Elephant Apple: Gorgeous Looking Underexploited and Multipurpose Horticultural Species

Bhende S.S.¹ and Chaitra H.P.²

¹Assistant Professor, College of Horticulture, Hiriyur, Chitradurga Dist., Karnataka
²University of Agricultural and Horticultural Science, Shivamogga, Karnataka
*Corresponding author. E-mail: siddhort@gmail.com

With decorative foliage and fragrant blooms, ‘Elephant Apple’ tree is highly valued for its medicinal properties. The apple-like yellow-green edible fruits of this tree are relished by elephants. Hence the name. Other common names are Indian catmon, Hondapara tree, Matad (Hindi: Chalta, Marathi: Karambel, Kannada: Bettakanigalu, Malayalam: Punna, Vazchpunna; Sanskrit: Avartaki, Bhavya, Bharija; Tamil: Kattaral, Ugakkay; Telugu: Revadi). Its scientific name is *Dillenia indica* L (Family Dilleniaceae) named after German Botanist Johann Jacob Dillenius. Fruit is large, knobby with acidic flavored. It is also rounded with a few odd bumps, a little bit like an elephant’s toe and also served as the main food source for the wild elephants and other animals like monkeys, deer in North-Eastern India thus, the tree plays a major role in forest ecology. This plant is widely used as herb by the various tribes of entire North East along with Assam. The fruits of *Dillenia indica* as well as *Dillenia pentagyna* are eaten raw but not very much well known by people.

**Nutritive Value and Chemical Constituents**

*Dillenia indica* fruits contain 82.3% moisture, 0.8% protein, 0.2% fat, 0.8% minerals, 2.5 % fibre, 13.4% carbohydrate, 0.016% calcium and 0.026% phosphorus. Total phenolics in methanolic extract and polysaccharide like an arabino galactan in fruits of *Dillenia indica* are 34%. While, seeds of *Dillenia* contain fixed oil, colouring matter, sterols, glycosides, saponins, proteins, free amino acids, sugars, free acids and tannins. The *Dillenia pentagyna* contain 6% of tannins, its stem contains naringenin Dxylopyranoside, flavonoid glycosides, naringenin 7-galactosyl glucoside and dihydroquercetin 5 galactoside along with rhamnetin 3-glucoside; terpenoids namely dipoloic acid from the methanolic extract, saponin namely alpha L rhamnopyranosyl3betahydroxylup20(29)-en-28-oic acid. The stem bark contains flavanoids like kaempferol, quercetin, isorhamnatin, naringenin-7-galactosyl (1-4) glucoside and rhamnetin 3-glucoside; terpenoids like lupeol, betunaldehyde, betulin, betulonic acid, mallic acid, asitosterol, stigmasterol and phenolics. The chemicals like betulin, betulonic acid and asitosterol is present in almost all parts of *Dillenia indica* and *Dillenia pentagyna*. The average weight per fruit is 592 g, specific gravity as 0.98, stalk stylar length as 8.8 cm, total sugars 0.61%, reducing sugars 0.43%, non-reducing sugars 0.17%, total titratable acidity (equivalence of citric acid) 0.69% and the vitamin C 20 mg per 100 g of pulp.

**Origin and Distribution**

The origin of *Dillenia indica* is southeastern Asia i.e. India, Sri Lanka east to southwestern China (Yunnan) and Vietnam, and south through Thailand to Malaysia and Indonesia. *Dillenia indica* and *Dillenia pentagyna* are widely distributed in many Asian countries. *Dillenia indica* are distributed in valleys, stream sides area of Bhutan, India, Indonesia, Laos, Malaysia, Myanmar, Nepal, Bangladesh, Philippines, Sri Lanka, Thailand, and Vietnam. In India,
it is distributed in Sub Himalayan tract, Assam, North Bengal, Bihar, Orissa, Madhya Pradesh, and Gujarat. While, *Dillenia pentagyna* is distributed in rain forest, thickets, and hills below 400 m. Hainan, Yunnan in Bhutan, India, Indonesia, Malaysia, Myanmar, Nepal, Thailand, and Vietnam. In India it is distributed in Himalayan terrain, also from Punjab to Assam, South India, Andaman, Gujarat, Mizoram and West Bengal.


Genus and Different Species
The Elephant Apple belongs to the genus Dillenia had around 60 species, of which Among these species *Dillenia indica* Linn. and *Dillenia pentagyna* Roxb. are found in India.

*Dillenia indica*: It is a medium sized evergreen trees upto 30 m tall. Bark is reddish brown in color, exfoliating. Young branchlet is brown pubescent, glabrescent and contains leaf scars. Leaves are fasciculate at the ends of branches; veins are close, running into serratures not forking at the margins. Bud is more than 5 cm in diameter. Flowers occur in May June Fruits are aggregate and
It is a deciduous trees upto 15 m tall. Bark is grayish in color, exfoliating. Branchlets are glabrous and stout. Leaves are petiolate, glabrous, with narrow wings, buds are less than 2 cm in diameter. Flowering starts in April May. Fruits are globose, 0.5-1 cm in diameter. Seed are exarillate.

**Botanical Description:**

**Taxonomy**

*Dillenia indica* is an evergreen large shrub or small to medium sized semi deciduous, branches spreading tree growing to 15m tall. Leaves are fascicled at the end of the branches, lanceolate, acuminate, 20-30 cm long and sharply serrate. The leaves are darkgreen, leathery, often minutely toothed, and blunt or notched at the apex, are dotted with oil glands and slightly lemon scented when crushed.

The flowers are white color and large upto 15 cm in diameter and solitary towards the end of each branchlet. *Dillenia* has the largest and stoutest flowers in the Dilleniaceae family. *Dillenia* species has two forms, one with spreading styal branches and two sets of stamens with heteranthery (roundabout flower) and this form is prominent, because roundabout flowers are otherwise rare in angiosperms and the other form with more connivent styal branches and without two distinct sets of stamens, although stamen size diminishes more gradually towards the periphery of the flower (revolver flower). The reflexed anthers or stamens, seems to be a constitutive feature of Dilleniaceous floral buds. The flowers are with 5 white petals and numerous yellow stamens. They arise solitary at the ends of the twigs, facing downward. The sepals are rounded and yellowish green. As floral visitors mainly bees, among them sometimes large bees (Xylocopa), but often small bees, which are probably not pollinators are indicated, also honey bees. Xylocopa and Melipona are good pollinators of *Dillenia suffruticosa* and Apis, Xylocopa and Ceratina are visitors/pollinators of *Dillenia pentagyna*. Bees, small beetles and flies are probable pollinators of Dillenia.

**Reproductive Biology**

The juvenile period is from 8 to 10 years from seed. Flowers are borne on the current season’s growth and are solitary towards the end of small shoots. In India, flowers open in late July and flowering continues for about 3 weeks. Anthesis is reported to start between 12.30 a:m and 11:30 a:m and lasts about 3 hours. Anthers dehisce 56 hours after anthesis. Flowers are cross pollinated and pollination seems to involve bees and flies.

**Fruit Development**

Fruit growth is simple sigmoid shape and lasts about 140-160 days. Fruit ripens in October - January in India when they change to a straw yellow with a greenish tinge. The fruits are large with 7.5 to 10 cm in diameter, sub-globose aggregate of 15 carpels, and each carpel containing five seeds embedded in an edible but fibrous pulp. The fruit is round to oval, 2 to 5 in (512.5 cm) wide, with a hard, woody, grayish white, scurfy rind about 1/4 in (6 mm) thick. The pulp is brown, mealy, odorous, resinous, astringent, acid or sweetish, with numerous small, white seeds scattered through it. The pulp is light yellowish brown and it is very slimy and slightly sticky. The taste is acidic to slightly sweet but is odorous. There are numerous small brownish seeds inside it.

**Climate and Soil**

It grows well in warm tropical areas with high mean annual rainfall of 2000 mm and temperatures of 24-35°C. It is found in tropical rain forest, usually near the banks of creeks or rivers from sea level 1100 m. It thrives in full sun or light shade, in moist soils of pH 5.5-7.0 and it is frost intolerant.
Propagation

It is mainly propagated by seeds and cuttings, although air layering and in-vitro shoot multiplication has also been reported.

**Seeds:** Seeds should be collected from ripe fruits. Ideal time for raising seedlings is rainy season. Seeds cannot be stored well for a long time as it losses viability soon. The seeds take nearly 30 days to germinate under appropriate conditions.

**Cuttings:** The hardwood cuttings treated with IBA 250 ppm showed superiority in respect of length of the longest primary root and cuttings treated with IBA 2000 ppm exhibited superiority over in respect of days required for rooting and survival percentage.

**Air layering:** In hot and humid climate, the best time for air layering is between July – August.

**Micro-propagation:** An efficient protocol was established for in vitro shoot multiplication of *Dillenia indica* using nodal explants. For explant sterilization, Clorox was used at 15% for 10 minutes which gave a decontamination rate of 85% with survival percentage of 95%. The maximum shoot multiplication rate was achieved with MS medium enriched with 2.0 mg/L benzyl amino purine (BAP).

Cultivation

**Planting:** The best time for planting is June-July. Pits of 60 x 60 x 60 cm should be dug out 20-25 days before planting. Pits are dug at a spacing of 7-8 m apart. Pits are then filled with soil and FYM mixture. Age of the seedlings for planting should be 7-8 months old seedling. seedlings are planted in the centre of the pits and the soil around the base are gently pressed.

**Training and pruning:** A clear bole should be maintained to 1 m and then pruned to shape. Regular pruning is not frequently carried out although removal of dead branches, diseased and crisscross branches is a must.

**Nutrition:** Being hardy in nature, manuring is not usually practiced by the growers, however manuring and fertilization should be adopted for commercial cultivation. 25 kg FYM and 2 kg wood ash should be applied per pit before planting. For a full grown tree apply 20 kg FYM on the onset of monsoon for the general health of the tree and economic return.

**Irrigation:** Regular irrigation is very much necessary for the proper growth and development of the elephant apple. During the time of establishment proper care should be taken for irrigating young plants. Irrigation is beneficial especially during dry season. It should be given 710 days interval during winter. Grown up plants do not need irrigation.

**Intercropping:** Provision for growing intercrops like ginger, turmeric and tuber crops is done to get additional income during initial growth stage of Elephant apple when there is sufficient inter space is available.

**Pests and their management:** Elephant apple is a hardy fruit plant and resistant to insect pests attack and diseases.

**Fruit borer:** The female lays egg on the young and tender fruits. On hatching caterpillars bore inside the developing fruits and feed inside. Affected fruits fall down and are not fit for consumption. Application of sevin 50% W.P @ 3 g/litre of water at 1015 days interval can control this pest.

**Stem borer:** The caterpillar bore into the stem. The entry holes are covered with silken web and excreta on the trunk. Infested tender shoots will dry up and affected tree declines in yield. To control this pest, fumigation of tunnels inside the stem with petrol, kerosene or formaldehyde followed by plugging the holes with wet clay soil.

**Harvesting and Yield:**
The fruits of *Dillenia indica* took about 160 days to reach maturity from fruit set. Maturity is indicated by change of fruit colour from green to straw yellow with a greenish tinge. The ripe
fruits are available during the end of rainy season. Matured and ripe fruits drop off from plants. Fruits should be harvested by hand picking. Commercial bearing starts from 6-7 years after planting. A 10 year old tree can produce 1000 fruits per year under proper management. Average weight of the fruit is 300 g.

Post-Harvest Management of Fruits and Storage:
The fruits are non-climacteric and are harvested when ripe. Fruit can be stored at 4-5 °C for 1 month. Since the fruit is seasonal, it may be processed to various food products to make it available round the year. Value added products like jam, jelly, pickle and chutney were produced from *Dillenia indica*, and these products were shelf stable up to 12 months in ambient conditions which were highly acceptable.

Utilization:
*Medicinal uses:* The different parts like bark, leaves and fruits are used traditionally and pharmacologically to cure ailments and diseases. Traditionally, the whole plant is used in case of fever, as an aphrodisiac and also promotes virility; Decoction of it can be used as a universal antidote. The roots of *Dillenia indica* also act as an ingredient of a medicine for burning sensation in the chest, root bark extract cures food poisoning; paste of rootbark along with leaf paste applied externally in sprains, young bark and leaf as an astringent, decoction of *Dillenia pentagyna* is given in case of body pain twice daily till cure. The stem and bark of *Dillenia indica* are served as a component of medicine for sores caused by mercury poisoning, chronic progredient sores and carbuncle as a prophylactic in the cholera season. *Dillenia pentagyna* bark powder is given with water for curing diabetes, also in diarrhea and dysentery. Bark paste is applied on head once a week for hair growth. Leaves of *Dillenia indica* are used as an astringent, anti-amphetamine and that of *D. pentagyna* are used in case of cut and wounds. The leaf preparation in different forms are also used for treatments like, paste is applied in bone fracture, and decoction is used in skin diseases and body pain. The sepals are highly acidic and hence, are not possible to consume as fresh. Fruit loaded with nutrients and it helps to lower the blood pressure due to high in potassium content, consumption of fruit is found beneficial for eye health due to good content of Vit. A, also helpful for maintaining the good immunity power of the body and delayed aging due to rich in Vit. C. Rich Vit. B content in the fruit helps to keep brain and nerve cells in an excellent condition and this will improve RBC thus, helps for flushing out impurities and toxic substances in the blood stream. Fruit is the best medicine to expel the kidney dis-functioning. It is acting as a lucrative for the liver and heart. Tannin content in the fruit are quite beneficial for endless bowels and stomach torment. Bark of the tree along with nector plays an important role for stomach issues. Decoction of the plant can also be used as widespread antidote for poison. Juice from fruit can also be consumed as a treatment of heart related diseases. In the tribal areas of Mizoram, juices from leaves bark and fruits are combined and given orally for the treatment of cancer and diarrhea. Fruit is kept beneath the bed for prevention of small pox and cholera in Assam. A decoction of fruit is used as anti-dandruff and applied on head to check frequent hair fall. Fruit is also eaten to combat weakness. Decoction of fruit is used to remove dandruff. Small piece of leaf is consumed in the treatment of dysentery. Root is used as prophylactic for cholera. Roots are also one of the main ingredients of a paste used in the treatment of burning sensation in the chest.

*Culinary Uses:* Fruits are sour in taste and are normally used to flavor food. Fruit pulp is used in jellies, jams, curries (particularly prawn curries) and drinks. Sepals of the flowers are used for preparing Syrup. Juicy pulp is quite aromatic but is very acidic. Unripe fruits are used to make curries due to its sour taste and ripe fruits are used for making pickles in most parts of Assam. In West Bengal, it is a very popular fruit to prepare chutneys, sour preparations and pickles.
Other Facts: The trees and the leaves are graceful in appearance for which, it is also planted along avenues. Tree is highly cherished for its large, good-looking and fragrant flowers and is normally planted for ornamental purpose and as a timber tree. Pulp of the fruit can also be used as hair shampoo. In India Timber are used for gun stocks and helves, ship building and in house construction. Water containing stem extract when sprayed, on and around the wound caused by spider bite helps in eliminating the poison. Fruits are usually rubbed in water to make soap. Leaf juice when applied to the scalp prevents baldness. Dried leaves can be used to polish ivory. Wood ash when added to clay bricks it increases their fire resistance. Wood, which is temperately hard and has durability under water of around 3 years, is occasionally used for house-building or gunstocks.

Future Research Thrust:
At present, there is no variety in our country; Therefore, there is a need to make promising selections to boost the production. Emphasis should be given for developing value added products for proper exploitation of fruits. Strategies need to be worked out particularly to make available quality planting material to the farmers to overcome constraints of production of planting material.