Fig. 1. Cherry trees, naturally infected with Phytophthora, in an advanced stage of decline. The decline follows severe root rot or crown rot shown in figure 2.

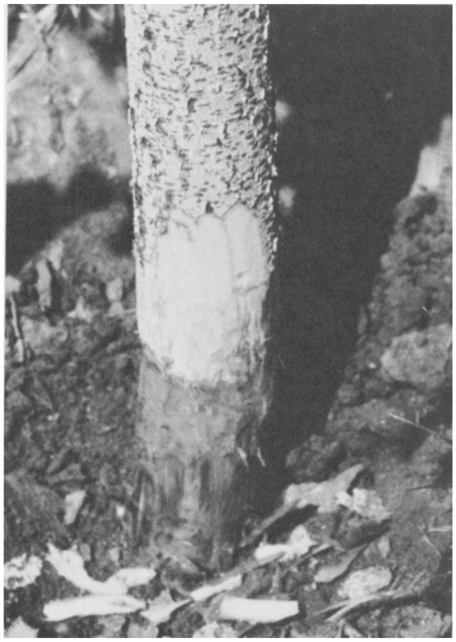

Fig. 2. Lower trunk of orchard cherry tree with decayed bark at the base due to Phytophthora. Outer bark has been removed to show the extent of bark canker.

Root and crown rot of cherry trees

Srecko M. Mircetich
Wallace R. Schreader
William J. Moller
Warren C. Micke

Decline and death of bearing cherry trees resulted in an estimated loss of 22 percent of all sweet cherry trees in San Joaquin County during 1973-75. During 1972-74 heavier than normal rainfall occurred, especially during late winter and early spring. In 1975 some orchards were almost 100 percent affected with crown and root rots. In previous years crown and root rot diseases were always prevalent in cherry orchards on poorly drained soil, but in 1975 these losses were excessive, and growers were forced to remove many acres of declining and dead trees.

Such occurrences of cherry tree decline in the past have been variously attributed to "wet feet," "soursap," or occasionally root-infecting fungi, but evidence for a clear-cut cause has often been lacking. The water mold fungus *Phytophthora* frequently has been suspected but never directly proved as a causal agent of cherry tree decline.

Surveys of orchards

In 1973-74, the occurrence of serious decline problems in numerous commercial cherry orchards led to surveys of orchards in the Stockton—Lodi and Morgan Hill—Hollister areas. It was apparent that the highest incidence of root and crown rot invariably occurred in orchards subject to poor internal soil drainage, prolonged saturation of soil with water, and prolonged immersion in water of the lower trunk of trees.

Typically, affected trees failed to grow in the spring. If growth occurred, the leaves were often small, yellow, and wilted. These trees usually died during the summer. By contrast, some trees that showed normal, early season growth collapsed and died suddenly during the first hot days of early summer. These trees had severely decayed roots, root rot, or extensive bark cankers on the lower trunk at or just below the ground level.

Bark canker at the base of trees, or crown rot, was more common on mahaleb than mazzard rootstock, although root rot was severe on both.

In many orchards, samples were taken from the crown, roots, and soil surrounding affected trees. These samples were then transferred to the laboratory for detailed analysis. By using a variety of culturing procedures, it was possible to recover consistently as many as three different *Phytophthora* species from affected trees and soil—*P. cambivora*, *P. megasperma*, and *P. drechsleri*. Often the three species were recovered from the same orchard and occasionally from the same tree with root or crown rot.

Greenhouse tests

These three fungi were then tested for their potential damaging effects on six-month-old mahaleb and mazzard seedlings in the greenhouse. Mahaleb and mazzard are the most commonly used cherry rootstocks in California.

Trees that had been artificially infested with the water molds were grown in potted soil, and the soil saturated every two weeks by flood irrigation. Because prolonged periods of soil saturation or standing water encourage the spread and infection by *Phytophthora* in the field, enough water was added to the pots at each irrigation to ensure standing water around the lower trunks of the seedlings for 48 hours.

After three months, *P. cambivora* and *P. megasperma* each completely destroyed the root system of six-month-old mahaleb seedlings. *P. drechsleri* was not as damaging, but it decayed large numbers of feeder roots and thus stunted plant growth. Mahaleb seedlings were more severely affected than mazzard in each case. In the field it was frequently suspected that the three *Phytophthora* species may act synergistically to cause more severe damage to the trees than when the trees are infested with single species; greenhouse tests confirmed this theory.

Our field observations and results from the greenhouse tests strongly indicated that the water regime in orchard soil infested with *Phytophthora* and the type of rootstock are very important factors that determine severity and incidence of *Phytophthora* root and crown rot in commercial orchards.

The influence of soil-water regime on severity of root and crown rot, and the relative resistance of mahaleb and mazzard rootstocks to *P. cambivora* and *P. megasperma*, were investigated in greenhouse experiments. One-year-old mahaleb and mazzard seedlings were planted in potted soil, each infested artificially with one of these two water mold species, or in soil without water molds. The seedlings were then irrigated by one of two procedures: flood-irrigation every two weeks, permitting free water to stand around the base of plants for 48 hours; or irrigation only when plants showed water stress, applying enough water to thoroughly wet the soil without prolonged saturation.

Within three months, both mahaleb and mazzard seedlings developed severe root rot when flood-irrigated in soil infested with the water molds. In addition, 70 percent of mahaleb seedlings developed crown rot and died in the flood-irrigated soil that contained the water molds, but none of the mazzard seedlings subjected to the same treatment developed crown rot or died. However, these mazzard seedlings were extremely stunted compared with flood-irrigated control plants growing in soil without the water molds.

In the treatment where plants were irrigated as needed, without prolonged saturation of soil, *P. cambivora* induced crown rot and death in 20 percent of mahaleb seedlings. None of the mahalebs died in the presence of *P. megasperma* under this irrigation regime, and these trees were as vigorous as the plants in soil free of the pathogen. Also, in the same irrigation regime, mazzard plants grew as well in infested soil as they did in non-infested soil.

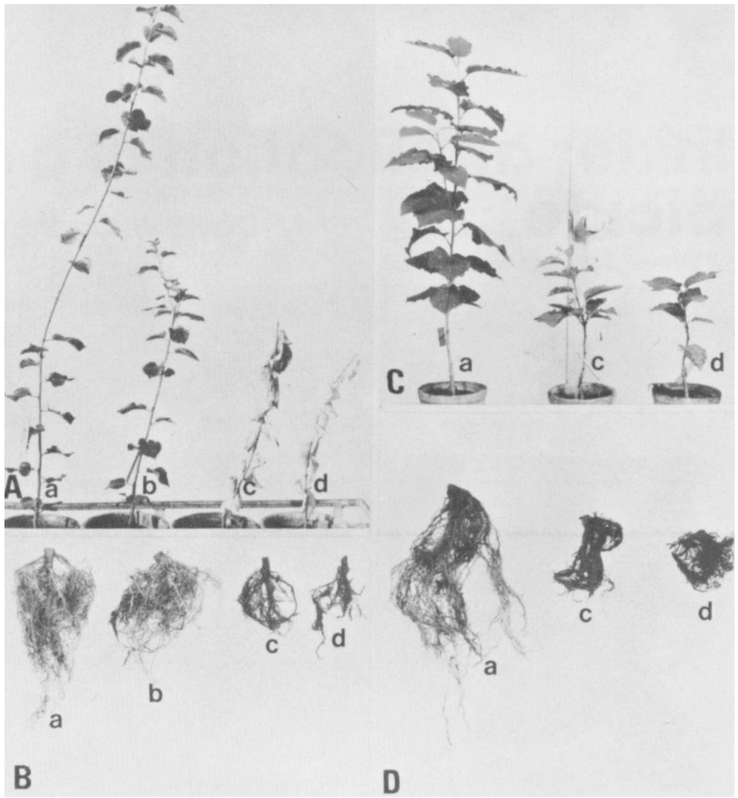

Fig. 3. Tops and roots of 6-month-old mahaleb (A and B) and mazzard (C and D) grown for 3 months in soil free of Phytophthora (a) and in soil containing Phytophthora drechsleri (b), Phytophthora megasperma (c) and Phytophthora cambivora (d). Note that Phytophthora caused root rot, stunting, and death of cherry rootstocks.

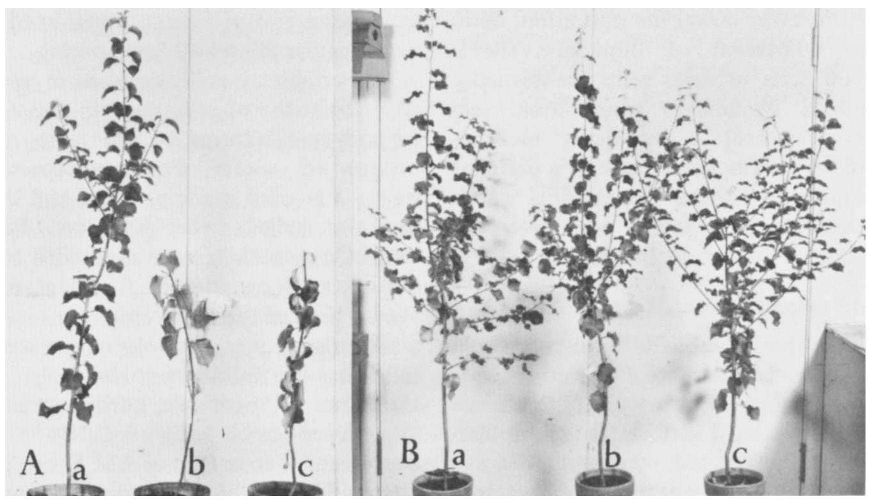

Fig. 4. One-year-old mahaleb seedlings grown for 3 months in noninfested soil (a), and in soil artificially infested with Phytophthora megasperma (b) and Phytophthora cambivora (c), which were subjected to one of two irrigation regimes: (A) flood-irrigated, permitting free water to stand at the base of the seedlings for 48 hours every 2 weeks; (B) irrigated only when water stress was observed on the mahaleb seedlings, applying enough water to thoroughly wet soil without prolonged soil saturation.

Conclusion

The overall results support the conclusion that *Phytophthora* can cause substantial losses of cherry trees, particularly on sites where excess soil water occurs periodically. The greenhouse tests also explain why a greater number of cherry trees on mahaleb have been affected by root and crown rots than those on mazzard.

In the light of this new information, further research is now necessary to develop better orchard management practices. Clearly, the use of mahaleb rootstock should be discouraged on soils with poor internal drainage; however, this approach complicates control of the buckskin disease because high-worked sweet cherries on mahaleb rootstock have been used for years as a means of reducing damage caused by this mycoplasma disease.

Alternative rootstocks, irrigation and soil management methods, and the possible use of chemicals are approaches that need further investigation so that long-term answers to control of crown and root rot of cherry trees might be obtained.

Srecko M. Mircetich is Research Plant Pathologist, Agricultural Research Service, U. S. Department of Agriculture, University of California, Davis; Wallace R. Schreader is Farm Advisor, San Joaquin County; William J. Moller is Extension Plant Pathologist, and Warren C. Micke is Extension Pomologist, University of California, Davis.