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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California Converted Its Irrigation to Save Water. So Why Is the Energy Bill Going Up?

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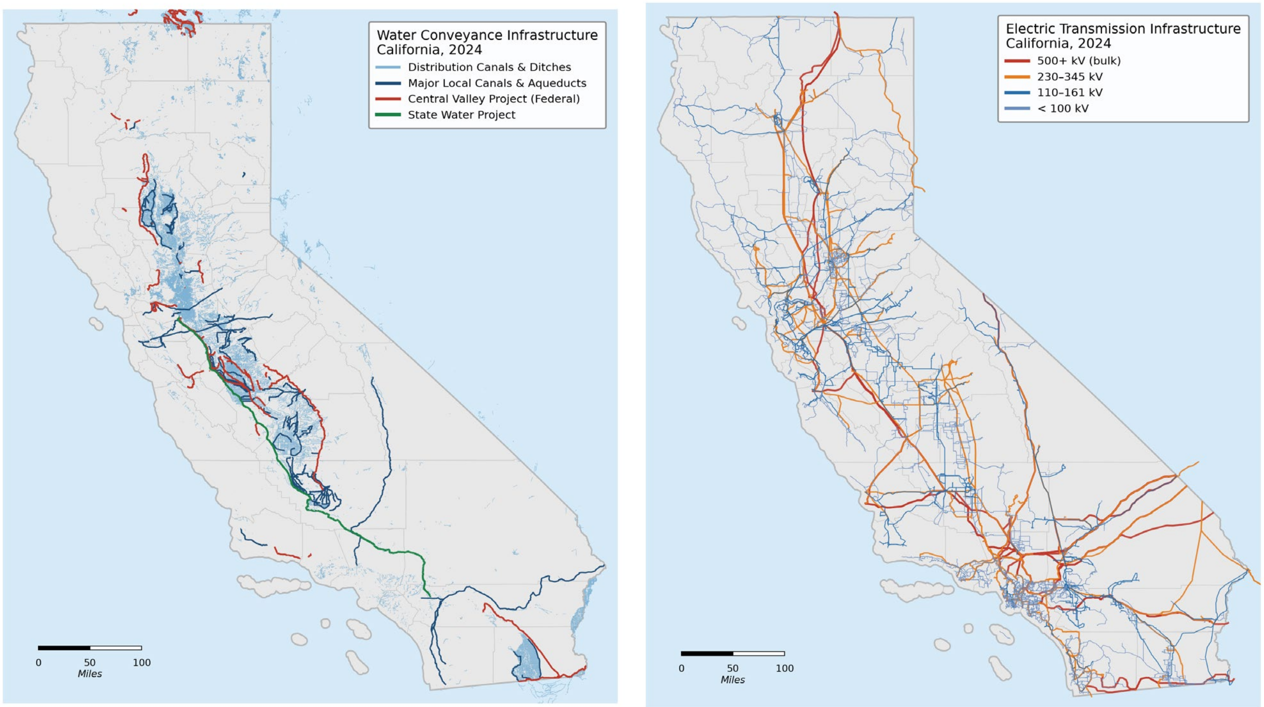
More than half of all California farmland now runs on drip or micro irrigation. That transformation is a genuine water efficiency win. But growers, advisors, and policymakers mostly missed a side effect: farm electricity use has not fallen. In many cases it has risen, and electricity rates have roughly doubled or tripled since 2008.

Here is what happened, and what growers can do about it.

Water and Energy: Two Systems, One Problem

Water and electricity are delivered through entirely separate infrastructures governed by separate agencies, priced by separate regulators, and measured in different units. Water flows through canals, pipelines, and aquifers. Electricity moves at the speed of light through transmission lines and substations.

But they are deeply dependent on each other. Moving water requires electricity; for pumping, treatment, pressurization, and distribution. And generating electricity requires water; for cooling thermal power plants, enabling hydropower, and supporting the supply chains for fuel and equipment. In California, that interdependence is especially pronounced because of the geography: most of the water is in the north, most of the demand is in the south, and moving it across the state at scale requires enormous pumping infrastructure.



California's water conveyance network (left) and electric transmission grid (right). The two systems are geographically entangled: water infrastructure depends on electricity to move, and electricity generation depends on water. Maps created by the author from public GIS data published by the California Department of Water Resources, the California Natural Resources Agency, and the California Energy Commission [18].

The scale of the connection is striking. California's water sector accounts for roughly 20% of the state's total electricity consumption when end uses like water heating are included. Surface water conveyance and groundwater pumping also account for about 7% of statewide electricity, a figure that rivals many large industrial sectors [1] [2] [3].

Agriculture sits at the center of this relationship. Irrigation accounts for roughly 80% of California's consumptive water use [4], and most of that water has to be pumped, from groundwater wells, from canals, and from storage reservoirs. The energy cost of that pumping is not a footnote. For many farms, electricity for irrigation is the second-largest operating expense after labor [5]. When water tables drop and pump depths increase, that cost climbs further, and the water and energy systems reinforce each other's stress at the worst possible time.

The Shift

In 1969, drip and micro irrigation covered essentially zero California acreage. By 2023, those systems account for 4.36 million acres, 56 percent of all irrigated farmland in the state[6]. The chart below tells the story over the past decades.

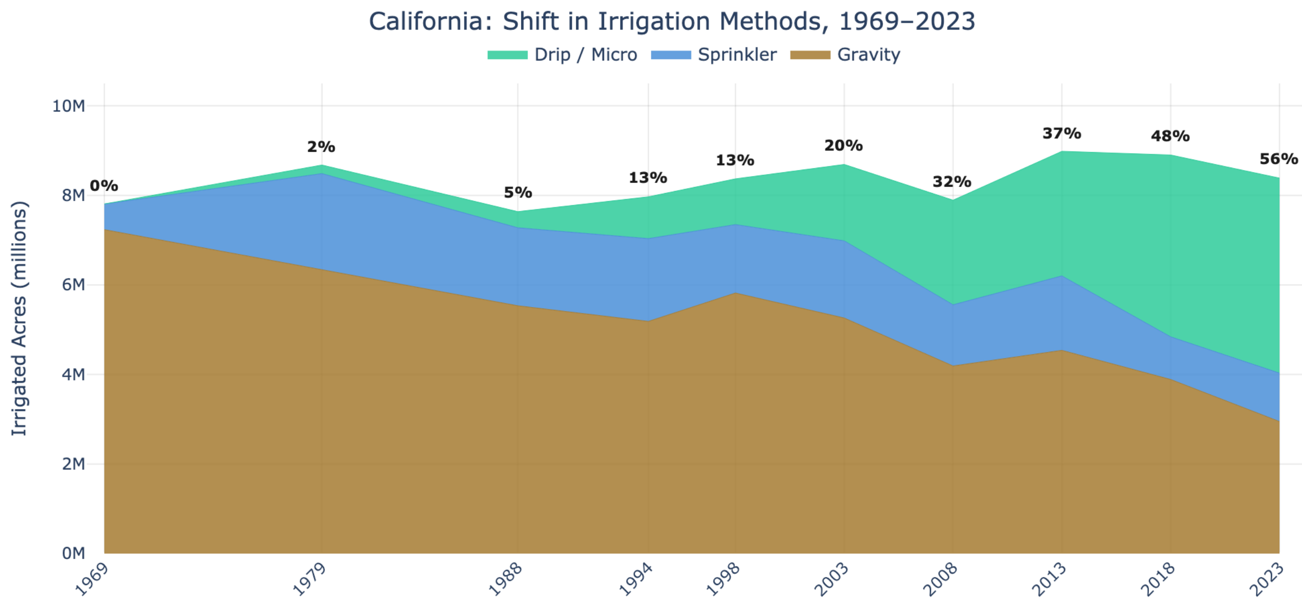


Figure 1. California irrigated acres by system type, 1969–2023. Source: USDA NASS Farm and Ranch Irrigation Survey / Irrigation and Water Management Survey, 1969–2023 [6]

The drivers are well understood: water scarcity, high-value crop economics, and regulation. What was not well understood was the energy consequence.

The Paradox

You might expect that as farms applied water more precisely, electricity demand would fall. That is not what happened. When drip/micro acreage share is correlated against on-farm electricity consumption (1994–2023), the relationship is positive and statistically significant: $r = 0.772$, $p = 0.042$.

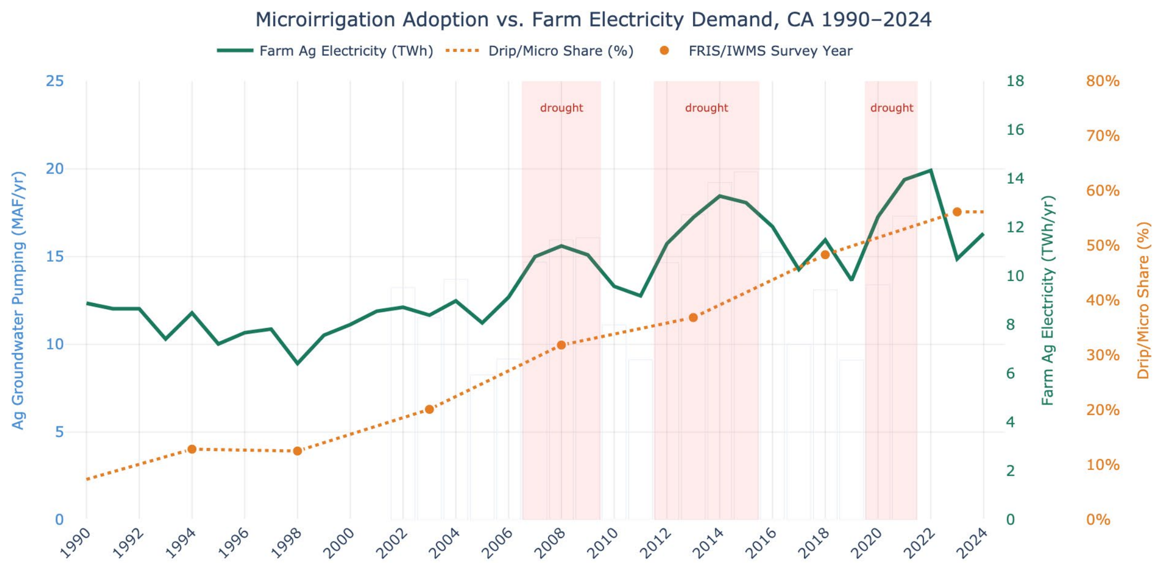


Figure 2. Farm electricity demand (green line) and drip/micro adoption (orange dotted) moved together, not apart. Sources: USDA NASS [6]; CEC QFER [7]; DWR Bulletin 118 [8]

As drip acreage share grew from 13% to 56%, farm electricity demand rose alongside it, driven by three compounding forces. Every drip system requires pumps, filters, and pressurized lines that gravity-fed flood systems never needed [9]. Drip also demands on-demand water, but most surface water deliveries are still rotational and schedule-based, pushing growers toward groundwater, available anytime, but energy-intensive and increasingly deep. And drought makes everything worse [8]: agricultural groundwater use nearly doubles in dry years, and as aquifers drop, the energy cost per acre-foot rises sharply with every additional foot of lift.

The Rate Problem

The energy demand story would be manageable if rates had stayed flat. They did not. PG&E agricultural rates have risen 107–197% since 2008, depending on the schedule [11]. Several structural forces are driving this: wildfire liability and grid hardening on one side [12]; renewable buildout, battery storage, and rising data center load on the other. None are going away.

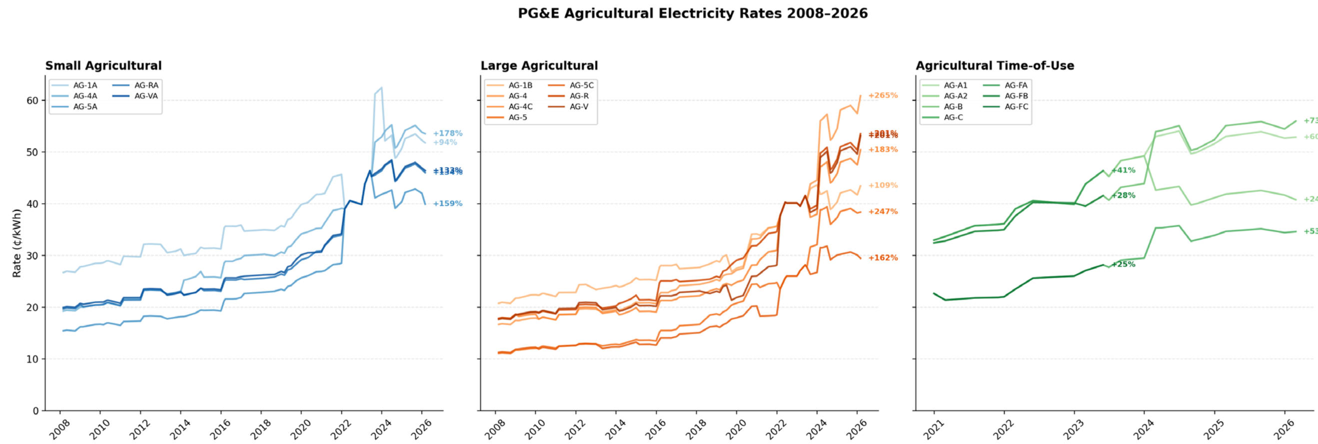


Figure 3. PG&E agricultural rate schedules, 2008–2026 (cents/kWh). Large-ag increases: AG-V +197%, AG-R +197%, AG-4C +179%, AG-5C +158%, AG-1B +107%. Source: PG&E tariff filings [11]

The Opportunity Nobody Told Growers About

The same grid changes driving rates up have created a daily price pattern most growers have never seen. California has built so much solar that wholesale electricity prices routinely go negative at midday: the grid is paying to move electricity off the system. By evening, prices spike as solar fades and demand peaks. [13]

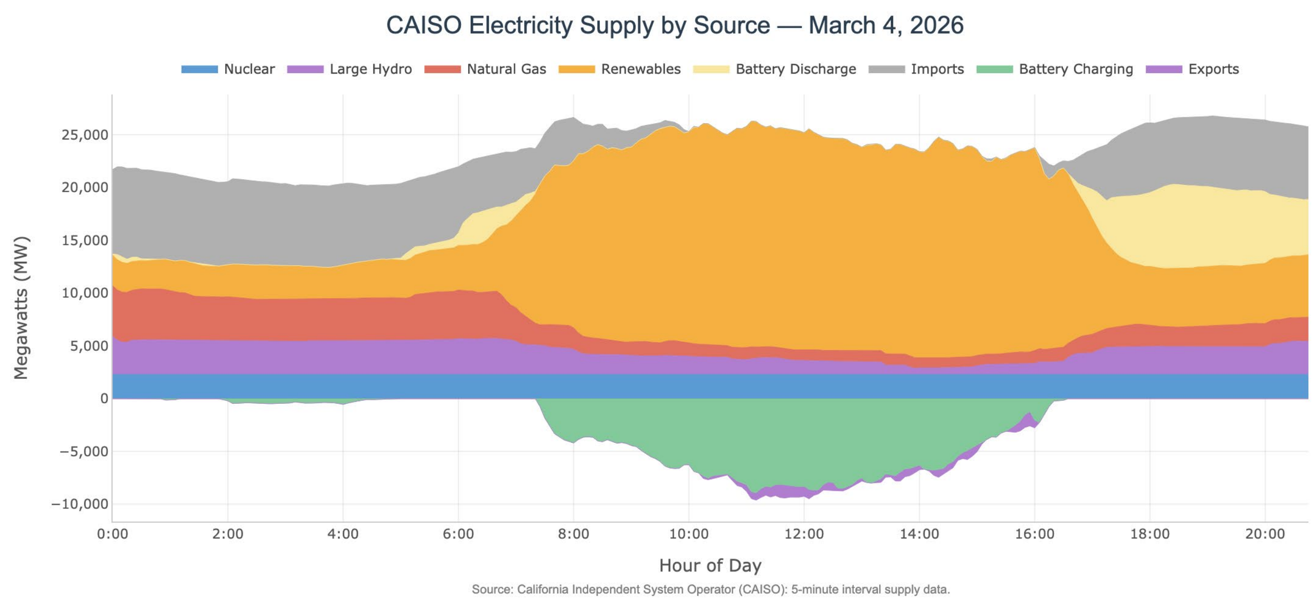


Figure 4. CAISO generation mix, March 4, 2026. Solar peaks midday; evening demand is met by batteries, gas, and imports. Source: CAISO Today's Outlook [13]

For irrigation operations this is actionable: shift pump load toward midday, away from morning and evening peaks. Time-of-use rate schedules (AG-V, AG-4C, AG-5C) price this directly. Demand response programs like PG&E's Base Interruptible Program and

Emergency Load Reduction Program pay growers to curtail during grid events. The agronomic scheduling decision and the energy cost optimization decision are the same decision.

Taking advantage of these grid dynamics is not as simple as it sounds. California's electricity system is among the most heavily regulated in the country, and for good reason. [14] There are many steps between an electron being generated and a retail customer receiving it: generation, ISO dispatch, utility procurement, transmission, distribution, metering, and rate design, each governed by its own set of rules. Those regulatory layers mean that negative midday wholesale prices cannot simply be passed through to a grower's meter.

That said, the regulatory structure has also created a set of programs specifically designed to let agricultural customers capture value from grid dynamics. They are not automatic: enrollment takes effort, some require infrastructure, and navigating the options takes time. But they exist, they are real, and for operations with significant pumping load, the payoff can be substantial.

Programs Worth Knowing

Program	Type	What It Offers	Who Runs It
TOU Rate Schedules (AG-V, AG-4C, AG-5C)	Rate	Lower rates during off-peak and midday surplus hours. No enrollment required: just reschedule pumps to match.	PG&E, SCE, IID
Base Interruptible Program (BIP)	Demand Response	Monthly bill credits for committing to curtail load during CAISO grid stress events.	PG&E
Emergency Load Reduction Program (ELRP)	Demand Response	Payments for voluntary curtailment. No penalty for non-performance: genuinely risk-free. [15]	PG&E, SCE
Automated DR (ADR)	Demand Response	Hardware incentives for automated pump curtailment. Signals sent directly to your controller.	PG&E
Yield Energy (formerly Polaris)	Aggregator	Turnkey enrollment and dispatch for ag load. 200+ MW of agricultural flexibility enrolled statewide, 100+ MW in PG&E's Hourly Flex Pricing. [16]	Third-party
AgFIT / Hourly Flex Pricing	Rate Pilot	Real-time wholesale price signals passed to the meter. 40% peak-hour shift achieved in pilot. [17]	Valley Clean Energy
USDA REAP	Generation	Grants up to 50% of on-farm solar cost, max $1,000,000 per project (post-IRA).	USDA Rural Dev.

Program	Type	What It Offers	Who Runs It
SGIP	Generation	Rebates for behind-the-meter battery storage: pairs well with TOU rate optimization.	CPUC / IOUs

The most accessible starting point for most growers is the TOU rate schedule: no enrollment, no new equipment, no application. Simply shifting pump run times toward midday can capture real savings immediately, while longer-term options like demand response enrollment and on-farm solar are evaluated.

The Bottom Line

California's microirrigation transformation saved water. The energy story is more complicated. Farms that treat energy as a strategic input, not just a utility bill, will be better positioned as rates continue to climb and grid conditions keep shifting.

The water savings are real. But they are only half the story.

About Klimate Consulting

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Silent Invaders: The Beetles That Could Threaten California's Avocado Empire

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In 2012, avocado growers were presented with the news that a newly discovered invasive beetle, named the polyphagous shot hole borer (*Euwallacea fornicatus*), could play havoc with production in Californian groves. Native to southeast Asia, the new arrival was a species of ambrosia beetle, a small weevil that bored into the sapwood (xylem) of host trees, creating brood galleries where they cultivated symbiotic "ambrosia" fungi that the beetles and their offspring fed on. Those fungi included a *Fusarium* species which also acted as a pathogen to the avocado tree, and could lead to branch dieback and, in extreme cases, mortality [1]. Those fears were fortified two years later when a second "Doppelganger" species, the Kuroshio shot hole borer (*Euwallacea kuroshio*), that looked and behaved exactly the same as the polyphagous shot hole borer, was also found to have established in California [2]. A decade on, those fears have diminished somewhat. Although the two beetles, collectively called invasive shot hole borers (ISHB), remain a serious threat to many tree species in natural and urban environments, it appears that ISHB can be largely controlled in avocado (in California at least) through vigilant cultural care; removing infested branches, followed by chipping and solarization.

With the threat to avocado posed by ISHB allayed, a new project is seeking to prepare growers (and land managers) for the eventuality that a similar but more dangerous non-native ambrosia beetle invades California. The redbay ambrosia beetle (RAB) (*Xyleborus glabratus*) has not been detected in California but is well-established in the southeastern United States, having been first found in Georgia in 2002. Like ISHB, RAB also carries along a fungal food source, *Harringtonia lauricola*, and that fungus causes a disease in some host trees. However, laurel wilt, as the disease is called, is much more lethal. Since RAB was first detected, laurel wilt has killed <u>hundreds of millions</u> of redbay (*Persea borbonia*) trees in the southeastern US and now occurs in 12 states. It continues to spread in the eastern US aided by another susceptible native tree, sassafras (*Sassafras albidum*), and in 2025, the disease "jumped" some 500 miles to Suffolk County, New York. A similar "jump" to California could spell disaster for the avocado industry.

A Lesson from Florida

In Florida, laurel wilt has already reshaped the agricultural landscape. In addition to killing all those native redbays, **the disease is also lethal to avocado, and the Florida avocado industry has lost over 300,000 trees due to laurel wilt disease.** At first glance, the story seemed straightforward: one beetle species, RAB, carried the pathogen and infected trees.

But reality proved more complicated. Although RAB is the primary carrier in natural forests, it actually performs poorly in avocado trees and is seldom found in affected orchards [3]. Instead, researchers discovered a surprising twist: **other beetle species, already living in the orchards, were responsible for introducing and spreading the disease.** Florida's avocado groves host a diverse community of ambrosia beetles — at least 17 native or established species. Among them, several species have formed new partnerships with the laurel wilt pathogen and at least three species of the genus *Xyleborus* can actively transmit it to healthy avocado trees [4, 5]. In two of those (*X. bispinatus* and *X. affinis*), the laurel wilt fungus can even replace the beetles' original fungal partners, establishing long-term relationships that could turn these insects into efficient disease vectors [6,7]. In other words, the pathogen has effectively recruited these beetle species to do its bidding. In addition, several ambrosia beetle species in the genera *Xyleborinus*, *Xylosandrus*, and *Ambrosiodmus*, have been found to carry high levels of the laurel wilt fungus on the outside of their bodies which may also help spread the pathogen [4, 8].

How can California benefit from the Florida experience?

California produces about 90% of all U.S.-grown avocados, with an annual value over the last 15 years often exceeding $400 million [9]. So far, the state has been spared, but the risk of laurel wilt is far from theoretical. Crucially, the primary vector (RAB) is not present in California, but should that change, knowing which potential secondary vectors are present in avocado production areas will help to prepare and direct a response. We know through recent experience that the two species that constitute ISHB are present in avocado growing areas, and historical records indicate that species like *Xyleborus ferrugineus* and *Xyleborinus saxesenii* may also be found. However, no systematic study of ambrosia beetles in California avocado orchards has been undertaken, so further potential vectors may be present. Hence, the need for this new project.

The Project – characterizing beetle communities in California avocado groves

In collaboration with researchers at the University of Florida, UC Riverside is engaged in a comprehensive, two-year survey of ambrosia beetles in avocado orchards across California. Beginning in spring 2025, fourteen groves (at 12 sites) are being surveyed across major avocado production areas (Figure 1). Lindgren funnel traps, baited with an RAB attractant (α-copaene) and a general ambrosia and bark beetle attractant (ethanol) [Synergy Semiochemicals #s 3302 and 3344, respectively], have been placed in each grove. The traps are suspended from branches at chest height (Figure 2) and the trap collection cups are filled with RV antifreeze (ethanol free propylene glycol) to preserve the DNA of anything that falls in. The first year of the project has focused on mapping the beetle community in orchards, and the contents of the traps have been retrieved monthly. Back in the lab, the numbers and identities of ambrosia beetles, bark beetles, and other common beetles are recorded. Identification is based on morphology and DNA sequencing, and the findings from year 1 are reported herein.

Figure 1. Location of avocado groves being surveyed in southern California (image from Google Earth).

Figure 2. Lindgren traps (8-funnel) hung from branches in avocado groves.

Scolytine beetles identified from the 2025 survey

Trapping sites were established in San Diego, Riverside, and Ventura Counties in April 2025 and a further three sites in San Luis Obispo County were added in June. The contents of each trap were collected each month through October and identified (Figure 3). Three Scolytine species were very common across all sites, including *Xyleborinus saxesenii* (a known potential secondary vector) and two bark beetles, *Hypothenemus eruditus*(?) and

Pagiocerus frontalis (see Figure 3 for an explanation of what distinguishes an ambrosia beetle from a bark beetle). Dubbed the world's most common bark beetle, we have placed a question mark alongside *H. eruditus* since it is likely a complex of closely related species rather than a single species [10]. *Euwallacea fornicatus*, one of the ambrosia beetles that comprises ISHB, was present in two groves throughout the year, one in San Diego County, the other in Ventura County. Another bark beetle, *Hylocurus hirtellus* was also picked up at a single grove in San Diego and one in Ventura County, but only in the spring. Perhaps the most surprising find was a species that was readily attracted to our traps in San Luis Obispo County. This species, tentatively identified as *Araptus schwarzi*, has not previously been reported from California. Three further bark beetles were intercepted on only one occasion: *Pityophthorus juglandis*, *Dendrocranulus cucurbitae*, and a *Monarthrum* species. Perhaps surprisingly, *Euwallacea kuroshio* was not recovered from our traps but, given its history, it deserves a spot on our suspect list.

Thus far, the findings appear favorable. California avocado groves harbor only one of the secondary vector species identified in Florida groves, *X. saxesenii*. However, the survey work is planned to continue through 2026, and as we enter the second year, live specimens of the other Californian species will be sent under strict permit to our colleagues in Florida, who will dive deeper into their fungal symbionts, examining how the laurel wilt pathogen interacts with these Californian species and whether it can potentially turn these beetles into vectors. Furthermore, the threat doesn't stop at the grove's edge. At least one susceptible native host, California Bay (*Umbellularia californica*), has a widespread, but patchy distribution in southern California. That distribution overlaps significantly with avocado production, and in 2026, beetle surveys are planned of natural areas (typically steep-sided canyons) where this tree is common.

The stealth-like spread of two seed feeding Scolytines

A fortuitous and insightful result of our 2025 trapping has been documenting the widespread distribution of *Pagiocerus frontalis* in California and the discovery of a second beetle with a similar taste for the seeds of fallen avocados, tentatively identified as *Araptus schwarzi*. Native to South America, Central America, Mexico and the Southeastern United States, the former was first detected in California in 2010, in San Diego County, and again during the early days of ISHB trapping. Since it wasn't viewed as a pest, at least not of avocados, nothing was subsequently done to determine its California range, although last year, the California Avocado Commission published a short note to quell concern after it was detected in Ventura County [10]. We now have evidence to suggest *P. frontalis* has actually spread to all avocado-growing regions in California. In contrast, the *Araptus* species appears to be limited to San Luis Obispo County. Note, that is based on just three sites (at two locations) and expanded trapping in that area will be needed if there is a desire to reveal the full extent of that beetle's range. Given their predilection for seeds, it seems unlikely that either of these species could become significant secondary vectors for laurel wilt. However, they do highlight, in the absence of anyone looking for them, how easily these small, wood-boring beetles can spread and establish unnoticed.

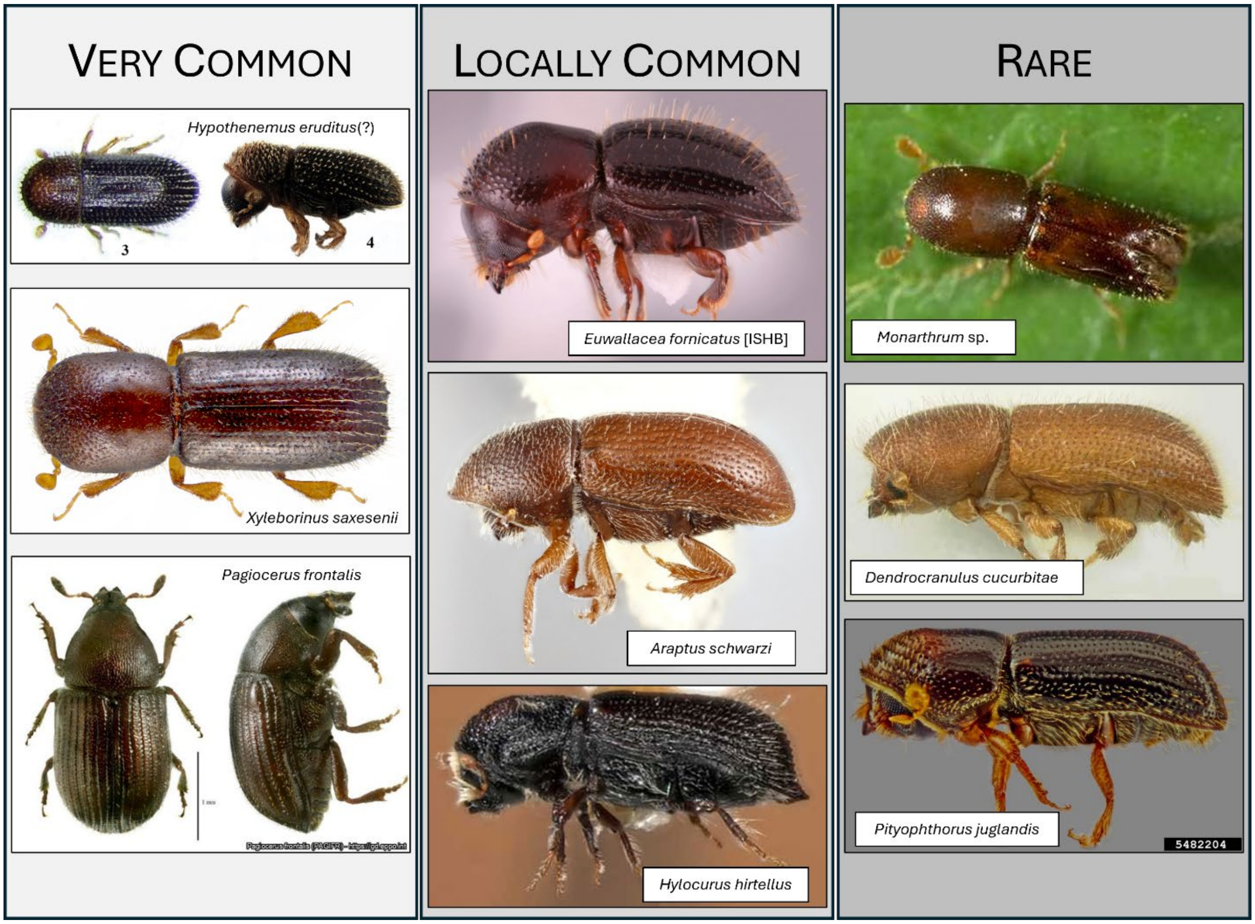

Figure 3. Identity of Scolytine beetles trapped in California avocado groves in 2025. The subfamily Scolytinae (and Platypodinae) contains a mix of ambrosia- and bark beetles. Ambrosia beetles bore into the sapwood (xylem) of host trees, creating galleries where they cultivate symbiotic "ambrosia" fungi that the beetles and their offspring feed on. This fungus-farming lifestyle sets them apart from bark beetles which create their galleries in the inner bark (phloem) and feed directly on the wood of a host tree. **The majority of Scolytines colonize stressed, damaged, or dying hosts, and aid in host plant decomposition, benefiting the environment.** Images retrieved from online resources: Wikipedia, EPPO, IDtools, UC ANR, and Bugwood.org

Final word

Laurel wilt is not just a disease carried by a single insect - it is a dynamic system capable of adapting, spreading, and exploiting new ecological relationships. For the Californian avocado industry, the stakes are high. The absence of the primary vector currently offers protection, but the presence of potential secondary vectors, and a widely distributed native host tree, California Bay, means the industry is already vulnerable. The question is not one of whether the conditions for an outbreak exist, but whether we, as scientists and growers, can understand, prepare for, and interrupt the process before it begins.

Acknowledgements

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Avocado Branch Canker: What Growers Need to Know and What We Are Learning

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Avocado branch canker disease (ABC) is an increasing concern in orchards across Southern California and in other avocado-growing regions worldwide [1, 2]. This fungal disease can reduce productivity in infected trees and, in severe cases, lead to branch dieback and even tree loss. The fungi involved belong to the family Botryosphaeriaceae. Our 2023-2024 survey in Southern California orchards showed *Neofusicoccum luteum* as the most prevalent species recovered from symptomatic trees, followed by *Lasiodiplodia theobromae*, *Botryosphaeria dothidea*, and *Neofusicoccum australe* [3]. Symptoms often appear when the tree is under stress and can vary. The signs of infection usually start with dark cankers appearing on the main trunk and branches. As the disease progresses, twigs die back, with the tips of branches turning downward and dying off. When cutting into an infected branch, a dark wedge-shaped stain extending deep into the wood can be seen. Often, these dead branches retain their mummified leaves rather than falling to the ground. Also, white dried sap leaking from necrotic lesions on the bark can be present. In severe cases, entire limbs will wither and die, which thins out the tree's canopy and significantly cuts down the amount of fruit the tree can produce (Figure 1).

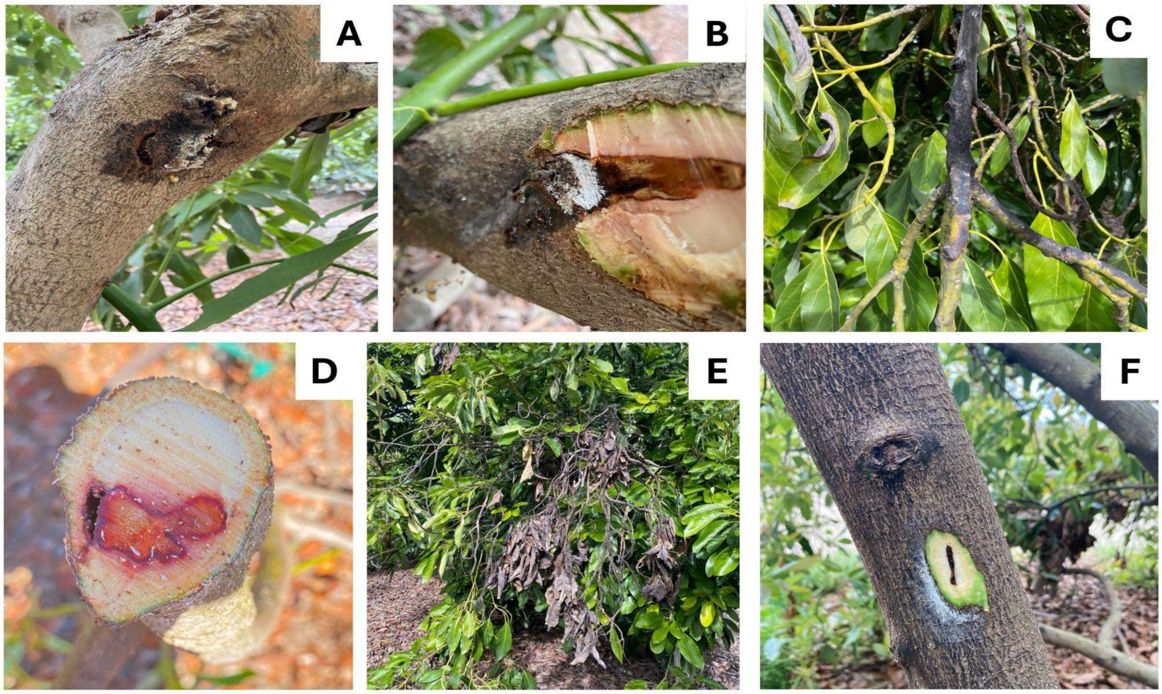

Figure 1. Symptoms of avocado branch canker disease observed in avocado trees in Southern California. A and B, Cankers on branches and trunks. C, Dieback and necrosis of twigs in the canopy. D, Cross-section of an infected branch showing a wedge-shaped canker extending deep into the wood. E, Necrotic branches with wilting leaves still attached. F, Necrotic lesion under the surface of a canker with white exudate.

These fungi can spread efficiently in the orchard. They survive on infected wood and produce small, dark reproductive structures called pycnidia that release spores during wet conditions [4]. Rain and wind can spread these spores from tree to tree, increasing the risk of new infections. Pruning and other mechanical injuries also play a key role in this process. Fresh pruning wounds are one of the main points for infection. When cuts are made, especially during periods of moisture or high humidity, spores can easily land on exposed tissue and begin to colonize the wood [5].

Conditions such as drought, salinity, or other environmental stressors can weaken the tree, allowing the pathogen to become active. With support from the California Avocado Commission (CAC), we are studying how drought and salinity affect the spread of disease in the orchards. Since these are challenges most California growers deal with every day, our goal is to give practical, field-tested information to help growers better manage the trees and protect the crop. We are comparing trees with different watering schedules to see if drought stress makes cankers worse and if specific irrigation habits increase disease. We are also testing how two common salts found in California water, sodium chloride and calcium chloride, affect both the fungus and the trees. After laboratory tests, we will move to greenhouse trials to see how saline water changes disease severity and overall tree health. Ultimately, this will show us if salinity or drought stress makes your trees an easier target for infection.

Current management for ABC in California primarily involves cultural practices in the groves [6]. These can be found on the UC IPM website and include:
1. Avoiding pruning or harvesting during or after rain, dew, or heavy fog
2. Pruning out dead limbs and twigs, where the spore-forming structures can persist
3. Sanitizing pruning equipment properly
3. Correcting environmental and nutritional stresses and minimizing other pest problems
4. Leaching the soil periodically and using low-salinity water if salt toxicity is a problem.

California avocado growers have very few registered fungicide options for treating this disease. For this reason, our research tested several fungicides, originally used on other crops, to see whether they could control these fungi on avocado. In our lab tests, we found that certain active ingredients are more effective than others. Specifically, products containing the active ingredients fluazinam, metconazole, or propiconazole were highly effective at inhibiting fungal growth, as indicated by their low EC_{50} values (Figure 2). EC_{50} is the concentration that produces 50% inhibition of mycelial growth relative to a non-fungicide control. Other treatments we tested either did not work as well or required much higher doses to see any results (Figure 2). These findings are encouraging because they help us narrow down which ingredients have the greatest potential to protect orchards in the field. We are currently conducting field trials at the experimental orchard in Santa Paula to evaluate how these fungicides perform under real-world conditions. Importantly, we are testing these products in both preventative (before infection) and curative (after infection) scenarios, focusing on pruning wounds as the primary point of entry. The compounds being evaluated include fluazinam (Omega 500F), metconazole (Quash), propiconazole (Tilt 250), flutriafol (Rhyme), penthiopyrad (Fontelis), cyproconazole (Alto), thiophanate-methyl (Topsin-M), and pyraclostrobin (Cabrio), as well as combinations with plant growth regulators such as 1-Naphthaleneacetic Acid (Tre-Hold® Sprout Inhibitor A-112). These trials will help determine which products are most effective and when they should be applied for maximum protection. As this work continues, we aim to better understand how this disease develops and how different practices may influence it, helping growers make more informed management decisions.

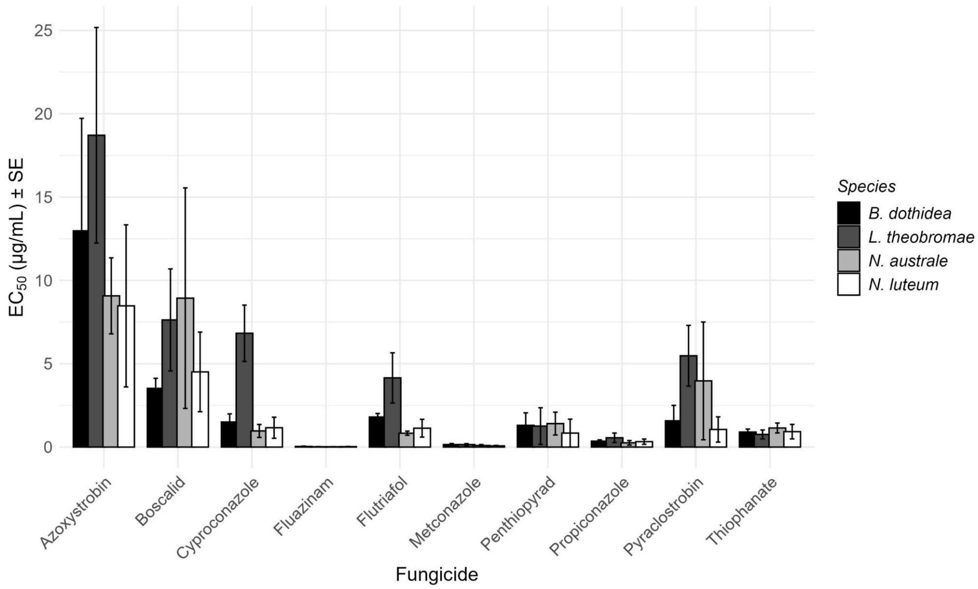

Figure 2. Mean values for 50% growth inhibition relative to the water control (EC_{50}) for 10 fungicides against Botryosphaeriaceae species causing avocado branch canker disease. The x-axis represents the chemicals used, and the y-axis represents the mean EC_{50} values in mg/ml. The error bars represent the SE.

Unfortunately, the damage from ABC doesn't just stop at the edge of the orchard; it can follow the crop all the way to the grocery store. Even if a tree looks okay during the season, infections that start in the branches can eventually move into the fruit. This is a major cause of postharvest issues like stem-end rot and body rot, where the fruit starts to decay or turn dark and mushy after it's been picked [7, 8]. Essentially, if the tree is struggling with the fungus, the quality and shelf life of the fruit can be negatively impacted. For growers, this means that managing branch canker in the orchard is not only about protecting tree health, but also about maintaining fruit quality after harvest. We will continue to share updates on the ongoing field and orchard studies. If you're looking for all the technical details on the pathogens and our full results, please check out our published paper: Bernal, V. V., Pegahrad, Z., Dashtarzhaneh, M. K., and Khodadadi, F. 2025. *Identification, characterization, and fungicide sensitivity of Botryosphaeriaceae fungi associated with avocado branch canker disease in Southern California*. *Plant Disease* 109:1690–1701. https://doi.org/10.1094/PDIS-12-24-2674-RE [1]

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Hydrogel baits offer targeted tool for earwig management in citrus, with broader IPM implications

Sandipa Gautam and **Sanjeev Dhungana**
UC Statewide IPM Program Operations

A recent study published in the *Journal of Economic Entomology* evaluated the use of insecticide-infused hydrogel baits for managing European earwig in California citrus orchards. The work, titled *"Efficacy of insecticide-infused hydrogel baits in managing European earwig in citrus"* [1], represents one of the more applied evaluations of bait-based delivery systems in subtropical tree fruit systems, particularly under California citrus conditions.

The European earwig in California citrus production can be viewed as both a potential beneficial predator and, under certain conditions, a direct pest. While earwigs can contribute to suppression of some soft-bodied pests, increasing reports of rind scarring and feeding injury on young fruit have raised concerns in orchards where populations build to high levels. This is especially relevant in fresh-market citrus systems where even minor surface damage can reduce fruit grade and market value [2]. Moreover, earwigs are damaging to young orchards as new growth provides continuous food sources and tree wraps or sleeves used to protect young citrus trees from sunburn and heat stress can provide a perfect habitat for earwigs. A recent study evaluated an alternative approach to earwig management using insecticide-infused hydrogel baits under both laboratory and field conditions in citrus orchards.

Hydrogel bait performance and key findings

The study tested hydrogel bait formulations containing two insecticides, spinosad and thiamethoxam, applied at multiple concentrations (0.1×, 0.5×, and 1× labeled rates). A central objective was to evaluate whether bait composition influenced feeding and control efficacy, including the role of sugar (sucrose) as an attractant.

Across laboratory trials, hydrogels were prepared either with 25% sucrose solution or without sugar (water-based formulation). Results showed:

- Earwig mortality increased over time for all insecticide-treated hydrogels.
- High levels of control were achieved across treatments, with mortality commonly reaching ~80–100% within 144 hours, depending on product and concentration.
- No consistent or statistically meaningful improvement in earwig mortality was observed from adding sugar to the hydrogel formulation.

In other words, the study found that sugar was not a determining factor in improving bait performance, and effective control was achieved with both sugar-amended and non-sugar hydrogels when insecticide was present.

Field validation in citrus orchards

Field trials using trunk-applied hydrogel bait stations confirmed that treated hydrogels could significantly reduce earwig populations compared to untreated controls at both 6 and 14 days after application. This suppression was observed across insecticide treatments, reinforcing the potential of hydrogel systems as a practical orchard tool rather than solely a laboratory concept.

The authors highlight that delivery method, localized bait placement rather than broad foliar spray, may be a key factor in improving exposure efficiency while reducing non-target impacts.

Relevance to citrus IPM programs

For growers and pest control advisers, the most important takeaway is that hydrogel bait systems represent a shift toward targeted, behavior-based pest management tools in citrus IPM programs. Unlike conventional sprays, these systems concentrate insecticide exposure within a bait matrix, potentially reducing overall orchard disruption.

This is particularly relevant in orchards where conservation of natural enemies is a priority, including systems managing California red scale, mealybugs, aphids, and other pests where biological control remains a cornerstone of suppression.

Although this study focused on earwigs, it directly connects to ongoing efforts to develop targeted hydrogel bait systems for managing sugar-feeding ants in subtropical citrus IPM. In California citrus, these baiting approaches based on attract-and-ingest delivery through hydrogel mediums are already being actively developed and evaluated for ant control, and field trials using similar active ingredients have demonstrated effective reductions in ant populations [3].

The results from this study extend that concept beyond ants, showing that the same bait-delivery principle can also be effective for earwigs. This reinforces the broader utility of hydrogel bait technologies as a targeted pest management tool that leverages feeding behavior rather than broad-spectrum exposure. More broadly, it supports the idea that bait-based systems can be adapted across multiple pest groups, strengthening their role in IPM programs aimed at reducing disruption of biological control while improving pest specificity.

Take-home message for growers and PCAs

Earwigs are notoriously difficult to monitor and control in orchards crops. Hydrogel bait technology shows strong potential as a selective, reduced-spray alternative for managing earwigs in citrus.

Further field-scale validation will be important to refine application timing, placement strategies, and economic feasibility under commercial citrus conditions.

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California and Its Creatures: Research on Bat Diet in Agriculture for Sustainable Pest Control

By: Sarah E. Heffelfinger
Lab: Dr. Rachel V. Blakey Lab California State Polytechnic University Pomona

Bats provide natural insect pest control to California's agriculture and urban areas. While multiple studies have been conducted on what bats eat in other parts of the United States [1,3,5] there is lacking research on what time of the year bats provide the most pest control services. Additionally, of the research on bat diets in California none have focused on the insect pests of Southern California's crops using modern DNA metabarcoding technologies. California is home to approximately 25 different bat species including common bats such as Mexican free-tailed bats (*Tadarida brasiliensis*), big brown bats (*Eptesicus fuscus*) and Yuma myotis bats (*Myotis yumanensis*). California also is home to species that have special conservation protections such as the California state bat Pallid bats (*Antrozous pallidus*) and the Townsend's big-eared bat (*Corynorhinus townsendii*). Bats thrive most in healthy native habitats but are known to utilize linear habitats as flyways to forage for insects and depending on the bats' foraging strategies may also use large open areas such as agricultural fields [2]. Some bats have been observed traveling up to 20km (12.5 miles) from their roost to reach foraging grounds [4]. We know generally that bats consume a variety of insect pests beyond the originally thought beetles, moths and flies. In one study two bat species had 160 different agricultural insect pests and disease vectors detected in their diet [3].

Figure 1. Pallid bats and Mexican free-tailed bat roosting in bridge crevice in Ventura county.

I am Sarah Heffelfinger, a graduate student at California State Polytechnic University, Pomona and the goal of my research is to analyze the dietary composition of multiple species of bridge dwelling bats for a full year in Southern California Agriculture. Some of these bride roosting bats include Pallid bats and Mexican free-tailed bats, See Figure 1. To analyze the pests in the diet of bats throughout the whole year, my team and I look at the bat scat. For the twelve-month collection period guano or poop of five different bat species has been collected. Guano samples were collected by placing tarps under known bridge roosts throughout the agricultural hub of the Santa Clara River Valley, in Ventura, CA. The guano is currently being prepared for DNA metabarcoding, a modern DNA analysis method, to extract all the species contained within the samples. The data will then reveal, both to the benefit of growers and the conservation of bats, in which seasons bats eat important agricultural pests. Results from this research may better the relationship between our native wildlife and agriculture, by revealing what pests bats consume and in which seasons.

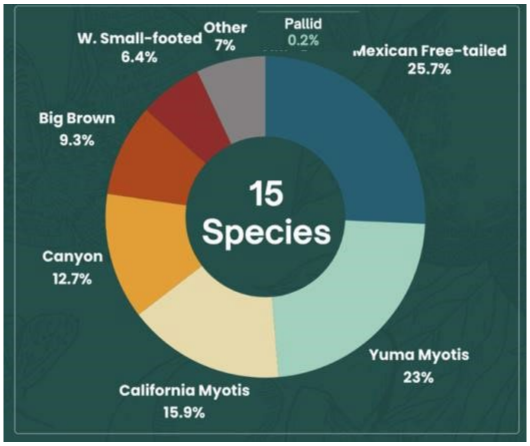

Figure 2. Jaime Neill's image of bat acoustic recording proportions by species in Ventura County.

While the project is currently ongoing, valuable findings have already been brought to light. Previously, it was unknown if bats in the study region were present to provide ecosystem services year-round and if they foraged on agricultural land at all. Previous bat acoustic research in the Blakey lab by Jaime Neill has revealed that many bat species do forage in riparian, lemon orchards and avocado orchards in the study region, (Figure 2). Preliminary data of this project has also revealed the presence of bats in various population sizes and species in Ventura County throughout the year, see Figure 3.

This study will contribute to our understanding of natural pest control and may influence a better implementation of sustainable agricultural practices. Agriculture will benefit fully by utilizing the relationship between bats and insects in each season, for example, by restoring nearby foraging habitats that contain insects preferred by bats. By conducting this research, we also look to support local crop growers by directly providing the results on this natural form of pest control, as well as provide new information to a data-deficient area in ecology, the dietary biology of common Southern California bats.

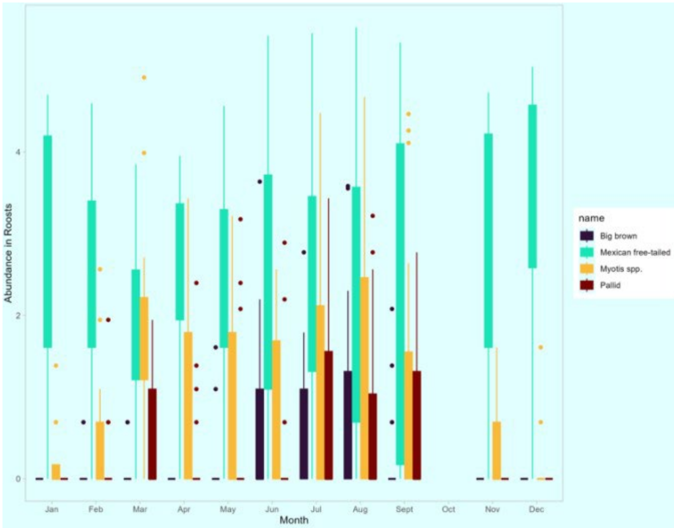

Figure 3. Bat abundance in bridge roosts by species each month excluding Oct. Note: Bats were also found roosting in the sites during October but have not yet been added to the graph

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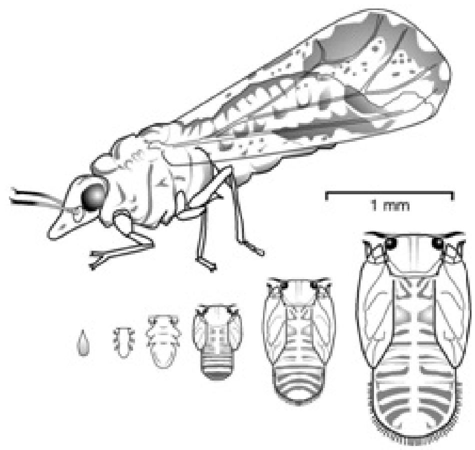

UC ANR Asian Citrus Psyllid Distribution & Management Website Evaluation Survey
We are currently updating the UC ANR Asian Citrus Psyllid Distribution and Management Website, available here to review before this survey: https://ucanr.edu/site/asian-citrus-psyllid-distribution-and-management

The purpose of this survey is to evaluate how useful the website is for growers, residents, and educators and to identify ways to improve the website and related outreach resources. The survey takes about 3-4 minutes to complete, and participation is voluntary. Responses will be anonymous and used to help improve the website. Improvements to this website are supported by funding from the Thelma Hansen Fund.

If you have questions about this survey, please contact:
Dr. Bodil Cass bodil.cass@ucr.edu

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Website: http://miami-dade.ifas.ufl.edu/

Laurel Wilt-Ambrosia Beetle Grant – Advisory Panel Meeting/Growers Workshop

Date: June 11th, 2026
Time: 1:00 PM - 3:00 PM (Eastern Time)
Venue: Zoom

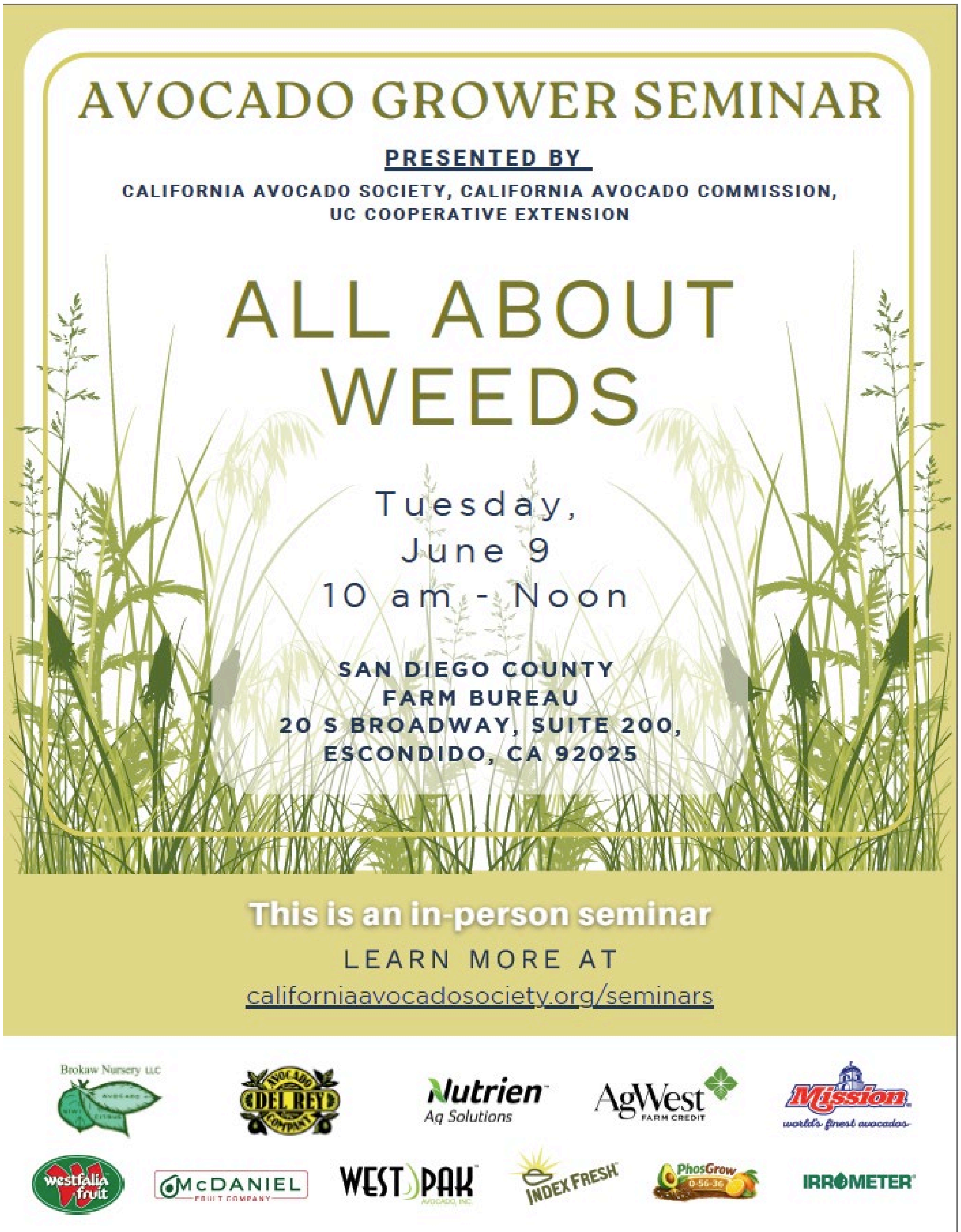
The purpose of this meeting is to briefly update the Advisory Panel members and avocado growers in **Florida and California** on the progress of the laurel wilt-ambrosia beetle research and discuss any topics and issues related to our research-extension effort.

To participate by Zoom you need to register in advance.
Here is the link:
https://ufl.zoom.us/meeting/register/2OYtBENYR3SB1fO6cK4Gvg

After registering, you will receive a confirmation email containing information about joining the meeting.

Laurel Wilt-Ambrosia Beetle Grower Workshop Agenda

Time (min)	Speaker	Title
5	Jeff Wasielewski	Welcome and introduction
10	Jeff Rollins	Status of research on host resistance and susceptibility
10	Daniel Carrillo	Status of the entomology research
10	Romina Gazis	Status of conventional and biological laurel wilt control research
10	Bruce Schaffer	Status report on LW symptom progression and host physiology related to scions, rootstocks, and pruning
10	Daniel Palberg	Extraction and use of fungal effectors ('plantigens') as an alternative strategy for defense against LW using immune priming
10	Karen Garrett	Status report on LW risk assessment for regional and national management
10	Jose Chapparo	Update on field trials to determine cold tolerance of avocado selections
10	Malek Hammami	Progress in economic evaluation of laurel wilt management strategies
5	Fatemeh Khodadadi & Malek Hammami	Extension Plans for California & Florida
		Q&A and group discussion



California Avocado Society Meeting: All about weeds!
June 9, 2026
San Diego Farm Bureau, 420 S Broadway, Escondido, CA
Information and link to register:
https://californiaavocadosociety.org/seminars.html