

ANALYSIS OF SUPPRESSIVE SOILS AND DEVELOPMENT OF BIOLOGICAL CONTROL METHODS FOR PHYTOPHTHORA ROOT ROT OF AVOCADO

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Report on Objectives and Expected Accomplishments for 1989-90:

Objective 1. Identify Phytophthora root rot (PRR)-suppressive soils in California avocado groves.

An ongoing survey, in collaboration with Dr. John Menge, is identifying sites which fit our criterion for disease suppressiveness: soils in which Phytophthora cinnamomi is believed to be present, but on which trees are not dying. Avocado rhizosphere soil has been collected from 7 of these sites so far. Additional sites have been identified and from which soil will be collected.

Objective 2. Determine physical/chemical characteristics of these soils and their correlation with PRR-suppressiveness.

Analyses of soils is in progress, but preliminary information indicates a higher than usual amount of organic matter for the suspected-suppressive soils (this is consistent with observations of P. cinnamomi-suppressive soils in Australia).

Objective 3. Identify soils in which suppressiveness is due to biological factors.

These experiments depend on successful PRR-suppression by field soils under greenhouse conditions, and await the results of experiments described under Objective 5.

Objective 4. Begin identification of microorganisms associated with PRR-suppressiveness.

Although testing soils for PRR-suppressiveness (Objective 5) are not completed, we have begun isolating and testing microorganisms from avocado rhizosphere soils from suspected PRR-suppressive sites. Approximately 50 fungi and 50 bacteria have been isolated from seven soils so far. Since antibiotic production has been implicated in biocontrol of other plant pathogens, isolated microorganisms are being screened for antibiosis against P. cinnamomi. The preliminary screening for antibiosis is as follows: P. cinnamomi and one of the test organisms are placed on opposite sides of growth medium in a petri dish. As the two organisms grow together, antibiosis is indicated by a zone of inhibited growth of P. cinnamomi around the test organism. Ten fungi, out of 29 tested so far, and 4 of the 50 bacteria show antibiosis against P. cinnamomi in culture.

In some cases, inhibition of growth is accompanied by disruption of the hyphae of *P. cinnamomi*.

Effective biological control may require the application of two or more microorganisms together, and obviously antagonism among biological control agents would be detrimental. Fortunately, the microorganisms isolated so far that show antibiosis against *P. cinnamomi* do not, in general, show antibiosis against each other. This apparent specificity of antibiotics for *P. cinnamomi* is not completely unexpected due to the rather distant evolutionary relatedness of *Phytophthora* with other fungi and bacteria. As a result, in many ways the physiology of *Phytophthora* is peculiar to these organisms, which is manifested, for example, by the resistance of *Phytophthora* spp. to most fungicides effective against other plant pathogenic fungi.

One of the isolated bacteria grows well along the hyphae of *P. cinnamomi*. Inoculation at one point of a colony of *P. cinnamomi* results in complete colonization of the *P. cinnamomi* mycelium and inhibition of further growth of the fungus.

A genus of fungi isolated in 6 out of 7 soils is *Trichoderma*. *Trichoderma* spp. are have been successful biological control agents against other plant pathogens. These fungi have been shown to parasitize the pathogenic fungi. The *Trichoderma* spp. isolated from avocado rhizosphere soils have shown coiling around hyphae of *P. cinnamomi*, which is indicative of parasitism.

We have isolated *P. cinnamomi* in only 1 of the 7 avocado rhizosphere soils, although surrounding soil is believed to be infested with the fungus. Of possible importance is that the soil from which *P. cinnamomi* was isolated apparently did not contain *Trichoderma*.

The isolated microorganisms are being tested in greenhouse experiments for biological control of PER. These experiments are in progress and results are not yet available.

Objective 5. Begin greenhouse studies on suppressive soils.

Greenhouse tests of avocado rhizosphere soils for PRR-suppressiveness will be performed under low disease pressure in order to detect even low levels of suppression. Optimum conditions for screening soils, including method of inoculation, are being determined in experiments conducted by Dr. Donald Ferrin, which are currently in progress. The results of these experiments are being awaited prior to performing extensive tests of field soils using large numbers of plants (var. Topa-Topa). However, a preliminary experiment using *Persea indica* as a host showed disease in only 1 of the 7 suspected-suppressive soils inoculated with *P. cinnamomi*. This result is encouraging since *P. indica* is extremely susceptible to *P. cinnamomi* and would be expected to become diseased in non-suppressive soil under the same conditions.