

## The Avocado—A Horticultural Problem

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About the turn of the century—in 1901, to be exact—George B. Cellon of Miami, Florida began to offer budded trees of named avocado varieties to the horticultural public. Thus one more tropical fruit came out of the jungle stage of its existence. Since then, named varieties have multiplied—chiefly in Florida and California—until they number several hundred. A cooperative association of California growers, organized for the dual purpose of studying the cultural problems of the young industry and of marketing the fruit, looks back on 25 years of successful work. The crop marketed in 1938-1939 totaled more than 18,000,000 pounds of avocados.

Yet the avocado remains a dooryard tree throughout the Caribbean region. Sporadic efforts to place it on a higher plane have generally failed. No one factor is responsible for this. Distance from good markets has played its part. Unfavorable soil conditions have in many instances been fatal. Insufficient attention to the selection of varieties has retarded progress in several countries. And there have been other obstacles.

The time seems ripe for us to stand back and survey the situation in the light of what has been learned regarding avocados since those days, 40 years ago, when Cellon singled out two dooryard trees near Miami, called them Trapp and Pollock, propagated them by budding, and placed them on the market with what impressed many persons as extravagant claims regarding the commercial possibilities of avocado culture—claims which subsequent experience has fully justified.

### Early History

We have no proof that the Very Magnificent Lord Don Cristobal Colon saw the avocado in the course of his voyages of discovery. It was not then grown in the West Indies, where most of the Great Admiral's time was spent. But Martin Fernandez de Encisco, whom Sir Clements Markham characterized as a "cartographer, a good observer with the gift of lucid description" saw it on the mainland near Santa Marta, Colombia, as he coasted along those shores with one of the first Spanish expeditions; and he described it in his "Suma de Geografia" which was published at Sevilla in 1519. Thus was the avocado made known to Europeans—and we might add, with a dignity befitting its merits, for Encisco's "Suma de Geografia," one of the first published accounts of the New World, has become a classic of classics.

Subsequent travelers and historians—Oviedo, Cieza de Leon, Cervantes Salazar, Acosta, and others—noted the presence of this fruit from Mexico to Peru, and in some instances described it in detail, always in flattering terms. Oviedo, for example, wrote in 1526, "On the mainland are certain trees called pear trees, but they are not like those of

Spain, though held in no less esteem; rather is their fruit of such a nature that they have many advantages over our pears."

From the tales of the early voyagers we are able to picture fairly clearly the distribution of the avocado in tropical America at the time of the Conquest. As has already been mentioned, it definitely was not present in the West Indies. It was abundantly grown in Mexico, extending almost to the Rio Grande on the north. It was a popular fruit among the Maya tribes of Guatemala, and was cultivated by the Indians of Nicaragua. Cieza de Leon recorded its presence in the western valleys of Colombia. Not long after the Conquest the Inca Garcilaso de la Vega told how it had been carried from the province of Palta (in what is now Ecuador) to the warm valleys near Cuzco by Tupac Yupanqui, some time between 1450 and 1475.

It is fair to assume, therefore, that the avocado was known throughout the territory between northern Mexico and central Peru; but there is no evidence that it was known in the eastern part of South America. On the other hand, it seems highly probable that it was not known east of the Venezuelan Andes.

### **Origin of the Cultivated Avocados**

With this understanding of the distribution of the avocado at the time of the Conquest, it is in order for us to ask, "Whence came these cultivated or semi-cultivated trees which were seen by the first voyagers? Were they derived from a wild form, still to be found somewhere between Mexico and Ecuador? If so, where does it grow and what is it like?"

This problem is complex, for we are concerned not with a single group of avocados, obviously of common origin; we are concerned with three groups, which may or may not have had a common origin. These three groups, which were recognized and characterized as early as 1653 by Fray Bernabe Cobo, in his **Historia del Nuevo Mundo** are today known horticulturally as the West Indian, Guatemalan, and Mexican races. Any investigation of their origin which we may attempt to carry out, brings us up against the more technical problem of their botanical classification and relationships.

Is more than one species of **Persea** involved in the origin of the cultivated avocados of today? It is my personal opinion that this question must be answered in the negative. Let us review the situation briefly:

### **Species**

Gaertner, in 1807, described **Persea gratissima**, the avocado. In recent years it has been shown that Miller had previously described it (1768) under the name **Persea americana**, and on grounds of priority this is the name now accepted by most American botanists.

In 1831 Chamisso and Schlechtendahl described **P. drymifolia**, thus raising to specific rank the Mexican race of avocados. This has not been generally accepted: more recent and exhaustive study, especially that of Sidney F. Blake of the United States Department of Agriculture, reduces this race to the status of a botanical variety of **P.**

**americana**. Personally I am not even willing to grant it that distinction; in my opinion the Mexican avocados constitute a geographical form of **P. americana**—but I am not a taxonomist and have no right to be heard.

At the time Blake made his "Preliminary Revision of the North American and West Indian Avocados" (**Journ. Wash. Acad. Sci.**, Vol. X, No. 1, 1920), he discovered that the horticultural variety Trapp—then the principal one cultivated in Florida—differed from all others of which he had material for study, in that the floral parts were almost glabrous. Since this constituted a botanical distinction Blake made a new species calling it **P. leiogyna**. Later he had opportunity to see specimens, not of Trapp, which exhibited this same characteristic, and in recent discussions he has expressed to me the conviction that **leiogyna** is not a good species.

This, then, brings us to the conclusion that all known avocados are referable to **P. americana** from which the Mexican race can be distinguished as a botanical variety, **drymifolia**, if one chooses. Though again I must say that extensive observation in the field convinces me that there are insufficient grounds for separating the Mexican race, botanically, from the others.

We are not here concerned with **Persea schiedeana** Nees, which some authors have considered a botanical variety of **P. americana**, but which in the light of more recent study is obviously entitled to the specific rank given it in 1836. This avocado-like fruit is the **chinini** of southern Mexico, the **coyo** and **chucte** of Guatemala, the **yas** of Costa Rica.

Our problem therefore boils down to this: Where is **Persea americana** found in an indigenous condition, and what is the wild tree like?

During my travels of the past 25 years, I have seen wild avocados of three distinct types in tropical America. It is my belief that at least two of these represent wild forms of two of the horticultural races, the Mexican and the Guatemalan. Regarding the prototype of the third race—the West Indian—I am not so clear.

In southern Mexico, particularly on the slopes of the volcano Orizaba, there occurs abundantly a wild avocado which bears small thin-skinned fruits, purple or green in color. The foliage and bark of the tree are characterized by a strong anise-like scent. This geographical form of **P. americana**, which I have called the wild avocado of Orizaba (cf. Yearbook of the California Avocado Association, 1935) can without any stretch of the imagination be considered the wild prototype of the Mexican avocado, the **P. americana drymifolia** of Chamisso and Schlechtendahl. It differs from the cultivated forms only in the size of its fruit.

### **Wild Avocado at Tecpan**

On the summit of the Chichoy mountains in central Guatemala not far from the town of Tecpan, there grows another wild avocado, so much like the cultivated forms of the Guatemalan race as to leave small room for doubt that it is in fact the prototype of this horticultural group. This geographical form—which I have called the wild avocado of Tecpan—grows at higher elevations than any other avocado known to me. It occurs in the forest surrounded by pines, oaks and the stately **Cupressus benthami**. Its foliage,

which is devoid of anise-like odor, resembles that of cultivated varieties of the Guatemalan race, while its fruit differs in no respect except its smaller size, and the relatively small amount of flesh. The "shell" is so hard and woody that it cannot be cut easily with a knife.

This leaves only the West Indian race to be accounted for. I have already explained that this does not come from the West Indies. I have studied no wild form which can with confidence be claimed as its prototype. Near the town of Boquete, in the Republic of Panama, I have seen on the slopes of the Chiriqui volcano at elevations of about 5,000 feet, a few trees which had every appearance of being indigenous and which bear avocados resembling very closely many West Indian seedlings. And again, on the slopes of the Sierra Nevada de Santa Marta, in Colombia I have seen the same sort of thing in great abundance. But I have always had a suspicion that these were escapes. If they are not, then the West Indian race has its native home in Panama and Colombia, which, in the light of what we know of its history, would seem logical.

In the lowlands of the Atlantic side of Honduras, and again in the vicinity of San Jose de Costa Rica, I have seen a wild avocado—which I have called the wild avocado of San Isidro—which may be the prototype of the West Indian race, though if this is true it argues a long period of cultivation; for the differences which exist between this wild form and the cultivated West Indians are considerable, though perhaps not insurmountable. The wild avocado of San Isidro has the anise-like odor which characterizes the Mexican avocado, and which never occurs in the cultivated West Indians. And it has the thick "shell" of the Guatemalan race—thicker and more woody than is common in cultivated forms of the West Indian.

### **Development of Commercial Varieties \***

I have tried to sketch the background—so far as we know it—of the present-day commercial varieties cultivated in California, Florida, and a few other regions. Now as to the origin of the varieties themselves:

They are—without exception I believe—chance seedlings, chosen for a sexual propagation because of their desirable commercial characteristics. Some of them are "pure-blooded" representatives of the West Indian race, some are Guatemalan, and some are Mexican. Some have characteristics which lead us to believe that they are natural crosses between two of these races. This group is perhaps the most interesting of all, and the most promising. The major purpose of this paper, in fact, is to point out the possibilities of some of these crosses for the West Indies.

### **Parentage of Crosses Unknown**

As stated above, no varieties on the market today are the result of crosses by man. We therefore do not know the parentage of those varieties which we consider crosses, except on one side. We do not in all cases know even this. Take Fuerte, for example—the variety which today makes up more than 75 per cent of the total acreage planted under avocados in California. Because its growth is unusually vigorous; because its foliage has the anise-like odor which is characteristic of the Mexican race, while its fruit

is thicker skinned and more suggestive of the Guatemalan—for these and a few other reasons we have always assumed Fuerte to be a Mexican-Guatemalan cross. But we know neither its seed-parent nor its pollen-parent. It was discovered in a garden in Atlixco, Mexico, already a full grown tree with no recorded history. The presence of numerous trees of the Mexican race in that neighborhood, as well as numerous trees of the Guatemalan race, made our hypothesis tenable. Further evidence was later acquired through the behavior of Fuerte seedlings.

Aside from Fuerte, California cultivates, in the main, varieties of the Guatemalan race and varieties of the Mexican race. In Florida, the situation is different.

Trapp and Pollock, the first two varieties placed on the market in that State, are typical West Indians, presumably to be traced back to Cuba since most of the West Indian seedlings found in Florida originally came from that source. In the years immediately following the introduction of Trapp and Pollock, several other West Indian varieties were placed on the market. Then, through the presence of a few trees of Guatemalan origin in the Plant Introduction Garden maintained by the United States Department of Agriculture at Miami, West Indian-Guatemalan crosses began to appear upon the scene.

We assumed, at least that they were crosses. The fruit was thicker skinned than was commonly true of the West Indians, and it matured considerably later. This latter characteristic immediately stamped the crosses as of great promise, for the chief commercial characteristic lacking in the Florida avocados previously cultivated was a ripening season which would take them out of competition with Cuban seedlings. The latter ripen from July to September, though an occasional one will hold part of its crop into October or even November. But the West Indian-Guatemalan crosses ripen much later enabling the grower to place fruit in northern markets during the winter months when high prices are realized. Pure-blooded Guatemalan varieties, many of which have proved highly successful in California, do not thrive so well in Florida. Out of 23 selections which I made in Guatemala during the years 1916-1917, and which were distributed for trial in Florida by the United States Department of Agriculture, I do not believe a single one has achieved any commercial importance, though Itzamna has given a good account of itself in several places.

In addition to these West Indian-Guatemalan crosses, which are assuming greater and greater commercial importance in Florida, there is one variety which, to me, has always possessed peculiar interest. This is Gottfried, believed to be a West Indian-Mexican cross, the only one which has ever come to my attention. Gottfried ripens early, wherein it resembles the Mexican. Its fruit, though considerably larger than that of any pure-blooded Mexican which I have seen, has the same thin skin, the same nutty flavor. The tree has leaves which look like those of the Mexican race, and they have the characteristic anise-like odor.

So much for the make-up of those avocado varieties which are commercially planted today in California and Florida—the two chief centers of avocado culture. Many of these varieties, during the past 25 years, have been planted experimentally in various parts of the American tropics. What can we learn from their behavior? What are the lines along which our future efforts should be directed?

## **California and Florida Varieties in the Tropics**

Before going into this matter, let us consider for a moment the situation around the Caribbean with regard to native seedlings. These are all of the West Indian race. Some regions possess fine specimens of this race, others poor ones.

Cuba has many excellent seedlings, particularly on the limestone soils of the western portion of the Island. The situation is much the same in Jamaica, and in parts of Haiti. Puerto Rico is characterized by few trees of inferior type, and it is my opinion that this same situation holds in a general way for the Lesser Antilles. Occasional exceptions occur, no doubt, but so far as my observation extends the native seedlings of the lower islands do not compare, on the whole, with those which grow on the limestone soils of Cuba and Jamaica.

Upon the Spanish Main there are excellent avocados to be seen in the neighborhood of Santa Marta, Colombia. The coastal region of Venezuela, on the other hand, has few choice ones and no great abundance of mediocre ones. Westward from Santa Marta there is no coastal region famous for its fine avocados until one reaches Yucatan. This is not saying that avocados of fair quality are not to be found here and there.

With the development of commercial avocado culture in California and Florida, horticulturists around the Caribbean awakened to the possibility of extending the short ripening season of their native West Indian seedlings through planting Guatemalans and Guatemalan-West Indian crosses. Puerto Rico was one of the first regions to go in for these new sorts.

During my later years in the Department of Agriculture at Washington— somewhere around 1920—we made numerous experimental shipments of budded trees to Puerto Rico. But when I visited that island recently I learned that little has come of the effort. In fact, there seem to be very few areas in Puerto Rico where avocados of any kind are happy. The region of Yauco on the southern side of the Island is one notable exception. I blame the trouble on heavy soils, which in turn mean lack of good drainage and a ration in most instances. If there is one thing the avocado simply will not tolerate it is wet feet.

Cuba had its fling, and at approximately the same time as Puerto Rico. Cuba is an avocado island, and at one time there seemed to be a strong probability that one or two of the Guatemalans, and several of the Guatemalan-West Indian crosses, would attain commercial importance there. But something happened. I don't know just exactly what it was. Perhaps a mixture of politics and bad drainage, with emphasis on the latter.

## **Experiment Station in Honduras**

In more recent years some of these same varieties have been planted in Jamaica, in Haiti, in Trinidad, in Colombia and elsewhere around the Caribbean. It is too early, in most cases, to talk of results. But I can speak with confidence regarding what has been done in one fairly representative region—the north coast of Honduras. Here, at Lancetilla Experiment Station, we introduced in 1925 and subsequent years, an

extensive collection of varieties including Guatemalans, West Indians, Guatemalan-West Indian crosses, one Guatemalan-Mexican cross (Fuerte), and the one known West Indian-Mexican cross, Gottfried.

As far as I can judge, climatic conditions on the north coast of Honduras are not unlike those of the wetter parts of the West Indies. We are at sea level and we have a dry season of one or two months' duration at Lancetilla proper; one of three or four months at our substation Quebrada Seca, some 40 miles up the Ulua valley from the coast. Annual rainfall at Quebrada Seca is in the neighborhood of 60 to 70 inches; at Lancetilla it varies from 125 to 175 inches.

### **Guatemalans A Highland Race**

Pure-blooded varieties of the Guatemalan race have been a complete failure here. This is not saying that the trees have not, in several cases made good growth; nor is it saying that they have not borne fruit. But I am convinced that it is a mistake to grow Guatemalans at sea level in the tropics. This is a highland race, and when taken down to the coast the fruit almost invariably loses its flavor and quality. We have grown such varieties as Nimlioh, Panchoy, Queen, and Linda: all mature their fruits very late in the season, ripening from November to January in the main, but all are disappointing and all show a tendency to produce small crops. They are not satisfactory.

Pure-blooded varieties of the Mexican race serve no purpose here, unless one might argue that their nutty flavor is a desideratum. Their value lies chiefly in their resistance to frost. But we have tried them, mainly out of curiosity and they have not done well. Like the Guatemalans', they belong to the highlands.

Fuerte, the leading commercial variety of California, is presumably a Guatemalan-Mexican cross. In the light of what has just been said regarding the behavior of these two races at sea level in the tropics, how could one do otherwise than predict a gloomy future for Fuerte in such a place as Lancetilla? We have grown it for 15 years: the trees vegetate well, they blossom freely, but they produce few fruits and these of poor quality. Even the southern part of Florida is too tropical for Puerte. This is distinctly a subtropical avocado. When grown in the tropics, it must be at high elevations. It might prove very useful in the Andes.

And now we come to the brighter side of the picture: the West Indian-Guatemalan crosses. This is, in my opinion, the group which will in time place avocado culture in the West Indies upon a new and sounder footing. Even with the varieties available today, much can be done; and new varieties can and will be produced in large numbers.

### **The Future**

Collinson, Winslowson, Collinred, and Lula have all done well in Honduras, and they have done well at several other places in tropical America. Perhaps they are not ideal varieties: from the commercial standpoint I am willing to concede that they are not. But they show what can be expected of this cross. It offers, in my judgment, the one real hope of producing in the Caribbean region avocados of good commercial quality at that

season of the year when avocados are most desired—the winter months.

Viewing the matter from another standpoint, here is an opportunity to lengthen the period during which avocados are available in the West Indies for local consumption. This is a matter of greater importance than appears at first glance. For the avocado as a source of human food is not yet fully appreciated in the Islands. We hear much talk these days of overpopulation. How are people to be fed? If they are to be largely dependent upon what they can produce—as most certainly is desirable—then we need crops which (1) will give maximum yields of food per acre (2) which are available during as many months of the year as possible and (3) which people will eat, and like.

When we horticulturists can offer avocados during six or eight months of the year, when we can supply varieties which contain 12 or 14 per cent of oil (this is by no means asking too much), we shall be making a real contribution towards the solution of one of the grave problems confronting some of the Islands. The one serious obstacle which I see is the admitted failure of the avocado to thrive on certain soils, or in certain areas. Whether this is a matter of drainage, whether it is due to root diseases of which we still know little, or whether it is due to something about which we still know nothing at all, it is a real and serious obstacle to wider and more successful cultivation of the avocado. So far as I have been able to observe, there is no trouble when avocados are grown on sloping lands derived from soft limestone. There is no trouble when they are grown on sandy loams and clay loams if these are well drained and not subject to flooding. But put the avocado on stiff, impermeable clays; put it on the best sandy loams and flood it for even a few days—in other words, cut off the oxygen supply to its roots—and if my experience is any guide, you will soon see the younger branches beginning to die back and the end is in sight.

To avoid further disappointment, let us put our avocados on the right kind of land; and let us then devote serious attention to the development of new varieties of the West Indian-Guatemalan group, varieties which will give us fruit of excellent quality and extend the present avocado season in the West Indies by three or four months at least.

*\* The Editor is indebted to Mr. R. O. Williams, Deputy Director of Agriculture, Trinidad, for preparing the following note which deals with varieties of avocado grown in Trinidad:—*

*"A good deal of attention has been paid to the improvement of avocados in this Colony. Selections of local types have been made by the Department of Agriculture and the Imperial College of Tropical Agriculture; the latter also have investigated the selections for good storage qualities. Introductions have also been made by the Department of Agriculture and others of good West Indian, Guatemalan and Mexican varieties, and hybrids of these.*

*The following is a list of those under cultivation:—*

*Local varieties: St. Ann's, St. Clair, River, St. Joseph No. 1, St. Joseph No. 2, Lenegan and Macqueripe No. 2.*

*Introduced varieties: West Indian—Pollock, Eudder, Simmonds, Butler. Guatemalan—Panchoy, Queen, Benik, Nabal, Dickinson, Anaheim, Dunedin. Mexican—Puebla, Blake, Mexicola. West Indian—Guatemalan Collinson, Winslowson, Lula. Mexican—Guatemalan Fuerte.*

*Of the early introductions Pollock is outstanding. Trapp was found to be worthless! The*

*later introductions which show particular promise for extending the avocado season are Collinson and Winslowson; a number of recent introductions have not fruited as yet."*

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