California Avocado Society 1958 Yearbook 42: 53-55

IS IT MACADAMIA—OR ELSE?

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Talk given at the annual meeting of the California Avocado Society, June 7, 1958.

Phytophthora root rot has become the most serious disease of avocado wherever they are grown. It is perhaps the most serious tree disease in California. Phytophthora root rot continues as a peril to the industry even though it was first recognized more than 25 years ago and despite much productive research, painstakingly secured at an ever increasing rate, largely through the fine, dedicated work of Dr. George A. Zentmyer, plant pathologist in the University of California, Citrus Experiment Station, Riverside.

What do we know about the disease? Many things; but conspicuous among the manifold discoveries is that citrus and macadamia thrive where avocados die. Is it macadamia — or else citrus?

Let us briefly review the known facts for control of avocado root rot (7) and evaluate the future prospect of the industry.

Most of the research work at the Citrus Experiment Station has been directed towards control of the disease. Most of the findings, however, have provided ways of preventing the spread of the disease, or methods for extending the life of infected trees. Significant among these are:

Fungicide treatments to kill the fungus in areas known to be infested;

Chemical and mechanical barriers to prevent the spread of the fungus;

Drainage systems to carry waste water and soil harboring the fungus away from healthy avocado trees;

Biological control of the fungus by soil amendments to prolong fruit production of infected trees;

And the fact that over-irrigation increases the amount of fungus in the soil and thereby increases the amount of root rot.

The most recent important step toward controlling the spread of the disease is the State Department of Agriculture regulation pertaining to Certification of Avocado Nursery Stock, which resulted from the requests of the California Avocado Society, and other segments of the Industry, together with the able assistance of the Agricultural Commissioners from avocado producing counties and cooperation of the University of California.

The active educational programs of the Agricultural Extension Service have done much to publicize the findings of the Agricultural Experiment Station and have helped many avocado growers combat the ravages of Phytophthora root rot.

Despite all this, the disease becomes increasingly important. Research has not been able to get ahead of the problem despite the expenditure of approximately $245,000 by the Department of Plant Pathology since 1940, exclusive of about $15,000 donated to the Department by the California Avocado Society, numerous gifts of chemicals and materials, and expenditures of other departments concerned with the disease. The present estimated University of California total annual expenditure for avocado root rot is about $82,000.

Successful reduction in root rot is extremely difficult to accomplish for at least two reasons; (1) because most of the desirable frost-free planting sites are ideal for Phytophthora root rot, and (2) because continuous, careful, considered, and correct orchard management must be provided, and this often is not available, and in any event is subject to natural human errors.

Research must continue for the purpose of improving control measures for Phytophthora root rot but a significant expansion in exploration for resistant rootstocks is required and a new program for systemics and chemotherapeutant chemicals is mandatory. Thanks to foreign explorations, highly resistant rootstocks have been obtained (6). Most unfortunately, however, none of these most promising rootstocks are graft-compatible with commercial fruit varieties. One notable exception may be the use of selected root rot resistant Duke clones for rootstocks (8) as they are graft-compatible with commercial fruit varieties. Graft-compatibility studies of resistant rootstocks by C. A. Schroeder and E. F. Frolich suggest that an extensive exploration for avocados must again be undertaken. A plan for making foreign collections has been formulated using botanists and other technicians in their native countries, USDA employees assigned to Ibero-America, and personnel of research foundations concerned with food production problems in several Pan-American countries. This program is now only partially activated, but can be fully implemented whenever sufficient funds are provided. Control of Phytophthora root rot by resistant rootstock is the ultimate goal — but this may be years away.

What is to be done in the meanwhile? Institute an immediate crash program to control Phytophthora root rot by systemic chemicals and chemotherapeutants. What is the likelihood of success? The following examples are instructive; further information can be secured by referring to Zaumeyer (9). When streptomycin is applied to bean stems bacterial halo blight is controlled in the leaves by upward movement of the chemical into leaf tissue according to Mitchell, et al. (2). Zentmyer (3) has shown that when quinolines are injected into infected trees that the Dutch elm disease is partially controlled. He (4) has also shown that wilting and root rot is reduced when the foliage of avocado seedlings is sprayed with quinolines before transplanting treated plants in badly infested soil. The chemical was apparently absorbed by the leaves, moved down into the root, and partially neutralized the Phytophthora toxin. Perhaps most interesting is the finding by Hamilton and Szkolnik (1) that the application of acti-dione to soil controls bacterial leaf spot of cherry by the movement of the chemical through the soil to the roots and then systemically upward to the infected leaves.

All of the successful applications of systemics have so far involved upward movement of chemicals in plants. Here is the challenge: to find chemicals that can either move downward from leaves to roots, or find chemicals that move from soil to root and control Phytophthora. Acti-dione kills Phytophthora in soil at 25 ppm (5), but is toxic to avocado. Undoubtedly there are other materials that will do the job and not be damaging to the tree. They must be looked for! This new work requires new manpower and new facilities. It requires new money, too.

Exploration for resistant rootstocks and systemic chemicals and chemotherapeutants offer two profitable avenues for Phytophthora root rot control.

Perhaps now you wonder whether it might not be best to plant citrus instead of avocado, for not only is it resistant to **Phytophthora cinnamomi**, but the fungus actually disappears from soils planted to citrus. But don't forget that the planting site and soil for Phytophthora root rot of avocado are also ideal for Phytophthora root rot of citrus. A change in crop will change the soil fungus flora, but Phytophthora will only change its name from **cinnamomi** to **citrophthora**.

Macadamia can thrive in the presence of Phytophthora. Will macadamia replace the important avocado industry in California?

It need not if a materially expanded research program can be financially supported. Sponsorship of research on fungitoxicity and the movement of systemic pesticides by the chemical industry will further activate the needed root rot studies. Continued industry support of research on avocado root rot enhances the prospect of additional financial aid by the University.

Instead of saying, "Is it macadamia — or else," let's say, "It is macadamia — or else much more money for root rot research."

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