

Section 2: Tropical Fruit Production in Miami-Dade County: Descriptions, Cultural Practices, and Technical Inputs

By
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MIAMI-DADE COUNTY TROPICAL AND SUBTROPICAL FRUIT CROPS

Miami-Dade County's unique warm-subtropical climate, rich ethnic diversity, and confluence of three research and education institutions lend itself to the development and sustainability of the tropical and subtropical fruit industry. In terms of total acreage, the largest tropical fruits are avocado, mango, and lychee. Other principle crops include 'Tahiti' lime, papaya, banana, longan, carambola, guava, jackfruit, and sapodilla. In addition to these crops, numerous others are grown on a limited commercial scale and many more as dooryard fruits in the home landscape.

Acerola

Native to the West Indies and Central and South America, acerola, also called Barbados cherry is a large shrub-like tree with small dark green leaves. This uncommon dooryard plant produces a small, crimson colored fruit very high in Vitamin C. The tree may have multiple crops per year. Plant acerola in full sunlight and well drained soil; mulching is beneficial. Season: April-Oct. Please see Barbados Cherry, HS 28 at <http://edis.ifas.ufl.edu> for more details.

Akee

Akee is indigenous to the Ivory Coast and Gold Coast of west tropical Africa. Akee is an uncommon dooryard tree, of medium size with bright green, glossy leaves. Trees produce a beautiful bright red colored, pear-shaped fruit. At maturity, the fruit splits open to reveal 3 cream-colored, off-white to yellow fleshy, arils attached to large black, smooth seeds. The flesh of the aril is cooked and is well known in the Caribbean region. Caution must be employed in picking the fruit at the proper stage of maturity, as immature fruit is poisonous. Season: mid-summer.

Atemoya

A hybrid between the sugar apple and cherimoya, atemoyas were first developed in the U.S. during the early 20th century. The atemoya, also called anon, is similar to the sugar apple is found to a limited extent in home gardens of south Florida because of its high quality fruit. It is a medium, open semi-deciduous tree with a rounded head and long, slender branches, rarely exceeding 30 feet in height and width. The fruit is heart-shaped, round, ovate or conical, from 2 to 4 inches in diameter. The pulp is white or creamy white, with a custard-like consistency and a sweet, pleasant flavor. When ripe, atemoyas become light green or yellow-green in color. The atemoya is consumed principally as a dessert fruit. Plant trees in

well drained soil in full sun. Season: Aug. -Jan. Please see The Atemoya, HS 64 at <http://edis.ifas.ufl.edu> for more details.

Avocado

Native to tropical America, there are three main races of avocado: Mexican, Guatemalan, and West Indian. The avocado is a common dooryard tree in south Florida. Miami-Dade County possesses more than 98 percent of Florida's avocado acreage and ranks number 2 nationwide behind California in avocado acreage. Florida grows over 23 major and 38 minor varieties of avocado. The fruit is a very large berry consisting of a single large seed surrounded by a buttery pulp. Mature fruit of Florida varieties are generally green, although some cultivars may be black, red or purple. Typically, avocados do not ripen until they are picked or fall to the ground. Mature fruit size varies considerably depending upon cultivar and growing conditions. Fruit are popular eaten fresh, in salads or used to make guacamole and other dishes. Plant in a well-drained site, as avocados do not tolerate flooding. Productivity, season of maturity, cold tolerance, and disease tolerance vary greatly depending upon the variety under consideration. Season: late May to March. Please see The Avocado, Circular 1034 at <http://edis.ifas.ufl.edu> for more details.

Banana

Indigenous to Southeast Asia, bananas have been cultivated for thousands of years. A true tropical favorite, bananas are perhaps the best known of the tropical fruits. There are many different cultivars available with a wide variation in fruit type and quality. Bananas are not cold tolerant and some varieties are better adapted to south Florida than others. Growth is extremely rapid during the very warm, wet summer months. Because they reproduce from underground rhizomes and not seed, a single stalk can quickly spread out producing multiple trunks in a matter of a few months. Fruits develop in clusters on the end of flower stalks usually within 1-2 years. Shortly after bearing, the stem dies. Bananas like full sun and moist but well drained soil. They will tolerate partial shade, but best growth and fruit production is obtained when plants are sited in full sun. Plants are readily available at a number of local nurseries and garden centers. Season: year round. Please see The Banana in Florida, Fact sheet HS 10 at <http://edis.ifas.ufl.edu> for more details.

Black Sapote

The black sapote is native to Mexico and Central America. Black sapote is a medium to large, evergreen tree with dark green, glossy leaves. An uncommon dooryard tree, black sapote, produces a bright green, globose, fruit that at maturity softens and has a muddy-green peel color. The flesh is dark brown, smooth, and mild, sweet flavor. Trees are moderately tolerant of drought and periodically wet soil conditions. Plant trees in full sun. Season: Dec.-March.

Canistel

Native to Mexico, Belize, Guatemala and El Salvador, the canistel is a medium sized, evergreen tree with green, lanceolate-shaped leaves. An uncommon dooryard tree, canistel, produces a bright orange-yellow, top-shaped, fruit that at maturity softens. The fruit flesh is bright orange, smooth, and has a sweet to musky-sweet flavor. Trees are moderately tolerant

SECTION 2
TROPICAL FRUIT PRODUCTION IN
MIAMI-DADE

of drought but, should be planted in well-drained soil. Plant trees in full sun. Season Dec. - March.

Coconut

Coconut palms are believed to be native to the Malay Archipelago or the South Pacific region. However, the tree has become synonymous with Florida. The coconut palm is a large, single-trunked tree with 6 foot wide by 18 feet long fronds. Still a relatively common landscape tree, however its use has diminished due to the spread of lethal yellowing, a disease caused by a phytoplasma. However, Malayan Dwarf and Malayan Hybrid types have some resistance to this disease. The trees are also grown for their immature fruit, which possesses a nutritious “milk” which is served as a popular cold drink. Season: All year. Please see The Coconut Palm in Florida, Fact Sheet FS 40 at <http://edis.ifas.ufl.edu> for more details.

Carambola (Star Fruit)

Originally from southeast Asia, star fruit is becoming increasingly popular and available in the U.S. Locally, commercial production occurs in the southern half of south Florida (including Broward, Palm Beach, and Lee Counties). Trees are generally small to medium in height (35 feet max.) and spreading with the majority of fruit borne on branches in the mid-canopy region. The fruit is a large fleshy berry, 2-6 inches in length, yellow skinned with a waxy surface and a five point star-shaped cross section. Flesh is light to dark yellow, translucent, crisp and very juicy. Better cultivars have a nice, slightly sweet to subacid flavor. It is served fresh, cut up in fruit salads, or as an iced juice drink. The fruit may also be canned, preserved, and dried

Carambola trees also have ornamental value with their dark green foliage and attractive flowers and fruit. Plant trees in a well-drained sunny spot, which has protection from wind. On alkaline soils (those with high pH) watch for signs of minor element deficiencies, particularly zinc, iron, and manganese and treat accordingly. Season: July-September, Nov.-Feb. Please see The Carambola (Star Fruit), HS 12 at <http://edis.ifas.ufl.edu> for more details.

Guava

Native to tropical America, guava trees are small, seldom exceeding 20 feet high and are quite easy to grow. Guava may be consumed fresh but more often is made into purees, juices and jellies. The fruit has an exotic flavor and aroma, and may or may not be quite seedy. It is an outstanding source of vitamin C, with some varieties having as much as five times the vitamin C content of fresh orange juice. Fruit are produced throughout the year, but the bulk of production in Florida occurs during the summer months. Fruit are ripe when the peel turns a light yellow. Depending upon the variety, interior flesh can be white, yellow, pink or red. Season: Aug.-Oct., Feb.-March. Please see The Guava, Fact Sheet HS 4 at <http://edis.ifas.ufl.edu> for more details.

Jaboticaba

Jaboticaba is native to Brazil and has an attractive bark and small green leaves. It is an unusual shrub-like tree in that the fruit which is a purple, and grape-like is produced

directly upon the trunk and larger branches either singly or in clusters. Under the skin is a whitish pulp with 1 to 4 seeds. The fruit has a pleasant flavor and tastes a bit like grape. They can be eaten fresh or made into jam, jellies or wine. Flowering and fruiting occurs periodically throughout the year so multiple crops are produced. Jaboticaba has a beautiful multicolored bark, which gives it value in the landscape. The tree is small, slow growing, and bushy, has a slow growth rate and seldom exceeds 20 feet in Florida. Flowers are small and white, interesting but rather inconspicuous and borne right on the trunk and larger branches. Jaboticaba is relatively hardy but will not tolerate drought. Plant in full sun in a moist but fairly well drained soil. The tree prefers a slightly acid soil, so some special attention will be required to provide the proper nutrition on our alkaline soils. Season: variable. Please see The Jaboticaba, Fact Sheet HS 39 at <http://edis.ifas.ufl.edu> for more details.

Jackfruit (jakfruit)

Native to India and Malaysia, this attractive large tree has glossy, dark green leaves and produces a very large, elongated, rather unusual looking segmented fruit. The fruit may be produced singly or in clusters of 2 or more at various heights and intervals along the trunk and major limbs. The skin of the fruit must be peeled to reveal the succulent, yellow to orange colored pulp. The flavor is sweet, not unlike that of banana or pineapple, but with a strong, fruity aroma and taste. Fruit may be used fresh, fried green, pickled or roasted (seeds). In south Florida, jackfruit trees have few serious pest or disease problems. Season: spring-fall (some all year round). Please see The Jackfruit, Fact Sheet at <http://edis.ifas.ufl.edu> for more details.

Kumquat

Native to China, kumquats are small shrubby trees with a dense canopy. The white fragrant flowers bear oval to round fruit. Fruit is golden-yellow to reddish-orange. The fruit is mostly composed of peel with 3-6 small segments of flesh. The whole fruit is eaten and has an acid to sweet flavor. At present, this tree should not be planted in the citrus canker quarantine area until the disease is declared eradicated. Season: Oct.-Feb. Please see Dooryard Fruit Varieties, Fact Sheet 23 and Cold Hardy Citrus, Fact Sheet 123 at <http://edis.ifas.ufl.edu> for more details.

Longan

Longan is native to Myanmar (Burma), southern China, southwest India, Sri Lanka, and the Indochina peninsula. The longan is an attractive tree with dark green foliage and has an excellent fresh fruit with a pleasant, unique, sweet flavor. Fruit are small (about the size of a quarter), round to oval, and borne in loose clusters. When fruit are ripe, the leathery skin develops an attractive golden brown color. Longan trees may grow as high as 40 feet. Plant in sunny, well-drained sites. Trees may begin to bear within 3-5 years of transplanting. However, unreliable bearing is a major constraint. Season: July-Aug. Please see The Longan (Dimorcarpus longan Lour.) in Florida, Fact Sheet FC 49 at <http://edis.ifas.ufl.edu> for more details.

**SECTION 2
TROPICAL FRUIT PRODUCTION IN
MIAMI-DADE**

Lychee

Native to southern China and southeastern Asia, lychee trees are attractive trees having a dense, rounded, symmetrical canopy of dark green foliage. They may grow to be very large trees. Lychee is an excellent fresh fruit with a pleasant, sweet flavor. Fruit are small (about the size of a ping pong ball), round to oval, and borne in loose clusters. When fruit are ripe, the leathery skin develops an attractive pinkish to red color. Plant in sunny, well drained sites, preferably where there is some protection from wind. Trees may begin to bear within 3-5 years of transplanting. However, unreliable bearing is a major constraint. Season: June, early July. Please see The Lychee in Florida, Fact Sheet HS 6 at <http://edis.ifas.ufl.edu> for more details.

Mamey sapote

Mamey sapote is indigenous to Mexico and Central American lowland areas. The tree is large and erect reaching a height of about 40 feet in Florida. The tree grows well in a variety of soils, but requires good drainage. The flesh of mature fruit is salmon pink to reddish brown in color and has a unique, sweet flavor. Mamey sapote can be eaten fresh, and is also excellent for use in ice cream, sherbets, jellies, and preserves. Milkshakes may also be prepared from the flesh. Mamey sapote makes an excellent specimen tree with handsome glossy foliage. It requires little care and yields a useful, good tasting fruit. Occasionally, an insect known as the Cuban May beetle may cause some defoliation. Season: Jan.-Sept. (some all year). Please see The Mamey sapote, Fact Sheet FC 30 at <http://edis.ifas.ufl.edu> for more details.

Mango

Mango trees are native to India and Southeast Asia. Like avocado, mango trees are common in Miami-Dade County. Mango trees may become very large trees and grow to 30-40 ft in height. South Florida has numerous varieties with varying shapes, colors and maturities. Most mangoes are ripe when the fruit softens slightly and takes on a yellow to orange or red color and carries a sweet fragrance. They can be eaten fresh or pureed. Perhaps more than any other tropical fruit, mangoes are readily available at many local nurseries and garden centers. Trees are tough and relatively easy to grow. Most varieties of grafted trees will bear in as little as 3-5 years after transplanting. Season: May-Oct. Please see The Mango, Fact Sheet HS 2 at <http://edis.ifas.ufl.edu> for more details.

Papaya

Native to tropical America and common throughout the tropics, papayas may have small to large fruits born on the stem of upright semi-herbaceous trunks. Fruit are sweet, have orange to reddish-salmon colored flesh and contain numerous small black seeds in the interior cavity. Papaya fruit is typically peeled, sliced and consumed fresh. Plants are relatively short lived (1-3 years) and are easily propagated from seed. Papayas are relatively easy to grow so long as they are sited in full sun and have excellent drainage. Papaya ringspot virus can be a problem causing stunting and fruit loss; at present there is no control for this disease. Papaya fruit fly is another problem but can be overcome by placing a 3-5 pound paper bag (tied around the fruit stem) over developing fruit. Amend the soil with

plenty of organic matter and mulch regularly to help suppress weeds and conserve moisture. Season: year round. Please see The Papaya, Fact Sheet HS 11 at <http://edis.ifas.ufl.edu> for more details.

Passion fruit

Passion fruit is native to the American tropics. Passion fruit is a vigorous perennial vine that produces purple, yellow, or reddish colored fruit containing seeds surrounded by an orange, sweet, watery pulp. The juice is very aromatic and is commonly used to make juice or punch. Passion fruit vines produce spectacular flowers. Plant vines in a well drained area with full sun. Vines begin to bear within 3-6 months after planting. Season June-Dec. Please see The Passion Fruit, Fact Sheet HS 60 at <http://edis.ifas.ufl.edu> for more details.

Persimmon

Persimmon trees are native to China, Japan, Myanmar, and northern India. Persimmon is a medium to large tree and there are two major fruit types, astringent and non-astringent. An uncommon dooryard tree in south Florida, persimmon trees produce a conical to round shaped fruit with a yellow, orange or reddish-brown skin. The flesh is yellow orange, or dark brown, and juicy with 4-8 seeds. Trees are tolerant of drought and periodically wet soil conditions. Plant trees in full sun. Season: fall and early winter. Please see Oriental Persimmons in Florida, SP 101 at <http://edis.ifas.ufl.edu> for more details.

Pummelo

Native to southeast Asia and Malaysia, pummelo trees are medium to large citrus trees with large leaves and winged petioles. Trees produce fragrant flowers and large (4-12 inches in diameter) globose fruit. Fruit at maturity have a yellow peel. The flesh may be greenish-yellow, yellow, or pinkish, juicy, with a sweet to bland flavor. At present, this tree should not be planted in the citrus canker quarantine area until the disease is declared eradicated. Season: Dec.-April. See Your Florida Dooryard Citrus Guide, SP 178 at <http://edis.ifas.ufl.edu> for more details.

Sapodilla

Indigenous to Mexico and Central America, sapodilla also called chicozapote is a medium to large tree with small, dark green, glossy leaves. The fruit is round to oval in shape with a brown peel; inside is a light to dark brown, sweet flesh. There are a number of good cultivars available from local nurseries. Plant trees in well drained areas away from other trees and structures. Trees usually begin bearing after 2-4 years from planting. Season: Feb.-June. Please see The Sapodilla (Manilkara zapota Van Royen) in Florida, Fact Sheet HS 1 at <http://edis.ifas.ufl.edu> for more details.

Star Apple

The origin of star apple is not fully known and may be Central America and the Caribbean. Star apple trees are medium to large, evergreen tree attractive leaves, which are glossy green on the upper surface and golden-brown beneath. An uncommon dooryard tree, star apple trees, produces a round, 2-4 inch diameter fruit with a red-purple, dark-purple, or pale-green fruit. The sweet flesh is soft, milky, and whitish with purple streaks. There are

**SECTION 2
TROPICAL FRUIT PRODUCTION IN
MIAMI-DADE**

up to 10 seeds. Trees are moderately tolerant of drought but not tolerant of wet soil conditions. Plant trees in full sun. Season: Feb.-May.

Sugar Apple

Native to tropical America, the sugar apple, also called sweetsop or anon, has been widely planted in home gardens of south Florida because of its high quality fruit. It is a small, open semi-deciduous tree with a rounded head and long, slender branches, rarely exceeding 20 feet in height and width. The fruit is heart-shaped, round, ovate or conical, from 2 to 4 inches in diameter. The pulp is white or creamy white, with a custard-like consistency and a sweet, pleasant flavor. When ripe, sugar apples become light green or yellow-green in color. The sugar apple is consumed principally as a dessert fruit. Plant trees in well drained soil in full sun. Season: July-Sept., Nov. -Jan. Please see The Sugar Apple, Fact Sheet HS 38 at <http://edis.ifas.ufl.edu> for more details.

‘Tahiti’ lime

Thought to be indigenous to Tahiti and introduced to California, the ‘Tahiti’ lime, also known, as ‘Persian’ lime is a small tree with a dense, round canopy. Trees produce a seedless, highly acid fruit used in limeade, garnish, and deserts. Trees grow best in full sun and well-drained soil. At present, this tree should not be planted in the citrus canker quarantine area until the disease is declared eradicated. Season: June-Sept. Please see The Tahiti Lime, Fact Sheet FC 8 at <http://edis.ifas.ufl.edu> for more details.

Wax jambu

Native to the Malay Archipelago, wax jambu is a small to medium, evergreen tree with green, glossy leaves. An uncommon dooryard tree, wax jambu, produces white, pink or red pear-shaped fruit. The fruit flesh is white, crisp, dry with a fragrant, mild flavor. Trees are moderately tolerant of drought and periodically wet soil conditions. Plant trees in full sun. Season: June-July.

White sapote

Native to central Mexico, white sapote is a medium to large, evergreen tree. An uncommon dooryard tree, white sapote, produces a green, round fruit that at maturity has a yellowish-green peel. The flesh is white, smooth, and resinous sweet flavor. There may be 1-6 seeds. Trees are moderately tolerant of drought but not tolerant of wet soil conditions. Plant trees in full sun. Season: May-Aug.

**SECTION 2
TROPICAL FRUIT PRODUCTION
IN MIAMI-DADE**

Table 1. Production of Tropical Fruits in Miami-Dade County.^a

Crop common name	Scientific name	Trees per acre	Drought tol	Flood tol	Cold tol	Damage temp (°F)
Acerola (Barbados cherry)	<i>Malpighia glabra</i>	201-290	M*	L	L	28-30
Akee	<i>Blighia sapida</i>	70-140	M	L	L	<32
Atemoya	<i>A. cherimola</i> x <i>A. squamosa</i>	108-145	M-H	L	L	32
Avocado	<i>Persea americana</i>	70-140	M	L	L-M	25-30
Banana/plantain	<i>Musa</i> spp.	450-680	L	M	L	28
Black sapote	<i>Diospyros ebenaster</i>	87-108	M	M	L	28-30
Canistel	<i>Pouteria campechiana</i>	70-145	M	L-M	L-M	23
Carambola (star fruit)	<i>Avorhoa carambola</i>	145-180	L	M	L-M	26-28
Coconut	<i>Cocos nucifera</i>	70-140	H	H	L	25-32
Guava	<i>Psidium guajava</i>	145-217	M	H	M	25-26
Jackfruit	<i>Artocarpus heterophyllus</i>	70-150	M-H	L	L	32
Kumquat	<i>Fortunella</i> spp.	145-217	H	M	H	18
Longan	<i>Dimocarpus longana</i>	70-140	M	L-M	M	24-28
Lychee	<i>Litchi chinensis</i>	70-140	M	L-M	M	24-25
Mamey sapote	<i>Pouteria sapota</i>	70-140	L-M	L	L	28
Mango	<i>Mangifera indica</i>	70-110	H	M	M	25-30
Papaya	<i>Carica papaya</i>	300-600	L	L	L	30
Passion fruit	<i>Pasiflora edulis</i>	200-300	L	L	L-M	32
Persimmon	<i>Diospyros kaki</i>	145-160	M-H	M-H	H	25-32
Pummelo	<i>Citrus grandis</i>	100-145	L-M	L-M	L	32
Sapodilla	<i>Manilkara zapota</i>	70-145	H	M-H	M	26
Star apple	<i>Chrysophyllum cainito</i>	70-100	M	L	L	29
Sugar apple	<i>Annona squamosa</i>	108-180	H	L	L	28-29
Tahiti' lime	<i>Citrus latifolia</i>	108-217	L-M	M	M	22-30
Wax jambu	<i>Syzygium samarangense</i>	108-145	L	M	L	<32
White sapote	<i>Casimiroa edulis</i>	87-140	M	L	M-H	24

^a Refer to key beginning on page 26 to interpret abbreviations.

**SECTION 2
TROPICAL FRUIT PRODUCTION IN
MIAMI-DADE**

Table 1. Production of Tropical Fruits in Miami-Dade County.^a

Crop common name	Salt tol	Hurricane tol	N-rate/A	P2O5-rate/A	K2O-rate/A	Irri. Req	Irri. Type	Insect. Req
Acerola (Barbados cherry)	L	M	150-200	0-100	150-200	L-M	O,U,M	L-M
Akee	M	L	75-150	50-100	75-150	L-M	O,U,M	L
Atemoya	L	L	75-150	50-100	75-150	L-M	O,U,M	L-M
Avocado	L	M	150-200	0-100	150-200	L-M	O,U,M	L-M
Banana	L	L	100-300	35-130	180-400	H	S,U,M,D	L-M
Black sapote	M	M-H	75-150	50-100	75-150	L-M	O,U,M	L
Canistel	L-M	M	100-200	50-100	100-200	L-M	O,U,M	O
Carambola	L	M	100-300	0-200	100-300	M-H	O,U,M	L
Coconut	H	M-H	100-200	25-30	100-200	L	O,U,M	O
Guava	M	M-H	100-250	50-100	100-250	H	O,U,M	M-H
Jackfruit	L-M	M	120-180	50-100	120-180	L-M	U,M	O
Kumquat	L	M-H	120-200	0-100	120-200	L-M	O,U,M	L
Longan	L	M	80-120	25-100	90-120	L-H	U,I,M	L
Lychee	L	L-M	90-120	25-100	90-120	L-H	U,I,M	L
Mamey sapote	L	L-M	150-200	50-100	100-200	M-H	U,M	L
Mango	L	L-M	100-150	0-150	100-200	L-M	O,U,M	L-M
Papaya	L	L	230-300	0-200	250-300	H	S,U,M,D	M-H
Passion fruit	L	L	35-100	0-20	35-100	L-M	S,M,D	L
Persimmon	L	M-H	100-120	50-60	100-120	L-M	O,U,M,D	M-H
Pummelo	L	M	120-200	0-100	120-200	M-H	O,U,M	L-M
Sapodilla	L-M	M-H	120-180	50-100	120-180	L-M	O,U,M	L
Star apple	L	M	100-200	50-100	100-200	L-M	O,U,M	O
Sugar apple	L	M	50-100	50-100	50-100	L-M	O,U,M	L-M
Tahiti' lime	L	L-M	150-250	0-100	150-200	M-H	O,M	M-H
Wax jambu	M	M	100-150	0-150	100-200	M-H	O,U,M	M-H
White sapote	L	M	100-200	50-100	100-200	L-M	O,U,M	O

^aRefer to key beginning on page 26 to interpret abbreviations.

**SECTION 2
TROPICAL FRUIT PRODUCTION
IN MIAMI-DADE**

Table 1. Production of Tropical Fruits in Miami-Dade County.^a

Crop common name	Fungicide Req	Yld range/tree	Yld range/acre	Crop Season
Acerola (Barbados Cherry)	L	15-40	3,000-9,600	April-Oct.
Akee	L	50-200	7,250-20,000	Aug.-March
Atemoya	L	25-70	2,700-10,150	Aug.-Jan.
Avocado	L-M	150-330	10,500-46,200	Late May-March
Banana	M	20-50	10,000-20,000	All year
Black sapote	L	70-200	7,000-10,500	Dec.-March
Canistel	O	50-200	5,400-29,000	Dec.-March
Carambola	L	150-350	21,750-63,000	July-Feb.
Coconut	O	50-200 (nuts)	4,350-17,400	All year
Guava	L	120-220	20,000-30,000	Aug.-Oct.; Feb.-March
Jackfruit	O	100-300	7,000-45,000	June-Sept.
Kumquat	O	40-50	5,800-10,850	Oct.-Feb.
Longan	O	50-250	4,350-35,000	July-Aug.
Lychee	L-M	50-250	3,500-35,000	May-June
Mamey sapote	O	60-300	4,200-42,000	Jan.-Oct.
Mango	H	200-300	14,000-36,000	May-Oct.
Papaya	M-H	30-100	10,000-60,000	All year
Passion fruit	M-H	50-100	15,000-28,000	June-Dec.
Persimmon	M-H	50-300	7,250-10,875	Aug.-Nov.
Pummelo	L-M	150-300	20,000-30,000	Dec.-April
Sapodilla	O	50-200	3,500-15,000	Feb.-June
Star apple	O	25-100	2,100-8,700	Feb.-May
Sugar apple	L	25-50	3,500-10,000	July-Sept.
Tahiti' lime	L-M	250-700	27,500-39,875	June-Sept., all year
Wax jamba	L	100-200	10,800-29,000	June-July
White sapote	O	100-275	8,000-38,500	May-Aug.

^aRefer to Key beginning on page 26 to interpret abbreviations..

Key to Tropical Fruit Crops Input Table

By

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Trees per acre. This is the range in the number of trees per acre commonly found under commercial production.

Drought tolerance. In general, tropical fruit trees should be irrigated for optimum growth and production. Trees tolerance to drought depends upon numerous factors including genetics, time of year, temperatures, stage of growth, and tree size. Furthermore, drought stress imposes other problem besides tree survival and always results in reduced fruit production. Dead grass in row middles and weeds may pose a fire hazard and insect infestations may increase under dry conditions. Key: L, trees may survive a few days of drought, however, this may result in severe leaf drop, poor vegetative growth, and a large reduction in yield; M, Trees may withstand several days of drought. However, drought stress may reduce tree growth and yields; H, Trees may tolerate a lack of water for a few days to several weeks. However, drought stress may reduce tree growth and yields.

Information source: Balerdi, C.F., J.H. Crane, and B. Schaffer. 2000. Managing your tropical fruit grove under changing water table levels. Miami-Dade Co. Coop. Extension Service, Univ. of Florida, IFAS, Homestead, FL. Information based on the scientific literature and observation.

Flood tolerance. In general, tropical fruit trees should not be planted in areas subjected to periodic flooding or continuously wet soil conditions. Trees tolerance to flooding depends upon numerous factors including genetics, time of year, temperatures, stage of growth, and tree size. Furthermore, flooding imposes other problem besides tree survival and always results in reduced fruit production. In addition, weed growth and the potential for root diseases increases. Excessive soil moisture and flooding make cultural practices such as fertilization, weed control, pest control, pruning, and harvest difficult to impossible. Key: L, Trees not tolerant of wet or flooded soil conditions, may sustain heavy damage or be killed by a day or few days of wet soil conditions. In addition, root disease may develop resulting in tree damage or death; M, Moderately flood tolerant trees will survive several days of excessively wet or flooded soil conditions. However, the stress of wet conditions may reduce tree growth and fruit production. In addition, root disease may develop resulting in tree damage or death; H, Flood tolerant fruit crops will survive excessively wet (high water table) and flooded conditions for several days to a few weeks. However, the stress of wet conditions may reduce tree growth and fruit production. In addition, root disease may develop resulting in tree damage or death.

**SECTION 1
TROPICAL FRUIT PRODUCTION
IN MIAMI-DADE (TROPICAL
FRUIT TABLE KEY)**

Information source: Balerdi, C.F., J.H. Crane, and B. Schaffer. 2000. Managing your tropical fruit grove under changing water table levels. Miami-Dade Co. Coop. Extension Service, Univ. of Florida, IFAS, Homestead, FL. Information based on the scientific literature and observation.

Cold tolerance. Cold tolerance of subtropical and tropical fruit crops is low to very low compared to temperate zone fruit crops (e.g., apple, cherry, peach). There are numerous factors, which affect tree cold tolerance including previous weather conditions, genetics, time of year, duration of freezing temperatures, depth of cold temperatures, stage of growth, and tree size. Fruit and leaves are less cold tolerant than large diameter wood and may be damaged at higher temperatures than the tree trunk and major limbs. Generally, young trees are much less cold tolerant than large, mature trees and are damaged or killed by temperatures at or below 30°-32°F. In general, we recommend installation and use of high volume irrigation systems for freeze/cold protection of subtropical and tropical fruit crops. This involves the use of extensive and expensive irrigation systems and large volumes of water during freeze events. Ice loading from the irrigation may result in structural damage to tree limbs. Cold tolerance ratings are for mature trees. Key: L, Mature trees have little to no tolerance for exposure to temperatures at or below 31°-32°F and may sustain major damage or die; M, Mature trees may withstand exposure to moderately low temperatures (26°-28°F) and may sustain leaf and small diameter wood damage; H, Mature trees may withstand subfreezing temperatures (24°-26°F) with little to moderate leaf and small diameter wood damage.

Damaging temperatures. These are the temperatures at or below which major tree damage or death of mature trees occurs.

Information source: Crane, J.H. 1999. Estimated temperatures for freeze damage or death of tropical fruit trees in south Florida. Tropical Research and Education Center, Univ. of Florida, IFAS, Homestead, FL. Information was derived from observational literature after major freezes in south Florida.

Salt tolerance. In general, tropical fruit trees should not be planted in areas with saline soils and/or a saline irrigation source, or areas subjected to salt water intrusion. Generally, tropical fruit trees are not tolerant of saline soil/water conditions. The degree of tolerance to saline conditions is strongly dependent on genetics. However, how rapidly and to what extent saline conditions affect tree performance depend upon soil/water salinity concentration, frequency and rate of irrigation, time of year, stage of tree growth, and tree size. Saline conditions generally result in reduced fruit production. Key: L, Trees not tolerant to saline soil and/or water conditions, may sustain heavy damage or be killed; M, Moderately saline tolerant trees. Trees will survive in moderately saline soil conditions and/or repeated applications of saline irrigation water for several weeks. However, the salinity stress may reduce tree growth and fruit production. H, Saline tolerant fruit crops will survive saline soil and/or repeated applications with saline water over a prolonged period (months). However, the salinity stress may reduce tree growth and fruit production.

**SECTION 1
TROPICAL FRUIT PRODUCTION IN
MIAMI-DADE (TROPICAL FRUIT
TABLE KEY)**

Information source: Schaffer, B. and P. Anderson. 1994. Handbook of Environmental Physiology of Fruit Crops: Vol. II. Subtropical and tropical crops. CRC Press, Inc., Boca Raton, FL.

Hurricane tolerance. Tolerance to strong and hurricane force winds depends upon numerous factors including genetics, tree size (especially height), propagation method, amount of soil moisture (rainfall), speed and duration of wind. Tropical depressions/storms with strong wind gusts and hurricanes almost always result in fruit drop, fruit scaring, and some defoliation and limb breakage. Common symptoms of wind damage include fruit drop, defoliation, stem and limb breakage, damage to the trunk and major scaffold limbs, toppling, wind-throw, stumping, sun burn (necrosis of the cambium layer), wind scaring from airborne debris, and tree death. Key: L, many trees may topple, be lifted out of the ground or be broken off at ground level, and be dead; M, trunk and branches may withstand moderately strong winds, most trees likely to recover; H, trunk and branches will withstand moderately strong winds and some hurricane force winds, trees likely to recover, some species more quickly than others.

Information source: Campbell, R.J., C.W. Campbell, J. Crane, and C. Balerdi. 1993. Hurricane Andrew damages tropical fruit crops in south Florida. *Fruit Varieties J.* 47:218-225; Crane, J., C. Balerdi, R. Campbell, C. Campbell, and S. Goldweber. 1994. Managing fruit orchards to minimize hurricane damage - lessons from hurricane Andrew. *HortTechnology* 4:21-27; Crane, J.H., R.J. Campbell, and C.F. Balerdi. 1993. Effect of Hurricane Andrew on tropical fruit trees. *Proc. Fla. State Hort. Soc.* 106:139-144; Crane, J., C. Balerdi, R. Campbell, C. Campbell, and S. Goldweber. 1993. Hurricane damage update. *Florida Grower and Rancher* 86:25-27; Crane, J.H., A.J. Dorey, R.C. Ploetz, and C.W. Weekley. 1994. Post-hurricane Andrew effects on young carambola (*Averrhoa carambola* L.) trees. *Proc. Fla. State Hort. Soc.* 107:338-339.

N-rate/A – actual nitrogen rate (pounds) per acre per year for mature trees. Nitrogen is the major growth enhancing and limiting plant nutrient required for plant growth and crop production. The nitrogen rate for subtropical and tropical fruit crops varies among species, tree age, and edaphic conditions. Recommendations for some crops such as avocado, ‘Tahiti’ lime, and mango are based on research completed under south Florida conditions. Research is underway on carambola and lychee. Recommendations for other crops such as mamey sapote, papaya, banana, guava, kumquat, jackfruit, pummelo, sapodilla, sugar apple, passion fruit, atemoya, star apple, white sapote and canistel is based on experience, observation, and research from other areas.

Information source: Data for avocado, lime and mango was from numerous research studies at Univ. of Florida.

P₂O₅-rate/A – actual phosphate pentoxide rate (pounds) per acre per year for mature trees. Phosphorous is a major plant nutrient. In general, in Miami-Dade County, we recommend

**SECTION 1
TROPICAL FRUIT PRODUCTION
IN MIAMI-DADE (TROPICAL
FRUIT TABLE KEY)**

regular phosphate applications during the first 4 years after planting. Afterward, phosphate may only need to be applied occasionally or on an as needed basis. The phosphate rate for subtropical and tropical fruit crops varies among species, tree age, and edaphic conditions. Recommendations for some crops such as avocado, ‘Tahiti’ lime, and mango are based on research completed under south Florida conditions. Research is underway on carambola and lychee. Recommendations for other crops such as mamey sapote, papaya, banana, guava, kumquat, jackfruit, pummelo, sapodilla, sugar apple, passion fruit, atemoya, star apple, white sapote and canistel is based on experience, observation, and research from other areas.

Information source: Data for avocado, lime and mango were from numerous research studies at Univ. of Florida.

K₂O-rate/A – actual potassium oxide rate (pounds) per acre per year for mature trees. Potassium is a major plant nutrient. The potassium rate for subtropical and tropical fruit crops varies among species, tree age, and edaphic conditions. Recommendations for some crops such as avocado, ‘Tahiti’ lime, and mango are based on research completed under south Florida conditions. Research is underway on carambola and lychee. Recommendations for other crops such as mamey sapote, papaya, banana, guava, kumquat, jackfruit, pummelo, sapodilla, sugar apple, passion fruit, atemoya, star apple, white sapote and canistel is based on experience, observation, and research from other areas.

Information source: Data for avocado, lime and mango were from numerous research studies at Univ. of Florida.

Irri. Req. – irrigation requirement. Irrigation is a major input for production of tropical and subtropical fruit crops in Miami-Dade County. Irrigation is essential for cold/freeze protection of fruit crops during freezing and subfreezing weather conditions and for optimum fruit production. The amount of water needed for tropical fruit crops varies with species, time of year, evaporative demand, crop growth stage, and soil water holding capacity. Key: L, relatively low demand for irrigation, requires 1-2 inches of water every 7-14 days; M, moderate demand for irrigation, requires 1-2 inches of water every 7 days; H, high demand for irrigation, requires 2-3 inches of water every 7-10 days.

Information source: Preliminary data for avocado, lime, and carambola. Information for other crops is based on observation and experience.

Irri. Type – type of irrigation systems used for a particular fruit crop. High volume irrigation systems are used for cold protection and apply a minimum of 0.20 inches of water per acre per hour. The sprinklers for these systems may be over the top of trees or only 2-3 ft high, or 2-8 ft high within the tree canopy. Low volume sprinkler and drip irrigation systems are used to meet water requirements of the tree and may apply 1-30 gallons of water per tree per hour. These systems are not designed for cold protection but may be designed to apply liquid fertilizers (called fertigation). Key: O, high volume overhead irrigation system; U, high volume under tree irrigation system; I, high volume in-

**SECTION 1
TROPICAL FRUIT PRODUCTION IN
MIAMI-DADE (TROPICAL FRUIT
TABLE KEY)**

tree irrigation system; M, low volume microsprinkler irrigation system; D, low volume drip irrigation system.

Insect. Req. – insecticide use requirement. The insecticide use requirement of tropical fruit crops varies greatly. In some cases, an insect pest or pests may be a major limiting factor to production of a particular crop; more commonly, insect pests are occasional or annual (specific time of year) problems that are controlled on an as needed basis. Key: L, few insect pest problems that warrant control, insecticide use very limited; M, one or a few insect problems that warrant control, moderate insecticide use at specific times of the year; H, one or more insect problems that must be controlled regularly, moderate to high insecticide use; O, no insect pests limiting production at this time.

Information source: J.H. Crane, Tropical Fruit Crop Specialist and Field Dir., TREC-IR-4 Center and C.F. Balerdi, Multi-County Tropical Fruit Crops Extension Agent, Miami-Dade Co. Coop. Ext. Service, Homestead.

Fungicide Req. – fungicide use requirement. The fungicide use requirement of tropical fruit crops varies greatly. In some cases, a disease problem or problems may be a major limiting factor to production of a particular crop; more commonly, disease pests are occasional or annual (specific time of year) problems that are controlled prophylactically. Key: L, few disease problems that warrant control, fungicide use very limited; M, one or a few disease problems that warrant control, moderate fungicide use at specific times of the year; H, one or more disease problems that must be controlled regularly, moderate to high fungicide use; O, no disease limiting production at this time.

Information source: J.H. Crane, Tropical Fruit Crop Specialist and Dir., TREC-IR-4 Center and C.F. Balerdi, Multi-County Tropical Fruit Crops Extension Agent, Miami-Dade Co. Coop. Ext. Service, Homestead.

Yld range/tree – yield range per tree per year. The values in this table are ranges of crop yields in pounds per tree per year. Crop yield varies among species, tree age, size, production practices, and cultivar. Crop yields are affected by previous and current weather conditions and production practices.

Information source: J.H. Crane, Tropical Fruit Crop Specialist and C.F. Balerdi, Multi-County Tropical Fruit Crops Extension Agent, Miami-Dade Co. Coop. Ext. Service, Homestead.

Yld range/acre – yield range per acre per year. The values in this table are ranges of crop yields in pounds per acre per year. Crop yield varies among species, tree age, size, production practices, and cultivar. Crop yields are affected by previous and current weather conditions and production practices.

**SECTION 1
TROPICAL FRUIT PRODUCTION
IN MIAMI-DADE (TROPICAL
FRUIT TABLE KEY)**

Information source: J.H. Crane, Tropical Fruit Crop Specialist and C.F. Balerdi, Multi-County Tropical Fruit Crops Extension Agent, Miami-Dade Co. Coop. Ext. Service, Homestead.

The Longan (*Dimocarpus longan* Lour.) in Florida¹

J.H. Crane, C.F. Balerdi, and Steve Sargent

Other common names: English: lungan, dragon eye; Spanish - mamoncillo chino, longana; Malaysian and Indonesian – leng keng; Thai – lam yai

Synonyms: *Nephelium longan* (Lam.) Carm.; *Euphoria longana* Steud.

Family: Sapindaceae

Relatives in the same family: Lychee, rambutan, pulasan, akee, Spanish lime, soapberry

Origin: Myanmar (Burma), southern China, southwest India, Sri Lanka, Indochinese peninsula

Distribution: China, Taiwan, Thailand, Cambodia, Vietnam, Laos, India, Australia, Kenya and South Africa. In the United States longan is grown in Hawaii, California and south Florida. The longan was introduced to the United States in 1903. Commercial acreage in southern Florida was planted in the 1990's and continues to the present.

Importance: Economically the longan is an important crop in southeast Asia and is of increasing importance in Florida. However, longan has not achieved the same importance as lychee in most areas such as China and the U.S.

BOTANICAL DESCRIPTION

Tree

The longan is a symmetrical, evergreen tree with dense dark green foliage. Depending upon climate and soil type the tree may grow over 100 ft (31 m) tall. However, in south Florida, trees typically grow to 30-40 ft in height and width. The crown tends to be round or oblong and the bark is corky.

Leaves

The pinnately compound alternate leaves are dark green, shiny, leathery, up to 12 inches (30 cm) long with wavy margins and blunt pointed. There are 6 to 9 pairs of leaflets per leaf.

Flowers

Inflorescences are terminal, 4 to 18 inches (10-45 cm) long, erect and widely branched. The inflorescence is commonly called a panicle or spike. Flowers on the panicle are held on numerous cymules on the many branchlets of the panicle. The flowers are small

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and have 5 to 6 sepals and petals, and are brownish yellow or greenish yellow, with a two-lobed pistal and usually 8 stamens. Panicles may carry a few to more than 350 fruit. There are 3 flower types in longan, staminate (functionally male), pistillate (functionally female) and hermaphroditic (bisexual). Flowering in each panicle occurs in progressive openings of staminate (male) flowers first, then hermaphroditic flowers functioning as female and then hermaphroditic flowers functioning as male.

Fruit

The drupaceous fruit are spherical to ovoid, $\frac{3}{4}$ to $1 \frac{7}{16}$ inches (22-36 mm) in diameter and 0.21 to 0.67 oz (6-19 g) in weight. The peel is tan or light brown, thin, leathery and smoother than that of the lychee. The pulp is whitish and translucent; thin in large seeded fruits and medium thick to thick in others. Fruit have 1 seed; globular and shiny, brown to dark brown. The pulp does not adhere to the seed and is flavorful and sweet; 12-21 percent soluble solids. Flowering to harvest is 140 to 190 days.

Season of Bearing

The main bloom season for longans in south Florida is from February/March through April and the beginning of May. However, some cultivars will produce off-season blooms after the crop is harvested in late August and September. The off-season crop matures in the fall.

Climate

Longan is a subtropical tree well adapted to tropical climates with distinctive wet/dry periods and subtropical areas with a cool, nonfreezing fall/winter period. Longans are indigenous to lowland and middle elevations in southeast Asia and grow at elevations from 6 feet to 1500 feet (1.8-460 m).

Longans produce more reliably in areas characterized by low non-freezing temperatures (59 °F; 15 °C or less) and dry period during the fall and winter (October-February). Warm temperatures (70-85 °F; 21-29 °C) during spring, followed by high summer temperatures (80-95 °F; 27-35 °C) and nonlimiting soil moisture are best for fruit development

Warm and rainy winters are conducive to vegetative growth. Excessive rains during flowering cause flower drop and may reduce pollination and fruit set. Young longan leaves are sensitive to strong winds during vegetative flushing which may result in leaf dehydration, browning and deformation.

Soils

Longan trees thrive on various soil types provided they are well drained. They do well on alluvial soils, sandy loams, sand and calcareous, rocky soils of south Florida. Young longan trees are not flood tolerant and may die quickly after several days of excessively high soil moisture or flooding. Mature trees appear more tolerant of excessive soil moisture.

ENVIRONMENTAL STRESS TOLERANCE

Drought Stress

Longan is tolerant of dry soil conditions. Withholding or reducing irrigation during the late summer/early fall through winter is recommended to stop or reduce excessive vegetative growth and enhance subsequent flowering during the spring. However, for optimum fruit production and quality, regular irrigation is recommended from flowering through harvest.

Flood Stress

Longan is not tolerant of excessively wet or flooded soil conditions. When ambient temperatures are high, young trees may decline and die with as little as 5 to 10 days of flooding or constantly wet soil conditions.

Cold Stress

Longan has been observed to be less cold tolerant than lychee. Young trees are very susceptible to freezing temperatures with severe damage at 29 to 31°F (-1 to -0.5°C) and may be killed at 26 to 28°F (-2 to -3°C). Older trees are more cold tolerant but branches are injured at 25 to 26°F (-3 to -4°C) with very severe damage or death below 24°F (-4°C).

Wind Stress

Longans have been observed to be tolerant of windy conditions and young trees can generally be established on windy sites. Mature trees under a tree size control program and limited to 16 to 20 ft (4.9-6.1 m) in height have been observed to survive hurricane force winds relatively well. The most common damage from hurricane winds is toppling over of the trees and loss of most limbs. Windy, dry, cool weather during flowering desiccates flowers and reduces fruit set.

Salt Stress

Longan is not tolerant of saline soil and water conditions. Symptoms of salt stress include marginal and tip necrosis of leaves, leaf browning and drop, stem dieback, and tree death.

Fruit Thinning, Maturity and Ripeness

Longan fruit set varies greatly among trees and years. In some years, individual longan panicles set in excess of 300 fruit. However, panicles with 150 or more fruit usually result in small, non-marketable fruit. Removing about 50 percent of the set fruit during the spring usually results in a large increase in fruit size. Fruit thinning is best done when fruit are ¼ to ½ inches (6-12 mm) in diameter and consists of removing one half to two-thirds of the distal end of each panicle. In Florida, longans ripen from late July to September. As fruit mature, there is a change in fruit color from greenish-tan to tan. However, the main maturity indicators are pulp sweetness, flavor, and fruit size.

Cultivars

There are numerous cultivars of longan; however, world-wide only 30 to 40 are grown commercially. Reliable bearing is the major production problem for longan throughout the world. In Florida, 99 percent of the acreage is planted with 'Kohala'. Other cultivars have been introduced, some for a long time and others recently. A number of new and re-introductions including 'Edau' (Daw), 'Chompoo', 'Haew', and 'Biew Kiew' are under evaluation by several institutions and producers. However, nothing superior to 'Kohala' has been identified.

One of the recently introduced cultivars is named 'Diamond River'. This cultivar is from Thailand and is reported to fruit every year, be precocious and produce a sizeable late season crop. However, it is too early to make definite recommendations.

Fruit Production

Seedling trees may take up to 6 years to bear fruit whereas air layered trees may bear fruit 2 to 3 years after planting. In general, longan trees do bear fruit each year and yields from individual mature trees may range from 50 to over 500 lbs (23-227 kg).

Spacing

Longans grow fairly fast and at maturity, are large trees. For this reason, wide between the row spacings are recommended (e.g., 22-25 feet; 6.7-7.6 m). In-row spacing may be closer 18 to 25 ft (5.5-7.6 m). A plant spacing of 25 x 25, 22 x 25 and 20 x 25 ft (7.6 x 7.6, 6.7 x 7.6, and 6.1 m x 7.6 m) spacing results in 69, 79, and 87 trees per acre, respectively. The closer spacings will have larger per acre yields in the early life of the grove. The best row orientation is north to south but some grove configurations make an east to west orientation more efficient. Homeowners should plant longan trees 22 to 25 ft (6.7-7.6 m) or more away from other trees and structures.

Propagation

Longan may be grown from seed; however cultivars do not come true from seed. Seedlings may be used for selection of superior types or rootstocks. Air layering (marcottage) is the most common propagation method used in Florida. April through August is the best time for air layering and roots form within 10 to 12 weeks. Grafting onto seedling rootstock may be done by side veneer or cleft grafting. Seedlings are usually grafted when pencil size (3/8th inch; 8 mm) or larger stem diameter. Trees may be top worked by grafting onto selected vigorous shoots. Trees may also be propagated by cuttings with mist and bottom heat.

PLANTING AND CARE

Planting may be done at anytime in south Florida if there is an adequate irrigation system to provide water for the newly planted trees and for frost and freeze protection. Otherwise, the best time to plant is in late spring or early summer during the rainy season.

Trees for planting are usually in 3-gallon (11 liter) containers. Trees should be planted in a hole twice as large as the diameter of the pot. A shovel-full or two of a well-

SECTION 2
TROPICAL FRUIT PRODUCTION IN
MIAMI-DADE (LONGAN)

decomposed compost (organic matter) may be mixed with the native soil; do not add heavy topsoil, mulch or fertilizer to the hole. The tree should be carefully removed from the pot without damaging the root system and planted at the same level it was in the pot; back fill the hole with the soil. The tree should be immediately watered and the soil around the tree lightly tamped. Newly planted trees should be watered 2 to 3 times per week for a month or two if it does not rain. After the tree is established watering may be reduced to twice per week. Commercially, the use of tensiometers to monitor soil moisture is recommended. See the irrigation section.

Fertilizer

A month after planting spread 1/4 lb (113 g) per tree of a young tree fertilizer, such as 6-6-6 (% nitrogen-% phosphate-% potassium) with minor elements with 20 to 30 percent of the nitrogen from organic sources. Repeat this every 6 to 8 weeks for the first year. Then, gradually increase the amount of fertilizer to 0.5, 0.75, 1.0 lb. etc., (227 g, 341 g, 454 g, etc.) as the trees grow. Six to 8 dry fertilizer applications per year may be made up to the third year. A foliar fertilizer mix composed of minor nutrients (manganese, zinc, boron, and molybdenum) and magnesium may be applied 4 to 6 times per tree per year any time from April to September. For trees in acid to neutral soils apply iron sulfate at 0.25 to 1 oz per tree to the soil 2 to 4 times per year. In alkaline soils with a high pH, drench the soil with iron chelate 2 to 3 times per year from June through September. To make a soil drench, mix 0.5 to 0.75 oz (14-21 g) of iron chelate with 4 to 5 gallons (14-19 liters) of water and pour on to the soil adjacent to the tree trunk.

For mature trees, 50 to 150 lbs of nitrogen per acre per year split into 2 to 3 applications is recommended. The fertilizer should be applied just prior or at bloom, perhaps during late spring, and again just before or at harvest. The fertilizer mix should also include phosphate (P₂O₅) and potash (K₂O); use a 6-6-6, 8-3-9 or similar material. In addition, 2 to 4 oz (57-114 g) of chelated iron per tree per year in a soil drench should be applied for trees growing in alkaline soils from June to September. Four or more foliar nutritional sprays per year should be made from April to September. Table 2 summarizes the fertilizer recommendations for longans.

Young Tree Training

Young longan trees are usually not trained in south Florida. However, young longan trees typically produce 2 to 5 long branches; making a scraggly tree structure with few terminals. However, several techniques will improve tree structure and bearing surface area. At planting or soon afterward, remove limbs with a narrow crotch angle. To force new shoot growth and increase the number of new shoots either bend long upright limbs to a horizontal position by tying or head back upright limbs. Shoot tip removal (removing 1-2 inches of the end of new shoots), once or twice during spring and summer will increase branching and make the tree more compact.

Weed Control

Weeds compete for water and nutrients and will slow tree establishment. Prior to planting trees, remove an 18 to 36 inch (45-91 cm) dia. ring of sod. Grass and weeds should

be kept away from the tree trunk. Placing a 2 to 4 inch (5-10 cm) thick layer of mulch will suppress weed and grass growth and hold soil moisture. Hitting the tree trunk with the lawn mower may damage the tree trunk and use of weed-eater near the tree trunk will damage the bark and weaken or kill the tree.

Irrigation

The water requirements of longan have not been determined for south Florida. Young trees have a limited root system and should be irrigated within the root zone 2 to 3 times per week during dry periods. For mature trees, irrigation should cease or be limited from Sept.-Oct. until trees bloom in the spring. However, from bloom through fruit development trees should be well watered and drought stress avoided. An irrigation system or a means of watering young trees, should be available for newly planted and young trees. Tensiometers are instruments that measure soil moisture tension and are valuable for monitoring soil moisture levels and scheduling irrigation. Properly installed, placed, and maintained tensiometers may save water, fuel, and fertilizer and are recommended.

Tree Size Control, and Pruning Mature Trees

Tree size control is done to facilitate equipment traffic, spraying, picking and to maintain high light levels from the bottom to the top of the tree. It also greatly reduces the potential damage sustained due to hurricanes and strong winds. As trees mature, most of the pruning is done to control tree size (height and width), and to maintain production of the lower tree canopy and light on all sides of the canopy. Typically a 6 to 8 foot-wide (1.8-2.4 m) space is left between the canopies of adjacent tree rows.

Commercially, longan trees are pruned mechanically with large machines. When cutting the sides of trees (hedging) an angle of 10 to 150 from the vertical should be used so trees will have a pyramid-like shape. This facilitates light penetration into the lower part of the tree canopy. In general, the best tree height is about 2 to 2 ½ times that of the between-row middle space, i.e. if the middle is 6 feet (1.8 m), tree height should be about 12 to 15 feet (3.7-4.6 m); if it is 8 feet (2.4 m), then the height should be about 16 to 20 feet (4.9-6.1 m). We recommend that trees not be higher than 15 to 16 feet (4.6-4.9 m).

Pruning may be done by hand, pneumatic, hydraulic or electrical cutting tools. If the top of the tree becomes too dense, selective removal of some branches will increase air circulation and light penetration.

There are many plans for pruning. These range from mechanically topping and hedging trees every year to topping all rows every year but hedge alternate rows every second or third year. It is important to have a plan that maintains good light penetration and enables the traffic of farm equipment while maintaining good production. Another pruning objective is the removal of dead, damaged or diseased branches.

Longan trees in the home landscape may be pruned by hand by selectively thinning out a few moderate and small sized limbs each year. Trees kept 8 to 15 ft high (2.4-4.6 m) and 15 to 30 ft (4.6-9.1 m) wide are easier to care for and pick. They are also less likely to topple during strong winds.

SECTION 2
TROPICAL FRUIT PRODUCTION IN
MIAMI-DADE (LONGAN)

Harvesting

The longan harvest season in south Florida is from the middle of July to early September but is mainly in August. At maturity, the fruit will be an intense tan color. The main ripeness indicator is pulp sweetness, which should be at its optimum before removing the fruit from the tree. Fruit that is 1¼ inches (32 mm) or greater in diameter with good flavor is most desirable. Once removed from the tree, the fruit will not increase in sweetness.

Fruit is harvested by hand; with pruning shears or a pole with a cutter that holds the entire cluster. Harvesting aids include ladders, platforms and hydraulic lifters. Usually, a portion of the branch behind the fruit-bearing panicle (about 1 ft; 30 cm) is cut, thus harvesting the fruit and pruning the tree simultaneously. Sometimes fruits are separated into small clusters (fruit plus some panicle). Harvested fruit should be placed in the shade immediately after harvest and then moved to the packing facility and cooled as soon as possible. Typically, the market requires longan fruit left on the panicle or in small clusters although this may accelerate fruit dehydration.

Postharvest

Longan fruit have a relatively short shelf life when stored at ambient temperatures of 75-85°F (24-29°C). Ideally, fruit should be hydrocooled or forced air cooled (at 95 percent RH) and then stored at 41-50°F (5-10°C) and 90-95 percent RH. Fruit harvested at home may be placed in plastic bags and kept in the refrigerator for 5 to 7 days.

Diseases

There are no major disease problems of longan at the present time. Red alga (*Cephaleuros virescens*) attacks limbs and shoots and is most prevalent during high humidity, warm, rainy weather. Symptoms include dark gray to reddish-rust colored patches or spots on bark and/or leaves. In severe infections, leaf drop and stem die back occur. Parasitic lichen (*Strigula* sp.) may attack leaves. Symptoms include white star-shaped spots on leaf surfaces. This lichen colonizes leaves reducing their ability to nurture the tree. Please contact your local County Cooperative Extension Service for current control recommendations.

Insect Pests

Longans have a few insect problems in south Florida. The most common pests are the lychee webworm and several scale insects. The lychee webworm (*Crocidesima* new species) attacks emerging shoots and panicles, flowers and young fruit and if left uncontrolled drastically reduces fruit set and crop yields. Scales include the banana shaped (*Coccus acutissimus*) and barnacle (*Ceroplastes* spp.) scales, which attack mostly the underside of leaves and the philephedra scale (*Phillephedra tuberculosa*) that attacks leaves and fruit. Adult citrus blue-green weevil (*Pachnaeus litus*), little leaf notcher (*Artipus floridanus*) and diaprepes weevil (*Diaprepes abbreviatus*) have been observed to feed on leaves and their larvae feed on roots. They are mostly a problem in marl and sandy soils. Please contact your local County Cooperative Extension Service for current control recommendations.

Other pests

Birds such as boat-tailed crackles (*Cássidix mexicánus*) and monk parakeets (*Myiopsitta monachus*) are becoming important pests of longans in some locations. Scare devices and gun blasts have limited success. Netting works but is expensive and very labor intensive.

Uses

Longan trees make excellent specimen or shade trees and enhance the landscape with their dark-green foliage. Longans produced in south Florida are consumed fresh or are frozen for later consumption. Fruit may be frozen whole in polyethylene bags or air-tight containers. In other producing countries fruit are dried and canned. This helps to popularize the fruit by extending the normally very short season.

Table 1. Nutrient Value of Longan Fruit [100 g (3.5 oz) or about 6-8 fresh fruit)].

Constituent	Proximate Value	Constituent	Proximate Value
Water content	83%	Calcium	1.0 mg
Calories	60 kcal	Iron	0.13 mg
Protein	1.3 g	Magnesium	10.0 mg
Fat	0.1 g	Phosphorus	21.0 mg
Cholesterol	0 mg	Potassium	266.0 mg
Carbohydrate	15.1 g	Sodium	0 mg
Total dietary fiber	1.1 g	Vitamin C	84.0 mg

Table 2. Longan Cultivar Evaluation.^a

Country of origin	Cultivar	Fruit size	Seed size	Fruit quality	Bearing habit	Season
USA-Hawaii	Kohala	M-L	S-M	G-VG	Erratic	mid-July - August
USA-Florida	No. 1	M-L	M-L	VG	Erratic	August - September
	No. 11	M	M	G	Erratic	August - September
	No. 12	M-L	M-L	G	Erratic	August - September
	Dagelman				Erratic	August-September
	Kay Sweeney	M-L	S	G-VG	Erratic	August-September
Thailand ^b	Ponyai	M	S-M	G	Erratic	
	Biew Kiew (Beow Keow)	M-L	S-M	G-VG	Erratic	
	Chompoo 1	M-L	S-M	G-VG	Erratic	
	Haew	L	S-M	G-VG	Erratic	
	Edau (Daw)	L	L	G	Regular?	
	Diamond River	M-L	S-M	G	Regular?	mid-July- October

^a L, large; M, medium; S, small; P, poor; F, fair; G, good; VG, very good.

^b Taken from evaluations in Australia.

The Sapodilla (*Manilkara zapota*) (Jacq) Gilly in Florida¹

C.F. Balerdi and J.H. Crane

Common names: English - naseberry, chikoo, chiku, dilly. Spanish - chicle, chicozapote, níspero, zapote, zapotillo.

Scientific name synonyms: *Manilara achras*, *Achras sapota*, *A. zapota*, *Sapota achras*

Family: *Sapotaceae*

Relatives on same family: mamey sapote, canistel, caimito, lucumo, green sapote, abiu, satin leaf.

Origin: Mexico (Yucatan Peninsula) and Central America

Distribution: The U.S., Caribbean, South America, Asia, India, Sri Lanka, The Philippines, Australia, New Zealand, and South Africa.

Importance: Sapodillas are extensively planted and consumed locally in Mexico, Central America, the Caribbean, India and some Asiatic countries.

BOTANICAL DESCRIPTION

Tree

Medium to large especially after 15 or more years of establishment. The long-lived trees grow slowly but after many years, can reach 60 to 100 ft. in height. It is well adapted to subtropical and tropical climates. The tree has ornamental value and may be used for landscaping. Branches are horizontal or drooping. A milky latex exudes from all tree parts. This latex is known as chicle and was used to make chewing gum.

Leaves

The foliage is evergreen. Leaves are 2 to 5 in. (5-20 cm) long, stiff, pointed and clustered at the ends of shoots.

Flowers

Flowers are off-white, bell-shaped, small, bisexual, borne at the leaf axils and measure about 3/8 -inch (9.5 mm) in diameter.

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Fruit and Seed

The fruit is a berry with a scurfy, brown, peel. Fruit may be round to oval-shaped or conical and 2 to 4 inches (5-10 cm) in diameter and weigh 2.6 oz to 2.2 lbs (75 to 1000 g). The pulp is light brown, brownish yellow to reddish brown, with a texture varying from gritty to smooth. The pulp has a sweet to very sweet (19-24°Brix), pleasant flavor. Seed number varies from 0 to 12. Seeds are dark brown to black, smooth, flattened, shiny, 3/4 inch (1.9 cm) long and have a white to cream colored surface on one side.

Season of Bearing

In Florida, trees mainly bear from May to September but fruit may mature throughout the year.

Climate

Sapodillas are adapted to tropical and warm sub-tropical climates. Trees are well adapted to south Florida and to the coastal areas of Florida as far north as Tampa and Merritt Island. Trees grow from sea level to an altitude of about 9,100 ft. (700 m) altitude.

Soils

Sapodillas are well adapted to a wide range of soils but grow best in well-drained, light soils. Trees are well adapted to the rocky, highly calcareous soils of south Florida.

ENVIRONMENTAL STRESS TOLERANCE

Drought Stress

Young sapodilla trees have been observed to defoliate or decline due to lack of water; therefore young trees should be watered every 2 to 4 days during dry periods. Mature sapodilla trees are tolerant of dry soil conditions. However, for optimum fruit production and quality, regular irrigation during dry periods is recommended from flowering through harvest.

Flood Stress

Sapodilla has been observed to be moderately tolerant of excessively wet or flooded soil conditions. However, prolonged excessively wet or flooded conditions may reduce tree growth and crop yields.

Cold Stress

Young sapodilla trees may be severely damaged or killed at 32°F (0°C) or below but mature trees may withstand down to about 26°F (-3°C).

Wind Stress

Sapodilla trees have been observed to be tolerant of windy conditions and young trees generally do not have a problem with establishment on windy sites. Mature trees under a tree size control program and limited to 16 to 20 ft. (4.9-6.1 m) in height survived hurricane force winds relatively well. The most common damage from hurricane winds was toppling over and loss of limbs.

**SECTION 2
TROPICAL FRUIT PRODUCTION
IN MIAMI-DADE (SAPODILLA)**

Salt Stress

Sapodillas grow well near the seashore, indicating a good tolerance to sea salt spray. Their tolerance to saline soils and irrigation water is not known. Typical symptoms of salt stress include marginal and tip necrosis of leaves, leaf browning and drop, stem dieback, and tree death.

Production

Seedling trees usually begin bearing in more than 6 or 7 years. Grafted trees may begin to bear in the 2nd or 4th year after planting. After 10 years, a good cultivar may bear 150 to 400 pounds (45-180 kg) of fruit per year. This yield may keep increasing, until about the twelfth to fifteenth year after planting depending on plant spacing and cultural practices.

Isolated sapodilla trees may not be productive. This is because some sapodilla cultivars are self-incompatible. Therefore the flowers of some cultivars may require cross-pollination by another sapodilla seedling or cultivar in order to produce fruit. Other cultivars may not require cross-pollination but produce more fruit when cross-pollinated.

Spacing

Although sapodillas grow slowly, trees eventually need a wide space between rows and in the row as they will develop a large canopy. Spacing between rows should be 24 to 30 ft. (7.3-9.1 m) and 15 to 30 ft. (4.6-9.1 m) in row, from tree to tree. We recommend 15 ft. x 25 ft., 20 ft. x 25ft., and 25 ft. x 25 ft. which will result in 116, 87 and 70 trees per acre, respectively. Closely spaced groves will result in higher yields in the early life of the planting (up to 10 years). When tree crowding begins, pruning and/or removal of every other tree are recommended. A rectangle pattern with a north to south row orientation is best. Sapodilla in the home landscape should be planted 25 ft. or more feet away from the nearest tree and/or structure.

Cultivars

Seed should not be used for commercial plantings as it takes a long time for trees to begin production and there is also a lot of variability among seedling trees. There have been a number of cultivars developed in India, the Philippines, Mexico and Venezuela. However, only a limited number have been evaluated and these should be used for commercial plantings. Table 2 shows a list of cultivars and some of their characteristics. Cultivars with good horticultural characteristics should have high yield, moderately large to large fruit, and possess a smooth, sweet and aromatic pulp with little or no grittiness.

Propagation

Although seeds can be used for propagation and are used for selection of superior types, they should not be used for commercial plantings. Marcottage (air layering) has not been an affective propagation method. Side veneer and cleft grafting on to seedling rootstock are the most common grafting methods. Chip budding can also be used. Scions or bud sticks are chosen from young terminal shoots. Cover the grafted scions completely with grafting tape. The best time to graft is late summer and early fall.

Top working undesirable mature sapodilla trees may be accomplished by cutting trees back to a 3 ft. stump, white washing the entire stump and then veneer-grafting several new shoots when they reach ½ inch (13 mm) in diameter or larger.

Planting and Early Care

In Florida, planting can be done at any time of the year if irrigation is available. If irrigation is not available, wait to plant trees until the beginning of the rainy season. Make a hole wider than the diameter of the pot, sometimes twice the diameter of the pot is used. You may add a handful of well-decomposed manure or sludge and mix it with the soil. Do not add fertilizer to the hole. Carefully remove the tree from the pot and place it in the hole at the same height it was in the pot and fill up the hole with the same soil that came out of the hole. Do not use mulch or black rich soil in the hole. After planting, build a berm about 2 ft. (0.6 m) away from the trunk and water the tree well. The berm will hold water in the root area. Water every day for the first month if it does not rain to keep the soil moist but not wet, then, water 2 to 3 times per week. Water every 10 to 14 days thereafter during dry periods. The installation of tensiometers to monitor soil moisture is recommended.

Weed Control

Weeds and lawn grass should be removed within a 2 to 4 ft. (0.6-1.2 m) radius around the trunk and under the canopy. Weeds compete for water and nutrients. Weeds may be controlled by herbicide applications of registered materials and/or by mulching. A 2 to 4 in. (5-10 cm) thick layer of mulch or a sheet of ground cover may be used to reduce soil drying and weeds. Keep mulch 8 to 12 inches (20-30 cm) from the trunk.

Fertilizer

After planting, when new growth begins, apply ¼ lb. (113 g) of a young tree fertilizer such as a 6-6-6 (% nitrogen-% phosphate-% potash) with minor elements with 20 to 30 percent of the nitrogen from organic sources. Repeat this every 6 to 8 weeks for the first year then gradually increase the amount of fertilizer to 0.5, 0.75, 1.0 lb. (227 g, 341 g, 454 g) as the tree grows. Use 4 to 6 minor element (nutritional) foliar sprays per year from April to September. Apply iron chelate once or twice per year as a soil drench if trees are planted in high pH, alkaline soils. Mix ½ to ¾ oz of iron chelate in 4 to 5 gallons of water and apply to the base of the tree. Table 2 summarizes the fertilizer recommendations for sapodillas.

Irrigation

Sapodillas are drought tolerant, however, because of the limited root system, newly planted and young trees will benefit from irrigation. The water requirements for mature trees have not been determined. As with other tree crops, the period of the main bloom and fruit development is important and drought stress should be avoided at this time by watering once or twice per week. Once the rainy season arrives, irrigation frequency may be reduced.

An irrigation system or a means of watering young trees, should be available for newly planted and young trees. In commercial plantings, tensiometers are instruments that measure soil moisture tension and are valuable for monitoring soil moisture levels and scheduling irrigation. Properly installed, placed, and maintained tensiometers may save water, fuel, and fertilizer and are recommended.

TREE TRAINING AND PRUNING TREES

Young Trees

The development of a strong limb framework is important to allow sapodilla trees to carry large crops of fruit without limb breakage. If the tree is leggy and lacks lower branches, remove part of the top to induce lateral bud break on the lower trunk. In addition, shoot tip removal (1 to 2 inches) once or twice between spring and summer will force more branching and make the tree more compact. Remove any limbs that have a narrow crotch angle as these may break under heavy fruit loads.

Mature Trees

As trees mature, most of the pruning is done to control tree height and width and to remove damaged or dead wood. A 6 to 8 ft. (1.8-2.4 m) wide space between rows will facilitate equipment traffic. When cutting the sides of trees (hedging) an angle of 10 to 150 from the vertical should be used so trees will have a pyramid shape. This facilitates light penetration to the lower part of the trees. The rule of thumb about the proper tree height is that tree height should be about twice that of the between-row middle space, i.e., if the middle is 6 ft., tree height should be about 12 ft.; if it is 7 ft. then the height should be about 14 ft. Trees should be kept at a maximum of about 15 to 16 ft. high. If the canopy becomes too dense, removing some inner branches will help in air circulation and light penetration. There are many plans for pruning. You may top and hedge every year or may top all rows every year but hedge alternate rows every year. Another pruning objective is the removal of dead, damaged or diseased branches. Low branches should not be cut however, they should not touch the soil. Cultural practices e.g., picking, spraying, and pruning are easier on small trees.

Fruit Maturity and Ripeness

For the beginner, fruit maturity is difficult to judge. Immature fruit may not soften for many days, not develop optimum sweetness and flavor, and contain pockets of coagulated latex within the flesh. Fruit picked over mature may soften (ripen) with 2 to 3 days and be difficult to pack, ship, and market. Fruit picked at optimum maturity usually ripen in 4 to 10 days. If the time of fruit maturity is unknown, you may wait until some fruits drop and then begin to harvest those of similar size. Other indicators of maturity are fruit size, loss of peel scurfiness, a change in skin color from brown to amber and sometimes the skin is smooth. Another test is to lightly scratch the skin, if it is amber it can be picked, but if it is green or oozes latex, the fruit is not fully mature.

Harvesting

Sapodilla trees may have harvestable fruit year round, though there is a main season for each cultivar (Table 2). Fruit can be harvested by hand, using a pole with a basket, or using machines or platforms that place the picker close to the fruit. Removing the fruit with a hook is not advisable as many fruits hit the ground before they can be caught in the air. Keeping tree height at 14 to 16 ft. (4.3-4.9 m) facilitates harvesting and other operations. Fruit should be handled carefully from harvesting through packing and shipping.

Ripening and Storage

Sapodilla fruit take about 4 to 10 days from picking to ripening (soften). As the season for each cultivar advances, the ripening time decreases. Store fruit at 50 to 55°F (10-13°C) and 85-90 percent relative humidity.

Diseases

There are no major diseases of sapodillas in Florida. A leaf rust (*Uredo sapotae*) causes minor leaf damage. Other diseases of minor importance include dry rot (*Fusarium solani*), septoria leaf spot (*Septoria sp.*), fruit rot (*Phytophthora palmivora*), phyllosticta leaf spot (*Phyllosticta sapoticola*), pestalotia leaf spot (*Pestalotia scirrofaciens*), anthracnose (*Colletotrichum gloeosporioides*), scab (*Elsinoe lepagei*), and Phomopsis leaf spot (*Phomopsis sp.*). Please contact your local County Cooperative Extension Service for current control recommendations.

Insects

Sapodilla has relatively few insect pests. Occasionally, a moth (*Barnisia myrsusalis*) causes extensive damage to blooms in some years in Florida. The fruit of some cultivars is susceptible to the Caribbean fruit fly (*Anastrepha suspensa*). Periodically, other pests attack sapodilla, including the Cuban May beetle (*Phyllophaga bruneri*), mining scale (*Howardia biclavis*), green shield scale (*Pulvinaria psidii*), pustule scale (*Asterolecanium pustulans*), leaf miner (*Eucosmophora sp.*), and Conotrachelus sp. beetle. Please contact your local County Cooperative Extension Service for current control recommendations.

Uses

Sapodillas are mostly eaten as fresh fruit. Sherbets, milk shakes and ice cream can be made from fresh pulp.

Table 1. Nutrient Value of Sapodilla Fruit [100 g (3.5 oz)].

Constituent	Approximate value	Constituent	Approximate value
Water content	78%	Calcium	210 mg
Calories	83 kcal	Iron	0.8 mg
Protein	0.4 g	Magnesium	12.0 mg
Fat	1.1 g	Phosphorus	12.0 mg
Cholesterol	0 mg	Potassium	193.0 mg
Carbohydrate	20.0 g	Sodium	12.0 mg
Total dietary fiber	5.3 g	Vitamin C	14.7 mg

**SECTION 2
TROPICAL FRUIT PRODUCTION
IN MIAMI-DADE (SAPODILLA)**

Table 2. Sapodilla Cultivars in Florida.

Name	Country of origin	Fruit shape and skin color	Fruit size ^a	Pulp color and texture	Quality	CFR rating ^b	Yield	Season
Alano	Thailand	conical to round, skin light brown, smooth	S to M, 115-250 g (4-9 oz)	smooth to slightly granular	very good to excellent	unknown	good	Nov.-June
Betawi	Mexico	conical	ML, 140-315 g (5-11 oz)	light amber - yellow, slightly granular	very good, juicy	unknown	good	late Dec.
Brown Sugar	United States	round to ovate, skin light brown, moderately scurfy	S to M, 133-170 g (4.6-6.0 oz)	brown, slightly granular	very good	medium	good to very good, regular bearing	May-Sept.
Gonzalez	Philippines	round to oval, skin very light brown, slightly scurfy	M, 90-260 g (3.1-9.2 oz)	light brown to brown, smooth	very good to excellent	unknown	very good	Nov.-April
Hasyá	Mexico	oval to slightly conical, skin light brown, moderately scurfy	ML, 150-365 g (5-13 oz)	brownish red	excellent	unknown	good	Nov.-June
Makok (dwarf) tree	Thailand	conical, skin light brown, slightly scurfy	S, 30-140 g (1-5 oz)	light brown to slightly greenish-red, smooth	very good	unknown	very good	May-Nov.
Modello	United States	Elliptic to ovate, skin light brown, moderately scurfy	M to ML, 227-340 g (8-12 oz)	whitish to tan, smooth	good	low	fair, irregular	Feb.-May

Continued.

**SECTION 2
TROPICAL FRUIT PRODUCTION
IN MIAMI-DADE (SAPODILLA)**

Table 2. Sapodilla Cultivars in Florida..

Name	Country of origin	Fruit shape and skin color	Fruit size ^a	Pulp color and texture	Quality	CFF rating ^b	Yield	Season
Molix	Mexico	oval	M to M-L, 150-360 g (5-13 oz)	brownish red, smooth	very good to excellent	unknown	very good	Feb.-April
Morena	Mexico	oval	M to ML, 170-345 g (6-12 oz)	brownish red, smooth	very good to excellent	unknown	good to very good	Feb.-April
Oxkutzcab (Ox)	Mexico	roundish	L to very L, up to 800 g (1 lb, 12 oz)	reddish brown	very good	unknown	very good	May-Sept.
Prolific		round to conical, ovate, skin light brown, slightly scurfy		light tan to reddish tan and smooth	very good	high	very good, regular	May-Sept
Russell	United States	round to conical to ovate, skin brown with grayish-brown patches, scurfy	M, 170-225 g (6.0-7.9 oz)					
Tikal	United States	ellipsoid to conical, skin light brown, slightly scurfy	L, 284--454 g (10-16 oz) S to ML, 80-325 g (3-11 oz)	pinkish tan, granular	good, mildly fragrant	high	erratic, poor, 25-100 kg (55-220 lbs per tree)	May-Sept.
	United States			light brown, smooth	very good, fragrant	low	very good, regular	Main, Dec. - March, minor, May-Sept

^a S=small; M=medium; ML=medium-large; L=large.

^b CFF, Caribbean fruit fly rating.

**SECTION 2
TROPICAL FRUIT PRODUCTION
IN MIAMI-DADE (SAPODILLA)**

Table 3. Suggested Fertilizer Recommendations for Sapodillas in Florida.

Year	Times per year	Amount/tree/ application (lbs) ^a	Total amount/tree/ year (lbs)	Minor element sprays (times /year) ^b	Iron chelate drenches (oz/tree/year) ^c
1	6	0.25-0.5	1.5-3.0	6	0.5-0.75
2	6	0.5-1.0	3.0-6.0	6	0.75-1.0
3	6	1.0-1.5	6.0-9.0	6	1.0-1.5
4	4	1.5-2.5	9.0-10.0	6	1.5-2
5	4	2.5-3.5	10.0-14.0	4-6	2-4
6	4	3.5-4.0	14.0-16.0	4-6	2-4
7	4	4.0-4.5	16.0-18.0	4-6	2-4
8	4	4.5-5	18.0-20.0	4-6	2-4

^a Use 6-6-6, 8-3-9, young tree, or slow release fertilizer.

^b Spray should contain zinc, manganese, boron, molybdenum and may also contain iron. Foliar sprays are most efficient from April to September.

^c Iron chelate drenches will avoid iron deficiency, not the sprays. Apply from June to September.

