

## California Avocado Association 1935 Yearbook 20: 72-80

### Practical Methods of Disease Control in Avocados

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In looking over some old literature on avocados recently, I ran across several statements to which I am going to take exception. One prominent grower stated "an avocado in order to be a success, must be both rich and nutty," and, he added, "the grower must be likewise." I am an avocado grower and I resent the statement that "one must be rich." I have found that it is much easier to be poor! Another statement to which I object is "the avocado is one of those favored plants which is not subject to the attacks of insects or diseases." The avocado is subject to both. Its tendency toward the development of disease has been largely due to man's lack of understanding of its basic requirements and his attempts to grow it under unfavorable conditions.

This is in no way a criticism of the judgment of our pioneer growers, for they had no literature or information upon which to depend for guidance. Even today, all literature written on avocado diseases in other states and countries is almost entirely without value to the California grower, as it deals with a different set of conditions and an entirely different group of diseases.

From information which we have gained through observation of our early avocado plantings, and from information which has been made available through the patient and careful research carried on by the personnel of the various departments of the Citrus Experiment Station, we are now able to offer certain definite information to the growers of California. What is of still more value is the information which we are able to offer prospective avocado growers, thereby preventing them from making the mistakes which have more or less characterized our plantings of the past.

The avocado requires the most favorable of climate, soil and water conditions for its successful growth, and most of our disease can be traced to unfavorable conditions with regard to one or more of these requirements. Our problem of disease control can be considered under two heads: the first and most important is the dissemination of information which will prevent the planting of avocados in unsuitable locations. If this could be entirely effective the problem of avocado disease would be a simple one. However, we cannot expect to be entirely successful in this and we must give relief to those areas which now need help. I am going to discuss these various troubles separately, then summarize them under the headings of prevention and control.

#### **DOTHIORELLA FUNGUS**

Prof. Wm. T. Horne has conducted the investigation work on this disease, and I have had the pleasure of carrying out some of the details of his field experiments. We have just completed our fourth year of experimental work with this disease and I believe that we are now in a position to draw up our plans of attack. I am merely going to give you the conclusions of these experiments as we interpreted them from the data collected

from year to year.

The spores which cause *Dothiorella* rot are found in tip-burned leaves and in dead twigs. If the tip-burn in an orchard could be entirely overcome no artificial control of this disease would be necessary. The problems of tip-burn will be discussed later on in this paper. Where certain conditions exist, tip-burn cannot be sufficiently overcome to effectively reduce the fungus, and it is under such conditions that these field experiments have been carried on and under which artificial control is necessary and recommended.

While *Dothiorella* rot is to be found in practically every variety of avocado it is more destructive to the thin-skinned varieties, as it penetrates a thin rind quickly. The injury to green varieties, while probably no greater than to the dark fruits, shows up a great deal plainer and for that reason is much more offensive in appearance. This means that the Fuerte and similar varieties are most seriously affected, and are thus most benefited by artificial methods of control.

Our first experiment was started in 1931 and from the data collected from this experiment and those carried on in 1932, 1933 and 1934, we have summarized our results, as follows:

- (1) From the commercial standpoint, *Dothiorella* rot can be completely controlled by the use of fungicides.
- (2) Liquid fungicides are more effective than those applied as dusts.
- (3) *Dothiorella* rot is increased by overhead irrigation.
- (4) Copper sulphate is more effective as a fungicide than zinc sulphate in controlling this disease.
- (5) The fungicidal value of copper sulphate in the treatment of this disease is greatly increased by the addition of sulphur.
- (6) Sulphur alone when applied as a liquid is very effective fungicide against *Dothiorella* rot.
- (7) The fungicidal value of zinc sulphate is increased by the addition of a small amount of copper sulphate. Copper sulphate when added to zinc sulphate in small amounts apparently did not interfere with fumigation.
- (8) Zinc sulphate alone in order to be effective in controlling *Dothiorella* rot had to be applied at such strong concentrations as to make it impractical from a commercial standpoint.
- (9) Our experiments indicated that the fruit is not infected until sometime after it has reached a diameter of one and a half inches. Therefore, early sprayings are not as important as applications made after the fruit is fairly well developed.
- (10) The most effective formula for the control of *Dothiorella* rot is as follows:

Commercial Bordeaux.....	16 lbs.
Wettable sulphur.....	6 lbs.
Blood albumen spreader.....	6 oz.
Water.....	100 gals.

- (11) The next most effective fungicidal material is wettable sulphur used alone.
- (12) Both of the above recommended formulae also give satisfactory control of Avocado Red Spider.
- (13) If fruit is picked as soon as possible after it has attained a satisfactory oil content, infection will be greatly reduced, particularly on unsprayed trees.

Spray recommendations for the control of Dothiorella rot must be based upon the combination of insects and diseases for which control measures are necessary.

Where no fumigation is contemplated, make two applications with the above formula, the first application to be made when the fruit is about one and a half inches in diameter, the second application to be made about two months later.

Spraying for the control of Dothiorella when fumigation is contemplated: Fumigate as soon as the fruit attains the size of one and a half inches in diameter. Follow this at once with an application of wettable sulphur. At least one subsequent application should be made with the same material about six to eight weeks later. Spraying for the control of Dothiorella rot where little-leaf is also present: Spray with the following formula, the first application to be made when the fruit has attained about one and a half inches in diameter, the second about two months later:

Zinc sulphate crystals.....	16 lbs.
Copper sulphate.....	1 lb.
Fresh hydrated lime.....	8 lbs.
Flotation sulphur.....	6 lbs.
Blood albumen spreader.....	6 oz.
Water.....	100 gals.

### TIP-BURN

While tip-burn must have a harmful effect on the avocado tree, due to its cutting down the active or functioning area of the leaf surface, it is of increased importance due to its relationship to Dothiorella rot. According to analysis of Dr. Haas and Prof. Thomas of the Citrus Experiment Station, one of the chief causes of tip-burn is salinity due to an excess of common salt in the soil and in the water used for irrigation. This condition is greatly aggravated by poor drainage as the alkali in the soil is brought up by capillary attraction and it is impossible for the salt to get away by leaching.

Tip-burn can be prevented by the wise choice of soil and irrigation water free from chlorides which are to be used in connection with the growing of avocados. A certain

amount of chlorine in the soil or irrigation water can be tolerated providing one has good drainage and pays attention to such details as

- (a) Wind protection
- (b) Frequent irrigations
- (c) Periodic leachings of the soil
- (d) Adequate fertilization including use of organic matter

The normal avocado leaf contains one or two tenths of one percent total chlorine in the dry matter. Newly developed avocado leaves contain small quantities of chlorine but as they continue to function the chlorine is brought up with the plant food by soil moisture. The water is given off from the leaf surfaces by transpiration and the chlorine is left behind. This is carried to the outer edges or tips of the leaves where it is deposited. When the total chlorine deposited becomes great enough the leaf turns yellow. As this accumulation progresses the yellow tissue is finally killed. This causes the condition known as tip-burn. Tip-burned leaves show as high as one and a half percent chlorine as compared to normal leaves with about one-tenth of one percent. There probably are other causes for tip-burn but excessive chlorine is one of the important causes and the one with which we have been most concerned.

## LIME CHLOROSIS

The avocado tree is very susceptible to injury from excessive carbonates, as well as chlorides. When the soil is too high in carbonates the trees develop a condition which is called lime chlorosis. The foliage becomes yellow and the trees lack the healthy green appearance of a normal tree. Heavy applications of sulphur or sulphate of iron, in some cases, will relieve this condition providing the carbonates are not too high and good drainage is available. The wisest **plan to follow is to refrain from planting: avocados in soil which is high in carbonates.** A good method of testing a soil in the field is to carry a small bottle of hydrochloric or muriatic acid with you and drop a couple of drops on the soil. If it effervesces, carbonates are present in quite large amounts, and avocados should not be planted there. Some people carry a lemon around with them and use lemon juice as a source of their acid.

This trouble is due entirely to excessive carbonates and should not be confused with excessive soil salinity or alkalinity, as the carbonates do not necessarily run up the alkalinity of a soil very high. Prof. E. E. Thomas of the Citrus Experiment Station is making a study of this problem and we hope that before very long he will be able to throw additional light on the subject.

## CANKERS

There are several of the more succulent varieties of avocados such as Itzamna, Anaheim and Nabal, which seem to be quite susceptible to cankers. Several different organisms have been isolated from these by Dr. Pawcett and Prof. Home. It is quite possible that these cankers may be caused by any one of a number of organisms which

gain entrance into the tissue through mechanical, chemical or other injuries. However, the treatment given is similar in all cases and is very effective in checking the disease if applied in the early stages and where the cankers have not spread down to the larger roots. The treatment consists of scraping away the diseased tissue and painting with any good fungicidal solution such as cyanide of mercury—one part to 500 parts of denatured alcohol and 500 parts of water. In scraping, care should be taken to scrape well above and below the affected area as there are oftentimes small infected areas which are just starting and cannot be detected in any other manner. Wet soils should not be piled up on the bases of the trees and so far as possible water should be kept from contact with the crowns. If the trees are badly defoliated they should be protected from sunburning by whitewashing with any of the commercial tree whites manufactured for this purpose. These cankers while apparently a specific disease, are invariably tied up with an unhappy root condition and do not exist under proper irrigation in soils having good drainage and freedom from alkali.

### **LITTLE-LEAF**

Dr. Parker of the Citrus Experiment Station has been carrying on some very interesting experiments on little-leaf. This work has been carried out most extensively on Citrus but his limited work on avocados indicates that the same effect can be expected from similar treatments on either citrus or avocados. This disease seems to be a physiological trouble, the cause of which is not definitely known. Applications of zinc sulphate have given satisfactory results in the treatment of this disease. This material has been applied as direct injections into the tree, as soil applications, and as a spray.

The most economical, and as a rule the most effective method of applying this material is as a spray, just prior to an important growth cycle. Trees seriously affected with this trouble usually show a quicker and more definite reaction to the zinc treatment than those only mildly affected. A satisfactory spray formula to use for the treatment of this disease is as follows:

Zinc sulphate crystals.....	10 lbs.
Hydrated lime.....	5 lbs.
Blood albumen spreader.....	6 oz.
Water.....	100 gals.

### **SUN BLOTCH**

Sun-blotch was first recorded and I believe named by Dr. Eliot Coit and was very vividly described by him in the 1928 Association year book. Further studies of sun-blotch have been carried on by Prof. Home and Dr. Parker, and we are indebted to them for the information which we now have concerning this disease.

Sun-blotch is another disease about which far too little is known and is that type of disease for which no cure has yet been devised. There are several points however which are pretty well understood and these should help us to prevent its further spread.

We know that sun-blotch is infectious and that when affected tissue is grown on normal trees they also become infected. The infectious principle is probably a virus and spreads about three feet vertically per year, horizontally much slower.

The spread of sun-blotch can best be prevented by selecting bud and scion wood from trees which are entirely free from this disease. This is oftentimes a very difficult matter, as the symptoms are often obscure. We believe that the most practical method of preventing further spread of sunblotch would be by some organization sponsoring the practice of certifying to budwood from trees of a high yield record and trees which have been observed for several years by experts to determine their freedom from disease. Until some such practice is followed, we can reasonably expect this disease to continue to be disseminated throughout all of our future plantings.

## **OAK ROOT FUNGUS**

The avocado is susceptible to oak-root fungus. This disease under favorable conditions for its development, progresses rapidly.

We have one instance on record in San Diego County where the disease advanced so rapidly that quite a large area in an avocado orchard was destroyed before the owner was aware of any difficulty. This disease is usually fatal and soil sterilization is necessary to remove the organism from the soil. This is a very laborious and expensive procedure and prevention of infection is the most satisfactory method of approaching the problem. The causal organism of this disease undoubtedly could be spread through the use of oak leaf mold. While this material makes a splendid mulch, it is always a potential carrier and its use around avocado trees should be discouraged. However, if the leaf-mold is dried out thoroughly before applying there is no danger of spreading infection by its use.

The avocado in the past has been regarded as resistant to this disease and some growers have made the practice of planting avocado trees in areas from which oak trees have been removed, or land known to be infected with oak-root fungus. This, however, is not a safe practice.

I wish now to summarize my remarks of this afternoon under "Precautions to be taken by the Prospective Avocado Grower in the Selection of a Location upon which to start his orchard."

(1)The necessity for controlling or enduring Dothiorella rot and tip-burn can be avoided by selecting soil and irrigation water which are comparatively low in chlorides.

(2)A serious form of chlorosis can be avoided by the selection of a soil low in carbonates.

(3)Most cankers can be attributed primarily to a poor soil condition and much trouble can be avoided by the selection of a soil having good drainage and freedom from alkali.

(4)Sun-blotch can be avoided by careful selection of bud-wood and scionwood and I recommend the payment of a premium on trees propagated from parent trees known to be healthy. I recommend that some method be adopted for providing certified scion wood for future use.

(5) Oak root fungus can be avoided by not planting trees in infected soil and by judicious management where oak leaf mold is used as a mulch.

Under the heading of control of those diseases which do exist, let me repeat the following:

**First**, Dothiorella rot can be controlled by spraying with fungicides of several different recommended formulae.

**Second**, lime chlorosis can sometimes be relieved by heavy applications of sulphur or iron sulphate, providing the carbonates are not too high and good drainage is available.

**Third**, cankers are satisfactorily treated by scraping and painting with a good fungicide.

**Fourth**, the condition of little-leaf can be relieved by spraying with zinc sulphate.

**Fifth**, Oak-root fungus can be removed from the soil by the use of soil fungicides.

I believe that the avocado disease problems are extremely well understood considering the comparative youth of the industry.

Speaking now as an avocado grower, I personally appreciate the interest and support which has been given the avocado growers by the men whom I have mentioned in this report and by the Calavo Growers and the California Avocado Association. Other men, including Dr. Batchelor, director of the Citrus Experiment Station, R. B. McLean, Agricultural Commissioner of San Diego County and the various farm advisors, the agricultural commissioners and numerous enthusiastic individuals are all closely cooperating in the solution of these problems, in an effort to relieve some of the growing pains which invariably accompany the development of a new industry.