CALIFORNIA AVOCADO COMMISSION
PRODUCTION RESEARCH COMMITTEE
MEETING MINUTES

October 29, 2024

A meeting of the Production Research Committee (PRC) of the California Avocado Commission (CAC) was held on Tuesday, October 29, 2024, with the following people participating:

MEMBERS PARTICIPATING:
Danny Klittich, Chair
Jim Davis (8:08)
Consuelo Fernandez
Darren Haver
Leo McGuire
Daryn Miller

CAC STAFF PARTICIPATING:
Ken Melban

OFFICIALLY PARTICIPATING:
Dr. Tim Spann, Spann Ag Research & Consulting
Mary Lu Arpaia, UC Riverside
Marllon Soares dos Santos, UC Riverside

GUESTS PARTICIPATING:
John Berns
Ben Faber
Rachael Laenen

CALL TO ORDER

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

OPPORTUNITY FOR PUBLIC COMMENT

There were no public comments.

APPROVAL OF MINUTES OF SEPTEMBER 13, 2024 PRODUCTION RESEARCH COMMITTEE MEETING

MOTION
To approve the minutes of the September 13, 2024 Production Research Committee meeting.

(Miller/Haver) MSC Unanimous

Motion 24-10-29-1

RESEARCH PROGRAM DIRECTOR'S REPORT

Dr. Spann updated the Committee on CAC's efforts to get a Special Local Needs (SLN) registration for a glufosinate-ammonium herbicide since BASF stopped manufacturing Rely. CAC was successful in receiving an SLN registration for Forfeit, manufactured by Loveland Products, effective October 15, 2024, and valid through October 31, 2029.

Dr. Spann then updated the Committee on responses to date on the request for concept proposals that was sent out to the research community. As of the meeting date, only a couple of concept proposals had been received. Dr. Spann stated that a reminder email would go out in mid-November to encourage researchers to submit their concept proposals by December 31. It was requested that an email be sent to Cal Poly San Luis Obispo specifically requesting a proposal from them for updated production cost studies.

Lastly, Dr. Spann informed the Committee that member John Burr had resigned from the Committee citing health reasons.

ACTION ITEMS

A. Consider research proposal, "Does artificial pollination improve yield of 'Hass' and 'GEM' avocado?"

Dr. Mary Lu Arpaia briefly summarized the submitted proposal for the Committee. There are two companies, BioPollen and BloomX, who have developed artificial pollination systems for avocados that are beginning to be marketed to growers in California. However, there are currently no independent data to confirm or refute the companies' claims about these technologies. This project would compare these two technologies with the "pollen dusting" method that has been used in California for many years along with untreated controls. The study would collect data on yield, fruit size, and fruit parentage to determine if any potential yield increase is from the applied pollen or some other factor. Furthermore, this project would take advantage of Dr. Inaki Hormaza (Spain) being on sabbatical in California in 2026 to conduct the paternity testing portion of the project.

Discussion ensued, with questions being asked about the application method, would it be ground or aerial? Dr. Arpaia stated that currently both systems use a ground-based application system. The pollen source used was also questioned. Dr. Arpaia indicated that in South Africa where the companies have conducted some trials, Zutano pollen was used, but the pollen used in the California studies would be collected locally from the best available local pollenizer variety following each companies recommended protocols.

A question was asked about how these technologies may interact with gibberellic acid (GA) applications. A lengthy discussion ensued on this topic with the conclusion that it

would be premature to consider GA applications in the current project. However, if one or both technologies proved effective, it would be beneficial to conduct a follow up study to determine if there would be any benefit to making a GA application along with these systems.

The Committee agreed that the proposal was a well-developed project that would determine if these systems are effective and the data would come from a neutral party not associated with the companies.

MOTION
To recommend funding the proposal as submitted for $172,825 over three years.

(McGuire/Haver) MSC Unanimous

Motion 24-10-29-2

ADJOURN MEETING

Danny Klittich, Production Research Committee (PRC) Chairman, adjourned the meeting at 8:41 a.m.

Respectfully submitted,

Timothy Spann
Timothy Spann

EXHIBITS ATTACHED TO THE PERMANENT COPY OF THESE MINUTES

EXHIBIT A September 13, 2024 Production Research Committee AB 2720 Roll Call Vote Tally Summary

EXHIBIT B Proposal: Does artificial pollination improve yield of ‘Hass’ and ‘GEM’ avocado?

CALIFORNIA AVOCADO COMMISSION
Production Research Committee
AB 2720 Roll Call Vote Tally Summary

To be attached to the Meeting Minutes

Meeting Name:	**Meeting Location:**	**Meeting Date:**
California Avocado Commission Production Research Committee Meeting	*Hybrid* *In-person – Ventura County Cooperative Extension Office, Ventura* *Online – Zoom*	*October 29, 2024*

Attendees Who Voted	***MOTION 24-10-29-1***	***MOTION 24-10-29-2***
Danny Klittich, Chair	*Did not vote*	*Did not vote*
Jim Davis (8:08)	*Absent*	*Yea*
Consuelo Fernandez	*Yea*	*Yea*
Darren Haver	*Yea*	*Yea*
Leo McGuire	*Yea*	*Yea*
Daryn Miller	*Yea*	*Yea*
Outcome	***Unanimous***	***Unanimous***

Proposal Title: Does artificial pollination improve yield of 'Hass' and 'GEM' avocado?

Principal Investigators: Mary Lu Arpaia[1], Iñaki Hormaza[2], Marllon Fernando Soares dos Santos[3]
[1 3] University of California, Riverside. Dept. of Botany and Plant Sciences, 900 University Ave, Riverside, CA 92521. mlarpaia@ucanr.edu marllons@ucr.edu
[2] Instituto de Hortofruticultura Subtropical y Mediterránea "La Mayora" (IHSM La Mayora- CSIC-UMA, Avda Dr. Wienberg s/n. 29750 Algarrobo, Málaga - Spain. ihormaza@eelm.csic.es (see attached letter of collaboration)

Total Budget Requested: $172,825
Estimated Duration: 2.7 years (11/01/2024 – 06/30/2027)

Project Abstract

Identify the issue or problem, describe the work proposed and describe how the work proposed will significantly help solve the issue or problem for California avocado growers.
Pollination efficiency in avocado trees, especially in the 'Hass' and 'GEM' varieties, is crucial to maintaining productivity, as avocado flowers have mechanisms that limit self-pollination. To ensure satisfactory production levels, California growers often transport large numbers of honey bee hives to their orchards during full bloom to ensure adequate pollination. However, adverse weather conditions during flowering can significantly affect the process. Alternatively, artificial pollination has been successfully applied in several crops, showing promising results. Therefore, this project aims to compare three artificial pollination technologies ('BioPollen Method', 'BloomX Ltd Method' and 'Pollen Dusting Method'), together with a control group that will rely exclusively on natural pollination with honey bees. The study will be conducted in fourorchards located in Ventura County. The proposal aims to evaluate the effectiveness of each technology in improving fruit set, increasing productivity and fruit quality, as well as to measure the costs associated with the technologies. These technologies are expected to promote higher fruit set and overall yield. Expected outcomes include providing California avocado growers with a cost-effective addition to the growers' tool kit that increases orchard productivity while reducing reliance on honey bees and mitigating the negative effects of adverse conditions during full bloom.

Proposed Objectives and Milestones:

A) Experimental design and application of three artificial pollination technologies (' BioPollen Method,' 'BloomX Method,' and 'Pollen Dusting Method') compared to an untreated control with honey bees (4 hives per acre) only over the California flowering season (March 2025 – March 2026) total of three applications with a 7-day interval. **Timeline: 01/01/25 – 05/01/25 and 01/01/26 – 05/01/26**
B) Evaluate the intensity of flowering at the three locations during the California blooming season (March 2025 – March 2026), with a total of four evaluations at 7-day intervals. **Timeline: 03/01/25 – 05/01/25 and 03/01/26 – 05/01/26.**
C) Evaluate pollen viability and germination for the three different technologies, quantify pollen germination *in vitro* and pollen germination and pollen tube-growth *in vivo*. **Timeline: 2025 and 2026 flowering seasons (approximately February – May).**
D) Evaluate fruit set and fruit drop three and five months after flowering, and yield (kg/plant) and fruit size grade when fruit reach commercial maturity. **Timeline: 03/01/25 – 04/30/27.**
E) Paternity test to determine the % of origin of the fruits (self versus cross fertilization and determination of the male parent in cross-fertilized fruits). This will be conducted on Year 3 from fruit set if the flowering period of Year 2. Fruits will be sampled ~January 2027 for testing. **Timeline: 01/01/25 – 04/30/27.**
F) Compilation of data and preparation of final report. **Timeline: 01/01/27 – 06/30/27**

List the set of tasks that comprise each objective (work plan).

Objective A.
Four sites (2 'Hass' and 2 'GEM') in Ventura County will be used in the research. Ideally, we will want to find solid blocks of trees with no pollinizers nearby. In each orchard, sufficient rows of trees will be selected for each treatment. There will be 4 treatments: a) untreated control (honeybees only); b) 'BioPollen' Method'; c) 'BloomX' Method; and d) 'Dusting' Method. The actual experimental design (i.e. number of rows) will be site specific depending on row length and tree spacing. A minimum of

2 rows buffer between treatments will be used. However, spray drift will be a consideration, for example the 'BioPollen' treatment requires a ~450 foot buffer between it and other treatments. Fifteen trees per treatment per site will be monitored. These will be selected from the innermost rows of each treatment. For instance, if a treatment occupies 4 rows, the 2 innermost rows will be used for data collection. The application of treatments will occur at intervals recommended by each company, totaling three applications (beginning, middle, and end) during the flowering period. The applications will follow the specific methodologies for each technology.

Objective B.

The flowering intensity will be measured using the BBCH methodology, which divides the main phenological stages of avocado cultivation, identifying the exact moment for treatment application and its interaction with flowering intensity, which may vary between orchards. The 15 preselected trees per treatment within each orchard and treatment will be monitored weekly.

- Alcaraz, M. L., Thorp, T. G., & Hormaza, J. I. (2013). Phenological growth stages of avocado (Persea americana) according to the BBCH scale. Scientia Horticulturae, 164, 434-439.

Objective C.

For viability, a fluorochromatic reaction based on fluorescein diacetate (FDA) will be used, and pollen germination will be assessed in vitro following all the criteria proposed in the methodology of Alcaraz et al. 2011. Pollen load on the stigma will be evaluated through fluorescent microscopy, where a minimum of 100 flowers will be collected after the application of treatments at each stage (female and male) and fixed in formaldehyde, alcohol, acetic acid (FAA) to visualize the pollen grains on the stigma and growing pollen tubes in the style. This work will be conducted at UC Riverside.

- Alcaraz, M. L., Montserrat, M., & Hormaza, J. I. (2011). In vitro pollen germination in avocado (Persea americana Mill.): Optimization of the method and effect of temperature. Scientia Horticulturae, 130(1), 152-156.

- Heslop-Harrison, J., & Heslop-Harrison, Y. (1970). Evaluation of pollen viability by enzymatically induced fluorescence; intracellular hydrolysis of fluorescein diacetate. Stain technology, 45(3), 115-120.

Objective D.

Effective fruit set will be calculated by the ratio of the estimated number of flowers per plant to the number of fruits produced in order to understand if the treatments can interfere with the number of fruits set, as well as generate estimates of fruit production per plant and per area. All fruit per tree on the 15 data trees per treatment will be harvested at time of commercial maturity. Total fruit weight and total fruit count will be measured. Ten fruits per tree (total 150 fruit) from each treatment will be randomly sampled to determine size by weight. We will work with each cooperator to collect individual tree yield data for each of the selected data trees as well as total row yield and packout if possible.

Objective E.

Parentage will be determined through DNA extraction and microsatellite analysis to verify the origin of the fruit (whether from cross-fertilization or self-fertilization and determination of the male parent in cross-fertilized fruits) by analyzing the amplified fragments through PCR.

- Sharon, D., Cregan, P. B., Mhameed, S., Kusharska, M., Hillel, J., Lahav, E., & Lavi, U. (1997). An integrated genetic linkage map of avocado. Theoretical and Applied Genetics, 95, 911-921.

- Alcaraz, M. L., & Hormaza, J. I. (2011). Influence of physical distance between cultivars on yield, outcrossing rate and selective fruit drop in avocado (Persea americana, Lauraceae). Annals of Applied Biology, 158(3), 354-361.

Describe how the project will be managed if there are delays, unexpected results, failures, etc.

The experimental design includes the selection of 4 orchards with a large sample size for each experiment, taking into account potential unforeseen issues related to project development and its replicability.

Does the researcher have access to the appropriate materials, facilities, equipment or other inputs needed to complete the proposed work?

YES, all project members have adequate resources to carry out all stages of the project.

Relevant experience of the research team.

Dr. Arpaia has a long history of developing avocado breeding in California, with a focus on extension and teaching at the University of California. She manages one of the largest collections of avocado germplasm in the world and has created new cultivars. She has also been involved in projects examining avocado pollination both in California and Chile. Dr. Hormaza is an expert in genetics, focusing on reproductive biology and temperature interactions in floral organs such as anthers, stigmas, pollen, etc., with many studies on the implications of avocado breeding on reproductive biology in fertilization and fruit set. Dr. Santos has expertise in pomology and robust statistical approaches in avocado flowering, conducting research on this topic at the University of California.

Roles and Responsibilities of each research team member for the proposed project.

The work will be conducted at the UC Riverside (UCR) with assistance from Dr. Arpaia and Dr. Hormaza's research groups. We will work closely with the commercial pollination providers to ensure that treatments are properly applied.

A. Project Planning: Arpaia, Hormaza, and Santos will share this responsibility.
B. Project Execution: Arpaia, Hormaza, and Santos will share this responsibility.
C. Project Data Summation and Analysis: Arpaia's team will be responsible for data summation and statistical analysis. For the paternity test, Hormaza's team and Santos will be responsible.
D. Project Report: Dr. Arpaia's team will take the lead in preparing the project report, in collaboration with Dr. Hormaza's team.

Expected Results

The project results should be implementable at the conclusion of this project. 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.

Impacts for the California Avocado Industry

California's avocado industry can benefit from choosing the pollen application technology that offers the best cost-benefit ratio for increasing productivity. The industry can benefit from supplementing pollen offered by the artificial pollination process, providing greater fruit-set and ensuring better production results. This practice which will augment the current practice of using honey bees could help to sustain the financial viability of California avocado growers.

Indicate if a commercial partner(s) has been identified or involved in this proposal?

BioPollen Solutions (Chile); see attached letter of collaboration
BloomX Ltd. (Israel); see attached letter of collaboration

Project Proposal Budget
FY 2025 - 2027

	Year 1 11/01/2024 – 10/31/2025	Year 2 11/01/2025 – 10/31/2026	Year 3 11/01/2026 – 06/30/2027
Salaries and Benefits			
Postdocs/Research Associates	34,605	35,746	18,463
SRAs	0	0	0
Lab/Field Assistance	0	0	0
Benefits	7,717	7,971	4,117
Supplies and Expenses	2,000	2,000	
Equipment	0	0	0
Services (Paternity Analysis)	0	0	24,000
Travel to research sites	16,398	16,398	1,409
Other Travel	2,000	0	0
Annual Total Amount Requested	***$62,719***	***$62,116***	***$47,989***
TOTAL AMOUNT REQUESTED	**$172,825**		

Budget Justification

Salary: Funds are requested to cover 0.50 FTE time for Post-Doctoral Scholar, Marllon Fernando Soares dos Santos. Dr. Santos will be responsible for the day-to-day oversight of the project activities at the proposed research sites and microscopic work to determine pollen load and tube growth. He will also coordinate with Dr. Hormaza on the paternity analysis. Salary projections are based on recommendations by our campus administrative officials for merit and range adjustments.

Benefits: Fringe benefits rates are calculated as a percentage of the gross salary and are based on campus recommendations.

Supplies: We are requesting funding for supplies, including fluorescein diacetate (FDA) for the fluorochromatic reaction and pollen viability observation. For germination, the acquisition of materials for culture media preparation and plates for analyzing pollen germination and tube growth will be required. The evaluation of pollen load on the stigma will require the purchase of historesin, formaldehyde, alcohol, acetic acid, as well as microscope slides and coverslips for sample preparation. Microscopes and a microtome will be provided by UCR.

Services: Paternity analysis will be conducted in Spain, at an estimated cost of $15 per sample. With 4 sites x 4 treatments x 100 fruit per treatment the estimated cost of paternity analysis is $24,000.

Travel: Travel funds are requested to cover the travel of Dr. Santos on a weekly basis to the research sites in Ventura in Years 1 and 2. Each trip will comprise of a 2 or 3 day trip with one or two overnight stays at a local hotel. We will lease a UC Vehicle for each trip for six months per year since this is less expensive than renting a car on a daily basis. The lease price is $663 per month x 6 months = $3,978. Additionally, we must cover the cost of fuel. We estimate ~400 miles per trip with 25 miles per gallon = 16 gallons at $4.50 per gallon = $72 per trip. Estimated fuel cost per year = $72 x 25 = $1,800. In Year 3, travel will be limited to the collection of the paternity sample (2 days) and yield data (1 days per site = 4 days) for a total of $389.

We estimate a total of 25 trips to Ventura County and lodging cost of $180 per night and $60 per day per diem each year. We estimate that 12 trips will be 1 night stay and 13 trips will be 2 night stay. Costs per year for hotel = $180 x 38 nights = $6,840 and per diem = 12 trips of 2 days (24 days) + 13 trips of 3 days (39 days) x $60 = $3,780. In Year 3 there would be 2 trips (1 trip = 2 days; 1 trip = 4 days) for a total of 4 hotel stays and 5 per diem days for a total of $1,020.

Other travel: We request $2,000 for airfare for Dr. Hormaza in Year 1 to participate in the research program.