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Pests and Diseases - Latest Developments in Avocado Disease Control

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Those of us who have been studying avocado diseases in California are somewhat in the position of "the old lady who lived in a shoe, and had so many children she didn't know what to do." There have been so many diseases that we haven't been able to find names enough to go around. However, Doctor Coit made a good beginning in the Avocado Yearbook for 1928.

We have been under the further difficulty that we are not able to be sure just how many distinct troubles we have. We have not yet been able to be sure whether certain manifestations of disease are forms of the same trouble or whether they are distinct diseases due to different causes and with distinct courses of development.

In this paper I am to discuss latest developments in control, and quits frankly I shall give my present ideas, reserving the privilege to change my mind. I shall discuss four diseases—Dothiorella rot, tip-burn, mottle-leaf and sun-blotch.

DOTHIORELLA ROT

Dothiorella rot is known to some of you. It does not appear on uninjured fruit in prime condition while it is on the tree, nor while it remains firm. Dothiorella rot makes its appearance as the fruit softens. Many kinds of spots appear on avocado fruits and some of them cannot be distinguished with complete certainty until the Dothiorella fungus has formed its spores, which may be at a rather late stage of decay.

The Dothiorella spot when first observed is usually somewhat larger than the head of a pin, it is not very dark, the outline is not distinct, and it is not sunken, though it may spread from a speckle which is small black and sharply depressed. In 2 or 3 days it may spread to about half an inch in diameter, still remaining smooth and the color being a rather light umber. If cut into, there is very little or no decay in the flesh.

From this point on the decay spot spreads more rapidly and the surface becomes somewhat wrinkled and roughened, and it begins to sink down. The flesh is invaded and becomes watery and rancid, but there is no clear boundary to the rot, and its spread is more rapid along the surface than downward into the flesh.

If used before the spots are too far advanced the fruit is unimpaired, but a bad odor develops rather early and trimming out of advanced spots is less satisfactory than with most of the decays.

If Dothiorella is suspected or feared in the fruit, samples may be taken as maturity approaches and held for softening at ordinary temperatures. Trial fruits should not be kept in an excessively dry atmosphere.

The most important immediate control measure for Dothiorella affected fruit is early harvesting. When oil content shows that it is permissible to harvest the fruit, it should be taken at once and marketed in such a way that it will be consumed promptly on softening.

This applies to the main crop of Fuertes. It does not solve the problem of the off-blooms. Last year certain off-blooms were prime in August while others were so old that they were worthelss, they had passed the time for softening. Mr. Palmer is working hard on this problem, though I think he would rather cut all the off-blooms down in April and forget them.

The second measure for control is to remove, as far as possible, the sources of Dothiorella infection. These are many, but probably all are negligible except in the avocado tree itself. Tip-burned leaves are the chief source of contamination and tip-burn should be prevented if possible, especially in coastal areas. Most tip-burned leaves will come down with the spring shedding—a sort of spring house cleaning. The new leaves should not show much tip-burn until the season is well advanced.

Once on the ground the Dothiorella in the leaves is not dead, but it will probably have little chance to again get into the tree. In leaves lying below the tree we have not found Dothiorella spreading to those parts which were green when they dropped.

The other important source of Dothiorella spores is dead twigs in the tree. Rather soon after a twig dies it becomes infected with Dothiorella. We do not know the time between death of twig and maturity of spores. It is probably 1 to 3 months—here again Mr. Palmer has the stop watch on them.

A second kind of spore is formed more abundantly in twigs than in leaves. These spores of the second type are shot out to a distance of about half an inch. They are large, heavy and sticky, and are shot off only when the twig is soaked with water. However, in tempestuous rain they might be carried long distances. The other spores, which merely ooze out, could also be carried in the same way in rain.

There is some reason to believe that thorough removal of dead twigs may greatly reduce the amount of Dothiorella in tip-burned leaves. However, we do not wish to favor any neglect of tip-burn.

Spraying—We have put on two careful spray programs and are starting the third. We hope to have a program to recommend later. Some treatments with Bordeaux have apparently given 100 per cent control of Dothiorella.

Dipping of fruit—Dipping recently picked fruits in various chemicals and in hot water have all failed to control the progress of the fungus.

Fumigation with agene gas—Mr. T. E. Galvin has cooperated with us and we seemed to have some encouragement but no program for fumigation can yet be recommended.

Many things remain to be tried, but evidently Dothiorella is inside, i.e., below the surface of the skin when fruit is ready to pick and control is not easy. Meantime we understand

the Association has been able to make some utilization of the fruit, so that nothing need be lost when we have solved the problem of the off-blooms.

TIP-BURN

Tip-burn is one of the avocado diseases so fortunately named by Dr. Coit in the California Avocado Association's Yearbook for 1928. The name itself makes a description almost unnecessary. Tip-burn appears on old leaves and increases with advance of the season. Tip-burned leaves are shed with others of similar age in the spring. The new leaves are normal at first.

The situations in which tip-burn appears were clearly recognized by Dr. Coit. Dr. A. R. C. Haas, plant physiologist and expert chemist, at the Citrus Experiment Station, found that tip-burned leaves contain more salt than normal leaves. This led to the discovery that severe tip-burn is nearly always associated with an excess of salt in the soil or in the irrigation water. Evidently the salt must be taken up into the leaf before it can cause tip-burn.

The studies of avocados in relation to salt are in charge of Mr. E. E. Thomas of the Citrus Experiment Station, and growers may be assured that this work is in competent hands.

Where reasonably good water is available and where drainage is possible the problem should not be excessively difficult. However, the avocado is more sensitive to salt than citrus and most other corps, and the matter should not be neglected. If there is suspicion of trouble from too much salt a good place to start inquiry is at the office of your local Farm Advisor.

I have observed cases of apparently typical tip-burn where the trouble seems to have been drouth. There may be cases of injury from forms of white alkali other than common salt. Accordingly it would be wise to have a rather careful examination of the soil, water and of the situation in general before taking corrective measures.

Tip-burn of itself must be injurious through reduction of effective leaf area. The development of Dothiorella and other fungi capable of causing decay of the fruit in the dead leaf areas is a matter of special importance. The present prospect is not encouraging- that these fungi can be controlled, while tip-burn remains severe, to a sufficient extent so that in coastal or near-coastal areas the fruit will be suitable for distant shipment or for marketing under guarantee.

MOTTLE LEAF

Mottle leaf or little leaf is a disease affecting a good many trees. Citrus, walnuts and especially pecans are susceptible. Avocados are showing some injury. During 1910 the late Dr. A. J. Cook, Professor of Biology at Pomona College, held a series of meetings and conferences in the endeavor to arouse interest and to find out if possible why so many citrus orchards were in poor condition. If I recall correctly the subject of the inquiry in those days was *"Decadence* of the naval orange tree in California."

Professor Ralph E. Smith began his work at Berkeley in 1903. He soon was called to examine citrus trees with mottle leaf. The Whittier Laboratory was founded in 1905 and one of its problems was mottle leaf.

Professor Smith was able to note that usually mottle leaf was worse where soil and water conditions were bad. Where soil became very hard for considerable periods between irrigations, and during irrigation became water logged, mottle leaf was liable to be intensified. Beyond this somewhat vague observation no considerable progress was made with mottle leaf.

Fertilizer experiments were put on in the Riverside area. The Citrus Experiment Station was established at Riverside and a fertilizer experiment, complete for its time, was laid out at the Rubidoux site. This fertilizer experiment planted in 1907 by Professor T. Francis Hunt, now of the University's Extension service, under supervision of Professor Smith, contained one plot, H, which was to receive nitrate of soda and no other soil application. This plot, H, proved to be of particular interest. By 1914, at 7 years from planting, Plot H had a severe case of mottle leaf, while adjacent plots were in at least reasonably good condition. I understand the fertilizer industry has never entirely recovered from its sense of personal injury. I am not sure whether it was more at the University or at Plot H.

It is often said that the Citrus Experiment Station was founded on mottle leaf. I do not doubt that the more recent fertilizer plots there are admirable in plan, that they have been cared for with much skill and intelligence, and that they will ultimately tell us much more than is now known about mottle leaf.

In the meantime we still have mottle leaf, and our information about it lacks the clarity and definiteness we should desire. We still advise the maintenance of a favorable texture and moisture condition of the soil by frequent additions or organic material and by the skillful use of water.

One new thing has come up rather recently. From various places it has been reported that a few pounds of impure iron sulfate (which presumably contains some zinc sulfate), or of crude zinc sulfate, to the soil has been surprisingly effective in the control of mottle leaf. Whether zinc is to be a universal cure for mottle leaf, whether it is to be effective in special cases, or whether it is to be like the many promising cures that have come and gone, is all to be seen. The University is trying the zinc treatment, I believe, on several tree crops, including avocados.

Where mottle leaf is giving concern it would seem that a few trees might be treated with zinc salts as the materials are not excessively expensive. However, maintenance of good soil texture and moisture and care to avoid adding large amounts of materials containing the strong alkaline elements should not be relaxed.

SUN-BLOTCH

We now consider the evidence sufficient to conclude that sun-blotch is not due to sun-burn or other injury of this nature. Sun-blotched trees, however, are more easily injured by sun-burn than normal trees and show symptoms suggesting sun-burn.

The disease is known to most of you by depressed yellowish streaks in green stems, by depressed streak or spots in fruit causing deformity which is often extreme, and by a generally decumbent stunted and aged appearance of severely affected trees.

The studies ordinarily given to a plant disease have practically all gone only far enough to give negative results. Experiments with seeds and with grafting (Dr. Parker's part of this project) have given conclusive results. (1) Diseased scions, if they grow, produce diseased shoots. Moreover, the disease spreads from a diseased scion into a healthy stock. This occurs sometimes when the scion fails to grow. (2) Healthy scions set in diseased stocks give diseased shoots; that is, the disease spreads from diseased stock into healthy scion. (3) So far as we know no seed from a diseased tree has given a diseased seedling. (4) Dr. Parker has some information as to rate of movement of whatever it is in the living sap of the plant which causes the trouble. Movement of this infective principle possibly a virus, probably varies, depending on many conditions, but he has evidence of movement of about 3 ft. per year.

The only known method, then, of the spread of sun-blotch is by grafting. We think some other method probably exists and we endeavor to be on the alert to discover it. Also we have stimulated our friends who are working with virus diseases to help us, and also the entomologists to keep an eye on suspicious insects.

Evidently the greatest importance attaches to the selection of trees from which scions are to be taken. Some diseased trees have only traces of infection. We believe no scions should be taken from such trees but it may be very hard to discover the minute traces of disease. Careful examination of the fruit, especially before the June drop should help. Very careful inspection of the twigs should also be made. A given block of nursery stock should be budded from a known tree and rebudding should be from the same tree.

Clearly all nursery stock with sun-blotch should be destroyed. However a difficulty arises from our lack of knowledge as to the significance of many conditions and minor irregularities of the trees. I have perhaps not been ready enough to cooperate with inspectors in making up a set of rules for procedure. If we are wrong it should be ascribed to unwillingness to put down a guess where it would be taken as information.

All small and inferior sun-blotched trees which do not have some special interest or value might well be destroyed. Large, fine and valuable trees with traces of bun-botch offer a puzzling problem. It is probably permissible to retain such trees, removing all branches on which the sun-blotch shows. All scions from such trees are under heavy suspicion, but we do not know that they are all bad. Two bearing Fuerte trees at the Citrus Experiment Station are apparently outgrowing what were distinct cases of sun-blotch, but we do not take scions from them.

Our information on the treatment of moderate sun-blotch cases by pruning is very limited. Usually, diseased trees when cut back give diseased shoots. Whether there is a chance to get some good limbs is not known. Limbs, which are apparently good come up from heavily diseased trees in very rare cases. This sort of behaviour is not unknown in other virus diseases. It has not been proven that these apparently good limbs are actually free from the disease.

The source of sun-blotch is still a mystery. The original mother tree of the Fuerte variety probably is not affected and the remaining early propagations at Mr. Popenoe's place in Altadena appear perfectly normal. If sun-blotch was imported in one single set of scions from some foreign country it seems strange that it could have been so widely distributed to many varieties. Failure of buds and reworking of nursery stocks, using an infected bud the first time and a different variety the second time could accomplish a certain amount of this crossing from one variety to another. Intensive study of the possibility of insect transmission has not yet been given. Virus diseases show many peculiarities such as are shown by sun-blotch. For example, one of the virus diseases of potato known as "giant hill" appears, in some cases at least, not to spread from plant to plant.

It has been one of my hopes that some day we may put on a campaign to completely eradicate sun-blotch from California but our lack of information about it and the difficulty of detecting it and of identifying it with certainty discourage the idea of eradication.