Pest management affects spider mites in vineyards

Greg M. English-Loeb □ Donald L. Flaherty □ Lloyd T. Wilson □ William W. Barnett
George M. Leavitt □ William H. Settle

Powdery mildew and leafhopper controls affect predator populations differently

The two principal pest mites in San Joaquin Valley vineyards are Pacific spider mite and Willamette spider mite. Pacific mite, *Tetranychus pacificus*, has the greatest potential for injury and can cause vine death at high infestations. Willamette mite, *Eotetranychus willametti*, is less likely to reach damaging levels and in some situations is even considered an important alternative prey for the predaceous mite *Metaseiulus occidentalis*. This common predator is especially effective in vineyards not disrupted by chemical treatments for other pests, such as leafhoppers.

Two changes in grape pest management may affect spider mite problems in vineyards. One has been brought about by a newly established insect pest, variegated leafhopper, and the other by the use of the fungicide Bayleton (triadimefon) for powdery mildew control.

The variegated leafhopper, *Erythroneura variabilis*, originating in Mexico, has recently become a serious pest of grapes in the San Joaquin Valley. A minute wasp, *Anagrus epos*, which efficiently finds and parasitizes eggs of the grape leafhopper, *E. elegantula*, on Thompson Seedless vines, is not an effective parasite of variegated leafhopper. Growers are now resorting to chemical control of the variegated leafhopper in Thompson Seedless vineyards where the grape leafhopper was not a problem. Unfortunately, treatment can disrupt spider mites and lead to serious problems in some of these vineyards. Well-defined economic thresholds and sampling procedures for leafhoppers and spider mites are essential to minimize chemical use and biological disruptions.

Possible results of the increasing use of Bayleton instead of sulfur for powdery mildew control are less clear. Many observers believe that the abundance of mites and other arthropods differs in Bayleton- and sulfur-treated vineyards.

To better understand the effects of these changes on spider mite management, we began a broad-based study in San Joaquin Valley Thompson Seedless vineyards in 1984. The overall goals have been to: (1) document the effect of Bayleton and increased insecticide use in vineyards on the composition and population dynamics of spider mites and their natural enemies; (2) determine within- and between-vine distribution patterns of spider mites and beneficial species to develop a reliable sampling plan; (3) develop economic thresholds for pest mite species; and (4) construct a computer model to simulate spider mite population trends that incorporates the role of predation so that spider mite abundance and damage can be predicted.

We have restricted our discussion here to the first two goals.

The 1984 study took place in two commercial Thompson Seedless raisin-producing vineyards in southern Madera County. One vineyard (Nelson) had a history of insecticide and acaracide treatments for grape leafhopper and spider mites. Powdery mildew was controlled with sulfur before 1984. The other vineyard (Radoicich), ¼ mile south, had no recent treatment history for grape leafhopper or spider mites, because the grower had been able to rely on natural control. Powdery mildew in the Radoicich vineyard was controlled with Bayleton in 1982 and 1983. Both vineyards received yearly treatments of Kryocide (cryolite), a highly selective stomach insecticide for control of grapeleaf skeletonizer, omnivorous leaffolder, and grape leafolder. Variegated leafhopper has only recently spread into both vineyards and has not yet reached damaging levels.

Effect of powdery mildew control

Growers in each case applied treatments as part of their regular powdery mildew control program. In the Nelson vineyard, 25 rows were treated three times with Bayleton. The rest of the vineyard was dusted with sulfur roughly every 10 days from April 3 to July 1. We sampled nine vines every week in each treated area.

In the Radoicich vineyard, 10 rows were dusted with sulfur, and the rest of the vineyard was treated twice with Bayleton. Ten vines were sampled weekly in each area.

We sampled by collecting leaves from the basal, shoulder, and terminal shoot types of each vine. These types were as follows: basal, a shoot originating on the trunk area; shoulder, originating from a cane in the region where the cane first contacts the trellis; terminal, originating between the shoulder regions of two adjacent vines. From each shoot type we collected three leaves: one near the base, one near the tip, and one from the middle. We sampled both the north and south sides of the vines for a total of 18 leaves per vine.

Spider mites. The Bayleton-treated areas had much lower spider mite populations than did the sulfur areas. In the Nelson vineyard, however, Pacific and Willamette mites only became abundant on sulfur-treated vines after treatments had stopped (fig. 1A). This finding might indicate some form of disruption by sulfur. Pacific mites were essentially absent from vines treated with Bayleton. In the Radoicich vineyard, Willamette spider mites became numerous in the sulfur-treated area and were considerably less abundant in the Bayleton-treated area (fig. 2A-B).

Predaceous mites. *Metaseiulus occidentalis* was the dominant predaceous mite species in the Nelson vineyard, whereas *Amblyseius hibisci* dominated in the Radoicich vineyard. In past studies, *A. hibisci* was rarely observed in sulfur-treated vineyards.

Although *M. occidentalis* was present in both the sulfur and Bayleton areas in the Nelson vineyard early in the season, it dropped to low numbers in the sulfur-

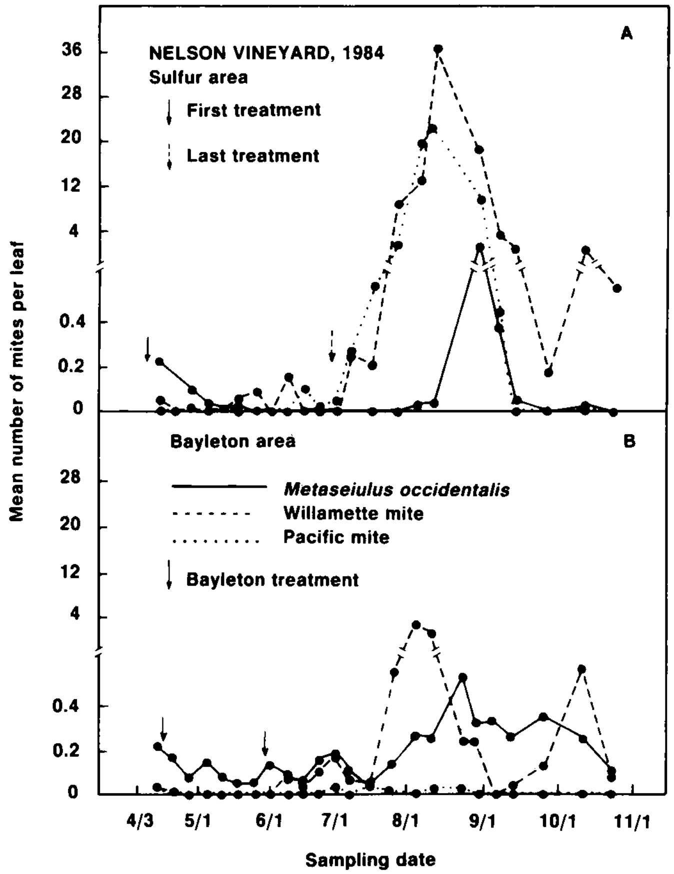

Fig. 1. Sulfur-treated areas of Nelson vineyard (A) had higher spider mite populations and greater fluctuations in predatory mite (*M. occidentalis*) numbers than did Bayleton areas (B).

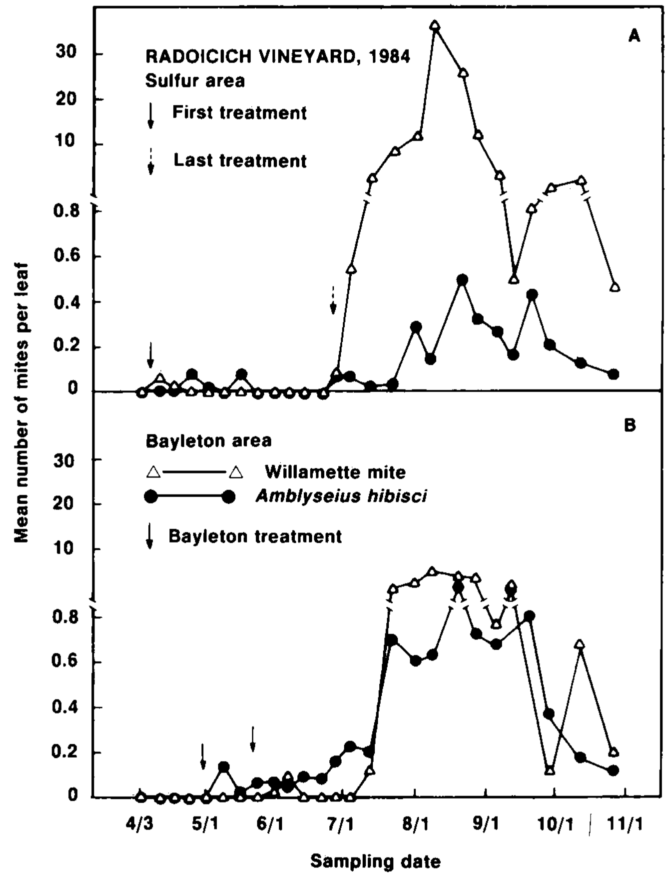

Fig. 2. In Radoicich vineyard, Willamette mite was more abundant in sulfur (A) than Bayleton (B) area. The dominant predatory mite, *A. hibisci*, apparently didn 't overwinter in the vineyard.

treated area (fig 1A), then built up to relatively high numbers after the last sulfur application. In the Bayleton-treated area, the population remained fairly constant. The *M. occidentalis* population in the sulfur treated area crashed in mid-August, presumably because of low prey densities.

In the Radoicich vineyard, *A. hibisci*, unlike *M. occidentalis*, was rare or absent in both treatment areas early in the season and remained suppressed in the sulfur-treated area (fig. 2A-B). Also, unlike *M. occidentalis*, *A. hibisci* was not found overwintering under the bark or in cane buds in samples taken in January 1985. Possibly *A. hibisci* does not overwinter in the vineyard but migrates from nearby overwintering sites on air currents. Migration by air currents has been documented for other predaceous mite species. In the Bayleton area, *A. hibisci* showed a marked increase in abundance starting in late June, which appeared to coincide with a modest increase in Willamette mite (fig. 2B). *Metaseiulus occidentalis* was present in very low numbers in both treated areas of the Radoicich vineyard, but numbers were particularly low in the Bayleton area. Very low populations of the predaceous mite *Typhloseiopsis citri* were observed in the Bayleton area of the Radoicich vineyard. This further indicates that sulfur suppresses predaceous mites in general.

Distribution patterns

Leaf and shoot counts in the various parts of the vines, sampled as described, enabled us to estimate the total number of mites on each vine. The number of vines sampled varied with the time of season and vineyard. In May and June, we sampled nine or ten vines weekly in each powdery mildew study area (two at each vineyard). In July, we increased the number of vines to 36 in the Nelson sulfur plot, concentrating the additional sampling here because it was the only site where both Pacific and Willamette mite populations were present and increasing. From late July on, we recorded additional information on whether or not leaves were exposed to direct sunlight.

Willamette mite was slightly more abundant on the north side of vines throughout the season, but there was no discernible difference with the other two species, Pacific spider mite and *M. occidentalis*. Early in the season, all three species were found mostly on basal leaves on basal shoots. As vines matured, mites became more randomly distributed but were more prevalent on leaves in the middle of shoots. Leaf exposure had the greatest influence on distribution. Pacific mite was slightly more abundant on leaves directly exposed to sunlight; Willamette mite showed the opposite pattern (fig. 3).

Broad-spectrum insecticides

We established six plots of 96 vines each in the Radoicich vineyard to study how spider mites and predator populations on Bayleton-treated vines are affected by broad-spectrum insecticides used for leafhopper control. Three plots were treated twice with Sevin (carbaryl) at commercial rates (2.7 pounds per acre at 200 gallons) by handgun on May 15 and May 30. Three plots were left untreated. We chose Sevin for the study, because it and other carbamate and phosphate insecticides are known to disrupt spider mites on sulfur-treated vines.

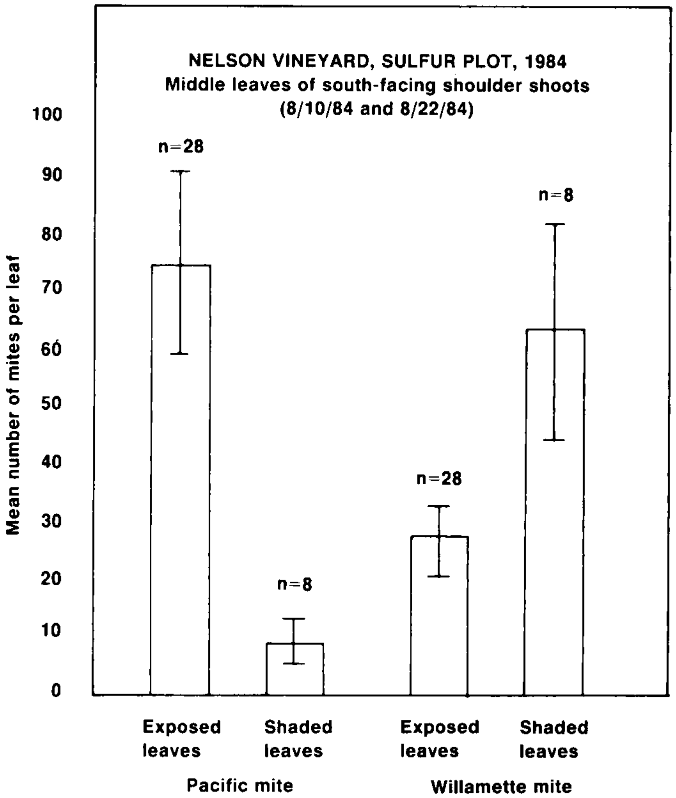

Fig. 3. Pacific mites were more abundant on leaves exposed to sunlight, Willamette mites more abundant on shaded leaves.

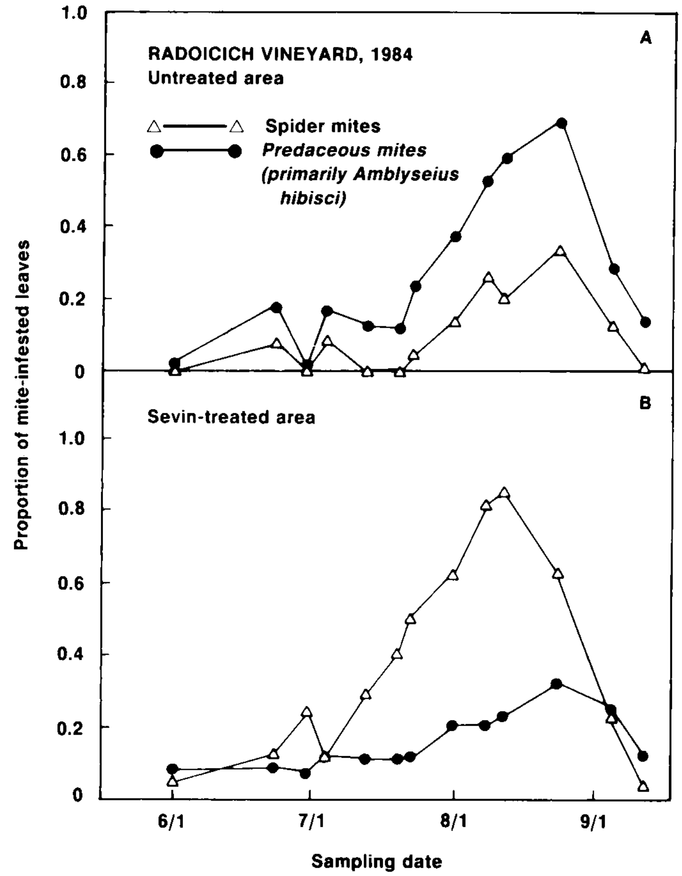

Fig. 4. Predaceous mite populations were higher in untreated (A) than treated (B) plots, where they were unable to control spider mites until possibly late in the season.

Every week from June 20 to mid-September, we examined 20 leaves in each of the six plots for the presence or absence of spider mites and predaceous mites. The infestation level at each week was expressed as the proportion of sampled leaves that were infested. A similar Sevin study was also established at the Nelson vineyard.

Early-season treatment had a profound effect on mites in the Radoicich vineyard. Predaceous mite populations were much lower in treated than untreated plots, and spider mite levels were higher. Neither *M. occidentalis* nor *A. hibisci* was able to control the spider mites until possibly late in the season (fig 4). Six-spotted thrips were partially responsible for the late-season crash of the spider mite population. Similar but less striking results were obtained in the Nelson vineyard.

Conclusions

The 1984 studies indicate that the use of Bayleton may result in an increased abundance of predator species and an associated decrease in spider mite populations. In one Bayleton-treated vineyard, *Amblyseius hibisci* was the dominant predaceous mite, a species rarely observed in sulfur-treated vineyards in past studies. The value of *A. hibisci* may be limited, however, because it does not overwinter in vineyards.

Spider mite populations seemed to fluctuate more widely on sulfur-treated than on Bayleton-treated vines where *Metaseiulus occidentalis* was the dominant predator. Studies are now in progress to determine if sulfur temporarily inhibits both *M. occidentalis* and spider mite populations early in the season. Because *M. occidentalis* is also affected by reduced prey abundance, the spider mites have a slight advantage, which may enable them to escape predation later, when sulfur treatment is stopped.

Early-season use of Sevin can cause mid-season mite problems in both sulfur- and Bayleton-treated vineyards, apparently by inhibiting natural controls. These problems are also likely to occur when other broad-spectrum insecticides are applied early in the season to control variegated leafhopper.

Preliminary analysis of distribution patterns suggests that, from approximately mid-June on, Willamette mites, Pacific mite, and *M. occidentalis* are distributed randomly with respect to shoots, but are more commonly found on middle leaves. If leaf exposure to direct sunlight is considered, however, distribution differences are greater, with Pacific mite preferring exposed leaves, and Willamette mite shady leaves. Additional data and further analyses will permit the development of quantitative sampling plans based on examination of a single leaf or a few leaves from each of several vines by concentrating on shoots or leaves most likely to have mites.

Greg M. English-Loeb is a graduate student, Department of Entomology, University of California, Davis; Donald L. Flaherty is Farm Advisor, Tulare County; Lloyd T. Wilson is Associate Professor and Associate Entomologist, University of California, Davis; William W. Barnett is Area IPM Farm Advisor, Kearney Agricultural Center, Parlier; George M. Leavitt is Farm Advisor, Madera County; and William H. Settle is a graduate student, Department of Entomology, University of California, Davis.