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Florida Crop/Pest Management Profile: Mamey Sapote and Sapodilla[1]

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Production Facts

- Mamey sapote (*Pouteria sapota*) and sapodilla (*Manilkara zapota*) are both tropical plants in the Sapotaceae (1).
- Acreage of mamey sapote has held fairly constant, with approximately 300 acres in production during the decade of the nineties (2,3).
- There are over a dozen cultivars of both mamey sapote and sapodilla, with various fruit sizes, flavors, colors, and maturity dates (4,5).
- The 1995-1996 average yield of mamey sapote in Florida was 4,870 pounds per acre. At a price of $2.40 per pound, the Florida crop was worth approximately $3.6 million (2).
- In 2000, there were approximately 20 acres of sapodilla in production (3).

Production Regions

Mamey sapote and sapodilla are grown exclusively in southern Florida. In 2000, 100 percent of both crops' acreage was located in Miami-Dade County (3).

Production Practices

The mamey sapote grows in an open, spreading form with a thick central trunk and few large branches. Trees grown in Florida may attain a height of about 40 feet. The tree is native to the American tropics (Mexico and Central America), and it is believed to be introduced to Florida in the mid-1880s. Leaves are large (twelve inches long and four inches wide), simple, and obovate to oblanceolate in shape. The underside is light green or brownish and

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pubescent when young but becomes smooth when mature. The leaves are clustered at the ends of the small secondary branches. Leaves fall just prior to flushing. Flowers are white, perfect, and borne along small branches, with a tendency to cluster toward the ends. Fruit may range from twelve ounces to six pounds in weight. The skin is thick and woody with a russet brown, somewhat scurfy surface. The pulp of mature berries is salmon pink, orange, red or reddish-brown, soft to finely granular in texture, and exhibits a sweet almond-like flavor. The fruit usually contains a single, large, elliptical seed but it may have up to four. The mamey sapote tree blooms throughout most of the year depending on variety. Depending on when they are set, the fruit may require from 13 to 24 months to mature (4).

Sapodilla is also a native of Mexico and Central America. The tree is long-lived and may reach heights of 60 feet or greater. Branches are horizontal or drooping. Leaves are two to five inches long and clustered at the end of shoots. They emerge light green or pink but become dark green as they mature. The small, bisexual flowers are off-white, bell-shaped, and borne at the leaf axils. The fruit is a berry with scurfy, brown peel and may weigh from 3 ounces to two pounds. The pulp is light- to reddish-brown, with a soft or gritty texture, and can be very sweet. Seed number ranges from zero to twelve. The trees bloom throughout the year, fruit requires four to ten months to mature, and the main bearing season extends from May through September (1,5).

Mamey sapote trees are relatively difficult to propagate vegetatively. Although seed is used, it is often used to produce seedlings for rootstock. Seeds are also only viable for a few weeks after they are mature. In the countries of origin, superior plants have been grafted and propagated as named cultivars. In Florida “Pantin” and “Magaa” comprise up to 95 percent of the commercial acreage. The most satisfactory time of the year to graft the plant is during warm days, cool nights, and low humidity. This corresponds to March to May and October to November in south Florida. Veneer or cleft grafting may be used, but care must be taken during scion preparation. Properly propagated and cultured trees may start to bear within three to five years, and a mature tree will produce from 200 to 500 fruit per year (4).

As with mamey sapote, marcottage is not an efficient propagation tool for sapodilla, whereas veneer and cleft grafting are used most successfully. Grafted trees may start to bear within two to four years while seedlings may take up to six or seven years to begin production. After ten years, a good cultivar may bear 150 to 400 pounds of fruit per year. Isolated sapodilla trees may not be productive because some cultivars are self-incompatible. Other cultivars may not require cross-pollination but produce more fruit when this occurs (5).

Both mamey sapote and sapodilla have high water requirements, although sapodilla is somewhat drought tolerant. Planting should be done just prior to the rainy season for good root development. Susceptibility to cold weather restricts mamey sapote and sapodilla growing in Florida to the southern portion of the state. Small trees may be killed by temperatures of 30-32°F. Older trees can withstand short periods of temperature as low as 26°F without much damage (4,5).

Under Florida conditions, mamey sapote plantings are spaced 25 to 30 feet between rows and 15 to 20 feet between trees (75 to 145 trees per acre). This spacing is also used for sapodilla. For young trees of both species, main trunk growth should be encouraged by removing all other leaders when the tree is in the nursery or newly planted. Mamey sapote has the tendency to form multiple branches close to one another on the trunk. It is advisable to prune these areas down to one branch. Shoot tip removal (one or two inches) between spring and summer will force more branching and make the trees more compact. It is also recommended that narrow V-shaped crotch angles be pruned out, as wide-angled branches support greater weight and are less likely to suffer wind damage. Since different cultivars of mamey sapote and sapodilla have different peak bearing dates, and all stages may be found on the same tree, harvest may occur largely year-round, except in March (4,5).

Insect/Mite Management

Insect/Mite Pests

Very few insects cause significant damage to mamey sapote or sapodilla. Larvae of the Cuban May beetle, *Diaprepes* root weevil, and a moth that attacks blooms in some years are the most serious economic pests of the plants. Some varieties of sapodilla are susceptible to Caribbean fruit fly infestation. There are a number of scale insects (mining, green shield, pustule, white peach, *Philephedra*, green, tessellated, wax) that attack both plants, but damage done is seldom sufficient to require control. Other minor pests include leafminer, beetle, and red spider mite (4,5).

Cuban May Beetle (*Phyllophaga bruneri*). True white grubs are the larvae of May beetles. These larvae vary in length from 20 to 45 mm and have a C-shaped body, brown head, and three pairs of legs. The hind portion of the abdomen is slightly enlarged and appears darker due to the soil particles showing through the body wall. Two parallel rows of spines seen on the underside of the last abdominal segment distinguish true white grubs from other similar-looking insects. The pupa is colored white, faint yellow, or dark brown. Life cycles for grubs can last from one to four years. Females deposit one to two dozen eggs in the soil and the larvae feed on plant roots and decaying vegetation until pupation occurs. After hatching, adults overwinter and emerge in the late spring/early summer. Damage often occurs in three-year cycles (6).

Root Weevil (*Diaprepes abbreviatus*). The larva of this weevil are capable of direct root damage which provides entry routes for fungal infection in the root tissue. Mature weevils cause only minimal damage from leaf feeding, which is apparent as "notches" on the leaf margins (7). This pest has a large host range, which includes many woody plants. The larva move readily in sandy soils, and have been found at depths of eight to ten feet.

Most mature female root weevils place their eggs in clusters between two leaves on newly flushed foliage. After ten or twenty days, eggs hatch and larvae fall to the ground. The larvae begin feeding on the fibrous feeder roots. Successively larger larval instars feed on larger roots. The final larval stages (of at least eleven) proceed to the tap root and major lateral roots of the tree. Even if direct feeding does not girdle these roots, lesions provide entry to debilitating fungi such as *Phytophthora*. Adult weevils emerge over a three month period which may begin as early as March. Larval development time ranges from nine to 18 months, which includes an inactive pupal stage of one to three months. Dry weather delays development and emergence (7).

Bloom Moth (*Barnisia myrsusalis*). There is scant information regarding this moth. It has occasionally caused extensive damage to blooms of both mamey sapote and sapodilla while in the larval form (4,5).

Caribbean Fruit Fly (*Anastrepha suspensa*). This fly is also referred to as the guava fruit fly or Greater Antilliean fruit fly. The fly is indigenous to the West Indies and aggressively attacks guava and Surinam cherry in its range and may infest certain cultivars of sapodilla. In Florida, this fly was absent from the late 1930s until 1965, when a large outbreak occurred near Miami. Since that time, the fly has continued to spread and it now occurs in most of southern Florida, commonly north to Citrus and Volusia counties. The fly is about the size of a housefly, and yellow-brown in color. The wings are yellow to yellow-brown as well and have a pattern of black markings.

Since 1990, a joint federal/state program has been implemented that rears an endoparasitic braconid wasp, *Diachasmimorpha longicaudata*. This wasp deposits eggs in the pupa of the fruit fly, which feed on the fly as they develop. Trapping results reflect a 40 percent reduction in fruit fly numbers with this plan in operation. Additionally, millions of sterile flies are produced and released yearly in a sterile insect technique program (8).

Chemical Control

In 1999-2000, 38 percent of responding surveyed mamey sapote growers reported insecticide use. This value was 57 percent for sapodilla growers. Those

survey respondents that provided an insect damage estimate indicated that from 10 to 30 percent of the mamey sapote crop would be lost to insect damage (n=2, mean of 20 percent). For sapodilla, this figure was estimated to range from 0 to 20 percent (n=3, mean of 8 percent).

Insecticides and miticides registered for use on Florida mamey sapote and sapodilla include azadirachtin, *Beauveria bassiana* (Mycotrol®), *Bacillus thuringiensis*, fenoxycarb (Logic® - for ants on non-bearing mamey sapote trees only), spinosad (SpinTor®), pyrethrin + rotenone (Pyrellin®), kaolin (Surround®), crop oil, and insecticidal soap.

Crop Oils. Crop oils work by smothering poorly mobile insects such as scales, aphids, and mites. The oils are usually made up as 0.5 to 1 percent solutions which are applied thoroughly to each tree. Price varies greatly based on amount, formulation, and brand used. There is a four hour restricted entry interval (REI) for crop oils (9).

In 1999-2000, 31 percent of surveyed mamey sapote growers and 43 percent of sapodilla growers in Florida applied crop oil either one (14 percent), two (57 percent), or four (29 percent) times for an average use of 2.4 times per season.

Soaps. Soaps also work by smothering poorly mobile insects such as scales, aphids, and mites. Price varies greatly based on amount and brand used. There is a twelve hour REI for soaps (10).

In 1999-2000, 15 percent of surveyed mamey sapote growers and 14 percent of sapodilla growers in Florida applied soap either two (67 percent) or four (33 percent) times for an average use of 2.7 times per season.

Fenoxycarb (Logic®). Fenoxycarb is a carbamate compound used as an insect growth regulator, which causes death in the last pupal stage. The bait product is used to manage ants (particularly the imported red fire ant). The price of fenoxycarb is $715 per pound of active ingredient and the approximate cost per application is $14.30 per acre (11). In 1999-2000, 15 percent of surveyed mamey sapote growers applied fenoxycarb either one (50 percent) or two (50 percent) times for an average use of 1.5 times per season. Sapodilla growers did not report the use of fenoxycarb.

Bacillus Thuringiensis. The biopesticide *Bacillus thuringiensis* (*B.t.*) is used to manage lepidopteran larvae. The median price of *B.t.* is $158.12 per pound of active ingredient and the approximate cost per application is $20.24 per acre (12,13). *B.t.* may be applied up to the day of harvest (PHI= 0 day), and the REI is 4 hours (13). In 1999-2000, 14 percent of sapodilla growers reported the use of a *B.t.* compound two times a year.

Alternative Control

At least one "reduced impact" insecticide has been registered for use on mamey sapote and sapodilla. Mycotrol® (*Beauveria bassiana*) is just now being assessed for insect management in these crops.

Cultural Control

Based on survey results of all tropical fruit growing respondents, 44 percent reported keeping records of pest problems, 50 percent adjusted applications (timing or rate) to protect beneficial insects and mites, and 52 percent alternated pesticides to reduce resistance. Sixty-two percent reported selecting the pesticide that is least toxic to beneficial insects and mites and 63 percent spot sprayed only infested plants or areas. Seventy percent reported selecting pesticides that are least toxic to the environment to make this the dominant form of cultural pest control.

Biological Control

Seven percent of the responding tropical fruit growers reported release of predatory wasps for control of lepidopteran pests. Additionally, 30 percent reported the use of biological-derived pesticides like *B.t.*

Weed Management

Weed Pests

Weeds can reduce yields to tree crops by competing mainly for water and nutrients. Although individual weed species may vary from region to region within the state, predominant weed species in groves are often grasses, sedges, and pigweeds (14). However, species composition is less important as the trend has been toward use of non-selective, post-emergent herbicides.

Chemical Control

In 1999-2000, 85 percent of surveyed mamey sapote growers and 57 percent of sapodilla growers reported herbicide use. There are two herbicides available to mamey sapote and sapodilla growers: glyphosate (Roundup®) and pelargonic acid (Scythe®). Both of these are post-emergence, non-selective herbicides.

Glyphosate (Roundup®). Glyphosate is a phosphorylated amino acid herbicide used for total vegetation control (15). Glyphosate is applied as a directed spray so that foliage is not injured. The median price of glyphosate is $10.95 per pound of active ingredient and the approximate cost per application is $21.90 per acre for annual weeds and $54.75 per acre for perennial weeds (12,16). The PHI for glyphosate is 24 hours and the REI is 4 hours (17).

In 1999-2000, 85 percent of surveyed mamey sapote growers in Florida applied glyphosate either three (18 percent), four (36 percent), five (18 percent), six (18 percent), or eight (10 percent) times for an average use of 4.8 times per season. Fifty-seven percent of sapodilla growers applied glyphosate either three (25 percent), four (50 percent), or six (25 percent) times for an average use of 4.3 times per season.

Disease Management

Disease Pathogens

The principal diseases affecting mamey sapote production in Florida include fungi and algae. Anthracnose (*Colletotrichum gloeosporioides*) and algal spot (*Cephaleuros virescens*) may become established in groves and require treatment (18). There are no major diseases of sapodilla in Florida (5). However, they may be minorly affected by anthracnose and leaf spot organisms.

Anthracnose (caused by *Colletotrichum gloeosporioides*). The fungus attacks flowers, leaves and fruit of mamey sapote. Infected flowers develop dark lesions on petals that enlarge and cause flower blackening and death. Young fruit which are infected will rot and mummify on the tree. When the fungus invades mature fruit, the resultant lesion is small and relatively cosmetic with a shallow area of hardened tissue. Infected leaves develop light green lesions that enlarge in irregular brown areas that scorch leaves and can cause leaf drop (18).

Algal Spot (caused by *Cephaleuros virescens*). Leaf spots on mamey sapote appear greenish-gray and are circular, slightly raised, and quite prominent. Spots turn red when the alga is reproducing. Numerous infections can cause some leaf drop. The alga is also capable of causing scaling and cracking of limbs (18).

Chemical Control

In 1999-2000, 38 percent of surveyed mamey sapote growers reported fungicide use. Those survey respondents that provided damage estimates indicated that from 10 to 30 percent of the mamey sapote crop would be lost to disease (n=3, mean of 20 percent). Sapodilla growers estimated from 5 to 70 percent of the crop would be lost to disease (n=4, mean of 35 percent). The only registered fungicide for use on mamey sapote is copper.

Copper (Kocide®). Copper has long been used as a fungicide and can be applied in multiple forms. Copper is used to manage anthracnose and algal spot. The median price of copper hydroxide is $2.11 per pound of active ingredient and the approximate cost per application is $13.00 per acre (12,19). The PHI and REI for copper hydroxide are 0 day and 24 hours, respectively (19).

In 1999-2000, 38 percent of surveyed mamey sapote growers in Florida applied copper (in some form) either one (40 percent), two (40 percent), or three (20 percent) times for an average use of 1.8 times per season.

Alternative Control

Based on work by IR-4, tolerances for mamey sapote and sapodilla have been obtained for the fungicides azoxystrobin and mefenoxam as of September, 2001. These materials will assuredly be assessed for disease management in these crops.

Nematode Management

Nematode Pests

Plant-parasitic nematodes are microscopic roundworms, found in soils, which primarily attack plant roots. General signs of nematode damage include stunting, premature wilting, leaf yellowing, root malformation, and related signs characteristic of nutrient deficiencies. Stunting and poor stand development tend to occur in patches throughout the field as a result of the irregular distribution of nematodes within the soil.

Chemical Control

There are no currently registered nematicides for use on mamey sapote or sapodilla. None of the surveyed mamey sapote or sapodilla growers reported the use of nematicides.

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