Enhancing BIOCONTROL

This is the first article in an eight-part series highlighting results of a five-year project to enhance biocontrol in orchards.

As organophosphate insecticides such as Guthion (azinphos-methyl) have been phased out and pest managers have made the switch to newer reduced-risk pesticides, pest control has become more complex and, at times, less reliable.

Some growers have experienced more frequent flare-ups of aphids and spider mites—pests once held in check by their natural enemies. In this era of reduced-risk pesticides, there is growing evidence that some new products may be responsible for the disruption of what was once a relatively stable natural biocontrol system.

Natural enemies provide a free service that can greatly contribute to pest control.

by Ute Chambers, Vince Jones, Angela Gadino, Wendy Jones, Nick Mills, and Jay Brunner

Natural enemies are insects, spiders, predatory mites, or microorganisms that kill pests by consuming them or using them as hosts for their offspring. Like insect or mite pests, natural enemies are exposed to pesticides in their environment, which can kill them or in other ways disrupt their life cycle and biological control functions. Reduced-risk pesticides pose lower risk to human health and the environment compared to organophosphates. However, their impacts on natural enemies are poorly understood and often underestimated.

A team of more than 30 researchers and technicians from Washington State University, Oregon State University, University of California-Berkeley, and the U.S. Department of Agriculture in Yakima, Washington, set out to examine the effects of reduced-risk pesticides on natural enemies and ways to enhance biocontrol in western U.S. orchard systems. This five-year project, which began in 2008, focused initially on apple, pear, and walnut orchards with their common challenge of controlling codling moth. Although the research has primarily been conducted in these commodities, the information gained is largely applicable to many other perennial crops. In a series of eight articles, we will highlight the activities and outcomes of this project and underline the value and benefits of biological control in orchard systems.

A key part of our project was to test the effects of selected pesticides on important natural enemies. We not only examined immediate mortality of these natural enemies, but also assessed other aspects of their life cycle that could be impacted by exposure to pesticides, such as reproduction or prey consumption. We tested five reduced-risk insecticides—Altacor (rynaxypyr), Delegate (spinetoram), Exirel (cyazypyr), Rimon (novaluron), and Warrior (lambda-cyhalothrin)—and two fungicides—Kumulus (sulfur) and Kocide/Manzate (copper hydroxide/mancozeb)—on eight natural enemy species. Some of these species are specific to a certain crop (e.g., a parasitic wasp that attacks woolly apple aphid in apple), while others are common to many cropping systems.

New monitoring tools

Knowing when and where natural enemies are present is critical for designing IPM programs that conserve them. We developed new monitoring tools that can be used to indicate the relative health of an orchard and to determine the timings for pesticide applications that minimize disruption of biocontrol. New lures combined with different trap types have revealed that some natural enemies, like lacewings or hover flies, are far more abundant in orchards than previously thought and that their abundance is linked to the kinds of pest control products used in orchards.

These new natural enemy monitoring tools also enabled us to measure activity patterns over time, and this data can be used to generate phenology models, similar to models for pests like codling moth or western cherry fruit fly. With these natural enemy models, pest managers will be able to minimize pesticide-induced disruptions of biological control by eliminating or shifting the timing of insecticides known to be detrimental.

Growers take part in a natural-enemy workshop prior to Washington State University's annual Sunrise Research Orchard field day last summer.

Knowing when and where natural enemies, such as the green lacewing, are active is critical in order to conserve them.

Another aspect of the project was to determine which natural enemies are important biocontrol agents of codling moth larvae after they exit the fruit and move to their overwintering sites. The best way to find out who preys upon codling moth larvae was to examine the gut content of ground-dwelling predators. Earwigs, spiders, and ground beetles had the most appetite for the soft-bodied larvae. While biological control is unlikely to be a stand-alone pest management tactic for codling moth, even a small increase in pest mortality by natural enemies can contribute significantly to a reduction in pest pressure.

Does it pay?

Besides the ecological implications, growers might ask: Does it pay to switch pesticides, modify spray programs, or sit out an aphid infestation in order to conserve natural enemies? Our analyses suggest that the use of disruptive pesticides in apple orchards increases the cost of management for aphids and mites. Other economic benefits might be more subtle and only apparent in the long run. Sole reliance on pesticides to suppress pests is not only economically and ecologically costly, but also affects worker safety, and goes against consumer concern about food safety.

As our project nears its end, efforts are now focused on synthesizing the information that has been developed and extending it to end users. We have surveyed growers and consultants to identify ways they considered optimal for receiving new information. Our project's Web site enhancedbiocontrol.org provides access to reports, survey summaries, and natural enemy picture galleries, as well as narrated presentations from our intensive two-day short course held in February 2012. Upon

COURTESY OF STACEY MCDONALD.

COURTESY OF ANGELA GADINO

Garden orb web spider in apple orchard.

COURTESY OF WENDY JONES

Adult ladybug feeding on aphids.

request, we are offering two- to four-hour workshops during 2013 where participants can learn more about biological control basics, natural enemy identification, monitoring, and pesticide effects.

Our goal is to promote the implementation of integrated pest management programs that are more stable and sustainable. Natural enemies provide a free service that, when conserved and enhanced through wise management practices, can greatly contribute to pest control, ultimately benefiting producers, consumers, and the environment.

This project is funded by the USDA-National Institute of Food and Agriculture's Specialty Crop Research Initiative, Washington Tree Fruit Research Commission, Washington State Commission on Pesticide Registration, California Walnut Board, Washington State University, University of California-Berkeley, USDA-ARS Yakima Agricultural Research Lab, and pear growers in Hood River, Oregon.

We could not have accomplished our goals without the help of our grower cooperators: California walnut growers in the Sacramento Valley, pear growers in Hood River, and Washington apple growers in Quincy, Bridgeport, Frenchman Hills, Yakima, and Wapato. ●