Aug/Sept 2022

Vegetable Crops Newsletter

University of California Agriculture and Natural Resources
Cooperative Extension
UC CE

In this issue…

Farm calls 2022

Disease	Tomato		Cucurbits	
	Colusa	Sutter	Colusa	Sutter
Beet curly top virus	8	2	1	
Resistance breaking TSWV	1	2		
Cucumber mosaic virus				1
Tentative Fusarium falciforme		3		
Fusarium wilt		2		
Vegetable weevil		1		
Frost damage		1		
Abiotic	1		2	1

Beet curly top virus was prevalent again this spring, with multiple fields showing symptoms, especially in Colusa County. Both the BCTV-SpCT strain and the BCTV-CO strain were identified. Though the incidence within fields does not seem as high as in 2021, there were areas with higher infections and it was confirmed in both processing tomatoes and squash. Resistance-breaking tomato spotted wilt virus is also increasing in range this year compared to 2021. Information on both viruses can be found in the May 2022 Vegetable Crops Newsletter. Keep an eye out for soilborne fungal disease symptoms in your tomato fields as the season progresses.

Pest highlight: Vegetable Weevil

The vegetable weevil caused significant damage in a tomato field this spring, but little is known about its management because it is not generally a major pest. According to UC IPM, both adults and larvae feed on foliage, buds, and roots of tomatoes, potatoes, carrots, lettuce and various other vegetables. Infestation of new areas occurs slowly because adults do not fly. Damage may be spotty and weevils may defoliate or cut plants at ground level (UC IPM). In the case of this field, young plants were consumed down to the soil level.

Photo credit: Jack Kelly Clark, UC Statewide IPM Program.

One strategy for preventing localized infestations is to destroy infested rows or pick weevils off plants at night, though in large scale operations, this is not a realistic management tactic. You can use sticky barriers to prevent weevils from migrating into new areas and spot treatments may be necessary (UC IPM). This pest is not likely to be a major concern most years, with occasional increased pressure in specific years.

UC IPM, How to Manage Pests-Pests in Gardens and Landscapes: Vegetable Weevil.
http://ipm.ucanr.edu/PMG/GARDEN/VEGES/PESTS/vegeweevil.html

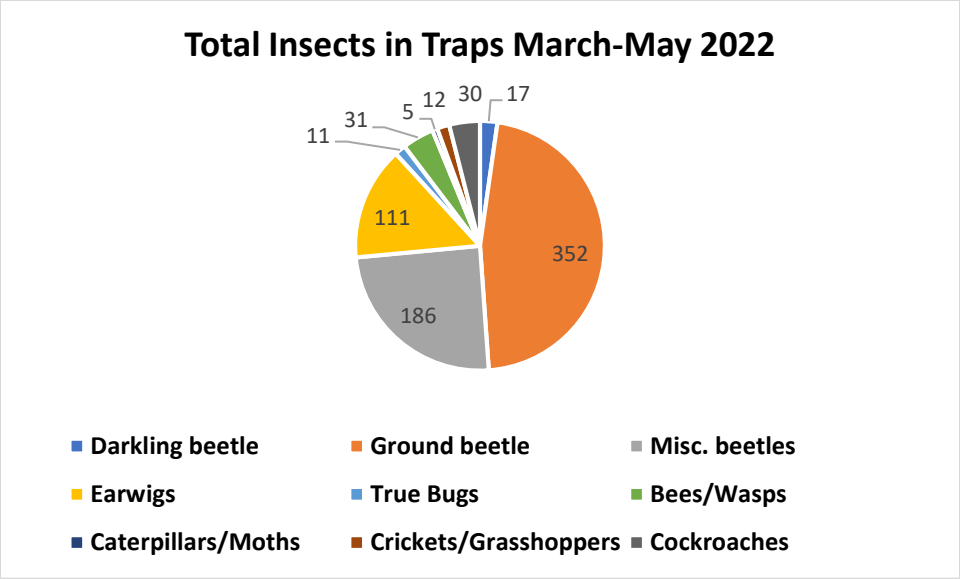
2022 Research Updates

Evaluation of darkling beetle overwintering locations and movement into tomato fields
Funded by the California Tomato Research Institute

Darkling beetles girdle seedlings at or below soil line by chewing which can cause significant damage and plant death when beetles are in high numbers. Darkling beetles are not usually a problem once plants are big enough to withstand the chewing damage. They move in from field edges, including weedy areas or adjacent crops like grains or alfalfa. Conventional control includes insecticide baits, but organic growers have more limited options.

The main goal of this project was to better understand darkling beetle movement into tomato fields and develop a monitoring strategy to assist with control before beetles migrate into crop fields. Probable habitats for darkling beetles were scouted March-May 2022. These sites included weedy vegetation, hedgerows, field borders, and other locations in close proximity to crop fields (examples of trap sites pictured below). To determine darkling beetle presence, pitfall traps and visual observations were used. Pitfall traps consist of plastic cups buried in the soil, so that the opening is even with the soil line and filled with a preserving liquid. Insects walking across the ground fall into the cup as they travel and are unable to escape.

Four organic field sites were monitored, with a total of 30 pitfall traps. The data is still being analyzed and beetles are currently being identified but the figure below shows a generalized overview of what was captured in the pitfall traps in Spring 2022. Because pitfall traps are better at measuring insect activity rather than density, they were not very effective at capturing darkling beetles. Darkling beetles do not move around as frequently as other insects like predatory ground beetles, which were caught in high numbers. However, darkling beetle damage was also not readily observed in these tomato fields. One field did however have significant damage from vegetable weevils which feed on foliage and stems, defoliating the plant, rather than girdle young plants at the base.



Ground beetles were the most abundant insects captured, followed by miscellaneous beetles (not including darkling beetles) which included carrion beetles, click beetles, lady beetles, rove beetles and others in smaller numbers. Earwigs were also commonly captured along with isopods, spiders and ants (data not included).

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; 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. Last year, we worked with AgSeeds and evaluated processing tomato varieties 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, we were unable to confirm *Fusarium falciforme* in the particular fields we evaluated, however, the number of fields where we have confirmed the disease through farm calls is increasing in our region. We are conducting the same evaluations in AgSeeds variety trials this season as well.

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 am entering the last year of 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. There is a need to improve soil health and reduce inputs such as fertilizer due to heavier restrictions on groundwater and the potential for leaching, in addition to improving sustainability of annual cropland. Due to soilborne fungal disease pressure and other risks associated with tomato production, implementing soil health practices may help mitigate these challenges. 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. The same applications were made to the Sutter County site in Fall 2021. 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 and collected annual soil samples Fall 2021 and will collect soil data again in Fall 2022 to determine any changes to soil health metrics.

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.

The South American Tomato Leafminer *Tuta absoluta*: Threats of Invasion and Future Plans for Control

Benjamin Lee, Ph.D. - Postdoctoral Researcher at the University of California-Davis
Ian Grettenberger, Ph.D. - UC Cooperative Extension Field and Vegetable Crops Entomology Specialist at the University of California-Davis

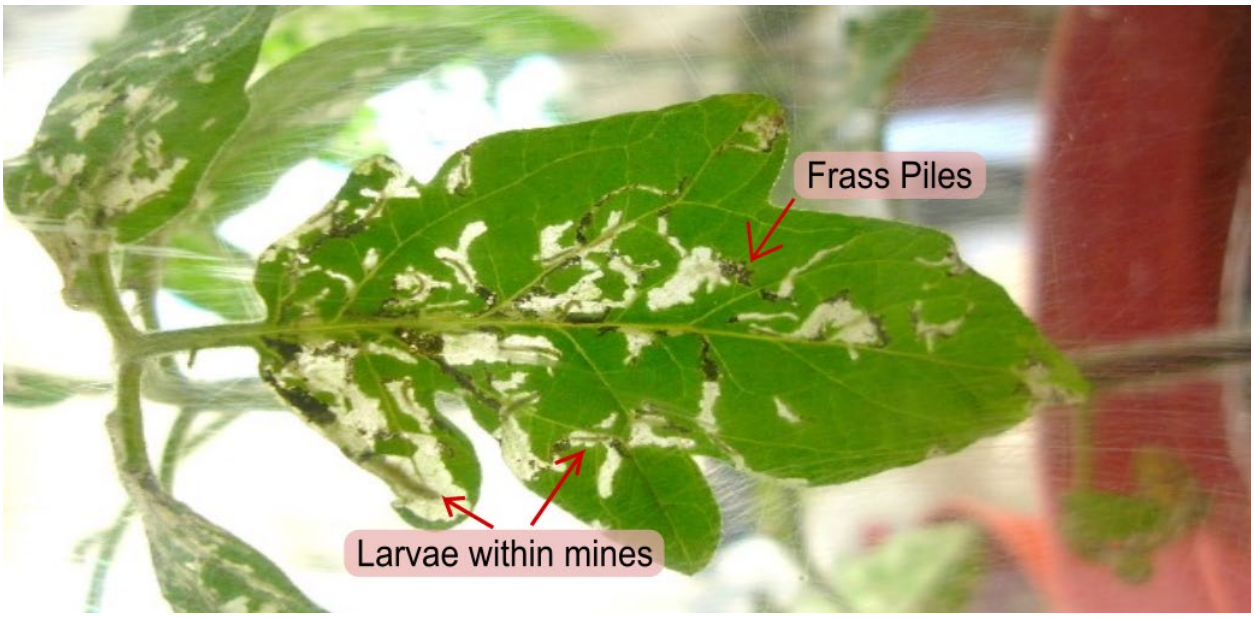
In 2006, a shipment of tomatoes infested with larvae of the South American Tomato Leafminer *Tuta absoluta* (recently renamed *Phthorimaea absoluta*) arrived in Spain, likely originating from Chile. While *Tuta* had been a pest in South America for decades, this was the first time it had been detected off the continent. In just 5 years, *Tuta* exploded across Europe, Asia and North Africa, expanding its range by more than 500 miles per year. Newly invaded countries struggled to control *Tuta* with insecticides, as the original population may have already been resistant to pyrethroids and resistance to other products grew rapidly. Both field and greenhouse production saw yield losses of 80-100% when *Tuta* was left uncontrolled, and most invaded nations took many years to develop effective pest management programs to limit *Tuta* damage. In 2020, *Tuta* was detected in China, leaving the US and Mexico as the only major tomato producing countries yet to be invaded.

Feeding damage on Tomato Leaves and Fruit, and an adult *Tuta absoluta* moth. (Photograph credit: A. Biondi).

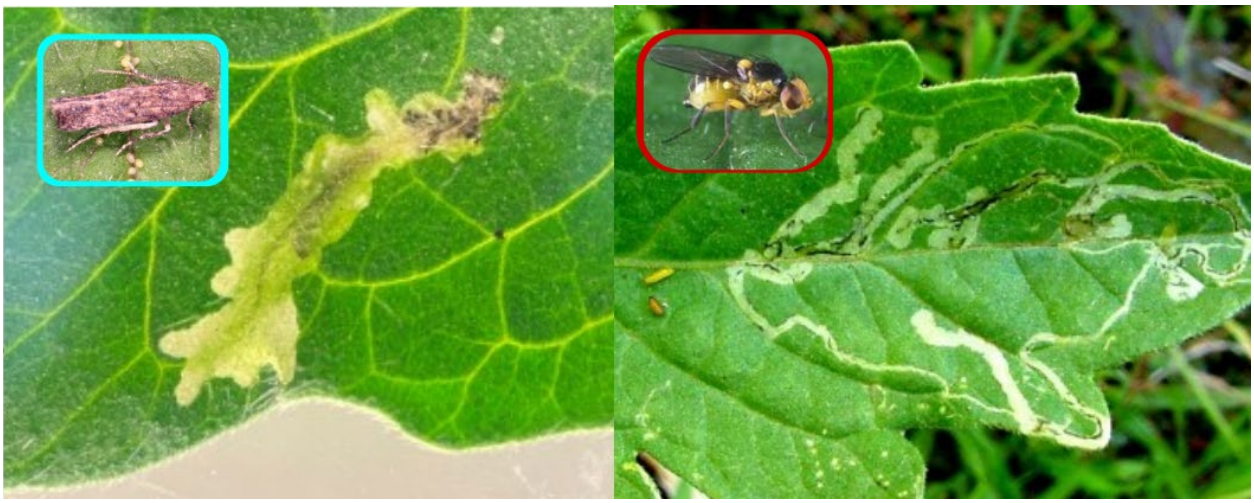
While *Tuta* hasn't been detected in the US yet, it stands as a serious threat to California tomato production should it arrive and establish. *Tuta absoluta* is a small brown moth (~1cm long) in the family Gelichiidae, feeding mostly on Solanaceous plants (tomatoes, peppers, eggplants, etc.). The larvae of *Tuta* are leaf-miners, burrowing between the upper and lower surfaces of leaves where they are protected from predators, the environment, and often many contact insecticides. *Tuta* larvae are voracious feeders and even moderate infestations can skeletonize entire plants, though larvae will occasionally burrow directly into fruit when most leaf tissue has been consumed. The movement of infested fruit is likely one reason why *Tuta* spread so rapidly and remains a likely pathway for *Tuta*'s introduction into the US. Currently, the California Department of Food and Agriculture (CDFA) lists *Tuta* as a Class A pest, requiring rigorous inspection of imported fruit from infested regions.

Identifying *Tuta absoluta* Damage In the Field

To prevent the establishment of *Tuta* in California, early identification of any *Tuta* populations will be critical. As leaf-mining larvae, *Tuta* make distinct mines in the surface of tomato leaves that can be used to diagnose an infestation. Mines occur in rounded, irregular shapes where larvae can often be seen underneath the translucent surface. They also almost always have a small compartment or exit hole where piles of black or brown frass (insect poop) can be found. With very high infestation rates, *Tuta* can consume all leaf tissue and begin burrowing into stems and fruit, where only frass can be found. Feeding damage can lead to reduced photosynthesis, poor plant architecture, and loss of fruit set, especially when damage occurs on younger plants.



Several other leaf-mining pest cause damage to tomatoes that could be mistaken for *Tuta absoluta*. Leaf-mining flies in the genus *Liriomyza* are common to tomato fields in California but generate distinctly different shaped mines as shown below. *Liriomyza* larvae feed in one direction, creating long, serpentine mines that often wrap around the surface of leaves and do not usually cause economic damage.



Tuta absoluta damage (left) next to *Liromyza* sp. damage (right) on tomato leaves. Mines of the fly *Liriomyza* are long and continuous, while *Tuta* mines are wider and have multiple feeding notches. (Photograph credit: B. Lee and J. Arno).

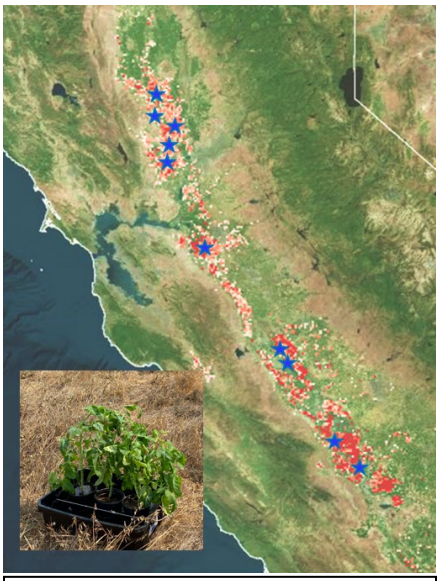
Importantly, California is home to another leaf-mining moth, the tomato pinworm *Keiferia lycopersicella*, that is closely related to *Tuta* and generates nearly identical damage. While it is difficult to tell mines and larvae of these species apart, infestations of the tomato pinworm *K. lycopersicella* have become rare in California tomato production as broad-spectrum insecticide use has eliminated most populations in the state. For this reason, if any damage is found that

matches the description for *Tuta*, growers should not assume it is pinworm and should submit a sample to their local county agricultural commissioner for species confirmation. Early detection of *Tuta* will be essential to prevent significant damage to tomato production should it arrive in the US.

Ongoing Research Efforts

At UC Davis, our research program has been working to develop our toolkit of rapid and long-term response options to a potential *Tuta* invasion into California tomato production. We've been evaluating the effectiveness of US-registered insecticides against *Tuta* with a focus on expanding our limited organic options and have been testing wild tomato relatives from *Tuta*'s native range in Peru and Ecuador to explore possible resistance traits that may be useful to breeding programs in the future.

For the past two years, we've also been sampling tomato fields across the state, including on farms in Sutter and Yolo counties, to identify natural enemies already present in fields that could be used in biological control programs to slow the establishment and spread of *Tuta*. Given *Tuta* populations are often resistant to several classes of insecticides, biological control using parasitoid wasps and other insect predators has been an important component of management internationally. We placed tomato plants infested with tomato pinworm at field edges adjacent to tomato production at 10 farms across the state, leaving them for 5 days before recovering any parasitized larvae and collecting any parasitoids that emerged. Our hope was that parasitoid wasps that will attack tomato pinworm will also attack *Tuta*, as the two species are closely related.



California processing tomato production (red) and locations sampled (blue stars).

We found relatively high parasitism rates of tomato pinworm (4.5-11% in the Sacramento Valley), primarily by two species of tiny parasitoid wasps, *Neochrysocharis* sp. near *formosa* and *Zagrammosoma flavolineatum*. Both species were consistently recovered from parasitized tomato pinworm larvae and were able to successfully parasitize *Tuta* within our laboratory facility. These naturally occurring parasitoids can locate and attack larvae hiding within mines, are unlikely to have non-target effects on other species, and are already adapted to local agronomic conditions, making them ideal candidates for use in future biological control programs. Future studies will examine exactly how effective these species might be at controlling *Tuta* populations in the field, but their willingness to attack *Tuta* and their presence throughout the state suggests these species might be valuable.

Neochrysocharis sp. (left) and *Zagrammosoma flavolineatum* (right) were recovered from parasitized tomato pinworm in fields across California's tomato production regions and could be useful in future biological control programs. (Photo credit: I. Grettenberger).

Our proactive research program aims to provide strategies to rapidly respond to *Tuta* invasion should it occur. For now, it is critical for growers to be aware of the risks of *Tuta* and to keep an eye out for any suspected infestations. If any damage matching the above description is found, contact your county agricultural commissioner or call the CDFA Pest Prevention Hotline at 1-800-491-1899.

Please feel free to contact Amber with any vegetable crop issues in the field, questions or comments, or to subscribe to this newsletter electronically.

Amber can be contacted at the Colusa UCCE office at 530-458-0575, or at acvinchesi@ucanr.edu.