Survey respondents are strongly in favor of having the residues collected by custom operations, primarily to save themselves time and effort, and secondarily because storing residues until pickup is a major concern. Residues will most likely be stored in roadside piles for one to several months. Most farmers contacted can provide the space for these piles, but would like not to be burdened with the management responsibilities caused by heavy rains on exposed piles; fires; strong winds scattering the residues; piles harboring diseases and pests; and esthetics of piles.

Timing of the residue collection operation is critical. Collection must not impede soil preparation, planting, harvest, chemical application, or other field practices. These factors must also be carefully considered in collection system design.

Farmers responding to the survey indicated that obtaining long-term commitments was more important than making a profit. But if the utilities are successful in this venture, farmers would, of course, like to receive a share of any profits. Some farmers fear that if they gave up open-field burning for even a short time, they might permanently lose this disposal method, even if the utilization program became unfeasible for any reason.

The number of conclusions that can be drawn from the survey are limited, for only rice growers and orchardists were involved. The attitudes of other farmers, including growers of cotton, cereal grains, other field crops, grapes, and vegetables, and operators of dairies and feedlots, are equally important to long-term attempts to utilize residues, and the selection of rice growers and orchardists for the survey does not necessarily indicate that these would be the first to participate in utilization programs. The survey was only a preliminary contact with farmers to discern their general opinions; all residue utilization programs, for whatever purpose, can only be initiated with the cooperation of the farmers. The positive response to the survey is encouraging for continuing research. By participating in utilization programs, farmers can develop new ways to dispose of residue and obtain a practical source of energy, while helping preserve our oil and natural gas.

Clarence F. Becker was Visiting Research Professor, Brian Horsfield was Assistant Professor, Bryan M. Jenkins is Graduate Student, and John R. Goss is Professor, Department of Agricultural Engineering, U.C., Davis.

The authors express their appreciation for the assistance received from several Extension specialists, farm advisors, others who provided valuable information during interviews, and growers who completed and returned the questionnaires. The investigation was supported in part by a grant received from the Pacific Gas and Electric Company.

Evaluation of insecticides for a grape IPM program

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The Pacific spider mite, *Tetranychus pacificus* McGregor, is a serious pest of grapes in the southern San Joaquin Valley, largely because some insecticides disrupt their natural control. Currently, when new insecticides are registered for the control of insect pest populations, little information is given, or known, about their effects on beneficial predator or parasite populations. If an insecticide is to be successfully incorporated into an integrated pest management (IPM) program for grapes, its effects on non-target beneficials must be known.

The purpose of the work in progress is to evaluate materials that have been registered or could be registered for use in vineyards, with emphasis on the effect that these materials have on spider mite population ecology. This report is the result of vineyard and laboratory studies with methomyl, recently registered for use on grapes, and permethrin, a synthetic pyrethroid not now registered for use on grapes. The target pests in the study were the grape leafhopper, *Erythroneura elegantula* Osb., and the grape leaf folder, *Desmia funeralis* Hbn.

Populations of Pacific mite, Willamette mite *(Eotetranychus willamette* Ewing), the predaceous mite *(Metaseiulus occidentalis* Nesbitt) and the tydeid mite *(Pronematus anconai* Baker) were monitored. Moderate populations of Pacific mite result in leaf burn, stunted shoots, and damage to the fruit by exposure to the sun. High populations may result in serious crop losses or even kill grapevines. On the other hand, Willamette mite has been overrated as a pest of grapes in the southern San Joaquin Valley. Studies have shown that high populations can be tolerated without risking yield and quality losses in wine, raisin, and table grape vineyards. Willamette mite is a beneficial species in that it serves as an alternate food source for predaceous mites; thus, its presence enhances control of the more serious Pacific mite. Tydeid mite has also been found to be an important alternate food source for predaceous mites. Tydeids are not a pest of grapevines. They feed primarily on windblown pollen and only secondarily on grape foliage.

Vineyard trials were established in 1976 near Dinuba and Exeter in Tulare County on Thompson Seedless and Emperor grape varieties, respectively. Both experiments were designed as randomized complete blocks with four blocks and twelve vine plots. Treatments in Dinuba were: (1) check, (2) methomyl (.75 pound ai per acre), (3) permethrin (.025 pound ai per acre), (4) permethrin (.050 pound ai per acre). Treatments in Exeter were: (1) check, (2) permethrin (.1 pound ai per acre), and (3) permethrin (.2 pound ai per acre). Materials were applied with a dilute sprayer using 200 gallons per acre on July 19 at Exeter and July 23 at Dinuba.

Grape leafhopper populations were monitored by counting leafhopper nymphs on ten leaves per plot. Basal leaves were selected for first generation counts and mid-cane leaves for second and third generation counts. At Exeter, grape leaf folder activity was measured on August 2 by counting rolls on six half-vines per plot. Spider mite populations were monitored by sampling ten leaves per plot weekly. Leaves were randomly taken from the vine tops at Dinuba, where Pacific mite predominated, and from northern vine sides at Exeter, where Willamette was present but not Pacific mite. Leaves were placed under refrigeration until counting with a dissecting scope. Adults,

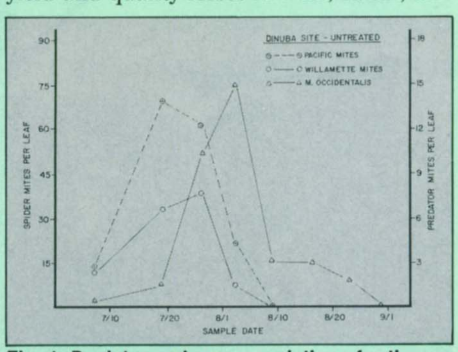

Fig. 1. Predator and prey populations for the untreated plots at the Dinuba Thompson Seedless vineyard.

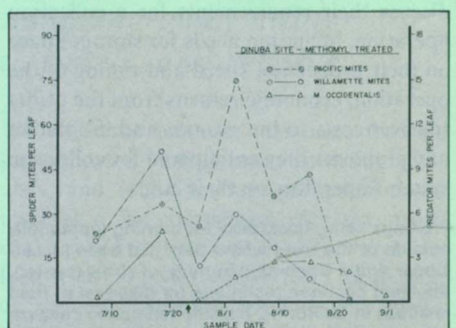

Fig. 2. Predator and prey populations for the methomyl treatment applied July 23 at the Dinuba Thompson Seedless vineyard.

nymphs, and eggs of Pacific, Willamette, tydeid, and predator mites were counted. All results are reported as totals of all stages of each species of mites per leaf.

During 1977, 14 population samples of the predatory mite *M. occidentallis*, were collected from San Joaquin Valley vineyards in Kern, Tulare, Fresno, and Madera counties and evaluated for their susceptibility to methomyl and permethrin. Adult females from these samples were placed on sticky tape attached to micro slides or on leaf disks and dipped into dosages of these pesticides to determine their LC_{50} values (the dose at which 50 percent of the population is killed).

Dinuba. Figure 1 shows spider mite-predator interaction in the untreated check at Dinuba. Pacific mite predominates over Willamette mite. Note that Pacific mite peaked on July 19 with 69 mites per leaf, and populations crashed by August 10. Predators lagged behind the spider mite populations before becoming effective control agents.

When methomyl was applied on July 23, predatory mites were reduced to low levels but numbers increased after 7 to 10 days (fig. 2). This period of little predation resulted in the Pacific mite population peaking at 80 per leaf and, more important, extending the peak abundance until August 23 before crashing two weeks later than in the untreated checks. The tydeid mite population significantly increased following the methomyl treatment, but is not shown on the graph. This increase could be due to a temporary release from predation by the methomyl treatment. Leaf damage in the methomyl treatment was slightly greater than the control and both would not require an acaracide.

Permethrin at .05 pound ai per acre dramatically increased spider mite populations in this vineyard (see fig. 3). It reduced predatory mites and tydeid mites (not graphed) to very low levels; these populations did not recover for the remainder of the season. The absence of predation, or physiological stimulation of Pacific mite reproduction, or a combination of both effects allowed the Pacific mite population to reach over 200 mites per leaf until the population crash finally occurred around September 1. Some vines were severely defoliated and all vines showed serious injury. The .025 pound ai per acre permethrin treatment had over 200 mites per leaf by August 2. However, predator survival was better than with the .05 pound ai per acre treatment and the peak abundance did not last as long. A significantly higher Pacific mite population was present in both permethrin treatments the following spring.

Exeter. Figures 4 and 5 show the predator-prey interactions for the untreated check and for the lower rate of permethrin application (0.1 pound ai per acre). In the untreated check, the Willamette mite population peaked on July 26 with 29 mites per leaf and the population subsequently declined in response to heavy predation. Tydeid mites increased late in the season and predatory mites correspondingly increased from the additional prey. Other studies have shown that this late season increase of predatory mites due to tydeid population increases is an important factor in maintaining control of Pacific mites in vineyards.

Toxicity of Permethrin to *M. occidentalis*, *T. pacificus*, *T. urticae*, and *P. anconai* as Determined by Leaf Dip Analysis

Mite species	LC50*	(95% confidence interval)
M. occidentalis	.0023	(.0009 - .0058)
T. pacificus	.0888	(.0237 - .3335)
T. urticae	.1320	(.0833 - .2092)
P. anconai	.0160	(.0048 - .0537)

*Dose at which 50% of the population is killed, expressed in lb ai/100 gal water.

Permethrin reduced both predator and tydeid mites to low levels (see fig. 5) at which they remained until September. At 0.1 pound ai per acre, Willamette mite was reduced immediately following treatment; but, with the absence of predation and possible physiological stimulation, the population resurged, peaking on August 30. The damage from Willamette feeding in the permethrin plots was well within the tolerable range. Similar results were observed with the 0.2 pound application rate.

All populations of predator mites tested by leaf dipping were very susceptible to permethrin. The table shows that the Pacific spider mite is much more tolerant of permethrin than the predator or the tydeid mites. This indicates a disruptive capability which was evidenced in the field trials. Additionally, methomyl was highly toxic to predator mites at 5 percent of the recommended concentration, indicating disruptive capabilities.

Permethrin effectively controlled grape leafhopper at both Dinuba and Exeter and at all concentrations except .025 pound ai per acre. Additionally, permethrin gave excellent control of grape leaf folder, reducing rolls by 90 percent compared with the untreated check. Methomyl effectively controlled grape leafhopper at Dinuba; grape leaf folder was not present in this plot for evaluation.

Permethrin was found to be effective in controlling both grape leafhopper and leaf folder. However, it is toxic to predatory mites and tydeid mites even at low concentrations. If synthetic pyrethroids are registered for use on grapes, they may have to be used in conjunction with a miticide in areas where spider mites are a potential problem.

Methomyl is currently registered on grapes for control of grape leafhopper and certain lepidopterous insects. Methomyl gave effective control of grape leafhopper, the only target pest tested, but caused increases of spider mites although the increase was less than with permethrin. Following methomyl treatments, predatory mites were reduced, but numbers increased in 7 to 10 days; tydeid mites increased in number, at least in this one trial.

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We thank J. Else, K. Smith, N. Knop, and R. Roush for their technical assistance. This project was supported in part by funds from ICI United States Inc., E.I. DuPont De Nemours & Company, The California Raisin Advisory Board, and the California Table Grape Commission.

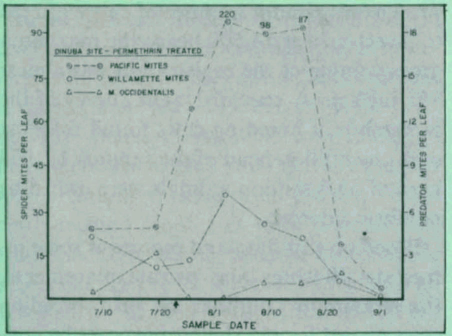

Fig. 3. Predator and prey populations for the permethrin treatment applied July 23 at the Dinuba Thompson Seedless vineyard.

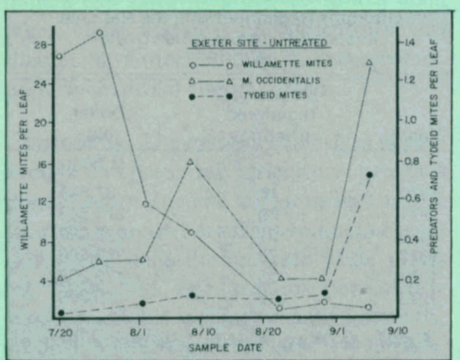

Fig. 4. Predator and prey populations for the check at the Exeter Emperor vineyard.

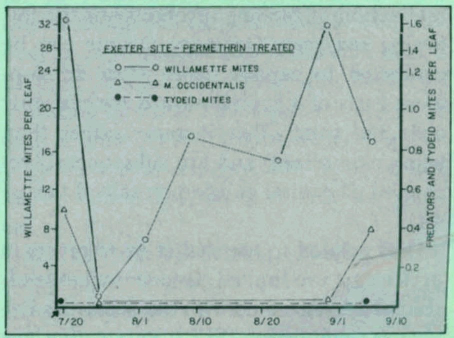

Fig. 5. Predator and prey populations for the permethrin treatment applied July 19 at the Exeter Emperor vineyard.