IMPACT OF INSECTARY STRIPS TO CONTROL CUCUMBER BEETLES

2017 Final Report for the Pennsylvania Vegetable Marketing & Research Program

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Introduction

Striped cucumber beetle is a major pest of Cucurbitaceae crops across the Northeast. Larvae and adult growth stages cause economic damage directly by feeding on plant roots, stems, flowers, leaves and fruits, and indirectly through the transmission of bacterial wilt, which can result in up to 80% yield loss. Cucumber and muskmelon are highly susceptible to bacterial wilt while squash and pumpkin are moderately susceptible. No curative control measures exist once plants are infected, and transmission rates increase as beetle densities increase. Current insecticides used to control cucumber beetles temporarily reduce cucumber beetle populations but have a detrimental effect on beneficial insect populations such as predators, parasitoids, and pollinators. In addition, insecticide use can endanger the health of farm workers, birds and other ecosystem service providers.

At Rodale Institute, a field trial was conducted in 2016 to assess the use of insectary strips as a biological tactic to attract beneficial insects and control cucumber beetles in organic cucumber beds. Preliminary data from 2016 suggest that insectary strips aid in increasing populations of beneficial insects and could play an important role in improving parasitism and predation as cucumber beetle population increases.

Beneficial insects can attack adult, eggs, and larvae of cucumber beetles on plants or on the soil surface. Predators such as wolf spiders have been shown to feed heavily on cucumber beetles (Snyder and Wise 1999). Also, it has been shown that cucumber beetles avoid feeding on the crop when spiders are around (Williams and Wise 2003). Ground beetles (predator arthropod) also feed on adult cucumber beetles (Snyder and Wise 1999), thus a biodiverse community of predators may be important for biological control of cucumber beetles rather than relying on any single predator species. The goal of this study was to repeat the trial in 2017 and expand on the preliminary data already gained and measure striped cucumber beetle densities, parasitism rates, and beneficial insects' counts over more sampling dates. **The objectives of this** project were to: 1) Monitor the populations of striped cucumber beetles, beneficial insects, and ground beetles attracted to insectary strips and cucurbit beds using yellow sticky cards and pitfall traps, and 2) Assess percent parasitism by parasitoids from field collected striped cucumber beetles.

Materials and Methods

A field experiment was established with insectary strips and two cover crop mixtures at Rodale Institute Farm, Kutztown, PA in fall 2016 to assess the impact of flowering insectary strips on beneficial insects, number of striped cucumber beetles, and cucumber yield. In a randomized complete block design with four replications, cucumber beds were either bordered with insectary strips (30 ft x 5 ft) or strips of ryegrass (no insectary strip) that were kept mowed throughout the cucumber growing season. The cover crop mixtures were rye/hairy vetch (R/HV) and rye/field peas (R/P). Organic 'Ministro' slicing cucumber (F1 hybrid) seedlings were established in a

greenhouse at Rodale Institute and were transplanted into beds (30 ft x 5 ft) covered with either black plastic or rolled cover crop mulch in early June 2017. One row of cucumber seedlings (two plants per hole) were spaced 18 inches in row. Row covers were deployed immediately after transplanting until first sign of flowering, to ensure protection of young seedlings from early feeding damage that can be caused by striped cucumber beetles.

Insectary strips included alfalfa as a base plant, fava bean, peas, dill, calendula, sunflower, sacred basil, lemon balm, sweet alyssum, and marigold. All plants were established in the greenhouse and transplanted into insectary strips – one row per plant species- between April and May 2017 except for fava bean and peas that were directly seeded in March 2017.

Monitoring of striped cucumber beetles and beneficial insects was done in cucumber beds and insectary strips on a weekly basis using yellow sticky cards. One sticky card per treatment was placed in the middle of the bed or the insectary strip and replaced on a weekly basis.

Pitfall traps: Each pitfall trap consists of two 16 oz. plastic cups, placed tightly in a hole in the ground and covered with plastic lids to prevent entry of rain. These pitfall traps were placed in the insectary strips, cucumber beds, and in the perimeter around the cucumber experimental plots (photo 1a). On Monday morning (between 8:00 am and 10:00 am) of each sampling week the lids were raised 2 inches from the soil surface (enough space to allow arthropod predators fall into the trap). Forty eight hours later, trapped predators (spiders and ground beetles) were identified and numbers of predators per species were recorded before releasing the predators and closing the lids.

Parasitism: Live striped cucumber beetles from cucumber plots were collected on four dates in 2017. Five to 10 striped cucumber beetles per bed were collected and placed in a glass jar and taken to the laboratory for incubation at 24 ^{o}C and 16 D:8N. The jars were then covered with mesh (photo 1b) to allow air entry and incubated for 21 days (maximum life cycle of parasitoid). Each week during the incubation period fresh cucumber leaves and cotton soaked with water were placed in jars for cucumber beetles. At the end of 21 days the number of dead and live striped cucumber beetles were counted, number of parasitoid (tachinid fly and pupae) were also counted (photo 1c). The collected pupae and emerging parasitoids were kept in small petri dishes for identification.

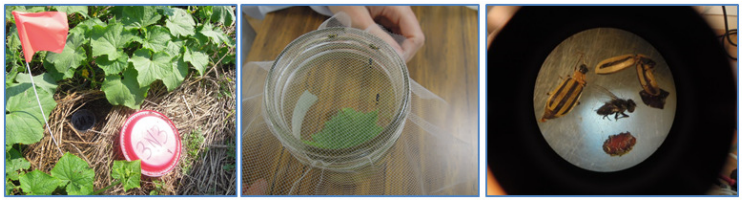


Photo 1. A) A pitfall trap in cucumber bed. B) Glass jars with cucumber beetles covered with mesh to allow air entry during incubation. C) Adult striped cucumber beetle, shattered parasitized cucumber beetle, adult tachinid fly (parasitoid) and pupa of tahinid fly.

Yield: Cucumber fruits were collected twice a week for four weeks. Total and marketable cucumber yields were recorded at each harvest.

Results

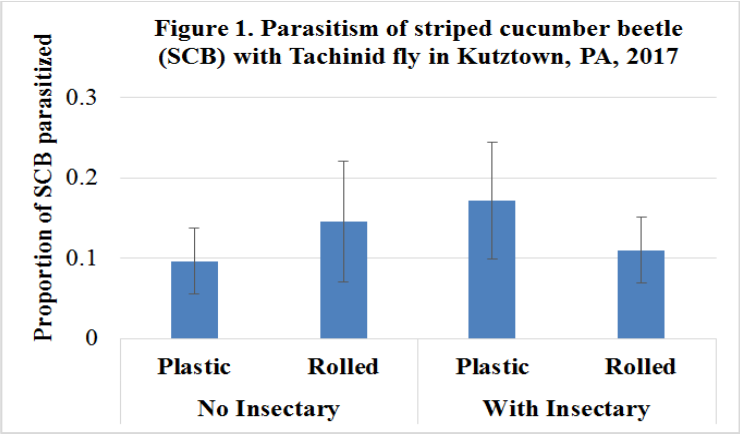
a. *Cucumber yield:* Average marketable cucumber yield was 63,500 lb/acre in R/HV plastic treatment versus 18,900 lb/acre in R/HV mulch, whereas, it was 47,500 lb/acre in R/P plastic

versus 7,300 lb/acre in R/P mulch treatment. The integration of insectary strips increased marketable cucumber yield in the R/HV rolled mulch treatment.

b. *Striped Cucumber beetles, Lady bugs, and minute pirate bugs:*
The average number of striped cucumber beetle per trap in all beds was 0.8/trap and <0.3/trap in the insectary strips. These numbers were much lower than those of 2016. Striped cucumber beetle number peaked on July 29, 2017 and continued to decline after that date. Average count of striped cucumber beetle per trap did not differ among mulch type as well as with and without insectary strips. However, the average number of lady beetles was higher in cucumber beds with and without insectary strips (1.2/trap to 1.3/trap) than within the insectary strips themselves (averaged 0.9/trap). The average number of lady beetle per trap was 9 times higher than those of striped cucumber beetle. The number of minute pirate bug was highest in the insectary strips averaging 1.3/trap versus 0.9/trap in cucumber beds with or without insectary strips.

c. *Ground beetle count and species and spiders:*
Over the cucumber growing season we collected a total of 693 ground beetles, 395 from cucumber beds and 298 in perimeter and insectary strips. The number of ground beetles was higher in cucumber beds with insectary strips (216) compared to beds without insectary strips (179). Average ground beetle count in cucumber beds with insectary was 2.68/trap and was higher than those in the cucumber beds without insectary (2.22/trap). However, average ground beetle count was always greater in cucumber beds with plastic mulch than those in rolled mulch with or without insectary strips. Average ground beetle population was highest in the insectary strips (2.8/trap) than in grass perimeter (1.3/trap). The dominant ground beetle species with average number per trap included *Chlaenius tricolor* (0.55), *Scarites subterraneous* (0.23), *Poecilus chalcites* (0.07), *P. lucublandus* (0.05), and *Harpalus pensylvanicus* (0.04). Total number of wolf spiders and other spiders was 264 and 49, respectively. Wolf spider population was highest in in cucumber beds with insectary strips (106) followed by beds without insectary strips (78), insectary strips themselves (42), and perimeter grassy areas (38).

d. Parasitism:
There was high variation between replicates and dates which resulted in no difference in parasitism between treatments (Figure 1). The mean percent parasitism of cucumber beetles collected in plots with insectaries was 13.96% and without insectaries was 12%. Parasitism spiked on July 29th at the same time that cucumber beetles reached the highest densities. On the first



Columns are the mean (±SE) proportion of striped cucumber beetles parasitized by *Celetoria sestosa* (Tachinidae) collected on four different dates on cucumber plants grown on plastic mulch, rolled cover crop, and surrounded by a flowering insectary strips or annual ryegrass (no insectary).

date of beetle collection (July 13th), parasitism was 19% in plots with insectaries and 1.5% in plots with no insectaries but did not differ significantly on the three later collection dates.

Outreach

The researchers showcased the project during the Rodale Institute's field day in July 2017 (photo 2a) and demonstrated the various ground beetle species that were collected from that study (2b). The results were also presented in a power point presentation at the American Society of Entomology Conference on November 8, 2017 at Denver, CO. A web article is in process and will be posted on Rodale's Institute website. This will be made available as a link from the Pennsylvania Vegetable Grower Associate website or as print article in the Pennsylvania Vegetable Growers Quarterly Newsletter.

Discussion

In this study, we provided cucurbit growers with scientific-based information on uses of insectary strips for enhancing number of natural enemies and control of striped cucumber beetle count. Ground beetles, wolf spiders and minute pirate bugs responded positively to inclusion of alfalfa-based floral insectary strips, suggesting that the addition of flowering resources to agroecosystem can positively enhance biological control of striped cucumber beetle. Number of striped cucumber beetles was greater in cucumber beds without insectary strips and similarly the number of lady beetle. The low number of striped cucumber beetle population in 2017 may have impacted our ability to detect differences in parasitism between treatments. However, parasitism was higher in plots with insectaries on the first collection date where it was virtually zero in plots without insectaries. It is important to note that we did not observe any wilting of cucumber plants due to bacterial wilt disease during the 2017 and 2016 trials. Cucurbit growers may adopt these tactics on a variety of cucurbit crops to reduce damage injury on fruits by cucumber beetles, eliminate or reduce pesticide use, increase flower pollination, and continuously provide beneficial insects with source of food and shelter.

Literature Citation

Snyder, W.E., and D.H. Wise. 1999. Predator interference and the establishment of generalist predator populations for biocontrol. Biol. Control 15: 283-292.

Williams J.L. and D.H. Wise. 2003. Avoidance of Wolf Spiders (Araneae: Lycosidae) by Striped Cucumber Beetles (Coleoptera: Chrysomelidae): Laboratory and Field Studies. Environmental Entomology 32:633-640.