

Title: Exploring the Feasibility of Perimeter Trap Cropping for Striped Cucumber Management on Organic Farms

Project Leader(s): Abby Seaman, NYS IPM Program, Jeffrey Gardner, Sylvie Pitcher, and Michael Hoffmann, Department of Entomology, Cornell University

Abstract (no more than 100 words): Striped cucumber beetle (SCB) is a serious pest of vine crops, reducing yield and quality through direct crop damage, and by transmitting bacterial wilt. SCB is often cited by organic farmers as one of their most serious pests. Organic growers do not have effective cultural or chemical control methods for dealing with this pest. Perimeter trap cropping (PTC) is a cultural practice that is used successfully on conventional farms, but important questions need to be answered to determine if it can be adapted for organic farms. A key question is whether SCB deposit more eggs on the PTC than the main crop, and whether destroying the PTC after SCB has completed egg-laying effectively kills larvae feeding on the roots, reducing emergence of summer adults. Lower numbers of emerging adults results in less late season damage to fruit, and fewer adults overwintering could potentially reduce local populations over the long term.

Background and Justification: Striped cucumber beetle is a serious and persistent pest on organic farms. Overwintered adults reduce yields through feeding damage on direct seeded or newly transplanted cucurbits and by transmitting bacterial wilt to susceptible crops such as cucumber and melon. The summer generation of beetles can scar and damage developing fruit, rendering it unmarketable. Rotation, the most fundamental pest management practice on organic farms is not effective because of the insect's mobility. Cultural practices such as exclusion by row covers are feasible only on a small scale, and no insecticides currently approved for organic production are effective against SCB.

Perimeter trap cropping (PTC), in which a very attractive cultivar is planted around the perimeter of a less attractive cultivar to arrest beetles on the trap crop and reduce movement into the main crop, is a useful technique on conventional farms, where effective insecticides are available to kill adult beetle populations on the PTC. The technique has not been adequately developed for organic farms, where effective insecticides are not available to kill adults on the PTC. In this situation, the differential attractiveness of the main and trap crop must be enhanced by the use of feeding stimulants or visual attractants in or on the trap crop, and the use of feeding deterrents such as kaolin clay on the main crop to minimize damage to the main crop. Population reduction may be possible for the summer generation and subsequent years by destroying the PTC after egg-laying is nearly complete. Larvae feeding on the roots would die, reducing the number of adults emerging to feed on fruit later in the season, and reducing the number of beetles overwintering for the subsequent season. If a large proportion of eggs is deposited on the trap crop, reduction of the summer population would be enhanced. Our goal in this project is to determine whether more eggs are deposited on the PTC than the main crop, and to examine the impact of different techniques for destroying the PTC on larval survival.

Objectives:

- 1) Determine if SCB deposits more eggs in PTC plants.
- 2) Determine if disking the PTC kills SCB larvae in the soil.

- 3) Determine if mowing the PTC is sufficient to kill SCB larvae in the soil.
- 4) Project evaluation.

STCB trap crop methods 2010:

Procedures:

Black Beauty Zucchini (produced by Seeds By Design: sold by Siegers Seed Co. Holland, MI)- was seeded in the greenhouse on 4-27-2010 and transplanted to field on 5-25-2010. Marketmore 76 cucumber (produced by Hollar Seeds: sold by Siegers) was seeded in the greenhouse on 5-11-2010 and transplanted 6-02-2010.

Four blocks were planted, each with five 20 foot rows (spaced 12 inches between plants and 5 feet between rows) of cucumber surrounded by a double row of zucchini with 5 feet spacing between the cucumbers and the perimeter trap crop of zucchini.

Cucumbers only were sprayed with Surround on 6-8-2010. Sandea (herbicide) was applied on 6-15-2010.

Adult beetles were counted on both the trap and main crops on 6-17-2010, 6-21 and 6-29. A total of 20 plants were sampled in the trap crop, five on each side. The main crop plots were divided by diagonal transects into four triangular subplots and five plants were sampled in each subplot for a total of 20 plants sampled. Beetles were counted visually on each plant sampled.

Beetle eggs, larvae, and pupae were sampled on 6-29 in the main and trap crops by using a trowel to dig soil samples from the root zone near the crown of randomly chosen plants. Eight soil samples were taken for each of the 4 blocks in both zucchini and cucumber plots. One liter of soil was measured and placed inside a plastic zip-lock bag. The bags were held in a walk-in cooler (40°F) until observations could be made at a later date (7/6, 7/9, and 7/13). After first soil sampling, zucchini trap crop rows were mowed on 07-07-2010. On 07-14-2010 trap rows oriented parallel to cucumber rows were also rototilled. A second soil sampling of the trap crop root zone was conducted on 07-30-2010 to determine whether mowing alone was sufficient to reduce larval populations.

To separate eggs, larvae, and pupae from soil, each soil sample was placed inside a large bucket and water was added. Soil clumps were broken apart manually, and agitated the soil-water slurry was agitated for a few minutes. Next the suspended debris was slowly poured through a series of two sieves. The top was number 10 sieve the bottom was number 50 sieve. We did this twice for each sample. We then placed the number 50 sieve inside a smaller bucket, added enough water to suspend the debris within the water but keep it contained within the sieve. We searched for eggs, larvae and pupae of the striped cucumber beetle under 10X magnification. All larvae found were placed inside a glass vial containing 95% ethanol to be re-examined under higher magnification.

A second soil sample was taken from the trap crop area 3 weeks after the trap crop was either mowed, or mowed and tilled and treated as above to assess SCB eggs, larvae, and pupae, and to determine whether there was a difference between the two destruction methods.

JMP (Version 9. SAS Institute Inc., Cary, NC, 1989-2007) was used to analyze data.

Results and Discussion

Objectives 1-3:

Adult beetle numbers were significantly higher on the zucchini trap crop than the cucumber main crop (t ratio = 16.97, $\text{Prob} > t = 0.0001$) on data pooled across all three sampling dates (Fig. 1), demonstrating that at this beetle population the trap crop effectively reduced numbers of adult beetles on the main crop, and the reduction persisted while the overwintered generation of SCB was present.

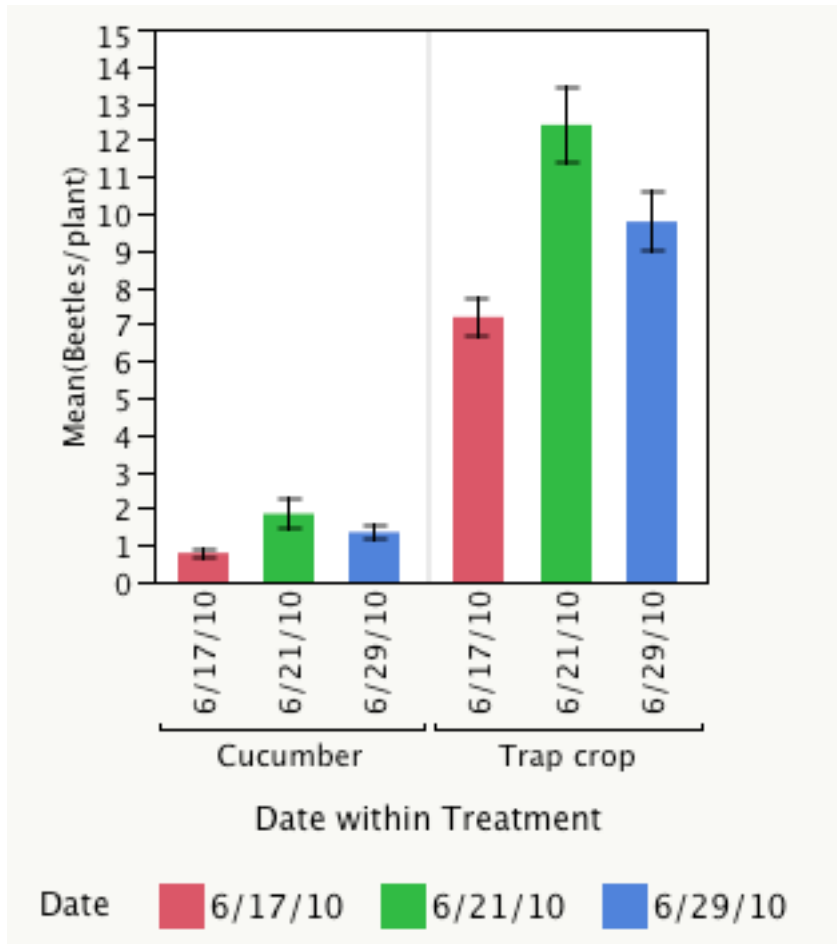


Figure 1. Mean number of beetles per plant on main (cucumber) and trap (zucchini) crops on three sampling dates

Only larvae were found in soil samples from the 6/29 sample of the root zones of the main cucumber crop and zucchini trap crop, and relatively few were recovered. Higher numbers of larvae were recovered from the root zone of the trap crop than from the main crop (Fig. 2), but differences were not significant (T ratio = 1.17, $p > t = 0.16$).

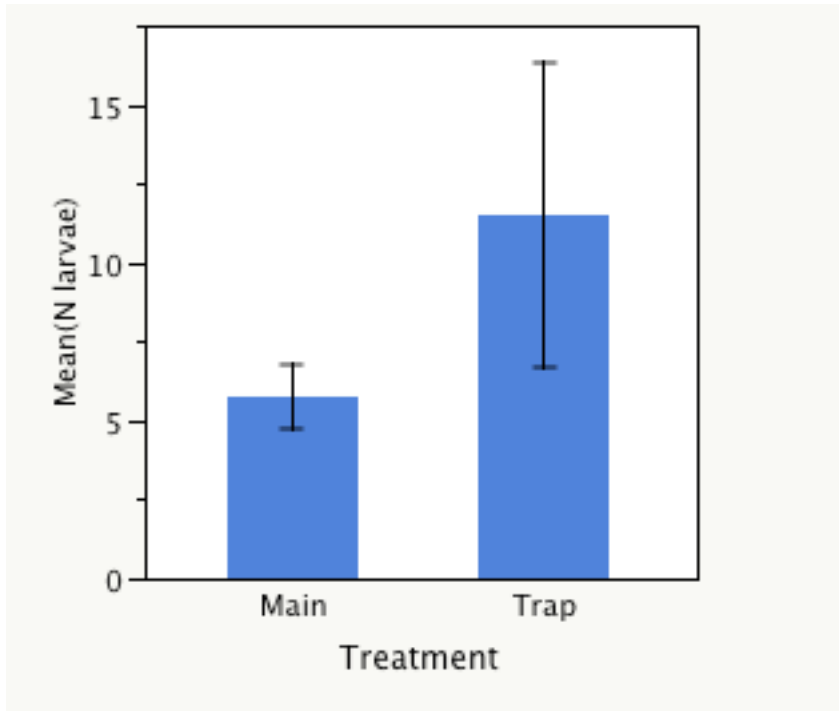


Figure 2. Mean number of SCB larvae recovered per plot from the root zone of the main (cucumber) and trap (zucchini) crops from soil sampled on 6/29/10.

Larvae, pupae, and adult beetles were recovered from the soil samples taken from the two trap crop destruction treatments, and analysis was conducted on the sum of all three life stages. Significantly higher (t ratio = 4.54, $p > t = 0.01$) numbers of beetles survived in the mowing-only treatment compared with the mow plus rototill treatment (Fig 3).

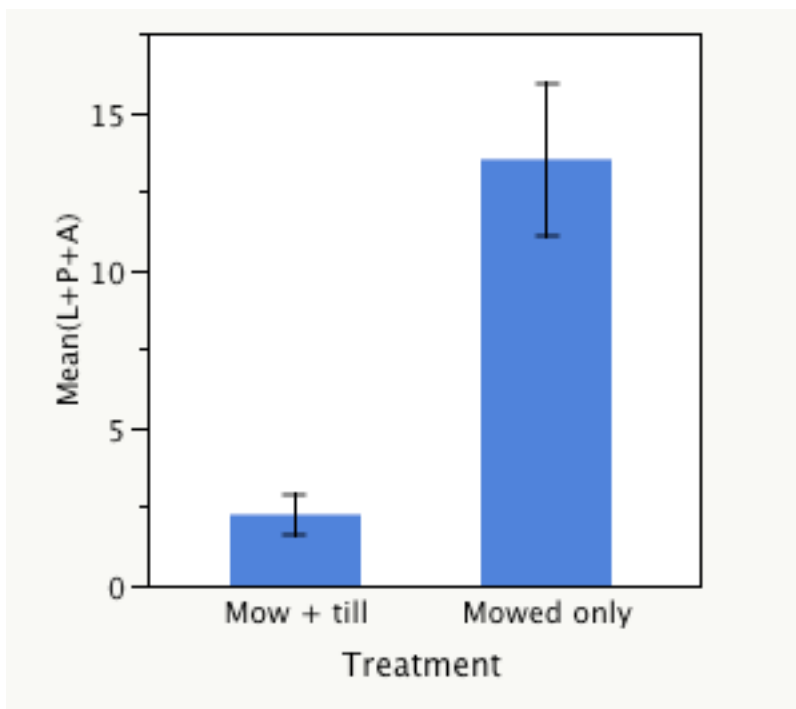


Figure 3. Mean number of SCB larvae, pupae, and adults surviving on PTC plants destroyed by mowing only, and mowing plus tillage.

This work answered some fundamental questions about the potential for perimeter trap cropping to contribute to striped cucumber beetle management on organic farms. Adult beetle numbers remained lower on the main crop throughout the life of the overwintered generation, despite the fact that they were not controlled on the trap crop. There is some indication that egg-laying is concentrated on the trap crop; sampling methods need to be refined to better assess this impact. Demonstrating that mowing alone is not sufficient to kill larvae feeding on the roots is an important piece of the puzzle. Now that these preliminary questions have been answered, we can begin to address other questions that need to be answered before PTC can be recommended to growers as an effective management tool. These questions include:

- How far do adult beetles travel to find host plants in the spring? Is reducing on-farm populations over time a worthwhile endeavor?
- Can the difference in attractiveness between the main crop and PTC crop be enhanced? Ideas include treating the main crop with resistance-inducing microbes or other allowed products, in addition to Surround, treating the PTC with gustatory (e.g. Cidetrak) or visual (e.g. yellow sticky tape) stimulants to enhance arrestment on the trap crop.
- Are there less labor-intensive methods for killing larvae on roots of the trap crop, e.g. entomopathogenic nematodes or fungi?
- Does a “superattractive” cultivar exist or could one be bred to provide the possibility for trap cropping with attractive main crops?
- Could early flowering increase the attractiveness of the trap crop enough to allow planting of the main and trap crop at the same time?

Objective 4

A Toward Sustainability Foundation proposal to further examine perimeter trap cropping has been submitted. This grant focuses on the role of flowers in attracting adult beetles of to the perimeter trap crop to assess the possibility of using an earlier planting of the same cultivar as the PTC, for situations where an attractive cultivar is the main crop. An OREI proposal is being developed that would address the questions listed above along with other issues negatively impacting successful cucurbit production on organic farms.