



# Beneficial insect habitat in an apple orchard—effects on pests

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Apple orchards attract many kinds of insects that damage vegetation and fruit. But these orchard pests have insect enemies of their own. Growers can provide habitat for these natural enemies, also known as beneficial insects, as part of an integrated pest management (IPM) strategy that reduces the need for pesticides.

Paul Whitaker and Dan Mahr of the UW-Madison Entomology Department studied habitat for beneficial insects at Turkey Ridge organic apple orchard near Gays Mills, Wisconsin. They planted flowering perennial plants to attract natural enemies and recorded insect population trends. They found that the presence of habitat plantings correlated with increased diversity and numbers of natural enemies, and, in some cases, reduced the populations of certain pests. But other factors were also important in determining pest abundance.

The researchers selected an organic orchard because they assumed insect abundance would be higher than in a conventional orchard, allowing them to better measure changes in insect populations. A USDA Hatch grant for agricultural research and the Organic Farming Research Foundation supported this project.

The researchers set up 16 pairs of habitat and control plots at Turkey Ridge. Each 7m by 50m plot consisted of two adjacent rows of 10 trees. In July 1994, they planted buckwheat and rye in the plots to reduce weed pressure. A year later, they transplanted habitat seedlings.

### Plant selection

“Because insect activity in apple orchards begins before spring bud-break and continues past harvest, we selected plants that would attract natural enemies throughout the growing season,” says Mahr. The researchers selected perennials because they require less management than annuals once established, and provide undisturbed habitat for insect overwintering. In addition, perennials made it possible for the habitat plantings to begin blooming earlier in the season than if annuals had been used.

Most research on beneficial insect habitat has been carried out on annuals, and the few

perennials that have been studied are not hardy in Wisconsin or are impractical for use in a commercial orchard. Whitaker and Mahr therefore designed their own habitat planting.

“We evaluated plant species according to several criteria that made them good choices,” says Whitaker, “and found that many native prairie wildflowers met our criteria.” The table on page 2 shows the plant species they chose. Selection criteria included:

- relation to species known to attract natural enemies;
- open flower structure and height 30-120 cm;
- at least one species in bloom at any given time during the growing season; and
- adaptation to local soils, climate, full sun.

### Insect response

Whitaker and Mahr sampled insects in the plots during 1996 and 1997. They found that habitat plots enhanced the abundance of most natural enemies on most dates. The differences in populations of specific natural enemies on specific dates between the habitat and control plots were not always statistically significant, however.

**Apple aphids**, which feed on foliage and stems throughout the growing season, can be controlled by native insects like lady beetles and lacewings. Aphid abundance throughout the study was among the lowest ever reported in published orchard research, but aphid populations were surprisingly greater near the habitat plots. Natural enemies were more populous in the habitat plots, but it is unclear whether this was due to the habitat plantings or the higher numbers of aphids there.



*Beneficial insect habitat (center, above) may offer a way to cut back on pesticide use.*

**Obliquebanded leafroller** caterpillars damage both apple foliage and fruit. Many natural enemies of this pest parasitize its larva. In 1996, habitat and control plots did not have significantly different levels of predation, parasitism, or disappearance of larvae, but parasitism reached 80% for both habitat and control plots, perhaps the highest ever reported for obliquebanded leafroller. In 1997, overall parasitism and parasitism by a tachinid fly were higher near the habitat plots than the control plots. Parasitism by wasps was lower near habitat plots than control plots in one generation and higher in the next.

**Spotted tentiform leafminer** can cause loss of foliage and reduce fruit size. Small wasps parasitize and kill their larvae. This pest was too scarce to sample in four of the six generations during this study. For the remaining generations, neither parasitism rates nor parasitoid diversity were affected by habitat plantings.

**Codling moth** larvae bore into fruit, causing wormy apples. Codling moth fruit damage at harvest was higher and more overwintering larvae were recovered adjacent to habitat plots; both measures decreased during the second year of the study. No parasitoids were recovered from larvae collected.

## Explaining the results

“We saw few significant differences between habitat and control plots,” said Mahr, “but we saw several unusual results.” Particularly surprising were the unusually low apple aphid and leafminer populations, high diversity of leafminer and leafroller parasitoids, extraordinarily high parasitism of leafrollers, a year-to-year decrease in codling moth abundance, and complete absence of parasitism in over 1,700 overwintering codling moth larvae.

Possible explanations for the results include:

- The spatial separation between habitat and control plots (20-60m) may not have been sufficient to prevent movement of natural enemies between the plots.

**Table 1. Plants selected for natural enemy habitat plots**

<b>Scientific name</b>	<b>Common name</b>	<b>Blooming Period in WI</b>
<i>Eryngium yuccifolium</i> Michaux	Rattlesnake-master	July-Sept.
<i>Levisticum officinale</i> Koch	Lovage	June-July
<i>Zizia aurea</i> (L.) Koch	Common golden alexanders	May-June
<i>Asclepias tuberosa</i> L.	Butterfly weed	June-Aug
<i>Aster ericoides</i> L.	Squarrose white aster	Aug-Oct
<i>Echinacea purpurea</i> (L.) Moench	Purple coneflower	July-Aug
<i>Heliopsis helianthoides</i> (L.) Sweet	Oxeye sunflower	June-Aug
<i>Euphorbia corollata</i> L.	Flowering spurge	June-Aug
<i>Potentilla arguta</i> Pursh	Tall potentilla	June-Sept
<i>Coreopsis lanceolata</i> L.	Longstalk tickseed	June-Aug
<i>Tradescantia ohioensis</i> Rafinesque-Schmaltz	Smooth spiderwort	June-July

- The cumulative effects of Turkey Ridge’s organic management—lower soil fertility, no synthetic insecticides, wider tree spacing, and numerous bird and bat houses—may have affected insect abundance.

- Turkey Ridge has a large planting of disease-resistant apple cultivars. Some of the unusual findings could have arisen from unidentified resistance to insect pests in these cultivars.

## Next steps

This study could not differentiate between the effects of habitat plantings and those of organic management and disease-resistant apple cultivars. However, a combination of these factors appeared to substantially enhance natural enemies and reduce populations of some apple insect pests. Future work is needed to identify the most important insect control factors and incorporate them into a viable management system for growers.

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