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Natural enemy INVENTORY

Katie Mulvaney monitoring an apple block in spring, using a beat tray.

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Knowing what's in your orchard helps to stabilize your IPM program.

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Monitoring is one of the key components of any successful integrated pest management program, because it provides a window into what is going on in an orchard. This is true not only for pests but also for natural enemies. New monitoring tools, developed as part of the multistate project "Enhancing Biological Control in Western Orchards," have shown that the presence of some natural enemies in orchards is much higher than previously thought.

The project focused on using plant volatile lures to monitor key natural enemies and determine the time during the growing season when they are present. Ultimately, the information gleaned from these tools will aid growers in making informed management decisions that include the conservation of natural enemies.

Historically, biological control has been difficult to measure. Traditional monitoring methods, like beating trays or yellow sticky cards, have a tendency to underrepresent certain natural enemy groups or life stages. They also collect only individuals that are active within the immediate sampling time and space. Their use can also be time-consuming or require a high level of taxonomic knowledge when a multitude of insects is caught.

These limitations lead to false impressions of low natural enemy abundance, and assumptions that biological control is of little value in the area sampled. Biological control is typically noticed only when it's not working. For example, pesticides can disrupt the balance between natural enemies and pests, resulting in secondary pest flare-ups (i.e., aphids and mites) and the need for additional sprays.

HIPVs

The discovery of herbivore-induced plant volatile lures has greatly improved natural enemy monitoring. HIPVs are natural chemicals released by plants (volatiles) when they are wounded by the feeding of insects (herbivores). Natural enemies use these volatiles to detect the location of food (prey or hosts). HIPV lures in combination with traps can capture natural enemies continuously, day and night, and can draw insects in from a large area, making them an advantageous monitoring tool.

Sticky traps of various colors used in combination with HIPV lures allow us to monitor a diversity of predators and parasitoids. HIPVs can attract a single species or a broad range of natural enemy species. For example, lures containing the HIPV squalene are highly attractive to the green lacewing, *Chrysopa nigricornis*. An odor blend containing geraniol, methyl salicylate, and 2-phenylethanol (known as GMP) is highly attractive to a broad range of natural enemies, including syrphid (or hover) flies, the predatory bug *Deraeocoris brevis*, parasitic wasps, and the green lacewing *Chrysoperla plorabunda*. So far, we have tested 54 possible blends of compounds in apples alone. To some extent, attractive blends can be tailored to target certain natural enemies that are important in different cropping systems.

Using HIPV lures, we've been able to compare natural enemy densities before and after insecticide sprays, and throughout the growing season in conventional and organically managed

Herbivore-induced plant volatile (HIPV) lure to attract natural enemies in orchards.

PHOTO BY ANGELA GADINO

Syrphid fly (hover fly) adults feed on pollen. However, their larvae are effective aphid predators in orchards.

PHOTO BY CALLIE BAKER

Ladybug pupa—the last stage before the adult ladybug emerges.

PHOTO BY ANGELA GADINO

Ladybug larva feeding on woolly apple aphids.

PHOTO BY ANGELA GADINO

A predatory true bug *(Deraeocoris brevis)* feeding on aphids.

orchards. We found that natural enemy abundance is linked to the type of pesticide products used in an orchard as well as to application timing.

Overall, programs using harsh pesticides and repeated applications tend to have lower numbers of natural enemies and are less diverse than programs using softer products and fewer applications. Natural enemies are not all the same; they have very different life cycles, prey on one or multiple pest insects, and have varying degrees of sensitivity to insecticides. Therefore, decisions about the timing and type of insecticides used should not only be based on pest biology, but also on associated natural enemies.

Models

Monitoring has allowed us to determine when natural enemies are present in orchards and to develop phenology models for some of the most important species. These models, the subject of the next article in this series, will allow growers to predict times when natural enemies are most vulnerable to sprays. Based on natural enemy monitoring and predictive models, a grower may choose to alter spray timings or select less harmful pesticides when natural enemies appear most active and abundant. For example, if HIPV lures capture large numbers of green lacewings, which primarily eat aphids, using a more selective product for codling moth control can help preserve the lacewing population and in turn prevent outbreaks of aphids that would require additional sprays.

In 2012, six crop consultants from north central Washington and the Yakima area volunteered to use the lures to monitor green lacewings in commercial orchards. We received valuable feedback on the general ease of use, comprehension of the trap catches, and the overall value of the information gathered from using lures. We plan to recruit more volunteers in 2013, and use grower input to improve the utility of the lures for natural enemy monitoring and pest management planning.

In addition to using lures for monitoring, we are working towards the incorporation of HIPV lures into management programs as another tool to directly increase biological control and suppress pest populations in orchards. Based on recent studies, we know that some natural enemies can travel considerable distances and are much more mobile than we had previously thought. We've also determined that natural enemies are responding to HIPV lures within a matter of hours in some cases. Knowing this, we are currently focused on using the lures to attract and move natural enemies to areas with high pest pressure and to repopulate areas where natural enemies have been depleted by pesticide residues or other disruptions.

Sole reliance on chemical insecticides for pest suppression in orchards is economically and ecologically costly, and has the potential to wipe out natural enemy populations. When beneficial insects are preserved, they do a good job at keeping pests in check and should be considered when making management decisions. By combining monitoring tools with selective pesticides, lower insecticide rates, mating disruption, and use of WSU's Decision Aid System, growers can reduce residues on fruit, lower overall costs, and improve orchard worker safety. HIPV lures/traps are still in the experimental stage, but it is hoped that with more industry involvement, they will be available for commercial use in the near future. ●

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