

PROGRAM AREA: Root and Root Zone Problems

PROJECT LEADER: W. H. English

PERSONNEL: Paul Bertrand, Frank Schick

OBJECTIVES:

To ascertain the nature of the gummosis-canker disease of prune trees and to develop a control for this disease.

WORK IN PROGRESS:

Since the true nature of this disease is not completely understood, research has been initiated on factors that might have a relation to it. This research is as follows:

1. The relationship of the bacterial pathogen, Pseudomonas syringae, to the disease is being investigated by means of isolations and inoculations. This organism has been obtained from both diseased and healthy appearing trees and it is able to induce at least some of the disease symptoms observed under natural conditions.

2. The fungus Cytospora is associated with canker and dieback of prune trees but its causal relationship to this condition has never been adequately determined. A graduate student, Paul Bertrand, has started research on the pathogenicity of this fungus to prunes and on factors affecting disease development. He is ascertaining the virulence of numerous isolates in studies at Davis, and is investigating the effect of pruning and/or spraying with Benlate on Cytospora infection of dieback-affected prune trees in both Sutter and Yolo counties.

3. The Harmeson Plot in Sonoma County continues to yield information on the effect of rootstock, type of budding, time of pruning, and soil fumigation on canker development and tree growth. Additional data on the effect of different methods of soil fumigation are being obtained from an experimental plot in Yuba County.

EXPERIMENTS COMPLETED

Although much of the research is still in progress, some results have been obtained that justify reporting at this time.

Harmeson Plot, Sonoma County: French prune on Lovell or Nemaguard has suffered only approximately 40% as much canker injury as on Myrobalan 29C or Marianna 2624. There has been no difference between the two peach or the two plum rootstocks. Soil treatments involving the following materials in pre- and/or postplant treatments have had no significant effect on canker severity: Trizone, Fumazone, Telone, carbon bisulfide, Dexon, Demosan, and Lanstan. Trees on soil that was preplant treated with ethylene dibromide showed 23% less canker than the check (significant at 5% level).

Other treatments that to date have not had a significant effect on the disease are time of pruning (fall, winter, or spring), height of budding, minor element fertilization (Hoagland's solution injected annually into root zone), Bordeaux or streptomycin sprays (applied fall, winter, and spring) or Cerano applied as a trunk and scaffold paint.

Although the soil treatments have had relatively little effect on canker development, preplant fumigation with Telone, Fumazone, or Trizone, followed by annual postplant fumigation with Fumazone, has resulted in a slight but significant increase in tree growth (based on trunk circumference). None of the treatments, however, resulted in a significant increase in yield. Mean 1970 yields (lb.) per tree on the various rootstocks were as follows: Myrobalan 29C - 16.6, Lovell - 14.3, Marianna 2624 - 13.8, Nemaguard - 10.0. The trees on the latter rootstock were orchard budded and are one year younger than the others. On the basis of total planted trees, the rootstock as yet has not had a significant effect on yield.

Although a higher incidence of cankers has been found on southerly than on other trunk exposures, artificial inoculations in January resulted in the formation of cankers on the north side of the trunk that were three times as large as those on the south side. Artificially induced cankers in French prune were 50% larger where plum rootstocks than where peach rootstocks were used.

The disease has been most severe in two areas of the plot, in one of which the trees were below average in vigor and in the other above average. A backhoe was used to expose soil and tree roots to a depth of 6-7 feet. Most of the roots tended to be in the upper foot of soil, but in some instances they penetrated to a depth of 6-7 feet. Except for one dead tree, with roots also entirely dead, the roots of both healthy and cankered trees were in good condition. No correlation could be found between soil conditions and canker development (cooperation of Dr. W. Wildman, Extension Soils Specialist).

Pettis Plot - Marysville: This plot was established in 1968-69 in a 40-acre block of French prunes, mostly on Myrobalan 29C rootstock, that had been planted in 1966. Heavy losses from canker and root-rot conditions had occurred in portions of this orchard in 1967 and 1968, and have continued into 1970. Two of the worst areas were cleared for preplant fumigation and replanting; two other areas were used for postplant fumigation. Fumigating was done in late October, 1968, and replanting was done in February, 1969.

Data taken in 1970 showed that all the preplant fumigation treatments induced a slight but significant increase in tree growth (trunk circumference) and decrease in canker severity. These treatments included combination deep-shallow injections of MC33 (methylbromide-chloropicrin) 300 lb./A, Telone (100 gpa), and Telone C (Telone-Picfume-100 gpa); deep injections of Telone and MC33; and a shallow injection of Telone. There was no clearcut difference between fumigation treatments. The ripped check showed less growth and greater canker severity than the unripped check.

The use of an auger (cooperation of Dr. W. Wildman) has shown the presence of a hardpan layer at about 2-1/2-3" in most of the sites where tree losses were heavy and the absence of such a layer down to 5' in the good areas. Roots of cankered trees varied from good to bad; most were in the upper foot of soil. No correlation has been found between tree decline and the population of Pythium spp. or nematodes (cooperation of Dr. B. Lownsbery, Nematology Department).

Trees that were prematurely yellow in the fall of 1969 did not show a greater incidence of canker in 1970 than relatively green trees.

WORK PLANNED:

Much of the work for the ensuing year will follow the lines already established; however, some changes in emphasis and direction will be made. A critical examination of soil moisture as a possible factor in disease development will be made. A portion of the Harneson Plot will be used for this study which, it is hoped, will include cooperation with the Department of Water Science and Engineering. Increased attention will be given to Cytospora and its role in the canker and dieback complex of prunes. Much of this research will be done by a research assistant who has started a Ph.D. program in this area. Additional attention, also, will be given to the part played by Pseudomonas in canker development. Isolates of this organism obtained from the interior tissues of apparently healthy trees must be rigidly tested for virulence, and additional isolations must be made to corroborate the results of the past season.

MAJOR ACCOMPLISHMENTS:

1. It has been shown for the first time that prune trees suffer more from canker on plum than on peach rootstocks.
2. Soil fumigation, although highly effective in reducing canker severity in prune trees on light soil, has been of limited value in controlling this disease in heavier soils.
3. Research to date does not implicate nematodes or the fungus, Pythium, as important factors in canker development.
4. Evidence to date suggests that neither time of pruning nor minor element nutrition are important factors in disease incidence.
5. The Pseudomonas bacterium appears to be the most important biotic factor in canker development, but factors other than dormancy that predispose prune trees to the disease have not been adequately elucidated.
6. It has been shown that P. morsprunorum, a canker bacterium important on Prunus in England, should probably be considered synonymous with P. syringae, the common species found on prunes in California. Another so-called species that occurs on sugar beets, was also found to be indistinguishable from the prune pathogen. No correlation was found between syringomycin, a toxin produced by P. syringae, and pathogenicity of this organism to stone fruits.

EVALUATION OF PROJECT:

The title of this project "Root and Root Zone Problems" is rather misleading as it does not indicate the true nature of the project. The disease we are concerned with principally involves the death of above-ground portions of the tree, generally with little evidence of injury to the roots. There is no good evidence as yet that root or root zone problems are directly or indirectly related to this disorder. Our research, therefore, has been concerned with both soil and aboveground factors.

Definite progress has been made on both the basic and the more applied aspects of the project. Although some of the information we have obtained has been negative, it has suggested other approaches that may lead to a clearer understanding of this perplexing disorder. Preliminary evidence obtained during the past year suggests that pathogenic bacteria may reside within apparently healthy trees. If this evidence can be substantiated this year, the nature and control of this disease takes on a totally new dimension. Research planned for this year should provide us with information on soil moisture as a possible factor in disease development.

PUBLICATIONS:

English, H., and J. R. Davis. 1969. Effect of temperature and growth state on the susceptibility of *Prunus* spp. to *Pseudomonas syringae*. *Phytopathology* 59:1025. (Abstr.)

Otta, J. D., and H. English. 1969. Pathological and serological delimitations of *Pseudomonas syringae*. *Phytopathology* 59:1043. (Abstr.).

Otta, J. D., and H. English. 1970. Epidemiology of the bacterial canker disease of French prune. *Plant Dis. Repr.* 54:332-336.