

*Casimiroa edulis*

Courtesy Chicago Natural History Museum

of the matasano which grows in the highlands of Central America. The two can easily be distinguished as follows: the leaves of the zapote blanco are glabrous on both surfaces, while those of the matasano (botanically *Casimiroa tetrameria*) are velvety on the lower surface.

Perhaps the zapote blanco is the better of the two; the matasano is sometimes rather bitter. In both species there exists a wide range of variation with regard to size, shape and quality of the fruit. In California, where the zapote blanco is cultivated on a small scale, an effort has been made to select the best seedlings and propagate them by grafting. Several named varieties are the result.

These trees thrive in the highlands, being sufficiently hardy to stand the cold up to 3000 meters, perhaps even higher. They are not exacting as to soil. They are easily grown from seeds and can also be propagated by shield budding as in the case of citrus. Attempts to graft them on citrus rootstocks, however, have not been successful at Escuela Agrícola Panamericana. These attempts were suggested by the fact that the two genera belong to the same family.

The culture of these trees is simple. They resist unfavorable conditions such as hard, rocky soil and long dry seasons. They are sometimes attacked by scale insects. Little attention has been given their cultivation in Central America, where they are invariably seen as dooryard trees or in a half-wild state.

FAMILY ANACARDIACEAE

The important family Anacardiaceae comprises about 60 genera and 500 species of trees and shrubs, some of which are tropical, while others are natives of the Temperate Zone. In addition to that delicious and universally popular fruit, the mango, the family includes the cashew or marañón; the jocotes or Spanish plums; the pistachio nut of the Mediterranean region; the molle (*Schinus molle*), a handsome ornamental tree; and some disagreeable members such as the poison oak or poison ivy of the United States and northern Central America.

The genus *Mangifera*, to which the mango belongs, is indigenous in tropical southeast Asia. Because mangos have been so long in cultivation, probably four thousand years or more, the origin of cultivated forms is lost in antiquity. Quite possibly they have been derived from more than one wild species. This is suggested by observable differences in the characteristics of the cultivated races.

THE MANGO

(*Mangifera indica*)

Probably because transportation was slow in those days when the Americas were being colonized and because mango seeds do not long retain their viability, this tree does not appear to have reached the western hemisphere until about 1700. It

spread rapidly and is now as commonly grown in the American tropics as is the apple in more northern regions.

Few fruits seem to have received such intensive horticultural attention in tropical Asia as this one. The fact that superior seedlings have been propagated by grafting since very early times has resulted in the presence of many named varieties (probably 500 or more) in India and adjacent regions. Toward the end of the last century these began to reach tropical America. As a result there are now available beautiful fruits of superior quality, practically free from the annoying fiber which is characteristic of the seedling mangos commonly seen in this part of the world.

The classification of races and varieties has not yet received sufficient attention at the hands of systematic pomologists. Aside from the seedling races which are recognized locally by almost everyone, there are two quite distinct major groups. These are commonly termed the Indian, and the Philippine or Manila races. Grafted varieties of the former group are cultivated in Central America, though not commonly so as yet. The latter group is well known in parts of Mexico and in Cuba, in the form of seedlings which are remarkably uniform as regards shape, color and flavor of their fruits.

Why is there so little variation among seedlings of the Philippine or Manila race (as it is known in Mexico), and so much among seedlings of the Indian? The answer is this: mangos of the Indian race are commonly monoembryonic while those of the Philippine race are polyembryonic. The meaning of these terms requires explanation.

From a fertilized ovule a single plant develops, which may show variation from its parent which is characteristic of seedlings, especially those of plants which have been subjected to long periods of cultivation and improvement. *Monoembryonic mango seeds give rise to only one plant.*

On the other hand, from polyembryonic mango seeds several, even as many as ten or a dozen, plants may grow. These could not possibly come from a single fertilized ovule. It has been shown that they are vegetative growths from the tissues surrounding the ovule, the tissues of the nucellus, whence they get the name nucellar embryos. In many cases they probably overwhelm the young plant which would normally develop from the fertilized ovule, so that it "falls by the wayside".

Otherwise it is hard to explain the remarkable uniformity of seedling Philippine mangos. Near Córdoba in Mexico, for example, there are hundreds of trees of this race. Thousands of fruits may be seen at one time in the markets of nearby Orizaba, or in Mexico City. These mangos are practically as uniform in character as are the fruits produced by trees of a grafted variety. *Mango trees grown from polyembryonic seeds reproduce the characteristics of the parent (provided they are true nucellar embryos) just as do trees propagated by other vegetative means.* It is a remarkable phenomenon, if it can be called such, which occurs in connection with two other genera included in the present treatise, the citrus fruits and the mangosteen.

It is not necessary nor practical to attempt a description of the minor races or groups of mangos which exist within these two major ones, for the subject is not sufficiently understood to make possible a complete and accurate classification. Indeed, the classification into the two major groups of monoembryonic and polyembryonic mangos does not hold invariably for it has been observed that seedlings of monoembryonic mangos may revert to polyembryony.

There are among the fine grafted mangos of India, a number of more or less natural groups, that is, several or more varieties which have in common characteristics of growth or fruiting habit or fruit characters which indicate natural relationships. The same is true of seedling mangos in tropical America. Many such groups are recognized in this part of the world; mango de seda, mango espada, and the like. Quite probably the existence of such groups is due in great part to the perpetuation of racial characteristics through polyembryony.

Among the fine grafted varieties of foreign origin which have been tested sufficiently in tropical America the following are some of the best.

MULGOBA

Introduced into Florida in 1899 from Bombay, India this is without doubt one of the world's finest mangos so far as quality is concerned. In many climates, however, it does not bear regularly nor produce large crops, hence its commercial

cultivation has not been profitable. It is noteworthy for its delicious flavor and freedom from fiber. In regions where climatic conditions are particularly favorable it should by all means be included in the home garden.

HADEN

This variety originated in Florida as a seedling of *Mulgoba*. It has become popular as a commercial mango because of its large size, its brilliant coloring, and its productiveness. While not the equal of *Mulgoba* in quality, it is a good mango with only a small amount of fiber. In Central America it has been planted more widely than any other grafted mango. Many seedlings of *Haden* have been grown in Florida. Several of these have been named and propagated by grafting.

AMINI

This small mango is almost the equal of *Mulgoba* in quality. Its aroma is delightful, its color beautiful, but the tree rarely yields heavy crops. Probably for this reason it has not attained commercial importance in Florida, where since 1900 the cultivation of fine mangos has received much attention. As in the case of *Mulgoba*, wherever climatic conditions are particularly favorable *Amini* deserves a place in the home garden.

PAIRI

(Sometimes spelled *Paheri*)

This variety belongs to the Bombay group, which includes many of the finest Indian mangos. It is a medium sized fruit, beautifully colored, of excellent quality, with practically no fiber. It rarely produces large crops and for this reason is not recommended for commercial cultivation except under the most favorable conditions of climate.

JULIE

This is an unusual mango for two reasons: the tree never attains large size, and it produces fair crops of fruit when many other varieties fail to do so. For this latter reason it has

become quite popular in Jamaica were grafted mangos have been grown for many years. *Julie* is a medium sized fruit, flattened on the sides, not highly colored, of good quality, but not as free from fiber as some of the Indian mangos.

SAIGON OR CAMBODIANA

This variety obviously is related to the Philippine or Manila mangos of Cuba and Mexico. It has been propagated by grafting but not widely planted in tropical America as yet. It is a long yellow fruit, flattened on the sides. Like other mangos of the Philippine race, the flavor is distinct from that of the Indian varieties.

CULTURE OF THE MANGO

One who has seen the tremendous crops produced by the seedling mango trees which are so abundant in tropical America finds it hard to understand why the fine grafted varieties seldom bear heavily.

Leaving out of account the fungus disease known as anthracnose, which destroys the flowers and young fruits of ordinary mangos as well as fine ones, the problem primarily is one of nutrition. On soils which are rich and moist, vegetative growth continues intermittently throughout the year and there is no accumulation of reserves in the leaves and branches to result in fruit production. In wet climates no practical method of inducing good crops of fruit has been found.

On the other hand, where there is a long dry season, especially if this coincides with the flowering and fruiting season, proper management will usually produce fairly good results. Once they have attained bearing size trees should receive little or no fertilizer unless the soil is extremely poor, and they should be given little or no water during the dry season.

Those who wish to grow fine grafted mangos commercially should by all means make a thorough study of local conditions before going into the business. The best mango regions in Central America are on the Pacific coast and in a few dry valleys on the Atlantic side, not near the ocean. Elevations between sea level and 1000 meters are suitable; mangos are occasion-

ally grown up to 1200 or 1300 meters. They should never be planted on soils which can not be dried out thoroughly.

Unfortunately this tree is not as easy to propagate by budding or grafting as are the citrus fruits and the avocado. However much depends upon climatic conditions. In regions of high humidity grafting is more successful than in extremely dry ones.

Up to now little attention has been given the subject of rootstocks. Common seedling mangos of all sorts are used. In Java the variety *Mudoe* is considered superior for this purpose and eventually it may be found that certain races or varieties make better rootstocks in Central America than others.

Seeds for the production of rootstocks should be sprouted, after removing the husks, in beds of sand or other moist material. When they are about 20 cms. high the young plants can be moved to the field, where they can be grafted when they have attained sufficient size and are in vigorous growing condition.

Shield budding has not generally proved as successful in this region as bark grafting, side grafting and veneer grafting, using tips of branchlets not in active growth at the time they are cut.

To keep the cions from drying out while a union is being formed a cap of waxed paper or plastic can be tied around them, or simpler still, a section 30-40 cm. long cut from a banana leafstalk can be placed over the cion to keep it moist. With a sharp stick a hole should be punched in the leafstalk so that it can be slipped over the cion without damaging the latter.

Mango trees require little pruning. As everyone knows, they usually form shapely compact crowns even with no help at the start. Grafted trees of most varieties come into bearing three to five years after they are planted in the orchard.

The disease known as anthracnose, caused by the fungus *Colletotrichum gloeosporioides*, is common in mango-growing regions. It is serious only in damp weather when it may destroy flowers and young fruits. On mature mangos it manifests itself in the form of black spots which spread as the fruit ripens. While this disease can be controlled by spraying with Bordeaux mixture, the treatment is so expensive that few growers are likely to use it. To protect flowers and fruits in regions

must be sprayed at weekly intervals until the fruits are at least six weeks old.

Scale insects attack the mango tree sometimes to an extent which demands control by spraying with oil emulsions. The presence of scales on the tree is often indicated by sooty mould, a fungus which develops on the leaves while feeding on the secretions of the insects.

The most troublesome pests in Central America, however, are fruit flies of the genus *Anastrepha* whose fat white larvae are well known to most people who have eaten mangos in this part of the world. These flies lay their eggs in immature fruits. Here they hatch and when the larvae have completed their development they crawl out and drop to the ground. In the pupal stage they live in the soil until they emerge as adult flies and repeat the cycle.

Though some study of the subject has been made, no satisfactory control methods have been devised due in large part to the fact that the flies breed in many wild or semi-wild fruits such as guavas and jocotes. It does little good to destroy infested mangos, for the insects promptly come in again from adjacent regions. The most hopeful feature of the situation is this: some varieties are quite resistant to fruit fly attack, others highly susceptible. *Julie* seems to be resistant at Escuela Agrícola Panamericana; *Saigon* or *Cambodiana*, on the other hand, is highly susceptible.

THE CASHEW OR MARAÑÓN (*Anacardium occidentale*)

This tropical American tree is cultivated on a small scale in several parts of the world. Most of the cashew nuts which enter into commerce, however, are produced by wild or semi-wild trees of which there are many in India, as well as in some parts of tropical America. The fruit is a peculiar one in that the fleshy part from which jelly and wine is made is in reality the peduncle or swollen fruit stalk while the seed or nut constitutes what is, botanically speaking, the fruit itself.

The cashew is not commonly propagated vegetatively and

*Anacardium occidentale*

Courtesy Chicago Natural History Museum

has received scant horticultural attention. It thrives best in hot semi arid climates but can be grown up to altitudes of at least 1000 meters. It grows on almost pure sands along the Brazilian coast, on rocky hillsides in Central America, and in the good soils of gardens and dooryards.

Trees should be planted about ten meters apart. They come into bearing at an early age, three or four years.

THE JOCOTE OR SPANISH PLUM

(*Spondias purpurea*)

This tree is of considerable importance in many parts of Mexico and Central America. It occurs in a wide range of

*Spondias purpurea*

Courtesy Chicago Natural History Museum

seedling races or forms propagated vegetatively by means of large cuttings which are placed in the ground to serve as fence posts.

There are no particular requirements as regards soil; with regard to climate, the jocote can be cultivated from sea level up to elevations of about 2000 meters.

While the fruits commonly have large seeds and a relatively small amount of flesh, occasional forms are seen which are worth propagating. This is especially true of some of those which grow in the Guatemalan highlands.

Spondias lutea, another species of this genus, grows wild throughout Central America. It is commonly called jobo, and is not highly esteemed due to the acidity of its small yellow fruits, which, in addition, are frequently infested with the larvae of fruit flies.

FAMILY SAPINDACEAE

The Sapindaceae, commonly known as the soapberry family, is a group of some 125 or 130 genera and 1000 species, most of which are native of tropical and subtropical regions. As far as Central America is concerned the best known member is undoubtedly the jaboncillo (*Sapindus saponaria*), the small brownish fruits of which are sold in markets and used in place of laundry soap.

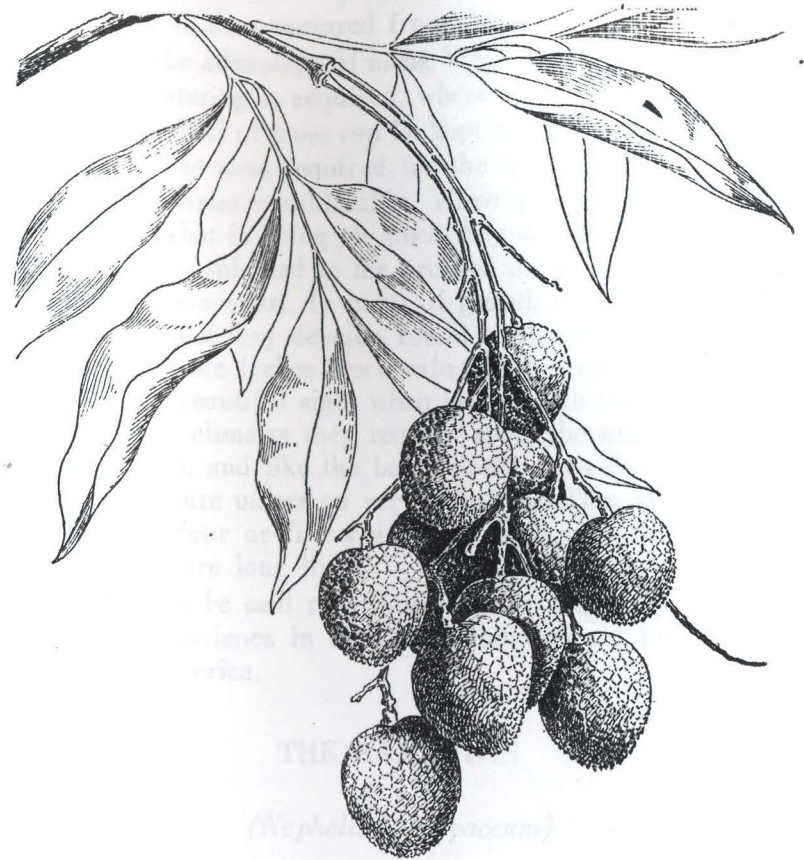
Horticulturally, the members of greatest interest are those which produce edible fruits. Unquestionably the Chinese Lychee or Litchi is the best. The Rambutan is of particular value because it grows and bears well on the wet Caribbean littoral where there is no surplus of good dessert fruits. The Mamoncillo (*Melicocca bijuga*), the only Central American member of the family notable for its edible fruits, is seen in dooryards of dry regions around the Caribbean and in the islands.

THE LYCHEE OR LITCHI

(*Litchi chinensis*)

One of the major purposes of this treatise is to call the attention of Central Americans to fruits which are new or little known in this region and which are at the same time worthy of extensive cultivation. The lychee is unquestionably one of these. Indeed, its fruits are so delicious that the people of south-eastern China, probably the native home of this species, consider them superior to oranges and peaches.

A word of explanation is necessary in connection with this statement. Chinese residents of Central America commonly import dried lychees from Canton, and at Christmas time present them to their Latin friends. Dried lychees taste more like raisins than like fresh lychees. The latter are about the size and color of large ripe strawberries; they have thin, tough, rather brittle skins within which is translucent white flesh, juicy, resembling the Muscat grape in flavor. There is a single seed, large in most varieties, but in some of the best ones relatively small.



Litchi chinensis

Courtesy Chicago Natural History Museum

In Central America the cultivation of this tree is of too recent origin to have provided much information about varieties. Colonel William R. Grove, who has done more than any other person to encourage lychee cultivation in this hemisphere, has clarified the subject to some extent, as has also G. Weidmann Groff who spent many years in southern China and in 1921 published a book in which he described the fine lychees of that region.

Probably many years will pass before the best varieties are available in Central America. In the meantime one should not hesitate to plant those which can be had, wherever conditions of climate and soil are suitable.

Being a subtropical rather than a tropical tree, it is often stated that the lychee requires a certain amount of winter chilling in order to produce good crops. Experience in Honduras and Guatemala suggests this need can largely be replaced through exposure to severe dry seasons. At Lancetilla Experiment Station on the wet northern coast of Honduras lychee trees do not fruit well, but fifty miles inland, where the dry season is severe, they have borne good crops, as was first demonstrated by the Pérez Estrada brothers in their remarkable botanic garden at San Pedro Sula.

It is difficult to set altitudinal limits for lychee cultivation in this part of the world. The tree is about as cold resistant as the orange and has done well in Guatemala at elevations of 1500 meters. It is reasonable to believe that it can be grown successfully from sea level to that altitude, or even higher, provided the climate is characterized by a rather severe dry season.

As regards soil, lychees do not seem to be more exacting than citrus fruits. It has been found that a somewhat acid soil is preferable.

The tree is commonly propagated by seeds which do not long retain their viability. The fine varieties must be propagated vegetatively. The method used is known as air layering. It has proved to be the best because lychees are extremely difficult to graft, and hard to rear from cuttings except under very special conditions.

Air layering is an ancient art in tropical Asia. As practiced in China and India it is rather laborious because frequent watering is required. A method developed by Colonel Grove of Florida avoids this. A small healthy branch, not more than one cm. in diameter, is selected and a ring of bark about 1 cm. wide is removed. A ball of wet moss or a mixture of moss and loamy soil is formed around the area from which the bark has been removed, extending about 5 cms. above and below. The ball should be sufficiently large to permit the development of a good root system, perhaps six to ten centimeters in diameter. It should be firmly wrapped with string to hold it in place, and then it should be covered tightly with Goodyear Vinyl film or other plastic which does not permit the evaporation of moisture. This is tied closely above and below the ball.

No further attention is required until roots have formed. The young plant is then removed from the parent tree.

While the advantage of using Vinyl film or similar plastic is that no watering is required, where these materials are not available the ball of moss can be kept moist by applying water frequently. The time required for the development of a good root system varies considerably. When plastics are used it is easy to see what is going on since they are transparent.

When transplanted to the orchard the trees should be set about 10 meters apart. In habit of growth they are something like mangos and they develop round compact crowns so handsome as to make lychee trees valuable as ornamentals. They are indeed a beautiful sight when loaded with their bright red fruits. In dry climates they require about the same irrigation as citrus trees, and like the latter profit from the application of stable manure unless on very rich soils. They should come into bearing four or five years after they are planted in the orchard, and are long lived.

Little can be said regarding pests or diseases since practically no experience in this connection has yet been gained in Central America.

THE RAMBUTAN

(Nephelium lappaceum)

The rambutan, whose native home is in the Malayan Archipelago, is of value in wet lowland regions, where it thrives and produces abundantly its handsome yellow or red fruits, the size of hens' eggs, covered with soft spine-like protuberances. Rambutans are much like lychees though not so delicious.

This species was introduced through Lancetilla Experiment Station in 1927. It has been propagated to a limited extent and planted in a few other regions. It does not thrive in the cool dry climate of the Escuela Agrícola Panamericana (elevation 800 m.). It is probably safe to say that it should be cultivated only in regions of relatively low elevation with abundant rainfall. It does not grow to such large size as the lychee nor is it so decorative. Propagation is by air layering as with the latter, and also by seeds which are easily grown.



Nephelium lappaceum

Courtesy Chicago Natural History Museum

Very similar to the Rambutan is the Pulasan (*Nephelium mutabile*), also introduced through Lancetilla Experiment Station in 1927 from the same part of the world, that is Malaya. The fruit of this tree can be distinguished from that of the rambutan by the short blunt protuberances in place of slender spine-like ones. Propagation and cultura requirements are the same as for the rambutan.

FAMILY VITACEAE

While the family Vitaceae includes about ten genera and five hundred species, its horticultural importance lies mainly in the grapes of the Old and New Worlds, some fifty species in all.

Everyone is interested in grapes. Their cultivation in the Old World dates back five thousand years or more. They are used in many ways, as dessert fruits, for the manufacture of wines, or dried as raisins.

The grapes presently receiving attention in Central America may be divided into three groups: (1) European grapes, that is, varieties of *Vitis vinifera*, which are the best known in this part of the world; (2) American bunch grapes, in the formation of which several species have taken part, principally *Vitis Labrusca* and *V. vinifera*; and (3) Muscadine grapes, which are varieties of *V. rotundifolia*, a species native to the southeastern United States.

The future of grape growing in the tropics may ultimately be influenced by the hybridization of some of the above with such tropical species as the common agraz or uva silvestre, botanically *Vitis tiliaefolia* (*V. caribaea*), whose small acid fruits are not an uncommon sight in local markets; and *V. Popenoei*, the totoloche of southern Mexico, which so far as known is the southernmost representative of the Muscadine group.

EUROPEAN GRAPES

Since the earliest days of colonization, varieties of *Vitis vinifera* have been planted in tropical America. They continue to be planted. Many vines growing in patios where they are warmed by surrounding walls mature good crops of fruit. Very few plantings made in the open have been successful, though stories persist to the effect that vineyards existed and wine was made in Central America during colonial times, for example at San Jerónimo in Guatemala. Tradition also says that the King of Spain finally forbade the cultivation of grapes in the American colonies in order to protect the wine industry of the mother country.

For more than a century there have been no restrictions on grape growing in this part of the world. Still, in spite of many attempts, there are no extensive vineyards and little if any wine is made.

Professor Bioletti wrote in 1929 ("Elements of Grape Growing in California"): "The vinifera grape is a typical fruit

of semi-arid subtropical regions. It will not thrive in regions of humid summers, whether temperate or tropical, nor in regions of intense winter cold, nor of short or cool summers. Its essential requirements in this respect are a hot dry summer and a cool wet winter. . . Rains after the grapes begin to ripen are deleterious unless they are light and short. A humid atmosphere during warm weather makes it very difficult to control fungus diseases such as Peronospora, black rot, and anthracnose”.

There exist in tropical America, as for example in the Cauca Valley of Colombia, and near Valencia in Venezuela, occasional small commercial plantings of vinifera grapes. Never the less, the experience of four centuries seems to indicate that the future of grape culture in this part of the world lies not in European varieties but in others which are better adapted to tropical climates, as would be inferred from Professor Bioletti's summary of essential climatic conditions.

AMERICAN BUNCH GRAPES

At first glance it seems difficult to understand just why the American grapes, which are natives of relatively cold climates, should do better in the tropics than European varieties which have their origin in subtropical ones. The answer lies mainly in resistance to certain diseases.

Unfortunately, American grapes are not always as sweet as those of Europe and Asia, and they are characterized by a musky flavor. For these reasons they are not so popular with Latin Americans. Plant breeders, notably Joseph L. Fennell of Florida, are working toward the development of hybrids which will succeed in tropical climates and at the same time have the quality of European grapes. Pending complete success of these efforts, the cultivation of present day varieties of American bunch grapes offers the best possibilities.

For many years the variety *Isabella* has been cultivated successfully in Brazil and Colombia on a commercial scale. It is difficult to say just why this is the only American grape which up to now has been grown commercially in this part of the world. It is, however, a vigorous grower, disease-resistant

and productive. It is believed to be a hybrid between *Vitis Labrusca* and *V. vinifera* but has more characteristics of the former than of the latter.

There are numerous other varieties which might well be planted experimentally. A few of these have already been tried in several places. *Beacon*, like *Isabella*, is a black grape (more properly dark blue) which originated with the late T. V. Munson, a famous Texan grape breeder. *Caco*, red in color, has been suggested for trial, as has also *Catawba*, another red grape. Both of these are considered to be hybrids between *Vitis Labrusca* and *V. vinifera*. *Delaware* is a small red grape of mixed parentage, notable for its fine quality. *Diamond*, the fruits of which are pale green in color, is a thrifty grower and prolific bearer. *Golden Muscat*, another “white” grape, was produced recently by the New York Agricultural Experiment Station and has been strongly recommended for its vinifera-like flavor. *Niagara* is an excellent variety, pale green in color, of good quality. A grape believed to be this one has been grown in the highlands of Guatemala for some years and has proved satisfactory there, though it is not a very strong grower. *Pierce* is similar to *Isabella*, perhaps even better in quality.

This list provides an adequate idea of the wealth of material available for trial. It may fairly be said that the possibilities of grape culture in Central America have scarcely been touched, largely because (as above pointed out) past efforts have been limited chiefly to the planting of European varieties.

Experience with *Isabella* and one or two other American grapes has shown that they succeed in the tropics at elevations between sea level and 2000 meters, or even higher. They are not exacting as to soils. Sandy or gravelly clay loams are perhaps the best ones; extremely rich soils should be avoided because they encourage vegetative growth at the expense of fruit. Grapes are by nature drought resistant but should be given occasional irrigations during the dry season.

Because of the damage done by an insect known as Phylloxera, European vineyardists many years ago were forced to graft their fine varieties on resistant rootstocks. Since it has not yet become necessary to worry about this problem in Central America, grapes of American as well as the European va-

rieties can be propagated by cuttings. These should be made when the plants are in a more or less dormant stage. They should be of fairly mature wood about the diameter of a lead pencil, and long enough to include three nodes. They should be planted in sand or soil, leaving about one-third of the cutting above the surface. A year after planting they can be transferred to permanent places in the field.

Vines may be set about three meters apart. They can be trained on trellises made by stringing two wires between posts placed five or six meters apart, or they may be grown (as in the Cauca Valley of Colombia) by training them on overhead trellises called barbacoas. These latter are formed by stringing wires in both directions a meter or less apart, on overhead supports about two meters above the ground.

Proper pruning constitutes the chief problem in connection with grape culture. In the Temperate Zone where cold weather results in a long dormant season, pruning is done once a year and only one crop is produced. In tropical America pruning is commonly done twice a year and two crops are obtained. This is possible because the vines have no well defined dormant season. The production of two crops probably shortens the life of the vine. In Colombia *Isabella* remains in production ten to fifteen years.

Since fruit is borne on new growths, and only near the base of these, pruning must be severe once the vine has been developed to a point where it has canes of sufficient length. These canes are trained to the wires or over the barbacoa and induced to produce the maximum number of side shoots, which are cut back after each crop. Two or three buds are left on each "spur" to produce new wood for the following crop.

Though European grapes, when grown in the tropics, are attacked by mildew and other diseases, American grapes are highly resistant and require no spraying in most cases. Bordeaux mixture can be used if necessary.

THE MUSCADINE GRAPES

This group is practically unknown in Central America. Several varieties, however, have been planted experimentally with promising results.

As has been mentioned above, the Muscadine grapes are horticultural varieties of the wild species *Vitis rotundifolia*. *Flowers*, *James*, *Scuppernong* and *Thomas* are well known varieties offered by nurserymen in the southern part of the United States.

The fruits of Muscadine grapes are not borne in large bunches but in small clusters. They have rather thick skins, commonly brownish or purplish in color, and sweet juicy pulp of milder flavor than that of grapes which have *Labrusca* blood.

In Central America the Muscadine grapes have exhibited a high degree of disease resistance. Propagation by cuttings is not as successful as with other grapes; layering is the method usually practiced in the United States.

The vines grow to large size. They are commonly planted five or six meters apart and trained on overhead trellises. They require relatively little pruning. To insure abundant production it is necessary to plant male vines to provide pollen.

FAMILY GUTTIFERAE

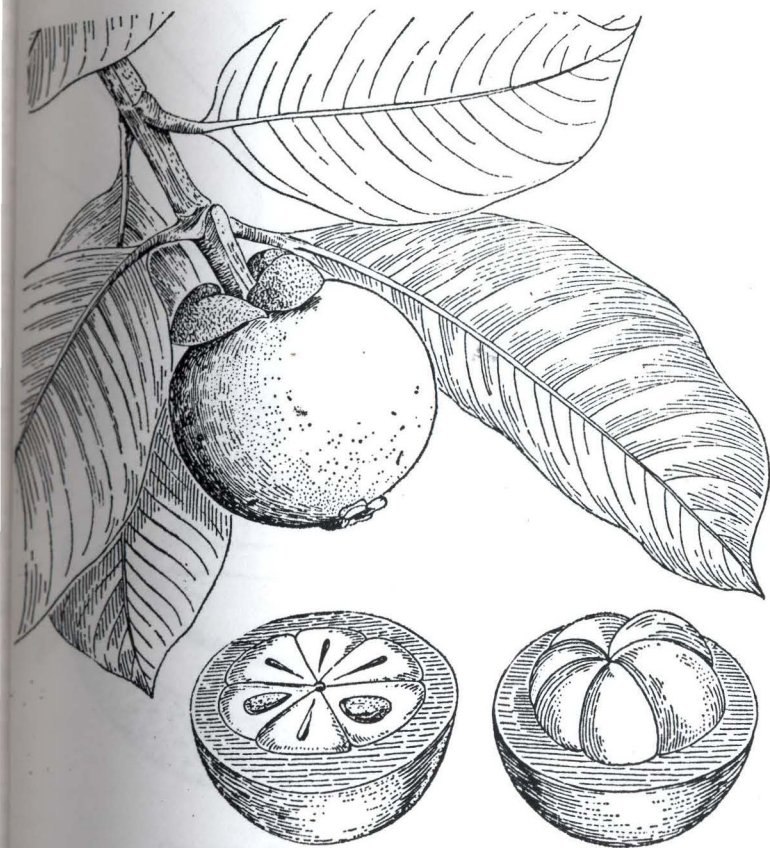
The family Guttiferae includes about 40 genera and 800 or 900 species, most of them tropical in origin. From the standpoint of Central American horticulture the two most interesting members are the mangosteen and the mamey.

THE MANGOSTEEN

(*Garcinia Mangostana*)

Often called the "Queen of Fruits", the mangosteen, probably native to Malaya, is not cultivated on an extensive scale even in that part of the world. When David Fairchild, who probably is entitled to be called the father of mangosteen culture in tropical America, visited Lancetilla Experiment Station, he remarked that the orchard of some 600 trees which he saw there was perhaps the largest in existence.

The fruit of this rare and rather delicate tree is the size of a mandarin orange, slightly flattened at both ends, with a thick and almost woody rind, red-purple in color. Inside are five or more white segments of delicately flavored juicy flesh

*Garcinia Mangostana*

Courtesy Chicago Natural History Museum

tasting somewhat like a fine plum and melting in the mouth like ice cream.

No well defined varieties are recognized, due most probably to the fact that this species is characterized by the phenomenon described in connection with the mango, i.e., embryos are not derived from fertilized ovules but from the tissues which surround these. Seedlings thus come as true to their parents as would grafts or trees grown from cuttings.

Though the mangosteen is exacting with regard to its environment there are many places in Central America where it can be grown successfully, as has been amply demonstrated

by experiments in Guatemala, Honduras, Costa Rica and Panama. It likes a moist warm climate, such as that which characterizes the Caribbean coast at elevations below 500 meters. It does not tolerate much drought, a well distributed rainfall being highly desirable. It does best on soils rich in organic matter and it must have good drainage.

While it has been shown that the mangosteen can successfully be grafted, propagation by seeds is the method usually employed. Since seeds live but a few days after removal from the fruit (unless carefully packed in slightly moist moss, charcoal or similar material) they should be planted promptly. Young trees are rather hard to rear. They should be given plenty of space for root development, and great care must be taken when transplanting them to the orchard. It is usually desirable to protect them during the first two or three years by providing shade, except on the side least reached by the sun. They grow more slowly than many other fruit trees, rarely coming into bearing before they are six to eight years of age. In favorable climates no special cultural attention is required.

The original orchard at Lancetilla, planted in 1927, sometimes produces large crops and in other years has failed to do so. For this reason, as well as for the long time required to reach bearing age, and the delicate nature of the fruit which makes shipment something of a problem, the commercial future of the mangosteen may not be great, but as a tree for the home garden it is highly to be recommended.

THE MAMEY OR MAMEY DE SANTO DOMINGO

(*Mammea americana*)

Probably indigenous in the West Indies and the northern part of South America, the mamey is often seen in home garden throughout the Central American lowlands. Its oblong glossy dark green leaves give it an ornamental value, while its large, round fruits are much appreciated when stewed or made into dulces. The bright yellow flesh, juicy but of firm texture, contains one to four large seeds and has a sprightly flavor often compared to that of the apricot.

The mamey can be grown from sea level up to elevations

ica several other species of *Carica* are cultivated, but none of these is to be seen in Central American gardens.

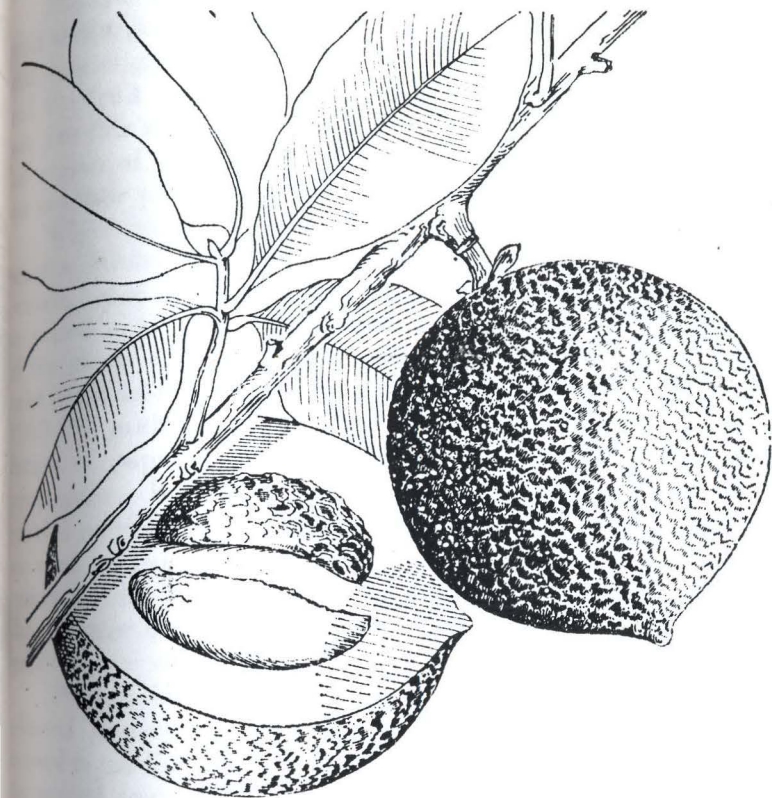
THE PAPAYA (*Carica Papaya*)

While the papaya is without doubt a native of Mexico or Central America, the wild species from which cultivated forms have been developed is not definitely known. Basing their belief upon the great variability exhibited by cultivated specimens, some botanists hold that they are of hybrid origin. Many more or less well defined races or strains are grown.

In Central America papayas are commonly divided into two groups, one of which has fruits with yellow or orange-yellow flesh, the other salmon-colored or salmon-red. In several parts of the world selections have been propagated by seed and given varietal names, but these selections are races rather than true varieties. When propagation by seed is continued from generation to generation variations occur. To maintain an acceptable degree of uniformity constant selection must be practiced.

Commonly and typically the papaya is dioecious, that is to say, female flowers which produce fruits are borne by one individual, male flowers which yield pollen to fertilize the female flowers are borne on a separate one. In cultivation there are so many deviations from this typical behavior as to be bewildering. To be convinced of this one has only to read the resumé of investigations which is to be found in Professor Chandler's work "Evergreen Orchards".

Forms which are more or less hermaphrodite in character are well known. From the standpoint of the practical grower this is important, for by planting seeds of such forms and selecting from generation to generation it is possible to have an orchard in which nearly all of the trees produce fruit. If, on the other hand, seeds of typically dioecious forms are used, about half of the plants will turn out to be males, and since it is not possible to distinguish these until the seedlings are some months old and have come into flower, they represent a considerable economic loss to the grower.



Mammea americana

Courtesy Chicago Natural History Museum

of about 1000 meters both in wet and semi-arid regions, more successfully, perhaps, in the latter. It does not seem to be exacting with regard to soil, but probably does best on well drained sandy loams.

Seedlings do not come into bearing until six to eight years of age. Little has been done as yet to select superior individuals and propagate them by grafting.

FAMILY CARICACEAE

The Caricaceae, a small family whose members are natives of tropical America, is of interest principally because it includes the well known papaya. In the Andes of South Amer-

Papayas do well on many different soils, but must have good drainage. They can be grown throughout tierra caliente and even slightly above the limits of that zone. They do best and the fruit is of superior quality if the climate is not too wet. For this reason certain places in Central America, such as the region of Escuintla in Guatemala, have local reputations for superior papayas.

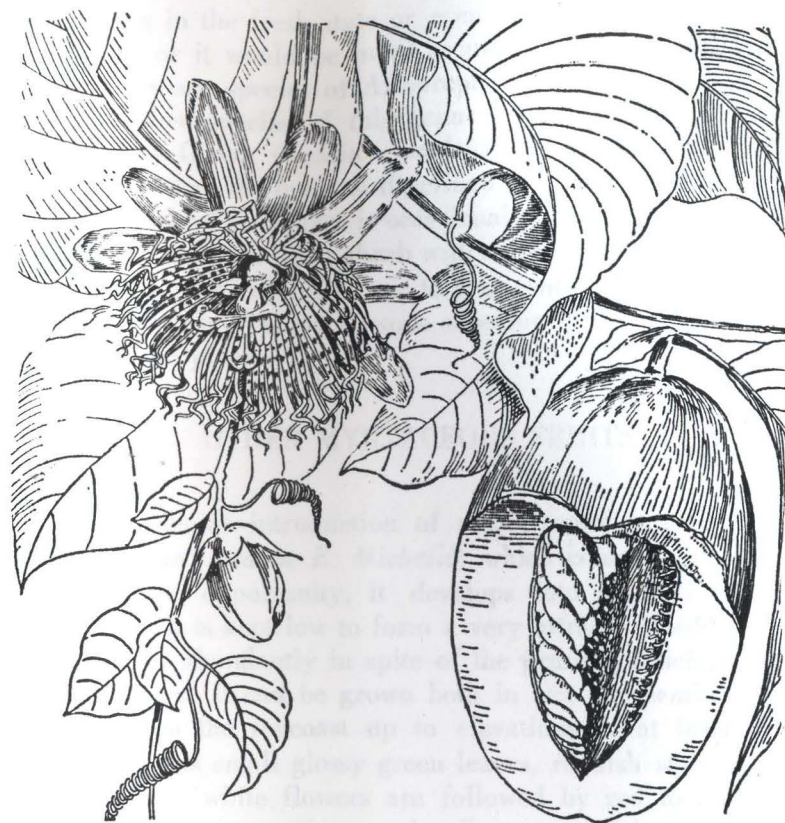
While grafting is feasible it has not become a common practice, probably for two reasons, (1), papaya plants rarely branch, hence it is difficult to obtain cions. This problem can be solved to a certain extent, however, by cutting off the tops of the plants and forcing into growth the dormant buds which exist in the leaf axils. (2), When it was shown in Florida about 1910 that grafting was not difficult, it was suggested that the future of papaya culture lay in the use of this method of propagation. But when the grafting of named varieties was carried on to the third or fourth generation, the plants became so weak and stunted that they were useless. The problem requires further investigation. Young plants which have attained the diameter of a lead pencil, or somewhat more, can be cleft grafted quite successfully.

Propagation by seed presents no problems. Seeds are planted in boxes or other containers; the young plants are moved to the field when 15 to 20 centimeters high. They should be spaced four or five meters apart. In warm climates they come into bearing when eight to ten months old. They rarely remain in profitable production more than three or four years, sometimes less.

Papayas are subject to one or more mosaic diseases, probably caused by viruses. These stunt their growth and eventually kill them. No effective means of control are known. Possibly breeding for resistance may eventually provide the solution to this problem. In some regions and in some seasons the fruits are infested by the larvae of a fruit fly of the genus *Toxotrypana*. As in the case of the *Anastrepha* flies which attack mangos and other fruits, no satisfactory control is known.

THE GRANADILLAS

The granadillas, of which two species are common in Central America, belong to the Passifloraceae, a family so



Passiflora quadrangularis

Courtesy Chicago Natural History Museum

closely related to the Caricaceae that the two were not separated by some of the earlier botanists. The family is a large one, some 300 species or more, many of which are climbing plants.

The most popular member of this family is *Passiflora ligularis*, widely grown in the highlands at elevations around 2000 meters. It is a vigorous climber whose egg-shaped orange or sometimes purplish fruits have a thin, brittle shell surrounding numerous small seeds imbedded in whitish juicy pulp of delicate perfumed flavor.

Another species, *Passiflora quadrangularis*, is grown only in the lowlands where it produces fruits of large size, up to

20 centimeters or more in length, of rather inferior quality. Propagation is by seed and by cuttings.

FAMILY MYRTACEAE

While the family Myrtaceae is a large one, comprising more than 70 genera and some 3000 species, most of which are natives of Australia and the American tropics, it does not include edible fruits which can vie with such favorites as the orange, the avocado and the mango. The common guava is one of the most important. From Brazil have come several Myrtaceous fruits occasionally seen in Central America which merit more extensive cultivation.

THE COMMON GUAVA

(*Psidium Guajava*)

Though commercially valuable because it forms the basis of a considerable industry, the manufacture of jams, jellies and preserves, probably more people in tropical America are interested in exterminating guava bushes than in cultivating them. They grow wild in many regions, often infesting pastures to an extent which makes them a nuisance. Most of the jellies and jams are made from the fruits of wild or semi-wild plants.

Many different kinds of guavas exist, which may be classified more properly as races rather than varieties, for none is propagated vegetatively to any extent. Some are relatively large and have few seeds, others are small with many seeds. The flesh may be white or yellowish or salmon-red.

In recent years considerable attention has been devoted to the selection and propagation of guavas at the Subtropical Experiment Station, Homestead, Florida. Cuttings are hard to grow and grafting is difficult. Air layering may prove to be the best method of asexual propagation, but is slow and laborious.

Little need be said regarding the culture of this plant. The fact that it becomes a pest in many regions sufficiently indicates its requirements.

The guava has one enemy, common in many parts of tropical America, which often makes its fruits unsatisfactory

for eating in the fresh state or even when cooked. This is the fruit fly, or it would be more accurate to say fruit flies, for more than one species of *Anastrepha* is involved.

Another species of this genus known as the Cattley or Strawberry Guava (*Psidium cattleianum*) is more popular in California than the one just described largely because it resists colder weather. This plant is occasionally seen in Central America. It is a medium sized shrub with small, thick, glossy leaves. The round, dark red fruits, two to four centimeters in diameter, are considered by many persons superior in flavor to those of the common guava.

OTHER MYRTACEOUS FRUITS

A welcome introduction of recent years is the Pitanga (*Eugenia uniflora* or *E. Michellii*) which comes from Brazil. If given the opportunity, it develops into a small tree but commonly it is kept low to form a very attractive hedge plant. It produces abundantly in spite of the pruning which must be given hedges. It can be grown both in wet and semi-arid climates, from the seacoast up to elevations of at least 2000 meters. It has small glossy green leaves, reddish when young. Its attractive white flowers are followed by red to dark red fruits about two centimeters in diameter which are characterized by an aromatic, almost pungent taste. They are excellent for jellies and sherbets.

The pitanga is easily propagated by seed and it succeeds on almost any soil. Its culture presents no difficulties.

Another recent immigrant from Brazil is the Grumichama (*Eugenia Dombeyi*) which develops into a somewhat larger tree than the pitanga, though it will not do this rapidly, for its growth is very slow. Its leaves are larger than those of the pitanga, dark green in color and glossy. The white flowers resemble cherry blossoms, and the fruits suggest European cherries in size and color, perhaps even slightly so in flavor.

The grumichama thrives from sea level up to elevations of 1000 meters or more but is happiest in warm moist climates. It yields abundantly of its attractive little fruits and forms a welcome addition to the home garden.