Project No. 80-T6
(Continuation of Project No. 79-U5)

Cooperators:
University of California
Cooperative Extension
Department of Plant Pathology
Davis, California 95616

University of California
Department of Entomological Sciences
Berkeley, California 94720

Project Leader: Dr. George Nyland Phone (916) 752-0313
752-0301

Personnel: Dr. S. M. Mircetich, ARS/USDA, UC Davis
Dr. W. J. Moller, Cooperative Extension Service, UC Davis
Dr. A. H. Purcell, Dept. of Entomological Sciences, UC Berkeley

Project: Almond Diseases
Almond Leaf Scorch (ALS)

Objectives: (1) To determine the host range of the causal bacteria among wild plants in the vicinity of orchards and evaluate their possible role as reservoirs of causal agent; (2) to determine how the disease spreads in commercial orchards; and (3) to develop effective economic control measures for the disease.

Progress: Almond leaf scorch is caused by a bacterium that lives in the water-conducting vessels of the tree and, by producing a powerful toxin, causes the leaves to burn and fruits to drop and eventually kill limbs and trees. Yield losses are very high in affected trees. The causal bacterium is the same organism that causes Pierce's Disease of grapes. These diseases constitute an ever present threat to both almonds and grapes because of the potential for epidemics. Leaf hopper vectors of the sharpshooter and spittle bug group that feed in the water-conducting vessels in the leaf veins spread the disease.

After injecting trees with several different chemicals at varying dosages it was concluded that Terramycin at 10-15 grams/tree (a.i.) in 1-2 liters water injected annually in the dormant season will result in remission of symptoms in mild to moderate cases. Severely diseased trees will not take up the chemical very well because the xylem is not sufficiently functional.

New chemicals are being tested to try to find cheaper and more effective ones. No residue was found in nuts or hulls from trees injected during the dormant season. Branches with incipient infections were cut out and the tree observed for recurrent symptoms. Results showed that new infections can be removed by surgery and trees can be cured. Careful annual inspections are required for this method to be effective

Field observations indicate that varieties vary in susceptibility to ALS. Rate of movement of infection tested in the plot at Davis shows that after 2 years the infection in Milo occurred throughout the entire 4 year old trees, whereas the infection in trees of the other varieties that became infected was still limited to inoculated branches. No infection occurred in Harvey, Ruby, Carmel and Fritz but these results must be verified.

Graft and needle inoculations were more efficient (31%) than insect inoculation

(5.5%) in tests made at Kearney and West Side field stations. Even though 31 of 131 inoculation sites showed symptoms the year they were inoculated only 3 developed symptoms again the following year. This lack of persistence of infections may account for the low incidence of the disease in the San Joaquin Valley.

No known vectors of the leaf scorch bacteria could be found in consistent association with diseased orchards or their environs. In the case of one orchard, spittle bugs seemed to be the most common potential vector in the vicinity. A search for possible reservoir hosts is being made in this area.

Non-vector leaf hopper species injected with leaf scorch bacteria did not vector the bacteria.

Many wild plants were collected in the vicinity of almond orchards with high incidence of disease. These plants will be tested for infection with the leaf scorch bacterium using a very sensitive serological technique.

Plans:

A. Tolerance of almond varieties and spread of the disease.

1. Continue evaluation of relative susceptibility of almond varieties in the trial plot at Davis.

2. Evaluate excision of incipient infections as a control measure in trees previously treated and in new cases.

3. Explore the use of the bacterial toxin produced by the causal agent to screen varieties and selections for tolerance and susceptibility.

4. Use recently developed serological methods to screen wild plants in the vicinity of infected almond trees that might be reservoirs of the causal bacterium.

B. Vectors and their role in natural spread of almond leaf scorch (ALS)

1. Continue studies of vector populations and species at selected sites in relation to disease spread and the persistence of insect and graft transmissions from one year to the next.

2. Evaluate non-sharpshooter xylem feeding insects for their possible role in spread of ALS.

3. Study possible migrant vectors in favorable ecological sites in relation to incidence of disease in orchards.

Almond Industry Participation $7,200

80-T6

Almond Leaf Scorch Disease

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Cooperators: Univ. of Calif., Dept. of Entomology, Berkeley and Plant Pathology, Davis; Cooperative Extension Service, UC Davis; USDA-ARS, UC Davis.

Project Leader: George Nyland Telephone: (916) 752-0300/752-0313

Personnel: Dr. S. M. Mircetich, ARS-USDA, UC Davis
Dr. W. J. Moller, Cooperative Extension Service, UC Davis
Dr. A. H. Purcell, Dept. of Entomology, UC Berkeley

Project Title: Almond Leaf Scorch (ALS)

Objectives 1 and 2 of the project concern the detection of wild plants in the vicinity of orchards that might be reservoir hosts of the bacteria which cause the disease and from which spread may occur to almond. We can report that three plants, Dallis grass, salt grass and umbrella sedge, were found infected with the pathogen and all of these plants are common host plants for sharpshooter leafhoppers that are vectors of the disease. In the immediate vicinity of a vineyard and almond orchard, both with diseased plants, we found infective vectors in the early spring and followed their migration away from the wild hosts and creek bed into the vineyard and orchard. We feel that the wild host plants are the primary source of inoculum for this disease and probably there is little spread from almond to almond, almond to grape or vice versa, or grape to grape. In certain cases where the area containing the wild plants is limited or under the control of the orchard owner, control of the reservoir weed plants or the vectors early in the spring might help control spread of the disease which is our project objective #3. Also, under our control objective we continued testing old and new chemicals for tree injection of diseased trees. Trees injected with Terramycin at the dosage of 5-15 grams a.i. per tree show nearly complete remission the following year. Trees require annual injections which may not be economically feasible. Three new chemicals also were effective but are not available for use as yet due to EPA requirements.

Almond varieties Harvey, Fritz and Ruby still have not shown symptoms of the disease from graft inoculations. Needle inoculations were made this year and these can be evaluated next year in our continued study of control measures under objectives 3 and 4.

We found a new host of the almond leaf scorch bacterium--sweet cherry. Symptoms resemble those of bacterial canker and plants infected by grafting were severely damaged. We don't know if the disease is present in our cherry orchards. We plan to test other fruit species as hosts for the pathogen.

This summarizes the status of work under the various objectives.

Results

Our results are summarized above and can be more briefly stated as follows:

a) Detection of three reservoir hosts in the vicinity of an almond orchard in Contra Costa County. These are Dallis grass, salt grass and umbrella sedge.

b) Proof that vector species feeding on these plants are actually infective (25%).

c) Evidence that the infective insects migrate from the stream-bed locations into orchard and vineyard plantings.

d) Inoculated Harvey, Fritz and Ruby almonds are still without symptoms.

e) Chemotherapy of diseased trees does not appear to be feasible with the only available chemical, Terramycin.

f) Sweet cherry became severely diseased when grafted with almond scions affected by leaf scorch.

g) Surgery of incipient infections isolated in small areas of the tree can be a useful control measure.

Discussion

We will try to corroborate our findings regarding weed hosts and sources of inoculum in the environs of other orchards in the areas where the disease occurs.

We reported last year that both insect and needle inoculations and subsequent infections in almonds in the San Joaquin Valley did not persist into the following season suggesting one or more environmental factors to be responsible for the general absence of significant numbers of affected trees in the main almond districts. This suggests that the disease is not likely to become a real threat to almond production.

In areas where the disease does occur growers have the choice of trying one of the as yet unaffected varieties and surgery of incipient infections as control measures.

We will continue to test the new chemicals, evaluate varietal resistance, determine significance of cherry as a host plant, and test other fruit tree species as possible hosts.

January 20, 1981

Coryneum Blight of Almond

Timing of fungicide sprays and dormant copper application for control of Coryneum blight are being evaluated. Preliminary data show a significant reduction in disease with two applications of either ziram or captan at pink bud and petal fall. There seems to be no difference between a single ziram or captan spray applied at either pink bud or petal fall. A single dormant copper spray has not reduced Coryneum blight.

Hull Rot of Almond

More evidence has been obtained to support the role of nitidulid beetles in transmitting Rhizopus stolonifer, the hull rot pathogen. 1) Beetles collected in almond orchards before hull split were found to be contaminated with R. stolonifer. 2) Beetles contaminated with a "marked" strain of R. stolonifer were released in two orchards and this "marked" pathogen was recovered from hulls ten days later. These two facts indicate that the nitidulid beetles may carry the primary inoculum for disease development. No control is available for these insects at present.

Data collected at five orchards showed than an extended hull split period is conducive to higher disease levels, indicating that practices which reduce this period should reduce hull rot levels. One possible way of reducing the time that green fruit are on the tree is early harvesting. At an orchard in Fresno County trees harvested about ten days before maturity had only 14% fruit wood killed (FWK) while trees on which the fruit were allowed to mature had 48% FWK. The proper timing for this practice needs to be worked out since shaking too early will leave large quantities of green fruit on the tree to rot and cause twig blight.

To determine the effect of hull rot on yield, disease was observed in an orchard with a natural epidemic and simulated by pruning and inoculation in another. Two of the three experiments showed a significant reduction in yield especially when there is more than 30% FWK.

This year R. stolonifer was found infecting nut meats. In most cases there was no apparent loss in quality, but in about 1-2% of the infected nuts the normally white meat turns caramel to black in color and has a corky texture and off flavor. This is the only time since the inception of this project that nuts have been found to be infected with this fungus. The total effect of this on production at this time is unknown.

Department of Plant Pathology
University of California
Davis, California

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