

Annual Results

SW99-061

Enhancing Biological Control with Insectary Plantings

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SUMMARY

This project comprises a large-scale investigation of aphid and hoverfly distribution in commercial broccoli that contains blocks of alyssum. The assessment includes spatial distribution of aphid and hoverfly eggs relative to flowers, hoverfly egg numbers on aphid-baited plants and adult numbers in pan traps.

Higher numbers of eggs were laid on plants close to the flower blocks, but this trend was not apparent in pan traps. Progress has been made with hoverfly culturing, and an experimental regime has begun to investigate predator-prey interactions. Analyses are continuing on threshold aphid densities for oviposition and patterns of response of ovipositing females to aphids.

OBJECTIVES

The three overall objectives of this SARE-funded research project are to:

1. Evaluate the relative attractiveness of selected insectary plants to entomophagous arthropods and key insect pests
2. Evaluate the potential of using beneficial insectary plants to enhance biological control of specific insect pests in broccoli production systems, including the cabbage-aphid complex and the worm complex
3. Develop an educational program to integrate beneficial insectary plantings into various farm operations to enhance biological pest control

This year's report focuses on work associated with Objective 2, which has these objectives for the 2001 season:

1. Quantify the within-field effect that added flowering plants have on the attraction and oviposition activities of hoverflies and on the abundance of other arthropod natural enemies and herbivores in broccoli
2. Evaluate the prey-finding and oviposition behaviors of adult hoverflies in commercial broccoli fields
3. Evaluate the ability of hoverflies to limit populations of aphids on single plants in controlled cage and field experiments

ACCOMPLISHMENTS/MILESTONES

Objective 1. This experiment was set up on the Stahlbush Island Farm 3 kilometers east of Corvallis. A block of broccoli 18 meters wide (20 rows) running the length of the field (400 meters) was left untreated with aphicides (Provado 43 days after transplant and Pynin 67 days after), which were applied to the rest of the field. Within the untreated strip, two insectary flower plots, 18 by 18 meters, of alyssum seedlings were planted 24 days after broccoli transplant. Bait plants of potted broccoli containing cabbage aphid colonies were set out at varying distances from the plots in transects radiating in each compass direction from the flower plots. Pan traps were set out oriented directly with the bait plants.

Counts showed that hoverfly eggs first appeared in low numbers two to three weeks before harvest, but they did not appear on broccoli plant leaves in any quantity until a week before harvest. There was also a trend toward greater oviposition at distances closer to the flowers on the final sampling date. Most of the eggs were either *Eupeoides fumipennis* or *Sphaerophoria sulphuripes*.

Hoverfly eggs appeared on the bait plants at about the same time as on the broccoli crop. However, there was no increase in oviposition on leaves at sampling points closer to the flowers, an observation that held for both blocks and in all transect directions.

In the pan traps, hoverfly adults appeared only after alyssum flowers were planted, with large numbers found after the 6th sampling date two weeks later. At this time in the broccoli crop season, the capture rate peaked at distances 5 meters from the flowers and gradually decreased out to 80 meters. Traps at 0 to 1 meter from the flowers trapped fewer flies on that date. Also, 90% of the flies captured on this date were *Toxomerus marginatus*. Data from the final three trap dates have yet to be processed.

Of the 192 broccoli heads sampled in the no-aphicide strip, only 7% contained aphids, and none of these had more than 10 aphids. Also, there was no effect with distance from flowers.

Objective 2. The oviposition behavior of hoverflies in relation to aphid distribution was assessed with these questions in mind: 1) How many aphids per leaf, or per plant, are needed before hoverfly eggs are seen? 2) At what aphid densities are the peak numbers of hoverfly eggs observed? 3) If these thresholds and peaks exist, do they vary by hoverfly species, by aphid species, by aphid colony type, by field site or over time? 4) Does this oviposition response vary on different parts of the broccoli plant? 5) How are the different aphid species distributed on different parts of the broccoli plant, especially at the end of the season?

Data were gathered from Stahlbush Island Farm every four days until harvest beginning 25 days after broccoli transplant. The project team expects to finish processing the data by spring 2002, but certain trends are already evident. One is that plants with fewer than 50 aphids had no hoverfly eggs. No such threshold has been seen for individual leaves – many leaves with no aphids had hoverfly eggs. Also, no peaks were seen in oviposition response per leaf or per plant. But a sustained increase in the number of eggs was observed with an increasing number of eggs.

Objective 3. This trial was done in a greenhouse. But no reliable were obtained because of problems with larval mortality and migration from plants. For those plants where larvae did remain on the plants, the maximal aphid mortality was 48 aphids in the first 12 hours of the experiment. The project team is continuing to find the best ways to examine the ability of locally occurring hoverfly species to limit aphid populations on broccoli. Early results demonstrated that a combination of glasshouse conditions and host plant quality (particularly the removal of most leaves) affect hoverfly larval survival. The researchers will try to enhance the microclimate and improve the colonization and survival rate of larvae by using clip cages for an initial period of acclimation.

“This technique could provide valuable, quantitative insights into the rate and pattern of hoverfly predation, interactions with other predators and the ability of hoverflies to limit aphid population growth and the colonization of broccoli heads,” says the project’s annual report.

IMPACTS AND CONTRIBUTIONS/OUTCOMES

Late-season predation of cabbage aphids by predacious hoverflies could suppress the aphids and prevent their contaminating broccoli heads. So far, the SARE research team has documented high numbers of predacious hoverfly eggs in broccoli before harvest and developed methods to identify the key predacious hoverfly species. The team has been unable to demonstrate that planting insectary flowers on the margins or within fields enhances the biological control, but it has made strides in understanding the key oviposition behavior of *Eupeoides fumipennis*, the major predacious hoverfly species in Oregon broccoli. There appears to be an “ovipositional threshold” of about 50 aphids per plant required before adult female hoverflies will begin to lay eggs on broccoli plants.

An Oregon State University Experiment Station bulletin on identifying predacious hoverflies in Oregon farmland is planned, as are three to five manuscripts to be submitted to refereed journals during 2002.

While Stahlbush Island Farm planted beneficial insectary flowers on more than 200 acres of broccoli in 2001, the researchers, because they have yet to document beneficial impacts, have not pursued an educational program to encourage grower adoption.