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PEST CONTROL—THE GROWING PROBLEM OF THE INDUSTRY

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I have brought along a box of tricks. I hope they won't shock you too much. All these were very heavily fumigated so there are no live pests. In common with the chairman I will begin my talk by saying:

One of the early romances indulged in by the pioneer growers of avocados and one which has more recently been revived and earnestly proclaimed by many subdividers of avocado properties was that avocados had no pests. It is true that for some time after their introduction into California these trees were comparatively free from either insect or fungous troubles, but as the plantings became more general and in larger blocks not widely separated, a number of pests developed which must now be reckoned with. It is also true, however, that up to the present time those that have been found to attack avocados in this state, with two or three definite exceptions, have not been especially serious, nor have they as yet caused a great deal of loss by reason of injury to fruit and trees, nor has the expense of control measures used been considerable.

However, the dietetic value of the avocado has now evidently been recognized by the insect world. During the past year between fifteen and twenty insects of major and minor importance have included it in their diet to such an extent as to require control measures. Up to about one year ago, very little difficulty had been experienced from insects on the avocado, in San Diego County, so we had little or no information to offer the growers in regard to their control. The little work that had been done on them was mostly in Florida and other countries, and did not apply to our local conditions, making it necessary that we start out on the ground floor. While our present control measures have only been tried for a short time and mostly along the coast, they have been fairly successful, and have given us something to work on in the future. It is most encouraging to know that up to the present time we have not encountered any insects that we cannot control if the work is done thoroughly and at the proper time.

We do not know as yet to what extent many of these pests will go, how injurious they will be or exactly what pest-control measures must be developed for this and that particular pest. It is the part of wisdom to be prepared, as your chairman has well said.

Inasmuch as the insect and disease pests to which avocados are now known to be more or less generally subject are in large part quite similar to those attacking citrus, it should not be very difficult to adapt to the former the general control measures that have been developed for the latter. Due to the fact that we are dealing with a tree of an entirely different character and habit of growth there are, of course, some specific cases in which other and new pest-control methods must be followed. Pest control on avocados is complicated to some extent by the fact that most groves are composed of

several varieties fruiting at different periods during the year. These varieties fruit and bloom, many of them, at different times. Some are carrying at the same time young and mature fruit. Some are blooming while others are not. To go through a mixed planting of avocados and attempt to give the same pest-control at the one time under present conditions seems almost impossible, at least with the standard materials now available. Then there is the difference in the ability of some trees to withstand certain treatments. We do not believe in our county that we can safely spray avocados while they are in bloom. We have not yet done any work or attempted to do any while these trees are blooming because we feel it would be too hazardous. It isn't always easy to get an avocado tree to set its fruit under the best conditions and to spray at this time, we think would be more or less fatal to the coming crop. Then our trees are blooming almost continuously from November to June and with a mixed orchard you can see that that complicates the spraying situation considerably. I am not talking about fumigation just now but am confining myself almost entirely to spraying at this period. In some instances we have experienced a very heavy drop when the fruit was at a critical period and the trees were sprayed with oils. It seems now that there is only a very short time during the latter part of the summer when you can spray successfully if you have to spray. On the whole, however, the avocado grower should consider himself extremely fortunate in having at his command the pest-control experience of more than fifty years of citrus growing. For the further encouragement of the avocado grower, it may be said that compared with citrus many of the worst pests of the latter, both disease and insect, are either not found at all on the avocado, or if present are apparently of negligible importance.

The animal pests of avocados that are of some importance at the present time are thrips, red spiders, and a number of scale insects. Nearly all the scale insects attacking avocados are armored, belonging to the genera Chrysomphalus and Aspidiotus.

Although more than one species of thrips has been known to attack avocados, the greenhouse **thrips,** Heliothrips haemorrhoidalis, is by far the most destructive. As some of you may not have seen specimens of thrips injury I think I will send some I brought with me around. I would like to have you see them so you will know exactly what a bad dose of thrips means. For the sake of local pride I will not say where these specimens came from. This thrips attacks the thin-skinned or Mexican varieties chiefly, although many of the Guatemalans are not by any means immune. The greatest amount of injury is usually found on the inside of older trees where the foliage is dense.

The adult greenhouse thrips is a small, active insect about one-twenty-fourth of an inch in length and dark brown in color, with the tip of the body decidedly lighter. The insect feeds on the fruit and foliage of the avocado. It removes all the coloring matter, leaving the fruit and foliage a dirty gray, and where the attack is severe, the leaves die and drop and the fruit either falls to the ground, or mummifies on the tree. They obtain their food by puncturing the epidermis of the leaf or fruit with their sharp mouth parts, and after lacerating the tissues, they suck out the vegetable matter, and plant juices at the point of attack. The insect then attacks the leaf or fruit in a new place.

This is, of course, a serious drain on the vitality of the tree and scars the fruit to varying degrees. During this period of feeding, the female deposits her eggs within the leaf tissue and these hatch in from eight to twenty days, depending upon the temperature.

The larvae which hatch from the egg, a minute white insect, feed together in colonies on the surface of the leaf or on the base of the fruit, removing the coloring matter in the same manner as do the adults. While engaged in feeding, they exude large drops of reddish fluid which later turns black and produces a marked discoloration. Upon becoming full grown, the larvae change to a resting stage, during which time they remain more or less motionless among the feeding young and take no food. This stage requires from four to twelve days after which the adults emerge. The total time required for this insect to develop, from the time the egg is laid until the adult emerges, ready to reproduce its kind, is usually from twenty to thirty-three days. This insect continues active the entire year and many generations occur each year.

Control measures that have been found most satisfactory are those that include some form of nicotine, either a nicotine dust or a nicotine spray with a spreader. Most often, I may say, we have used fish oil soap as a spreader because it has a very definite insecticidal value. The nicotine dust may be combined with sulphur and arsenate of lead, if desired, where red spiders and leaf-eating insects are also to be controlled. Inasmuch as nicotine in any form does not apparently kill thrips eggs, two or three applications must be made from eight to twelve days apart in summer and from fourteen to thirty days in winter. We used a combination dust in San Diego County composed of 40% sulphur, 20% basic arsenate of lead, 32% hydrated lime and 8% nicotine sulphate. We found this was a specific for spider, thrips, the Amorbia moth and to some extent the Omnivorous looper and Fuller's rose beetle. I want to go into the question of dusting vs. spraying a little later.

The best control measures for thrips seem to be along the lines of prevention and in this connection the following suggestions are offered by Dean F. Palmer of Carlsbad, my inspector there, who is responsible for much of the material given in this talk.

“First: Avoid planting ornamental host plants and remove these when planted as infestations often start here. Among the chief ornamental host plants in this district are the following: Laurestinus, Statice, Strawberry Guavas, Mandervilla, Strawberry trees, Euonymus, Viburnums, etc.

Second: Avoid planting thin-skinned Mexican seedlings or budded varieties such as Godfrey, Northrup, and Puebla, as they are most susceptible to thrips.

Third: Keep leaves and debris raked up from beneath the trees.

Fourth: A circulation of air through the orchard discourages thrips."

Most important of all is to make frequent careful inspections and when thrips are located, control them before they spread to surrounding trees.

After the first application of dust or spray there will usually be a heavy hatch in from eight to twelve days in the summer and from fourteen to twenty days in the cooler months. The follow-up applications should be made after the majority of eggs have hatched, but before the succeeding egg-laying periods begin. These periods will vary as to the time of the year and the lasting effect of the material applied.

We have found also that some commercial heavy oils combined with nicotine will kill thrips in all stages if applied at strengths of $2^{l}/2\%$ or greater. However, oils of this weight and strength of solution are apt to cause a fruit and foliage drop, especially on the thin-

skinned varieties of avocados. Most damage to the fruit seems to be done if sprays are applied as the fruit is approaching maturity.

As insect control with nicotine is very expensive, thrips should be controlled as early as possible, before they have a chance to spread. For this reason, spot work is desirable and hand outfits are more economical where they can be used. Nicotine in the liquid form gives the best control, if applied with a power sprayer, but is not satisfactory when applied with hand outfits. For spot work with hand outfits, hand dusters are more satisfactory than hand sprayers.

Probably the most widespread insect at the present time is the red spider. It has been found in nearly every orchard to some extent and is more or less active over the entire year. It spreads rapidly and is so small that it often does considerable damage before it is noticed. In my own opinion, red spider is one of the things we will have to fight the hardest. On these leaves you will note the reddening and browning of the leaves. The damage is caused by piercing the upper epidermis of the leaves and extracting or pumping out the juice causing first a reddening or browning, then a dropping of the leaves. Red spiders have been doing serious damage to avocados for three years past in some sections.

This spider has been variously identified as the "citrus red spider," and the "Florida red spider or Florida camphor mite," Paratetranychus yothersi. At one time we had a tentative determination as Paratetranychus yothersi but the last word the writer has had in this connection is that the exact identification is still in doubt. McGregor has stated it is a species very close to both yothersi and citri, but Prof. Quayle believes it closer to the former than the latter. Paratetranychus yothersi is a species well known to be troublesome to avocados in Florida. No matter what its identification is, it is a bad actor and you will have to watch it. An interesting experiment has been tried on several occasions in which spiders from citrus leaves have been moved to avocado leaves and the spiders on avocado leaves moved to citrus leaves. All the leaves were then placed together in a jar. After a short time, the leaves were examined and it was found that all the spider mites had returned to the original leaves.

The spider mites live thirty to thirty-five days during the summer and complete a life cycle in a month or six weeks, all depending on the climatic conditions.

Where these spiders are entirely uncontrolled infested trees will certainly suffer considerable damage. I have seen photographs of trees in Florida entirely defoliated by this spider, if it is the same spider. It looks very much like the citrus red spider with which most of you are familiar. It is a little darker in color and I believe it will do more damage in a shorter time to avocados than the citrus red spider to citrus. In our experience it has.

We have found that the red spider has been very satisfactorily and economically controlled by dusting with a finely divided or ground sublime sulphur. This has given good results even at our lower Fall and Winter temperatures. The dusting should be done early in the morning, before the wind comes up. It is not necessary to have the trees wet, but a certain amount of heat is necessary as it is the fumes that kill. Temperature between 70° and 80° is necessary to make the sulphur effective. Sulphur, of course, should not be applied when the weather is too hot, or too cold, and should

not be applied in windy or wet weather. Young trees can be very effectively dusted with a hand duster, but ordinarily trees over four years old require a power duster. Where a hand duster is to be used, dusters of the Root type give good results.

Red spider can also be controlled with oil emulsion sprays. 1½% solution of a light or medium weight oil will give good results.

Now as regards the relative merits of dusting and spraying. I have recommended nicotine dust for thrips and sulphur dust for spiders. There are a number of reasons for recommending dusting instead of spraying.

First: Spiders and thrips work on the upper surfaces of the leaves which are easily reached with dusts. The dust will readily collect on avocado leaves which are broad and slightly pubescent and will hold the dust laid thereon.

Second: Dusting is more economical and has proven as lasting on the coast as oil sprays perhaps for the following reasons:

(a) Very many avocado orchards are planted closely and with the trees and irrigation pipes, it is almost impossible to get into them with a power sprayer or fumigation outfit.

(b) As I stated before, in many cases we cannot spray for part of the year. *We* are afraid to spray because the trees are in bloom or are carrying young or mature fruit and dusting in that connection seems to be the best bet.

(c) The dust sticks readily and stays on the leaves for a long time, both the nicotine and sulphur dust, and apparently will remain as long as a light oil.

(d) It is easier to spot with a duster than a sprayer.

There are some types of dusters on the market which we have used in our experiments that are thoroughly effective. There is the Root duster, for instance, which has given excellent satisfaction. Of course, dusting is more economical where you have only a few trees to dust. You can get in with the duster and do that work with very much less cost than working with a sprayer out among the trees. The fact that you can do spot work very quickly as necessary is one of the principal things in favor of dusting. You may have only a few trees with thrips or red spider. A grower who only has fifteen minutes to spare can go in and dust these trees with nicotine or sulphur as the need may be. If he has only fifteen or twenty minutes, he will not go to the trouble of rigging up a sprayer. So the work is not done when it should be. We have found we can get very much more work done at the proper time when dusters are used rather than sprayers.

Our temperatures being fairly low, sulphur and nicotine volatilize slowly and their effect is spread over a considerable time. As only the lighter oils can be used, these wash off under overhead irrigation and heavy fogs about as rapidly as do the dusts.

A number of **scale insects,** the red, dictyospermum, greedy, ivy, camellia and lataniae are occasionally injurious to avocado twigs, fruits, and leaves. These are not as yet abundant in every avocado-growing section, but as a rule one or more will be found here and there in nearly every district. At present what is known as the **lataniae** scale, Aspidiotus lataniae, apparently does more damage to fruit and twigs of trees growing in the coastal regions than any other scale insect. For some time there was considerable doubt as to its exact identification, as it is very close to the ivy and camellia scales in

habit and appearance. We have, for instance, had scales from the same branch identified by authorities as camellia and again as lataniae. The **dictyospermum** scale is a serious pest of avocados in Florida, but though found in certain sections it has not yet become generally established in the avocado districts of California, and fortunately for us not yet in San Diego County. What it will do here if once widely distributed can only be conjectured."

The lataniae scale represents another case of an insect adapting itself readily to a new host. This is a palm scale which, as far as I know, has not been previously recorded as working on avocados except in California. It may possibly infest them in Florida, however. The Florida bulletins apparently do not mention it. We do know that the lataniae scale in our district is the worst scale pest we have to contend with. I have here some specimens on leaves and twigs all of which have been very heavily fumigated. There is nothing alive in this box of tricks. I don't know that this shows the fruit but here are a couple of photographs showing the appearance of this lataniae scale on the fruit. It apparently gets on the fruit while the latter is young and in some cases will pit and deform it badly.

You see what scales we already have to contend with. We don't know yet what the Dictyospermum scale is going to do in California. It is found in one or two districts—it is found in Whittier. Personally, I have no experience with it and as previously stated don't know what it is going to do. From our experience in the South, we believe that the lataniae scale is the worst one we will have to deal with. I have seen fruit so infested with this scale that at least half of the surface was covered—it was very heavily incrusted. I have also seen twigs solidly infested. I think these specimens I am sending around will show you something of this kind.

These insects mentioned can be controlled, we believe, by fumigation or oil sprays although much is yet to be learned concerning the effects of these materials upon the trees and the proper time to apply them in order to avoid injury to fruit and leaves. We have already learned, however, that we cannot apply oils when the fruit is maturing. The oil accumulates on the base of the fruit stems causing them to drop easily. At this period the mechanical difficulty of throwing tents over trees heavy with fruit without breaking limbs and shedding fruit is also to be considered. These trees have rather brittle wood at the best and when carrying fruit must be handled very carefully. We have done some spraying, using *1½* to *2%* medium oils, and have fumigated with 18 cc. during the dormant season after the fruit was off and in some cases with the fruit on without injury to the trees and with a good scale kill. The relative efficiency of these two control methods against the lataniae scale, which is the principal one we have attempted to control, is in our experience in favor of fumigation. There is a very real difficulty in fumigating avocado trees. It needs no argument of mine to indicate how brittle the wood is and how easily the tree may be injured by throwing tents over them. I do not know if possibly some other method of handling fumigating tents will have to be developed, such as putting them on frames so they will not crush down the trees. We have fumigated some trees without any injury to the trees or fruit but it does require a great deal of caution.

I have a record here which will be of interest in connection with spraying. However, let me say first with reference to fumigation that we have double treated some trees in the

Rancho Santa Fe, using Viscona 2% and then following up in nine or ten days with 100% fumigation. We got an almost perfect kill without damage to fruit or foliage. This work was done about the middle of December on Fuertes. The fruit then, of course, was pretty well mature. We also fumigated a number of trees at Fallbrook using 100% and got an almost 100% kill. These trees were treated about the middle of March. There was no fruit on the trees and no injury came to the trees. We believe that if properly done avocados can be successfully fumigated. It has to be mighty carefully done, however.

"Our results in the use of spray materials in the Rancho Santa Fe—Encinitas — Carlsbad district, are shown in the following chart which was compiled by Dean F. Palmer:

Spray Material Used	*Strength*	*Date*	*Pest*	*Results*	*Location and Owner*
Nicona	1½%	July 14, 1930	Calif. Red Scale	Scale kill poor, some leaf burn. Hot weather followed spraying.	Hitching, Carlsbad
Volck (Light)	2⅓%	Aug. 4, 1930	Lataniae Scale	Scale kill only fair, leaf and fruit drop on some varieties.	Wheeler, Carlsbad
Volck	1½%	Aug. 20 1930	Young Black Scale	Scale kill very good, no damage.	Warrenton, Carlsbad
Special Nicona, 80W	2%	Oct. 1, 1930	Lataniae Scale	Scale kill poor, heavy fruit and foliage drop.	Coffin, Carlsbad
Nicona	2%	Oct. 1, 1930	Lataniae Scale	Scale kill poor, heavy fruit and foliage drop.	Coffin, Carlsbad
Fish-oil Soap	5 Lbs. to 100 Gal. Water	Oct. 1, 1930	Calif. Red Scale	Scale kill poor, no damage.	Hitching, Carlsbad
Pest Oil	1½%	Oct. 28, 1930	Lataniae Scale	Scale kill poor, no damage.	Bullock, Encinitas
Viscona "E"	2%	Oct. 28, 1930	Lataniae Scale	Scale kill good, heavy leaf drop on some varieties.	Rancho Leucadia, Encinitas
Viscona "E"	1½%	Oct. 28, 1930	Lataniae Scale	Scale kill fair, some leaf drop.	Rancho Leucadia, Encinitas
Liquid Lime Sulphur	1 to 30	Oct. 28, 1930	Lataniae Scale	Some leaf burn, scale kill poor, spraying followed by hot weather.	Rancho Leucadia, Encinitas
Liquid Lime Sulphur	1 to 60	Oct. 28, 1930	Lataniae Scale	Slight leaf burn, scale kill very poor, spraying followed by hot weather.	Rancho Leucadia, Encinitas
Viscona "E"	2%	Dec. 15 1930	Lataniae Scale	Exceptionally good scale kill, no damage to fruit or foliage.	Kennedy, Rancho Santa Fe

Double Treatment: On December twenty-third, at 4:12 P. M., a Fuerte avocado tree was fumigated on the Kennedy Ranch at Rancho Santa Fe, with a dosage of 100 Hydro-cyanic acid gas. The weather was cold, with a slight breeze blowing. The tree had been sprayed on December fourteenth, nine days before, with 2% Viscona "E." Kill very, very good, no damage to fruit or foliage.

From the above limited data, it would seem that where it is possible to treat in the cooler weather, that better results may possibly be obtained.

Another record follows, that of Inspector L. H. Field at Vista: Freidmann, Fallbrook: One Fuerte tree sprayed for Ivy Scale. Spray was applied with a hand sprayer. Material: Imperial Medium at 2%. Kill: About 70%. Time: About the middle of March. Matured fruit was hanging on the tree at the time of spraying. Care was taken to cover the fruit. No apparent damage to tree or fruit. No work with power sprayer.

Frank Dau, Fallbrook: Two Fuerte trees fumigated for Ivy scale (Lat-aniae). Dosage: 18 cc. Kill: About 98%. Time: About the middle of March. No fruit on trees at time of work. No apparent injury to trees."

These reports indicate that as the trees become dormant, resistance to the effects of the oil is increased. But taken all in all our limited experience, and I admit it is limited, indicates that fumigation is more successful against these scale insects than are oils. In spraying there are many factors to be considered, one of which is the wide variation in the amounts of oil that trees of different varieties will stand. For instance, oil sprays that will apparently not affect the Fuerte will cause a heavy leaf drop when applied to some other variety, such as the Godfrey. Other factors are that in an orchard of mixed varieties, some may be in the proper condition to spray at a necessary time while others are not; the condition of the weather, etc. All these lead us to feel that we are safer in using fumigation although as I have indicated a number of times, it is an exceedingly delicate operation on avocados. A final factor in connection with the use of oil sprays that is giving us some concern is that some trees treated with oil have failed to set fruit the season following its use, despite the fact that untreated trees adjoining, of the same variety, have set heavy crops.

In addition to the pests previously mentioned, a number of leaf-eating insects sometimes injure avocado trees, principally serica beetles, omnivorous loopers, diabroticas, Fuller's rose beetle, and the avocado moth, Amorbia essigana. These beetles breed on wild growth and migrate onto the avocados during the early spring and summer. They are small brown or dark-red insects that hide in the ground during the day and work on the foliage at night. The Amorbia moth is the worm, I believe, that does the most damage to the fruit. I have seen fruit entirely destroyed by the larvae of this moth. Here you will see an interesting exhibit, the work of the moth on the leaves and young fruit. When they attack the young fruit, it is entirely ruined. As you will note by the specimens I am sending around they eat holes in the leaves and the fruit, tieing the leaves together when they are ready to pupate. For some time after this worm was first identified in San Diego County, it was only taken on Puebla trees, but later on was found attacking other varieties as well.

Some of the leaf-eating insects are more or less seasonal, appearing from early spring and summer to fall, and disappearing during the winter. Others are with us most of the time. Diabrotica beetles, grasshoppers and other insects may damage a few trees here and there but the injury caused by them is relatively unimportant. Some scale insects in addition to those named, such as black and soft brown, and various species of mealybugs, may also be found occasionally on avocado trees but have not yet been known to do any great amount of damage. In one or two instances heavy infestations of citrophilus mealybug have been noted, although in such cases the absence of preferred hosts nearby may have accounted for the degree of infestation.

Control of these insects is obtained by dusting or spraying with arsenicals, principally arsenate of lead. We have gone back to plain arsenate of lead, using the basic material instead of the acid which will surely burn along the coast, though it might not inland. Where we dust with arsenate of lead, we haven't very much trouble with Fuller's rose beetles, except perhaps in one section. I have recently had word from Santa Barbara County that this insect is doing considerable damage to avocados there.

It seems that avocado insects have come to stay and their control will become just another orchard operation, as it now is with citrus. We may even have to change our cultural methods somewhat. It may become necessary for us to give up mulching, to avoid close planting, and to keep our trees up off the ground, to minimize the points of contact with the ground, and to remove unnecessary breeding places for insects.

This covers the present list of insects of importance to avocado growers in San Diego County and probably in California, and while it seems to be a large number yet it does not include the more serious pests which are to be found in other parts of the world. Among those affecting the avocado elsewhere are the avocado seed weevil of Mexico and the Mediterranean Fruit Fly of most of the tropical countries."

Avocados are subject to a number of diseases, both of fruit and tree; although up to the present time we have had comparatively little trouble from them. A great many trees have died from certain physiological or nutritional troubles, such as poor drainage, root stocks grown from immature seeds, improper irrigation, improper feeding, low temperatures, etc.

In some sections **tip-burn** is quite serious, manifesting itself in the browning and dying back of the tips of the leaves. Apparently this trouble is more general on the lighter soils near the coast and is intensified in situations exposed to ocean breezes. Some investigators believe there is a definite relation between excessive accumulations of chlorine or salts in the irrigation water or in the soil, and tip-burn. Generally speaking, adequate fertilization and irrigation may be expected to at least reduce leaf injury from this cause. Due to the fact that tip-burn seems to be brought on from so many different causes, I prefer to regard it as a symptom of trouble rather than a specific disease. Just as fever in man is a symptom of trouble, so is tip-burn in a tree. It can be brought on by excess chlorine, poor drainage, improper irrigation, improper feeding, etc. Each one of us has found a reason for tip-burn, and no doubt we are all of us right.

A comparatively new disease of avocado trees has been recently described by Dr. J. Eliot Coit and is called by him, **Sun-blotch.** The beginning of this trouble is with weak, spindling or poorly cared-for nursery trees. Such trees begin to sunburn on the main stems and branches and fail to produce an upright top, the branches assuming a drooping or weeping form. The old bark becomes rough and scaly and the new growth usually shows yellow or light-colored streaks in the bark and when fruit is produced, it is often badly dwarfed, misshapen, and distorted by irregular, depressed yellow or reddish-yellow blotches. Trees or branches affected are dwarfed and fail to grow or set fruit satisfactorily. The appearance of affected branches and fruits often resembles that resulting from severe sunburn; in other cases is more like variegated types of plant life. The cause of this condition is not known. The effect appears to be permanent, as the affected parts do not recover and the subsequent growth and fruits are likewise

affected. No cure is known, the remedy being one of prevention, this being to use strong, stocky nursery trees well cut back at planting and given such good care as to force them quickly into vigorous upright growth. It is also well to employ measures to prevent sunburn, such as whitewashing, shading, and low heading of trees particularly until they become well established. Until more is learned about this condition, budwood or scion wood should not be selected from trees so affected.

A disease of the bark which causes it to turn black and die has been identified as being caused by the same organism responsible for pythiacystis gummosis in citrus. This disease is characterized by black areas on the bark from which small beads of gum appear, followed by deposits on the surface of a white powdery substance. This disease is not considered serious, although large trees are sometimes affected. Conditions favorable for the development of this disease are excessive moisture and poor drainage. The remedy is the same as in citrus, an early detection of the disease, then cutting out diseased portions carefully and disinfecting with Bordeaux paste or similar material.

The avocado is also subject to Oak root fungus and as no satisfactory method of control is known, care should be taken not to let the disease get started.

In the past few years diseases affecting the fruit have become important, though possibly none of them, with one or two exceptions, threatens to be serious. Various fungi and bacteria have been isolated from avocados decaying while still on the tree. The effect of some of these organisms is to crack and split the skin, while others attack the flesh of the fruit. Some varieties, such as the Challenge and Puebla, seem also to be affected by a physiological breaking down which starts at the bottom end. Experimental work is now being done on these, and we hope in a short time to be able to report good control or preventive measures.

One particularly serious type of fungus is anthracnose. This causes dark spots on the fruit while still on the tree. These spots develop later on after the fruit is picked and is in storage or transit, resulting in decay. Another trouble which may possibly result from a fungus is known as ring-neck, particularly affecting Fuertes. The outer bark or cortex of the fruit stem dies, turns brown and scales off, leaving the center of the stem alive. Fruit so affected almost entirely ceases to grow, remaining small and stunted. No cause for this trouble, nor its cure are yet known. I have, however, seen ring-neck on Fuerte fruit that were entirely mature and had reached their full size and were in no way affected by this disease, if it is a disease. Prof. Home at Riverside is doing considerable work on many of these diseases.

Still another type of fruit trouble is known as blast, which causes a russetting or scabbing of the surface of mature fruits of some varieties, especially the Taft. This results in the cracking and dropping of much fruit in some sections. A bacterium has been found responsible for this disease, identical with that causing citrus blast on oranges, Pseudomonas citriputeale. No control has yet been developed for this disease. Other troubles are known as black crack, end spots, carapace spots, etc. They are more or less of obscure origin and no adequate explanation of their cause can be given at present. They may be physiological, climatological, or nutritional, or may be due to the attacks of some unknown disease organism. Professor Wm. T. Home, of the Citrus

Experiment Station at Riverside, as I said before, is conducting some careful investigations into these troubles.

A comparatively new and apparently serious fruit disease has made its appearance in certain sections along the coast, attacking Fuertes particularly, although Dorotheas may also be affected. The disease in question causes the fruit to rot prematurely after it has been picked and is in storage or transit. Fruit may leave the trees in apparently perfect condition, yet as it ripens and becomes ready for use a week or two later, a rot sets in which quickly ruins it. It has been determined that the causal agency is a saprophytic fungus known as Dothiorella. This fungus normally lives on dead wood or leaves, the spore bodies appearing as little black dots. Rain, fog, or overhead irrigation may wash the spores onto the green fruit which then germinate there, the fungous threads penetrating into and under the skin. As the fruit ripens following picking, it ceases to respire and in effect dies, the fungus then becoming active and destroying the flesh rapidly. Control must undoubtedly be by methods of prevention and these are being carefully worked out at the present time. A series of spraying and dusting experiments are now under way, financed by San Diego County and under the joint direction of the writer's office and the Agricultural Extension Service, looking towards the development of control measures. We have a number of experimental plots worked out and are experimenting from the beginning of the time of blossoming. We are using Bordeaux as a spray, and also various copper dusts. We also have some pruning experiments under way because it has been determined that this fungus lives on dead twigs. When the fruit is small it doesn't show any sign of this infection. It is just as sound-appearing when it leaves the tree as if it had no infection. No exterior treatment will remove the disease because the fungous threads are already under the skin where they will not develop until, as I indicated before, the fruit dies. After it is picked, it is all right until it ripens. If it is used when it is just mature, it is all right and you will never know anything is wrong. However, if you leave it a day or two, spots will develop and the fruit goes down very quickly. It is quite a serious trouble. We are spending in our county considerable money to find the remedy. The infection undoubtedly originates at the time of blossoming. Prof. Home has done considerable work with the disease also, and we hope sooner or later to have a solution of this problem.

It has not been my purpose to discourage anyone but to mention some of the difficulties that we may encounter so that we may be better able to handle them, should they arise. There is no doubt but that trees weakened through neglect are subject to more insects and diseases than those which are kept in good condition. The best way to insure your orchard against insects and diseases is to keep it in a strong, thrifty growing condition at all times; to make frequent, careful inspections of your trees, and to take immediate steps to remedy whatever pest may be found. Your local agricultural inspector will be glad to identify your insects and diseases and to suggest methods of control. There is no doubt but that avocado insects and diseases have come to stay. If we wish to remain in the avocado business, we must recognize that the avocado is not free from insects and diseases and be prepared to combat them intelligently.

There is no reason whatever for any grower of avocados to become alarmed at the list of diseases and insect pests of avocados herewith presented. Control measures have been developed and are already in operation, where necessary, against some of the

pests mentioned. There is no evidence yet that the grower of avocados will be required to spray, dust, or fumigate his trees annually or oftener, as must now be done with most citrus groves. On the other hand he must not take it for granted that his trees will need no treatment and so neglect them. It is only the part of wisdom to watch avocado trees carefully and be prepared to treat them when and as necessary. Although we have only been growing avocados a few years commercially, we already know more about them than we did for many years about citrus. The grower has every reason to be confident as to the ultimate solution of these problems. It took us many years to know how to handle our citrus groves that were troubled with these and similar pests. We believe most of the avocado troubles will be thoroughly worked out as to cause and remedy in a comparatively short time.

Question: Have you run across a condition where the tree seems to be weakened and it seems to be marked like a city section. It seems to be a superficial fungus that you can rub off with your finger nail and the bark is alive underneath though it gets black on top. We have sent a number of those specimens in to Riverside and Sacramento and always they give us negative results.

Answer: They say it is not injurious to the tree but I do not think that a tree with black bark is going to do as well as one with green bark. I do not know that there is any spray that can control this condition.

Chairman Halm: I want to suggest that the speaker has failed to mention one pest with which we have had a good deal of experience—the genus Mexicano and sometimes Americano who steals fruit.

Avocado Institute, June 9, 1931.