



### **WOOD PROPERTIES OF SELECTED PLANTATION SPECIES: *TECTONA GRANDIS* (TEAK), *NEOLAMARCKIA CADAMBA* (KELEMPAYAN/LARAN), *OCTOMELES SUMATRANA* (BINUANG) AND *PARASERIANTHES FALCATARIA* (BATAI)**

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#### **INTRODUCTION**

Forest plantations were established in many parts of the Peninsular Malaysia as a result of the anticipated timber shortage in the 1900s. The compensatory plantation project that were launched in 1981, mainly concentrated on the medium quality timber grown on a short rotation basis (Thai 2000). For the project, fast growing hardwoods such as *Acacia mangium*, *Gmelina arborea*, *Paraserianthes falcataria* and *Eucalyptus camaldulensis* were selected as potentially able to meet the needs of the project (Krishnapilly & Appanah 2002). To expedite the development of forest plantation in the country, the government had established a soft loan programme managed by Malaysia Timber Industrial Board (Zaini Ithnin 2010); eight species promoted under this programme *Azadirachta excelsa* (sentang), *Khaya ivorensis* (African mahogany), *Tectona grandis* (teak), *Acacia* spp., *Hevea brasiliensis* (rubberwood), *Neolamarckia cadamba* (kelempayan/laran), *Paraserianthes falcataria* (batai) and *Octomeles sumatrana* (binuang). The properties, durability and uses of four species, i.e. *Khaya ivorensis* (African mahogany), *Azadirachta excelsa* (sentang), *Endospermum malaccense* (sesendok) and *Acacia mangium* are summarized in the Timber Technology Bulletin (TTB) no 51. For this TTB issue the properties, durability and uses of the remaining four species i.e. *Tectona grandis* (teak), *Neolamarckia cadamba* (kelempayan/laran), *Paraserianthes falcataria* (batai) and *Octomeles sumatrana* (binuang) will be elaborated.

According to Appanah & Weinland (1993) planting of *Tectona grandis* or locally known as teak in Malaysia is to establish plantations of high quality timber. This species originated from India, Burma, Thailand and Cambodia. Teak belongs to the family Verbenaceae, its wood has beautiful grain, characteristically strong and easy to work with. Teak has a characteristic fragrance and an oily feel (Hashim & Mohd Noor 2002). In Malaysia, the first trials were reported from as early as 1800 when teak was planted for ship building purposes in Penang (Burkill 1966). The best growth rates for teak were observed in the states of Kedah and Perlis, which are at the northern part of Peninsular Malaysia where the climate is similar to its natural habitat (Ahmad Zuhaidi & Mohd Noor 2002) with Mata Ayer, Perlis being one of the successful plots for teak plantation. Similar teak plantation was also established in Sabah by the private sector (James & Zamrie 2011).

*Neolamarckia cadamba* or its standard Malaysian name Laran is also known as Kelampayan in Peninsular Malaysia belongs to the family Rubiaceae. Laran was recommended as a plantation tree due to its fast growth. Laran grows very well and gregariously in exploited and denuded areas especially in logged-over areas. The straight bole and self pruning characteristics have attracted attention to the tree as a potentially useful species for tree plantation. The many uses of this tree make it even more attractive to many countries to include this species in their plantation programmes. In Peninsular Malaysia, Laran is planted mainly in the states of Perak and Pahang (Mohd Sukhairi et al. 2013). Other Laran plantations are in Sarawak and Sabah.

*Octomeles sumatrana* or locally known as binuang belongs to the family of Datisceaceae and has been selected for plantation programme due to its fast growing and straight bole. Binuang has been widely used as substitutes for the light hardwood dipterocarps in Sabah. According to Lee et al. (2005) binuang has been selected for forest plantation and intercropping with oil palm in Sabah. This species produce very valuable timber. Though is considered as not durable for outdoor conditions, it is much sought after for high end-uses such as panels and face veneer.

*Paraserianthes falcataria* locally known as batai belongs to the family Leguminosae is a very fast growing, light wood tree species native to Indonesia that also has been widely planted throughout the tropics (Soerianegara & Lemmens 1994). According to Francis (1969) this species successfully planted in Bangladesh, India, Indonesia, Malaysia, Phillipines, Mexico, Hawaii and Samoa. As a fast-growing tree that can reach 45 meters in height and at the same time maintain a clear bole for over 10 meters, the species has gained wide interest in the field of industrial wood processing (Soerianegara & Lemmens 1994, Bhat et al. 1998). Other than that, this species has been promoted due to its characteristics as multipurpose trees which is able to fix nitrogen, for fodder production and produces valuable timber. This species also has been selected by the Indonesia government as a plantation species (Haruni et al. 2011).

## GENERAL CHARACTERISTICS, PROPERTIES, DURABILITY AND USES

General characteristics, anatomical, physical, mechanical, wood working and seasoning properties, durability and the uses of the four plantation species viz *Tectona grandis* (teak), *Neolamarckia cadamba* (kelempayan/laran), *Octomeles sumatrana* (binuang) and *Paraserianthes falcataria* (batai) are presented in Table 1.

**Table 1** Timber characteristics, properties, durability and uses of *Tectona grandis* (teak), *Neolamarckia cadamba* (kelempayan/laran), *Octomeles sumatrana* (binuang) and *Paraserianthes falcataria* (batai)

Parameter	<i>Tectona grandis</i> (teak)	<i>Neolamarckia cadamba</i> (kelempayan/ laran)	<i>Octomeles sumatrana</i> (binuang)	<i>Paraserianthes falcataria</i> (batai)
<b>General characteristics</b>				
1. Colour of heartwood	dull yellowish when fresh turning to golden brown or dark grayish brown on exposure, often with grayish or dark coloured streaks	white with a yellow tinge and darkens to creamy yellow on exposure	pale brown or sometimes pinkish brown	White to light brown with a pink tinge
2. Colour of sapwood	yellowish white or pale yellow-brown	sapwood is not differentiated from the heartwood	white with a greyish tinge	white with a greyish tinge
3. Porosity	ring-porous and semi-ring porous	diffuse-porous	diffuse-porous	diffuse-porous
4. Growth rings	growth rings are distinct	growth rings are absent	growth rings are absent	growth rings are absent
5. Grain	straight, wavy or slightly interlocked	straight	interlocked grain	interlocked and spiral
6. Texture	rather coarse to coarse	moderately fine and even	moderately coarse to coarse	coarse and even
<b>Anatomical properties</b>				
1. Vessels				
i. Vessel grouping	predominantly solitary and some with radial multiples of 2-3	predominantly solitary or in radial multiples of 2-6	predominantly solitary, sometimes in radial multiples of 2-3	predominantly solitary and in radial multiples of 2-4

(continued)

Table 1 (continued)

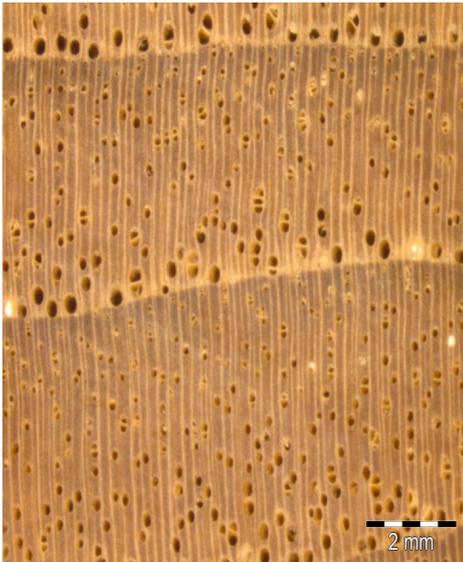
Parameter	<i>Tectona grandis</i> (teak)	<i>Neolamarckia cadamba</i> (kelempayan/ laran)	<i>Octomeles sumatrana</i> (binuang)	<i>Paraserianthes falcataria</i> (batai)
ii. Vessel arrangement	vessels diffuse, sometimes arrange in radial series, mainly oval, sometimes round	arrange in radial series, vessels round to oval shaped	vessels diffuse, sometimes arrange in radial series, mainly round in shaped	arrange in radial series, a slight tendency to oblique arrangement, vessels round to oval shaped
iii. Vessel contents	yellow deposits or tyloses are common	deposit and tyloses absent	deposit absent, tyloses infrequent	tyloses and deposit absent
2. Wood parenchyma	axial parenchyma is sparsely vasicentric in latewood, in marginal or in seemingly marginal bands	axial parenchyma diffuse to diffuse in aggregates	axial parenchyma vasicentric, sometimes aliform	Axial parenchyma vasicentric and diffuse
3. Rays	multiseriate rays with 3–6 cells, homocellular	multiseriate rays with 2–4 cells, heterocellular	multiseriate rays with 2–5 cells, heterocellular	usually uniseriate sometimes biseriates homocellular
<b>Physical properties</b>				
1. Timber classification	light hardwood <sup>[d]</sup>	light hardwood <sup>[d]</sup>	light hardwood <sup>[d]</sup>	light hardwood <sup>[d]</sup>
2. Density (kg/m <sup>3</sup> )	610–750 <sup>[d]</sup>	370–465 <sup>[c][d]</sup>	270–465 <sup>[d]</sup>	220–430 <sup>[d]</sup>
3. Shrinkage from green to air dry (%)	tangential: 1.1–2.5 <sup>[d]</sup> radial: 0.7–1.5	tangential: 2.1 <sup>[d]</sup> radial: 0.8	tangential: 7.0 <sup>[d]</sup> radial: 3.0	tangential: 3.7 <sup>[d]</sup> radial: 2.0
<b>Mechanical properties</b>				
i. Modulus of rupture (MOR) (N/mm <sup>2</sup> )	85–106 <sup>[a]</sup>	50 <sup>[e]</sup>	49 <sup>[b]</sup>	51 <sup>[b]</sup>
ii. Modulus of elasticity (MOE) (N/mm <sup>2</sup> )	8600–13400 <sup>[a]</sup>	7700 <sup>[e]</sup>	6700 <sup>[b]</sup>	6800 <sup>[b]</sup>
iii. Compression (N/mm <sup>2</sup> )	43–72 <sup>[a]</sup>	37 <sup>[f]</sup>	32 <sup>[b]</sup>	28 <sup>[b]</sup>
iv. Shear (N/mm <sup>2</sup> )	8–15 <sup>[a]</sup>	15 <sup>[f]</sup>	5.4 <sup>[b]</sup>	7.3 <sup>[b]</sup>
<b>Wood working properties</b>	is not difficult to work, but requires some effort, mainly because of the presence of silica in the cell, tools tipped with tungsten carbide are recommended for sawing and planing operation, the woods turns well, the nailing property is rated good, gluing is good. <sup>[d]</sup>	generally easy to work with hand and machine tools. It is easy to resaw and cross-cut, planing is easy and the planed surface produced is smooth. <sup>[c][d]</sup>	easy to work with hand and machine tools, produces a smooth finish, satisfactory nailing properties. <sup>[d]</sup>	easy to work with hand and machine tools, easy to resaw and cross-cut, planing is easy and the surface produced is smooth, nailing property is rated good. <sup>[d]</sup>

Table 1(continued)

Parameter	<i>Tectona grandis</i> (teak)	<i>Neolamarckia cadamba</i> (kelempayan/ laran)	<i>Octomeles sumatrana</i> (binuang)	<i>Paraserianthes falcataria</i> (batai)
<b>Seasoning properties</b>	dries very well with few defects. Boards of 13 mm thick take 15 days to air dry from 40 to 15 % moisture content, boards of 25 mm thick take 30 days and boards of 38 mm thick take 50 days. <sup>[d]</sup>	the timber seasons fairly rapidly, with slight end checks, splitting. Boards of 13 mm take approximately 2.5 months to air dry, while 38 mm boards take 3.5 months. <sup>[d]</sup>	the timber seasons slowly with severe checking, splitting and distortion as the major defects. <sup>[d]</sup>	the timber seasons fairly rapidly with slight end-checking, splitting and insect attack as the main sources of degrade, 13 mm boards take approximately 1.5 months to air dry, while 38 mm boards take 3 months. <sup>[d]</sup>
<b>Durability and treatability</b>	the sapwood is susceptible to attack by powder-post beetles, heartwood is rated as durable to very durable. Sapwood easy to treat with preservative, heartwood is difficult to treat with preservatives. <sup>[d]</sup>	non-durable but easy to treat with preservative. <sup>[c][d]</sup>	non-durable, heartwood is perishable and highly susceptible to termite attack, sapwood liable to sapstain and powder-post beetle attack. Easy to treat with preservative impregnation. Penetration of heartwood is unsatisfactory. <sup>[d]</sup>	non-durable, very prone to sapstain fungal attack and is not easily treated, especially the heartwood. <sup>[d]</sup>
<b>Uses</b>	used for high ship decking, other constructional work in boat building such as furniture and interior fitting of boats, excellent timber for bridge building and other construction in contact with water such as docks, quays, piers and floodgates in fresh water. The timber has also been extensively used for house construction like interior and exterior joinery, used for floors exposed to light to moderate pedestrian traffic. Other uses include musical instrument, toys, carving, laboratory, kitchen tables, vats, veneer and plywood manufacturer. <sup>[d]</sup>	suitable for face and core veneer in plywood, particleboard, cement-bonded board, hardboard, packing cases, wooden sandals, disposable chopsticks, source of short fibre pulp, it is also suitable for canoes and less expensive furniture if properly seasoned. <sup>[d]</sup>	suitable for plywood manufacturer, light construction, furniture components, cabinetwork, packing cases, concrete shuttering and match boxes. <sup>[d]</sup>	suitable for general utility purposes, picture frames, veneers for plywood, furniture, lightweight packing materials and light-construction materials. <sup>[d]</sup>

Source: a = James & Zamrie 2011    c = Choo et al. 1999    e = Trairat & Nikhom 2010  
b = Anonymous 1997    d = Lim & Chung 2002    f = Soerianegara & Lemmens 1994

## MACROSCOPIC STRUCTURE OF TIMBER



*Tectona grandis* (teak) (10 ×)



*Neolamarckia cadamba* (kelempayan/laran) (10 ×)



*Octomeles sumatrana* (binuang) (10 ×)



*Paraserianthes falcataria* (batai) (10 ×)

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