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THE TREE TOMATO, OR "TAMARILLO", A FAST-GROWING, EARLY-FRUITING SMALL TREE FOR SUBTROPICAL CLIMATES

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Abstract. **The tree tomato** (Cyphomandra betacea **Sendt.), from the Andes of Peru and neighboring countries, is a fast-growing, small, brittle tree cultivated for its fruit in the highlands of South and Central America, Jamaica, Puerto Rico, Haiti, southern Asia, East Indies, New Guinea, Australia and New Zealand. It is occasionally grown in California and potted specimens are sold throughout the United States as indoor curiosities. The plant is intolerant of cold, wind and prolonged drought; bears in 1-1/2 to 2 yr from seed and may have a productive life of 6-12 yr. The fruit may be dark-purple, red, orange, yellow or variegated. Its tough skin and firm layer of flesh surrounding the soft central pulp enable it to stand long-distance shipping. It may be consumed as a fruit or vegetable, raw or baked "in the half shell", or peeled, sliced and used in desserts, salads, sandwiches, soups, stews or preserves.**

The tree tomato, *Cyphomandra betacea* Sendt. (*C. hartwegi* Sendt.; *Solanum betaceum* Cav.), is the best-known of about 30 species of *Cyphomandra.* Among its various regional names are: tomate, tomate extranjero, tomate de árbol, tomate granadilla, granadilla, pix, and caxlan pix (Guatemala); tomate de palo (Honduras); árvore do tomate, tomate de árvore (Brazil); lima tomate, tomate de monte, sima (Bolivia); pepino de árbol (Colombia); tomate dulce

purple and red fruits, yellow in yellow and orange fruits. The whitish seeds are thin, nearly flat, circular, larger and harder than those of the true tomato and distinctly bitter (23). The fruit has a slightly resinous aroma and the flavor suggests a mild or underripe tomato with a faintly resinous aftertaste.

Origin and Distribution

Although its place of origin is not certain, the tree tomato is generally believed to be native to the Andes of Peru and probably also Chile, Ecuador and Bolivia where it is extensively grown, as it is also in Argentina, Brazil and Colombia. It is cultivated and naturalized in Venezuela and grown in the highlands of Costa Rica, Guatemala, Jamaica, Puerto Rico and Haiti (9, 12, 13, 19, 21, 31, 33, 34, and V. A. Wynne personal communication).

It must have been carried at an early date to Asia and the East Indies, as it is well established in the Nilgiri heights and the hills of Assam in southern India, and in the mountains of Malaya, and was popular in Ceylon and the Dutch East Indies before 1903 (11, 15, 22, 30). It has been grown in Queensland, Australia, in home gardens, for many years and is a practical crop in the highlands of the Australian part of New Guinea (25) and to some extent in the uplands of East Africa (40).

D. Hay & Sons, Nurserymen, introduced the tree tomato into New Zealand in 1891 and commercial growing on a small scale began about 1920. Shortages of tropical fruits in World War II justified an increased level of production. A promotional campaign was launched in 1961; window banners and 100,000 recipe leaflets were distributed. This small

Fig. 3. The red strain of tree tomato turns from green to purple and then blood-, or ruby-red as it ripens. On Victor Wynne's farm above Kenscoff, Haiti, at an altitude of 6,000 ft (1828 m), the tree tomato produces successive crops the year around. (Photo by Julia Morton).

facilitates harvesting and, if timed appropriately, can extend the total fruiting period. Early spring pruning of some of the trees brings about early maturity; fall pruning of other trees delays fruit maturity to the following fall (6, 14, 20, 24).

Irrigation

The tree tomato cannot tolerate prolonged drought and must have an ample water supply during severely dry periods. A mulch is very beneficial in conserving moisture at such times.

Trials in Haiti

Victor Wynne, owner of the Haiti Seed Store in Kenscoff, Haiti, has found several crops that do well on the lateritic soil of his farm extending from 6,000 to 6,500 ft (1,820-1,980 m) on a mountaintop above Kenscoff. The 'Sequoia' strawberry from California and the 'Renova' potato from Holland flourish on his contoured, back-slanting, lipped, erosion-proof terraces. He has been growing red tree tomatoes from New Zealand seed for 12 yr or more, without fertilizer, and finds them very productive, flowering and fruiting successively all year. One tree that blew over in a hurricane recovered fully in 3 yr. It is more or less recumbent but bearing heavily. Seven or eight years ago, Dr. Franklin Martin supplied seeds from a yellow-fruited tree in Puerto Rico. All the seedlings but one bore yellow fruits. The exception produced red fruits somewhat milder in flavor than the usual red type. The yellow-fruited trees are less vigorous than the red-fruited, and somewhat less productive but Wynne prefers the yellow for jam which he is able to market through some supermarkets in Port-au-Prince. He wants to increase his plantings but has to combat snails which defoliate the young seedlings, and mildew attacks the plants in his plastic-covered greenhouse. If the seedlings get a fair start outside, they progress steadily. The tree tomato in this situation is remarkably drought-tolerant though the crop is reduced if droughts persist for several months. The tree tomato, thus far, seems an ideal crop for this altitude in Haiti and the attractiveness and superior flavor of the yellow type should encourage its planting in protected locations in central Florida (41 and V. A. Wynne, personal communication).

Pollination

Tree tomato flowers are normally self-pollinating. If wind is completely cut off so as not to stir the branches, this may adversely affect pollination unless there are bees to transfer the pollen. Unpollinated flowers will drop prematurely (5).

Cropping and Yield

The tree usually begins to bear when 1-1/2 to 2 yr old and continues to be productive for 5 or 6 yr. If then adequately nourished, it may keep on fruiting for 10 to 12 yr. In Brazil, each tree is expected to yield 44 to 66 *lb* (20 to 30 kg) of fruit annually (9, 20, 23).

The crop does not ripen simultaneously and several pickings are necesary. The fruits are clipped, leaving about 1/2 inch (12.7 cm) of stem attached. They are collected in bags worn by the harvesters.

In New Zealand, the fruits are sorted by size—small, medium and large—and packed in paper-lined wooden boxes for marketing. Because of its tough skin and firm flesh, the fruit can be shipped long distances without bruising. However, it deteriorates rather rapidly under ordinary storage conditions (7, 20).

Pests and Diseases

The tree tomato is generally regarded as fairly pest-resistant. A looper caterpillar makes large holes in the leaves of young plants in the nursery but causes little damage to

Fig. 4. The yellow tree tomato is a less vigorous grower than the red but bears prolifically on Victor Wynne's mountain farm in Haiti. This crop was maturing in late August, 1982. (Photo by Julia Morton).

trees in the field. Occasionally the plants are attacked by the green aphis.

In South America and the Caribbean, the fruits are subject to attack by fruit flies—*Anastrepha* sp. and *Carpolonchaea pendula* Bezzi (*Silba pendula*). In Colombia the tree tomato has been found to be the preferred host of the tree tomato worm (*Neoleucinodes* sp.) which infests also the tomato and the eggplant. The larvae feed on the fruits and cause heavy losses. Rigorous spraying and sanitary measures are required to reduce losses and means of biological control are being sought (19).

The principal disease is powdery mildew (both *Erysiphe* sp. and *Oidium* sp.), which may cause serious defoliation if not controlled. Minor problems include Sclerotinia disease (*Sclerotinia sclerotiorum* (Lib.) d By., the black lesions of which girdle stems and cause terminal wilting; and Ascochyta disease (*Ascochyta* sp.) which is evidenced by small, round, black, dead areas on leaves, especially mature leaves. Tree *tomato mosaic* virus causes pale mottling on leaves and sometimes on the fruits which has not been considered a serious disadvantage. Another virus disorder, called "bootlace virus", distorts the leaf, especially on young plants, reducing it to little more than the midrib. Affected plants are pulled up and destroyed (20).

The tree tomato 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. A strain of Arabis mosaic virus (which, in combination with two other unidentified viruses, causes sunken necrotic rings on the fruit surface) was reported in two plantations in the TePuke-Tauranga area of New Zealand in 1971, together with the identification of its vector, the nematode *Xiphinema diversicaudatum* (Micoletzky) Thorne (20, 23, 37).

Abnormality

In Haiti and New Zealand small, hard, irregular, semitransparent "stones" occur in the flesh of tree tomatoes and must be strained out in the process of jam-making. Victor Wynne was told by the Assistant Director of FAO that he and his fellow New Zealanders don't worry about the "stones" in the fruit but just "spit them out". It is not known if these are similar or identical to the "two gritty lumps in the wall of the fruit (on opposite sides)" mentioned by E. J. H. Corner as observed in Malaya (16). Samples of the stones were examined at the Div. Plant Industry, Florida State Dept. Agri., and were found to contain "large amounts of sodium and calcium, probably as silicates, borates, aluminum-magnesium-oxygen complexes, or aluminates or magnesium oxides. In addition, small amounts of tin, copper, chromium, iron and phosphorus were found." It is well known that plants may accumulate minerals from mineral-rich soils, but such stony accretions are usually found in the leaves, not in the fruits (27). At Tela, Honduras, concretions occur in mangosteens, often rendering the fruit inedible (H. J. Teas, Univ. Miami, personal communication).

Fig. 5. The juicy pulp surrounding the seeds is the most flavorful part of the tree tomato. Because the skin is bitter, Colombian field workers squeeze out and consume the refreshing pulp and discard the "shells". (Photo by Julia Morton).

Food Uses

Ripe tree tomatoes may be merely cut in half lengthwise, sprinkled with sugar and served for eating by scooping out the flesh and pulp. Or the halves may be seasoned and grilled or baked for 15 min for service as a vegetable. The fruit should not be cut on a wooden or other permeable surface, as the juice will make an indelible stain. For other purposes, the skin must be removed and this is easily done by pouring boiling water over the fruit and letting it stand for 4 min, then peeling is begun at the stem end. The peeled fruit can then be sliced and the slices added to stews or soups, or served with a sprinkling of sugar and perhaps with a scoop of vanilla ice cream. Seasoned with salt and pepper, the slices can serve as sandwich-filling or may be used in salads. Chopped slices are blended with cream cheese and used as sandwich spread.

Peeled, diced fruits, with diced onion, breadcrumbs, butter and appropriate seasonings are employed as stuffing for roast lamb. Tree tomato slices, alone, or combined with sliced apple, are cooked in pies. They may be packed in preserving jars with water or sugar sirup and cooked for 55 min, or may be put into plastic containers with a 50% sirup and quick-frozen for future use in pies or puddings. The peeled fruits can be pureéd in a blender or by cooking, strained to remove the seeds and then packed in plastic containers and frozen. Lemon juice may be added to the puree to enhance flavor. The peeled, stewed fruits are combined with gelatin, milk, sugar and lemon juice to make a dessert which is then garnished with fresh tree tomato slices. Peeled, sliced and seeded tree tomatoes, with lemon rind, lemon juice and sugar, are cooked to a jam; or, with onions and apples, are made into chutney. Chutney is prepared commercially in a factory in Auckland, New Zealand. Being high in pectin, the fruit is easily made into jelly but it oxidizes and discolors 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 (7, 10, 20, 24, 26, 35, 38).

Food Value

Analyses of tree tomatoes in Ecuador, Guatemala and India showed the following constituents, per 100 g: moisture, 82.7 to 87.8 g; protein, 1.5 g; total carbohydrates, 10.3 g; fat (ether extract), 0.08 to 1.28 g; crude fiber, 1.4 to 4.2 g; nitrogen, 0.223 to 0.445 g; ash, 0.61 to 0.84 g; calcium, 3.9 to 11.3 mg; phosphorus (with seeds), 52.5 to 65.5 mg, or (without seeds), 13.1 mg; iron, 0.66 to 0.94 mg; carotene, 0.371 to 0.653 mg; (or, calculated as vitamin A, 540 I. U.); thiamine, 0.038 to 0.137 mg; riboflavin, 0.035 to 0.048 mg; niacin (with seeds), 1.10 to 1.38 mg, or (without seeds), 1.011 mg; ascorbic acid, 23.3 to 33.9 mg. Most of the ascorbic acid is lost in cooking (1, 17, 28, 29).

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CHILLING REQUIREMENTS OF 3 FLORIDA BLUEBERRY CULTIVARS[1]

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Abstract. **Models were developed for rabbiteye blueberries (**Vaccinium ashei **Reade) for prediction of chilling completion. Plants and budsticks were held at constant temperatures ranging from 25°F to 75°F (—4.0°C to 24.0°C). Plants and budsticks were removed at intervals over the suspected chilling requirement. Days to budbreak were compared to observed chilling completion dates in the field. 'Aliceblue' and 'Woodard' have higher chilling temperature optima, 45°F and 50°F (7.2°C and 11.0°C), respectively. 'Tifblue' has a lower chilling temperature optimum near 40°F (6.7°C). Flowering in 'Aliceblue' and 'Woodard' is normal after exposure to temperatures below their optimum, provided temperatures remain above 25°F (—4.0°C). However, 'Tifblue' budbreak is poor after constant exposure to 32°F (0.0°C) and below.**

Insufficient chilling in perennial fruit crops has been noted as a limiting factor in production in the Southeastern United States and especially Florida (7, 11, 16). Winter temperature fluctuations may often lead to early bloom and frost damage, or prolonged dormancy due to insufficient chilling. Chilling model development has been helpful in investigating the behavior of perennial fruit crops in response to variation in winter temperatures. A plant held for 1 hr at its optimum chilling temperature is said to have

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