

Tree tomato for enhancing farmers' livelihood in Uttarakhand Hills

The tree tomato or tamarillo (egg-shaped fruits) is a native of the Andes hills of Peru and Argentina. It belongs to the nightshade (Solanaceae) family and the genus *Cyphomandra* contains about 30 species. Its botanical name is *Cyphomandra betacea* Sendt. The plant is a fast-growing, evergreen small tree or semi-woody shrub growing up to 5 m. The first or second year after transplanting, tree-tomato plants begin to bear fruit. Tree tomato cultivation has a lot of potential in the hill. Tree tomatoes may be cultivated in different regions of Uttarakhand like Almora, Bhowali, Bhimtal, Nainital, Mukteshwar, Lamgara, and Pithoragarh because it can readily fruit in greenhouses, and tree tomato production can help hill farmers boost their income.

TREE tomato is distributed in the hills of West Bengal, Maharashtra, Tamil Nadu, Uttarakhand, Himachal Pradesh, and Karnataka at an elevation of 300 to 2500 m. The plant can be multiplied using seeds and cuttings, although seed propagation is easy. Flowering begins 6-8 months after the planting. After 9 to 12 months, the tree will begin to yield fruit. Its fruit is high in dietary fibre, antioxidants, minerals such as potassium, and iron, as well as vitamins such as beta-carotene (pro-vitamin A), vitamin B₆, vitamin C (ascorbic acid), and vitamin E. The tree tomato is a fruit that alleviates tension and aids in the treatment of migraines and severe headaches. It's used to treat obesity, high blood pressure, colds, sore throat, liver disorders, and diabetes, and it's claimed to boost the immune and circulatory systems while also acting as an anti-aging agent.

The plant is perennial usually lasting 12-15 years and gives maximum yield at about 4-5 years of growth. The leaves are 10-35 cm long and 4-12 cm broad, evergreen, alternate, muskily odorous, and more or less heart-shaped at the base, having thin soft hair with coarse veins. The fragrant 1/2 to 3/4-inch flowers are borne in small, loose clusters near the branch tips. They have 5 pale pink or lavender, pointed lobes, 5 prominent yellow stamens, and green-purple calyx. Tree tomato flowers are hermaphrodite and normally self-pollinated. However, pollination requires the flowers to be shaken by the wind or visited by insects. Fruit set can be very poor when cultivated in the greenhouse where wind and insect presence is limited. Flowers have a pleasant scent that attracts insects. The fruit set appears to be improved by cross-pollination. Unpollinated flowers will drop prematurely. Flowers are usually borne in late summer or fall but may appear at any time. The fruit is

pendently borne singly or in clusters of 3 to 12 in smooth egg-shape, which is pointed at both the ends and capped with the persistent conical calyx. These fruits are egg-shape, about 5-10 cm long and 4-5 cm wide. The fruits, which are greenish or purple in the early stages, assume a reddish, yellow, or orange colour as they mature. One should prefer to not eat immature fruits as they may be poisonous and only be consumed after they ripen on the tree. Yellow and orange fruits are sweeter than red fruits. The skin of the fruit is tough, the flesh is firm, succulent, and contains numerous soft, juicy, sub-acid to sweet seeds. The fruits have a musky acid and tomato-like flavour and can be eaten raw or cooked. The fruits after plucking may be preserved for several weeks without loss in edible quality. The fruits are rich in vitamins (A and C), iron, and pectin and can be stewed and made into jam and jelly. The hard and bitter seeds of the fruit are removed before making jelly, jam, or sauce.

The skin can be removed by the process of blanching (i.e. immersing the fruit in boiling water for one or two minutes). The seeds are thin, flat, circular, larger and harder, and higher in numbers than those of common tomato.

Origin and distribution

The plant is presently distributed in subtropical areas of South Africa, India, Hong Kong, China, the United States, Australia, and New Zealand. In India, it is cultivated in the hilly regions of Assam, West Bengal, Maharashtra, Tamil Nadu (Nilgiri hills), Uttarakhand, Himachal Pradesh and Karnataka (Mysore) at an elevation of 300 to 2500 m. In low-lying tropical areas, the growth is poor and the tree seldom fruits.

Soil and climate

The tree tomato requires fertile, light soil with a good amount of oxygen content. Water standing for even a few days may kill the tree, so proper drainage is required. The plant is easily propagated from seeds or cuttings. If it is cultivated deeply with well-manured soils, it grows rapidly and comes into bearing in about 1 ½ to 2 years.

They grow best in full sun except in hot, dry situations, where partial shade is better. They need protection from strong winds. It requires fertile, light soil that is rich in organic matter. Perfect drainage is also necessary. Water standing for even a few days may kill the plant. Because of the shallow root system, deep cultivation is not possible, but light cultivation to eliminate weeds is acceptable.

Cultivars

Even though the tamarillo has a wide range of fruit characteristics, only a few cultivars have been commercially cultivated. Three tamarillo skin types, rather than cultivars, are known in the Andean region.

Propagation

Seeds and cuttings may be used for propagation. Propagation using seed is easy although plants are high-branched, erect trees, while cuttings (basal and aerial suckers) develop into a shorter, bushy plant with low-lying branches. The tree does not always come true from seed but is most likely to if one is careful to take seed from red fruits with black seed pulp or yellow fruits with yellow seed pulp. Germination is accelerated by placing washed and dried seed in a freezer for 24 h before planting out. Cuttings should be of 1 to 2-year-old wood, 3/8 to 1 inch thick and 18 to 30 inches long. The leaves are removed and the base cut square below a node. Cuttings can be planted directly in the ground.

Cultivation

Spacing: Close planting at the spacing of 1.2–1.5 m between plant and row is recommended in areas affected by winds. Otherwise in normal conditions planting at 2-3 m (Plant × row) is recommended. Single rows with planting distances of 1 to 1.5 m between plants and 4.5 to 5 m between rows or double rows with planting distances of 2.5 to 3 m between rows, 2.5 m between plants, and 4.25 m between double rows are also followed in some countries.

Manure and fertilizers: Apply recommended fertilizer at the rate of 0.25-1.0 kg per tree in the ratio 5: 6: 6:: N:P: K. Half of the fertilizer is used in early spring and

half in mid-summer.

Irrigation: Because its roots are shallow, the tree needs a relatively continuous supply of water for good fruiting. In a dry period, a high quantity of water may be supplied. Mulching helps to conserve soil moisture. Waterlogged soil, on the other hand, should be avoided since it might cause plant mortality.



Tree tomato plant growing on farmer field in village Lakhani, Bageshwar, Uttarakhand

Character	Red	Yellow	Purple or dark red/black
Colour	The most common type. When ripe, the skin is reddish to orange with slight green to brown markings.	It has bright yellow skin with faint brown to green longitudinal lines.	The skin of the fruit is a vibrant dark red with faint green vertical streaks.
Shape	It has oval shape fruits and orange-coloured skin flesh.	It has oval shape fruits and yellow-coloured skin flesh.	It has round shape fruits and purple skin flesh.
Fruit weight	The fruit is between 50 and 80 g in weight.	The fruit is between 50 and 70 g in weight.	The fruit is between 60 and 100 g in weight.
Fruit taste	Acidic	Less acidic	Acidic
Cultivars	Oratia Red, Red Beam, Red Delight	Goldmine, Inca Gold, Egmont Gold	Rothamer, Ruby Red, Kaitaia



Ripe tree tomato fruits



Longitudinal section of tree tomato fruit

Pruning: Depending on whether the plant was produced from seed or a cutting, different pruning procedures will be used. When growing plants from seed, the tip is removed when the plant reaches about 1.5 to 1.8 m to encourage branching. Lower branches of plants produced from cuttings must be trimmed to establish a crown at the desired height. Yearly pruning is better to eliminate branches that have already fruited and to induce ample new shoots close to main branches since fruit is produced on new growth. Pruning should be done in spring. Suckers appearing on the trunk should be removed.

Flowering and fruiting habit: Both honey bees and bumblebees pollinate the flowers. Plants can also produce fruit without cross-pollination. Flowering begins 6-8 months after the plant is planted but should not be permitted to fruit the first year. From the time the fruit is set until the time it ripens, it takes around 25 weeks. The tree usually begins to bear after 1½ to 2 years and peaks production at 5-6 years.

Pest and diseases: The tree tomato is not typically seriously affected by pests, although they are occasionally attacked by green aphids (*Myzus persicae*), Tomato worm (*Neoleucinodes elegantalis*) and fruit flies (*Trialeurodes vaporariorum*) will attack the fruits. All of these pests are treatable with the same chemical treatments that are used on other solanaceous plants. The principal disease is powdery mildew, which may cause serious defoliation if not controlled. The plant is noted for its resistance to tobacco mosaic virus, though it is susceptible to cucumber mosaic virus and potato virus. Die-back, of unknown origin, at times, is lethal to the flowers, fruit cluster, twigs, and new shoots. Potted plants grown inside should be watched for the common house plant pests, such as mealy bugs, cottony scale, and whiteflies. Affected plants should be destroyed.

Physiological disorder: Small, semi-transparent, hard, irregular stones are sometimes discovered in the flesh of fruit containing sodium and calcium and small quantities of tin, copper, chromium, iron. These stones are most likely the result of crop cultivation on mineral-rich soils i.e. lateritic soils.

Yield: The plant starts fruiting at two years of seed sowing and reaches peak production in the third or fourth year. It may keep on fruiting for 11 to 12 years. A tree is expected to yield 25-30 kg fruits annually.

Storage: In ordinary storage conditions, it deteriorates rapidly. However, at 3.5 to 4.5°C fruit can be stored for about 12 to 14 weeks. These fruits have firm flesh and tough skin so can be sent to long distances without cracking. At high-temperature storage, a significant postharvest loss can occur due to bitter rot (*Colletotrichum* sp). Applications of postharvest fungicides greatly reduce this loss.

Harvesting: It fruits almost throughout the year but chiefly during November to March. Fruits are ready to harvest when they develop the yellow or red colour characteristic of the particular variety or at a turning stage (when green colour begins to change to yellow or red colour. To harvest, the fruit is simply pulled from the tree with a snapping motion, leaving the stem attached. The fruit can be stored in the refrigerator for up to 10 weeks, but temperatures below 38° F can cause the skin to discolour.

How to use?

It is used as half-cut, sprinkled with sugar, and served for eating by scooping out the flesh and pulp. Its fruits should not be cut on a wooden or another permeable surface, as the juice will make an indelible stain. For another purpose, it is used after blanching (i.e. after removing its skin). Tree tomato slices, alone or with sliced

Table 1. Food value per 100 gm of the edible portion of tree tomato

Characteristic	Value
Soluble solids content (°Brix)	10.0-13.5
pH	3.2-3.8
Total acidity (g/100 g)	1.0-2.4
Moisture (g/100 g)	81.0-87.8
Proteins (g/100 g)	1.5-2.5
Fat (g/100 g)	0.05-1.28
Carbohydrates	10.3 g
Glucose (g/100 g)	0.5-1.0
Fructose (g/100 g)	0.7-1.2
Sacarose (g/100 g)	0.3-2.5
Fibre (g/100 g)	1.4-6.0
Citric acid (g/100 g)	1.27-1.80
Malic acid (g/100 g)	0.05-0.15
Quinic acid (g/100 g)	0.40-0.80
Ash (g/100 g)	0.60 – 0.83
Vitamin A (I.U.)	540-2475
Ascorbic acid (mg/100 g)	19.7-57.8
Mineral matter	1.1 g
Sodium (mg/100 g)	1.3-8.9
Potassium (mg/100 g)	290-347
Calcium (mg/100 g)	3.9-11.3
Magnesium (mg/100 g)	19.7-22.3
Iron (mg/100 g)	0.40-0.94
Copper (mg/100 g)	0.05-0.20
Zinc (mg/100 g)	0.10-0.20
Manganese (mg/100 g)	0.10-0.20
Phosphates (mg/100 g)	33.9-65.5
Energy	31 Kcal

Source: Morton 1982; Rodriguez-Amaya et al. 1983; Pileri 1989; Rathore 1992; Romero-Rodriguez et al. 1994; Boyes and Strubi 1997)

apple are cooled in pies. It can be preserved in jars with water or sugar syrup and cooked for 55 min. Peeled fruits can be blended or by cooking can be pureed strain to remove the seeds and then packed in plastic containers and frozen. To give flavour, lemon juice can be added.

Jam, Juices, desserts, ice cream, jelly, and chutneys can also be prepared from it. Being high in pectin, the fruit is easily made into jelly but the fruit oxidizes and discolours without special treatment during processing. Whole, peeled fruits, with sugar, are cooked to a sauce for use on ice cream. The peeled fruits may be pickled whole or may be substituted for tomatoes in a hot chili sauce but seeds should be removed first.

Food and medicinal uses

It contains a good amount of dietary fiber, antioxidants, minerals i.e. potassium, phosphorus, calcium, nitrogen, iron, vitamins like beta-carotene (pro-vitamin A), vitamin B₆, vitamin C (ascorbic acid), vitamin E, and carbohydrates like Glucose, Fructose, and Sacarose (Table 1). As a natural remedy, the tree tomato is considered a fruit that relieves stress and helps to cure migraines and severe headaches. It is used to treat obesity because it is low in calories (31 Kcal) - as well as corrects high blood pressure because it is high in potassium, this fruit helps control blood pressure. It is used for colds, sore throats, liver diseases, and diabetes and it is said to improve the immune and circulatory systems. Its fruits are also high in antioxidants i.e. anthocyanin, phenols, and flavonoids that protect the skin from pollution and oxidative stress and act as antiaging.

Scope of cultivation in hills

The cultivation of tree tomato can have great prospects in the hill. In hills, these tomato trees are grown between the altitudes 1500 to 2000 m above mean sea level. The tree tomato in this region can be seen in Almora, Bhowali, Bhimtal, Nainital, Mukteshwar, Lamgara, Pithoragarh areas. The processing of these tomatoes is tough in the hills. It is used for the preparation of Jam, Jelly, pickles, chutneys, etc. Therefore, setting up food preservation units/ processing factories in hills can enhance the employment rate in hills, which in turn can reduce the migration of youngsters from hills. It can easily fruit in greenhouses; therefore, the economy of hill farmers can be increased by the cultivation of tree tomato.

For further interaction, please write to:

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**Flowers always make people better, happier, and more helpful;
they are sunshine, food and medicine for the soul.**

– Luther Burbank