when the trees are exposed to wind. It is difficult to control due to short duration of external life of the larvae. However, it is reported that threat of shoot borer can be controlled by extensive pruning until 3 years after planting, and planting of repellent trees around the plantation, or by raising mixed plantation. Further, it reported that it can be controlled to some extent by application of a solution of 0.5 per cent lead arsenate paste.



Shoot borer infested tree in Burliyar, Tamil Nadu in 2017

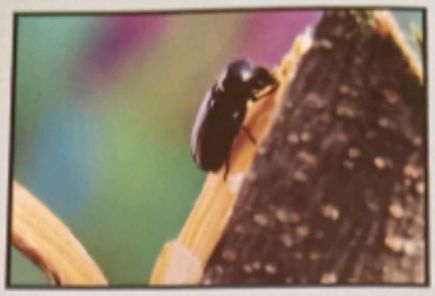


Symptom, borer and adults of shoot borer (Source: www.entnemdept.ufl.edu/creatures)

The accrues of heartwood borer (*Apate monachus*), commonly called as shot-hole-borer was first in 3-year-old Honduran mahogany plantation in Anaikatty, Coimbatore, Tamil Nadu (India) in April, 2016. It is a potential pest causing severe damage in young mahogany trees. The pest damage is characterised by a small hole in the trunk, from where the shot-hole-borer enters constructing tunnels, and produces lot of saw dust while feeding the wood. Mechanical control measures may be adapted to control this pest when the pest infestations are sporadic. Natural enemy, *Sclerodermus* species and other braconid species (*Glyptodoryctes)* may also be helpful to control this pest.



Tunnels in infected tree



Adult, Shot-hole-borer

11. Diseases

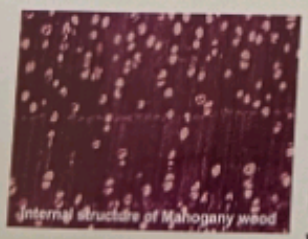
Leaf spot is caused by the fungi viz., *Botryodiplodia theobromae*, *Colletotrichum gloeosporioides* and *Pestalotiopsis adusta*. The causal organisms viz., *Fusarium mexicanum* and F.pseudocircinatum cause leaf malformation symptoms on young seedlings of Honduran mahogany.



Malformation in Honduran mahogany (Source: Santillán-Mendoza et al. 2018)

12. Wood and its properties

When freshly sawn, the heartwood color ranges in from yellowish-white to salmon pink, but after exposure to air and light its color changes to a rich golden brown. A characteristic feature of mahogany wood is its high natural lustre. The grains may be straight or interlocked, and grains irregularities produce a wide variety of such figures as fiddle-back, blister, stripe, swirl, crotch, and mottle. Texture is uniform, and the wood is without odour or taste. The wood is moderately hard and heavy (weight 560 kg/m^3). Growth rings are distinct, both true and false rings occur. The Indian mahogany is superior in quality with respect to weight, hardness and resistance to splitting and is inferior for strength, stiffness and figure when compared with Central American mahogany (Anon., 1976).



The density of plantation wood (<40 and >40 years old) significantly differ from wood of natural forests. The mean density of young plantation wood (<40 years old) is 16.3% lower than older plantation wood (>40 years old). Likewise, the density of mature plantation is 11.5% lower than that of natural forest. However, the density of wood varies with site. The density of mahogany wood in Honduras ranges between 420-660 kg/m3 with mean of 540 kg/m3. The density of mahogany in Puerto Rican is 470 kg/m3 whereas in Asian countries, it is ranged from 510-570 kg/m3. The density of mahogany wood of Indian origin is 551 kg/m3. The total tangential and radial shrinkage of young mahogany trees (<40 year old) are 83 and 44%

respectively, higher than those of natural forests. Similarly, the total tangential and radial shrinkage of older mahogany trees (>40 years old) is 54 and 40% respectively, higher than those of natural forests. Based on shrinkage, older plantation wood is more stable than that of young plantation and natural wood is more stable than that of plantation wood. The MOR (modulus of rupture) values of plantation timbers significantly differ from that of naturally grown mahogany timbers. The MOE (modulus of elasticity) of <40- and >40-year old plantations are 24.8 and 17.6% respectively, lower than that of natural timbers. Properties of plantation-grown mahogany timber such as static bending strength, crushing strength and modulus of elasticity are little inferior to that of forest-grown mahogany.

Timber is easy to season by both air- and kiln-seasoning. It is, however, liable to develop fine surface cracks in air-seasoning; this defect can be avoided by careful handling and stacking of sawn material, protected from the sun and hot winds. The timber can be kiln-dried rapidly and with ease without any appreciable degradation. Mahogany wood is comparable with that of teak with respect to suitability indices, except for shear strength and surface hardness (Rajput *et. al.* 1996). Mahogany wood is a very easy to work, known as craftmen's wood for many years and is ranked top among 25 American hardwoods. Large logs with relatively uniform structure are well suited for the manufacture of veneer. Due to the inter-locking grain, quarter slicing produces straight or broken strips. The gluing of mahogany does not involve any special problems in the control of gluing conditions. The mean decay resistance of genuine mahogany species is higher than that of other mahogany species. Most mahogany samples fall either in 'very resistant' or 'resistant' category. Cuban mahogany has much better decay resistance than Honduran mahogany. Marine borer resistance is very low. The heartwood is difficult to treat with preservatives.

13. Identification of mahogany wood

The presence of ripple marks on the flat-sawn surfaces will generally separate *Swietenia* species from the other woods called mahogany. In African mahogany, the growth rings are absent and ripple marks occur only rarely. The Philippine mahogany is readily identified by the presence of more or less widely spaced lines of resin canals that appear as white lines, much wider than the lines in true mahogany. The Philippine mahogany woods also lack the dark colored deposits found in the pores and vessels of the other woods mentioned. The woods most closely resembling true mahogany in gross appearance are the African mahogany (*Khaya ivorensis*) and Azadirachta integrifoliola. Recently, advanced techniques like NIRS and Partial Least Squares for Discriminant Analysis are successfully used to differentiate mahogany wood with 96.8% accuracy.

14. Timber value

As per the Kerala Forest Department schedule rates (2004-2006), the price of Grade –I and Grade II of mahogany timber is Rs. 23,205/m^3 and Rs. 12,881/m^3 respectively. According to the revised scheduled rates (2013-14 and 2014-15), the price of Grade –I and II of mahogany is 38,290/m^3 - and 15,430/m^3, respectively. In the international market, the price of sliced veneer- export quality and sawn wood-export quality is US$ 1743/m^3 and US$ 1570 -1655/m^3. If the price of sawn wood of mahogany timber (6 ft. length) is US$ 1570 -1655/m^3 in 2020, the predicted timber yield and income per ha in 15-30 years rotation is 200 - 501 m^3/ ha and US$ 3,14,000 – 8,29,155/ha (equivalent to Rs. 2.38- 6.3 crore), respectively.

15. Uses of Wood

Due to qualities like medium density wood with reddish or pinkish colour, attractive appearance, easily working with hand tools, excellent finishing, high dimensional stability and durability, polishes well and does not crack or bend, mahogany wood is being used for construction, plywood, high-grade furniture and cabinet making, and also suitable for panelling, framing, flooring, automobile bodies, interior trim of boats, radio and phonograph cabinets, bodies of musical instruments, mouldings and other ornaments. USA and UK are leading importers of mahogany wood, and Peru and Brazil are the largest exporters in the world.





Products made from Mahogany
(a) Laughing buddha and (b) Chitra veena



Flooring with mahogany



Mahogany kitchen cabinet

16. Medicinal uses

A number of phyto-chemicals are present in leaf, seed, fruit, and bark of mahogany. Alkaloids, terpenoids and carbohydrate are the main constituents in seed and leaves, whereas the content of tannins is high in leaf and central fruit axis. A neutral, non-bitter principle, swietenine and a bitter, hygroscopic component, swietenolide have been isolated from the seeds. Mahogany seeds yield about 50% of clear, yellow, and bitter taste fatty oil. The mahogany seed oil contains six types of fatty acids viz., palmitic, stearic, arachidic, oleic, linoleic and linolenic. Both linoleic and oleic account for more than 50% of fatty acids in seed oil. Genuine mahogany is tapped as "cure-all medicine" and "Queen of Plant" as it is used for common illnesses viz. diabetes, arthritis, rheumatism, gout, diarrhoea, fever, malaria, cough and high blood pressure. Seeds are traditionally used for high-blood pressure, hypertension, diabetes and malaria. Crushed seed's decoction is used to treat skin ailments and wounds. Amazonian Bolivian ethnic groups use seeds to induce abortion. Seeds are also used for treatment of cancer, amoebiasis, coughs, chest pains and intestinal parasitism. The seed oil appears to be useful as a moderate drying oil, and also in soap-making.

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For Further Details, Please Contact

Extension Division

Institute of Wood Science and Technology

P.O. Malleswaram, Bengaluru - 560 003

E-Mail: extension_iwst@icfre.org

Website: http://iwst.icfre.gov.in

Phone: 080- 22190201

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