



AGENDA

California Avocado Commission Production Research Committee Meeting

Meeting Information

Date: Thursday, February 19, 2026

Time: 8:00 a.m.

Location: Hybrid Meeting

Physical Meeting Location:

Ventura County Cooperative Extension Office

Conference Room

555 Airport Way, Suite D

Camarillo, CA 93010

Web Conference URL:

<https://californiaavocado.zoom.us/j/5375836823?pwd=aURBZ3BELL29tclBRSlZRY3QrMkhZQT09&omn=83351558989>

Conference Call Number: (669) 900-6833

Meeting ID: 537 583 6823

Passcode: 348652

Meeting materials will be posted online at least 24 hours prior to the meeting at:

<https://www.californiaavocadogrowers.com/commission/industry-calendar>

Committee Member Attendance

As of Thursday, February 12, 2025, the following individuals have advised the Commission they will participate in this meeting:

Danny Klittich, PRC Chair

Victor Araiza

Allisen Carmichael

Jason Cole

Jim Davis

Consuelo Fernandez

Herman Els

Time	Item
8:00 a.m.	<ol style="list-style-type: none">1. Call to Order<ol style="list-style-type: none">a. Roll Call/Quorum2. Opportunity for Public Comment<p>Any person may address the Committee at this time on any subject within the jurisdiction of the California Avocado Commission.</p>3. Approval of Minutes<ol style="list-style-type: none">a. Consider approval of Production Research Committee Meeting Minutes of April 3, 20254. Research Program Consultant's Report<ol style="list-style-type: none">a. Avocado Lace Bugb. ProGibb SLN renewalc. Praetorian PR videos5. Discussion Items<ol style="list-style-type: none">a. Review currently funded research projects and production research budgetb. Review research priorities listc. Pine Tree Ranch fertilizer program/Decision Support Tools
11:00 a.m.	<ol style="list-style-type: none">6. Adjourn Meeting

Disclosures

Some agenda items may not be discussed prior to adjournment. Such items will be rescheduled for a subsequent meeting. All meetings of the Commission are open to the public and subject to the Bagley-Keene Open Meeting Act.

All agenda items are subject to discussion and possible action.

For information or a request regarding disability-related modification or accommodation for the meeting, please contact April Aymami at 949-341-1955 via email at aaymami@avocado.org. Such requests should be made at least 48 hours prior to the meeting.

This meeting schedule notice and agenda is available on the internet at <https://www.californiaavocadogrowers.com/commission/meeting-agendas-minutes> and <http://it.cdfa.ca.gov/igov/postings/detail.aspx?type=Notices>.

Contact Tim Spann at tim@spannag.org or 423-609-3451 if you have any questions.

Summary Definition of Conflict of Interest

Members and alternates are responsible to determine whether they have a conflict of interest and whether to recuse themselves from discussion or vote during a meeting. The following **Summary Definition of Conflict of Interest** may be helpful.

A Commission *member or employee* has a conflict of interest in a decision of the Commission if it is reasonably foreseeable that the decision will have a material effect, financial or otherwise, on the member or employee or a member of his or her immediate family that is distinguishable from its effect on all persons subject to the Commission's jurisdiction.

No Commission member or employee shall make, or participate in making, any decision in which he or she knows or should know he or she has a conflict of interest.

No Commission member or employee shall, in any way, use his or her position to influence any decision in which he or she knows or should know he or she has a conflict of interest.

**CALIFORNIA AVOCADO COMMISSION
PRODUCTION RESEARCH COMMITTEE
MEETING MINUTES**

April 3, 2025

A meeting of the Production Research Committee (PRC) of the California Avocado Commission (CAC) was held on Thursday, April 3, 2025, with the following people participating:

MEMBERS PARTICIPATING:

Danny Klittich, Chair
Victor Araiza
Allisen Carmichael
Jim Davis (8:14)
Darren Haver
Leo McGuire
Daryn Miller

CAC STAFF PARTICIPATING:

Ken Melban
April Aymami (8:19)

OFFICIALLY PARTICIPATING:

Dr. Tim Spann, Spann Ag Research & Consulting

GUESTS PARTICIPATING:

John Berns

CALL TO ORDER

Danny Klittich, Production Research Committee Chair, called the meeting to order at 8:01 a.m. with a quorum present.

OPPORTUNITY FOR PUBLIC COMMENT

There were no public comments.

APPROVAL OF MINUTES OF FEBRUARY 17, 2025 PRODUCTION RESEARCH COMMITTEE MEETING

MOTION

To approve the minutes of the February 17, 2025, Production Research Committee meeting.

(Miller/Haver) MSC unanimous

Motion 25-4-3-1

RESEARCH PROGRAM DIRECTOR'S REPORT

The Research Program Director had nothing to report.

ACTION ITEMS

The Committee began discussions of the research proposals submitted for funding in response to the request for proposals.

Proposal: Validation of the use of flowers at the cauliflower stage for nutrient analysis to better time fertilizer applications; Mary Lu Arpaia, et al.

The committee thought that the concept of using bloom to determine tree nutrient status was a good idea but presented some practical challenges that would likely make such a system difficult to implement. Specifically, the bloom season presents a relatively short window in which the industry would need to collect samples, which may overwhelm laboratories with a large number of samples all at once. Additionally, the information would be coming relatively late for growers to develop their fertilizer plan for the season and purchase needed materials. It was felt that the overall cost of the project was high for an uncertain benefit.

MOTION

Recommend the Board fund the proposal to use flowers at the cauliflower stage for nutrient analysis as submitted.

(Carmichael) Motion died for lack of a second

Proposal: A pesticide resistance monitoring program for avocado thrips; Hamutahl Cohen, et al.

The Committee felt that thrips resistance monitoring is critical for the industry. Without sound data to prove that resistance exists to currently registered pesticides, the Department of Pesticide Regulation will be unwilling to register new products to help control this pest. The Committee liked the outreach component of the project and believed that price was very reasonable.

MOTION

To recommend that Board fund the avocado thrips resistance monitoring program proposal as submitted.

(McGuire/Davis) MSC Unanimous

Motion 25-4-3-2

Proposal: Creating a Weather Station Network to Guide Irrigation Decision of Avocados; Andre Biscaro

The Committee agreed strongly that the industry needs a better option for weather reporting than CIMIS, particularly in the southern growing region. There was some concern that the project is using old technology, and maybe newer technology such as satellite-based weather monitoring could be a better investment. There was some concern that the grass requirement currently needed for accurate weather station data is a severe limitation; that this part of this project aims to determine the minimum grass area needed for accurate data was seen as a strong plus.

MOTION

To recommend funding the weather station network proposal as submitted.

(Carmichael/Miller) MSC Unanimous

Motion 25-4-3-3

Proposal: Evaluating diverse avocado rootstocks for salinity using morphological, ionic, and physiological parameters; Jorge Ferreira and Devinder Sandhu

The Committee believes strongly that salinity is a major issue for the industry and research in this area is very much needed. However, there was concern that the researchers may not have a good grasp of the real-world situation facing growers. For example, the proposal suggested testing 30 different rootstocks, but there are not 30 different rootstocks available to growers so is money being spent on rootstocks that are already known to not be viable? The Committee felt that the proposal is an example of “siloeed” research, and the proposers would benefit from adding a co-PI with practical field experience. There was also uncertainty about what benefit the data from the research would have for growers. Overall, the Committee thought the project was too broad, had unrealistic goals, and would not provide practical information to help growers. There was no support for recommending this project for funding.

Proposal: Continued Research at the San Luis Obispo Rootstock Trial Site (2025-2027); Lauren Garner

The Committee liked this project from the point of staying engaged with Cal Poly SLO, which is seen as a strong option for practical, applied research going forward. However, there was some concern that the amount of student time budgeted to the project was high relative to the amount of data being collected. As part of the broader rootstock research program, the feeling was that the data generated from this trial site would only provide an incremental increase in knowledge. There was also some concern that the

revenue from the fruit produced by the trial should be going to help offset the ongoing maintenance of the plot.

MOTION

To recommend the Board fund the proposal to continue the research at the Cal Poly SLO rootstock trial site provided that a better accounting of fruit revenue be provided.

(Davis/Carmichael) MSC 5 yea, 1 nay

Motion 25-4-3-4

Proposal: Leveraging and establishing rootstock/scion trials to determine the effect of rootstocks on improving scion's abiotic and biotic stress resilience; Patricia Manosalva and Mary Lu Arpaia

Overall the Committee believed that CAC has contributed enough money to UCR for rootstock development over many years with very little to show for it. When the current funding was initiated six years ago it was done with the promise that data would be collected to release the commercially viable rootstocks. However, after six years of funding no rootstocks have been released. Several Committee members are involved in the current round of trials and agreed that it is clear which rootstocks are viable and which are not and more data collection will not be of benefit to growers. There was no support for recommending the proposal for funding.

Proposal: Integrating Chemical and Cultural Practices for Bot Canker Control in Avocado; Fatemeh Khodadadi

The Committee felt strongly that this proposal addresses a critical need for the industry and it is important to engage with a new researcher before she is pulled away from avocado work by another commodity. There was general agreement that branch canker is a growing problem, particularly in the south and as more growers prune more frequently to keep tree size under control. There are new fungicides on the market that need to be screened so that effective products can be moved into the registration process. It was commented that this work would have a direct benefit for growers and is exactly the type of practical research that the industry needs.

MOTION

To recommend that the Board fund the proposal for Botryosphaeria canker control in avocados.

(McGuire/Davis) MSC Unanimous

Motion 25-4-3-5

Proposal: Addressing the relationship between soil characteristics and soil salinity in California avocado orchards; Jesse Landesman

As discussed with previous proposals, salinity is a major concern for the industry. The Committee felt that some of the ideas proposed were somewhat unrealistic, such as biochar, but it may be a tool that will be becoming more available and it would be worthwhile to have some data. The engagement with a student interested in avocado research was seen as a strong component of the project since the industry needs more researchers interested in avocados. It was generally felt that treating irrigation water is a better way to deal with salinity rather than treating the soil, but there is not data to support that so this proposal would provide good information about that. The support of the Lamb Ranch for the project was seen as a benefit since that ranch offers two very distinct soil types that are being irrigated with the same water source.

MOTION

To recommend the Board fund the proposal as submitted and that the researcher be encouraged to further develop relationships with other researchers.

(Davis/Carmichael) MSC Unanimous

Motion 25-4-3-6

Proposal: Development and Demonstration of a Cost-effective Electrodialysis Reversal (EDR) Process for Chloride Removal from Avocado Irrigation Water; Haizhou Liu

The Committee felt that if this technology worked it could be revolutionary for the industry by generating only 5-10% brine compared with current water purification technologies. The greatest concern was that the flow rates achieved to date, 1 gallon/min, are much too low to be commercially viable. The technology could potentially be tailored to specific water issues on different farms rather than simply being a one-size fits all model. However, there is always concern with funding technology development that a commercial company will then profit from after CAC pays for product development.

MOTION

To recommend the Board fund the proposal to develop EDR technology for the removal of chloride from avocado irrigation water.

(Araiza/Davis) MSC 5 yea, 1 nay

Motion 25-4-3-7

Proposal: Chloride Removal and Sequestration System for Irrigation Water; Tailwater Systems

There were mixed feelings from the Committee about this proposal. Some members thought that the technology proposed in the research seemed more practical than that from Liu and vice versa. Again, the issue of system capacity was discussed and the need to have water storage so that there would be sufficient volume of treated water available to irrigate with. There was also some concern that since the technology has already been patented that means it is proven and CAC is being used to pay for commercial development. There was no motion to recommend funding the project.

Proposal: Impact of Natural Vegetation on Insect Pollinators in Agroecosystems; Carson Lauderfelt, et al.

The general consensus from the Committee was that this was a good proposal for very little money. The goal of the project is to understand the value of other plants in the orchard to attract pollinators. It was noted that the EQIP program has been funding growers to plant insect habitats, but there is little research to understand which plants attract what insects. It was also noted that we don't fully understand what role native pollinators play in avocado pollination, but there could be little downside to attracting pollinators into the orchard. One potential risk that was raised was if certain plants attract endangered or at risk species into the orchard.

MOTION

To recommend the Board fund the insect pollinators in agroecosystems proposal as submitted.

(Davis/Haver) MSC 4 yea, 3 nay

Motion 25-4-3-8

Proposal: Improve *Phytophthora cinnamomi* management by monitoring field populations for changes in fungicide sensitivity and conducting efficacy field trials; Patricia Manoslava and James Adaskaveg

There was consensus among the Committee that Phytophthora is a major issue and we need to continue to pursue control strategies for this disease. It was noted that although Orondis is proving to be very effective, we will lose it if we do not have good alternatives to rotate with it. There are some promising new chemicals on the market that need to be evaluated so we can manage resistance development.

MOTION

To recommend the Board fund the proposal to improve Phytophthora cinnamomi management as submitted.

(McGuire/Araiza) MSC Unanimous

Motion 25-4-3-9

Proposal: Assessing irrigation management tools and strategies on avocado fruit quality and yield impacts; Ali Montazar

The Committee agreed that Dr. Montazar has proven himself to be a knowledgeable researcher who does very good, applied work. It was noted that when he presented his findings from his previously funded project it was an eyeopener as to how poorly many growers are managing irrigation. The Committee agreed this work would be readily applicable and benefit growers, noting that irrigation makes or breaks an operation and anything to help better manage irrigation is worth the money.

MOTION

To recommend the Board fund the proposal for assessing irrigation management tools and strategies as proposed.

(Haver/Miller) MSC Unanimous

Motion 25-4-3-10

ADJOURN MEETING

Danny Klittich, Production Research Committee (PRC) Chair, adjourned the meeting at 11:23 a.m.

Respectfully submitted,

Timothy Spann

EXHIBITS ATTACHED TO THE PERMANENT COPY OF THESE MINUTES

EXHIBIT A April 3, 2025, Production Research Committee AB 2720 Roll Call Vote Tally Summary

EXHIBIT B Proposals reviewed by the Production Research Committee



CALIFORNIA AVOCADO COMMISSION

Production Research Committee

AB 2720 Roll Call Vote Tally Summary

To be attached to the Meeting Minutes

Meeting Name: <i>California Avocado Commission Production Research Committee Meeting</i>	Meeting Location: <i>Hybrid In-person – South Coast Research & Extension Center, Irvine, CA 92618 Online – Zoom</i>	Meeting Date: <i>April 3, 2025</i>
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Attendees Who Voted	<u>MOTION</u> <u>25-4-3-1</u>	<u>MOTION</u> <u>25-4-3-2</u>	<u>MOTION</u> <u>25-4-3-3</u>	<u>MOTION</u> <u>25-4-3-4</u>	<u>MOTION</u> <u>25-4-3-5</u>
Danny Klittich, Chair	<i>Did not vote</i>				
Victor Araiza	<i>Yea</i>	<i>Yea</i>	<i>Yea</i>	<i>Nay</i>	<i>Yea</i>
Allisen Carmichael	<i>Yea</i>	<i>Yea</i>	<i>Yea</i>	<i>Yea</i>	<i>Yea</i>
Jim Davis (9:14)	<i>Absent</i>	<i>Yea</i>	<i>Yea</i>	<i>Yea</i>	<i>Yea</i>
Darren Haver	<i>Yea</i>	<i>Yea</i>	<i>Yea</i>	<i>Yea</i>	<i>Yea</i>
Leo McGuire	<i>Yea</i>	<i>Yea</i>	<i>Yea</i>	<i>Yea</i>	<i>Yea</i>
Daryn Miller	<i>Yea</i>	<i>Yea</i>	<i>Yea</i>	<i>Yea</i>	<i>Yea</i>
Outcome	<i>Unanimous</i>	<i>Unanimous</i>	<i>Unanimous</i>	<i>5 yea, 1 nay</i>	<i>Unanimous</i>

Attendees Who Voted	<u>MOTION</u> <u>25-4-3-6</u>	<u>MOTION</u> <u>25-4-3-7</u>	<u>MOTION</u> <u>25-4-3-8</u>	<u>MOTION</u> <u>25-4-3-9</u>	<u>MOTION</u> <u>25-4-3-10</u>
Danny Klittich, Chair	<i>Did not vote</i>	<i>Did not vote</i>	<i>Yea</i>	<i>Did not vote</i>	<i>Did not vote</i>
Victor Araiza	<i>Yea</i>	<i>Yea</i>	<i>Nay</i>	<i>Yea</i>	<i>Yea</i>
Allisen Carmichael	<i>Yea</i>	<i>Nay</i>	<i>Yea</i>	<i>Yea</i>	<i>Yea</i>
Jim Davis	<i>Yea</i>	<i>Yea</i>	<i>Yea</i>	<i>Yea</i>	<i>Yea</i>
Darren Haver	<i>Yea</i>	<i>Yea</i>	<i>Yea</i>	<i>Yea</i>	<i>Yea</i>
Leo McGuire	<i>Yea</i>	<i>Yea</i>	<i>Nay</i>	<i>Yea</i>	<i>Yea</i>
Daryn Miller	<i>Yea</i>	<i>Yea</i>	<i>Nay</i>	<i>Yea</i>	<i>Yea</i>
Outcome	<i>Unanimous</i>	<i>5 yea, 1 nay</i>	<i>4 yea, 3 nay</i>	<i>Unanimous</i>	<i>Unanimous</i>

Avocado Lace Bug Update

Tim Spann, PhD

Spann Ag Research & Consulting

The avocado lace bug (ALB; *Pseudacysta perseae*) was first described in 1908 from specimens collected in Florida and was originally believed to be native to Florida. In Florida, the Caribbean and eastern Mexico, damage from ALB can be quite severe. So naturally, when ALB was first discovered on backyard avocado trees — primarily Bacon or Bacon-like cultivars — near Chula Vista and National City in southern San Diego County in 2004 there was concern that similar damage would occur in California. That didn't happen — that is until recently.

A Jekyll and Hyde Pest

In 2004, the California Avocado Commission funded Dr. Mark Hoddle to conduct foreign exploration in ALB's presumed native range (Florida, the Caribbean and eastern Mexico) with the goals of determining where the population in California came from through DNA analysis and to determine if egg parasitoids could be found for potential use in a biological control program. Through direct collecting and samples being provided by other researchers, ALB specimens were examined from Florida, the Caribbean, throughout Mexico, Central America, Florida, Texas and South America.

Results of these DNA analyses determined that the ALB population in California had most likely originated from the state of Nayarit on Mexico's west coast, not from Florida or the Caribbean. This DNA work also revealed that ALB likely was not native to Florida, the Caribbean and eastern Mexico as presumed, but also was invasive in these areas. It's most likely native to western Mexico where ALB population genetic diversity is high. Additionally, no specialist natural enemies or egg parasitoids were found, dashing hopes for a biological control program.

In 2017, the ALB situation in California changed dramatically. After more than a decade of hanging out in backyards in southern San Diego County, ALB started to appear in commercial Hass avocado groves in northern San Diego County and Riverside County. By 2019, the pest was found on backyard trees in Los Angeles County and Hawaii also was invaded. In 2022 and 2023, infestations were found in commercial groves in Orange and Santa Barbara Counties, respectively. So, what changed with ALB?

CAC once again turned to Mark Hoddle who went back to the DNA. Samples of ALB from the newly infested commercial groves did *not* match the population that had existed in southern San Diego County since 2004. Rather, these new infestations matched populations in Florida and the Caribbean. These two populations, the original one from western Mexico, and the new one from Florida/Caribbean, are dramatically different in their behavior, with the latter being much more aggressive in its propensity for infesting Hass avocados.

Avocado Lace Bug Biology

ALB adults and nymphs have specialized piercing-sucking mouth parts that allow them to extract sap from the underside of avocado leaves. This feeding results in necrotic islands — chlorotic areas that turn into brown, dead lesions — on the upper leaf surface. Heavy feeding damage can result in leaf loss that may lead to sunburn damage to fruit.

Adult ALB are about 2mm (<0.1in) long with blackish-brown bodies covered by yellowish wings and appearing quite flat. Their life cycle is between 21 to 42 days from egg to adult, depending on temperature, and there are four instars (developmental stages) before adulthood. Nymphs (immature stages) are ovoid, reddish-brown to black, with spines around the edges. Eggs are often laid in loose rows and are covered in tar-like fecal matter to protect the eggs from desiccation.

Ms. Paloma Dadlani, an M.S. student in Mark Hoddle's lab who was partially funded by CAC, conducted detailed temperature studies on ALB development and survivorship. These studies were conducted in temperature cabinets that were programmed to simulate six fluctuating temperature profiles that averaged 15, 20, 25, 30, 32 and 35°C (i.e., 59, 68, 77, 86, 90 and 95°F) over a 24-hour period. These cycles were developed based on historical weather data to represent various ALB-infested areas of southern California.

Data from these studies indicate that the optimal temperature range for reproduction and instar development was 25-32°C (77-90°F). The minimum temperature for ALB development is about 9-10°C (48-50°F). The upper lethal temperature range was 34-39°C (93-102°F). This is supported by field observations of ALB where the pest appears more problematic in coastal areas (e.g., Oceanside and Carpinteria) than inland areas (e.g., Bonsall). Inland areas experience higher summer temperatures that may cause populations to crash due to heat stress.

Avocado Lace Bug Management

As with all invasive pests, management practices lag behind pest spread and we are learning a lot from pest control advisors and growers who are actively trying to manage ALB. Several insecticides are currently registered for use on avocados against avocado lace bug (Table 1). Unfortunately, most of these pesticides are from the same class, making resistance management difficult (see "Pesticide Resistance Issues Facing California Avocado", Fall 2025 *From the Grove* for more information on resistance management).

Imidacloprid (Admire®) has not performed well on mature trees when applied as a soil drench but may work well on younger trees (4-5 years old at most). Foliar sprays on mature trees have resulted in moderate control. The label rate for imidacloprid on avocados is 10.5 – 14 fluid ounces/acre, with 14 fluid ounces being the maximum amount allowed per year. Thus, if trying imidacloprid for ALB control, it's advisable to use the 14 fluid ounce rate for maximum efficacy.

Fenprothrin (Danitol®) is effective at controlling ALB but is very disruptive to natural enemies and other beneficial insects. For this reason, fenprothrin may be best suited for use during the winter to minimize impacts on beneficials.

Spirotetramat (Movento®) is not specifically labeled for use against lace bug on avocado. However, California Department of Food and Agriculture rules allow PCAs to write recommendations for use of products against non-labeled pests if the product is registered for use on the crop. Spirotetramat has provided good control of ALB. Given that spirotetramat is in a different insecticide class than most of the other available products, and it can be applied two to three times per year depending on the application rate, it is likely a good option to use in rotation with other insecticides.

Organic options are more limited and may be less effective at controlling ALB. Products containing *Beauveria bassiana*, an insect-killing fungus, are likely to be ineffective since these products generally do best in high humidity climates. Azadirachtin has not produced very good results to date. Pyrethrins (Pyganic®) are likely to be effective but, like fenpropathrin, can be disruptive to biological control. Some horticultural oils are available for use under organic certification but often can only be used when other control measures have failed. Kaolin clay products (Surround®) are effective at smothering ALB, but growers should talk with their handlers before using them to be sure packing houses have brushes on their packing lines to adequately remove the material during the packing process. Growers should always check with their organic certifier before using any product to make sure its use will not jeopardize their certification.

Since ALB lives on the underside of leaves, they are difficult to control even with the most efficacious insecticides. Coverage is extremely important and is likely best achieved with high spray volumes applied from the ground. It is unlikely aerial applications of any product will prove effective at controlling ALB especially if canopies are tall and interlaced. To this end, canopy management is going to be critical for managing ALB. Infestations and damage in high density plantings or hedge rows are often much more severe than in more traditional spacings. Growers should prune their trees to allow good spray penetration.

In situations where severe infestation has occurred and leaf loss is significant, extra nitrogen applications may be warranted to push new growth to replace lost leaves.

What's On the Horizon?

Developing effective management tools for ALB was a high priority topic for CAC's Production Research Committee. To fulfill this priority, CAC worked with staff at the IR-4 Project to begin the process of getting more insecticide products registered for use against ALB. The IR-4 Project (Inter-regional project 4) is a federally funded program designed to help specialty crop industries address pest management concerns since the crop protection industry typically focuses their efforts on major crops (corn, soybean, cotton), leaving specialty crops (fruits and vegetables, ornamental crops) with fewer tools to effectively manage pests. IR-4 is a competitive program and specialty crop industries must submit proposals that are reviewed and ranked regionally and then nationally. If proposals are accepted into the program, IR-4 will coordinate and pay for the necessary trials to get a new insecticide registered.

In 2025, CAC submitted proposals for eight different insecticides as well as a proposal for an integrated solutions (IS) project. IS projects screen multiple insecticides for efficacy against a specific target pest and then move effective products into the registration pipeline. Typically, only two or three IS projects are selected annually and the ones selected in 2025 have all been put on hold due to funding shortfalls.

Discussions with the IR-4 entomologists led to the selection of the eight products submitted (Table 2). Of these, five products are already registered for use on avocados in California, but not specifically for ALB. The manufacturers of all of these, except spinosad, support adding ALB to the label if efficacy and crop safety data are provided to them. The manufacturer of spinosad will not support the addition of ALB to the label until they review preliminary efficacy data. CAC's PRC will discuss the best way to generate this efficacy data.

The remaining three products are not registered for use on avocados. Of these unregistered products, afidopyropen (Sefina Inscalis®) was selected to move forward into the IR-4 program. Afidopyropen, is the first product in a new insecticide class (9A) and is derived from a compound produced by *Penicillium coprobium*. We were, in part, successful in getting this product into the IR-4 program because its use on avocados to control ALB was also supported by Florida, Puerto Rico, and Hawaii. Trial work will begin in 2026, and, if everything goes smoothly, a registration packet will be submitted to EPA in 2-3 years. At that time, CAC will ask the manufacturer to request a concurrent review by the California Department of Pesticide Regulation.

Flunicamid (Beleaf 50 SG) is another unregistered product. The manufacturer is supportive of completing the necessary work to register this product if efficacy data show that it is effective against ALB.

The final product, isocycloseram, is a brand-new chemistry that is being brought to market by Syngenta. Syngenta has indicated they are supportive of adding avocado and ALB to the label if preliminary efficacy data can be provided. However, this product belongs to the class of chemicals commonly known as PFAS — forever chemicals. That makes it questionable whether it could ever receive CDPR approval. Additionally, it is a broad-spectrum insecticide so it would be harmful to beneficials, will have a bee restriction, aerial applications will be prohibited (except for corn, cotton, soybean and potato), and a spray drift buffer will be required for all applications.

The PRC will continue to discuss ALB and how CAC's limited resources can best be used to address this critical issue. In the meantime, growers should work closely with their PCAs to monitor ALB populations and take proactive corrective measures before populations get out of control.

[LINK TO IMAGES](#)

Table 1. Pesticides currently registered for use in California on avocados for the control of lace bugs.

Active Ingredient	Example Product ¹	IRAC Class ²	Organic	Comments ³
Imidacloprid	Admire	4A	No	Chemigation only effective on young trees; apply foliarly on mature trees
Piperonyl butoxide, Pyrethrins	Evergreen EC 60-6	3A	No	
Permethrin	Pounce 25WP	3	No	
Azadirachtin, Pyrethrins	Azera	UN/3A	Yes	
<i>Beauveria bassiana</i>	BotaniGuard	UNF	Yes	Works best in humid climates; unlikely to be effective in California
Zetacypermethrin	Mustang	3A	No	
Fenpropathrin	Danitol	3	No	Broad-spectrum, very disruptive to beneficials; probably best used in winter
Geraniol, peppermint oil, cotton seed oil, rosemary oil	Furious	N/A	Yes	
Zetacypermethrin/Avermectin	Gladiator	3/6	No	
Pyrethrins	Pyganic	3A	Yes	Broad-spectrum, likely to disrupt beneficials

¹Trade names are given only as examples of products that contain the listed active ingredient(s) and do not represent recommendations for specific products.

²The Insecticide Resistance Action Committee classifies pesticides based on their mode of action to aid in insecticide resistance management. Repeated applications of insecticides from the same class leads to resistance.

³The comments provided are based on grower and/or pest control advisor experiences that have been shared with the author.

Table 2. Insecticides currently registered for use in California on avocados but not specifically labeled for control of lace bugs, and pesticides not currently registered for use in California on avocados but may be useful in the lace bug management.

Active Ingredient	Example Product ¹	IRAC Class ²	Organic	Comments
Registered for use on avocados				
Flupyradifurone	Sivanto Prime	4D	No	Registrant supports adding lace bug to the label with E/CS ³ data
Spirotetramat	Movento	23	No	Registrant supports adding lace bug to the label with E/CS data
Fenazaquin	Magister SC	21A	No	Registrant supports adding lace bug to the label with E/CS data
Spinosad	Entrust	5	Yes	Registrant will consider supporting registration after reviewing preliminary efficacy data
Chlorantraniliprole	Altacor	28	No	Registrant supports adding lace bug to the label with E/CS data
Not currently registered for use on avocados				
Fonicamid	Beleaf 50 SG	29	No	Registrant supports adding avocado and lace bug to the label if efficacy data support its use
Afidopyropen	Sefina Inscalis	9D	No	Entering IR-4 trials in 2026; if successful, a registration package will be submitted to EPA in 2-3 years
Isocycloseram	Plinazolin	30	No	Registrant is supportive of adding avocado and lace bug to the label, but this chemical has many downsides that may make registration in California difficult (see article text for more details)
¹ Trade names are given only as examples of products that contain the listed active ingredient(s) and do not represent recommendations for specific products.				
² The Insecticide Resistance Action Committee classifies pesticides based on their mode of action to aid in insecticide resistance management. Repeated applications of insecticides from the same class leads to resistance.				
³ Efficacy and crop safety data				



Figure 1. An adult avocado lace bug shown on a penny for scale. Photo credit: Mike Lewis, UC Riverside.



Figure 2. An avocado leaf showing adult, juvenile avocado lace bugs and eggs.



Figure 3. Large-scale defoliation caused by an extreme infestation of avocado lace bug in a grove in Carpinteria, Santa Barbara County.



Figure 4. Avocado leaves showing the classic necrotic islands symptoms of avocado lace bug feeding damage.

Avocado Salinity Screening experiment 2025-26

by Jorge Ferreira and Devinder Sandhu

US Salinity Laboratory (USDA-ARS)

Objectives

The purpose of this experiment is to evaluate the salinity tolerance of eight clonal avocado rootstocks grafted with ‘Hass’ under controlled conditions. Specifically, we aim to determine rootstock effects on growth, leaf mineral composition, and ion accumulation (Na^+ and Cl^-) under saline irrigation ($\text{EC}_{\text{iw}} = 2.2 \text{ dS m}^{-1}$) compared to control water. Additionally, we will assess correlations between physiological responses and the expression of candidate genes associated with salinity tolerance to identify rootstocks that provide improved salt exclusion and minimize chloride toxicity in ‘Hass’ avocado.

Experimental Setup

From April 15–30, 2025, we received 160 18-month-old ‘Hass’ avocado trees grafted onto eight clonal rootstocks (Table 1). Plants were shipped from Brokaw Nursery Inc. (Ventura, CA) and were kept in their original plastic bags until June 5, 2025. Trees were transplanted into 6-gal (10.6 × 20 in) pots. At repotting, plants averaged ~50 in in height from the soil surface to the apical meristem (or ~70 in measured from the bottom of the pot). Canopy architecture varied by rootstock; for example, ‘Hass’/‘Tami’ tended to be taller with fewer leaves, whereas ‘Hass’/‘Zerala’ was shorter with a denser canopy. The original nursery medium consisted of peat and coconut coir and was pre-fertilized with Osmocote (45 g per 2-gal capacity added to the medium). To prevent sand loss through drainage holes, pots were lined at the bottom with paper towels before adding filler sand. The experiment was set up in a Randomized Complete Block Design (Figure 1). Pots were arranged in three blocks (replicates), with three plants per rootstock in each block (9 plants per rootstock), and assigned to two irrigation treatments: control water and saline water ($\text{EC}_{\text{iw}} = 2.2 \text{ dS m}^{-1}$). This design resulted in 144 experimental plants (8 rootstocks × 9 plants × 2 treatments).

Table 1. Rootstock cultivars, origin, and previous information on salinity tolerance (if known). Saline water treatment was initiated on July 23, 2025.

Cultivar	Altern. name	Origin/ Selection Program	Salinity tolerance
‘Dusa’	‘Merensky 2’	85% Guatemalan+15% Mexican/South Africa-Westfalia	Low to moderate. Accumulates high leaf-Cl (0.76%)
‘Tami’	‘VC801’	West IndianXGuat/Israel Volcani Center	Group with lowest fruit yield (Lazare et al. 2021)

‘VC207’ (new)	‘Day’	Mexican x West Indian/Florida-Volcani	Unknown, high visual salt damage (Lazare et al. 2021). Salt tolerance anecdotal
‘VC66’	‘Ben Ya’acov1’	West Indian X Guat/ Florida-Volcani Center	Unknown
‘Leola’ (new)	‘R0.06’ (Nydia’s trial) ‘Merensky 6’	Unknown/South Africa-Westfalia Technol. Srv.	unknown
‘Zerala’	‘Merensky 5’	Unknown/South Africa-Westfalia Technol. Srv.	unknown
‘Borchard’	None	Mexican, Used since 1970’s/CA-UCR	Low, susceptible to <i>Phytophthora cinnamomi</i> but resistant to <i>P. citricola</i>
‘Duke 7’	None	Mexican/CA-UCR	low

Irrigation

Irrigation was delivered using pressure-compensated drippers (2-gal h⁻¹). During summer 2025, trees were irrigated daily for 15–20 min per event (approximately 0.5 gal per irrigation), with scheduling based on reference gross evapotranspiration (ET₀) to estimate avocado crop evapotranspiration (ET_c) using a CIMIS crop coefficient (K_c). Additional water was applied to achieve a target leaching fraction of 0.25. During winter 2025–2026, trees are irrigated four times per week for 15 min per event.

Table 2. Composition of Irrigation water for grafted ‘Hass’ avocado plants 2025 (started on 7/23/2025). The pH of the control water is 7.8 and of the saline water is 7.9. All plants received fertilizer from a slow-release fertilizer* at Brokaw Nursery and again when repotted at the US Salinity Laboratory.

Treatment	EC _{iw} (dS m ⁻¹)	Ion concentration (mmolc L ⁻¹)								
		Cl ⁻	SO ₄ ²⁻	NO ₃ ⁻	PO ₄ ³⁻	HCO ₃ ⁻	Na ⁺	K ⁺	Ca ²⁺	Mg ²⁺
Control	0.65	0.92	1.32	0.38	0	3.7	1.7	0.08	3.2	0.75
Saline	2.2	13.42	3.82	0.38	0	3.7	12.2	0.08	5.7	2.75



Figure 1. ‘Hass’ plants grafted onto 8 rootstocks and repotted on June 05, 2025, before salinity treatment started on July 23, 2025. Two rows (left) received control water, and two rows (right) received saline water. Average plant shoot height at the time of the photo was ~50 in.

Fertigation

Although the nursery medium contained fertilizer, we applied an additional 20 g Osmocote® Plus (15-9-12) per pot at repotting. An additional application of Osmocote® Plus (45 g per pot) was added on January 27, 2026, to promote new growth and maintain stem growth through the end of the trial (May 2026) (Figure 2).

Trial timeline and measurements

The saline water treatment was initiated on July 23, 2025 (Table 2). Stem diameter of all plants was measured on July 21, 2025. Leaf tissue samples were collected 48 h after salinity initiation (July 25, 2025) and flash-frozen in liquid nitrogen and are stored at -80°C .



Figure 2. Avocado salinity trial as pictured on December 08, 2025. Two rows (left) received control water and two rows (right) received saline water.

After six months of salinity treatment, control plants exhibited substantially faster growth compared to those irrigated with saline water (Figure 2). The difference in growth rate is evident in canopy development and stem elongation, highlighting the strong impact of salinity stress on avocado physiology. Moreover, significant variation among rootstocks has emerged under saline conditions, with some genotypes maintaining relatively better growth and fewer toxicity symptoms, while others show pronounced leaf burn and chlorosis. These contrasting responses suggest inherent differences in salt exclusion and ion compartmentalization mechanisms among rootstocks. An example of such variation is illustrated in Figure 3, where two genotypes display markedly different levels of leaf damage and overall vigor under identical saline conditions.

At trial completion (May 2026), we will measure: (1) stem diameter, (2) leaf nutritional status (macro- and micronutrients), (3) leaf Na and Cl concentrations to quantify rootstock effects on salt exclusion, and (4) gene expression of candidate genes involved in salinity tolerance in avocados. The stem diameter, leaf mineral nutrition, leaf concentrations of Na and Cl, and gene expression of these genotypes will be evaluated one against the other to assess how many of the parameters correlate with the expression of the main genes involved in salinity tolerance.



Figure 3. Plant performance under salinity after 6 months (January 27, 2026) of salinity treatment. Panels A) and C) show salt-tolerant rootstock and panels B) and D) show a salt-sensitive rootstock.

Concluding remarks

This experiment was designed using an irrigation water salinity based on the field experiment conducted by the USDA in collaboration with UCR testing water salinity in field plants that were 2.5 years old (Celis *et al.*, 2018). However, given the limited one-year timeframe to extract the most information out of these ‘Hass’ plants grafted onto 8 rootstocks, we increased both Na and Cl concentrations from the ones used in the USDA-UCR field experiment. While Celis *et al.*, 2018, used the saline water with 8.9 meq/L of Na and 4.94 meq/L of Cl obtaining a final salinity of 1.5 dS/m, our treatment used 12.2 meq/L of Na and 13.4 meq/L of Cl, with water salinity of 2.2 dS/m, from July 2025 to July of 2026.

The primary goal of this trial is to determine which of the 8 rootstocks are more tolerant to salinity and which rootstock impair the best salt control to protect ‘Hass’ from leaf chloride transport from roost to leaves where Cl accumulates causing more toxicity than Na, eventually killing the plant.

In addition, preliminary observations of micronutrient deficiencies (most probably Fe) in field plants due to high pH conditions suggest that future trials should incorporate water compositions with mixed cations (Ca, Mg, Cl, SO₄) and bicarbonate (HCO₃⁻), as these factors influence pH and the availability of essential micronutrients such as Fe, Mg, and Zn.

Looking ahead, expanding evaluations to include additional rootstocks and irrigation water profiles representative of major avocado-producing regions (e.g., Ventura and San Diego counties) will provide valuable insights for growers seeking salt-tolerant options. Continued research in this area will require sustained funding to support long-term trials and comprehensive analysis.

PRODUCTION RESEARCH BUDGET 2025-26 ACTUAL THROUGH 2028-29 PROPOSED

Acct Code	Investigator	Project	2025-26 Budget	2026-27 Budget	2027-28 Budget	2028-29 Budget
Reasearch - Pest and Disease Projects						
65132	Hoddle	Surveys for avocado fruit feeding insect pests in Guatemala	\$243,700	\$172,409		
65133	Hoddle & Kou	Chemical Synthesis and Field Evaluation of an Enantiopure (+)- Grandisol, the Putative Avocado Seed Weevil (<i>Heilipus lauri</i>) Aggregation Pheromone	\$85,740	\$146,699		
65134	Cohen	A pesticide resistance monitoring program for avocado thrips	\$12,149	\$3,300	\$5,300	\$3,300
65135	Khodadadi	Integrating Chemical and Cultural Practices for Bot Canker Control in Avocado	\$77,149	\$79,970		
65136	Loudermelt	Impact of Natural Vegetation on Insect Pollinators in Agroecosystems	\$6,071	\$3,291		
65137	Manosalva & Adaskaveg	Improve Phytophthora cinnamomi management by monitoring field populations for changes in fungicide sensitivity and conducting efficacy field trials	\$101,266	\$105,696	\$117,939	
			Pest and Disease Sub-total	\$511,365	\$123,239	\$3,300
Research - Breeding, Varieties, Genetics Projects						
65216	Manosalva	Commercial-scale field testing and potential release of five elite advanced rootstocks				
65217	Garner	Cal Poly Project #24-044 Avocado Rootstocks				
65218	Garner	Continued Research at the San Luis Obispo Rootstock Trial Site (2025-2027)	\$29,232	\$28,833		
			Breeding and Genetics Sub-total	\$28,833	\$0	\$0

PRODUCTION RESEARCH BUDGET 2025-26 ACTUAL THROUGH 2028-29 PROPOSED

Acct	Investigator	Project	2025-26 Budget	2026-27 Budget	2027-28 Budget	2028-29 Budget
Research - Cultural Management Projects						
65323	Montazar	Developing tools and information on crop water use and effective irrigation management for more profitable and sustainable avocado production				
65324	Biscaro	Adapting a user friendly online irrigation calculator for avocados				
65325	Arpaia	Does artificial pollination improve yield of Hass and GEM avocado?	\$62,116	\$47,990		
65326	Landesman	Addressing the relationship between soil characteristics and soil salinity in California avocado orchards	\$5,507			
65327	Biscaro	Creating a Weather Station Network to Guide Irrigation Decision of Avocados	\$88,375	\$4,371		
65328	Montazar	Assessing irrigation management tools and strategies on avocado fruit quality and yield impacts	\$116,325	\$57,370	\$45,415	
			Cultural Management Sub-total:	\$109,731	\$45,415	\$0
Industry Research Support						
65403	Landesman	FFAR Fellowship Support	\$32,500			
			Industry Research Support Sub-total	\$32,500	\$32,500	\$32,500
			Annual Total	\$649,929	\$168,654	\$3,300



California Avocado Commission
Production Research Priorities

California Avocado Commission
12 Mauchly, Suite L
Irvine, CA 92618-6305
September 25, 2024

CAC Production Research Priorities

Cultural Methods

High Priority Topics:

1. Pollen sprays for avocado orchards: Do they work?
 - a. Dusting/spraying of pollen has been done in the avocado industry for decades. Some growers swear by it and others feel that it is not needed. Controlled replicated studies are needed. Methods could include embryo genotyping to verify cross-pollination. Application methods could also be assessed by comparing liquid (AvoSolutions) or dry applications.
2. Updated Cost Studies;
 - a. Farming is a business and costs vary depending on operation size and location. A project updating the 2011 Cost Study, providing reference formats for cost analysis, and general reference information to growers would be of value.
 - b. Updated avocado cost studies - UC Davis, Riverside, Cal Poly SLO for northern growing regions. Possible senior Projects using 2011 Cost study updated with pricing
3. "Above Average Grower" Survey
 - a. The annual California production average is between 5000-7000 pounds per acre however there are growers who consistently outperform this average with 10-year average yields exceeding 12,000 pounds per acre. A project that quantifies what practices and/or conditions allow for this level of success would provide a framework for growers to invest in their operations and build future yields.
4. Leaching Fractions with Modern Rootstocks and Water Sources
 - a. Reclaimed water is becoming more available but differs chemically from well and surface water sources. Work assessing how management techniques may need to differ when using these water sources may be of interest.
5. Nitrogen planning and nitrate credits
 - a. Nitrogen regulations may impact avocado growers in the future. Many wells and some reclaimed water may contain high nitrate levels, however this nitrogen source does not seem to be 100% plant usable. Work assessing the efficiency of nitrate in well water as a nitrogen source is needed. How does a fertilizer program need to be adjusted for these nitrates?
 - b. Are current nitrogen recommendations correct for all clonal rootstocks and scion varieties? Some cultivars, such as GEM, can flower very heavily and defoliate. Would increased nitrogen be an effective strategy to mitigate behavior?
6. Investigate and Evaluate Current Research into Soil Health;
 - a. USDA has conducted considerable research into soil health, somewhat at the cornerstone of sustainability. The objective is the building of organic matter. Quantitatively OM translates into higher crop yields. How does this research relate to commercial avocado production in California, and if so the best approach to evaluate it and ultimately educate growers for their application.

Other Topics of Interest:

7. Rootstock trials for high carbonate and salinity conditions (Do we have enough areas with high carbonates issues that would make it worth establishing a trial?)
8. Tree stress monitoring tools review
9. Use of sulfur for soil acidification. Rates and timing by soil general type (injection of sulfuric acid vs. sulfur burner vs soil applied dry sulfur).
10. Does mulch have effects in frost areas? Does it make it colder or warmer?
11. Is pulse irrigation better than other methods? Do avocados like it or are their roots too saturated too often?
12. Can you apply too much fertilizer that it will harm the tree? Can you oversalt an avocado tree to the point of killing it with common fertilizer?
13. Precision Farming; Introduce the concepts of precision farming into avocado production in California

Irrigation

High Priority Topics:

14. Small farm automation cost analysis: many different systems exist that integrate soil moisture sensors and weather stations with automatic valves and computers to manage irrigation more efficiently and effectively. How does efficient irrigation improve grove performance (yield, phytophthora levels, pest pressure, fertilizer uptake efficiency, etc.). If automation doesn't improve these then does it ever make economic sense to invest in these systems? At what scale does it make economic sense for growers to invest in these systems?
15. Determine practical cultural practices to help mitigate chloride in groves and pursue promising technologies for this problem.
 - a. Salinity in general, and chlorides specifically, are especially detrimental to avocado production. What cultural practices or promising technologies exist to practically manage salinity and chlorides in California avocado groves?
16. The CIMIS system provides valuable data to the agricultural community. Unfortunately, we have lost several stations in the avocado growing regions of California which has reduced the system's utility to avocado growers. Work is needed to place new stations or develop and test alternative systems (local stations, small on-farm stations, satellite-based modeling, etc.) support and advocacy needed
17. *Update/code a simple irrigation calculator tailored for avocado growers (Andre Biscaro at Ventura County UCCE funded in 2024)*

Other Topics of Interest:

18. Irrigation Planning/Management tool including water budgeting tool
19. Small farm automated valves

20. Determine appropriate timing and duration of leaching irrigation for different levels of salinity in irrigation water, soil type, effects of winter rains, weather, etc. to maintain a healthy soil solution for avocado trees.

Pest Research

High Priority Topics:

21. Avocado Lace Bug: Dr. Mark Hoddle recently completed detailed work on the biology of the avocado lace bug in California. Important follow-up work is now needed to develop management practices for this pest of increasing importance to avocado growers.
 - a. Develop effective scouting methods to accurately assess lace bug populations in avocado groves.
 - b. Determine treatment thresholds for lace bugs based on feeding damage and predicted damage based on the new biology and lifecycle data so that timely control measures can be implemented.
 - c. Conduct pesticide efficacy trials, with particular emphasis on organic options, for the avocado lace bug.
22. Fruit flies: California has seen an unusually high number of fruit fly invasions in recent years. Hass avocados are recognized by the USDA as a non-host of fruit flies in their mature, hard green state on the tree, but this status cannot be extended to other varieties without data to support each variety's non-host status.
 - a. Data are needed for GEM, Lamb Hass and other minor varieties to establish their non-hosts status. Ideally, these data will be collected in areas where fruit fly species of importance (Oriental fruit fly, Mediterranean fruit fly, Mexican fruit fly, Queensland fruit fly) are naturally occurring, in cooperation with local cooperators, to avoid having to establish colonies in quarantine facilities in California.
23. Avocado thrips degree day model: the data for the existing degree day model for avocado thrips were collected about 25 years ago. Compared to current techniques for this type of work, these data are very outdated and do not reflect changes in population biology or climate that have taken place over the past 25 years.
 - a. Updated data, similar to what was recently completed for the North American bean thrips, for the degree day model of avocado thrips is needed to help avocado growers more effectively manage this pest.
24. The U.S. avocado market has grown exponentially over the past several decades. As a result, many avocado producing countries are trying to gain access to the U.S. market. However, imported fruit poses a risk of introducing unknown pests and diseases that could be detrimental to the California avocado industry. Most known avocado pest risks are only known due to previous CAC-funded field surveys in potential export countries, but it has been more than a decade since any such work has been conducted.
 - a. Countries that are likely to gain access to the U.S. market in the near future need to be identified and field surveys of commercial groves and wild populations (if

they exist) of avocados should be surveyed for pests and diseases. New pests and diseases will then need to be identified and their biology understood to ascertain the potential risk of invasion through commercial fruit export.

Other Topics of Interest:

25. Persea mite bio-control
26. How can we measure overall tree stress levels to observe how heavy pest presence impacts productivity/fruitfulness? Dendrometers? NDVI?
27. Find out the impact on leaf productivity of both Persea Mite and Avocado Brown Mite in order to develop a treatment threshold to prevent both damage to tree health and over-spraying of miticides.
28. Make field studies to determine naturally occurring biocontrol agents currently active for both Persea Mite and Avocado Thrips as possible candidates for insectary mass-rearing and release.
29. Elucidate the role of *Eusieus hibisci*, a common predatory mite on avocados throughout California, in controlling Avocado Thrips and if there is a link between numbers of *E. hibisci* found in an orchard and the severity of Avocado Thrips pressure.

Ag Chem Product Research

High Priority Topics:

30. Avocado thrips and persea mite management: Abamectin has been the primary tool for managing avocado thrips and persea mite for decades and concern about resistance is growing.
 - A survey of thrips and mite populations for abamectin resistance throughout California avocado groves would be helpful to pest control advisors for making informed decisions about abamectin use.
 - What insecticides are most effective against persea mite and avocado thrips that can be used in lieu of abamectin?
 - What are the best timing, rate, adjuvants to use in combination with pesticides for most effective control of mites and thrips? Are any products effective if applied through chemigation?
 - What new bee-safe products are available to replace neonics?
 - What products are effective for control in organic production systems?
31. Resistance management of chemical controls for Phytophthora. How best to rotate phosphites, Orondis and Ridomil for maximum effect and control of resistance management.
 - Are any phytophthora populations in California avocado groves showing resistance to currently registered products?
 - Do other active ingredients exist that could be added to the suite of products available for phytophthora management?

32. *CDPR approval for Indaziflam (Alion)*
 - *Alion was included in the project that Peggy Mauk completed in 2022. At that time Bayer was unwilling to support registration due to issues they have seen in other shallow rooted species, although no such issues were observed in avocados.*
33. *CDPR approval for Rimsulfuron (Matrix).*
 - *Matrix is in the IR-4 program and residue trials began in 2023.*
34. Avocado Branch Canker (Dothiorella canker, Botryosphaeria canker): recent research projects have done a good job of identifying the suite of pathogens causing branch canker in California avocado groves.
 - b. Research is needed to screen fungicides for control and work with manufacturers to get products registered (ex. Syngenta Topsin)
 - c. Cultural management practices for branch canker control: pruning, when to pruner, how to prune, sanitation practices, tree removal/when to remove trees.

Other Topics of Interest:

35. *Herbicide Resistance Management; Survey industry for new herbicides with potential in avocados. (Funded with Peggy Mauk, concluded in 2023)*
36. Evaluate Microbes that convert or fix atmospheric nitrogen to plant utilizable nitrate nitrogen. Rationale: Source of nitrogen with the potential of being more economical than nitrogen produced via petroleum and natural gas, both now and in the future. (ex: Pivot Bio, Kula Bio, Azotic Technologies, Joyn Bio, Max Plans Institute for Terrestrial Microbiology, New Leaf Symbiotic, Intrinsyx Bio, Novozymes, Corteva Utrisha)
37. Evaluate Microbes that enhance the availability and utilization of phosphate by plants. Phosphate is very immobile within the soil, certain microbes can enhance uptake and reduce the quantities of phosphate applied. (ex: Novozymes, AgBiome, BioConsortia, Bayer, Stoller, Valent BioSciences, Verdesian, Lallemand Plant Care, Symborg)
38. Humic Acids; Humates are known to provide a carbon source for stimulating the soil microbiome, which in turn provides for enhanced uptake of macro, secondary and minor elements. Research into evaluating what microbes are stimulated (UC Santa Barbara Ph.d. project) and their efficacy in taking up nutrients by humic acid...objective is to reduce the quantities of fertilizer.
39. Deer Control; Deer cause significant damage to newly planted groves (and established) each year. Several candidate sprays are being advertised. Set up and evaluate deer repellants in randomized trials. Establish project to survey for potential repellants
40. Additional research into alternative weed control methods for new orchards.
41. Preemergent herbicide use on new orchards assessing impacts on tree establishment.

DST Analysis of Avocado Yield Potentials and Leaf Nutrient Concentrations

Yield Potential Model Results 2025

Pine Tree Ranch / Tim Spann
 tim@spannag.com
 17-Nov-25

Leaf Analysis Data

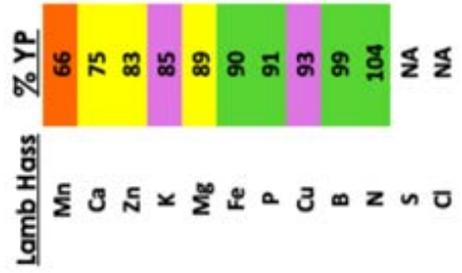
Location	N	P	K	Ca	Mg	S	Zn	Mn	Fe	Cu	B	Cl
Hass	2.53	0.16	1.31	1.38	0.49	NA	26	39	60	11	41	NA

Target Level 1.9-2.6 0.19-0.21 0.95-1.1 2.2-2.4 0.6-0.7 0.45-0.52 45-55 180-250 >80 7.0-9.0 40-60 <0.5

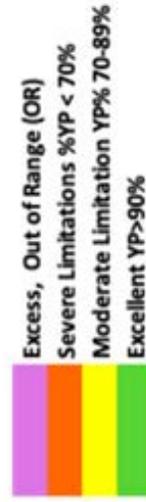
Yield Potential Model Results

Location	N	P	K	Ca	Mg	S	Zn	Mn	Fe	Cu	B	Cl
Lamb Hass	104	91	85	75	89	#VALUE!	83	66	90	93	99	#VALUE!

Rank of Most Limiting Elements



Key



Predicted Effects of Individual Elements on % Yield Potential (%YP)

Comments:

Yield potentials at this grove are predicted to be approximately 66% of the maximum possible as compared to trees having optimal leaf nutrient values. A critical factor affecting tree yields is the excess of potassium (K). Yields of avocado trees are strongly coupled to both deficiencies and excesses of this element, which has an optimum target range of 0.95-1.1% (see attached figure below). Trees at the Lamb Hass grove presently contain 1.31% K or approximately 20% too much potassium (see graph attached below). The good news is that this element should self-correct quickly as potassium is carried off in large amounts by fruit harvest, and depending on your soil texture, is leached into the deep subsoil by percolation of irrigation water and rain. The strategy to hit the target range for this element depends on first on your estimated crop load and K carry-off. Potassium retention in the soil profile depends on the soil texture (sand, silt, clay) and organic matter content, which determine the cation exchange capacity. Potassium is stored on negatively charged surfaces and organic functional groups that retain positively charged K⁺ ions. The amount of fertilizer that can be stored on the exchange complex is greatest in soils with high organic matter and clay and can be assessed using a soil test report. Knowing the soil texture, you can decide on the best strategy for optimizing potassium management and fertilization practices in relation to your soil type and organic matter content.

Fertilization of high CEC soils having high clay and organic matter content can provide potassium for several years before becoming depleted by fruit carry off. On the other hand, potassium is not retained in sandy soils and is readily leached below the root zone. To calibrate the fertilizer needed to maintain your desired root target level, start with your soil test report, which reports lbs. per acre for each element that is stored in the root zone. Then use the fruit potassium carry off estimator on avocadosource.com. Once the canopy reaches target levels, you can further calibrate by calculating your fertilizer use efficiency (% of K applied that is actually taken up).

In conjunction with excess potassium, calcium deficiency is also a concern and is the most limiting element. The optimum level of calcium is 2.2 to 2.4%, whereas your trees are currently at 1.38%. This deficiency is associated with a 25% decrease in yield potential. Calcium deficiencies can be readily corrected with gypsum or lime, or by using calcium nitrate for tree fertilization. An important consideration is that lime will increase soil pH to 7.2 or more, which is too high and affects all aspects of plant

nutrition. The optimum soil pH is 6-6.5 for phosphorus uptake. Lower pH will increase solubilities of all trace metals but boron. Lime should not be used if your soil is already alkaline $\text{pH} > 7$, in which case use gypsum which has 300x the solubility of lime should be used to supply this element.

The moderate deficiency of phosphorus (P) is readily correctable by addition of a phosphorus fertilizer or by adjustment of soil pH to the optimum range where phosphorus is most available (pH 6-6.5). Zinc (Zn) is slightly low and can be corrected with a trace metal chelate.

Manganese (Mn) is low, but recommendations for this metal come with a caveat, as there are not yet any studies showing yield responses to this element. Mn is highly soluble in soils that are well irrigated and occurs in two chemical forms as oxidized Mn^{4+} and as the reduced form Mn^{2+} , which is the predominant ionic form taken up by plants. Because the availability of this element is affected by soil pH, water availability and soil redox status, it has been found to serve as a proxy for irrigation management and soil organic matter which drive formation of Mn^{2+} . The actual levels considered adequate for avocado range from 30 to 500 ppm, with less than 15 ppm considered deficient. On the other hand, in the research for the DST model, relatively high levels of 189-250 ppm were associated with the highest yielding trees suggesting that Mn is not actually deficient below 180 ppm, but is instead serving as a surrogate indicator for how well the trees have been watered over the growing season. While increased levels of Mn can be attained by fertilization with MnSO_4 or chelated Mn, yield reductions that occur at levels below 180 ppm, likely reflect other factors such as cumulative water stress, a high soil pH or poor soil conditions such as compaction, high pH, or low organic matter that are associated with poor root growth and decreased yields. While there is not a problem with increasing Mn levels to the optimal range by fertilization, caution should be used not to exceed 1000 ppm in the canopy, which can result in toxicity. If you decide to fertilize for trace metals including iron, zinc and manganese, these elements are best applied during periods of active root growth in either the spring or fall root flush.

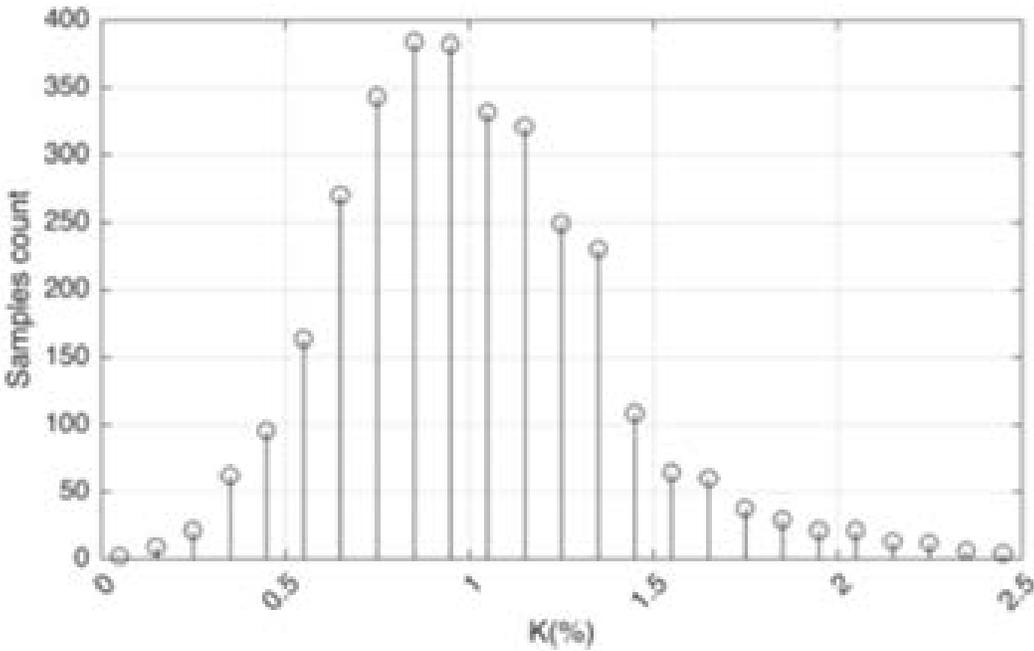
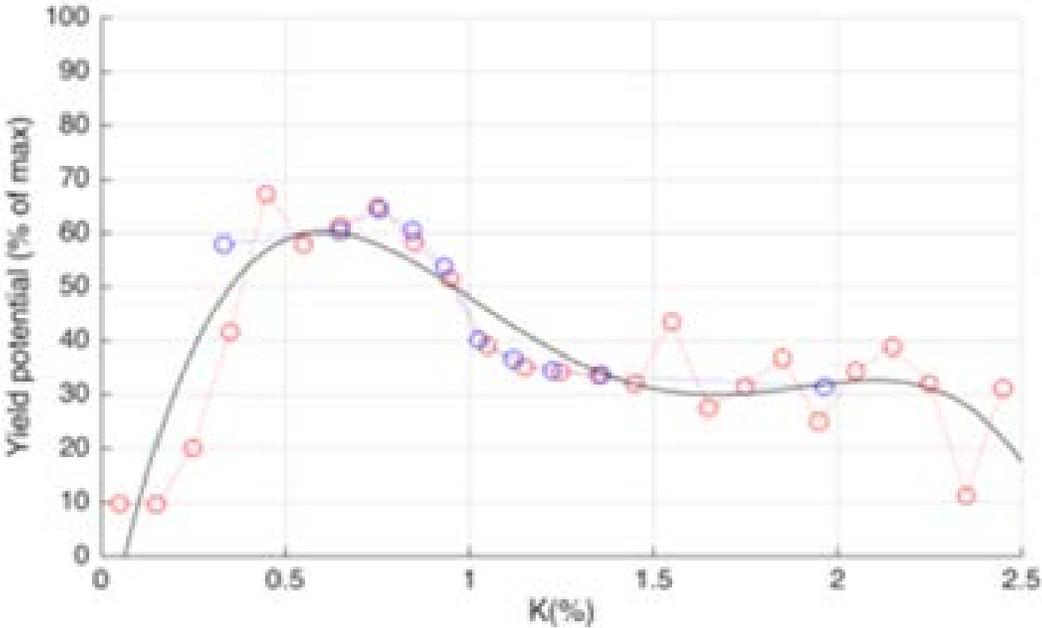
Leaf chloride levels were not reported. If your irrigation water has a salinity of greater than EC 1.0 and / or a chloride level of greater than 100 ppm, you should carefully optimize your irrigation program to provide sufficient leaching of salts from the upper soil profile where roots are exposed to high salinity levels. Chloride will also leach from the soil during the winter rain months and can be monitored using a salinity pen to test soil water extracts from different depths in the soil profile.

Sulfur was not included in the leaf analysis report, but is an essential element that is closely correlated with avocado yields. It is important to keep track of this element as both deficiencies and excesses of sulfur are associated with yield reductions. Sulfur is often introduced by soil treatment with gypsum, which is supplied to improve soil drainage. Sulfur is also introduced with sulfur burners that are used to reduce soil pH, or to generate gypsum in situ in calcareous soils. You should ask for sulfur to be included in next year's leaf analysis.

Over all, the grove is in fairly good condition with respect to tree nutrition. Most of the essential elements are well managed. However, it will be important to reduce leaf potassium and increase calcium. The DST model indicates reduction of potassium levels and correction of the calcium deficiencies can provide an approximately 25% increase in % yield potentials. As indicated by leaf Mn status, some non-nutritional factors such as water management may also be affecting yields and should be examined to alleviate yield reductions.

Many factors affect avocado yields. The DST model cannot predict actual yields, but does provide data driven guidelines that predict potential avocado fruit yields as affected by tree nutritional status.

Relationship between yield potential and leaf potassium levels for highest yielding trees (frontier analysis) for the DST model training set. Note optimum range of leaf K is approximately 0.8% with losses in yield potential above this concentration. Bottom figure, number of grower reports showing where most of the avocado industry in S. California is poised. Approximately half of the groves analyzed are too low or too high and are predicted to have reduced yields.



October 24, 2025

Sierra Pacific Farm Management
 P.O. Box 1537
 Temecula, CA 92593

Description : Pine Tree Hass
 Project : Sierra Pacific Farm Management

Lab ID : SP 2517242-008
Customer : 2013044

Sampled On : October 8, 2025
 Sampled By : Alejandra
 Received On : October 8, 2025
 Age :

Hass Plant Tissue Analysis

Test Description	Result	Units	Optimum Range	Graphical Results Presentation				
				Deficient	Low	Ample	High	Excessive
Macro Nutrients								
Total Nitrogen (Leaf)	2.53	%	2.4 - 2.6					
Phosphorus (Leaf)	0.164	%	0.080 - 0.44					
Potassium (Leaf)	1.31	%	1.0 - 3.0					
Calcium (Leaf)	1.38	%	1.0 - 4.5					
Magnesium (Leaf)	0.491	%	0.25 - 1.0					
Micro Nutrients								
Zinc (Leaf)	25.8	ppm	30 - 250					
Manganese (Leaf)	39	ppm	30 - 700					
Iron (Leaf)	60	ppm	50 - 300					
Copper (Leaf)	11	ppm	5.0 - 65					
Boron (Leaf)	41.0	ppm	12 - 100					
Sodium (Leaf)	<0.004	%	< 0.25					
Nutrient Ratios								
Nitrogen:Potassium	1.93		1.7 - 2.2					
Nitrogen:Phosphorus	15.4		11 - 23					
Phosphorus:Zinc	63.6		20 - 50					
Potassium:Magnesium	2.67		1.5 - 3.5					
Nitrogen:Calcium	1.83		0.90 - 2.0					

Good  Problem

Note: Color coded bar graphs have been used to provide you with 'AT-A-GLANCE' interpretations.

Interpretations are based on dry weight in 5 to 7 month old Hass, Spring cycle, leaves from non-fruiting, non-flushing terminals. Leaves and/or petioles are thoroughly washed prior to drying.

BRW:DMB

Reviewed and Approved By **Ben Waddell**  Digitally signed by Ben Waddell
 Title: Director of Ag. Services
 Date: 2025-10-24

