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RESISTANCE - IS IT THE ANSWER TO ROOT ROT?

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Avocado root rot, commonly referred to as the number one enemy of the industry, is still with us today and probably will be with us for some time in the future.

For the benefit of those who are not familiar with this disease, it might be well to review what it is, its causes and symptoms.

Avocado root rot is a disease caused by the cinnamon fungus, Phytophthora cinnamomi, a soil-inhabiting organism. There are two contributing factors involved: First, the fungus must be present; second, excess soil moisture must be present, as the fungus requires water for production of spores and root invasion. One without the other results in little, if any, damage.

Symptoms may be divided into two groups: Above ground

1. Sparse foliage.
2. Foliage light green or yellowish in color.
3. New leaves are small.
4. Tendency for leaves to droop.
5. Staghorn effect of tree top.
6. Moderate-to-heavy crop of small fruit.

Below ground

1. Lack of small fibrous roots.
2. If present, fibrous roots are blackened, brittle, and dead.

The presence of the above-ground symptoms, the diseased roots, and the presence of the cinnamon fungus are positive evidence of root rot.

Trees may be affected at any age, from large trees to small trees in the nursery row. Latest unofficial estimates have set the loss to the industry from root rot at 2,500 to 3,000 acres.

The avocado is not the only plant affected by the fungus. The fungus has been found on camellias, heather, azalea, chestnut, papaya, oak and many other plants. The movement of these susceptible plants from place to place can be an important method of fungus dissemination.

Now for the most important phase—control. To control a disease means reducing the

amount of damage caused or economic loss. Perfect control is rare, but profitable control is possible and practical. When a plant disease threatens a crop, one of the following procedures may be used for control:

1. Exclusion
2. Eradication
3. Protection
4. Resistance

By exclusion we mean preventing the entrance and establishment of a disease organism in areas where they are not known to exist. This procedure usually involves quarantines enforced by an inspection service empowered to disinfect, eradicate, or condemn diseased plants or plant materials to prevent them from becoming sources of infection. Can this method be applied to the avocado root rot situation? The answer is no. Why? Because the cinnamon fungus has been recovered from trees throughout the avocado districts in San Diego, Orange, Los Angeles, Ventura, and Santa Barbara Counties. You cannot control by excluding something that is already so widespread. Our main consideration, as far as exclusion is concerned, should be aimed at trying to prevent new land from becoming contaminated. The movement of soil and plants from one location to another should be done with care. Nurserymen should be encouraged to select new sites for nurseries. Locations known to be infected must be avoided. Locations situated downhill from an infected grove likewise must be avoided because contaminated irrigation water and soil may spread the disease into the nursery. If tar paper containers are used, it is advisable to fumigate or thoroughly dry the soil before using.

By eradication we mean the elimination of the organism once it has become established. To date, experiments by the Citrus Experiment Station using various chemicals have not been successful. The use of alfalfa meal has shown some promise but for only a short period of time. A few chemicals will kill the fungus at a high concentration—a concentration higher than that which would be considered safe to use around living plants.

By protection we mean the placing of a chemical barrier between the plant and the organism. This method of prevention is of little practical value with soil fungi.

By resistance we mean the ability of a plant to withstand, or retard, the activity of an organism. To date the first three principles have failed for all practical purposes, so that leaves us with the one ray of hope—the development of a resistant rootstock. This is not a simple task. Resistance can be acquired by employing one of three methods: namely, selection, breeding, and the use of close relatives. Dr. George A. Zentmyer has made several trips into the Central American countries for the purpose of collecting seeds from apparently healthy trees growing in swampy, infected regions, hoping they may have developed some resistance. These seedlings are under rigid experimental tests to see if they are resistant or not. Another system being used is the planting of numerous seeds from our own commercial varieties and localities in beds heavily infected with the fungus to see if some degree of resistance may be shown. Exposing the plants to such extreme disease attack, the great bulk of the non-resistant individuals

are soon destroyed. To date, one or two have withstood the test and may show some promise. In nature this is a slow and gradual process. Scientists have greatly accelerated the process by creating such conditions in their laboratories and greenhouses.

Breeding for resistance is also a slow and tedious procedure. Several crosses have been made by Dr. R. S. Bringhurst, of UCLA, but it is too early for results. This work is being continued by Dr. P. A. Peterson at the Citrus Experiment Station. However, from past experiences with other tree disorders, this procedure may extend over a period of many, many years. Developing resistance in annual crops involves less time because two or three months is all that is required to complete its life cycle.

The other method is the use of plants closely related to the avocados. Several now under trial include Persea Skutchii, P. Donnell-Smithii, P. gigantea, and P. schiedeana. Several others have been tried without success. If these in themselves are resistant and also compatible, the solution would be near at hand. Work on compatibility is being carried on at UCLA.

Let us assume that it were possible to report to you that a resistant root-stock had been developed. What then? Would our problems be solved? No! Being resistant to a fungus is only part of the solution. It would be necessary to make thorough investigations as to whether or not it is compatible with our commercial varieties, how it reacts toward tree vigor, productiveness, quality, size, chlorosis, frost, and others — any one of which might make it an undesirable rootstock.

In the meantime, what can you, as a grower, do to help check avocado root rot? While there is no cure, there are several things you can do to reduce the chances of infection and impede the spread of the disease:

1. Do not irrigate the infected area and its border.
2. Irrigate by using alternate middles.
3. Remove affected trees and do not replant with avocados.
4. Drain off excessive surface water.
5. Do not water trees because they are wilting. Check the soil to find out if it is wet.
6. Insist on healthy, vigorous nursery stock.
7. Be careful where you plant. Do not plant on poorly drained, heavy soils.

The last item is of utmost importance and should not be minimized. To those who already have an established grove, the first six items would apply. Those who are contemplating going into the production of avocados should make a thorough study of the soil conditions before planting. Until the development of a rootstock resistant to the fungus, much of the loss due to this disease can be avoided by planting on well-drained soils.

The development of disease resistance in plants extends back only to about 1900, but in these 50 years great advances have been made. It was estimated in 1937 that disease resistance in 17 farm crops were adding 60 to 70 million dollars a year to the farm income. Some crops could not be grown successfully today were it not for varieties

resistant to their leading diseases. Few undertakings in science or industry have paid such huge dividends in comparison to the original cost. The only cost of disease control through resistance is the original cost of development, which is a decided advantage over the more costly practices of disease control by quarantines or chemical treatments. The economy, the labor saving, the ease of widespread adoption, and the absence of risk through errors are the reasons why resistant varieties represent the best of all forms of disease control.

There is no reason why the avocado industry can't enjoy these benefits of control by resistance. However, it will take time, and you should be cautioned about being too overly optimistic. Someday the problem will be solved and until then we must rely upon cultural methods for checking avocado root rot. We don't know when, but we are sure of one thing: We have the cooperation of the University, the industry, and you as individual growers.