



The Mango¹

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- **Scientific name:** *Mangifera indica* L.
- **Family:** Anacardiaceae
- **Origin:** Mangos are indigenous to India and Southeast Asia.

DISTRIBUTION

Mangos are grown in tropical and subtropical lowlands throughout the world. In Florida, mangos are grown commercially in Dade, Lee, and Palm Beach Counties and as door yard trees in warm locations along the southeastern and southwestern coastal areas.

HISTORY

Mangos have been cultivated in India for more than 4000 years. Beginning in the 16th Century, mangos were gradually distributed around the world, reaching the Americas in the 18th Century. The first recorded introduction into Florida was Cape Sable in 1833. Importance: Mangos are universally considered one of the finest fruits and are one of the most important fruit crops in tropical and subtropical areas of the world. Increasing commercial acreage and improved handling methods and shipping

throughout the world will no doubt increase the mango's popularity and availability in US markets. Major producers include India, Pakistan, Indonesia, Mexico, Brazil, and the Philippines. Other important producers are Australia, South Africa, Israel, Egypt, and the U.S.

DESCRIPTION

Tree: A medium to large (30 to 100 ft; 9.1 to 30.5 m), evergreen tree, with a symmetrical, rounded canopy ranging from low and dense to upright and open.

Leaves: Leaves are alternately arranged, lanceolate shaped, 6 to 16 inches (15 to 40.6 cm) in length, and leathery in texture. Pinkish, amber or pale green-colored when young, leaves become dark green at maturity.

Inflorescence: The inflorescence is a many-branched panicle borne at shoot terminals, 2.5 to 16 inches long (6.4 to 40.6 cm), and possessing 550 to more than 4000 flowers. Flowers are small, pinkish-white, with the majority staminate and the remainder perfect. In Florida, mangos bloom from December to April depending upon climatic conditions and variety. Pollination is by various insects such as thrips, flies, and to a small extent, honey bees.

1. This document is Fact Sheet HS-2, a series of the Horticultural Sciences Department, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida. Publication date: April 1994.

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Fruit: Classified as drupes, mangos vary in shape (nearly round, oval, ovoid-oblong), size, and color depending upon the variety. Mangos may be greenish, greenish-yellow, yellow, red, orange, or purple and weigh from a few ounces to more than 5 pounds (2.3 kg). The skin is smooth and leathery, surrounding the fleshy, pale-yellow to deep-orange edible portion. The fruits possess a single large, flattened, kidney-shaped seed that is enclosed in a woody husk. Although the fruit will ripen on the tree, commercially it is usually picked when firm and green for shipment to market. The crop is considered mature when the shoulder of the fruit broadens (fills out) and some fruits on the tree have begun to change color from green to yellow. Prior to this external color break, the fruit is considered mature when the flesh near the seed changes color from white to yellow. Generally, mature fruit are available from May to September in Florida.

Seeds: Mango varieties produce either monoembryonic or polyembryonic seeds. Polyembryonic seeds contain more than 1 embryo and most of the embryos are genetically identical to the mother tree. Monoembryonic seeds contain 1 embryo and this embryo possesses genes from both parents.

VARIETIES

It is generally accepted that there are two main types of mango, the Indian and the Indochinese.

Indian type typically has monoembryonic seeds and often highly colored fruit. Susceptible to anthracnose and internal breakdown of the fruit. Most commercial Florida varieties are of this type.

Indochinese type typically has polyembryonic seeds and fruit often lack attractive coloration. Relatively resistant to anthracnose. Florida varieties of this group are not commercially important, although some are appreciated in home plantings.

In many areas of the tropics, there are seedling mangos which do not clearly fit in either of these types. Some of these are 'Turpentine', 'Number 11', 'Madame Francis', and 'Kensington'.

Some characteristics of the most important Florida varieties are summarized in Table 1.

CLIMATE

Mango trees are grown in protected locations as far north as Merritt Island in Florida. Well adapted to lowlands of the tropics and subtropics, mature trees can withstand air temperatures as low as 25°F (-3.9°C) for a few hours with injury to leaves and small branches. Young trees may be killed at 29° to 30°F (-1.7 to -1.1°C). Flowers and small fruits may be killed if the temperature falls below 40°F (4.4°C) for a few hours. Mango trees do not appear to acclimate to cold temperatures and no significant difference in cold resistance among mango varieties or types has been observed in Florida.

PRODUCTION AND HARVESTING

The number of fruits that set and mature is very small in relation to the number of flowers produced by the tree. Most commercial varieties in Florida produce an average of less than one fruit per 5 panicles of flowers and therefore are considered to be shy bearers.

Grafted trees will begin to bear 3 to 5 years after planting. In Florida, average yields of 4 to 6 bushels (220 to 330 lbs; 100 to 150 kg) can be expected from mature trees. Greater yields are possible with good management and favorable weather conditions. Fruits of most varieties mature from May to September (Table 1), with greatest production in June and July. The period of development from flowering to fruit maturity is 100 to 150 days. In warmer areas of the world, less time is required.

Anthracnose, powdery mildew, and low temperature during bloom generally reduce fruit set and are the most limiting factors to mango production in Florida. A dry season preceding and during the blooming period is considered optimal for good fruit production.

Mangos are picked by hand or by using a long picking pole which has at its distal end a canvas or nylon bag attached to a metal ring with a cutting blade; ladders and hydraulic lifts are also used to enable pickers to reach fruit high in the tree canopy.

SPACING, PRUNING AND IRRIGATION

Planting distance depends upon soil conditions, current technology, and economic factors. In the poor soils of South Florida, commercial groves are planted 10 to 30 feet (3.1 to 9.1 meters) apart in rows and 20 to 30 feet (6.1 to 9.1 meters) between rows. Closer spacings require more intensive culture as trees mature and are not recommended unless hedging and topping and/or grove thinning is planned. Homeowners should allow a distance of 30 feet (9.1 m) or more between mango trees and adjacent buildings or trees.

Formative pruning of young trees is usually not necessary. After several years of production, commercial growers periodically cut back the tops ("topping") to 16 to 18 feet (4.9 to 5.5 meters) and sides of the trees ("hedging") to leave a 5 to 8 foot (1.5 to 2.4 meters) open space between rows. This increases foliar spray efficiency, facilitates movement of grove equipment, helps reduce harvesting costs (smaller trees), and may help reduce storm damage. However, this is not necessary for dooryard growers. The best time for the hedging and topping operation is immediately after fruit harvest. Severe pruning does not injure the trees, but will reduce fruit production the following season.

Observations indicate irrigation of newly planted mango trees, especially during dry periods, improves tree establishment and early growth. Research also suggests that irrigation during the period of fruit development increases mango size, earliness, and yields.

Commercially, high volume overhead and under tree irrigation is used for cold protection during freezing weather. Irrigation should be started before freezing temperatures are reached and continued until temperatures are above freezing and ice has melted off the trees. Where electric motors are used, high volume irrigation should only be considered where power outages are not a problem during freezing weather conditions.

SOILS

Mangos are well adapted to many soil types. In Florida, trees growing in light sand and limestone soils must be fertilized periodically for satisfactory growth and fruit production.

Generally, mango trees tolerate some flooding or wet soil conditions; however, the response among trees is variable. Flooding stress symptoms include leaf wilting and desiccation, stem dieback, reduced growth, and tree death. Previous and current environmental conditions and plant size and health affect the response to wet conditions.

FERTILIZER

In Florida, young trees should receive fertilizer applications every two months during the first year, beginning with 1/4 lb (114 g) and gradually increasing to one pound (455 g). Thereafter, increase fertilizer amounts proportionate to the increasing size of the tree. For mature trees, a maximum of about 20 to 35 pounds per tree of a mixed fertilizer, split into two to four applications per year should be sufficient.

Fertilizer mixtures containing 6 to 10% nitrogen, 6 to 10% available phosphoric acid, 6 to 10% potash, and 4 to 6% magnesium give satisfactory results with young trees. For bearing trees potash should be increased to 9 to 15% and available phosphoric acid reduced to 2 to 4%. Nitrogen, phosphoric acid, and potash fertilizer ratios commercially available in mixes include 6-6-6, 8-8-8, 10-10-10, and 8-3-9.

In neutral and acid pH soils, micronutrients such as iron, zinc, and manganese can be applied as dry materials to the soil either separately or in mixes. Mango trees growing in calcareous soils should receive nutritional sprays of copper, zinc and manganese for the first four or five years. Thereafter, only zinc and manganese are necessary. Iron should be applied in chelated form (FeEDDHA compounds are the best) as a soil drench 2 to 3 times per year. Boron (sodium borate formulation) should be applied annually in a foliar spray or in dry form.

PROPAGATION

Seed

Polyembryonic varieties generally come true from seed, and this is a common method of propagation in many parts of the tropics. Monoembryonic varieties do not come true from seed and must be propagated vegetatively to maintain desirable qualities.

Vegetative

Veneer-grafting and chip-budding are the most common and successful methods in Florida. Young, vigorously growing seedlings are used for rootstocks. Scionwood is selected from young, leafy terminals or mature terminals with swelling buds. Grafting can be done at any time of the year when suitable rootstocks are available, but is most successful during warm weather.

Undesirable varieties can be changed by top-working. Scions of the desired variety are veneer-grafted directly on the trunk or limbs of the tree or on new shoots which develop after the tree is cut back.

Air layering of some varieties ('Tommy Atkins') has been successful by applying a 2% naphthaleneacetic acid (NAA)/lanolin mixture to the distal bark/wood interface of the girdle. Adventitious roots form in about 10 to 12 weeks. However, this method has not been practiced on a commercial scale and tree performance under field conditions has not been tested.

Rootstocks

Seedling rootstocks of the polyembryonic mango varieties 'Turpentine' or 'Number 11' are commonly used in Florida. These rootstocks are tolerant of high pH soils and seedlings are vigorous and relatively uniform.

PESTS

The most important pests in Florida are mites, scale insects and thrips. Although these pests seldom limit fruit production, their populations occasionally become large enough to require control measures.

Currently, the most important insect pests in Florida are Red-banded thrips (*Selenothrips rubrocinctus*), False Oleander scale (*Pseudaulacaspis*

cockerelli), Pyriform scale (*Protopulvinaria pyriformis*), Dictyospermum scale (*Chrysomphalus dictyospermi*), Florida red scale (*C. aoidum*), mites (*Paratetranychus yothersii*), Florida thrips (*Frankliniella bispinosa*) and Ambrosia beetles (*Xylosandrus* sp.). For more information and control measures, consult your county agricultural extension agent.

DISEASES

Successful chemical control of diseases caused by fungi requires that all susceptible parts of the plant be thoroughly coated with the fungicide before infection occurs. Sprays applied after infection (which occurs several days to months before the disease is evident) have no effect on disease development. Sprays must be re-applied as new tissues become exposed by growth and as spray residues are reduced by weathering. A successful program depends on (1) use of the right amount of a recommended fungicide and adjuvant, if required, (2) timely applications before infection is most likely to occur and (3) thorough coverage of susceptible parts. For more information and control measures, consult your county agricultural extension agent.

Anthracnose (*Colletotrichum gloeosporioides*):

The most important disease of mango in Florida, the anthracnose fungus attacks flowers, young fruits, leaves and twigs. It also appears as a storage disease of mature fruits. Symptoms appear as black, slightly sunken lesions of irregular shape, which gradually enlarge and cause blossom blight, leaf spotting, fruit staining, and fruit rot. Disease development is encouraged by rains or heavy dews. Prevention can be accomplished by maintaining a coating of fungicide on susceptible parts starting when bloom buds begin to expand and ending at harvest.

Mango scab (*Elsinoe mangiferae*): The fungus attacks leaves, flowers, fruits, and twigs. In early stages, mango scab infection resembles anthracnose. Lesions on fruit usually become covered with corky brown tissue and leaf distortion is particularly severe in nurseries. Mango scab is usually not important in commercial groves because the anthracnose spray program also controls scab. Infection in nurseries can be prevented by frequent sprays of neutral copper on young leaves.

Powdery mildew (*Oidium* sp.): The fungus attacks leaves, flowers and young fruits during the dry spring. Infected tissues are covered with whitish powdery growth of the fungus. Lesions develop along the midrib or under sides of leaves and become dark brown and greasy-looking as leaves mature. Severe infections destroy flowering panicles and cause failure of fruit set and defoliation of trees. If mildew occurs in the grove, applications of sulfur will prevent spread of infection to new growth.

Verticillium Wilt (*Verticillium albo-atrum*): Verticillium Wilt can occur in the limestone soils of Dade County and is usually observed in new trees planted on land previously used for vegetable production (especially tomatoes). This fungus attacks the tree roots and vascular (water conducting) system, decreasing and blocking water movement into the tree. Symptoms of infection include leaf wilting, desiccation and browning, stem and limb dieback, and browning of the vascular tissues. Occasionally Verticillium will kill young trees.

Alga Spot (*Cephaleuros* sp.): This parasitic alga attacks leaves and stems. Symptoms begin as circular green-gray spots which then turn rust red indicating sporulation. Stem infection appears similar but can lead to bark cankers and thickening and stem death. This organism is normally not a problem where copper fungicides are periodically used.

DISORDERS

Mango Decline: Research to date suggests that mango decline is caused by deficiencies of manganese and iron. These deficiencies may predispose trees to infection by fungal pathogens (*Botryosphaeria ribis* and *Physalospora* sp.) which attack shoots, or by root feeding nematodes (*Hemicriconemoides mangiferae*). Leaf symptoms include interveinal chlorosis, stunting, terminal and marginal necrosis, and retention of dead leaves that gradually drop. Dieback of young stems and limbs is common and even tree death may occur. Increased applications of iron, manganese, and zinc micronutrients have been observed to reduce or ameliorate this problem.

Internal Breakdown: This is a fruit problem of unknown cause, which is also called jelly seed and

soft nose. Generally, it is less of a problem on the calcareous (limestone) soils found in south Dade County and more common on acid sandy soils with low calcium content. The degree of severity may vary from one season to another. Several symptoms may appear including (1) a softening (breakdown) and water soaking of the fruit flesh at the distal end while the flesh around the shoulders remains unripe, (2) an open cavity in the pulp at the stem end, (3) over-ripe flesh next to the seed surrounded by relatively firm flesh, or (4) areas of varying size in the flesh appearing spongy with a grayish-black color. This disorder is aggravated by high nitrogen fertilization. Increased calcium fertilization may help alleviate this problem in acid soils. Fruits harvested mature-green are less affected than those allowed to ripen on the tree.

Mango Malformation: This disorder is caused by *Fusarium moniliforme* Sheld, a fungus. Symptoms include the drastic shortening of panicles giving them a clustered appearance and/or a shortening of shoot internodes. Affected panicles do not set fruit and eventually dry up and turn black. This disorder is not common in Florida but growers should watch for it and prune-off affected flower panicles and shoots and destroy them, preferably by burning.

RIPENING AND STORAGE

The best temperatures for ripening mangos are from 70° to 75°F (21 to 24°C). Fruits ripened at higher temperatures often shrivel and develop off-flavors. Mature fruits ripen in three to eight days after harvest. Commercially, to delay ripening and facilitate shipment, fruit can be stored at cold temperatures no lower than 55°F (12.8°C). Chilling injury symptoms may not become evident until fruit is exposed to higher temperatures. Symptoms may include brown or grey discoloration of the skin, surface pitting, uneven flesh ripening, and off-flavors.

USES

Mango is one of the most highly esteemed fruits of the tropics. The fruit is used in many ways, with fresh consumption being the most important. It can

also be frozen, dried, canned, or cooked in jams, jellies, preserves, pies, chutney and ice cream. The fruit is a good source of vitamins A and C.

Table 1. Some characteristics of Florida mango varieties.

Variety	Fruit maturity ¹	Fruit weight (oz)	Fruit color ²	Fruit prod. ³	Anthracnose rating ⁴	Seed type ⁵	Recommndation ⁶	
							Home	Commercial
Earlygold	M J	10-14	Pi Y	F	MR	-	Y	N
Florigon	M J J1	10-16	Y	G	MR	P	Y	N
Saigon	M J J1	6-12	G Y	G	MR	P	Y	N
Zill	M J J1	8-12	R Y	G	S	M	Y	N
Edward	M J J1	16-20	Y Pi R	P	MR	M	Y	N
Glenn	J J1	12-18	Y Pi R	GP	MR	M	Y	N
Haden	J J1	16-24	R Y	F	S	M	Y	M
Irwin	J J1	12-16	R	G	VS	M	Y	M
Carrie	J J1	10-12	G Y	GP	MR	M	Y	N
Julie	J J1	12-16	G Pi Y	P	S	M	Y	N
Van Dyke	J J1	10-16	R Y	G	MR	M	Y	Y
Tommy Atkins	J J1	16-24	R Y	G	MR	M	Y	Y
Lippens	J J1	14-20	Pi Y	G	S	M	Y	N
Adams	J J1	6-10	R	G	S	M	Y	N
Pascell	J1 A	12-18	Pi R Y	G	S	M	Y	N
Ruby	J1 A	6-8	R	G	S	M	Y	N
Smith	J1 A	16-32	R Y	G	S	M	Y	N
Kent	J1 A	16-30	G R Y	G	VS	M	Y	M
Palmer	J1 A	20-30	R Y	G	S	M	Y	Y
Sensation	J1 A	10-12	P R	G	S	M	Y	N
Keitt	A S	20-40	G Pi Y	G	MR	M	Y	Y
1, Fruit maturity: M, May; J, June; J1, July; A, August; S, September.								
2, Fruit color: G, green; P, purple; Pi, pink; R, red; Y, yellow.								
3, Fruit production: G, good; F, fair; P, poor.								
4, Anthracnose susceptibility: MR, moderately resistant; S, susceptible; VS, very susceptible.								
5, Seed type: M, monoembryonic; P, polyembryonic; Earlygold, majority of fruit seedless.								
6, Recommended for planting; Y, yes; N, no; M, maybe.								