



AGENDA

California Avocado Commission Production Research Committee Meeting

Meeting Information

Date: Thursday, May 28, 2026

Time: 10:00 a.m.

Location: Hybrid Meeting

Physical Meeting Location:

UC ANR South Coast Field Station

Annex Building Conference Room

7601 Irvine Blvd.

Irvine, CA, 92618

Web Conference URL:

<https://californiaavocado.zoom.us/j/5375836823?omn=87403475594>

Conference Call Number: (507) 473 4847

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 Friday, May 22, 2026, 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

Herman Els

Matthew Fatino

Consuelo Fernandez

Time	Item
10:00 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>Persons may address the Committee on subjects within the jurisdiction of the Committee.</p>3. Approval of Production Research Committee Meeting Minutes of February 19, 20264. Research Program Consultant’s Report5. 2026 Request for Proposals6. Consider funding request for “Evaluating diverse avocado rootstocks for salinity using morphological, ionic, and physiological parameters”7. Consider funding request for “Enhancing integrated pest management for avocado lace bug in organic production”8. Consider additional funding request for mowing needs for project “Creating a weather station network to guide irrigation decision of avocados”9. Consider additional funding support for project “Does artificial pollination improve yield of ‘Hass’ and ‘GEM’ avocado?”
11:00 a.m.	10. Adjourn Meeting

Disclosures

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.com or 423-609-3451 if you have any questions.

Summary Definition of Conflict of Interest

Committee members are responsible for determining whether they have a conflict of interest.

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

No Committee member shall make, or participate in making, any decision in which they know or should know they have a conflict of interest.

No Committee member shall, in any way, use their position to influence any decision in which they know or should know they have a conflict of interest.

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

February 19, 2026

A meeting of the Production Research Committee (PRC) of the California Avocado Commission (CAC) was held on Thursday, February 19, 2026, with the following people participating:

MEMBERS PARTICIPATING:

Danny Klittich, Chair
Victor Araiza
Allisen Carmichael
Jason Cole (8:12)
Herman Els
Consuelo Fernandez
Leo McGuire
Rachael Laenen (*ex officio*)

CAC STAFF PARTICIPATING:

Ken Melban
April Aymami

OFFICIALLY PARTICIPATING:

Dr. Tim Spann, Spann Ag Research & Consulting

GUESTS PARTICIPATING:

John Berns (Member, District 3)
Matthew Fatino (Farm Advisor, UCCE San Diego County)

CALL TO ORDER

Danny Klittich, Production Research Committee Chair, called the meeting to order at 8:02 a.m. with a quorum present.

Following the roll call, Chair Klittich asked the members to introduce themselves as this was the first meeting of the newly appointed committee. Following member introductions, Chair Klittich asked Matthew Fatino, a new UC Cooperative Extension Farm Advisor for San Diego County, to introduce himself.

OPPORTUNITY FOR PUBLIC COMMENT

Ken Melban asked the Committee members if they could provide some updates following the recent storms that hit southern California. Members reported rainfall totals for various regions but no one was aware of any significant damage to trees or the crop.

APPROVAL OF MINUTES OF APRIL 3, 2025 PRODUCTION RESEARCH COMMITTEE MEETING

MOTION

To approve the minutes of the April 3, 2025, Production Research Committee meeting.

(Cole/Araiza) MSC unanimous

Motion 26-2-19-1

RESEARCH PROGRAM CONSULTANT'S REPORT

Dr. Spann brought to the Committee's attention the opportunity to serve on the USDA Specialty Crops Research Initiative proposal review panel. Dr. Spann stated that he had forwarded an email to the Committee and if they were interested in serving, they could follow the instructions in the email.

Dr. Spann informed the Committee that Brokaw Nursery had provided some trees to researchers at the USDA Salinity Laboratory in Riverside in 2025 to conduct a small-scale trial like what they had previously proposed to CAC. A 6-month progress report on the scaled-back project was shared with the Committee members. The Committee was impressed with the work that was being done and was interested in considering providing some funding to help complete the analysis of the samples that had been collected. The Committee asked Dr. Spann to request a budget from the researcher's for completing the sample analysis.

Dr. Spann brought to the Committee's attention that the Special Local Needs (SLN) registration for the use of ProGibb on avocados expired at the end of December 2025. This lapse was the result of Valent Biosciences, the manufacturer of ProGibb, not getting a full label registration for ProGibb use on avocados. Dr. Spann explained that CAC was working with the Department of Pesticide Registration to renew the SLN and were hopeful that it would be in place before bloom in spring 2026.

Dr. Spann informed the Committee that CAC had contracted with Praetorian PR to help develop short videos to help with grower outreach. The first video had already been completed on avocado lace bug (ALB) and Dr. Spann played the video for the Committee. Dr. Spann then asked the Committee to share any ideas they may have for topics for future videos.

Lastly, Dr. Spann updated the Committee on the situation with ALB. He explained that CAC was successful in getting one new pesticide into the IR-4 program and trial work for that product would begin in 2026. He also mentioned that there are several products registered for use on avocados that have shown some efficacy against ALB and the manufacturers are willing to add ALB to the labels if they are provided with efficacy and

crop safety data. Additionally, there are two products which are not registered for use on avocados that may be helpful in controlling ALB. The manufacturers of those products are willing to consider registration if they are provided with some preliminary efficacy data.

DISCUSSION ITEMS

A. Review currently funded research projects and production research budget

Dr. Spann shared the current production research budget with the Committee and walked through each of the funded projects. He briefly described each project, its objectives, progress to date if any had been reported, and the timeline for each project. Questions, if there were any, were answered as each project was reviewed.

B. Review research priorities list

Chair Klittich provided background on how the current priorities list was developed during 2024 and how it led to the request for proposals (RFP) that was distributed to the research community in September 2024. Subsequently, that RFP led to the funded projects reviewed during the budget discussion. The chair explained that the research priorities list was intended to be a living document with topics crossed off as projects were completed and new priorities added as they arose.

Discussion ensued and Consuelo Fernandez brought up two topics that came to light recently. First was the idea of flower quality that Dr. Iñaki Hormaza discussed at a recent California Avocado Society meeting. Dr. Hormaza showed data that suggests the carbohydrate content of flowers is correlated with fruit set, with the flowers that have higher carbohydrate content being more likely to set fruit. Research on how to improve flower quality may be worth investigating. Second was about tools to help growers make better management decisions for their groves, such as using soil moisture sensors. It was suggested that a neutral person could develop a talk and/or article that could be distributed to explain the different types of sensors and systems available and how growers can use them to improve their grove management.

Herman Els noted that nitrogen planning and reporting was listed in the priorities topics but wasn't well developed. He indicated that in Ventura County the current nitrogen removal rates seemed low and a study to verify those rates and potentially revise them may be necessary as reporting requirements continue to evolve.

C. Pine Tree Ranch fertilizer program/Decision Support Tools

Dr. Spann reminded the Committee about the project that had been funded with Dr. David Crowley to develop avocado decision support tools (DST). When that project was completed and the tool was made available to growers there was minimal adoption by growers and the Board made the decision to discontinue funding for the DST system. Since then, Dr. Crowley has been providing the tool on fee basis through Grangetto's Farm Supply. Grangetto's had approached CAC about using the tool at Pine Tree Ranch to help spread the word that the system is still available. Dr. Spann submitted a leaf analysis from Pine Tree Ranch and the report was shared with the Committee highlighting the changes the report recommended.

Discussion ensued, and there was general consensus among the group that some of the numbers in the report, particularly for potassium, seemed off. There was discussion about whether the original data used to develop the tool may be skewed to southern groves and not representative of the entire industry. Some members commented that they liked the idea of getting new technology into the hands of growers, but this tool didn't seem ready for full release at this time. There was also concern that pursuing this could negatively impact the current arrangement with Redox and Ag Rx to provide fertilizer at no cost for Pine Tree Ranch. Chair Klittich called for a motion but there was no motion to support the use of the DST at Pine Tree Ranch.

Chair Klittich asked if there was any additional business or discussion. A question was raised about silicon and its benefit. It was discussed that there is still no conclusive evidence that silicon is essential for all plants, but is required by certain groups of plants, for example rice.

ADJOURN MEETING

Danny Klittich, Production Research Committee Chair, adjourned the meeting at 9:53 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 Article: Avocado Lace Bug Update
Report: Avocado Salinity Screening experiment 2025-26

EXHIBIT C 2025-26 Production Research Budget
California Avocado Commission Production Research Priorities
DST Analysis of Avocado Yield Potentials and Leaf Nutrient
Concentrations

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

Acct Code	Investigator	Project	2025-26 Budget	2025-26 Budget Amendment	2026-27 Budget	2027-28 Budget	2028-29 Budget
Research - Pest and Disease Projects							
65132	Hoddle	Surveys for avocado fruit feeding insect pests in Guatemala	\$243,700	\$243,700	\$172,409		
		Chemical Synthesis and Field Evaluation of an Enantiopure (+)-					
65133	Hoddle & Kou	Grandisol, the Putative Avocado Seed Weevil (Heilipus lauri) Aggregation Pheromone	\$85,740	\$85,740	\$146,699		
65134	Cohen	A pesticide resistance monitoring program for avocado thrips	\$12,149	\$12,149	\$3,300	\$5,300	\$3,300
65135	Khodadadi	Integrating Chemical and Cultural Practices for Bot Canker Control in Avocado	\$77,149	\$77,149	\$79,970		
65136	Loudermelt	Impact of Natural Vegetation on Insect Pollinators in Agroecosystems	\$6,071	\$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	\$101,266	\$105,696	\$117,939	
	Cohen	Enhancing integrated pest management for avocado lace bug in organic production		\$18,375	\$20,055		
			\$526,075	\$544,450	\$531,420	\$123,239	\$3,300
Research - Cultural Management Projects							
65218	Garner	Continued research at the San Luis Obispo rootstock trial site (2025-27)	\$29,232	\$29,232	\$28,833		
65325	Arpaia	Does artificial pollination improve yield of Hass and GEM avocado?	\$62,116	\$62,116	\$64,388	\$93,087	
65326	Landesman	Addressing the relationship between soil characteristics and soil salinity in California avocado orchards	\$5,507	\$5,507			
65327	Biscaro	Creating a Weather Station Network to Guide Irrigation Decision of Avocados	\$88,375	\$103,975	\$4,371		
65328	Montazar	Assessing irrigation management tools and strategies on avocado fruit quality and yield impacts	\$116,325	\$116,325	\$57,370	\$45,415	
	Ferreira	Evaluating diverse avocado rootstocks for salinity using morphological, ionic, and physiological parameters		\$50,000			
			\$301,555	\$367,155	\$154,962	\$138,502	\$0
Industry Research Support							
65403	Landesman	FFAR Fellowship Support	\$32,500	\$32,500			
			\$32,500	\$32,500	\$686,382	\$261,741	\$3,300
			\$860,130	\$944,105			

NOTE: For budget discussion purposes, the higher budget number (contract mowing) was used for the budget project for project 65327.

Title: Evaluating diverse avocado rootstocks for salinity using morphological, ionic, and physiological parameters

Summary

Avocado production in southern California faces major challenges, including water scarcity, high freshwater costs, Phytophthora pressure, labor shortages, and rising operating expenses, all of which reduce profitability. Irrigation-water quality is also a critical issue because avocado is highly sensitive to salinity and has its fruit yield drastically reduced even under low salinity levels. In collaboration with Brokaw Nursery, we initiated a screening experiment in April of 2025 to evaluate the salt response of eight rootstocks grafted with ‘Hass’ under two salinity treatments (0.65 and 2.2 dS/m) using three replicates and three plants per replicate, for a total of 144 plants. Control irrigation was Riverside municipal water ($EC_w = 0.65$ dS/m) while salinity treatment ($EC_w = 2.2$ dS/m) was composed of water with 13.4 meq/L of Cl^- , 12.2 meq/L of Na^+ and 3.7 meq/L of bicarbonate (HCO_3^-). The avocado rootstocks were provided by Brokaw Nurseries (Ventura, CA) and were ‘Dusa’, Tami’, ‘VC207’, ‘VC66’, ‘Leola’, ‘Zerala’, ‘Borchard’, and ‘Duke 7’. From those, 2 are new rootstocks of interest (‘VC207’ and ‘Leola’) and four have unknown (or uncertain) tolerance to salinity (‘VC207’, ‘VC66’, ‘Leola’, and ‘Zerala’). One of the rootstocks is considered as the “industry standard” (‘Dusa’ or ‘Merensky 2’) for his tolerance to Phytophthora root rot and high fruit yield. ‘Dusa’ was also considered moderately salt tolerant (43% survival in USDA-UCR field trial) and will be used for comparison in our salt tolerance trial. Plants were transplanted into 6-gallon pots, and their stem diameter was measured before initiating salinity treatment on July 23, 2025. Plants were irrigated daily during the summer of 2025 using pressure compensated drippers (2 gal/hour, 20 minutes/event) dispensing approximately 0.5/irrigation event. During the winter (2025/2026), plants are irrigated four times a week for 15 minutes per event.

After seven months of treatment, control plants displayed substantially greater canopy growth and stem elongation compared to those receiving saline water, highlighting the strong physiological impact of salinity. Clear differences among rootstocks have emerged under saline conditions: some maintain better growth and exhibit fewer toxicity symptoms, whereas others show pronounced leaf burn and chlorosis. These contrasting responses suggest important genetic differences in salt exclusion, tolerance, and ion compartmentalization. At study completion in May 2026, measurements will include stem diameter, leaf nutrient status (macro- and micronutrients), and leaf Na and Cl concentrations to assess rootstock-mediated salt exclusion.

Deliverables

At the conclusion of this experiment, we will provide the ranking of 8 rootstocks, compared to the rootstock standard (Dusa), to salinity tolerance provided by an irrigation water with high concentrations of Na and Cl. All the rootstocks are cloned and grafted with ‘Hass’. Thus, comparisons will specifically reflect rootstock-driven differences in Na and/or Cl transfer to the scion. The macro and micronutrient analyses will reveal how the plants are maintaining (or not) their homeostasis of essential minerals required for growth and development under prolonged salinity stress. The salinity tolerance will also be gauged through stem diameter taken at the beginning and at the end of the experiment, ionomic (mineral nutrients, Na, and Cl leaf concentration), and physiological parameters taken with a LI-COR system (stomatal conductance, chlorophyll fluorescence, CO_2 assimilation rate, photosynthetic efficiency, transpiration, and water-use efficiency). Results will be shared with Brokaw Nursery and the California Avocado Commission, once all data is collected, statistical analyses and data visualization and interpretation are complete.

BUDGET

Direct Costs - Personnel

Personnel: Salaries and benefits are requested for a limited term employee (LTE) who will devote 40% of their time (832 hrs/year) to this project. Fringe benefits are requested at 40% of LTE’s salary. The LTE will

be responsible for supervising two undergraduate students. The LTE will supervise two undergraduate students and will manage all laboratory aspects of the project, including recording morphological and physiological measurements, conducting ion and biochemical analyses, and coordinating day-to-day experimental activities.

Salaries are also requested for two UCR undergraduate students for a total of 1,000 hours at \$17 per hour. The undergraduate students will conduct field-based activities including transplanting, watering, plant maintenance, sample collection, and preparation of materials for subsequent analyses.

Direct Costs - Other

Materials and Supplies: A total of \$3,500 is requested to cover chemical reagents for ionic and mineral analyses, salinizing salts, pots, and potting soil mix. An additional \$2,000 is requested for pots, tags, tissue-collection tubes, pipette tips, glassware, and plasticware. A one-time amount of \$2,000 is requested for irrigation system setup. Finally, \$4,320 is requested for ion analysis of 144 tissue samples at \$30 per sample.

1. Personnel

Description	Amount
1 Lab/Field Technician – 832 hours/yr @ \$30/hr.	\$ 24,960
2 Undergraduates, Hourly - 500 hours/yr each @ \$17/hour	\$ 17,000
Fringe Benefits for Lab/Field Technician @ 40%	\$ 9,984
Personnel Subtotal	\$ 51,944

2. Other operating Expenses

Description	Amount
Chemical reagents, salinizing salts, pots, potting soil mix	\$3,500
Tags, Tubes for plant-tissue collection, Tips, glassware, plastic ware	\$2,000
Cost of irrigation system (hoses, pressure-compensated drippers)	\$2,000
Sample preparation, complete suite (macro & micronutrients), and Na and Cl analysis of 144 leaf samples for various elements including Na, Cl, K, Ca, Mg, S, Zn, Mn etc.	\$4,320
Other Operating Expenses Subtotal	\$11,820

Total expenses for the experiment = \$51,944 + \$11,820 = \$63,764

Funds contributed by US Salinity Laboratory (USDA-ARS) = \$13,764

In addition to the resources described above, this project will require part-time contributions of two USDA research technicians with extensive experience in field and laboratory experimentation and analyses (Dr. Manju Pudussery, 10% time and Layton Chhour, 10% time).

Funds requested from CAC = \$50,000

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.

Title: Enhancing integrated pest management for avocado lace bug in organic production

Executive Summary

Avocado lace bug (*Pseudacysta perseae*) is an emerging and concerning pest in California avocado production. Feeding damage from this pest reduces the photosynthetic capacity of the tree and frequently leads to significant defoliation and yield loss. Conventional insecticides provide control, but their use is limited by resistance concerns and regulatory constraints, while organic options in coastal California show very low efficacy. In response to the lack of grower options, this project evaluates particle film as an organic-compatible tool for avocado lace bug (ALB) management. Replicated field trials will compare particle films to standard organic treatments and untreated controls. We will measure the ability of each treatment to suppress pests and feasibility for grower adoption. This work aims to provide growers with a novel pest management strategy for avocado lace bug.

Project Participants

PI. Hamutahl Cohen, Ph.D., Entomology Advisor. UC Cooperative Extension, Ventura.

Co-PI. Mark Hoddle, Ph.D., Professor, Entomology, University of California, Riverside

Co-PI. Ben Faber, Ph.D., Farm Advisor. UC Cooperative Extension, Ventura.

Principal Investigator Hamutahl Cohen (UC ANR) will serve as project leader and manager, overseeing day-to-day operations of the experiments, including communication with the participating growers, implementing data analysis and curation, adhering to the project timeline, reporting deliverables, and organizing outreach activities. Co-PI Mark Hoddle (UC Riverside) is the leading expert on avocado lace bug in California and will advise on experimental design, data analysis, and reporting. Co-PI Ben Faber (UC ANR) will facilitate grower participation in the trial and is the primary lead for extension activities. All team members will contribute to experimental design, project implementation in the field, data management, report writing, and disseminating research through outreach.

Project Narrative

Avocado lace bug (*Pseudacysta perseae*) is a piercing-sucking insect that feeds on the underside of avocado leaves, causing chlorosis, necrosis, and defoliation under high infestations. The avocado lace bug (ALB) was first described in Florida in 1908, and was discovered in San Diego County in 2004. Since its introduction into California, populations have expanded into commercial production areas in Santa Barbara and Ventura, with recent outbreaks causing substantial concern among growers.

Adult ALB are ~2 mm long and yellow-orange with dark heads and lace-like wings. Females lay their eggs on the underside of leaves near leaf veins, then smear the eggs with fecal matter, which appears as black tar-like material. This serves to protect the eggs from desiccation and moisture (and likely insecticides), and makes the yellow eggs appear as small black dots to the observer. Eggs hatch into nymphs, which are small, darker, and oblong. In San Diego, egg

density is highest in fall through winter, and adult populations peak in late summer through fall (we lack phenological data for our coastal production regions).

Management options are **extremely** limited. In conventional farms, systemic applications of imidacloprid and contact applications of the pyrethroids fenpropathrin (Danitol) or zeta-cypermethrin (Mustang Maxx) provide control of avocado lace bug. These products require multiple applications and have serious non-target impacts to aquatic life and pollinators. Softer products such as abamectin (conventional) and spinosad (organic) have not worked well in trials. The conventional insecticides currently labeled for ALB share the same mode of action, complicating resistance management. There is one pesticide with a unique mode of action that can be rotated for ALB control, but it is a conventional neonicotinoid (imidacloprid). Because of concerns about neonicotinoids and pollinator health, its use in California is prohibited during avocado's six month bloom period along the coast.

Organically approved tools include insecticidal soaps, oils (Ecotec), pyrethrins (PyGanic) and *Beauveria bassiana* (Mycotrol-WPO), which unfortunately only works in humid conditions. In recent trials in Hawaii, soil drenches of organic azadirachtin (from neem oil) had promise for controlling the lace bug in young trees. Overall, organic tools such as oils, soaps, and microbial products provide poor, short term, or inconsistent control.

There is no specialized natural enemy that only feeds on avocado lace bug. Generalist predators such as lacewings, spiders, beetles, and *Franklinothrips* attack them under laboratory conditions, but it is thought that they do not suppress pest levels in the field. Lacewings are likely the most effective predator as they consume all life stages, but they tend to fly away when released on farms. Predatory mites are the least effective predator (Humeres et al. 2009). There may be novel biological control agents from Mexico that control ALB, but studies to determine if they are candidates for rearing and release will take a number of years – in the interim, growers desperately need tools now.

With limited available chemical and biological control options, growers, especially organic producers, urgently need effective management options. To identify priority research solutions for this pest, we convened a grower meeting in March 2026 in Ventura County. Over 100 growers participated and expressed concern about the spread of ALB and the need for evaluating non-chemical control options. Some growers reported anecdotal success with particle film technologies, including kaolin clay and silica-based materials. These film technologies form a physical barrier on plant surfaces that disrupt insect host-finding and feeding. While effective in other cropping systems, these materials have not been evaluated for avocado lace bug control in avocado orchards. We therefore propose to evaluate the efficacy of particle film treatments for ALB control.

Particle film treatments are made of products that are naturally occurring and found in deposits around the world. They are generally sprayed as a powdered suspension on crops, where they form a barrier film that repels and prevents pests from penetrating plant tissue. These particle film treatments have been found to be effective for Asian citrus psyllid control in citrus (Pierre et al. 2021) and in other crops, but have not been evaluated for ALB control in avocado. The benefit of these sprays is that they pose minimal health risks to people, including sensitive

farmworker populations (the dust can be an irritant to inhalation pathways, but this is mitigated by wearing a mask). Particle films also pose no harm to non-target organisms such as bees or aquatic organisms. In addition to suppressing pests, particle films have been found to enhance the growth of plants such as citrus (Lapoint et al. 2006) by mitigating heat stress. The downside of particle films is that fruit treated with crop protectants need to be washed prior to distribution, which may complicate processing. However, many packinghouses in Ventura County that accept avocado have already developed fruit washing protocols for lemon (due to Asian citrus psyllid quarantine regulations) and are able to adapt to this requirement.

Objectives

1. Evaluate the efficacy of particle film treatments for reducing avocado lace bug populations.
2. Compare particle films to a commonly used organic insecticide.
3. Assess impacts of treatments on tree growth, canopy condition, and fruit set.
4. Determine feasibility of particle film adoption in commercial avocado systems.

Procedures

Field trials will be conducted at 2-3 commercial avocado orchards in Ventura County twice a year using a randomized, complete block design. There will be 6 treatments, which are replicated two times during each sampling period (or three, depending on if farm size allows). In year 1 of the trial, we will compare the efficacy of industry standard, organic products:

- 1) Entrust
- 2) Pyganic
- 3) Azadirachtin
- 4) Evergreen
- 5) Negative Control (no treatment)
- 6) Positive Control (conventional product, e.g. Movento)

In year 2 of the trial, we will focus on comparing the efficacy of novel, secondary organic products:

- 1) kaolin particle film (Surround WP)
- 2) diatomaceous earth (mixed with Entrust)
- 3) PFR-97 microbial
- 4) silicon dioxide spray (Blue Gold),
- 5) phospholipid cuticle coating (Parka),
- 6) Negative Control (no treatment)
- 7) Positive Control (conventional product, e.g. Movento)

Each treatment plot will be approximately .25 acre (5 rows, 6 trees deep), and separated by other plots by 1 row. At each farm, we will select medium-sized trees (under 10 feet tall). We will survey all plots for preliminary ALB density to ensure that pest pressure is equal across treatments (we will first survey more treatment plots than needed so that we can drop plots that

are characterized by higher or lower pressure than the average block). Treatments will be randomly assigned to each treatment block at each site for each year.

Treatments will be sprayed at maximum label rates by a contracted pest control company (Oxnard Pest Control). We will conduct a pre-count within 2 days of the spray treatment. We will conduct the spray, then count 3 days post spray, 7, 14, 21, and 28 days post spray. The first treatment round will occur in July/August, when pest populations begin to increase. The second treatment round will occur in September/October, when peak populations cause the most severe damage.

We will use visual searches, examining 10 trees per treatment within the core central area of each plot. At each tree we will count ALB on 15 leaves per tree. All eggs, instars, and adults will be counted.

To compare the impact of each treatment on pest levels, we will construct a generalized mixed linear model, with pest counts as the response variable. Predictor variable will include treatment. Fixed effects will include treatment, sample round, and we will include a random effect for site.

Extension of Results

We believe this work will generate research-based recommendations with immediate implications for grower adoption. Results will be disseminated through multiple extension channels. We will host a field day to show growers what the particle film products look like on the trees. At the field day we will bring in a panel of growers, pest control advisors, and packinghouse professionals to discuss implications for management, harvesting, and processing. We will survey attendees to document grower intent to adopt the practice. The event will be co-sponsored by the California Avocado Commission and California Avocado Society to maximize our audience reach. Since ALB is an issue across multiple regions of the state and across the globe, we will reach more growers by publishing in the CAC magazine “From the Grove” and by publishing in “Topics in Subtropics,” a UC ANR newsletter. We also plan to publish results in a peer-review journal, aiming for journals such as “Crop Protection” or “Horticultural Technology.”

Milestones

Outcome	Year 1 (July 26- Oct 26)	Year 2 (Nov 26- Oct 27)
Identify field sites, develop methods, obtain supplies	X	X
Trial different products	X	X
Analyze Data	X	X
Share results to growers at a field day/seminar		X
Share results to growers in “From the Grove”		X
Publication & Outreach		X

Budget & Budget Justification:

UC ANR	Year 1 (July 26-Oct 26)	Year 2 (Nov 26-Oct 27)
Personnel: The Lab Assistant (\$30/hr) will support field surveys (360 hours) each year, as well as provide support with data entry (40 hours) for a total of 400 hours of support each year.	\$12,400	\$12,400
Materials and Supplies: We are requesting support for materials, anticipating that for each of the 2 years we will require items such as hand lens, vials, and personal protective equipment during field work, for a total of \$1,000 for two years (\$2,000).	\$1,475	\$1,555
Consulting/Contracted Services: Oxnard Pest Control will provide spraying services, including equipment and labor to spray all treatments across participating farms.	\$4,500	\$4,500
Publication Costs: We are requesting for support for fees associated with peer-reviewed journals such as <i>Environmental Entomology</i> .		\$1,000
Extension materials: We are requesting funds to provide lunch for a grower field day at one of the participating farms.		\$600
Total	\$18,375	\$20,055

TOTAL: \$38,430

Support from CAC is critical for the success of this project, which is currently unfunded. The research team includes early-career UCCE researchers proposing to advance integrated pest management of a key pest of avocado. Our budget includes requests for materials, labor, and contracting a pest control company to apply treatments.

HAMUTAHL COHEN
 Entomology Advisor
 University of California Cooperative Extension
 hcohen@ucanr.edu

EDUCATION and POSITIONS

2023-current Extension Advisor, Entomology, University of California
2021-2023 Extension Agent, Commercial Horticulture, University of Florida IFAS
2018-2021 Postdoctoral Researcher, Entomology, University of California, Riverside
2012-2018 Ph.D., Environmental Studies, University of California, Santa Cruz
2009-2011 B.S., Molecular Environmental Biology, University of California, Berkeley

SELECTED PUBLICATIONS (last 5 years)

- Bishop, G. A., Kleijn, D., Albrecht, M., Bartomeus, I., Isaacs, R., Kremen, C., ...**Cohen, H.**,... & Fijen, T. P. (2025). Critical habitat thresholds for effective pollinator conservation in agricultural landscapes. *Science*, 389(6767), 1314-1319.
- Cohen, H.**, Valdes-Berriz, M., & Daugovish, O. (2025). Field efficacy of isocycloseram (plinazolin technology sc200), a new insecticide product for control of diamondback moth in cabbage in Southern California, 2024. *Arthropod Management Tests*, 50(1).
- Tsang, T. P., De Santis, A. A., Armas-Quiñonez, G., Ascher, J. S., Ávila-Gómez, E. S., Báldi, A., ...**Cohen, H.**... & Bonebrake, T. C. (2025). Land Use Change Consistently Reduces α -But Not β -and γ -Diversity of Bees. *Global Change Biology*, 31(1), e70006.
- Smith, G.P., **Cohen H.**, Zorn, J.F., McFrederick, Q.S., Ponisio, L.C. (2024). Plant-pollinator network architecture does not impact intraspecific microbiome variability. *Molecular Ecology*. 33(7), e17306
- Ponisio, L.C., **Cohen, H.**, Galbraith, S.M., Zorn, J.F., Zitomer, R.A., Rivers, J.W. (2023). Host and floral communities shape parasite prevalence and reproduction in intensively managed forests. *Ecosphere*. 15(1), e4709. doi: 10.1002/ecs2.4709
- Jha, S., Egerer, M.H., Bichier, P., **Cohen, H.**, Liere, H., Lin, B.B., Lucatero, A., Philpott S.M. (2023). Multiple ecosystem service synergies and landscape-mediation of biodiversity in urban agriculture. *Ecology Letters*. 26(3), 369-383.
- Ong, T.W., Lin, B.B., Lucatero, A., **Cohen, H.**, Bichier, P., Egerer, M.H., Danieau, A., Sha, J., Philpott, S.M., Lieri, H. (2022). Rarity begets rarity: Social and environmental of rare organisms in cities. *Ecological Applications*
- Cohen, H.**, Ponisio, L.C., Russell, K., Philpott, S.M., McFrederick, Q.M. (2022). Floral resources shape parasite and pathogen dynamics in bees facing urbanization. *Molecular Ecology* doi: 10.1111/mec.16374
- Ivers, N.A., Jordan, Z., **Cohen, H.**, Tripodi, A., Brown, M.J.F., Lieri, H., Lin, B.B., Philpott, S., Jha, S. (2022). Parasitism of urban bumble bees influenced by pollinator taxonomic richness, local garden management, and surrounding impervious cover. *Urban Ecosystems* doi: 10.1007/s/11252-022-01211-0
- Cohen, H.**, Egerer, M.H., Thomas, S-S., Philpott, S.M. (2022) Local and landscape features constrain the trait and taxonomic diversity of urban bees. *Landscape Ecology*

COMMUNICATION & EXTENSION

Presentations at Professional Meetings (2014-current): 11 oral presentations & 10 posters at conferences such as Entomological Society of America & Ecological Society of America

Extension Classes (2020-current): >80 in-person and virtual presentations for the crop growers, horticultural professionals, pesticide applicators, and the public on topics related to bee conservation, agricultural sustainability, and IPM in commercial horticulture, subtropical crops, and vegetable production

Extension Materials (2020-current): 16 articles in blogs, newsletters, & magazines, 8 factsheets, 261 phone calls, walk-ins, e-mails, & visits, 927 followers on social media

SELECTED GRANTS (last 5 years)

PI California Avocado Commission “A pesticide resistance monitoring program for avocado thrips” (2025-2029 \$33,500, subaward \$15,660)

co-PI CDFA Biologically Integrated Farming Systems “Improving sustainability of diamondback moth management in cruciferous vegetables” (2025-2030, \$1,000,000, subaward \$135,026)

co-PI Thelma Hansen Foundation “The effect of micro-sprinkler irrigation on predatory and pest mite populations in strawberry” (2024-2026, \$23,122)

co-PI Thelma Hansen Foundation “Influence of nitrogen application on western flower thrips populations in gerbera daisy production” (2024-2026, \$24,952)

co-PI Hrdy Foundation “Evaluation of climatic drivers of citrus pests using grower data” (2024-2028, \$125,000)

co-PI Agricultural Research Institute “Integrating vegetation into landscape scale pest management practices” (2023-2025, \$107,198, subaward \$28,000)

co-PI Agricultural Research Institute IPM “Landscape scale pest management practices in citrus and avocado” (2022-2024, \$803,635, subaward \$37,875)

PI Extension Foundation – USDA NIFA “Climate-smart landscapes” (2022, \$5,000)

BEN A. FABER

Soils/Water/Subtropical Horticulture Advisor
University of California Cooperative Extension
669 County Square Dr. Ventura, CA 93003-5404

Phone: 805-645-1462 Fax: 805-645-1474
bafaber@ucanr.edu

EDUCATION

Ph.D. Soil Fertility, University of California, Davis. 1989
M.S. Soil Fertility, University of California, Davis. 1986
A.B. Biology, University of California, Santa Cruz. 1973

RESEARCH

Research experience in pest management, plant nutrition and soil management. Current research on irrigation requirements of avocado and citrus, methods of controlling groundwater nitrate pollution, effects of yardwaste mulches on citrus production, pest and disease management in avocado and citrus, citrus rootstock evaluation and citrus weed management.

EXTENSION ACTIVITIES

2012-2015; Organized 64 grower meetings (12 of which are bi-monthly avocado grower meetings) making 106 presentations to such diverse organizations as CAPCA, PAPA, Small Farms Conference, Women in Ag, Master Gardeners, CA Avocado Society; publish quarterly newsletter (Topics in Subtropics), a blog (Topics in Subtropics) with over 400 contributions and contribute materials to four websites (Ventura River Watershed Council, UC Drought, Ventura RCD and UC Statewide MG Program).

GRANTS

2015-2020; PI or Co-PI on \$767,800 in grants from sources: Hansen Trust, Western SARE, CDFA, CA Avocado Commission, PetroCanada, UC Competitive Grants, USDA Specialty Crops, UC Riverside and Pixie Growers Ass.

SELECTED RECENT PUBLICATIONS

Frankie, GW, SL Witt, BA Faber. 2024. Hedgerow gardens provide floral resources for diverse insect visitors to avocado flower in southern California. *J Kansas Ent Soc.* 96(3): 39-67.

Faber, B., G. Frankie, J. Pawelek, M. Chase and S. Witt. 2020. Native pollinators of avocado as affected by constructed pollinator habitat gardens in southern California. *Acta Hort.* 1299. DOI.10.17660/ActaHortic.2020.1299.49

Downer, Jim and Ben Faber. 2019. Non-chemical control of *Armillaria mellea* infection of *Prunus persica*. *J Plant Sci and Phytopathology* 3: 050-055. <https://doi.org/10.29328/journal.jpssp.1001031>

Lu, Jianhang; Wu, Laosheng; Newman, Julie; Faber, Ben; Gan, Jianying. 2006. Degradation of pesticides in nursery recycling pond waters. *J. Agric. Food Chem.* 54: 2658-2663.

Lu, J., L.; Wu, J. Newman, B. Faber, D. Merhaut, and J. Gan. 2006. Sorption and Degradation of Pesticides in Nursery Recycling Ponds. *J. Env. Quality.*35: 1795-1802

Grafton-Cardwell, E.E., 20 authors and B. Faber. 2006. Citrus leafminer. UC-IPM Guidelines. UC-ANR.

Faber, B.A., G.S. Bender, H.D. Ohr and J.A. Menge. 2007. Avocado-Diseases. UC IPM Pest Management Guidelines. UC ANR Pub 3436.

Phillips, P.A., B.A. Faber, J.G. Morse and M.S. Hoddle. 2007. Avocado-Insects and Pests. UC IPM Management Guidelines. UC ANR Pub 3436.

Faber, B.A., A.J. Downer, D. Holstege and M.J. Mochizuki. 2007. Accuracy varies for commercially available soil test kits analyzing nitrate-nitrogen, phosphorus, potassium and pH. HortTechnology 17(3): 358-362.

References cited

Ávila-Quezada, G. D., Téliz-Ortiz, D., Vaquera-Huerta, H., González-Hernández, H., & Johansen-Naime, R. (2005). Progreso temporal del daño por trips (Insecta: Thysanoptera) en aguacate (*Persea americana* Mill.). *Agrociencia*, 39(4), 441-447.

- Gao, Y., Lei, Z., & Reitz, S. R. (2012). Western flower thrips resistance to insecticides: detection, mechanisms and management strategies. *Pest management science*, 68(8), 1111-1121.
- Goldarazena, A., Gattesco, F., Atencio, R., & Korytowski, C. (2012). An updated checklist of the Thysanoptera of Panama with comments on host associations. *Check List*, 8(6), 1232-1247.
- Hoddle, M. S., Morse, J. G., Phillips, P. A., Faber, B. A., & Jetter, K. M. (2002). Avocado thrips: new challenge for growers. *California Agriculture*, 56(3).
- Humeres, E. C., & Morse, J. G. (2006). Resistance of avocado thrips (Thysanoptera: Thripidae) to sabadilla, a botanically derived bait. *Pest Management Science: formerly Pesticide Science*, 62(9), 886-889.
- Immaraju, J. A., Morse, J. G., & Brawner, O. L. (1990). Evaluation of three bioassay techniques for citrus thrips resistance and correlation of the leaf dip method to field mortality. *J. Agric. Entomol*, 7(1), 17-27.
- Morse, J., Urena, A., Humeres, E., Robinson, L., Flores, P., & Watkins, P. (2006). Biology, management, and resistance monitoring of avocado thrips and perseia mite. In *Proceedings, California Avocado Research Symposium* (pp. 16-24). Santa Ana, CA: California Avocado Commission.
- Rugg, D., Buckingham, S. D., Sattelle, D. B., & Jansson, R. K. (2005). The insecticidal macrocyclic lactones.

Item 8. Consider additional funding request for mowing needs for project “Creating a weather station network to guide irrigation decision of avocados”

CAC is currently funding a project with Andre Biscaro, UC Irrigation and Water Resources Management Farm Advisor, to investigate the minimum grass area size necessary around a weather station to collect accurate data. The ultimate goal of the project is to establish a lower cost, more diverse weather station network for growers compared with the current CIMIS network.

Andre has signed memoranda of understanding with organizations (Limoneira and Fillmore School) to host weather stations. In addition, a more traditional setup with a 4-acre grass field will be established at the UC’s new Hansen Agricultural Research and Extension Center in Camarillo. However, the HAREC does not have the equipment needed to maintain the grass area around the weather station.

Andre is requesting if CAC can fund the purchase of a mower to maintain the grass, with the HAREC providing the labor and maintenance of the equipment. The cost of the mower is \$13,789.97.

Another option is to hire a contractor to mow the site as needed. Sierra Pacific Farms, Inc has provided a quote for mowing at a rate of \$650 per mowing. Assuming 24 mowings per year, the annual cost of mowing would be \$15,600.

Customer:

Quotes are valid for 30 days from the creation date or upon contract expiration, whichever occurs first.

A Purchase Order (PO) or Letter of Intent (LOI) including the below information is required to proceed with this sale. The PO or LOI will be returned if information is missing.

Vendor: Deere & Company

2000 John Deere Run

Cary, NC 27513-2789 US

FED ID: 36-2382580

UEID: FNSWEDARMK53

Signature on all LOIs and POs with a signature line

Contract name or number; or JD Quote ID

Sold to street address

Ship to street address (no PO box)

Bill to contact name and phone number

Bill to address

Bill to email address (required to send the invoice and/or to obtain the tax exemption certificate)

Membership number if required by the contract

Quotes of equipment offered through contracts between Deere & Company, its divisions and subsidiaries (collectively "Deere") and government agencies are subject to audit and access by Deere's Strategic Accounts Business Division to ensure compliance with the terms and conditions of the contracts.

For any questions, please contact:

ALBERT CENDEJAS

Cal-Coast Machinery, Inc.

2450 Eastman Avenue

Oxnard, CA 93030

Work Phone: 1-805-207-9006

Cell Phone: 1-805-207-9006

Email: albertcendejas@jdccm.com



ALL PURCHASE ORDERS MUST BE MADE OUT TO (VENDOR):

Deere & Company
2000 John Deere Run
Cary, NC 27513-2789 US
FED ID: 36-2382580
UEID: FNSWEDARMK53

ALL PURCHASE ORDERS MUST BE SENT TO DELIVERING DEALER:

ALBERT CENDEJAS
Cal-Coast Machinery, Inc.
2450 Eastman Avenue Oxnard, CA 93030

Prepared For

UNIVERSITY OF CALIFORNIA
HANSEN AG CENTER
5352 BEARDSLEY RD
CAMARILLO, CA 930108332
(805) 645-1467
SPGOMEZ@UCANR.EDU

Prepared By

ALBERT CENDEJAS
Cal-Coast Machinery, Inc.
2450 Eastman Avenue
Oxnard, CA 93030
1-805-207-9006
albertcendejas@jdccm.com

Quote Id 2040794

Creation Date 05-May-2026

Expiration Date 04-Jun-2026

Quote Summary

Equipment Summary	Suggested List	Selling Price	QTY In Group	Extended
Z955M EFI ZTrak California	\$17,899.96	\$13,782.97	1	\$13,782.97
Equipment Total				
				\$13,782.97

Contract: Sourcewell Grounds Maint 112624-DAC (PG NB CG 70)
Price Effective Date: 04-May-2026

Quote Summary

Total Selling Price	\$13,782.97
Ventura County - Ag - (2.75%)	\$379.03
Sub-total	\$14,162.00
*Total Non-Taxable Equipment Fees	\$7.00
Balance Due	\$14,169.00

Salesperson : X _____

Accepted By : X _____



Selling Equipment

Quote # 2040794
Customer UNIVERSITY OF CALIFORNIA HANSEN AG CENTER

Z955M EFI ZTrak California

QTY In Group : 1

Hours	---	Suggested List
Serial Number	---	\$17,899.96
Stock Number	---	Selling Price
Contract	Sourcewell Grounds Maint 112624-DAC (PG NB CG 70)	\$13,789.97
Price Effective Date	04-May-2026	Discount Amount
PUK Parent Serial #		(\$4,116.99)

Equipment Summary

Code	Description	Qty	List Price	Discount %	Discount \$	Adjusted Selling Price
2524TC	Z955M EFI ZTrak California	1	\$16,949.00	23.0%	(\$3,898.27)	\$13,050.73

Base / Options

Code	Description	Qty	List Price	Discount %	Discount \$	Adjusted Selling Price
001A	United States /Canada	1	\$0.00	23.0%	\$0.00	\$0.00
1504	60 In. Side Discharge Mower Deck	1	\$0.00	23.0%	\$0.00	\$0.00
2093	Fully Adjustable Suspension Seat with Armrests (24" High Back)	1	\$595.00	23.0%	(\$136.85)	\$458.15
1036	24x12x12 Pneumatic Turf Tire for 54 In. and 60 In. Decks	1	\$0.00	23.0%	\$0.00	\$0.00
Total Base / Options			\$17,544.00		(\$4,035.12)	\$13,508.88

Dealer Attachments

Code	Description	Qty	List Price	Discount %	Discount \$	Adjusted Selling Price
TCB10953	Mulch Kit (1524-mm (60-in.) 7Iron, 7Iron II and 7Iron PRO) Serial Number: --- Stock Number: ---	1	\$303.48	23.0%	(\$69.80)	\$233.68



JOHN DEERE

AM115838	Spark Arrester Screen Serial Number: - - - Stock Number: - - -	1	\$52.48	23.0%	(\$12.07)	\$40.41
Total Dealer Attachments			\$355.96		(\$81.87)	\$274.09
Selling Price Subtotal						\$13,782.97
CA Tire Fee						\$7.00
Total Selling Price			\$17,899.96		(\$4,116.99)	\$13,789.97



Flat Fee Management Program
California Avocado Commission – Weather Station Site
5352 Beardsley Road, Camarillo

May 21, 2026

Presenting a flat fee proposal of \$650 per mow, expecting to mow 2 times per month.

This includes the following:

- Mowing of grass surrounding weather station
- Weed whacking around sprinklers
- Disposal of grass clippings

This does not include:

- Herbicide treatment
- Fertilizer

Items outside of the scope of work, upon request, would be billed on a time and material basis.

We are excited for the opportunity to work with you. If you would like to proceed with our services, sign below.

* This cost estimate is provided as my opinion or the opinion of Sierra Pacific Farms, Inc. and is based on sources which we believe to be reliable. Our opinions are not representations, guarantees, or warranties. Sierra Pacific expressly disclaims representations, guarantees, or warranties including warranties of merchantability, whether express or implied, regarding the opinions, services, materials, information, or data to be furnished by Sierra Pacific to Owner as a part of this communication or otherwise.

NAME

DATE

Request for One-Year Project Extension

Project contract number: 65325-00-000

Project title: *Does artificial pollination improve yield of 'Hass' and 'GEM' avocado?*

Project start date: January 2025

Revised Project end date: September 2028

Project Leader: Mary Lu Arpaia

Position Title: Professor of Extension

Research Institution: University of California, Riverside, Department of Botany and Plant Sciences, 900 University Ave, Riverside, CA 92521

Primary Telephone Contact Number: 559-288-8507 (cell)

E-mail Address: mlarpaia@ucanr.edu

Collaborators: Inaki Hormaza, Instituto de Hortofruticultura Subtropical y Mediterránea "La Mayora" (IHSM La Mayora- CSIC-UMA, Avda Dr. Wienberg s/n. 29750 Algarrobo, Málaga – Spain

Marllon Fernando Soares dos Santos, University of California, Riverside, Department of Botany and Plant Sciences, 900 University Ave, Riverside, CA 92521

Justification for 1-Year Extension (07/01/2027 – 06/30/2028)

The current funded project has generated the most extensive datasets currently available under commercial California avocado production systems involving artificial pollination technologies, flowering dynamics, fruit set, and yield responses under highly heterogeneous orchard conditions. Across the 2025 and 2026 seasons, the project expanded from the originally proposed four orchards to seven commercial orchards distributed across Ventura County to better capture the substantial environmental and biological variability naturally present in avocado production systems.

This expansion was necessary because avocado production is strongly influenced by multiple interacting factors that cannot be fully controlled experimentally under commercial conditions. These include orchard age, rootstock-scion combinations, local management practices, climatic variability, and flowering behavior. The orchards included in the project range from approximately 3- to 6-year-old trees and involve multiple rootstocks, including Dusa, Duke 7, and Toro Canyon. Furthermore, the project includes both 'Hass' and 'GEM' varieties, allowing broader evaluation across commercially important cultivars, although responses may still differ in additional avocado varieties not evaluated in the current study.

Ventura County itself presents substantial microclimatic variation. Temperature differences exceeding 18°F may occur between orchards located a few miles apart, directly affecting flowering synchronization, pollen viability, pollinator activity, fruit set, and final yield responses. In addition, each orchard presents unique local management practices involving fertilization

programs, irrigation management, pruning history, pest control programs, and other cultural practices that may substantially influence productivity and treatment responses.

One of the major scientific challenges associated with avocado research is the naturally high alternate bearing behavior of the crop together with its strong interaction with climatic events such as El Niño and La Niña. These climatic conditions may shift flowering timing by up to one month between years as well as affecting the length of the flowering season substantially affecting overlap between male and female flower stages, fruit set dynamics, and productivity. Because of this, avocado experiments generally require multiple production cycles before robust conclusions can be made. Scientifically, evaluation across at least four harvest seasons (two cycles of on/off years) would be ideal to properly capture the natural biological variation associated with the crop.

The incorporation of the BloomX electrostatic pollination system during the 2026 season further reinforces the need for an extension of the project. Due to logistical delays associated with the current geopolitical situation involving Israel, where the company is headquartered, the BloomX equipment arrived later than originally planned. As a result, the first applications in several orchards were delayed relative to the remaining three treatments. Although the applications were ultimately standardized operationally, the delayed incorporation of the technology may influence the interpretation of the first-year BloomX results. Under these conditions, drawing definitive conclusions based on a single production season could generate scientifically misleading interpretations and potentially create unintended impacts for current commercial operations and technology adoption decisions.

The variability observed in the current dataset strongly supports the need for an additional season of evaluation which would provide the California industry with 3 years of data. Preliminary analyses from Year 1 (2025 applications) examined 639 trees and more than 11 metric tons of harvested fruit. We observed extremely high biological variability among orchards and treatments. Coefficients of variation (CV) ranged from 32.59% to 167.85% for fruit number per tree and from 31.41% to 146.01% for total fruit weight. Similarly, standard errors ranged from 4.39 to 65.72 fruits per tree and from 0.79 to 15.84 kg for total fruit weight. In practical terms, the CV reflects how variable individual trees were within each treatment at an individual location, whereas the standard error reflects the uncertainty associated with estimating the treatment average. The higher the value for both CV and SE, the greater the uncertainty in the data. Additionally, the dataset contains a substantial excess of zero values, with 5% of the trees producing no fruit during the 2026 harvest; and an additional 13% of the trees yielding less than 5 fruit per tree for a total of 18% of the 639 data trees with extremely low yield. These characteristics indicate a high heterogeneous biological response typical of avocado production systems under commercial field conditions.

Under this level of variability, interpretation based solely on arithmetic means may lead to incorrect conclusions regarding treatment effectiveness. Even with a relatively large experimental scale involving seven orchards, 639 evaluated trees, and approximately 11 tons of harvested fruit, substantial uncertainty remains due to the natural variability of the avocado production systems. Therefore, long-term sampling combined with robust statistical analyses is

essential to correctly interpret treatment responses while minimizing the risk of inaccurate recommendations.

Additionally, future paternity analyses represent a critical component of the project and will provide essential information regarding pollen donor origin and the effectiveness of each pollination technology under commercial orchard conditions. Ideally, paternity testing should also be conducted across multiple years to ensure consistency and biological reproducibility of the observed results. We collected embryo samples from all treatments for each site in 2026. Continuation for an additional year will give us 3 years of paternity results and result in a robust data set, allowing us to draw meaningful conclusions from the data.

Based on the scientific, biological, operational, and statistical considerations described above, we respectfully request a one-year extension of the project through September 2028. Data collection (yield data) should be completed by June of 2028 and we are requesting an additional 3 months to complete paternity analysis, data analysis and preparation of the final report. This will provide the California avocado industry with 3 years data regarding the BioPollen and Dusting treatments and 2 years data regarding the BloomX treatment. This additional year is essential to ensure that any future recommendations provided to growers and industry stakeholders are supported by sufficiently replicated and biologically reliable data.

Objectives of the Research:

- Evaluate the effectiveness of three artificial pollination systems in improving fruit set, increasing productivity and fruit quality.
- Measure the costs associated with using technologies.

Deliverables:

- The data from this project will assist producers in decision-making regarding the selection of the best artificial pollination technology, either as a complement to or replacement for the use of honey bees, potentially reducing the costs associated with pollination processes. Additionally, the most effective technology could serve as a valuable tool in mitigating the impacts of adverse climate conditions during California’s flowering season.

REVISED Milestone Table:

The following Milestone Table outlines the activities associated with the Project and scheduled completion dates from the onset of the project. **Additional milestones are highlighted in RED and are listed chronologically in terms of completion dates.**

Milestone	Activities	Scheduled Completion	Budget
1	<ul style="list-style-type: none"> • Select cooperating orchards and develop the experimental design. • Apply three artificial pollination technologies • Evaluate flowering intensity at trial sites 	May 2025	\$31,360

	<ul style="list-style-type: none"> Evaluate pollen viability and germination for the three different technologies, quantify pollen germination in vitro and pollen germination and pollen tube-growth in vivo. 		
2	<ul style="list-style-type: none"> Evaluate fruit set and fruit drop 3 months post treatment. Evaluate fruit set and fruit drop 5 months post treatment 	October 2025	\$31,359
Year 1 Total:			\$62,719
Year 2			
3	<ul style="list-style-type: none"> Apply three artificial pollination technologies Evaluate flowering intensity at trial sites Evaluate pollen viability and germination for the three different technologies, quantify pollen germination in vitro and pollen germination and pollen tube-growth in vivo. 	May 2026	\$31,058
4	<ul style="list-style-type: none"> Evaluate fruit set and fruit drop 3 months post treatment. Evaluate fruit set and fruit drop 5 months post treatment Harvest trial plots and collect yield and fruit size data 	October 2026	\$31,058
Year 2 Total:			\$62,116
Year 3			
5	<ul style="list-style-type: none"> Apply four artificial pollination technologies Evaluate flowering intensity at trial sites Collect samples for pollen viability and germination for the three different technologies, quantify pollen germination in vitro and pollen germination and pollen tube-growth in vivo. Initiate examination of samples. 	May 2027	\$16,398
6	<ul style="list-style-type: none"> Harvest trial plots and collect yield and fruit size data Conduct paternity testing to determine the percentage of origin of the fruits. 	June 2027	\$47,990
Year 3 Total			\$64,388

Year 4 (ONE YEAR EXTENSION)			
7	<ul style="list-style-type: none"> Evaluate fruit set and fruit drop 3 months post treatment. Evaluate fruit set and fruit drop 5 months post treatment Complete evaluation of microscope work on pollen deposition and pollen tube growth in response to pollination treatments 	October 2027	\$46,543
8	<ul style="list-style-type: none"> Harvest trial plots and collect yield and fruit size data Conduct paternity testing to determine the percentage of origin of the fruits 	June 2028	\$31,543
9	<ul style="list-style-type: none"> Compile data and prepare final report 	September 2028	\$15,000
Year 4 Total			\$93,086
REVISED Total Project Budget:			\$282,3

**Project Proposal Budget
FY 2025 - 2028**

	ORIGINAL PROPOSAL			ONE YEAR EXTENSION
	Year 1 01/01/2025 – 12/31/2025	Year 2 01/01/2026 – 12/31/2026	Year 3 01/01/2027 – 06/30/2027	Year 4 07/01/2027– 09/30/2028
Salaries and Benefits				
Postdocs/Research Associates	34,605	35,746	18,463	45,452
SRAs	0	0	0	0
Lab/Field Assistance	0	0	0	0
Benefits	7,717	7,971	4,117	21,635
Supplies and Expenses	2,000	2,000		2,000
Equipment	0	0	0	0
Services (Paternity Analysis)	0	0	24,000	24,000
Travel to research sites	16,398	16,398	1,409	16,398*
Other Travel	0	2,000	0	
Annual Total Amount Requested	\$60,719	\$64,116	\$47,989	\$109,485
REVISED TOTAL AMOUNT REQUESTED	\$172,825 ORIGINAL TOTAL AMOUNT ALLOCATED			\$282,309

* See budget justification (Travel) for explanation.

Budget Justification for 1-Yr Extension covering Milestones 5,7, 8.

The requested budget for the 1-Yr Extension covers new expenses that will be incurred during the current project timetable (Milestone 5) which are necessary to complete Milestones 7 and 8. The budget for Milestone 5 (Year 3) is \$16,398. The budget for Milestones 7 and 8 is \$93,087.

Salary: Funds are requested to cover 0.50 FTE time for Assistant Project Scientist, Marllon Fernando Soares dos Santos. Dr. Soares dos Santos will continue to be responsible for the day-to-day oversight of the harvest activities across the proposed research sites during the 2028 production season, including coordination of fruit harvest, individual tree yield evaluations, fruit counting, organization of field datasets, and statistical analyses associated with the project. He will also coordinate with Dr. Hormaza on the paternity analysis workflow and integration of the production and molecular datasets. Salary projections are based on recommendations by our campus administrative officials for merit and range adjustments.

Benefits: Fringe benefits are calculated according to current University of California benefit rates and institutional recommendations associated with Assistant Project Scientist appointments.

Travel: Travel funds are requested to support field activities associated with the 2027 pollination season (Milestone 5), final experimental evaluations across seven commercial avocado orchards located throughout Ventura County, California, and harvest of the research sites (Milestones 7, 8). The funds originally allocated for travel in Year 3 (\$1,409) will be applied to the travel expenses occurred in the completion of Milestones 5, 7 and 8. Additional funds (similar to Years 1 and 2) are also requested to reflect a general increase in cost in fuel, lodging and food. We estimate that the total cost of travel for Year 3 (with extension) and Year 4 will be \$17,807.

Due to the geographic distribution of the orchards and the operational requirements associated with individual tree harvest assessments, multiple overnight trips will be required. Based on previous harvest evaluations, each orchard is expected to require approximately three field days, resulting in an estimated total of 21 field days distributed throughout the harvest season. Travel activities will include repeated round trips between Riverside and Ventura County, in addition to daily transportation between orchards and lodging locations. Lodging expenses are estimated at approximately \$1,300 to \$1,500 (room rental) per month during the harvest evaluation period, depending on seasonal availability. Per diem expenses are estimated at approximately \$65 per day to cover meals and field-related operational costs during travel periods. Additional travel expenses include UC vehicle leasing costs estimated at approximately \$109 per day, fuel expenses, and transportation between orchards. Travel is essential due to the extensive geographic distribution of the orchards, the large volume of harvested fruit and individual tree evaluations, and the time-sensitive nature of avocado harvest operations, where harvest notifications are often provided with limited advance notice.