

Tectona grandis

teak

L. f.

Verbenaceae

LOCAL NAMES

Bengali (Segun,saigun); Burmese (kyun); English (teak wood,Indian oak,teak tree); Filipino (dalanang,djati); French (teck); German (tiek,Teak(holz)baum); Gujarati (sagach,saga); Hindi (saigun,sagwan,sagun); Indonesian (kulidawa,deleg,jati); Italian (teck); Javanese (deleg,kulidawa); Lao (Sino-Tibetan) (sak); Malay (jati); Nepali (teak,saguan); Sanskrit (bardaru,bhumisah,saka,dwardaru,kharchhad); Sinhala (takku,teaku); Spanish (teca); Swahili (msaji,mtiki); Tamil (tekku,tekkumaram,tek); Thai (sak,mai-sak); Trade name (teak); Vietnamese (gi[as] t[ij],c[aa]y t[ees]ch)

BOTANIC DESCRIPTION

Tectona grandis is a large, deciduous tree reaching over 30 m in height in favourable conditions. Crown open with many small branches; the bole is often buttressed and may be fluted, up to 15 m long below the 1st branches, up to 1 m dbh. Bark is brown, distinctly fibrous with shallow, longitudinal fissures. The root system is superficial, often no deeper than 50 cm, but roots may extend laterally up to 15 m from the stem.

The very large, 4-sided leaves are shed for 3-4 months during the later half of the dry season, leaving the branchlets bare. Shiny above, hairy below, vein network clear, about 30 x 20 cm but young leaves up to 1 m long.

Flowers small, about 8 mm across, mauve to white and arranged in large, flowering heads, about 45 cm long; found on the topmost branches in the unshaded part of the crown.

Fruit is a drupe with 4 chambers; round, hard and woody, enclosed in an inflated, bladder-like covering; pale green at first, then brown at maturity. Each fruit may contain 0 to 4 seeds. There are 1 000-3500 fruits/kg.

The generic name comes from 'tekka', the Malabar name for *T. grandis*. The specific name, 'grandis', is Latin for 'large' or 'great'.

BIOLOGY

T. grandis is 96-100% self-incompatible. The species is hermaphroditic and pollinated by insects such as black ants, horse flies, and particularly by bees. Fruits mature about 4 months after fertilization. Premature shedding of fruit is a problem. Up to 60% fruit set has been reported following cross-pollination of teak. The individual flower has a 1-day cycle; optimum pollination period is between 1130 h and 1300 h.

The height of the tree at the moment of first flowering is important in silviculture. When it is long (it may reach up to 10 m), the final bole form is positively affected, but early-flowering trees may develop extremely wide crowns and short boles. This characteristic is clearly undesirable in timber-crop species and warrants strong selection against flowering in conjunction with increased effort to develop commercial methods of vegetative propagation. The time of the 1st inflorescence is determined by both genetic and environmental factors.

In Thailand, flowering normally starts at the age of 8 to 10 years. However, trees have been observed to flower at the age of 3 months, while a few specimens of superior phenotype did not flower until the age of 27 years. Flowers usually appear during the rainy season, and trees tend to flower synchronously. In Thailand, flowering occurs in June-September and fruiting in November-January. In Java, trees flower every year at the beginning of the rainy season (October-November) and only a few flowers (about 1%) develop into fruits. Fruits fall gradually during the dry season.

Although natural fruit set in Thailand is low (0.5-5%), 6 to 60% of fruit set can be achieved by artificial pollination. Fruits develop to full size about 50 days after pollination. They are dispersed by wind over 10-15 m and also by running water after heavy rainfall.



T. grandis, seedlings in nursery. (David Boshier)



Leaves and fruit at Kihei Maui, Hawaii (Forest and Kim Starr)



Habit at Keanae Arboretum, Maui, Hawaii (Forest and Kim Starr)

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ECOLOGY

T. grandis will survive and grow under a wide range of climatic and edaphic conditions. For example, in northern Togo it grows in a region with an annual rainfall of nearly 600 mm and in Bangladesh a region with close to 4 000 mm. It grows best in a warm, moist, tropical climate with a significant difference between dry and wet seasons. It is a pioneer species, but with a long life span. In contrast to other pioneer species, *T. grandis* is able to persist and dominate and to naturally regenerate towards the climax phase of succession in most parts of its natural range.

It occurs naturally in various types of tropical deciduous forests. In seasonal climates, *T. grandis* is deciduous, while trees grown in non-seasonal climates are semi-deciduous. It is often a dominant member of a mixed deciduous forest, where its main associates are *Xylia* spp., *Azelia xylocarpa*, *Terminalia* spp. and *Lagerstroemia* spp. The forest floor is often covered with bamboo. *T. grandis* generally occurs scattered but can form almost pure stands under favourable conditions. Young plants show a remarkable capability to recover after fire.

BIOPHYSICAL LIMITS

Altitude: 0-1 200 m, Mean annual temperature: 14-36 deg. C, Mean annual rainfall: (600)1 200-2 500(4 000) mm

Soil type: Their most suitable soil is deep, well-drained, fertile alluvial-colluvial soil with a pH of 6.5-8 and a relatively high calcium and phosphorous content. The quality of growth, however, depends on the depth, drainage, moisture status and the fertility of the soil. Teak does not tolerate waterlogging or infertile lateritic soils.

DOCUMENTED SPECIES DISTRIBUTION

Native: India, Indonesia, Laos, Myanmar, Thailand

Exotic: Antigua and Barbuda, Bangladesh, Barbados, Brazil, Brunei, Cambodia, China, Cote d'Ivoire, Cuba, Dominica, Dominican Republic, Ghana, Grenada, Guadeloupe, Jamaica, Kenya, Malaysia, Mauritius, Nepal, Nigeria, Pakistan, Panama, Philippines, Puerto Rico, South Africa, Sri Lanka, St Lucia, St Vincent and the Grenadines, Tanzania, Togo, Trinidad and Tobago, Uganda, US, Vietnam, Virgin Islands (US)



The map above shows countries where the species has been planted. It does neither suggest that the species can be planted in every ecological zone within that country, nor that the species can not be planted in other countries than those depicted. Since some tree species are invasive, you need to follow biosafety procedures that apply to your planting site.

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PRODUCTS

Fuel: Teakwood has been used in the manufacture of charcoal and as fuelwood, but nowadays it is usually considered too valuable for anything but pruning remnants and other rejects to be used in this way.

Timber: A rare combination of superior physical and mechanical properties makes *T. grandis* a paragon of timber, and there is no likelihood of it being eclipsed by any other. The wood is a medium weight timber that is rather soft and has a characteristic appearance. The heartwood is often dull yellowish when freshly cut but turns golden brown or sometimes dark greyish-brown after exposure, often streaked grey or black. The sapwood is yellowish-white or pale yellowish-brown and up to 50 mm thick. Grain is straight, wavy or slightly interlocked, with rather coarse and uneven texture. Density of the wood is (min. 480) 610-750 (max. 850) kg/m³ at 12% mc. The wood is oily to the touch and when freshly cut has a smell reminiscent of leather.

Being classified as very resistant to teredo activity, the wood is excellent timber for bridge building and other construction in contact with water such as docks, quays, piers and floodgates in fresh water. In house building, teakwood is particularly suitable for interior and exterior joinery (windows, solid panel doors and framing) and is used for floors exposed to light to moderate pedestrian traffic. It is also used quite extensively for garden furniture. Other uses are for building poles, transmission line poles, fence posts, wallboards, beams, woodwork, boxes, musical instruments, toys, railway sleepers and railcar construction. It is brittle and therefore less suitable for articles requiring high resilience, such as tool handles and sporting goods. Its high resistance to a wide variety of chemicals makes it ideal for laboratory and kitchen tables as well as for scrubbing towers, vats, pipes and fume ducts in industrial chemical plants. The wood grains are figured well, producing an attractive veneer, which is extensively used in the manufacture of furniture and interior fittings. Teakwood is suitable for the manufacture of decorative plywood.

Larger logs are utilized for beams and sleepers, smaller ones for scantlings and battens, and thinner top ends and poles are used as round posts. Thinnings are also used for timber. The wood is very durable, difficult to preserve, saws fairly and seasons easily. For the export market, teakwood is recommended for ship decking and other constructional work in boat building. *T. grandis* is economically one of the most important timber tree species of Indonesia.

Tannin or dyestuff: Both the rootbark and the young leaves produce a yellowish-brown or reddish dye, which is used for paper, clothes and matting.

Medicine: In traditional medicine, a wood powder paste has been used against bilious headaches and swellings and internally against dermatitis or as a vermifuge. The charred wood soaked in poppy juice and made into a paste has been used to relieve the swelling of the eyelids. The bark has been used as an astringent and the wood as a hair tonic.

Other products: Sawdust from teakwood is used as incense in Java; the dust, however, may irritate the skin.

SERVICES

Ornamental: *T. grandis* is occasionally cultivated in tropical countries as an ornamental for its large leaves and spreading flower clusters. The species was originally introduced into Malaysia as a roadside and ornamental tree.

Intercropping: Soya bean mixed with *T. grandis* not only makes the latter grow better but also allows harvesting of the bean for food; the soya stems, roots and leaves are added to the soil as fertilizer.

TREE MANAGEMENT

For plantations, stumps are planted at a spacing of 2 x 2 m. As the tree is deciduous, raising pure plantations is discouraged; rather, it is recommended to raise 80% of mixed indigenous species and the remaining 20% *T. grandis*. Fire protection is important; each year's planting area should be protected by a fire line 10 m wide, which is cleared of all vegetation. Plantations must also be protected from grazing animals, as the soil is often susceptible to erosion. Coppicing and weeding should also be practised. *T. grandis* is a very strong light demander, and the optimum for its growth lies at 75-100% of full sunlight. It is intolerant of crown friction.

Initial growth of the tree is rapid. At an age of 5 years, an average height of 13 m and 10 cm dbh is not unusual; after 10 years, 16.5 m and 15 cm; after 20 years, 21.5 m and 23.5 cm. After 15 or 20 years, growth slows down. In stands of 80-year-old trees, maximum height is about 45 m, with a maximum diameter of 75 cm. Thinning takes place 4 times, at 5-, 10-, 18- and 28-year intervals after planting. The rotation period is approximately 80 years.

The average plantation yield in Java is 60-100 m³/ha, including thinning. Occasionally the final harvest may yield as much as 390 m³/ha in stands 80 years old. The mean annual volume increment is (min. 1) 3-6 (max. 15) m³/ha.

GERMPLASM MANAGEMENT

To reduce bulk in storage, the seed can be husked by rubbing it over a sieve. Another method is to load seed and large river gravel into a cement mixer. The seed can then be 'floated' off. Stumps, used for propagation, can be stored for up to a year.

Seed storage behaviour is orthodox. Viability can be maintained for at least 7 years in hermetic, air-dry storage at room temperature; there is no loss in viability after 7 years in hermetic, air-dry storage at 0-4 deg. C with 12% mc. Seed can be maintained for 10 years in hermetic, air-dry storage at 2 deg. C. There are 800-2 000 seeds/kg.

PESTS AND DISEASES

The main attack on the stems is by the insect *Calothermes tectonae*. At first sign of attack, trees should be felled and burned, because no effective insecticide is known. Other plantation pests are *Eutectona machaeralis* (teak skeletonizer) and woodborers *Xyleutes ceramicus* in Thailand and *Xyleborus destruens* in Indonesia. Leaf-eating caterpillars such as *Hyblaea puera* and *Pyrausta machaeralis* may defoliate branches. Termites such as *Neotermes tectonae* may damage the trees, although many provenances show a high resistance. Seeds can be infested by larvae of Lepidoptera and Coleoptera (longhorn beetles).

A bacterial wilt caused by *Pseudomonas solanacearum* often attacks 6-month to 2-year-old seedlings. To control, choose a nursery site with good drainage and avoid root injury during weeding and transplanting. Fungi such as *Corticium salmonicolor* can cause disease. Crowns are often infested by semi-parasitic mistletoes, such as *Loranthus* spp. and *Dendrophthoe falcata*, which cause severe retardation; lopping affected branches controls them.

FURTHER READING

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SUGGESTED CITATION

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