Beneficial Arthropod Survey in Transgenic and Non-Transgenic Field Crops in Ohio

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Objectives

Ohio is ranked seventh nationally in field corn and soybean production (*Agricultural Statistics, 1999*). Approximately 3.5 million acres of corn and 4.5 million acres of soybeans are planted in Ohio each year. In the last few years, transgenic field corn acreage (primarily *Bt* corn) has reached nearly 350,000 acres (personal communication, Hal Willson), and transgenic RR soybeans acreage has exploded to nearly two million acres (personal communication, Mark Loux, OSU weed science specialist). The purpose of this study is to determine if certain non–target organisms, especially natural enemies, are being negatively impacted by either loss of potential prey, feeding on prey that have consumed transgenic tissue, or by directly consuming transgenic tissue.

Background

Thirteen transgenic (6 *Bt* corn, 1 RR corn, and 6 RR soybean) and 11 non–transgenic (5 hybrid corn and 6 conventional soybean) fields were selected for this study in the northwestern, southwestern, and central parts of Ohio. Each region had two survey sites; each site contained a pair of transgenic/non–transgenic cornfields and a pair of transgenic/non–transgenic soybean fields. One pair of cornfields in Clark County actually consisted of a *Bt* hybrid and a non–*Bt* RR hybrid. The following is a list of the study sites by county, nearest town, and field type:

Site 1. Darke County, Greenville, *Bt*/non–*Bt* Corn and RR/non–RR Soybean fields.
Site 2. Miami County, Tipp City, *Bt*/non–*Bt* Corn and RR/non–RR Soybean fields.
Site 3. Clark County, Springfield, *Bt*/non–*Bt* Corn and RR/non–RR Soybean fields.
Site 4. Champaign County,Urbana, *Bt*/non–*Bt* Corn and RR/non–RR Soybean fields.
Site 5. Wood County, Cygnet, RR/non–RR Soybean fields.
Site 6. Van Wert County, Convoy, *Bt*/non–*Bt* Corn and RR/non–RR Soybean fields.
Site 7. Hancock County, Van Buren, *Bt*/non–*Bt* Corn fields.

Methods

Sampling in the soybean fields was accomplished using a sweep net and Pherocon AM yellow sticky traps. Weekly sweep–net sampling began at the end of June and was discontinued mid August after pod set. For the first two weeks, six locations in each field were swept (two at 100,

200, and 300 feet from the field edge). From the third week through the end of the study, only four locations in each field were swept (100 and 300 feet from the field edge).

Two Pherocon AM yellow sticky traps were deployed mid–July in the same soybean fields monitored with sweep nets. The traps were attached to posts above canopy level at approximately 100 and 300 feet from the field edge. Traps were collected and replaced with fresh ones every week. Sticky trap sampling was discontinued mid–August.

Sampling in field corn also relied upon the use of Pherocon AM yellow sticky traps, which were attached to the stalk of the corn plant near the ear. Placement of the first trap within the field was at least 24 rows into the field, with the second trap placed an additional 100 feet toward the interior of the field. Both sticky traps were changed weekly in each field starting at the beginning of July and ending around mid–August.

Beneficial insects and arthropods captured in sweep–net and sticky–trap samples were identified. The sweep–net data covered 14 categories, and the sticky–trap data included 15 categories. The following are the categories used to count the insects and the arthropods collected:

Coccinella septempunctata–7	Spotted ladybird beetle
Coleomegilla maculata	Cmac ladybird beetle
Harmonia axyridis	Multi–colored Asian ladybird beetle
Cycloneda munda	No–spot ladybird beetle
Orius sp.	Insidious flower bugs and Minute pirate bugs
Parasitoid wasps	(several families)
Spiders	(several families)
Mites	(several families)
Staphylinidae	Rove beetles
Carabidae	Ground beetles
Syrphidae	Hoover flies
Cantheridae	Soldier beetles
Nabidae	Damsel bugs
Chrysopidae	Green lacewings
Hemerobiidae	Brown lacewings

Differences in the transgenic/non–transgenic field–crop natural–enemy data were statistically analyzed by technique (sweep net and sticky trap) and by crop (soybean and corn) at each site. Site data were then combined into regional data, and the regional data then combined to look for study–wide effects. Statistical analysis of data includes two–sample t–test and non–parametric Mann–Whitney median tests. All tests of significance were conducted at $P = 0.05$.

Results

Sweep–net samples collected from each pair of transgenic and non–transgenic soybean fields revealed no statistical differences for any of the 14 natural–enemy categories compared (two sample t–test). Pooling the sweep–net site data into three regions (southwest, northwest, and central) revealed no statistical difference for any of the 14 natural–enemy categories (two sample t–test). Pooling all site data together revealed no study–wide statistical difference for any of the 14 natural–enemy categories (two sample t–test). Very few of the analyzed populations were normal in distribution; therefore, a Mann–Whitney non–parametric test was run on the sweep–net data set by site, region, and over the complete study. No statistical differences between the 14 natural–enemy categories were found.

Pherocon AM yellow sticky trap data between transgenic and non–transgenic soybean fields revealed a significant increase in the number of spiders in non–transgenic fields at Champaign County (two sample t–test). Comparisons of the remaining beneficial insect categories and other sites revealed no other statistical difference. Pooling site data into regions revealed no statistical difference for any of the 15 natural–enemy categories (two sample t–test).

Combining all site data together revealed a significant increase of green lacewing adults in non–transgenic soybean fields, but none of the other 14 natural–enemy categories (two sample t–test). Very few of the analyzed populations were normal in distribution; therefore, a Mann–Whitney non–parametric test was run on the sticky–trap data set by site, region, and over the complete study. Combining two sites in the central region showed an increase of spiders in non–transgenic fields. No other statistical differences between the 14 natural–enemy categories were found.

Pherocon AM yellow sticky–trap data between transgenic and non–transgenic cornfields revealed an increase of *Orius sp.* in transgenic fields at Hancock County (two sample t–test). Comparisons of the remaining beneficial insect categories and other sites revealed no other statistical differences. Pooling site data into regions revealed no statistical difference for any of the 15 natural–enemy categories (two sample t–test). Pooling all site data together revealed no study–wide statistical differences (two sample t–test). Very few of the analyzed populations were normal in distribution; therefore, a Mann–Whitney non–parametric test was run on the sticky–trap data set by site, region, and over the complete study. No statistical differences between the 15 natural–enemy categories were found.

Summary

Three of the six sites where both RR and conventional soybeans were planted used glyphosate herbicide for either burndown or post application. Two other sites were comparisons of RR soybeans and STS soybeans. Most soybean fields were planted no–till; all soybean fields were insecticide–free. Statistically, none of the 14 natural–enemy populations collected using a sweep net were different between transgenic and non–transgenic fields. There were statistical differences in the data collected from sticky traps. Populations of spiders at the Champaign County site and green lacewing adults study–wide were significantly higher in non–transgenic soybean fields. Weed populations in these fields are a major consideration affecting beneficial

insect populations in soybean fields. According to the sweep–net and sticky–trap data collected, it would appear that transgenic soybean plants have an overall neutral effect on the beneficial insects identified by this study.

Most cornfields utilized some type of minimum tillage, such as a field cultivator, and were untreated with insecticide except for three fields. Sticky–trap data from transgenic and non–transgenic cornfields revealed statistically higher *Orius sp.* at the Hancock County *Bt* corn site. Additionally, no–spot ladybird beetles, green lacewing adults, and mites were more numerous in transgenic cornfields. The remaining 11 categories of beneficial insects were higher in non–transgenic fields. More than 2,000 parasitic wasps were collected in non–transgenic cornfields, about 100 more than transgenic cornfields. Given the direct impact *Bt* corn has on European corn borer populations, various life stages of which are parasitized by several families of Hymenoptera, the effect of *Bt* corn on these organisms is minimal compared to conventional hybrid corn. This suggests the possibility that alternative hosts (prey) in these fields may be able to support them.

Of the 15 beneficial arthropods identified, there are only a few instances where any statistical difference between transgenic and non–transgenic field crops could be detected. There are instances where specific beneficial insects, both generalists and specialists, were found in greater abundance in transgenic or non–transgenic fields. Based on the data collected, very few negative impacts on beneficial arthropods may be associated with transgenic soybean and corn crops in Ohio.

Acknowledgment

We would like to thank the Champaign, Clark, Darke, Hancock, Miami, Van Wert, and Wood county Extension agents who helped identify the fields necessary for this study.

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