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AVOCADO CULTURE IN CALIFORNIA – CULTURE PRODUCTION, AND MARKETING

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The avocado is a fruit native to the tropical and semi-tropical regions of North and South America, where it is used as a common and much-prized article of food. From its native home it has spread to practically all tropical countries. Since its introduction into California, at Santa Barbara in 1870, many trees grown from seed obtained from Mexico, Guatemala, Hawaii, and from local trees, have been planted, principally in the southern part of the state. The abundant fruiting of many of these seedling trees and the high prices received for the fruit in local markets account for the rather sudden interest in avocado planting. Many orchards ranging in size from a fraction of an acre to five or ten acres have been planted in various sections of the state and much larger plantings are contemplated.

The avocado tree is an evergreen with fairly large, leathery leaves and under favorable circumstances reaches a height of sixty or even eighty feet. It belongs to the Laurel family, the leaves having the spicy odor and taste common to plants of this family. This odor is usually much more noticeable in the leaves of the hardy thin-skinned Mexican varieties than in the more tropical hard-shelled varieties. The fruit varies in form from round to pear-shaped with a short or elongated neck, and in weight from a few ounces to four or five pounds. It contains a single large seed which is surrounded by yellowish, buttery flesh. The fleshy edible part is rich in protein and oil, the percentage of the latter varying from 9.8 to 29.10 per cent. (See p. 400.) The flavor and quality are also extremely variable; undoubtedly some varieties which are excellent so far as early bearing and productiveness of tree and size and shape of fruit are concerned will have to take lower rank on account of poor quality.

The flesh of the avocado is essentially a vegetable butter, a substantial food. The fruit contains an extremely small amount of acid and sugar and a very large amount of oil, but on account of its scarcity has been used in the United States almost entirely as a salad, requiring only a little salt and lemon juice or vinegar to make it acceptable to most palates. In fact, from the earliest records up to the present time the flesh of the avocado has been described as a natural mayonnaise and is often eaten as taken from the fruit, without additional preparation. The natives of Mexico spread the pulp on their black bread in place of butter.

The rapid growth of young trees, the early fruiting and prolificness of many good varieties, the high food value, and the popular demand for the fruit have caused many fruit-growers to become interested in the commercial possibilities of the avocado in

those sections of the state where climatic conditions are most favorable. It is hoped that the information herein set forth may prevent some of the mistakes which are likely to occur in the development of any new fruit industry.

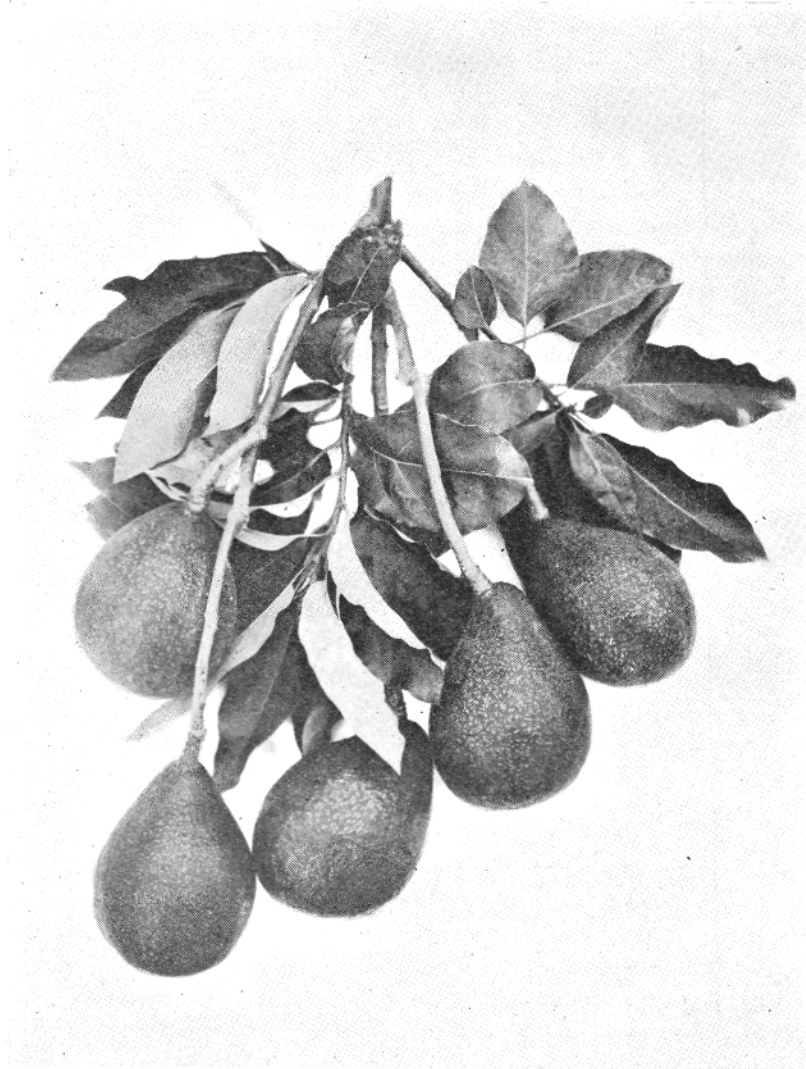


Fig. 1.—The Taft avocado averages over one pound in weight. The tree blossoms in the spring, the fruit maturing in about fifteen months, although it may be held on the tree three or four months longer.

CLIMATIC REQUIREMENTS

Many types of avocados have been introduced into California, some from the tropical lowlands of Hawaii, Mexico, and Central America; others from the highlands of Mexico, where the winter frosts, although quite severe, do not entirely prevent the production of abundant crops. In general, the thin-skinned Mexican varieties have proved hardier than the hard-shelled Guatemalan types. Hard-shelled varieties from elevations of 5000 to 6000 feet in Mexico, Columbia, and Chili have already been introduced and it is

believed that they will prove hardy in the citrus-growing districts of California. It is advisable, however, to test out the fruiting qualities of these new varieties under our climatic conditions before planting them extensively. Some types will be uninjured by ten degrees of frost, provided the season's growth is properly hardened by reducing the amount of water during the latter part of the season; other types are injured by three or four degrees of frost, while the strictly tropical varieties will not withstand even cold, frostless nights, the leaves and tender branches turning brown and dying back under such conditions. Mature trees themselves are not so subject to damage on frosty nights as the blossoms and young fruit of winter-flowering varieties. Varieties of the Guatemalan type usually bloom so late in the spring that there is very little danger of frost. The partly matured fruit of such varieties usually passes through the winter without injury except in unusually severe seasons, such as that of 1912-13, when the freezing of the stems caused the fruits to drop. It is advisable to protect young trees from frost during the first two or three seasons with cornstalks, palm leaves, burlap, or by the use of orchard heaters. The broad leaves of avocado trees are not resistant to excessive dry heat as are those of the loquat and olive and are often seriously injured by hot, dry winds. The trunks of young trees should be shaded by some form of tree protector or by loosely wrapped newspapers, as many young trees have been ruined by direct exposure to the mid-day sun. The branches are rather brittle and young trees should be protected from violent winds. Although bearing trees have sufficient elasticity to enable the branches to carry heavy loads of fruit without breaking, it is advisable to select, for planting, locations where the wind is not too severe.

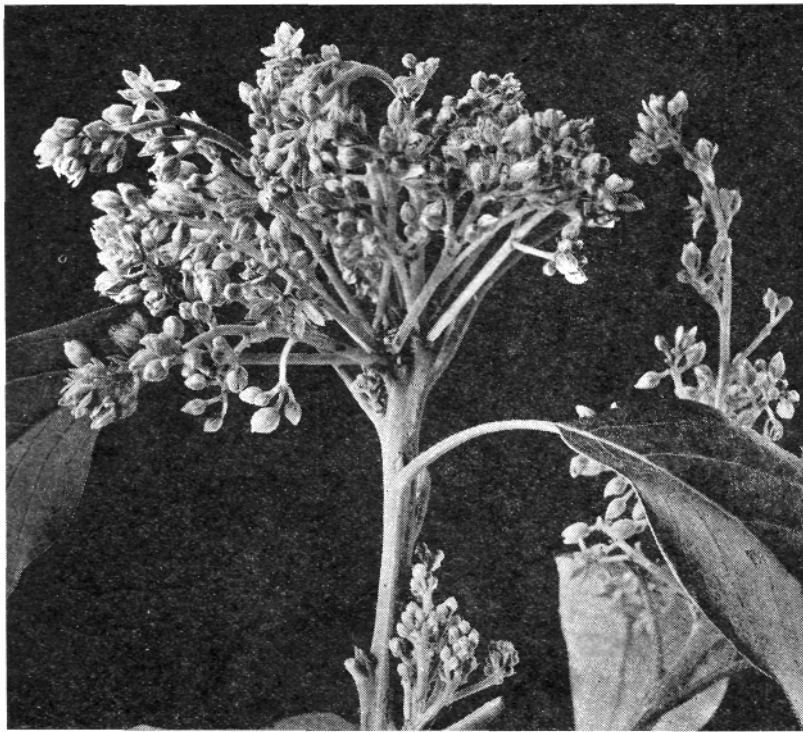


Fig. 2.—Avocado flowers are perfect and usually set fruit in abundance. Heavy rains at the time of blossoming prevent pollination; severe frosts may destroy the blossoms entirely.

The southern coast districts of California appear to be well adapted to avocados since many large trees of various types have been fruiting successfully there for several years. Other parts of the state from Riverside to Butte County are now being tested by planting, not only seedlings but, also, budded trees of numerous varieties, and some seem to be withstanding successfully both the winter's cold and the summer's heat. It is impossible at present to state definitely what the geographical limits of commercial avocado culture will be. It is not unlikely, however, that some varieties of avocados can be grown successfully wherever the orange, lemon, and pomelo thrive. Those who contemplate planting avocados in untried localities should proceed cautiously and not plant any variety extensively unless they are willing to assume the risks of the pioneer.

PROPAGATION AND CULTURE

Avocados are easily „grown from seed, but the resulting plants are exceedingly variable in growth, age of bearing, and productiveness. Some trees never blossom, others blossom but set very little if any fruit, while a few produce very good fruit. Budded trees are reproductions of the tree from which the bud was taken and only budded trees of known varieties should be planted for commercial purposes. Seedlings grown from the small, thin-skinned Mexican fruits are preferred as stock for budding on account of their greater hardiness, but there are very little if any data at present to show the superiority of one stock over another so far as the resulting tree is concerned.

Producing Seedlings.—Seeds are commonly planted with the pointed end up, in four or five-inch pots containing sandy soil about one-fourth of the seed being left exposed. Germination often takes place in one month if bottom heat is used; in a lath house or in the open three or four months are required for germination. In some nurseries the seeds are germinated in seed beds and then placed for a short time in four-inch pots. Seedlings should not be left in small pots for any great length of time. If the root system once becomes pot-bound or establishes a circular growth of roots, it is very difficult to get young trees to thrive when planted out. When the seedlings are from six to eight inches high they are transplanted to nursery rows, being placed about sixteen inches apart in the row. The seedlings should be ready to bud by the following October or November, the buds remaining dormant until early spring.

Methods of budding.—The method of budding is very similar to that used with citrus trees, a large shield bud being preferred. The degree of success in budding depends upon the condition of the stock, the selection of good buds, the skill of the operator, and the subsequent treatment of the plants. The following method of budding has been most successful. Select young wood of the current season's growth, cut the bud from one to one and one-half inches long, insert it into a T-shaped incision in the bark of the stock whenever the sap is flowing freely, and bind firmly with waxed tape. At the end of two weeks, examine the work and loosen the tape if it is beginning to bind the stock too tightly. Remove the tape entirely at the end of six weeks, at which time the bud should be firmly united with the stock. The bud is usually forced into growth by gradually cutting back, first, the side branches and" later, the main stem of the stock, the stub of which should not be cut back to the bud until the lower leaves of the new shoot have become

quite mature. Budded trees are allowed to grow for one year in the nursery row before transplanting.

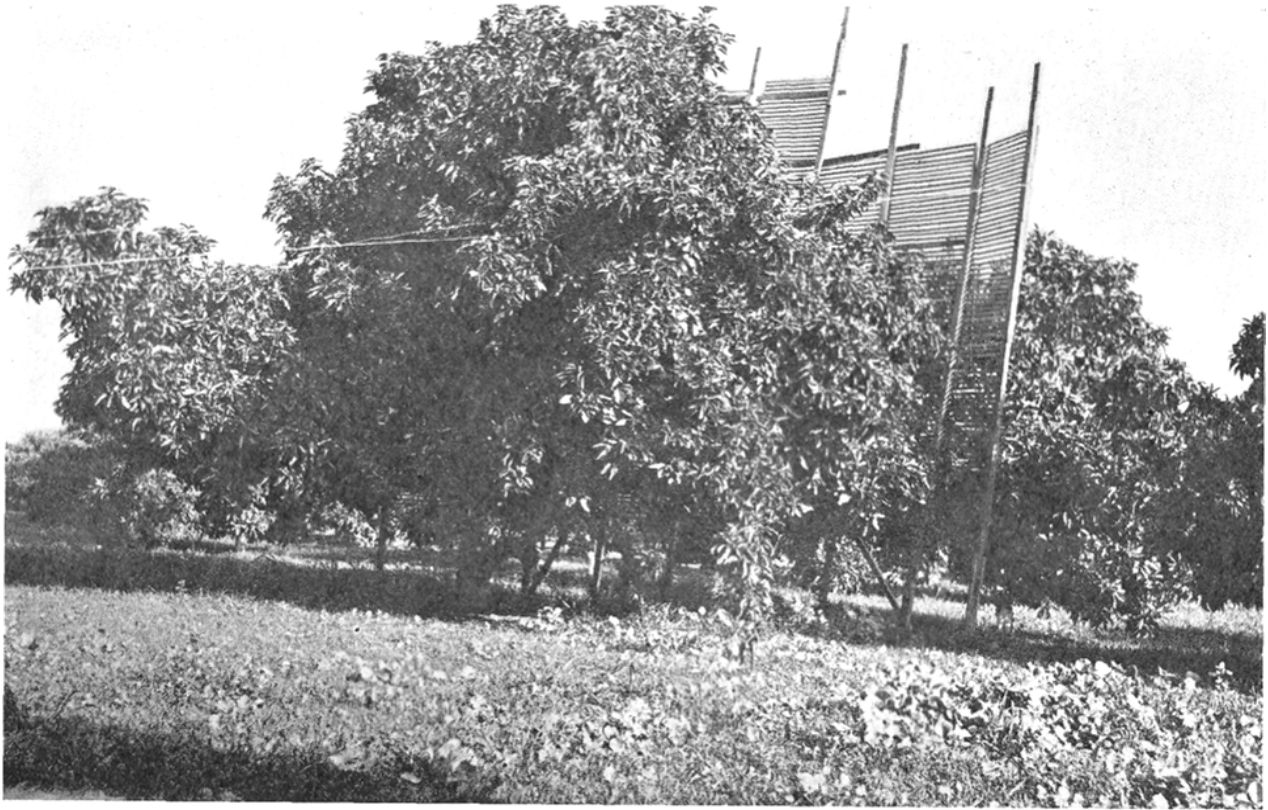


Fig. 3.—Avocado trees need protection from high winds, lath shelters being commonly used for this purpose. The original tree of the Taft variety shows a more spreading habit of growth than is the case with many seedling trees of the same age.

Transplanting from Nursery.—The transplanting of balled trees from nursery rows is best done from January to March, and it is advisable to hold the trees in a lath house for a couple of weeks before planting. As a result of early planting, the trees will become established and the new growth becomes more or less mature before the heat of summer. Trees in orchard form should be spaced at least twenty-five feet apart. Young trees require little pruning except an occasional pinching back of vigorous shoots to induce a more symmetrical growth.

General Care of Trees.—Budded trees are usually more or less dwarfed and come into bearing early as a rule, although there is considerable variation among the different varieties in this respect. Budded trees should begin to bear profitably the fourth or fifth year, in the orchard; some will begin fruiting even in the nursery row. The avocado tree should be planted in soil which has considerable depth, contains an abundance of plant-food, and is well drained. For ease of cultivation and irrigation, a sandy loam is preferable, but the tree grows just as well, if not better, on a rather heavy soil with plenty of humus. Very little if any fertilizer should be necessary until the trees come into bearing; a mulch of straw or coarse manure may be placed around the tree to conserve

moisture, but care should be taken to keep the latter from direct contact with the trunk or injury from heating will occur. Water in abundance should be provided during the first season or two in order to keep the tree in active growth, but the amount should be reduced in the late fall, as previously stated, to induce the tree to stop growth and mature its new wood in preparation for winter. However, when very hot days occur in late summer or fall, water should always be given, if only a bucketful at a time to each young tree. Avocados require about the same amount of irrigation water as lemon trees.

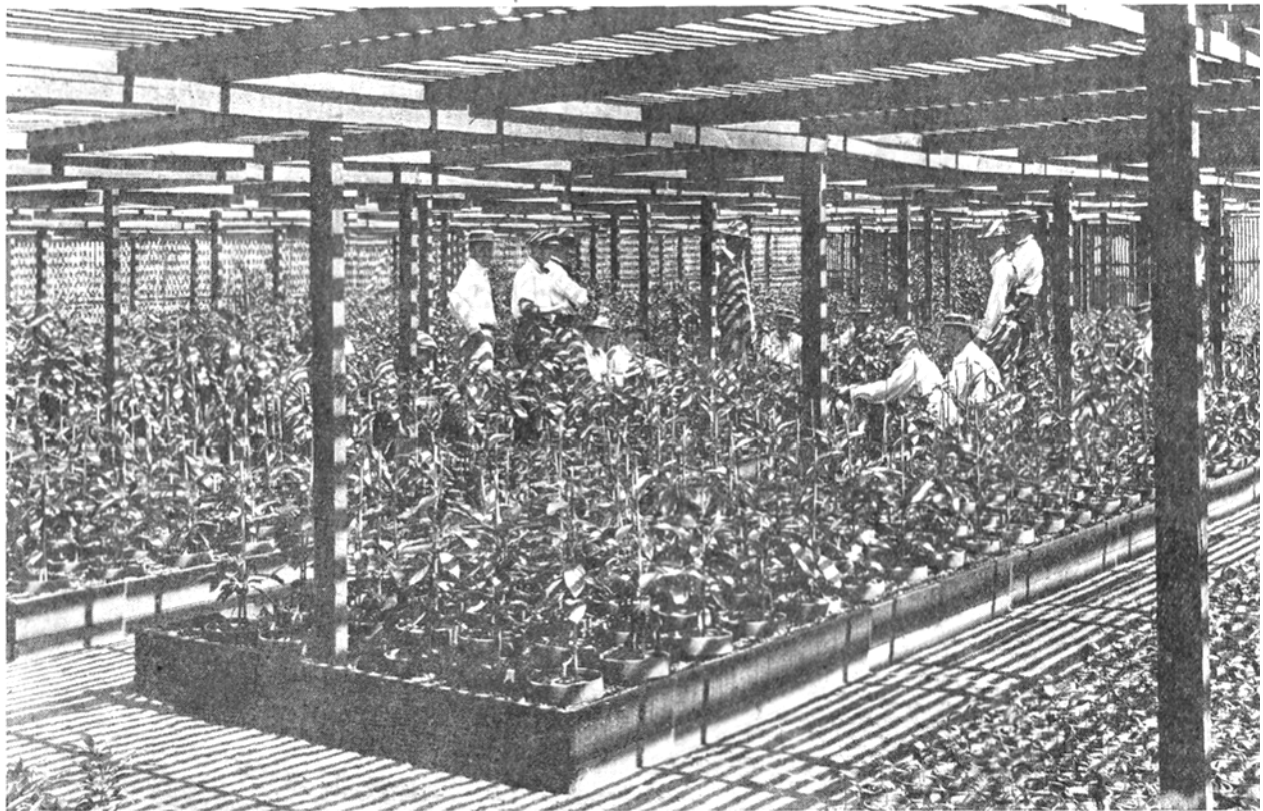


Fig. 4.—The West India Gardens at Altadena have grown thousands of seedlings in pots under a lath house, but are now growing the bulk of their nursery stock in the open ground.

It is often desirable to top-work large seedlings or trees of one variety to another. This has been successfully accomplished by budding into new wood forced out for the purpose. The trees are cut back severely in the spring and the ends of the stubs are covered with heavy grafting wax or asphaltum paint to prevent decay. Only three or four of the new shoots should be left, and when these have reached a diameter of three-fourths of an inch they may be budded in the same manner as seedlings. The shoots from the buds grow rapidly and often begin to bear in two years.

PKODUCTION AND MARKETING

Avocado trees are in many cases remarkably prolific. Individual trees of the thin-skinned

Mexican type in Los Angeles County have produced annually as many as 5000 small fruits with thin flesh and rather large seed. Such fruits are at present valuable for their seeds, on account of the scarcity of root stocks for budding. Many trees fifteen to twenty years old, both of the thin-skinned and hard-shelled types, have produced over 1000 fruits each in one season, while a few have produced from 2000 to 2500. It is doubtful if such large yields can be obtained from orchard trees season after season, since budded trees do not usually grow as large as seedlings. A yearly average of 500 marketable fruits per tree from ten to fifteen-year-old trees planted twenty-five feet apart may be considered a fair yield. Some varieties with small-sized fruit may produce more.

The thin-skinned avocados bloom in the late winter and early spring, the fruit maturing from August to December. The hard-shelled varieties thus far grown in California bloom early in spring and usually require more than a year to mature. The fruit should be picked when mature and ripened off the tree, the length of time the fruit will keep varying with the different varieties but depending largely upon the degree of ripeness when it is picked. If the fruit is kept too long, on retail fruit stands, for example, the oil in the flesh becomes rancid, rendering the fruit unfit for consumption. Experiments with cold storage for avocados show that the fruit can be held at a temperature ranging from 32° to 35° F. for a period of at least two months.

Avocados grown in California and shipped to Eastern or even to Middle Western markets will have to compete more or less with fruit from Florida and the West Indies, especially in the fall of the year. Whether this competition can be met with avocados as successfully as it is being met with citrus fruits remains to be seen. Even should it be found impracticable to pack and ship thin-skinned fruits to Eastern markets and have them arrive in condition to sell in competition with hard-shelled fruits from Florida, such fruit should be in demand in the local markets for some years to come.

Estimates of profits to be derived from an avocado orchard should not be based on the performances of large seedling trees, nor on the prices received for fruit in the past. The present price of from \$4 to \$8 a dozen may not long be maintained when orchards now planted come into bearing and the fruit becomes more common, although high prices will probably be received for some years to come. In the United States the avocado is a comparatively new and little known fruit and experience in San Francisco has shown that it is easy to overstock that market.

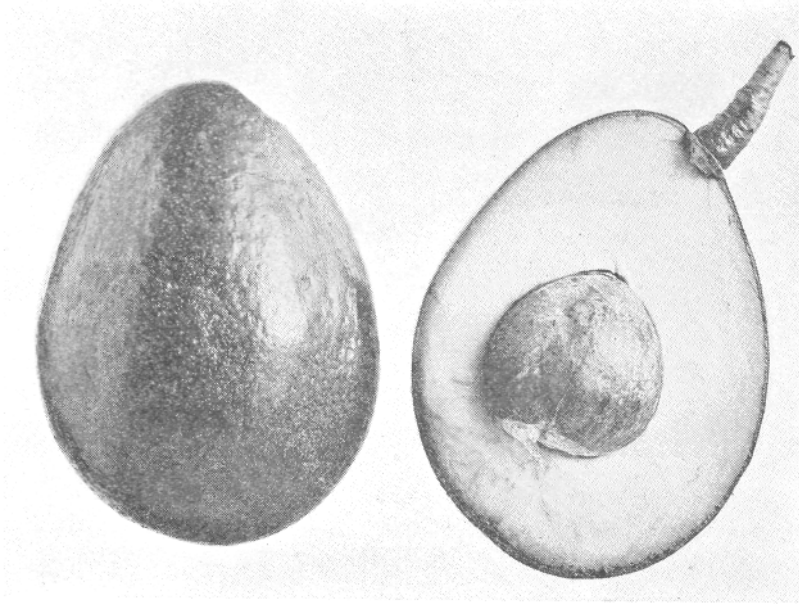


Fig. 5.—The Solano is a large, green-fruited avocado having a small seed and a large amount of flesh of fair quality. Size of fruit, $5\frac{3}{4}$ by $3\frac{7}{8}$ inches.

INSECTS AND DISEASES

There are no serious pests of the avocado in California, although in other countries the tree and fruit are subject to the attacks of several injurious insects and fungi. Shipments of avocado fruit into this state from Hawaii are prohibited on account of the danger of introducing the Mediterranean fruit fly in the fruit. Shipments from Mexico are no longer made, since the seeds of Mexican avocados are liable to be infested with the larva of a weevil which might become established here. Occasional shipments of one to two hundred crates are being made into California from the Island of Tahiti, where the fruit fly has not so far been found, and from Florida, where there are no known pests liable to be introduced with the fruit.

The fruits of some varieties of thin-skinned avocados in California have a tendency to ripen and turn dark at the apex first if left on the tree too long. In the past this has been considered to be due to a fungus disease, and while its exact nature is uncertain it has been found that this softening can be largely avoided by picking the fruit at the proper stage of maturity.

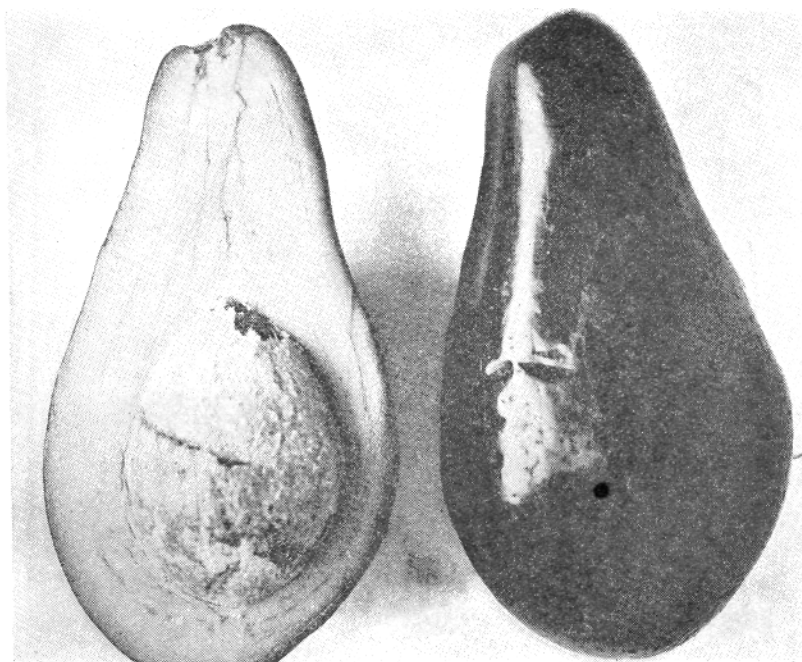


Fig. 6.—The Chappelow is a good example of the purplish-black, thin-skinned type of avocado. The quality and flavor of such fruits is usually very good. This variety analyzed 29.10 per cent of fat in the fresh fruit. Size of fruit, $3\frac{1}{2}$ to $4\frac{1}{4}$ inches long.

VARIETIES

Probably the most important and at the same time the most perplexing question confronting avocado planters today is that of varieties. At least twenty-five varieties of California origin have already been described and doubtless as many more are being propagated and heralded by enthusiastic owners or nurserymen. In addition, a score or more varieties from other countries have been introduced and are being propagated by the thousand in some cases. The unbiased opinion of some persons who have traveled in Mexico and other countries and eaten avocados from native trees is that the commercial avocado variety of the future has not yet appeared; others claim that some California varieties have no superior anywhere. New kinds should be thoroughly tested in order to show their adaptability to our climatic conditions before being planted extensively. California seedlings which have been fruiting for several years have a decided advantage, as it is already known what they will do under certain California conditions.

The requirements of a good commercial variety may be briefly outlined as follows:

1. The bud of such a variety should be able to grow into a vigorous, upright, orchard tree.
2. It should be sufficiently hardy to withstand ordinary frosts.
3. It should be precocious, prolific, and a regular bearer.
4. It should blossom late enough for the flowers to escape heavy spring frosts.
5. The fruit should be of good flavor and quality.

6. The size and shape of the fruit should be uniform, and not too large, approaching oval or round, rather than "bottle-necked," and averaging about one pound in weight.
7. The fruit should be well adapted to shipping.
8. The seed should be small and tight in the cavity.

Many of the thin-skinned Mexican avocados are superior so far as flavor is concerned and are excellent fruits for home use and local market. Seedlings and budded trees of such varieties as the Harman, Northrup, Chappelow, and Carton grow vigorously and develop into shapely orchard trees. Growers who are undecided as to the variety to set out are advised to plant a hardy type, such as one of the above, and, if desired, bud the trees over a few years hence when there are more reliable data regarding commercial varieties.

Pomological descriptions of varieties are reserved for a later publication. The notes presented herewith are intended merely to assist • the grower in selecting the variety best suited to his needs and location.

Thin-Skinned Varieties:

Harman.—Purplish green, averaging about one-half pound in weight, with a tendency to crack around the apex when mature; seed usually loose in the cavity; tree hardy, prolific; one of the best of its type.

Northrup.—Almost black, of medium size and good quality; has two crops a year, a large fall crop and a small spring crop.

Carton.—Very dark purple, pear-shaped, averaging about 12 ounces in weight; surface smooth, not glossy; quality good.

Chappelow.—Black with a glossy surface, bottle-necked; tree only moderately productive; blossoms early and the flowers are sometimes injured by frost.

Ganter.—Green, medium sized, of good quality-; turns black at the apex and decays rather quickly when mature; tree hardy, vigorous, and very productive.

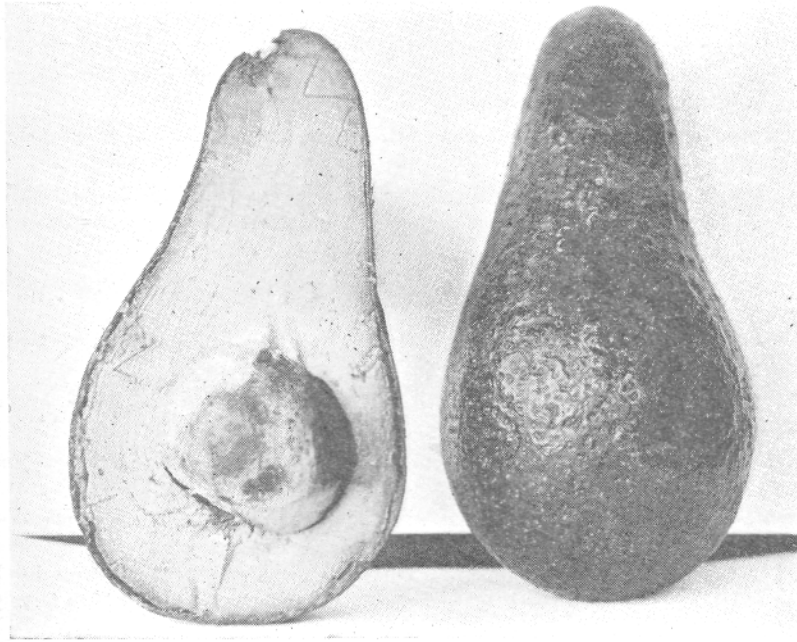


Fig. 7.—The seed of an avocado should be small and tight in the cavity. The Sharpless, shown here, has an exceptionally large proportion of edible matter and a relatively small seed. Size of fruit, $6\frac{1}{4}$ by $3\frac{1}{2}$ inches.

White.—Black, elongated, of medium size and fair quality; surface smooth and glossy; has no points to recommend it over other varieties.

The Fowler and Blake are green-fruited varieties, pear-shaped and of fairly good quality, but have no strong characteristics in their favor.

The Taft Hardy, a variety put on the market last season, should not be confused with the original Taft, a larger, hard-shelled fruit.

Hard-Shelled Varieties:

Taft.—Pear-shaped, of over one pound weight, and of extra good quality; budded trees have not shown a tendency to bear early; the original tree bears regularly and is becoming more productive as it grows older; tree ornamental; one of the hardiest of its type; a leading commercial variety.

Challenge.—Very prolific, bearing round fruits averaging about one pound in weight; a very promising commercial variety.

Lyon.—Large, pear-shaped, of good quality; tree prolific and precocious.

Meserve.—Dark green, round, of good size and quality; a promising commercial variety.

Dickey.—Green, pear-shaped, of good quality; difficult of propagation; buds start to grow but seldom live more than a few months.

Blakeman.—Green, pear-shaped, medium to large, of about one pound weight, of extra good quality; a promising commercial variety.

Walker.—Pear-shaped, medium in size, only fair in quality, its chief recommendations being precocity and productiveness.

Royal.—Oval, medium sized, weighing one pound or more, of fair quality; tree vigorous, only moderately prolific.

Miller.—Oval, of medium size and fairly good quality; tree only moderately prolific.

Murrieta.—A good round-fruited variety which matures in the spring; a desirable type and of extragood quality; almost impossible to get buds to develop into good orchard trees.

Solano.—Large, weighs from one to two pounds; quality good; tree productive considering the size of the fruit.

Colorado (commonly known as Purple Murrieta).—Purplish-black, rather large; weight about one pound; flavor and quality good.

El Presidente.—Oblong, pear-shaped, olive-green, of about one pound weight and of fairly good quality.

Dickinson.—Medium sized, dark purple, with very rough surface; tree vigorous but rather tender.

Sharpless.—Large, pear-shaped, averaging over one pound in weight; seed very small in proportion to amount of flesh; a promising variety.

The Rhoad, Senor, Champion, Rita, Ultimate, and Beauty are varieties developed in Orange County and are more or less promising, but have not been largely propagated.

The Wagner bears round fruit of medium size. The tree shows promise of being quite prolific.

The Ideal, Two-pound Green, San Sebastian, Querétaro, Redondo, California Trapp, Montezuma, Atlixco, Sinaloa, Modesto, Furnival No. 1, Popocatepetl, Val de Flor, Itzia, and Johnson No. 5 and No. 6 have been introduced from the highlands of Mexico during the last few years and are now under trial.

The Chili was introduced from the highlands of Chili. Other introductions have been made from Guatemala and Colombia and are now being propagated. Among these numerous introductions there are undoubtedly some very hardy and superior varieties, but until they have shown their adaptation to our conditions extensive plantings are not advisable.