

*Guilielma utilis*

Courtesy Chicago Natural History Museum

THE PEJIBAYE

In this native palm (*Guilielma Gasipaes*, also known botanically as *Guilielma utilis*) Central America has a fruit-bearing species of its own which is fully appreciated in only a few regions, notably in Costa Rica.

As a wild or naturalized plant the pejibaye (sometimes spelled pejivalle, and there are numerous other common names) occurs from Nicaragua southward to Bolivia, and thence eastward into the Amazon basin. In cultivation it is commonly seen around humble homes on river banks or on the littoral.

In several parts of Costa Rica and Panama, however, there are small commercial plantings.

The pejibaye may reach 15 meters in height. It has a slender trunk covered with long sharp spines. The species is monoecious, male and female flowers being produced upon the same plant. The fruits, which are borne in compact clusters, weighing 10 kilograms or even more, are sometimes nearly as large as a hen's egg but more sharply pointed, and in color range from light yellow to orange-scarlet. Occasional palms produce seedless fruits, but there is normally a single large hard seed. The flesh is mealy or farinaceous in texture and is eaten after being boiled in salted water. It is highly nutritious, containing as much as 35% of carbohydrates, 5% or even more of fats, and several vitamins in good quantity.

In Costa Rica the pejibaye is cultivated occasionally at the altitude of San José (1100 meters) but it is much more commonly seen at lower elevations. It will not produce much fruit, or very good fruit, in extremely dry climates. It is essentially a plant of the rain-forest zone. As regards soil it does not seem to be exacting. Propagation is almost invariably by seed, though efforts have been made to reproduce some of the seedless forms by planting the suckers which spring up around the base of the palm in small numbers. Under favorable conditions, pejibayes grown from seeds come into bearing when they are three or four years old, and a mature palm may yield four or five large bunches of fruit annually. Because it is so easy to grow; because it yields so abundantly of its nutritious fruit; and because the latter is so palatable, the pejibaye should be cultivated more extensively than it is today.

FAMILY BROMELIACEAE

The Bromeliaceae is a family of some 35 or 40 genera and upwards of a thousand species native to tropical and subtropical America. Many bromeliads are epiphytic on trees and are known by the common name *pata de gallo*. One, the *piñuela* (*Bromelia Pinguin*), is commonly used to form hedges and the oblong, yellow or reddish rather acid fruits are occasionally sold in the markets. The really important member of the family is the pineapple, well known to everyone.

THE PINEAPPLE

Botanically *Ananas comosus* (*A. sativus*, *Ananassa sativa*, etc.), native to Brazil and adjacent regions, this plant was widely cultivated in tropical America before the arrival of Europeans.

Today it is grown throughout the tropical world and extends into the subtropics. It has attained its greatest importance in Hawaii, where the production of canned pineapple and pineapple juice has reached tremendous proportions. There is a smaller industry of this sort in Malaya, while Cuba and Puerto Rico produce considerable quantities of fresh pineapples for shipment to the United States. Several attempts to grow pineapples in Central America for the export trade have met with discouraging results, but this region produces enough for its own needs.

Two varieties constitute the bulk of the world's commercial production. These are *Smooth Cayenne*, practically the only one cultivated in Hawaii, and *Red Spanish*, grown and exported as fresh fruit from the West Indies. The first-named possesses qualities which make it particularly suitable for canning, while the second suffers less when transported long distances and placed on the market in the form of fresh fruit.

These and several other varieties are grown in Central America, often under names which vary from place to place. Certain regions are famous for their pineapples, as Taboga Island in Panama, Alajuela and Turrialba in Costa Rica, Chamelecón in Honduras, and so on.

Pineapples are cultivated from sea level up to elevations of about 1500 meters. If the fruit is to be shipped any great distance it should be grown in a relatively dry climate but for local consumption excellent pineapples are produced in climates as wet as that of Turrialba in Costa Rica. The best soils are some of the friable clays not too rich in nitrogen, or light sandy soils which have the same characteristic. Soils which are too rich produce fruit which is fibrous and of inferior flavor.

Although certain varieties occasionally produce seeds, these are used only by plant breeders interested in developing new varieties. For practical purposes, propagation is limited

to the use of vegetative material of three closely related sorts: the ratoons which arise from the stem below the surface of the soil or close to it; suckers which arise from leaf axils above the ground; and slips, the most numerous of all, which develop around the base of the fruit. These three kinds of material have different names in different regions.

Various planting distances are customary, either in single or double rows. Using single rows the rows can well be 1.25 meters to 1.50 meters apart with the plants about 75 cm. from each other in the row. Using double rows, the distance can be 2 meters between the pairs of rows and the plants slightly less than 75 cm. in the row. In extremely poor soils it may be advisable to use chemical fertilizers, but this is rarely practiced in Central America.

Pineapples mature their first crop 18 to 24 months after planting, depending upon climate and the kind of propagating material used. The plantation may be kept in production for some years by allowing ratoons to develop after each crop, but it is usually advisable to replant after three or four years.

Among insects which attack this crop perhaps the most common is the mealy bug (*Pseudococcus brevipes*), a pest almost impossible to exterminate because it infests roots which are close below the surface of the soil, as well as the leaf axils. Fortunately, if cultural conditions are favorable, control measures are usually not necessary. A fungus disease known as heart rot (*Thielaviopsis paradoxa*) attacks the interior of the fruit, especially in wet regions.

FAMILY MUSACEAE

The Musaceae is a small family, including about six genera and sixty species, all of them tropical in origin, some in the Old World, some in the New. Among its members are those extremely important food plants, the bananas and plantains. Species of the genus *Heliconia* abound in the lowlands of Central America, where they are usually known as *platanillos*. The Abyssinian banana, *Musa Ensete*, probably the largest member of the family, does not produce edible fruits but for its decorative value is grown in gardens and dooryards, principally in the highlands. The so-called "Travelers' Palm",

Ravenala madagascariensis, has been introduced into this part of the world where it is occasionally cultivated as an ornamental plant.

THE BANANA

There are so many forms of the banana that botanists have difficulty in classifying them. It is a common practice to list those which are eaten after cooking under the name *Musa paradisiaca* and those eaten principally in the fresh or uncooked state as horticultural forms of *Musa paradisiaca* var. *sapientum*. The best taxonomic study which has been made of this group, from the practical standpoint, is probably that of Professor E. E. Cheesman who worked for fifteen years at the Imperial College of Tropical Agriculture in Trinidad.

There can be little doubt that all species of *Musa* are natives of the Asiatic tropics where they have been cultivated since time immemorial. Many varieties have originated there and have been perpetuated because vegetative propagation by means of suckers is so simple. It is generally believed that bananas were first brought to the New World in 1514 by Fray Tomás de Berlanga, probably from the Canary Islands.

The commercial cultivation of bananas, chiefly of the kind known variously as Gros Michel, Roatán, Johnson and so on, now forms one of the most important horticultural industries in several tropical American countries, notably Honduras, Guatemala, Costa Rica and Panama. For local consumption numerous varieties are grown. These are known under names which vary from place to place. One is of such importance as to merit special mention. This is the *chato*, *butuco*, *majoncho*, *topocho*, *cuatro filos*, *burro*, etc., the only form which is reasonably successful under highly unfavorable conditions of soil and climate. Throughout Central America (and in numerous other tropical American regions) it is to be seen in small plantations even on the steepest hillsides, where there is scarcely any good soil; and it will continue in production despite six months without rainfall or irrigation. The bunches are small; the fruit short, angular, grayish-green on the surface, rather inferior in quality. It is an important article in the dietary of thousands of small farmers, both as a fresh and as a cooked fruit.

Since there are so many varieties of plantains and bananas, the cultural requirements of which are much the same, and since commercially the Gros Michel far outranks all others in importance, the discussion which follows is concerned with this one.

The ideal climate would be devoid of extremes of temperature, with frequent light rains falling throughout the twelve months of the year, and without strong winds at any time. Obviously, such a climate is rare. There is, however, no place in this region where maximum temperatures are too high for successful banana cultivation; 40° C. is not harmful. On the other hand, if the temperature often goes below 10° C. difficulty will be experienced from chilling (this term is used to express the effect of low temperatures upon the ripening of the fruit). For this reason, commercial production of bananas for export is limited to regions below approximately 1200 meters, more commonly below 1000. A long period of cool weather is a distinct disadvantage.

Where rainfall is not adequate it can be replaced, to a large extent, by irrigation. The frequency with which water must be applied varies with soil texture and climatic factors, but in general it can be said that in regions where periods of dry weather eight weeks or more in duration must normally be expected, it pays the grower to irrigate.

Little can be done to control damage by wind. Probably the best advice which can be given is to avoid planting in regions where winds strong enough to blow down banana plants are known to be of such frequency as to take all profit out of the business. Obviously this is a point on which sufficient knowledge in advance is often lacking. Constant light winds, not strong enough to blow down the plants, must also be taken into account. In some regions these so interfere with normal development, by causing excessive transpiration, as to make commercial banana growing unprofitable.

The best soils are clay loams and fine sandy loams, two meters or more in depth. There are several other satisfactory soils, especially the light clays and even the heavier clays if friable and well drained. The least desirable are the mixtures of coarse sand and heavy plastic clay which exist in many areas. But even the best soils, if there is gravel or a layer of impervious clay at a depth of half a meter or less, should be avoided.

Drainage is a problem in many banana plantations. For best results free or standing water must be kept out of the soil to a depth of one meter at least. Flooding for a few days will not kill the plants, but drainage must be available so that as soon as the flood passes, free water will be taken out of the soil rapidly.

Three drainage factors must be kept in mind. They are (1) outlet, (2) run-off, and (3) drainage ditches. Outlet means that water, once removed from the plantation, can flow away freely until it is finally dumped in some place where it can do no harm. Satisfactory run-off requires that there shall be no low spots where water can stand for a long enough period to injure the plants. Attention to these two factors may be all that is required in some cases, but in many others it is necessary to install drainage ditches of adequate depth, spaced at appropriate distances, to hold down the water table. Proper spacing and depth of these drains is a matter which requires considerable investigation and experience.

Before planting the farm, it is important to decide upon the spacing to be used and the number of mature plants which will be maintained in each "mat". There is an optimum population of mature plants per hectare, the optimum being the number which will yield the largest crop without sacrificing quality of fruit. Optimum population depends in great measure upon two factors, climate and soil.

While planting may be done on the square system, hexagonal planting, on equilateral triangles, increases the number of mats per hectare more than 14%. This system is now widely employed in Central America.

A spacing of 5 x 5 meters on the square, with three mature plants per mat is often used. In any case, it is probably undesirable to attempt a program which requires four plants per mat. Necessity of controlling Sigatoka disease, to be discussed further on, has in recent years been a factor in determining the optimum population. The grower should give this whole problem careful attention before planting, for, once the spacing-pruning program has been set, it can not easily be changed. To control grass, a difficult problem in many plantations, there must be sufficient shade unless more expensive methods are used; but on the other hand fruit quality suffers if shade is too heavy.

The provision of good planting material is a problem which merits more attention than is sometimes given it. Three kinds are used: heads (entire pseudobulbs), bits, and sword suckers. In Central America the first two are practically the only ones employed. They are considered superior to sword suckers because the latter must be handled very carefully to avoid injury in transporting them to the field and they only produce one bunch of fruit in the first crop whereas heads will often send up two strong plants and produce two bunches. If abundant material is available, it is best to use heads from strong young plants about 4 meters high which have not yet produced fruit; and if this kind of material is not available in sufficient quantity, then bits (parts of heads), each piece weighing not less than 3 or 4 kilos are to be preferred. Heads from plants which have produced fruit should never be used, and care should be taken to see that the rhizome tissue is sound and in healthy condition. There must be one or more strong buds or "eyes" on each piece.

On rich soils and in moist climates maintenance of a banana plantation is reduced to its simplest and least expensive form. If the proper shade relation has been achieved, grass is kept under control and it is only necessary to cut down the broad-leaved vegetation which, even under shade, will usually develop if not checked. Cleaning is done with a machete three to five times per year as conditions may require.

The use of chemical fertilizers has become standard practice in banana plantations. Since it has been found that nitrogen is the element usually needed to produce large crops of excellent fruit, such materials as sodium nitrate and calcium cyanamid are the most popular. These are applied at intervals of six to eight weeks during the rainy season. They do not produce such good effects if applied during dry weather, even where irrigation is practiced.

Pruning is necessary. Frequency depends on conditions of climate and soil. The objectives are (1) to maintain at all times the optimum plant population; (2) rapid sequence of crops through selection, from time to time, of those suckers best fitted through origin and position to produce fruit; and (3) protection of these suckers from undesirable competition. In general, pruning consists in saving the first strong, properly

located sucker and removing others so they will not compete. Adequate space must be left between suckers which are destined for fruit production, not less than 75 cms. On rich soils and in moist climates pruning need not be done more than three or four times per year.

Where irrigation is practiced it must be based, as has already been mentioned, not only on climate but also on the texture of the soil. Deep loamy soils sometimes do not require the application of water more frequently than once in three or four weeks; heavy clays may require light irrigation every ten to fourteen days; and shallow soils with sand or gravel beneath may get too dry even on a ten day cycle.

Enemies of the banana plant are numerous, but only a few present serious problems in Central America. Chief among these are Sigatoka and Panama Disease.

Sigatoka, which was not known here before 1934, seems to have had its origin in the Asiatic tropics and to have reached South America in some unknown manner about 1930. It is caused by the fungus *Cercospora Musae* which attacks the leaves of the plant, destroying them to such an extent that marketable fruit may not be produced. It is spread by microscopic spores which are carried from place to place by air currents. Fortunately, it can be controlled by frequent spraying with Bordeaux mixture, formula 5-5-50, but applications must be maintained on a regular cycle which varies in accordance with conditions of climate and soil, and they must be thorough.

Panama disease, caused by the organism *Fusarium oxysporum* var. *cubense*, attacks through the soil and is therefore difficult to control on a practical basis. It causes the death of the plant in most cases, but does not prevent the land from being used for other crops. It works more rapidly on some soils than on others. Though it has been investigated intensively for many years, much remains to be learned regarding methods by which it is carried from place to place, and no cure has ever been found.

Among insect pests, the borer *Cosmopolites sordidus* is one of the commonest, but in Central America rarely causes sufficient damage to require control measures. This insect tunnels through the rhizomes.

Largely due to the appearance of Sigatoka disease in Central America, banana culture has developed from a primitive

industry to one of the most highly specialized ones in the tropics. The horticulturist of today must devote careful attention to such things as selection of soil, drainage, pruning, the use of fertilizers, and the control of Sigatoka.

FAMILY JUGLANDACEAE

The Juglandaceae is a small family, seven genera and some thirty species, notable for the production of edible nuts, several of which are of commercial importance. The major species are not tropical in origin but at least two of them deserve attention in Central America because experience has shown that they can be grown here successfully and because good nuts are scarce.

While the important members of the family come from colder regions, there is a wild *nogal* in the Andes (Ecuador to Bolivia) which produces edible nuts appreciated in numerous places such as Ibarra in Ecuador, where the tree grows in many dooryards and the kernels are used to prepare the popular sweets known as "nogadas". This species is probably *Juglans neotropica*. In Honduras there is a wild tree of the same genus, recently described as *Juglans olanchana*, which produces edible nuts though they are not much used for food. In Cuba there is another one, *Juglans insularis*. Most of the wild tropical species are better known for the fine quality of their wood than for their nuts.

THE ENGLISH OR PERSIAN WALNUT

This tree, *Juglans regia*, is usually known as English Walnut but is more properly called Persian Walnut, since it probably had its origin in Persia or the northern part of India. It is extensively cultivated in that part of the world, and in China, around the Mediterranean, in California, in Chile and elsewhere. The fact that it has been grown commercially for a long time, though on a small scale, by the Indians of Momostenango in Guatemala (elevation about 2200 meters) should encourage more extensive planting in Central America. The most favorable climatic conditions which can be hoped for are probably those of regions lying between 2000 and 3000 meters in elevation. Ideally the tree should be subjected to rather low

temperatures during part of the year, and cool, dry weather during the fruiting season.

In various parts of the world numerous varieties have been selected and propagated by grafting. Some of the principal ones available in the United States are *Eureka*, *Placencia*, *Franquette* and *Payne*. It has been suggested that the last named may prove to be the best for Central America.

The English walnut likes a deep rich soil with good drainage. While it is probable that most of the trees now growing in this part of the world are seedlings, superior varieties must be propagated by grafting. The question of rootstocks will have to be investigated in Central America before it will be possible to recommend the best; perhaps one of the native tropical species will be found more satisfactory than any of the northern ones. Seedlings of *Juglans regia* have been widely used but in California have been superseded in large part by the native black walnut. A hybrid known as *Royal* is also popular because of its vigor.

Since the walnut, though of slow growth, eventually reaches large size, ample space should be given it, about 12 meters each way. Careful pruning is required during early years, after that little need be done. The tree is slow to commence bearing, seven or eight years in many instances, and does not as a rule produce very heavy crops.

THE PECAN

Distinctive common names in Spanish for the different members of this family do not exist in many instances, it is more usual to call them all *nogal*. The species *Carya illinoensis*, commonly called pecan in English, is called *nogal* in Mexico. Since it is native to the northern part of that country, as well as the southern part of the United States, perhaps it would be convenient to call it *nogal mexicano* in order to distinguish it in Spanish from the English or Persian walnut.

Like the latter, this tree is not really tropical in origin. In recent years it has become a product of commercial importance in the southern United States, where numerous superior varieties have been selected from the thousands of seedlings

grown. These varieties, which are propagated by patch budding and grafting on rootstocks of the same species, are noteworthy for the large size of the nuts and their thin shells. It is impossible to say, until they have been tested extensively in Central America, which ones will prove most valuable in this part of the world. It would seem worth while to try the following among others: *Stuart*, *Schley*, *Frotscher*, *Curtis*, *Mahan* and *Success*, all of which are available in the United States.

The pecan tree grows well on light sandy soils but will also succeed on those of heavier texture. It needs cold weather during part of the year, but thrives best where the climate is hot during the growing and fruiting season. The fact that it is one of the common economic trees in the valley of Oaxaca, Mexico (elevation about 1200 meters) and that there are a few trees in Guatemala, Honduras and perhaps elsewhere in Central America which have grown well for many years and have produced fairly good crops, makes it eminently worth while to test it elsewhere, especially at elevations between 1500 and 2000 meters. Since the trees eventually attain large size, they should not be spaced closer than 12 x 12 or 14 x 14 meters. They grow slowly and cannot be expected to commence bearing before they are 6 to 8 years of age. Like the English walnut, they need pruning during the first few years to form a shapely tree; after that little is required and cultural attention is simple. In moist climates certain fungus diseases attack the tree and may require control measures; little is known about this subject in Central America, because the tree is still so rare here.

FAMILY MORACEAE

The Moraceae is a large family of monoecious or dioecious trees and shrubs, characterized by having milky sap and multiple (compound) fruits. An important member of the family is the mulberry (*Morus*), the leaves of which are fed to silkworms. Some species of this genus are cultivated in the temperate zone for their fruits.

THE FIG

The fig, known to botanists as *Ficus Carica*, is of such ancient cultivation that it is difficult to say just where it may