

LOCAL NAMES

Burmese (mingut); Dutch (manggis,manggistan); English (mangostan,king's fruit,mangosteen); Filipino (mangis,mangostan); French (mangoustanier,mangostanier,mangouste,mangostier); German (Mangostanbaum); Indonesian (manggis); Lao (Sino-Tibetan) (mangkhut); Malay (sementah,manggis,semegah,mesetor); Portuguese (mangusta,mangosta,mangostao); Spanish (mangostan,palo de cruz,mangostao); Thai (mangkhut); Vietnamese (caay mwanng cujt,mang cut,kandis,cay mang cut)

BOTANIC DESCRIPTION

The mangosteen is a small, evergreen tree, very slow-growing, erect with a pyramidal crown; attains 6-25 m in height, has dark-brown or nearly black, flaking bark, the inner bark containing yellow, gummy, bitter latex.

Leaves opposite, short-stalked, ovate-oblong or elliptic, leathery and thick, dark-green, slightly glossy above, yellowish-green and dull beneath; 9-25 cm long, 4.5-10 cm wide, with conspicuous, pale midrib. New leaves rosy.

Flowers 4-5 cm wide, fleshy, may be male or hermaphrodite on the same tree. The former are in clusters of 3-9 at the branch tips; there are 4 sepals and 4 ovate, thick, fleshy petals, green with red spots on the outside, yellowish-red inside. Stamens many, fertile and sterile. The hermaphrodite are borne singly or in pairs at the tips of young branchlets; their petals may be yellowish-green edged with red or mostly red, and are quickly shed.

Fruit a subglobose berry, capped by the prominent calyx at the stem end, with 4-8 triangular, flat remnants of the stigma in a rosette at the apex, dark-purple to red-purple and smooth externally, 3.4-7.5 cm in diameter. The rind is 6-10 mm thick, red in cross-section, purplish-white on the inside; contains bitter yellow latex and a purple staining juice. There are 4-8 triangular segments of snow-white, juicy, soft flesh (actually the arils of the seeds).

The fruit may be seedless or have 1-5 fully developed seeds. Seed ovoid-oblong, somewhat flattened, 2.5 cm long and 1.6 cm wide that cling to the flesh. Flesh slightly acid, mild to distinctly acid in flavor, acclaimed to be exquisitely luscious and delicious.

The generic name is after L. Garcin (1683-1751), a naturalist and a correspondent of Linnaeus.

BIOLOGY

At low altitudes in Sri Lanka, the fruit ripens from May to July; at higher elevations, in July and August or August and September. In India, there are 2 distinct fruiting seasons, one in the monsoon period (July-October) and another from April through June. Puerto Rican trees in full sun fruit in July and August; shaded trees, in November and December.



(Manuel Bertomeu)



Garcinia mangostana nursery seedlings
(Manuel Bertomeu)



Garcinia mangostana showing fruits (Manuel Bertomeu)

ECOLOGY

The mangosteen is ultra-tropical. It cannot tolerate temperatures below 4 deg C, nor above 38 deg C. It is limited in Malaysia to elevations below 450 m. In Madras it grows from 76-1 500 m above sea-level. It ordinarily requires high atmospheric humidity and an annual rainfall of at least 1 270 mm, and no long periods of drought. The tree needs good drainage and the water table ought to be about 1.8 m below ground level. The mangosteen must be sheltered from strong winds and salt spray, as well as saline soil or water.

BIOPHYSICAL LIMITS

Altitude: 76-1 500 m

Mean annual rainfall: 1 200 mm

Mean annual temperature: 4-38 deg C

Soil type: The tree is not adapted to limestone and does best in deep, rich organic soil, especially sandy loam or laterite, which have good drainage. In India, the most productive specimens are on clay containing much coarse material and a little silt. Sandy alluvial soils are unsuitable and sand low in humus contributes to low yields.

DOCUMENTED SPECIES DISTRIBUTION

Native: Indonesia, Malaysia

Exotic: Australia, Cuba, Dominica, Ecuador, Gabon, Ghana, Guatemala, Honduras, India, Jamaica, Liberia, Myanmar, Philippines, Puerto Rico, Singapore, Sri Lanka, Thailand, Trinidad and Tobago, United States of America, Vietnam, Zanzibar



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

Food: The best table fruits are those with the highest number of stigma lobes at the apex, for these have the highest number of fleshy segments and the fewest seeds. The numbers always correspond. Mangosteens are usually eaten fresh as dessert. The fleshy segments are sometimes canned, but they are said to lose their delicate flavor in canning, especially if pasteurized for as much as 10 minutes. Tests have shown that it is best to use a 40% syrup and sterilize for only 5 minutes. The more acid fruits are best for preserving. To make jam, in Malaysia, seedless segments are boiled with an equal amount of sugar and a few cloves for 15-20 minutes and then put into glass jars. In the Philippines, a preserve is made by boiling the segments in brown sugar, and the seeds may be included to enrich the flavour. The seeds are sometimes eaten alone after boiling or roasting. The rind is rich in pectin. After treatment with 6% sodium chloride to eliminate astringency, the rind is made into a purplish jelly.

Timber: In Thailand, all non-bearing trees are felled, so the wood is available but usually only in small dimensions. It is dark-brown, heavy, almost sinks in water, and is moderately durable. It has been used in construction and cabinetwork, to make handles for spears and rice pounders.

Tannin or dyestuff: The fruit rind contains 7-14% catechin tannin and rosin, and is used for tanning leather in China. It also yields a black dye.

Poison: The fruit hulls show anti-fungal and anti-protozal activity.

Medicine: The sliced and dried rind is powdered and administered to overcome dysentery. Made into an ointment, it is applied on eczema and other skin disorders. The rind decoction is taken to relieve diarrhoea and cystitis, gonorrhoea and gleet and is applied externally as an astringent lotion. A portion of the rind is steeped in water overnight and the infusion given as a remedy for chronic diarrhoea in adults and children. Filipinos employ a decoction of the leaves and bark as a febrifuge and to treat thrush, diarrhoea, dysentery and urinary disorders. In Malaysia, an infusion of the leaves, combined with unripe banana and a little benzoin is applied to the circumcision wound. A root decoction is taken to regulate menstruation. A bark extract called "amibiasine", has been marketed for the treatment of amoebic dysentery.

Other products: Mangosteen twigs are used as chewsticks in Ghana. The rind of partially ripe fruits yields a polyhydroxy-xanthone derivative termed mangostin, also β -mangostin. That of fully ripe fruits contains the xanthenes, gartanin, 8-disoxygartanin, and normangostin. A derivative of mangostin, mangostin-e, 6-di-O-glucoside, is a central nervous system depressant and causes a rise in blood pressure.

TREE MANAGEMENT

A spacing of 10.7-12 m is recommended. Planting is preferably done at the beginning of the rainy season. Pits 1.2 x 1.2 x 1.3 m are prepared at least 30 days in advance, enriched with organic matter and topsoil and left to weather. The young tree is put in place very carefully to avoid root injury and given a heavy watering. Partial shading with palm fronds or other means should be maintained for 3-5 years. Indian growers give each tree regular feeding with well-rotted manure, (45-90 kg) and peanut meal (4.5-6.8 kg) total, per year.

Some of the most fruitful mangosteen trees grow on the banks of streams, lakes, ponds or canals where the roots are almost constantly wet. However, dry weather just before blooming time and during flowering induces a good fruit-set. Where a moist planting site is not available, irrigation ditches should be dug to make it possible to maintain an adequate water supply and the trees are irrigated almost daily during the dry season.

In Malaysia and Sri Lanka, it is a common practice to spread mulch of coconut husks or fronds to retain moisture. It has been suggested that small inner branches be pruned from old, unproductive trees to stimulate bearing. Cropping is irregular and the yield varies from tree to tree and from season to season ranging from 6 years in Central America to 12-20 years in Thailand. The first crop may be 200-300 fruits. Average yield of a full-grown tree is about 500 fruits. The yield steadily increases up to the 30th year of bearing when crops of 1 000-2 000 fruits may be obtained. In Madras, individual trees between the ages of 20-45 years have borne 2 000-3 000 fruits. Productivity gradually declines thereafter, though the tree will still be fruiting at 100 years of age.

GERMPLASM MANAGEMENT

Seeds are recalcitrant and should be stored in their fruit at room temperature, or in moist peat moss, even these will lose viability in 5 days after removal from the fruit, though they are viable for 3-5 weeks in the fruit. Viability can be maintained for 1-2 months in moist storage at 20 deg C, storage temperature of 10 deg C is damaging. Seeds packed in lightly dampened peat moss, sphagnum moss or coconut fiber in airtight containers have remained viable for 3 months. Only 22% germination has been realized in seeds packed in ground charcoal for 15 days. Soaking in water for 24 hours expedites and enhances the rate of germination. Generally, sprouting occurs in 20 to 22 days and is complete in 43 days.

PESTS AND DISEASES

A leaf-eating caterpillar in India may perhaps be the same as that which attacks new shoots in the Philippines and which has been identified as *Orgyra* sp. of the tussock moth family, Lymantridae. A small ant, *Myrmelachista ramulorum*, in Puerto Rico, colonizes the tree, tunnels into the trunk and branches, and damages the new growth. Mites sometimes deface the fruits with small bites and scratches. Fully ripe fruits are attacked by monkeys, bats and rats in Asia. In Puerto Rico, thread blight caused by the fungus, *Pellicularia koleroga*, is often seen on branchlets, foliage and fruits of trees in shaded, humid areas. The fruits may become coated with webbing and ruined. In Malaysia, the fungus, *Zignoella garcineae*, gives rise to "canker"—tuberous growths on the branches, causing a fatal dying-back of foliage, branches and eventually the entire tree. Breakdown in storage is caused by the fungi *Diplodia gossypina*, *Pestalotia* sp., *Phomopsis* sp., *Gloeosporium* sp., and *Rhizopus nigricans*.

A major physiological problem called "gamboge" is evidenced by the oozing of latex onto the outer surface of the fruits and on the branches during periods of heavy and continuous rains. It does not affect eating quality.

FURTHER READING

Chen ShaoXing, Wan Min, Loh BoonNee, Chen SX, Wan M, Loh BN. Active constituents against HIV-1 protease from *Garcinia mangostana*. *Planta Medica*. 62(4): 381-382.

FAO. 1982. Fruit-bearing forest trees: technical notes. FAO-Forestry-Paper. No. 34. 177 pp.

IBPGR. 1986. Genetic resources of tropical and subtropical fruits and nuts (excluding *Musa*). International Board for Plant Genetic Resources, Rome.

Nakasone HY, Paull RE. 1998. Tropical fruits. *Crop Production Science in Horticulture* No. 7 CAB INTERNATIONAL, Wallingford, UK.

National Academy of Sciences. 1975. Underexploited tropical plants with promising economic value. National Academy of Sciences, Washington, D.C.; USA

Richards AJ. 1990. Studies in *Garcinia*, dioecious tropical fruit trees: the origin of the mangosteen (*G. mangostana* L.). *Botanical Journal of the Linnean Society*. 103(4): 301-308.

Sosef MSM, Hong LT, Prawirohatmodjo S. (eds.). 1998. PROSEA 5(3) Timber trees: lesser known species. Backhuys Publishers, Leiden.

Yaacob O, Tindall HD. 1995. Mangosteen cultivation. FAO Plant Production and Protection Paper. No. 129, 100 pp. Food and Agriculture Organization (FAO). Rome, Italy.

SUGGESTED CITATION

Orwa C, A Mutua, Kindt R, Jamnadass R, S Anthony. 2009 *Agroforestry Database: a tree reference and selection guide* version 4.0 (<http://www.worldagroforestry.org/sites/treedbs/treedatabases.asp>)