Biological control of grape leafhopper

Hiroshi Kido □ Donald L. Flaherty □ Daniel F. Bosch □ Karen A. Valero

Jack Kelly Clark

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Prune orchards discovered to be a good source of grape leafhopper parasite

A season-long movement of *Anagrus* wasps from French prune orchards into adjacent vineyards provided effective biological control of grape leafhopper.

High populations of grape leafhopper, the most common insect pest of grapes in northern and central California, cause damage by reducing leaf chlorophyll, defoliating vines, marring the surface of table grapes with excrement, and annoying pickers at harvest.

Previous studies have shown that large acreages of grapes planted near streams and rivers where wild blackberries (*Rubus* spp.) flourish seldom require control for the grape leafhopper, *Erythroneura elegantula* Osborn. In such areas, a tiny wasp, *Anagrus epos* Girault, parasitizes the eggs of grape leafhopper and blackberry leafhopper, *Dikrella californica* Lawson. The latter is an economically unimportant species whose eggs are present throughout the year on wild blackberries. Because grape leafhopper overwinters in the adult stage, survival of the parasite around vineyards depends on the presence of *Dikrella* eggs on nearby blackberries. In early spring, the wasp moves from blackberries into adjacent vineyards to parasitize eggs laid by overwintering grape leafhoppers. The effectiveness of the wasp in vineyards is related to the distance between wild blackberry refuges and grapes. Early-season parasitism of first-brood grape leafhopper eggs thus contributes greatly to low leafhopper populations in succeeding broods.

In 1980, high parasitization of grape leafhopper eggs by *Anagrus* was observed in vineyards near Easton, Fresno County, where there were no blackberry plantings. In nearby French prune orchards, heavy parasitism by the wasp was observed in another leafhopper species, *Edwardsiana prunicola* Edwards. The prunes seemed to be the source of *Anagrus* found in the vineyards. The prune leafhopper, which overwinters in

Jack Kelly Clark

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Grape leafhopper (far left) causes extensive damage to grapes in central and northern California. The prune leafhopper (left) is not considered a serious pest, but its eggs serve as an alternate host for the tiny *Anagrus* wasp (above), which after hatching moves into nearby vineyards and lays its eggs in grape leafhopper eggs (above), parasitizing them and reducing the need for chemical control.

the egg stage, could provide another important winter host for *Anagrus* in the San Joaquin Valley.

We began studies in Fresno and Tulare counties to determine the importance of *Anagrus* movement from prune orchards to grape leafhopper populations in vineyards. Most prune growers do not consider prune leafhopper a serious pest, and few treatments are applied that would disrupt the benefits from *Anagrus*.

Easton studies

In a 16-acre French prune orchard near Easton, we monitored population trends of the prune leafhopper and *Anagrus* adults with sticky traps wrapped around prune branches. The traps — thin, 5- by 15-inch metal sheets painted yellow and coated with "Stikem" — were replaced weekly and examined for adults. Leafhopper nymphal counts were recorded from weekly leaf samples. These same leaves were examined with a dissecting microscope to record white (normal-appearing) and red (parasitized) leafhopper eggs. Twig samples were also taken starting in September to record overwintering white and red eggs.

We monitored *Anagrus* movement from the prune orchard to a 30-acre Thompson Seedless vineyard ½ mile downwind. A single leaf was collected from every 15th vine in a row. This was repeated downwind in a north-to-south direction on every fifth row. The number of white and red eggs on the leaves were counted with the aid of a dissecting microscope.

Delano studies

Near Delano, in Tulare County, sticky traps monitored *Anagrus* movement from prunes to an adjacent Thompson Seedless vineyard. The traps were placed in the vineyard on every 10th vine in a row (nine traps) that was less than 100 feet from the prune orchard and in another row about ⅓ mile downwind from the orchard.

Trap placement on March 24, 1982, was about four weeks before the wasps emerged in the prunes and before grape leafhopper eggs were first found in the vineyard. The traps were replaced and examined weekly for *Anagrus* and grape leafhopper adults.

Starting on April 22, grape leaf samples taken weekly from the two rows were examined for numbers of leafhopper nymphs and white and red eggs. The trapping procedure in the adjacent prune orchard was the same as in the Easton prune plot.

Results

Easton. Although the egg parasite from the Easton prune orchards was identified as *Anagrus epos*, we conducted tests to determine whether it was able to parasitize grape leafhopper eggs.

Parasitism was verified in greenhouse experiments. Wasps collected from the Easton prune orchard were released in cages containing potted grapevines and grape leafhoppers. Two weeks later, parasitized eggs were observed on the grape leaves. Later, emerging wasps from these vines were introduced into a cage containing a small prune tree and prune leafhoppers. This test showed that *Anagrus* reared from grape leafhopper eggs also parasitized prune leafhopper eggs.

Prune leafhoppers lay eggs in the leaf veins during the growing season, and eggs are present from early spring to late fall. Late in the summer they begin laying eggs in the twigs, primarily in two-year-old twig growth. Prune leafhoppers overwinter in the egg stage until April, when prune leaves begin to unfold. Then they hatch into nymphs and start to feed. We first noted adults in late April. There are four distinct generations of prune leafhopper in the San Joaquin Valley: nymphal peaks occurred in April, June, August, and September.

In late fall, adult leafhoppers were still present in large numbers (fig. 1). The abrupt reduction in late November was probably caused by aging and leaf drop with the onset of cold weather. Adult prune leafhoppers appear to persist later in December than the wasp, and overwintering prune leafhopper eggs laid during this period would escape parasitism.

Anagrus parasitizes prune leafhopper eggs in leaves and twigs. During the dormant period, the immature wasps develop slowly, and adults emerge in mid-April. This emergence coincides with the beginning of egg laying by overwintering grape leafhoppers. *Anagrus* moving out of prunes into adjacent vineyards would help to reduce grape leafhopper populations.

Leaf samples collected on May 6 in the nearby 30-acre vineyard had 12 percent egg parasitism, and most were in the northern part of the vineyard nearest the prune orchards. On May 20, parasitism was 34 percent, and the northern part of the vineyard still showed the greatest number of parasitized eggs. By June 24, parasitism (54 percent) was fairly uniform throughout the vineyard In early September, very few leafhoppers were observed.

The large numbers of *Anagrus* trapped in the prune orchard in October and November, when grape leafhoppers are not laying eggs, may have moved from surrounding vineyards rather than

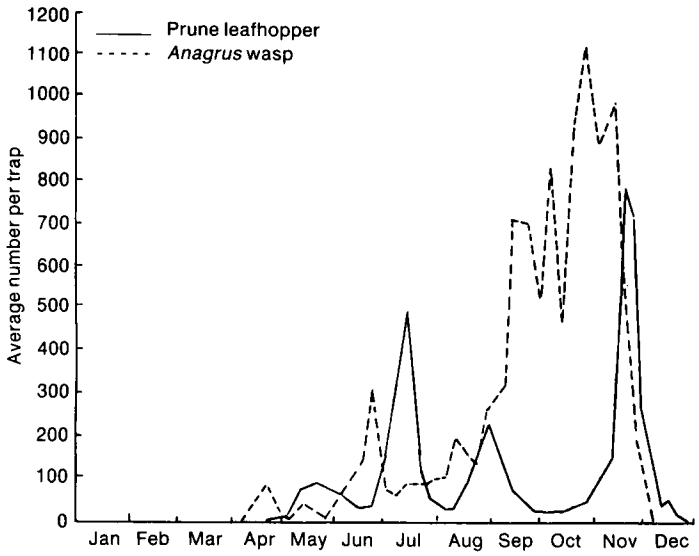

Fig. 1. Adult prune leafhoppers and *Anagrus* wasps in Easton French prune orchard were both numerous until late November. Leafhoppers persisted longer.

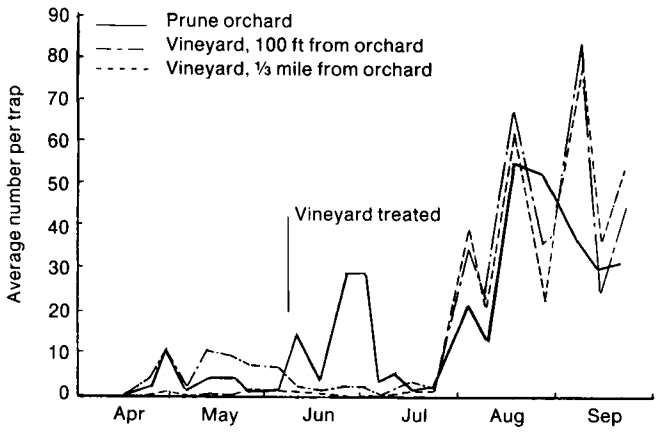

Fig. 2. Trap catches showed *Anagrus* wasps were active in Thompson Seedless vineyard at the time overwintering grape leafhoppers started to lay eggs.

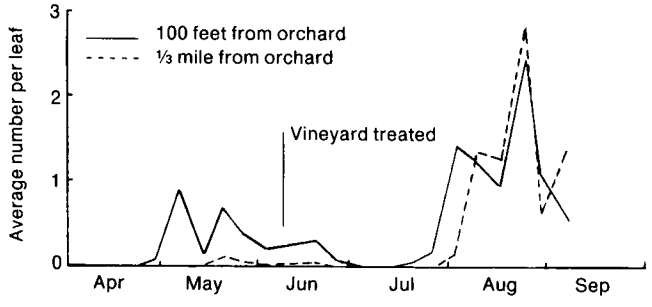

Fig. 3. Grape leafhopper eggs in areas closer to prune orchard were parasitized earlier than those laid farther away.

having been generated in the prune orchard. Heavy late-season *Anagrus* movement and parasitism of prune leafhopper eggs would ensure good numbers of overwintering *Anagrus* populations.

Delano. *Anagrus* adults were active in the Thompson Seedless vineyard on April 22, at about the time overwintering grape leafhoppers started to lay eggs. (fig. 2). Initially, more adults were trapped in the northern part of the vineyard adjacent to the prunes than ⅓ mile away. We also found earlier and consistently higher numbers of red eggs in the northern part of the vineyard (fig. 3). From early May to early June higher numbers of *Anagrus* adults were trapped in the northern part of the vineyard than in the adjacent prune orchard. This difference was probably caused by the production of adults in the vineyard as well as movement of the wasp from the prunes into the vineyard.

On June 10, the grower applied dimethoate in the vineyard, a preventive insecticide treatment for grape leafhopper commonly used by table grape growers in the Delano area. This treatment precluded a study of the development of undisturbed leafhopper populations in the vineyard.

The low trap catches of wasp adults in the vineyard in June and July probably resulted from treatment effects on the host leafhopper population as well as on the wasp. There was little delay in parasitic activity as the leafhopper population recovered from the treatment. The number of parasitized eggs increased rapidly after July 26. Apparently, numbers of *Anagrus* sufficient to maintain levels of parasitism were able to move into the vineyard from the prune orchard. Moreover, in August leafhopper nymphal counts from vines adjacent to the prune orchard and midway in the vineyard peaked at less than one nymph per leaf, indicating very effective parasitism. A season-long movement of *Anagrus* adults from prunes into adjacent vineyards ties in very well with the integration of chemical and biological control in vineyards.

Hiroshi Kido is Staff Research Associate, Department of Entomology, University of California, Davis; Donald L. Flaherty is Farm Advisor, Cooperative Extension, Tulare County; Daniel F. Bosch is Staff Research Associate, Department of Entomology, U.C., and Karen A. Valero is Staff Research Associate, Cooperative Extension, Tulare County. Photographs by Jack Kelly Clark.