Integrated pest management for olives

Christine A. Shoemaker ■ Carl B. Huffaker ■ Charles E. Kennett

Olives in California have three major pests or potential pests: olive parlatoria scale, *Parlatoria oleae* (Colvée); black scale, *Saissetia oleae* (Bern.); and olive knot, caused by *Pseudomonas savastanoi* (E.F.S.). In addition, oleander scale, *Aspidiotus nerii* Bouche, and two fungous diseases, *Verticillium alboatrum* R. & B. and *Cycloconium oleaginum* Cast., can also present problems, but their occurrence is not generally serious.

Parlatoria scale

The pest that caused by far the most general, devastating damage to olives, before its biological control, was parlatoria scale. The control achieved is among the most nearly perfect ever closely documented for a biological control effort (see *California Agriculture*, October 1977). There is no reason to use chemicals for this pest if the parasites can be kept active. The parasites will be affected, however, if chemicals are used for treatment of parlatoria scale—or other pests such as black scale or oleander scale—that are detrimental to the parasites. Consequently, chemical use must be restricted to oil, parathion and oil, or Sevin and oil and must be applied appropriately.

Black scale

Black scale has become a more common pest since chemical treatments for parlatoria scale were discontinued. This pest is normally prevented from becoming a serious problem by the severe, hot, dry summer weather that kills vast numbers of the crawlers and early stages of this scale. Pruning, a cultural control which opens the trees to sun and wind, has long been used as an effective means of preventing outbreaks of this pest. Biological control is sometimes a suppressing factor, but it rarely prevents black scale outbreaks. But in cooler, more humid areas or in dense tree plantings or lush-growth trees, black scale can become a severe problem requiring chemical treatment. Oil, or Sevin and oil, have been shown to be effective and to interfere little with biological control of parlatoria scale. Thus both chemical and biological control can be employed on olives. A single treatment of parathion and oil for oleander scale control does not seem to disrupt biological control of parlatoria scale.

Olive knot

Olive knot can considerably reduce yields in heavily infected groves. Preventive treatments with copper and lime, and pruning, are commonly used where there is a threat.

The decision of which combinations of methods should be used for the specific pest, variety of olive, and area depends upon many factors, including the weather, pest densities, and effects of the methods on the pest species and on their natural enemies.

A diagram of the major factors and the numerous interactions in the systems approach for olives is shown in the figure. The three major pests and the three types of control methods are indicated and the impact, negative or positive, of the first component on the second is shown. Thus olive scale has a negative effect on yield, and parasites of this scale have a negative effect on the scale. Each of the control tactics has negative effects on the pests, and one of them, pruning, has a positive effect on yield.

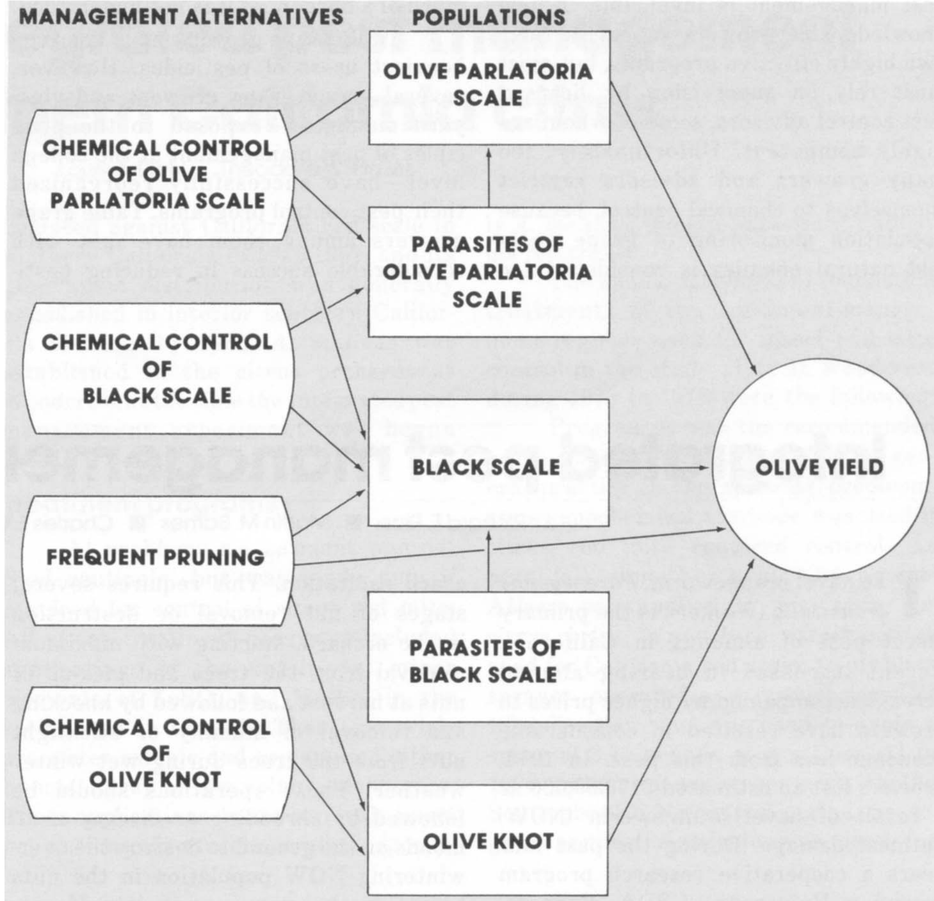
Heavy Parlatoria oleae damage on olives treated with DDT (above); clean olives in Aphytis plot (below).

The procedure for testing advantages of integrated pest management was to obtain from experts the probable benefits for each region and variety of various control methods and the costs of their use (as of 1976). Calculations were then made to determine the general profit advantage to the grower from using the various possible combinations of control methods, by variety and region. While the estimates for gains and losses associated, for example, with effects of pruning on black scale were not supported by extensive data, a considerable range of variation in the estimates would not affect the conclusions.

Conclusions

The costs of pruning and pesticide applications and estimates of the effect of pruning frequency on pest outbreaks indicate that: biological control of parlatoria scale costs less than chemical control; and all varieties should be pruned at least every two years.

Christine A. Shoemaker is Assistant Professor, School of Environmental Engineering, Cornell University, Ithaca; Carl B. Huffaker is Professor of Entomology, and Charles E. Kennett is Specialist, Division of Biological Control, University of California, Berkeley.



Grape pest management in the San Joaquin Valley

Donald L. Flaherty ■ William L. Peacock ■ Frederik L. Jensen

Pest management in grapes had its beginnings in the late 1950s when grape leafhopper, *Erythroneura elegantula* Osborn, developed resistance to the new synthetic organic insecticides, and when those chemicals resulted in biological upsets of spider mites and mealybugs. University of California Experiment Station entomologists and Cooperative Extension viticulturists, with active support of the grape industry, began intensive studies in 1960 to lay the groundwork for integrating chemical, cultural, and biological control into a pest management program. A number of growers and vineyard managers quickly adopted the new research findings.

Blackberry refuges

Studies showed that large acreages of grapes planted near streams and rivers where wild grapes and wild blackberries *(Rubus* spp.) flourished seldom required control for grape leafhopper because of the activity of a minute wasp, *Anagrus epos* Girault, which parasitized grape leafhopper eggs. This parasite also develops on the eggs of another leafhopper, *Dikrella cruentata* Gillette, a non-economic species which breeds throughout the year on wild blackberries. Survival of the parasite depends upon the presence of *Dikrella* because the grape leafhopper does not breed during the winter. Planting blackberry refuges near vineyards is recommended in areas where natural refuges are too far away for the parasite to have a significant effect on grape leafhopper populations. Vineyards within five to ten miles of natural refuges receive adequate leafhopper parasites in most years.

Additional accomplishments in grape pest management included economic treatment levels for various insect and spider mite pests; development of vineyard cultural practices to take advantage of either abiotic or biotic natural controls; and the use of selective pesticides to reduce the problem of upsetting primary and secondary pests.

Implementing IPM

Unfortunately, wide adaptation of integrated grape pest management by the grape industry has not occurred. This is due in part to the ease of solving pest problems in the short run by applying pesticides, compared with the difficulty of acquiring the knowledge necessary to implement long-range integrated pest management programs. Moreover, the University's research and teaching programs were interrupted in the early 1970s.

A clear understanding of grape