Sustainable and Responsible Trade Promoted to Wood Processing SMEs through Forest and Trade Networks in China, India and Vietnam.

Timber Identification Manual

Manual of Timbers Used by Wood Based Handicrafts Industry Of Kerala, Uttar Pradesh and Rajasthan

This project is funded by the European Union

A MATTER OF FACT:
Complying with Lacey Act and the FLEGT Action Plan in India

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&

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INTRODUCTION

Wood has been of service to mankind through the ages. The most unique feature of wood, unlike other natural materials, is its high degree of structural variability. Even, two pieces of wood belonging to the same timber species may not be exactly alike. Even though the basic wood structure of the species is more or less similar; every fragment of it may show some difference. This attracts a unique fascination and attraction for this material. At the same time, it makes timber identification a tricky business. One has to learn to isolate those features that are characteristic of a certain timber, from others that many kinds of woods share.

Due to ignorance about the identity of timbers, usage of inferior and often unsuitable timber species such as Malaysian sal, pynkado, merbau, kusia and different species of acacias, eucalyptus and even conifers from temperate regions such as pines, have found their way into the timber market and have become popular for various end uses. However, the timber dealers, officials and the common man are left wondering as to the correct identification and utility of such species. Many instances of substitution of popular and traditional species by less costly and inferior species is happening in timber trade in the country, leading to litigations which have been reported from governmental as well as from other quarters.

There are a large number of indigenous timbers whose identification poses problems to even professionals in the field. Reliable anatomical key differentiators of important timber species used by the Wood Based Handicrafts Industry (WBHI) in the states of Uttar Pradesh, Rajasthan and Kerala, which could help in their accurate identification, are currently not available. Also, very accurate identification techniques requiring elaborate laboratory facilities may not be possible to practice, especially under field conditions. Hence field relevant key indicators based on general and gross anatomical features that can be observed using a hand held lens is the need of the hour.

Identification studies of Indian timbers

Identification of Indian woods based on their macro and micro features began a long time ago. The first record on the identification of Indian timbers is the compilation by Troup (1909), a forest economist in the Forest Research Institute, Dehradun. He gathered information about major commercial timbers of India, which at that time numbered about 553 species. The main purpose of the publication was to help the foresters and other users in identifying timbers based on their general features and to make decisions regarding the suitability of the woods for specific purposes.

Lushington (1919) describes the gross anatomical characters of the timbers of the Madras Presidency. Apart from description of the timber species growing in this region, information regarding commonly imported timbers and comparison between the indigenously produced and imported timbers is made in the publication. A detailed account of the commercial timbers of India is given by Gamble (1922) who included description about the common field identification features such as colour, weight, hardness, grain characters, etc., supported by photomicrographs of transverse sections of wood.

Pearson and Brown (1932) published an illustrative account of the commercially important timbers of India. The publication titled “Commercial timbers of India” describes the anatomy of 320 species of timbers falling under 53 families. Along with minute anatomy the book provides notes on distribution, supply, physical properties, mechanical properties and uses of each timber. The description is supplemented with photomicrographs of transverse sections of timbers and classification according to their end uses. A brief description of the gross structural features such as growth ring characters, parenchyma, pore arrangement and ray characters of 26 Burmese timbers including Andaman padauk and teak is given by Chowdhury (1945). Trotter (1959) provides information regarding

150 commercial timbers common to India. This manual includes details such as species name, trade name, vernacular name, weight, seasoning quality, strength, durability, uses and source of supply and price of each timber along with brief description of the wood characteristics. He classifies the timbers according to their uses to help the users to select the timber species best suited to their need.

Harikrishanan (1960) recorded the gross and minute anatomical characters of twenty-five commercial timbers of the Madras state. This publication includes gross features and general properties of common timber species such as *Adina cordifolia, Artocarpusheterophyllus, Toona ciliata, Grewia tiliifolia, Dalbergia latifolia, Lagerstroemia microcarpa, Mangifera indica, Mesua ferrea, Palaquium ellipticum, Pterocarpus marsupium, Tectona grandis, Terminalia crenulata,* etc. He also mentions the uses to which each species can be put to.

A comprehensive compilation series, “Indian Woods” dealing with Indian timbers was published by the Wood Anatomy Branch of FRI, Dehra Dun (Chowdhury and Ghosh, 1958; Rao, 1963; Rao and Purkayastha, 1972; Purkayastha, 1982; Purkayastha, 1985). This series deals with the structure, identification, properties and uses of woods occurring in the Indian sub-continent and Burma. In addition to trees, wood structure of shrubery species has also been described briefly. Purkayastha *et al*. (1976) recorded the anatomical description of important commercial timbers of the Andamans. The publication provides detailed description of 36 timbers, including their general features, gross structure, minute anatomy along with notes regarding their supply and uses. This manual is intended to ease the identification of all the important timbers of the Andamans both in the field and laboratory.

The anatomical make up of Indian albizias was studied in detail by Chauhan and Dayal (1985). They provide anatomical features helpful to distinguish 10 Indianalbizias. Chauhan and Rao (2003) present a detailed account of the anatomy of leguminous trees of India. They describe the anatomy of 87 timber species belonging to three sub families of Leguminosae viz., Mimosoideae, Caesalpinioideae and Papilionoideae. The publication also provides photomicrographs of these timbers to make the identification easier.

A handbook dealing with 162 common commercial timbers of Kerala was published by Nazma *et al.* (1981). This publication deals with general characters and gross anatomy of wood which will aid in the identification of these timbers. In addition to the identification characters, the trade name, local name, tree characteristics, distribution, strength, working properties and uses of these timbers are also given.

A Handbook of lesser known timbers by Bhat *et al.* (2007) is a source of ready reference for timber users to get acquainted with the lesser known timbers of the domestic market particularly in Kerala. Properties and uses of 77 timbers are provided in the handbook of which 52 timbers are imported species.

Identification studies of imported timbers

Large scale industrialization and urbanization has created a huge gap between demand and supply of timber in our country. The ban on all types of felling from natural forests also has contributed to the timber shortage. To mitigate the acute shortage, timber industry resorted to import of timbers from outside the country on a large scale. A large number of timbers are imported into our market, which are used mainly for constructional purposes. Some of these timbers are meranti (*Shorea* sp.), teak (*Tectona grandis* L.f), pyinkado (*Xylia dolabriformis* Benth.), greenheart *Ocotea rodiaei* (Schomb) Mez.), kusia (*Nauclea diderrichii* Kuntze), kempas (*Koompassia malaccensis* Maing.), Brazilian rosewood (*Dalbergia nigra* Fr. All.) and Malaysian padauk (*Pterocarpus* sp.). However, very little work has been done on the identification of these timbers, imported into the country. Information available about these timbers from the studies done in their native states is also much scattered and fragmentary.

For identification of any timber species, photomicrographs of the species are much valuable. Howard (1941) provided photomicrographs of 504 softwood and hardwood timbers of the world. He advocated that the minute anatomical photos would nullify any confusion regarding the identity of a wood specimen and even serve as a witness before legal courts. More recently, Miles (1978) has brought out a book on photomicrographs of important world woods.

The importance of general and anatomical features for identification was emphasized by Edlin (1977) who gave a description of 40 timbers which are commonly used in the world along with a collection of the actual wood samples. Rendle (1970) compiled a comprehensive three volume work on timbers of the world. Over 200 of the better known world timbers are illustrated in colour with concise description of each timber. This is mainly intended to enable the architects and industrialists to select timbers based on their characters and uses. The third volume deals with timbers produced from Asia, Australia and New Zealand. Titmuss (1971) has given details of 252 commercial timbers of the world with regard to their distribution and macroscopic features which help in the field identification of timbers and in some cases the microscopic features also along with illustrations. This manual will aid in the field identification of some of the commercially utilized timbers of the Indian market.

Miscellaneous notes including a brief report on the identification of greenheart (*Ocotea rodiaei* (Schomb) Mez.) as a species used for lintels in Martello Tower on Barbuda are given by Record (1945). Menon (1955, 1959, 1971) describes the wood anatomy of commercial timbers in Malaysia. In the latter publication he deals in detail with the anatomical distinction between some of the confusing groups of timbers viz., light red, dark red, white and yellow meranti.

Titmuss (1971) studied macroscopic features for identification of commercial timbers of the world, mentioning some of the timbers which are coming under the currently imported timbers of Kerala. Features like porosity, growth ring, distribution of pores, parenchyma arrangement, colour, odour, presence or absence of gum ducts, along with tree characteristics and distribution are described in detail. Farmer (1972) gives full description of 117 commercially important hardwoods which includes the meranti group of timbers, teak, greenheart, kusia, kempas, etc. The aim is to provide information that will assist users of hardwoods to select the timber best suited for their purposes and to process them in the most satisfactory manner, having regard to the individual features of timbers like colour, grain, weight, strength properties, working properties, wood bending properties, natural durability and preservation.

Chong *et al.* (1992) studied the wood properties of lesser known species grown in Indonesia such as kempas (*Koompassia malaccensis*). Newman *et al*. (1996) covered all timber–size Dipterocarpaceae members occurring in the rainforests of Malaysia. This manual includes dichotomous keys based on forest characters, information on silviculture, timber, wood anatomy and uses and line drawings of leaves and fruits.

Identification keys

Keys based on the anatomical features serve a pivotal role in the identification of an unknown sample of wood. Since the anatomical features are relatively constant for each species they can be successfully employed in identification keys. The commonly used keys for wood identification are the dichotomous key, perforated card key and the computer aided identification key.

Dichotomous key

These are the most simple and easy to use keys. This type of key has been used for over centuries in biological identification. Pearson and Brown (1932) provided the family-wise dichotomous keys for the identification of timbers of India belonging to 53 families. The anatomical identification key for 26 timbers of Burma was given by Chowdhury (1945). Ghosh (1960) emphasized the importance of the dichotomous key in the identification of wood samples and described the way to use this key. Rao and Juneja (1971) provided the identification key for discerning fifty common commercial timbers of India. The manual on “Indian Woods” published by FRI, Dehradun provides dichotomous keys for the identification of timber species of the Indian sub-continent and Burma.

Perforated card key

The multiple entry perforated card type of key was introduced by the Forest Product Research Laboratory in 1936, when a key for the identification of hardwoods based on microscopic features was constructed. The first key of this kind was fully developed by Clarke (1938). This key contains one card for each taxon and the cards have perforated edges, the perforations are numbered sequentially and

each numbered perforation represents one feature. The department of scientific and industrial research (1960) published a card key for the identification of 390 hardwood species belonging to the United Kingdom. The Princes Risborough microscopic key to hardwoods (Brazier and Franklin, 1961) has been one of the most valuable keys which covers 380 timbers representing 800 botanical species. Species descriptions are based on at least four samples, with more than 60% of the sample having herbarium vouchers. Rao and Juneja (1971) listed a card key for the identification of fifty commercial timbers of India.

This manual will serve as a source of ready reference particularly for the Wood Based Handicrafts Industry (WBHI) of the three states of Kerala, Rajasthan and Uttar Pradesh. Properties and uses of 34 species are provided in the handbook which includes 6 imported timber species and Coconut.

The information presented on various properties of timbers and their trade, vernacular and botanical names will facilitate selection of right timber for various applications by the handicrafts sector of these states. This will also be of use to organisations like State Forest Departments, Central Public Works Department, and various public-sector units/ Corporations, who commonly handle timbers. This user-friendly handbook with illustrations of wood figure (colour, grain and texture) and appearance will point to right choice of timbers especially to substitute the well known commercial timbers which are increasingly becoming scarce in the market.
The handbook was prepared from new investigations and by collating published technical information and properties of 32 timbers obtained from timber depots, retail timber outlets, farm/agroforestry sectors and imported sources of Kerala, Rajasthan and Uttar Pradesh. Besides the hardcopy, computer CD- ROM is also provided for the benefit of those who seek real images of surface appearance of different wood species along with technical properties, Timber Classification/ Explanatory Note Name and Timber Identity. The CD can be autorun and can be browsed in any computer running Windows.

For each timber, before description of properties, standard trade name and vernacular names are given in accordance with Indian Standard or as mentioned in the international sources of publications for imported timbers. This is followed by the botanical name and family of the timber before indicating the distribution/origin of supply. Timber species are organized in the text as per the standard trade name in alphabetical order.

METHODOLOGY

Heartwood samples collected from the timber depots, retail timber outlets, farm/agroforestry sectors and imported sources of Kerala, Rajasthan and Uttar Pradesh were used for collecting the information provided in this book. Trade name, local name, distribution and tree characteristics were incorporated in the description of each species from the existing records. Features which were used in the identification studies include:

(a) General features

These include features which can be directly observed without the aid of a microscope. General features were studied based on the description of features put forward by Rao and Juneja (1971). Non- anatomical features mentioned in the International Association of Wood Anatomists (IAWA) list of microscopic features for hardwood identification (Wheeler, 1989) which were relevant were also incorporated. The major general features which were studied include:

1. Colour
2. Hardness
3. Weight
4. Odour
5. Lustre
6. Texture
7. Grain

(b) Anatomical features

For studying the anatomical features, Blocks of size 1 cm x 1 cm x 1 cm were first chiseled out from the samples and subjected to microtomy. Transverse (TS), radial longitudinal (RLS) and tangential longitudinal sections (TLS) of 15–20 µm thickness were prepared using a Leica Sledge Microtome (Leica SM 2000R). The sections were stained using saffranin. Anatomical observations were recorded using an image analysis system (Labomed Digi 2). Maceration of fibres and vessels for recording the cellular dimensions was done using Schultz's method.

Anatomical features covered include the arrangement, distribution, frequency and size of the various cell elements viz., vessel, axial parenchyma, ray parenchyma and fibres in the wood. These characters included both macroscopic and microscopic characters. For explaining macroscopic features, terminologies used by Rao and Juneja (1971) were made use of and for describing microscopic features, the IAWA list of microscopic features for hardwood identification (IAWA, 1989) was made use of.

Photomicrography of the transverse, radial and tangential sections was undertaken using a Nikon Digital Camera (Nikon D-50), which was mounted on a Leica trinocular microscope (Leica DME). Based on the characters studied, a dichotomous key for 32 timbers was prepared as per the characters suggested by Rao and Juneja (1971).

This manual provides detailed information about the general features, gross anatomical properties, physical and mechanical properties that are useful in the identification and efficient utilization of 32 timbers used by the Wood Based Handicrafts Industry (WBHI) of Kerala, Rajasthan and Uttar Pradesh. These include 22 indigenous and 6 imported timbers. A dichotomous field key, based on general features and gross anatomical features is also provided. Also provided are colour plates depicting the tree, gross surface view (flat sawn) cross cut and microscopic sections (T.S. and T.L.S) reveal the anatomy of the timbers. Index to family, scientific, trade and local names are also given. Uses of the timber species are given at the end of species description. This book is intended for wood users for field identification of the timbers with limited knowledge of anatomy, but also for accurate laboratory identification of these timbers by wood anatomists.

Timber Description

Each timber is described in the following manner:

Colour	Generally referred to heartwood only unless noted otherwise as heartwood and sapwood
Weight (Specific gravity)	Depending on weight, in air-dry condition, timber is classified as: a. Very light and light (Specific gravity up to 0.55) b. Moderately heavy (Specific gravity 0.55-0.75) c. Heavy and very heavy (Specific gravity above 0.75).
Texture	a. Fine (Smooth to feel) b. Medium (Fairly smooth to feel) c. Coarse (Rough to feel)
Strength group	a. Weak (Compression parallel to grain up to 28 N/mm^{2*}) b. Moderately strong (Compression parallel to grain: 28-41 N/mm^2) c. Strong and very strong (Compression parallel to grain: above 41 N/mm^2)
Durability	Life span in years (as determined by graveyard tests) a. Perishable (Less than 5 years) b. Moderately durable (5-10 years) c. Durable (10-25 years) d. Very durable (above 25 years)
Treatability	Ability of the timber to preservative Treatment a. Easy (Timbers that can be penetrated with preservatives completely under pressure without difficulty) b. Moderately resistant (Timbers that are fairly easy to treat) c. Resistant (Timbers that are difficult to impregnate under pressure) d. Extremely resistant (Timbers that are refractory to treatment)

DESCRIPTION OF WOODS

ACACIA

Tree

Cross Cut

Flat Sawn

Trade Name	Acacia
Vernacular Names	*Akasia* (Indonesia); *Australian Babul, Australian wattle, Acacia, Kasia* (India); *Darwin Black wattle, Tan wattle* (Australia)
Botanical Name	*Acacia auriculiformis A. Cunn.ex Benth.*
Family Name	Leguminosae (Fabaceae)
Origin (Distribution)	An exotic. Native to Papua New Guinea (PNG), Australia and Solomon Islands; introduced into many tropical countries as a fast growing species for pulp wood.
Tree	A medium-sized tree reaching about 20m in height and 90cm in diameter. The species has become naturalized in many parts of India including Kerala.

General features

Acacia auriculiformis is moderately heavy wood. To identify the wood, check the following:

- Heartwood is dark brownish
- Wood is moderately heavy
- Parenchyma paratracheal and vasicentric.
- Rays fine, numerous and closely spaced.
- Vessels solitary and in radial multiples of two to three.

Colour Heartwood is light brown to dark red; clearly demarcated from the yellowish white sapwood.

Weight Moderately heavy (Air-dry specific gravity 0.60-0.75 with average values of 0.72)

Grain Straight or wavy

Texture Fine

Strength Strong

Static bending		Compression parallel to grain
Modulus of Rupture (MOR) N/mm^2	Modulus of Elasticity (MOE) N/mm^2	Maximum Crushing Stress (MCS) N/mm^2
74	10531	45.0

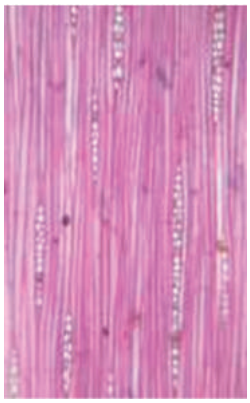
Drying and Shrinkage Dries easily; shrinkage-radial (2.0%), tangential (4.0 %), volumetric (6.0 %).

Durability Moderately durable

Treatability Moderately resistant

Working Properties Planing-easy; boring-easy; turning-easy; nailing-satisfactory; finish-good.

T S (x100)



TLS (x10)

Gross features Growth rings fairly distinct. Diffuse porous wood.

Vessels solitary and in radial multiples of two to three, large to medium sized and moderately numerous (15-24/mm^2). Soft tissue forms sheaths around vessels.

Rays fine, numerous and closely spaced; one to three cell wide, homogeneous, wholly made up of procumbent cells.

Parenchyma paratracheal and vasicentric.

Uses	Used for furniture making and construction purposes. Mainly used for pulp wood production. Suitable for door and window shutters, light construction, furniture, flooring, industrial and domestic woodware, tool handles, turnery articles, carom coins, agricultural implements, charcoal etc.

AYANI/ANJILI

Trade Name	Ayani
Vernacular Names	*Anjili, Ayani, Ansfeni* (Mal.), *Hebbalesu, Hessua,Hessuain* (Kan.), *Dinipilla*(Tam.), *Pejata* (Tel.)
Botanical Name	*Artocarpus hirsutus* Lamk.
Family Name	Moraceae
Origin (Distribution)	West coast tropical evergreen, west coast semi-evergreen and southern secondary moist mixed deciduous forests; commonly seen in Western Ghats in Karnataka and Kerala and in South Maharashtra
Tree	A lofty evergreen tree, large to very large, 25-45m in height with a clear bole of 10-20m and 130cm in diameter. Bark dark brown, smooth.

General features

Artocarpus hirsutus Lamk (Ayani) is a moderately hard and moderately heavy wood. To identify the wood, check the following:

- Heartwood is golden yellow to yellowish brown
- Parenchyma: paratracheal- vasicentric to aliform
- Rays moderately broad to fine, fairly wide spaced
- Vessels very large to large, few, solitary or in radial multiples of two or three, often filled with tyloses or white chalky deposits
- Resembles Jack wood in many respects, but differs in its yellowish-brown colour and lustrous appearance

Colour	Heartwood golden yellow to yellowish brown, lustrous when first exposed; darkens on exposure to dark yellowish brown with darker streaks. Sapwood is greyish or yellowish white.
Weight	Moderately hard and moderately heavy (595 kg/m^3 at 12% m.c.)
Grain	Straight to interlocked

Texture Medium to coarse

Strength Strong

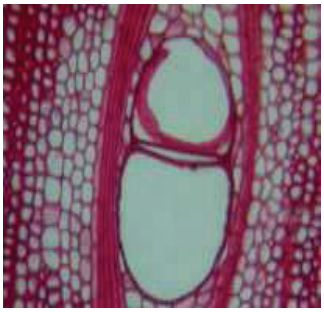
Static bending		Compression parallel to grain
Modulus of Rupture (MOR)kg/cm^2	Modulus of Elasticity (MOE) kg/cm^2	Maximum Crushing Stress (MCS) kg/cm^2
969	1 22 400	616

Drying and Shrinkage Air and kiln-seasoning offer no difficulty. Shrinkage green to oven dry- radial (3.4%), tangential (5.3%). The converted material stacked in open piles with good circulation of air through the stock, gives best results. Kiln-drying schedule IV is recommended.

Durability Durable. Moderately refractory

Treatability The heartwood is refractory to treatment.

Working Properties Easy to saw and machine when green; turns well to a good shining surface; takes lasting polish.



TS

TLS

Gross features

Growth rings indistinct to distinct, when distinct demarcated by slightly denser and darker coloured latewood fibrous tissues. A diffuse porous wood.

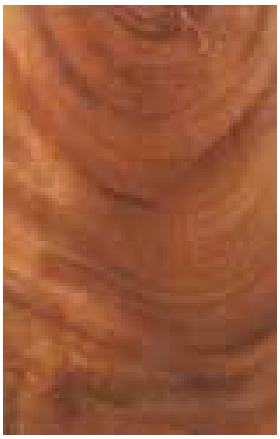
Vessels very large to large few solitary or in radial multiples of two or three, oval to round in outlines, often filled with tyloses or white chalky deposits.

Parenchyma paratracheal - vasicentric to medium to aliform, forming light coloured haloes or eye-lets round the vessels often extending sideways joining similar extensions.

Rays moderately broad to fine, fairly wide spaced and uniformly distributed, forming distinct or inconspicuous flecks on the radial surface.

Uses The wood is used practically for all purposes for which teak is used. It is also used for furniture and cabinet work, boat and ship building, vehicle bodies, beams and rafters, windows, door frames and ceiling boards, furniture and cabinets, turnery, piles, flush door shutters, class I plywood and veneers, marine plywoods, blockboard, tool handles, beater heads, fence posts, textile mill accessories, cooperage, hurdles for sports, mathematical, engineering and drawing instruments, brushware, carts and carriages. It is also used for masts, rafts and life boats, railway sleepers, packing cases, ladder and trestles, mallet heads, tent accessories, artificial limbs and turnery articles, general decorative marine and concrete shuttering plywood, blockboards and flush doors.

BABUL



Trade Name	Babul
Vernacular Names	*Babul* (India), *Gabdi* (Cameroon), *Mgunga* (East Africa), *Babla* (Bangali), *Bamura* (Gond.), *Baval, Bawal* (Guj.), *Babul, Babur* (Hind.), *Fati*, *Gobli, Jali, Karrijali, Meshwal* (Kan.), *Karuvelam* (Mal.), *Kikar* (Punj.), *Karuvai*, *Karuvelam* (Tam.), *Nella tuma* (Tel.)
Botanical Name	*Acacia nilotica* (Linn.) Wild. ex Del. Syn. *Acacia arabica* Auct. non (Lamk.) Willd.
Family Name	Leguminosae (Fabaceae)
Origin (Distribution)	India (Gujarat, Rajasthan, Maharashtra, Madhya Pradesh) and Africa. Grows naturally in the deciduous forests of Peninsular India. In Kerala, occasionally grown in dry areas.
Tree	Small sized evergreen tree reaches a height of 10 m and is about 30 cm in diameter with short thick cylindrical trunk and a spreading crown. Bark is dark brown or black, rough, with deep narrow longitudinal fissures running spirally.

General features

The heart wood of *Acacia nilotica* (Babul) is pinkish brown to reddish brown and is lustrous. To identify the wood, check the following:

- Pinkish brown to reddish brown and lustrous heart wood.
- Wood is hard and heavy
- Growth rings are indistinct
- Prominent paratracheal (vasicentric) parenchyma
- Vessels are small and few and filled with dark brown gummy deposits

Colour Heartwood pinkish brown to reddish brown, lustrous; Sapwood wide, white to pale yellow. Heart wood is sharply demarcated from the sapwood.

Weight Hard and heavy (800 kg/m3 at 12% m. c)

Grain Straight to interlocked

Texture Medium to coarse

Strength Strong

Static bending		Compression parallel to grain
Modulus of Rupture (MOR)N/mm^2	Modulus of Elasticity (MOE) N/mm^2	Maximum Crushing Stress(MCS) N/mm^2
87	11058	52.5

Drying and Shrinkage Dries rather slowly without degrade; Shrinkage- radial (2.6%), tangential (6.0%), volumetric (8.6%). It requires care in seasoning as it is liable to develop surface cracking and end- splitting unless protected against rapid drying.

Durability Very durable

Treatability Resistant

Working Properties Planing rather easy; Boring-easy; Turning-easy; Nailing- good but pre- boring necessary; Finish-good

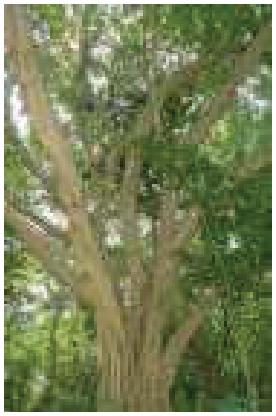
T S (x100)

TLS (x100)

Gross features **Wood** is diffuse porous. **Growth** rings are indistinct. **Vessels** medium to small, few to moderately few, mostly solitary or in radial multiples of two, three or more, occasionally in clusters; filled with dark brown gummy deposits. Soft tissues are visible to the eye forming thick sheaths or 'halos' round the pores. **Parenchyma** paratracheal- vasicentric, fine lines delimiting growth rings. **Rays** moderately broad to fine, rather widely andirregularly spaced.

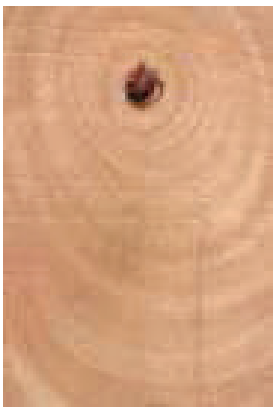
Uses Used in constructional work for posts, beams, rafters, bridges, door andwindow shutters and frames. Also used for agricultural implements, tool handles, tent accessories cart building, parts of hulls of boats, legs of bedsteads, sports goods and charcoal. The tree yields pale yellow to brown gum used inconfectionery, medicines and calico printing. A heavy, somewhat twisted- grained and coarse textured reddish brown non-ornamental wood; one of the best of Indian Acacia species.

BANYAN



Tree

Flat Sawn



Cross Cut

Trade Name	Banyan
Vernacular Names	*Peepal, Peral, Banyan* (India), *Bor* (Asm.), *Vad*, *Vor* (Guj.), *Bar, Bargad* (Hind.), *Alada* (Kan.), *Vata* (San.), *Ala, Alai* (Tam.), *Marri* (Tel.), *Aal*, *Peral* (Mal.)
Botanical Name	*Ficus bengalensis* L.
Family Name	Moraceae
Origin (Distribution)	Asia-through out the forest tracts of India, both in sub-Himalayan region and in deciduous forests of Deccan and other parts of South India.
Tree	Large tree with spreading branches attaining a height of 30 m. Bark greyish white, smooth.

General features

Ficus bengalensis L. (Banyan) is light to moderately heavy wood. To identify the wood, check the following:

- Creamy white to greyish white when first exposed turning grey or pale brown-ish grey with age, discolours rapidly by sap stain.
- Wood is light to moderately heavy
- Parenchyma abundant, visible to the eye, forming more or less concentric narrow or broad bands alternating with fibrous tissue: 4-20 per 5mm.
- Rays moderately broad to broad, distinct to the eye, widely spaced, forming inconspicuous to conspicuous flecks on radial surface.

Colour Creamy white to greyish white when first exposed turning grey or pale brownish grey with age, discolours rapidly by sap stain; heartwood and sapwood not distinct.

Weight Light to moderately heavy. Air- dry specific gravity approx. 0.61

Grain Shallowly interlocked.

Texture Coarse and uneven.

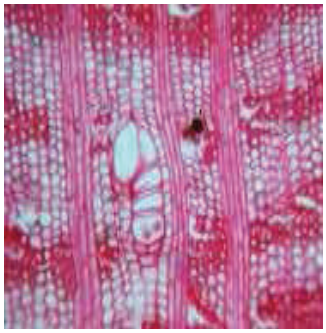
Strength Weak

Drying and Shrinkage Dries easily; liable to warp. Shrinkage data not available

Durability Perishable. Timber is not durable in exposed condition but quite durable in dry places and under cover.

Treatability Easy.

Working Properties Sawing- easy; mottling figure may be obtained by flat sawing.



T S (x100)

TLS (x10)

Gross features Diffuse porous wood. **Growth rings** inconspicuous. **Vessels** large to small distinct under the hand lens, Solitary or in radial multiples of 2-4, few to moderately numerous (5-15 per mm^2), more or less evenly distributed, open or often plugged with tyloses, vessel lines distinct.

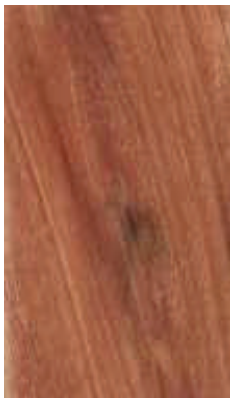
Parenchyma abundant, visible to the eye, forming more or less concentric narrow or broad bands alternating with fibrous tissue: 4-20 per 5mm.

Rays moderately broad to broad, distinct to the eye, widely spaced, forming inconspicuous to conspicuous flecks on radial surface.

Uses Third class wood used for making tea boxes, toys and for light packing cases. The wood of aerial roots can be used for tent poles, cart yokes and carrying shafts.

BENTEAK

Tree



Flat Sawn

Cross Cut

Trade Name	Benteak
Vernacular Names	*Arale, bendeku, brntik, nandi* (Kan.), *Ventek* (Mal.*), Nana* (Mar.), *Vivella, Venteak, Venteku* (Tam.), *Chennangi, Ventaku* (Tel.)
Botanical Name	*Lagerstroemia microcarpa* Wight.Syn. *Lagerstroemia lanceolata* Wall.exClarke, *Lagerstroemia thomsonii* Koehne
Family Name	Lythraceae
Origin (Distribution)	West coast semi evergreen, moist teak bearing and southern moist mixed deciduous forests. It is commonthroughout the Western Ghats from Bombay southwards through Karnataka extending to Travancore and the Nilgiris.
Tree	Large about 20-30 m in height and up to 110 cm in diameter, 2.4-3 m in girth with a clear bole of 12-15 m.Bark white or yellowish- grey, smooth, exfoliating in large papery flakes.

General features

Lagerstroemia microcarpa Wight. (Benteak) is a moderately heavy wood. To identify the wood, check the following:

- Heartwood reddish brown to walnut brown.
- Wood is moderately heavy
- Parenchyma paratracheal- predominantly aliform-confluent.
- Rays fine, numerous and closely spaced.
- Vessels large in early wood, medium to small in late wood, moderately numerous (4-6/mm^2), solitary or in radial multiples of 2 or 3, usually filled with abundant tyloses.

Colour Sapwood grey or pink, heartwood reddish brown to walnut brown, darkening on exposure.

Weight Moderately hard to moderately heavy, slightly to fairly lustrous, 640 kg/m3 at 12% m.c. Air dry specific gravity 0.59- 0.76

Grain Straight to somewhat interlocked.

Texture Medium

Strength Strong

Static bending		Compression parallel to grain
Modulus of Rupture (MOR)kg/cm^2	Modulus of Elasticity (MOE) kg/cm^2	Maximum Crushing Stress (MCS) kg/cm^2
986	126,500	474

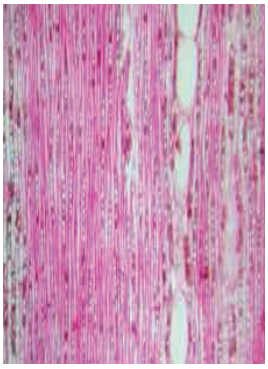
Drying and Shrinkage Air-seasoning is difficult. Kiln-seasoning recommended.

Durability Durable

Treatability Heartwood very refractory to treatment

Working Properties Sawing and machining satisfactory, finishes to a smooth surface and takes good polish.

T S (x100)



TLS (x100)

Gross features

Wood is semi-ring-porous to ring porous.

Growth rings distinct, demarcated by large early wood vessels and fine to fairly broad parenchyma bands.

Vessels large in early wood, medium to small in late wood, moderately numerous (4-6/mm^2), solitary or in radial multiples of 2 or 3, round to oval, vessel lines distinct, usually filled with abundant tyloses, clearly visible to the unaided eye. Soft tissue forms eyelets around vessels, often join together to form bands.

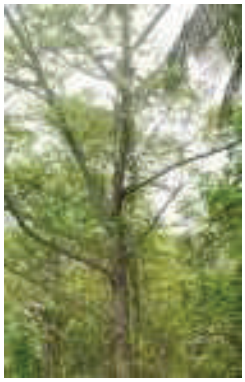
Parenchyma p aratracheal- predominantly aliform-confluent, abundant, mainly as 'haloes' or eyelets round the vessel or vessel groups

Rays fine, numerous and closely spaced.

Uses

The timber is largely used for construction, door and window frames, battens for tea- chests, packing cases, ammunition and explosive boxes, pent top wooden cases, wooden ladders and trestles, wooden poles for overhead power andtelecommunication lines, fence posts, panelled and glazed shutters, furniture and cabinets, tool handles, poles and posts, wooden crates, mine work, ballies, railway sleepers, textile mill accessories, artificial limbs and rehabilitation aids, boat and ship buildings, lorry and bus bodies, clubs, strip flooring, balancing bench, javelins, hurdles, vaulting stands and balancing bars, cooperage, cart and carriages, bent wood articles and toys. Its bending properties are good and makes good bends for common grades of badminton and tennis rackets, boat parts, shafts, walking sticks etc

CHARCOAL TREE



Tree

Flat Sawn

Cross Cut

Trade Name	Charcoal tree, Indian nettle tree
Vernacular Names	*Sapong, Sempak* (Asm.), *Chikan* (Beng.), *Gol* (Guj.), *Bada manu* (Hind.), *Gorklu, Kevu-hale* (Kan.), *Ama, Ayali malan totali, Pottama, Rathi*, *Ambarki* (Mal), *Kapashi, Kagol* (Mar.) *Ambarathi, Chenkolam* (Tam.), *Buda maru, Chakamaanu* (Tel.)
Botanical Name	*Trema orientalis* (Linn.) Blume
Family Name	Ulmaceae
Origin (Distribution)	India, Nepal, Bangladesh, Myanmar and Sri Lanka. It occurs in Sub-Himalayan tract from the Jamuna eastwards to Assam,very scarce to the West, in, central, Western and Southern India,except in the very dry tracts and upto 1500m.
Tree	A fast growing but short lived ever green tree or a large shrub, attaining a height of 10 m and a girth of 1m.Bark thin, greenish-grey or bluish-green. It gives a fibre which is used to tie the rafters of native houses and for binding loads.

General features

Trema orientalis (Charcoal tree) is a light wood. To identify the wood, check the following:

- Heartwood off white, light reddish-grey or tinged with pink colour; not distinct from the sapwood.

Colour — Heartwood off white, light reddish-grey or tinged with pink colour; not distinct from the sapwood.

Weight — Light; air dry specific gravity approx.0.39

Grain — Straight to interlocked. Texture Fine to medium

Strength — Weak

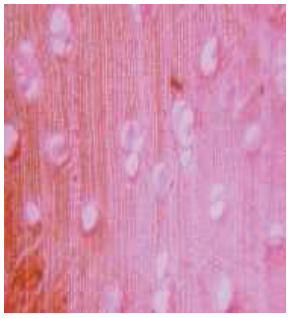
Static bending		Compression parallel to grain
Modulus of Rupture (MOR)N/mm^2	Modulus of Elasticity (MOE) N/mm^2	Maximum Crushing Stress (MCS) N/mm^2
54	8535	26.8

Drying and Shrinkage Drying moderately difficult; Shrinkage- radial (6.9%), Tangential (9.8%),Volumetric (18.8%). Refractory to seasoning, liable to warp, greenconversion and careful stacking under cover recommended.

Durability Perishable

Treatability Easy.

Working Properties Planing-easy; Boring- easy; Turning- easy; Nailing-easy; Finish-good.



T S

TLS

Gross Featurs

Growth ring boundaries indistinct or absent

Wood is diffuse-porous Vessels solitary and outline angular.

Fibres with simple to minutely bordered pits are present. Axial parenchyma absent or extremely rare.

Axial parenchyma scanty paratracheal.

Rays are 1 to 3 cells width radial multiples not common, high proportion of solitary vessels.

Uses Suitable for manufacturing panel products, poles and drumsticks. Also used in making wooden shoes, fruit boxes, packing, handicrafts, particle board, charcoal, pulp and paper. In Assam it is used to make the coarse Amphak cloth.

COCONUT

Tree

Flat Sawn

Cross Cut

Trade Name	Coconut
Vernacular Names	*Thengu* (Mal), *Gari, Nariyal*, *Narial* (Hindi*), Narikela* (Sanskrit)
Botanical Name	*Cocos nucifera (L)*
Family Name	Palmae
Origin (Distribution):	Native to South Asia and northwestern South America. It is distributed throughout the tropics.
Tree :	It has an erect pole-like stem andsymmetrical crown; Coconuts can grow to between 15 and 30 m tall. Their trunks are ringed with scars where old leaves have fallen. The trunk is 30-40 cm in diameter sometimes reaching a meter at the base. The slender and branchless trunk reaches a height of 20-25 m or more. The top of the trunk is crowned with a rosette of leaves.

General features

The heart wood of *Cocos nucifera* (Coconut) is brown to reddish brown and is lustrous. Wood is moderately hard. Its main anatomical elements include the fibro-vascular bundles, fibrous bundles and the ground tissue

- Growth rings are indistinct
- Prominent paratracheal (vasicentric) parenchyma
- Vessels are large and filled with dark brown gummy deposits

Colour: Heartwood reddish brown, Sapwood wide, white to pale brown. Heart wood is not sharply demarcated from the sapwood.

Weight: Hard and heavy (Air-dry specific gravity 0.5to0.60 with average value of .602)

Grain: Clear grain **Texture** Medium to coarse **Strength** Moderately Strong

Static bending		Compression parallel to grain
Modulus of Rupture (MOR)MPa	Modulus of Elasticity (MOE)MPa	Maximum Crushing Stress (MCS)
26-86 MPa	3.1-10.9	15-49 MPa

Drying and Shrinkage:	Shrinkage- radial (5.9%), tangential (6.1%), the wood is truly flat or quarter-sawn some distortion of shape is inevitable on drying.
Durability	Non-durable
Treatability	No natural resistance; drying before treatment is essential. Drying the material before treatment permits adequate penetration and uniform distribution and reduces risks of checking and the consequent exposure of untreated timber.
Working Properties:	Sawing-difficult; Planing satisfactory; Boring-easy; Turning-easy; Nailing- good but pre-boring necessary; Finish-good

TLS (10X)

Gross features	**Wood** is diffuse porous. **Growth** rings are indistinct. The cross-section of the stem has three zones: dermal, subdermal and the central core. The dermal is the outer-most annular portion just below the bark. The fibro-vascular bundles consist of phloem, xylem, axial parenchyma and thick-walled schlyrenchyma fibres. The latter element serves as the palm's major mechanical support. The cell walls of the schlyrenchima fibres become progressively thicker from the centre to the cortex of the stem. The **xylem** is enveloped by parenchyma cells usually containing two wide vessels, a combination of wide and small vessels or clusters of several small and wide **Vessels**. The ground tissue is parenchymatous and its cell wall thickness decreases from cortex to the inner zone of the central cylinder.
Uses	The coconut is commonly given the title "Tree of Life". As flooring, for furniture making, pulping, Constructional works. Local uses of coconut palm products are many: coir, from the husk of the nut, is a fibre used in the manufacture of mats, ropes, brushes and baskets; the hard endocarp provides charcoal; the stem is used for house construction and increasingly for other purposes

DHAMAN

Tree

Flat Sawn

Cross Cut

Trade Name	Dhaman
Vernacular Names	*Damnak (*Bhil.*); Dhamani, daman (*Mar.*); Dadsal, butale, thadsal, batala (*Kan.*); Dhamana (*Guj.*); Dhaman, baringa (*C. P*); Khosla, kasul (Gondi); Charachi, jana, tharra, (*Tel.*); Unu, chadachchi, charachi, unam (*Tam.*); Pharsa, phalsa, dhamin (*U. P*); Pharsia (*Kumaon*); Dhaman, dhamin, phalsa, pharsa , (*Hind.*); Chadache, chadicha, sadachu (*Mal.*); Bhangia, dhamani, dhamono, dhamuro (Or.)*
Botanical Name	*Grewia tiliifolia Vahl*
Family Name	Tiliaceae
Origin (Distribution):	Southern moist mixed deciduous, teak bearing and semi-evergreen forest. It is a common tree of Himachal Pradesh, Bihar, West Bengal, Assam, Orissa, Rajasthan, Gujarat, Maharashtra, Goa, Andhra Pradesh, Karnataka, Tamil Nadu and Kerala; also in Sri Lanka.
Tree :	Medium sized tree with 20 m height, 60 cm diameter and 1.5 m in girth with a clear bole of 4-6 m.; bark pale grey in young trees, dark or blackish brown in old trees, fibrous, rough, peels off in thin flakes.

General features

Grewia tiliifolia (Dhaman) is a moderately heavy wood. To identify the wood, check the following:

- Heart wood reddish brown to brown with black or dark streaks.
- Wood is moderately hard to hard, moderately heavy to heavy
- Parenchyma paratracheal, abundant, vasicentric or aliform.
- Rays fine to broad and close.
- Vessels punctuate with the naked eye, solitary and in radial multiples of two to three; medium-sized; few to moderately numerous (6-10 per mm^2), filled with tyloses or chalky deposits.

Colour: Sapwood yellowish white or pale yellowish, turning brownish grey with age. Heartwood reddish brown to brown with black or dark streaks.

Weight: Moderately hard to hard, moderately heavy to heavy (785 kg m3 at 12 % m. c)

Grain: Straight

Texture Medium to coarse

Strength Strong

Static bending		Compression parallel to grain
Modulus of Rupture (MOR) kg/cm^2 (air-dry)	Modulus of Elasticity (MOE) kg/cm^2 (air-dry)	Maximum Crushing Stress (MCS) kg/cm^2 (air-dry)
1301.9	1 63 900	701.2

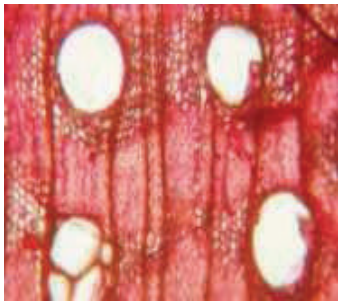
Drying and Shrinkage: Moderately refractory, liable to surface cracking and end-splitting; conversion soon after felling and stacking under cover recommended.

Shrinkage: Radial 4.1%; tangential 7.9 %; volumetric 14.5%.

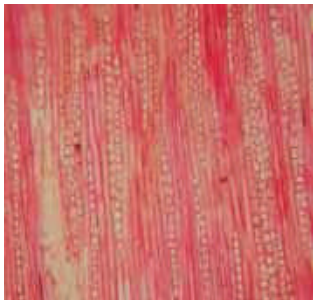
Durability A very durable timber both in the open and under cover.

Treatability Heartwood refractory to treatment.

Working Properties: Easy to saw and worked up very easily, both on machines and by hand; can be brought to a smooth finish and takes good polish



TS



TLS

Gross features Growth rings distinct, demarcated by dense, darker latewood fibers. Diffuse porous to semi-ring-porous wood.

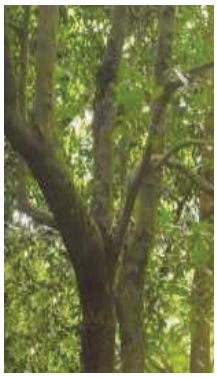
Vessels punctuate with the naked eye, solitary and in radial multiples of two to three; medium to small-sized; few to moderately numerous (6-10 per mm^2), filled with tyloses or chalky deposits. Soft tissue forming halos around vessels and also banded; not readily visible, even with a hand lens.

Rays fine to broad, close, 5-11 mm; few and spaced. Ripple marks occasionally faintly visible.

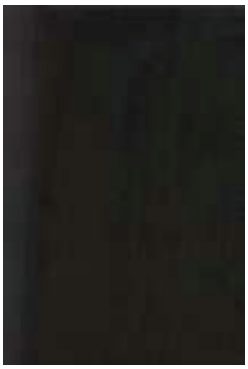
Parenchyma paratracheal, abundant, vasicentric or aliform, visible with a hand lens. Apotracheal parenchyma diffuse and also in tangential lines.

Uses Agricultural implements, axe-helves, tool handles, constructional purposes like door and window frames, furniture, poles, shafts, panels and bent parts in carriage and spokes in cart construc tion, ballies, cross arms and fence posts, railway sleepers, boat and ship building, badminton rackets, clubs, balancing bench, hurdles, cricket stumps and bails; lorry and bus bodies and brushwares. It is used by tent- markers for making poles for military tents; it is used for making wagon- bottoms and doors in railway. This timber is using for picker-arms in textile mills, oars, felloes, and as shuttles, rabbet, tubes, pins, cotton tubes and warper bobbins. It is an ornamental timber. Dhaman is specified for handles of pruning knives, slay bottoms and slay cap for cotton looms, beams for gymnastics, temporary nail joined construction, beater heads, anvil blocks, ladders and trestles and fence posts.

EBONY



Tree



Flat Sawn

Cross Cut

Trade Name	Ebony
Vernacular Names	*Balemara (*Kan.*), Karimaram (*Mal.*), Kendhu (*Or.*) Nalluti (*Tel.*)*
Botanical Name	*Diospyros ebenum Koenig* ex Retz.
Family Name	Ebenaceae
Origin (Distribution):	Sporadic in West coast semi-evergreen forests. It is also found in the forests of Deccan extending north to the Cudappah and Kurnool districts of Andhra Pradesh, Tamil Nadu and in South Orissa, South Coimbatore, Tirunelvely and Srilanka
Tree :	Small to medium, occasionally attains a height of 20 m, girth of 2.5 m and about 40 cm in diameter. Bark dark grey with longitudinal fissures.

General features

Diospyros ebenum Koenig. (Ebony) is very hard and very heavy. To identify the wood, check the following:

- Heartwood is uniform jet black or black brown sometimes with streaks.
- Vessels small, few to moderately few, solitary or in radial multiple of two or three; filled with brownish-black or black gum.
- Parenchyma apotracheal-fine undulating tangential lines.
- Rays very fine and closely spaced.

Colour: Heartwood small, uniform jet black or black brown sometimes with streaks; clearly demarcated from the pale red brown or light yellow-ish grey sapwood.

Weight: Very hard and very heavy; air dry specific gravity 0.96-1.12 with an average value of 1 (1150 kg/m^3 at 12% m.c).

Grain: Straight to slightly interlocked or somewhat curly.

Texture Fine

Strength Very strong.

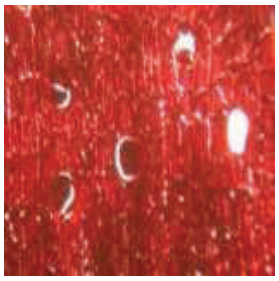
Static bending		Compression parallel to grain
Modulus of Rupture (MOR) N/mm^2	Modulus of Elasticity MOE) N/mm^2	Maximum Crushing Stress Stress (MCS) N/mm^2
NA (Not Available)	NA	NA

Drying and Shrinkage: Dries fairly rapidly. Shrinkage radial (5.5%), tangential (6.5%), volumetric (12%). It is difficult to season as it has a tendency to develop splitting and surface-cracking and requires protection against rapid drying.

Durability Very durable

Treatability Extremely resistant. Refractory to treatment. The light coloured portion of the wood can be treated satisfactorily with preservatives.

Working Properties: Planing-slightly difficult; Boring-easy; Turning-easy; Nailing-good; but pre- boring necessary; Finish-good



T S (x100)

TLS (x10)

Gross features

Wood is diffuse porous.

Growth rings are indistinct.

Vessels small, few to moderately few, moderately numerous (6-15 per mm^2) solitary or in radial multiples of two or three, evenly distributed; filled with brownish-black or black gummy deposits in the heartwood. Vessel lines indistinct to inconspicuous.

Parenchyma apotracheal-fine undulating tangential lines, diffuse to diffuse-in-aggregates at places forming a reticulum with the rays.

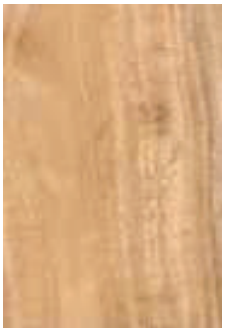
Rays very fine closely and evenly spaced.

Uses

It is an attractive timber used for hardwood flooring and inlaid work, parts of musical instruments, handles of cutlery and tools, pocket knives, khukris, walking sticks, toys, decorative carvings, turnery and antiques. It is also used for dobby and pegs in textile mills, mathematical, engineering and drawing instruments, swagger sticks and handicrafts. The sapwood is mainly used for constructional purposes, axe handles, light hammer handles, shafts, shoulder poles, picture frames and furniture.It is a timber for general purpose plywood and for face veneer of commercial type of block boards.

GAMARI/ KUMBIL

Tree



Flat Sawn

Cross Cut

Trade Name	Gamari, Kumbil
Vernacular Names	*Gamar (*Bangladesh*), Gamari, Gumhar, Kumbil, Gomari, Gambar, Shewan, Kumil (*India*).Yemane (*Myanmar, Malaysia, Philippines*), Gomari (*Asm.*),Shewan (*Guj.*), Gambhar (*Hind.*),Kulimavu (*Kan.*), Kumala (*Tam.*), Gummadi (*Tel.*)*
Botanical Name	*Gmelina arborea* Roxb.
Family Name	Verbenaceae
Origin (Distribution):	Native to India, Sri Lanka, Myanmar, Southern China, Laos, Cambodia, Vietnam, Indonesia and introduced to many tropical countries as a fast growing tree species. Sporadic in moist teak bearing and southern secondary moist mixed deciduous forest.
Tree :	Medium, 15-20 m in height, 40-65cm in diameter and a girth of 1.5-2 m. Bark whitish grey, corky, warty, lenticellate ex- foliating in regular thin flakes.

General features

Gmelina arborea Roxb. (Gamari, Kumbil) is soft to moderately hard and light to moderately heavy. To identify the wood, check the following:

- Wood is creamy white to pale yellowish-grey turning to yellowish- brown on exposure.
- Parenchyma mostly paratracheal-vasicentric and also in terminal bands delimiting growth rings.
- Rays broad to moderately broad, distinct to the eye, few, rather widely spaced and uniformly distributed.
- Vessels large to medium, distinct to fairly distinct to the eye, rather unevenly distributed, few to moderately numerous, mostly solitary and in short radial multiples of 2 or 3, rounded in outline; tyloses abundant.

Colour: Heartwood and sapwood not distinct in color; creamy white to pale yellowish- grey or buff turning to yellowish-brown on exposure, moderately lustrous.

Weight: Soft to moderately hard and light to moderately heavy

Grain: Straight to interlocked or slightly wavy

Texture Medium to coarse

Strength Moderately strong

Static bending		Compression parallel to grain
Modulus of Rupture (MOR) N/mm^2	Modulus of Elasticity (MOE) N/mm^2	Maximum Crushing Stress Stress (MCS) N/mm^2
64.6	8896	33.4

Drying and Shrinkage: Easy to air-season; kiln-seasoning offers no difficulty. Dries fairly rapidly; shrinkage-radial (2.4%), tangential (4.9%), volumetric (8.8%).

Durability Very durable

Treatability Resistant; heartwood is very refractory to treatment.

Working Properties: Planing-easy; Boring-easy; Turning-easy; Nailing-easy; Finish-good. Easy to saw, works to a fairly smooth finish and takes good polish.Usually very uniform in colour and except for occasional roe-mottling which gives the wood a silvery sheen. Being very steady after seasoning, it is considered as a first class work-shop wood.

T S (x100)

TLS (x10)

Gross features Wood is diffuse-porous to semi-ring- porous. Growth rings scarcely distinct and delimited by comparatively larger early wood vessels and fine lines of parenchyma. Vessels large to medium, distinct to fairly distinct to the eye, rather unevenly distributed, few to moderately numerous, mostly solitary and in short radial multiples of 2 or 3, rounded in outline; tyloses abundant. Parenchyma mostly paratracheal-vasicentric and also in terminal bands delimiting growth rings. Rays broad to moderately broad, distinct to the eye, few, rather widely spaced and uniformly distributed.

Uses It is mainly used for building construction, shipbuilding, Class I plywood for general purpose, tool handles, artificial limbs and rehabilitation aids, textile mill accessories, cooperage, carrom draughts, tennis and badminton rackets, brushware, musical instruments, shoe-lasts and pencil slats. Highly valued timber for door and window panels, joinery, furniture and cabinets, especially for drawers, wardrobes, cupboards, kitchen and camp furniture because of its light weight, stability and durability. It is also used for bent wood articles, picture frames, toys, block boards, frame core and cross bands of flush door shutters, plane tables, thermometer scales, cheaper grade metric scales, tea-chest, turnery articles, tool handles, instrument boxes, boat building, packing cases and crates, decking and for cars; also used in paper making and matchwood industries.

HALDU

Tree

Flat Sawn

Cross Cut

Trade Name	Haldu
Vernacular Names	*Manjakadambu, Veembu* (Mal*), Lampatia, Tarak chapa* (Asm.*), Keli- kadam* (Beng.*), Haladwan, Holdarvo* (Guj.*), Haldu, Hardu* (Hind.*), Avanu, Kadambe* (Kan.*), Manja-kadambai* (Tam.*), Bandaru, Dodaga* (Tel.*)*
Botanical Name	*Adina cordifolia* (Roxb*). Hook.f.ex. Brand.*(Syn. *Haldina cordifolia)*
Family Name	Rubiaceae
Origin (Distribution):	Southern moist mixed deciduous forests throughout India, except in arid regions of Rajasthan, moist teak bearing forests and West-coast semi ever green forests. It also occurs in the sub-Himalayan tract from Jamuna eastwards upto Bhutan and is common throughout central, western and southern India, Burma and Sri Lanka.
Tree :	Medium to very large tree, 15-35 m in height, 2-3.5 in girth with a clear bole of 9-12 and upto 110 cm in diameter; often unevenly fluted and buttressed at the base. Bark grey, soft, thick, exfoliating in small irregular flakes, blaze light red inside with white streaks.

General features

Adina cordifolia (haldu) has heart wood that is deep yellow. To identify the wood, check the following:

- Heart wood is deep yellow turning reddish or brownish on exposure.
- Wood is light to moderately heavy and has a fine texture
- Parenchyma is sparse and indistinct to the naked eye
- Rays are fine, numerous and closely spaced
- Vessels are small, solitary and in radial multiples of two to three

Colour: Sapwood pale yellowish or yellowish white. Heart wood is deep yellow turning reddish or brownish on exposure.

Weight: Moderately hard and light to moderately heavy (695 kg/m3 at 12% m.c).

Grain: Fairly straight to somewhat interlocked.

Texture Fine textured

Strength Moderately strong

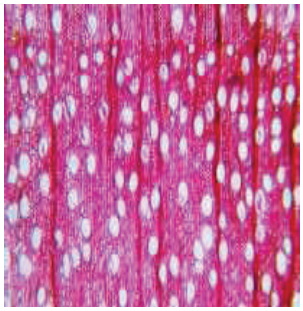
Static bending		Compression parallel to grain
Modulus of Rupture (MOR) N/mm^2	Modulus of Elasticity (MOE) N/mm^2	Maximum Crushing Stress Stress (MCS) N/mm^2
735	101,600	421

Drying and Shrinkage: Green conversion and open stacking under cover recommended. Kiln- seasoning offers no difficulty and brightness of the colour is retained better than the air-seasoned stock. Shrinkage- radial (3.4%), tangential (6.8%).

Durability Non-durable

Treatability Easily treatable, but the uses to which the timber is currently put, do not necessitate preservative treatment.

Working Properties: Sawing not difficult, machining satisfactory, works fairly easy giving good finish.



T S (x100)

TLS (x10)

Gross features Wood is diffuse porous. Growth rings indistinct. Vessels solitary and in radial multiples of two to three, small to very small sized, numerous to very numerous (25-45 per mm^2), evenly distributed, oval in outline, open, vessel lines indistinct, not clearly visible to the naked eye. Soft tissue indistinct to the eye, but visible as bands under a hand lens. Parenchyma extremely sparse paratacheal-scanty; apotracheal, relatively abundant, diffuse and diffuse in aggregate. Rays fine, numerous and closely spaced.

Uses It is one of the best turnery and carving wood and is largely used for class I ply wood, Tea chests, furniture and cabinets, block board and tool handles, pen- holders, combs, reels of cott on and other yarns, jute and textile mill accessories, slubbing and rover tubes and skewers, carrom draughts, chesspieces, bobbins, packing cases and crates, pentop cases, frame, core and cross band of flush door shutters, mine work, ceiling boards, ornamental caskets and picture frames, cricket stumps and bails; musical instruments, mathematical engineering and drawing instruments, brush ware, bent-wood articles and toys; shoe lasts, battery separators, folding chairs and camp furniture and house hold fitments.

HIMALAYAN FIR

Tree

Flat Sawn

Cross Cut

Trade Name	Himalayan Fir
Vernacular Names	*Morinda, Partal, Pindrau, Span,Tos (*Hind.*), Badon, Drewar (*Kash.*)*
Botanical Name	*Abies pindraw* Royle
Family Name	Pinaceae
Origin (Distribution):	Trees are distributed in temperate regions of northern hemisphere. It occurs from Afghanistan to Nepal between 2300 and 3300 m elevation mostly associated with Deodar, Spruce and Oak.
Tree :	It is a lofty tree 45-60 m in height and 4 m in girth. Bark is dark grey and rough.

General features

Abies pindraw (Himalayan Fir) is a soft and light wood To identify the wood, check the following:

- The wood is creamy white, turning light brown on ageing, without any distinct heartwood and no odour.
- Growth rings are distinct; transition from early to latewood is usually gradual.
- Rays are very fine, distinct only under hand lens as closely-spaced fine lines.
- Resin canals are absent.

Colour: The wood is creamy white, turning light brown on ageing, without any distinct heartwood. No odour

Weight: Soft and light wood. 450 kg/m3 at 12% m. c.

Grain: Straight

Texture Fine and even

Strength Weak

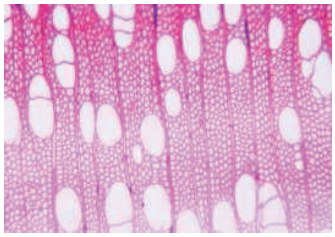
Static bending		Compression parallel to grain
Modulus of Rupture (MOR) N/mm^2	Modulus of Elasticity (MOE) N/mm^2	Maximum Crushing Stress Stress (MCS) N/mm^2
NA	NA	NA

Drying and Shrinkage: Easy to air-dry.

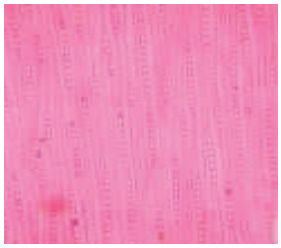
Durability Easily decayed in contact with ground or in exposed locations, but durable indoors and like other conifers is not attacked by borers.

Treatability Easy to saw and work.

Working Properties: Sawing not difficult, machining satisfactory, works fairly easy giving good finish.



T S (x100)



TLS (x10)

Gross features Growth rings are distinct. Vessels transition from early to latewood is usually gradual. Rays are very fine, distinct only under hand lens as closely- spaced fine lines. Resin canals are absent

Uses It is in great demand for all types of light packing cases and fruit crates. Being odourless, it is particularly suitable for packing delicate articles prone to tainting.

JACK WOOD

Tree

Flat Sawn

Cross Cut

Trade Name	Jack wood
Vernacular Names	*Plavu, Pilavu, Kathal (*Mal*), Kanthol (*Beng.*), Alasu, Halasu (*Kan.*), Phanas (*Mar*), Pila, Pilapalam (*Tam.*), Panasa (*Tel.*)*
Botanical Name	*Artocarpusheterophyllus* Lamk.Syn. *Artocarpus integrifolia (*Linn.f*)*
Family Name	Moraceae
Origin (Distribution):	West coast tropical evergreen and southern hill-top tropical evergreen forests and Western Ghats commonly in Deccan, warmer parts of the countries like West Bengal, Bihar and Manipur; widely cultivated.
Tree :	A medium to large, evergreen tree reaching 18-25 m in height and 120 cm in diameter. Bark thick and blackish, mottled with black and green, rough with warty excrescences.

General features

Artocarpus heterophyllus (jack wood) is a moderately hard and moderately heavy wood. To identify the wood, check the following:

- Heartwood which is distinguishable from sap wood is yellow to yellowish brown and lustrous
- Parenchyma is paratracheal, forming halos around vessels
- Rays are clearly visible to the naked eye
- Vessels solitary and in radial multiples of two to three; large to medium-sized and often filled with tyloses and white chalky deposits

Colour: Heartwood yellow to yellowish brown or pinkish brown with darker streaks, lustrous when first exposed. Sapwood is greyish or pale yellow.

Weight: Moderately hard and moderately heavy.
555 kg/m3 at 12% m.c.

Grain: Straight to interlocked

Texture Coarse to medium

Strength Strong

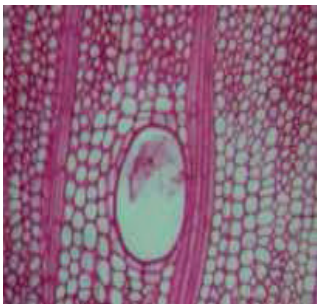
Static bending		Compression parallel to grain
Modulus of Rupture (MOR) kg/cm^2	Modulus of Elasticity (MOE) kg/cm^2	Maximum Crushing Stress Stress (MCS) kg/cm^2
806	100,700	496

Drying and Shrinkage: Seasons well when open stacked after conversion without trouble or degrade. The converted material stacked in open piles with good circulation of air through the stock, gives best results. Kiln-drying schedule III is recommended.

Durability Very durable

Treatability The heartwood is refractory to treatment.

Working Properties: Easy to saw and work, can be brought to a smooth finish and takes good polish.



T S (x100)

TLS (x100)

Gross features Growth rings indistinct to distinct, when distinct, demarcated by slightly denser and darker coloured latewood fibrous tissues. Wood diffuse porous. Vessels solitary and in radial multiples of two to three; large to medium-sized, clearly visible with a hand lens; few to moderately numerous (2-5 per mm^2), oval to round in outlines, often filled with white chalky deposits or tyloses. Soft tissue forming light coloured halos around vessels often extending sideways joining similar extensions and sometimes forming bands. Parenchyma paratracheal-vassicentric to aliform.
Rays moderately broad to fine, few and widely spaced and uniformly distributed, forming inconspicuous flecks on the radial surface; clearly visible to the unaided eye.

Uses A multipurpose constructional timber also used for furniture and cabinets, carving, turnery, class II plywood and veneers, marine plywoods and concrete shuttering plywood, blockboard, flushdoors, musical, mathematical, engineering and drawing instruments, lorry, bus bodies and brush ware. In boat building, they are recommentrials for hull planking, decking, ribs, stringers, flooring transom and dugouts.

KADAM

Tree

Flat Sawn

Cross Cut

Trade Name	Kadam
Vernacular Names	*Kadam (*Hin.*), Cadamb, Attu –teak, Kodavara, Chakka, Kadambam (*Mal.*), Roghu (*Asm.*), Kadam (*Beng.*), Kadamb, Karam (*Hind.*), Bale (*Kan.*), Kadamba, Nhyu (*Mar.*), Kadambo (*Or.*), Vellei- Kadamba, Kola-aiyila (*Tam.*), Kadambe (*Tel.*)*
Botanical Name	*Anthocephalus chinensis (Lamk.) A.Rich. ex Walp. [Syn. Anthocephalus cadamba (*Roxb.*) Miq.*
Family Name	Rubiaceae
Origin (Distribution):	West coast semi-evergreen forests. It occurs in the sub-Himalayan tract from Nepal eastwards in the lower hills of Darjeeling, Assam, Bihar, Orissa, Eastern Ghats, Andamans and Burma. It is a tree of moist warm regions, deciduous and evergreen forests.
Tree :	Medium to large tree with a straight cylindrical bole and horizontal branches, 15-25 m in height and 1.5-2.5 m in girth with a clear bole of 9 m and about 60 cm in diameter. Bark dark grey with longitudinal fissures; peels off in thin scales.

General features

Wood of *Anthocephalus chinensis* is white with a yellowish tinge and heartwood that is not distinguishable from sap wood. To identify the wood, check the following:

- Wood is light to moderately heavy
- Growth rings are fairly distinguishable
- Parenchyma is scanty
- Rays are coarse-storied
- Vessels are large to very small and moderately numerous to numerous, mostly solitary or in radial multiples of 2, 3 or 4.

Colour: Heart wood and sapwood are not distinct. White with yellowish tinge to cream white or yellowish grey.

Weight: Light to moderately heavy, 385 to 640 kg/m3 at 12 % m. c

Grain: Straight

Texture Medium to fine

Strength Soft and weak.

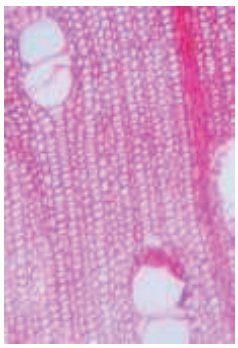
Static bending		Compression parallel to grain
Modulus of Rupture (MOR) kg/cm^2	Modulus of Elasticity (MOE) kg/cm^2	Maximum Crushing Stress Stress (MCS) kg/cm^2
884.1	95,200	541.1

Drying and Shrinkage: It can be seasoned easily without any cracking and warping. Conversion soon after felling and stacking between stickers under cover recommended.

Durability Perishable.

Treatability Heartwood easily treatable with preservatives.

Working Properties: Sawing and working are not difficult. It can be peeled readily on a rotary cutter.



T S (x100)

TLS (x100)

Gross features

Wood is diffuse porous.

Growth rings fairly distinct, but not conspicuous.

Vessels large to very small, moderately numerous to numerous (4-15 per mm^2), mostly solitary or in radial multiples of 2, 3 or 4,oval in outline, open, vessel lines distinct

Parenchyma paratracheal-scanty; apotracheal diffuse to diffuse-in- aggregates, tending to form a net like structure with rays.

Rays very fine, closely spaced.

Uses

It is extensively used for packing cases, ceiling boards, bottom of drawers, backing of cupboards, toys. It is also used for furniture, tea chests, building construction, class III veneers for plywood, match boxes and match splints, soles and heels of sandals and shoes, pencil slats, turnery and battens. It is also suitable for writing and printing paper.

KANJU

Tree

Flat Sawn

Cross Cut

Trade Name	Kanju, Indian elm
Vernacular Names	*Anjan* (Beng.)*; Chirol, Karanji, Papri* (Hind.)*; Aval* (Mal.)*; Papara* (Mar.)*; Thapsi* (Kan.)*; Chilbil* (Or.)*; Ayili* (Tam.)
Botanical Name	*Holoptelea integrifolia* (Roxb.) *Planch.*
Family Name	Ulmaceae
Origin (Distribution):	West coast semi-evergreen and occasionally in moist teak bearing forest.
Tree :	Medium to large-sized, 15-25 m in height and 80 cm in diameter; bark whitish-grey, thin, with longitudinal furrows and exfoliating in irregular flakes

General features

Holoptelea integrifolia (Kanju) is a moderately heavy wood. To identify the wood, check the following:

- Heartwood and sapwood are not distinct. Wood light yellow or yellowish grey
- Wood is moderately hard and moderately heavy.
- Parenchyma paratracheal, aliform and winged type
- Rays fine to moderately broad, closely spaced and numerous
- Vessels solitary and in radial multiples of two to three, medium- sized

Colour: Heartwood and sapwood are not distinct.Wood light yellow or yellowish grey, darkening on exposure; somewhat lustrous.

Weight: Moderately hard and moderately heavy (595-600 kg/m3 at 12 % m.c)

Grain: Shallowly interlocked

Texture Medium coarse

Strength Strong

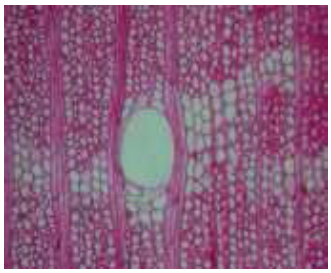
Static bending		Compression parallel to grain
Modulus of Rupture (MOR) kg/cm^2	Modulus of Elasticity (MOE) kg/cm^2	Maximum Crushing Stress Stress (MCS) kg/cm^2
719	91,500	411

Drying and Shrinkage: Seasons well. Kiln-seasoning offers no difficulty.

Durability Non-durable

Treatability Heartwood treatable but complete penetration not always obtained.

Working Properties: Easy to saw and work, turns to a fine smooth surface and takes good polish. Turning-easy, finish-good.



T S (x100)

TLS (x100)

Gross features Growth rings distinct. Diffuse porous wood.Vessels solitary and in radial multiples of two to three, medium-sized, moderately numerous (5-8 per mm^2), filled with white chalky deposits. Soft tissue forms eyelet shaped patches around vessels. Rays fine to moderately broad, closely spaced and numerous. Ripple marks present.Parenchyma paratracheal, aliform and winged type; also confluent bands of one to three cell widths present.

Uses The wood is used for constructional works, bobbins and cotton reels in textile mills, general purposes Class I plywood, tea chests, decorative plywood, block boards, furniture, and cabinets, tool handles, agricultural implements, bentwood articles and toys.

KASSI / MULLU-VENGA

Tree

Flat Sawn

Cross Cut

Trade Name	Kassi, Mullu-Venga
Vernacular Names	*Mullu-venga, Kassi (*India*), Seikchi, Seikchibo(Myanmar), Kuhir, Kunhir (*Assam*), Geio, Kantakoi (*Bengal*), Moniu (*Gujarat*), Gonduli, Khaja (*Hind.*), Paathor, Mark (*Punja.*)*
Botanical Name	*Bridelia squamosa (*Lamk.*) Gehrm.Syn. Bridelia retusa Spreng.*
Family Name	Euphorbiaceae
Origin (Distribution):	India and Myanmar, planted outside the forests mainly in home gardens. Mostly in southern moist mixed deciduous, west coast semi-evergreen and moist teak bearing forests.
Tree :	Small to medium, 8-18 m in height, 1.5 m to 1.8 m girth with cylindrical straight stem having strong conical spines up to 5 cm long on the bark of the young stem and up to 65 cm in diameter. Bark greyish-brown, rough with many cracks, exfoliating in irregular plates.

General features

Kassi (Bridelia squamosa) has heart wood that is dull olive brown with light bands with little demarcation from sapwood . To identify the wood, check the following:

- Growth rings distinct only under the hand lens, delimited by interrupted fine lines of terminal/marginal parenchyma.
- Vessels medium to small, few, mostly solitary or in radial multiples of 2-4, oval or angular in outline, tyloses present.
- Parenchyma paratracheal-scanty and not visible to the eye but distinct under the lines as fine lines delimiting growth marks.
- Rays fine to moderately broad, fairly closely spaced and uniformly distributed, forming silvery radial flecks, filled with dark coloured deposits and crystals.

Colour: Heartwood dull olive brown, sometimes with light bands due to interlocked fibres; not sharply demarcated from the greyish white to grey sapwood.

Weight: Moderately hard and moderately heavy; (785kg/m3 at 12% m.c)

Grain: Shallowly or deeply interlocked

Texture Medium to coarse

Strength Moderately strong

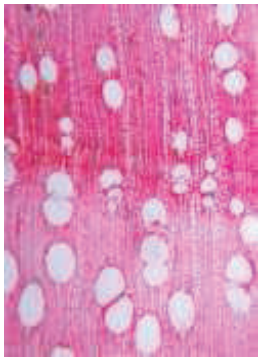
Static bending		Compression parallel to grain
Modulus of Rupture (MOR) N/mm^2	Modulus of Elasticity (MOE) N/mm^2	Maximum Crushing Stress (MOE) N/mm^2
74.4	10617	41.3

Drying and Shrinkage: Dries fairly rapidly without any degrade; green conversion and stacking under cover recommended; shrinkage – Radial (2.5%), Tangential (6.2%), Volumetric (8.3%)

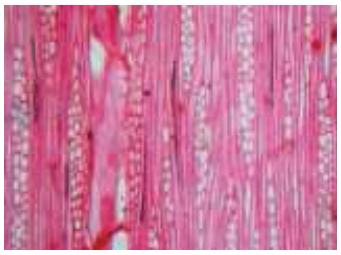
Durability Moderately durable. Timber is durable.

Outer heart wood is resistant and inner heart wood is moderately resistant.

Working Properties: Planing-easy; Boring-easy; Turning- easy; Nailing-easy; Finish-good. No difficulty in sawing and machining and works to a fairly smooth surface.



T S (x100)



TLS (x100)

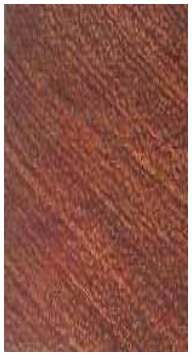
Gross features Diffuse porous wood.Growth rings distinct only under the hand lens, delimited by interrupted fine lines of terminal/ marginal parenchyma, 2-10/cm. Vessels medium to small, few to moderately few, 10-20/mm 2 evenly distributed, mostly solitary or in radial multiples of 2-4, oval or angular in outline, tyloses present. Vessel lines distinct, but not conspicuous. Parenchyma paratracheal-scanty and not visible to the eye but distinct under the lens, as fine lines delimiting growth marks. Rays fine to moderately broad, fairly closely spaced and uniformly distributed, forming silvery radial flecks, filled with dark coloured deposits and crystals.

Uses Good second class timber used for construction, door and window shutters, rafters, posts and floor boards and other domestic purposes. Also used for agricultural implements, tool handles handicrafts, yokes, drums, ballies, cross arms, packing cases, mine work, dunnage pallet, railway sleeper, ceiling, furniture, cabinet making, carts and carriages.

KEEKAR

Tree

Flat Sawn



Cross Cut

Trade Name	Keekar
Vernacular Names	*Perdesi baval (Guj.), Vilayati babul, Vilayati khejra (Hindi), Vilayati jhand, Vilayati kikar (Punjab & Haryana), Ganda babul, Ghaf Bahri or Velvet Mesquite (India)*
Botanical Name	*Prosopis juliflora DC*
Family Name	Leguminosae (Mimosae)
Origin (Distribution):	A native of tropical America introduced and now naturalized throughout arid areas in India chiefly Andhra Pradesh, Delhi, Haryana, Karnataka, Madhya Pradesh, Maharashtra, Punjab, Rajasthan, Tamil Nadu and Uttar Pradesh. It is usually seen in ever green and semi-ever green forests.
Tree	It is a small to medium-sized tree usually unarmed, attaining a height of 9-12 m and girth of 90 cm. It may attain a height of 18 m in favourable localities. Bark greyish-brown, rough, longitudinally fissured and thin

General features

Prosopis juliflora DC (Keekar) is a hard to very hard wood. To identify the wood, check the following:

- Heartwood dark brown to purplish-brown
- Wood is very hard
- Parenchyma paratracheal, mostly aliform to aliform confluent, enclosing several vessels at places forming wavy band particularly in the late wood also as diffuse scattered cells and terminal/ marginal in broken lines on growth rings, strands fusiform.
- Rays homogenous, composed of procumbent cells only, gummy infiltrations common.
- Vessels moderately large to small, visible to the eye, 45-190 µm in diameter (mean 115 µm, few to moderately numerous or numerous (13-26/ mm^2). The mesquite pods are sweet and edible and flowers are the source of honey.

Colour: Sapwood distinct from heartwood. Heartwood dark brown to purplish-brown and sapwood yellowish –white or buff

Weight: Hard to very hard and heavy to very heavy. Specific gravity 0.88-0.90 (Air- dry)

Grain: Straight to slightly interlocked

Texture Medium to coarse

Strength Strong

Static bending		Compression parallel to grain
Modulus of Rupture (MOR) kg/cm^2	Modulus of Elasticity (MOR) kg/cm^2	Maximum Crushing Stress (MOR) kg/cm^2
NA	NA	NA

Drying and Shrinkage: NA

Durability NA

Treatability: NA

Working Properties: The wood is hard to saw and work, turns well.

T S (x100)

TLS (x100)

Gross features

Wood is diffuse porous.

Growth rings inconspicuous but usually distinct in the sapwood under the hand lens, delimited by a fine interrupted line of parenchyma and denser zone of latewood fibres, 1-5 per cm.

Vessels moderately large to small, visible to the eye, 45-190 µm in diameter (mean 115 µm, few to moderately numerous or numerous (13-26/mm^2). Parenchyma paratracheal, mostly aliform to aliform confluent enclosing several vessels at places forming wavy band particularly in the late wood also as diffuse scattered cells and terminal/marginal in broken lines on growth rings, strands fusiform. Fibres libriform, angular in cross section, sometimes arranged radially, non- septate.

Rays homogenous-composed of procumbent cells only, gummy infiltrations common.

Uses

The mesquite pods are sweet and edible and flowers are the source of honey. The gum obtained is used as an adulterant or substitute for gum Arabic. The wood takes paint and polish well. It is cheaply valued for fuel and charcoal but locally can be used for tool handles, agricultural implements and cheap furniture.

MAHOGANY, AMERICAN

Tree

Flat Sawn

Cross Cut

Trade Name	Mahogany
Vernacular Names	*Honduras mahogany, Guatemala mahogany, Brazilian mahogany, Mogno* (Brazil), *Zopilote, Chiculte* (Mexico)
Botanical Name	*Swietenia macrophylla* King
Family Name	Meliaceae
Origin (Distribution):	Native to Central and South America, particularly Mexico and Honduras, and introduced to many tropical countries including India. It is widely cultivated as an avenue tree.
Tree	A medium sized tree reaching a height of 12-18 m and a diameter of 80-130 cm

General features

Swietenia macrophylla (bigleaf mahogany) is a hardwood. To identify the wood, check the following:

- Heartwood is reddish brown
- Wood is moderately hard and heavy
- Prominent marginal parenchyma
- Rays are coarse-storied
- Vessels are large (easily visible with naked eye), often in multiples of 2/3. It is a CITES Appendix II timber species.

Colour: Heartwood colour varies from light reddish or yellowish brown to dark reddish brown, lustrous. Sapwood yellowish white to pale brownish gray.

Weight: Moderately heavy 650 kg/m3 at 12% m. c

Grain: Straight to interlocked. Flat-sawn surface produce prominent growth ring figure.

Texture Medium to coarse

Strength Strong

Static bending		Compression parallel to grain
Modulus of Rupture (MOR) kg/mm^2	Modulus of Elasticity (MOR) kg/mm^2	Maximum Crushing Stress (MOR) kg/mm^2
83	8800	44.2

Drying and Shrinkage: Dries fairly rapidly without degrade; Shrinkage- radial (2%), tangential (3%), volumetric (5%)

Durability Moderately durable

Treatability: Extremely resistant

Working Properties: Planing-easy; boring-easy; Turning- easy; Nailing-satisfactory, but pre-boring necessary; Finish-good

T S (x100)

TLS (x100)

Gross features

Wood is diffuse porous.

Growth rings distinct.

Vessels solitary and in radial multiples of two to three, medium-sized, moderately numerous (10-15 per mm^2). Soft tissue banded and forms incomplete sheaths around vessels. Pores usually stained or discoloured, darker, are large and evenly spread through the wood.

Rays fine to moderately broad, few and widely spaced. Rays can be seen clearly on radial-cut surfaces as smooth plates which reflect the light.

Uses

High class furniture and cabinet making, paneling and Interior joinery, boat interiors, musical instruments, show cases, counters and interior decoration, Jewellery boxes, carvings, rotary cut logs for ply wood and sliced veneers for decorative work.

MANGIUM

Tree Flat Sawn Cross Cut

Trade Name	Mangium
Vernacular Names	*Brown salwood, Black wattle, Hickory wattle (*Aus.*); Mangge hutan, Tongke hutan (*Ceram*), Nak (*Maluku*), Laj (*Aru*), Jerri (*Irian jaya*) (*Indonesia*); Arr (* Papua New Guinea*); Mangium, Kayu SAFODA (*Malaysia*); Kra thin tepa (*Thailand)
Botanical Name	*Acacia mangium* Willd.
Family Name	Leguminosae (Fabaceae)
Origin (Distribution):	An exotic, native to Australia, Papua New Guinea and Indonesia; widely cultivated in different parts of Kerala.
Tree	A medium-sized tree, reaching a height of 10-18 m and a diameter of 60-70 cm

General features

Acacia mangium is moderately heavy wood. To identify the wood, check the following:

- Heartwood is yellowish brown.
- Wood is moderately hard and moderately heavy.
- Parenchyma paratracheal and vasicentric.
- Rays fine, numerous and closely spaced.
- Vessels solitary and in radial multiples of two to three.

Colour: Heartwood is yellowish brown and sapwood is creamy white in colour.

Weight: Moderately hard and moderately heavy (70 kg/m3 at 12 % m. c

Grain: Straight to interlocked

Texture Medium to fine

Strength Strong

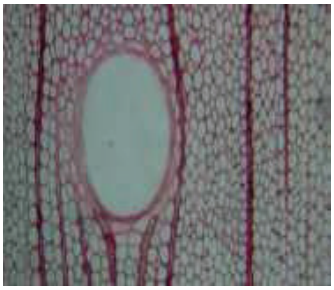
Static bending		Compression parallel to grain
Modulus of Rupture (MOR) kg/mm^2	Modulus of Elasticity (MOR) kg/mm^2	Maximum Crushing Stress (MOR) kg/mm^2
105	11588	59.9

Drying and Shrinkage: Dries slowly, kiln-dries fairly rapidly but marked collapse may occur during the early stages of seasoning; collapse may be remedied by reconditioning; shrinkage-tangential (6.1%), volumetric (8.3 %) and radial (2.2 %).

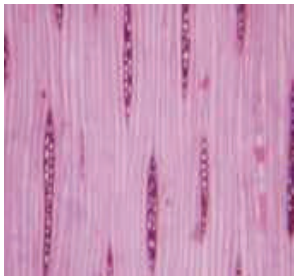
Durability Moderately durable, inner heart wood is subjected to heart rot. The wood is liable to be attacked by termites on ground contact

Treatability: Moderately resistant

Working Properties: A tough and hard timber easy to work with hand tools. Planing-easy; boring- easy; turning-easy; nailing-easy; finish- good.



T S (x100)



TLS (x100)

Gross features Growth rings fairly distinct. Diffuse porous wood.

Vessels solitary and in radial multiples of two to three; large to medium-sized; moderately numerous (10-16 per mm^2). Soft tissue forming a sheath around vessels.

Rays fine, numerous and closely spaced. Rays one to three-cell wide, homogeneous.

Parenchyma paratracheal and vasicentric

Uses Used for furniture making, agricultural implements and construction work. Mainly used for pulp wood production. Suitable for door and window frames, cabinet making, light structural work, moldings, boxes, crates, paneling and turnery, sports goods and charcoal. It is used as a component of composite wood products.

MANGO

Tree

Flat Sawn

Cross Cut

Trade Name	Mango wood
Vernacular Names	*Maavu, moochi (*Mal.*), Aaam (*Hin.*)*
Botanical Name	*Mangifera indica* Linn.
Family Name	Anacardiaceae
Origin (Distribution):	West coast tropical evergreen and West coast semi evergreen forests; cultivated extensively
Tree	Medium to large 15-30 m in height and 50-100 cm in diameter. Bark brown or dark grey, rough

General features

Mangifera indica (mango wood) is a moderately hard and heavy wood. It has yellowish white to greyish brown and somewhat lustrous wood. To identify the wood, check the following:

- Growth rings are fairly distinct
- Wood is moderately hard and heavy
- Aliform to confluent parenchyma and often delimiting growth rings
- Rays are fine to moderately broad and numerous
- Vessels are large to medium, often filled with tyloses, numerous and solitary or in radial multiples of 2-3

Colour: Yellowish white to greyish brown, sap wood and heart wood not distinct or sometimes heartwood distinct and dark brown; somewhat lustrous.

Weight: Moderately hard and moderately heavy. 690 kg/m3 at 12% m.c

Grain: Straight to somewhat interlocked

Texture Medium to coarse

Strength Strong

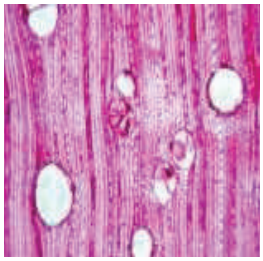
Static bending		Compression parallel to grain
Modulus of Rupture (MOR) kg/cm^2	Modulus of Elasticity (MOR) kg/cm^2	Maximum Crushing Stress (MOR) kg/cm^2
904	111,800	448

Drying and Shrinkage: Not refractory; green conversion followed by stacking in dry ventilated area recommended. Kiln-seasoning improves the appearance of the timber without degradation. Retains its shape remarkably well seasoning. Shrinkage green to oven dry radial (3.2%); Tangential (4%)

Durability Non-durable

Treatability: Easily treatable

Working Properties: Easy to saw, machining satisfactory, good polish. Nail and screw holding capacity excellent. Peels well.



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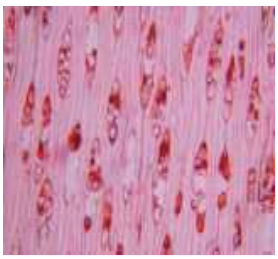


TLS (x100)

Gross features

Wood is diffuse porous.

Growth rings fairly distinct.

Vessels large to medium, few to moderately numerous solitary or in radial multiples of 2-3 or more, often filled with tyloses.

Parenchyma paratracheal- aliform to confluent, often delimiting growth rings.

Rays fine to moderately broad, numerous, closely spaced. Pith flecks are usually present.

Uses Ceiling boards, window frames, general purpose class I plywood, furniture and cabinets, block boards, match splints and boxes, boat and ship buildings, bobbins, bent wood articles, shoe-lasts

MYSORE GUM

Tree

Flat Sawn

Cross Cut

Trade Name	Mysore gum, Eucalyptus hybrid
Vernacular Names	*Eucalyptus, Eucali (*Mal.*), Mysore gum, Forest red gum, Eucalypts (*India*), Queensland blue gum (*Australia*)*
Botanical Name	*Eucalyptus tereticornis* Sm
Family Name	Myrtaceae
Origin (Distribution):	Native of Australia extensively raised in plantations in many tropical and sub tropical countries including India for pulpwood production. Mostly seen in Uttar Pradesh, Madhya Pradesh, Karnataka, Tamil Nadu and West Bengal. It is also seen in Long Islands in Middle Andaman Division. It is indigenous to coastal districts of eastern Australia and Papua New Guinea. In India it is the most widely planted species upto 1,200 m elevation.
Tree	Large, about 25-45 m in height, 3-6 m in girth, and straight bole of about 15-22 m and large open crown and 40 cm in diameter. Bark smooth, whitish or ash coloured, deciduous decorticating in more or less long plates and irregularly blotched throughout, sometimes with a little rough and flaky bark persisting at base.

General features

Eucalyptus tereticornis Sm. (Mysore gum) is a very hard and heavy wood. To identify the wood, check the following:

- Heartwood is pale brown to reddish brown
- Parenchyma: moderately abundant to abundant, apotracheal, diffuse
- Rays fine, closely and more or less evenly spaced
- Vessels medium sized, visible to the eye, moderately numerous (5-20 per mm^2), mostly solitary, open or filled with abundant tyloses, kino-like deposits sparse to moderately abundant.

Colour: Heart wood pale brown to reddish brown fairly well demarcated form the sapwood. Sapwood light greyish-brown or pale red

Weight: Lustrous, hard to very hard. Heavy to very heavy. Air dry specific gravity 980 kg/m3

Grain: Straight to shallowly interlocked or wavy

Texture Medium to coarse

Strength Moderately strong

Static bending		Compression parallel to grain
Modulus of Rupture (MOR) kg/mm^2	Modulus of Elasticity (MOR) kg/mm^2	Maximum Crushing Stress (MOR) kg/mm^2
85	9882	50.3

Drying and Shrinkage: Seasoning difficult, liable to warp and crack Shrinkage Green to oven-dry, Radial – 6.3%, Tangential – 9.6%. The high values for shrinkage indicate that the dimensional stability of the wood may be poor.

Durability Moderately durable under cover

Treatability: It is likely to be refractory to preservative treatment.

Working Properties: Planing easy, boring easy, turning easy; pre-boring necessary. Easy to saw and work, takes a good finish. Nail holding capacity is good

T S (x100)

TLS (x100)

Gross features Wood is diffuse porous.

Growth rings are indistinct.

Vessels medium, visible to the eye, moderately numerous(5-20 per mm^2), mostly solitary, rarely in radial or oblique chains, round to oval, open or filled with abundant tyloses, kino-like deposits sparse to moderately abundant.

Parenchyma moderately abundant to abundant, apotracheal-diffuse to diffuse- in aggregates, kino-like deposits sparse to abundant. Parenchyma indistinct to distinct to the eye, distinct under hand lens forming thin sheet round the vessel.

Rays fine, closely and more or less evenly spaced, kino-like deposits abundant. Specific gravity of this species. varies in different localities.

Uses Mainly used for fuel, paper and pulping, suitable for packing cases and boxes, beams, columns, power transmission poles and posts. It is now being used by some paper mills in North India in mixture with other raw materials. It is also used for rayon grade pulp by some mills. It is highly suitable for construction work, furniture and stakes.

NEEM

Tree

Flat Sawn

Cross Cut

Trade Name	Neem
Vernacular Names	*Aryaveppu, Veppu, Vempu, Leemdo, Kadunimb, Neem (*India*), Nim (*Pakistan*), Baypay (*Malaysia*) Kwinin (*Thailand*) , Mindi (*Indonesia*)*
Botanical Name	*Azadirachta indica* A. Juss
Family Name	Meliaceae
Origin (Distribution):	Native of Indian subcontinent; distributed throughout South- East Asia, East and Sub-Saharan Africa, Fiji and some parts of Central America. Naturally found in deciduous forests of Peninsular India and homesteads of Kerala
Tree	Medium to large tree with a height of 15-20 m with a clear bole of 7 m and diameter of 50 cm.

General features

Azadirachta indica A. Juss (Neem) is a moderately heavy wood.To identify the wood, check the following:

- Heartwood is reddish brown, aromatic and slightly lustrous
- Distinct growth rings
- Parenchyma: Apotracheal, paratracheal- vasicentric, also in tangential lines connecting vessels
- Vessels medium sized, few and occurring in solitary or in radial multiples of two to three, often in clusters and filled with reddish gummy deposits

Colour: Heartwood reddish brown, aromatic, moderately lustrous. Sapwood is yellowish white, yellowish brown or greyish yellow.

Weight: Hard to moderately hard; moderately heavy. (835 kg/m3 at 12% m.c)

Grain: Interlocked

Texture Coarse

Strength Strong

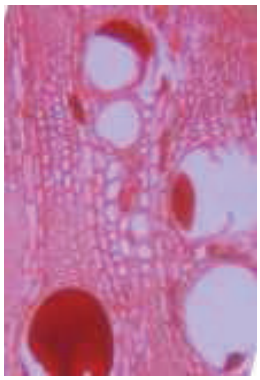
Static bending		Compression parallel to grain
Modulus of Rupture (MOR) kg/mm^2	Modulus of Elasticity (MOR) kg/mm^2	Maximum Crushing Stress (MOR) kg/mm^2
89	9666	47.1

Drying and Shrinkage: Dries well. Green conversion followed by open stacking under cover recommended; Shrinkage- green to oven dry; Radial (4.5%), Tangential (6.2%) volumetric (10.7%)

Durability Durable, resistant to termite damage.

Treatability: Resistant

Working Properties: Planing-easy, boring-easy, Turning-easy, Nailing-good, but pre-boring necessary; Finish-good. Sawing and machining fairly good, gives fair finish.



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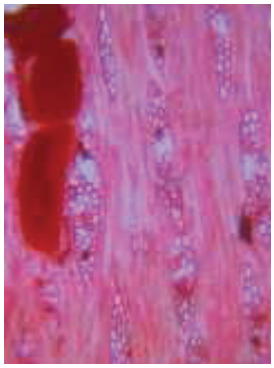


TLS (x100)

Gross features Growth rings distinct.

Vessels medium, few to moderately few, solitary or in radial multiples of two to three, often in clusters; numerous (16-20 per mm^2). Vessels filled with reddish gummy deposits. Soft tissue forms bands delimiting growth ring and also associated with vessels.

Parenchyma – Apotracheal-irregularly placed tangential and continuous bands delimiting growth rings, Paratracheal- Vasicentric, also in tangential lines connecting vessels.

Rays fine to medium sized, numerous and somewhat widely spaced.

Special Featurs The wood possesses characteristic odor. The wood has insect repellant properties due to the presence of neem oil. Gum canals often present in tangential bands.

Uses Used in light construction, furniture, doors and window frames boards and panels, cabinets, boxes and crates. Also used for agricultural implements, tool handles, musical instruments, cigar boxes, matches, ply wood, veneers, carving, and toys

NEERMARUTHU

Tree

Flat Sawn

Cross Cut

Trade Name	Arjun
Vernacular Names	*Arjun (*Beng., Hind., Or.*), Arjuna- sadada (*Guj.*), Holematti, Nadiam (*Kan.*),Kahu, Sandura (*Mar.*), Kula muruthu, Vella marda (*Tam.*),Yermaddi (*Tel.*)*
Botanical Name	*Terminalia arjuna* Bedd.
Family Name	Combretaceae
Origin (Distribution):	The tree occurs throughout greater part of the Peninsula from Avadh Southwards on banks of streams. It is found in Bihar, Orissa, coastal Andhra Pradesh, the Deccan and Central India, but uncommon in Tamil Nadu Except in Tirunelveli. It occurs on the West Coast from Gujarat southwards. It also occurs locally along banks of streams in sub-Himalayan tract in Uttar Pradesh and Himachal Pradesh.The tree is extensively planted for shade and ornament in avenues and parks.
Tree	Large evergreen tree with spreading crown and drooping branchlets, 18-24 high and over 3 m in girth. The bole is rarely long or straight and is usually buttressed and often fluted.Bark is pale greenish-grey and smooth.

General features

Terminalia arjuna (Neermaruthu) is a hard and heavy wood. To identify the wood, check the following:

- Sapwood is reddish-white and the heartwood, which is sharply delineated from the sapwood, is brown to dark brown variegated with darker coloured streaks.
- Wood is diffuse-porous.
- Growth rings delimited by fine concentric lines of soft tissues which are distinct only under hand lens.
- Vessels - The pores are large, distinct to the eye, few, more or less evenly distributed solitary or in radial multiples of 2-3, partially filled with tyloses and also reddish-brown gummy deposits in the heartwood.
- Soft tissues form sheath or eye lets round the pores which are usually distinct to the eye, occasionally also with short lateral extensions which connect adjoining pores.
- Rays are fine to very fine, distinct only under hand lens.

Colour: Sapwood is reddish-white and the heartwood, which is sharply delineated from the sapwood, is brown to dark brown variegated with darker coloured streaks.

Weight: Hard and heavy. Air-dry weight about 800 kg/cum

Grain: Interlocked

Texture Coarse

Strength Strong

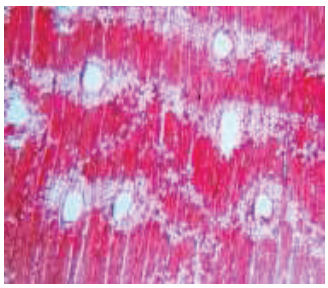
Static bending		Compression parallel to grain
Modulus of Rupture (PSI)	Modulus of Elasticity (PSI)	Maximum Crushing Stress
8706	12614	N. A

Drying and Shrinkage: Difficult to air-dry as it is liable to warping and splitting. Radial shrinkage 4%, tangential 7%, volumetric12%.

Durability Durable

Treatability: Heartwood response to treatment is reported to be good, but complete penetration may not be always achieved.

Working Properties: Difficult to work, but with care can be brought to a fine finish, and takes lasting polish



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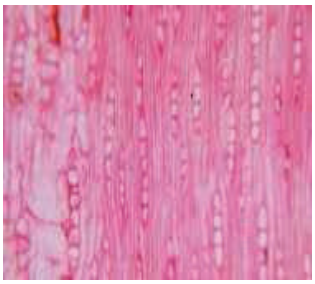


TLS (x100)

Gross features Wood is diffuse-porous.

Growth rings delimited by fine concentric lines of soft tissues which are distinct only under hand lens.

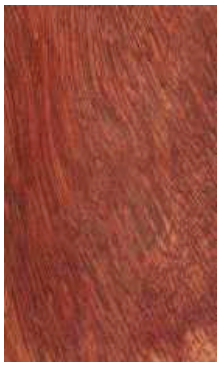
Vessels - The pores are large, distinct to the eye, few, more or less evenly distributed solitary or in radial multiples of 2-3, partially filled with tyloses and also reddish-brown gummy deposits in the heartwood.Soft tissues form sheath or eye lets round the pores which are usually distinct to the eye, occasionally also with short lateral extensions which connect adjoining pores.

Rays are fine to very fine, distinct only under hand lens.

Uses The timber is mainly used for agricultural implements, water troughs; boat building, cart making and pit props. It is also used for constructional purposes like door and window frames. It is also used for block boards and plywood. As the trees are found on river banks, they are often not felled for fear of erosion.

POON/PUNNA

Tree



Flat Sawn

Cross Cut

Trade Name	Poon, Punna
Vernacular Names	*Kath champa, Sultana champa (*Beng. and Hindi*),hona,vuma (*Kan.*), Pinna,Punna (*Mal.*), Pinnai,Punnai (*Tamil*), Ponna,Punna (*Tel.*)Bintangur (*Indonesia*), Kraathing (*Thailand*), Penaga (*Malaysia*), Ponnyet (*Myanmar*)*
Botanical Name	*Calophyllum inophyllum Linn.*
Family Name	Clusiaceae (Guttiferae)
Origin (Distribution):	India, Myanmar, South-East Asia and Australia along the coastal regions and river banks in restricted localities. Also in West Coast from Konkan Southwards, Coast of Orissa and Andaman.
Tree	Medium, 15-18 m in height and 65 cm or more in diameter.Bark brownish-black with shallow irregular fissures

General features

Calophyllum inophyllum Linn. (Poon/Punna) is a moderately hard and heavy wood. To identify the wood, check the following:

- Heartwood reddish-brown with darker streaks.
- Wood is hard
- Parenchyma- apotracheal -narrow tangential bands.
- Rays fine to very fine, distinct numerous closely spaced lines.
- Vessels large to medium, few exclusively solitary appear as radial or oblique chains, occasionally filled with tyloses and gummy deposits.

Colour: Heart wood reddish-brown with darker streaks, lustrous without characteristic odour or taste. Sapwood pale yellow or pinkish brown.

Weight: Moderately hard and moderately heavy (600 kg/m3 at 12% m. c)

Grain: Broadly interlocked

Texture Medium

Strength Strong

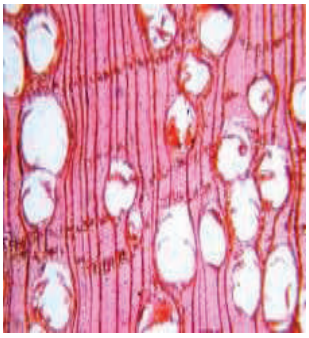
Static bending		Compression parallel to grain
Modulus of Rupture (MOR) kg/mm^2	Modulus of Elasticity (MOR) kg/mm^2	Maximum Crushing Stress (MOR) kg/mm^2
75	6892	50.9

Drying and Shrinkage: Drying moderately difficult, liable for surface cracks; Shrinkage-radial (5.8%), tangential (7.7%), volumetric (13.5%)

Durability Moderately durable

Treatability: Moderately resistant

Working Properties: Planing-moderately difficult, Boring easy, nailing-good but pre-boring necessary, finish-good



T S (x100)

TLS (x100)

Gross features

Wood is diffuse-porous.

Growth rings indistinct.

Vessels large to medium, few exclusively solitary appear as radial or oblique chains, occasionally filled with tyloses and gummy deposits.

Parenchyma- apotracheal -narrow tangential bands.

Rays fine to very fine, distinct, numerous closely spaced lines.

Uses

Hard and strong timber suitable for general construction like bridge poles, ceiling boards, plankings, rafters and boat building, especially for keels and for pulley blocks. It is also used for the manufacture of furniture, paneling, cabinet work, heavy packing boxes, tent poles, plywood, handicrafts, musical instruments and decorative veneer. It is a specified timber for ballies for general purposes, poles for overhead and telecommunication lines, battens of plywood for packing tobacco for export returnable wooden crates for vegetable battens of plywood class III tool handles, frames of table tennis table tops, sides and panels of vaulting boxes, catamarans, planks, masts ribs and temporary nail jointed constructions. A general construction timber of the fisher folk along the coastal regions. It is also used for core, cross bands and face veneers of commercial type of block boards and wooden flush door shutters, wooden ladder and trustless, wooden crates, face veneers of marine plywood, plywood cold and boiling water resistant and expandable pallets for handling tea chests.

RED SANDERS

Tree

Flat Sawn

Cross Cut

Trade Name	Red sanders
Vernacular Names	*Yerra chandanam, yerra sandanam (*Tel.*); chemmaram, sevapu chamdrium (*Tam.*); Raktha chandanam (*Mal.*), Lal chandan, (*Hind.*); Kempu gandha, rakta chandana (*Kan.*);*
Botanical Name	*Pterocarpus santalinus* L. f
Family Name	Leguminosae (Fabaceae)
Origin (Distribution):	Southern moist mixed deciduous forest, moist teak bearing forest, west coast semi-evergreen and southern dry mixed deciduous forests. It occurs gregariously on the dry hill slopes of the Eastern Ghats. Endemic to Andhra Pradesh and Tamil Nadu.
Tree	A moderate sized tree, upto 10 m in height with a clear bole of 4.5-6 m and 35 cm in diameter; 1 m in girth but may attain 1.5 m in girth. Bark dark dirty- brown, rough with deep vertical and horizontal cracks.

General features

Pterocarpus santalinus L. f (Red sanders) is a heavy wood. To identify the wood, check the following:

- Heartwood dark orange red with darker streaks when freshly cut, turning deep red to purplish black on exposure.
- Wood is hard to very hard, very heavy
- Parenchyma paratracheal, aliform and narrow aliform confluent but also forms narrow confluent wavy bands, also marginal and as diffuse scattered cells, strands storied.
- Rays fine to very fine, somewhat closely spaced, and uniformly distributed.
- Vessels moderately large to small, just visible to eye, few to moderately few (3-12 per mm^2), solitary or in radial multiples of two to three, frequently filled with reddish brown gummy deposits.

Colour: Heartwood and sapwood clearly demarcated. Sapwood yellowish white, heartwood dark orange red with darker streaks when freshly cut, turning deep red to purplish black on exposure.

Weight: Wood is hard to very hard, very heavy (1120 kg/m3 at 12 % m. c

Grain: Interlocked to wavy grain

Texture Medium-fine

Strength Extremely strong

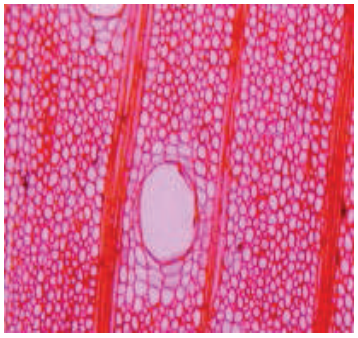
Static bending		Compression parallel to grain
Modulus of Rupture (MOR) kg/cm^2 (air-dry)	Modulus of Elasticity (MOR) kg/cm^2 (air-dry)	Maximum Crushing Stress (MOR) kg/cm^2 (air-dry)
NA	NA	345

Drying and Shrinkage: Seasons well; Radial 2 %; Tangential 6%; Volumetric 8 %

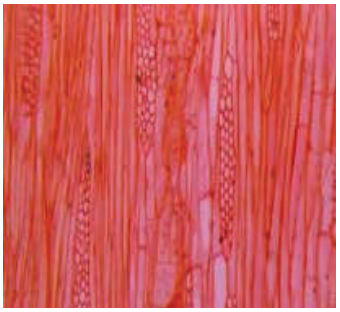
Durability Very durable

Treatability: It does not need preservative treatment

Working Properties: It is difficult to saw and work, but can be turned and carved exceptionally well. It works fairly well with hand-tools.



T S (x100)



TLS (x100)

Gross features Growth rings are indistinct or barely visible even under the hand lens. Diffuse porous wood.

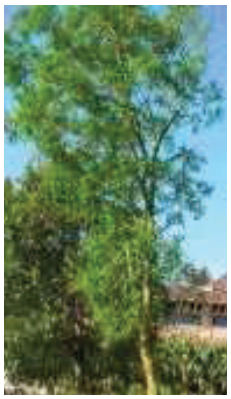
Vessels moderately large to small, just visible to eye, few to moderately few (3-12 per mm^2), solitary or in radial multiples of two to three, frequently filled with reddish brown gummy deposits. Soft tissue narrow, broken to fairly continuous bands often connecting the vessels, sometimes appearing as aliform with fine short or long lateral extensions and also a fine interrupted line delimiting growth rings.

Rays fine to very fine, somewhat closely spaced, and uniformly distributed. Ripple marks are present, distinct in the sap wood under hand lens but usually inconspicuous in heartwood.

Parenchyma aliform and narrow aliform confluent but also forms narrow confluent wavy bands, also marginal and diffuse scattered cells, strands storied and fusiform.

Uses It is used to make musical instruments especially “shamisen”, carving idols, toys, ornamental house-posts and planks. It is generally used for agricultural implements, sports goods, tool handles, verandah pillars, bent rims in cart construction and picture frames. Its powder and chips are used for the manufacture of dyes and medicines and is reported to be exported

ROSEWOOD



Tree

Flat Sawn

Cross Cut

Trade Name	Rosewood
Vernacular Names	*Sitsal* (Beng), *Seris* (Gon.), *Sissu* (Guj.), *Pahari, sissu, saise, sirsai, sissui,sitsal* (Hind.), *bide, bidi, biti,* (Kan.), *kiri, rute* (Kol.), *Colavitti, Etti, Ilti, Karitti, Veetti, Vitti, Blackwood* (Mal.), *Shisham, Bhotbeula* (Mar.), *Satisal* (Nep.), *Sissua* (Or.), *mahle, satsaye* (Sant.), *eruvade, itti, karundorviral* (Tam.), *cottage, jilegi, virugudu chava* (Tel.), *setisar* (Th.)
Botanical Name	*Dalbergia latifolia* Roxb.
Family Name	Leguminosae
Origin (Distribution):	West coast semi-evergreen, moist teak bearing and southern secondary moist mixed deciduous forests. It is distributed in the Peninsula, Andaman Islands, Bihar, Gujarat, Rajasthan, Sikkim, Uttar Pradesh, West Bengal, Nepal and Malaysia.
Tree	Medium to large sized tree reaching a height of 15-30 m and upto 130 cm in diameter. Bark about 12 mm thick, grey to rusty brown with irregular short cracks peeling off in small flakes.

General features

Dalbergia latifolia Roxb. (Rosewood) is a hardwood. To identify the wood, check the following:

- Heartwood is purplish brown with black or red streaks
- Wood is hard and heavy
- Parenchyma: paratracheal- aliform to confluent and banded, also fine or interrupted lines
- Rays are fine to very fine, closely spaced and numerous
- Vessels solitary and often in radial multiples of two to four, large, small to medium sized occasionally filled with gummy deposits
- Soft tissue forming diamond- shaped patches around vessels which are sometimes interconnected to form bands.

Colour: Heartwood purplish brown with black or red streaks producing an attractive figure, color uniform. Sapwood is pale yellowish white with pinkish tinge

Weight: Hard, heavy (815 kg/m3 at 12% m.c.)

Grain: Straight to shallowly interlocked.

Texture Medium

Strength Strong

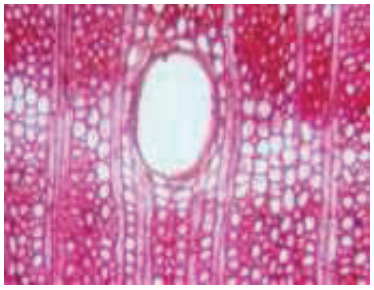
Static bending		Compression parallel to grain
Modulus of Rupture (MOR) kg/cm^2 (air-dry)	Modulus of Elasticity (MOR) kg/cm^2 (air-dry)	Maximum Crushing Stress (MOR) kg/cm^2 (air-dry)
943	101,700	486

Drying and Shrinkage: Offers no difficulty in seasoning, if carefully stacked undercover. Can be kiln- seasoned without difficulty. Shrinkage- green to oven dry - radial(2.3%), tangential(5.6%).

Durability Very durable

Treatability: Sapwood perishable but readily treatable with complete penetration.

Working Properties: Works comparatively easy with hand and machine, can be brought to a fine finish and takes good polish. Peels and slices well and very thin veneers can be obtained.



T S (x100)

TLS (x100)

Gross features Wood is diffuse porous, rarely with a tendency to semi- ring-porous.

Growth rings scarcely distinct.

Vessels solitary and often in radial multiples of two to four, large, small to medium-sized, not clearly visible to the naked eye, few to moderately numerous (8-12 per mm^2). Vessels occasionally filled with gummy deposits.

Soft tissue forming diamond- shaped patches around vessels which are sometimes interconnected to form bands; discontinuous bands delimiting growth rings also present.

Rays fine to very fine, closely spaced and numerous. Parenchyma paratracheal-aliform to confluent and banded, also fine or interrupted lines.

Uses Used for high class furniture and cabinets, construction of buildings, flush door shutters, Class-I ply wood, decorative ply wood, aircraft ply wood, marine ply wood, tool handles, knobs, drawer pulls, handles of furniture, cutlery and carpenter's tools, artificial limbs and rehabilitation aids, textile mill accessories, chess pieces, discus and carrom draughts, musical instruments, engineering instruments, bentwood articles, handicrafts. In China, it is used for the spokes of the wheels of chariots.

RUBBER

Tree

Flat Sawn

Cross Cut

Trade Name	Rubber
Vernacular Names	*Rubber tree*
Botanical Name	*Hevea braziliensis* (HBK) Muell. Arg
Family Name	Euphorbiaceae
Origin (Distribution):	Native of Brazil; raised extensively in plantations in Malaysia, Indonesia, Thailand, Sri Lanka and India for latex production.
Tree	Large tree reaching a height of 30m and diameter of 40-70 cm, bark greyish-black, smooth.

General features

Hevea braziliensis (HBK) Muell. Arg. (Rubber) is a soft and light timber. To identify the wood, check the following:

- Wood is white to creamy in colour
- Wood is light to moderately heavy
- Parenchyma: abundant, apotracheal-diffuse, tangential wavy lines and also in more or less continuous fine line delimiting growth rings, paratracheal- vasicentric.
- Rays fine, somewhat closely spaced.
- Vessels medium to small moderately numerous to few, solitary or in radial multiples of 3 or 4, occasionally with tyloses and white to chalky deposits.

Colour: Heartwood and sapwood are not distinct. Wood is white to creamy in colour when freshly cut, sometimes with a pinkish ting, turns to light brown or creamy white on exposure.

Weight: Light to moderately heavy; (525-610 kg/m^3 at 12% m. c).

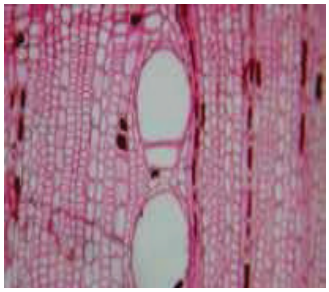
Grain: Straight

Texture Even and medium textured

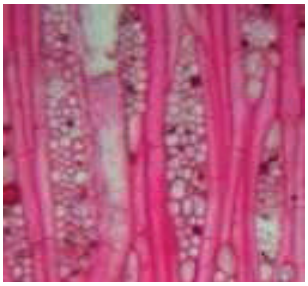
Strength Moderately strong

Static bending		Compression parallel to grain
Modulus of Rupture (MOR) kg/cm^2	Modulus of Elasticity (MOR) kg/cm^2	Maximum Crushing Stress (MOR) kg/cm^2
66	9240	32.3

Drying and Shrinkage:	Dries easily; but care is needed to avoid seasoning defects such as cupping, twisting, bowing, checking and splitting; a conventional kiln seasoning (steam- heated, forced-air drying system) is preferred in drying, shrinkage-radial (1.2%), tangential (1.8%), volumetric (3.0%)
Durability	Perishable, the wood has to be treated with preservatives soon after felling (preferably with for 48 hrs.) liable to discolouration caused by sap stain fungi and attack by pinhole and powder post beetles.
Treatability:	Easy. Simple dip treatment or vacuum- pressure impregnation process with preservatives such as borax-boric acid and copper-chrome arsenate (CCA) with adequate retention will protect the wood from fungal and insect attack.
Working Properties:	Planing-easy; boring-easy; Turning-easy; Nailing-good, but pre-boring necessary; Finish-good. Tension wood can lead to fuzzy grain when machined. Finger jointing is often applied to achieve larger dimensions. Rubber wood can be stream bent with good results. It can easily be stained to resemble teak, rosewood, walnut, cherry, oak or other woods, depending on consumer demand.



T S (x100)



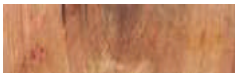
TLS (x100)

Gross features	Growth rings indistinct, but sometimes appearing as faint impressions due to comparatively thick walled fibrous tissues.Diffuse porous wood. Vessels medium to small moderately numerous to few, solitary or in radial multiples of 3 or 4, occasionally with tyloses and white to chalky deposits, oval in outline. Parenchyma abundant, apotracheal- diffuse, tangential wavy lines, touching the vessels and also in more or less continuous fine line delimiting growth rings, paratracheal- vasicentric. Rays fine, light in colour uniformly distributed and somewhat closely spaced.
Uses	Used for the manufacture of furniture (dining sets, bedroom sets, lounge sets, rocking chairs) and furniture parts, bentwood furniture , second grade door furniture, dunnage pallets, parquet and strip flooring, paneling, wood based panels particle board, cement and gypsum- bonded, medium-density fibre board, packing cases, match splints and boxes etc. Traditionally it is used for fuel wood and industrial brick burning.

SEMUL

Tree

Flat Sawn



Cross Cut

Trade Name	Semul
Vernacular Names	*Himila* (Asm.), *Simal*(Beng.), *Khatsaweri* (Bhil.), *Shimal* (Garhwal), *Bolchu* (Garo.), *Bargu* (Gon.), *Sawar* (Guj.), *Semul, Semur* (Hind.), *Bonju-phang* (Kach), *Shimlo* (Kamrup), *Burla* (Kan.), *Savar* (Mar.), *Simbal* (Punj.), *Illavam* (Tam.), *Buraga* (Tel.), *Mullilavu, Poola, Cotton tree* (Mal.)
Botanical Name	*Bombax ceiba L.Syn . Bombax malabaricum (DC.) Salmalia malabarica (DC.) Schott. and Endl.*
Family Name	Bombacaceae
Origin (Distribution):	Widely distributed throughout India, except in very arid tracts, ascending to over 1,500 m. Commonly it is seen in west coast semi evergreen, southern moist mixed deciduous and moist teak bearing forests. Occasionally it tends to be gregarious on alluvial soils near river banks, also occur in Myanmar.
Tree	Large to very large, deciduous 25-40 m in height with a clear bole of 15-25 m and upto 150cm in diameter, 3 m in girth; huge buttressed 4.5-6 m in height. Under favourable condition it grows to enormous sized trees 59 m in height and 4.5 m in girth. On poor soil and higher elevations, it is usually stunted. Bark grey, covered with conical prickles when young, deeply cracked when old, outer bark fleshy and soft, inner fibrous, upto 2.5 cm in thickness.

General features

Bombax ceiba is a light wood. To identify the wood, check the following:

- Heart wood and sap wood are not distinct. Creamy white to pale yellowish-brown or yellowish-brown, greyish brown on exposure, often lustrous showing silver effect on radial surface.
- Diffuse porous wood
- Growth rings not always distinct to the eye, but clearly visible under hand lens, delimited by the slightly denser latewood and closely spaced bands of parenchyma,
- Parenchyma predominantly apotracheal-visible only under the lens, diffuse to diffuse-in-aggregate, closely spaced, fine interrupted tangential line forming reticulum with rays
- Vessels very large to large, clearly visible to the eye, very few to few, scanty, mostly solitary or in radial multiples of 2 or 3,oval in outline, usually open or partly filled with tyloses.
- Rays fine to very broad, widely spaced, forming conspicuous flecks on radial surface, distinct only under lens, interspersed with broader rays sometimes tending to be storied. Ripple marks usually present.

Colour: Heart wood and sap wood are not distinct. Creamy white to pale yellowish-brown or yellowish-brown, greyish brown on exposure, often lustrous showing silver effect on radial surface.

Weight: Very light to light (365kg/m3 at 12% m.c)

Grain: Straight

Texture Coarse

Strength Weak

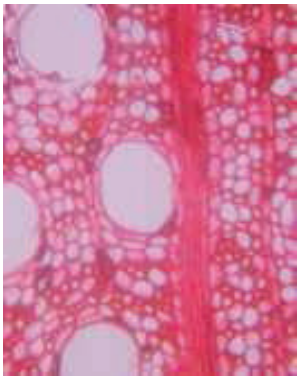
Static bending		Compression parallel to grain
Modulus of Rupture (MOR) kg/mm^2	Modulus of Elasticity (MOR) kg/mm^2	Maximum Crushing Stress (MOR) kg/mm^2
428	59,600	242

Drying and Shrinkage: Very easy to season; quick conversion and open stacking under cover recommend. Shrinkage-Green to oven dry, radial-2.3, Tangential-5.1, Volumetric-7.4

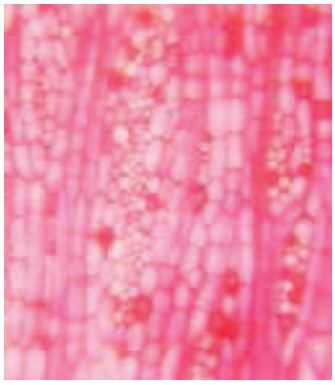
Durability Perishable

Treatability: Heartwood easily treatable with preservatives, penetration being complete.

Working Properties: Easy to saw; peels and glues well, however, absorbs too much paint and varnish.



T S (x100)



TLS (x100)

Gross features Wood is diffuse porous .

Growth rings not always distinct to the eye, but clearly visible under hand lens, delimited by the slightly denser latewood and closely spaced bands of parenchyma, usually less than 2 per cm.

Vessels very large to large, clearly visible to the eye, very few to few, usually more or less evenly distributed, scanty, mostly solitary or in radial multiples of 2 or 3,oval in outline, usually open or partly filled with tyloses, vessel lines conspicuous on the longitudinal surfaces, vessel elements being individually distinct 20-25 per cm.

Parenchyma predominantly apotracheal-visible only under the lens diffuse to diffuse-in-aggregate, closely spaced, fine interrupted tangential line forming reticulum with rays. Lines of parenchyma same or wider than fibre layers, 10-15 per mm. Rays fine to very broad, widely spaced, forming conspicuous flecks on radial surface, just visible or indistinct to the eye, distinct only under lens, interspersed with broader rays sometimes tending to be storied. Ripple marks usually present, distinct to just visible to the eye, but sometimes under the lens, 20-22 per cm due to storied parenchyma.

Uses It is used for making class III plywood and veneers, packing cases and boxes, match splints and boxes, shipbuilding, fishing floats, cooperage toys, pencil slates, dug-outs, drums and cheap grade pencils, returnable wooden crates, shooks of wooden packaging. ‘Compreg’ from semul has proved suitable for bosshead of air screw blades.

SHAITAN WOOD

Tree

Flat Sawn

Cross Cut

Trade Name	Shaithan wood
Vernacular Names	*Satian (*Hind.*), Dodapale (*Kan*), Ezhilam pala, manglapala (*Mal.*), Chatiwan (*Nep.*), pale garuda, Elalaipalai (* Tam.*), Yedakalapala (*Tel.*)*
Botanical Name	*Alstonia scholaris* R.Br
Family Name	Apocynaceae
Origin (Distribution):	It occurs throughout the moist regions of India especially on the West coast, Pakistan, Sri Lanka, Burma, Thailand, Laos, Vietnam, Cambodia, and Malaysia. Found naturally occurring in Southern moist mixed deciduous and moist teak bearing forests.
Tree	Evergreen, medium to large up to 30 m in height with a clear bole of 6-15 m and about 60-180 cm in diameter. Buttressed at the base. Bark grayish brown, rough, lenticellate, 13 mm thick, inner bark yellow with much milky juice.

General features

Alstonia scholaris (shaitan wood) is a light weight wood. To identify the wood, check the following:

- White to yellowish white wood often discolored due to sap stain and is lustrous.
- Wood is light to very light and soft
- Parenchyma is visible to the eye and is fine, paratracheal (vasicentric) and as wavy, concentric lines connecting the vessels.
- Rays are very fine
- Vessels are small, solitary and in radial multiples of 2 to 3 or 5

Colour: Heartwood not distinct, basically white to yellowish white or pale brown or grey; often discoloured due to sap stain, lustrous. Sap-wood colour similar to heartwood colour.

Weight: Light to very light. Basic specific gravity 350-465kg/m^3 at 12% m.c.

Grain: Straight

Texture Medium to fine textured

Strength Soft and light

Static bending		Compression parallel to grain
Modulus of Rupture (MOR) kg/cm^2	Modulus of Elasticity (MOR) kg/cm^2	Maximum Crushing Stress (MOR) kg/cm^2
466	70,400	273

Drying and Shrinkage: Green conversion and soaking in water before seasoning recommended.

Durability Non durable

Treatability: Extremely resistant

Working Properties: Easy to saw; peels and glues well, however, absorbs too much paint and varnish.

T S (x100)

TLS (x100)

Gross features

Wood is diffuse-porous.

Growth ring boundaries indistinct.

Vessels small to medium, few, occasionally solitary mostly in radial multiples of two, three or often five (5-12/ mm^2); distinct under the hand lens, few to moderately numerous (5-12 per mm^2), occasionally filled with tyloses and yellowish gummy deposits, usually open, vessel line distinct.

Parenchyma visible to the eye, fine, paratracheal- vasicentric and in wavy, concentric lines connecting the vessels; apotracheal-diffuse; crystals often present.

‘

Rays fine to very fine, distinct under hand lens, closely and evenly spaced; crystals occasionally present, yellow gummy infiltration sparse. Wood is soft.

Uses

The timber is mainly used for class III plywoods and veneers; light packing cases and boxes; match splints; pencil slats; black boards and wooden footwear. It is a specified timber for the manufacture of extension ladders for fire fighting and escape ladders.

SHISHAM

Tree

Flat Sawn

Cross Cut

Trade Name	Sissoo
Vernacular Names	*Shisham, Sissoo (*India*), Sissou (*Nepal*), Hihu (*Asm.*), Sisam, Shishma (*Guj.*), Agara, Birdi (*Kan.*), Shishai (*Punj.*), Shinshapa (*San.*), Gette, Yette (*Tam.*), Sinsupa (*Tel.*)*
Botanical Name	*Dalbergia sissoo* Roxb.
Family Name	Leguminosae (Fabaceae)
Origin (Distribution):	Punjab to Assam in the Sub-Himalayan tract in India and Nepal, Bangladesh, Bhutan, Myanmar, Afghanistan, Pakistan, Iran and Iraq.
Tree	Small to large up to 30 m in height with curved or crooked and buttressed stem. Bark grey or brown, longitudinally and somewhat reticulately furrowed, thick

General features

Heartwood of *Dalbergia sissoo* (Shisham) is golden brown to dark brown with deep dark streaks. To identify the wood, check the following:

- Hard and moderately heavy wood
- Growth rings are distinct to indistinct, demarcated by a fine line of parenchyma
- Parenchyma is aliform to aliform confluent, also forming straight to wavy narrow bands in late wood
- Vessels are large and few in early wood and small and few in late wood, often filled with dark, gummy deposits, solitary and in radial multiples of 2 or 3

Colour: Heartwood golden brown to dark brown with deep dark streaks, soon becoming dull, clearly demarcated from the pale brownish to white sapwood.

Weight: Hard and moderately heavy; 820 kg/m3 at 12 % m. c

Grain: Narrowly interlocked

Texture Medium to coarse

Strength Strong

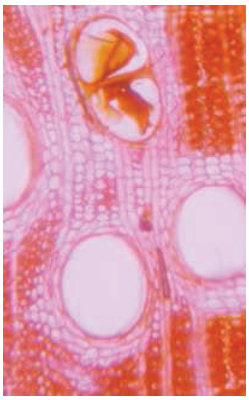
Static bending		Compression parallel to grain
Modulus of Rupture (MOR) kg/mm^2	Modulus of Elasticity (MOR) kg/mm^2	Maximum Crushing Stress (MOR) kg/mm^2
95	10526	53.2

Drying and Shrinkage: Seasons slowly with little degrade; kiln- seasoning enhances the value of the timber by darkening the colour. Shrinkage- radial (3%), Tangential (5.4%), Volumetric (8.4%)

Durability Very durable, highly resistant to termites

Treatability: Extremely resistant

Working Properties: Planing-easy; Boring-easy; Turning-easy; Nailing-good, but pre-boring necessary; Finish-good.



T S (x100)

TLS (x100)

Gross features

Wood is diffuse porous.

Growth rings are distinct to indistinct, demarcated by a fine line of parenchyma but indistinct or inconspicuous.

Vessels large to small, few to moderately few, rather unevenly distributed, generally larger and comparatively more numerous in early wood, mostly solitary and in radial multiples, open but occasionally filled with white or dark, gummy deposits, perforation simple, inter vessel pits vestured and small to medium sized.

Parenchyma aliform to aliform confluent also forming straight to wavy narrow bands in late wood. Terminal or marginal, delimiting growth rings, strands are storied, fusiform often subdivided into crystalliferous locules.

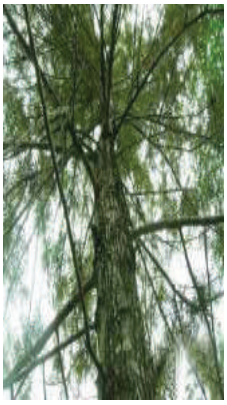
Fibres libriform, round to angular in cross section, often gelatinous, non-septate, storied, inter fibre pits small, simple to narrow bordered.

Rays mostly uniseriate but may be up to 2 or 3 ceriate, 7-16/mm, homogenous weakly heterogenous composed of mainly of procumbent cells.

Uses

First class timber for cabinetry and furniture, paneling and flooring. It yields a very strong veneer cut on a rotary machine which is also highly decorative. Also used for boards, rafters, posts, boat building, truck and lorry bodies, door, window shutters and frames, carvings and engraving, printing blocks, brush backs, superior walking sticks, umbrella handles, pencil slates, sport goods, mallet heads, anvil blocks flooring and ceiling furniture, agricultural and musical instruments and tool handles. It is used for marine and air craft grade plywood, decorative plywood and block boards. The root wood is suitable for tobacco pipes.

SILVER OAK



Tree

Flat Sawn

Cross Cut

Trade Name	Silver oak
Vernacular Names	*Southern silky-oak* (Australia), *Lacewood* (USA), *Silky-oak* (Indonesia), *Savukkuma-ram* (Tam.),
Botanical Name	*Grevillea robusta* A. Cunn. Ex R. Br.
Family Name	Proteaceae
Origin (Distribution):	Native to Eastern Malaysia, New Caledonia and Australia, extensively planted as a shade tree for coffee and tea plantations in Africa, India, Sri Lanka and other parts of the world.
Tree	An evergreen tree attaining a fair height with long conical crown. Medium to large 18-25 m in height and about 65 cm in diameter. Bark dark grey and rough with vertical fissures.

General features

Grevillea robusta A. Cunn. Ex R. Br. (Silver oak) is a hard and moderately heavy timber. To identify the wood, check the following:

- Wood is pinkish brown becoming yellow brown on exposure
- Parenchyma paratracheal- vasicentric and aliform to aliform- confluent, just visible to the naked eye
- Rays are of two types; broad to very broad and fine to very fine.
- Vessels large to medium, moderately numerous (3-9/ mm^2), mostly in tangential rows filled with deposits and separated by fibrous tissue in alternate fashion, usually in irregular clusters or short radial or tangential multiples, rarely solitary, round to oval, mostly open and vessel lines distinct.

Colour: Heartwood distinctly pinkish brown becoming yellow brown on exposure, lustrous, well demarcated from the cream coloured sap-wood.

Weight: Hard and moderately heavy

Grain: Straight to wavy

Texture Medium to coarse

Strength Strong

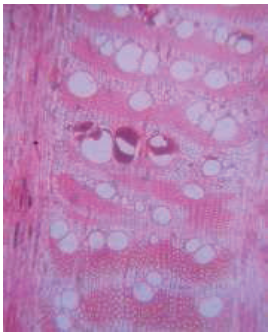
Static bending		Compression parallel to grain
Modulus of Rupture (MOR) kg/mm^2	Modulus of Elasticity (MOR) kg/mm^2	Maximum Crushing Stress (MOR) kg/mm^2
77	10490	45.0

Drying and Shrinkage: Dries slowly, shrinkage-radial (3.2%), tangential (9.6%), volumetric (12.8%)

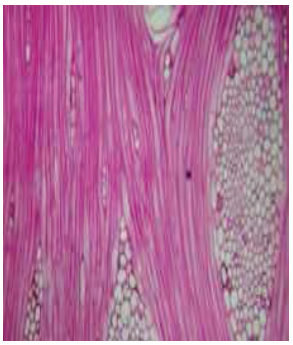
Durability Moderately durable or perishable

Treatability: Treatable by the diffusion process and complete penetration of the preservative both in the sapwood and heartwood is obtained. It is moderately resistant.

Working Properties: Planing-easy, Boring-easy, Turning-easy, Nailing-easy, Finish-good.



T S (x100)



TLS (x100)

Gross features

Wood is diffuse porous.

Growth rings are fairly distinct.

Vessels large to medium, moderately numerous (3-9/mm^2), mostly in tangential rows filled with deposits and separated by fibrous tissue in alternate fashion, usually in irregular clusters or short radial or tangential multiples, rarely solitary, round to oval, mostly open and vessel lines distinct.

Parenchyma paratracheal- vasicentric and aliform to aliform-confluent, just visible to the naked eye, distinct under hand lens in closely spaced lines enclosing or connecting the vessels tangentially (18-34/ cm).

Rays are of two types; broad to very broad and fine to very fine, the former prominent to the naked eye, widely spaced and the later rarely visible under the hand lens. Prominent silvery radial flecks present. Gum canals of traumatic type occasionally present in tangential rows.

Uses

Used for carpentry, cabinet work, joinery, furniture, parquet flooring, interior finishes, paneling, turnery and light construction work. Also suitable for bent wood furniture, packing cases and crates, boxes, truck bodies, naval uses and handicrafts. It is used for building construction, door shutters, class III general plywoods, boards, mathematical engineering and drawing instruments, High speed jute bobbins and rehabilitation aids. It is a highly decorative timber and is used for making decorative plywood and veneers, core and cross bands of block boards and flush doors. Also used to make spool centres for jute spool winding machines, wedges of tennis rackets, brush backs and slate frames. In some countries, it is used for furniture in place of oak and also for flooring in the form of blocks and strips as its resistance to abrasion is high.

TEAK

Tree

Flat Sawn

Cross Cut

Trade Name	Teak
Vernacular Names	*Jati, Tek (*Indonesia*), Java teak (*Germany*), Kyun (*Myanmar*), Teca (*Brazil*), Segan (*Beng.*), saga, sagach (*Guj.*), sagon, Sagwan (*Hind.*), Tega (*Kan.*), Sag, Saga (*Mar.*), Singua (*Or.*), Tekku, Tekkumaram (* Tam.*), Adaviteeku , Peedateeku (*Tel.*)*
Botanical Name	*Tectona grandis* Linn.f.
Family Name	Verbenaceae
Origin (Distribution):	It is a deciduous tree with a rounded crown which under favourable conditions attains large size with a clean cylindrical bole often becoming buttressed and fluted
Tree	Towards the base. The tree is large to very large, 25-45 m in height and upto 190 cm in diameter, but in the dry hot areas of Madhya Pradesh, Gujarat and Rajasthan the tree is comparatively smaller, often branchy and much fluted in advanced age. Bark light brown or grey with shallow longitudinal furrows and fibrous, about 0.4-1.8 cm thick, exfoliating in long thick strips.

General features

Tectona grandis (teak) has golden brown heart wood with black streaks. However, wide variation in colour is present between teak available from different regions. The heartwood has an oily feel with a distinct smell resembling old leather. Teak is a typical ring porous hard wood. The early wood vessels are large and few, compared to the late wood vessels which are small and numerous. To identify the wood, check the following:

- Wood is moderately hard and moderately heavy
- Parenchyma is paratracheal (vasicentric and in broad bands); distinct to the eye in the early wood, forming a continuous zone enclosing the vessel along with initial band of parenchyma delimiting growth
- Vessels are filed

Colour: Sapwood and heartwood sharply demarcated. Heartwood golden brown when fresh or dark brown on exposure occasionally with black streaks with a waxy feel, lustrous sometimes with white glistening deposit, distinct aromatic odour with the smell of leather. Sapwood white, pale yellow or grey. Well defined.

Weight: Moderately hard and moderately heavy (650 kg/m3 at 12 % m. c)

Grain: Straight, sometimes wavy.

Texture Coarse

Strength Strong

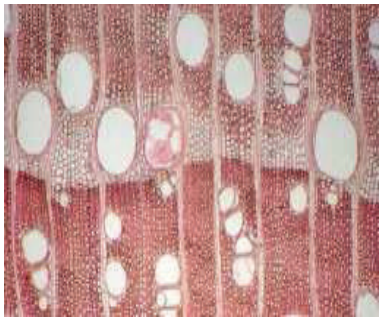
Static bending		Compression parallel to grain
Modulus of Rupture (MOR) kg/mm^2	Modulus of Elasticity (MOR) kg/mm^2	Maximum Crushing Stress (MOR) kg/mm^2
106	10000	60.4

Drying and Shrinkage: Dries well but rather slowly with little or no degradation. Seasons very well, the best model wood for air seasoning; kiln seasoning also good for very good results. Shrinkage radial (2.3%), tangential (4.8%), volumetric (7.1%). High resistance to water absorption

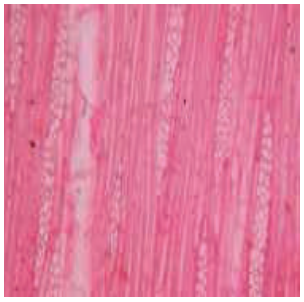
Durability Very durable, highly resistant to termite damage.

Treatability: Extremely resistant; heart wood very refractory to treatment.

Working Properties: Easily worked with both hand and machine tools. Planing easy, boring easy, turning- rather easy, nailing-good but pre-boring necessary, finish good.



T S (x100)



TLS (x100)

Gross features Wood is ring porous.

Growth rings are distinct, delimited with early wood vessels enclosed in parenchymatous tissues, less than 1-6/ cm. Vessels large in early wood, oval in out line, occasionally filled with tyloses and yellowish-white powdery deposits.

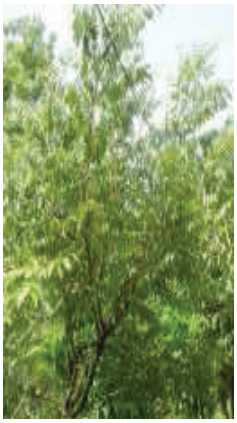
Vessels medium to small in late wood, mostly solitary or in short radial multiples, round to oval in out line, vessel lines of the early wood zone conspicuous on longitudinal surfaces.

Parenchyma paratracheal- vasicentric and in broad bands, distinct under the hand lens but distinct to the eye in the early wood forming a continuous zone enclosing the vessel along with initial band of parenchyma delimiting growth rings.

Rays moderately broad, fairly wide spaced and uniformly distributed; visible to the eye, distinct under the lens.

Uses A versatile wood. Used extensively for ship and boat building, class I general purpose plywood, cabinet making, interior and exterior joinery, flooring and fine furniture, carving, paneling, turnery, sliced for decorative and face veneers. Teak laboratory fittings and laboratory accessories are logical choice due to the acid and alkalis resistant properties of this timber, it is also used for vats, towers etc. in chemical plants. Building construction poles and cross arms, textile mill accessories, musical instruments, mathematical, engineering and drawing instruments and bus bodies. It is used for doors and windows in house construction, paneling and interior fittings. It is also used for air crafts, marine plywood and block boards. It is an approved timber for table tennis tables, frame of carom boards and general requirements of play ground and park equipment, wooden butter-scoop, butter moulds, wooden boxes for microscopic slides, stand for ammunition explosive boxes and caulking mallets. Teak poles are used for scaffolding, fence posts and for overhead and telecommunication lines.

TOON



Tree

Flat Sawn

Cross Cut

Trade Name	Toon
Vernacular Names	*Calantas , Danupra (*Philippines*), Chomcha (*Cambodia*), Ranggog (*Sabah*), Madagiri-Vempu, Toon , Vempu, Chandana Vempu, Chuvannaagil (*India*)*
Botanical Name	*Toona ciliata RoemerSyn. Cedrela toona Roxb.ex.Rottler*
Family Name	Meliaceae
Origin (Distribution):	Indigenous to Thailand, Myanmar, Pakistan and India. West-coast tropical evergreen, southern hill-top tropical evergreen, west coast semi-ever green and occasionally moist teak bearing forests.
Tree	Large, 20-30 m in height with a clear bole of 9-12 m and 60-90 cm in diameter. Bark greyish-brown, thick, rough, exfoliating in irregular woody scales in old trees.

General features

Toona ciliata (Toon) is a light wood. To identify the wood, check the following:

- Heartwood reddish- brown with a spicy odour, rather lustrous;
- sapwood pinkish-brown or greyish white.
- Wood is semi ring-porous to ring- porous. Growth rings are distinct.
- Vessels are large in the early wood, transition from early wood to late wood gradual, small and moderately few in late wood, solitary or in radial multiples of two or three; occasionally filled with dark brown gummy deposits.
- Parenchyma paratracheal-scanty, faintly delimiting growth rings.
- Rays moderately broad to fine, rather few, fairly wide spaced.
- Gum canals vertical, traumatic, occasional. Pith flecks often present.

Colour: Heartwood reddish- brown with a spicy odour, rather lustrous; sapwood pinkish- brown or greyish white.

Weight: Light to moderately heavy (515 kg/ m3 at 12 % m.c)

Grain: Straight*

Texture Coarse to medium

Strength Moderately strong

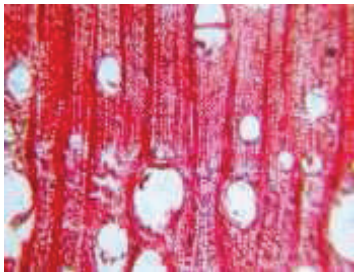
Static bending		Compression parallel to grain
Modulus of Rupture (MOR) kg/mm^2	Modulus of Elasticity (MOR) kg/mm^2	Maximum Crushing Stress (MOR) kg/mm^2
83	9445	38.3

Drying and Shrinkage: Dries easily; shrinkage-radial (3.8%), Tangential (6.3%), Volumetric (10.1%). Refractory to seasoning, liable to warp, green conversion and careful stacking under cover recommended.

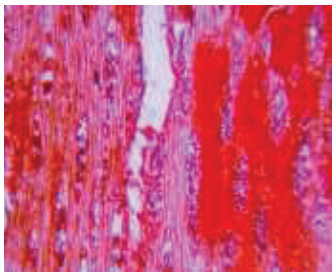
Durability Perishable

Treatability: Easy; heart wood only partially treatable.

Working Properties: Planing-easy; Boring- easy to difficult; Turning-easy; Nailing-good; Finish-good.



T S (x100)



TLS (x100)

Gross features

Wood is semi ring-porous to ring- porous.

Growth rings are distinct.

Vessels are large in the early wood, transition from early wood to late wood gradual, small and moderately few in late wood, solitary or in radial multiples of two or three; occasionally filled with dark brown gummy deposits.

Parenchyma paratracheal-scanty, faintly delimiting growth rings.

Rays moderately broad to fine, rather few, fairly wide spaced. Gum canals vertical, traumatic, occasional. Pith flecks often present.

Uses

Used for cabinets, furniture, general purpose class I plywood, block boards, agricultural implements, paneling, cigar boxes, packing cases, textile mill accessories, tennis, badminton and squash racket frames, musical instruments and decorative veneer.

VATTA

Tree

Flat Sawn

Cross Cut

Trade Name	Vatta
Vernacular Names	*Upligi, Upalkai, Upranti, Kanchupranti (*Kan.*), Chanda, Upilla, Vatta (*Mal. & Tam.*), Chandwar (*Mar.*), Alamanda (*Tel*)*
Botanical Name	*Macaranga peltata (*Rox.*)* Muell-ArgSyn. Macaranga roxburghii Wt.
Family Name	Euphorbiaceae
Origin (Distribution):	It is found in the Western Ghats from Konkan Southwards, common in evergreen forests upto 1000 m, also in Orissa and Andhra Pradesh.
Tree	A small resinous evergreen tree. A reddish gum kino exudes from the cut branches.

General features

Macaranga peltata (Vatta) is a very light to light wood. To identify the wood, check the following:

- Wood grayish brown to reddish brown
- Wood is soft
- Parenchyma diffuse and diffuse-in-aggregates, indistinct.
- Rays fine to very fine, closely spaced.
- Vessels moderately large to small, visible as pinpricks to the eye, distinct under hand lens, moderately few to moderately numerous (5-20/mm^2), more or less uniformly distributed, solitary and in short radial multiples of 2-3, sometimes more, oval in outline, mostly open, sometimes filled with white deposits

Colour: Sap wood and heart wood indistinct. Wood grayish brown to reddish brown, soft.

Weight: Very light to light (490 kg/m3 a 12% m. c)

Grain: Straight*

Texture Fine

Strength Soft

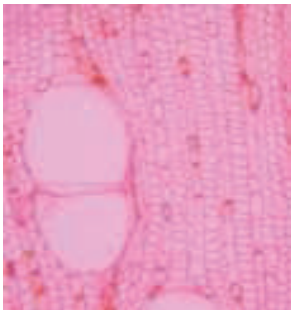
Static bending		Compression parallel to grain
Modulus of Rupture (MOR) kg/mm^2	Modulus of Elasticity (MOR) kg/mm^2	Maximum Crushing Stress (MOR) kg/mm^2
NA	NA	NA

Drying and Shrinkage: NA

Durability NA

Treatability: NA

Working Properties: NA



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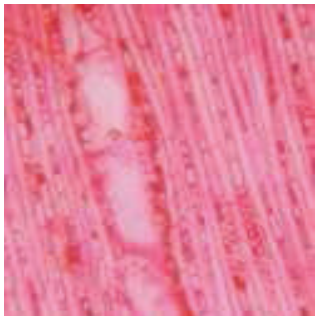

TLS (x100)

Gross features

Diffuse porous wood, growth rings indistinct.

Vessels moderately large to small, visible as pinpricks to the eye, distinct under hand lens, moderately few to moderately numerous (5-20/mm^2), more or less uniformly distributed, solitary and in short radial multiples of 2-3 sometimes more, oval in outline, mostly open, sometimes filled with white deposits, vessel lines distinct on longitudinal surfaces.

Parenchyma not visible to the eye, somewhat distinct only under the lens, more conspicuous on moist surface, diffuse and diffuse-in-aggregates.

Rays fine to very fine just visible to the eye, distinct under the lens, lighter in colour against the background, closely spaced.

Uses

The wood is used locally, for temporary huts, fencing and temporary ladders. The wood from larger trees may serve for tea- boxes. The wood is suitable for matches, paper pulp and for making charcoal.

FIELD KEY FOR THE IDENTIFICATION OF 32 TIMBERS USED IN WOOD BASED HANDICRAFTS INDUSTRY OF KERALA, UP AND RAJASTHAN

1. Ring porous.....2
1. Diffused Porous.....4
2. Truly Ring Porous.....*Tectona grandis*
2. Semi Ring Porous.....3
3. Soft tissue paratracheal aliform type.....*Lagerstroemia lanceolata*
3. Soft tissue paratracheal scarity to vasi centric.....*Toona ciliate*
4. Wood produces a fragrant smell.....5
4. Wood without smell.....7
5. Growth rings distinct.....6
5. Growth rings indistinct.....*Pterocarpus santalinus*
6. Wood moderately heavy.....*Azadirachta indica*
6. Wood is hard and heavy.....*Eucalyptus tereticornis*
7. Wood is light in weight.....8
7. Wood is heavy.....12
8. Heart wood yellowish white to yellowish brown.....9
8. Heart wood greyish brown to reddish brown..... *Macaranga peltata*
9. Vessels with chalky deposits.....*Hevea braziliensis*
9. Vessels without chalky deposits.....10
10. Wood often discoloured due to sap stain.....*Alstonia Scholaris*
10. Wood without sap stain.....11
11. Wood lustrous showing silver effect on radial surface .....
.....*Bombax ceiba*
11. Wood is not lustrous.....*Trema orientalis*
12. Vessels filled with chalky deposits.....13
12. Vessels without chalky deposits.....15
13. Heart wood is yellowish.....14
13. Heart wood reddish brown to brown with dark strea
ks.....*Grewia tilifolia*
14. Heart wood yellowish brown and lustrous....*Artocarpus heterophyllus*
14. Heart wood dark yellowish brown and without lustre.....
Artocarpus hirsutus
15. Vessels filled with tyloses.....16
15. Vessels without tyloses.....20
16. Growth rings clearly distinct under hand lens.....17
16. Growth rings indistinct.....19
17. Heart wood is distinct from sap wood.....*Terminalia arjuna*
17. Heart wood and sap wood not distinct.....18
18. Rays filled with dark coloured deposits and crystal.....
Bridelia retusa
18. Rays not filled with deposits.....*Mangifera indica*
19. Heart wood yellowish.....*Holoptelia integrifolia*
19. Heart wood reddish brown.....*Calophyllum ionophyllum*

20. Vessels with gummy deposits.....21
20. Vessels without gummy deposits.....25
21. Heart wood jet black.....*Diospyros ebanum*
21. Heart wood brownish.....22
22. Soft tissue forming diamond patches around vessels.....
Dalbergia latifolia
22. Soft tissue does not form diamond patches around vessels.....23
23. Two types of rays.....*Grevillea robusta*
23. Single type of rays.....24
24. Parenchyma paratracheal.....*Acacia nilotica*
24. Parenchyma aliform to aliform confluent....*Dalbergia sisoo*
25. Heart wood and sap wood distinct.....26
25. Heart wood and sap wood indistinct.....30
26. Parenchyma Paratracheal abundant.....27
26. Parenchyma Paratracheal and scanty.....29
27. Heart wood yellowish brown.....*Acacia mangium*
27. Heart wood dark brown to reddish brown.....28
28. Gummy infiltrations in rays.....*Prosopis juliflora*
28. No gummy infiltrations in rays.....*Acacia auriculiformis*
29. Prominent marginal Parenchyma.....*Swietenia macrophylla*
29. No prominent marginal parenchyma.....*Adina cordifolia*
30. Parenchyma paratracheal.....*Gmelina arborea*
30. Parenchyma not paratracheal.....31
31. Parenchyma abundant.....*Ficus bangalensis*
31. Parenchyma scanty.....*Anthocephalus cadamba*