Topics in Subtropics Newsletter

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News from the Subtropical Tree Crop Farm Advisors in California

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Irrigation Practices and Water Management in Avocado Orchards: Insights from an 85-Farm Survey

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Ben Faber, UCCE Subtropical Crops Advisor, Ventura and Santa Barbara

1. Introduction

Efficient irrigation management is essential for sustaining avocado production in California, where orchards are often located on sloping terrain with heterogeneous soils and rely on a combination of district or surface water and groundwater supplies. Avocado trees are highly sensitive to both water stress and salinity, making irrigation decisions related to scheduling and salinity management critical to long term orchard productivity and health.

In recent years, increasing water costs, variable district allocations, and greater reliance on groundwater have intensified the need for practical irrigation strategies. These challenges are especially relevant in California's major avocado producing regions, where orchards vary widely in size, layout, and management capacity. As a result, irrigation recommendations must be flexible, scalable, and economically feasible, particularly for small and mid-sized operations.

To better understand how avocado growers are managing irrigation under current conditions, a survey of 85 avocado farms located primarily in San Diego, Ventura, Riverside, and Orange counties was conducted between 2023 and 2025. The survey captured information on irrigation water sources, orchard size, soil conditions, irrigation systems, scheduling practices, measurement of applied water, salinity concerns, and root zone health. Rather than prescribing specific technologies or practices, the survey was designed to document existing management approaches, identify common challenges, and highlight opportunities for incremental improvements.

The results presented in this article provide a snapshot of current irrigation practices across California avocado orchards. By linking water source strategies, soil and root zone conditions, irrigation scheduling, and salinity management, these findings offer practical insights that can help growers refine irrigation decisions and improve water management efficiency under real world orchard conditions. Findings reflect grower reported practices and observations and are intended to provide context and guidance for irrigation management decisions rather than prescribe specific practices.

2. Irrigation Water Sources

Avocado growers in California rely on a range of irrigation water sources, and many operations use more than one supply to meet orchard water demands. When water sources were grouped into mutually exclusive categories, nearly half of surveyed farms used a combination of district or surface water and groundwater, while the remaining farms were divided between exclusive use of district or surface water and exclusive reliance on groundwater.

Specifically, 47 percent of surveyed farms reported using both district or surface water and groundwater, 27 percent relied only on district or surface water, and 26 percent relied only on groundwater. This distribution indicates that blended water sourcing is a common strategy among avocado growers, particularly in regions where surface water deliveries may be variable or insufficient to meet full seasonal demand. These patterns are summarized in Figure 1. Water source choice has important implications for salinity management. When salinity concerns were evaluated within each water source category, farms relying on groundwater alone or on a combination of district or surface water and groundwater reported salinity concerns more frequently than farms using district or surface water exclusively. As shown in Figure 2, salinity concerns were most commonly reported among groundwater only and blended water users, highlighting the importance of water quality considerations in irrigation management.

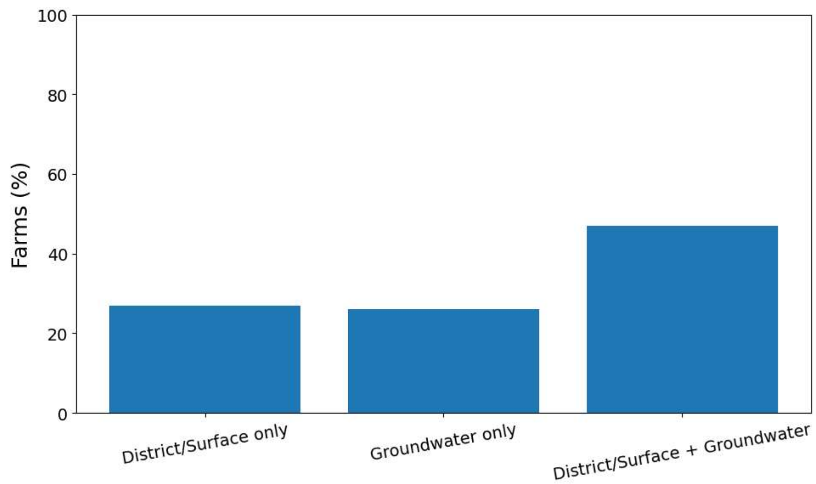


Figure 1. Irrigation water source combinations used by surveyed avocado farms.

In addition to general salinity concerns, several growers noted chloride related issues in irrigation water or soils in survey comments. These observations were often described in terms of leaf burn, salt injury, or reduced tree vigor consistent with avocado sensitivity to chloride. Chloride related concerns were reported across multiple water source strategies, reflecting that chloride levels can be elevated in both district or surface water supplies and groundwater depending on source water quality and blending practices. This reinforces the need to consider specific water quality constituents, not only overall salinity, when selecting and managing irrigation sources.

Taken together, these findings highlight the importance of incorporating water source and water quality considerations into irrigation planning. Where groundwater is part of the irrigation supply, either alone or in combination with district or surface water, growers may need to consider irrigation timing, leaching practices, and monitoring strategies to address salinity and chloride related risks. Integrating information on water source quality with soil conditions and irrigation scheduling can help support informed management decisions aimed at protecting root health and maintaining long term

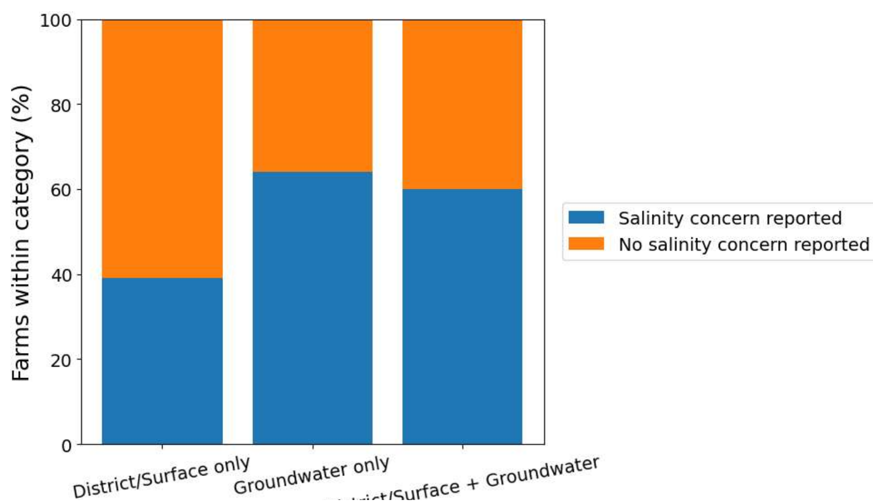


Figure 2. Relationship between irrigation water source strategy and reported salinity concern among surveyed avocado farms.

orchard productivity under variable water supply and water quality conditions.

3. Orchard Size and Operation Scale

Surveyed avocado operations spanned a wide range of grove sizes, but the distribution was strongly weighted toward small to mid-sized farms. As shown in Table 1, 40 percent of surveyed farms operated 1-5 acres, and an additional 34 percent operated between 5-25 acres. Taken together, nearly three quarters of surveyed orchards were 25 acres or smaller, indicating that most avocado growers in the survey manage relatively limited acreage. Larger operations were less common. Only 16 percent of surveyed farms exceeded 50 acres, and 10 percent exceeded 100 acres. While these larger orchards influence average acreage values, they represent a minority of the surveyed population and do not reflect the typical grower. We emphasize the importance of framing irrigation guidance and management recommendations around practices that are feasible for small and mid-sized operations.

Table 1. Orchard size distribution of surveyed avocado farms.

Orchard size category (acres)	Percent of farms (%)
1 to 5	40
Greater than 5 to 10	17
Greater than 10 to 25	17
Greater than 25 to 50	8
Greater than 50 to 100	8
Greater than 100	10

Orchard size influences management approach and operational complexity. Smaller orchards typically operate with fewer irrigation blocks and rely more heavily on direct observation and hands on management, while mid-sized and larger orchards often manage multiple blocks across variable terrain and soil conditions. Despite differences in scale, growers across orchard sizes reported facing similar constraints related to labor availability, time, and the need for efficient use of water resources. These findings highlight the need for scalable and practical management guidance. Recommendations that are simple, flexible, and economically feasible are most likely to be adopted by the majority of growers represented in this survey, while remaining applicable to larger operations.

4. Soil and Root-Zone Conditions

Soil conditions reported by surveyed avocado growers were highly variable, but the majority of orchards were located on coarse textured soils, including decomposed granite and sandy loam. These soil types accounted for more than half of reported orchards, while finer textured soils such as clay and clay loam were less common. Several growers reported rocky, mixed, or site-specific soil conditions, reflecting the diverse landscapes where avocados are grown. Reported soil distributions are summarized in Table 2.

Soil textures have direct implications for irrigation and root zone conditions. Coarse textured soil typically has low water holding capacity and rapid drainage, which increases sensitivity to irrigation timing and short-term water stress. At the same time, these soils can facilitate effective drainage when irrigation is managed appropriately. In contrast, finer textured soils retain water for longer periods and require careful irrigation scheduling to avoid poor soil aeration and excess moisture in the root zone.

Table 2. Predominant soil types reported by surveyed avocado farms. Soil categories reflect grower reported descriptions; "Not specified" indicates responses where soil type was not provided.

Soil type category	Percent of farms (%)
Decomposed granite	29
Sandy loam	22
Clay or clay loam	14
Loam	7
Rocky or bouldery	4
Silt loam	2
Other or mixed	14
Not specified	7

Grower reported root zone health outcomes reflect this balance. Most surveyed farms, approximately 80 percent, indicated low or no incidence of root rot, suggesting that current irrigation practices are generally effective at avoiding excessive soil saturation. However, a notable subset of farms reported high root rot pressure, underscoring the importance of matching irrigation frequency and duration to soil properties, particularly in heavier soils or orchards with limited drainage.

Overall, these findings reinforce the importance of soil aware irrigation management. Understanding soil texture and drainage characteristics is critical for maintaining healthy root zone conditions and avoiding physical stress associated with excess moisture across California avocado growing regions.

5. Irrigation Systems and Scheduling

Survey responses show that efficient irrigation delivery systems are widely adopted among surveyed avocado farms. Micro sprinkler irrigation was used by approximately 92 percent of surveyed operations, confirming it as the dominant irrigation system in California avocado orchards. A smaller proportion of farms, about 13 percent, reported using drip irrigation, most often in specific blocks or younger plantings. Several farms reported using more than one irrigation system across different orchard areas, reflecting site specific adaptation rather than uniform system choice While irrigation hardware adoption was relatively consistent, irrigation scheduling practices were more variable. Approximately 49 percent of surveyed growers reported relying on direct tree or plant observation to guide irrigation timing. Use of soil

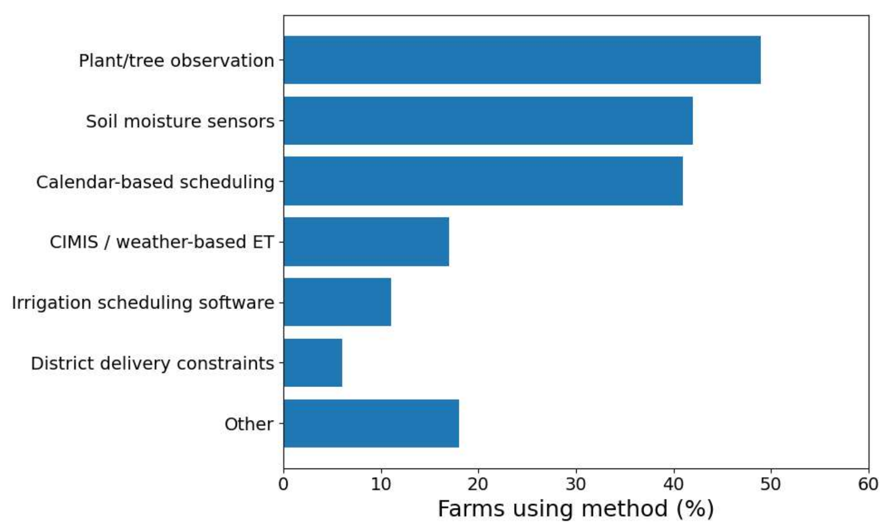


Figure 3. Irrigation scheduling methods reported by surveyed avocado farms.

moisture sensors was reported by about 42 percent of farms, and calendar-based scheduling was used by approximately 41 percent. These results indicate that most growers rely on multiple information sources rather than a single scheduling approach. In contrast, weather-based or evapotranspiration tools such as CIMIS were used by about 17 percent of farms, and avocado irrigation scheduling calculators or software were reported by roughly 11 percent, indicating more limited adoption of formal decision support tools. Reported scheduling approaches are summarized in Figure 3.

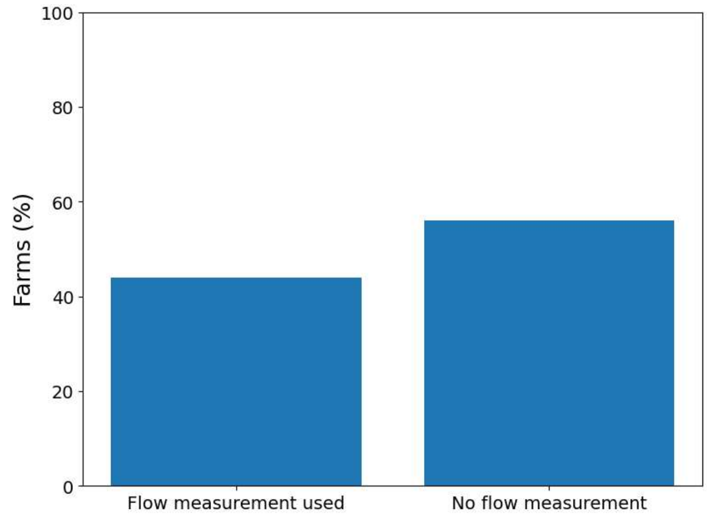


Figure 4. Adoption of flow measurement for irrigation among surveyed avocado farms.

Grower responses highlighted clear patterns in how irrigation frequency and application style are adjusted over the season. Many respondents described more frequent irrigation events during periods of high evaporative demand, such as hot summer conditions, particularly on coarse textured soils with limited water holding capacity. Outside of peak demand periods, growers reported modifying irrigation frequency and run times based on tree condition, soil moisture observations, and recent weather events rather than following a fixed interval throughout the season. These responses indicate that irrigation management is generally adaptive, with frequency and duration adjusted in response to changing orchard and environmental conditions.

Irrigation practices were frequently described as differing between young and mature avocado trees. Growers noted that younger trees are typically irrigated more frequently with shorter run times to maintain moisture in a shallow and developing root zone, particularly during establishment. Mature trees were more often managed with deeper and less frequent irrigation sets reflecting greater rooting depth and canopy demand. Where orchards included mixed age classes, several growers described adjusting irrigation schedules by block, highlighting the importance of tailoring irrigation management to tree developmental stage rather than applying a single schedule across the entire orchard.

The survey revealed a substantial gap in measurement of applied irrigation water. Only about 44 percent of surveyed farms reported using flow meters or other methods to directly measure irrigation volumes, while the remaining 56 percent did not measure applied water directly and instead relied on runtime estimates, pump capacity assumptions, or water delivery records. The lack of direct measurement limits the ability to evaluate irrigation efficiency, refine irrigation scheduling and leaching practices, and document changes in water management over time. Adoption of flow measurement practices is shown in Figure 4.

Survey responses further indicated that a subset of growers reported conducting irrigation system evaluations through Resource Conservation Districts or similar programs. Among participating growers, reported evaluation frequency varied, with some indicating routine assessments and others describing evaluations conducted primarily in response to system issues or management changes. These responses suggest that while irrigation system evaluation is recognized as a useful management tool, participation and frequency vary across operations.

Orchard layout and topography further influence irrigation management needs. Many avocado orchards include variable slopes, differing row orientations, and multiple irrigation blocks, which can result in uneven water application when uniform schedules are used. In these situations, selective use of irrigation automation, such as zone-specific scheduling, automated valves, or sensor integrated controllers, can improve water delivery efficiency by allowing irrigation timing and duration to be adjusted at the block level. Given the prevalence of small to mid-sized orchards, irrigation automation should be evaluated for economic feasibility, simplicity, and return on investment, with emphasis on low cost, scalable solutions.

When automation may be most useful in avocado orchards

Irrigation automation is not necessary for every operation, but it can provide meaningful benefits under certain orchard conditions. Automation may be particularly useful when orchards have variable slopes or hillside terrain, where uniform irrigation run times can result in over irrigation in downslope areas and under irrigation in upslope areas. Differences in row orientation or block layout can also create variation in sun exposure, wind, and evaporative demand, making a single irrigation schedule inefficient across the entire orchard.

Automation can be beneficial where soils differ across irrigation blocks, requiring different irrigation frequencies or durations to maintain uniform root zone moisture. It may be useful in orchards with multiple irrigation blocks that must be managed with limited labor availability, or where soil moisture sensors are already in use and growers want to translate sensor readings into consistent and repeatable irrigation actions.

In orchards using blended water sources, automation can help support targeted leaching in specific areas rather than applying uniform leaching across the entire orchard. When applied selectively and at an appropriate scale, automation can improve water distribution uniformity, reduce unnecessary water use, and support more precise irrigation management without increasing overall management complexity.

6. Salinity Management and Root Zone Health

Salinity was identified as a common concern among surveyed avocado growers. Approximately 55 percent of surveyed farms reported that salinity affects their orchards, while about 45 percent did not report salinity problems, underscoring the importance of site-specific evaluation. As shown earlier, salinity concerns were reported more frequently among farms using groundwater alone or in combination with district or surface water, highlighting the role of water sources in salinity risk.

Growers described a range of approaches to managing salinity, with leaching or flushing irrigations reported by a majority of respondents who identified salinity concerns. In most cases, these leaching events were applied in response to observed tree symptoms, known water quality issues, or seasonal conditions rather than guided by routine soil or water salinity measurements.

While this approach can be effective, its success depends on appropriate timing, sufficient water volumes, and adequate drainage.

In addition to overall salinity, several growers noted chloride related concerns in survey comments, reinforcing the importance of considering individual water quality constituents alongside total salinity when evaluating irrigation water quality. These observations underscore that salinity management decisions are influenced not only by total salt levels but also by the specific composition of irrigation water.

Growers noted the importance of coordinating nitrogen management with irrigation practices. Several respondents indicated that nitrogen applications are timed to coincide with irrigation events to support uptake, while avoiding excessive irrigation that could increase nitrogen movement below the root zone. These observations highlight that irrigation management influences not only salinity and chloride dynamics but also nutrient availability, reinforcing the need to consider water and nitrogen management together when making irrigation decisions.

Soil properties influence how salinity and chloride affect the root zone by shaping water movement, salt accumulation, and leaching effectiveness. As a result, salinity management strategies must be considered in the context of site-specific soil conditions rather than applied uniformly across orchards.

Overall, these findings highlight the importance of integrating water quality awareness into routine irrigation decisions. Where groundwater is part of the irrigation supply, either alone or in combination with district or surface water, growers may need to consider irrigation timing, leaching practices, and monitoring strategies to address salinity and chloride related risks. Coordinating irrigation decisions with soil conditions and nitrogen management can help support long term orchard health under variable water quality conditions.

7. Key Takeaways

Results from this survey indicate that many avocado growers are already using efficient irrigation systems and practical decision-making approaches, but additional improvements can be achieved through better integration of water source information, soil conditions, and irrigation scheduling. Blended water use is common, increasing the importance of managing water quality and salinity risk as part of routine irrigation planning. Most avocado orchards are small to mid-sized, highlighting the need for irrigation strategies that are practical, scalable, and economically feasible.

Soil texture and root zone conditions play a central role in irrigation performance, particularly on coarse textured soils. Efficient irrigation delivery systems are widely adopted, but scheduling practices vary, and many growers rely on a combination of plant observation, soil moisture sensors, and calendar-based approaches. A key opportunity for improving irrigation management is the measurement of applied water. Where orchard layout, slope, or soil variability complicates irrigation management, selective use of automation and block level scheduling may help improve water delivery efficiency when implemented at a scale appropriate for orchard size and management capacity.

Together, these findings support an integrated approach to irrigation management that emphasizes flexibility, site specific decision making, and incremental improvements to sustain avocado production under variable water supply and water quality conditions in California.

Acknowledgments
The authors thank participating avocado growers for their time, insights, and willingness to share information on irrigation and water management practices. Their contributions were essential to the development of this survey and the findings presented in this article.

What Can Happen with Too Much Rain? Watch that Mulch!!! And sometimes competitive weeds are good.

Ben Faber, UCCE Subtropical Crops Advisor, Ventura and Santa Barbara Counties

Rain is wonderful stuff. If it comes and washes the accumulated salts of the last several years out of the root zones of citrus and avocado, that's a good thing. But what happens if there is a little too much of the good stuff? In the winter of 2005, Venture got over 40" of rain, which is 200% of what is normal. The last time big rains occurred prior to that was in the winter of 1997-98. That year the rains were evenly spaced on almost a weekly basis through the winter and into the late spring and over 50" fell. That year we had major problems with both citrus and avocados collapsing from asphyxiation. The same occurred in 2005 but not so pronounced.


Waterlogged avocado removed from field in attempt to resurrect it

Rain is good, right?

In 2023 we had a lot more rain than we normally see and in Carpinteria it rained 4 inches in July!!!!!! In some young trees with poorly developed root systems, we saw some collapse from asphyxiation. Avocados tend to be more susceptible than citrus, and some rootstocks more than others. Even big trees collapsed.

Asphyxiation is a physiological problem that may affect certain branches, whole limbs or the entire tree. Leaves wilt and may fall, the fruit withers and drops and the branches die back to a greater or lesser extent. The condition develops so rapidly that it may be regarded as a form of collapse. Usually, the larger stems and branches remain alive, and after a time, vigorous new growth is put out so that the tree tends to recover. Young trees can be harder hit, but sunburn damage from lack of leaves may be more of a problem.

Asphyxiation is related to the air and water conditions of the soil. The trouble appears mainly in fine-textured or shallow soils with impervious sub-soils. In 1997-98, this even occurred on slopes with normally good drainage because the rains were so frequent. When such soils are over-irrigated or wetted by rains, the water displaces the soil oxygen. The smaller roots die when deprived of oxygen. When the stress of water shortage develops, the impaired roots are unable to supply water to the leaves rapidly enough and the tree collapses. The condition is accentuated when rainy weather is followed by winds or warm conditions.

Excluding air reduces root function, especially on the uptake of iron. It also allows ethylene to accumulate. Ethylene is a plant growth regulator that accelerates maturity. When roots sense ethylene, it causes leaf and fruit drop. The combined lack of oxygen and accumulation of ethylene leads to iron chlorosis and leaf drop. These are characteristic symptoms of asphyxiation and wet soils.

And then came the winter of 2023/24, and there was more rain and more devastation (mudslides, buried orchards, etc.). But in general, trees looked good. The consequences of low rainfall and the resulting greater application of salty irrigation water are leaf burn and often Botryosphaerias. After two wet rainy winters, we see much less of this kind of damage. And in the right drainage situations, the trees loved all that water. Then came two winters of low rainfall and trees started to look droughted – tip burn from salt and leaf blight from water stress.

And now we have had the beginning of 2025/2026 winter and since October 1, we have had nearly our normal yearly average in most places – 42inches at San Marcos Pass as of January 1, 2026!!!!!!!. And we have most of January and February to go, usually the rainiest months of the year. So more rain?

It doesn't take standing water to have asphyxiation occur.

Mulch is good, right?

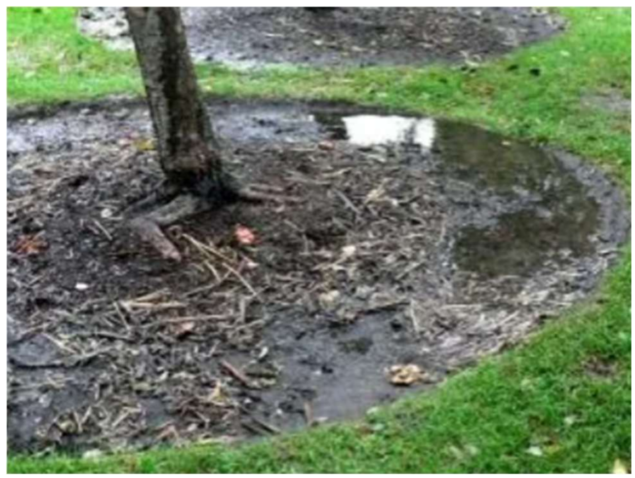
Mulch does lots of good things, like reducing erosion, controlling weeds, improving infiltration, increasing organic matter to control root disease, reducing soil temperatures, reducing evaporation loss and therefore improving soil moisture content. Ah, but that is a problem when there is a lot of rain. It can lead to asphyxiation, just because of that last point. In rainy conditions, there needs to be a period of air entry into the soil and mulch because it reduces evaporative loss and can keep the soil TOO wet, leading to

So, what do you do with a thick layer of mulch when there is too much rain? You pull it away several feet from the base of the tree, so that sun can dry out the soil. It's a lot of work, especially after you have put a lot of work into spreading it.

On flat ground, your avocados are planted on mounds or berms, right? And the soil texture is somewhat sandy and well drained, right? In that case, unless we get rain like 1997-98 when Ojai got nearly 50 inches and it rained just about every week from November through April and it seemed everything was under water, most trees should be all right this year. But this last fall I have seen cases where unbermed, heavy soil avocado plantings have had severe asphyxiation problems. Besides pulling back the mulch, it might be a good idea to let the weeds grow so that they can help dry out the soil. In a managed situation, it's called a cover crop. When confronted with new conditions it's time to make changes to your regular practices.

Mulch can get spread awfully thick.

Asphyxiated tree that has been overmulched and is now recovering after whitewashing.



After a rain, the roots need to dry out, and it can only happen if exposed to light and wind and ambient temperature

Cover crop between avocado

Pest Alert for Guava Growers

Bodil Cass, Subtropics Entomologist, UC Riverside

Residential and commercial guava growers in California are asked to be on the lookout for **Cardin's Whitefly (*Metaleurodicus cardini*, (Back) Hemiptera: Aleyrodidae)**. This pest is not known to be established in the environment in California; however, it is intercepted on incoming plant shipments at a frequency to cause concern. It can complete its lifecycle on a wide range of host plants, including guava, citrus, pomegranate, cherimoya and various ornamentals including plumeria/frangipani. It is known to be established in Hawaii and Florida, and in Nigeria and throughout the Caribbean (Bermuda, Cuba, Dominican Republic, Haiti, Jamaica, Puerto Rico).

It was evaluated by CDFA in September-October 2025[i], and given an "A" rating, meaning that it is an actionable pest[ii]. It causes damage to plants by direct feeding on phloem, and excreting honeydew that can be a substrate for sooty mold. This species is not a know vector of plant pathogens. In most conditions, it does not reach economically concerning densities, however, can be problematic on guava when natural enemies are disrupted. Since it has not previously been detected in California, it has the potential to be more challenging here, as it may find new suitable host plants, and may reach higher densities if no natural enemies are naturally present in the local environment. Parasitoids and generalist beneficial predators are thought to keep its densities low in its current range.

The Cardin's whitefly lifecycle consists of eggs laid on short stalks in a waxy trail (Figure 2); four nymphal stages including the newly-hatched, mobile, "crawler", two transparent-yellow, sessile stages and a red-eyed 'pupal' stage (Figure 3); and the winged adult stage. The most conspicuous feature of this species is a dark spot near the center of each of their dusty, white wings (Figure 1). Whitefly species are generally taxonomically distinguished by slide-mounting the pupal stage and comparing microscopic anatomical features such as number of dorsal pores, whereas the adults of this species can be putatively identified from the spots on the wings[iii].

Adult Cardin's whiteflies, Metaleurodicus cardini (Back). Credit: Lyle J. Buss UF/IFAS

Eggs of Cardin's whiteflies showing the stalk and waxy trail.
Credit: Lyle J. Buss, UF/IFAS

Nymphs of Cardin's whiteflies showing waxy secretions.

Adults are capable of flight, which allows them to move between hos plants and contribute to their dispersal potential. Related species are know to exhibit a migration behavior in which they ignore feeding cues and fly up into the wind column to be dispersed over long distances[IV]. The crawler stage is also mobile and can wander short distances between neighboring plants. However, the most common route of spread over long distances is through the anthropogenic movement of infested plant material.

Do your part to protect our local agriculture and environments: if you suspect you have found Cardin's whitefly, please contact UCCE, CDFA or your local Agricultural Commissioner immediately. It is illegal to ship or move plant material without a permit, even from your home garden. Purchase clean plants from reputable nurseries. Early detection is the best chance of averting an invasive pest problem.

Please report potential pests to UCCE or the
CDFA Pest Hotline
1-800-491-1899
https://www.cdfa.ca.gov/plant/reportapest/

[1] California Pest Rating Profile for *Metaleurodicus cardini* (Back): Cardin's whitefly Hemiptera: Aleyrodidae https://blogs.cdfa.ca.gov/Section3162/wp-content/uploads/2025/10/Metaleurodicus-cardini-002.pdf
[1] More information about pest ratings is available here: https://ucanr.edu/site/plant-pest-regulations-and-permits/cdfa-pest-ratings. Active pest rating proposals open for public comment are found here: https://www.cdfa.ca.gov/plant/regs_pestrating.html
[1] Factsheets from University of Florida: https://edis.ifas.ufl.edu/publication/IN310 and https://journals.flvc.org/edis/article/download/109061/104199/152036
[1] Byrne DN. Migration and dispersal by the sweet potato whitefly, *Bemisia tabaci.* Agricultural and forest meteorology. 1999 Nov 30;97(4):309-16. https://doi.org/10.1016/S0168-1923(99)00074-X

Cellulase Production by Various Sources of Mulch

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Abstract. Organic mulches are reported to control root rot of avocado, caused by *Phytophthora cinnamomi*. A possible mechanism for this control is enzyme (specifically cellulase and glucanase) production by the large microbial population supported by the mulch, which can degrade the cell walls of the pathogen. Samples of a wide range of organic mulches were set out in plots at two sites for two years. Rate of decomposition, measured as change in depth, and cellulase activity in the mulch, at the mulch-soil interface and in the soil were measured. Mulches with a low rate of decomposition tended to have low levels of cellulase activity, whereas mulches that decomposed rapidly varied in their cellulase activity. Manuka and eucalyptus mulches had the highest activities. Cellulase activity in the soil 5cm below the mulches was not increased by any of the mulches. Mulches taken from an avocado orchard had similar cellulase activities to mulches from the trial plots, but fresher samples (four months cf. two years) had lower activities.

Introduction

Biological control of *Phytophthora cinnamomi* in avocado through the use of mulches was identified by an Australian grower and later described as the "Ashburner Method" by Broadbent and Baker. The technique uses large amounts of organic matter as a mulch along with a source of calcium. Control of avocado root rot in the Ashburner method was attributed to the presence of *Pseudomonas* bacteria and actinomycetes. Multiple antagonists are more likely the cause of biological control, since no single organism has been found to be consistently associated with soils suppressive to *P. cinnamomi*.

The use of organic mulches has multiple effects, such as altered soil nutrient and water status and improved physical structure. Any improvements in plant status resulting from improvements in the growing environment can improve plant health. The effect of organic amendments on soil physical and chemical properties can vary considerably depending on soil texture and the environment. One of the most consistent effects of organic amendments is an increase in biological activity. Increases in organic substrate lead to increased fungal and bacterial populations. In numerous cases, this increase in biomass has been associated with disease suppression, especially of *Phytophthoras*. This biological control can be ascribed to several mechanisms: competition, antibiosis, parasitism, predation and induced resistance in the plant.

The microbial biomass is responsible for release of enzyme products and polysaccharides in soils. The microbially-produced enzymes cellulase and glucanase have been demonstrated to have a significant effect on *Phytophthora* populations. This mechanism of antibiosis is possible because the microbes are releasing these enzymes to solubilize organic matter. Unlike other fungi, *Phytophthora* have cell walls that are comprised of cellulose and in the process of decomposing organic matter with enzymes, an environment is created that is also hostile to the pathogen.

This study was designed to evaluate whether there are differences in the production of cellulase from different mulching materials in a field setting. The materials used were commonly available and if necessary, could be readily available to growers at a reasonable cost. The fields were established in two different environments to determine the impact of climate on cellulase production.

Experimental Design

Two sites with different climatic regimes and soil types were used. Te Puke Research Station (sandy loam) situated on the east coast of New Zealand's North Island has an annual rainfall average of 1691 mm and mean annual temperature of 14.5° C. Ruakura Research Center (loam soil texture) is an inland site with mean annual rainfall of 1190 mm and mean annual temperature of 13.7° C. At both stations, areas were cleared and cultivated and 1.5 meter by one meter plots of mulch materials were laid out in the open. Materials were spread to a depth of 100 mm in side-by-side plots and covered with polypropylene bird netting to prevent wind dispersion. Materials included those easily available from windbreak plantings, such as poplar, willow and casuarina, as well as materials from the forest and greenwaste industries. These materials were also selected for their range in texture and potential rate of decay. Each material was replicated two times at each site.

Windbreak materials were chipped in place and applied as fresh materials at the test sites. One of the mulches was inoculated with Trichoderma, a beneficial fungus. At Ruakura, 21 materials were evaluated and 23 at Te Puke (Table 1). Weeds were controlled by occasional glyphosate sprays. Depths of the mulches were measured at the end of one and two years. Cellulase activity was measured in samples of the mulch, the mulch-soil interface and soil at a depth of 5cm at Ruakura and in samples of three mulches only at Te Puke at the end of year two. Cellulase activity was also determined in mulch samples taken from a commercial avocado orchard near Te Puke where four different mulches had been applied 22 months previously and from fresh (4 month old) samples of two of the materials that had high cellulase activity in the two year old samples (manuka and eucalyptus) (Table 2).

Table 1. Materials applied as mulches at Te Puke and Ruakura

Willow *Salix matsudana*	Cryptomeria *Cryptomeria japonica*	Poplar *Populus nigra*	Avocado *Persea americana*
Pine bark *Pinus radiata*	Eucalyptus *Eucalyptus globulus*	Casuarina *Casuarina cunninghamiana*	Bamboo* *Phyllostachys bambusoides*
Cypress * *Cupressus sempervirens*	Manuka *Leptospermum scoparium*	Pine sawdust	Pine wood chips + cow manure
Greenwaste + chicken manure compost	Biosolids compost	Recycled wood chips, fine	Recycled wood chips, coarse
Greenwaste compost screenings, coarse	Greenwaste compost screenings, fine (1)	Greenwaste compost screenings, fine (2)	Composted pine bark
Composted pine bark + *Trichoderma*	Composted greenwaste	Wool waste	*@Te Puke only

Table 2. Extra samples included in cellulase analysis

Avocado (orchard sample)	Willow plus composted manuka and greenwaste (orchard sample)	Willow plus liquid fish waste (orchard sample)	Pine bark (orchard sample)
Manuka (fresh)	Eucalyptus (fresh)		

Duplicate sub-samples (100 mg) were taken from each mulch or soil sample and incubated for four hours at room temperature with 2 ml of 2 mmol/L p.nitrophenyl-cellobioside in 50 mmol/L acetate buffer (pH 5.0). Cellulase activity was determined by absorbance at 410 nm and expressed as µmoles of substrate hydrolyzed per hour per gram dry weight. This is a modification of the method of Tank and Webster (1988). Least significant differences (lsd) between means at 5% significance were calculated using Genstat.

Results and Discussion

Since cellulase production is part of the decomposition process, the rate of decomposition should be a partial indicator of the amount of cellulase present. Figure 1 shows the depths of various materials at the Ruakura site after one and two years of decomposition. After a mulch application there is generally settling due to rainfall-caused compaction, but much of the decline by the second year is due exclusively to decomposition. The more recalcitrant materials, such as bark, wood chips and sawdust have barely lost half their depth after two years, while others such as shredded eucalyptus, manuka, avocado and willow are less than 20% of their initial depth. Much of the shredded/chipped material, such as eucalyptus had a significant fraction of leaves in the mulch. The wool disappeared a little after one year. The greenwaste + chicken manure compost is nearly the same depth as the wood chips, since it is a material that had gone through a decomposition process prior to its application and much of the easily digestible materials had already been decomposed. Decomposition at Te Puke followed a similar pattern (data not shown).

The rate of decomposition has some bearing on the rate of cellulase production (Figure 2). Eucalyptus and manuka had the two greatest rates of decomposition and show the highest levels of cellulase production. However, poplar, willow and avocado had high rates of decomposition, but their cellulase activities were half those of manuka and eucalyptus. Cellulase level regressed against the two year loss of the materials gave an equation of :

$$\text{Cellulase} = -19.64 + 13.72\ (\text{dry matter loss}).$$

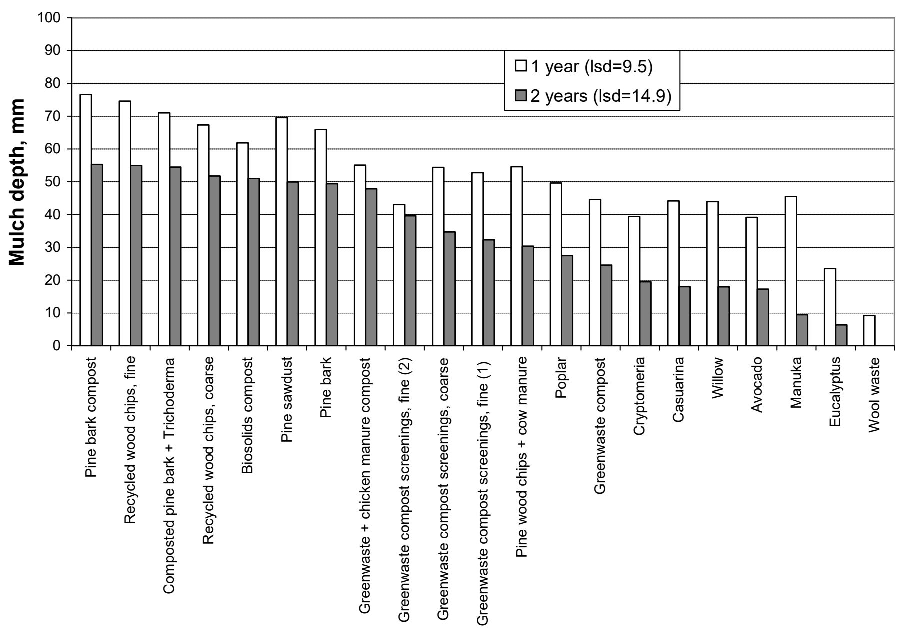
The P-value in the ANOVA tables is less than 0.10 so there is a 90% confidence in the fitted model. The correlation coefficient (R^2) equals 0.388 which indicates a weak relationship between the variables.

Samples removed from a commercial orchard with materials of a similar age as those in the Te Puke and Ruakura trials show similar levels of cellulase as those found in the more controlled environment. These similar levels would indicate that the levels are probably indicative of what would be expected in a real life field. The fresher eucalyptus and manuka had lower levels than the two-year old materials. This is probably due to the materials being too newly chipped and not in full decomposition. Cellulase activities of the manuka samples from Ruakura and Te Puke were similar (Figure 2).It is clear that the cellulase effect is limited to the layer of mulch and not to depth within the soil. There is some effect at the soil surface, but at 5 cm. cellulase activity drops to background levels (Figure 2). There is earthworm activity at these test sites and one idea was that earthworm incorporation of organic matter would move the cellulase production into the soil. Maybe with further time this would occur. As it is, when mulches are applied to avocado, the roots tend to proliferate in the mulch, out of the soil where the cellulase activity is the least.

We do not know what levels of cellulase are necessary to control the root rot fungus or if in fact cellulase production is a major mode of *Phytophthora* control. If cellulase does control the pathogen, it may be that levels seen with pine bark are more than adequate. Also we have measured cellulase production at only one time in a two-year period and it is quite likely that this does not fully represent what is happening before and after. A further reminder is that cellulase is only one of the many by-products associated with decomposition and many of the antagonistic properties that are associated with the microbial biomass are not being measured in this trial. Having developed this screening procedure, what needs to be done next is to take high, medium and low cellulase producing mulches and challenge the fungus to verify that this is a good way to evaluate mulches.

Figures

Figure 1. Depths of applied mulches at Ruakura, one and two years after application. Initial depth was 100 mm.



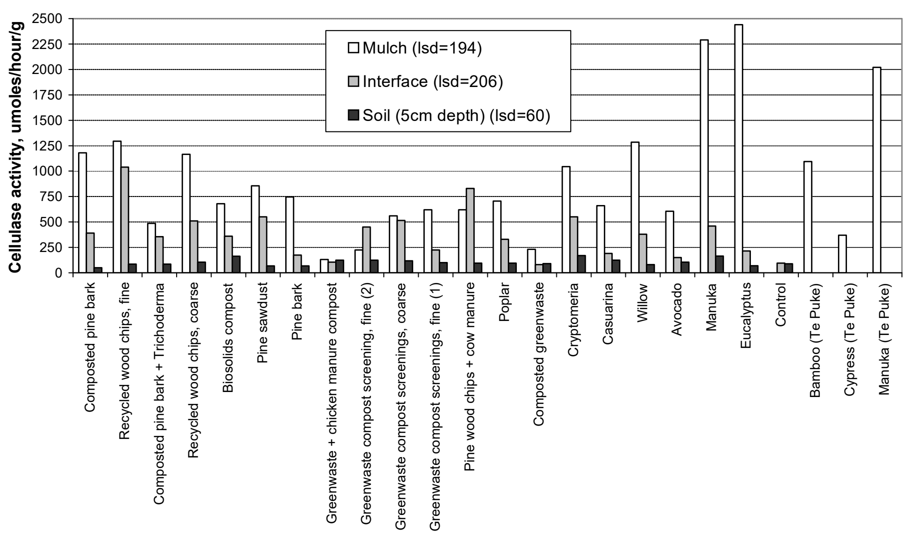


Figure 2. Cellulase activity within the mulch, at the soil-mulch interface and at a depth of 5 cm in the soil below the mulch

Using Bees to Scout for Avocado Sunblotch: A Smarter Way to Protect Your Grove

Fatemeh Khodadadi, Mehdi Kamali Dashtarzhaneh, Department of Microbiology and Plant Pathology, UC, Riverside
Ben Faber[2], Hamutahl Cohen, UCCE Advisors, Ventura and Santa Barbara

The detection and management of Avocado Sunblotch Viroid (ASBVd) remain one of the most persistent hurdles for the California avocado industry. ASBVd is an insidious, submicroscopic pathogen that disrupts the tree's normal development, leading to losses in both yield and fruit quality. The "sunblotch" name itself is derived from the characteristic symptoms that often resemble physical sunburn: irregular, sunken crevices of white, yellow, or even reddish-pink coloration on the fruit. Beyond the fruit, infected trees may exhibit yellow or white streaks on young green stems and a distinctive rectangular cracking of the bark on the trunk and larger branches, a condition often referred to as "alligator bark." In severe cases, the entire tree becomes stunted, taking on a sprawling, horizontal growth habit that makes it look far older and less productive than its healthy counterparts.

The challenge for growers is that ASBVd is famously erratic; symptoms may appear on only one branch of a tree or vanish and reappear depending on environmental stress and the specific viroid strain. Because of this, "symptomless carriers" can exist within a grove, quietly spreading the pathogen through root grafting and pollen while appearing perfectly healthy to the naked eye. To combat this hidden threat, our laboratory has developed and refined a well-established molecular detection method—utilizing highly sensitive dLAMP and droplet digital PCR techniques (Dashtarzhaneh et al. 2025; Xu et al. 2026)—that are now ready to serve the growers community. This diagnostic capability allows us to identify the viroid long before physical symptoms manifest, providing a critical window for intervention.

While we have long understood the primary pathways of infections such as contaminated grafting tools and seed transmission—recent research has shifted our focus toward a more mobile participant in our orchards: the honeybee. It is crucial for growers to distinguish between a "vector" and a "carrier" when it comes to this viroid. While honeybees do not transmit ASBVd in the traditional sense—meaning they do not inoculate the tree's vascular system as they forage—they serve as highly efficient environmental samplers. They carry the viroid through the collection of contaminated pollen and by harboring particles on their bodies. This distinction is vital because it transforms the honeybee from a potential threat into a powerful ally for orchard-wide surveillance.

Growers have long relied on honeybees as indispensable partners in the orchard, bringing in hives during the bloom to ensure the heavy pollination required for a profitable fruit set. While it is incredibly helpful to know these bees can act as "scouts" by collecting the viroid for surveillance, this discovery naturally raises concerns for many managers. It is common to worry that if bees are carrying ASBVd, they might be transporting the pathogen from a neighboring, less-managed orchard into a clean grove. However, it is important to remember that honeybees are not biological vectors; they do not possess the mechanism to inject the viroid into the tree's circulatory system.

While they may bring contaminated pollen back to the hive or drop it on a flower, the primary risk of actual infection remains tied to mechanical transmission—such as unsterilized pruning tools—or through root grafting and seed. Therefore, finding the viroid on a bee is an alert that the pathogen is present in the vicinity, but it does not mean the bees are actively infecting your healthy trees.

Figure 1. A honeybee visits an avocado flower (right) where it inadvertently picks up viroid traces, which we then collect as pollen samples back at the hive (left) to monitor orchard health.

To validate this surveillance strategy within our specific regional climate and management practices, we conducted a study involving nearly 80 pollen and bee samples across three of California’s primary avocado-producing counties: Riverside, San Diego, and Ventura. Our goal was to determine if the viroid could be reliably detected within the hive environment after bees had foraged in areas with known infections. The results were definitive. We successfully detected the viroid both in the pollen stored within the hives and on the bodies of the bees themselves. This confirmation proves that the viroid is physically present and detectable in the biological materials that bees bring back from the field, making them effective bio-indicators for the presence of ASBVd in the surrounding acreage.

During the study, we strategically placed hives at varying distances from known infected trees. Whether the hives were nestled directly under the canopy of a positive tree or situated at a distance, the "scout" bees were able to find and return with evidence of the viroid. This spatial data is particularly encouraging for growers, as it suggests that a relatively small number of hives can monitor a wide radius of trees, providing an early warning system that far exceeds the efficiency of manual inspections. Testing every tree for ASBVd is logistically and financially overwhelming. Traditional sampling is labor-intensive and often misses "asymptomatic carriers" that lack visible symptoms like yellow streaking or "alligator skin" bark. By using honeybee-mediated surveillance, growers can leverage bees as a "living net" to sweep orchards for pathogens. This centralized, hive-level sampling provides a comprehensive health snapshot while significantly reducing diagnostic costs.

If you’re worried that sunblotch might be hiding out in your grove, don't hesitate to reach out to us—we're here to help you get ahead of it.

References
Dashtarzhaneh et al. 2025. Detection and Quantification of Avocado Sunblotch Viroid in California Avocado Orchards Using Digital Loop-Mediated Amplification and Droplet Digital PCR. Phytopathology.
Xu J., et a. 2026. Ultrasensitive, Low-Input Detection of Avocado Sunblotch Viroid via RPA-CRISPR and Nanopore-Array Single-Bead Fluorescence Readout. bioRxiv 2026.01.19.70002

Field Trial Results You Can Use: Citrus Thrips Insecticide Research are Published on Arthropod Management Tests

Sandipa Gautam, Area Citrus IPM Advisor, UCCE, UCANR

For citrus pest control advisors (PCAs) and growers, in-season citrus thrips decisions depend on reliable, field-validated data. Each year, insecticide efficacy trials conducted at the **University of California Lindcove Research and Extension Center** are published in the journal **Arthropod Management Tests** and they are fully open access and free to download.

If you are making citrus thrips management decisions, these reports are a practical, data-driven resource you can use immediately.

What Is *Arthropod Management Tests*?
Arthropod Management Tests (AMT), published by the **Entomological Society of America**, is a peer-reviewed journal dedicated specifically to field efficacy trials. Unlike traditional research papers that focus heavily on theory or long-term ecological interpretation, AMT reports are concise and highly practical.

What Has Been Published for Citrus Thrips?
Since 2017, the Lindcove REC team has published multiple citrus thrips insecticide trials covering standard efficacy comparisons, evaluation of new chemistries, organic and reduced-risk options, pre-bloom applications, spray volume trials, and year-to-year performance evaluations. These trials represent field-generated data under commercial production conditions, not small laboratory bioassays.

Citrus thrips management continues to evolve due to, variable population pressure across districts, resistance risk and chemistry rotation needs, shifts in spray timing strategies, increasing emphasis on scar-free fruit and marketability.

Having access to replicated field trial data allows you to, compare relative performance of products, assess consistency across seasons, evaluate spray timing strategies, support treatment decisions with published data, and communicate evidence-based recommendations to clients
For PCAs especially, AMT publications can serve as documentation supporting product performance discussions with growers and regulators.

How to Access *Arthropod Management Tests* (Free & Open Access)
All AMT articles are open access and free to download. No subscription is required.

Step-by-Step Navigation:

- Go to the **Entomological Society of America** website, navigate to Journals and select *Arthropod Management Tests*. You can use keywords such as citrus thrips or the active ingredient, or a specific year or combination to look for trials from specific year. Click on the article title. Download the PDF directly, no login required. Alternatively, if you have the DOI (Digital Object Identifier), you can paste it directly into your browser, and it will take you straight to the article page.

Table 1. The table below lists the products and pesticide class based on multiple seasons trials by UC researchers at the Lindcove Research and Extension Center.

Trade Name	Common Name	Pesticide Class	
Insecticides that work best when thrips pressure is heavy			
Exirel	cyantraniliprole	28	
Minecto Pro	cyan. + abamectin	28+6	
Beleaf	flonicamid	29	
Plinazolin*	Isocycloseram	30	
Insecticides that work best when thrips pressure is light to moderate			
Entrust/Success	spinosad	5	
Delegate	spinetoram	5	
Agri-Mek	abamectin	6	
Movento	spirotetramat	23	
Bexar	Tolfenpyrad	21A	
Veratran D + sugar	sabadilla	botanical	No longer available to purchase.
PQZ*	Pyrifluquinazon	9B	
Resistance in the SJV thrips			
Carzol SP	formetanate	1A	Effective products. SJV citrus thrips have developed resistance. Use in rotation.
Cygon/Dimethoate	dimethoate	1B	
Baythroid XL	beta cyfluthrin	3	
Danitol 2.4 EC	fenpropathrin	3	
Delegate	Spinetoram	5	

*Not registered in CA.

Heavy Thrips Pressure

- Use stronger, high-efficacy materials such as IRAC 28 (Exirel), 28+6 (Minecto Pro), 29 (Beleaf), or 30 (not yet registered in California, has EPA registration).
- Prioritize fast knockdown and strong residual during the fruit's susceptible scarring window, especially at petal fall and weeks that follow petal fall.
- Do not rely on softer materials when populations are well above threshold. Although there is no specific threshold for citrus thrips due to several factors such age of fruit, variety, presence of predatory mites, growing region etc., thrips presence at petal fall, regardless of the numbers, warrants a treatment. Monitor 2x weekly starting at petal fall, pay attention to number of thrips and both adults and immature life stages. Visit citrus thrips monitoring and UCIPM Guidelines.
- Rotate to a different IRAC group for any follow-up spray avoid back-to-back applications of the same mode of action.

Light to Moderate Thrips Pressure

- When the pressure is moderate, many products provide Use effective rotational tools such as IRAC 5 (Entrust/Success, Delegate), 6 (Agri-Mek), 23 (Movento), 21A (Bexar), or 9B

(where registered). Target early instars and apply based on monitoring, not calendar timing.
- Group 5 materials can perform well but should be used cautiously and only in rotation due to resistance concerns in the SJV. Consider beneficial preservation and overall IPM program fit when selecting products.

Resistance Considerations (SJV)
- Research has shown that there is established resistance IRAC 1A, 1B (Carzol SP, Dimethoate), and 3 materials (Baythroid, Danitol), avoid relying on these for thrips control. Resistance to Group 5 (Delegate) has been documented. Rotate by IRAC group, not trade name. Do not use as first application, use only in rotation and avoid repeated use in the same season.
- Evaluate control based on rind scarring and field performance; uneven control may signal resistance issues.

Below are the links to citrus thrips trials conducted at Lindcove REC from 2017-2025
1. Effects of insecticide treatments on thrips-induced rind scarring in citrus. https://doi.org/10.1093/amt/tsaf137
2. Insecticide efficacy trial on rind scarring caused by citrus thrips, 2024. https://doi.org/10.1093/amt/tsaf020
3. Insecticide spray volume trial against citrus thrips, 2024. https://doi.org/10.1093/amt/tsaf025
4. Effects of pre-bloom application of insecticides on rind scarring damage caused by citrus thrips in 2024. https://doi.org/10.1093/amt/tsaf019
5. Citrus thrips insecticide efficacy trial, 2024. https://doi.org/10.1093/amt/tsaf021
6. Citrus thrips insecticide trial, 2023. https://doi.org/10.1093/amt/tsae072
7. Effects of Sabadill-V to reduce severe rind scarring caused by citrus thrips in navel oranges, 2022. https://doi.org/10.1093/amt/tsac124
8. Citrus Thrips Insecticide Trial, 2022. https://doi.org/10.1093/amt/tsac121
9. Citrus Thrips Insecticide Trial, 2019. https://doi.org/10.1093/amt/tsaa012
10. Citrus Thrips Insecticide Trial, 2018. https://doi.org/10.1093/amt/tsz024
11. Citrus Thrips Insecticide Trial 1, 2017. https://doi.org/10.1093/amt/tsy022
12. Citrus Thrips Insecticide Trial 2, 2017. https://doi.org/10.1093/amt/tsy023
13. Citrus Thrips Insecticide Trial, 2016. https://doi.org/10.1093/amt/tsx046

Asian Citrus Psyllid and HLB Outreach Day at Lindcove
March 05, 2026

We are excited to bring to you a field day dedicated to Asian Citrus Psyllid and Huanglongbing, at the Lindcove Conference Room on **Thursday, March 05, 2026.** This is a great opportunity for citrus pest control advisors and growers to learn about the current status of ACP and HLB in California and hear from grower liaisons and regulators on current regulations and mitigation measures, ongoing research efforts, and interact with the speakers. This field day will also provide hands-on training to identify Asian citrus psyllid on a trap card and conduct mock sampling of new flush and tap sampling.

CE: 0.5 hours laws and 3 hours other pending
Registration link: Click here to register.
Registration cost: $20
When: Thursday, March 05, 2026
Where: 22963 Carson Avenue, Conference room

Time	Presenter/Affiliation	Topic
8:00- 8:30 am	**Registration begins**	
8:30 to 9:00 AM	Ashraf El-Kereamy, CE Specialist, Horticulture UC Riverside; LREC Director	Current status of ACP and HLB in California and updates from HLB mitigation research
9:00 to 9:30 AM	Lea Pereira, Environmental Scientist Fabian Velasco, Sr. Environmental Scientist Citrus Pest and Disease Prevention Division, CDFA	San Joaquin Valley regulatory updates on ACP/HLB Management
9:30 to 10:00 AM	Judy Zaninovich, Grower Liaison, Kern County and Central Valley Pest Control District	ACP/HLB detection updates from grower liaison
10:00 to 10:30 AM	Bo Cass, CE Specialist, Subtropical fruit crops, UC Riverside	Current Best IPM approaches to manage ACP and research updates from Southern California
10:30 to 11:00 AM	Spencer Walse Research Chemist USDA ARS	Postharvest bulk citrus fumigation – a safe choice for bulk citrus movement
11:00 to 11: 45 PM	Lunch Break	
11:45 to 12:15 PM	Saurabh Gautam Entomologist Alliance of Pest Control District	ACP Trapping and research updates from CLas detection
12:15 to 12:45 PM	Sandipa Gautam Area Citrus IPM Advisor UCCE Statewide IPM Operations	Research updates on novel research tools for ACP/HLB management
12:45 to 1:30 PM	Sandipa Gautam IPM Advisor, UCCE Statewide IPM Program Operations Saurabh Gautam Entomologist APCD	Identifying characters of ACP on sticky trap card ACP life stages and identifying characters Monitoring Mock sampling (flush) and tap sampling (in field)

2026 ADVANCED SCHOOL ON MICROIRRIGATION FOR CROP PRODUCTION

March 30 – April 3, 2026

Final Schedule of Class Lectures at UC Davis Conference Center (Days 1-3) and Field/Demonstration Visits (Days 4-5)

<u>Day 1 (March 30, 2026)</u> – Topics: General Aspects of Microirrigation

- ✓ Introduction to Microirrigation: Definition; Advantages and Constraints; Types of Microirrigation Systems; Microirrigation Use Worldwide; Enabling Conditions for Successful Adoption of Microirrigation (J. Ayars)
- ✓ Hydrological and Basin-scale Considerations for Microirrigation (P. Steduto)
- ✓ Water Delivery Requirements for Successful Adoption of Microirrigation (E. Rothberg)
- ✓ Economic and Financial Considerations for Adapting Water Delivery Systems and Services to Microirrigation (FAO-CFI)
- ✓ Microirrigation Systems' Components and Functions (T. Devol)
- ✓ Water Movement from the Soil and through the Plant (P. Steduto)
- ✓ Measuring and Regulating Plant-Water Status (K. Shackel)
- ✓ Water Movement and Storage in Various Soil Types under Microirrigation (B. Sanden)
- ✓ Methods and Tools for Microirrigation Scheduling in Specialty Crops (D. Zaccaria; M. Cahn)
- ✓ Using Microirrigation for Frost Protection and Evaporative Cooling (R. Snyder)
- ✓ Energy Demand and Supply Dynamics with Microirrigation (A. Aghajanzadeh)

08:00 – 08:30 am: Coffee and Refreshments

08:30 – 08:45 am: Welcome to the Advanced Microirrigation School for Crop Production

Session 1 – General Introduction and Hydrologic/Basin-scale Considerations. *Coord's: J. Ayars; P. Steduto*

08:45 – 09:00 am:	Introduction to Microirrigation (J. Ayars)
09:00 – 09:20 am:	Does Microirrigation Save Water on a Basin Scale? (P. Steduto)
09:20 – 09:50 am:	Adapting Different Water Delivery Systems and Services to Microirrigation (E. Rothberg)
09:50 – 10:30 am:	Economic and Financial Considerations for Adapting Water Delivery Systems and Services to Microirrigation (Speaker from FAO-UN Investment Center)
10:30 – 10:50 am:	Questions & Answers

10:50 – 11:15 am COFFEE BREAK

Session 2 – The Soil-Plant-Microirrigation Continuum: Water Application, Uptake, and Regulation. *Coord's: P. Steduto; K. Shackel*

11:15 – 11:40 am:	Microirrigation Systems' Components and Functions (T. Devol)
11:40 – 12:00 pm:	Water Movement and Storage in Various Soil Types under Microirrigation (B. Sanden)
12:00 – 12:20 pm:	Water Movement from the Soil through the Plant (P. Steduto)
12:20 – 12:45 pm:	Measuring and Regulating Plant-Water Status (K. Shackel)
12:45 – 1:00 pm:	Questions & Answers

1:00 – 2:00 pmLUNCH

Session 3 – Scheduling Water Applications, Microclimate Management, and Energy Dynamics in Microirrigation Systems. *Coord's: D. Zaccaria; M. Cahn*

2:00 – 2:30 pm:	Methods and Tools for Microirrigation Scheduling in Specialty Crops (D. Zaccaria)
2:30 – 3:00 pm:	Using Microirrigation for Frost Protection and Evaporative Cooling (R. Snyder)
3:00 – 3:30 pm:	Energy Demand and Supply Dynamics with Microirrigation (A. Aghajanzadeh)
3:30 – 3:45 pm:	Questions & Answers

3:45 – 4:00 pm COFFEE BREAK

4:15 - 5:30 pm	Outdoor Field Session: Measuring Soil and Plant Water Status (M. Cahn; K. Shackel; C. Albuquerque)

6:00 – 8:00 pm – Social Dinner with Sponsors and Exhibitors at the UC Alumni Center

6:30 – 7:30 pm – Tributes to Irrigation Research Leaders (George H. Hargreaves; Jack Keller; Freddy R. Lamm; Claude J. Phene)

Day 2 (March 31, 2026) - Topics: Microirrigation System Design and Operation

- ✓ Design Principles for Resource-Efficient Microirrigation Systems (D. Zaccaria)
- ✓ Hydraulics for Microirrigation Systems (O. Lagos)
- ✓ Design Considerations for Sub-surface Drip Irrigation (J. Ayars)
- ✓ Filtration and Fertigation Systems (K. Bali; Z. Wang)
- ✓ Design and Operational Considerations for Pumps, Valves, and Flow Measurement (T. Devol)
- ✓ Microirrigation Systems Operation, Monitoring, and Maintenance (M. Cahn)
- ✓ Performance Evaluation of Microirrigation Systems and Financial Considerations (J. Anshutz)
- ✓ Microirrigation System Automation and Monitoring (A. Rehnvall; B. Sanden; J. Nichols)

08:30 – 09:00 am: Coffee and Refreshments

Session 5 – Design Criteria and Hydraulics for Microirrigation Systems. *Coord's: O. Lagos; D. Zaccaria*

09:00 – 09:30 am:	Design Criteria and Procedure for Resource-Efficient Microirrigation (D. Zaccaria)
09:30 – 10:00 am:	Hydraulics for Microirrigation Systems (O. Lagos)
10:00 – 10:30 am:	Subsurface Drip Irrigation System Design Considerations (J. Ayars)
10:30 – 10:45 am:	Questions and Answers

10:45 – 11:00 am COFFEE BREAK

Session 6 – Filtration and Fertigation Systems, Pumps, Valves, and Flow/Pressure Control Devices. *Coord's: K. Bali; Z. Wang*

11:00 – 11:25 am:	Filtration Systems, Operation, and Monitoring (K. Bali)
11:25 – 11:50 pm:	Chemical Injection Systems, Operation, and Monitoring (Z. Wang)
11:50 – 12:15 pm:	Design and Operational Considerations for Pumps, Valves, and Flow Measurement (T. Devol)
12:15 – 12:30 pm:	Questions and Answers

12:30 – 1:30 pmLUNCH

Session 7 – Operation, Monitoring, Maintenance, and Field Evaluation of Microirrigation Systems. *Coord's: M. Cahn; J. Anshutz*

1:45 – 2:45 pm:	Field session on Microirrigation System Evaluation • Monitoring Microirrigation Systems and Troubleshooting (M. Cahn) • Evaluating Field Performance of Microirrigation Systems (J. Anshutz)
3:00 – 3:30 pm:	A Novel Tool for Evaluating Microirrigation Performance and Financial Considerations (J. Anshutz)

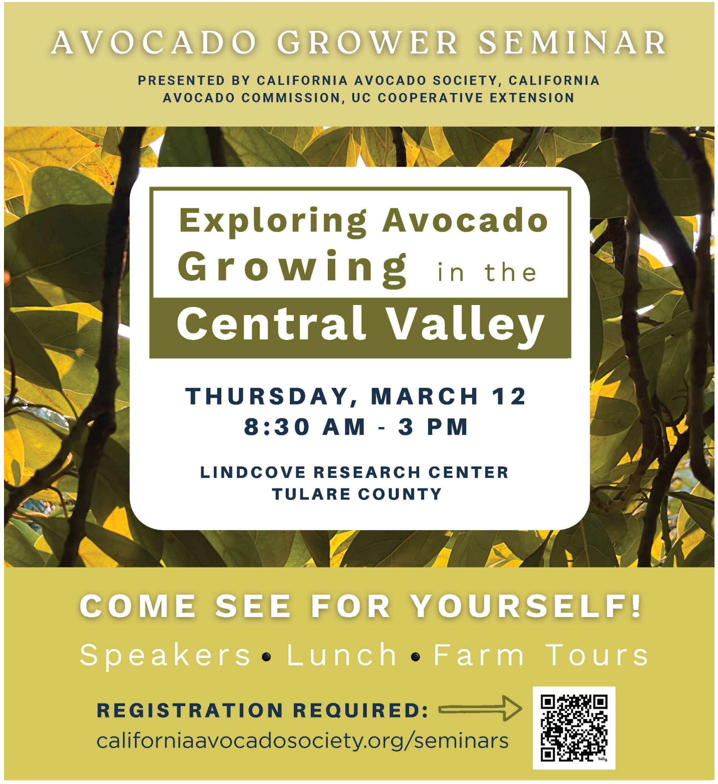
3:30 – 3:45 pm COFFEE BREAK

Session 8 – Microirrigation System Automation and Monitoring. *Coord's: B. Sanden; J. Nichols*

3:45 – 4:15 pm:	Principles of Irrigation Automation (A. Rehnvall)
4:15 – 4:45 pm:	Automation and System Monitoring Components (B. Sanden)
4:45 – 5:15 pm:	Success Stories in Implementing Microirrigation Automation (J. Nichols)
5:15 – 5:30 pm:	Questions & Answers

5:30 pm ADJOURN

5:45 – 7:45 pm – Social Hours and Refreshments with Sponsors and Exhibitors at UC Davis Conference Center



Topics in Subtropics

Newsletter by Tree Crops Farm Advisors

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