

Effect of Habitat Modification on Biological Control of European Corn Borers in Bell Peppers

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Introduction

Pest management practices for vegetable growers are becoming more diverse with the adoption of integrated pest management (IPM). One component of IPM is biological control using supplemental releases of natural enemies to control a pest. This should result in a reduction in pesticide use and preserves natural enemies of other insect pests in the field.

The European corn borer (ECB), *Ostrinia nubilalis*, presents a unique problem to pepper growers as the primary pest for the crop. The larvae tunnel below the stem cap and enter the fruit to develop and pupate. Once inside the fruit, it is impossible to control using pesticides. Timing is therefore crucial for all management options. The major damage is caused by mid- to late-season presence of the second and third generation ECB larvae in early July through late August.

As part of an ongoing study on the use of *Trichogramma ostriniae*, a parasitic wasp imported to control ECB in sweet corn, the University of Kentucky continued experiments to test biological control options for ECB in bell peppers. Previous studies at Virginia Polytechnic Institute and State University and the University of Kentucky have found significant reductions in ECB-infested pepper fruit by using this method. A new project to test the effects of habitat modification (providing a food source within the crop) on the performance *T. ostriniae* was carried out in 2005.

Materials and Methods

This study was conducted at five sites at University of Kentucky Research Farms in Lexington, KY: four replicates were located at the Spindletop Research Farm (North Farm) and one replicate at the Horticulture Research Farm (South Farm). A popular bacterial spot-resistant cultivar, 'Aristotle', was used for the experiment. Seeds were sown in the greenhouse at South Farm on 21 March and peppers were transplanted into raised beds with black plastic mulch and drip irrigation on 20 May (South Farm) and 24 May (North Farm). Beds were 6 ft. from center to center and 50 ft. in length. Two rows of 35 pepper plants were grown on each bed with plants spaced 12 in. apart in the row with 15 in. between rows. Each main plot consisted of two subplots of 5 beds (10 rows) each separated by 16 rows of sweet corn. Sweet corn was planted as a lure to attract ECB to the peppers and to buffer the effects of the treatments. Sweet corn was planted on May 27 at the North Farm and on June 6 at the South Farm.

The experimental design was a randomized complete block with a split plot arrangement of treatments. Main plots were *T. ostriniae* release and no release, while subplots were flowers and no flowers. For the flower subplots, 20 buckwheat (*Fagopyrum esculentum* Moench) plants were direct seeded on 3 ft. of plastic at both ends of the pepper beds to provide a nectar source and attract beneficial insects. The buckwheat was planted on 9 June, flowered within four weeks, and continued to flower throughout the experiment until the last harvest.

The two main plots in each replicate were separated by at least 1000 ft to prevent dispersal of *T. ostriniae* into control plots from release plots. Release plots were located downwind from control plots whenever possible. One replicate at the North Farm was separated by only 600 ft due to property boundaries.

ECB pheromone traps (Texas cone traps) were placed adjacent to each plot to monitor ECB moth flights. Traps were checked weekly and pheromone lures were changed monthly. Trap counts were recorded beginning on 16 June and continued until the week of the final harvest on 22 September. Sticky card insect traps were placed in the center of each subplot to gauge beneficial insect activity and determine if the flowers helped attract beneficial insects.

Trichogramma wasps were obtained from Cornell University. They were shipped overnight in parasitized *Ephestia kuehniella* eggs on cards. Each card contained roughly 16,000 parasitized eggs and each main (release) plot (0.034 acre) received one card per release. The release rate was roughly 464,640 *T.o*/acre/release. Cards were placed in the center of the plots enclosed in petri dishes with holes covered with fine mesh. This allowed *T. o.* to emerge while protecting the parasitized eggs from predation. Four release dates were established according to a degree-day model predicting egg-laying of second-generation ECB (Brown 1982). Initial releases began near the degree-day target for initiation of second-generation ECB egg-laying (15-18 July). Additional releases were made in coordination with the degree-day target for 25% (27-29 July) and 75% (10-12 August) completion of egg laying and one later release (26-29 August). since ECB activity was still considered steady.

Sentinel ECB egg masses were provided by the USDA Corn Insects and Crop Genetics Research Laboratory at Iowa State University. Twenty egg masses were placed on the underside of pepper leaves at regular intervals on the border rows of each subplot in both the control and release plots. The egg masses were in place at the time of *T.o.* release and collected within 48 to 72 hours. After removal from the field, these were stored in gelatin capsules for later determination of percent parasitism.

Peppers were harvested twice during the season. Peppers from different sites (blocks in the randomized complete block design) matured at different times and were harvested over a relatively long period: the first harvests were made from 28 July to 9 August while the second harvests were made from 11 August to 27 September. All rows except border rows were harvested in each plot. Marketable and unmarketable yields were recorded and marketable fruits were counted and graded according to USDA standards. Insect-damaged fruits were carefully dissected to determine ECB presence. Numbers of infested fruits were recorded as well as the number of ECB larvae found.

An additional harvest of was performed on border rows for each subplot on September 1. This was to gauge the impact of *T.o.* and flowers on fruits that had not been harvested since planting and were therefore exposed to potential ECB infestation throughout the season. A sample of 100 fruit from each border row in each subplot was examined for ECB presence.

Total marketable yields were compared among treatments. The number of ECB-infested fruits was compared according to treatment and effect of flowers present in the plots. The experiment was compared using analysis of variance; the arcsin of the square root transformation was used to analyze percentages of infested fruits.

Results and Discussion

The overall percentage of fruits infested with European corn borer appeared to be lower in the release plots than the control plots but this difference was not statistically significant when data were combined for both main harvests (Table 1). Overall, plots with flowers had lower ECB infestations than plots without flowers although this difference was also not statistically significant (Table 1). Very low ECB pressure throughout the season, especially in the later two generations, accounts for low ECB infestations in both treatments. Total marketable yields did not differ significantly between treatments which might be expected with low ECB activity. (Table 1)

A significant difference was found between treatments with flowers and those without flowers for the harvest of border row fruits (Table 2). Averaged over both release and non-release main plots, subplots with flowers had about half as many ECB-damaged fruit (2 %) compared to those without flowers (3.7 %, Table 2).

Percent parasitism of sentinel egg masses has not yet been determined. Predation of the egg masses will be a concern in estimating parasitism as it cannot be determined if the eggs were parasitized prior to removal by predators. Sentinel egg mass predation rates will also be determined to see if there is any correlation between the flowers present and the attraction of beneficial insects.

These data together with results from previous experiments indicate reductions in ECB infestations with *T.o.*; thus biological control of ECB in peppers remains a promising option for vegetable pest management. Companion planting also appears to be useful in reduction of ECB damage as it seems to increase natural enemies and aid *T.o.* activity. This is an ongoing study that has experienced low ECB presence in several years of experiments. Next year we will attempt to supplement the infestation by releasing ECB larvae into each plot and measure the effects of the *T. ostrinia* and flowers on an established pest population.

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Literature Cited:

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Table 1. Bell pepper yields and European corn borer (ECB) infested fruit from Control (no *Trichogramma* release) vs. *Trichogramma* Release plots and Flowers vs. No-flower treatment plots in Lexington, KY, 2005; data are means of five replications.

Treatment	Marketable		ECB-Infested Fruit	
	Yield (tons/acre)	Unmarketable Yield (tons/acre)	%	No./acre
Control	7.6	5.5	7.1	368
Release	8	5.9	4.0	266
Flower	---	---	6.4	368
No-Flower	---	---	4.8	266

Table 2. Percentages of European corn borer (ECB) infested fruit from harvest of border rows of Control (no *Trichogramma* release) vs. *Trichogramma* Release plots and Flowers vs. No-flower treatment plots in Lexington, KY, 2005; data are means of five replications.

Treatment	% ECB-Infested Fruit/acre
Control	3.3
Release	2.4
No-Flower	3.7 a ¹
Flower	2.0 b

¹Numbers followed by different letters are statistically different (P<0.05).