

4. Chemical Control

EFFICACY AND RESIDUE ANALYSIS OF PYRETHROID INSECTICIDES ON PEST AND BENEFICIAL SPECIES

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Although the role of pyrethroids in mite and other pest outbreaks has been documented, it is important to revisit them in relation to California orchards as their use increases. Some growers are choosing to use pyrethroids in the dormant season as an alternative to the organo-phosphate insecticides for control of peach twig borer, aphids, and scale insects. Other growers are understandably applying pyrethroids in-season for other insect pests instead of more costly treatments. They are known to be effective as dormant sprays, but it is not known if they can be used without causing other problems at that time. Field and laboratory trials carefully testing these materials have been conducted to establish guidelines for its possible use in pest management programs.

Field trials carefully testing these materials were conducted in single tree plots in prunes and almonds and large orchard plots in prunes for the second year in 1996. Treatments in the single tree plots were applied by hand gun to single trees in eight replicated complete blocks. Treatments in the single tree prune plots consisted of 96 dormant season esfenvalerate (Asana), dormant diazinon, and dormant Asana and diazinon over the 95 treatments, untreated control treatments, and in-season Asana treatments. The plots in almonds repeated the Asana treatments with permethrin. The additional 96 esfenvalerate and permethrin treatments were added to find effects of repeated pyrethroid applications.

Treatments in the large prune plots, 8 X 8 trees with 3 replicates, were applied by an orchard sprayer. Treatments consisted of Dormant oil as the untreated control, Dormant oil plus Asana, Dormant oil plus Diazinon, and two *Bacillus thuringiensis* (Bt) with 2 gals/acre sprays during bloom, and Dormant oil Diazinon plus in-season Asana. Monthly mite samples from each tree in the single tree plots and 6 center trees in the large plots were collected and using a mite brushing machine to evaluate for European red mites, two spotted mites, and predator mites. Mite populations were monitored in both the single tree plots and the large plots in May, June, July, and August.

Branches were cut from trees in the esfenvalerate, permethrin and control treatments in the single tree plots periodically during the season, and residue analysis performed on the samples. The extraction and analysis process involves about 20 separate steps. Results of the residue extractions have shown that almost all of the insecticides is in the bark and very little or none is in the woody portion. A laboratory experiment was conducted on a subsample of the branches to determine effect of residues remaining on prune twigs on the western orchard predator mites. Twigs were collected from almond and prune trees several days after the dormant spray application. Predator mites were placed on 2 cm

circular pieces on the twigs collected and evaluated for mortality and egg-laying after 48 hours.

Results from the almond plot indicated that residues of both esfenvalerate (0.047 ng/mm^2) and permethrin (cis- = 1.153 ng/mm^2 ; trans- = 0.012 ng/mm^2) had persisted the entire year since the previous dormant season application, and that there remained biological activity on predators during this time. Residues remaining from the one year old dormant spray and a hullsplit spray applied to the same trees was not significantly different from that remaining from the one year old dormant spray alone. By comparison, residue analysis of small branches collected less than 1 day following application yielded higher residues of esfenvalerate (0.265 ng/mm^2) and permethrin (cis- = 1.693 ng/mm^2 ; trans- = 1.603 ng/mm^2). In 2 independent bioassays of the small almond twigs collected from these treatments, all esfenvalerate and permethrin treatments resulted in significantly higher predator mite mortality than was observed on the untreated control twigs. The diazinon application resulted in some mortality of predator mites (~15%), but this was not as great as that observed for the various esfenvalerate and permethrin treatments that varied from 24% to 38% for esfenvalerate and from 19% to 42% for permethrin. Similarly the number of eggs per treatment replicate were also significantly affected relative to the untreated control, and somewhat more by the esfenvalerate treatments than by the permethrin treatments. This effect was also seen in the lab bioassays conducted on prune twigs where one dormant application of Asana reduced predators by 40%, a 95 in-season Asana application by 24%, and 95 dormant Asana plus a 95 in-season Asana by 14%, and the three Asana applications reduced predators by 35%. Not only does the Asana reduce predators but they lay fewer eggs. The three Asana applications treatment had significantly less egg laying than all the other treatments.

In these associated laboratory trails, we were able to develop a relationship of field rate of both esfenvalerate and permethrin to bark residues, and to relate this to predator mite mortality and oviposition. In this way we are now able to accurately predict the biological effect of a given level of bark residue. We were also able to determine the effect of permethrin leaf residues on predator mite mortality and oviposition. In this study we found significantly increased mortality (54%) and decreased oviposition (86%) at the 0.125 label rate.

These results indicate that the pyrethroid insecticides esfenvalerate and permethrin can have long term negative residual effects on predaceous mites on bark where they overwinter and disperse within tree, and short term negative effects from residues on leaves. Growers using pyrethroids with repeated applications will have to watch for increasing mite populations. As a result some PCAs are recommending lower rates of pyrethroids.