

Avocado Studies in Mexico in 1938

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The Fuerte is the most important commercial avocado variety grown in California, since more than seventy-five per cent of the acreage and production is of that variety. This relatively high proportion is increasing because the Fuerte trees in southern California have survived low winter temperatures more successfully than most other commercial varieties. The Fuerte variety originated as a bud propagation of the parent Fuerte tree (fig. 1) that is located in the Le Blanc garden at Atlixco, state of Puebla, Mexico.



Fig. 1. The parent Fuerte tree in the Le Blanc garden, Atlixco, with Alejandro Le Blanc (left) and Wilson Popenoe. Photographed April 16, 1938. Circ. of trunk at 3 ft.—4 ft. 4¼ in., height—29 ft. 7 in., spread—42 ft. 4 in. This seedling tree was planted about 1898 (Le Blanc).



Fig. 2. The parent Puebla tree in Vicente Pineda garden, Atlixco, with Ernesto Santillana standing beside it. Photographed April 23, 1938. The present owner reported that Mr. Schmidt obtained buds from this tree in 1911 and the foliage and fruits are identical with the characteristics of the Puebla variety. The tree was broken off at an early age. Circ. of trunk at 3 ft.—3 ft. 6 in., height—25 ft., spread—23 ft.

The next most important commercial variety, Puebla, has been propagated in southern California from buds of a tree in the Vicente Pineda garden (fig. 2) that is located near the Le Blanc garden. The buds from the parent trees of both the Fuerte and Puebla were obtained at the same time, 1911, by Carl B. Schmidt of Mexico City, and sent to the West India Gardens at Altadena, California.

The recent visit of about fifty members of the California Avocado Association and friends to Atlixco on April 17, 1938, was for the purpose of unveiling a memorial tablet at the site of the Fuerte tree and presenting medals to Alejandro Le Blanc, son of the man who planted the parent Fuerte tree, and to Carl B. Schmidt, who sent the buds to California. Appropriate congratulatory speeches were made by the Governor of the state of Puebla, the Secretary of the Mexican Department of Agriculture representatives of the U. S. Department of Agriculture, the U. S. Ambassador to Mexico, the Mexican Department of Foreign Relations the University of California, the California Avocado Association and others.

The writer, representing the Secretary of the United States Department of Agriculture at the ceremonies and later as a representative of the Division of Plant Exploration and Introduction, was privileged to stay in Mexico for a two months' period in order to study avocado trees in some of the most important avocado growing districts and to introduce summer fruiting varieties into the United States. A brief report on that study will be presented in this paper.

AVOCADO PRODUCING DISTRICTS VISITED IN MEXICO

The avocado trees in the order studied in this plant exploration are located in the following districts: Queretaro, state of Queretaro; Atlixco, Tochimilco, Huilango, Matamoras, Tlaxcala, Cholula, San Baltazar, San Pedro, San Diego, Nexatengo, state of Puebla; Mexico D.P. Amecameca, state of Mexico; Cauatla, Yautepec, Cuernavaca, state of Morelos; Morelia, Patzcuaro, Uruapan, state of Michoacan; Atotonilco, Guadalajara, Chapala, Tequila, state of Jalisco; Tepic, San Bias, state of Nayarit; Mazatlan, Eldorado, Los Mochis, state of Sinaloa; and Guaymas, state of Sonora. The most intensive search was centered in the Atlixco and other districts in the state of Puebla which are located at about 6000 feet or higher elevations above sea level. The reasons for this action included the fact of the known good performance in southern California of the Fuerte, Puebla and other varieties from Atlixco, as well as the opinion of our Mexican friends that the avocados from that area are amongst the best ones grown in Mexico.

It was reported that in a mountain valley located near Uruapan, state of Michoacan, many so-called "wild" avocado trees are to be found growing in a mountain valley about 50 kilometers long and 3 kilometers wide under natural conditions in the forests without any cultural care. Since it would have required several weeks in order to visit that valley and since the fruits were reported as maturing during the fall and winter, that interesting study was postponed.

The survey party included Dr. Juan A. Gonzalez, Director of Rural Economics in the Mexican Department of Agriculture, Sr. Alejandro Le Blanc, Sr. Ernesto Santillana, and

the writer. In addition in every district visited, local officials and avocado growers kindly assisted us. That cooperation enabled us to visit many gardens and obtain information that otherwise would not have been practicable. All those contacted were friendly, hospitable and anxious to be of service in the work of the survey.

METHOD OF AVOCADO STUDY

The study included visits to gardens where outstanding avocado trees were reported by local officials and avocado growers. Permission to enter the private gardens and to make individual tree studies was always granted by the owners, who in all instances assisted in the tree studies.

The characteristics of the trees studied included presence or lack of anise odor in the leaves; the shape, size, color and amount of foliage, the approximate age of the tree and indications of disease or insect pests. The fruit characteristics noted included season of maturity, shape and size; color and relative thickness of skin, as well as size, shape and tightness of the seed in the cavity. The approximate garden elevations were also noted. For those avocado trees that appeared to be of particular interest the circumference of the trunk, height of tree and spread of branches were measured. Only those trees bearing summer maturing fruits were studied in some detail, with the purpose of selecting a few of the most promising ones for testing in southern California and Mexico.

In most of the gardens tropical and subtropical fruits other than avocado, as well as occasional peach, pear and apple trees, were usually found. While extensive notes were not made of such trees, their presence was noted, and, in a few instances, some detailed observations were recorded of particularly interesting ones.

ENVIRONMENTAL CONDITIONS IN THE ATLIXCO AREA

The altitude of the city of Atlixco is 1830 meters or 6001 feet above sea level at the National Railways of Mexico railroad station. Most of the avocado trees in the municipality are located above that point. The parent Fuerte and Puebla trees are growing at an elevation of about 6150 feet. The soil is a well drained, deep, fertile, volcanic loam of loose texture that is easily handled during cultivations and irrigation. The climate is semi-arid, with an annual rainfall of from 25 to 30 inches. Rains occur during the so-called "wet" season, from June to September, while during the "dry" season, October to May, little or no rainfall occurs and irrigation is necessary. The maximum temperatures were reported as being about 90° P. and the minimum about 32°. Occasional frosts were expected, especially at the higher elevations and the cold of 1937 was said to have been particularly severe. However, avocados from the Atlixco area were available in the markets of Puebla, Mexico City and others during every month of the year following the freeze. In that connection it was reported that the Atlixco area is the only one in Mexico that supplies avocados during the entire year, and our observations confirmed those reports.

AGE OF TREES

All of the trees studied were of seedling origin and not a single budded avocado tree was found in any garden visited. Many of the trees had been grown from seedlings planted intentionally by the growers but some were apparently grown from seeds in fruits that had fallen from the trees which had sprouted in place and were allowed to survive. Many of the trees studied were of considerable age, some of them having an estimated age of a century or more. Those old trees were of particular interest to the writer because they had survived for such a long period of time in good physical condition, notwithstanding occasional frosts at most of the higher locations as well as other occasional adverse environmental conditions. In the Queretaro district where the trees are located on heavy soils along canyon walls and at considerable elevations above that of the city, which is about 5938 feet, and where rather frequent frost damage occurs, the trees appeared to be in rather poor physical condition. This was due, we were told, to abnormally heavy rainfall and to frost damage that had occurred during recent seasons, especially that of 1937. The tree trunks, limbs, leaves and fruits in that locality were attacked by insect pests to a much greater degree than that observed in any other avocado district visited. No trees were observed at Queretaro that were apparently as old as some of those studied in the Atlixco, Tochimilco and Huilango districts.

In each district visited only a few small plantings of young avocado trees were observed. Most of the trees were of full bearing age, with a considerable number of very old ones. Only one small nursery with about 500 avocado seedlings, from one to two years old, was seen.

LOCATIONS OF AVOCADO TREES

Most of the avocado trees studied were located in small "huertes" or home gardens, which usually were not more than an acre or two in size. In some instances only a few trees were found in the individual gardens. Some trees of interest because of their age were found along roadways, borders of cultivated fields and in a few instances they occurred in the midst of corn, bean, wheat or alfalfa fields. One orchard planting of 3500 seedling trees about twenty years old was studied near Atlixco, and several orchards were visited at Patzcuaro, Uruapan and Eldorado.

Most of the systematic search for summer fruiting trees was carried on in districts of the Atlixco area at elevations 6150 feet or more above sea level where the trees grow under somewhat similar or more severe climatic conditions than occur where the parent Fuerte and Puebla trees are located.

In addition to the municipality of Atlixco, other districts visited in the Atlixco area included, Tochimilco, Huilango, Matamoras, San Diego, Xalpatlaco, Nexatengo, San Pedro and San Baltazar. The fruits from those districts are frequently marketed as "Atlixco avocados" as was found upon inquiries in the Atlixco, Puebla and Mexico City and other public markets. This is probably due in part at least to the widespread belief in the superiority of the Atlixco avocados.

The Tochimilco district has about 5000 avocado trees of all ages, from young to many

very old trees (fig. 3). The people of that very interesting district are mainly dependent on the avocado crop, which is largely sent to the city of Atlixco for distribution. From a point near the plaza there is a beautiful view of the valley and hillsides (fig. 4) showing a dense forest of avocado trees interspersed now and then with cherimoya and other fruit trees, and with "Fresno" shade trees surrounding the plaza and growing along the roadways. Many of the avocado trees here were found growing at elevations exceeding 6788 feet. A part of the Tochimilco district called San Juan Tochimilco was found to contain some of the largest trees observed anywhere in Mexico.

IN VICINITY OF ATLIXCO

The Huilango avocado district is located at a lower elevation than that of the Tochimilco district but higher than that of Atlixco. About 5000 avocado trees were reported as growing in the Huilango district, some of which were of very large size and great age and similar in many respects to those at Tochimilco.

In the Matamoras district located at a lower elevation than Atlixco were about 2500 avocado trees, and also many more such tropical trees in evidence as mango, yellow sapote, mamey sapote, chico sapote. Sugar cane was also cultivated extensively there.

In the San Diego district located about 4 or 5 miles distant from the city of Atlixco and at a similar elevation, about 3500 bearing seedling avocado trees were found on the Rodiles hacienda. Those trees, from 20 to 30 years old, are spaced about 25 ft. by 25 ft. in the orchard and generally were in good physical condition. A few summer bearing trees were observed while walking through the orchard but most of the trees were apparently winter bearers.

At Xalpatlaco in the Atlixco area, one of the largest and oldest avocado trees was studied. That tree was estimated (by the tenant of the hacienda) to be more than 200 years old. Its trunk circumference at 4 feet from the ground was 13 feet, 6 in., the height 85 feet, and the spread of its branches 54 ft. 7 in. Its fruits mature during December and January, and were reported to be of large size and green color, with medium thin skin, good flavor of flesh, and small seeds. However, the immature fruits available for examination did not appear to have commercially valuable characteristics for culture in southern California.

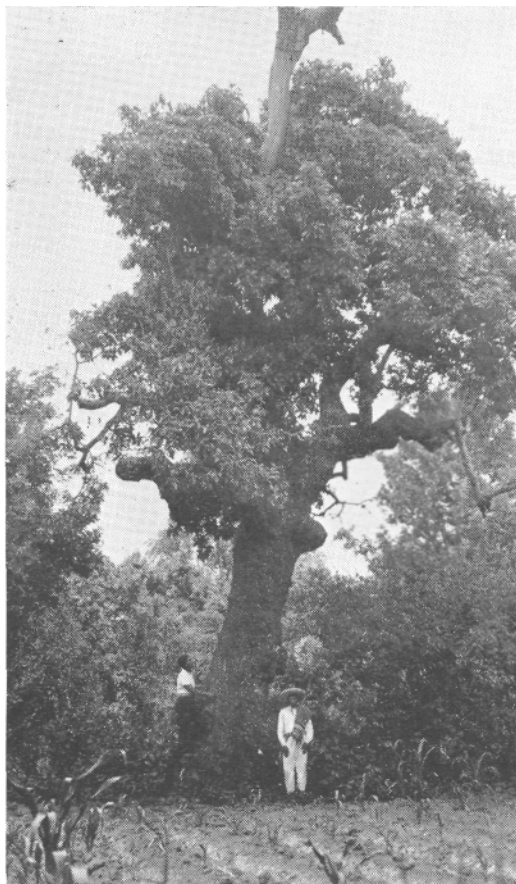


Fig. 3. One of the many productive old seedling avocado trees in the Tochimilco district. It is said to be more than 100 years old. The leaves have strong anise odor, the fruits mature during the winter season, are of small size, dark colored, thin skin, large seeds, greenish flesh of good flavor.

ANISE-LEAFED TREES HARDIEST TO COLD

San Pedro, in the San Baltazar district, is located at a considerably higher elevation than that of Tochimilco. The many avocado trees observed at San Pedro were largely without fruits on account of the low temperatures at blossom time, we were told. However, a few were fruiting heavily, but most of these were of the "corriente" or common type as they are termed by the growers. All of the trees had leaves having a strong anise odor. This fact is worthy of comment from the fact that the leaves of all of the more resistant avocado trees observed in Mexico possessed that characteristic to a greater or less degree and the leaves of the hardiest trees apparently had the strongest anise odor indicating that this characteristic is correlated with foliage resistance to frost injuries.

The San Baltazar district is located about one mile from San Pedro and its higher elevation is correlated with more frequent frost damage to the avocado blossoms. At the time of our visit, May, 1938, the crop was a failure due to low temperatures during the blossom time.

Other communities visited in the Atlixco area where a few avocado trees are located

include Metepec, Cholula, Tlaxcala and Puebla. In October, 1936, the writer had visited Tehuacan and Oaxaca. In the Oaxaca markets and those of nearby communities, many avocados were noticed, some of which had been grown at elevations of about 5000 feet, but most of which had come from districts of the states of Oaxaca and Vera Cruz at lower elevations. Some of those fruits were of very large size and most of them had thick skins, more or less characteristic of the Guatemalan avocados. The leaves of the trees examined were without any trace of anise odor. A further study of avocado trees in those states would be very desirable in the opinion of the writer but owing to a lack of roads and hotel accommodations such a search would be made only under considerable difficulties and would require careful preparation. Several weeks would be needed in order to visit the remote mountain valleys where we were told most of the avocado trees of interest to the Southwest are located.

CULTURAL CONDITIONS IN THE ATLIXCO AREA

The main supply of the irrigation water used in the Atlixco area is from the San Baltazar river, originating from numerous large springs on the east slope of snow clad Mt. Popocatepetl, about 18,000 feet high. The method of irrigating the avocado trees is largely the furrow or basin systems similar to those used in southern California.

No thinning of the growth, shaping the trees, or other systematic pruning practice was noted anywhere. As the lower, older branches die they drop off or are cut off, and broken limbs are removed.

In the Rodiles orchard in the San Diego district clean cultivation was carried on similar to that in some southern California orchards. Elsewhere, aside from the annual plowing or other stirring of the soil, little cultivation was observed. The weed growth in the gardens was mowed down or scraped off occasionally, but in some cases even this practice was not followed.



Fig. 4. General view of Tochimilco district at a higher elevation than that of the Atlixco district with Mt. Popocatepetl in background. Municipal buildings and plaza in the foreground. The trees covering the hillsides and valleys are avocado seedlings, some of which are very old and most of them producing "corriente" or small fruits with large seeds but flesh of excellent flavor. All avocado trees examined had leaves with anise odor.

No fertilizer applications were observed anywhere but we were told that in a few instances animal manures were applied to the soil at infrequent intervals.

HARVESTING AND MARKETING MEXICAN AVOCADOS

Owing to the large size of the older avocado trees in many districts visited, the harvest of the fruits is rather difficult. In such instances long poles with small baskets at the end, open on one side, or poles with hooks, are commonly used. In the first instance the picker climbs the tree, inserts the fruit in the open side of the picking basket and twists or pulls the fruit off from the stem when it is lowered to the ground. In other cases the fruits are hooked off and fall, being caught in baskets or on trays or in the hands of the men standing on the ground. With younger, smaller trees, the fruits are twisted or pulled off by hand and placed in convenient baskets or other receptacles. Little careful handling is carried on during the harvesting operations with the result that many of the fruits are bruised and in some instances are so badly injured that they must be disposed of quickly in order to prevent deterioration and rapid decay. Furthermore, while some care is used in order to prevent picking immature fruits, many such find their way to the markets as was discovered during our many visits to public markets.

The avocados intended for market are usually placed loosely in baskets, nets, bags, sacks, or other containers of various kinds and sizes. No attempt to pack the fruits in uniform boxes or other containers was noticed anywhere. Little assortment of the avocados as to shape, size, color or other characteristics was observed excepting in some instances where they were arranged in the market stalls in piles according to size and color.

The avocados are transported from the trees to the market by train, truck, muleback and by individuals, depending upon the distance, roads and other factors. Some of the

growers in remote districts carry as much as from 100 to 200 pounds of fruit on their backs for considerable distances and over rather difficult roads and trails.

Most of the commercial avocados are sold in the public markets of cities, towns and villages. While in the larger cities the markets are open daily, in the smaller towns and villages usually one or two days each week are set aside as market days. The prices of avocados are relatively low for those of the "corriente" class and everyone seems to like them so that they are an important article of trade and in the diet of the people. The large-sized, superior fruits bring high prices in the markets investigated and it was reported everywhere that a greater demand existed for them than could be supplied. This observation indicates a favorable opportunity for producing and marketing larger, superior fruits.

It seems logical to the writer that the Mexican and California avocado growers can be of mutual assistance and that a thorough cooperative search for Mexican avocado seedling trees for the development of superior varieties which would be of great value to the industries of both countries. An exchange of marketing experience as well as propagating material resulting from the study of progeny performance both as regards methods of bud propagation, bud strains and rootstocks, as well as cultural care of the nursery and fruiting trees would be beneficial to all those concerned.

INSECT PESTS AND DISEASES

In the limited time available for our avocado studies in Mexico no systematic study of insect pests or diseases could be undertaken. At Queretaro in the La Canyada district the trees and fruits were seriously attacked by insect enemies. Those insects were classified by officials of the U. S. Bureau of Plant Quarantine at Mexico City as (1) the avocado seed weevil (*Heilipus lauri*), (2) avocado leaf gall (*Trioza koebelei*), and (3) avocado worm (*Stenoma catenifer*). The presence of those pests were noticed at only a few other locations at the time of our visit, a few leaf galls being observed at Uruapan and at Atotonilco. The leaf gall injury was not considered to be very important but the raised galls on the leaves were quite noticeable. The seed weevil, where present, is a very serious trouble and is largely responsible for the exclusion of the Mexican avocados from export into most of the United States. The wood borers were only found at a few places and in those instances the injuries to the tree trunks and limbs were not deemed important. The presence of a few mealy bugs were observed on avocado trees in some of the gardens visited.

No avocado diseases with which the writer is familiar were observed anywhere. However, this does not mean that there are no diseases present but simply that we did not notice any on the trees or fruits examined. In view of the existence of many very old avocado trees in most districts visited that are still developing vigorous vegetative growth and bearing abundant fruits it seems likely that no very serious diseases have attacked the avocado trees in those districts.

OTHEK FRUIT TREES AND PLANTS IN THE AVOCADO DISTRICTS

As the Atlixco area lies considerably below the Tropic of Cancer the plants, both

introduced and native ones, growing there are largely tropical or subtropical, with some temperate zone plants at the higher elevations. A list of the more striking ones observed will be given in the following paragraphs.

Calocarpum mammosum, Pierre, commonly called "mamey sapote" in Mexico, native to tropical America, is rarely found in the vicinity of Atlixco or at higher elevations but is quite common at Matamoras, state of Puebla, and at other lower, warmer locations. The fruit is oval in shape commonly about 5 or 6 inches long, russet-brown in color, the skin thick and woody, the flesh salmon red to reddish brown in color, and with one large smooth elliptic seed. It is a quite popular fruit in Mexico and was found in all markets visited. The flavor is rather insipid from a lack of acidity but in sherbets and other food preparations it is relished by many people.

Achras sapota, L., sapodilla, chico sapote, native to tropical America, was found at only a few of the warmer locations, as at Matamoras, state of Puebla, and at Eldorado, state of Sinaloa. The latex of the tree is used as a base for chewing gum. The fruits are held in esteem by some Mexicans; but are not widely popular.

Amygdalus persica, L., durazno, peach, introduced, was found in almost every garden visited in Mexico, usually seedling trees and in poor physical condition. Red spiders and other insect pests, delayed foliation and other causes of poor tree growth were evident almost everywhere.

Annona cherimola, Mill., cherimoya, native to tropical America, was found in most gardens and along roadways in the Atlixco area even those located at high elevations, as at Tochmilco and San Baltazar. Those trees were in bloom at the time of our visit and produce fruits that mature during the late fall and winter seasons. The writer, on previous autumn visits to Mexico, had been given cherimoyas and found them to be delicious and one of the best flavored of all tropical fruits. Of the few late maturing available for examination last spring none superior to those grown in California were found. A search for superior hardy fruiting trees during the main fruiting season there, the late fall and winter months, in the mountain valleys of the state of Michoacan, at Queretaro and perhaps at other cherimoya locations might be worth while in the hope of finding inherently productive strains where the fruits have superior flavor and few seeds. The irregular bearing tendencies and tenderness of the trees now grown in California as well as the seediness of their fruits render their commercial culture rather hazardous.

Annona sp. A few trees of species other than (*A. cherimola*) were found at Matamoras, Puebla and other warm locations, including (*A. purpurea*) Noc and Sesse, but the fruits were distinctly inferior in eating qualities to the cherimoyas.

Carica papaya, L., native to Mexico, found rarely in gardens located at higher elevations, but widely grown at lower, warmer elevations and fruits in abundance were observed in all markets visited. The fruits vary greatly in size, shape and flavor and none of the superior Solo variety from Hawaii were noticed. A red fleshed variety called "Redheart" was quite popular but the writer did not consider it to be superior in flavor to the yellow fleshed varieties. Numerous plants of (*C. nana*), considered by P. Khankhoje to be a primitive form of (*C. papaya*) were observed in fruit in a tropical jungle below Tepic, state of Nayarit.

Casimiroa edulis, LeLlave & Lex., sapote blanco, white sapote, native to Mexico, fruiting trees found in nearly every garden visited in the Atlixco area and in most other districts visited from near sea level and up to an elevation of about 7500 feet. Trees appeared to be as hardy as avocado trees and were rather heavy bearers of fruit which is very popular. No young trees were noticed in any of the gardens visited. None of the trees or fruits examined seemed to be superior to some of those now growing in southern California such as the Wilson variety. The Atlixco area is probably the most favorable locality for a systematic search for superior varieties for growing in the Southwest.

Citrus sinensis, (L). Osbeck, naranja, sweet orange, introduced in Mexico by early missionaries from Spain, mostly seedlings but a few orchards of Washington Navel and Valencia varieties of recent introductions from the United States were observed. Sweet oranges are amongst the most popular fruits in Mexico. Old seedling trees were found in most of the early church gardens as well as in many private gardens. The younger orchard plantings observed in the states of Michoacan, Jalisco, Sinaloa and Sonora were largely of the Washington Navel and Valencia varieties and the fruits were of excellent eating quality. The seedling oranges were juicy but were quite variable in size, shape, color and flavor due to environmental conditions and also to inherent variations. The fruits having best eating qualities were observed at the higher elevations while the more insipid ones were grown at lower elevations.

Citrus aurantifolia, Swingle, Union, Mexican lime, probably introduced, commonly found in the gardens in every district visited and commercially grown at Uruapan, state of Michoacan, Colima, state of Colima; Ato-tonilco, state of Jalisco; and a few other locations. Considerable quantities of Mexican limes are exported to the United States and marketed by the Calavo Association. This fruit is generally used in Mexico for making drinks, for flavoring most foods, and it was found in all markets at the time of our visit. Sweet lime trees (*C. limetta* Risso), were found in most gardens, particularly in the Atlixco area. The fruits were insipid to our taste but are popular with all Mexicans with whom we came into contact and were usually eaten out of hand as a fresh fruit.

Citrus grandis, (L.) Osbeck, toronja, grapefruit, introduced, found to a limited extent in the Atlixco area but rather widely grown on the West Coast and available in most markets. The fruits had excellent eating qualities.

Citrus medica, L., cidra, citron, introduced, found only at lower, warmer locations. The fruit is rather widely used in making confections and was available in most markets.

Citrus aurantium, L., sour orange, introduced, and (*C. limonia*) Osbeck, lemon, introduced, were observed at only a very few locations. A few fruiting sour orange trees were seen on the Redo ranch that is located near Guaymas, state of Sonora, and individual trees were observed at a few other places. The lemon trees observed were located in an old monastery at Tepozatlan, at Santa Monica (the hidden convent) at Puebla, and in the Tonalart pottery garden at Tlaquepaque, state of Jalisco.

Citrus sp., lima-naranja, lime-orange, and others, rarely found and of no commercial importance.

Crataegus mexicana, Moc. and Sesse, tejocote, native to Mexico, trees found near

Puebla and Amecameca. This beautiful tree is very ornamental with its symmetrical growth and dense, shining leaves. Two varieties were observed, one bearing reddish fruits about one-half inch in transverse diameter, and the other with yellowish fruits about one inch in diameter. The fruits are popular in Mexico, have a haw-like flavor, the trees are quite hardy and doubtless can be grown at some locations in the Southwest.

Cydonia oblonga, Mill., membrillo, quince, introduced, universally grown in gardens, along walls and roadways, and in some orchard plantings in the districts visited. The seedling trees bear quite uniform fruits that are generally used in the preparation of a cheese-like paste that is very popular in Mexico and was found in abundance in all markets. The fruits are also used in the form of conserves and are perhaps one of the most widely used of all of the introduced fruits grown in Mexico.

Diospyrus ebenaster Retz., sapote negro, black sapote, native to Mexico, not commonly found but several large, handsome fruiting trees were observed at Atlixco and in other gardens. This tropical member of the persimmon family fruits abundantly but the trees are rather easily injured by low temperatures. The oblate shaped fruits, about two and one-half inches in transverse diameter, are quite popular in southern Mexico and often used in the preparation of sherbet, ice cream and similar desserts. They are not as good eating, in the opinion of the writer, as the persimmons grown in the United States. They are available in most Mexican markets at relatively high prices.

Eriobotrya japonica (Thurb.) Lindl., nispero, loquat, introduced, individual trees found in many gardens and the fruits highly prized. The term "nispero" was also used by some of our acquaintances for other plum-like fruits not of the loquat species.

Ficus carica, L., higo, fig, introduced, commonly found in nearly all gardens visited in Mexico. There were several varieties but the so-called Mission fig that was introduced by the early Spanish missionaries was most common. The trees did not seem to be very fruitful but the fruits were very popular and available in most markets.

Hylocereus sp., pitahya, cactus fruit, native to Mexico, commonly found in many districts, particularly in the arid and semi-arid areas from the organ cactus. Abundant in all markets visited with the spine-like hairs freshly removed or the fruits peeled when sold. This rich, reddish-purple fruit is universally used by the Mexican people and is considered to be a delicacy. It is about the size of a tennis ball and is sold at very moderate prices. To the writer's taste the fruits were rather insipid as compared with the other more highly flavored competing tropical and subtropical fruits.

Inga jinicuil Schlect., jinicuil, native to tropical America, found in Le Blanc garden at Atlixco and others. A beautiful ornamental tree bearing large bean-like pods that are relished by some, particularly by children.

Lecuma salicifolia. H.B.K., amarillo, sapote, yellow sapote, native to Mexico, commonly found in gardens at Matamoros, state of Puebla, and at some other locations up to 5000 feet elevation. The large trees, about 25 feet in height with long lanceolate shaped leaves with obtuse tips, bear brownish colored oval shaped fruits with deep yellow colored, mealy flesh and large seed. Its flavor is not very attractive and no young trees were observed.

Mangifera indica, L., mango, introduced, commonly found at Matamoros, state of

Puebla, and at the lower, warmer, locations. The "corriente" or common mango trees have beautiful deep green foliage and bear abundantly. Some of the fruits are delicious but many have a rather strong turpentine taste. The "Manila" variety produces larger sized fruits of yellow color, and their flavor is delicious. From different districts in Mexico the Manila fruits are available in the markets from May until September. The price of the small corriente fruits is low but that of the Manila variety is relatively high. The trees are rather tender and not generally grown above about 5000 feet elevation in the districts visited.

Monstera deliciosa, Liebm., pinanona, native to Mexico, large leaved climbing vines commonly found in many gardens. The fruits resembling in appearance slender ears of corn and were not highly recommended by Mexican companions or the growers. However, some like them and the plants are quite ornamental. They are frequently grown indoor in pots in southern California for decorative purposes.

Morus rubra, L. mora, mulberry, introduced, commonly found in many gardens and along roadsides. The large trees bear profusely and the small, soft, dark red or nearly black fruits are highly esteemed locally. No outstanding trees bearing fruits of superior size or quality were observed.

Oleo europaea, L., aceituno, olive, introduced, found rarely in old church gardens located at higher elevations. Mission, the leading commercial variety grown in California, was introduced from Mexico by the pioneer missionaries and doubtless from some of the Mexican church gardens.

Opuntia sp., nopal, prickly pear, the so-called "tuna" fruits from those cacti are widely used in Mexico and were commonly found in all markets. Hedges or groups of the plants were observed almost everywhere but more frequently in the arid and semi-arid districts. The tuna and pitahya fruits are commercially important in the public markets.

Passiflora ligularis, A. Juss., granadita, granadilla, (*P. edulis*) Sims, purple granadilla, natives to tropical America, were found in a few gardens but seemed to be of little interest and none were observed in the markets visited.

Persea americana, Mill., ahuate, aguacate, Mexican avocado, native to Mexico, the most important commercial fruit tree in Mexico. It is better adapted generally to small or large plantings than any other tree fruits observed on account of its relative freedom from insect pests and fungus diseases, its vigor of growth, its hardiness as shown by trees about two or three centuries old, its adaptation for culture under widely different soil and climatic conditions, and its universal appetite appeal. All trees observed were of seedling origin, their culture extending from near sea level to about 7500 feet elevation and all grown under irrigation.

Prunus armeniaca, L., chabacano, apricot, introduced, commonly found in most gardens visited and available in most markets from early maturing districts. The trees were vigorous but the leaves showed some evidence of red spider injury and delayed foliation. The fruits are highly prized by Mexicans and their price was relatively high at the beginning of the present season.

Prunus capuli, Cav., capulin, wild cherry, native to Mexico, observed in state of Puebla and the Federal District. The trees are attractive as ornamentals but the fruits have a

rather bitter taste and poor flavor. However, they seemed to be quite popular and were generally available in the markets.

Psidium guajava, L., guayabo, guava, native to tropical America, widely grown in Mexico. The trees are very hardy, easily grown and fruitful. The fruits are generally used, of low price and are popular with all Mexicans.

Punica, granatum, L., granada, pomegranate, introduced, rarely found and of little importance.

Pyrus communis, L., pera, pear, introduced, commonly found in gardens above 6000 feet elevation. It was interesting to find several pear trees where the pear grafts had been successfully grown on young tejocote trees (*Crataegus mexicana*) and this practice was reported as a general one. The fruits were of small size and poor eating quality so far as observed. The foliage was attacked by red spiders and the fruits by other insect pests excepting at the highest locations, and the trees seemed to be affected by delayed foliation.

Pyrus malus, L., manzana, apple, introduced, observed in Puebla valley at about 7000 feet elevation and at a few other locations. The trees and fruits were evidently attacked by several insect pests and seemed to be suffering from delayed foliation.

Spondias mombin, L., ciruela, plum, native to tropical America, widely grown everywhere visited. Two varieties, red and yellow fruited respectively, seemed to be grown in about equal abundance. The fruits appear before the leaves. The trees were loaded with oval-shaped, thin skin fruits about 5/8 inch in transverse diameter and with a large seed. The rather scanty amount of flesh is juicy and has a, pleasant, acid taste. Available in all markets at quite low prices and generally popular.

OTHER CULTIVATED FOOD TREES AND PLANTS

Pecan and English walnut trees were observed at several locations about 6000 feet elevation. Particularly fine plantings were found at Amecameca that appeared to be very fruitful. Coffee bushes were observed fruiting in most of the more tropical gardens. Some of the berry fruits and European and American grapes, including the Mission variety, were found growing in a few gardens but none appeared to be very successful. Strawberry plantings and fruits were found in every locality and were very successful. Peanuts, native to Mexico, were also universally grown and generally consumed. Amongst the vegetable crops tomatoes, peppers, squash, watermelons, field beans, potatoes, string beans and peas were most extensively grown commercially. Of these the peppers, squash and beans are native to Mexico. The universally grown field crops include corn, native to Mexico, cotton, native to Mexico, wheat, alfalfa, and, at lower elevations, sugarcane. Some fields were observed where beans, corn and peppers were inter-planted and growing together successfully. Often corn follows a crop of wheat and in other cases two successive crops of corn are grown on the same field during the year. Wheat, of varieties adapted to Mexican climatic conditions, is being grown to an ever-increasing extent and replacing corn to some extent in the diet of the people. An interesting local crop near Matamoras is "Alegria" (**Amaranthus caudatus** L.). It produces small seeds which pop about four times larger proportionally than pep

corn seeds. The popped seeds are molded into small bricks with honey, called "Alegria", somewhat like pop corn bricks. This delicious product was available in most of the markets visited. Its price is very low and it is a very popular confection, particularly with children.

ORNAMENTAL TREES, SHRUBS AND FLOWERS

The Mexican ash tree (**Fraxinus uhdei** (Wenzig) Lingelsheim) "Fresno", Mexican Ash, native to Mexico, is one of the most beautiful shade trees known to the writer. A tree in the garden of Carl B. Schmidt, Mexico City has a trunk circumference of 15 ft. 1 in., at five feet from the ground, an estimated height of 160 ft. and a spread of the branches of 112 ft. Magnificent Fresno trees were observed growing from about 2000 ft. elevation at Tepic, state of Nayarit, to about 8500 feet near Amecameca. It is one of the most popular ornamental trees in the plazas of many cities visited including Mexico City, Puebla, Atotonilco, Tepic, Cholula, Tochimilco and Atlixco. Forests of this species were seen along the highway from Toluca to Morelia and on the hillsides near Atotonilco. The wood is widely used in Mexico for furniture manufacture, for meat blocks, and for building homes. Some of the largest trees examined were estimated as being more than a century old and no evidence of insect injuries or fungus diseases were apparent on any of them. It should be a valuable introduction in the Southwest for street, highway and other ornamental purposes.

The Montezuma Bald-Cypress, (**Taxodium mucronatum** Ten.) "Ahuehuete," native to Mexico, an evergreen tree observed growing along streams in the states of Puebla and Oaxaca by the writer. At Santa Maria del Tule, state of Oaxaca, El Tule, a magnificent specimen of that species was measured by the writer on Oct. 4, 1936 and found to have a trunk circumference of 113 ft. 4 in. at 5 ft. from the ground, height of 118 ft. 7 in. and spread of 100 ft. in Chapultepec Park, Mexico, D.F., a considerable number of very large specimens were observed, some of which were measured and photographed by the writer. Twelve very fine specimens occur in Fairmount Park, Riverside, California, and several others have been noticed in private gardens located in southern California.

Humboldt's willow, (**Salix humboldtiana** Willd.) native to Mexico, is extensively planted at Xochimilco, the "floating gardens," and at a few other locations near Mexico City. It should succeed in the southwest and will be tried at a few favorable locations. It is quite similar in appearance to the Lombardy poplar but apparently not subject to the insect injuries of that tree. Mesquite trees were observed everywhere and are amongst the most valuable of all native trees as soil builders, food for animals and bees, firewood and human shelter. (**Prosopis chilensis** (Mol) Stuntz) is considered to be one of the best species for those purposes.

The introduced ornamental trees widely observed in Mexico include Glossy Privet, (**Ligustrum japonicum** Thunb.) grown as individual trees and found everywhere, "Indian Laurel" (**Ficus nitida**), (**Eucalyptus** sp. L.), (**Araucaria** sp.), date palms, (**Phoenix** sp.) "Peru Pepper," (**Schinus molle** L.) trees and others. Some of the plazas like those of Taxco and Oaxaca have very large Indian Laurel trees that are especially admired by both the Mexicans and the tourists. At Guadalajara the many beautiful Flamboyant, (**Pcinciana regia** Baj.) Jacaranda, (**J. ovalifolia**, R. Br.) both introduced

from Brazil, are particularly beautiful trees during their blooming season.

Of the shrubs in bloom at the time of our visit, (**Bignonia stans**) and (**Nicotiana glauca**) were most in evidence. Small Cordia trees, some white and others pink flowered, were common in most of the districts visited. A blue flowered shrub observed along the roadways near Los Mochis, Sinaloa, called "guayacan" (**Guaiaecum coulteri**, A. Grey) native to Mexico, is one of the most attractive flowering shrubs known to the writer. It should be adapted to the semi-arid conditions in the Southwest.

The wild flowers native to Mexico observed during the writer's visit include dahlia, cosmos, marigold, lantana, Turks Cap (**Hibiscus sp.**) Mexican primrose (**Oenothera mexicana**), Mexican sunflower (**Tithonia**), Mexican creeper (**Antigonon**) and several striking varieties of morning glories.

Of miscellaneous plants observed that are probably native to Mexico, the following were of most interest to the writer, the Cohune oil palm in the state of Nayarit, (**Attalea cohune**, H.B.K.), "gumichil", (**Pithecolobium dulce**); Sonora fan palm, (**Washingtonia sonorae**); (Agave **tequilana**), from which tequila is derived, (A. **Americana**, **A. sisalana**, **A. mescal**); Candelabra cactus and several other striking cacti including the glorious, large flowered night blooming cereus. The interested observer of plants native to Mexico cannot help be impressed by the large number of food, ornamental trees, flowers and shrubs that have proved to be of great economic value to the United States and other countries, as well as the possibilities for finding additional ones which can be improved through systematic plant breeding.

CLASSES OF MEXICAN AVOCADO TREES

The avocado trees observed in Mexico may be arranged in four general groups with respect to anise odor in the leaves: (1) strong, (2) medium, (3) slight, and (4) none.

Each of those general groups may be divided into two sub-groups with regard to the color of the skin, as greenish, dark, or "negro." again the sub-groups vary in thickness of skin, as thick, medium or thin; and also with respect to such flesh characteristics as thickness, texture, color and flavor. The size of seed and its tightness or looseness in the cavity are usually correlated with one of the general group characteristics. The foliage and fruit characteristics of the Fuerte and Puebla parent trees in Atlixco were used as standards for classifying the avocado trees studied in this survey. Systematic notes on selected outstanding summer bearing trees are given on pages 84 and 85.

SOME EARLIER CONTRIBUTIONS

Previous contributions on Mexican avocados include those by Guy N. Collins, who referred to Mexican avocados in bulletin No. 77, B.P.I., U.S.D.A., 1905; Carl B. Schmidt who introduced the Fuerte, Puebla and some other varieties into California in 1911; Dr. F. Franceschi, of Santa Barbara, Calif., through an article entitled "Early History of the Ahuacate in California," published in the March 1912 issue of Pacific Gardens; Wilson Popenoe who visited Atlixco in 1918 and reported on his observations there in the Annual Report of the California Avocado Association for 1919 and 1920; Juan Murrieta

of Los Angeles through an article entitled "Early Introduction of the Avocado in California," published in the Annual Report of the California Avocado Association for 1918 and 1919, pp. 83-84; Paul C. Standley who discusses the Mexican avocado in "Trees and Shrubs of Mexico, U. S. Nat. Herbarium, Vol. 23, part 2, p. 83; James G. France who reported his observations on Mexican avocados in the 1936 Yearbook of the California Avocado Association, pp. 82-84; and the writer who described the parent Fuerte tree as well as a summer bearing one provisionally called "LeBlanc" in the LeBlanc garden, and in the 1936 Yearbook of the California Avocado Association, pp. 86-92, and in the issue of the Journal of Heredity for May, 1937.

During recent years several members of the California Avocado Association and others have visited Atlixco and other avocado growing districts in Mexico and reported informally of their observations there. It is to be hoped that Mexican growers will return those visits in order to observe the propagation, cultural and marketing of avocados in California and Florida.

SUMMARY

A study of Mexican avocado trees located in the Atlixco area, in the Federal District, in the vicinity of Morelia, Patzcuaro, Uruapan, Atotonilco, Guadalajara, Eldorado, Los Mochis and other Mexican avocado growing districts that was carried on during the period of April 8 to June 8, 1938, inclusive, as described in this report.

New information relative to avocado growing in Mexico was obtained through studies of the trees and their fruits and by interviews with growers. All the trees studied were of seedling origin and were quite varied in their habits of growth, foliage and fruit characteristics. As a result of those studies buds from eight trees that mature their fruits during the spring and summer seasons were selected for testing in southern California. Of those, six survived the quarantine treatments in California and were successfully propagated.

The writer wishes to acknowledge his personal thanks for the many courtesies extended to him by Mexican avocado growers, officials of the Mexican and the U. S. Departments of Agriculture, officials of the municipalities visited, officials of the Southern Pacific of Mexico Railway, and others who cooperated in this study.



THE TOWN AND VALLEY OF ATLIXCO

This old Spanish city, lying at the edge of a fertile plain given over to wheat culture, is the Mecca of all California avocado growers. The trees upon which the avocado industry in California was founded have mainly come from the orchards which lie to the right and left of this picture.

Description of Summer Bearing Avocado Tree and To Growers in The

TREE NO.	ANISE ODOR	TREE		
		Circ. trunk at 3 ft.	Ht. tree	Spread
Atlixco A	none	6ft. 7in.	35ft.	34ft. 8in.
Atlixco D	small	7ft.	30ft.	37ft. 9in.
Atlixco E	slight	7ft. 4½ in.	30ft.	54ft. 5in.
Atlixco F	none	12ft.	55ft.	58ft. 9in.
Atlixco Parent Puebla tree	med.	3ft. 6in.	25ft.	23ft.
Atlixco Parent Fuerte tree	med.	4t. 4½ in.	29ft.	42ft. 4¼ in.
Atlixco K	none	medium size tree		
Atlixco L	none	large tree		
Atlixco 2	none	11ft.	45ft.	62ft.
Atlixco 3	strong	6ft. 10in.	20ft.	21ft. 6in.
Atlixco 4	strong	11ft.	45ft.	62ft.
Atotonilco H	strong	18ft. 6in.	100ft.	85ft.
Eldorado U	none	5ft. 6in. at 2 ft.	25ft.	30ft.
Huilango R	none	large tree		
Huilango S	none	large tree		
Huilango T	none	4ft. 9in.	30ft.	29ft. 6¼ in.
Matamoras I	strong	8ft. ¾ in.	75ft.	52ft.
Nexatengo 7	none	5ft. 9in.	25ft.	30ft.
San Baltazar 8	strong	7ft. 4½ in.	45ft.	62ft. 6in.
San Diego M	none	3ft. 9in.	25ft.	27ft.
San Diego N	small	2ft. 6in.	18ft.	20ft.
San Diego O	strong	3ft. 8in.	22ft.	30ft.
San Diego P	strong	3ft. 4in.	25ft.	30ft.
San Diego Q	strong	5ft.	25ft.	40ft.
Tochimilco B	strong	13ft. 4in.	40ft.	35ft.
Tochimilco C	strong	12ft.	45ft.	30ft.
Tochimilco J (ave. 6 trees)	strong	11ft.	59ft.	40ft.
Tochimilco I	strong	8ft. 4in.	50ft.	71ft. 8in.
Tochimilco Z	strong	8ft. 1in.	50ft.	49ft. 9in.
Tequila V	none	1ft. 8in. at 4 ft.	15ft.	18ft.
Uruapan W	strong	6.55ft.	73.5ft.	52.3ft.
Uruapan X	strong	2ft. ½ in.	18ft.	20ft.
Uruapan Y	strong	medium size		
Xalpatlaco	none	13ft. 6in	85ft.	54ft. 7in.

Fruit Characteristics Selected as of Particular Interest United States and Mexico

FRUIT				Skin	SEED		SEASON
Long. dia.	Trans. dia.	Shape	Color		Wt. fruit & seed grams	Wt. seed grams	
4.5	2.75	oval	green	thick	230	22	May & Dec.
4.0	2.625	oval	dark	med.	212	8	June & Dec.
4.25	2.75	oval	green	med.	210	23	June & Dec.
4.00	3.25	round	green	thick	290	13	June & Dec.
	medium	oval	dark	thin			Sept. & Oct.
	medium	pyr.	green	med.			Dec. & Jan.
5.25	3.50	pyr.	dark	thick	432	91	Apr. & Dec.
4.25	4.00	round	green	thick	522	98	Apr. & Nov.
3.75	2.75	pyr.	green	med.	210	30	May & June
4.94	2.75	pyr.	dark	thin	250	40	Mar. & Apr.
4.25	2.75	pyr.	dark	med.	275	50	Apr. & May
12 to 14 oz.		oval	dark	thin	medium		July & Aug.
9.00	3.35	long	dark	med.	medium		Aug. & Sept.
5.25	4.25	oval	green	hard thick	785	195	Mar. & Apr.
4.25	3.25	oval	green	hard thick	310	5	Feb. & Mar.
5.00	3.75	oval	green	hard thick	535	50	Jan. & Mar.
	small fruit	pyr.	green	thin	large		June & Dec.
4.5	2.75	oval	green	med.	250	40	Apr. & Dec.
3.75	2.25	oval	dark	thin	150	25	May & Dec.
3.63	3.00	round	green	med.	260	35	June & July
4.00	3.00	pyr.	green	thick	240	24	Summer
3.75	2.88	oval	green	thin	227	46	May, Jun., Jul.
4.50	3.25	oval	green	med.	230	20	July & Aug.
3.63	2.50	pyr.	green	thin	200	41	Aug.
			"corriente" and too immature to measure	oval	dark	large	Dec.
			"corriente" and too immature to measure	oval	dark	large	Dec.
"corriente"	small	oval	dark	thin	large		Winter
	med. size	oval	dark	thin			Sept. & Apr.
"corriente"		oval	dark	thin	large		Winter
3.75	2.85	oval	green	med.	medium		July & Aug.
3.00	2.00	oval	green	thin	Very large		Summer
4.50	2.65	oval	"rose" dark	med.			Mar. Apr. May
5.00	1.50	long	dark	thin	95	12	Spring
	large size		green	med.	small		Dec. & Jan.

"Corriente"—common type or ordinary run of seedling avocados.