

## Bael – A Multipurpose and Nutritive Fruit

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**B**ael, one of the oldest fruits cultivated in India has a mythological significance viz., a sacred tree whose leaves are used for worship of Lord Shiva. The fruit pulp is carbohydrate. One hundred gram of pulp contains 55 µg of carotene, 0.13 mg thiamine, 1.19 mg riboflavin, 1.1 mg niacin and 8 mg vitamin C. From its pulp sherbet and syrup can be made. The marmalade prepared from its fruits is used in curing diarrhea and dysentery. From the stem, gum is obtained. The wood is used for making agricultural implements. The leaves are used as fodder. All parts of the plant are medicinally important due to a substance called 'marmelosin'.



### Origin

Woody tree, native to India. Now naturalized in Sri Lanka, Pakistan, Bangladesh, Myanmar, Thailand and most of southeastern Asian countries.

### Botany

#### Taxonomy; Morphology and Floral Biology

*Aegle* belongs to one of the three monotypic genera of orange subfamily Aurantioideae, tribe Clauseneae and subtribe Balsamocitrinae. Bael has capacity to adapt successfully to a wide range of habitat from arid, semiarid to mesophytic conditions. It can be grown up to an altitude of 1219 meters above mean sea level and is not injured by temperatures as low as -8°C.

*Aegle marmelos* Correa is deciduous, 6–8 meters in height with trifoliate aromatic leaves. The branches sometimes bear long straight spines. The bark is shallowly furrowed and corky. The bisexual flowers are nearly 2 cm wide, borne in clusters, sweet scented and greenish white. The shallow calyx has 5 short sepals and is pubescent on the outside. The 5 petals are oblong ovoid, blunt, thick, pale greenish white and dotted with oil glands. Stamens are numerous, sometimes coherent in bundles. Ovary are oblong ovoid, slightly tapering, axis wide, cells numerous (8–20), small arranged in a circle with numerous ovules in each cell. Fruits are 5–7.5 cm in diameter, globose, oblong pyriform, rind gray or yellow, pulp sweet, thick yellow, orange to brown in color. Seeds are numerous and arranged in the cells surrounded by a slimy transparent mucilage. Seeds have wooly hairs.

**Food Value Per 100 g of Edible Portion\***

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
Carotene	55 mg
Thiamine	0.13 mg
Riboflavin	1.19 mg
Niacin	1.1 mg
Ascorbic Acid	8-60 mg
Tartaric Acid	2.11 mg

\*Fresh bael fruit, as analyzed in India and in the Philippines.

**Other Uses**

**Fruit:** The fruit pulp has detergent action and has been used for washing clothes. Quisumbing says that bael fruit is employed to eliminate scum in vinegar-making. 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.

The limonene-rich oil has been distilled from the rind for scenting hair oil. The shell of hard fruits has been fashioned into pill- and snuff boxes, sometimes decorated with gold and silver. The rind of the unripe fruit is employed in tanning and also yields a yellow dye for calico and silk fabrics.

**Leaves:** In the Hindu culture, the leaves are indispensable offerings to the 'Lord Shiva'. The leaves and twigs are lopped for fodder.

**Flowers:** A cologne is obtained by distillation from the flowers.

**Wood:** 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.

**Medicinal Uses:**

- The fresh ripe pulp of the higher quality cultivars, and the "sherbet" made from it, are taken for their mild laxative, tonic and digestive effects. 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 Malaya 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. Bael fruit was resorted to by the Portuguese in the East Indies in the 1500's and by the British colonials in later times.

- A bitter, light-yellow oil extracted from the seeds is given in 1.5 g doses as a purgative. It contains 15.6% palmitic acid, 8.3% stearic acid, 28.7% linoleic and 7.6% linolenic acid. The seed residue contains 70% protein.
- The bitter, pungent leaf juice, mixed with honey, is given to allay catarrh and fever. With black pepper added, it is taken to relieve jaundice and constipation accompanied by edema. The leaf decoction is said to alleviate asthma. A hot poultice of the leaves is considered an effective treatment for ophthalmia and various inflammations, also febrile delirium and acute bronchitis.
- A decoction of the flowers is used as eye lotion and given as an antiemetic. The bark contains tannin and the coumarin, aegelinol; also the furocoumarin, marmesin; umbelliferone, a hydroxy coumarin; and the alkaloids, fagarine and skimmianine. The bark decoction is administered in cases of malaria. Decoctions of the root are taken to relieve palpitations of the heart, indigestion, and bowel inflammations; also to overcome vomiting.
- The fruit, roots and leaves have antibiotic activity. The root, leaves and bark are used in treating snakebite. Chemical studies have revealed the following properties in the roots: psoralen, xanthotoxin, *O*-methylscopoletin, scopoletin, tembamide, and skimmin; also decursinol, haplopinine and aegelinol, in the root bark.

#### Uses

- ✓ Various parts of the tree are used for its curative, pesticidal and nutritive properties. Fresh half ripe bael fruit is mildly astringent and used to cure dysentery, diarrhoea, hepatitis, tuberculosis, dyspepsia and good for heart and brain.
- ✓ Roots have antidiarrhoeic, antidote to snake venom, anti-inflammatory and wound healing properties.
- ✓ The Bael fruit is one of the most nutritious fruits, rich in riboflavin and used for the preparation of a number of products like candy, squash, toffee, slab, pulp powder and nectar. The leaves and seed oil have pesticidal properties.

#### Medicinal Uses

- It is used as a medicine to cure a number of diseases in India. Its medicinal properties have been listed within "Charaka Samhita," an early medical treatise.

#### Climatic and soil requirements:

A subtropical condition with hot dry summer and mild winter would be ideal for the cultivation of bael. It can be grown even upto an altitude of 1200 M MSL and it is not damaged by temperature even as low as -7 0 C. Bael can be grown in any type of soil such as sandy, clay, water logged, unirrigated, acidic or alkaline in the pH range of 5–10.

Since it is a hardy tree, it thrives well in a wide range of soil right from pH 5 upto pH 10 where many other fruit trees fail. It can tolerate even every alkaline soil as well as stony soils. However, well drained sandy loam is the best.

#### Cultivars and propagation:

There are lot of variation seen among the progenies raised from seeds for size and shape of fruits, bearing habit, pulp quality, colour, texture, sugar percentage etc., Cultivars like 'Mirzapuri', 'Kaghli', 'Gonda' and a few selections from Faizabad like KB 11, KB 1, Dhar Road and Ayodhya are found to be better. Root stocks are raised from seeds. On 6 months old seedlings, patch budding is done during June-July.

#### Planting and interculture:

Pits of size 50 cm x 50 cm x 50 m are dug at spacing of 10 M x M. The top soil should be mixed with 10 15 kg of FYM and pits filled up. Planting can be done during June-July or at beginning of monsoon. Every year regular application of 20-30 kg FYM should be done at

the beginning of monsoon. Young plants are irrigated whenever there is monsoon failure. Any legume or forage crop can be taken as inter crop during early years. Young plants are trained with the help of stake. No annual pruning. However, criss-cross, weak and broken branches have to be removed periodically. Harvest and yield: Seedlings take 7-8 years for bearing, while budded plants start bearing at the age of 4-5 years. Flowering is seen in May-June and fruits become ready in 8-10 months viz., April-May matured fruits to be harvested individually along with fruit stalk and they should not be allowed to fall on the ground. A well grown tree of about 12-15 years age gives 300-500 fruits/year.



### Crop Culture (Horticulture)

Bael is usually propagated by seeds. The seeds are recalcitrant and can not be stored for longer periods under normal storage conditions. Budding, patch or shield on seedling rootstocks in June or July gives very good success. Air layering is also successful under humid tropical conditions. In vitro propagation has also been standardized but it is not feasible commercially.

### Training and Pruning

Bael trees may be trained in modified central leader. Pruning is done twice in a year, once in May and other in August. Pruning is limited to the removal of dead and diseased twigs/branches in May while in August healthy leaves are pruned for sale.

### Nutrition

The deficiency of nitrogen and zinc is common in Bael orchards and can be corrected by soil application or foliar spray.

### Pests and Diseases

More than a dozen insects have been found feeding on Bael. *Phyllocnistis citrella*, *Aonidiella aurantii* and *Papilio demoleus* are the important insects which can be easily controlled by use of insecticides. Bacterial shot hole, fruit canker and gummosis are the serious diseases. Fruit cracking is the physiological disorder in some genotypes of Bael which occurs just before ripening.

### Harvesting and Yield

Fruits take about 11 months to ripen. These are harvested with fruit stalk when color changes to yellowish green. A full grown tree produces from 400-1000 fruits depending upon the cultivar.

### Cultivars

A number of cultivars have been selected recently and the following are among the best with regards to yield and fruit quality.

**NB 5**—Fruit size medium, round having smooth surface at maturity, low mucilage, moderately fibrous, soft flesh with excellent taste.

**NB 6**—Fruit size medium, round with smooth surface, thin rind, few seeds, soft flesh, low mucilage, mild acidic.

**Pant Shivani**—Mid season cultivar, shape ovoid oblong, size 2 kg, color lemon yellow at ripening, fiber and mucilage content medium, rind medium thick, pulp light yellow with very good taste and pleasant flavor

**Pant Aparna**—Late cultivar, fruit size small (0.6-0.8 kg), globose, seed, mucilage, fiber and acidity low. Flesh yellow, sweet, tasty and having good flavor rind medium thick.