A succession of insect pests

Hiroshi Kido

From the inception of commercial vineyards in California, insects and mites have been a problem. The abundance of pests may be attributed to the fact that most grape pests were native to America, and the extensive plantings and mild climate favored development of a considerable number of pests. Some of the insects have remained a problem in the vineyards to the present time, while other species have become less important. The introduced grape phylloxera, *Daktulosphaira vitifoliae* (Fitch), and the native grape leafhopper, *Erythroneura elegantula* Osb., were present in the early years of viticulture and are still considered major problems. Insects such as the sphinx moths, *Pholus achemon* (Drury) and *Celerio lineata* (Fabr.), and the western grape rootworm, *Adoxus obscurus* (Linn.), which previously caused considerable damage to vines, have become minor problems, whereas the omnivorous leafroller, *Platynota stultana* Wlshm., the orange tortrix, *Argyrotaenia citrana* (Fernald), and the western grapeleaf skeletonizer, *Harrisina brillians* B. and McD., have become serious pests.

The grape phylloxera was introduced into a Napa Valley vineyard on planting materials brought in the later 1850s from either the eastern United States or Europe. At first the insect went unnoticed; even after it had destroyed sizable areas in some vineyards and its symptoms and devastating effects were known from earlier infestations in France, its presence was disregarded. In 1873 phylloxera was found and recognized on grape roots near Sonoma, but there were still doubts, because injury was confined to the roots; no symptoms could be detected on the leaves as had been recorded in Europe and in eastern United States. But by 1878 the original Sonoma plantings were destroyed, and other sections were becoming infested.

The discovery of phylloxera contributed to the development of studies in economic entomology at the University of California. A survey in 1880-81 found infestations in Sonoma, Napa, Solano, Yolo, Placer, Fresno and El Dorado counties. U. C. studies also showed that the winged forms of phylloxera in California were sterile and not a factor in the dissemination of the insect. In later studies entomologists for the U. S. Department of Agriculture found that phylloxera multiplied by asexual reproduction in California. Phylloxera control was eventually attained through the use of resistant rootstocks, based on studies conducted in France on host plant resistance and on grafting techniques.

The presence of phylloxera in California was also responsible for passage of a state law in 1880 establishing quarantine regulations to prevent spread of diseases and pests. The law also provided for treatments and disinfection of cuttings and rooted grapevines imported from any region outside the state or transported within the state.

Pierce's disease, now known to be caused by a bacterium, has been destructive since it was first reported in the late 1800s in southern California vineyards. U. C. researchers in the early 1940s found that the grape leafhopper was unable to transmit the disease, but that it was transmitted by various other leafhoppers and spittle bugs and carried by many different plants.

Both the grape leafhopper, *Erythroneura elegantula* Osb., found in northern California and the closely related species, the variegated leafhopper, *Erythroneura variabilis* Bea., in southern California (both formerly called vine hoppers) were indigenous to those areas and inhabited wild grape plants so they rapidly moved into newly planted vineyards. In some areas, leafhoppers caused severe damage by defoliating the vines and exposing the clusters to the sun. In the absence of effective insecticides, growers relied on mechanical and cultural practices to combat the insect. Some of the recommendations included placing sheep in vineyards after harvest to eat the fallen leaves, keeping down weed growth, raking and burning the leaves during the dormant period, placing green hay on the vines to prevent exposure of the clusters to the sun, and using insect nets to collect and destroy adult leafhoppers. Treatments included sprays of dried pyrethrum flower mixed with soap or soap and sulfur mixed with tobacco leaves. Later, sprays of nicotine sulfate and soap in water proved to be effective in controlling the insect.

Leafhoppers were found to overwinter as adults in vegetation surrounding vineyards. J. F. Lamiman in University studies in 1933 showed the developmental stages of the insect and the number of generations that occurred during the season. Researchers also discovered that the insect population could be reduced by plowing the vineyard at temperatures below 50° F when the insect was immobile, and by using trap crops grown in the dormant period and then destroyed in early spring.

Since research in the 1930s, a minute wasp, *Anagrus epos* Girault, has been known to parasitize grape leafhopper eggs, but investigators were puzzled by the disappearance of the wasp during the winter. In the early 1960s it was found that the wasp overwintered by parasitizing the eggs of another leafhopper species, *Dikrella cruentata* (Gillette), living in naturally occurring blackberry plants. They also found that parasitism of the grape leafhopper eggs was more effective the closer the vineyards were to the primary source of the wasp in blackberry plants.

Infestation of grapevines by some of the other pests did not occur or were not identified in the early years of California viticulture. The Pacific spider mite, *Tetranychus pacificus* McG., was probably present on grapes for a long time, because spider mites were noted on grapevines in Fresno County in 1876. The Pacific mite was confused with the two-spotted spider mite, *Tetranychus urticae* (Koch), and it was not until 1919 that the distinction between the two species was made. In 1935, the injurious effects of the Pacific mite were noted as well as the beneficial effects of the predators, the six-spotted thrips, *Scolothrips sexmaculatus* (Pergande), and the predaceous mite, *Seius pomi* Parrott. U. C. re-

searchers have more recently shown a relationship between various species of mites present on grape and the predaceous mite, *Metaseiulus occidentalis* (Nesbitt).

The grape thrips, *Drepanothrips reuteri* Uzel, was first reported in 1926 causing damage to Tokay and Emperor grapevines in the Florin and Lodi district of the Sacramento Valley. In 1970 researchers found that damage to the berry clusters was caused by the western flower thrips *Frankliniella occidentalis* (Pergande) and not by the grape thrips.

The grape bud beetle, *Glyptoscelis squamulata* Crotch, was first found on grapevines in Las Vegas Valley, Nevada, in 1922. In 1923, it spread over the entire Coachella Valley of California and became a major pest, sometimes destroying as much as 90 percent of the crop. By 1936, the insect had become established in parts of the San Joaquin Valley.

The grape leaffolder, *Desmia funeralis* (Hubner), was apparently introduced into California in the late 19th century. In California, the larvae roll the leaves instead of folding them to make nests. Most larvae found outside California fold the leaves; a few roll them, however, and the California insect may have come from one of the leaf-rolling strains.

Before its arrival in California, the western grapeleaf skeletonizer was known to occur in southwestern United States and northern Mexico. The insect was first found infesting wild grape in San Diego County in 1941. Eradication efforts were unsuccessful, and later the California State Department of Food and Agriculture began a program to suppress and prevent the spread of the insect. Entomologists at the University of California, Riverside, have been comparatively successful with the importation and establishment of a parasitic wasp, *Apanteles harrisinae* Mues., a parasitic fly, *Sturmia harrisinae* Cog., and a viral disease. Present efforts are devoted to biological and chemical control programs by the state and the University.

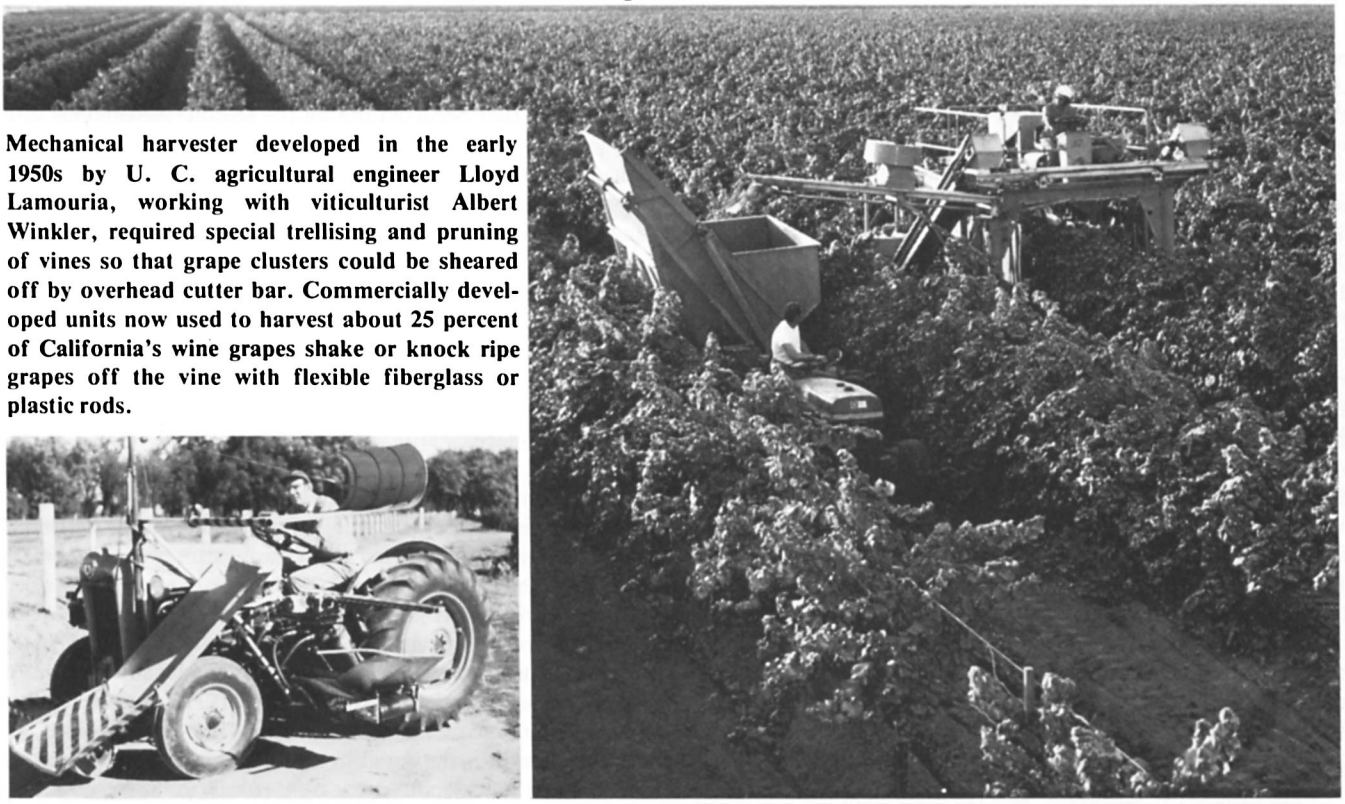
The major impetus for grape pest investigation came in 1961 with the development of the University program for integrated grape pest control. The program combined desirable features of all control methods—biological control, cultural practices, and the judicious use of pesticides. The purpose of the program was to offer maximum possibilities for efficient control, high yield of quality fruit, lowest costs, and minimum environmental disruption.

Several studies have been conducted to obtain basic information related to the various insect and mite problems. In one study, for example, the presence of tydeid mites on vines increased the survival rate of overwintering predaceous mites. Researchers investigating the ecology of the grape leafhopper found that reproduction and development were regulated by environmental temperatures and photoperiods.

Currently, the University is involved in investigations concerned with chemical control of spider mites and pesticide resistance in spider mites and predaceous mites, biological and chemical control of the western grapeleaf skeletonizer, biological and chemical control of the grape mealybug, studies on the mode of transmission of the Pierce's disease bacterium in leafhoppers and transmission from various host plants to grape, the ecology of the omnivorous leafroller and orange tortrix, and the ecology of the *Dikrella* leafhopper on blackberry plants.

Hiroshi Kido is Staff Research Associate, Department of Entomology, University of California, Davis.

Mechanical harvesting of grapes



Mechanical harvester developed in the early 1950s by U. C. agricultural engineer Lloyd Lamouria, working with viticulturist Albert Winkler, required special trellising and pruning of vines so that grape clusters could be sheared off by overhead cutter bar. Commercially developed units now used to harvest about 25 percent of California's wine grapes shake or knock ripe grapes off the vine with flexible fiberglass or plastic rods.

Above left: Despite eradication attempts, the western grapeleaf skeletonizer continues to spread. Properly timed chemical treatments keep it in check.

Above: The omnivorous leafroller (OLR) and orange tortrix, shown here, have become serious pests of grapes in California. The damage they cause in vineyards is similar.

Left: Grape leafhopper, destructive in its own right and carrier of the devastating Pierce's disease, long resisted chemical control. Cultural and biological approaches offer growers some relief.

Below: Recent research at U. C. has shown that the Pacific spider mite, a long-time grape pest, may be controlled by predaceous mites. Vineyard shows typical Pacific mite damage.