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About the Institute
The Hunt Institute for Botanical Documentation, a research division of Carnegie Mellon University, specializes in the history of botany and all aspects of plant science and serves the international scientific community through research and documentation. To this end, the Institute acquires and maintains authoritative collections of books, plant images, manuscripts, portraits and data files, and provides publications and other modes of information service. The Institute meets the reference needs of botanists, biologists, historians, conservationists, librarians, bibliographers and the public at large, especially those concerned with any aspect of the North American flora.

Hunt Institute was dedicated in 1961 as the Rachel McMasters Miller Hunt Botanical Library, an international center for bibliographical research and service in the interests of botany and horticulture, as well as a center for the study of all aspects of the history of the plant sciences. By 1971 the Library's activities had so diversified that the name was changed to Hunt Institute for Botanical Documentation. Growth in collections and research projects led to the establishment of four programmatic departments: Archives, Art, Bibliography and the Library.

Calocarpum - what species is the sapote

Achras sapota — should we use a later name?

{ What is the color of sapodilla wood?

How old are the Maya lintels?

Include ucaco and abiu (of Brazil)

Put all sapotaceous fruits together

Notes to be used in preparation of Fruit Growihg in Tropical America.

From "Flora of Guatemala", by Standley and Williams, Fieldiana: Botany, Vol. 24, Part VIII, Number 3. May 5, 1967

SAPOTACEAE

"We have accepted Dr Arthur Cronquist's survey of the North American genera as a basis for the Sapotaceae in this flora. "Cronquist's publications s eem to be 1945 and 1946).

Chrysophyllum cainito L. Caimito. Star-apple. "Sometimes found more less naturalized, but not native in Central America; perhaps native in the West Indies but possibly unknown in a truly wild state. Native of America but also planted in the Old World tropics.

Manilkara achras (Mill.) Fosberg. Achras zapota L. Sapota achras Mill. Native in the mixed forests of Petén, Baja Verapaz and Alta Verapaz. Mexico, Vera Cruz to Oaxaca and the Yucatan peninsula. British Honduras; doubtfully native in other parts of Central America, "It was estimated that one hundred million trees existed in the Yucatan peninsula. At the height of chicle production it was estimated that 12 millions pounds annually; this was in 1927-1929. In 1930 it was estimated that the import of chicle into the U S was nearly 14 million pounds.

Pouteria mammosa (L) Cronquist. Achras mammosa L. Lucuma mammosa Gaertn. Calocarpum mammosum Pierre. Achradelpha mammosa Cook. Calocarpum sapota Merrill. "Planted co,monly in fincas at 600 meters or less, less common at 900 meters, but rare at 1200 meters or more although sometimes seen as high as 1500 meters; frequent or common throughout Guatemala at these elevations; often found more or less

wild or naturalized, and perhaps native in Izabal and Petén. Southern Mexico, British Honduras; common in cultivation in lowlands of Central America, and possibly native along the Atlantic coast. "Seed 1, very large, lustrous brown, with a very large, pale scar on one side."

Pouteria viridis (Pittier) Cronquist. Calocarpum viride Pittier. Achradelpha viridis Cook. "Native habitat uncertain, but quite possibly Alta Verapaz. Cultivated also in Mexico, El Salvador, Honduras, Nicaragua and Costa Rica. "I-2 seeded".

Pouteria campechiana (HBK) Baehni. Lucuma campechiana HBK. Lucuma laeteviridis Pittier. Lucuma heyderi Standl. Lucuma nervosa A.DC. Lucuma salicif olia HBK, and Pouteria campechiana var. palmeri (Fernald) Baehni.

Diospyros digyna Jacq. D. obtusifolius Humb. and Bonpl. D. ebenaster of authors. Dry or wet mixed forests usually at or a little above sea level. Izabal. Said to grow in the lowlands of Huehuetenango, and to be planted occasionally in other regions, but the tree is not cultivated commonly in Guatemala. Mexico, British Honduras, Nicaragua, Costa Rica, West Indies; naturalised in the Old World Tropics, and cultivated there.

THE SAPODILLA, AND SOME OTHER SAPOTES

Among the fruits grown by the inhabitants of Middle America in pre-Columbian days the sapodilla (Achras zapota) is one of the best. It must have been especially popular in that large area which today comprises the Department of Petén in Guatemala, and in adjacent parts of Mexico, for it was, and still is, abundant in all that region.

In modern times the sapodilla has become a dual-purpose tree, through the use of its milky sap in the production of "chewing gum", that great solace of children, stenographers and many other people in all parts of the world. Sapodilla trees are tapped in much the same manner as rubber trees. The coagulated juice, which unlike rubber is not elastic, was chewed to relieve thirst by people of the Maya and Nahuatl nations in prehistoric times. Today it is the most important commercial product of an extensive region, though the tree is not grown in plantation form; ~~like rubber, but~~ yet occurs abundantly in the wild.

In spite of the esteem in which this fruit is held in many tropical countries, it has not yet formed the basis of commercial plantings anywhere in the American tropics. Dooryard trees supply the fruit which is commonly seen in local markets. In India, the total number of trees which are cultivated, ~~are~~ is considered equivalent to 5000 acres, while in the Philippines they would amount to some three thousand.

In Mexico the sapodilla is commonly known as chicosapote, from the Nahuatl (Aztec) words tzictli, gum, and tzapotl, meaning a soft, sweet fruit. The early Mexicans had an interesting classification of edible fruits. Those which were soft-fleshed and sweet were distinguished by the word tzapotl, with a prefix to characterize

the particular species, while those which were not so soft, and more acid, were called by the name xocotl, again with a prefix in most instances.

The common English name, sapodilla, is from the Spanish zapotillo or small sapote (to distinguish it from the large sapote, Calocarpum sapota). In Central America the inappropriate name nispero is used, probably because the early Spaniards saw in this fruit a faint resemblance to the European Mespilus germanica. By a twisting of tongues, nispero became "Naseberry" in the British West Indies, - a good example of the early custom of applying the terms apple, pear, plum, or berry to new fruits met in the tropics, in each case prefixing it with what was considered a descriptive word, for example, star-apple, Spanish-plum, and the like. In India the sapodilla is called chiku, obviously the first half of chicosapote, or sometimes sapote.

The sapodilla tree is a handsome evergreen, very sturdy and storm-fast, with a dense, compact crown sometimes reaching a height of 75 feet. The wood is fine-grained, hard, dense, reddish in color, easily worked and polished, and very resistant to insects and fungi. In the American tropics it is sometimes used for cabinet work, posts, and rafters. The lintels of Mayan temples (the Maya did not know the true arch) were made of sapodilla beams, some of which have lasted ~~600~~ 1000 years or more in humid, tropical rainforests.

The glossy, dark green, leathery leaves are from 3 to 5 inches long, clustered at the tips of the stiff, slender twigs. Flowers are borne singly on pedicels in the axils of the newest leaves at the tips of twigs. They appear at almost all seasons of the year, although most abundant in late autumn. Consequently there may be some fruits maturing at any time of the year, with a marked peak of production in summer. Sapodilla trees grow slowly, about 1 ~~ft.~~ foot

a year; often they are 8 to 9 years old before they come into bearing. The fruit is rich in sugar, from 8 to 14%, but very low in acid. Individual fruits, which vary in shape from oblong to oblate, may be from 2 to 4 inches in diameter. The thin, scurfy skin is light brown in color, while the flesh ranges from light tan to reddish brown, with a texture when ripe much like that of a European pear. From several to a dozen large, flat, shining black seeds are enclosed, but trees with seedless fruits (always small) occur occasionally.

It is difficult to recognize maturity in the fruits, as there is no color change. If they are left on the tree until ripe and soft, they cannot be carried to any but local markets because the skin is so delicate. However, soft-ripe fruit can be stored up to 3 weeks in good condition at 33 degrees F. Fully mature but still hard fruits can easily be separated from the tree without dripping much objectionable latex from the stem. They will ripen in 5 or 6 days, which makes possible commercial shipment to markets at some distance. The sapodilla is almost always eaten as a fresh fruit; it is never cooked or canned, but may be employed in making sherbets and ice creams.

Climate and Soil

Sapodillas will endure about as much cold as avocados of the West Indian race. Mature trees may tolerate temperatures as low as 26 degrees F., while very young trees may be killed to the ground at 28 degrees F. or even at 30 degrees.[2] There does not seem to be any upper limit of temperature tolerance. Soil preferences are not marked; trees may thrive on dry, rocky soil or moist clay, tolerating even brackish water used for irrigation. Wind is not a serious handicap, but reports differ as to the effect of salt spray. On the Florida Keys sapodillas are notably tolerant, but on the

coast of Bombay (India) it is said that they must have a shelter belt to protect them from salt injury. Rainfall ranging from 30 to as much as 120 inches per year has proved satisfactory. While growth and production are best on well-drained soils, long periods of standing water are tolerated.

Propagation

Usually sapodilla trees are grown from seeds, which, if fresh, germinate in about 30 days. They can be stored for several months without losing viability. Some seedlings produce larger fruits or bear heavier crops than others, and these can be multiplied ~~by~~ by vegetative propagation. The Ponderosa variety in the Philippines and the Russell in Florida have very large fruits, while the Prolific variety of Florida is notable for consistently heavy crops of medium-sized fruits. In both India and the Philippines, amateurs have found approach-grafting on 1-year-old stocks successful, while professional propagators have reported 90% of success with cleft-grafting on 2-year-old seedlings. In Florida, where nurserymen consider vegetative propagation of the sapodilla difficult, veneer-grafting on 1-year-old stocks has given fair results. Except in early spring, it is desirable to girdle the scions about a month before using them, to assure an adequate store of food. It is wise to make a cut through the bark of the stock plant a little above the point where the graft is to be made, to drain the bark of latex which would prove troublesome when grafting, by forming a waterproof layer between stock and scion. Air-layering or marcottage is sometimes much used in India, requiring about 6 months before the marcot can be cut off and potted. ~~However, some varieties are not easy to root.~~

Culture

Trees may be planted 25 to 40 feet apart, depending on the fertility of the land. Nursery trees are usually grown in containers

to facilitate transplanting. If they must be moved from field nurseries, a ball of soil should be kept around the roots. A great deal of risk is involved in moving bare-root trees even when they have been cut back heavily. No experience has been reported regarding the fertilizer requirements of sapodillas, but they will probably thrive on about the same program as oranges. Weed control in the orchard should be carried out as with other evergreen fruit trees. In dry climates irrigation should be about the same as for avocados. Heavy mulching with grass or other organic matter will help conserve moisture. Rarely are there any pest problems, except infestation of the ripe fruit by fruitflies, all too common in most tropical countries. These are hard to control, as ~~has been~~ is mentioned in the chapter on guavas.

THE SAPOTE

The true or common sapote (Calocarpum sapota) is the only fruit properly entitled to be called "sapote" without qualification. In Central America and southern Mexico it is known simply as zapote; in Jamaica as mammee-sapote, and in Cuba as mamey colorado, both these latter names indicating its superficial resemblance to the mamey, Mammea americana, which grew in the islands of the Caribbean before the sapote was introduced. Occasionally the curious name marmalade plum is found in the literature. The "plum" part is quite inappropriate for so un-plumlike a fruit, but the marmalade part refers to the resemblance of the reddish pulp to quince marmalade, in spite of the fact that it is altogether different in taste.

The sapote is probably a native of southern Mexico and Central America, though it is such a rarity in the wild state as to deter botanists from making positive statements on this point. There is an interesting story in connection with this fruit. On the famous march from Mexico to Guatemala in 1524, the soldiers of Cortes were

at times kept from starvation by the abundance of wild sapotes. Modern writers have assumed that this was the fruit here discussed, but the scarcity of this species in the Petén region, as compared with the great abundance of wild sapodilla trees (exploited in modern times for chicle gum) makes it seem almost certain that the early chroniclers are speaking of sapodillas.

The sapote tree reaches large size. It has thick twigs and large, leathery leaves, oblanceolate in shape, 8 to 12 inches long, clustered at the ends of the branchlets. The flowers are produced in groups of 2 to 6 at the nodes after the leaves have fallen. The same nodes continue to produce clusters of flowers year after year, until the branchlets have become an inch or more in thickness. This interesting characteristic is botanically known as ramiflory. Fruits mature during a large part of the year, but the main crop ripens during the warmer months. The fruit is from 4 to 8 inches long and 2 to 5 inches wide, usually rounded at the base and pointed at the tip. On the outside is a hard rind, cinnamon brown in color and rough or scabby on the surface. The flesh is reddish, like a firm peach in texture, very sweet without acidity. Imbedded in the flesh there is usually a single large, handsome seed, 2 to 3 inches long, with a hard, shining, brown seed coat and a broad, white, rough area lengthwise on one side. Propagation has been entirely by seeds which germinate in about a month. There are, as yet, no horticultural varieties needing vegetative multiplication. Removal of the hard, woody seed coat hastens germination.

The tree is definitely tropical, enduring less cold than the sapodilla; in Central America it is rarely seen above 3000 feet. Good soil drainage is more important than for the sapodilla. Seedlings begin to bear at about 7 or 8 years of age. The fruit is usually eaten fresh but is sometimes made into sherbets, or it may be

cooked with lime or lemon juice to make a conserve. No special pests are known.

THE STAR-APPLE

Probably native to the West Indies, the star-apple (Chrysophyllum cainito) is grown in dooryards at low elevations throughout the American tropics. The common Spanish name, caimito, is taken from the Carib language.

The tree is strikingly handsome because of its rounded head of slender, willowly branches clothed with leaves which are dark green above and shining, golden-brown beneath. A slight breeze is enough to set them turning, so that they give the impression of changing color every moment. They are lanceolate, 3 to 5 in. long. Trees may reach 50 ft. in height. This is a lowland species, ~~and~~ but it needs good drainage.

The flowers are inconspicuous; the fruits, ~~which mature in late winter and spring~~, are oblately round, from 2 to 4 in. in diameter, with smooth, leathery skins. There are two seedling races, one dull purple, the other light green; no other qualities seem to be associated with skin color. When cut transversely through the middle, the flesh which fills most of the fruit is a finely granular mass of the same color as the skin. In the center are the flat seeds, their width oriented along a radius, so that they make a star-shaped cluster, hence the common name "star-apple." Around each seed is a shining, white, gelatinous covering. Both this and the granular flesh are sweet without any relieving acidity. There may be up to 8 seeds, 3/4 in. long, though usually only 3 to 5 develop to maturity. They retain viability for several months and germinate readily in about 6 weeks.

Vegetative propagation is not commonly practiced, but since

seedling trees vary greatly in size and ~~yield~~ quality of fruit, it is often desirable to resort to budding, which has been done successfully in the Philippines, or veneer-grafting which has proved satisfactory in Florida. Marcottage is one of the easiest methods of propagation.

THE CANISTEL OR "EGG-FRUIT", AND THE YELLOW SAPOTE

For many years these two fruits were considered to be different species, but botanists now consider that they are forms of the same one, Pouteria campechiana. The canistel is native to Middle America from southern Mexico to northern Colombia; it is a lowland species, cultivated in dooryards all through the West Indies as well as in its native habitat. Nowhere is it a fruit of great importance, however, and horticulturists are inclined to differ considerably in their appreciation of its peculiar qualities. The name canistel comes from the Maya kanisté.

The tree is medium-small in size, rarely over 25 ft. high, with stiff but rather slender twigs like those of the sapodilla. The leaves are thin, smooth, oblanceolate, from 5 to 8 in. long, clustered near the tips of the twigs. The rather inconspicuous flowers are borne on new shoots, mostly just below the clusters of leaves, during the late spring and summer months. They are followed some 6 months later by ripe fruits, ~~which have a peak of maturing from November to January. These fruits are~~ rounded or oval, from 2 to 3 in. long, with a tough, smooth skin orange-yellow in color. The flesh resembles the yolk of a hard-boiled egg, giving rise to one of the common names, "egg-fruit." Like ~~the above~~ other sapotaceous fruits, the canistel is sweet without a trace of acidity, and sometimes has a slightly musky flavor. Imbedded in the flesh are from 1 to 3 seeds, much like those of the sapote except for the smaller size, being only an inch long at most. These seeds

require 3 to 5 months for germination.

The yellow-sapote differs from the canistel chiefly in having larger leaves, fruits, and seeds. The fruits are 4 or 5 inches long; the seeds are double the size of those of the canistel. This Mexican fruit, called zapote amarillo in its native home, is probably a tetraploid form of the canistel, and does not differ from it in fruit quality. There are often two crops, one in late winter from midsummer bloom, and the other in early summer from early winter bloom. Seeds are used for propagation as with the canistel, but the larger fruit size has encouraged vegetative propagation. Veneer-grafting has been satisfactory if scions are pre-girdled a month before they are wanted.

Probably neither of these fruits has much of a commercial future. They are only eaten fresh. Mixing lime juice with the flesh often improves the taste.

THE BLACK SAPOTE

This is a sapote which is not a sapote, by our standards, for it does not belong to the Sapotaceae but to the ebony family, Ebenaceae. It is a native of southern Mexico, and very little known elsewhere; being a soft, sweet fruit, Aztec horticulturists of pre-Columbian days included it in their group of sapotes, with the name tliltzapotl, or "black sapote".

The tree, botanically Diospyros ebenaster, is common in the Isthmus of Tehuantepec, and elsewhere in Mexico at elevations from sea level up to 5000 or 6000 feet. That it will tolerate cool weather is shown by the fact that it has been grown successfully for the past fifty years in the vicinity of Miami, Florida. The leaves are elliptic or oblong, 4 to 6 inches or more in length, bright green and shining. The fruits are the size and shape of good

tomatos, bright green in color, with soft, unctuous flesh dark brown in color, sweet but without much character. ~~By many people~~ the appearance of the flesh is often likened to axle grease, and as a matter of fact it is not very tasty unless mixed with orange or lemon juice, which is the way the Mexicans eat it. The seeds are one to ten in number, occasionally none, the size and shape of those of the Kaki or Japanese persimmon. They are easily germinated, and the tree is not difficult to grow. Its chief value, perhaps, lies in its highly ornamental character - and as a curiosity in collections of tropical fruits.

THE GREEN SAPOTE

This tree, botanically Calocarpum viride, is much more restricted in its distribution than its sister species, the sapote. It occurs ~~as a~~ in dooryard ~~tree,~~ or around cultivated fields, at elevations between 3500 and 6500 feet in the Guatemalan highlands, where its fruits appear in village markets from October or November until February. It is occasionally seen in El Salvador, Honduras and Costa Rica; elsewhere it does not seem to be known, though its flavorsome fruits (usually considered superior to those of the sapote) deserve to be produced more widely in the tropical American highlands.

The common name, green sapote, is a literal translation of rax-tul, by which it is known to the Kekchi Indians of northern Guatemala. In the central part of that country it is called in Spanish injerto, which means "graft", probably because it suggests a cross between the sapote and the sapodilla. The tree somewhat resembles that of its congener the sapote, but the leaves are considerably smaller. The fruits are three or four inches long, turbinate to elliptic in form, brownish green to yellowish green in color when fully ripe. The skin is thin and membranous, which

makes it difficult to put fully ripe fruits on the market in good condition. The flesh is pale reddish brown in color, melting, sweet and somewhat juicy. The large seeds, commonly two in number, are elliptic in form and about two inches long.

Propagation by seeds presents no problems, but seedlings are usually slow to come into bearing - often as much as eight to ten years. No varieties have been propagated vegetatively, but the species lends itself to veneer grafting. Its limited distribution can probably be blamed on the fact that it does not thrive in the tropical lowlands. In recent years it has been fruited successfully at Miami, Florida.

THE WHITE SAPOTE

Here again we fall back on Aztec nomenclature, for the white sapote, strange as it may seem, belongs to the Citrus family, Rutaceae. This is another one of those soft sweet fruits which the Aztec loved. They termed it cochiztzapotl, which means "sleep producing sapote", because they considered it to be a soporific. Whether or not this is the reason for its popularity, the sapote blanco is well known today in many parts of Mexico, and has received quite a bit of attention in southern California, where several named varieties have been established, propagated by shield budding as with citrus.

In Guatemala, Honduras and a few other regions a very similar species - if it is a valid species - is known as matasano. This has been termed by some taxonomists Casimiroa tetrameria, differentiating it from the Mexican species, Casimiroa edulis, but the late Paul Standley, an outstanding authority, was inclined to consider the two specifically identical. The leaves are palmately compound, those of C. edulis glabrous above and below, those of C. tetrameria

velvety pubescent beneath. In both forms the fruits are the size of an orange (sometimes smaller), pale green in color, thin-skinned, with soft, sweet flesh enclosing one to five large oval or elliptic seeds.

These are distinctly trees of the highlands, growing in door-yards and around cultivated fields in Mexico and Guatemala up to elevations of 8000 or 9000 feet. They are rarely seen in the lowlands. They resist unfavorable conditions of soil and moisture, and bear good crops annually. The fruits of the matasano are oftentimes somewhat ~~objectionably~~ bitter; those of the Mexican sapote blanco are not commonly so. Both are liked by many people.

Mamey colorado	Calocarpum mammosum
Sapote, green	Calocarpum viride
Sapote, yellow	Pouteria campechiana
Sapodilla	Manilkara Zapotilla

Crataegus pubescens	Tejocote
Spondias Mombin	Hog plum
Jocote	Spondias purpurea
Guava	Psidium Guajava
Matasano	Casimiroa Sapota
Sapote, white	Casimiroa edulis
Sapote, black	Diospyros Ebenaster

Bullock's heart	Annona reticulata.
Cherimoya	Annona Cherimolia

In Standley "Trees of Mexico"
matasano is listed as the name
of C. edulis in Oaxaca and in
Nicaragua.

In Flores of Yucatan, Brit Honduras
+ Costa Rica, C. edulis is not listed
+ matasano is name for C. tetrameria.

I don't think we can limit matasano
to the C. tetr. form!

In Florida the bitter taste is
equally likely to be found in both
forms.

K. ex. White-sapote

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to facilitate transplanting. If they must be moved from field nurseries, a ball of soil should be kept around the roots. A great deal of risk is involved in moving bare-root trees even when they have been cut back heavily. No experience has been reported regarding the fertilizer requirements of sapodillas, but they will probably thrive on about the same program as oranges. Weed control in the orchard should be carried out as with other evergreen fruit trees. In dry climates irrigation should be about the same as for avocados. Heavy mulching with grass or other organic matter will help conserve moisture. Rarely are there any pest problems, except infestation of the ripe fruit by fruitflies, all too common in most tropical countries. These are hard to control, as has been mentioned in the chapter on guavas.

THE SAPOTE

The true or common sapote (*Calocarpum sapota*) is the only fruit properly entitled to be called "sapote" without qualification. In Central America and southern Mexico it is known simply as *zapote*; in Jamaica as *mammee-sapote*, and in Cuba as *mamey colorado*, both these latter names indicating its superficial resemblance to the mamey, *Mammea americana*, which grew in the islands of the Caribbean before the sapote was introduced. Occasionally the curious name *marmalade plum* is found in the literature. The "plum" part is quite inappropriate for so un-plumlike a fruit, but the marmalade part refers to the resemblance of the reddish pulp to quince marmalade, in spite of the fact that it is altogether different in taste.

The sapote is probably a native of southern Mexico and Central America, though it is such a rarity in the wild state as to deter botanists from making positive statements on this point. There is an interesting story in connection with this fruit. On the famous march from Mexico to Guatemala in 1524, the soldiers of Cortes were

at times kept from starvation by the abundance of wild sapotes. Modern writers have assumed that this was the fruit here discussed, but the scarcity of this species in the Peten region, as compared with the great abundance of wild sapodilla trees (exploited in modern times for chicle gum) makes it seem almost certain that the early chroniclers are speaking of sapodillas.

The sapote tree reaches large size. It has thick twigs and large, leathery leaves, oblanceolate in shape, 8 to 12 inches long, clustered at the ends of the branchlets. The flowers are produced in groups of 2 to 6 at the nodes after the leaves have fallen. The same nodes continue to produce clusters of flowers year after year, until the branchlets have become an inch or more in thickness. This interesting characteristic is botanically known as ramiflory. Fruits mature during a large part of the year, but the main crop ripens during the warmer months. The fruit is from 4 to 8 in. long and 2 to 5 in. wide, usually rounded at the base and pointed at the tip. On the outside is a hard rind, cinnamon brown in color and rough or scabby on the surface. The flesh is reddish, like a firm peach in texture, very sweet without acidity. Imbedded in the flesh there is usually a single large, handsome seed, 2 to 3 in. long, with a hard, shining, brown seed coat and a broad white, rough area lengthwise on one side. Propagation has been entirely by seeds which germinate in about a month. There are, as yet, no horticultural varieties needing vegetative multiplication. Removal of the hard, woody seed coat improves germination.

The tree is definitely tropical, enduring less cold than the sapodilla; in Central America it is rarely seen above 3000 feet. Good soil drainage is more important than for the sapodilla. Seedlings begin to bear at about 7 or 8 years of age. The fruit is usually eaten fresh but is sometimes made into sherbets, or it may be

cooked with lime or lemon juice to make a conserve. No special pests are known.

THE STAR-APPLE

Probably native to the West Indies, the star-apple (Chrysophyllum cainito) is grown in dooryards at low elevations throughout the American tropics. The common Spanish name, caimito, is taken from the Carib language.

The tree is strikingly handsome because of its rounded head of slender, willowy branches clothed with leaves which are dark green above and shining, golden-brown beneath. A slight breeze is enough to set them turning, so that they give the impression of changing color every moment. They are lanceolate, 3 to 5 in. long. Trees may reach 50 ft. in height. This is a lowland species, and it needs good drainage.

The flowers are inconspicuous; the fruits, which mature in late winter and spring, are oblately round, from 2 to 4 in. in diameter, with smooth, leathery skins. There are two seedling races, one dull purple, the other light green; no other qualities seem to be associated with skin color. When cut transversely through the middle, the flesh which fills most of the fruit is a finely granular mass of the same color as the skin. In the center are the flat seeds, their width oriented along a radius, so that they make a star-shaped cluster, hence the common name "star-apple." Around each seed is a shining, white, gelatinous covering. Both this and the granular flesh are sweet without any relieving acidity. There may be up to 8 seeds, 3/4 in. long, though usually only 3 to 5 develop to maturity. They retain viability for several months and germinate readily in about 6 weeks.

Vegetative propagation is not commonly practiced, but since

seedling trees vary greatly in size and yield of fruit, it is often desirable to resort to budding, which has been done successfully in the Philippines, or veneer-grafting which has proved satisfactory in Florida. Marcottage is one of the easiest methods of propagation.

THE CANISTEL OR "EGG-FRUIT", AND THE YELLOW SAPOTE

For many years these two fruits were considered to be different species, but botanists now consider that they are forms of the same one, Pouteria campechiana. The canistel is native to Middle America from southern Mexico to northern Colombia; it is a lowland species, cultivated in dooryards all through the West Indies as well as in its native habitat. Nowhere is it a fruit of great importance, however, and horticulturists are inclined to differ considerably in their appreciation of its peculiar qualities. The name canistel comes from the Maya kaniste.

The tree is medium-small in size, rarely over 25 ft. high, with stiff but rather slender twigs like those of the sapodilla. The leaves are thin, smooth, oblanceolate, from 5 to 8 in. long, clustered near the tips of the twigs. The rather inconspicuous flowers are borne on new shoots, mostly just below the clusters of leaves, during the late spring and summer months. They are followed some 6 months later by ripe fruits, which have a peak of maturing from November to January. These fruits are rounded or oval, from 2 to 3 in. long, with a tough, smooth skin orange-yellow in color. The flesh resembles the yolk of a hard-boiled egg, giving rise to one of the common names, "egg-fruit." Like the above sapotaceous fruits, the canistel is sweet without a trace of acidity, and sometimes has a slightly musky flavor. Imbedded in the flesh are from 1 to 3 seeds, much like those of the sapote except for the smaller size, being only an inch long at most. These seeds

require 3 to 5 months for germination.

The yellow-sapote differs from the canistel chiefly in having larger leaves, fruits, and seeds. The fruits are 4 or 5 inches long; the seeds are double the size of those of the canistel. This Mexican fruit, called zapote amarillo in its native home, is probably a tetraploid form of the canistel, and does not differ from it in fruit quality. There are often two crops, one in late winter from midsummer bloom, and the other in early summer from early winter bloom. Seeds are used for propagation as with the canistel, but the larger fruit size has encouraged vegetative propagation. Veneer-grafting has been satisfactory if scions are pre-girdled a month before they are wanted.

Probably neither of these fruits has much of a commercial future. They are only eaten fresh. Mixing lime juice with the flesh often improves the taste.

THE BLACK-SAPOTE

This is a sapote which is not a sapote, by our standards, for it does not belong to the Sapotaceae but to the ebony family, Ebenaceae. It is a native of southern Mexico, and very little known elsewhere; being a soft, sweet fruit, Aztec horticulturists of pre-Columbian days included it in their group of sapotes, with the name tliltzapotl, or "black sapote".

The tree, botanically Diospyros ebenaster, is common in the Isthmus of Tehuantepec, and elsewhere in Mexico at elevations from sea level up to 5000 or 6000 feet. That it will tolerate cool weather is shown by the fact that it has/been grown successfully for the past fifty years in the vicinity of Miami, Florida. The leaves are elliptic or oblong, 4 to 6 inches or more in length, bright green and shining. The fruits are the size and shape of good

tomatos, bright green in color, with soft, unctuous flesh dark brown in color, sweet but without much character. By many people the appearance of the flesh is likened to axle grease, and as a matter of fact it is not very tasty unless mixed with orange or lemon juice, which is the way the Mexicans eat it. The seeds are one to ten in number, occasionally none, the size and shape of those of the Kaki or Japanese persimmon. They are easily germinated, and the tree is not difficult to grow. Its chief value, perhaps, lies in its highly ornamental character - and as a curiosity in collections of tropical fruits.

THE GREEN SAPOTE

This tree, botanically Calocarpum viride, is much more restricted in its distribution than its sister species, the sapote. It occurs as a dooryard tree, or around cultivated fields, at elevations between 3500 and 6500 feet in the Guatemalan highlands, where its fruits appear in village markets from October or November until February. It is occasionally seen in ElSalvador, Honduras and Costa Rica; elsewhere it does not seem to be known, though its flavorsome fruits (usually considered superior to those of the sapote) deserve to be produced more widely in the tropical American highlands.

The common name, green sapote, is a literal translation of rax-tul, by which it is known to the Kekchi Indians of northern Guatemala. In the central part of that country, it is called in Spanish injerto, which means "graft", probably because it suggests a cross between the sapote and the sapodilla. The tree somewhat resembles that of its congener the sapote, but the leaves are considerably smaller. The fruits are three or four inches long, turbinate to elliptic in form, brownish green to yellowish green in color when fully ripe. The skin in thin and membranous, which

makes it difficult to put fully ripe fruits on the market in good condition. The flesh is pale reddish brown in color, melting, sweet and somewhat juicy. The large seeds, commonly two in number, are elliptic in form and about two inches long.

Propagation by seeds presents no problems, but seedlings are usually slow to come into bearing - often as much as eight to ten years. No varieties have been propagated vegetatively, but the species lends itself to veneer grafting. Its limited distribution can probably be blamed on the fact that it does not thrive in the tropical lowlands. In recent years it has been fruited successfully at Miami, Florida.

THE WHITE SAPOTE

Here again we fall back on Aztec nomenclature, for the white-sapote, strange as it may seem, belongs to the Citrus family, Rutaceae. But it is another one of those soft, sweet fruits which the Aztec loved. They termed it cochiztzapotl, which means "sleep producing sapote", because they considered it to be a soporific. Whether or not this is the reason for its popularity, the sapote blanco is well known today in many parts of Mexico, and has received quite a bit of attention in southern California, where several named varieties have been established, propagated by shield-budding as with citrus. In some parts of Mexico and Central America it is called matasano.

In Guatemala, Honduras and a few other regions a very similar species - if it is a valid species - is also known as matasano. This has been termed by some taxonomists Casimiroa tetrameria, differentiating it from the Mexican species, Casimiroa edulis, but the late Paul Standley, an outstanding authority, was inclined to consider the two specifically identical. The leaves are palmately compound, those of C. edulis glabrous above and beneath, those of C. tetrameria

The treatment here is not satisfactory. My text was more accurate!

velvety pubescent beneath. In both forms, the fruits are the size of an orange (sometimes smaller), pale green in color, thin-skinned, with soft, sweet flesh enclosing one to five large oval or elliptic seeds.

These are distinctly trees of the highlands, growing in door-yards and around cultivated fields of Mexico and Guatemala up to elevations of 8000 or 9000 feet. They are rarely seen in the lowlands. They resist unfavorable conditions of soil and moisture, and bear good crops annually. The fruits of the matasano are oftentimes somewhat objectionably bitter; those of the Mexican sapote blanco are not commonly so, and are liked by many people.

Fruits of woolly-leaved white sapote are much larger than common white sapote!

THE WHITE-SAPOTE

Here we are following Aztec nomenclature, for the white-sapote (Casimiroa edulis), strange as it may seem, belongs to the Citrus family, the Rutaceae; but it is another of those soft, sweet fruits which the Aztecs loved. They termed it cochitzapotl, the "sleep-producing sapote", because they considered it to be a soporific. Whether or not this is the reason for its popularity, the sapote blanco is well known today in many parts of Mexico, and has received some attention in southern California and Florida, where several named varieties have been established. In some parts of Mexico and Central America it is called matasano.

The evergreen tree is of medium size, 8 to 13 m. high, and spreading in habit. Leaves are alternate and palmately compound, with 5 leaflets usually, each 7 to 12 cm. long, glabrous beneath. Flowers are inconspicuous, greenish-yellow, borne in small clusters on old twigs before the new growth flush. Where summers are warm, the fruits mature some 4 or 5 months later, but much more slowly where the growing season is cool. They are greenish-yellow, from 3 to 7 (rarely 10) cm. across, somewhat flattened or nearly round. Under a thin, delicate skin is a soft, melting flesh, from white with flecks of yellow to golden yellow in color, with slightly gritty texture like pears. There are 1 to 5

large seeds, each with a thin, white, fibrous coating which is a "stone". The sugar content of the flesh is high, 12 to 20%, and the acidity very low; commonly the taste is slightly bitter. Seedlings differ much in size of fruit and in the degree of bitter taste, and some produce very palatable fruits, as in most named varieties.

Another form of white-sapote occurs from Yucatan to Costa Rica in areas where the usual form is not found. It is distinguished by velvety pubescence on the lower leaf surface, and by the larger average size of its fruits, 8 to 10 cm. in diameter. The common name is also matasano. The scientific name C. tetrameria is in the literature, but the late Paul Standley, an outstanding authority, considered that this form did not deserve distinct species rating; it is probably a mutant, polyploid form of C. edulis. Fruit characters, except size, are identical in the two forms, both of which are commonly eaten out of hand. The only distinctive name for this second form is woolly-leaved white-sapote.

These are highland trees, found in dooryards and around cultivated fields in Mexico and Central America at elevations of 1000 up to 3000 m. They are rarely seen in tropical lowlands, although in the subtropics they thrive at sea level. The trees tolerate almost as much cold as do orange trees. They seem much better adapted to semi-arid than to humid climates, but need irrigation in long, dry periods. Any well-drained soil seems satisfactory.

Propagation is commonly by seeds, which germinate in about 2 weeks; they only remain viable for a month or so. Superior seedlings may easily be grafted on seedling stocks, using whip- or veneer-grafting, or may be shield-budded.