Beneficial Insect Habitat Enhances Ecosystem Services for Agriculture

The University of California, Berkeley
Lora Morandin and Claire Kremen

The Xerces Society for Invertebrate Conservation
Eric Mader, Jennifer Hopwood, Mace Vaughan, and Scott Hoffman Black

Introduction

Creation of beneficial insect habitat to increase pollination and biological control is receiving increased interest from farmers, conservation districts, and the NRCS because of the NRCS Organic Initiative, National Organic Program rules about improving on-farm biodiversity, and a growing interest in pollinator-safe pest management.

Hedgerow restoration offers a promising method for increasing beneficial insects and ecosystem services in intensive agricultural landscapes. However, while hedgerows are relatively easy to create and manage, there is little information documenting how floral enhancements along farm edges affect native pollinator communities, natural enemies, and pests.

Here we describe results from a CIG-funded project where we assessed pollinators, pests, and natural enemies (i.e., predators and parasitoids that attack crop pests) to document how mature hedgerows increase beneficial insect abundance and diversity, and the impact of these insects on pollination and pest control in adjacent fields.

We also provide a summary of guidelines we are writing for the NRCS, farmers, and conservation partners on Conservation Biological Control and how beneficial insect habitat may be incorporated into farm landscapes.

Conservation Biocontrol Guidelines

In order to help put beneficial insect habitat into practice, we are collaborating with scientists across North America to develop a new set of guidelines for recognizing beneficial insects and creating their habitat in farm landscapes.

When complete in September 2012, these guidelines will help farmers and conservation planners understand the value of the natural enemies of crop pests, recognize these beneficial insects and their diverse habitats, and ultimately provide guidance for how to create habitat and protect these insects from farm pesticide and management practices.

These new guidelines include numerous case studies of how farmers and scientists are creating habitat around the United States, as well as profiles of important plants, details about the biology of key pest predators and parasitoids, strategies for adding habitat to farms, and resources for more detailed regional information.

Hedgerows for Biological Control

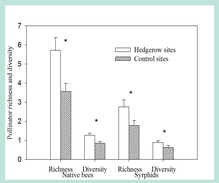
In 2009 and 2010, scientists at the University of California, Berkeley worked in Yolo County, in the Central Valley of California, to document how **mature, native perennial plant hedgerows (>8 yrs post planting)** affected populations of beneficial insects.

Four mature hedgerows and four control sites were monitored each year. All sites were adjacent to processing tomato fields.

Pollinators

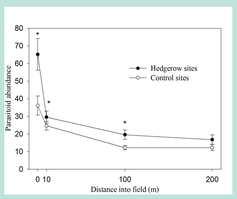
In this study, bees and syrphid flies (hover flies) were more abundant in hedgerows than control edges.

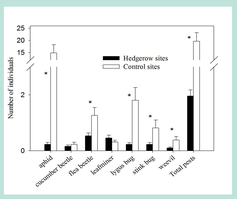
Native bee and syrphid flies were also more species rich and diverse at hedgerow sites compared to control sites.



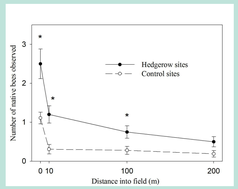
Natural Enemies and Pests

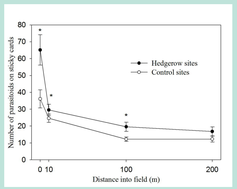
Predatory arthropods showed little difference between controls and hedgerows. However, parasitoids were more abundant in hedgerow edges and in adjacent fields than at control sites. Aphids and most other pest groups were less abundant in hedgerow vegetation than in control edges.





Hedgerows were also **net exporters of native bees and parasitoids** to adjacent fields. They did not concentrate these insects away from fields.



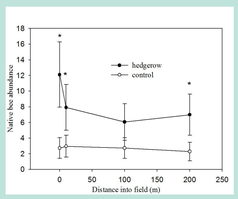


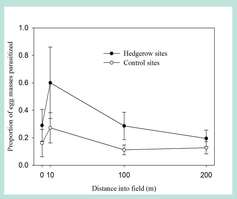
Hedgerows also did not concentrate ambient managed honey bee populations away from crop fields.

Pollination and Pest Control

More native bees visited sentinel plants that were adjacent to hedgerow sites than control sites.

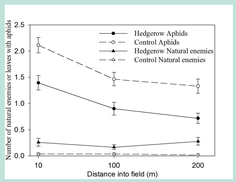
Parasitism of stink bug sentinel egg masses was greater in hedgerows and adjacent fields than at control sites.





Crop Assessments

Aphid abundance was lower on tomato leaves at hedgerow sites compared to control sites. However, pest damage was low in all fields and not different between hedgerow and control sites.



Economic Analysis

Long-term cost/benefit of hedgerows using (1) the **cost of establishment** and upkeep, (2) benefit from **fewer pests and insecticide applications**, and (3) **pollination increases** are being explored.

We still have data to collect on potential seed set increases. However, based only on **cost savings from reduced pesticide usage**, early analysis suggests that costs can be returned within 6 to 9 years depending on whether a cost-share program such as EQIP is used.

Summary and Conclusions

- Hedgerows **support a diversity** of pollinators and natural enemies in intensive agricultural landscapes.
- Diverse native plantings support fewer pests and these native plants are preferred by bees.
- Perennial native plant hedgerows act to **export not concentrate** beneficial insects.
- **Pollination services by native bees** and **pest control by parasitoids was greater** up to 200 m into fields adjacent to hedgerows.
- Costs of perennial hedgerows can be recouped within 10 years of planting and are a **cost-effective way to enhance biodiversity and ecosystem services** in intensive agricultural landscapes.
- **New guidelines** will soon be available on creating habitat that supports pest management.

Acknowledgements

Special thanks to the farmers who allowed us to work on their farms and to the Yolo County RCD. Thanks also for financial support from the NRCS CIG program, the CS Fund, Turner Foundation, Panta Rhea Foundation, Columbia Foundation, Goldman Foundation, Gaia Fund, and Disney Worldwide Conservation Fund.