Proceedings of the
AMERICAN SOCIETY FOR HORTICULTURAL SCIENCE
1915 12:13-22

THE AVOCADO INDUSTRY IN CALIFORNIA

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The avocado industry in California is in its infancy; properly speaking it can hardly be said to have reached sufficient importance to be classed as an industry. Enthusiasts lead us to believe that the future avocado acreage in this state will be greater than that of citrus fruits, reminding us that the fruit has real food value, not being (to use their own words) a mere confection such as the orange and lemon. Whatever the future importance of the industry may be, the fact *now* is that the propagation of trees and the production or fruit from these trees is absorbing the attention of an increasingly large number of persons. The rather sudden interest in avocado planting can be accounted for by the abundant fruiting of many large seedling trees in Southern California and by the high prices received for the fruit in the local markets. Many orchards ranging in size from a fraction of an acre to five, ten and even twenty acres, have been planted, and much larger plantings are contemplated. The present acreage is probably considerably less than two hundred. There is little doubt that this will be doubled or even tripled in another year if a sufficient supply of trees is available.

The importance of putting this infant industry on a firm foundation was realized recently by many interested parties and a conference was held in Los Angeles May 14, 1915, with the result *that t*here was effected an organization known as " The Ahuacate Association of California," with sixty charter members. The objects of the association are as follows: The prevention of errors which are bound to occur in any new industry; the dissemination of cultural and other information; and the education of the public concerning the uses and the food value of the fruit. After considerable discussion by several growers present at the meeting, it was decided to use the word " ahuacate" rather than " avocado" for the fruit and for the name of the organization. Dr. Franceschi of Santa Barbara has long advocated the adoption of the name "ahuacate" in place of "avocado," which, as he says, has no meaning and historical sense. On account of the fact that such a comparatively small number of people are familiar with the fruit handled by commission men under the name " alligator pear," it was the opinion of the association that the correct name "ahuacate" which has been the name of the fruit since the time of Cortez' invasion of Mexico, could be brought into common use as easily less correct one, "avocado." The word avocado "is the past participle of the Spanish verb 'avocar' meaning, 'to call up by a superior from an inferior', generally used in times past by a superior judge taking a case out of an inferior judge's court without the necessity of an appeal. The practice is obsolete now and the word has fallen into disuse. The Century dictionary also gives it as a corruption of the Spanish word 'abogado' meaning

* Letter from E. G. Hart.

† Catalogus Plantarum quae in Insula Jamaica, London, 1696, p. 185.

advocate". *

As early as 1696 Hans Sloane wrote of the "avocado or alligator pear-tree" and listed several other names appearing in literature at that time. De Candolle in 1882 referred to the fruit as avocado or alligator pear, stating that the name avocado is a corruption of the Mexican ahuaca, or aguacate. In 1902 the Florida State Horticultural Society expressed itself in favor of the name avocado, while in 1901 and 1903 the American Pomological Society listed the names in the following order, aguacate, avocado, alligator pear. In its list of fruits recommended for planting in the United States published in 1909 the latter society used the name avocado with no mention of other names. Other references to literature in which English writers have used the word avocado may be noted -as follows:

John Lindley—Transactions of the Hort. Society of London, 1824.

Chas. Knight—A Description and History of Vegetable Substances Used in the Arts, 1829.

John Lindley—Botanical Register. No. 1258, 1829.

W. J. Hooker—Botanical Magazine, Plate 4580, May 1, 1851.

Sir Robert H. Schomburgh—Journal of the Hort. Society of London, 1847.

E. J. Hooper—Pacific Rural Press, Nov. 18, 1871.

Geo. Nicholson, in the Dictionary of Gardening, 1887, uses Alligator or Avocado Pear.

L. H. Bailey, in the Encyclopedia of American Horticulture, Edition of 1901, uses Alligator Pear, Avocado Pear, Aguacate, Midshipman's Butter. In the Edition of 1914 he uses Avocado.

Since the use of the name avocado has thus been officially sanctioned by the societies mentioned as well as the United States Department of Agriculture, and its occurrence in English literature has been so frequent during the past century or more, it would seem that the attempt to introduce another name at this time would not only be ineffective but would result in even greater confusion than at present so far as the general public is concerned. It is interesting to note that one prominent member of the Ahuacate Association expects to ship his fruit under the label Alligator Pear, with Ahuacate in parenthesis; another will label his fruit Alligator Pear with Avocado in parenthesis.

The avocado was first planted in California at Santa Barbara in 1870. Probably the oldest fruiting tree in the state is the Miller at Hollywood, first planted in 1886, but transplanted to its present location several years later. The largest tree in California is the Chappelow near Monrovia; it is over forty feet high and the branches spread over sixty-five feet. The girth of the trunk three feet from the ground is seventy-one inches. Other large seedling trees which have produced abundantly are to be found in and around Los Angeles, Orange, Whittier, and Pasadena. Seedling trees several years of age are to be found at Visalia, Los Gatos, San Luis Obispo and Napa, while near the Center Street entrance to the University campus at Berkeley, there is a tree at least twenty years old which is in a thriving condition, but which so far as known has never blossomed. The southern part of the state including San Diego, Los Angeles, Orange, Ventura and Santa Barbara Counties, has shown itself to be well adapted to the

avocado tree and it is there that the largest plantings are being made. Trees are being planted out to a small extent in practically all the citrus belts of the state with the exception of Imperial Valley where the extreme heat has so far destroyed young plants in the open ground. Just what the geographical limits of successful avocado culture will be, no one can definitely state at present. It is generally believed, however, that some varieties of avocado can be grown profitably wherever the orange, lemon, and pomelo thrive.

What, then, are some of the factors which limit the healthy growth of the avocado tree in California? As already stated the extremely dry heat and sunshine of the valleys bordering the desert have so far proved fatal although it may be possible in the future to develop a type of tree whose foliage, will successfully withstand such conditions. The amount of frost which an avocado tree will endure depends first upon the kind of tree, those bearing thin-skinned fruits ordinarily being hardier than those bearing the larger hard-shelled fruit; second, the condition of the tree, dormant trees being able to stand much more cold than trees in a growing state; third, the weather conditions following a freeze; and fourth, the duration and extent of the low temperature. Some avocado trees in California have not been seriously injured by temperatures as low as 10°F although the fruit and blossoms were killed; other trees have been injured by 3° or 4° 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. Varieties which bloom late enough in the spring to escape heavy frosts should be preferred for commercial planting. The avocado fruit itself when fairly mature is not injured by low temperatures which seriously injure the leaves and branches. Immature fruits drop to the ground when the stems are frozen.

Another factor to be taken into consideration is the wind. There are comparatively few sections of California which are not subject at certain seasons of the year to rather violent winds. Scores of avocado trees are now planted out in situations where they would undoubtedly thrive were it not for the damage done by the wind to the broad leaves and brittle branches. The original trees of the Taft, Rhoad, Ganter, Challenge, and Royal varieties, have all been protected from wind by immense lath shelters in some cases thirty feet high, which also serve as supports to keep the branches from breaking down under the great weight of fruit. Young trees of most varieties require staking during the first two or three years in the orchard to keep them from growing crooked under the force of the wind.

So far as soil is concerned the avocado is no more particular than the citrus tree. There must be good drainage and considerable depth to the soil for the best development of the tree.

In California the avocado tree is propagated almost exclusively by budding. Cuttings may be and have been rooted to some extent, but this method is not used commercially. Nurserymen prefer the seeds of the thin-skinned Mexican type of avocado for the production of seedlings on account of their greater hardiness. Because of the scarcity of seed, however, many thousand trees have been budded on seedlings of the hard-shelled Guatemalan type of fruit. The seeds of this type, being larger, produce seedlings of budding size somewhat sooner than those of the thin-skinned Mexican type, but the former are tender and succumb much more readily to frost than

seedlings of the latter. Whether there is any appreciable effect of the different stocks upon the hardiness of the resulting tree has not been demonstrated. The supply of seed of the thin-.skinned Mexican type should be amply sufficient in a year or two since individual trees of this type growing in California have been known to produce in one season 5000 fruits of the size of an egg. Avocado seeds are planted whenever obtainable either in pots, in .seed beds, or in the open ground. The method of propagation used by most nurserymen is as follows: Plant the seed in pots or seed bed in December, January, or whenever obtainable, transplant to the open ground as soon as the seedlings are six to eight inches high, and bud whenever the bark is slipping. If budding is performed in October or November, the buds remain dormant until early spring. The nursery trees are transplanted, by balling, most successfully when about one year old, the month of March being largely preferred.

For some reason, not yet known, nurserymen have been unable to propagate by budding any large percentage of trees of at least three varieties, each of which, however, bears fruits of desirable size, shape, and quality. The original trees of two of these varieties, the Dickey and the Murrietta, are growing in Los Angeles and are healthy, vigorous, and productive. Buds placed in seedlings start to grow, out after a few weeks almost invariably cease their growth and either die, stock and all, or struggle along in a weak, sickly condition season after season. With some varieties the supply of good budwood is limited and the nursery prices for the trees of such varieties are relatively high, the Challenge being a good example of such a variety. One nurseryman budding into the same stock used for other varieties, and using the best Challenge buds he could find not only from the old tree but also from young trees, could get not over a 20 per cent stand. One reason why the variety known as the Harmon has been so largely planted is that good buds are plentiful, they unite readily to the stock, and grow rapidly into symmetrical orchard, trees. The present price of seeds is about 4 or 5 cents each, of buds 2 to 10 cents each, and of budded field-grown trees $2.00 to $5.00, depending upon the variety.

The heavy production of many of the large seedling trees in Southern California is remarkable. The account of the Ganter tree at Whittier, from which was sold in one year $1500.00 worth of fruit and $1700.00 worth of budwood, seems to be authentic. During the past season the Challenge tree at Hollywood produced 1540 fruits for which the owner received $756.36. In this connection the record of the Chappelow tree at Monrovia is interesting; the tree was planted in 1893 and began bearing in 1898. Since 1902 it has produced as follows:

1902	310 fruits
1903	380 fruits
1904	605 fruits
1905	575
1906	235
1907	465

1908	1209	
1909	260	
1910	285	
1911	1023	
1912	350	
1913	Year after freeze, about 20 fruits	
1914	July	34 fruits
	August	113 fruits
	September	1051 fruits
	October	1602 fruits
	November	457 fruits
	December	35 fruits
	TOTAL	3293 fruit

The variation in production is probably due to the fact that the tree blossoms very early and the flowers are apt to be damaged by frost.

The range in the price of avocados during the past season has been from a few cents for the small black or green seedling fruits to 75 cents and one dollar for larger specimens such as the Taft and Lyon. The prospect of immediate gain from the sale of fruit at such prices was naturally a great temptation to some growers who therefore picked and marketed the fruit before it had properly matured on the tree. A grower can hardly be criticized, however, for so doing when buyers come to the tree with cash in hand and almost demand fruit for a special occasion. This naturally raises the question as to just what stage of maturity the avocado has the greatest food value as shown by the maximum oil content, a subject not studied here so far, but which we hope to investigate the coming season.

So far there have appeared no serious pests of the avocado in California although it is known that there are several insects and fungi which attack the tree and fruit elsewhere. Shipments of avocados 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 110 longer made since the seeds of some Mexican varieties are infested with the avocado weevil, *Heilipus Lauri.* 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; the value of these shipments amounted in 1912 to $2,004.00, in 1913 to $2,519.00, and for the first ten months of 1914, to $2,429.00. During the fall months avocados from Florida are more or less common in our California markets.

Minor insect attacks may be noted as follows: Mealybug, greedy and black scales in Ventura and southern coast counties; a species of *Crabro* which infests the twigs of young trees in Butte County, the omnivorous looper, *Sabulodes caberata,* the larvae of which were commonly found on seedlings at Berkeley; the twig borer, *Polycaon confertus,* and a chafer, *Serica alternata,* both of which have done injury to nursery trees in Ventura County; and an unidentified miner, the galleries of which have been noticed on the tender branches of nursery trees in various parts of Southern California. A leaf trouble, probably similar to that occurring in other countries and due to a species of *Gloeosporium,* is very commonly found on young trees. It has been the experience of some growers that certain varieties seem to be more or less resistant to the attacks of this fungus, one variety, the Champion, grown at Orange, not being affected at all. The fruits of some varieties, notably the Ganter, Harmon, and Blake have a tendency to ripen and turn dark at the apex first if left on the tree too long. While this may be due to some fungous disease its exact nature is uncertain; the softening and darkening can be largely avoided by picking the fruit at the proper stage of maturity and allowing it to ripen off the tree.

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, more than a score of varieties from other countries have been introduced and are being propagated by the thousand in some cases. The unbiased opinion of several persons who have traveled in Mexico and other countries and eaten avocados from native trees, is that the commercial varieties of the future have not yet appeared; others claim that some California varieties have no superior anywhere. California seedlings which have been fruiting for a number of years have a decided advantage, as it is already known how they will thrive under certain California conditions. The requirements of a good commercial variety of avocado may be stated as follows:

1. The bud of such a variety must be able to grow into a vigorous upright, orchard tree. Many seedlings which bear excellent fruit will probably have to be eliminated on account of their poor habit of growth when propagated. Allow me here to quote the experience of a prominent grower in Southern California as an example: "Four years ago I planted an orchard of a certain well-known variety. The trees are now five years old from the bud. They are as large as full-grown orange trees and beautiful to look at. I expect a considerable crop this year. 1 planted at the same time on adjoining ground an orchard of another variety. I was sorry at the time that I did not have more of this last named kind and less of the others. The parent tree seemed strong and healthy, but the young budded trees, when placed in the orchard, made poor growth, suffered from cold and were in due time taken out and replaced with another kind. These, also a failure, were in turn removed and still another variety substituted. Now I am taking out this third lot and planting the variety growing in my five-year-old orchard. This time I am going to have trees, though they do not bear fruits weighing two pounds each."

Several large collections of trees representing all the principal varieties are now growing in various parts of the state and it will be very interesting to observe the habits of growth of these varieties under the different local conditions.

2. The tree of a good variety should be sufficiently hardy to withstand ordinary frosts. It seems reasonable to believe that the best varieties of avocados from the highlands of Mexico and Guatemala will thrive wherever lemons are successfully grown.

3. A good variety should be fairly precocious, prolific, and a regular bearer. Many of the California varieties are remarkably precocious; some are too much so. A budded tree which blossoms in the nursery row as does the Lyon almost as soon as the bud starts, cannot at the same time make the wood growth which is sufficient to support future profitable crops. On the other hand a variety which does not show any disposition to blossom in the four or five years after budding is rather disappointing to the grower who desires early returns from his tree, even though it may produce most excellent fruit in later years. A variety therefore which develops during the first two or three j ears into a vigorous symmetrical tree and then gradually comes inn bearing is to be preferred.

The prolificness of some of our California seedlings has already been discussed. Viewing the subject from a commercial standpoint alone it would be more profitable to handle 300 fruits from a tree such as the Taft or Lyon at 50 cent each than 600 fruits of a variety such as the Harmon or Chappelow at 25 cents each. If the high production of such a variety as the Challenge can be maintained, it may be more profitable to the grower even though the quality of its fruit is somewhat inferior.

Avocado trees have not been growing for a sufficient length of time or in sufficient numbers in California to show to what extent regular crops can be produced. Barring unfavorable climatic conditions such as frosts or rain at blossoming time, a good variety should bear regularly if the grower keeps the tree in a healthy condition and does not allow it to overbear in any one season. In Mexico some trees are said to bear more than one crop in a year and this is true of at least two varieties in California. The Northrup bears a small spring crop and a large fall crop; the White at Santa Barbara has shown a tendency to produce three and even four distinct sets of blossoms and fruit.

4. The tree of a good variety should blossom late enough for the flowers to escape occasional spring frosts. It has long been recognized in this state that trees bearing thin-skinned fruits blossom earlier than those bearing hard-shelled fruits. A study of the table of varieties shows the following dates of blossoming: Thin-skinned varieties, Chappelow, November to March; Topa Topa, January; White, February; Northrup, April; Harmon, April; Azusa, Carton, Ganter, and Hathaway, January; hard-shelled varieties, Wagner, February to March; Challenge, Walker and Royal, March and April; Solano, May and June; Taft, April and May; Dickinson, April and May. For the most part these dates seem to corroborate the fact mentioned above.

5. The fruit should be of good flavor and quality. The flavor and quality of any fruit are to a certain extent matters of the personal opinion of the consumer. Many of the thin-skinned Mexican avocados are of superior flavor. This is supposed to be due to the higher oil content as shown by analysis. The flavor of one large-fruited variety was long ago described as insipid arid watery. Recently this variety was analyzed for the first time and found to average but 3.85 per cent of fat. The fiber so noticeable in the pulp of many imported avocados is only slightly noticeable in the California varieties.

6. The size and shape of the fruit should be uniform and not too large, approaching round, rather than "bottle necked" and averaging about one pound in weight. The

Sharpless is the only California variety producing a large, hard-shelled fruit having a prominent neck. The Chappelow and Blake are examples of thin-skinned fruits which are prominently "bottle-necked." Theoretically an oval or round fruit will pack to better advantage than an elongated fruit; practically, however, the shape of the fruit will probably have little effect upon its marketing qualities if other qualities are good.

7. The fruit of a good variety should be well adapted to shipping. Very little is known about the shipping qualities of the California varieties. While those varieties having a thick, granular shell are undoubtedly less susceptible to bruises than are varieties having a thin skin, it is by no means certain that they will keep in better condition during shipment and while on the market if the latter are carefully handled. Even should it be found impracticable to ship thin-skinned fruits to Eastern markets and have them arrive in condition to sell in competition with hard-shelled fruits from Florida and the West Indies, such fruits will always be in demand in the local markets and for home use.

8. The seed should be small and tight in the cavity. Studies of a large number of varieties show that the size of seed in the round avocados is proportionately greater than in the pear-shaped fruits. For example the Challenge and Florida Trapp, typical round fruits, show 26 and 20 per cents, respectively, of seed to the whole fruit. Some of the typical pear-shaped varieties show the following percentages of seed: Taft, 18; Miller, 16; Sharpless, 12; Solano,9.9; Royal, 15.8 ; Lyon, 25 ; Blakeman, 14.

Various writers have emphasized the importance of having the seed of an avocado fill its cavity. Just how important this character is has not been determined by careful shipping experiments. In most of the hard-shelled fruits grown in California the seed is tight in the cavity; in a few of the thin-skinned varieties, namely the Ganter, Blake, Harmon, and Mattern a large percentage of the fruits has loose seeds which move about in the seed cavities. The majority of specimens of the Florida-grown Trapp and Cardinal which I have examined, has had loose seeds, but the flesh around the cavity did not show any appreciable darkening. A Florida shipper has communicated with me as follows regarding this point: do not favor the planting of any loose-seed varieties in a commercial way. Of course the seedlings are apt to be either loose or solid, but the budded varieties now in favor are all tight seeded. The Trapp is so far our best commercial variety and is almost always found to have a tight seed. When packed in excelsior and reasonably handled, the loose seed should not injure the fruit unless it is too ripe. However, it is an additional risk and considered a defect."

During the past year the California Experiment Station has made analyses of a large number of varieties of avocados, the results of which have been published in Bulletin 254, Part II, entitled, "The Composition and Food Value of the Avocado." Especial mention should be made of the following points brought out in this bulletin. The average percentage of dry matter for the avocado is 30.84. The nearest approach to this figure is found in the banana with about 25 per cent dry matter. Sugar and starch predominate in the banana as against fat in the avocado. So far as protein content of various fresh fruits is concerned, the avocado stands far in the lead, having a maximum percentage of 3.7, and a minimum of 1.3. The mineral matter in the avocado is much greater than that found in any fresh fruit although detailed analyses of the ash have not been completed. The average percentage of ash of 28 varieties is 1.26, only slightly below that in dates.

Since the chief value of the avocado as food is due to its high fat content, growers of any variety have been especially interested in learning the percentage of fat as shown by analyses of their fruit. The average fat content is shown to be 20.1 per cent of the edible portion while the maximum is 29.1 per cent. A table giving the percentages of fat or oil in the varieties of the avocado and olive respectively show that the avocado ranks higher in this respect than the average or commonly used olive. The latter fruit is not consumed fresh, except by the unsophisticated tourist, and should be classed as a processed rather than a fresh fruit.

Mention has already been made of the superior richness and quality of most of the thin-skinned Mexican avocados. The average fat content of thirteen such varieties recently analyzed was 22.16 per cent, while the average of fourteen hard-shell varieties was 14.13 per cent. It is a well-known fact that in Mexico, the natives and others who appreciate the difference prefer the small thin-skinned "paltas", scorning the large "paltas" as inferior in quality and flavor. The commercial grower must therefore take into account both the eating qualities and the market qualities of a variety of avocado.

During the past few months many predictions have been made by various persons regarding the future of the avocado industry in California. Almost without exception these expressions are very encouraging to prospective planters and to those who are interested in the development of the industry. The most common question asked of avocado men today is, "Do you really think the avocado will become an important commercial fruit" and they usually answer "I really think so". It is not only the nurseryman who has trees to sell who thus expresses himself, but conservative business men, experienced ranchers, and others who have been watching the fruit for many years both here and in other countries. It is of course conceded that there will be many failures, that scores of trees now planted will never come into bearing, and that some varieties which look promising at present will prove of little value in the light of future experience. I believe with others, however, that commercial avocado culture offers very bright prospects at present if the grower plants good healthy trees of the proper varieties in an approved locality and uses good business judgment as well as common sense in handling his orchard and marketing his fruit.