Citrus Irrigation Water Survey

runoff water from diseased groves, carried in canals, can contaminate other land with infective Phytophthora spores

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Twelve irrigation canals, sampled repeatedly for one year, all harbored one or more of the species of Phytophthora that cause citrus diseases. The species that were prevalent varied with the seasonal temperature of the water. The fungus was found in only one of the three reservoirs tested.

Phytophthora citrophthora (Sm. & Sm.) Leonian, P. parasitica Dast., P. syringae Kleb., P. hibernalis Carne, and P. megasperma Drech. cause brown rot or other diseases—either above or below ground—in commercial citrus groves in California. Some are widespread in soils of the major citrus producing areas of the world.

Water-testing work was initiated in the fall of 1957 to determine the prevalence and the origin of infestation of Phytophthora spp., pathogenic to citrus, in irrigation water of open canals and reservoirs in five southern California counties: Riverside, San Bernardino, Los Angeles, San Diego, and Orange.

Lemon-Trap Method

To test for the presence of Phytophthora spp., 5–20 lemons at the silver stage were suspended—in a perforated plastic bag—in a canal or reservoir. Two weeks were allowed, during which any fungus spores present in the water could infect the fruit and cause brown rot. The bags of fruits were then brought to the laboratory, where those with brown rot lesions were cultured. Boiled hempseeds were added in each trap to increase the probability of trapping any Phytophthora spp. Lemons were the most satisfactory trapping agent for P. citrophthora, P. parasitica and P. syringae in water. Oranges were used as a trap for P. hibernalis.

A trap was placed at or near the source of the canal water, if possible, and two to five traps were placed at intervals along each canal. The locations were usually sampled every two weeks.

Occurrence of Spores

Of the 12 canals tested from September 1957 to September 1958, all yielded Phytophthora spp. at one time or another, some more consistently than others. The most commonly distributed and frequently recovered species was P. citrophthora—11 canals; less frequently, P. parasitica—five canals; and least frequently, P. syringae—two canals. P. hibernalis and P. megasperma were not found. Four of the canals yielded P. citrophthora only, and four yielded both P. citrophthora and P. parasitica. Two canals yielded both P. citrophthora and P. syringae. One canal yielded P. citrophthora, P. parasitica, and P. syringae. One canal yielded an unidentified Phytophthora sp., which tolerated an exceptionally high temperature, up to 113°F incubation. Under greenhouse conditions it was capable of producing gummosis lesions both in the bark and on the cambium layer of the trunk of one-year-old seedlings of Cleopatra mandarin, Standard sour orange, Jameson sweet orange, and Sampson tangelo.

Where more than one species of Phytophthora was found in the canal during the several samplings, the species isolated seemed to be related to the prevailing water temperature. During winter and spring months, when the water temperature was between 43°F and 63°F, P. syringae was isolated. During the warm summer and early fall months, when the water temperature ranged from 63°F to 89°F, P. parasitica was isolated. However, P. citrophthora was recovered all through the year, with the water temperature ranging from 43°F to 88°F. These temperatures are close to the range at which the fungi grow in laboratory cultures.

In the five canals where it was possible to set the lemon traps at the source of water supply, no Phytophthora spp. were recovered there. However, as the canals passed through citrus areas where excess irrigation water or rain could drain into the canals, the fungi were readily isolated from the water thus contaminated. Soil samples collected and cultured from four separate paths of runoff water which drained into irrigation canals also yielded the fungi. All the soil samples yielded P. citrophthora, indicating that runoff water can introduce Phytophthora zoospores from infested citrus groves into canals.

In six of the 12 canals tested, copper sulfate was used for control of moss and algae. One canal received paint thinner—a petroleum distillate. Commercial aquatic weed killer was added to one, and another was given aquatic weed killer plus copper sulfate. Two received no treatment. Most of the chemical treatments were applied during the warm summer months when ecological factors are conducive to the growth of algae and moss. The frequency and amount of application were governed by the quantity of aquatic weeds developing in the canals. No correlation between presence or absence of Phytophthora spp. and the time or kind of chemical application was found.

Only one of three reservoirs tested during the year was infested with P. parasitica. However, following monthly applications of copper sulfate to the infested water, repeated testing failed to recover any Phytophthora spp. Apparently copper sulfate is effective against Phytophthora fungi under the static condition of the water in a reservoir. Preliminary experiments have indicated that chlorination may be an effective means for disinfecting water of Phytophthora spp. Two parts per million of chlorine maintained in water for two minutes kill the infective zoospores.

The 12 canals tested are capable of infesting with pathogenic species of Phytophthora. Concluded on page 16
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topothra all the 40,000 acres of orchards using those sources of water, and any new citrus plantings will become infested with Phytophthora spp. when irrigated with water from those canals. Moreover, Phytophthora-free irrigation water can become infested when runoff water from infested citrus groves is permitted to drain into a canal, and irrigation with Phytophthora-infested water rapidly distributes the fungi in a groove.

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