Topics in Subtropics Newsletter

University of California Cooperative Extension

Fresno, Kern, Madera, Riverside, San Bernardino, San Diego, San Luis Obispo, Santa Barbara,Tulare,&Ventura Counties

News from the Subtropical Tree Crop Farm Advisors in California

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TOPICS IN THIS ISSUE

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Bifenthrin application added as an option to Fuller Rose Beetle Mitigation with Voluntary Sampling to Reduce Pesticide Application

Sandipa Gautam, Area Citrus IPM Advisor, UCCE
James R Cranney, President CCQC

At a roundtable discussion on April 24, 2025, held at the Lindcove Research and Extension Center, Jim Cranny and Sandipa Gautam met with citrus growers, pest control advisors (PCAs), County Agricultural Commissioners, and USDA APHIS representatives to review current mitigation measures for Fuller rose beetle (FRB). As an outcome of this meeting reviewing several years of research findings, the California Citrus Quality Council (CCQC) and UC proposed an additional option, using bifenthrin soil application with voluntary sampling, to expand choices for FRB management. This option is approved and growers now can choose from three possible pesticide options listed below:

1. Make one ground application with bifenthrin between June 1 and July 15 in combination with the sampling protocol (new option): or,
2. Make one foliar application in combination with the sampling protocol by October 31: or,
3. Make two foliar applications, first by September 7 and second by October 31.

For all options, skirt pruning and herbicide treatments are required.

Fuller Rose Beetle

Fuller rose beetles are brown, flightless snout beetles (Figure 1). They have one generation in a year, of which three-fourths of their life cycle is spent as larval grubs underground, where they feed on roots and go through development. Adults are known to emerge from the ground year-round, but the major emergence in the San Joaquin Valley occurs from July to September. All beetles are females, and adult females do not require mating to begin reproduction. Beetles climb the tree canopy and feed on citrus leaves and lay eggs in cracks and crevices, including under the fruit sepal (Figure 2). Eggs may be present on fruit at harvest, thereby making this beetle a quarantine concern for Korea's Animal and Plant Quarantine Agency.

Figure. 1. Fuller rose beetle adult.

Growers have been using a systems approach that combines cultural and chemical methods to target FRB since 2010, aiming to reduce the beetle population and egg laying. Until 2023, the regulatory requirements for managing FRB were:

a) Skirt pruning sufficient to prevent tree skirts from contacting the ground, and
b) Weed control sufficient to prevent forming a bridge from ground to tree skirt, and
c) **Two insecticide treatments** to control FRB using only University of California recommended pesticides from the UCANR IPM Guidelines web page at http://ipm.ucanr.edu/PMG/r107300311.html

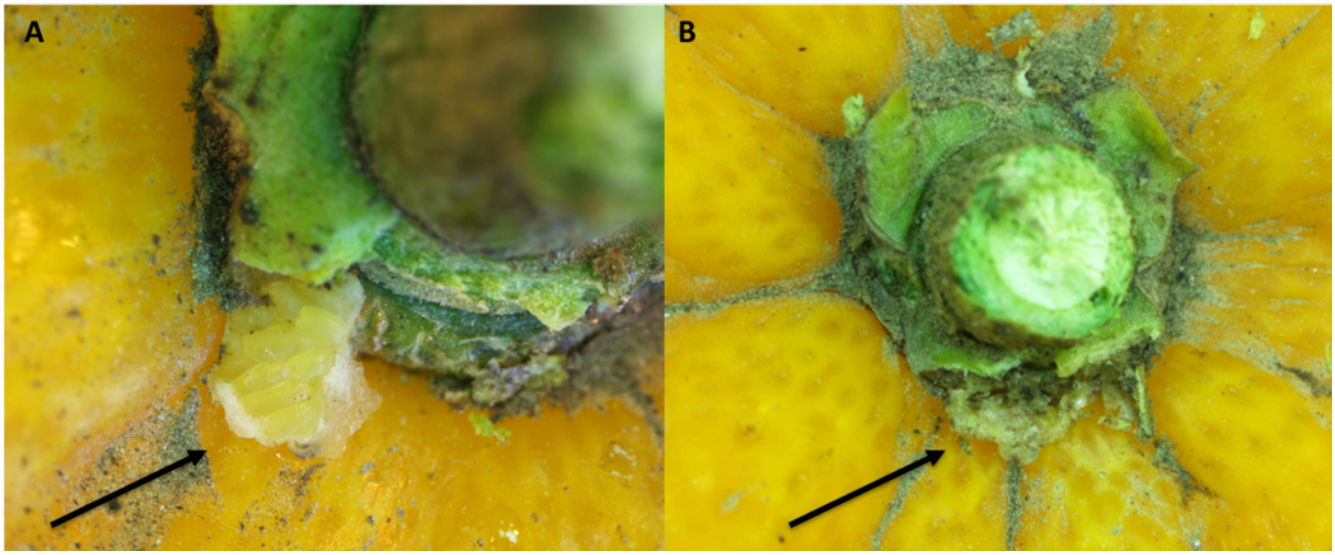


Figure 2. Fuller rose beetle egg masses, live eggs (A) – note yellowish and plump eggs; dead or hatched eggs (B) – dried out egg mass.

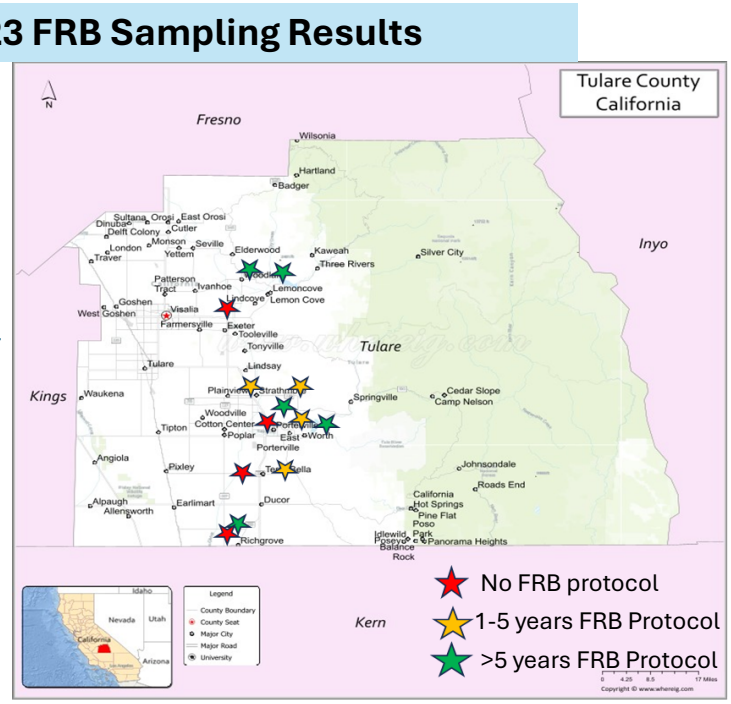
In the last 4 years, growers and pest control advisors have reported a significant decline in FRB detection across most citrus orchards. Supporting this observation, the USDA APHIS phytosanitary inspections found FRB in only 0.05% of all containers sampled. Based on these developments, the USDA APHIS approved a voluntary sampling protocol developed and proposed by the CCQC and UC. This allows growers to assess FRB presence in their orchards and, if infestations are below the threshold of 3 infested trees out of 72 sampled, they may opt to skip one insecticide application. This approach aims to reduce pesticide use while maintaining compliance with export requirements, particularly for markets like South Korea that have stringent quarantine standards for FRB.

The sampling protocol, described below in detail, involves conducting FRB sampling from August 7 to August 31, dividing each citrus block into four quadrants, and sampling 18 trees per quadrant (totaling 72 trees). Inspectors check for signs of FRB by examining inner suckers for leaf chewing and shaking branches to detect beetles. If no more than two infested trees are found, growers may eliminate the first pesticide application and treat just once before October 31 using UC-recommended pesticides. Detailed guidelines and pesticide recommendations are available on the UC IPM website.

Based on these reports, CCQC and UC led efforts to develop a FRB sampling protocol, which provides options for growers to sample orchards (see sampling protocol below for details) and skip an insecticide application if the threshold of FRB-infested trees is 2 or less. To validate the proposed sampling

program and to collect data, Sandipa Gautam's team conducted surveys in 2023 and 2024, sampling 27 and 21 citrus groves, respectively. Using the USDA APHIS-approved protocol of inspecting 72 trees per grove, they found that in 2023, only 1 out of 14 groves participating in the Korea Program exceeded the threshold of ≥3 infested trees (Figure 3). In contrast, 5 out of 7 citrus orchards, not in the Korea program, had FRB detections, albeit at low levels, possibly due to other pest management practices.

	Sites	Infested trees	Total FRB found
>5 years Korea FRB Protocol	1	0	0
	2	0	0
	3	0	0
	4	0	0
	5	0	0
	6	0	0
	7	0	0
	8	0	0
	9	0	0
	10	0	0
	11	6	11
	12	0	0
1-5 years Korea FRB Protocol	1	0	0
	2	0	0
	3	1	1
	4	0	0
	5	0	0
	6	0	0
No FRB protocol	1	4	7
	2	18	26
	3	7	32
	4	11	14
	5	0	0
	6	0	0
	7	15	28



26 blocks sampled, block size from 10-40 acres. Tree age: 21-59 yrs

Figure 3. Number of FRB adults found in citrus groves in 2023, map shows sampling locations.

In 2024, a follow-up study was conducted on 21 citrus groves that had implemented the voluntary FRB sampling protocol in 2023. These groves had opted for a single foliar pesticide application after their 2023 sampling results showed fewer than three infested trees per 72 sampled. The 2024 assessments (Figure 4) revealed that none of these orchards exceeded the infestation threshold, reinforcing field observations by growers and PCAs of sustained, low FRB populations in recent years.

This outcome supports the effectiveness of the integrated management approach, which combines cultural practices—such as skirt pruning and weed control—with targeted chemical applications based on sampling results. The continued low detection rates of FRB suggest that the voluntary sampling protocol is a viable strategy for reducing pesticide use while maintaining compliance with export requirements.

Based on recent field observations and data indicating historically low populations of FRB the CCQC and UC have proposed an enhanced protocol for FRB mitigation. This protocol aims to reduce pesticide usage while maintaining compliance with export requirements, particularly for markets like South Korea.

2024 FRB Sampling Results

Site	Block	Infested Trees	Total FRB found
1	1	0	0
	2	0	0
	3	1	1
	4	0	0
2	1	0	0
	2	0	0
3	1	0	0
	2	0	0
	3	0	0
4	1	0	0
	2	0	0
	3	0	0
	4	0	0
5	1	0	0
6	1	0	0
	2	0	0
	3	0	0
	4	0	0
	5	1	1
	6	0	0
	7	0	0

Total number of blocks sampled = 21
Size of Blocks: ~20 Acers

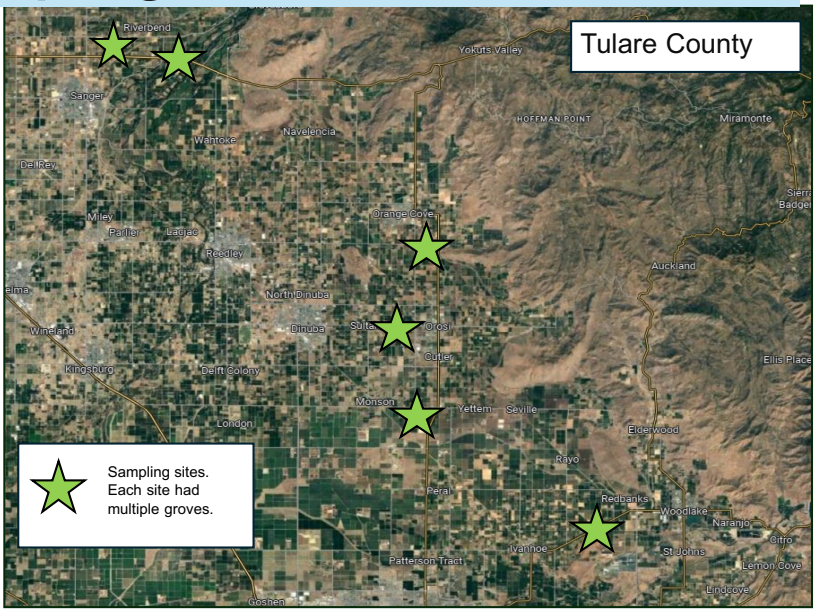


Figure 4. Number of FRB adults found in citrus groves in 2024, map shows sampling locations.

Revised FRB Mitigation Protocol for the Korea Export Program

To align with the updated guidelines, growers are required to implement the following cultural practices:

1. **Skirt Pruning**: Ensure tree skirts are pruned to prevent branches from contacting the ground, thereby limiting beetle access to the canopy.
2. **Weed Management**: Apply herbicide treatments to eliminate weeds that could serve as pathways for beetles to reach tree canopies.

In addition to these practices, growers must choose one of the following pesticide management options:

Option A: Soil-Applied Bifenthrin with Sampling Protocol

- **Application Timing**: Apply bifenthrin to the soil between June 1 and July 15, targeting the larval and pupal stages to prevent adult beetle emergence.
- **Sampling Requirement**: Conduct the FRB sampling protocol (detailed below) between August 7 and August 31.
- **Action Threshold**: If no more than two FRB-infested trees are detected out of 72 sampled, growers may eliminate the two subsequent foliar applications for that season.

Option B: Single Foliar Application with Sampling Protocol

- **Sampling Requirement**: Implement the FRB sampling protocol between August 7 and August 31.
- **Action Threshold**: If no more than two FRB-infested trees are found out of 72 sampled, growers may eliminate the first foliar application and proceed with a single application, before October 31, using pesticides recommended by the UC IPM program.

Option C: Two Foliar Applications

- **Application Timing**: Apply the first foliar pesticide treatment by September 7 and the second by October 31, using UC-recommended pesticides.

FRB Sampling Protocol

To accurately assess FRB infestation levels, adhere to the following sampling procedure:

1. **Timing**: Conduct sampling between August 7 and August 31, coinciding with the peak period of adult beetle emergence.
2. **Sampling Method**:
    - **Block Division**: Divide each citrus block into four quadrants.
    - **Tree Selection**: Randomly select and sample 18 trees in each quadrant, totaling 72 trees per block.
3. **Inspection Procedure**:
    - **Interior Examination**: Inspect suckers inside each tree for signs of FRB leaf chewing. If beetles are detected, consider the tree infested.
    - **Exterior Examination**: If no beetles are found internally, shake two large exterior branches over a light-colored cloth and inspect for beetles. Presence indicates infestation.
4. **Record Keeping**: Maintain detailed records, including:
    - **Block Identification**: Assign a unique identifier to each block.
    - **Inspection Date**: Note the date of each sampling activity.
    - **Inspector Name**: Document the name of the individual conducting the inspection.
    - **Infestation Count**: Record the number of infested trees out of the 72 sampled.
5. **Action Threshold**: If three or more trees are found to be infested, growers must follow Option C, implementing two foliar pesticide applications.

How Will the New Protocol Help?

- Reduced pesticide use could reduce grower costs to manage FRB.
- Fewer pesticide applications should improve biological control in citrus groves by preserving beneficial insects. Many PCAs and growers attribute severe mealybug outbreaks to increased pesticide use to control FRB and Asian citrus psyllid.

Reducing pesticide use to control FRB will help California citrus growers adopt more sustainable production practices and align the industry with the California Department of Pesticide Regulation's Sustainable Pest Management Roadmap.

With the added option, growers now have more choices to manage FRB and reduce neonicotinoids usage. It is important to perform the inspections with diligence and maintain records of actions taken. Missed beetles may mean that population will build in the orchards and may lead to interceptions compromising the shipment and the export agreement.

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Selective Egg Staining: a New Tool to Support Breeding of Whitefly Resistant Crops

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The sweetpotato whitefly, *Bemisia tabaci* MEAM1, is a damaging pest in California and Arizona, with the potential to cause complete yield losses in certain crops, including: tomato, cotton, and melons. Sweetpotato whiteflies primarily damage vegetable crops by transmitting plant viruses, but at high whitefly populations – as are often found in the Low Desert (Imperial and Yuma Counties) – economic losses can even occur from feeding alone (Navas-Castillo et al., 2011; Perring et al., 2018). Currently, cultural methods like crop scheduling, along with foliar and soil applied insecticides are the main options to control sweetpotato whitefly (Palumbo, 2016). However, these controls are often not sufficient to prevent damage. Sweetpotato whitefly control efforts are further complicated due to whitefly's resistance to many common insecticides (Horowitz et al., 2020). New California regulations restricting the use of neonicotinoid insecticides at certain stages of crop development also leave growers with reduced options for sweetpotato whitefly control (Cal. Code Regs. Tit. 3, § 6990, 2024). Plant breeding of crop varieties resistant to sweetpotato whitefly has the potential to provide growers with a new and sustainable whitefly control tool, easing the persistent challenge of whitefly management.

Figure 1. Left, whiteflies on melon, photo from Rebecca A. Melanson, MSU Extension, Bugwood.org. Right, symptoms caused by the whitefly-transmitted viruses, CYSDV and CCYV on melon plants, photo from W. M. Wintermantel, USDA-ARS.

To create an insect resistant crop, plant breeders first collect many available varieties of that crop, and often some uncultivated wild relatives. In a process called "phenotyping," plant breeders allow the insect to feed on many plant varieties to look for differences in insect behavior and development, or for plants with an ability to tolerate insect damage. When those traits allow a plant variety to avoid or tolerate insect damage without losses in marketable yield, that is called "resistance."

Accurate phenotyping methods are required to correctly measure these traits. And that phenotyping must be high-throughput so breeders can screen large numbers of plant varieties within a reasonable time-frame. Once breeders find a variety with traits that convey resistance to the insect, they will then work to move that resistance into crop varieties favored by growers (Smith, 2005). This is done through many generations of crossing those plants together and selecting the resistant offspring.

Fecundity, the number of eggs produced by each female insect, is a common measure of insect development, as this directly relates to the growth rate of insect populations. Comparisons of fecundity are often used in the phenotyping process as a measure of how resistant a plant might be to that insect species (Silva et al., 2012). Fewer eggs laid per female insect over time results in slower insect population growth and therefore less insect damage. Fecundity is a useful measure of sweetpotato whitefly resistance in crops, but applying this method is difficult due to the very small size of the eggs of this insect (Figure 2). The small size makes counting whitefly eggs difficult and time consuming, slowing the progress for breeders who must screen many plants during the phenotyping process.

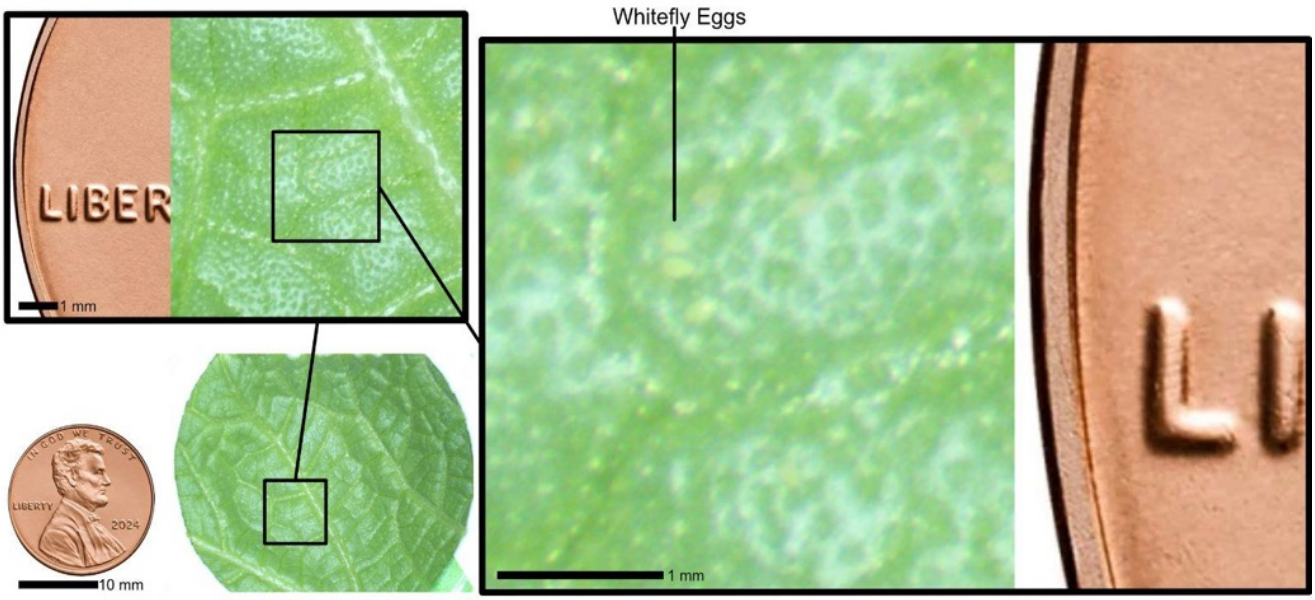

Figure 2. Size of whitefly eggs at various zoom levels with a standard U.S. penny included for scale.

A New Tool for Plant Breeders

To address these issues and support crop breeding efforts, we developed a new selective staining method for sweetpotato whitefly eggs. This work was published in the journal *Plant Methods* in 2024: "Evaluation of a low-cost staining method for improved visualization of sweet potato whitefly (*Bemisia tabaci*) eggs on multiple crop plant species," https://link.springer.com/article/10.1186/s13007-024-01209-z.

Our new method uses a chemical stain that attaches more strongly to the whitefly eggs than the plant leaf. A second step in the process uses heat, pressure, and a lactic acid-based solution to remove green pigments (chlorophyll) and other colors from the leaf surface. After these two steps, the eggs are visible as dark purple dots against a lighter purple background, resulting in faster counting of the stained eggs (Figure 3). We tested this method on cassava, cowpea, melon, sweetpotato, and tomato; we found that staining greatly improved speed and accuracy of egg counting in tomato and melon, but was less useful for sweetpotato and cassava, with intermediate results for cowpea (van Raalte et al., 2024).

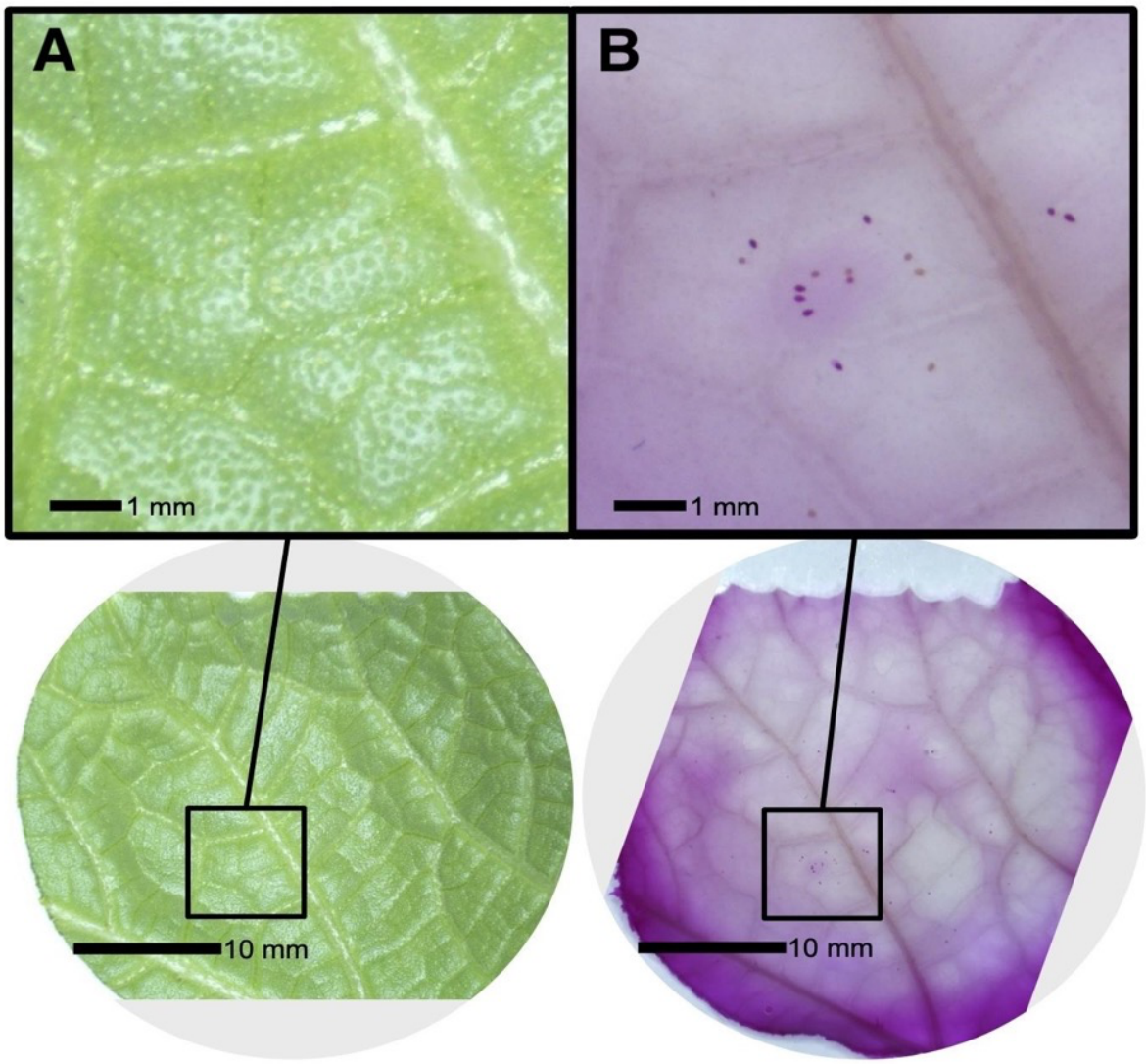

Figure 3. Sweetpotato whitefly eggs on a melon leaf before (A) and after (B) the selective staining process. Figure from van Raalte et al. 2024.

Since plant breeding projects are often limited in funding, we also worked to make sure this method could be done quickly and at a low cost. For the clearing solution we confirmed that a commercially available pressure cooker ("Instant Pot®") could achieve similar results to the much more expensive autoclaves that are often used in a lab setting. While counting stained eggs still requires a microscope, the greater visibility allows counting to be done with lower-magnification and therefore lower-cost microscopes.

A Note on Scouting

While this method is useful for plant breeders, we do not currently recommend growers use this in their scouting programs to assess sweetpotato whitefly pressure. All current recommendations for sweetpotato whitefly control are based on the presence of nymphs and adults, therefore proper use of egg counts would require development of new treatment thresholds.

Future Directions

This new selective egg staining technique allows plant breeders to quickly and accurately measure the fecundity of sweetpotato whiteflies. This speeds up the process of identifying new sources of sweetpotato whitefly resistance, and moving that resistance into crop varieties. Using this new method, we are currently working to breed melon varieties with increased resistance to sweetpotato whitefly. These efforts will eventually provide growers with a new tool to manage this damaging pest.

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Sunblotch! New Tools to Spot This Sneaky Avocado Thief

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Hey Avocado Growers! You know the feeling – you've poured your heart and soul into your orchard, and then something starts to chip away at your profits. One of those silent culprits in California avocado groves is the **Avocado Sunblotch Viroid (ASBVd)**. It's a tiny, microscopic troublemaker that can cause big headaches, leading to lower yields and those tell-tale scars and spots on your precious fruit.

For years, spotting ASBVd early was like finding a needle in a haystack. The old tests just weren't sensitive enough, especially when trees weren't showing obvious signs. This meant the viroid could be lurking in your orchard, spreading slowly but surely, without you even knowing it.

But hold onto your hats, because we've been working hard at the University of California to develop some cutting-edge tools to help you get ahead of this sneaky thief! Our research team has cooked up a new, super-sensitive way to detect ASBVd, and we've put it to the test right here in California orchards, just like yours. Think of it like upgrading from an old magnifying glass to a powerful microscope. This new technology allows us to see the ASBVd even when it's present in very small amounts, giving you a much earlier warning system.

Why Early Detection Matters – Your Bottom Line!

- **Stop the Spread:** Catching ASBVd early means you can take action *before* it infects more trees, saving you time, money, and a lot of heartache down the road.
- **Healthy Trees, Happy Harvests:** By identifying and removing infected trees (or using clean propagation material), you're ensuring the health and productivity of your remaining orchard.
- **Protecting California Avocados:** ASBVd is a threat to our entire industry. Early detection is key to keeping California avocados strong and competitive.

So, what's this new magic we've been working on? Let's dive in!

Unmasking the Viroid: dLAMP to the Rescue

We've been exploring some molecular techniques, and two really stood out: **digital Loop-Mediated Isothermal Amplification (dLAMP)** and **droplet digital PCR (ddPCR)**. Think of them as super-sleuths that can find even the tiniest traces of the ASBVd's genome.

Why dLAMP is a Game-Changer:

Imagine a regular light bulb (that's like the older detection methods) versus a super-bright LED (that's dLAMP!). dLAMP is a newer version of a technique called LAMP, and it's like turning up the sensitivity dial to eleven! Here's why it's so promising for you:

- **Super Sensitive:** dLAMP can detect ASBVd even when there are very few copies present in the plant. This means we can potentially spot infections much earlier than before, even in trees that look perfectly healthy.
- **Relatively Fast:** While it's a lab-based test for now, LAMP technology in general is known for its speed compared to some other methods. We're working on making it even more user-friendly for quicker turnaround.
- **Specific:** Our dLAMP assay is designed to specifically target ASBVd, so we're not getting false alarms from other things in the avocado tree.

How We Put dLAMP to the Test in Your Backyard:

Over the past couple of years (2023-2024), our team went out to eight avocado orchards right here in California – in Ventura, San Diego, and Riverside counties. We collected samples from all parts of the trees: leaves, fruits, and even flowers. We looked at trees that showed the tell-tale signs of sunblotch, and also their healthy-looking neighbors to see if the viroid was hiding.

We even tried pooling samples – like putting a few leaves together in one test – to see if we could still detect the viroid efficiently. This could potentially save time and resources in the future (Figure 1).

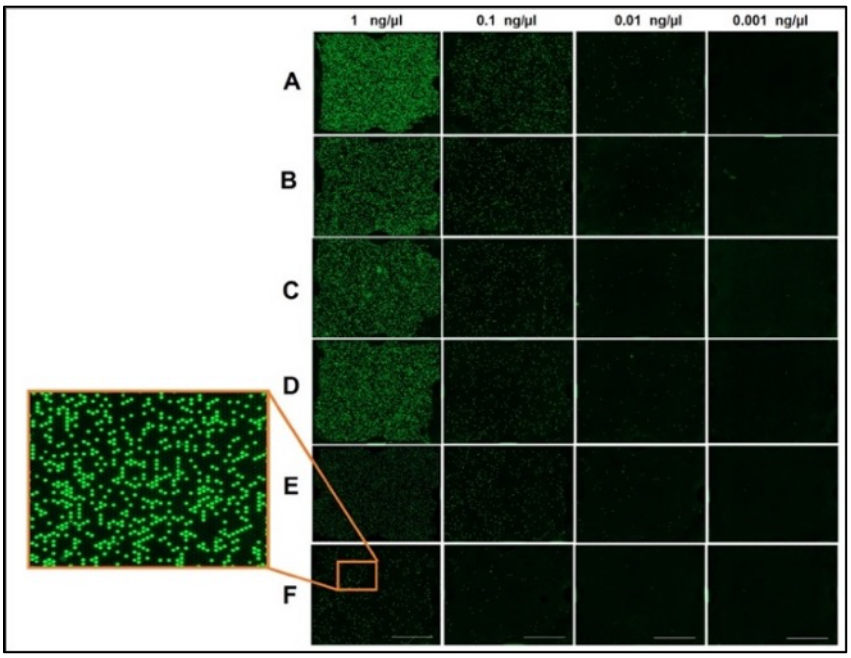

Figure 1: Think of this picture like a close-up view from our super-sensitive dLAMP test. Each little dot shows a positive signal for ASBVd. We tested different amounts of the viroid from both fruits (A-C) and leaves (D-F), and also tried testing single samples versus groups of samples to see how well dLAMP could find it.

What We Found with dLAMP:

Our results were exciting! The dLAMP test was really good at finding ASBVd, even when it was present in very small amounts in the lab. When we tested the samples from your orchards, dLAMP was able to detect the viroid in about 31% of them, showing it's a reliable tool for real-world conditions (Figure 2).

Comparing the New Tools: dLAMP vs. ddPCR

We also used another powerful technique called **droplet digital PCR (ddPCR)**. Think of ddPCR as counting individual raindrops to see how much rain has fallen. It's incredibly precise for measuring the exact amount of the viroid in a sample.

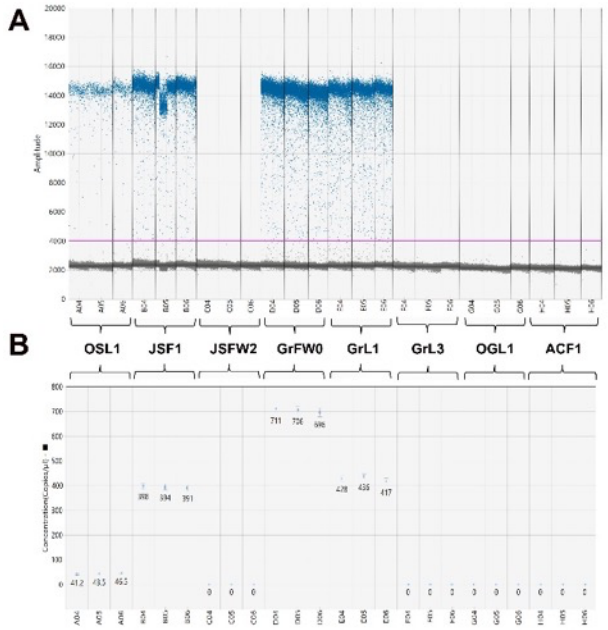

Figure 2: This graph shows how sensitive our ddPCR test is. We tested different amounts of ASBVd from infected leaves (A) and fruits (B), both individually and in groups. The more of the viroid present, the stronger the signal. This helped us confirm that our dLAMP test was also working accurately.

ddPCR: The Gold Standard for Counting:

- **Super Accurate:** ddPCR can tell us not just *if* the viroid is there, but *how much* of it is present. This can be helpful for understanding how the infection progresses in a tree.
- **Good for Validation:** We used ddPCR to double-check the results we got with dLAMP, making sure our new dLAMP test was accurate.

What We Learned Comparing the Two:

Both dLAMP and ddPCR were great at finding ASBVd in the orchard samples. In fact, they gave us pretty similar results! This is great news because it means dLAMP has the potential to be a highly effective tool for routine testing.

What This Means for You:

- **More Sensitive Testing Options:** You'll potentially have access to more accurate and sensitive tests for ASBVd in the future, allowing for earlier detection.
- **Better Understanding of Spread:** These tools can help us understand how ASBVd is moving through orchards, even in trees that don't show symptoms.
- **Informed Management Decisions:** With more reliable testing, you can make better decisions about managing your orchard, like which trees to remove or which propagation material to trust.

The Future is Bright (and Viroid-Free!): What's Next?

Our research has shown that these new molecular tools, especially dLAMP, hold great promise for improving ASBVd detection in California avocado orchards. We're excited about the potential to get these technologies into the hands of growers and agricultural professionals.

What We're Working on Now:

- **Making dLAMP Even Easier:** We're exploring ways to make the dLAMP test even more user-friendly and potentially adaptable for on-site testing in the future. Imagine being able to get quick results right in your orchard!
- **Understanding How ASBVd Moves:** Now that we have these sensitive tools, we can start to dig deeper into how ASBVd spreads within and between orchards. This will help us develop even better prevention strategies.
- **Working with Growers:** We're committed to sharing our findings with you through workshops, field days, and extension publications like this one. We want to make sure you have the knowledge and tools you need to protect your groves.

Your Role in Protecting Your Orchard:

- **Stay Vigilant:** Keep an eye out for any unusual symptoms in your trees. Remember, early signs can be subtle.
- **Use Clean Propagation Material:** This is still the number one way ASBVd spreads. Always source your grafts and seedlings from reputable, certified disease-free nurseries.
- **Get Tested:** If you suspect ASBVd, don't hesitate to get your trees tested using reliable methods. Reach out to us or talk to your local agricultural advisor about available options.
- **Stay Informed:** Keep up to date on the latest research and recommendations for ASBVd.

We're in this together! By working together and utilizing these new, powerful detection tools, we can take a big step towards protecting California's valuable avocado industry from the threat of Avocado Sunblotch Viroid and ensure healthy, productive groves for years to come. Stay tuned for more updates, and don't hesitate to reach out with any questions!

The Avocado Cone Roller Moth Is Here to Stay—Now What?

Alejandra Rocha
UC Riverside, Department of Entomology

Looking Back

In 2020, Ben Faber wrote an article sharing an early warning of a new and unfamiliar avocado pest, a leaf miner/roller (Faber 2020). At the time, it had just been discovered in San Diego County and was beginning to spread north along the coast. This pest appeared to target leaves rather than fruit. The signs were subtle but concerning, blotchy mines on young avocado leaves and distinctive cone-shaped leaf rolls at the tips of tender flush.

The moth's behavior and external morphology suggested it belonged to the *Caloptilia* (Lepidoptera: Gracillariidae), a group known for mining and rolling the tips of leaves into a cone shape on many different host plants. This genus-level identification was confirmed by CDFA and it was given a C rating, meaning it is not pursued as a quarantine pest. In 2021 it was reported in Ventura county, and we had more questions than answers about the moth's biology and management (Faber 2021). While parasitoid wasps were found associated with the moth, none had been formally identified, and little was known about its life cycle, distribution, or potential impact. At that point, it was anyone's guess whether this moth would become a long-term problem, or just a passing concern.

What We've Learned

Five years later, it's clear that the avocado cone roller is here to stay. The moth has now been observed in multiple counties, and signs of infestation are turning up across commercial orchards. Since January, we've been collecting field samples across infested Hass avocado orchards, the most common variety in California. PCAs have reported economic loss in mature and young groves in coastal Ventura and in nurseries, and in San Deigo reporting moth presence below damage thresholds.

Figure 1. Reported sightings of avocado cone roller in California by county (2025): Santa Barbara, Ventura, Orange, Riverside, San Diego.

In the field, signs of infestation are unmistakable: young leaves display blotchy, irregular mines, while the tips of leaves curl under into tight, cone-shaped rolls. These rolled leaf tips serve a dual purpose; they provide both a feeding site and a protective shelter for the caterpillars as they prepare to pupate. The early instar caterpillars begin by mining a leaf feeding between the upper and lower leaf surfaces, then the later instar caterpillars move to a fresh leaf to create their cone-shaped roll. This behavior is characteristic of many *Caloptilia* species (Kawahara et al. 2017). Their feeding causes stress to the tree by defoliation. This can result in sun damage to the fruit, and is particularly harmful for young trees. During our recent fieldwork in Ventura County, we observed high

levels of infestation. In a mature orchard, we collected 1-4 samples per tree from a row of mature trees. In a younger orchard, with trees approximately two years old, we collected 1-3 samples from almost every tree along the transect.

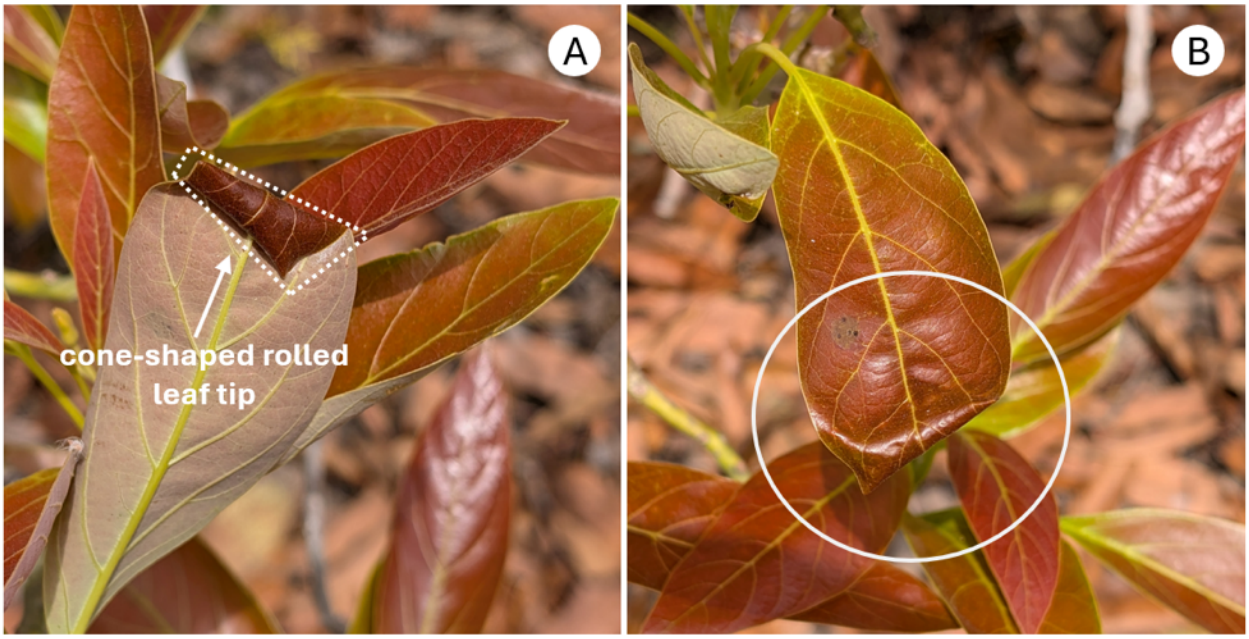

Figure 2. Characteristic leaf damage caused by the avocado cone roller moth: (A) underside view of a leaf showing cone-shaped rolled leaf tip, created by the late instar caterpillar; (B) topside view of the same leaf.

In the lab, we've been rearing adult moths and parasitoids from field-collected samples. These efforts have helped us begin establishing a standardized rearing protocol, which will be essential for future studies on life history, pesticide efficacy, and parasitoid-host interactions. We've started capturing high-quality images of both the moth and its parasitoids for documentation and identification purposes and will soon begin extracting DNA for sequencing to aid in identification.

While the moth itself still hasn't been identified to species, we've made good progress on the parasitoids. So far, we've identified at least two distinct species, both members of the family Eulophidae, collected from orchards in Ventura County. These natural enemies may prove useful for developing future biocontrol strategies.

What's Next

We're still early in the research process, but here's a look at where this project is headed.

Species Identification: We're working to formally identify the cone roller moth to species level using morphological and molecular data. The same goes for its parasitoids. Knowing exactly what we're dealing with is the first step toward meaningful control.

Origin and Genetic Comparisons: There are reports of the cone roller moth affecting avocados in Florida and Mexico. Are we seeing the same species here in California, or is this a native species that shifted hosts? By comparing genetic variation across these populations, we hope to find out.

Phenology & Distribution: We'll be studying the moth's development and behavior under both nursery and field conditions in coastal areas. How many generations does it have per year? When is it most active? What is the best monitoring method?

Host Plant Susceptibility: We are sampling over 200 avocado varieties in UC Riverside's Avocado Breeding Program at AgOps and the South Coast Research and Extension Center in Irvine for cone roller presence. These trees are planted across two climate zones, and we'll be sampling them repeatedly throughout the summer. These mixed block plantings serve as a natural field experiment and will give us information about which varieties are most at risk.

Parasitoid Surveys: We'll continue to survey infested regions to track where the moth is found, and which parasitoids are present. This will help us understand natural levels of control and whether any species could be a candidate for biological control, and how to incorporate parasitism rate into a treatment threshold.

Pesticide Testing: We'll begin evaluating the efficacy of different organic and conventional pesticides on the larval stages for potted nursery stock and young trees. We'll also look at potential non-target effects on the parasitoids, for a comprehensive integrated pest management program.

The more we understand about this pest's biology, economic impact, pesticide susceptibility, and natural enemies, the better equipped we'll be to manage it.

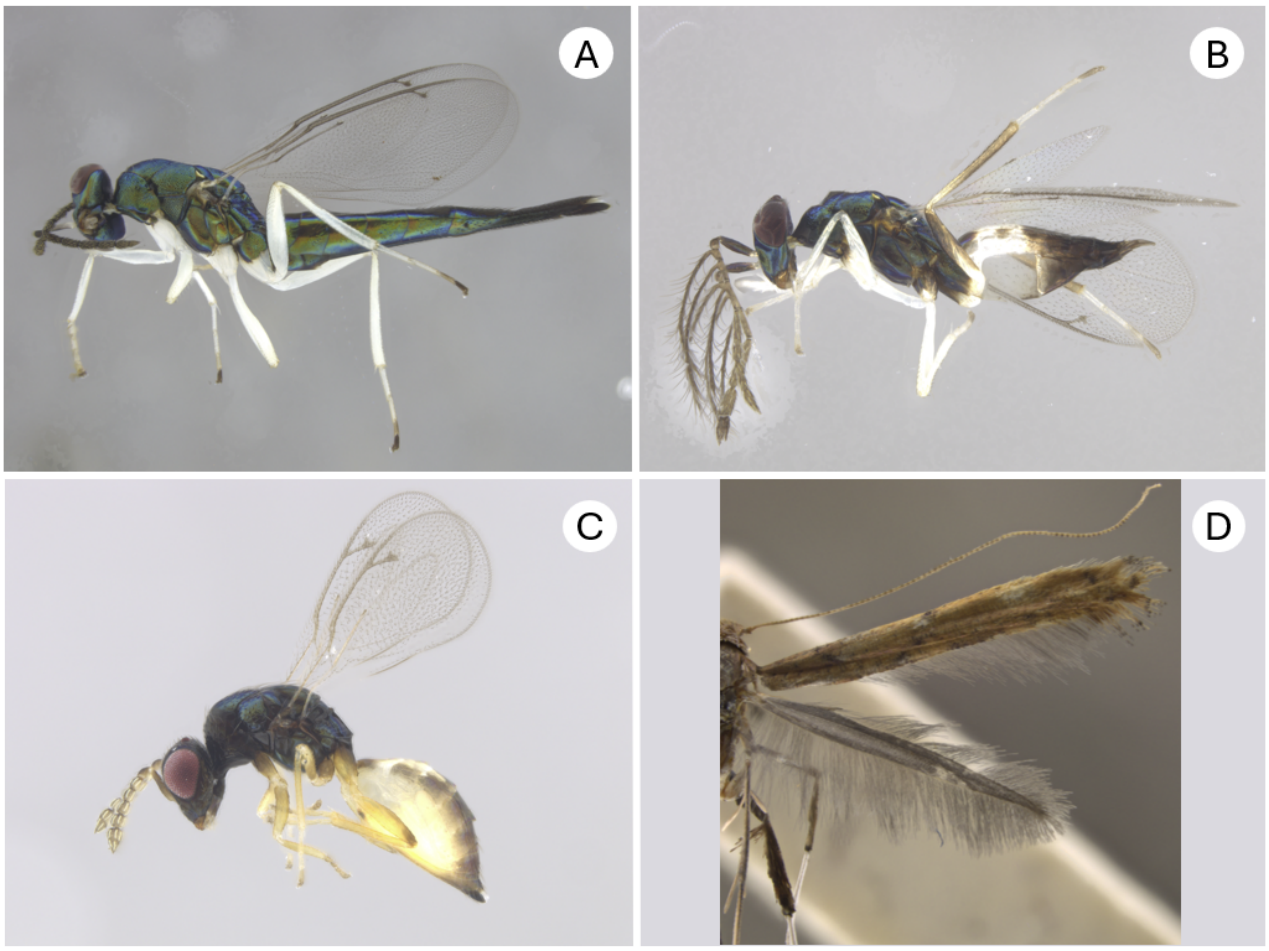

Figure 3. Parasitoid wasp species (family Eulophidae) reared from field-collected caterpillar samples: (A) female of species 1; (B) male of species 1; (C) female of species 2. (D) Adult *Caloptilia* moth.

References

Faber BA. 2020. "New Avocado Pest?" UC Agriculture and Natural Resources. July 31, 2020. Available from https://ucanr.edu/blog/topics-subtropics/article/new-avocado-pest.

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Kawahara AY, Plotkin D, Ohshima I, et.al., 2017. A molecular phylogeny and revised higher-level classification for the leaf-mining moth family Gracillariidae and its implications for larval host-use evolution. Syst. Entomol. 42:60–81.

Report Sightings

If you've seen signs of the avocado cone roller moth in your orchards or nursery, or have questions about what to look for, please reach out. This is a collaborative effort, and we want to hear your observations, and what monitoring and control options you have tried. We are looking to collect samples for genetic analysis and locations to set up monitoring.

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I'm a first-year Ph.D. student who joined the Subtropical Fruit IPM Lab at UC Riverside in September 2024. I completed a Master's degree in chalcidoid systematics at UCR focusing on ant parasitoids (Hymenoptera: Eucharitidae) where I described twelve new species. My training spans sequencing, insect identification, taxonomy, parasitoid rearing, specimen imaging, and curatorial techniques. I'm now applying that experience to this new problem affecting avocados in California.

Spring Subtropics Meetings Recap

Bodil Cass, Department of Entomology, UC Riverside

We have started the 2025 season with a full of engaging and productive industry meetings. Here are a few highlights:

Habitat Impacts on Pest Control and Wildlife in Avocado and Lemon meeting held in Oxnard on February 21st, hosted by Hamutahl Cohen and Liz Scordato presented updates on a large-scale, multi-year project running in Ventura County. The project team including researchers from California Poly Pomona, California State University Long Beach, UC Santa Barbara and UCCE. This multi-year, collaborative effort is working in commercial farms along the Santa Clara River basin to evaluate the effects of hedgerows and large-scale habitat patches on wildlife including birds, bats, bees and mammals. The engaging talks featured graduate student presentations with the discussions extending well into lunchtime, with the audience delighted by tales of researchers going to extreme lengths to collect bat guano under bridges, sort through thousands of mice and gopher 'selfies' taken by night-monitoring cameras, and bobcats navigating patchworks of land use. This study is unique in the scale and breadth of research to address the multifaceted relationship Impact of habitat enhancements on pest pressure. Growers are keenly following the research findings to learn how local and area-wide changes to surrounding wildlife habitat can in turn modulate pest control in their farmland.

UCR Citrus Field Day for Growers & Industry Members on February 20th organized by Tracy Kahn and Peggy Mauk, with support from the Citrus Research Board and Syngenta, was held partly indoors this year at Agricultural Operations due to weather. This year featured a variety breeding with a special report from Dr. Kim Bowman visiting from the University of Florida, with some promising updates on the breeding of HLB-resistant rootstock varieties that are staring to be evaluated in California conditions. Attendees also handled lacewing larvae feeding arenas and taste-tested scions from the fruit display.

Citrus Thrips Field Day held at Lindcove REC on April 24th is a staple field training held each year during petalfall for this most damaging direct pest. This year it was combine with the Fuller Rose Beetle meeting (see article above by organizers Sandipa Gautam and Jim Cranney; and photos in Figure 1). The workshop covered citrus thrips identification, biology, monitoring, and best management practices. PCAs/field scouts learned how to recognize the various life stages of citrus thrips and western flower thrips and the predatory mites that attack them. A grower panel discussed past experiences and the 2025 outlook on managing citrus thrips, for this notoriously unpredictable insect.

Figure 1. Citrus thrips field day hands-on species identification and classroom learning.

ACP/HLB Grower Meeting on April 8th hosted by the Farm Bureau of Ventura County included presentations from citrus industry partners, including representatives from the Citrus Pest and Disease Prevention Division (CPDPD), University of California and the Ventura County Agricultural Commissioner's (CAC) Office, and Grower Liaisons. Highlights included citrus epidemiology research updates from Dr. Neil McRoberts, mealybug, hydrogels and CA-Craft program updates from Dr. Ivan Milosavljevic. The meeting included a recap of the regional ACP/HLB taskforce and subcommittee meetings held earlier in the year; discussions about updating the Citrus IPM Guidelines; and options to create a Pest Control District.

Citrus Mealybug Workshop held at Lindcove REC on May 7th by Dr. Sandipa Gautam and David Haviland for PCAs to learn about citrus mealybug, an emerging concern for citrus growers. The field day included lectures on pest identification and biology, ant control, scouting/monitoring, and best management practices. A session highlight was a presentation of ongoing research activities and recent results by graduate student Kelby Keeling from Fresno State University, about natural enemies of the citrus mealybug. The workshop included hands-on activities to differentiate between life stages of mealybugs and counting males on the trap cards.

California Date Palm Workshop organized by Dr. Ali Montazar with support from the California Date Commission was held at the UC Riverside Palm Desert Center on April 23rd (Figure 2). This is annual meeting featured local, interstate and international speakers on all aspects of date palm production, from plant pathology, pest management, irrigation, nutrition and marketing. A highlight this year was the grower panel where the audience heard from industry experts Albert Keck, Frank Becerra and Linden Anderson.

Figure 2. Date Grower Panel at the UCR Palm Desert Center.

Look out for all these great annual meetings next year, and add these upcoming events to your calendar:

Citrus Meeting at Lindcove, May 29th -- see flyer below!

Avocado Field Day Innovations and Insights, June 3rd

Registration is required & must be completed by May 29. You must register to receive the location map and Limoneira's waiver form. It will be emailed to you few days before the event.
Click here to Register

Registration open: International School on Microirrigation for Crop Production

View the detailed program at this link: https://caii.org/international-micro-irrigation-school/

CITRUS MEETING

Thursday, May 29, 2025

8:00 a.m. – 12:30 p.m.

UC Lindcove Research and Extension Center

Ray Copeland Citrus Center

22963 Carson Ave., Exeter, CA 93211

Topics to be covered

Ray Yokomi, USDA-ARS Scientist, Parlier

- Update on Citrus Yellow Vein Clearing Virus (CYVCV) in Tulare County – what can Master Gardener's do to prevent spread?

Sandipa Gautum, UCANR Area Citrus IPM Advisor, Lindcove REC

- Spring pests of citrus, challenges, and best management practices

Ashraf El-Kereamy, LREC Director and Subtropical Horticulture Specialist

- Update on lemon pitting and LREC update

Jim Cranney, President CA Citrus Quality Council (CCQC)

- Current activities at CCQC

Philippe Rolshausen, Subtropical Horticulture Specialist, UC Riverside

- Soil amendments and rootstocks

Riley Jones, PhD candidate, UCR

- Water relations, how water moves in the plant
- CUPS project and how it will protect against ACP and HLB

Daneile Zaccaria, Agricultural Water Management Specialist, UC Davis

- Stakeholder survey on citrus evapotranspiration

Ashraf El-Kereamy, LCREC Director and Subtropical Horticulture Specialist

- Discussion of Trellis Systems for Citrus

Optional field tour will include stops at the CUPS facility, 40+ year flying dragon rootstock variety trial and other points of interest

AVOCADO FIELD DAY

PRESENTED BY

CALIFORNIA AVOCADO SOCIETY

CALIFORNIA ASSOCIATION OF PEST CONTROL ADVISORS

LIMONEIRA

FARM BUREAU OF VENTURA COUNTY

Innovations & Insights

Speakers

Ben Faber (UCANR)
Pests and Diseases

Danny Klittich (Mission Produce)
Anatomy and Nutrition

Bodil Cass and Hamutal Cohen (UCANR)
Integrating IPM, Pesticide Resistance & Cover Crops for Beneficial Insect Support

Briana Layfield (Ag-Bee)
Drone use for IPM

Pending: Continuing education hours for PCA and CCA!

TUESDAY, JUNE 3
9 AM - 1 PM

Limoneira Ranch
Santa Paula, CA
Address provided upon registration

Join fellow avocado growers for morning presentations in the field followed by a catered lunch.

REGISTRATION IS REQUIRED & MUST BE COMPLETED BY MAY 29

https://bit.ly/LimoneiraFieldDay

UCDAVIS COLLEGE OF AGRICULTURAL AND ENVIRONMENTAL SCIENCES

COTH2O Cátedra Tecnológica del Agua

UNIVERSITY OF CALIFORNIA Agriculture and Natural Resources

2025 INTERNATIONAL SCHOOL ON MICROIRRIGATION FOR CROP PRODUCTION

CALIFORNIA IRRIGATION INSTITUTE

SAVE THESE DATES:

CLASS LECTURES: OCTOBER 13-15
FIELD TRIPS: OCTOBER 16-17

Class lectures will be held in the UC Davis Conference Center. Field trips will be in the San Joaquin Valley and Central Coast of California.

ATTENDING THIS SCHOOL WILL PROVIDE:

- 3 days of practical class lectures on principles and implementation of microirrigation systems and management practices for crop production
- 2 days of field demonstration visits (one day in the San Joaquin Valley for modernized irrigation delivery systems, and fruit and nut crops; one day in the Central Coast for vineyards, vegetable crops, and berries)

SIGN UP TO THE MAILING LIST TO GET MORE INFORMATION!

QUESTIONS? PLEASE CONTACT US:

Daniele Zaccaria - UC Davis: dzaccaria@ucdavis.edu
Mary Ann Dickinson: maryann@dickinsonassociates.com

Instructors of the School are professionals with extensive experience on principles and practical applications of microirrigation for resource-efficient crop production.

WHAT YOU WILL LEARN:

- Technical aspects of water delivery systems to allow for successful adoption and management of microirrigation systems
- Soil-water movement and soil-plant-water relations with microirrigation
- Microirrigation systems design, operation, maintenance, automation, and performance evaluation
- Methods and tools for microirrigation scheduling
- Managing microirrigation for different crops (field and agronomic crops; vegetable crops; berry crops; fruit crops; nut crops; vineyards)
- Chemigation and fertigation
- Salinity management with microirrigation

Topics in Subtropics

Newsletter by Tree Crops Farm Advisors

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