



AGENDA

**California Olive Committee
Research Subcommittee Meeting
San Joaquin County Ag. Commissioner Office
2101 E. Earhart Ave.
Stockton, CA 95206
Zoom/Conference Call**

**August 7, 2024
9:00 AM**

Join Zoom Meeting:

<https://us02web.zoom.us/j/88631846244>

Dial-in:

+1669-900-6833

Meeting ID: 886 3184 6244

- I. Call to Order-Chairman Dennis Burreson**
 - a. Roll Call page 2
 - b. Research Subcommittee Chairman's comments
 - c. Approval of December 7, 2023 Minutes (action item) page 3
- II. Review of 2023 Research Final Reports** page 10
- III. Update on CA Specialty Crop Block Grant Projects** page 40
- IV. Product Registration Update** page 41
- V. Discussion and Approval of 2025 Research Priorities** (action item) page 43
- VI. Other Business**
- VII. Adjournment**



2023-2025 Research Subcommittee:

Producer Members:

Carolina Burreson
Michael Silveira
Kevin Neeley
Andy Weinrich
Michael Stokes
Vito DeLeonardis
Giulio Zavolta
Pat Ricchiuti
Galen Pfeiffer
Mark Heuer

Handler Members:

Dennis Burreson-Chairman
John Pieretti
Tomas Masanes Autard
Julia Tinsley
Phil Quigley
Vacant



California Olive Committee

Research Subcommittee Meeting

DECEMBER 7, 2023

10:30 am

Zoom/Conference Call

<http://US02web.zoom.us/j/8647441964>

MINUTES

I. CALL TO ORDER

A meeting of the Research Subcommittee Meeting was called to order by Mike Silveira at 10:32 a.m. and the following members were present:

Members

Michael Silveira
Kevin Neeley
Andy Weinrich
Michael Stokes
Vito DeLeonardis
Giulio Zavolta
Pat Ricchiuti
Galen Pfeiffer
Mark Heuer
Dennis Burreson - Chairman
John Pieretti
Tomas Masanes Autard
Julia Tinsley
Phil Quigley
Damian Gaytan

Affiliation:

Producer
Producer
Producer

Producer
Producer
Producer
Producer
Producer
Handler
Handler
Handler
Handler
Handler
Handler

STAFF

Todd Sanders California Olive Committee
Elise Oliver California Olive Committee
Janette Ramos California Olive Committee

GUESTS:

Jeremy Sasselli USDA



With the appropriate number of members from producers and handlers in, a quorum was established.

- **MOVED by RICCHIUTI, duly seconded by PFEIFFER and carried THAT the minutes for July 26, 2023, be approved as presented. (MOTION 12-7-23 #1)**

Chairman’s Comments:

Chairman Dennis Bureson asked Mike Silveira to reinstate what he said in the Executive meeting regarding approval of various projects. Mike discussed, we have allocated funds in the past for certain needs and to receive new plant protection products. Mike explained, that researcher Jim Adaskeveg has previously worked for the past 4-6 years on plant protection products, and several of those products are in the EPA. Mike suggested we should write a letter to the U.S. Environmental Protection Agency (EPA) and legislatures to find out what is taking so long on some products. Todd Sanders informed the committee, that the COC can send a letter to the EPA asking for them to move forward with this, but, that the Olive Growers Council of California (OGCC) must handle the Congressional aspect of it.

II. DISCUSSION AND REVIEW OF 2023 PROJECTS

2023 Project Titles

TOPIC	LEADERS	AMOUNT
Management of Foliar Diseases-A. Olive Knot and B. Evaluation of New Fungicides For Control of Olive Leaf Spot	J.E. Adaskaveg	\$10,000*
Epidemiology and Management of Olive Knot Caused by Pseudomonas Savastanoi pv. Savastanoi	J.E. Adaskaveg	\$21,150*
Integrating Alternate Bearing Mitigation Strategies in a Commercial Table Olive Orchard	Carol Lovatt Elizabeth Fichtner	\$36,511
Evaluating Accede for Ability to Decrease 'Manzanillo' Fruit Detachment Force and Increase Efficiency of Commercial Trunk Shaking and Experimental Canopy of Contact Harvesters	Georgia Drakakaki Louise Ferguson	\$115,186
Precise Water Management Strategies for Table Olive Orchards in California	Giulia Marino Ken Shackel	\$13,104
Southern San Joaquin Valley Olive Fruit Fly Monitoring	Jim Stewart	\$11,000
Sacramento Valley Olive Fruit Monitory Project	Ernie Simpson	\$9,250
Updated Table Olive Cost Studies on Existing and Modern Acreage	Brittney Goodrich	\$20,174**
Total		\$236,375



*Projects co-funded by the Olive Oil Commission of California.

**Project funded utilizing 2022 contingency. See below link to access both studies!

[Current Studies with Olives - UC Davis Cost Studies](#)

III. PRESENTATION OF 2024 PROPOSALS

2024 Research Proposals

Researcher		Amount
Dr. Jim Adaskaveg	Management of Foliar Diseases of Olive-A. Olive Knot and B. Evaluation of new fungicides for control of olive leaf spot page 11	\$13,715
Dr. Jim Adaskaveg	Epidemiology and Management of Olive Knot Caused by Pseudomonas Savastanoi pv. Savastanoi page 16	\$21,150
Dr. Carol Lovatt and Elizabeth Fichtner	Integrating Alternate Bearing Mitigation Strategies in a Commercial Table Olive Orchard page 21	\$33,825
Georgia Drakakaki and Louise Ferguson	Evaluation of Accede® (ACC) efficacy on enhancing horticultural maturity and abscission zone development and commercial trunk shaking efficiency in table olives page 39	\$86,993
Becky Wheeler-Dykes	Evaluation of the Effects of Harvester Type, Tree Architecture, and Use of Loosening Agent on Harvest Efficiency in ‘Manzanillo’ Table Olives page 50	\$57,950
Rodrigo Almeida	Survey of Xylella fastidiosa diversity within California olive trees page 57	\$29,752
Jim Stewart	Southern San Joaquin Valley Olive Fruit Fly Monitoring Project page 69	\$12,000
Ernie Simpson	Sacramento Valley Olive Fruit Fly Monitoring Project page 71	\$9,250
	Contingency Fund	
	Total	\$264,635

Presentations for all proposals can be downloaded here in the WeTransfer Link!

<https://we.tl/t-Ih1h1KU5T4>

IV. APPROVAL OF AUTHORITY TO THE EXECUTIVE DIRECTOR AND CHAIRMAN TO APPROVE NO-COST EXTENSIONS

ACTION

Each year, researchers will request a no-cost extension should their program run past the fiscal year. COC staff asks that the Committee grant authority to the Executive Director in conjunction with the Chairman to approve requests for no-cost extensions.

No Cost Extension Requests:



RIPE OLIVES

ENJOYED BY FAMILIES EVERYWHERE

Principal Investigator:	Project Title:
Louise Ferguson/Georgia Drakakaki	Evaluating Accede® for Ability to Decrease ‘Manzanillo’ Fruit Detachment Force and Increase Efficiency of Commercial Trunk Shaking and Experimental Canopy Contact Harvesters
Carol Lovatt/Elizabeth Fichtner	Integrating Alternate Bearing Mitigation Strategies in a Commercial Table Olive Orchard

- **MOVED by PFEIFFER, duly seconded by TINSLEY and carried THAT the Research Committee grant authority to the Executive Director and Chairman to approve No-Cost Extensions. (MOTION 12-7-23 #2)**

V. APPROVAL OF 2024 BUDGET

ACTION

Each year the Research Subcommittee approves various research projects funded by the Full Committee. The Subcommittee must determine which proposed projects to recommend to the Full Committee for funding. An estimated budget of **\$316,313.80** (with nocost extensions) is proposed based on the submitted projects.

2024 RESEARCH PROPOSAL FOR THE CALIFORNIA OLIVE COMMITTEE

TOPIC	LEADERS	AMOUNT
Management of Foliar Diseases of Olive-A. Olive Knot and B. Evaluation of new fungicides for control of olive leaf spot	J.E. Adaskaveg	\$13,715*
Epidemiology and Management of Olive Knot Caused by Pseudomonas Savastanoi pv. Savastanoi	J.E. Adaskaveg	\$21,150*
Integrating Alternate Bearing Mitigation Strategies in a Commercial Table Olive Orchard	Carol Lovatt Elizabeth Fichtner	\$33,825
Evaluation of Accede® (ACC) efficacy on enhancing horticultural maturity and abscission zone development and commercial trunk shaking efficiency in table olives	Georgia Drakakaki Louise Ferguson	\$86,993
Evaluation of the Effects of Harvester Type, Tree Architecture, and Use of Loosening Agent on Harvest Efficiency in ‘Manzanillo’ Table Olives	Becky Wheeler-Dykes	\$57,950
Survey of Xylella fastidiosa diversity within California olive trees	Rodrigo Almeida	\$29,752
Southern San Joaquin Valley Olive Fruit Fly Monitoring	Jim Stewart	\$12,000
Sacramento Valley Olive Fruit Monitory Project	Ernie Simpson	\$9,250
2023 NCE Integrating Alternate Bearing Mitigation Strategies in a Commercial Table Olive Orchard	Carol Lovatt Elizabeth Fichtner	\$14,604.4



RIPE OLIVES

ENJOYED BY FAMILIES EVERYWHERE

2023 NCE Evaluating Accede® for Ability to Decrease ‘Manzanillo’ Fruit Detachment Force and Increase Efficiency of Commercial Trunk Shaking and Experimental Canopy Contact Harvesters	Georgia Drakakaki	\$37,074.4
Contingency		TBD
Total * budget estimate; actual budget pending on results		\$316,313.80

*The COC traditionally co-funds these projects with the OOC

The Research Committee discussed that to save costs, we must should reach out to researchers, Drakakaki, Wheeler-Dykes and Almeida, and determine if they are willing to collaborate their research proposals and combine them into one study to reduce costs.

With opposition coming from the Committee as to which research proposals to support, it then went into a vote. A roll call vote took place and the results were, ten in favor and two opposed. With the 10-2 approval in favor of reaching out to two researchers to find out if they will combine their two proposals at a lower cost.

Listed are those who voted in support and those that were opposed:

In Support

- Michael Silveira
- Michael Stokes
- Vito DeLeonardis
- Galen Pfeiffer
- Mark Heuer
- Tomas Masanes Autard
- Julia Tinsley
- Phil Quigley
- Damian Gaytan
- Dennis Burreson

Opposed

- Giulio Zavolta
- Pat Ricchiuti

- **MOVED by SILVEIRA, duly seconded by QUIGLEY and carried THAT the Research Committee approve the 2024 Budget as presented, with the caveat that, staff return back to the Researchers Drakakaki/Ferguson and Wheeler-Dykes, regarding the two projects, to determine if the researchers are willing to combine the two research projects at a lower cost. We will then present those findings at the December 12th Full Committee meeting. (MOTION 12-7-23 #3)**



VI. APPROVAL OF AUTHORITY TO THE EXECUTIVE DIRECTOR AND CHAIRMAN FOR INTER-ITEM TRANSFER OF THE RESEARCH SUBCOMMITTEE BUDGET

The Committee discussed granting authority to the Executive Director and Chairman for inter-item transfer of the Research Subcommittee Budget.

- **MOVED by PFEIFFER, duly seconded by TINSLEY and carried THAT the Research Committee grant authority to the Executive Director and Chairman to approve inter-item transfers of the Research Subcommittee Budget. (MOTION 12-7-23 #4)**

VII. OTHER BUSINESS

- Julia Tinsley suggested that she would like to receive the Research Packet at least three days in advance.

VIII. ADJOURNMENT

Chairman Dennis Burreson adjourned the Research Subcommittee meeting at 12:15 p.m.

Todd W. Sanders
Executive Director
California Olive Committee



SUMMARY OF MOTIONS FOR DECEMBER 7, 2023

Motion 12-7-23 #1

APPROVED

MOVED by RICCHIUTI, duly seconded by PFEIFFER and carried THAT the minutes for July 26, 2023, be approved as presented.

Motion 12-7-23 #2

APPROVED

MOVED by PFEIFFER, duly seconded by TINSLEY and carried THAT the Research Committee grant authority to the Executive Director and Chairman to approve No-Cost Extensions.

Motion 12-7-23 #3

APPROVED

MOVED by SILVEIRA, duly seconded by QUIGLEY and carried THAT the Research Committee approve the 2024 Budget as presented, with the caveat that staff return back to the Researchers Drakakaki/Ferguson and Wheeler-Dykes, regarding two projects, to determine if they are willing to combine the two research projects, at a lower cost. We will then present those findings at the December 12th Full Committee meeting.

Motion 12-7-23 #4

APPROVED

MOVED by PFEIFFER, duly seconded by TINSLEY and carried THAT the Research Committee grant authority to the Executive Director and Chairman to approve inter-item transfers of the Research Subcommittee Budget.

*****INFORMATION ONLY*****

FROM: RESEARCH SUBCOMMITTEE

SUBJECT: REVIEW OF 2023 RESEARCH FINAL REPORTS

BACKGROUND:

2023 RESEARCH PROJECTS FOR THE CALIFORNIA OLIVE COMMITTEE

- Projects in red had No Cost Extensions and are now complete. Final Reports can be found in the following pages of the packet.

Researcher	Project	Amount	No Cost Extension
Dr. Jim Adaskaveg	Management of Foliar Diseases-A. Olive Knot and B. Evaluation of New Fungicides For Control of Olive Leaf Spot	\$10,000	
Dr. Jim Adaskaveg	Epidemiology and Management of Olive Knot Caused by Pseudomonas Savastanoi pv. Savastanoi	\$21,150	
Carol Lovatt and Elizabeth Fichtner	Integrating Alternate Bearing Mitigation Strategies in a Commercial Table Olive Orchard	\$36,511	6/30/2024
Georgia Drakakaki and Louise Ferguson	Evaluating Accede for Ability to Decrease 'Manzanillo' Fruit Detachment Force and Increase Efficiency of Commercial Trunk Shaking and Experimental Canopy of Contact Harvesters	\$115,186	6/30/2024
Jim Stewart	Southern San Joaquin Valley Olive Fruit Fly Monitoring	\$11,000	
Ernie Simpson	Sacramento Valley Olive Fruit Monitor Project	\$9,250	
	Contingency Fund	\$0	
	Total	\$203,097	

Contains confidential information for the COC. Please do not post online.

Department of Botany and Plant Sciences
Relevant AES/CE Project No.: 4556

**University of California
Division of Agricultural Sciences**

FINAL REPORT

(Year 1 2023 Final Report August 12, 2024, with a NCE through December 31, 2024)

Project Year: 2023 Anticipated Period of Performance: year 1 of 3 requested

Project Leaders:

Carol Lovatt, Ph.D.
Department of Botany and Plant Sciences-072
University of California
Riverside, CA 92521-0124
(O) 951-827-4663 FAX: 951-827-4437 (M) 951-660-6730
carol.lovatt@ucr.edu

Elizabeth Fichtner, Ph.D.
University of California Cooperative

Extension

4437 S. Laspina St.
Tulare, CA 93274
(O) 559-684-3310 FAX: 559-685-3319 (M) 559-684-2057
ejfichtner@ucdavis.edu

Project Title: Integrating Alternate Bearing Mitigation Strategies in a Commercial Table Olive Orchard

Collaborator:

Kent Daane, Professor and Cooperative Extension Specialist, Department of Environmental Science, Policy, and Management, UC-Berkeley, CA, and Kearney Agricultural Research and Education Center, 9240 S. Riverbend Ave., Parlier, CA 93648; Phone: 559-646-6522; Fax: 559-646-6593; E-mail: kdaane@ucanr.edu

KD volunteered his time *gratis* to train the Co-PIs and their technical staff (1) to quantify black scale populations at important stages in their life cycle, honeydew produced by black scale, and sooty molds that grow on the honeydew and rate the impact on fruit quality, (2) to analyze the collected data, and (3) to assist the PIs in interpreting the results.

Cooperators:

Ismael Gutierrez, I.G. Harvesting, 113 E. Hickory St., Lindsay, CA 93247; Phone: 559-805-8181; E-mail: Gutierrezismael559@gmail.com

Donald Cleek, Agricultural Supervisor, UC Lindcove Research & Extension Center, 22963 Carson Avenue, Exeter, CA 93221; Phone: 559-592-2408, Ext 1157; Email: dlcleek@ucanr.edu

IG provided us with a ‘Manzanillo’ olive orchard in the Woodlake area through the 3-year project period. The orchard meets our research requirements, including having black scale infestation.

DC coordinated the application of treatments, applied the foliar treatments (approval for DC to spray off the Lindcove REC and on the cooperators property was secured), and coordinated the harvests. DC also provided us with a ‘Manzanillo’ olive orchard at Lindcove, Exeter, CA, to determine whether pruning one side of the tree 28 DAFB and then the other side *biennially* is superior to pruning both sides of the trees in every other row every other year (there was not room for this at Woodlake).

Objectives for 2023 (Year 1): Background information. A reliable strategy for mitigating the economic problem of alternate bearing (AB), production of a light, low yield “off crop”, followed by a heavy, high yield “on” crop, is critical to the sustainability of both the table and oil olive industries. In ON-crop years, trees produce numerous small size fruit with reduced commercial value. In OFF-crop years, trees produce large fruit, in some cases too large, but there are too few commercially valuable size fruit to provide growers with a good income. In addition, our research also documented that fruit quality was reduced in some OFF-crop years, e.g., the large fruit of OFF-crop trees tend to turn black earlier in the season, which can further exacerbate the problem of too few commercially valuable fruit. In the ON-crop year, fruit take longer to mature, attain size, and accumulate oil, which delays harvest and further reduces floral intensity the following spring. Alternate bearing often occurs beyond the tree or orchard level, synchronizing across geographic regions, particularly when initiated by environmental conditions that affect crop load (e.g., heat at bloom in ‘Manzanillo’ orchards). An industry-wide shortage of fruit in the OFF-crop year has a negative economic impact on every step in the production chain from farm to consumer, including orchard management, harvesting, packinghouse and processor operations, manufacture of value-added products, marketing, and consumer prices, which individually and taken together threaten the stability and sustainability of the table and oil olive industries.

Climate is the major factor initiating alternate bearing. Adverse climate events, such as high or low temperatures, water-deficit stress or excessive winter rain causing soil hypoxia etc., which significantly reduce yield, result in an OFF crop that is followed by an ON crop. Conversely, optimal climate conditions during flowering and fruit set, such that natural fruit thinning fails to occur result in an ON crop that is followed by an OFF crop. Adverse climate events can also reduce bloom of the pollinizer trees in an orchard and impact pollinator activity, reducing out-crossing and causing an OFF-crop. Climate events repeat in a random manner, creating a reoccurring need for a strategy to mitigate alternate bearing and the negative economic impact of alternate bearing on table and oil olive growers and industries.

Objectives for 2023 (Year 1): Justification. Results of our prior COC-funded research demonstrated that the young developing fruit of the ON crop of ‘Manzanillo’ olive trees inhibit summer vegetative shoot growth and thereby reduce the number of nodes that can produce floral (inflorescence) buds the following spring (Fichtner and Lovatt, 2018; Sibbett, 2000). The developing ON crop also inhibits the transcription of key genes required for inflorescence

development and flower formation. The maturing fruit of the ON crop significantly increase abscission of floral buds for next year's bloom starting in September, as well as inhibit spring bud break (Chao, 2014; Fichtner and Lovatt, 2018; Fichtner et al., 2021). These latter effects are consistent with reports that late-harvested ON crops further reduce return bloom. For ON-crop olive trees, the negative effects of fruit set on a shoot (localized effect) are stronger than the effects of the total number of fruit (crop load) on the tree (whole tree effect). As a result, bearing shoots on ON-crop trees, which are subjected to both localized and whole tree effects of the fruit produce virtually no flowers the following spring (0.8 inflorescences/shoot) (Fichtner and Lovatt, 2018). Thus, it is the nonbearing shoots on ON-crop trees, which are in the minority, that produce the inflorescences at spring bloom following the ON-crop year (13.8 inflorescences/shoot) (Fichtner and Lovatt, 2018). Further, a cytokinin-based strategy was only effective in stimulating summer vegetative shoot growth and increasing return bloom on nonbearing shoots of ON-crop trees (Fichtner and Lovatt 2018; Fichtner et al., 2021). Thus, a crop reduction strategy that increases the number of nonbearing shoots is necessary to mitigate the negative effects of the ON-crop in an alternate bearing olive orchard.

Results of our COC-funded research identified two effective crop reduction strategies. Foliar-applied NAA at full bloom (FB) and pruning (hedging and topping) 28 days after full bloom (DAFB) to one side of the tree and then the other side of the tree every other year, *biennially not annually*, evened out total annual yield, but more importantly increased the 3-year cumulative yield of medium + large size fruit with near equal yield distribution in 3 out of 4 years (Fichtner and Lovatt, 2023). However, it is important to note that these results were obtained in an experiment conducted at a single site. Additionally, the success of these two treatments was due in part to not carrying out the scheduled crop reduction treatments in year 5 (the final project year) due the low number of inflorescences at bloom based on the sum of the estimated floral intensity at bloom on the east and west sides of the trees in north-south running rows. Thus, knowing when to carry out crop reduction and when not to is important for maintaining high yields of medium + large size fruit. Before this information is recommended for implementation by table olive growers, the results need to be validated in a second experiment conducted in a new commercial table olive orchard.

Crop reduction strategies reduce yield and are thus, economically viable in high yield ON-crop years because they increase the yield of commercially valuable size fruit. Foliar application of NAA or pruning to low or medium bloom trees can reduce total yield and yield of medium + large size fruit below the profit margin. Pruning is critical to tree crop production to open the canopy for light penetration (no light, no flowers, not fruit), to increase canopy complexity to create new fruiting shoots and to balance the proportion of bearing vs. nonbearing shoots to maintain yield and fruit size on an annual basis, in addition to keeping rows open for orchard management, e.g., canopy spraying, harvesting. Pruning both sides of the tree in winter has the disadvantage that nonbearing and bearing shoots from the previous year, which have a high and low potential to flower the following spring, respectively, are not as easy to distinguish. Given the random reoccurrence of climate conditions that result in OFF or ON blooms, decisions about when, how many sides of the tree, and how frequently to prune or apply NAA in an orchard are critical and are best made based on a visual inspection of bloom, with knowledge of the potential impact that each decision has on the yield of medium + large size fruit not just in the ON year, but in subsequent years also. Additionally, it is important to know whether the strategy selected to mitigate alternate bearing will impact table olive orchard pest management. Choices for crop

reduction starting in an ON-crop year include pruning both sides of the tree annually, just one side of the tree annually, one side of the tree every other year, or eliminating pruning in favor of using foliar-applied NAA. Thus, the crop reduction strategy selected to mitigate alternate bearing regulates the degree to which the canopy is open or closed at different times of the year and would thereby affect black scale survival, associated honeydew production and sooty mold growth, fruit quality and pesticide use.

Black scale population densities and damage have long been associated with temperatures in the olive tree canopy. More open canopies and more frequent pruning result in higher temperatures and drier conditions – both of which result in greater scale mortality. This relationship is also clearly associated with summer temperatures, but traditional pruning strategies are timed to post-harvest winter periods, when the scale population has already established and reached the second to third instar stages. Proposed herein are pruning strategies timed closer to June when the scale first instars have hatched and are most vulnerable to hot, dry conditions. By increasing scale mortality at this critical period, damage resulting from the scale’s associated honeydew production and growth of sooty molds may be lowered, resulting in reduced use of insecticide sprays targeting black scale.

Objectives for 2023 (Year 1): *Plant material and experimental plan.* There are three research objectives and goals:

- (1) to test the results of our prior COC-funded research in a second commercial ‘Manzanillo’ table olive orchard to confirm that foliar-applied NAA at full bloom (FB) or pruning (hedging and topping) 28 days after full bloom (DAFB) to one side of the tree and then the other side of the tree every other year (*biennially*) are the best crop reduction strategies for mitigating alternate bearing and increasing yields of medium + large size fruit to near equal distribution over multiple years compared to the ON-/OFF-yields of alternate bearing (untreated) control trees, trees pruned on one side of the tree 28 DAFB annually, and trees pruned on two sides of the tree in winter annually (grower standard practice). Note: all pruning treatments include topping at the time of pruning. The goal is to determine the management strategy that maximizes yield of commercially valuable size fruit both during and after mitigation of alternate bearing.
- (2) to use the sum of the bloom (floral intensity) estimates on two sides of each olive tree to decide when to prune or not prune a set of trees in order to maintain high yields of medium + large size fruit and thereby, test how well the relationships among estimated bloom, total yield and yield of medium + large size fruit from our previous COC-funded research hold up in a second orchard and to make any needed adjustments. The goal is to develop a decision support tool that growers will find easy, rapid and valuable to use annually across multiple acres of table olive trees to maintain yields of medium + large size fruit.
- (3) to quantify the effects of the crop reduction strategies, which range from pruning both sides of the tree annually, one side annually, one side every other year, to no pruning for three years (NAA treated trees and the untreated alternate bearing control trees) on the resurgence of black scale populations, honeydew, associated sooty molds, and fruit quality in a ‘Manzanillo’ table olive orchard. The goal is to determine, to the degree climatic conditions during the 3-year experiment permit, whether the integration of specific alternate bearing mitigation strategies in a commercial table olive orchard has the potential to positively or negatively affect black scale pest management, e.g., pesticide use, and table olive fruit quality.

Research Accomplished in 2023.

To meet the objective 1, we established a field experiment in a commercial ‘Manzanillo’ olive orchard in Woodlake going into an ON bloom/ON-crop year (2022 was an OFF-crop year) (see objective 3 for additional orchard selection criteria). The experiment is a randomized complete block design with 17 individual tree replications per treatment and seven treatments that specifically meet the three objectives of the proposed research. The treatments included:

- (1) Untreated ON-crop control (last pruned and topped in winter 2021), e.g., alternate bearing control
- (2) Foliar applied NAA @ full bloom (FB) to one side of the tree then the other side of the tree every other year (*biennially*)
- (3) Pruning (hedging and topping) @ 28 days after full bloom (DAFB) to one side of the tree then the other side every other year (*biennially*)
- (4) Foliar-applied cytokinin biosynthesis stimulator applied two weeks after a set of trees were pruned (hedging and topping) @ 28 DAFB on one side of the tree then the other side every other year (*biennially*). The cytokinin biosynthesis stimulator is applied annually to increase yield of medium + large size fruit in the current year and to stimulate summer vegetative shoot growth to increase return bloom
- (5) Pruning (hedging and topping) @ 28 DAFB to one side of the tree then the other side every other year (*biennially*) on a flexible schedule, using a decision support tool based on estimated sum of the bloom on the two opposing sides of the tree. This orchard runs east-west, bloom estimates were made on the north and south sides of the tree
- (6) Pruning 28 DAFB to one side of the tree and then the other side of the tree *annually*
- (7) Control – grower standard practice of pruning two sides of the tree and topping in winter *annually*

Pruning was done as described in each treatment by our cooperator I.G. Harvesting. Liqui-Stik Concentrate[®] NAA (Loveland Products), which is identical to and has the exact same label and application rate as AMVAC’s Olive Stop[®], which we used in our previous experiment, was applied according to the label directions by our cooperator D. Cleek. He also applied the material that stimulates cytokinin biosynthesis (this is not a plant growth regulator and does not require registration by the State DPR or Federal EPA). It was applied 42 days (6 weeks) after FB to a set of trees pruned (hedging and topping) 28 DAFB on one side of the tree and then the other side every other year (*biennially*). The cytokinin biosynthesis stimulator is applied *annually* to increase yield of medium + large size fruit in the current year, even in the Year 1 ON-crop year, and to stimulate summer vegetative shoot growth to increase return bloom compared to other treatments.

In addition, to meet objective 1, we established a second pruning trial in Exeter, CA, to compare pruning one side of the tree 28 DAFB and then the other side *biennially* with pruning both sides of the trees in every other row every other year, e. g., both sides of trees in rows 1, 3 and 5 pruned in years 1 and 3, whereas both sides of trees in rows 2, 4 and 6 are pruned in years 2 and 4. There were not enough trees to include this comparison at our Woodlake site. Moreover, this orchard was added to serve as a control for testing our estimated bloom model. We know our bloom model works in the Lindcove REC orchard. If it does not work at Woodlake and continues to work at Lindcove, then we learn that modification is required to expand its use across orchards. If the model does not work at either site this year, then we learn that the model’s efficacy is influenced by climate.

Trees at both sites were harvested by I.G. Harvesting in mid-October 2023. Total yield and fruit size distribution as kg/tree were determined and used to calculate yield and fruit size distribution as kg and number of fruit per tree to quantify treatment effects on yield of M+L size fruit and the relationship with total yield.

Starting in year 2, alternate bearing index (ABI) will be calculated for total yield and yield of medium + large size fruit as $ABI = (\text{year 1 yield} - \text{year 2 yield}) / (\text{year 1 yield} + \text{year 2 yield})$, in which yield is in kilograms of fruit per tree and the difference in yield between years 1 and 2 is expressed as an absolute number. An ABI of zero means no alternate bearing, whereas an ABI of one is complete alternate bearing, i.e., crop one year, no crop the other year (Pearce and Dobersek-Urbanc, 1967). Analysis of variance (ANOVA) will be used to test for treatment effects on bloom estimates, yield and fruit quality parameters, and ABI using the General Linear Model procedure of SAS (version 9.3; SAS Institute, Cary, NC). When ANOVA testing indicates significant differences, post-hoc comparisons will be determined utilizing Fisher's protected least significant difference (LSD) test. Pearson's product moment correlation coefficients calculated to identify significant relationships ($r > 0.5$, $P \leq 0.05$). Significant correlations will be subjected to regression analyses, using the least squares method for the generalized linear model. The experiment is designed to determine the management strategy that maximizes yield of commercially valuable size fruit both during and after mitigation of alternate bearing, the goal of objective 1.

To meet objective 2, we estimated the floral intensity at full bloom at our research orchards in Woodlake and Lindcove on two opposing sides of the tree on a scale from 0 to 3 (0 = no bloom, 1 = low bloom intensity, 2 = medium intensity bloom and 3 = high intensity bloom) and calculated the sum of the estimated bloom. Bloom estimates were made on the south and north sides of the trees (east-west rows) in the Woodlake orchard and east and west sides (north-south rows) in the Lindcove orchard. In 2023, the estimated sum of the bloom, based on the relationships with total yield and yield of medium + large size fruit observed in our previous COC-funded research, was used to determine which trees in treatment 5 should or should not be pruned. As a result, three trees in treatment 5 were not pruned, to test the efficacy of our current decision support tool in Year 1. Data collected in Year 1 and subsequent years will be used to analyze the relationships among bloom estimates, total yield and yield of medium + large size fruit by calculating Pearson's product moment correlation coefficients to identify significant relationships ($r > 0.5$, $P \leq 0.05$) to determine how well the new data fit our earlier results. Significant correlations will be subjected to regression analyses, using the least squares method for the generalized linear model, and more sophisticated analyses as warranted. Prior results suggest that the variability in the relationship between the range in total yields that result in high yields of medium + large size fruit is limited. If the yield data from this second experiment prove this to be the case, the sum of bloom estimates on two opposing sides of the tree should be able predict when and when not to impose a crop reduction strategy to better maintain yields of medium + large size fruit from one year to the next across orchards of similar size trees pruned according to our prescribed strategy (Fichtner and Lovatt, 2023). Importantly, the model will indicate poor crop years when the yield of commercially valuable size fruit can only be maintained by eliminating the use of a crop reduction strategy.

To meet objective 3, in addition to going into an ON-crop year, the 'Manzanillo' table olive orchard we selected has a history of black scale and has not been treated for black scale in recent

years. Black scale population numbers were monitored in spring and fall. The presence of honeydew droplets on olive leaves in spring, which correspond to a rapid increase in scale size, is often the earliest signal of increased scale density in the orchard. In May, the terminal ends [20 inches long (about 50 cm)] of four branches were monitored on one tree per each of the 7 treatments in 6 replication and honeydew and sooty mold accumulation were rated on a scale of 0-3 (0 = no honeydew or no sooty mold, 1 = presence of honeydew or sooty mold, 2 = honeydew or sooty molds on < 30% of the branch, and 3 = honeydew or sooty mold on > 30% of the branch. In May and October, the scale density was evaluated by counting the number of mature scales (third instar to adult) on the terminal ends of the four branches on each tree per 7 treatments for six replications. For categorical ratings of scale honeydew and sooty mold accumulation, treatment effects were compared by ANOVA with treatments separated by Fisher's Least Significant Difference (LSD) and in a 2 by 2 contingency table with treatments separated using Pearson's Chi-square test. Scale densities were compared using the General Linear Model function, with treatments separated using Tukey or Dunnett Pairwise comparison.

To the degree climatic conditions during the 3-year experiment permit, the treatments in our experiment provide a range in canopy openness and closure and pruning times, which combined with our detailed analyses of black scale at two periods of the life cycle, plus honeydew and sooty mold ratings, will enable us to determine whether the integration of specific alternate bearing mitigation strategies in a commercial table olive orchard has the potential to positively or negatively affect black scale pest management, e.g., pesticide use, and table olive fruit quality (goal 3).

Results for 2023.

At the start of the experiment ($\text{Time}_{\text{zero}}$), there were no significant differences in the sum of bloom estimates at full bloom for the north and south sides of the trees in the 'Manzanillo' olive orchard in Woodlake (an orchard that runs east-west) or on the east and west sides of the 'Manzanillo' olive trees in the orchard in Exeter (a north-south running orchard) (Tables 1 and 2). Remember the bloom estimates were completed before any treatments were applied. Thus, the yield potential was equivalent for all trees across treatments at each site. The sums of estimated floral intensity were all greater than 4.5 ± 0.25 , the threshold value identified in our earlier research above which trees need to be treated with a crop reduction strategy in order to maximize yield of medium plus large (M+L) size fruit. At Woodlake, in Treatment 5, for which pruning is carried out on a flexible schedule based on the sum of the bloom estimate, three trees had bloom estimates for the sum of the north and south sides of the tree that were below 4.5. These trees were not pruned.

At harvest in October 2023, it was clear that the heavy bloom had been impacted by climate during fruit set, resulting in a significant number of "shot berries" and rendering the total yield of the 'Manzanillo' olive trees at Woodlake very low (≤ 4.1 kg/tree) (Table 1), resulting in no significant effect of any treatment on yield. Due to the low total yield and high number of "shot berries", fruit size distribution was not determined. In contrast, there was significantly greater yield for the trees in the 'Manzanillo' olive orchard at the Lindcove REC in Exeter, ranging from 94 to 131 kg/tree (Table 2). The treatments compare pruning one side of the tree and then the other side every other year (*biennially*) versus pruning both sides of the tree in every other row every other year. There were no significant differences in yield across the trees in the experiment. Due to treating every other year, two sets of trees are required for each treatment. The sum of the yield for trees treated

on one side of the tree and then the other side biennially (treatments 1 and 2) was greater (248 kg/tree) than the yield of trees pruned on both sides combined with the trees not pruned in year 1 as part of this treatment (treatments 3 and 4) (204 kg/tree). The differences in total yield were accompanied by differences in yield of commercially valuable medium plus large (M+L) size fruit. Trees pruned on only one side of the tree biennially produced 29.8 kg/tree M+L size fruit, whereas pruning trees on both sides of the tree every other row every other year produced 16.6 kg/tree M+L size fruit. These first-year results are both interesting and promising. However, keep in mind that the yield differences were not statistically significant. At Lindcove, which produced a good bloom and average yield, there was a strong significant correlation between total yield and yield of commercially valuable M+L size fruit ($r = 0.74$, $P < 0.0001$), as we have demonstrated in our previous research.

In May 2023, the start of the experiment (Time_{zero}), there were no significant differences in honeydew, sooty mold or number of black scales per tree (Table 3). Thus, these parameters were uniform across treatments at the start of the experiment prior to the application of any treatments. This is optimal for testing for treatment effects on scale populations. There was no honeydew visible on shoots in the ‘Manzanillo’ olive trees in Woodlake (Table 3). Sooty mold per tree was less than 1 on a scale from 0 to 3, with 1 meaning that sooty mold was present at a low level on each tree, except trees in treatments #2 and #3. The number of individual black scales per tree was also less than 1 per tree, with no black scales on trees in treatments #2 and #3. This is consistent with honeydew and sooty mold being putative predictors of the presence of black scale. Whereas there was no honeydew observed in the ‘Manzanillo’ olive orchard in Woodlake, there was a strong, significant relationship between the level of sooty mold present on the shoots of a tree and the number of individual black scale on the shoots of the tree ($r = 0.88$, $P < 0.0001$).

At harvest in October 2023, honeydew remained absent on all tagged shoots (Table 3). In contrast, sooty mold increased on all shoots by an average of 0.7. The number of individual black scale increased negligibly on the shoots of trees in treatment 1, which were not pruned since the winter of 2021-22. Black scale number remained unchanged for trees in treatments 2, 3, and 4, but decreased slightly on the shoots of trees in treatments 5, 6 and 7. No changes were statistically significant. Trees in treatments 6 and 7 were pruned on both sides of the tree, but trees in treatment 5 were only pruned on one side as were the trees in treatment 3. Whether the degree of pruning played a role in black scale number remains to be established in up-coming years. Note that the strong, significant relationship between the level of sooty mold present on the shoots of a tree and the number of individual black scale on the shoots of the tree ($r = 0.88$, $P < 0.0001$) in May continued through harvest in October ($r = 0.75$, $P < 0.0001$).

Results of the NCE through Spring 2024.

In 2023 at Woodlake, trees in treatment 7 were pruned on both sides of the tree in winter and had the lowest bloom estimate on the south ($P < 0.0001$) and north ($P = 0.0084$) sides of each tree at bloom in 2024 (Table 4).. With the exception of treatment 7, the 2024 bloom estimates on the south side of the trees were not significantly different across treatments, despite the fact that NAA was applied at FB to the south side of the trees in treatment 2. In contrast, trees in treatments 3 to 5 were pruned only on the north side of the tree, whereas treatment 6 was pruned on both sides. Thus, the 2024 bloom results were interesting because they signaled that the low yield of 2023 restored a heavy bloom in 2024 in all trees except the trees in treatment 7, which were pruned on

both sides of the tree in winter, a common practice among table olive growers. The 2024 sum of the bloom estimates for the two sides of the trees was above the threshold value of 4.5 ± 0.25 for trees in all treatments, except treatment 7, indicating fruit thinning (NAA or pruning) was required in 2024 to increase yield of commercially valuable M+L size fruit for all trees, except those in treatment 7.

For the 2024 bloom estimates at Lindcove, trees in treatment 4, which were not treated in 2023 and had the lowest yield in 2023, had the highest bloom on the west side of the tree and the highest sum of the estimated bloom (Table 5). Pruning on one side of the tree (west side) biennially starting in the ON-crop year (2023) for trees in treatments 1 and 2 increased yields, including yields of M+L size fruit, and resulted in lower bloom estimates on the west side of the tree and lower sum of the bloom estimates in 2024. The sum of the estimated bloom for trees in treatments 1 to 3 were below the threshold value of 4.5 ± 0.25 , indicating that fruit thinning treatments should not be applied in 2024. Note that they were not scheduled to be applied in 2024, consistent with biennial pruning being optimal. Trees in treatment 4 were scheduled to be pruned on both sides in 2024 and we proceeded with the scheduled pruning to maintain the experiment and because the sum of the bloom estimate was 4.4, close to our threshold value of 4.5 ± 0.25 . Pruning these trees will help us further define our threshold value for deciding to treat or not treat.

Future goals.

All the research proposed for Year 1 (2023) has been completed. We are now in Year 2 (2024). The remaining goals for 2024 are to complete the harvest to determine total yield and fruit size distribution per tree and to analyze the relationships among estimated floral intensity, total yield and yield of M+L size fruit and test the validity of our model at our Lindcove 'Manzanillo' olive orchard, for which we will have 2 years of bloom, total yield and yield of M+L size fruit. We also need to select a new 'Manzanillo' olive orchard to test our model of the relationships among bloom, total yield, and yield of M+L size fruit and the effect of canopy density on black scale populations.

Outreach during Year 1 (2023) and the NCE.

During this period, Dr. Elizabeth Fichtner and Dr. Carol Lovatt have participated in outreach programs that have contributed significantly toward educating table and oil olive growers about factors that initiate alternate bearing, mechanisms that perpetuate the repeating cycles of ON/OFF crops, and strategies that mitigate alternate bearing.

- 1) IX International Society of Horticultural Science Olive Symposium, September 2023, Davis, CA, oral presentation and paper, entitled "Alternate bearing in olive - *Mitigation with properly timed foliar-applied naphthaleneacetic acid or pruning.*"
- 2) California Olive Oil Commission Annual Member Meeting, March 2024, Monterey, CA, oral presentation, entitled "Mechanisms and Mitigation of Alternate Bearing in Olive."
- 3) North Coast Olive Field Day, July 2024, St. Helena, CA, oral presentation, poster and handouts, entitled "Alternate Bearing in Olive - *Initiation, perpetuation of OFF/ON yield cycles and mitigation strategies that reduce the severity of alternate bearing and increase yield of commercially valuable size fruit.*"

References:

Chao, Y.Y. 2014. Alternate Bearing in Olive (*Olea europaea* L.). MS Thesis. University of California, Riverside, CA.

Fichtner, E., Lovatt, C.J. 2018. Alternate bearing in olive. *Acta Hort.* 1199:103-108. doi:10.17660/ActaHortic.2018.1199.17

Fichtner, E., Lovatt, C.J. 2023. Alternate bearing in olive - *Mitigation with properly timed foliar-applied naphthaleneacetic acid or pruning*. *Acta Hort.* In review.

Fichtner, E.J., Y.Y. Chao, L. Ferguson, J.S. Verreynne, L. Tang and C.J. Lovatt. 2021. Repeating cycles of ON and OFF yields in alternate bearing olive, pistachio, and citrus trees — *Different mechanisms, common solutions*. *Acta Hort.* 1315. DOI 10.17660.

Pearce, S.C. and S. Dobersek-Urbanc. 1967. The measurements of irregularity in growth and cropping. *J. Hort. Sci.* 42(3):295–305.

Sibbett, S. (2000). Alternate bearing in olive trees. *California Olive Oil News*. 3(12),1

Table 1. Estimated floral intensity (bloom) of ‘Manzanillo’ olive trees in Woodlake, CA, prior to the application of the 2023 fruit thinning treatments, including foliar-applied naphthaleneacetic acid (NAA) at approximately full bloom (May 30), pruning 28 days after full bloom (June 26) to one side of the tree and then the other side *annually* or *biennially*, with a set of trees pruned *biennially* treated 14 days later (July 5) with a foliar-applied cytokinin biosynthesis stimulator to increase yield of commercially valuable medium plus large (M+L) size fruit in the current year and return bloom the following year, grower standard practice of pruning trees on both sides *annually* in winter, and untreated ON-crop control trees and the effect of these treatments on total yield and yield of M+L size fruit (kg/tree) in October.

2023 Treatments	2023 Bloom estimates ^y (Before 2023 treatments applied)			2023 total yield (M+L size fruit) (kg/tree)
	South side of tree	North side of tree	Sum per tree	
#1 Untreated ON-crop control (last pruned and topped in winter 2021–2022) (alternate bearing control)	2.7 a	2.3 a	5.0 a	4.0 a (1.3 a)
#2 Foliar-applied NAA at FB to the south side of tree in 2023 and the other (north) side of the tree every other year (2025)	2.7 a	2.5 a	5.2 a	2.7 a (0.8 a)
#3 Pruning (hedging and topping) 28 DAFB on the north side of tree in 2023 and then the other (south) side every other year (2025)	2.5 a	2.3 a	4.8 a	4.1 a (0.9 a)
#4 Foliar-applied cytokinin biosynthesis stimulator annually to the whole tree 14 days after pruning as in Treatment #3 was completed at 28 DAFB	2.6 a	2.5 a	5.1 a	2.7 a (0.7 a)
#5 Pruning (hedging and topping) 28 DAFB to the north side of tree in 2023 and then the other	2.8 a	2.5 a	5.3 a	2.3 a (1.0 a)

(south) side every other year (2025) on a flexible schedule based on estimated floral intensity

#6 Pruning (hedging and topping) 28 DAFB on the north side of the tree in 2023 and then the other (south) side of tree annually (2024 and 2025)	2.7 a	2.7 a	5.4 a	1.7 a (0.5 a)
#7 Grower standard practice of pruning both sides of tree and topping in winter 2023 and annually (2024 and 2025)	2.7 a	2.2 b	5.0 a	3.2 a (0.9 a)
<i>P</i> -value	0.7811	0.2810	0.3621	0.1769 a (0.6485)

^z Bloom was evaluated on the following scale: 0, no inflorescences; 1, low floral intensity; 2, medium floral intensity; and 3, high floral intensity.

^y Full bloom was May 19, 2023. Bloom estimates were made May 23, 2023. NAA was applied May 30, 2023. Pruning was done June 26, 2023. The cytokinin synthesis biostimulator was applied on July 5, 2023.

^x Mean values within a vertical column followed by different letters are significantly different at the specified *P* level by Fisher's Protected LSD test.

Table 2. Estimated floral intensity (bloom) of ‘Manzanillo’ olive trees in Exeter, CA, prior to the application of the 2023 fruit thinning treatments, which included pruning (hedging and topping to 14 feet) 28 days after full bloom (DAFB) (June 20) to one side of the tree and then the other side *biennially versus* pruning 28 (DAFB) (June 20) on both sides of the trees in every other row every other year and the effect of these treatments on total yield and yield of commercially valuable medium plus larges (M+L) size fruit (kg/tree) in October.

2023 Treatments	2023 Bloom estimates ^y (Before 2023 treatments applied)			2023 total yield (M+L size fruit) (kg/tree)
	East side of tree	West side of tree	Sum per tree	
#1 Pruned 28 DAFB on west side of the tree in 2023; pruned on the east side in 2025	2.6 a	2.6 a	5.2 a	116.6 a (10.8 a)
#2 Pruned 28 DAFB on west side of the tree in 2023; pruned on the east side in 2025	2.5 a	2.6 a	5.1 a	131.3 a (19.1 a)
#3 Pruned 28 DAFB on both sides of the tree in years 2023 and 2025	2.5 a	3.8 a	6.3 a	93.9 a (9.6 a)
#4 Pruned 28 DAFB on both sides of the tree in 2024	2.6 a	2.6 a	5.2 a	110.5 a (7.1 a)
<i>P</i> -value	0.8623	0.5123	0.6078	0.5579 (0.5960)

^z Bloom was evaluated on the following scale: 0, no inflorescences; 1, low floral intensity; 2, medium floral intensity; and 3, high floral intensity.

^y All trees were pruned on June 20, 2023, and all trees were topped on June 20, 2023.

^x Mean values within a vertical column followed by different letters are significantly different at the specified *P* level by Fisher’s Protected LSD test.

Table 3. Honeydew and sooty mold ratings and number of black scale per shoot of ‘Manzanillo’ olive trees in Woodlake, CA, in May (Time_{zero}), prior to the application of the 2023 fruit thinning treatments, including foliar-applied naphthaleneacetic acid at approximately full bloom (May 30), pruning 28 days after full bloom (DAFB) (June 26) to one side of the tree and then the other side *annually* or *biennially*, with a set of trees pruned *biennially* treated 14 days later (July 5) with foliar-applied cytokinin biosynthesis stimulator to increase the yield of M+L size fruit in the current year and increase return bloom the following year, grower standard practice of pruning trees on both sides *annually* in winter, and untreated ON-crop control trees.

2023 Treatments	2023 honeydew and sooty mold ratings and number of black scales ^z					
	Data collected 1 week prior to 2023 full bloom treatment applications			Data collected 1 week prior to 2023 harvest		
	Honeydew	Sooty mold	Black scale	Honeydew	Sooty mold	Black scale
#1 Untreated ON-crop control (last pruned and topped in winter 2021–2022) (alternate-bearing control)	0 a	0.33 a	0.04 a	0 a	1.00 a	0.08 a
#2 Foliar-applied NAA at FB to the south side of tree in 2023 and the other (north) side of the tree every other year (2025)	0 a	0 a	0 a	0 a	0.43 a	0 a
#3 Pruning (hedging and topping) 28 DAFB on the south side of tree in 2023 and then the other (north) side every other year (2025)	0 a	0 a	0 a	0 a	0.95 a	0 a

#4 Foliar-applied cytokinin biosynthesis stimulator annually to the whole tree 14 days after pruning, as in Treatment #3, was completed at 28 DAFB	0 a	0.75 a	0.67 a	0 a	1.52 a	0.76
#5 Pruning (hedging and topping) 28 DAFB to the south side of tree in 2023 and then the other (north) side every other year (2025) on a flexible schedule based on estimated floral intensity	0 a	0.08 a	0.12 a	0 a	0.91 a	0 a
#6 Pruning (hedging and topping) 28 DAFB on the south side of the tree in 2023 and then the other (north) side of tree <i>annually</i> (2024 and 2025)	0 a	0.50 a	0.50 a	0 a	1.22 a	0.26 a
#7 Grower standard practice of pruning both sides of tree and topping in winter 2023 and <i>annually</i> (2024 and 2025)	0 a	0.25 a	0.42 a	0 a	0.83 a	0.33 a
<i>P</i> -value	NA	0.2076	0.4287	NA	0.4208	0.4785

^z Honeydew and sooty mold were evaluated on the following scale: 0, not present; 1, present; 2, present on < 30% of the shoot; and 3, present on > 30% of the shoot and reported as average per shoot; individual black scales were counted and reported as number/shoot.

^y Full bloom was May 19, 2023. Data were collected May 23, 2023. NAA was applied May 30, 2023. Pruning was done June 26, 2023. The cytokinin synthesis biostimulator was applied on July 5, 2023.

^x Mean values within a vertical column followed by different letters are significantly different at the specified *P* level by Fisher's Protected LSD test; NA = not applicable.

Table 4. Estimated floral intensity (bloom) of ‘Manzanillo’ olive trees in Woodlake, CA, prior to the application of the fruit thinning treatments in 2024, which included foliar-applied naphthaleneacetic acid (NAA) at approximately full bloom, pruning 28 days after full bloom to one side of the tree and then the other side *annually* or *biennially*, with a set of trees pruned *biennially* treated 14 days later with a foliar-applied cytokinin biosynthesis stimulator to increase yield of commercially valuable medium plus large (M+L) size fruit in the current year and return bloom the following year, grower standard practice of pruning trees on both sides *annually* in winter, and untreated ON-crop control trees and the effect of these treatments on total yield and yield of M+L size fruit (kg/tree) in October.

2023 Treatments	2024 Bloom estimates ^y (Before 2024 treatments applied)		
	South side of tree	North side of tree	Sum per tree
#1 Untreated ON-crop control (last pruned and topped in winter 2021–2022) (alternate bearing control)	2.9 a	2.1 ab	5.0 a
#2 Foliar-applied NAA at FB to the north side of tree in 2023 and the other (south) side of the tree every other year (2025)	2.6 a	2.1 ab	4.8 ab
#3 Pruning (hedging and topping) 28 DAFB on the north side of tree in 2023 and then the other (south) side every other year (2025)	2.8 a	1.9 bc	4.7 b
#4 Foliar-applied cytokinin biosynthesis stimulator annually to the whole tree 14 days after pruning as in Treatment #3 was completed at 28 DAFB	2.8 a	2.0 ab	4.8 ab
#5 Pruning (hedging and topping) 28 DAFB to the north side of tree in 2023 and then the other	2.7 a	2.1 ab	5.3 a

(south) side every other year (2025) on a flexible schedule based on estimated floral intensity

#6 Pruning (hedging and topping) 28 DAFB on the north side of the tree in 2023 and then the other (south) side of tree annually (2024 and 2025)	2.9 a	2.3 a	5.2 a
---	-------	-------	-------

#7 Grower standard practice of pruning both sides of tree and topping in winter 2023 and annually (2024 and 2025)	2.3 b	1.7 c	3.9 c
---	-------	-------	-------

<i>P</i> -value	< 0.0001	0.0084	< 0.0001
-----------------	----------	--------	----------

^z Bloom was evaluated on the following scale: 0, no inflorescences; 1, low floral intensity; 2, medium floral intensity; and 3, high floral intensity.

^y Full bloom was May 19, 2023. Bloom estimates were made May 23, 2023. NAA was applied May 30, 2023. Pruning was done June 26, 2023. The cytokinin synthesis biostimulator was applied on July 5, 2023.

^x Mean values within a vertical column followed by different letters are significantly different at the specified *P* level by Fisher's Protected LSD test.

Table 5. Estimated floral intensity (bloom) of ‘Manzanillo’ olive trees in Exeter, CA, prior to the application of the fruit thinning treatments in 2024, which included pruning (hedging and topping to 14 feet) 28 days after full bloom (DAFB) to one side of the tree and then the other side *biennially versus* pruning 28 (DAFB) on both sides of the trees in every other row every other year and the effect of these treatments on total yield and yield of commercially valuable medium plus larges (M+L) size fruit (kg/tree) in October.

2023 Treatments	2024 Bloom estimates ^y (Before 2024 treatments applied)		
	East side of tree	West side of tree	Sum per tree
#1 Pruned 28 DAFB on west side of the tree in 2023; pruned on the east side in 2025	2.5 a	1.4 bc	3.9 ab
#2 Pruned 28 DAFB on west side of the tree in 2023; pruned on the east side in 2025	2.1 a	1.0 c	3.1 b
#3 Pruned 28 DAFB on both sides of the tree in years 2023 and 2025	2.0 a	2.0 ab	4.0 ab
#4 Pruned 28 DAFB on both sides of the tree in 2024	2.1 a	2.3 a	4.4 a
<i>P</i> -value	0.5072	< 0.0001	0.1732

^z Bloom was evaluated on the following scale: 0, no inflorescences; 1, low floral intensity; 2, medium floral intensity; and 3, high floral intensity.

^y All trees were pruned on June 20, 2023, and all trees were topped on June 20, 2023.

^x Mean values within a vertical column followed by different letters are significantly different at the specified *P* level by Fisher’s Protected LSD test.

Workgroup/Department: Olive / Plant Sciences, UC Davis

Project Year: April 1, 2023 – March 31, 2024. Anticipated Duration of Project: 1 year
(UC Davis Sponsored Programs Proposal 2023: COC)

Project Title:

Evaluating Accede® for Ability to Decrease ‘Manzanillo’ Fruit Detachment Force and Increase Efficiency of Commercial Trunk Shaking and Experimental Canopy Contact Harvesters

Project Leaders:

Dr. Georgia Drakakaki: Professor, Department of Plant Sciences, 210 Asmundson Hall, Mail Stop III, UC Davis, 1 Shields Ave., Davis CA 95616

Dr. Louise Ferguson: Extension Specialist, Department of Plant Sciences, 2037 Wickson Hall Mail Stop II, UC Davis, 1 Shields Ave., Davis CA 95616. LFerguson@ucdavis.edu. Cell:559-737-3061

Dr. Giulia Marino: Extension Specialist, Department of Plant Sciences, 2034 Wickson Hall, Mail Stop II, UC Davis, 1 Shields Ave., Davis CA 95616. Giumarino@UCANR.edu. Cell (530) 304-4509

Becky Wheeler-Dykes: Orchard Systems/Weed Ecology Farm Advisor University of California, Cooperative Extension Glenn, Tehama, and Colusa Counties. P.O. Box 697, 821 E. South St. Orland, CA 95963. bawheeler@ucanr.edu. Office: (530) 884-9313

Cooperators:

Dr. Minmin Wang: Associate Project Scientist, UC Davis

Emily Santos: Assistant Specialist, UC Davis

Franz J. Niederholzer: Colusa County Director and Director Leslie J, Nickels Trust

2023 Season Research Summary

Field Trial Summary:

During the 2023 growing season we applied the ethylene precursor ACC, 1-aminocyclopropane-1-carboxylic acid, at two different spray volumes per acre at one time point based on the fruit removal force. Foliar applications of 1500 ppm Accede® (ACC, 1-aminocyclopropane-1-carboxylic acid) at 1080 GDD after full bloom via a spray application at 100 GPA and 400 GPA significantly reduced fruit removal force one week after application and significantly increased trunk-shaking harvester efficiency. Notably we timed the ACC application at the point where the fruit removal force was below 0.3 kg. There was no significant difference in fruit removal force or trunk shaking-harvester efficiency between 100 GPA and 400 GPA Accede® applications. This indicates a 1500 Accede® application at 100 GPA has the potential to increase trunk-shaking harvester efficiency.

The yield of 2023 was an average of 3,869 lbs./acre (~1.9 US tons/acre) in the control trunk shaken trees, with 8,161 lbs./acre (~4 US tons/acre) combined trunk shaken and hand harvested yield.

Neither application of ACC produced a similar reduction in the canopy contact harvester’s efficiency.

However, while the 1500 ppm Accede® application significantly decreased fruit removal force and significantly increased trunk-shaking harvester efficiency the efficiency of both harvesters was low: ~ 54% for the trunk shaking harvester and ~ 45% for the canopy contact harvester. Observations during harvest, and during postharvest hand gleaning to determine efficiency suggested that the major proportion of the of the remaining fruit was in the tree skirts, less than 4-6 feet above the ground and was not successfully harvested by either harvester. The trunk-shaking harvester cannot remove fruits on low hanging shoots or shoots that contact the harvester bed. In addition, the canopy contact harvester does not harvest the fruits it does not come in contact. In both cases the results suggest that pruning modification, removing the tree skirts below 5 feet will greatly increase the efficiency of both harvesters.

Here

One additional observation; during postharvest hand gleaning that was performed to obtain the harvester efficiency was that the leaf fall was strikingly heavier in the 400 GPA versus the 100 GPA 1500 Accede® application. This suggests the 400 GPA 1500 ppm Accede® application will induce an unacceptable level of leaf loss in ‘Manzanillo’. This is consistent with earlier reports of leaf removal force being more sensitive to ethylene generating compounds than fruit removal force (Goldental-Cohen et. al., 2017).

The cumulative 2023 season experimental field trial results suggest that the 2024 season trials should focus on applying a 1500 ppm Accede® + 0.025% nonionic surfactant in 100 GPA, harvesting 7-10 days after application @ ~ 1000-1200 GDD above 60°F (15°C) after bloom and comparing the difference between trunk-shaking and canopy harvester in trees that have been skirted to exclude shoots with fruit below 4-5 ft and traditionally lower skirted trees. With these experimental parameters of a single 1500 ppm Accede® concentration applied at 100 GPA, and comparing skirted versus non-skirted trees, we should also be able to do 15 tree runs with each harvester and obtain some continuous harvesting operating and capacity parameters: ground speed, seconds per tree, acres per hour and capacity per hour.

Cellular Analyses of Fruit Abscission Zone Summary:

On-going transcriptome and cellular analyses of 2022 small-scale ethephon dipping experiments revealed critical molecular players in the development of olive fruit abscission zone. The transcriptome analysis is being cross validated by cellular analysis of cell wall biopolymer deposition. Identification of key players will help establish marker genes and cellular parameters to evaluate fruit loosening agent of table olives.

2023 Season Materials and Methods:

Orchard preparation:

- Half-bloom date was recorded as May 23rd, 2023.
- All trees were chemically thinned with 150 ppm NAA + 0.025% non-ionic surfactant in 300 GPA on June 5th, 2023.
- All rows were mechanically topped at 11’, hedged on alternate row middles 3’ feet from the trunk on June 20th, 2023. The objective was to maintain a harvestable height and width. All rows were pruned with a chain saw to on June 22nd and 23rd 2023 to remove major scaffolds that would impede a trunk shaking harvester shaking head.
- All rows were hand pruned on June 27th, 2023, to increase light penetration within the canopy.

ACC Treatment Experimental Design: Attachment 1: map

The experimental design had 4 treatments with 2 untreated control treatments:

Treatment:

1. 1500 ppm Accede @ 100 GPA spray + trunk shaking harvester.
2. 1500 ppm Accede @ 400 GPA spray + trunk shaking harvester.
3. 1500 ppm Accede @ 100 GPA spray + canopy contact harvester.
4. 1500 ppm Accede @ 400 GPA spray + canopy contact harvester.
5. Untreated water + 0.025% nonionic surfactant control treatment for trunk shaking harvester.
6. Untreated water + 0.025% nonionic surfactant control treatment for canopy contact harvester.

Each treatment consisted of 60 trees: 4 replications of 15 treated trees and control trees for 240 treated trees and 120 control trees; a total of 360 trees.

The orchard consisted of 12, 30-tree rows: each application was replicated 4 times in a 3-row, 5-tree set (15 trees per replication with 60 trees per treatment) with the interior 3 trees as data trees.

- Accede® treatments were applied at 100 and 400 GPA on 9/28/23 (1054 GDD, $T_{base} = 15^{\circ}\text{C}$) at fruit removal force below 0.3 kg
- Control trees were sprayed with 1000 and 400 GPA water + 0.025% nonionic surfactant on 9/29/23.
- Trunk shaking and canopy contact harvesting were performed one week after application on 10/5/23.
- Hand gleaning of the orchard was performed on 10/11/23 and 10/12/23 for the harvester efficiency calculations.
- A 10-pound post mechanical harvesting sample and hand gleaning fruit for all 72 Accede® + mechanically harvested treatments was submitted to the Musco Family Olive Co. receiving station in Orland the day of harvest for quality and value evaluation.

2023 Field Experiment Result

ACC spray induced fruit removal force reduction and promoted trunk shaking harvester efficiency.

In the 2023 field experiment 1-Aminocyclopropane-1-Carboxylic Acid (ACC, Accede®) application decreased the fruit removal force and improved trunk-shaking harvest efficiency (**Figure 1A**).

Furthermore, no reduction of value or increase of culls/trash was induced by ACC application (**Figure 1B**). No statistical difference was detected between 100 GPA and 400 GPA in all aspects tested.

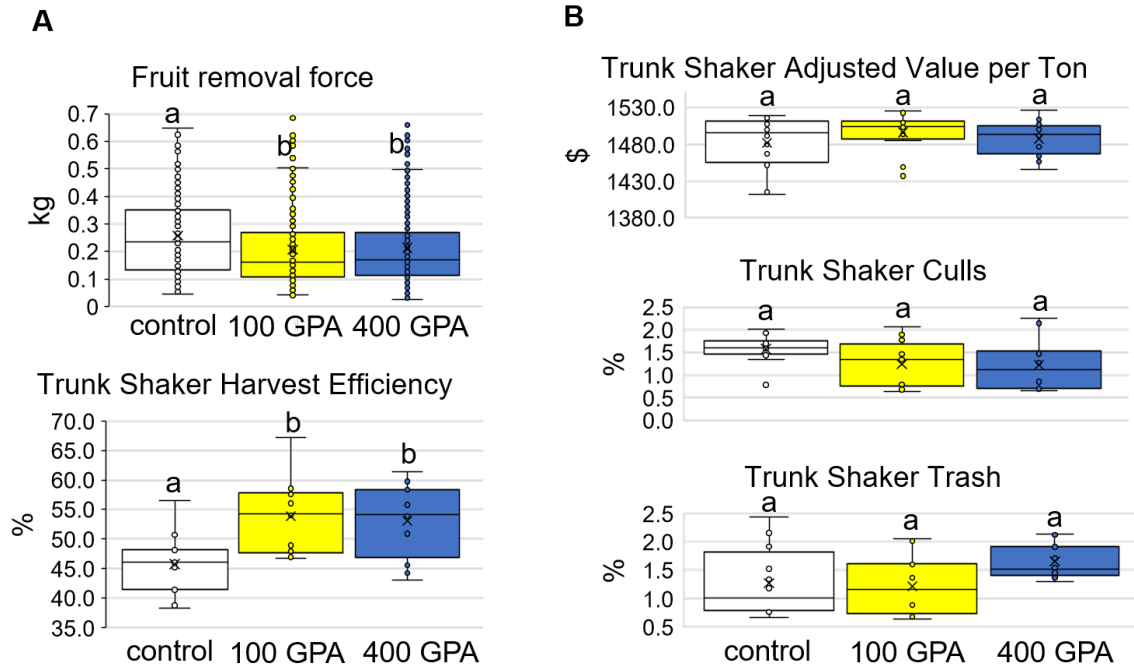


Figure 1. 2023 ACC efficacy test on trunk-shaking harvester. (A) The ACC treatment reduced the fruit removal force and increased the trunk-shaking harvest efficiency by approximately 8%, from 47% for the control to 55% for the trunk shaking harvester. However, the final trunk-shaking harvester efficiency is unacceptably low at ~55%. We hypothesize this value is strongly skewed by the fruit left in the tree skirt; a management decision based upon whether post trunk-shaking harvest a hand crew gleans the tree. In the 2024 season we will examine the economics of leaving the fruit in the skirts and hand gleaning versus removing the skirts. (B) The ACC did not reduce the fruit value or increase the percentage of culls/trash. The ACC spray was applied at 100 and 400 two different volumes GPA (gallon per acre). Fruit removal force was measured on the harvest day (Oct 5, 2023) (n = 240 for each group). Other measurements were analyzed by grouping 5 trees (n = 12 for each group).

The fruit yield of 2023 averaged 3,869 lbs/acre (~1.9 US tons/acre) in the control trunk shaken trees, with 8,161 lbs/acre (~4 US tons/acre) combined yield of trunk shaken and hand harvesting.

Harvest efficiency evaluation of draft-design canopy contact harvester

The adjusted value per ton evaluated by the processing plant showed that trunk shaker did not induce more accumulation of culls or trash than hand gleaning during the harvest (**Figure 2**). However, the canopy contact harvester received penalty for high trash accumulation in the collection, as current design of canopy contact harvester does not have a built-in blower/conveyor belt to remove the trash before collecting the fruits in a receiver.

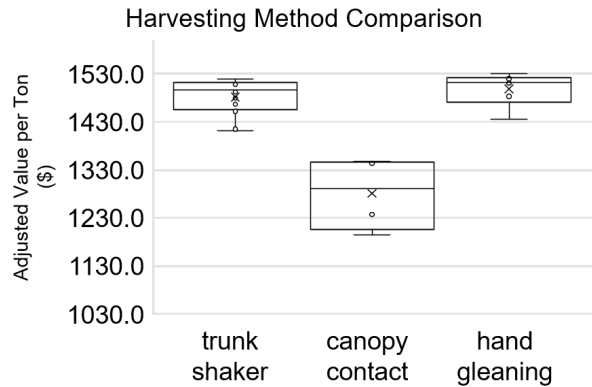


Figure 2. Adjusted value per ton of different harvesting method. 10 pounds samples of every 5 trees were sent to processing plant for evaluation. N = 12 for the trunk shaker; N = 4 for canopy contact; N = 6 for hand gleaning.

ACC application did not increase harvesting efficiency for canopy contact harvester significantly (**Figure 3**), likely because the effect of the fruit removal force was masked by other factors determined by the harvester itself. Other factors like contact arm flexibility and coverage area/volume may be determinants to adjust together with the ACC application.

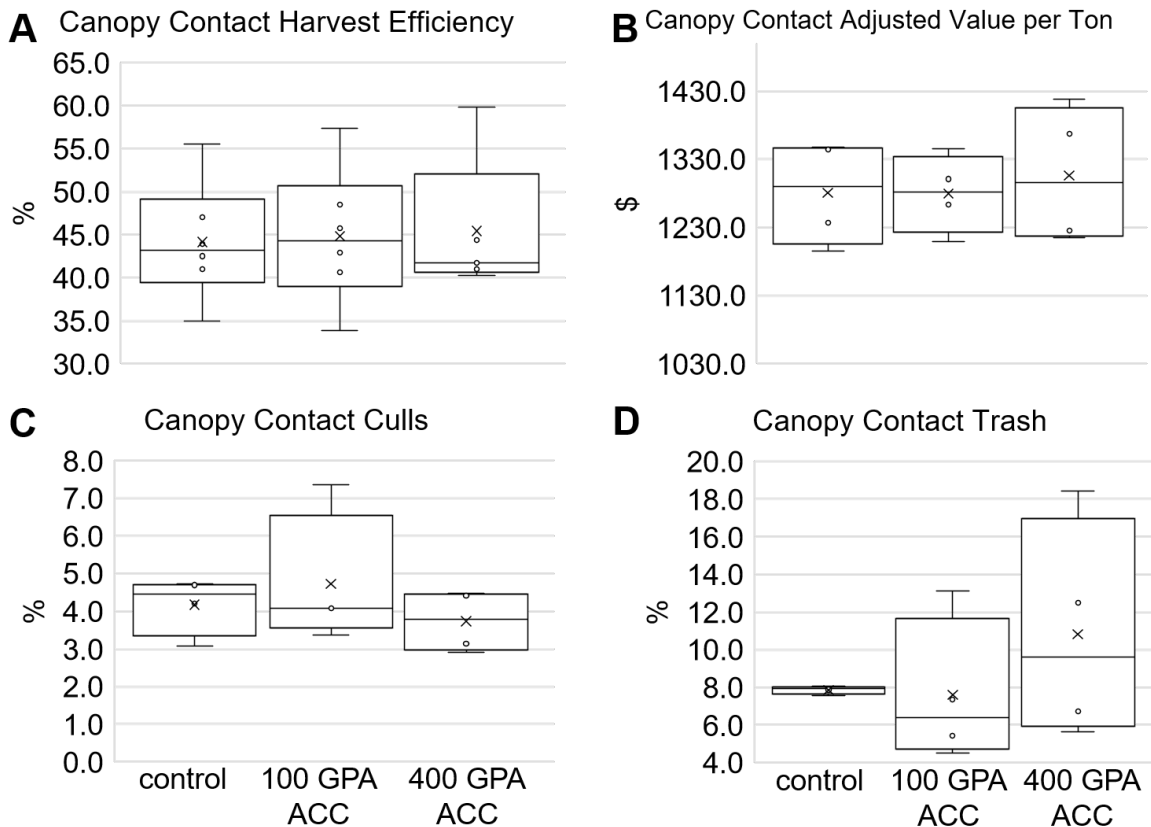


Figure 3. 2023 ACC efficacy test on canopy contact harvester. N ≥ 4 for each group. As shown in the four figures above, the Accede[®] had no effect on harvester efficiency (**A**), adjusted value per ton (**B**), culls (**C**), trash in the bin (**D**). Also, the final harvest efficiency is low at 45%. Observations during harvest demonstrated a high level of fruit removal where the canopy contact harvester head engaged the canopy. This suggests the fruit left in the lower canopy, the tree skirt, is obscuring the true harvester efficiency.

2023 Post-season field data analysis and cellular analysis of abscission zone

Fruit removal force distribution and mechanical harvest efficiency

Figure 4A is the distribution curve of fruit removal force on the day of harvest this year, and alternative plot as a cumulative distribution curve is shown in **Figure 4B**. According to **Figure 4B**, fruit removal force lower than 0.2 kg corresponds to 43.8% of the tested fruit population ($n = 240$) in the control group, which is similar to the control group trunk shaker mechanical harvest efficiency, 45.8% (**Figure 1A**), suggesting trunk shaker can efficiently remove the fruit with pulling force lower than 0.2 kg. Fruit removal force lower than 0.2 kg in 100 GPA and 400 GPA groups accounts for over 60% of the tested population, but the trunk shaker harvest efficiency of both groups is below 54%. The discrepancy between the cumulative distribution curve prediction and actual trunk shaker efficiency suggests the efficacy of Accede may not be completely translated into mechanic harvest efficiency. The reduction of fruit removal force was not completely utilized by the mechanical harvest, indicating other efforts such as pruning or tree shape modification needed to be performed prior to the growing season, to prepare to further promote the mechanical harvest efficiency.

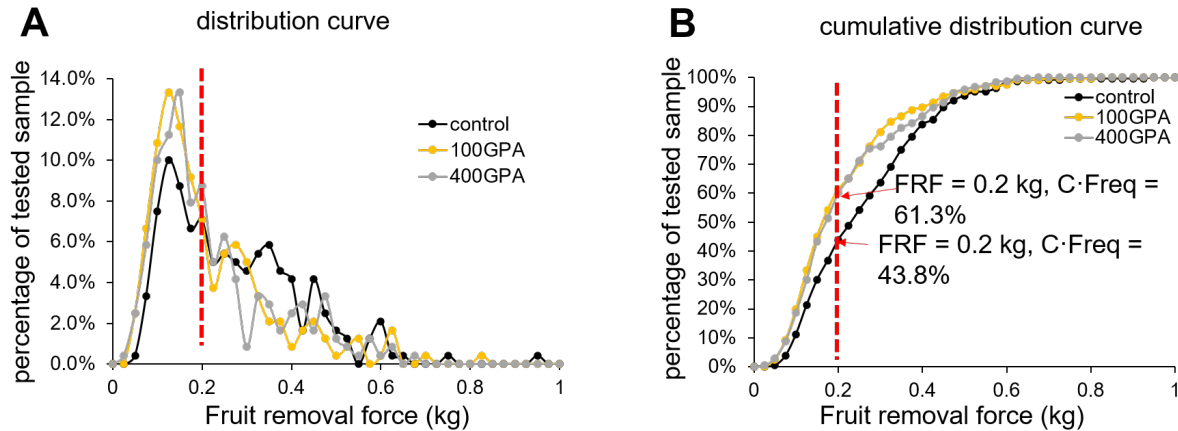


Figure 4. Distribution curve (A) and cumulative distribution curve (B) of sampled fruit removal force. Samples of fruit removal force measurement was collected on the morning of Oct 5th, 2 hours before the trunk shaker mechanical harvest ($n = 240$ for each group).

Comparison of growing degree days during the 2022 and 2023 growing seasons

We are working to build the growing degree day (GDD) model for the table olive mechanical harvest and general olive industry (**Figure 5**). Using the **formula (1)** with T_{base} as 15°C, which is a basic growing degree day model formula, the last ethephon application date (Sept 14th) was 1288°C GDD in the year 2022, and the Accede[®] application date (Sept 28th) was 1054°C GDD in the year 2023, representing more than 200°C difference between the two seasons.

$$GDD = \frac{(T_{max} + T_{min})}{2} - T_{base} \quad (1)$$

Furthermore, by the end of the growing season, when the GDD no longer increased (the daily average temperature drops below T_{base}), the total GDD of the year 2023 by Oct 25th based on the **formula (1)** was 1214°C (**Figure 5B**, $F' = 1214^\circ\text{C}$), which was still less GDD accumulated than the GDD of the last ethephon application date of 2022.

$$GDD = \frac{(T_{cutoff} + T_{min})}{2} - T_{base} \quad (2)$$

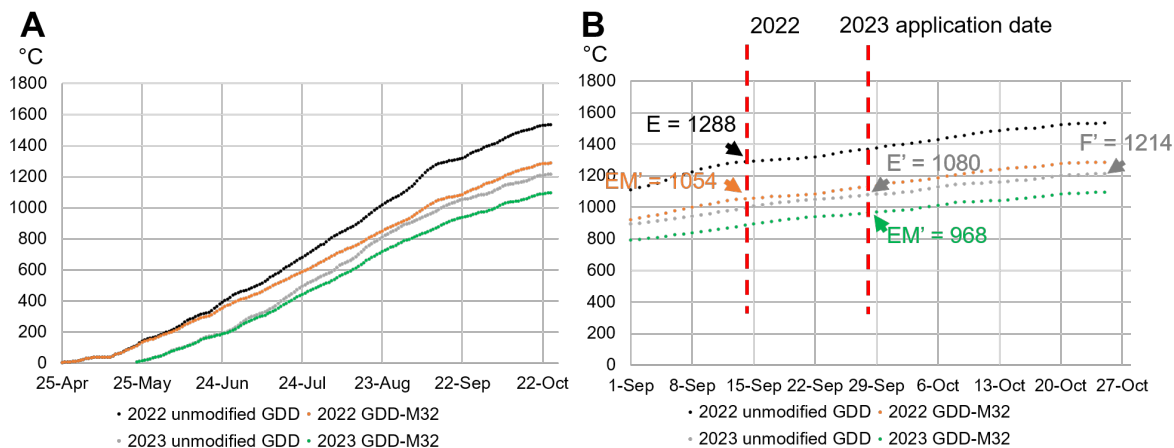


Figure 5. Growing degree days (GDD) calculation of 2022 or 2023 based on formula (1) and (2). (A) GDD of whole growing season. Half-bloom date of 2022 and 2023 is Apr 25th and May 23rd, respectively. (B) zoom-in of September and October heat accumulation. Unmodified GDD is calculated by **formula (1)**. Modified GDD (GDD-M32) using T_{cutoff} as 32°C is calculated by **formula (2)**. Red vertical dashed lines in (B) are ethylene-releasing agent application dates of 2022 and 2023.

Modified T_{max} (T_{cutoff} , ceiling temperature) has been set up in the field for many crops, and the suggested ceiling temperature is 86°F (30°C) in general (Fraisse and Paula-Moraes, 2018). The GDD calculation is changed to **formula (2)** by using T_{cutoff} instead of T_{max} . Yields increase in temperature until about 29°C for corn, 30°C for soybeans, and 32°C for cotton (Deschenes and Greenstone, 2007; Roberts, Michael J, Schlenker, 2008; Ritchie and Nesmith, 2015), and that temperature for olives has not been determined. A 32°C ceiling temperature was tested in this report, which resulted in the modified curves of GDD (**Figure 5**). The modified GDD curve suggests that both year’s ethylene releasing agent application time is around 1000 GDD with modified ceiling temperature ($EM = 1054^\circ\text{C}$ for 2022, $EM' = 968^\circ\text{C}$ for 2023, **Figure 5B**). Using modified GDD, the current estimation is to spray at 1000 GDD and harvest 1 week afterwards. We did observe similar levels of purple olives at harvest during these two years. We will look at the growing season situation for another year and communicate with other plant physiology studies of olive to obtain a more accurate ceiling temperature for olive GDD formula modification.

Repetition of small trial ethephon dipping treatment

As we did not observe conclusive results of harvesting efficiency in whole-tree application of ethylene in 2022, we supplemented a small-scale ethephon dipping experiment on Oct 17, 2022, also using 1500 ppm ethephon (Ethrel) versus control on 12 control trees and 12 treated trees with two olive carrying branches dipped in each tree. FRF was lower than the controls in samples submerged in a high dosage of ethephon (**Figure 6A**). A repetition of the same experiment was performed on Sept 28 of 2023, and a similar result was obtained, confirming the effectiveness of the ethephon dipping experiment, which is also consistent with the literature (Goldental-Cohen et al., 2017).

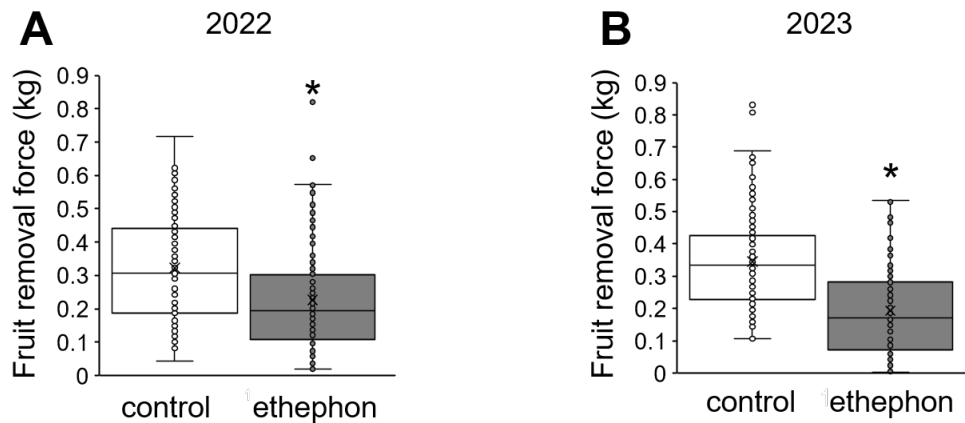


Figure 6. Ethephon induced reduction of fruit removal force. Horticulturally mature fruits were submerged in 1500 ppm ethephon solution or water, and fruit removal force was measured after one week in 2022 (A) and 2023 (B) (n = 120 fruits from 12 trees). Asterisks indicate a significant difference from the control (t-test, $p < 0.05$).

Progress on transcriptome analysis and cellular mechanism of olive fruit abscission

Alkalization of fruit abscission zone in abscising samples

We concluded in 2022 studies that we will focus on the fruit abscission zone to study the effect of ethylene releasing agent, but not the peduncle abscission zone or leaf abscission zone. **Figure 7A** and **7B** show the enlargement of the longitudinal section and various morphologies of the olive fruit abscission zone in immature table olives.

We reported in the 2022 annual report that we obtained transcriptome data. Pectin modification related differentially expressed genes were identified mostly favoring the direction of pH increase, including higher expression polygalacturonase inhibitor (PGIP), pectin methylesterase inhibitor (PMEI), and pectate lyase. A higher methylesterification level of pectin was implicated in ethephon treated/horticulturally mature samples, which is associated with less exposure of acidic ends of pectin galacturonic acid subunit, corroborating with the alkalization of fruit abscission zone hypothesis/model (Patharkar and Walker, 2018).

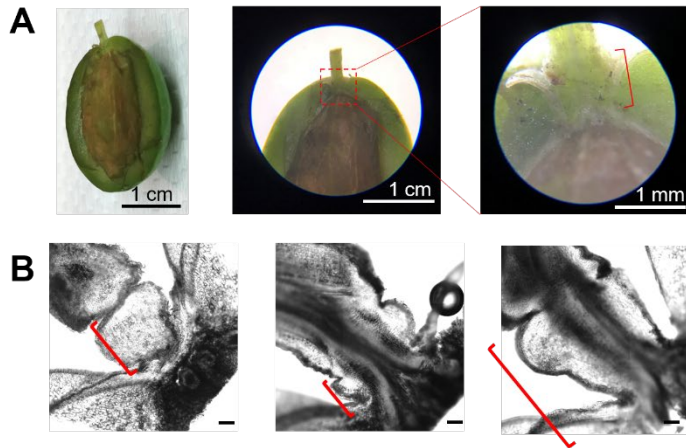
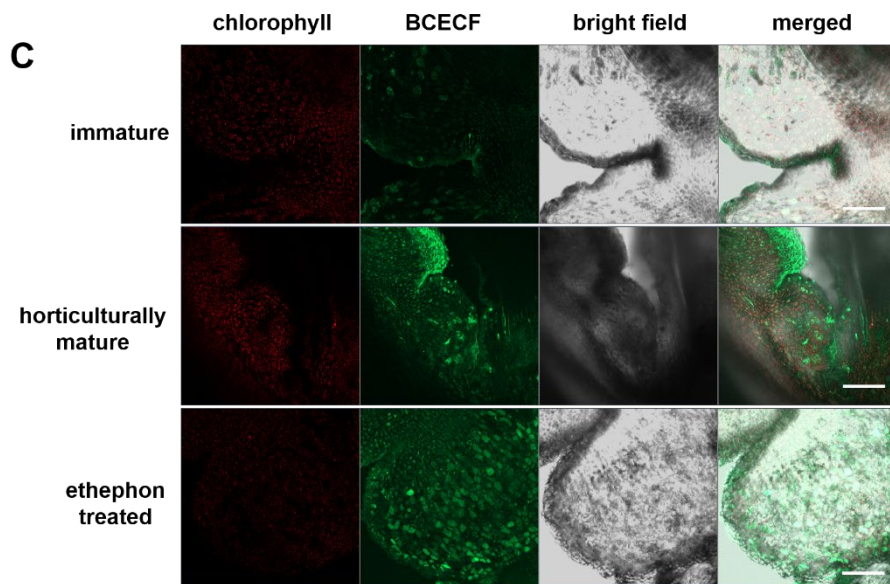


Figure 7. Alkalization of fruit abscission zone was detected in horticulturally mature or ethephon treated samples. (A) Longitudinal sections of whole olive with abscission zone zoom in by red square. (B) Various morphologies of olive fruit abscission zone, indicated by red bracket. (C) BCECF staining of abscission zone, excited at 488 nm
 Scale bar = 200 μ m in B and C.



Levels of callose deposition may be associated with fruit abscission.

We found in the transcriptome analysis that 9 out of 10 differentially expressed β -1,3-glucanases were upregulated in ethephon treated or horticulturally mature fruit abscission zone compared to immature samples, suggesting callose degradation is involved in the development of fruit abscission zone.

Therefore, we plan to perform callose staining in fixed samples. A live staining trial of 1500 ppm ethephon treated samples (**Figure 8**) indicated callose can be detected by aniline blue fluorochrome staining. We will use antibody staining (Wilkop et al., 2019) to compare immature samples and ethephon treated samples or horticulturally mature samples, to quantify if more callose at plasmodesmata is present in immature samples.

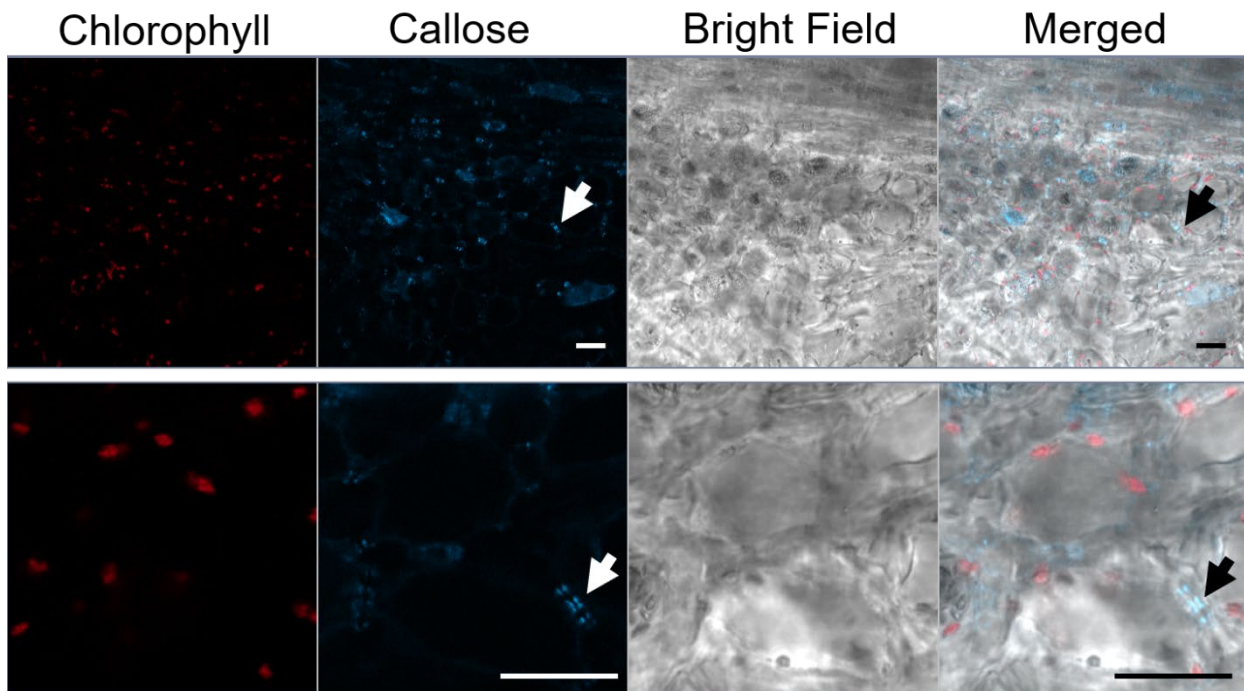


Figure 8. Live staining trial for callose in 1500 ppm ethephon treated samples. Both panels are of one biological sample treated by 1500 ppm ethephon under 10X and 40X objective, respectively. Arrows indicate the same plasmodesmata with callose deposition stained by fluorochrome aniline blue. Scale bar = 20 μ m.

Conclusions

Application of Accede[®] (1-aminocyclopropane-1-carboxylic acid) at 1080 GDD at 100 GPA or 400 GPA successfully induced reduction of fruit removal force one week after application. The trunk shaker harvesting efficiency was increased by Accede[®] at 100 GPA and 400 GPA versus the control group, confirming the effectiveness of Accede[®] application in promoting mechanical harvesting efficiency.

However, the final harvester efficiencies at ~47% for the prototype canopy contact harvester and 55% for the trunk-shaking harvester were unacceptably low. Our in-field observations suggest both measured harvester efficiencies were skewed by the fruit left in the unharvested skirts of the trees; neither harvester removed this fruit. The trunk-shaking-harvester did not remove it because the harvester receiver often

contacted the skirts and damped the shake. The prototype canopy contact harvester did not contact the skirts. In 2024 we will examine harvester efficiencies with and without the skirts removed. If harvester efficiency is improved by the ~ 20% our observations suggest then leaving, or removing the skirts the skirts is a management decision based upon labor cost and availability.

Progress on transcriptome analysis and cellular mechanism of olive fruit abscission implicates the alkalization of fruit abscission zone in abscising samples via live staining and detection of callose deposition at plasmodesmata. Further analyses on the molecular and cellular mechanisms of table olive fruit abscission in response to the ethylene-releasing agent will be summarized for publication and will be used for the development of markers for harvesting.

References

- Deschenes O, Greenstone M** (2007) The Economic Impacts of Climate Change : Evidence from Agricultural Output and Random Fluctuations in Weather. *Am Econ Rev* **97**: 354–385
- Fraisse CW, Paula-Moraes S V.** (2018) Degree-Days: Growing, Heating, and Cooling. *Edis* **2018**: 1–5
- Goldental-Cohen S, Burstein C, Biton I, Ben Sasson S, Sadeh A, Many Y, Doron-Faigenboim A, Zemach H, Mugira Y, Schneider D, et al** (2017) Ethephon induced oxidative stress in the olive leaf abscission zone enables development of a selective abscission compound. *BMC Plant Biol* **17**: 1–17
- Patharkar OR, Walker JC** (2018) Advances in abscission signaling. *J Exp Bot* **69**: 733–740
- Ritchie JT, Nesmith DS** (2015) Temperature and crop development. *Model Plant Soil Syst* 5–29
- Roberts, Michael J, Schlenker W** (2008) Estimating the Impact of Climate Change on Crop Yields : 1–35
- Wilkop T, Pattathil S, Ren G, Davis DJ, Bao W, Duan D, Peralta AG, Domozych DS, Hahn MG, Drakakaki G** (2019) A hybrid approach enabling large-scale glycomic analysis of post-golgi vesicles reveals a transport route for polysaccharides. *Plant Cell* **31**: 627–644

*****INFORMATION ONLY*****

FROM: RESEARCH SUBCOMMITTEE

SUBJECT: UPDATE ON CA SPECIALTY CROP BLOCK GRANT PROJECTS

BACKGROUND:

The 2025 Specialty Crop Block Grant Program will be opening its application submission period in the Fall; as a result, the COC is currently looking for potential grant ideas from the Committee.

- Funding Areas include:
 - Market Enhancement
 - Access, Education, and Training
 - Research

******INFORMATION ONLY******

FROM: RESEARCH SUBCOMMITTEE

SUBJECT: PRODUCT REGISTRATION UPDATE

BACKGROUND:

GWSS:

COC staff is currently looking into products registered to combat GWSS, as GWSS is a vector for Xf.

Staff has reached out to Valent regarding their products PyGanic and Danitol.

Product	Active Ingredient	Registrant	Status
Actara	Thiamethoxam	Syngenta	Not registered on olives
Assail 70 WP	Acetamiprid	United Phosphorous, Inc.	Not registered on olives
Assail 30 SG	Acetamiprid	United Phosphorous, Inc.	Not registered on olives
Baythroid XL	Beta-cyfluthrin	Bayer	Not registered on olives
Tombstone	Beta-cyfluthrin	Loveland Products, Inc.	Not registered on olives
Mustang	Zeta-cypermethrin	FMC Corporation	Not registered on olives
Danitol 2.4 EC	Fenpropathrin	Valent	Registered on Olives for Olive Fruit Fly, etc.
Lannate SP	Methomyl	TKI (Novasource)	Not registered on olives or in CA
Platinum 75 SG	Thiamethoxam	Syngenta	Not registered on olives
Sevin XLR Plus	Carbaryl	TKI (Novasource)	Registered on Olives for Black Scale
Sivanto Prime	Flupyradifurone	Bayer	Not registered on olives
PyGanic Crop Protection EC 5.0	Pyrethrins	Valent	Registered on olives for GWSS

Accede:

Valent will be pitching in \$8,500 towards the research project currently underway!

COC Research Subcommittee Chairman, COC Chairman, and COC staff participated on a IR-4 call expressing support for Accede to become an IR-4 program project. We are waiting to hear back from the IR-4 program.

Syllit and Polyoxin-D (Ph-D):

UPL has submitted applications to EPA. Syllit and Ph-D will be used for managing Peacock spot and Syllit will be used for managing olive knot in mixtures with copper and other new bactericides such as Kasumin.

Approvals are pending at the EPA level until the Endangered Species Act (ESA) review is completed.

*****ACTION REQUIRED*****

FROM: RESEARCH SUBCOMMITTEE

SUBJECT: DISCUSSION AND APPROVAL OF 2025 RESEARCH PRIORITIES

BACKGROUND:

- Each year the Research Subcommittee sets priorities of research they would like executed on their behalf for the following year. These efforts are to fund more specific and calculated research to enhance the benefits to the industry. Once the priorities are set, they are provided to the University of California liaisons to request proposals from researchers. Additionally, priorities are distributed to land grant universities across the nation and to private research facilities. Proposals will be reviewed for funding in November by the subcommittee.
- On the following page are the 2024 Research Priorities.

2024 RESEARCH PROJECTS FOR THE CALIFORNIA OLIVE COMMITTEE

Researcher	Project	Amount
Dr. Jim Adaskaveg*	Management of Foliar Diseases-A. Olive Knot and B. Evaluation of New Fungicides For Control of Olive Leaf Spot	\$13,715
Dr. Jim Adaskaveg*	Epidemiology and Management of Olive Knot Caused by Pseudomonas Savastanoi pv. Savastanoi	\$21,150
Carol Lovatt and Elizabeth Fichtner	Integrating Alternate Bearing Mitigation Strategies in a Commercial Table Olive Orchard	\$33,825
Georgia Drakakaki and Becky Wheeler-Dykes	Evaluation of effects of Accede (ACC), tree architecture, and harvester type on enhancing horticultural maturity and abscission zone development and commercial trunk shaking efficiency in table olives	\$131,380
Rodrigo Almeida	Survey of Xylella fastidiosa diversity within California olive trees	\$29,752
Jim Stewart	Southern San Joaquin Valley Olive Fruit Fly Monitoring	\$12,000
Ernie Simpson	Sacramento Valley Olive Fruit Monitor Project	\$9,250

Total: **\$251,072**

*Projects are co-funded by the California Olive Oil Commission.

California Olive Committee Research Priorities for 2024

- Olive Fruit Fly Trapping
- OFF management techniques with an emphasis on examining new traps that attract flies. Also, OFF management techniques focused on needing a membrane and a new delivery system.
- Management of Olive Knot with an emphasis on developing new methods of control via soil applications. Management of Olive Knot focused on systemic rather than topical treatments.
- Management of Peacock Spot
- Evaluation of drone technology and satellite mapping pertaining to moisture evaluation and crop load estimates
- Mechanical harvesting on existing and new high density orchards
- Development of Loosening Agents
- Olive DNA evaluation to distinguish between different varieties in the market place
- Chemical control of Glassy-winged sharpshooter/Leaf Hoppers
- Determine costs of preventative measures relating to the spread of xylella-fastidiosa (xf)
- Pollination assist techniques focused on Manzanillo
- Investigation of Urea as a thinning agent. What is the cost and optimal application rate? Where is it currently being used?
- Field measurement tool to determine optimal pollination timing
- Determine what research has already been conducted regarding sterilization of OFF