

Cocoa (Chocolate Bean) Growing in the Florida Home Landscape¹

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Scientific Name: *Theobroma cacao* subsp. *cacao*
and. *T. cacao* subsp. *sphaerocarpum*

Common Names: cocoa and chocolate
(English), cacao (Spanish), cacaoyer and cacaotier
(French), kakao (German), cacau (Portuguese)

Family: Sterculiaceae

Related Species: cola nut (*Cola acuminata*)

Origin: Central and northern South America.

Distribution: Grown throughout the tropical world.

History: Cacao, or cocoa, is an ancient crop having been harvested and used by the indigenous people of Central and South America for thousands of years. Cocoa was introduced to Europe during the 16th century. In 1825-1828 technology to separate the cocoa butter from the dried beans was developed, which lead to the manufacture of solid chocolate. The invention of milk-chocolate by the Swiss in 1876 lead to the world-wide multi-billion-dollar chocolate processing industry.

There are two distinct types of cocoa, Criollo types (*cacao dulce*) that developed north of the Panama isthmus, and Forastero ('*cacao amargo*') which originated in the Amazon basin. Criollo types were cultivated by the indigenous people of Central and South America and were the type Europeans were first exposed to. Commercial production commenced in Brazil using the Forastero types, mainly a uniform type called Amelonado. Both types were distributed throughout the Caribbean, where they hybridized in Trinidad, creating a distinct hybrid called Trinitario. Spanish explorers took cocoa to the Philippines, where it spread throughout southeast Asia, India, and Ceylon. Amelonado cocoa was taken to West Africa.

Importance: Cocoa is grown in 58 countries and on more than 17 million acres (6.9 million ha) world-wide and is worth in excess of \$4 billion to the world's economy annually.

Caution, Fruit and Plant Enthusiasts: Cocoa plants are adapted to and grow best in hot, humid tropical areas with evenly distributed rainfall. Truly tropical areas are characterized by year-round

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temperatures at or above 68°F and no freezing temperatures. However, cocoa plants with their beautiful foliage and striking pods (fruit), can be grown in well protected areas, and they make unique, interesting, challenging, and fun additions to the home landscape.

Description

Tree

Cocoa are small to medium sized trees (25-30 ft; 7.6-9.1 m) with few branches under tropical environments.

Leaves

Leaves are found toward the ends of the branches. Leaves are simple with a long petiole, which has a swelling at each end called a pulvinus. The pulvinus allows the leaf to swivel to catch sunlight. Leaves are lanceolate, bright green, and up to 24 inches (61 cm) long by 4 inches (10 cm) wide. Young leaves have a pinkish-red color. They turn green as they mature. As the plant grows new leaves, older ones may drop.

Inflorescence (Flowers)

Cocoa flowers and fruits on the older branches and trunk (called cauliflorous flowering). One to 5 flowers arise from a special tissue along the leafless parts of the stem, called the cushion. Flowers may arise from this cushion repeatedly. Flowers are small, with 5 petals and sepals and 10 stamens. They are hermaphroditic (they have male and female plant parts).

Fruit

The fruit is called a pod (technically it is a drupe), and the time from flower pollination to a fully developed pod takes 5 to 7 months or more. The pod has a thick peel (pericarp) and may be 4 to 13 inches (10–33 cm) long. It may be cylindrical to round shaped with longitudinal ribs. The pod may be green or green-white, turning yellow upon ripening, or it may be red and develop some yellow color upon ripening. The pods are very attractive from an ornamental standpoint. Pods contain 20 to 60 seeds. Seeds are covered with a white, pinkish or brownish,

subacid mucilage that is sweet. Seeds may be extracted and the mucilage surrounding the seed consumed. The seeds are processed to make chocolate.

Pollination

Cocoa is pollinated by crawling and flying insects. Some cocoa types and varieties are self incompatible, requiring cross pollination with a compatible variety. The Amelonado variety is fully self-compatible.

Roots

Seedling cocoa has a tap root that may extend several feet in deep soils. In addition, secondary, shallow, fibrous roots radiate laterally from the trunk; these roots are the major roots for water and nutrient absorption.

Varieties

There are two distinct types of cocoa, Criollo types and Amazonian Forastero. Criollo types developed in Central America and have long, narrow pods and a red or green peel with longitudinal furrows. Forastero types were developed south of Panama and have ovoid pods with long, shallow, narrow furrows. These two cocoa types have been crossed in Trinidad, forming hybrids called Trinitario. Trinitario types have intermediated characteristics between the Criollo and Forastero types. Many cocoa types will not set fruit from self pollination or from specific other varieties or clones. The Amelonado variety selected from the Forastero types and is self-compatible (i.e., will set fruit from its own pollen).

Climate

Cocoa evolved as an understory shade tree in hot, humid, tropical rainforest areas dominated by cloudiness and with well distributed rainfall and a short dry period. South Florida's warm subtropical environment is very marginal for cocoa growing and plants may be damaged or killed during prolonged cool or brief freezing temperatures.

Temperature. Optimum temperatures for cocoa growth range from 65 to 90°F (18-32°C). Temperatures below 50°F (10°C) may damage or kill the plant and temperatures in excess of 90°F (32°C) may limit plant growth. Flowering only occurs when temperatures are at or above 68°F (20°C).

Rainfall. Cocoa require access to soil moisture (water) nearly year round and thus benefit from regular watering during dry periods. Drought stress leads to leaf and flower drop and poor fruit production.

Light. Cocoa is a shade plant and grows best with about 25% shade. It may be planted under the canopies of tall overhanging trees or next to buildings or structures. However, cocoa planted in deep shade tends to be spindly and non-productive.

Wind. Cocoa does not tolerate windy conditions and should be planted in only wind-protected areas.

Propagation

Cocoa may be grown from seed, although depending upon the seed source, it may not result in the exact same plant as the parent, and it may have pollination problems. Cocoa may also be propagated from upright stem cuttings possessing 2 to 5 leaves and including 1 to 2 buds. The cutting should be taken early in the morning and the leaves cut to about 1/2 their length and then dipped in a rooting hormone and placed in a small container filled with moist, clean, well-draining, soil media. The cutting should then be covered with a polyethylene bag and placed in a warm but shaded area. The soil should be kept moist but not overly wet. Rooting should take place in about 4 weeks, during which time the bag may be slowly opened. Once the plant is fully rooted and growing, it may be moved repeatedly to increasing light levels. Cocoa may also be propagated by marcottage (air-layering) and budding and grafting.

Production (Crop Yields)

Depending upon plant vigor, climate, cultural practices, and variety, up to 50 pods per plant may be produced per year. The time from flowering (fertilization) to fruit maturity ranges from 5 to 6 months, depending upon temperatures.

Spacing

Cocoa plants should be planted 10 to 20 ft (3-1-6.1 m) from the base of overhanging trees or structures. Adjacent cocoa plants should be 10 to 15 ft (3.1-4.6 m) apart from each other.

Soils

Cocoa plants require well drained soil and grow best in slightly acid to neutral pH soils. Amending the top 4 to 8 inches (10-20 cm) of acid and alkaline soils with a mixture of compost, topsoil, and native soil may enhance plant establishment and growth.

Planting a Cocoa Tree

Cocoa plants are not commonly produced by nurseries in Florida. However, proper planting is one of the most important steps in successfully establishing and growing a strong, productive tree. The first step is to choose a healthy nursery tree. Nursery cocoa trees may be grown in 1- to 3-gallon (4- to 11-liter) containers, and trees stand 2 to 3 ft (0.6-0.9 m) from the soil media. Large trees in smaller containers should be avoided because the root system may be "root bound." This means all the available space in the container has been filled with roots to the point that the tap root is growing along the edge of the container in a circular fashion. Root bound root systems may not grow properly once planted in the ground. Inspect the tree for insect pests and diseases, and inspect the trunk of the tree for wounds and constrictions. Select a healthy tree and water it regularly in preparation for planting in the ground.

Site selection

Cocoa trees should be planted in partial shade for best growth and fruit production. Select a part of the landscape adjacent to overhanging trees, buildings and structures but away from power lines. Cocoa trees can become moderately large if not pruned to contain their size. Select the warmest area of the landscape (usually the south side) that does not flood (or remain wet) after typical summer rainfall.

Planting in Sandy Soil

Many areas in Florida have sandy soil. Remove a 3- to 10-ft-diameter (0.9- to 2.1-m) ring of grass sod. Dig a hole 3 to 4 times the diameter and 3 times as deep as the container the cocoa tree came in. Making a large hole loosens the soil next to the new tree, making it easy for the roots to expand into the adjacent soil. It is not necessary to apply fertilizer, topsoil, or compost to the hole. However, placing a small amount of topsoil or compost with the native soil may be beneficial. If you wish to add topsoil or compost to the native soil, mix it with the excavated soil, no more than a 1:1 ratio.

Backfill the hole with some of the excavated soil. Remove the tree from the container and place it in the hole so that the top of the soil media from the container is level with or slightly above the surrounding soil level. Fill soil in around the tree roots and tamp slightly to remove air pockets. Immediately water the soil around the tree and tree roots. Staking the tree with a wooden or bamboo stake is optional. However, do not use wire or nylon rope to tie the tree to the stake because they may eventually damage the tree trunk as it grows. Use a cotton or natural fiber string that will degrade slowly.

Planting in Rockland Soil

Many areas in Miami-Dade County have a very shallow soil, and several inches below the soil surface is a hard, calcareous bedrock. Remove a 3- to 10-ft-diameter (0.9- to 2.1-m) ring of grass sod. Make a hole 3 to 4 times the diameter and 3 times as deep as the container the cocoa tree came in. To dig a hole use a pick and digging bar to break up the rock or contract with a company that has augering equipment or a backhoe. Plant the tree as described for sandy soils.

Planting on a Mound

Many areas in Florida are within 7 ft (2.1 m) or so of the water table and experience occasional flooding after heavy rains. To improve plant survival, consider planting fruit trees on a 2- to 3-ft-high by 4- to 10-ft-diameter (0.6- to 0.9-m by 1.2- to 3.1-m) diameter mound of native soil. After the mound is

made, dig a hole 3 to 4 times the diameter and 3 times as deep as the container the tree came in. In areas where the bedrock nearly comes to the surface (rockland soil), follow the recommendations for the previous section. In areas with sandy soil, follow the recommendations from the section on planting in sandy soil.

Care of Cocoa Trees in the Home Landscape

A calendar outlining the month-to-month cultural practices for cocoa is shown in Table 1.

Suggested Fertilizer Recommendations for Cocoa Plants in the Home Landscape.

Frequent applications of small amounts of fertilizer are best for continuous cocoa growth and fruit production. Fertilizer mixtures containing 6 to 10% nitrogen, 6 to 10% available phosphoric acid, 6 to 10% potash, and 4 to 6% magnesium give satisfactory results with young trees. Examples of commonly available fertilizer mixes include 6-6-6-2 [6 (N)-6 (P₂O₅)-6 (K₂O)-2 (Mg)] and 8-3-9-2 [8 (N)-3 (P₂O₅)-6 (K₂O)-3 (Mg)]. Young plants should be fertilized every 14 to 21 days with 1/8 to 1/4 lb (69-118 g) of a complete fertilizer (6-6-6, 8-3-9 or similar materials), with the amounts increasing as trees become larger. Once trees become about 12 to 18 months old, they should be fertilized with up to 1 to 2 lbs (474-948 g) every other month. Fertilizer rates may be reduced from November through February due to cool temperatures reducing plant growth.

Minor elements should be applied every other month but are most effective during the warm summer months. Minor elements including manganese and zinc may be applied to the ground in soils with a pH less than 7 and foliarly applied for plants growing in high-pH soils. Similarly, iron sulfate may be applied to the ground for plants growing in low-pH soils. However, for plants growing in high-pH soils, chelated iron should be mixed in water and applied as a soil drench.

Irrigation (Watering)

Watering is essential for best cocoa plant growth and fruit production. Cocoa plants that lack water (drought stress) may drop leaves, flowers and young fruit, and they may produce small fruit.

Plants growing in sandy or rocky soils that are well drained and do not hold much water should be watered every other day or every day during hot, dry conditions and less often during cool parts of the year (late fall, winter). Plants growing in soil with a capacity to hold water (loams, sandy loams) should not be overwatered and therefore watered at 3- to 4-day intervals, especially during hot weather.

Cacao Trees and Lawn Care

Cocoa trees in the home landscape are susceptible to trunk injury caused by lawn mowers and weed eaters. Maintain a grass-free area 2 to 5 or more feet (0.6–1.5 m) away from the trunk of the tree. Never hit the tree trunk with lawn mowing equipment and never use a weed eater near the tree trunk. Mechanical damage to the trunk of the tree will weaken the tree, and if severe enough can cause dieback or kill the tree.

Roots of mature cocoa trees spread beyond the drip-line of the tree canopy, and heavy fertilization of the lawn next to cocoa trees is not recommended because it may reduce fruiting and or fruit quality. The use of lawn sprinkler systems on a timer may result in over watering and cause cocoa trees to decline. This is because too much water too often applied causes root rot.

Mulch

Mulching cocoa trees in the home landscape is recommended. Mulch helps retain soil moisture, reduces weed problems next to the tree trunk, and improves the soil near the surface. Mulch with a 2- to 6-inch (5- to 15-cm) layer of bark, wood chips, or similar mulch material. Keep mulch 8 to 12 inches (20–30 cm) from the trunk.

Pollination and Thinning

Self-incompatibility of cocoa flowers may result in little to no pod production. Therefore either a self-compatible type (variety) should be grown or 2 or more compatible types (varieties), should be grown near each other. Since cocoa is normally pollinated by specific midge species (*Forcipomyia* spp.) that may not be present in Florida, hand pollination is one way to increase the chance of pod formation. Flowers usually open in the early morning, and hand pollination during the morning hours is best. This may be accomplished by using a small artist's paint brush that is first placed in contact with the anthers of an open flower and then placed in contact with the stigma of another flower.

Cocoa plants may set a large number of fruit, which may lead to plant decline. In general, only 1 to 2 pods should be allowed to develop at any one flowering cushion on a limb. In other words, if more than 1 of the flowers from a cushion sets a fruit, leave only 1 or 2 to develop. Removing an excessive number of pods will result in faster development and larger pods of remaining fruit.

Pruning

Initial Pruning. Newly planted trees should be allowed to grow to 1 to 2 ft (0.3–0.6 m). If no branching occurs, then the top should be cut back to initiate branching. Three to 4 main branches should be allowed to develop. Remove all others.

Maintenance Pruning. Plant height should be limited to 6 to 8 ft (1.8–2.4 m) to facilitate care and make protection from winds, excessive light, and cold temperatures easier. Periodically, selected branches should be removed to allow an increase in light and air movement inside the plant canopy. This will enhance pod production and reduce fungal disease problems. Damaged or diseased branches should also be removed regularly.

Insect Pests

Numerous insects are reported to attack cocoa plants, however, since cocoa is rarely grown in south Florida, insect problems may be reduced although not eliminated. Contact your local county extension agent for current control recommendations.

Diseases

Numerous diseases are reported to attack cocoa plants. Because cocoa is rarely grown in south Florida, however, disease problems may be reduced, although not eliminated. Several *Phytophthora* species common to Florida are reported to attack cocoa shoots, leaves, roots, and pods. Several pod rotting fungi may be present in Florida. Never propagate new cocoa plants from mother plants showing symptoms of distorted growth. The distorted growth may indicate a viral infection.

Harvest

Pods should be harvested soon after developing their characteristic yellow or red and yellow peel color. The pods should be clipped off carefully. Pulling them off may damage the cushion and reduce pod production. The pod may be opened with a knife and the mucilaginous seeds removed.

The process of extracting the chocolate from the seeds involves fermentation, drying, cleaning, roasting, and pressing. This process, while possible, is not practical with the small amount of cocoa seeds produced from a few trees and therefore will not be reported here.

Uses

Chocolate is used as an essential ingredient in numerous commercial products, including candy, desserts, and drinks.

Table 1. Cultural calendar for cocoa production of mature (bearing) trees in the home landscape.

Operation	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
General NPK¹	Apply NPK		Apply NPK		Apply NPK		Apply NPK		Apply NPK		Apply NPK	
Nutritional sprays²			Apply 4 to 5 foliar nutritional sprays.									
Iron applications			Apply iron 2 to 4 times.									
Watering	Reduce watering frequency.			Water plants frequently during dry periods.								
Insect and disease control	Monitor for insect and disease pests year round. Contact the county extension service for current control recommendations.											
Pruning				Selectively prune plants to reduce plant height and increase air and light penetration.								
¹ NPK, nitrogen-phosphate-potash. Many fertilizer mixes also contain magnesium (Mg). ² Foliar nutritional sprays should include manganese, zinc, and other micronutrients.												

Table 2. Fertilizer recommendations for mature (4 or more years old) cocoa plants in the home landscape.

Year	Month	Times per month	NPK amount per tree per application (lbs) ¹	Micronutrient applications	Iron soil drench applications ³
1	Jan.	1	1/8-1/4	March	April
	March	1	1/4-1/2	May	June
	May	1	1/4-1/2	July	August
	July	1	1/2-3/4	Sept	October
	Sept.	1	3/4-1		
	Nov.	1	1		
2+	Every other month	1	1	Every other month from March to Sept.	Every other month from April to Oct.
¹ NPK, nitrogen-phosphate-potash, dry soil applications. ² Micronutrient applications should be made to the leaves and contain magnesium, manganese, zinc, and other microelements (follow label directions). ³ Chelated iron materials should be used in high-pH soils (e.g., Miami-Dade County). Mix the iron chelate with water and pour the mix under the canopy of the plant. In low-pH soils, iron sulfate may be applied in a dry granular form.					

Table 3. Nutritional value of 3 oz (100 g) dry powder, unsweetened, cocoa.^z

Constituent	Value	Constituent	Value
Water	3.0 g	Iron	12.9 mg
Protein	19.6 g	Magnesium	499 mg
Fat	13.7 g	Phosphorus	734 mg
Carbohydrate	54.3 g	Potassium	1524 mg
Fiber	33.2 g	Theobromine	2057 mg
Calcium	128 mg	Caffeine	230 mg

^z USDA National Nutrient Database for Standard Reference, Release 18 (2005). [website: <http://www.nal.usda.gov/fnic/foodcomp/search/>] [Accessed, Feb., 5, 2006].