May 2023

Vegetable Crops Newsletter

University *of* California
Agriculture and Natural Resources
Cooperative Extension

UC CE

Announcement!

I have left my position as Vegetable Crops Advisor as of May 2023 to move back home to New England. I have accepted a position with University of New Hampshire as an Extension State Specialist for Entomology and IPM. This will be my last issue of the Vegetable Crops Newsletter for Colusa, Sutter and Yuba counties, though 2023 project results may be shared later this year. A huge thank you to all of my colleagues, mentors, and grower and PCA collaborators over the last seven years!

For farm calls and diagnostics: If you need vegetable plant samples diagnosed for **fungal or bacterial** disease issues with Dr. Cassandra Swett's lab, please contact Sudan Gyawaly, IPM Advisor for the Sacramento Valley (sgyawaly@ucanr.edu), headquartered in the UCCE Butte office. You can also contact the UCCE Colusa office (530-458-0570) for his cell phone number. If Sudan is unavailable, you may drop samples off at either the UCCE Colusa office (100 Sunrise Blvd, **Suite E**, Colusa, CA) or the UCCE Sutter-Yuba office (142A Garden Hwy, Yuba City, CA), but please let Sudan know. For those of you in south Sutter County, you also have the option of dropping them off at the UCCE Yolo office (70 Cottonwood St., Woodland, CA) for Patricia Lazicki, the new Yolo Veg Crops Advisor. When collecting diseases plant samples, be sure to collect whole plant samples (fruit can be shaken off if it has no symptoms) and place them in labeled plastic or paper bags. Also, it is best to collect plants that are showing symptoms but are not dead or severely collapsed. There will be a form to fill out including crop, grower/PCA name, county, % acreage affected, descriptions of the problem, variety, contact information, etc. Please note that samples brought to the offices may not be delivered to campus as quickly as in the past, however, we will do our best to make sure the plant samples get to the Swett lab at UC Davis for testing.

For **virus** samples (ex: TSWV or BCTV), you can bring samples directly to Dr. Bob Gilbertson's lab at UC Davis, Rm 273/274.

In this issue:

Evaluating commercially available processing tomato varieties for their tolerance/susceptibility to the new soilborne pathogen, *Fusarium falciforme*

PI: Brenna Aegerter, UCCE San Joaquin; Co-PIs: Tom Turini, UCCE Fresno; Amber Vinchesi-Vahl, UCCE Colusa/Sutter/Yuba; Cassandra Swett, UC Davis Extension Pathology Specialist; Collaborators: AgSeeds
Funded by California Tomato Research Institute

In recent years, there has been an increase in crown rot/vine decline problems in processing tomatoes. Many tolerant, as well as several susceptible tomato cultivars, have been identified from previous efforts funded by CTRI. The number of fields in the Sacramento Valley with

confirmed *Fusarium falciforme* vine decline has been increasing each year. In 2022, eight new tomato fields were diagnosed in Sutter and Colusa counties, for a total of 20 fields since 2019. In 2021 and 2022, we worked with AgSeeds and evaluated processing tomato varieties in field trials for their tolerance or susceptibility to *Fusarium falciforme* by rating disease severity and sending diagnostic samples to the Swett lab at UC Davis for confirmations. Unfortunately, in 2021, we were unable to confirm *F. falciforme* in the particular fields we evaluated, however, in 2022, all three fields in Sutter County where we evaluated trials were positive for *F. falciforme*, along with Fusarium crown and root rot in 2/3 fields. We evaluated fields for advanced decline and whole plant collapse. Yield data was provided by AgSeeds. Below is a table with the average number of declined plants at our three field sites in Sutter County. The table also includes percent decline and yield for two of the fields. Also worth noting, field #2 was evaluated the day before harvest, whereas field #1 was evaluated a couple weeks before harvest and field # 3 was not harvested due to September rain events in 2022.

Sutter County Advanced Decline Evaluations							
Date	**9/1/2022**						**9/23/2022**
Site	**Field 1-harvested 9/17/2022**			**Field 2-harvested 9/2/2022**			**Field 3**
Diagnosis	**Fusarium falciforme and Fusarium crown and root rot**			**Fusarium falciforme and Fusarium crown and root rot**			**Fusarium falciforme**
	Average decline	**Percent decline**	**Yield (tons/A)**	**Average decline**	**Percent decline**	**Yield (tons/A)**	**Average decline**
Variety							
N6428	0	0	63.25	11	14.1%	59.98	4.33
HM3287	0	0	91.72	1.67	2.3%	65.31	2.33
SVTM9016	0.33	0.6%	78.55	32.67	43.1%	51.12	6.33
SVTM9019	1	1.8%	63.2	20.33	27%	61.08	3.33
SVTM9036	1.33	2.3%	74.65	37.67	49.7%	51.55	5
SVTM9037	0.33	0.6%	78.6	15	19.6%	57.01	4
SVTM9038	1	1.9%	76.36	24	33.4%	50.57	7
HM8512	0	0	72.43	21.33	28.8%	46.79	4.33
HM58841	1.33	2.4%	77.64	3.67	4.8%	74.52	5.67
H2016	0.67	1.2%	74.32	23.67	31.5%	53	3.33

The varieties with the highest decline are similar to results we have seen at other sites over the years and a more comprehensive table (developed by UCCE Vegetable Crops Advisor, Brenna Aegerter, in San Joaquin County) which can be found in my December 2022 newsletter. If you are interested in more results and information from other regions of the state, you can see Brenna's article on pages 4-5 in the UCCE San Joaquin County Field Notes newsletter from February 2023.

Evaluation of compost application to processing tomato fields in the Sacramento Valley

Collaborator: Suellen Witham, Westside Spreading LLC
Funded by Healthy Soils Demonstration Program, CDFA

I have completed a 3-year Healthy Soils Demonstration Project funded by CDFA to evaluate compost at two rates compared to a no compost control in processing tomato fields. Westside Spreading LLC applied yard waste compost at 3 tons and 6 tons/acre to two processing tomato fields (Colusa and Sutter County) in the fall of 2020 and 2022. The same applications were made to the Sutter County site in Fall 2021 though weather and other environmental and operational challenges delayed compost application at the Colusa site until Spring 2022. We collected baseline soil samples and data before compost application in 2020 and collected annual soil samples in Fall 2021 and 2022 to determine any changes to soil health metrics. There were no significant changes from year to year at the Colusa field. However, at the Sutter County field site, EC was significantly higher for all treatments in Year 2. Soil sampling was conducted earlier than usual due to the grower schedule and compost application occurring shortly after tomato harvest at the end of August. When we took soil samples, it was only a couple of weeks after processing tomato harvest and this may have affected the results for Year 2. Also, the nitrate was numerically higher in Year 2 at the Sutter site in Treatment 2 plots (6 tons/acre of compost), though not significantly. At the Colusa site, we observed significantly lower % total carbon and % organic matter in Year 2 than in Year 1, but not significantly different from Year 3. In general, we did not observe major differences in soil health metrics between treatments from 2020-2022. This was to be expected since the benefits of implementing soil health strategies are usually not observed until 3+ years of adding compost.

The 2020 Healthy Soils Demonstration Project is part of California Climate Investments, a statewide initiative that puts billions of Cap-and-Trade dollars to work reducing greenhouse gas emissions, strengthening the economy, and improving public health and the environment — particularly in disadvantaged communities.

An update on floral and pheromone attractants for cucumber beetles and utility for IPM

Seth Jean[1], Ian Grettenberger[1], and Amber Vinchesi-Vahl[2]
[1]University of California, Davis, [2]UC Cooperative Extension

There are two species of cucumber beetles that are important pests of cucurbit crops in California, the western striped cucumber beetle (CB), and the western spotted CB. The western striped CB are cucurbit specialists that can cause significant damage and are the primary species of concern of growers. Western spotted CBs are generalists and tend to not be as problematic and are a more minor pest. Adult beetles overwinter in cover, usually around field edges, or in other crops and invade the fields once temperatures rise and crops are planted. Larvae feed within the rhizosphere, causing minor damage. Adults tend to feed below the dense crop canopy within the floral whorl and underneath developing melons; it is the voracious feeding of the adult striped beetles on young melon rinds that causes scarring, which is the primary crop damage. Unfortunately, monitoring and controlling these pests has proven difficult. The beetles' feeding habits and behavior, especially for western striped CB, make getting good contact with insecticides an issue.

To improve IPM, previous research discovered that western striped CB are responsive to a lure based on synthetic floral compounds. Additionally, male western striped cucumber beetles produce vittatalactone, an aggregation pheromone that has also been synthesized and shown to be attractive when paired with the floral lure. However, while the aggregation pheromone is specific to cucumber beetles, the floral lure can attract both beetles and pollinators. The attraction of non-target species to the

floral/pheromone lure combo is an obstacle that needs to be overcome to best employ these lures for effective strategies like monitoring or attract-and-kill techniques.

Objective: **Evaluate attraction of cucumber beetles and pollinators to various floral attractants and a synthetic cucumber beetle pheromone.**

The floral lure is made up of three compounds (trimethoxybenzene, indole, and cinnamaldehyde, commonly called a "TIC lure"). We wanted to test if specific floral compounds, possibly paired with the pheromone, were attractive to the cucumber beetles and if they were attractive to pollinators. Adding to this, we wanted to see if the striped and spotted CBs followed a similar pattern in their response. We conducted a field trial along the edges of an organic cucurbit farm near Esparto, CA (Figure 1). We had 6 blocks of 6 treatments. Each treatment consisted of a double-sided clear sticky trap (Figure 2) attached to a 3' wooden stake, with one of the lures or with lure combinations (Table 2).

Figure 1. Traps were placed along field edges, with the Red lines indicating trap locations.

Figure 2. Sticky trap, floral lure+pheromone.

Treatments
1. Blank (control)
2. Vittatalactone (pheromone)
3. TIC (floral blend)
4. Indole (individual component of TIC)
5. Vittatalactone + TIC
6. Vittatalactone + indole

Table 1. Treatment list.

Each week, we collected and replaced the trap, and the lure treatment was randomized within the block. We identified and counted the striped/spotted CBs and pollinators on each trap. The experiment was conducted for 8 weeks in the spring (starting on April 15), and 10 weeks in the fall (starting on August 26). The data (beetle counts) were analyzed using summed counts over the season to deal with periodic low counts.

Results

In terms of striped CB attraction, the full floral lure (TIC) and the indole lure performed significantly better than the control, followed by the aggregation pheromone (Figure 3). The floral lure and indole lure performed much better when combined with the pheromone. Importantly, there was no statistical difference between these two treatments, showing the full floral lure was not needed. We saw a similar, though less pronounced pattern in the fall. When viewed for each week, we can see captures increase as the striped CB migrate from and to their overwintering sites in the spring and fall respectively (Figure 4) and we observed the same overall treatment patterns.

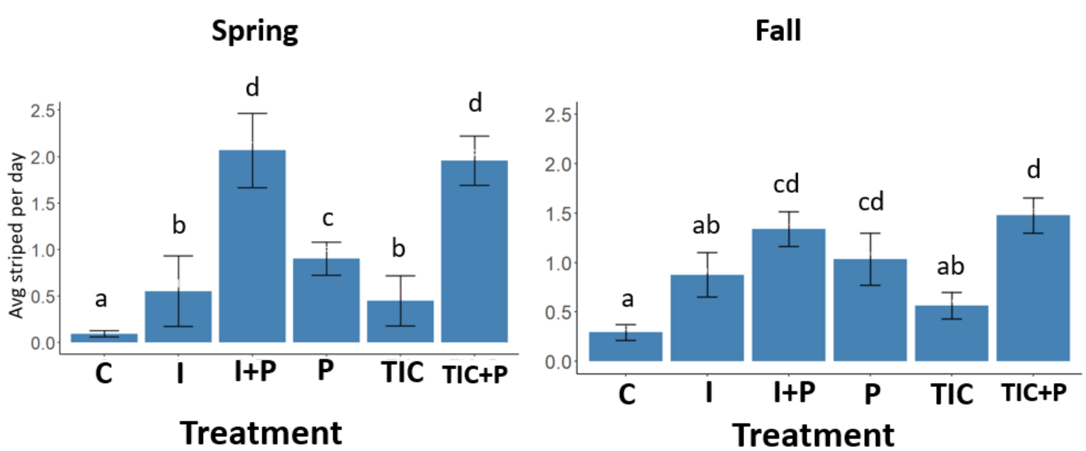

Figure 3. Striped cucumber beetle captures, with the average number of striped beetles caught per week across the whole season for each sampling period. C=Control, I=Indole, P=Pheromone, TIC=full floral lure. Different letters above the bars indicate significant differences between treatments.

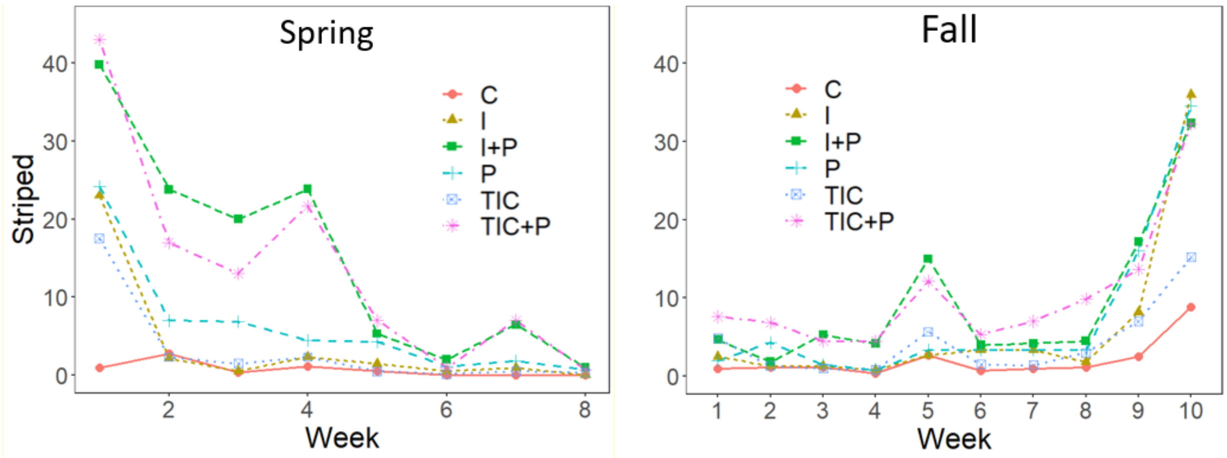

Figure 4. Striped cucumber beetle captures, with the average number of striped beetles caught per week season for each sampling period. C=Control, I=Indole, P=Pheromone, TIC=full floral lure.

The spotted CB followed a similar pattern to the striped, with the greatest attraction to the TIC+pheromone and indole+pheromone treatments. This is interesting because the aggregation pheromone was thought to be species specific, but the spotted CB still responds (Figure 5).

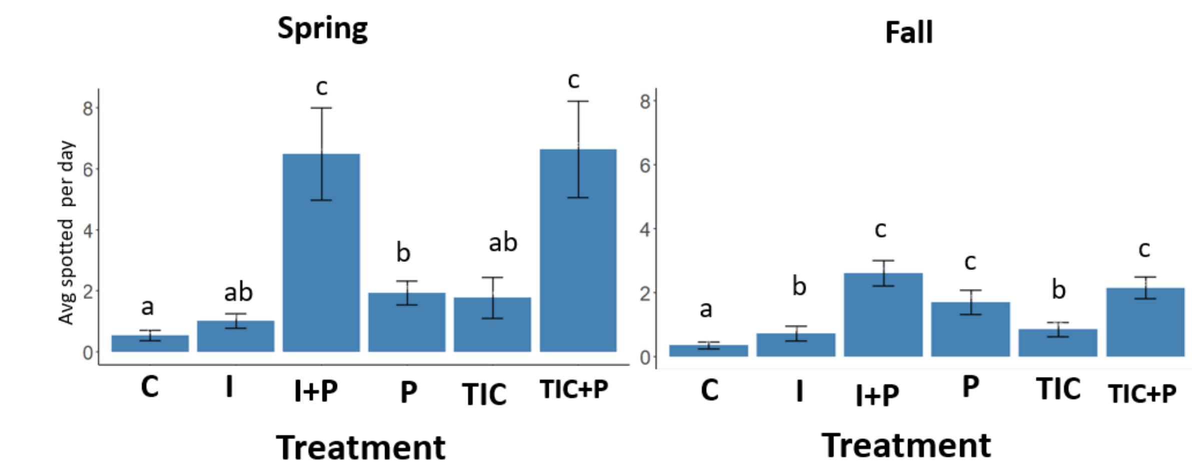

Figure 5 Spotted cucumber beetle captures, with the average number of striped beetles caught per week across the whole season for each sampling period. C=Control, I=Indole, P=Pheromone, TIC=full floral lure. Different letters above the bars indicate significant differences between treatments.

The attraction effects were different for pollinators, specifically honeybees, which was by far the most dominant pollinator (Figure 6). There was no difference in attraction (no attraction) of the pollinators to the control, pheromone, indole, or any combination of those compounds. However, there was significant attraction to the full floral lure (TIC), with or without the pheromone. These results held true in the fall as well. These effects can similarly be seen when examining the overall seasonal trend (Figure 7).

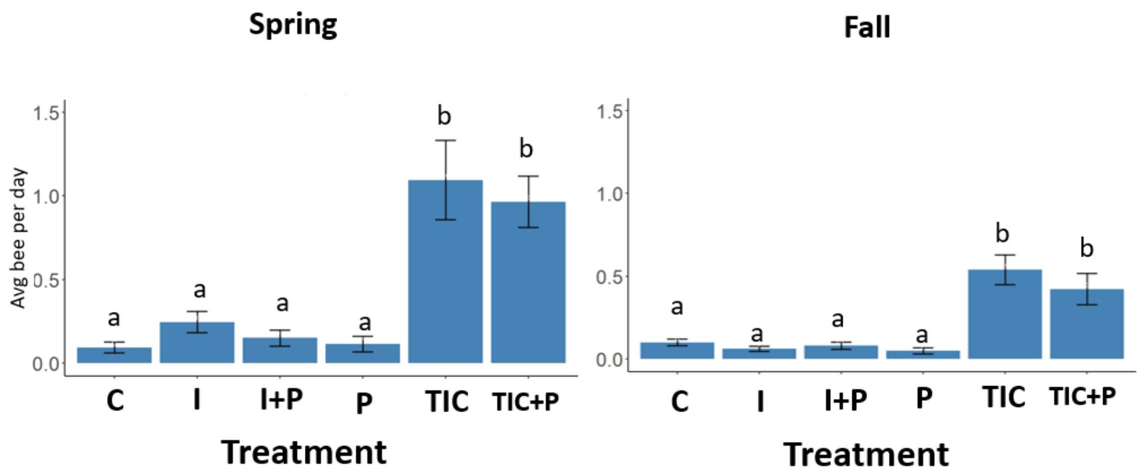

Figure 6. Honey bee captures, with the average number of striped beetles caught per week across the whole season for each sampling period. C=Control, I=Indole, P=Pheromone, TIC=full floral lure. Different letters above the bars indicate significant differences between treatments.

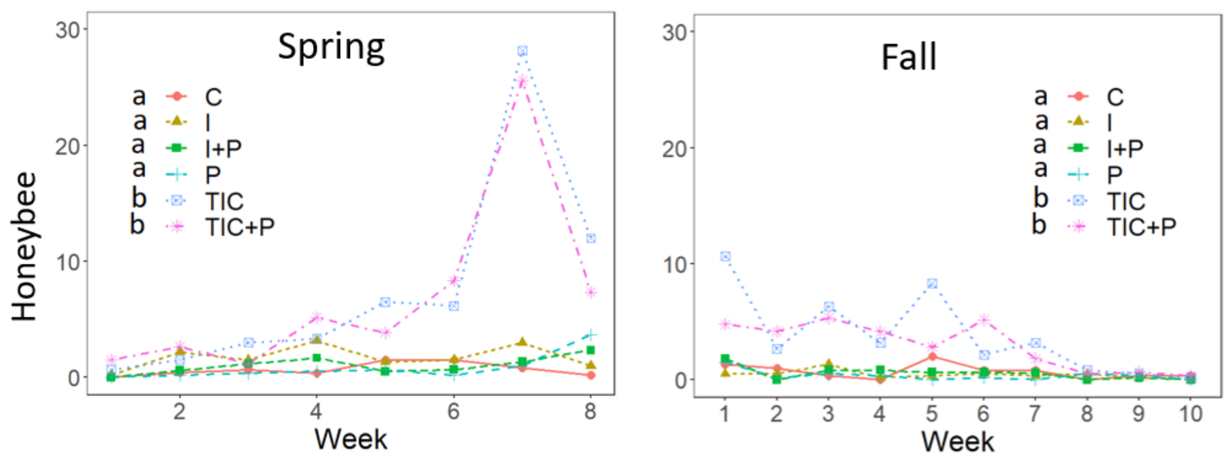

Figure 7. Honey bee captures, with the average number of striped beetles caught per week for each sampling period. C=Control, I=Indole, P=Pheromone, TIC=full floral lure.

Conclusions

Our study shows that there is strong attraction of both striped and spotted CB to a combination of synthetic indole and pheromone (vittatalactone) lures. Because pollinators were not attracted to either of these treatments, they could be used for targeted attraction of the pests without pulling in pollinators or other non-target species. This could facilitate easier field scouting and population monitoring and could also unlock the possibility for more targeted insecticide applications or trapping in an attract-and-kill strategy.

Feeding stimulants for managing cucumber beetles in melons

Seth Jean[1], Ian Grettenberger[1], and Amber Vinchesi-Vahl[2]

[1]University of California, Davis, [2]UC Cooperative Extension

Plants have evolved a myriad of chemical defenses to protect themselves from herbivorous insects. These compounds can act as feeding deterrents or even toxins; however, some insects have evolved mechanisms to overcome these defenses, such as developing a tolerance for certain plant compounds or actively detoxifying the toxins. Cucurbitacins are produced by plants in the cucurbit family and are known to deter some insect herbivores. Some Diabroticina beetles (subtribe containing cucumber beetles) adapted to feed on cucurbits, causing cucurbitacins to act as a feeding stimulant, instead of a deterrent. Cidetrak L is a processed formulation containing cucurbitacins, and it has been shown to stimulate feeding in corn rootworm. Given that western striped cucumber beetle (CB) is a cucurbit specialist, we wanted to see how it responds to Cidetrak (CT). Using a field trial and a lab bioassay, we evaluated cucurbitacins as a feeding stimulant to see if it could improve management of western striped and spotted cucumber beetles using insecticides.

Figure 8. Field of cucurbits.

Field trial

Methods

For the field component, we set up a randomized trial at the Plant Pathology Research Farm at UC Davis. Honeydew melons were planted on beds with subsurface irrigation. The field was divided into 6 blocks of 30'x 30' plots, and each plot was treated with one of the following treatments (Table 1). Assail (acetamiprid) is a widely used neonicotinoid, while Avaunt (indoxacarb) is a material without cucumber beetles on the label that could serve as an additional mode of action. A full rate of Assail = 5.3 oz/ac and for Avaunt = 6 oz/ac. Treatments were applied three times during the trial (14-day intervals) using a backpack sprayer.

Treatment	Chemical name
Untreated check	--
Assail 30 SG (full rate)	acetamiprid
Assail 30 SG (full rate) + CidetrakL	acetamiprid + gustatory stimulant
Assail 30 SG (1/4 rate) + CidetrakL	acetamiprid + gustatory stimulant
Avaunt* + CidetrakL	indoxacarb + gustatory stimulant

*Table 2. Tested treatments for the field trial. * = not registered for cucumber beetles in California, experimental use.*

Data was collected via recurring timed counts of the number of live and dead striped and spotted cucumber beetles found within each plot. Counts occurred every 3, 7, 10, and 13 days after each treatment application. At the end of the trial, 20 melons from each plot were randomly chosen and rated for damage on a 0-5 scale (with 1 being a cull in conventional production, with > a 25 ¢. piece-sized scar, and scarring severity increasing up to a 5 rating, Figure 3). Count data was analyzed using beetle counts summed across the whole season.

Figure 9 (left). Striped cucumber beetles on a melon leaf. Figure 3 (right). Honeydew melons with various degrees of scarring.

Results and discussion

The counts showed that the control plots had the highest number of alive striped CB, followed by the Avaunt + CT plots (Figure 4). The treatments containing Assail all had significantly less alive striped cucumber beetles than either the control or Avaunt + CT Plots. The full treatment of Assail, the ¼ rate + CT treatment, and the full rate of Assail + CT showed no significant difference. The inverse can be seen in the number of dead striped cucumber beetles in the second graph (Figure 4). *Note: these analyses were run using summed counts due to relatively low overall beetle counts.*

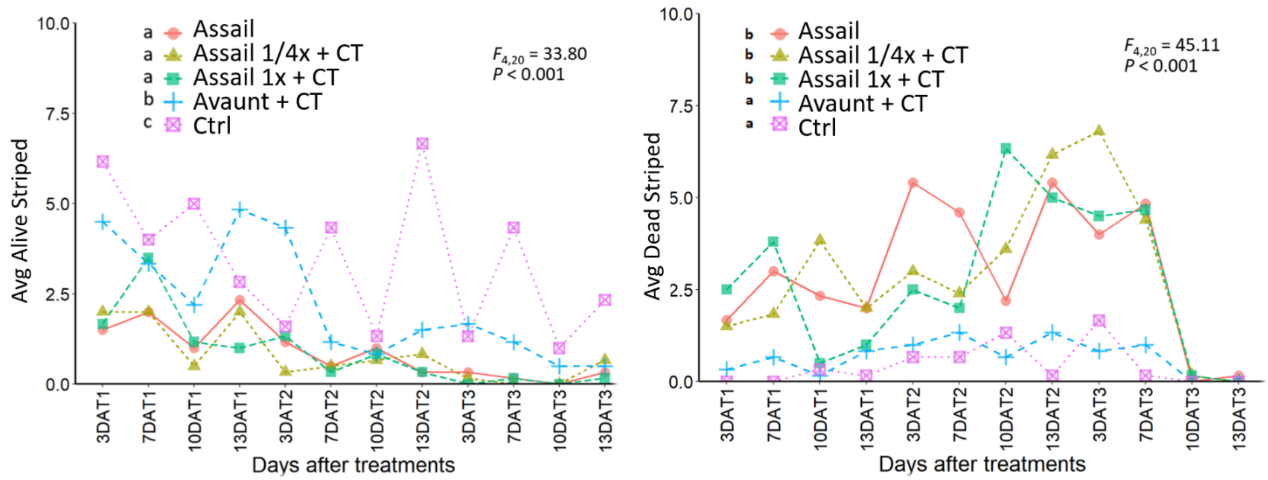

Figure 10. Average number of 1) alive and 2) dead striped cucumber beetles. Results from the analyses using season-long summed counts are shown in the legend. Treatments not sharing a letter are significantly different. CT=CidetrakL.

The results were generally similar for the spotted CB, except no difference was detected between the Avaunt + CT, and the Assail ¼ + CT treatment in number of alive spotted; however, that was not true for the number of dead spotted CB.

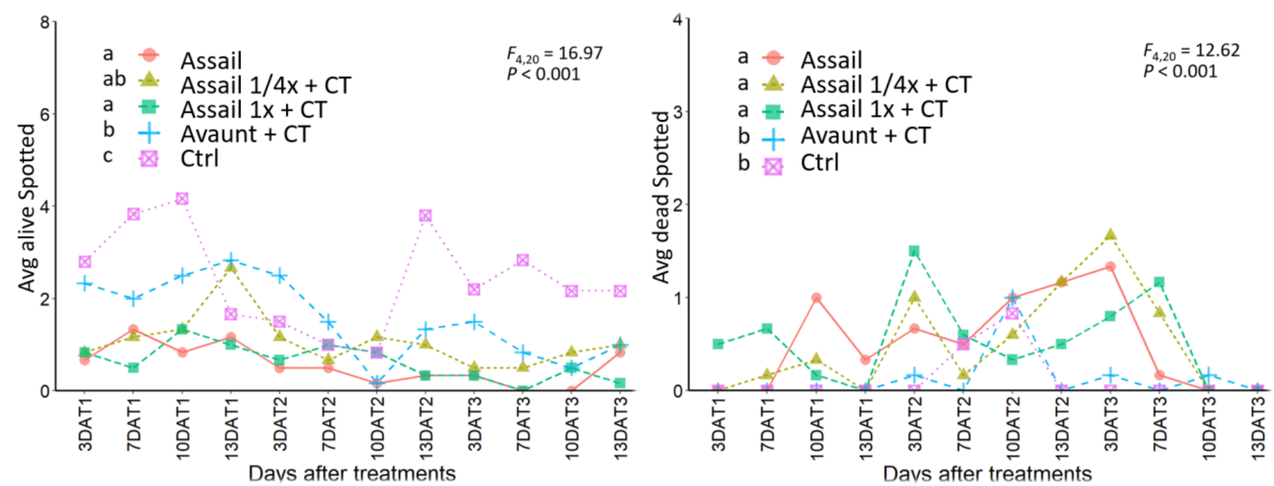

Figure 11. Average number of 1) alive and 2) dead spotted cucumber beetles. Results from the analyses using season-long summed counts are shown in the legend. Treatments not sharing a letter are significantly different.

At the end of the season, Avaunt + CT did not differ from the control treatment in terms of number of melons damaged. There was a marginally significant effect seen across treatments driven by lower damage in treatments containing Assail. In addition, the Assail ¼ rate + CT appeared to perform as well as the full rate of Assail. No difference was detected between the full rate of Assail with or without CT added (Figure 6). We saw that the Assail, Assail + CT, and

Assail ¼ + CT treatments all had similar levels of melons damaged at a 0, 1 or 2 rating (Figure 7). Additionally, these treatments had fewer melons falling in the higher/more damaged ratings of 2,3,4, or 5 when compared to the Avaunt + CT or Control treatments.

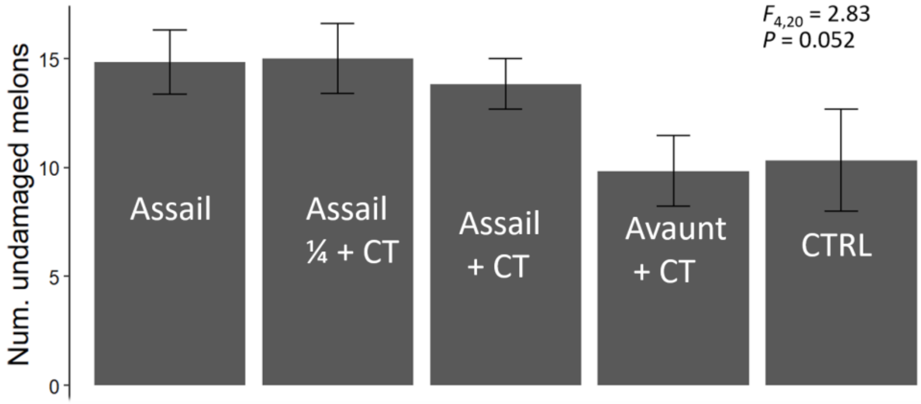

Figure 12. Number of "undamaged" melons at harvest (out of 20 assessed), with an undamaged equalling a 0 on a 0-5 scale and having no damage scars larger than a quarter coin.

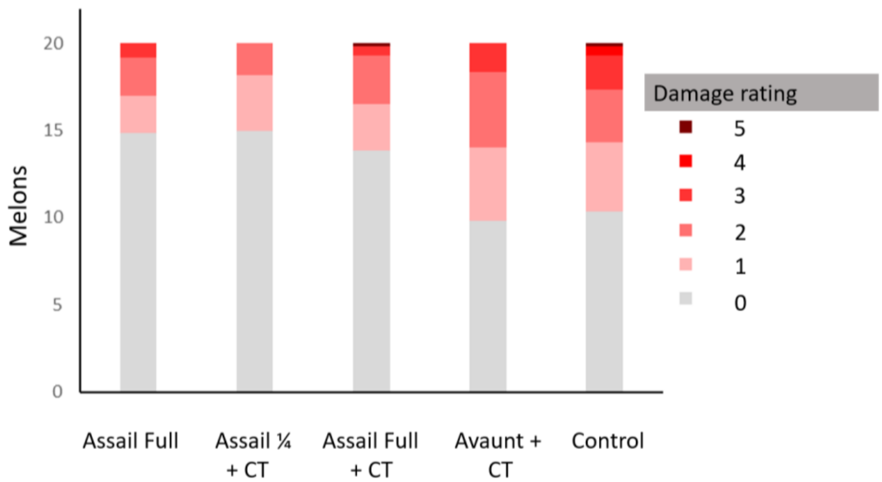

Figure 13. Number of melons in the different damage categories for the different treatments. Damage ratings ranged from 0 (undamaged) to 5 (heavily scarred).

Lab bioassay

Methods

We also performed a lab bioassay (Figure 8) to better assess the effect of Cidetrak/cucurbitacins on insecticide rates in a more controlled environment. Cucurbit leaves and striped CB were collected from the Plant Pathology Research Farm at UC Davis. Treatments tested are given in Table 2.

Treatment
Assail 1x
Assail 1x + CT
Assail 1/4x
Assail 1/4x + CT
Control

Table 3. Treatments tested in the lab bioassay, with rates the same as in the field trial.

Figure 14. Cut piece of squash leaf used for the bioassay. Cucumber beetle feeding is evident.

The leaves were cut into 10x15 cm rectangles and placed into a plastic deli container. Sixty individual 1mm VMD droplets were applied to each leaf using a pipettor and allowed to dry. Ten beetles were then placed into the container and the container was kept in a growth chamber set at field conditions. The beetles were allowed to feed and percent mortality was then assesed after 48 hours.

Results and Discussion

The bioassay followed a similar pattern to the field trial (Figure 9). The ¼ rate of Assail + CT treatment perfomed just as well as the full rate of Assail, and better than the ¼ rate of Assail without CT. There was no statistically significant increase in beetle mortality for the full rate of Assail compared to the full rate + CT.

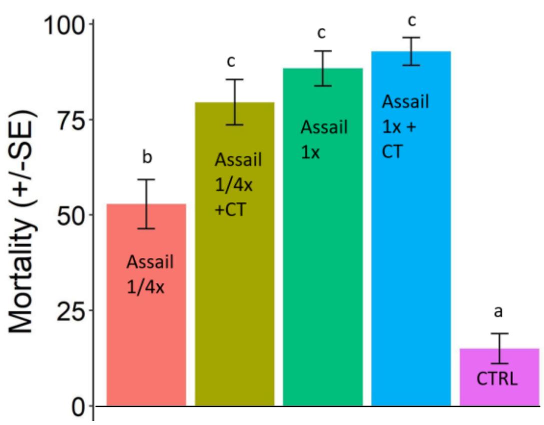

Figure 15. Percent mortality of striped cucumber beetle in the lab bioassay.

Conclusions

The results of this field and lab study seem to sugest that although we did not see any increase in the efficacy of insecticides applied at the full rate when combined with the feeding stimulant, we did see evidence that the additon of feeding stimulants may allow for a reduced insecticide rate to maintain the same level of efficacy as full rates. In addition, the insecticdes combined with the feeding stimulant seemed to have a marginally signifigant effect on melon damage.