LEOPOLD CENTER
FOR SUSTAINABLE AGRICULTURE

Optimizing buffers strips for improved ecosystem services

Abstract: The project objective is to enhance delivery of insect-derived ecosystem services provided by perennial buffers through a strategy of combining research and outreach.

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Budget:
$38,312 for year one
$32,876 for year two
$4,825 for year three

Q Are the current buffer strips and conservation practices found in agricultural landscape optimal for improving the abundance and diversity of beneficial insects? If not, what is the best bet for a habitat that could conserve beneficial insects?

ECOLOGY

A Generally, existing buffer strips play a positive role but are not optimal. The best habitat would be buffers that use native flowering forbs that are attractive to beneficial insects in a mixture that provides a flower resource throughout the growing season. A higher density of highly attractive native species is better for beneficials than a high diversity of native species.

Background

The project investigators seek to understand how perennial vegetation can improve conditions for crop production, specifically through the delivery of pest suppression and pollination ecosystem services (i.e., insect-derived ecosystem services). Plant diversity is an important factor in determining the diversity of higher trophic levels, including insects that mediate ecosystem services. Beneficial insects can mediate ecosystem services through biological control of herbivorous pests and pollination. Habitat management practices that incorporate non-crop vegetation into agricultural landscapes can affect the amount and timing of insect-mediated ecosystem services necessary for successful crop yields. Native perennial plants attractive to beneficial insects may improve the value of buffer strips by contributing to local biodiversity and enhancing the delivery of insect-derived ecosystem services.

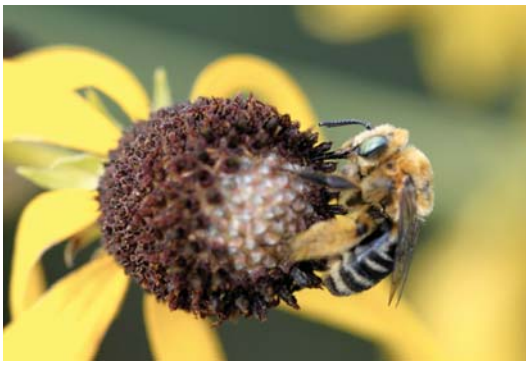
The goal was to determine the optimal composition of perennial plant communities for buffer strips that could enhance beneficial insect abundance and diversity. The researchers hypothesized that diversity and abundance of beneficial insects will be:

1. greatest in diverse plant communities with continuous availability of floral resources,
2. intermediary in plant communities reduced in species richness and availability of floral resources, and
3. lowest in plant communities composed of single species.

The project investigated whether current recommendations for conservation and current components of the Iowa landscape are attractive to beneficial insects. These components were compared to a "best practice" approach based on using native plants found in prairies (for details see: www.nativeplants.msu.edu).

Approach and methods

The team conducted two field experiments in 2010 and 2011 that compared multiple



options for buffer construction to improve the level of ecosystem services delivered to crops (Field experiment 1) and measured the response of beneficial insects to existing buffers found in the central Iowa landscape (Field experiment 2). Using data from these experiments, growers were informed about the potential to improve buffer performance through conservation with native plants.

Field experiment 1: Evaluated multiple buffer options (nine different plant communities) established in 2009. These options represented degrees of plant diversity and included a 'Best bet' mixture of native forbs and grasses attractive to beneficial insects; a prairie plant mixture recommended for Iowans enrolled in the Conservation Reserve Program; switchgrass, as a possible biomass crop that may harbor beneficial insects; alfalfa, a forage crop; willow, a woody perennial; and five other plant communities. In fall 2009 the team established nine treatments (different plant communities) composed of single and multiple plant species of varying attractiveness to beneficial insects.

Field experiment 2: Described the beneficial insect community in buffer strips already established on organic farms and in the land adjacent to these buffer strips. Data collection occurred in June, July and August 2010 and 2011 across four sites in central Iowa. During each sampling, insects were collected at measured distances (50m) along 400m replicated transects across a landscape matrix that included: (1) organically operated, mixed vegetable farms; (2) non-crop, multiple-species, perennial buffer strips; and (3) conventionally managed, corn-soybean monocultures.

Results and discussion

In field experiment 1, the research determined that a habitat comprised of the 'best bet' mixture of native plants increased the diversity and abundance of beneficial insects. Furthermore, this habitat improved upon 1) those constructed from existing recommendations for reconstructing prairie and 2) those plants that already exist in the Iowa landscape (corn, alfalfa, switchgrass, willow). The plants used in the 'best bet' mixture are not a common component of existing buffers on organic farms. In field experiment 2, on-farm research showed that established buffers contain more types of beneficial insects than what is found in the adjacent organic or conventional farms, suggesting that maintaining perennial buffers can enhance insect-derived ecosystem services in the Iowa landscape. These data indicate that insect-friendly improvements to buffers need to focus on constructing habitats that are not necessarily designed for maximum plant diversity, but on abundance of key plant species that in total provide flowering resources throughout the growing season. Moving from a habitat with one species to including as few as two flowering, late spring and summer species can make a measureable, positive insect-friendly difference.

Implementation of these research findings would improve the capacity of buffers to enhance insect-derived ecosystem services in bordering agricultural lands. The research suggests that both organic and conventional farms could benefit from improved buffers. Buffers already are required for organic certification and there is interest in improving these buffers for beneficial insects by organic farmers, who would benefit greatly from insect-derived ecosystem services such as pest suppression. The

value of this research is not limited to organic farmers and their neighbors. "Best practices" are needed to conserve all declining pollinators.

Conclusions

Results from the field experiments indicate that:

1. Plant communities that dominate existing buffer strips and lands designated for conservation are generally not optimal for beneficial insects;
2. Adding flowering perennial forbs improved buffer strips as habitats for beneficial insects, especially pollinators;
3. Buffer strips can be further optimized by intentionally combining native species that are highly attractive to beneficial insects at modest levels (i.e., only two very attractive plant species) such that flowering resources for pollen and nectar are available throughout the growing season;
4. Established buffers on organic farms house more beneficial insects than adjacent conventional crop fields (although the organic buffers are not consistently more or less populated than the organic croplands they border); and
5. Conservation of beneficial insects appears to be more a function of the density of key species than a general increase in the diversity of native plants species.

Impact of results

The researchers have shared the project findings at several venues for both fellow scientists and the general public. One example is a recent meeting hosted at Iowa State University at the request of the Environmental Protection Agency. At this meeting, representatives from EPA, USDA, and NRCS of Iowa shared recent findings about the decline in pollinators within Iowa and the Midwest and considered ways to conserve them. Iowa NRCS staff expressed interest in incorporating these findings into outreach efforts to generate greater public interest in pollinator conservation.

Education and outreach

A M.S. thesis was written by an ISU entomology graduate student on conserving beneficial insects. Two journal articles for *Environmental Ecology* are being prepared. Four articles have appeared in newsletters and in a state report on soybean aphid.

The investigators gave oral presentations, talks and poster presentations at

- The Ohio State University, Ohio Agriculture Research and Development Center, Wooster, Ohio
- Yunnan Agricultural University, Kunming, Yunnan Province, China
- 67th Annual Conference of the Entomological Society of America, North Central Branch, Lincoln, Nebraska
- Entomology seminar series, Iowa State University
- 59th Annual Conference, Entomological Society of America, Reno, Nevada
- Field Extension Education Laboratory, Boone County, Iowa
- 66th Annual Conference of the Entomological Society of America, North Central Branch, Minneapolis, Minnesota
- Sustainable Agriculture Graduate research symposium, Iowa State University, Ames
- 58th Annual Conference, Entomological Society of America,San Diego, California

Leveraged funds

This project was used to leverage $201,583 from Pioneer Hi-bred International, resulting in a 2.63 return on the investment by the Leopold Center. Before this project was funded by the Leopold Center, limited research was being conducted at ISU on pollinators, especially those pollinators within field crops such as corn and soybean. Thanks to funding from this project, the PI was able to train a graduate student in entomology whose skills with pollinator ecology and identification proved attractive to several stakeholders.

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