Beneficials beyond the greenhouse

Photo 1. Predatory midges are natural enemies of aphids. Here they are shown being hatched as part of an OSU study on the effect of releasing beneficial insects in Willamette Valley Christmas tree farms.

Scientists track the use of predatory insects for aphid control in Christmas tree farms

By Ryan Hill, Chal Landgren and Jana Lee

Many growers aspire to control aphid populations on field-grown conifers through the use of beneficial insects.

But unlike greenhouse releases of beneficial insects, which happen in an enclosed space, field releases suffer from a number of inherent problems. It is challenging to design studies that can confirm exactly what works best for a given crop in various regions.

In the summer of 2014 we began an observational study of aphids in Christmas tree plantations in the Willamette Valley. Our fundamental question was, can we limit aphid damage in Christmas trees by releasing and/or attracting beneficial insects?

For many Christmas tree growers, the 2013 growing season exhibited some of the worst aphid damage of the past decade, leading to increased insecticide applications. Sensitivity over bee deaths due to pesticide application has raised interest in alternative pest control strategies for a range of field-grown crops.

After reviewing numerous options for biological control of aphids in conifers and consulting with practitioners, we selected three natural enemies of aphids for field release:

- *Aphidoletes aphydimyza* (pred- ▶

An ongoing series provided by Oregon State University in collaboration with the United States Department of Agriculture and in partnership with OAN

Photo 2. Another beneficial insect, green lacewings were released as eggs on sticky cards attached to the limbs of noble fir trees. Adults prey on mites, aphids and other small arthropods.

atory midge). Our target release was 10,000/acre. The midges arrived as larva and were released as adults (Photo 1) within days of hatching.

• *Aphidius matricariae* (small parasitic wasp). Our target release was 2,000/acre. The initial release of adults was 400/acre, then 600/acre, then 1,000/acre.

• *Chrysoperla rufilabris* (green lacewing). Our target release was 5,000 eggs/acre, released on sticky cards (Photo 2) spread around fields. Fondren et al. (2004) suggested that a release of this generalist predator could lower aphid populations in Fraser fir Christmas trees.

The releases were conducted in three stages, which took place the first week of May, the middle of May, and the first week in June.

Another way to improve biological control of pests is to attract natural enemies into the field. Plants release volatile chemicals when insects feed on them. These odors can attract natural enemies. Methyl salicylate is one common plant-produced odor, which is available as a commercial lure (Predalure™).

In addition to the natural enemies, we also dispersed 15 Predalure tabs/acre (Photo 3). Methyl salicylate has shown some potential for being an effective component of an integrated pest management strategy, although its ability to improve pest management is not always clear (Rodriguez-Saona et al., 2011).

Sites and evaluations

We released natural enemies at eight Christmas tree sites which were planted with a mix of noble and Grand fir. The treatment areas varied from one to four acres. We paired green lacewing and midges at five sites (Photo 4). At three sites, we paired the release of parasitic *Aphidius* wasps with Predalure.

For the sake of comparison, we included non-release control sites at nearby and adjacent tree fields. The final release counts on one site varied somewhat from our target rate: this four-acre field received only 30,000 *Aphidoletes*, rather than the desired 40,000.

Starting June 8, 25 random trees

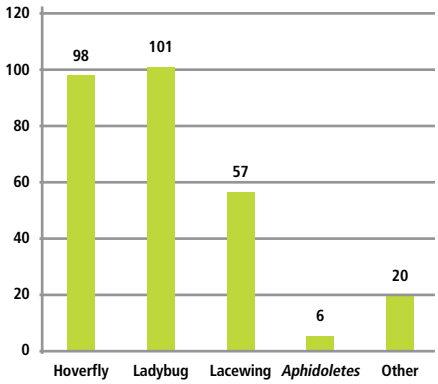

Figure 1. Counts for all beneficial insects observed during the duration of the study.

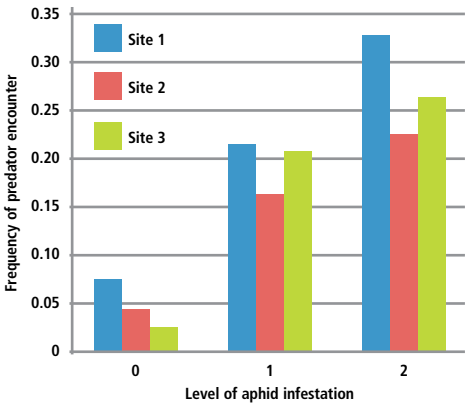

Figure 2. Frequency of predator encounter based on aphid infestation level for the sites with highest aphid counts.

per acre at each site were inspected every two weeks until mid-August, such that each site was scouted five times. During inspection, each tree was evaluated for live aphid presence on the trunk as well as new and older needles, on a scale ranging from 0 (none), 1 (1–20 aphids), and 2 (20+ aphids).

Mummified eggs and the presence of cast aphid skins were recorded for presence or absence. Visual damage from aphids was rated from 1–4 (1 = none, 4 = heavy aphid population), and all aphid predators were tallied when found.

Observations

At the end of the study, all observed predators were tallied for all sites (Figure 1).

Ladybugs and hoverflies turned out to be the most common aphid predator identified. Neither was part of our releases, which suggested that naturally occurring beneficial insects could have a positive role in Christmas tree fields. ▶

DIGGER Marketplace

Photo 3. In addition to the beneficials, researchers also dispersed a commercial lure (Predalure™), which contains methyl salicylate. The chemical has shown some potential for being an effective component of an integrated pest management strategy.

Photo 4. Two of the eight sample study sites where beneficials were released. The treatment areas, which varied from one to four acres, were planted with a mix of noble and Grand fir.

Released lacewings were the third most commonly observed beneficial. Mummies from *Aphidius* wasp activity were never observed, and *Aphidoletes* midge predators were rare (the small size of *Aphidoletes* made it difficult to identify). Other insects that were found included minute pirate bugs, damsel bugs, stilt bugs, predatory mirids and soldier beetles.

Of the eight fields, only three sites showed increasing aphid populations during the summer. Of these fields, all had more natural enemies observed on trees with higher aphid infestations (Figure 2). *Aphidoletes* midge and green lacewings were released at these sites.

Further study is necessary to find a method for increasing the efficiency of each treatment. This may include testing the species separately, altering release times or release methods (releasing adults, eggs or larvae).

The five fields that did not have severe aphid infestations still contained beneficial insects. Also, three of the five fields that had low aphid populations were treated with the *Aphidius* wasp and Predalure, though almost no *Aphidius* activity was observed. Predalure may have potential, though the lack of aphid activity in general limited our ability to draw conclusions on effectiveness.

Sadly for our trial, 2014 was not a problem year for aphids across the region. We can speculate as to why, but this observational study was a first step to see if we could find signs of activity from the released natural enemies within fields.

Conclusions

Most of the aphid predators we observed were not from our releases; therefore, enhancing these existing predators is worth looking into.

Conservation techniques, such as planting native floral vegetation, can help sustain these predator populations with pollen, nectar and alternative non-pest prey before pests are available in the field.

Among the predators we did release, lacewings were the most numerous. We have no way to determine if the lacewings we found hatched from eggs

we placed on trees, but releases of these beneficial insects are straightforward and deserve additional review.

Evaluating the impacts from *Aphidius* wasp releases and Predalure was difficult. A study of releases on smaller sites with adequate spacing from homogenous control sites would be necessary to draw firmer conclusions.

Ryan Hill is studying biology at George Fox University and was a summer student intern funded by an OAN/ODA research grant in 2014.

Chal Landgren is a professor in the Department of Forest Engineering, Resources and Management at Oregon State University, and is the OSU Extension Christmas tree specialist at North Willamette Research and Extension Center. He can be reached at Chal.Landgren@oregonstateuniversity.edu.

Jana Lee is a research entomologist at the USDA-ARS Horticultural Crops Research Unit, which focuses on the biology of ornamental and small fruit pests, and biological control.

Special thanks to Glenn Ahrens, Michael Flores, Amy Grotta, Mary Halbleib, Gayla Hansen, Paul Jepson, Jeff Parson, Judy Kowalski, Betty and Pat Malone, John Mauer, Rod McNiel, Terry Muilenburg, Tom Norby, Robin Rosetta, Victoria Skillman and Ric Sward for helping in this investigation.

This project was funded by a grant from the Clackamas OSU Extension Innovation Fund.

References

Fondren, K. M., Walter, A. J., & McCullough, D. G. (2004). Insect predators and augmentative biological control of balsam twig aphid (Mindarus abietinus Koeh) (Homoptera: Aphididae) on Christmas tree plantations. *Environmental Entomology*, 33(6), 1652–1661.

Rodriguez-Saona, C., Kaplan, I., Braasch, J., Chinnasamy, D., & Williams, L. (2011). Field responses of predaceous arthropods to methyl salicylate: A meta-analysis and case study in cranberries. *Biological Control*, 59(2), 294–303.

DIGGER Marketplace