

AVOCADO DISEASES



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This report will cover the more important diseases of avocado trees in California, including information on the symptoms of these troubles, the cause, and suggestions on control for most of them. The known parasitic diseases of the avocado are, with one exception, caused by fungi. The one exception is the virus disease known as sun blotch; Dr. J. M. Wallace is conducting the research on this, disease on the Riverside campus of the University of California. The diseases caused by fungi include: root rot, verticillium wilt or avocado wilt, dothiorella rot of fruit, a trunk canker sometimes known as gummosis, and a new trouble that is being called girdling canker of seedlings and young budded trees.

Root rot is the number one problem of the industry in most areas. It is a disease in which a soil fungus (*Phytophthora cinnamomi*), known as the cinnamon fungus, attacks the roots of avocado trees, primarily in poorly drained soil. This fungus was originally described from the tropics on cinnamon trees, hence its name. Since then it has been found over many parts of the world, including California, Texas, Florida, Puerto Rico, Hawaii, Guatemala, Mexico, Honduras, Peru, South Africa, and Australia. The report from Honduras, incidentally, is through the courtesy of Dr. Wilson Popenoe. He sent some roots from one of their plantings to Riverside last fall; cultures from these showed that this fungus is present in Honduras. The report from Mexico is the result of our trip to

that country in April 1951. On this trip a number of root samples were taken from avocado trees from the east coast to the west coast of Mexico. The cinnamon fungus was found in only one case out of the 31 trees sampled. While the fungus was thus shown to be present in Mexico it is not nearly as common as had been supposed.

This fungus has a number of other hosts. It attacks such plants as the pineapple, pine, chestnut, camellia, heather, rhododendron, in addition, of course, to the avocado which is the primary host here in California. With all the other plants the story is much the same as with avocado. There is invariably some record of excess moisture in connection with this disease. The main reason moisture is important is apparently because it favors the cinnamon fungus. This fungus forms spores that need water in which to swim, and water is necessary for infection.

During the last two years we have been able to reproduce this disease very readily merely by growing this fungus in the laboratory and adding these cultures to the soil around trees in an experimental plot at U.C.L.A. The fungus was added to the soil in January 1949 and trees showed typical disease symptoms 8 or 9 months later. The disease appeared first in trees that were watered more heavily than normal. However, the trees that were not watered as heavily finally showed symptoms and now (two and one-half years after inoculation) all trees which were originally inoculated are showing severe disease symptoms. The trees in this particular plot that were watered heavily, without any addition of fungus, are making excellent growth.

It is quite obvious, considering the statement that practically no disease has been found on well-drained soil, that this is one of the solutions to the problem. This does not necessarily mean deep soils, merely well drained. A second point is that in many cases the initiation of this trouble can be traced directly to some history of excess water in the grove, such as a leak in the irrigation line or an accidentally heavy irrigation, or an unexpected rainfall following an irrigation. This, of course, points to the fact that irrigation is quite important in relation to this disease. Dr. S. J. Richards of Riverside is cooperating on this aspect of the problem and the general conclusion has been that careful irrigation can in many cases retard the progress of the disease. This means watching the water use, not watering spots that tend to stay wet, and trying to avoid the accumulation of water in the grove from any reason. By careful irrigation the fungus cannot be eliminated but it may be possible to reduce its activity. In addition, *Phytophthora cinnamomi* is very sensitive to drying of the soil, as shown by greenhouse experiments. If the soil is dried to a low moisture content (one percent), the fungus will be killed. This may have application in several ways. One is in establishing a dry barrier on the margin of a disease area to try to prevent the fungus from spreading to the healthy trees. Also, drying the soil may be useful to nurserymen, particularly to those growing trees in large tarpaper pots. This soil can first be dried thoroughly by spreading in the sun and by turning several times over a two or three week period.

A fourth method of reducing the cinnamon fungus population in the soil is by means of soil fumigants. These include such materials as chloropicrin and some of the chlorinated hydrocarbons, known commercially as Dowfume N or Shell D-D. A number of field plots have been established on soil fumigation, in cooperation with members of the Agricultural Extension Service. Results from these plots indicate that this type of approach will not be practical and that it will not be possible completely to eliminate the

fungus from areas of considerable size by fumigation. Under ideal conditions these fumigants can kill the fungus, and it should be possible to eradicate it if only a small area is involved. The dosages which will kill *Phytophthora cinnamomi* are 40 gallons per acre of chloropicrin and 125-150 gallons per acre of Shell D-D or Dowfume N.

The method of control that has the most possibility of success in the long run is the development of a rootstock resistant to *Phytophthora cinnamomi* and wet soil conditions. That is the ideal solution to this type of problem. We have been testing a number of avocado seedlings (various Guatemalan, Mexican and West Indian types) with the cooperation of Dr. F. F. Halma of U.C.L.A. These have not shown any resistance. During the past year some of the avocado relatives from Mexico provided by Dr. C. A. Schroeder of U.C.L.A. have also been tested. This work is just beginning and there is as yet no information available on the resistance of various species of *Persea*. If resistant rootstocks are developed there is, of course, also the possibility that diseased trees could be inarched to the resistant types.

Clean nursery stock is important in preventing the introduction of the cinnamon fungus to areas where it may not now be present. With this in mind, nurseries should not be planted on old avocado soil or on areas that tend to stay wet, are poorly drained, or are adjacent to groves with root rot. It is much better, particularly on soils that tend to be problems at all, for nurseries to move every year to new soil. Under these conditions there is little possibility of building up the cinnamon fungus in the soil.

There are several other crops that are apparently resistant or immune to *Phytophthora cinnamomi*. From observation and from experiments now under way, citrus can be satisfactorily replanted where avocados have gone out with this disease. Also, it looks as though the macadamia nut is very resistant, as are the persimmon and cherimoya. The cinnamon fungus does not affect vegetable crops or any of the other types of annual crops. Growers interested in replanting diseased areas should contact the Farm Advisor in their county for suggestions.

A second disease of avocado is verticillium wilt, or avocado wilt. It was formerly known as collapse, asphyxiation, or apoplexy. We have determined recently that it is caused by another soil fungus of entirely different type from the cinnamon fungus. This fungus enters the tree through the roots and grows up into the branches of the tree through the water-conducting system. It occurs on many soil types. Typical symptoms are a rather sudden wilt and death of the leaves; the leaves remain hanging on the tree for a considerable period of time and the trees die back to some extent. Another characteristic symptom of this disease is the occurrence of brown streaks just under the bark of the trunk, branches and roots. Most trees affected with this disease recover rapidly. After a month or two new growth will appear and within two or three years the tree will recover completely. This disease is not a serious problem in California and it is sporadic in its appearance. This fungus attacks a wide variety of other crops, including tomato, pepper, eggplant, potato, many flowers, peach, apricot, maple and elm trees.

Control suggestions: (1) Avoid planting tomatoes or other susceptible crops prior to planting avocados, or as interplants in young groves. This fungus builds up very rapidly in the soil where any susceptible host is present. (2) There is some indication that trees with avocado wilt recover more rapidly if they are pruned soon after the initial wilt

symptoms appear. Farm Advisor Arnold White has noted this in Santa Barbara County. (3) Avoid any trees that have shown this disease in the past as bud sources, as there is a possibility that avocado wilt can be transmitted in budwood or graftwood. This has been shown to be the case with verticillium wilt of rose.

A third avocado disease is known as dothiorella rot of fruit. It is primarily important on the Fuerte variety along the San Diego county coast. The fungus [*Botryosphaeria ribis* (*Dothiorella gregaria*)] is usually a harmless saprophyte. It lives on dead leaf tips, dead branches, and dead wood throughout the tree.

Fruit is invaded while it is still hanging on the tree but the disease does not develop until the fruit gets to the market or to the consumer. When the fruit softens, brownish rot spots begin to develop. The nature of this disease makes it impossible to cull out the fruit which will develop this rot in the packinghouse. Control suggestions which will help to reduce this trouble are: (1) Make every effort to reduce dead wood, dead leaf tissue, and tipburn in the grove. This will cut down on the amount of fungus present. (2) Pick fruit early. It has been shown that picking fruit before January helps to reduce the disease percentage. (3) Spray the trees with two applications of fungicides in the fall. Results from our experimental plots during the past four years show good control with materials such as standard bordeaux mixture (6-6-100) or a new fungicide known as Crag potato fungicide 658 (1.5 pounds per 100 gallons) or zineb (Parzate or Dithane Z-78, two pounds per 100 gallons). One spray in mid-September and a second in early November have given best results. Further field trials are planned this coming season to test the treatments on a commercial scale.

Another avocado disease is avocado canker or avocado gummosis. This is very similar to citrus gummosis, and is caused either by *Phytophthora cinnamomi* or by another related fungus. The fungus attacks the lower trunk or rootstock of the tree, causing a bleeding and oozing of white powdery material and a reddish-brown stain. The control in this case, when the disease is detected early enough, is merely to cut out all discolored bark and wood, cutting one inch into healthy bark and wood, and to paint over the wound with bordeaux paste.

Girdling canker is a new disease that has been found in Ventura, Santa Barbara, and Orange counties. It is a disease of young transplants or young seedlings in the nursery, and was first observed in La Habra about two years ago. The disease is caused by still another soil fungus (*Gylindrocarpon*). The symptoms are a yellowing of the top of the tree or in extreme cases a complete death of the top of young seedlings or young budded trees. The most characteristic symptom, however, is a very marked girdling and constriction of the root-stock near the ground level, with a swelling immediately above this girdled area. The causal fungus is usually a very common saprophyte present in most soils. Apparently it attacks seedlings only through a wound or when the original stem tissue is buried considerably below the soil when the young tree is planted in the field. The obvious control measures are to plant the seedlings at about the same level that they were planted in the nursery, and to avoid wounding of the rootstock.