

# PEAR DECLINE RESEARCH

## —progress summary

**P**EAR DECLINE disease has been known and studied in British Columbia, Washington, and Oregon for a number of years but did not appear in California pear orchards until 1959. The staff of the University of California's Division of Agricultural Sciences initiated research as early as 1957 in anticipation of the disease appearing in California. By the end of 1959, an estimated 10,000 trees were showing decline symptoms. During 1960 the total rose to 100,000 trees, and in 1961 a million trees were affected by pear decline.

A major shift in activities and in financial support for the University's pear decline research was made within existing facilities by 1960. However, the problem had become so critical by this time that it threatened to wipe out the industry. Additional funds were made available in 1961 by the State Legislature and the industry for an extensive coordinated program of research. The primary goals of this program were to determine the nature and cause of the disease and develop satisfactory methods of control.

A research team on pear decline was organized under the chairmanship of Dr. T. A. Shalla, in the summer of 1960. Agricultural scientists from the Davis, Berkeley and Riverside campuses of the University, the U. S. Department of Agriculture and Oregon State University participated. The problem was attacked from every possible point of view and with all available financial and scientific resources. The team of agricultural scientists who have worked on this problem are indicated at the end of this report.

This summary reports the principal results to date, outlines areas of research to be continued and gives the latest information on methods of controlling pear decline in California. Most of the problems involved in pear decline have been evaluated and various possible solutions are within sight.—*M. L. Peterson, Director, University of California Agricultural Experiment Station.*

### Research progress

**Diagnosis**—Histological methods were developed for diagnosing pear decline, and it was demonstrated that the disease developed as a result of phloem breakdown at the graft union. The California Department of Agriculture established laboratory facilities at Sacramento for the diagnosis of pear decline, using these histological methods developed by University personnel. This pear decline diagnostic service is now available to all agencies working with experimental trees.

**Satisfactory rootstocks**—It was deter-

mined which species of pear were satisfactory and which were unsatisfactory as rootstocks on the basis of phloem diagnosis.

**Virus involvement**—A factor was transmitted to test trees by grafting which caused phloem necrosis typical of pear decline. This constituted the first direct evidence that a virus is involved in the disease development.

**Pear psylla role**—Experiments with the pear psylla, in the greenhouse and with field trees, have provided very strong support of the theory that this insect plays a major role in the pear decline.

**Abandoned orchards**—Summer migration of pear psylla creates a potential problem of reinfestation, and abandoned trees are a reservoir of the insect.

**Pear psylla control**—Oils were shown to be promising chemicals for pear psylla control, and several natural enemies including predators and one parasite may play a role in reducing pear psylla populations.

**Own-rooted pears**—Practical means were developed for vegetatively propagating decline-resistant stocks, such as Old Home, on their own roots. Also, methods were improved for rooting cuttings of the Bartlett variety, thereby avoiding a graft union and, in turn, susceptibility to pear decline.

**Cultural practices**—California tests substantiated results from other areas indicating that cultural practices such as irrigation or manipulation of nutrition cannot prevent decline. However, evidence was obtained that irrigation practices which prevent drought or excessive moisture may retard the progress of the disease.

**Other causes**—Water molds and plant parasitic nematode species were recovered during a survey of California pear orchard soils in cooperation with the California State Department of Agriculture. These were not closely associated with pear decline, and there was no evidence that they have a primary role in causing the disease. However, root-rots, probably involving pathogenic fungi, cause symptoms which may be mistaken for those of decline.

**Biochemical rootstock identification**—Methods were developed for distinguishing among common rootstock species based on extracted biochemical compounds. These procedures are being adapted for use by the California Department of Agriculture in a program aimed at comparing, testing, and combining methods of identification based on various morphological as well as biochemical characteristics.

**Moria disease link**—It was established that pear decline and the Moria disease of pear trees in Italy were the same disease. This resulted in the formation of a cooperative research project on pear decline between Italy and the United States and led to the introduction of foreign rootstocks believed to be resistant to Moria for testing in California.

### Continuing and proposed studies

1. Studies are in progress to determine whether the graft-transmissible factor associated with pear decline can multiply in the plant, a primary property of viruses, and whether it can cause other symptoms of the disease.
2. The exact nature of the pear psylla's role in pear decline will be studied to determine if this insect (a) can cause the disease by means of a phytotoxic secretion alone; (b) transmits a virus that is solely responsible for the disease symptoms; or (c) is involved with both a virus and a toxin that contribute to the decline problem.
3. The search for other possible virus vectors will be continued.
4. Taxonomic studies of the species of *Psyllidae* that breed on pear trees will be continued.
5. The integration of chemical and natural control of the pear psylla will be studied. Investigations will continue on the behavior of the insect with special emphasis on summer migration. Studies will also continue to determine whether intensive psylla control will influence the incidence of pear decline.
6. The effects of inarching of healthy trees on susceptible rootstock combinations are being studied to determine if such manipulation will help control the disease, at least in part, by establishing the trees on satisfactory roots.
7. The chemical identity and function of pear psylla toxin and biochemical events leading to phloem necrosis in decline-affected trees will be studied.
8. Refinements will be made in methods of diagnosing the bark measles factor in Old Home propagating material to be used for decline-resistant stock.
9. Testing of various rootstocks for decline resistance will be continued under local growing conditions.
10. The search will continue for woody or herbaceous plants that could be used as quick indicators of the virus believed to be a cause of pear decline.
11. A quick method will be sought for detecting viruses in pear tissue by cytological means.
12. A certification program for pear stock will be developed in cooperation with the California State Department of Agriculture. It is anticipated that pear trees may eventually be "certified" free from serious disease-causing or-

ganisms and as satisfactory scion-rootstock combinations for sale to nurserymen.

*Members of the University of California Research Committee on Pear Decline include the following researchers:*

*From the U. C. Davis campus—D. C. Alderman, P. B. Catlin, W. H. Griggs, H. T. Hartmann, Kay Ryugo and Kiyoto Uriu, pomologists; L. J. Booher and D. W. Henderson, irrigationists; B. F. Lownsbury, nematologist, and George Nyland, H. J. O'Reilly and T. A. Shalla, plant pathologists.*

*From the Berkeley campus—C. S. Davis, D. D. Jensen and H. F. Madsen, entomologists, and C. E. Yarwood, plant pathologist. From the Riverside campus—R. C. Dickson, entomologist, and Henry Schneider, plant pathologist.*

*U. S. Department of Agriculture, Riverside—L. S. Jones and George Kaloustian, entomologists, and T. S. Pine, plant pathologist. California State Department of Agriculture, Sacramento—C. W. Nichols, plant pathologist. Oregon State University—M. N. Westwood, horticulturist.*

### CONTROL OF PEAR DECLINE

At present, control of pear decline is based primarily on use of decline-resistant rootstocks and control of pear psylla.

In California, the following rootstocks appear to be the most satisfactory under decline conditions: Winter Nelis or Bartlett seedlings—preferably from seed collected in areas where there is little likelihood of pollination from Oriental species and from trees free of known viruses. Old Home trees developed from rooted cuttings—preferably free of the factor causing bark measles. Such material will be available in limited quantities from the University of California Foundation Plant Materials Service, Davis, during 1963.

There is some evidence that the severity of pear decline may be reduced by minimizing tree stress. This involves using the best possible cultural practices, particularly maintaining adequate moisture. There are also indications that inarching trees on unsatisfactory rootstocks before decline symptoms appear may be beneficial. At present, however, this practice can only be suggested on a trial basis.

Pear psylla control involves a delayed dormant spraying during bud swell in late February, the possible addition of psylla control materials to the first and second codling moth sprays, and postharvest spraying in late September or October. Delayed dormant control of pear psylla has been found possible by using (1) 2½

gallons of dormant oil emulsion or 2 gallons of dormant emulsive oil (per 100 gallons of water for full-coverage spraying) plus either: 1 lb. 25% Trithion wettable; or 1 lb. 25% parathion wettable; or 1 lb. 25% Diazinon; or 1 pt. Phostex dormant concentrate; or (2) 2 gallons 2% Ethion-dormant oil (0.16 lb. per gallon). Pear psylla will also be controlled by the first two regular codling moth sprayings (first at petal fall, or when traps indicate moth activity, and again 25 days later) if any of the following sprays are used: (1) 2 lbs. 50% DDT wettable plus 1 lb. 25% parathion wettable; or (2) 1 lb. 25% Guthion wettable, using from 6 to 8 lbs. of Guthion wettable per acre; or (3) 1½ lbs. 50% Sevin wettable, using from 8 to 10 lbs. of Sevin wettable per acre. If DDT is used alone for codling moth spraying, one of the following materials should be added for pear psylla control: (1) 1 lb. 25% parathion wettable; or (2) 1 lb. 25% Diazinon wettable; or (3) 1 pt. dieldrin emulsifiable (1½ lbs. per gal.); or (4) either 1 lb. 25% Ethion wettable or 2 lbs. 25% malathion wettable. Postharvest control of pear psylla can be obtained with Phostex or Diazinon-oil combinations or 1 pt. dieldrin emulsifiable (1½ lbs. per gal.) or 1 pt. Dilan emulsifiable (5 lbs. per gallon). For details on pear psylla control and application precautions, see Leaflet 71, revised, "1963 Pest and Disease Control Program for Pears."