Aegle marmelos (L.) Correa

Rutaceae

LOCAL NAMES
Burmese (opesheet,ohshit); English (bael fruit,Indian bael,holy fruit,golden apple,elephant apple,Bengal quince,Indian quince,stone apple); French (oranger du Malabar,cognassier du Bengale,bel indien); German (Belbaum,Schleimapfelbaum,Baelbaum); Gujarati (bili); Hindi (baelputri,bela,sirphal,siri-phal,kooralam); Indonesian (maja batuh,maja); Javanese (modjo); Khmer (bnau); Lao (Sino-Tibetan) (toum); Malay (bilak,bel,bila,maja pahit); Portuguese (marmelos); Thai (matum,mapin,tum); Vietnamese (trai mam,mbau nau)

Fruits (Trade winds fruit)

Tree with immature fruits. (Gifu University)

BOTANIC DESCRIPTION
Aegle marmelos is a slow-growing, medium sized tree, up to 12-15 m tall with short trunk, thick, soft, flaking bark, and spreading, sometimes spiny branches, the lower ones drooping. Young suckers bear many stiff, straight spines. A clear, gummy sap, resembling gum arabic, exudes from wounded branches and hangs down in long strands, becoming gradually solid. It is sweet at first taste and then irritating to the throat.

The deciduous, alternate leaves, borne singly or in 2's or 3's, are composed of 3 to 5 oval, pointed, shallowly toothed leaflets, 4-10 cm long, 2-5 cm wide, the terminal one with a long petiole. New foliage is glossy and pinkish-maroon. Mature leaves emit a disagreeable odor when bruised.

Fragrant flowers, in clusters of 4 to 7 along the young branchlets, have 4 recurved, fleshy petals, green outside, yellowish inside, and 50 or more greenish-yellow stamens.

The fruit, round, pyriform, oval, or oblong, 5-20 cm in diameter, may have a thin, hard, woody shell or a more or less soft rind, gray-green until the fruit is fully ripe, when it turns yellowish. It is dotted with aromatic, minute oil glands. Inside, there is a hard central core and 8 to 20 faintly defined triangular segments, with thin, dark-orange walls, filled with aromatic, pale-orange, pasty, sweet, resinous, more or less astringent, pulp.

Embedded in the pulp are 10 to 15 seeds, flattened-oblong, about 1 cm long, bearing woolly hairs and each enclosed in a sac of adhesive, transparent mucilage that solidifies on drying.

BIOLOGY
In India flowering occurs in April and May soon after the new leaves appear and the fruit ripens in 10 to 11 months from bloom–March to June of the following year.

ECOLOGY
The tree grows wild in dry forests on hills and plains of central and southern India and Burma, Pakistan and Bangladesh, also in mixed deciduous and dry dipterocarp forests. A. marmelos is a subtropical species. In the Punjab, it grows up to an altitude of 1,200 m where the temperature rises to 48.89º C in the shade in summer and descends to -6.67º C in the winter, and prolonged droughts occur. It will not fruit where there is no long, dry season, as in southern Malaysia.

BIOPHYSICAL LIMITS
Altitude: 0-1200 m
Mean annual temperature: -6- 48 deg C.
Mean annual rainfall: 570-2000 mm

Soil type: A. marmelos is said to do best on rich, well-drained soil, but it has grown well and fruited on the oolitic limestone of southern Florida. It also grows well in swampy, alkaline or stony soils having pH range from 5 to 8. In India it has the reputation of thriving where other fruit trees cannot survive.

DOCUMENTED SPECIES DISTRIBUTION

Native: India
Exotic: Bangladesh, Egypt, Malaysia, Myanmar, Pakistan, Sri Lanka, Thailand

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: A. marmelos fruits may be cut in half, or the soft types broken open, and the pulp, dressed with palm sugar, eaten for breakfast, as is a common practice in Indonesia. The pulp is often processed as nectar. Beating the seeded pulp together with milk and sugar makes a popular drink called sherbet in India. A beverage is also made by combining bael fruit pulp with that of tamarind.

Mature but still unripe fruits are made into jam, with the addition of citric acid. Confection, bael fruit toffee, is prepared by combining the pulp with sugar, glucose, skim milk powder and hydrogenated fat. Indian food technologists view the prospects for expanded bael fruit processing as highly promising.

The young leaves and shoots are eaten as a vegetable in Thailand and used to season food in Indonesia. They are said to reduce the appetite. An infusion of the flowers is a cooling drink.

The food value per 100 g of fresh bael fruit as analyzed in India and the Philippines is: water 54.96-61.5 g, protein 1.8-2.62 g, fat 0.2-0.39 g, carbohydrates 28.11-31.8 g, ash 1.04-1.7 g, carotene55 mg, thiamine 0.13 mg, riboflavin1.19 mg, niacin 1.1 mg, ascorbic acid 8-60 mg and tartaric acid 2.11 mg.

Fodder: The leaves and twigs are lopped for fodder.

Timber: The wood is strongly aromatic when freshly cut. It is gray-white, hard, but not durable; has been used for carts and construction, though it is inclined to warp and crack during curing. It is best utilized for carving, small-scale turnery, tool and knife handles, pestles and combs, taking a fine polish.

Gum or Resins: The gum enveloping the seeds is most abundant in wild fruits and especially when they are unripe. It is commonly used as a household glue and is employed as an adhesive by jewelers. Sometimes it is resorted to as a soap-substitute. It is mixed with lime plaster for waterproofing wells and is added to cement when building walls. Artists add it to their watercolors, and it may be applied as a protective coating on paintings.

Tannin or dyestuff: There is as much as 9% tannin in the pulp of wild fruits, less in the cultivated types. The rind contains up to 20%. Tannin is also present in the leaves. The rind of the unripe fruit is employed in tanning and also yields a yellow dye for calico and silk fabrics.

Essential oil: The essential oil of the leaves contains d-limonene, 56% a-d-phellandrene, cineol, citronellal, citral; 17% p-cyrnene, 5% cumin aldehyde. The limonene-rich oil has been distilled from the rind for scenting hair oil.

Poison: The leaves are said to cause abortion and sterility in women. The bark is used as a fish poison in the Celebes. Tannin, ingested frequently and in quantity over a long period of time, is antinutrient and carcinogenic. Leaf extract from A. marmelos has been found to have insecticidal activity against the brown plant hopper (Nilaparvata lugens Stål), an important pest of rice plant in Asia.

Medicine: A decoction of the unripe fruit, with fennel and ginger, is prescribed in cases of hemorrhoids. It has been surmised that the psoralen in the pulp increases tolerance of sunlight and aids in the maintaining of normal skin color. It is employed in the treatment of leucoderma. Marmelosin derived from the pulp is given as a laxative and diuretic. In large doses, it lowers the rate of respiration, depresses heart action and causes sleepiness. For medicinal use, the young fruits, while still tender, are commonly sliced horizontally and sun-dried and sold in local markets. They are much exported to Malaysia and Europe.
Because of the astringency, especially of the wild fruits, the unripe bael is most prized as a means of halting diarrhea and dysentery, which are prevalent in India in the summer months.

Other products: The fruit pulp has detergent action and has been used for washing clothes. The shell of hard fruits has been fashioned into pill- and snuff boxes, sometimes decorated with gold and silver. A cologne is obtained by distillation from the flowers. In the Hindu culture, the leaves are indispensable offerings to the 'Lord Shiva'.

TREE MANAGEMENT
The tree has no exacting cultural requirements, doing well with a minimum of fertilizer and irrigation. The spacing in orchards 6-9 m between trees. Seedlings begin to bear in 6 to 7 years, vegetatively propagated trees in 5 years. Full production is reached in 15 years. Normally, the fruit is harvested when yellowish-green and kept for 8 days while it loses its green tint. Then the stem readily separates from the fruit. A tree may yield as many as 800 fruits in a season but an average crop is 150 to 200, or, in the better cultivars, up to 400.

PESTS AND DISEASES
The bael fruit seems to be relatively free from pests and diseases except for the fungi causing deterioration in storage.

FURTHER READNG

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SUGGESTED CITATION

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