Cucumber beetle management in fresh-market melons

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Figure 1. Western striped and western spotted cucumber beetles feeding on a pumpkin seedling. *Photo: Marja Koivunen.*

Figure 2. Western striped cucumber beetle and scarring damage on a honeydew melon. *Photo: I. Grettenberger.*

The western striped cucumber beetle (*Acalymma trivittatum*, henceforth "striped CB") and the western spotted cucumber beetle (*Diabrotica undecimpunctata undecimpunctata*, "spotted CB") are serious pests of fresh-market muskmelons in the Sacramento Valley and northern San Joaquin Valley (Fig. 1). Pressure from cucumber beetles in cucurbits has been especially severe the past several years. The most problematic damage is by adult striped CB. They feed on the bottom surface of fruit and scar the rind, creating cosmetic damage and unmarketable fruit, especially for smooth-skinned varieties like honeydew (Fig. 2). They are difficult to control with pesticides later in the season because they hide underneath fruit. Melon is their preferred host and they have three generations per year. Spotted CB beetles feed on foliage, flowers and fruit of cucurbits and produce less rind damage, but can cause stand losses in seedling fields. Pressure from striped CB has been severe at times during the past few years in muskmelons, although cucumber beetles have been an ongoing issue in both organic and conventional production systems.

Melon fields are regularly scouted for cucumber beetles and conventional management relies on insecticides, commonly neonicotinoids and pyrethroids. Current management consists of insecticide sprays when beetles are detected in the field. Applications are repeated as needed throughout the season to avoid crop injury, which may be once a month, or weekly in high-pressure years. Pest managers use stringent thresholds in conventional fields, and insecticides are applied when one striped CB or ~five spotted CB are found. In years where markets are saturated, melons with scarring damage larger than a quarter are not marketable, but these guidelines can relax if melons are in short supply.

Cucumber beetles are also major pests for organic cucurbit producers. Insecticide options are minimal, but include spinosad, pyrethrins, kaolin clay and diatomaceous earth. However, some can have detrimental effects on natural enemies that help manage other pests. Cultural methods like row covers can work, but require extensive investments of time and money. Avoidance by varying planting date can also be an option.

To address issues managing cucumber beetles, our research focuses on developing tools to better monitor and manage cucumber beetles in melons.

Figure 3. Non-crop area adjacent to a field to be planted with cucurbits at an organic farm in the Sacramento Valley. Photo: Jasmin Ramirez Bonilla.

Descriptive non-crop habitat surveys

Striped CB appear to overwinter as adults in close proximity to melon fields, although what drives habitat choice is unknown. Spotted CB overwinter in other crops (e.g., alfalfa) and adults migrate into melons in the springtime. Anecdotal evidence suggests striped CB shelter underneath protective structures like tree bark and leaf litter in the winter. They become active as early as mid-February when temperatures rise above ~ 53 °F and remain in non-crop areas until cucurbit hosts are planted. These areas could be targeted for monitoring or managing these beetles prior to or immediately after cucurbit plantings.

To better understand overwintering habitat of striped CB, we monitored non-crop areas at two organic farms in the Sacramento Valley with mixed cucurbit operations in early spring 2020 (Fig. 3). Samples were taken weekly at each farm using yellow sticky cards with a floral lure, sweep net sampling, and visual counts. Weed assessment (by percent cover) was documented to associate weed species with beetle abundance from visual counts.

With all of our sampling methods, striped CB were active when no melons were planted in fields (Fig. 4). We found substantially more beetles at Farm #1 and more beetles on non-crop plants during visual counts, so we focus here on that farm. Across dates, we found striped CB on a subset of the weed species (Fig. 5; other species present as well). There did appear to be a strong preference for broadleaf weeds over grasses. We did find striped CB most frequently on little mallow and milk thistle, but these were also the most abundant weeds at sites at Farm #1 that had many striped CB. None of the weed species appeared to be especially attractive to striped CB, although we did find the most striped CB at locations with more of these weeds. There were a number of weed species at the farms we monitored, but it is likely other areas have different suites of weeds.

Figure 4. Weekly counts of striped CB using three monitoring methods. Counts were summed across the eight locations at each farm.

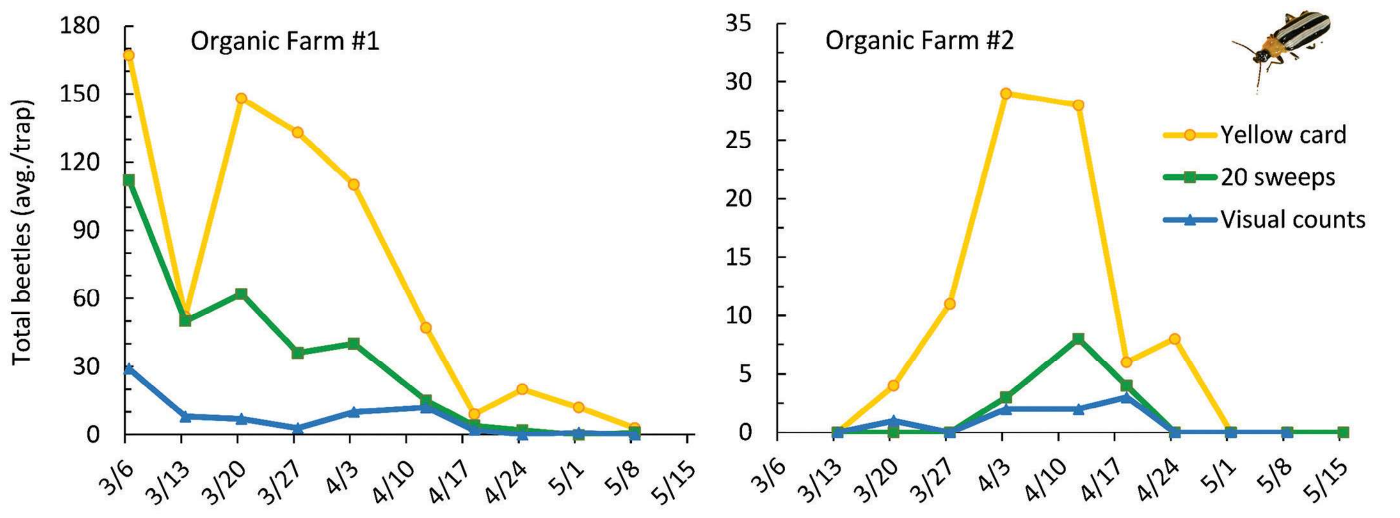


Figure 5. Number of striped CB observed on specific weeds (and off plants) at each sampling date per trap location at Farm #1. Off plants* used to record beetles observed flying or on the soil.

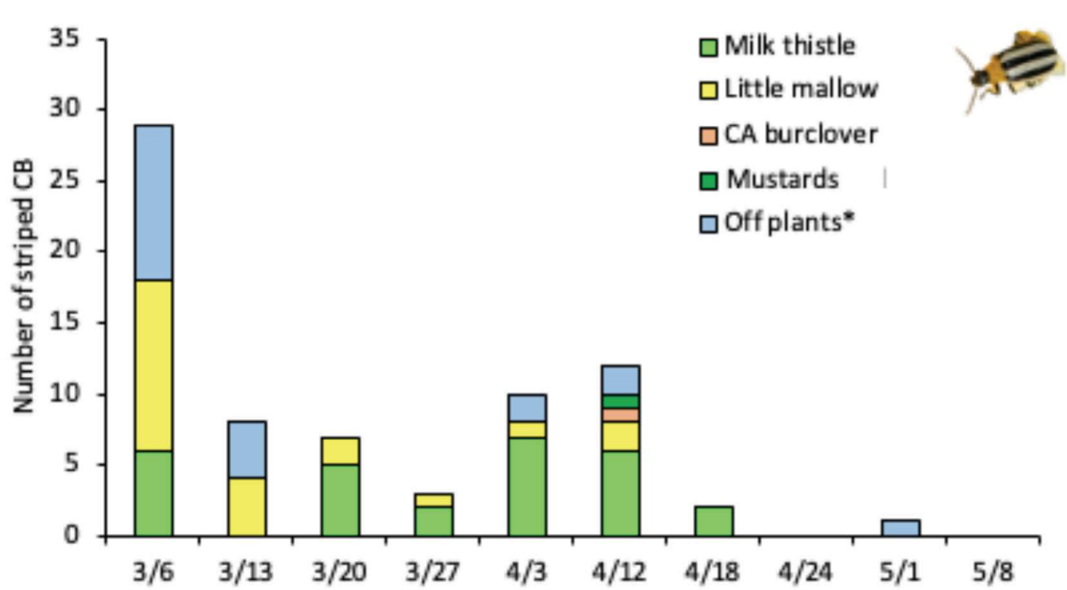
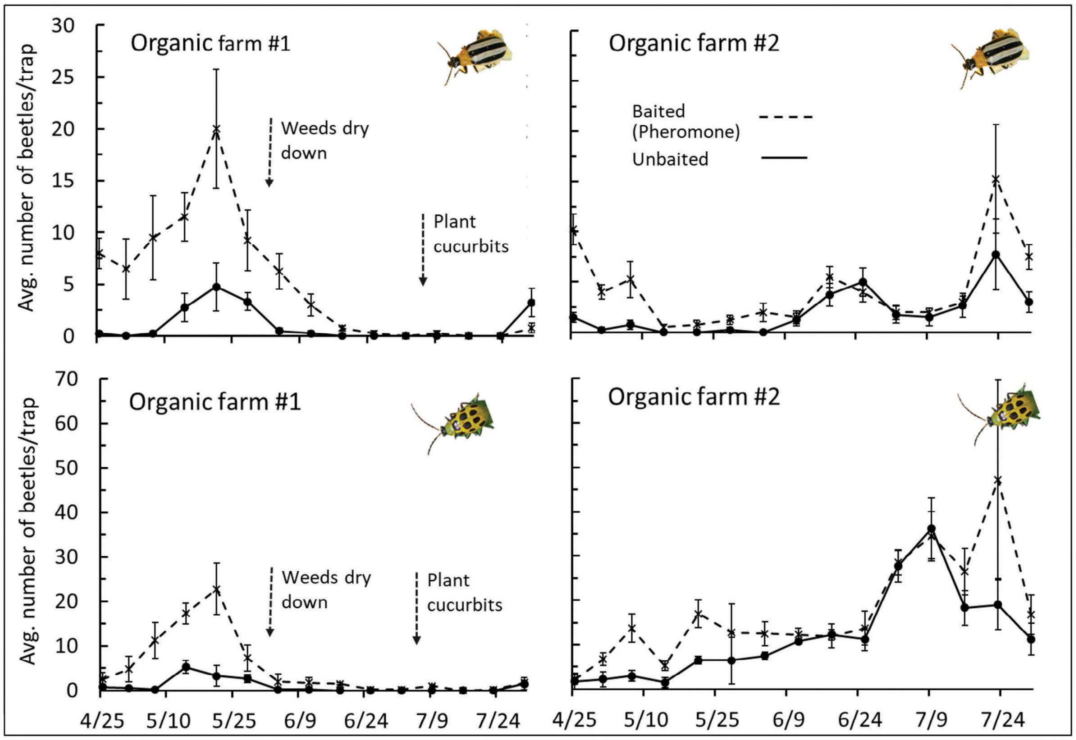


Figure 6. Average numbers of striped CB and spotted CB caught per treatment over time at Farm #1 and #2.



Pheromone trial

The cucumber beetle aggregation pheromone, vittatalactone, has been identified for the related eastern striped cucumber beetle species, and USDA ARS has commissioned a pilot batch for field testing for both the eastern and western species. This pheromone is emitted by males, attracts both males and females, and can be used to enhance trap captures. In addition, the pheromone has been found to attract the (eastern) spotted cucumber beetle. We are currently evaluating the efficacy and attractiveness of vittatalactone for western cucumber beetle species at two organic farms in the Sacramento Valley with mixed cucurbit operations. This field trial focused on two treatments: clear sticky trap either baited with vittatalactone or unbaited.

Preliminary results indicate that pheromone-baited traps capture higher numbers of both striped and spotted cucumber beetles than unbaited traps throughout the season (Fig. 6). The decrease in captures from June to late July at Farm #1 may be due to the absence of planted cucurbits; summer squash was planted in early July. Beetles likely dispersed away from non-crop habitat once weeds senesced and dispersed back into fields later. Another trial from the end of the 2019 season also indicated the pheromone is attractive. This study indicates the pheromone could improve monitoring efforts for both western cucumber beetle species. Furthermore, it could serve as a component of an attract-and-kill tactic targeting beetles early in the season, before cucurbits are planted.

Insecticide Trial

Methods

We conducted an insecticide trial in fresh-market melons in 2019. We chose treatments commonly used commercially and two organic treatments (Table 1). Honeydew (Tam Dew) was direct-seeded on 60-inch beds on June 19 at a UC Davis research farm with 20 × 25-ft plots and four replicates per treatment.

Once beetles were readily observed, we applied treatments using a backpack CO_2 sprayer (July 22). We treated plots again on August 15 and September 5. Our spray schedule was not aggressively timed. On "off" weeks for applications, applications of only kaolin clay were made weekly to the two treatments that included clay. We counted beetles in plots for 4 minutes 3, 7, 10, 14, and 21 days after the first application (DAT). They were also counted 4, 14, and 19 DAT2 and 4, 7, 11, and 14 DAT3. We assessed damage by scoring 12-20 melons (ideally 20, but limited in some plots) on size of scarring injury. We assessed damage on a scale of 0-3 based on severity of damage (Fig. 7). Melons with cucumber beetle feeding scars larger than the size of quarter coin were considered a cull (rating: 1-3). This was based on conversations with PCAs working with conventionally grown melons. Damage was primarily on the bottom of the melons and was likely due largely to feeding by striped CB.

Table 1. Treatments used in the insecticide trial.

Trt#	Insecticide	MOA	Rates (per acre unless otherwise noted)
1	Untreated check	--	
2	Acetamiprid	4A	2.3 oz
3	Bifenthrin	3A	8.5 fl oz
4	Bifenthrin + imidacloprid	3A+4A	6 fl oz
5	Carbaryl	1A	32 fl oz
6	Kaolin clay + spinosad + gustatory stimulant (Organic 1)	5	25 lbs + 10 fl oz + 3 oz
7	Kaolin clay + diatomaceous earth (Organic 2)	--	25 lbs + 40lbs
Treatment 6 was applied at 87 GPA			
Treatment 7 was applied at 300 GPA, except for applications of only kaolin clay, which were made at 87 GPA			

Figure 7. Damage scores used to assess cucumber beetle damage at harvest.

0: Little to no damage and feeding scars smaller in size than a quarter.

1: Minimal damage, one scar larger than the size of a quarter or many, spread out and small feeding scars, creating a speckled pattern.

2: Moderate damage, two scars equal to the size of a quarter, or one measuring 3 in. wide.

3: Severe damage, three separate quarter-sized scars, two or more 3-in. scars, or extensive scarring damage that blends together.

Results

Populations were low at the beginning of the season. There was no beetle pressure at the seedling stage, so we cannot comment on efficacy at this stage. We will focus on performance of the treatments when viewed across the course of the study (summed counts).

For striped CB, plots sprayed with carbaryl or acetamiprid had the fewest beetles (Fig. 8). The untreated and both organic treatments had the highest numbers of striped CB. Patterns were generally similar for spotted CB (Fig. 8). The untreated and organic treatment plots all had the highest spotted CB populations over the course of the study. Plots with the fewest spotted CB were those with applications of acetamiprid or bifenthrin.

As seen in Fig. 9, there were differences in patterns of damage between treatments. The acetamiprid treatment, along with the premix of bifenthrin and imidacloprid, were most successful at protecting melons from cucumber beetle feeding and preventing culls. These treatments kept culls (based on a stringent damage threshold) below 20%. Bifenthrin and carbaryl plots had greater cull percentages, but they were not statistically different from the treatments that were most effective. We tested several other unregistered conventional insecticides in the trial, but results are not reported here. While some held promise for managing cucumber beetles in melons, future work will need to follow up on these results.

Figure 8. Summed counts across dates of striped and spotted cucumber beetles for various insecticides treatments. ** = treatments/materials not registered for melons in CA. Values are means ±SE. Means for each species that are not significantly different share the same letter.

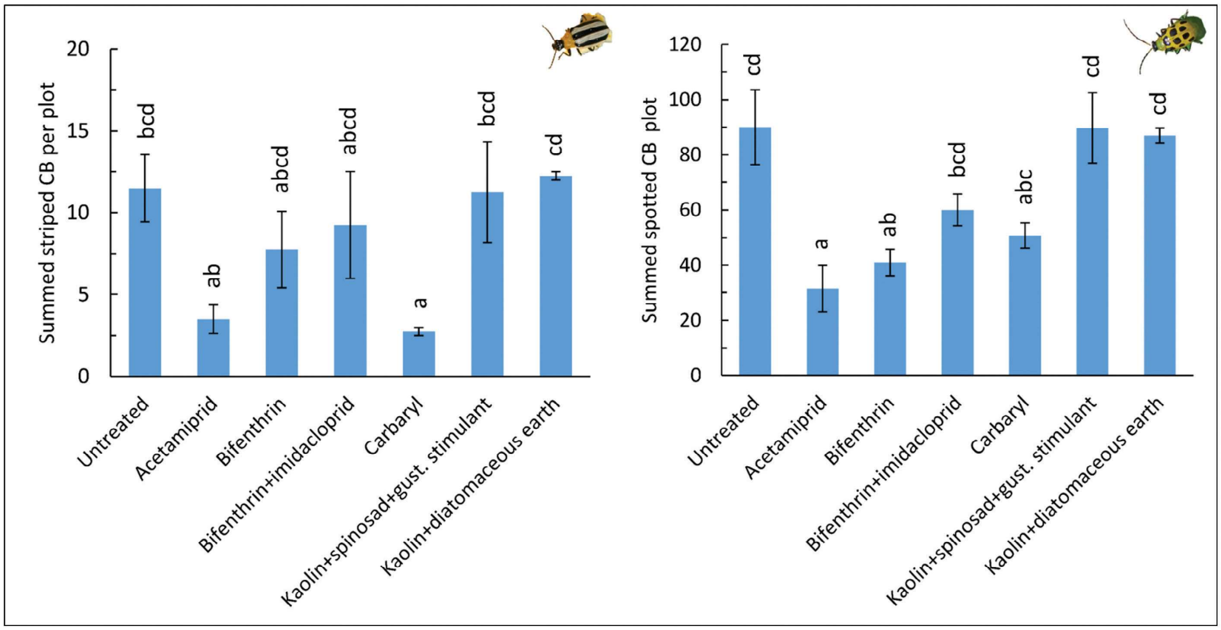
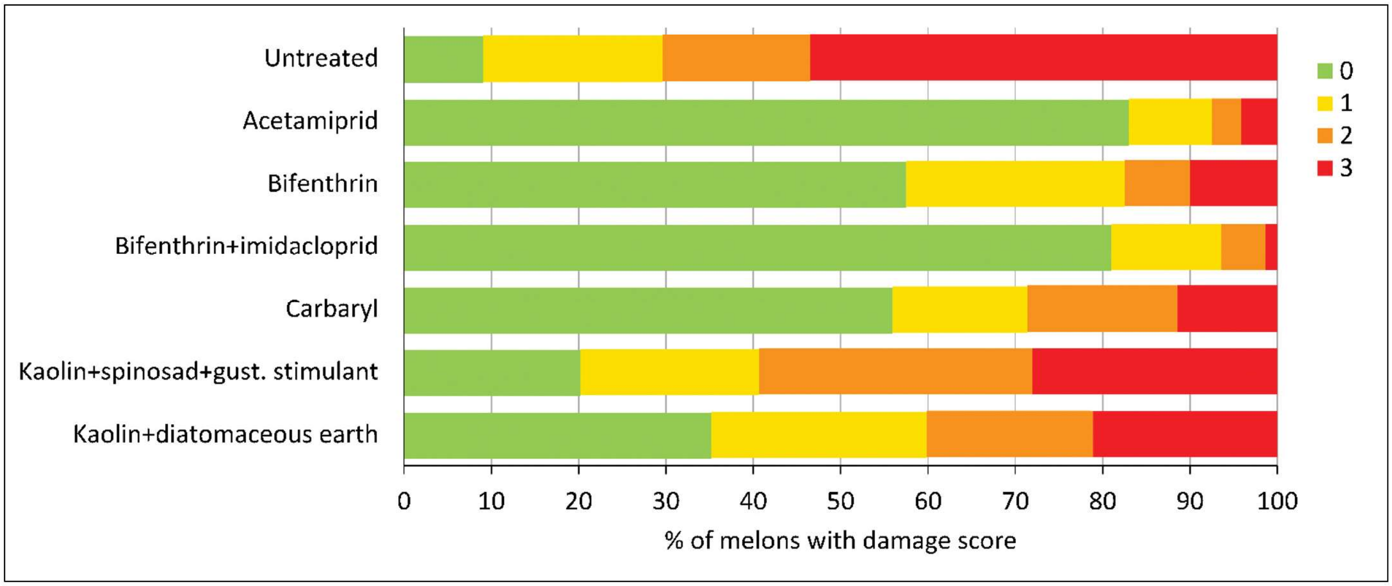


Figure 9. Damage assessment from the melon damage scoring using the damage scores defined in Fig. 7.



The organic treatments did not statistically reduce culls compared to the untreated. They also did not differ statistically from the untreated for the most extreme damage categories (2-3). There was an interesting trend research needs to follow up on, in which the kaolin clay + diatomaceous earth treatment had 65% culls vs. 91% in the untreated and 40% of melons in the most extreme damage categories compared to 70%. It is worth noting that the market for organic melons has different standards when it comes to cucumber beetle feeding damage.

Conclusions

Cucumber beetles likely will remain problematic pests due to the low thresholds for damage in conventional systems, their at-times high populations, and current availability of tools in organic production. In the long-term, we hope that improved IPM practices, including monitoring and targeted management, will help prevent and suppress damage by these pests. ■