Pongamia pinnata

(L.) Pierre

Fabaceae - Papilionoideae

pongam, karanj, karanga, kanji

LOCAL NAMES

Arabic (um al shuur); Bengali (karanj,s[aa]m hoa,karanja); Burmese (thiuwia); Cantonese (honge); English (karum tree,Indian beech,pongam,poonga-oil-tree,oil tree,seashore mempari,pongam oil tree); Filipino (báni); French (arbre de pongolote); Hindi (karanja,kanji,karanj,papar); Indonesian (ki pahang laut,bangkong,biansu,kranji,melapari); Javanese (bangkong); Lao (Sino-Tibetan) (dok kom koi,(do:k) ko:m ko:y); Malay (pari-pari,malapari,mempari,biansu,pongu,mempare,kacang kayu laut); Nepali (karanji,karauini); Sanskrit (karanj,karanja); Sinhala (kona,karanda); Tamil (punku,pungam,pongam,ponga,dalkaramcha); Thai (ko:m ko:y,khayi,yi-nam); Trade name (kanji,pongam,karanga,karanj); Vietnamese (kh[oor],day lim,kh[oor]s[aa]m hoa,d[aa]y m[aas]u,d[aa]y kim,s[aa]m hoa,day mau)

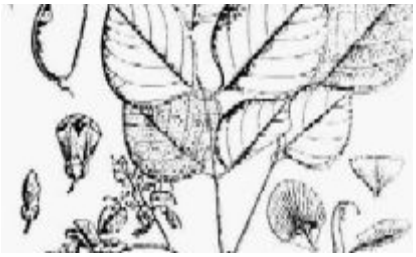

Illustration of all plant parts. (Beddome)

BOTANIC DESCRIPTION

Pongamia pinnata is a medium-sized evergreen or briefly deciduous, glabrous shrub or tree 15-25 m high, with straight or crooked trunk 50-80 cm or more in diameter and broad crown of spreading or drooping branches. Bark grey-brown, smooth or faintly vertically fissured. Branchlets hairless with pale stipule scars.

Leaves alternate, imparipinnate with long slender leafstalk, hairless, pinkish-red when young, glossy dark green above and dull green with prominent veins beneath when mature. Leaflets 5-9, paired except at end, short-stalked, ovate elliptical or oblong, 5-25 x 2.5-15 cm, obtuse-acuminate at apex, rounded to cuneate at base, not toothed at the edges, slightly thickened.

Inflorescence raceme-like, axillary, 6-27 cm long, bearing pairs of strongly fragrant flowers; calyx campanulate, 4-5 mm long, truncate, finely pubescent. Flower clusters at base of and shorter than leaves, to 15 cm long, slender, drooping. Flowers 2-4 together, short-stalked, pea-shaped, 15-18 mm long. Calyx campanulate, 4-5 mm long, truncate, finely pubescent; corolla white to pink, purple inside, brownish veined outside, 5-toothed, standard rounded obovate 1-2 cm long, with basal auricles, often with green central blotch and thin silky hairs on back; wings oblong, oblique, slightly adherent to obtuse keel.

Pods borne in quantities, smooth, oblique oblong to ellipsoid, 3-8 x 2-3.5 x 1-1.5 cm, flattened but slightly swollen, slightly curved with short, curved point (beaked), brown, thick-walled, thick leathery to subwoody, hard, indehiscent, 1-2 seeded, short stalked. Seed compressed ovoid or elliptical, bean-like, 1.5-2.5 x 1.2-2 x 0.8 cm, with a brittle coat long, flattened, dark brown, oily.

This species has been placed alone in its genus Pongamia, derived from the Malabar local name (pongam). In 1972, S. R. Bennet, an Indian taxonomist gave the pongam a new name, Derris indica (Lamk.) Bennet, but this change has not been generally adopted. The name Derris, derived from Greek, means ‘leather covering or skin’; the specific name ‘indica’ obviously means of India.

BIOLOGY

In Florida, it sheds its leaves in April and develops new leaves and flowers from May onwards. In India, seed ripens from February to May. Pod production starts 5-7 years after sowing. They do not open naturally, and must decay before seeds can germinate.

ECOLOGY

P. pinnata is native to humid and sub-tropic environments; common along waterways or seashores, with its roots in fresh or saltwater. It is very tolerant of saline conditions and alkalinity, and occurs naturally in lowland forest on limestone and rocky coral outcrops on the coast, along the edges of mangrove forest and along tidal streams and rivers. It is a shade bearer and can grow under the shade of other trees; it is, however, not a shade demander and grows well even with full overhead light. It is also drought resistant and well adapted to adverse climatic conditions and soil moisture conditions; prolonged drought may however kill seedlings. In its natural habitat, the species tolerates a wide temperature range. Mature trees withstand light frost, waterlogging and tolerate temperatures of up to 50 deg. C. In addition to rain, trees require a dry season of 2-6 months.

BIOPHYSICAL LIMITS

Altitude: 0-1 200 m, Mean annual temperature: 1-16 to 27-38(50) deg. C, Mean annual rainfall: 500-2 500 mm

Soil type: P. pinnata can grow on most soil types; best growth is found on deep well-drained sandy loams with assured moisture, but it will also grow on sandy soils and heavy swelling clay soils. It does not do well on dry sands, although it tolerates saline conditions, alkalinity and waterlogged soils.

DOCUMENTED SPECIES DISTRIBUTION

Native: Bangladesh, India, Myanmar, Nepal, Thailand

Exotic: Australia, China, Egypt, Fiji, Indonesia, Japan, Malaysia, Mauritius, New Zealand, Pakistan, Papua New Guinea, Philippines, Samoa, Seychelles, Solomon Islands, Sri Lanka, Sudan, Tonga, 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.

PRODUCTS
Fodder: Opinions vary on the usefulness of P. pinnata as a fodder; its value is greatest in arid regions. The leaves can be eaten by cattle and are readily consumed by goats however it is not common. The leaves contain 43% dry matter, 18% crude protein, 62% neutral detergent fibre, and in vitro dry matter digestibility of 50%. The presscake (seed residue) after oil extraction is bitter and unfit for use as a sole animal feed. It is high in protein but posses several toxic factors, particularly karanjin, pongamol and tannin. It is suggested as a short-term substitute for other protein sources but never serving as more than a 75% replacement.

Apiculture: P. pinnata flowers are considered a good source of pollen for honeybees in India and they yield adequate nectar.

Fuel: With a calorific value of 4 600 kcal/kg, pongam is commonly used as a fuelwood. The seed oil was formerly indispensable as an illuminant in lamps, but has been largely replaced by kerosene.

Fibre: The bark fibre is made into string, twine or rope, and the wood provides paper pulp.

Timber: Wood varies from white to yellowish-grey with no distinct heartwood; beautifully grained and medium to coarse textured. Although it is a moderately strong timber that is relatively easy to saw, turn and finish, the wood is not considered a quality timber because it is not durable, tends to split and warp during seasoning and is susceptible to insect attack. The wood is used for cabinet making, cartwheels, posts, agricultural implements, tool handles and combs.

Tannin or dyestuff: Roots yield a natural pigment, pinnatin, which was synthesized in 1967. The wood ash is employed in dyeing. Oil from the seeds is used for leather dressing in tanning industries.

Lipids: Oil is the most important product of the pongam tree and vast amounts of seeds are collected in India for commercial processing of industrial uses. It has been found that the seed contains 27-40% of a thick, yellow or reddish-brown oil and that 2 kg of mature pods will yield about 1 kg of husked kernels. Extracted oil amounts to 13.4% of the whole seed pod; 26.97% of the kernels. The oil has a bitter taste, a disagreeable aroma and a specific gravity of 0.9371 at 15 deg. C. It is used as a lubricant, varnish, water-paint binder and in soap making. It is one of the few nitrogen-fixing trees to produce seeds containing oil.

Poison: The presscake, when applied to the soil is valued as a pesticide, particularly against nematodes. In rural areas, dried leaves are stored with grain to repel insects. Pounded and roasted seeds used to be utilized as fish poison.

Medicine: The seed oil is rubbed as liniment on skin diseases and rheumatic parts. Internally, it is given as a stomachic and cholagogue in dyspepsia and cases of sluggish liver. A seed powder is given as an expectorant in bronchitis and whooping cough, and is also prescribed as a ferbifuge and tonic. Seed paste is spread on sores and rheumatic parts. An infusion of the leaves is used to relieve rheumatism, a decoction is a cough remedy, expressed juice is used on herpes and itches, and when they are crushed, applied as a poultice for the treatment of parasitic skin diseases. The flowers are claimed to have anti-diabetic action. Fresh stem bark is applied to reduce the enlargement of the spleen. It is astringent and taken internally to relieve bleeding heamorrhoids while a poultice of young leaves is laid on externally. The root bark contains a bitter alkaloid and is employed by the people of Guimaras Island in the Philippines as an abortifacient. The antiseptic root juice is put on sores and ulcers and used to clean teeth.

Other products: In India, the tree is a host for the useful lac insect. It is also used as a host for the hemiparasitic sandalwood, Santalum album L.

SERVICES
Erosion control: A preferred species for controlled soil erosion and binding sand dunes because of its extensive network of lateral roots.

Shade or shelter: Grass grows normally beneath the tree so it has been planted for shade in pastures. P. pinnata is grown as a windbreak for tea plantation in Sri Lanka.

Reclamation: Because it tolerates moderate levels of salinity, pongam is an ideal candidate for recovering a variety of wastelands such as saline soil reclamation. It is also used in reforestation of marginal land.

Nitrogen fixing: Nodulation is reported on pongam. In nurseries and fields the presence of nodules on uninoculated pongam seedlings is common. Therefore, this species may not be specific in its Rhizobium strain requirement. It nodulates and fixes atmospheric nitrogen with Rhizobium of the cowpea group.

Soil improver: Incorporation of leaves and the presscake into soils improves fertility. Decomposed flowers are valued in the tropics as rich nutrition for special plants, especially when grown in greenhouses.

Ornamental: P. pinnata is often planted in homesteads as an ornamental tree and in avenue plantings, roadsides, and stream and canal banks. However the large amounts of flowers, leaves and pods that it regularly sheds make it not very

suitable for this purpose.

TREE MANAGEMENT
Seedling survival and growth benefit from annual weed control for the first 3 years after transplanting. Growth of young trees is fairly slow; a growth of 1.3 m in height and 0.4 cm in diameter in 13 months was recorded in India. Trees coppice well and can also be pollarded. When planted as a shade or ornamental tree, pruning may be necessary to obtain a trunk of appropriate height. The spacing adopted in avenue planting is about 8 m between plants. In block plantings, the spacing can range from 2 x 2 m to 5 x 5 m.
The lateral spread of roots on this species, about 9 m in 18 years, is greater than most other species; moreover it produces root suckers profusely. Because of these characteristics, pongam is unsuitable for agroforestry and has the potential to become a weed if not managed carefully. Individual trees yield 9-90 kg of pods annually, while mature trees yield 8-24 kg of seeds annually.

GERMPLASM MANAGEMENT
Seed storage behaviour is orthodox and seeds remain viable for about a year when stored in air-tight containers. There are 1 500-1 700 seeds/kg.

PESTS AND DISEASES
P. pinnata attracts many pests and diseases. Some of the important pests are Parnara mathias, Gracillaria spp, Indarbela quadrinotata, Myllocerus curvicornis, and Acrocercops spp. Attacks by these insects cause whitish streaks and the formation of galls on affected leaves. Aspongopus brunneus Thunberg has been found to cause 20-30% damage to nursery seedlings in India. Both adults as well as nymphs suck the sap from the seedlings.
Several fungi attack the seedlings and the trees. Ganoderma lucidum causes root rot and Fomes merilli (Murrill) Sacc. & Trott attack the tender shoots and leaves and cause early defoliation in the seedlings and trees. Because of the long delays in transfer and poor storage conditions, there is a serious fungal infection of stored seeds by at least a dozen species - Aspergillus spp, Penicillium spp, Chaetomium spp and Dothiorella spp predominating the year round.

FURTHER READNG

Anon. 1986. The useful plants of India. Publications & Information Directorate, CSIR, New Delhi, India.

Daniel JN. 1997. Pongamia pinnata - a nitrogen fixing tree for oilseed. A Publication of the Forest, Farm, and Community Tree Network (FACT Net). Winrock International.

Faridah Hanum I, van der Maesen LJG (eds.). 1997. Plant Resources of South-East Asia No 11. Auxillary Plants. Backhuys Publishers, Leiden, the Netherlands.

Hocking D. 1993. Trees for Drylands. Oxford & IBH Publishing Co. New Delhi.

Hong TD, Linington S, Ellis RH. 1996. Seed storage behaviour: a compendium. Handbooks for Genebanks: No. 4. IPGRI.

Kayastha BP. 1985. Silvics of the trees of Nepal. Community Forest Development Project, Kathmandu.

Little EL. 1983. Common fuelwood crops. Communi-Tech Association, Morgantown, West Virginia.

MacDicken GK. 1994. Selection and management of nitrogen fixing trees. Winrock International, and Bangkok: FAO.

Morton JF. 1985. Indian almond (Terminalia catappa), salt-tolerant, useful, tropical tree with 'nut' worthy of improvement. Economic Botany. 39(2):101-112.

Morton JF. 1990. The pongam tree, unfit for Florida landscaping, has multiple practical uses in underdeveloped lands. Proc. Fla. State Hort. Soc. 103:338-343.

National Academy of Sciences. 1980. Firewood crops. National Academy Press. Washington D.C.

Perry LM. 1980. Medicinal plants of East and South East Asia : attributed properties and uses. MIT Press. South East Asia.

Singh RV. 1982. Fodder trees of India. Oxford & IBH Co. New Delhi, India.

Vimal OP, Tyagi PD. Fuelwood from wastelands. Yatan Publications, New Delhi, India.

SUGGESTED CITATION

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