Research Review: Antibiotic injections control pear decline disease

James A. Beutel ■ William J. Moller ■ Forrest D. Cress

After more than a decade of devastating orchard losses to pear decline, the disease is now under effective control.

Pear decline first hit Pacific Coast pear orchards in 1949, when many bearing trees in British Columbia suddenly collapsed and died from damage to their phloem or food-conducting tissue. The malady began killing pear trees in Washington State in 1950, and in California by the late 1950s. During an unusually hot summer in 1959, some 10,000 California pear trees collapsed. Thousands of acres of mature, productive pear trees were destroyed by the malady during the next 10 years; the entire pear industry in the Sierra foothills was almost wiped out.

Not all infected trees died: many declined slowly or developed a purple leaf curl in late summer or fall that often was followed by premature leaf drop and a smaller crop the following year. "Pear decline" became the name used to cover all three of these pathological conditions.

Sensitive rootstocks

Some rootstocks were found to be much more sensitive to the disease than others. Pear trees on oriental rootstocks were the most sensitive, the most prone to collapse and die from the disease. California had some 2-1/4 million trees on these rootstocks when pear decline moved into the state. Most had been planted during the big boom in pear plantings during the 1920s. Between 1959 and 1972, the disease killed nearly 2 million of these mature, top producing trees, diminishing the state's pear acreage to the survivors on oriental rootstocks plus roughly 2 million trees on other rootstocks more tolerant of pear decline.

The disease was accompanied by orchard infestations of the pear psylla, an insect pest first reported on the West Coast in Washington just prior to World War II. By 1964, researchers knew that the pear psylla could transmit the disease. They also were able to show that budding material from diseased trees could infect healthy trees. Because of these findings, it was thought at the time that pear decline was a "virus-like" disease—which ruled out any field cure for the disease. (Even today there is no known feasible cure for a true virus disease in orchard trees.) Growers' control measures were limited to chemical sprays to keep down the numbers of pear psylla which transmitted the disease, good cultural practices which could result in a partial recovery of decline-stricken trees, removal of infected trees, and use of tolerant rootstocks for replacement trees.

Not a virus

In 1969, the pear decline control outlook changed. Researchers at UC Riverside found that the organism causing pear decline is not a virus but a mycoplasma-like organism, intermediate in size and structure between a virus and a bacterium. It was known at that time that antibiotic materials could be used to cure some animal diseases caused by mycoplasma. Could they be used to cure mycoplasma-caused diseases in plants?

In 1970, Dr. George Nyland, a plant pathologist at UC Davis, showed that transfusions of a tetracycline (Terramycin) into decline-infected trees could prevent two of the disease's basic effects: tree decline and leaf curl.

Transfusion method

Simply put, Dr. Nyland's transfusion method entailed boring holes into the trunk of an infected tree with a brace and bit, hooking up a transfusion bottle full of tetracycline solution to the holes through plastic tubing, and hanging the bottle from a tree limb. The liquid moved into the tree's xylem tubes (water-conducting vessels) by gravity flow. Depending on the tree and time of year, it took from an hour to two days to get 6 quarts of the solution into a tree. Each tree treated received approximately 1 gram of tetracycline which had been dissolved in water with an emulsifier.

Authorized by the Environmental Protection Agency (EPA) to transfuse tetracycline into pear trees for experimental purposes, Dr. Nyland supervised transfusions for 110 diseased Bartlett trees growing in 16 orchards in El Dorado, Lake, Mendocino, and Sacramento counties. Most of the trees were in advanced stages of decline.

Decline was stopped in all of the treated trees, and 100 of them improved in general vigor and appearance. Helping in this field study and subsequent ones were Extension Plant Pathologist W.J. Moller and Farm Advisors R.S. Bethell, C.L. Hemstreet, B.E. Bearden, and G.W. Morehead.

The dramatic results from the 1971 transfusions prompted a larger test the next year, in which 70 growers from the four counties treated about 2,000 old pear trees that showed severe decline. The consensus of the participating growers was that Dr. Nyland's method was feasible for large-scale use.

In October 1973, the EPA approved registration of tetracycline for commercial use on pears as a post-harvest application. Dr. Nyland's experiments provided much of the performance and residue data required to obtain this registration. Results of residue analyses prior to registration showed that no tetracycline can be detected in fruit even one month after a tree is treated in the spring. Because the material is only transfused the first few weeks following harvest in the fall, there is a built-in safety factor of 8 to 9 months with respect to any chance of a tetracycline trace occurring in fruit.

Following its registration for commercial use, growers transfused tetracycline solutions into some 10,000 trees in 1973. The next year, about 60,000 trees were treated. During these seasons, many growers were so desperate to save their trees that they put together 30 to 40 transfusion kits in order to treat their orchards faster. One grower reputedly ended up with some 400 transfusion kits and a 10-man crew to use them.

Tree-injection equipment

In 1972, while Dr. Nyland's transfusion treatment was being tested for its feasibility in the field, Davis researchers began evaluating several types of tree-injection equipment. After three years of testing, W.O. Reil, Staff Research Associate, and J.A. Beutel, Extension Pomology Specialist, with the assistance of colleagues at Davis, perfected a method for treating decline-infected trees quickly and efficiently with a portable pressure-injection machine. Using this machine, a grower could inject 1 quart of fluid through three injection sites into a mature pear tree in less than 1 minute for a fall treatment. (Injection takes longer in early morning or at night than it does in the afternoon and varies according to climatic and tree conditions. The machine and how it is used are described in detail in the December 1976 issue of this magazine.)

During 1975, the first year that pressure injection was available to growers, some 140,000 pear trees were treated – half by transfusion bottles and half by pressure injection. The methods were equally effective in pear decline control. During the 1976 season, between 140,000 and 200,000 trees were treated.

Following their initial transfusion or pressure injection, decline-infected trees must be treated the following year or two. If trees improve in vigor following treatment and regain nearly normal growth, the yearly treatment can be withheld until trees again show partial decline. Then, only those trees need be treated.

Generally, according to Beutel, growers report that they are getting double the fruit production they had before beginning their tetracycline treatments. Their production per tree, however, is only around 70 to 80 percent of what they obtained before pear decline initially infected their orchards.

In addition to playing an important role in the pear decline control program, antibiotics and the pressure-injector machine show potential for helping growers of other orchard crops solve some of their disease problems. Bactericides and fungicides have been injected, with favorable results, into cherry, peach, apple, almond, walnut, and olive trees. Other potential uses of pressure injection include treatment of minor nutrient deficiencies and control of sucking insects. Thus, as is often the case, research which has led to the resolution of one problem may well lead to the solutions of others.

James A. Beutel is Cooperative Extension Specialist, Department of Pomology, University of California, Davis; William J. Moller is Cooperative Extension Specialist and Lecturer, Department of Plant Pathology, University of California, Davis; Forrest D. Cress is Communications Specialist, Plant Science, Tree Fruit and Nut Crops, University of California, Riverside.

Sunlight and temperature effects on corn growth and yield

William G. Duncan ■ Donald L. Shaver ■ William A. Williams

Grain yields of corn in the United States differ considerably between one area and another even when soil fertility and moisture supply are considered near-optimal. Reasons for such variation are difficult to evaluate because direct comparisons are confused by differences in sunlight amount, temperature, photoperiod, and variety.

To study these differences in relation to the adaptability of corn varieties, experiments were conducted in 1969 and 1970 at three locations that differed widely in sunlight and temperature regimes but only slightly in other climatic characteristics. Fertilizer and water were provided in amounts considered adequate for maximum grain yields at all locations.

The locations chosen were Davis and Greenfield, California, and Lexington, Kentucky. Davis, in the lower Sacramento Valley, has a hot, dry summer climate with large amounts of sunlight, but modified to some degree by cooler air from the Pacific Ocean. Greenfield, in the Salinas Valley, California's largest coastal valley, has less sunlight and a climate strongly modified by cooling onshore winds. Lexington has a humid continental climate reasonably representative of the southern edge of the corn belt, and the least sunlight along with the highest mean temperature in the growing season.

Five varieties with a wide range of maturity were planted April 15 and May 15 in each of the two years. The varieties were: Renk NR1, DeKalb XL 45, P.A.G. SX 29, DeKalb XL 85 (1969 only), Pioneer 3306, and TX508 x K64 (1970 only) in order of maturing. The first matured extremely early; the second was intermediate; and the last four matured later and were quite similar in maturity.

Plant populations were 8,000, 19,000, and 30,000 plants per acre in 1969; and 10,000, 19,000, and 29,000 (also 44,000 at Davis and Greenfield) in 1970. No significant insect or disease problems were experienced aside from southern leaf blight, which affected four of the five varieties at Lexington in 1970. Irrigation water was supplied by overhead sprinklers at Davis and Lexington, and by furrow at Greenfield.

Plant height and development rate

There was a striking difference in plant height at the three locations in 1970. Average plant heights for the two dates of planting are 112 inches at Davis, 83 inches at Greenfield, and 97 inches at Lexington. There was also a slight increase in height at each location for each increase in plant population.

Such differences must be accounted for either by differences in internode length or numbers or both. The number of nodes above the soil level for all varieties averaged 25 percent more at Davis and 5 percent more at Greenfield than at Lexington. Since the plants were shorter but with more nodes at Greenfield than