PHOTOS BY ELIZABETH BEERS, WASHINGTON STATE UNIVERSITY

Deraeocoris is an important predator of pear psylla. Some common pesticides are acutely toxic to the bug, while others have little effect.

The western predatory mite, Galendromus occidentalis, has developed resistance to organophosphates, but is susceptible to other pesticides.

Scientists study PESTICIDE EFFECTS

The choice and timing of pesticide sprays can influence biological control.

by Geraldine Warner

This is the second article in a series about a major research project on enhancing biological control in tree fruits."

Some of the newer, reduced-risk pesticides being used in tree fruits today can harm important beneficial insects in apple and pear orchards, even if they don't kill them outright, research shows.

Over the past 15 years or so, many new types of insecticides have been introduced to replace older, more toxic pesticides as a result of the Food Quality Protection Act. Though the U.S. Environmental Protection Agency calls them "reduced risk," that term applies primarily to human health and doesn't necessarily mean that those products are less risky to other organisms in the environment, says Dr. Nick Mills, entomologist with the University of California, Berkeley.

Mills is working with a team of West Coast entomologists to figure out how growers can use new pesticides to kill pests without seriously impacting beneficial insects and mites. Ultimately, they hope to see enhanced biological control in orchards, which should reduce pesticide inputs, leading to higher profits and fewer worker safety problems or environmental issues for growers.

The pesticide effects study is just one aspect of a five-year, $4.5-million research project focusing on enhancing biological control in western orchards, which is now in its third year.

Nonlethal effects

Mills has been working with Dr. Elizabeth Beers at Washington State University in Wenatchee, Dr. Peter Shearer at Oregon State University in Hood River, and Dr. Tom Unruh with the U.S. Department of Agriculture in Yakima, Washington, to conduct laboratory tests and field trials in the three states to assess the effects of popular insecticides and fungicides on important natural enemies of key pests in apple, pear, and walnut orchards.

They're studying the effects on the short- and long-term mortality of both the immature and adult stages of the natural enemies, as well as nonlethal effects. Traditional insecticides, such as organophosphates, only had short-term lethal effects. Insects would be dead within 48 hours.

"What we're seeing with some of these newer classes of pesticides is that they are not necessarily acutely toxic to natural enemies, but they can affect other life-history traits, such as fecundity," Mills said.

For example, sometimes the eggs of insects that have been exposed to pesticides don't hatch. Some insecticides affect the sex ratio of the progeny.

"I think everybody understands if you have a product that kills natural enemies directly, then that can be a bad thing, but what if that product reduces the fecundity of the natural enemy by 50 percent? What does that mean?"

Sublethal effects, such as reducing the natural enemy's ability to reproduce, can be extremely important if they prevent them from sustaining their populations in the orchard, but are difficult to research, Mills said.

The natural enemies that the team has looked at so far are: *Deraeocoris brevis*, a predator of pear psylla; the western predatory mite *Galendromus occidentalis; Aphelinus mali*, a parasitoid of woolly apple aphid; the spiders *Pelegrina aeneola* and *Misumenops lepidus*, which are predators of codling moth; and *Trioxys pallidus*, a parasitoid of the walnut aphid.

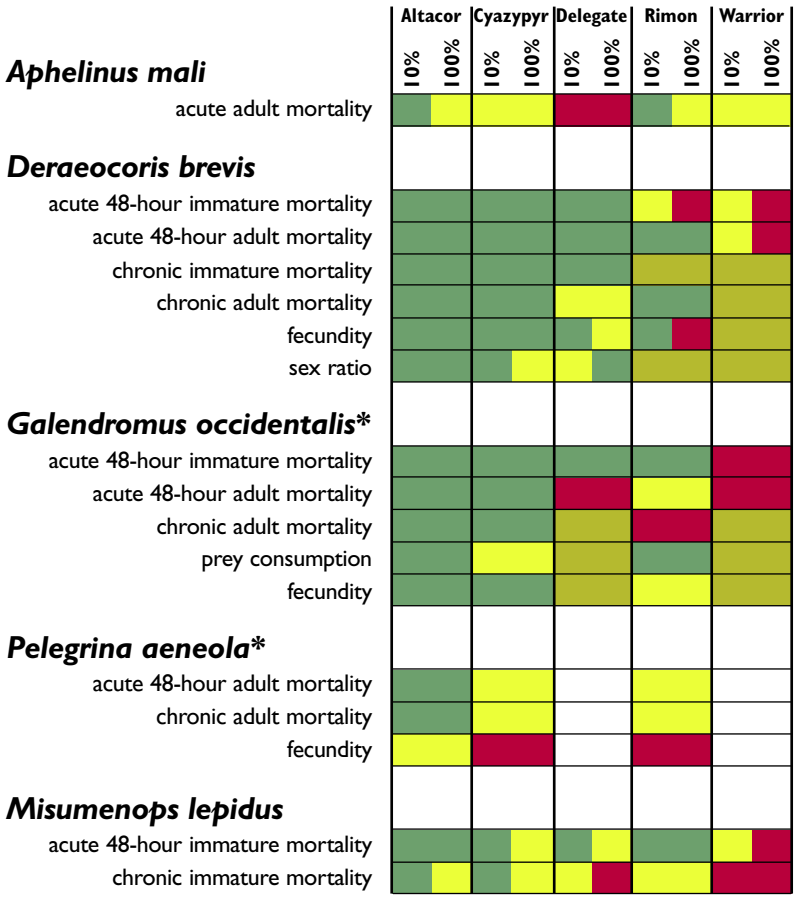
The pesticides studied are Altacor (rynaxypyr), Cyazypyr (cyantraniliprole), Delegate (spinetoram), Rimon (novaluron), and Warrior (lambda-cyhalothrin).

The western predatory mite has been able to survive in orchards and prey on pest mite species, because it developed resistance to organophosphates, such as Guthion (azinphos-methyl), and pyrethroids. But the current studies show that it can be impacted by some of the new classes of pesticides, as shown in the "Effects of pesticides on natural enemies" chart.

For example, Delegate, a spinosyn product used to control codling moth, is acutely toxic to adult predatory mites. Whether the predatory mites would eventually

Effects of pesticides on natural enemies

The results, so far, of lab studies conducted by West Coast entomologists to assess the direct and sublethal effects of new pesticides on important natural enemies in tree fruit. Cell color reflects the impact on the natural enemy: green (less than 25% reduction), yellow (25 to 75% reduction), red (more than 75% reduction), white (test not yet analyzed), and gold (test not applicable). Percentages indicate label rate.



* Only 100% field rate used

SOURCE: Nick Mills, University of California, Berkeley

gain resistance to the pesticide and how long that might take is not known. In the meantime, integrated mite control could be disrupted, requiring more miticide applications and resulting in increased costs and possibly impacts on other beneficials.

"This is why it's such an important time of change in orchard pest management, because we have these totally new classes of insecticides that are now being used for management of codling moth," Mills said. "The assumption always is that because they are low-risk products, then they're going to be compatible with the natural enemies. It seems that's not always the case."

The spiders *Pelegrina aeneola* and *Misumenops lepidus* can play an important role in codling moth control. They eat codling moth larvae when they emerge from the fruit and make their way down the trunk to the ground to pupate over the winter. That's one of very few times in the codling moth's life cycle when it is vulnerable to predation, Mills said. However, the tests so far show that Rimon (a benzolphenyl urea) is moderately toxic to *P. aeneola* and dramatically reduces its ability to reproduce. Rimon is also toxic to *M. lepidus*, though to a lesser degree.

Rimon kills adult western predatory mites, but does not affect the immature stages. However, the same product is toxic to young *Deraeocoris* bugs, rather than older ones, and prevents eggs from hatching.

Of the products tested, the diamide Altacor appears to be the most benign, but Mills said that doesn't mean growers should totally avoid the other products. They could be used at specific times of the growing season when they are least likely to affect a vulnerable stage of the natural enemy.

This is where the work of Dr. Vince Jones at WSU comes in. Jones, who is director of the overall project, is developing phenology models for important natural enemies—something that's only been available for pests until now. With knowledge of when the various stages of natural enemies are active in the orchard, growers can time sprays to avoid them. The models will be available online at WSU's Decision Aid System Web site: *das.wsu.edu.*

The scientists studying the pesticide effects are continuing their lab and field studies and have started to study the impact of the same pesticides on two more beneficial insects: the ladybird beetle and the green lacewing.

Results of their research will be made available at *das.wsu.edu,* at the project Web site *enhancedbc.tfrec.wsu.edu,* and on the University of California's Integrated Pest Management Web site at *www.ipm.ucdavis.edu.* ●