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AVOCADO CULTURE IN FLORIDA

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For centuries the avocado has been an important food crop of Central America and adjacent territory. Only recently has the population of the United States become acquainted with it. Avocados are now obtainable on most markets in the United States at reasonable prices, considering their high food value. Avocado production and commercial utilization in California and Florida have, in general, increased during the past 25 years; but hurricanes and freezes in Florida and occasional years of overproduction have not made avocado culture in Florida free of hazards. A few avocados are produced in the Rio Grande Valley of Texas. In the past, some avocados have been imported from Cuba and Puerto Rico. However, practically all avocados in the United States markets are grown in California (about 63% in 1962) and Florida. This circular answers briefly some common questions about its culture, varieties, and possibilities in Florida. More detailed information about the Florida avocado industry occurs in the University of Florida Bulletin 602.

Uses of the Fruit

The avocado possesses nutritive value far exceeding other fresh fruit. The fruit is used widely for salads in the United States, where it is prized for its delicate, nutlike flavor and its smooth, buttery consistency. The most common way of serving the avocado in the United States is "on the half shell" or sliced, with the addition of lime juice, salt, or salad dressing. The fruit is a frequent ingredient for Waldorf salads, or mixed with grapefruit and orange sections. Fully ripe fruit have been used successfully to make avocado ice cream. However, the most exotic use is the famous "guacamole" salad common throughout Mexico. It is made hundreds of different ways, but the basic formula for guacamole salad mixture, as reported by the Weslaco laboratory of the Southern Utilization Research and Development Division, ARS, USDA, includes: 7 cups of macerated avocado flesh, 6 tablespoons of lime juice, 1 teaspoon onion powder, 5 teaspoons of salt, and 12 tablespoons of cracker meal. Tomatoes, peppers, and spices may be added to suit the tastes of different individuals.

Avocado Trees in Florida

The avocado is a large, rapid-growing subtropical evergreen tree of handsome appearance. It grows well on a wide range of soils, including the limerock of Dade County and the sands of the lower ridge area. However, because of

their sensitivity to cold, 90% of the trees in the State are grown in Dade County, the southernmost portion of the State, where freezes are less likely to occur. The acreage there comprises nearly 10,000 acres. An additional estimated 500 acres of avocados are grown in Highlands, Pinellas, Hillsborough, and Polk Counties.

Exposure to strong, prevailing winds or occasional hurricanes damages avocado trees because of the extreme brittleness of avocado wood. It is desirable to plant windbreaks of Casuarinas where there is no natural protection from the winds.

Avocado Varieties in Florida

The avocado is *Persea americana* Miller of the laurel family. Three general groups of avocados have been recognized for horticultural purposes. These are loosely termed West Indian, Guatemalan, and Mexican races.

The leaves of trees of the Mexican race are anise-scented; the fruits have very thin, tender rinds and are mostly small sized and black or maroon colored and ripen in the summer. The Mexican avocados are the most cold hardy of the three races, are the least salt tolerant, and are highly susceptible to anthracnose black spot of the fruit.

The West Indian race avocados usually ripen in the summer and fall, have a moderately thin, smooth, leathery skin, and are generally larger-sized fruit than those of the Mexican race.

Most West Indian fruit are green skinned, although some are maroon colored. The trees are tender to cold, highly salt tolerant, and are resistant to anthracnose black spot disease.

The fruit of the Guatemalan race have thick, usually roughened skins woody in texture and green or ~~black~~ dark purple in color and ripen in the spring. They are more cold hardy than the West Indian avocado in Florida.

The grouping of varieties by races is becoming constantly less useful because of the increasing number of presumed hybrid types between Guatemalan and West Indian found in Florida and between Guatemalan and Mexican, now grown in California, and West Indian and Mexican found in Mexico, now grown in Texas. Avocado explorers of the California and Texas Avocado Societies have found many wild forms with hard skins of the Guatemalan race but with anise-odored leaves of the Mexican race in the State of Puebla, Mexico. Also, there have been found many dooryard trees in the State of Tamaulipas, Mexico, of large-sized, green West Indian type with anise-odored leaves. These are undoubtedly hybrids of the races because dooryard seedlings of all three races grow in close proximity in some areas of Mexico.

Of the varieties now grown commercially in Florida, most are Guatemalan-West Indian hybrids or are West Indian. In 1962, Lula, the leading variety, accounted for 28% of

the total production. The other principal varieties for the year 1962 were Booth 8 (24%), Waldin (12%), Booth 7 (10%), Pollock (7%), Hickson (5%), Booth 3 (3%), and Fuchs (2%). Other varieties include the Taylor, Tonnage, Monroe, Hall, and Choquette. Seedlings, and some 40 other varieties, make up the remainder. Some characteristics of several important varieties are described below. Information on other varieties can be found in University of Florida Bulletin No. 602.

Lula.--This variety is believed to be a Guatemalan-West Indian hybrid, originating as a seedling of the Taft, a Guatemalan race variety. It is a thrifty, upright growing tree, producing pear-shaped, light green and nearly smooth-skinned fruit weighing 10 to 15 ounces. The flesh is pale greenish-colored and of good flavor; oil content ranges from 3 to 12%; and the harvesting season is from October through January. The variety is precocious and highly productive.

Booth 7.--It originated as a seedling of unknown Guatemalan-race parent in mixed planting with West Indian avocados and is probably a hybrid of the two races. The fruit is rounded ovate; weighs 10 to 20 ounces; skin is glossy green, slight pebbled, and thick and woody. The flesh is of light yellow and of good flavor. The oil content ranges from 4 to 13%. The fruit is harvested from October to mid December. The variety fruits heavily but tends toward alternate bearing.

Booth 8.--The origin is from a seedling of unknown Guatemalan-race parent in the same mixed planting with West Indian avocados in which Booth 7 was found. The fruit is oblong-ovate and weighs from 9 to 28 ounces. The skin is a dull green color, slightly roughened, and rather thick and woody. The oil content ranges from 4 to 13% and the flesh is cream colored and of fair flavor. The variety is prolific with much of the fruit grown in clusters. The trees often bear so heavily that they show loss of foliage, sunburned bark, and dieback of branches. The tendency to alternate bearing is strongly developed.

Waldin.--This variety originated from a West Indian seed and appears to be a typical West Indian type. The fruit is oblong to oval, with a flattening on one side of the blossom end. The fruit weighs 14 to 28 ounces and is harvested September through November. The skin is smooth and pale green. The oil content ranges from 3 to 12%. The tree is highly productive.

Pollock.--This is a typical West Indian variety, pear shaped, smooth skinned, with a light glossy green color and is large sized, weighing from 18 to 40 ounces. The flesh has a rich yellow color and is of good flavor. The oil content is low, ranging from 2 to 8%. The tree is a shy bearer and is very tender to cold. It is the best variety now available for the season of July 15 through August.

Taylor.--This is a typical pear-shaped Guatemalan variety. The skin is rough pebbled, dark green, and the fruit ranges in weight from 12 to 18 ounces and is harvested November 15 through January 15. The oil content ranges from 6 to 14%. The tree is the most resistant to cold of the varieties grown commercially in Florida.

Choquette.--This variety of unknown origin is probably a West Indian-Guatemalan hybrid. The fruit is oval shaped, weighs 24 to 40 ounces, is harvested December 1 to February 1, and has a smooth, leathery green skin. The flesh is yellow and of good flavor. The oil content ranges from 4 to 8%.

The Need for New Cold-hardy, Disease-resistant Varieties

None of the Mexican-race varieties are grown commercially in Florida, even though they are as hardy as the sweet orange. There are scattered dooryard Mexican-race seedlings grown as far north as Gainesville. The fruit is generally small, black, of exceptionally high quality, and ripens in the summer. The fruit is poorly adapted to the moist summer climate of Florida because of its susceptibility to anthracnose black spot. The trees will often drop their entire crop from the ravages of black spot before the fruit reaches maturity.

None of the Mexican-West Indian hybrids found in Tamaulipas, Mexico, have been tested for adaptability to

Florida conditions. Some of these, under Texas conditions, have been found to carry cold hardiness and have some resistance to anthracnose black spot.

Hybrids of the Mexican race with the other two races should be obtained and tested in Florida in an attempt to find an adapted variety with greater cold hardiness. This process, however, would delay progress on this project by 10 to 20 years, and quicker results could be obtained by introductions of hybrid selections from Mexico, Texas, and California. Because of the high incidence of the budwood- and seed-transmitted virus called sun-blotch in avocados in Mexico and Texas, it would be desirable to index these introductions for sunblotch, using West Indian seedlings as indicator plants.

To find an adapted cold-hardy variety for Florida, it will be necessary to discard all selections susceptible to anthracnose black spot, which is difficult to control commercially under Florida's moist summer climate. In the dry climate of California, anthracnose black spot is not serious, and the California avocado industry has, accordingly, developed around the more cold-hardy Mexican and Mexican-Guatemalan varieties.

Not so much

Propagation

Nurserymen in Florida propagate the avocados by grafting and budding. Little information is available concerning

racial and varietal compatabilities of rootstock and scion. There is no information to indicate whether some rootstocks import greater cold hardiness to mature trees. Seeds of the West Indian varieties and of the Lula from locally grown fruit are used widely to provide nursery stock. Large seed of Waldin and Lula provide a high percentage of sturdy uniform stocks, and seed of these varieties are usually available in large quantities.

Seeds are planted in paper cylinders made from 30-pound roofing paper, wooden planting boxes, or in 1-gallon-sized tin cans. If cans are used, holes are punched on the sides near the bottom of the cans to provide drainage. The cans are filled with a light sandy loam containing a light sprinkling of commercial fertilizer. Good drainage and regular watering are essential to growing seedlings successfully. Seeds begin to germinate within a few weeks. The seedlings are ready for grafting after about 3 months, when the stems are pencil sized and still pliable.

Cleft grafting of seedlings has largely superseded budding in Florida. Terminal scions or tips 2 to 2 1/2-inches long are used and they should be from the last matured growth. In cleft grafting the seedling top is cut off about 2 to 3 inches above the soil level, and an incision about 2 inches deep is made in the seedling stump. The base of the scion is trimmed to a wedge shape and is inserted in the cleft incision

of the rootstock seedling. Rubber or polyethylene budding strips are used to wrap the graft union.

Grafted plants are suitable for transplanting to the field any time after the top has matured one or two flushes.

Interplanting of Varieties

The grouping of varieties in commercial plantings has been in the past considered desirable to assist in flower pollination and fruit setting. All varieties thus far studied fall into two classes, referred to as Class A and Class B. Class A varieties have flowers ready to be pollinated in the forenoon but shedding pollen from a second set of flowers in the afternoon of the next day; while Class B varieties have their first opening in the afternoon and second opening the next morning. Waldin, Lula, and Taylor are known to be Class A, and Booth 7 and Booth 8, Class B.

There is no reliable evidence regarding which reciprocating varieties are mutually most helpful, or is it bees that really are needed? From experience in Florida, Lula, Taylor, and Waldin fruit as well in solid blocks as in mixed plantings. Apparently, few, if any, Florida varieties, except Collinson, are self-unfruitful.

Some consideration should be given to variations in disease resistance and fungicide requirement of the different varieties in planting a grove. Varieties highly susceptible

to avocado scab, such as Lula and Hall, should be grouped to facilitate spraying and usually require five to six sprayings a year. The more scab-resistant varieties may require only two or three sprayings during the year.

Planting

On the limerock soils in Dade County the trees are set higher than in other sections because of the slow surface runoff in rainy weather. They are planted in a mound so that the crown roots are about 6 inches above the general ground level.

When the trees are planted from cans, the plants can be freed by cutting the can away with a special can-cutting tool. Care should be taken to avoid leaving air pockets in the soil about the roots. A basin should be made about the tree for watering. The basin should be mulched heavily with grass or sawdust to prevent the soil about the new roots from drying out or overheating. Frequent waterings are necessary until the trees are established. By the end of 3 months the trees should require less watering, unless a long dry spell occurs.

Shading of newly planted trees is desirable when plantings are made at any season, but especially in the summer. Three or four palm leaves arranged in a wigwam fashion over the trees are satisfactory, although a burlap feed sack stretched in a V-form around three stakes placed

around the tree serves just as well. These shades give protection from wind as well as sun.

Cultivation, Mulching, and Cover Crops

Soil care should conserve moisture and fertility and add humus. Clean cultivation the year round is unsatisfactory as it destroys too much humus. Clean cultivation through the dry season, followed in the summer rainy season by the growing of cover crops, to be turned into the ground in the fall, has given very good results in a number of avocado orchards. In others, a system of permanent mulching is used with excellent success. Excellent mulching material is cheaply obtained in some groves by sowing velvet beans, pigeon peas, crotalaria, beggar-weed or Natal grass in the row middles, cutting these crops from time to time and adding the hay to the mulch beneath the trees.

Fertilizing

Avocados are heavy feeders and should be well fertilized for best results. As a general rule, the trees should be fertilized four or five times the first year after planting, giving them at each application a pound of fertilizer containing about 5% of nitrogen, 6 or 7% of phosphoric acid, and 3 or 4% of potash. This amount may be increased to 2 pounds per application in the second year and gradually increased until the trees reach full bearing size.

By that time they should receive from 40 to 60 pounds annually.

The nitrogen used in the avocado fertilizers should be derived mostly from organic sources such as guano and tankage, rather than from nitrate of soda or other inorganic forms. Additional applications of stable manure or other fertilizer containing organic nitrogen may be made with advantage. It is difficult to overfeed an avocado tree. For more detailed information on fertilization, the reader should refer to University of Florida Bulletin No. 602.

Irrigation

The avocado requires an abundant supply of water and should not be planted in very dry soils unless an irrigation system is installed. Even in more favorable soils, irrigation is highly desirable because droughts are frequent in Florida.

Pruning

Trees of most varieties require but little pruning if properly headed at planting time. Later pruning will consist largely in removing weak or undesirable growth. Trees of a few varieties tend to grow very tall, and these need occasional heading back to lessen the danger of wind damage and to facilitate spraying and harvesting operations.

Insect Pests and Fungus Diseases

Several insect pests and fungus diseases require the grower's attention but their control has been fairly well worked out. Red spider, which is especially injurious in dry weather, may be checked by spraying with commercial lime-sulphur solution (1-70) or with sulphur dust. Scale infestation and white fly, with the sooty mold that follows, call for the use of oil emulsion sprays (1-70) in the dormant season (November to February).

Avocado scab, affecting both fruit and foliage, and anthracnose black spot, affecting the fruit, are the most serious fungus troubles to be guarded against. They are usually controlled by the use of Bordeaux mixture (3-5-50), and two or three applications usually are sufficient. The first application should be either immediately after the blooming period or during the last of the bloom.

Avocado trees often become stunted, beginning to die back and the leaves curl up and drop off. This condition, called by the growers "die-back" or "leaf curl", is most common with trees on light dry land and in nearly all cases seems due to neglect or to overbearing, rather than to the presence of any specific fungus. When thoroughly mulched, watered and fertilized with stable manure or other fertilizer high in organic nitrogen, the sickly trees, if not too badly affected, usually make a quick recovery. When the trouble

is due to unfavorable soil conditions, the recovery may be temporary.

Virus Diseases

The avocado is subject to at least one virus disease. Because the symptoms resemble sunburn, it was named sun-blotch. The symptoms include yellowish or white depressed markings on green fruit, depressed yellow streaks in green twigs, slightly distorted growth of leaves, and stunting of the tree. However, the absence of fruit and leaf symptoms is not proof that the tree is not infected. Avocado trees are sometimes symptomless carriers of the sun-blotch virus.

Many avocado selections from Mexican-grown seedlings were introduced as budwood into Texas during the 1950's and propagated onto West Indian-race rootstocks. As the trees grew older, trees of certain selections were stunted in growth; others were not. No distinctive foliage, fruit, or twig symptoms were observed, but the West Indian rootstock showed characteristic rough, deep grooves in the bark. In 1963, E. O. Olson reported evidence that the causal agent of this disease of West Indian rootstock is seedborne and bud-transmitted in some Mexican-race selections and it is associated with or identical with sun-blotch.

Trees with sun-blotch are generally less productive than healthy trees. The disease was reported in Florida by H. E. Stevens in 1929 and several other cases have been

observed. Because certain avocado trees are symptomless carriers of the disease, care should be exercised in introducing selections and varieties from other areas where the disease occurs. As discussed earlier, all importations of avocado budwood should be virus-indexed, using the West Indian seedling-indicator plants. Also, it is advisable for Florida nurserymen to discard any plants from any source which show roughened rootstock symptoms when grafted to West Indian rootstock. Likewise, the nurserymen should abandon any rootstock seed source whose seedling progeny consistently transmits sun-blotch symptoms to grafted tops of susceptible varieties.

Maturity, Ripening, and Harvesting

The oil content of the fresh pulf of Florida avocados ranges from 3 to 14%, while those from Mexico and California may have a considerably higher oil content. It is influenced by variety, climate, and time of harvesting. The Mexican-race varieties usually have more oil than the Guatemalan- and West Indian-race varieties. Fruit of a given variety ripens earlier and has less oil when grown in the Rio Grande Valley of Texas than when grown in Florida; Florida-grown fruit ripens earlier and has a lower oil content than California-grown fruit of the same variety. However, it is rarely the same variety being grown in the two areas.

The Mexican-race varieties and hybrids, which are commonly grown in California, have an unusually high oil content, and these high oil contents are associated with high flavor rating. However, with varieties grown in Florida (Waldin, Lula, Pollock, Booth 7, etc.) at any given picking, there was no consistent preference in marketing quality studies in flavor for fruit of higher oil content. However, the oil content and flavor increases as the crop year advances.

It is difficult to determine the proper period for harvesting the avocado, especially the green-skinned varieties. The season of maturity varies slightly from year to year for each variety, according to time of bloom and seasonal conditions during fruit growth, so no calendar date can be used as a sole index for maturity of any variety. Mature and immature fruits appear similar externally.

It is common knowledge that fruits of many varieties of avocados, when mature, will ripen (soften) quickly if harvested but more slowly or not at all if left on the tree. An extreme case of this behavior is that of the Fuerte variety (grown in California) which seldom softens while attached to the tree by a healthy stem. Similarly, mature Florida avocados are stimulated to ripen when they are detached, but they differ from the California fruit in that most varieties will eventually soften on the tree. However,

harvesting and shipping fruit which have reached the fullest possible degree of maturity on the tree is not recommended.

Selection of avocados at harvesting for a specific percentage of oil does not seem feasible in Florida because of the wide range in oil content in individual fruit. Because oil content, like fruit weight and diameter, is related to maturity, its merits cannot be overlooked. However, the present method of determining avocado maturity in Florida by using beginning shipping dates in conjunction with minimum fruit weights and diameters for each of the many varieties appears satisfactory under present marketing conditions. The reader is referred to Technical Bulletin No. 1310 of the U. S. Department of Agriculture for more detailed information on seasonal changes in maturity of Florida avocados.

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Chapter 4 The Avocado

Origin and History

The avocado, Persea americana Mill., is the most valuable tree fruit native to the New World, where it was growing from Central Mexico to Colombia and Peru in 1492. First observed in 1510 in N. Colombia, it was carried all over the West Indies in the 16th century but was very slowly adopted elsewhere. Culture in Florida and California began in the latter half of the 19th century, and in other parts of the world began on any commercial scale only since 1900.

While Middle America and the West Indies still produce more avocados, probably, than all the rest of the world, their production is almost all from seedling trees. The United States has the largest plantings of grafted trees, some 35,000 acres with 100 to 150 million pounds of fruit annually. Two-thirds of the acreage is in California and most of the rest in Florida. South Africa has 10,000 acres of grafted trees, Chile about 4500 acres. Brazil has around 1000 acres, and Argentina, Israel, and Australia (Queensland) about 500 acres each. The Philippines has the only large production in Asia, with an equivalent of some 7000 acres in seedlings and grafted trees.

Avocados are unlike nearly all other orchard fruits in having the stored food present as fats instead of as carbohydrates. Only olives share this distinction. Since fats are twice as concentrated a form of food energy as carbohydrates, an avocado with 10% fat content has the energy value of a banana with 20% carbohydrate for equal weights of fruit. Avocado fat is easily digestible, and so the fruit is a valuable food resource. It is surprising that it has failed to find favor in most of southern Asia, and is little cultivated in most of South America, considering its potential for supplying food cheaply to small farmers.

Races and Varieties

When Europeans first became acquainted with avocados, there were 3 distinct races in existence, which we call West Indian, Guatemalan, and Mexican. Actually there were no avocados yet in the West Indies, and the race we call by that name was introduced

there from the lowlands of Colombia and Central America. But when horticultural interest in avocados began to develop in Florida, this race was most readily available in Cuba and Puerto Rico, and so was called West Indian. The Guatemalan race is known chiefly from highland areas of Guatemala, and the Mexican race is indigenous to highlands of central Mexico. The following table indicates many of the characters which differentiate these races.

Race / Charac.	West Indian	Guatemalan	Mexican
Foliage	not scented	not scented	anise scented
Season	summer and autumn	winter and spring	summer and autumn
From Bloom to maturity	5 to 8 months	10 to 15 months	6 to 8 months
Skin color	green to purple or red	green to purple or red	green to purple-black
Skin texture and thickness	leathery, pliable, to 1/16 in.	woody, brittle, to 1/8 in.	papery, tender, to 1/32 in.
Skin surface	smooth	rough, pebbled or ridged	smooth
Fruit size	1 to 5 lb.	1/2 to 5 lb.	under 1/2 lb. usually
Fruit stem	short	long	short
Seed	large, usually loose	small, usually tight	large, usually tight
Seed coats	usually separated	adhering tightly	either of these
Cotyledons	rough surface	smooth	smooth
Blooming	early - midseason	midseason - late	very early
Adapted to	below 3000 ft.	from 3000 to 6000 ft.	above 6000 ft. in tropics
Grown commercially in	Florida, Cuba	Florida, California, Israel, South Africa	California Chile Ecuador
Cold limits	24 to 28°F	21 to 26°F	16 to 25°F

Crossing between races has given many hybrid forms with characters which are intermediate. Around Puebla, Mexico, there have long been grown natural hybrids between Guatemalan and Mexican races, known locally by the curious name "aguacates de

China". One of these was introduced to California as the Fuerte variety, and has become the most important variety in the world. Hybrids between Guatemalan and West Indian races arose in Florida around 1916, and have become the leading varieties there. Some West Indian x Mexican hybrids have appeared but have not proved valuable. In general, wherever avocados are planted in orchards of grafted trees, hybrid varieties are of more value than the racial varieties today.

Coyo ?

VARIETIES

Climate and Soil

Climatic adaptations differ for the three races. The West Indian race thrives in tropical lowlands, while the Guatemalan race is not productive there and needs the cooler growing season found above 3000 ft. The Mexican race can be grown in the lowlands, but cannot compete there with the large-fruited West Indians. Its hardiness to cold enables it to be grown in the tropics above 6000 ft., where the other races do not succeed. All three races need abundant, well-distributed rainfall, or irrigation, so that there is no prolonged dry period.

Good drainage is the most important soil characteristic. A wide range of soil texture and acidity is satisfactory. ~~The West Indian race seems to be~~ more tolerant of salinity ~~than the other two.~~

Botanical Considerations

Leaves are rather leathery, entire, usually from 6 to 10 inches long.

Elaborate or all avocados are evergreen trees reaching 30 to 60 ft., with rather brittle wood. The small flowers are borne in late winter or spring in large, subterminal panicles. The flowers are perfect, but stamens and pistils do not mature together, so that there may be pollination problems. Every flower opens twice, for a total of 2 days, with a night between first closing and second opening. ~~and~~ At the first opening the pistil is receptive to pollen but the stamens of that flower shed pollen only at the second opening. All flowers on a tree, or on all trees of a variety, open and close within a few minutes of each other. Some trees (or varieties) have the first flower opening in the morning and the second opening

Varieties

In both Florida and California there are many varieties which have been planted commercially and come on the market in large amounts. The number recommended for planting in those states has steadily decreased, however, and the trend is toward a few very satisfactory varieties instead of a great many. It is necessary to have varieties which will give a continuous sequence of production through as much of the year as possible. The varied climatic zones in California make this possible with only 2 varieties, while in the more uniform climate of Florida at least 6 or 8 varieties must be grown. The following varieties have been sufficiently tested in Central America to be recommended confidently for tropical America generally. All are vigorous and productive.

Varieties for low elevations (all originated as seedlings in Florida)

SIMMONDS — This is a typical West Indian variety, maturing early (about 6 or 7 months from bloom). The fruit is large, 20 to 30 oz., with light green skin at maturity, and is of very good flavor.

WALDIN — ~~Also a typical West Indian form~~, this variety matures later than most West Indian types, from 7 to 8 months after bloom, but still early in the season. Fruit is large, 14 to 25 oz., with pale green skin, and good flavor. Sometimes so heavy a crop is set that limbs die back somewhat and fruits are sunburned. Thinning of fruits early in their development may prevent this.

BOOTH 8 — A hybrid resulting from pollination of a Guatemalan variety by a West Indian one, this variety is intermediate to its parents in season of maturity. It may be called midseason, maturing 9 to 11 months from bloom. The fruit is fairly large, 14 to 25 oz., with thick, woody rind and slight roughened skin, dull green in color. Quality is good. There is a tendency to alternate bearing of light and heavy crops, but the average is good.

LULA — One of the most consistently heavy bearing varieties, this Guatemalan × West Indian hybrid has a long bearing season, midseason to late, ranging from 10 to 13 months from bloom.

It has some undesirable features — great susceptibility to scab, a tendency to grow too tall, a very large seed, and only fair quality — but its heavy bearing outweighs these defects for most growers.

Varieties for medium elevations

FUERTE — This is the leading variety in California and is widely grown in other countries. A ~~hybrid~~ Guatemalan × Mexican hybrid, it was introduced from Atlixco, Mexico, in 1911. In suitable climatic conditions it bears heavy but somewhat irregular crops, maturing over a long period, from 8 to 14 months after bloom. Fruits are medium-small, 6 to 16 oz., with fairly thin, slightly pebbled skin of dull green color, turning dark as the flesh ripens. Fuerte is much better adapted to dry than to humid climates, being subject in the latter to scab and black spot. Quality is good.

HASS — A pure Guatemalan variety, this arose as a seedling in California and has become second only to Fuerte there. It rather regularly bears heavy crops, maturing very late, some 14 to 18 months from bloom in climates with cool, dry summers. Fruits are small, 8 to 10 oz., with fairly thick pebbled skin of dark purple or black color on ripening. Quality is very good.

Varieties for high elevations

BACON — Considered a Mexican × Guatemalan hybrid, this variety is predominantly Mexican in character except for its late season of maturity — some 11 to 13 months from bloom. It is tall and slender in habit and regularly bears heavy crops. Fruits are medium small, 8 to 12 oz., with thin, green skin. Quality is good. It is quite resistant to cold.

ZUTANO — This Mexican variety bears larger fruits than is usual for this race. Tree and fruit characters are very much like those of Bacon, but the season of maturity is earlier, from 9 to 12 months after bloom. It is recommended for cold sections of the California avocado area.

the next afternoon (Class A), while other trees open flowers first in the afternoon and have the second opening next morning (Class B). Every day during several weeks of blooming, a new group of flowers opens for the first time, and the group which opened the previous day, closes for the second and last time. Usually the pistil is no longer receptive to pollen at the second opening.

This notable condition of synchronous dichogamy appears to make self-pollination almost impossible, and since avocado flowers only set fruit after pollination interplanting of Class A and Class B varieties would seem essential. In practice this interplanting is often very helpful to obtaining good crops, but not always needed. This is largely a matter of weather conditions during the bloom period. When there is a regular succession of warm, sunny days, the flowers open and close with great regularity. But cool, cloudy weather disturbs the regularity of opening and closing, so that there is overlapping of cycles and pollen may be shed by some flowers while others on the same tree are receptive. A single cool day after a succession of warm ones will cause flower cycles to be mixed up for a couple of days, and continuous cloudy weather may keep the cycles disturbed indefinitely. Under such conditions, self-pollination can take place and interplanting may not be advantageous.

Pollination is done by insects. Even when the pistil may still be receptive at second opening, as in some Class B varieties which have their first opening very late in the afternoon, the arrangement of the stamens precludes close pollination. The insects most active in pollination are wild bees and flies; honey bees do not seem to be very effective.

An avocado tree may produce over a million flowers, but still may mature only a few or no fruits, instead of the several hundred which constitute a good crop. Sometimes this poor setting may be due to lack of pollination, as found in isolated trees or orchards of one variety only. Under the same climatic conditions some varieties set good crops much more regularly than others. There is no evidence that when interplanted, some varieties are better pollinators than others if the varieties interplanted are of

The fruit contains one large seed enclosed in a third layer of flesh around which is a more or less thick peel or rind.

opposite bloom classes and bloom at the same time. Trees in vigorous condition set heavier crops than weak trees. Guatemalan varieties and hybrids of this race often exhibit a marked tendency to alternate bearing of heavy and light crops, whereas this does not usually occur in the other two races. Low temperature (not above 28°F) during the bloom period reduces pollinator activity and pollen growth, and so decreases fruit set.

(See over)

Propagation

Avocado seeds remain viable only a few weeks and are best planted at once after removal from fruits. They germinate in 3 to 4 weeks, and usually make vigorous seedlings. Seeds should be planted with the broad end downward, the position in which the seed is found in fruits as they hang from the tree. The top of the seed should be slightly above the soil surface, and in seeds with tightly fitting seed coats, these should be cut away at the top to allow free penetration of oxygen to the plumule. There are advantages to letting seeds germinate in a shallow tray of sand or peat, and transferring them to pots as soon as germination is evident. The potting soil should be free-draining, preferably a mixture of loam and organic matter, although sand alone can be used if the seedlings are watered with nutrient solution.

For vegetative propagation, seedling stocks are used almost exclusively because of the difficulty in rooting cuttings. The larger the seed, the larger the resulting seedling in a given time. Vigorous seedlings of any well-adapted race seem equally satisfactory in most situations. However, seedlings of West Indian race are more tolerant of salinity than those of other races, and some seedlings of Mexican race (notably of the variety Duke) are somewhat resistant to avocado root rot disease. Varieties of West Indian and Guatemalan races are often more difficult to graft on seedlings of Mexican race than on those of the other two races. In general, the larger and more vigorous the seedling, the easier it is to graft.

1st 9 pp. under Propg.

Seedlings may be planted directly in the orchard, or even seeds may be planted where trees are to be, for seedling orchards. Seedling trees are usually slow to begin bearing, sometimes waiting until 10 years old or more, and the size, season, and quality of fruit will not be known until then. For dooryard planting this may not be a big handicap, yet even there it is desirable to be assured of a long season of fruit maturity. For city markets it is important to have fruits of uniform appearance and season of maturity, and only vegetative propagation will assure this.

Seedling stocks may be grown in containers or in field nurseries like orange stocks. Grafting is more conveniently done on young stocks in containers, while budding is satisfactory on 1-yr. stocks in nursery beds. Containers should hold a gallon of soil to prevent stocks from becoming pot-bound before planting. Usually seedlings reach a satisfactory size for grafting — 12 to 18 in. tall with 8 to 12 well developed leaves — in about 3 months of warm weather. It is important that seedlings grow rapidly and are slow in developing woody tissues, as such seedlings are easier to graft. Judicious application of water and light fertilizing will keep growth vigorous.

In humid climates, grafting on young stocks is preferred; in rather arid climates, budding on yearling stocks is more satisfactory. For grafting, both the wedge side-graft and veneer-grafting are popular. In side-grafting scions 3 to 4 in. long of well-matured terminal twigs are used. Preferably, they should have the lateral buds swollen but not visibly pushing out shoots. The lower end of each scion is cut to form a tapering wedge about 1 in. long. An incision is made in the stock, starting a few inches above the soil and slanting steeply downward for at least 1 in. This cut should not extend past the center of the stem. Into this incision the scion wedge is inserted, and the stock tied with thin rubber strips for the length of the cut, leaving the scion uncovered above this. Because the stock continues to increase in diameter while the graft is uniting, elastic wrapping is less likely to constrict the stock than wrappings which cannot stretch. After a month the top of the stock should be cut back one half, to encourage scion growth, and cut back clear to the scion when the latter has grown to

a few inches in length. If the side-graft fails to succeed, the stock can be cleft-grafted lower down or veneer-grafted.

Veneer-grafting has some advantages over side-grafting, in that the succulent condition of the stem is less important and both stock and scion may be older. If they are in proper condition, side-grafting is probably the quickest and easiest method. In veneer-grafting, the cut on the stock stem should be 2 or 3 in. long, extending only to a depth of 1/16 in. The base of the scion, which may be 4 to 5 in. long and of either terminal or subterminal growth, is cut from one side only in a tapering fashion, so that the bottom end has no thickness at all, for a length to match the stock incision. The cut surfaces of stock and scion are held tightly together by rubber or vinyl plastic strips. After-treatment is the same as for side-grafting.

Shield-budding is done on stocks of 3/8 in. diameter or greater, usually about 1 yr. old. Buds are cut from the last matured growth just as they are swollen for a new flush. The technique is very similar to that used for citrus nurseries. Because the scion tissues, except for the bud itself, are well protected from drying out by the bark and wraps, they are much more suited to dry atmospheric conditions than graft scions with much tender tissue exposed. After buds are certainly united with the stocks, the tops are cut back as for side-grafting.

Seedlings grafted at 3 to 4 months of age are ready to be planted in the orchard by the time they are 6 months old. When budding is necessary, it is usually about 2 years from planting seeds to planting budlings in the orchard, but the trees are much larger at planting than are the grafted trees.

Bearing seedling trees can be converted rather easily to clonal varieties by topworking during the dormant period. If a tree has branched fairly low, these limbs should be cut squarely across at a distance of 1 or 2 feet from their origin; if there are no low main branches, the trunk itself should be cut across at 2 or 3 feet from the ground. Scions are taken from well-matured wood, 1 or 2 growth flushes below the terminal one, ~~and should be cut so that a ring of tiny buds marking the end of a flush is~~

and may be 6 to 8 in. long and 3/5 to 3/4 in. thick.
~~is at the top of the scion. In length scions may be from 6 to 8 in., and in diameter from 3/5 to 3/4 in.~~; with at least two well-developed lateral buds. It is very desirable to have the ring of tiny buds marking the end of a growth flush at the top of the scion. Two methods of topworking are widely used: the fitted-cleft graft and the saw-kerf graft.

For the fitted cleft graft, the cleft should be cut with a saw instead of split with a grafting iron, since avocado wood does not split cleanly. Cut vertically to a depth of 5 or 6 inches and open the cut with a wooden wedge until the opening at the top is the diameter of the scions to be used. Trim the sides of the cut with a sharp knife to make smooth surfaces. Cut the lower part of the scion to a wedge, 3 to 4 in. long, which exactly fits the cleft, making sure that the outer edge of the wedge is slightly thicker than the inner edge. Then adjust the scion very carefully so that the cambium layer (the line between wood and bark) of the scion exactly matches the cambium of the stock, and push the scion tightly into the cleft. Usually two scions are placed in each cleft, one at either side of the trunk. When both are in place, the wedge is loosened enough to hold them tightly. Except in stocks not over 3 in. across, the wedge should not be removed completely lest the scions be crushed. Fill the cleft and coat the edges of the scions with melted (but not too hot) wax consisting of 4 parts beeswax to 1 part paraffin. To protect the scions from sun scald, wrap the top of the stock with heavy paper which extends several inches above the scions, and fill the collar with dry grass or leaves.

For the saw-kerf graft, a V-shaped cut is made in the side of the stock for a length of 3 or 4 inches, to a depth of ½ in. at the top and flush with the surface at the bottom. The sides of the tapered notch should be trimmed smooth with a sharp knife. Then the scion is shaped at the lower end to fit closely into the opening and fastened tightly in place so that cambium layers of stock and scion match. A ½ in. brad driven through the scion into the stock will hold it in place. Several scions can be inserted around the periphery of the stock. When all are in place, the scions should be coated with wax on all cut surfaces, the depressions over the scions filled with wax slightly beyond the bark level, and the top of the stock wrapped with heavy cord. The same precaution against sun-scald should be taken as suggested above.

After topworking, many suckers or sprouts will start from latent buds on the stock, and these should promptly be removed. When the scion buds push out, the new shoots are easily broken by wind and should be fastened to a stake with soft twine when they are a foot long. Eventually only 1 strong shoot should be allowed to remain on each trunk or main branch to make a new top or branch. Two years after topworking, the tree should bloom again.

Plantings

Unless it is known from previous experience that in your location certain varieties bear well in unmixed plantings, it is sensible to interplant varieties for assured pollination. Such interplanted varieties should be of opposite bloom class and should bloom at nearly the same time. It is suggested that 6 rows of an A variety be alternated with 6 rows of a B variety.

Avocado trees are spaced anywhere from 20 to 35 ft. apart, depending on variety habit and soil conditions. Varieties of upright growth may be spaced 20 ft. apart in rows 25 ft. apart on rather poor soil. Spreading varieties on good soil will need 35 ft. each way. For good bearing, trees should have free space all around them; crowded trees bear very lightly. When the orchard area has been staked, a hole should be dug where each tree is to be planted, about 18 in. deep and of the same diameter. In this hole a few shovelfuls of animal manure or compost should be mixed with topsoil and 1 qt. of acid phosphate. If the manure is fresh, the holes should be prepared several months before planting.

Nursery trees in containers should be hardened by increased exposure to light for a few weeks before planting. Field-grown nursery trees should be dug with a ball of soil, and the top cut back to mature wood. It is important that the soil around the roots be disturbed as little as possible, and that the tree be set so that the crown roots are slightly higher than they were in the nursery. Very young trees planted in bright sun or exposed to much wind should be protected by a partial shade or windbreak. The newly planted trees will need watering during dry periods for the first year at least. They should receive the equivalent of 1 in. of rainfall weekly for good development. Weed competition retards greatly growth of young avocados, and is best avoided by a heavy mulch of grass or straw around the young trees. This mulch helps greatly the conservation of soil moisture.

Fertilizing

The same general program of fertilizer applications may be followed for avocados as has been suggested for orange trees, with a few exceptions. In humid regions, avocados respond to somewhat heavier applications than are optimum for oranges; perhaps about 20% more. However the young grafted trees of avocado which are usually planted in humid climates are very much smaller than are orange trees at planting, and so the fertilizer applications in the first year should only be half the amount suggested for orange trees. The amounts may be increased at a slightly more rapid rate for avocados, until by the 5th year the avocado and orange trees receive equal amounts. Thereafter the bearing avocado trees may well receive heavier applications than the orange trees each year, to a maximum of 20% more for 10-yr.-old trees.

In arid climates, avocado trees seem to be most productive with only 2/3 as much nitrogen as oranges require. Since budded avocado trees are about the same size at planting as are orange trees, the schedule of fertilizing suggested for oranges may be followed with a uniform reduction to 2/3 of the amounts. Indeed, on fertile soils, avocado trees may not need any nitrogen applications, and fertilizer need only be supplied when tree growth and color indicate a shortage of nitrogen after some years.

Trees bearing heavy crops of fruit should be fertilized more heavily than those with light crops, as the developing fruit tends to deplete the mineral nutrient supply of the branches, with yellowing and dying-back sometimes resulting. In areas of heavy summer rainfall it is often profitable to make additional applications of nitrogen halfway between the regular applications of mixed fertilizer. These extra applications may supply from 1/2 to 3/4 as much nitrogen as the regular applications do. Thus, if 3 lbs. of 16-0-16 are used in the regular fertilizer applications, 1½ lbs. of 20% sulphate of ammonia would be used for the intermediate applications.

Avocado trees sometimes show symptoms of deficiency of minor elements, especially of zinc on calcareous soils and of copper on sandy soils. The zinc-deficient trees bear very small, "grenched" leaves in rosettes at the twig tip, a condition known as "little leaf". Such trees

respond quickly to a spray containing 10 lbs. zinc sulfate and 5 lbs. hydrated lime in 100 gal. of water. In less severe cases, use only half these amounts of chemicals. After correcting the deficiency, it may be necessary to spray the spring flush of growth each year with 2 lbs. zinc sulfate and 1 lb. lime in 100 gal. to prevent appearance again of deficiency symptoms.

Symptoms of copper deficiency are seen only on young trees planted on soil which has never had a crop which was sprayed with copper. Characteristic symptoms include S-shaped shoots, early loss of leaves, and dying back of new shoots. Application of copper sulfate either to the soil or as a spray (6 lbs. copper sulfate, 6 lbs. hydrated lime in 100 gal. of water) usually gives prompt correction.

Other Cultural Practices

Pruning is mostly done to avocado trees for reasons of health, to remove dead or diseased branches. When trees have been planted much too closely and are crowding each other badly, it is usually better to remove every other tree than to prune all of them. However, some varieties tend to grow very tall and upright, instead of forming a rounded head. Lula is one of these, on which the fruits are borne further from the ground each year until spraying and picking become both expensive and difficult. Heading back a 40-ft. tree to 20 ft. is of no benefit, as the shoots which develop just below the cut tend to grow only upward, and within a couple of years the tree is again 40 ft. high. The only remedy seems to be to train the tree during the first few years so that it must spread laterally instead of developing an upright leader. Later, if height becomes excessive, head back to a lateral branch and do not allow any vertical shoots above it.

Avocado trees respond to addition of organic matter to most soils. Mulching heavily with grass, weeds, or other organic material is very good practice. Cultivation is needed only to keep weeds under control, and often mowing is better for this than cultivation. After trees reach 10 yrs. of age, they usually shade the ground so heavily that few weeds can grow under them, and the fallen leaves form an excellent, slowly decomposing mulch.

Irrigation is essential in arid regions, but must be practiced with great caution on heavy soils because of the danger from avocado root rot. During the dry period irrigation should be as little as will keep trees alive – admittedly a difficult amount to determine because avocado [illegible] to [illegible] an indication of soil moisture deficiency. During the period of

OVER

~~during~~ fruit setting, right after ~~the~~ blooming, shortage of soil moisture seriously affects the amount of fruit which develops. A small increase in irrigation rate would be desirable at this time.

Avocado control

Pest Control

Fungi

The most common avocado fruit disease is cercospora spot, caused by the fungus Cercospora purpurea. It attacks both foliage and fruits, but its chief economic injury is to fruits. The small, slightly sunken lesions on the rind do not injure the fruit except in its appearance, lowering its grade, but they tend to form cracks which permit development of black spot. The anthracnose fungus which causes the flesh decay called black spot, Colletotrichum gloeosporioides, is unable to penetrate the intact rind of avocados, and the cercospora lesions are the principal places of entrance for the anthracnose fungus. Once an opening has been found through the rind, this fungus enters and lies dormant. As the fruit ripens, the fungus causes rapid decay of the flesh. Control of cercospora spot gives almost complete control of black spot. Cercospora lesions on the leaves carry the fungus over from one season to the next. ~~even if fruit~~

The critical period for spraying to control cercospora is about a month after the end of the bloom, when the small fruits are partly grown. In Florida, applications of neutral copper sprays in early May and early June give very effective control on varieties maturing in summer and autumn, while a third spraying in July assures control on winter varieties. In areas where the rainfall is low during the growing season, the disease is not likely to need control measures. The usual spray mixture contains 3 lb. tribasic copper sulfate or 1 lb. of cuprous oxide in 100 gal. of water. All avocado varieties are susceptible to cercospora, but some are much more so than others. Varieties maturing early in the summer seem less susceptible than later ones.

The scab disease of avocados, caused by the fungus Sphaceloma perseae, is a very selective pest. A few varieties are attacked severely, others only lightly, and many more are very resistant. Lula is the only commercial variety which requires special spraying for scab control; usually all other commercial varieties which are subject to attack are sufficiently protected by the cercospora sprays. The disease causes only external injury, seriously lowering fruit grade, although severely affected young fruit may be stunted in growth.

The critical period for infection of fruits is just after the petals fall. In the case of Lula, as of such moderately susceptible varieties as Booth 8 when they have many old scab lesions on leaves and fruit or are interplanted with Lula, the first application of spray should be made just as bloom panicles begin to push out. This spray is to coat old infection lesions and decrease the amount of infectious spores which can invade young fruits. The spray mixture used is a copper one, either 1½ lb. of red copper oxide or 4 lb. of neutral copper compound in 100 gal. of water. The second spray application should be made as soon as the tiny fruits are visible after petal fall. It is always needed on Lula, and should be made on Booth 8 if there were many old scab lesions. A month later, Lula should receive a third application.

Insects and Mites

Spider mites are very common pests of avocado in tropical America, especially the red mite Oligonychus yothersi and the brown mite, O. punicae. These are very similar except for slight differences in color and in size, the former about 1/80 in. long, the latter 1/60 in. Both multiply rapidly in warm, dry weather and injure the leaves by feeding on them, so that their food-making ability is reduced. In severe infestations, the tree may lose all its leaves. With the onset of the rainy season the mites decrease greatly in numbers, but previously attacked leaves remain in their injured state. Sulfur as a dust or a spray (8 lb. wettable sulfur in 100 gal. of water) is effective in control if applied as soon as infestation begins to build up — which means that the grower must frequently examine leaves with a hand-lens to detect this situation.

Psyllids (Trioza anceps) cause spectacular injury to avocado leaves by causing numerous, long, slender galls to form on the upper leaf surface. These galls, first green and then red-tipped, result from egg-laying by the adult psyllids. While the leaves are horribly disfigured by a heavy coating of galls, and food-making activities must be somewhat decreased, there is general agreement that unless infestation is heavy enough to cause defoliation of the trees, there is little indication of reduction in tree growth or yield. No control can be recommended.

Seeds and fruit flesh are seriously attacked by larvae of certain weevils and moths. Thus in Mexico, Costa Rica, and Panama, the weevil Heilipus lauri is a very harmful pest and

many parts of tropical America
is responsible for the quarantine by the United States against avocados from these countries. In Guatemala the related weevil, Conotrachelus perseae, causes similar injury, rotting of flesh and partial rotting of seed. In ~~Cuba, Brazil, Guatemala~~ Brazil, the larvae of the moth, Stenoma catenifer, causes injury to flesh and seed like that due to weevil larvae, and may also injure twigs by tunneling in them, or cause much shedding of young fruit by feeding on fruit stems. Burying infested fruit deeply before the larvae emerge to pupate is about the only control measure which can be recommended.

Various moth larvae (caterpillars) feed on avocado leaves, especially young leaves soon after a growth flush begins. Sometimes they fasten leaf tips or edges together to form a protected place for themselves or for the pupal stage which follows the larval one. While they may do a considerable amount of damage, it is seldom great enough to warrant control measures. If control is deemed desirable, spray with 3 lbs. lead arsenate in 100 gal. of water. DDT gives effective control but is likely to increase populations of scales and mites.

Leaf-cutting ants are sometimes very destructive pests of avocado trees. See the discussion of their control on p. . Many other insects attack avocados but are rarely destructive enough in tropical America to warrant control measures.

Harvesting ~~and Marketing~~

Avocado fruits never soften on the tree, nor do they change color as they become fully mature, so that there is no easy way to tell when to pick them. The longer they are allowed to remain on the tree, the larger they become and the better their quality. If left too long, however, fruits may fall to the ground. With a new variety, one must discover the normal season of maturity by trial and error. If fruits which are not infested by larvae begin to be shed regularly and the dropped fruits ripen acceptably, the fruits are mature. Or, fruits may be picked at weekly intervals and set aside to ripen. If they soften to good consistency within a week or so, and have good taste, they are mature; if they only become rubbery after 10 days, or have an unpleasant taste, they are not yet ready to harvest.

Once the normal season of a variety (or a seedling tree) is known, the testing program

can be greatly simplified. As the season approaches, weekly tests are made to find when satisfactory maturity has been attained, since the time may vary a few weeks from year to year. The largest fruits mature first and should be chosen for testing. When some of them ripen properly, all other fruits of similar size may safely be picked and shipped to market. Gradually harvesting may be extended to slightly smaller fruits on the same tree or trees, and after a month ~~for West Indian and Mexican types, or 6 months for Guatemalans~~ all fruits may safely be picked.

Since the fruits do not form an abscission layer as they become mature, they cannot be pulled from the tree; the fruit stem must be cut. The branches of an avocado tree are too brittle to permit ladders to be placed against them from which to pick fruit. Most of the crop must be harvested by means of bamboo poles provided at the tip with a knife and a canvas sack to catch the cut fruit. The fruit is easily injured by careless handling, since the rind is likely to be broken by a blow of any kind and decay organisms readily enter a broken spot.

Fruits sent to a distant market should be shipped in containers not more than 3 fruits deep, to avoid crushing, and should be graded for size and appearance. In developing a market, it is very important that immature fruit is not allowed to be shipped. Fruits of different varieties should not be put in the same container. In areas with advanced avocado technology, like California and Florida, fruits are shipped in containers holding a single layer only, nested in excelsior ("wood wool").

PESTS

xxxxxxxxxxxxxxxx

I believe we should first give attention to the tree. It seems logical. In that case, the most important disease would come first. I have prepared 1-1/2 pages onroot-rot and have sent them to George Zentmyer for correction and emendation. We should certainly give this pest first place, as it is far more important than any other.

I dont think we need to mention other diseases of the tree. Then, as to the fruit:

Anthracnose is bad, where certain thin-skinned fruits are grown. In the tropics it does not seem to hit the Guatemalan race very hard. Some of the thinner-skinned Guatemamal x Mexicans yes. I believe we should discuss control.

The Cercospora spot hits West Indians (as it does here) though I have never heard much comment.

Avocado scab should perhaps come right after root-rot, though we have never given much attention to it in Central America. But the fact that it hits Lula so hard probably means that we will have to give more attention to it in the future. And I believe it is fairly widespread, dont ytou?

I think we should mention that we are only discussing a few of the major diseases. Due probably to the lack of large plantings, many pests which have been troublesome in California and Florida are not yet well know in tropical America. We all know that as commercial plantings build up, so do parasites. When I wrote my Manual, I said the avocado had few pests. There were very few trees in California at that time. Now, with thousands of acres, we have so many pests that numerous bulletins have been written about them.

As to insects, the Red Spider should perhaps come first. It is very common in tropical America, not terribly destructive, but sufficiently so that control measures should sometimes be used. It is bad in the dry season, disappers with the rains.

Those annoying insects of the genus Trioza psyllids disfugure the leaves of many trees in certain regions, making them unpleasant to look at, but they dont seem to do a great deal of harm to the tree. Not much attention has been given to their control. If a simple spray could be found which would keep the leaves clean it would be worth using, as the presence of a tremendius number of galls on a tree must have some effect. I think you have seen this pest in Guatemala: slender conical galls up to 1/4 inch high.

In some areas, but not universally the insects which bore in the seeds are bad. Heilipus lauri in Mexico, insects of the genus Cryptorhynchus Stenoma in Guatemala. These should hev brief treatment. I dont think any control has been perfected.

The avocado leaf-roller often attacks so severly as to make a very unsightly tree, but as Ruehle says the damage done is not sufficiently severe, as a rule, to warrant the expense of control. We have this pest just about every year at Zamorano; it is highly seasonal.

Thesea are just come suggestions. You can use them as you see fit (they are not in shape to be quoted, by any means) and add to them any others you think we should mention. I dont think the scale insects are sufficiently troublesome in general to be included.

From 1934 Yearbook

Mac Arthur (Guat). Originated by Thos H. Sheldon of Monrovia in 1922. Pear shaped, 16 oz. Seed 2 oz. Green, skin thin and soft, flavor good, fiber none. Season late, Sept-Oct of 2nd year. Vigorous grower and good bearer.

Simmonds SPI 36270

Gottfried ~~SPI~~ (Mex) SPI 19094 and 43637

Taylor (Guat.) SPI 26710

Originated at U S Plant Introduction Gdn, Miami, Florida 1908. A seedling from the Royal. Fruit rough, pyriform to oborate, 12 to 18 ozs; dull green. Seed medium. Season at Miami Nov 15 - Jan 15.

Anaheim. (Guat) Originated on E C Dutton place, West Anaheim Calif. Trees very tall and slender. Fruit elliptical, 18-24 ozs; rough, green, glossy. Very prolific. Seed medium to small. Season, April thru July, later on Ventura coast. Marketability only fair to medium. Illus. An. Report 1927, p. ~~38~~ 64. Oil content 15%. Best quality on smaller sizes. Early pickings ship and handle best.

Duke (Mex). Originated at Sunnslope Nursery, Butte Co, Calif. 1912. Fruit pyriform, green, 8 to 12 ozs. nearly smooth. Seed not always tight. Tree productive. Season Sept to Nov. Quality excellent. Oil content Sept 16.2%, October 21%. Tree a vigorous grower and very hardy to cold.

2716

1 Simmonds
~~2 Pollock~~
3 Waldin
4 Booth Eight
5 Lula
6 Fuerte
7 Hass
8 Bacon
9 ~~Lutano~~
10 Nabal

Home garden + Mulgoba

Haden
Julie
Manila
~~Zomorrie~~
Paiki
Carrie
Irwin early
Keitt late
Kent mid-season
~~Tommy Atkins~~

Clone: The aggregate of individuals propagated asexually.

1961 Yearbook

Lychee: Small planting of 10-12 old trees at El Cajon which bears very well. When cultural requirements are better understood "it is quite possible..... a commercial enterprise will develop". (See Ybook 1956-57)

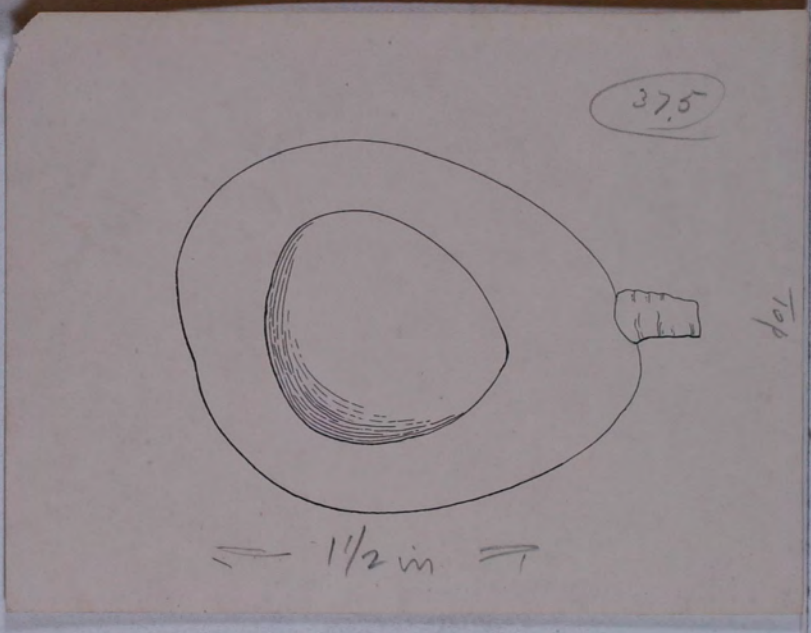
Passion Fruit: "There is some commercial production in California but only a few acres"

Avocados in Queensland: Four main varieties Hass, Fuerte, Rincon, and Sharwil (local). Zutano ripens a month before Fuerte (on trial) Edranol, Anaheim, Nabal grown but losing ground.

In Calif - Bacon has good climatic adaptability. Lencadia poor in productivity. Edranol also poor bearer in all locations. Bacon promising in many of the colder regions.

Duke (Mex) Vigorous very cold resistant, productive. Season Sept. Nov. Color green, wt 8-12 ozs shape pyriform skin nearly smooth, quality excellent, oil content 21% Seed medium, sometimes loose.

Zutano (Mex) Pyriform, 8 ozs skin thin, seed medium 1½ ozs flavor (good) Oil 16% Season Dec-Jan - Consistent producer, more hardy than Fuerte. Originated 1926 at Fallbrook.



{Found loose}

COMMON NAMES

During the early days of avocado growing in the United States, the correct name of this fruit was warmly debated. Alligator pear was admitted to be a corruption and a misnomer; aguacate had many partisans, who claimed it as the Aztec or Nahuatl name, and the only correct one. Others accepted this but preferred to spell it ahuacate. Those who had been in Peru and Chile were accustomed to palta. The English name avocado, while known to be a corruption of the Aztec name, was finally accepted by most, as the one best adapted to the genius of the English language, and at the same time justified by long usage in the West Indies.

Many vernacular names for this fruit are current in tropical America. The region between Mexico and Peru, throughout which the avocado is cultivated, was peopled, at the time of the Conquest by numerous tribes or nations, each having its own language. Some of these tribes were closely related to each other, as shown by the similarity of their languages; others were so distinct that no linguistic relationships can be traced. A study of the vernacular nomenclature of this fruit is valuable, not alone because it demonstrates the origin of common names in use at present, but more particularly because it throws light on the early distribution of the tree. It has long been recognized by students of plant geography that the presence of a native or local name for a plant tends to indicate an ancient cultivation in that particular region. While not in itself sufficient to be accepted as establishing the origin or distribution of a species, in connection with

other data, such as the presence of wild relatives, it is by no means insignificant.

Mexico was originally peopled by numerous tribes of different linguistic stocks. The Otomi, that is, the group of tribes speaking the Otomi language and its dialects, occupied a large area in the central part of the country, extending from Mexico City northward to San Luis Potosi, and including the modern city of Querétaro, one of the principal centers of avocado growing in the republic. The name for this fruit in Otomi is given as nttzáni. It is doubtful if this is used in many places at the present day.

Westward and southward of the Otomi area, the state of Michoacan is peopled by Indians speaking the Tarascan language. The avocado is known as cupanda in this tongue.

In northwestern Mexico; along the Pacific coast as far southward as Acapulco; and from this region across the plateau of Mexico City to the state of Veracruz, languages of the Nahuatlan family are spoken. Aztec or Mexican is one of these, and the principal one, for it was spoken by the people of Tenochtitlan or Mexico City, who dominated a large part of central and southern Mexico at the time of the Spanish conquest. In this language the avocado is called ahuacatl, a word which possesses particular interest as the origin of most of the names by which the avocado is now known in other countries.

Dictionaries of the Aztec language give two meanings for the word ahuacatl: one, the fruit of Persea americana, and the other, testicle. The name is probably not a derived one,

though certain writers have attempted to find its root in ahuatl, which means oak tree. In their hieroglyphic writing, the ancient Mexicans represented the avocado tree by means of the figure cuahuitl, tree, to which were attached green ellipsoidal fruits, which made it stand for the avocado tree, in place of tree in general. By substituting other fruits for avocados, the tree-hieroglyph was made to serve for numerous words. These were used to express the names of places; thus the avocado tree, with the addition of a locative suffix,-- the tlan sign, teeth placed in the trunk,-- read Ahuacatlan, the name of at least two towns in Ancient Mexico. These sent tribute to Moctezuma, the Aztec emperor, and the hieroglyph representing them was probably devised to render possible the keeping of records concerning the character and quantity of tribute expected. According to Zelia Nuttall, the two towns of this name were Ahuacatlan in the present state of Nayarit, near the Pacific coast; and Ahuacatlan (now called Aguacatan) in northern Guatemala.

Several compound words containing ahuacatl exist in the Aztec language. Ahuacachiauallotl means avocado oil, and is formed of ahuacatl and chiauallotl, oil. Ahuacamulli is a dish prepared from avocados: it is the correct form of the term guacamole, current in Mexico and Cuba, and is derived from ahuacatl and mulli, the latter being a term used by the Aztec to indicate a soft dish or sauce. Ahuacamilli is an avocado orchard; it is formed by combining ahuacatl and milli, an orchard or planted field.

Apparently the Aztec did not apply distinguishing names

to many forms of the avocado. Early writers, however, mention a few which were current at the time of the Conquest. The quilahuacatl (quiltic, green, plus ahuacatl) was a green variety; the tlacocatahuacatl was another, whose name means, "the harmful ahuacatl" or perhaps "the small harmful ahuacatl." The term tonalahuate, said to be applied to the avocado in some parts of Mexico, probably comes from tonalli, summer, and ahuacatl, meaning a summer-ripening variety. The name pahua, also used at present in certain parts of the country, but only with reference to forms having large, thick-skinned fruits (Guatemalan race), does not appear in any of the early accounts, and may have been applied to this fruit since the Conquest. It is probably the Aztec word pahuatl, meaning fruit.

East of the region in which languages of the Nahuatlan family are spoken, on the Pacific coast at the northern end of Vera Cruz state, is a small area in which the Totonac language is used. This is believed by most authorities to exhibit affinities with the Mayan linguistic family. Two names for the avocado are reported in this language, one cucáta, applying only to small thin-skinned fruits (Mexican race), and the other cucatlízl, signifying the larger varieties.

The Zapotec tribe, which attained a relatively high state of civilization in pre-Cortesian days, occupies the valley of Oaxaca, and most of the state of the same name. There are dialectical differences in the Zapotec language as spoken in different towns and villages, which accounts for the fact that the avocado is variously known in this tongue as yasú, yashú,

ishú, and isú. Adjoining the territory of the Zāpotecs in the Isthmus of Tehuantepec is a region occupied by tribes of the Zoquean family. Their language, like that of the Zapotecs, exhibits several dialectical difference: at Oluta, Veracruz, the avocado is called cuytem; at Texistepec cuchem; and at San Juan Guichicovi cuchpe. The form of Zoquean spoken at the last-named place is Mixe.

Throughout Yucatan, most of Tabasco and Chiapas, and the neighboring Republic of Guatemala, languages of the Mayan stock are spoken. During the first ten centuries of the Christian era, the Maya achieved the highest degree of civilization attained in pre-Colombian America. They excelled in arts and sciences, and developed the most elaborate system of hieroglyphic writing in the New World.

In Maya proper, which is spoken in Yucatan, the avocado is called on. This is its name, also, in the dialect of Peten, which differs very little from Maya proper, and in Tzental, Tozolabal, Motozintleca and Jacalteca.

The Kiché (or Quiché) dialect, second to Maya proper in importance, is spoken in the highlands of Guatemala: The avocado is known as okh in this tongue, as it is in the closely allied Cakchikel dialect, and in Tzutuhil, Pokonchi, Pokomam, Aguacateca, Mam, and Uspanteca. In Kekchi, which is spoken in the Alta Verapaz region of northern Guatemala, an important center of avocado culture, it is called oh; while in Chicomulcelteca it is ou, in Chol um, in Chorti and Chontal un, and in Huasteca hu. The last-named is spoken far to the north of the principal

Maya area, in the vicinity of Tampico, Mexico.

It has not been possible to ascertain the names by which the avocado was known in any of the languages spoken between Guatemala and Costa Rica. In the latter country most of the dialects are believed to be of the Chibchan family, hence related to the language of the Colombian highlands. In Bribri, one of a group of closely allied dialects which together form the Talamanca language, the avocado is called amó. In Térraba, one of the same group, it is known as debó-ua. In Guatuso, a distinct language, yet believed to belong to the Chibchan family, the tree is called di-kora. In the Chibcha area proper, which comprised the plain of Bogotá, in the central part of Colombia, and certain adjacent regions, the avocado was known as cura, a name which was adopted by the Spaniards who settled in that region, and which is still used at Bogotá, though aguacate is the name current on the Colombian littoral and in the lowland regions of the interior.

Unfortunately, early writers do not record names for this fruit in most of the languages of northern South America. Many of these are now extinct or practically so, and it is consequently impossible to obtain the information at first-hand. The only indigenous name which it has been possible to find south of the Chibcha area in Colombia is that which was used in Peru, and which is said by Garcilaso de la Vega to have been given to this fruit by the Quichuas at the time they conquered southern Ecuador. This is palta, originally the name of a small tribe inhabiting the region of Zaraguro in the northern part of Loja

Province. It would be interesting to know whether the Paltas took their name from the fruit (which is not unlikely), or whether they knew it under a different name, and the Quichuas first termed it palta, meaning thereby "the fruit of the Paltas."

The names current in European languages have been derived, directly or indirectly, from the Spanish ahuacate or aguacate. The Portuguese have made of this abacate, a name extensively used in Brazil. The German advogado and avocato are probably adaptations of the English avocado, rather than direct derivatives of ahuacate. The French generally call the fruit avocat or poire d'avocat, which means "Lawyer's pear." The similarity between some of the corruptions of ahuacate and the Spanish word "abogado," meaning advocate or lawyer, has led numerous writers to assume falsely that the name of this fruit has something to do with the latter; hence, in attempting to translate the name such atrocities have arisen as "peral de abogado" (lawyer's pear tree) and the above mentioned poire d'avocat.

The numerous corruptions of ahuacate which have, at various times and places, crept into the English language and literature, are due in the main to the efforts of travelers to reproduce the name as they had heard it pronounced. The earliest mention of this fruit in English is under the name alvacatas, in Hakluyts Voyages: more than likely the man who wrote this, Henry Hawkes, spelled the word ahuacatas, and the h was taken by the printer for an l and a v.

In 1655, the British took the island of Jamaica from

the Spaniards. Here they found the avocado cultivated under its Spanish name, ahuacate. Since this was not well suited to the genius of the English language, it promptly underwent corruption. In 1657, the form avocata was published in the "Book of a Continuation of Foreign Passages. Forty years later Sloane records avocado and alligator pear as the two names under which it was known in Jamaica, but in his later description, published in 1725, he mentions only the first of these, calling the fruit "albecato pear" in place of alligator pear. Several other corruptions of the Spanish name appeared in English publications during the eighteenth century. Avocato, and avigato are two of them.

The term alligator is an extreme, just as avocado is a more moderate corruption of the Spanish name, while the addition of the word pear is a natural consequence of the fruit's appearance, and in accordance with the custom prevalent in the early days of American colonization, when many products hitherto unknown to the Old World received names at the hands of the European settlers: the term pear, apple, or plum, with a qualifying word, was applied to many strange fruits thought to suggest in appearance or character those of European gardens and orchards.

A few names exist in English which have no relation to the Spanish ahuacate, but none of them has ever enjoyed wide usage. Subaltern's butter, midshipman's butter, and marrow were obviously given because of the peculiar character of the fruit; the derivation of shell pear and Spanish

pear is equally patent.

It does not seem desirable to perpetuate typographical errors, such as the spelling patta in lieu of palta, which occurs in Lunan's work. It should be mentioned, however, that the name aouacate or aouaca, affirmed by several French authors to be of Carib origin and current in the West Indies, is clearly the Spanish name ahuacate, not indigenous to the Islands.

Origin and History

Fernandez de Enciso first reported it in 1519. Taken to the West Indies by the Spaniards. Native on the mainland from Mexico to Ecuador? Not east of the Orinoco?

The native names are a guide. Ahuacatl in Nahuatl. Names in other mid-American languages. Palta probably not a native name. Huayna Capac took it to Cuzco, - "fruit of the Paltas". Ahuacatl became Aguacate and in Jamaica passed the usual number of corruptions to avocado.

One comprehensive species - the geographical forms and horticultural races. The hybrids; In Atlyco the names pahua and aguacate de China. In Tamaulipas. In Ecuador at 6000 ft.

Padre Cobo and the 3 races.

Modern hybridization in Florida and elsewhere.

From "The Conquest of New Granada", pp.58-59, by Sir Clements R Markham. E P Dutton and Cp., N Y, 1912.

"We are mainly concerned with the expedition of Pedrarias in this chapter, because it sailed along our Colombian coast, and because it was honored by the presence of an eminent geographer per se. Its history belongs to that of the Isthmus.

The presence of Enciso gives lustre to the expedition. He was a cartographer, a good observer, and had the gift of lucid description. His latitude of Cabo de la Vela is absolutely correct, and it is from him alone that we have an intelligent description of the coast. In his famous work, the "Suma de Geografia", there is a very interesting account of the coast almost amounting to sailing directions, with latitudes, the distances between anchorages, and other particulars.[1]

After leaving Cabo de la Vela he mentions Yaharo, a good port with fertile land on the skirts of the snowy mountains. Among the other edible fruits, Enciso here first became acquainted with what we callethe alligator (avocado) pear. He describes the inside as like butter, "with such a wonderful flavor, and a taste so good and pleasant that it is wonderful."

He gives the latitude of Santa Martha, and describes it as the best harbor on the coast. The land, he says, is irrigated by hand and by channels, the cereals and other crops they raise being thus watered....."

[1] La Suma de Geografia del Bachiller Martin Fernandez de Enciso, Alguazil Mayor del Castilla del Oro (Sevilla, 1519) eighty leaves. The work of Enciso is extremely rare, and fetches extraordinarily high prices.

The Most Important Known References to the Avocado

in Literature, Down to the End of the Seventeenth Century

1519. ENCISO. First reference to the avocado in print. Without stating the common name, this chronicler shows that the fruit was commonly grown in the vicinity of Santa Marta, Colombia, at the time of the Conquest.

1526. OVIEDO. States that avocados are found on "Tierra Firme", the coast of what is today Colombia; he describes them, but gives no common name, calling them simply "pear trees". In his later and more extensive work, he calls them "wild pear trees", and adds that he has seen them in Nicaragua as well as on Tierra Firme.

1532 - 1550. CIEZA DE LEON. Reports having seen them in northern Colombia; the Cauca valley of Colombia; and in the coastal valleys of Ecuador and Peru. He uses both "aguacate" and "palta" as common names. First appearance of either of these names in print, so far as I can find.

1554. CERVANTES SALAZAR. First mention of the aguacate in Mexico. Without details.

1565. BENZONI. Describes the fruit as growing in Nicaragua, but gives no common name for it.

1569?. SAHAGUN. Uses the Aztec name, which he spells aoacatl, and describes several forms grown in Mexico.

1589. HAWKES, in HAKLUYT. First mention of the fruit in English, so far as I have been able to ascertain. Hawkes saw it in Mexico, and lists it among other fruits of the country, under the name "alvacata".

1590. ACOSTA. Distinguishes between the large, thick-skinned paltas of Peru and the small, thin-skinned ones of Mexico, without using the Mexican name aguacate.

1601. CLUSIUS. Gives a botanical description of the aguacate, based upon a tree which was then growing in a garden at Valencia, Spain. It is thus evident that the thee was introduced into Europe before the end of the XVI century.

1605. GARCILASO DE LA VEGA. Recounts the history of its introduction into Peru, from the province of Palta (in territory which is now Ecuador) during the reign of Tupac Yupanqui, circa 1450. This is the only work, so far as known to me, which takes the history of the avocado into pre-Columbian days. It is valuable also as explaining the origin of the name palta.

1615. XIMENEZ. Explains that the Aztec name of the fruit was corrupted by the Spaniards to aguacate. This work was based on the manuscript of the following, which had not yet been published at the time.

1651. HERNANDEZ. This eminent Spanish physician travelled in Mexico 1571-1575, investigating the medicinal virtues of the plants found in that country. His is the first extensive account of the Mexican avocado, with the exception of Ximenez, which (as above mentioned) was in reality an earlier publication of the same account.

1653. COBO. Using the name Palta, this writer was the first to differentiate between the three horticultural forms now known as the west Indian, Guatemalan, and Mexican races. Explains that palta is the Peruvian name, and says it is known as aguacate in Mexico, also the West Indies.

1657. A BOOK OF THE CONTINUATION OF FOREIGN PASSAGES. Second known reference to the fruit in English. Under the name avocata, the fruit is said to be grown in Jamaica, and to sell for "eight pence per piece".

1660. COWLEY. A poetical account of the aguacata, of interest principally as being

one of the early English descriptions of this fruit.

1672. HUGHES. First extensive description in English, so far as I have been able to ascertain. Under the name "Spanish Pear" this author calls it "very delicious meat" and says he has seen it only in Jamaica, though he thinks it may also be found in adjacent islands.

1680. SHARPE, in DAMPIER. Saw the "albecato" at Taboga island, near Panama City.

1696. SLOANE. First known appearance of the names avocado and alligator pear. In his later, more extensive work on Jamaica (1725) this same author calls it the "albecato pear tree" and states, erroneously, that the Spanish name is abacado or avocado.

From Ed Shooks notes about Kaminal Juyu:

The best lot of seeds was recovered from Pit 1, Las Charcas phase, approx. 800 B.C.

"Other than corn, seeds of avocado or alligator pear were recovered." — The frequency of these large seeds in rubbish pits suggests that this fruit was an integral part of the diet of Kaminaljuyu people from very early times. Guatemala may be the center of origin of the avocado".

Co has also found avocado seeds of about 500 B.C. in diggings ancient pits of the Jacatepeque phase, between Santiago and Sumpango.

Avocado seeds were found by Michael Coe "1000 to 850 B.C" cf. Early Cultures and Human Ecology in South Coastal Guatemala" Smithsonian Press. Washn 1967. Salina la Blanca site near Tilapa, approx. sea level.

~~These seeds are in Mangelsdorf's~~