

Cunninghamia lanceolata

shatiao, shagan, pigao

Lamb.) Hook

Taxodiaceae

LOCAL NAMES

Chinese

(shashu,shanmu,shamu,sha,zhengsha,zhengmu,mutoushu,cisha); English (China fir,Chinese fir); French (sapin de chine); Japanese (koyozan zoku); Trade name (shatiao,shagan,pigao); Vietnamese (sa mu,sa moc)

BOTANIC DESCRIPTION

Cunninghamia lanceolata is an evergreen tree to 30 m tall and 2.5-3 m dbh. The crown is pyramidal or dark green. The branches are in whorls of 5-6 together, spreading and pendulous at the ends. Bark dark brown, fissured, shedding in long strips and exposing aromatic, yellowish or reddish inner bark.

Leaves stiff, densely and spirally arranged, but spreading in 2 ranks, glossy deep green adaxially, linear-lanceolate, straight or slightly falcate, 3-6.5 cm long by 1.5-5 mm thick by 0.3-1.2 mm wide, with finely serrated margins.

Male and female flowers in separate clusters at the end of the shoots. Pollen cone fascicles terminal, broadly obovoid, 1-3(-5) together, each with 8-20 cones, occasionally a few also around base of seed cone; peduncle 2-4 mm.

Female cones ovoid or rounded, 2.5-5 cm long by 3-4 cm wide, solitary or several together; cone-scales brown with serrate margin and the apex elongated into a spine. The female cones are normally situated lower in the crown than the male cones.

Seed on each scale, thin, dark brown, oblong or narrowly ovate, 7-8 mm long and 4-5 mm wide, surrounded by a thin membranous wing.

The genus name is after James Cunninghame, a British doctor in China, who collected (1701-2) and sent plants to England. The specific name 'lanceolata' is derived from a Latin word 'lanceolatus', meaning 'having lance-shaped leaves'.

BIOLOGY

Flowering and seed setting begin when the trees are 6-8 years old. In China, female flowers are formed in the autumn, enclosed in leafy scales that open in March-April. Male flowers blossom for 5-10 days in mid to late March when the monthly temperature reaches 10-13°C. After successful pollination the scales around the female flowers close tightly and young cones are formed 10 days later. Seeds ripen in October to November. Empty cones remain on the tree for one or more years.



foliage at Strybing Arboretum, Golden Gate Park, San Francisco, CA. (J.S. Peterson @ USDA-NRCS PLANTS Database)



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ECOLOGY

C. lanceolata is usually found in evergreen and deciduous mixed forests. In the southern China, it's found in moist monsoon evergreen broad-leaved forests while in central China, it occasionally can be found in secondary forests. It is tolerant to frost although young trees may suffer damage below -15°C .

BIOPHYSICAL LIMITS

Altitude: 1000-2600 m

Mean annual temperature: 12-23°C

Mean annual rainfall: 660-2450 mm

Soil type: Best growth is obtained on well-drained loamy soils with topsoil pH of 4.7-6.4 and Carbon-Nitrogen ratio of 6.8-16.

DOCUMENTED SPECIES DISTRIBUTION

Native: Cambodia, China, Laos, Malaysia, Vietnam

Exotic: Argentina, Japan, New Zealand, South Africa



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.

shatiao, shagan, pigao

PRODUCTS

Fuel: The species produces quality firewood.

Timber: The desirable wood properties make it an important timber species. In China, it accounts for 20-30% of the total commercial timber production. The pale yellow to white wood has straight grains, soft but durable, uniform-textured and has a density 0.4-0.5. It is easily to work, strongly resistant to rot and resistant to insects and termites. It is used for house construction, poles, bridges, boats, vehicles, building and furniture. The older and larger branches are used in turnery.

Tannin or dyestuff: The bark is used for tannin production.

Essential oil: The branches produce an essential oil used in the perfume industry. Cedrol, pinene, phellandrene, citrene, terpinol, thujenol, cadinol and borneol are the main constituents of the essential oil

Medicine: Traditionally, the Chinese valued this tree for its many medicinal properties. A wood decoction was used as a bath for fetid (smelly) feet. The decoction was ingested for lacquer poisoning, to help chronic ulcers, cholera, and even alleviate flatulence. An essential oil made from the stem was for bruises, pain from rheumatism, and wounds. Similarly, the ash from old bark was applied to burns, scalds, and wounds. A decoction from the cones was taken as a cough remedy

Other products: The bark is used in paper and textiles industry

SERVICES

Reclamation: It is suitable for reforestation in subtropical evergreen, coniferous and mixed broad-leaved forests

Ornamental: It is widely used for landscaping in public gardens, along the roads, parks and temples because of its fast growth, beautiful crown shape, and resistance to pests and diseases

Intercropping: It is a suitable species for agroforestry systems in China as it is usually intercropped with a number of crops such as maize, beans, wheat, Chinese sorghum, buckwheat, potato, 'ground chestnut' (*Arachis hypogaea*), tobacco and upland rice or with other tree species such as the tung oil tree (*Aleurites fordii*), tea and *Litsea cubeba*. The interplanting is important not only to increase the income of farmers during early stages of plantations but also to avoid the land degradation that results from continuous cropping of *C. lanceolata*.

TREE MANAGEMENT

C. lanceolata is a fast growing species and coppices well. It is topophytic, meaning if cuttings are taken from lateral growth, they grow laterally and if taken from vertical growth, they grow vertically. It also sprouts from the roots if cut down. It requires protection from windswept sites.

In plantation establishment, site preparation includes tillage to a depth of 20-30 cm. Initial stocking rate is 2500-3600 stems/ha. Tending should be carried out 2-3 times during the growing season in each of the first 3 years after planting. Pruning is not usually practiced. In forests, the lower branches eventually self-prune when the tree canopy closes. Thinning 2- 3 times is done according to initial density and growth. About 1500 trees/ha are retained as a final crop.

It produces good height growth from 3-10 years, with mean annual increment of 0.5-1 m height up to 3 cm. Volume growth occurs at 30-35 years old when the mean annual height increment decreases to 0.2-0.3 m/yr. Total harvest volume is estimated at 500-800 m³/ha.

GERMPLASM MANAGEMENT

The optimal time for harvest is 2-3 weeks after seed ripening, when the cones have turned from dark green to yellow brown. The cones are harvested using long hooks. The yield is usually 30-50 g seeds/kg of dry cone. After harvest, the seeds are after-ripened in shade for one week.

Seeds storage behaviour is orthodox. If stored in airtight containers, the seeds normally retain full viability for one year. They can be stored at 5°C and 8-10% moisture content to prolong viability. There are 130000-150000 seeds/kg.

PESTS AND DISEASES

Semanotus sinoauster, *Callidium villosulum* and *Lobesia cunninghamiacola* are the major pests in *C. lanceolata*. *S. sinoauster* is a cerambycid borer is controlled by artificial capture, by spraying insecticide on stems, or by physical removal of the pests (by scraping the bark) in combination with insecticide application. *C. villosulum*, a borer, is effectively controlled by filling the boring holes with insecticide. *L. cunninghamiacola*, which eats the terminal buds on new shoots, can be effectively controlled by releasing parasitoids such as *Trichogramma dendrolimi*, during egg production, by spraying insecticides during the larval stage, or fumigation during the imago stage.

In the nurseries, *Macrotermes barneyi*, *Odontotermes formosanus*, *Gryllotalpa africana* and *Agrotis ipsilon* affects *C. lanceolata*.

Rhizoctonia solani, *Glomerella cingulata*, *Pseudomonas cunninghamiae* and *Lophodermium uncinatum* causes diseases in this species. These diseases frequently occur on weak trees or on lower-quality plantation sites, where the trees are susceptible to attack by these pathogens.

FURTHER READING

Fung LE. 1994. A literature review of *Cunninghamia lanceolata*. *Commonwealth Forestry Review*. 73(3): 172-192.

Jen IA. 1994. Outlook and historical review of Chinese fir (*Cunninghamia lanceolata*) timber production in the Taiwan private forests. *Bulletin-of-the-Taiwan-Forestry-Research-Institute*. 9(3): 235-240.

Liu JF, Tong SZ. 1996. New technique of Chinese fir management. *World Forestry Research*, Vol. 9, Special issue.

Mueller-Starck G and Liu YQ. 1989. Genetics of *Cunninghamia lanceolata* Hook. 2. Genetic variation within and between two provenance samples. *Silvae Genetica*. 38(5-6): 172-177.

Nguyen Ngoc Chinh, et al. 1996. Vietnam forest trees. Hanoi, Vietnam: Agricultural Publishing House. 788p.

Shaohui F, et al. 1998. Chinese Fir Plantation in Fujian Province, China. In: Nambiar EKS et al. (eds.), Site Management and Productivity in Tropical Plantation Forests. Workshop proceedings, February 1998, South Africa. CIFOR.

Yeh FC, Shi J, Yang R, Hong J and Ye Z. 1994. Genetic diversity and multilocus associations in *Cunninghamia lanceolata* (Lamb.) Hook from the People's Republic of China. *Theoretical and Applied Genetics*. 88(3-4): 465-471.

Zhi JW, Chen YT. 1994. Combining ability for main characters of wood qualities in Chinese fir. *Forest Research*. 7(5): 531- 536.

Zhu LF, Li YH, Li BL, Lu BY, Xia NH. 1993. Aromatic plants and essential constituents. South China Institute of Botany. Chinese Academy of Sciences. Haifeng, Guizhou, China: Haifeng Publishing Co.

SUGGESTED CITATION

Orwa C, Mutua A , Kindt R , Jamnadass R, Simons A. 2009. Agroforestry Database:a tree reference and selection guide version 4.0 (<http://www.worldagroforestry.org/af/treedb/>)