

pest management is invaluable. A few knowledgeable growers supervise their own highly effective programs, but most must rely on supervision by licensed pest control advisors, some of whom are highly competent. Unfortunately, too many growers and advisors restrict themselves to chemical control, because population monitoring of grape pests and natural enemies is considered too

much of a burden, or it is not understood.

Table grape growers have been the heaviest users of pesticides. However, several young grape growers and vineyard managers—exposed to the principles of pest management at the college level—have successfully reorganized their pest control programs. Table grape growers among them have met with considerable success in reducing pesti-

cides. These growers recognize that strict supervision and a clear understanding of grape pest management are keys to their success.

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Integrated pest management in almonds

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The navel orangeworm, *Paramyelois transitella* (Walker), is the primary insect pest of almonds in California. Recent increases in bearing almond acreage accompanied by higher prices to growers have resulted in considerable economic loss from this pest. In 1976, growers lost an estimated \$17,000,000 as a result of navel orangeworm (NOW) nutmeat damage. During the past four years a cooperative research program involving University, USDA, Cooperative Extension, and almond industry personnel has brought about significant improvements in management and control of NOW. Grower losses have decreased 60 to 75 percent in many cases.

The most important aspect of navel orangeworm management is or-

chard sanitation. This requires several stages of nut removal or destruction in the orchard, starting with maximum removal from the trees and pick-up of nuts at harvest and followed by knocking and removal of mummy or sticktight nuts from the trees during wet winter weather. These operations should be followed by shredding or discing of almonds on the ground to destroy the overwintering NOW population in the nuts before moth emergence in late March, especially in orchards without ground cover.

Where growers have had difficulty in performing adequate orchard sanitation because of unfavorable winter weather, shortage of equipment, or large areas to cover during optimum weather,

carefully timed insecticide sprays can be applied. Egg traps and hull split determine the appropriate timing. One drawback of the insecticide program is the potential problem of increasing other pests on the crop, such as mites. However, growers are aware of these problems and can take them into account when considering their choice of programs. Many orchards in the San Joaquin Valley require miticide treatments even when no insecticides are applied.

Economic justification for either a sanitation or chemical approach to NOW management is easily determined by calculating control costs per acre against anticipated losses based on expected yields, history of damage, and value of the crop.

Early and rapid harvest followed by fumigation and processing helps greatly in reducing the numbers of NOW that enter the overwintering period in mummy or sticktight nuts.

Several other factors enhance management of NOW in almonds: control of the peach twig borer with a standard dormant spray, destruction of mummy nuts in the orchard by birds during the winter and early spring, and cleanup of alternate NOW hosts in orchards adjacent to almonds.

With these several approaches and options available for control of navel orangeworm, growers can select and design the total management package that best suits their individual needs.

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