OLIVE OIL COMMISSION OF CALIFORNIA
RESEARCH COMMITTEE MEETING

FRIDAY
FEBRUARY 27, 2026
10:00 AM

2565 Alluvial Ave., Suite 152
Clovis, CA 93611

Join Zoom Meeting

https://us02web.zoom.us/j/81705357646

Conference Number: 1 (669) 900-6833

Meeting ID: 817 0535 7646

AGENDA

I. CALL TO ORDER – Matt Lohse – Chairman

i. Roll Call
ii. Establish Quorum
iii. Approval of Previous Minutes: (action item) (page 3)
  - October 7, 2025

II. CHAIRMAN'S COMMENTS

III. 2026 STRATEGIC PLAN (page 8)

IV. REVIEW OF 2025-2026 RESEARCH (action item) (page 9)

V. PUBLIC COMMENT

VI. OTHER BUSINESS

VII. ADJOURNMENT

RESEARCH COMMITTEE

Matt Lohse – Chairman Big W Ranch 5919 County Rd Orland, CA 95963 (530) 680-0080 matt@bigwranch.com	Vincent Ricchiuti ENZO Olive Oil, P-R Farms 2917 E. Shepard Ave. Clovis, CA 93619 (559) 299-0201 vincent@prfarms.com
Brittany Fagundes California Olive Ranch 265 Airpark Blvd. Ste. 200 Chico, CA 95973 (559) 381-7593 bfagundes@cal-olive.com	Larry Maben Maben Farms 7250 County Road 60 Willows, CA 95988 (530) 518-6660 mabenfamilyllc@gmail.com
Adam Englehardt Englehardt Ag Services 22712 Chard Avenue Gerber, CA 96035 (530) 801-1410 aenglehardt@outlook.com	Richard Marchini Marchini Ag. 9000 W Howard Rd Stockton, CA 95206 (209) 481-3035 richmarchini@gmail.com
Paul Busalacchi Corto Olive Co. 10651 Live Oak Rd. Stockton, CA 95217 (209) 604-0055 pbusalacchi@corto-olive.com	Randy Post Agricultural Advisors 3995 East Butte Rd. Live Oak, CA 95953 (530) 300-4669 agadvisors.rp@gmail.com.
Leandro Ravetti Cobram Estate Olives 455 Harter Avenue Woodland, CA 95776 (844) 626-2726 l.ravetti@cobramestateolives.com	

OLIVE OIL COMMISSION OF CALIFORNIA

RESEARCH COMMITTEE

TUESDAY
OCTOBER 7, 2025
10:00 a.m.

OOCC
2565 Alluvial Avenue, Suite 152
Clovis, CA 93611

Zoom Information
https://us02web.zoom.us/j/82968730535

M I N U T E S

CALL TO ORDER

Chairman Matt Lohse called the meeting of the Research Committee to order at 1:31 p.m. The following Committee Members were in attendance:

i. Roll Call

Matt LOHSE	-	Big W Ranch
Brittney FAGUNDES	-	California Olive Ranch
Larry MABEN	-	Maben Farms, LLC
Paul BUSALACCHI	-	Corto Olive Co.
Randy POST	-	Agricultural Advisors
Leandro RAVETTI	-	Cobram Estate Olives

STAFF:

Todd SANDERS	-	Olive Oil Commission of California
Michelle BORGES	-	Olive Oil Commission of California
Mary McDONNELL	-	Olive Oil Commission of California
Ethan CRANMER	-	Olive Oil Commission of California

GUESTS:

Cliff BEUMEL	-	Agromillora California Nursery
Patrick BROWN	-	UC Davis

ii. Establish Quorum

Having received a sufficient number of Committee members present, a quorum was established.

iii. Approval of Previous Minutes – ACTION
The minutes of May 13, 2025, and June 17, 2025, meeting was presented to the Board for approval.

- **MOVED by MABEN, duly seconded by FAGUNDES, and unanimously carried THAT the minutes of May 13, 2025, and June 17, 2025, be approved as presented. (MOTION 10-7-25 #1)**

II. Chairman's Comments

None

III. REVIEW OF 2024-2025 PROJECTS

The following 2024-2025 research project has received a No Cost Extension until December 1, 2025.

2024-2025 RESEARCH PROJECTS

Researcher	Project	Amount
Paul Long **	Olive Oil Cost of Production Study	$16,114

IV. RESEARCH PRIORITIES

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. Priorities are distributed to land grant universities across the nation and to private research facilities.

OOCC Research Priorities for 2025-2026

Control of the following existing or potential threats to the industry:

- Research How to Grab Carbon Money
- Understanding Sap Analysis
- New Canopy Management Trial
- Loosening Agents like Accede
- Nitrogen/Nutrient Analysis Oil yield analysis 10,000 acres and everyone sharing tissues vs yield and finding sweet ranges on elements
- Foliers Sprays and their effectiveness efficacy for absorption and if it helps with yield
- Anything to help hold the bloom on the plants
- Super high-density bloom volume self-fertile? They are only self-fertile to a small degree
- More consistent yields and then it all falls off. Another 2% would make a huge difference

California Olive Committee Research Priorities for 2026

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/ Field measurement tool to determine optimal pollination timing
• Investigation of Urea as a thinning agent. What is the cost and optimal application rate? Where is it currently being used?
• Determine what research has already been conducted regarding sterilization of OFF
• Attract and Kill trap for Olive Fruit Fly
• Black Scale Control from a Natural Insect Pest
• GWSS research on mass trapping
• Biological Research on Black Scale
• Unexplained Crop Failures specifically in the South
• Health Claims backed with Research for Canned California Ripe Olives

OOCC Research Priorities for 2026-2027

Control of the following existing or potential threats to the industry:

- Research How to Grab Carbon Money
- Understanding Sap Analysis
- New Canopy Management Trial
- Loosening Agents like Accede
- Nitrogen/Nutrient Analysis Oil yield analysis 10,000 acres and everyone sharing tissues vs yield and finding sweet ranges on elements
- Foliers Sprays and their effectiveness efficacy for absorption and if it helps with yield
- Anything to help hold the bloom on the plants
- Super high-density bloom volume self-fertile? They are only self-fertile to a small degree
- More consistent yields and then it all falls off. Another 2% would make a huge difference
- Green Olive Knot – showing up on fruit; possible reduced efficacy of copper treatment?
- Neofabraea Treatments
- Wider range of pesticide options for organic and conventional
- Detecting residues in oil

V. PEST QUARANTINES

Quarantines are established when survey results indicate an infestation is present, the Department has defined the infested area and the local California County Ag. Commissioner is notified and requests the quarantine area be established.

Oriental Fruit Fly (OFF):
• Olives are not listed as a host.
• Quarantine areas in Orange County.
• Interactive GIS Map Outlining Quarantine Zones.

Huanglongbing (HLB):
• Olives are not listed as a host.
• Quarantine areas in Ventura, LA, Orange, San Bernardino, Riverside, Oceanside, Fallbrook and San Diego.
• Interactive GIS Map Outlining Quarantine Zones.

Sweet Orange Scab (SOS):
• Olives are not listed as a host.
• Quarantine areas in Orange, LA, San Bernardino, Burbank, Imperial, and Riverside.
• Interactive GIS Map Outlining Quarantine Zone.

Mediterranean Fruit Fly (Medfly):
• Olives are listed as a host.

• Quarantine areas in Santa Clara County.
• Interactive GIS Map Outlining Quarantine Zone.

VI. PUBLIC COMMENT

Patrick Brown of UC Davis, Department of Plant Sciences, was a guest at the meeting, and spoke regarding his role as an Associate Professor and Nut Crops Breeder. Patrick is also a tree breeder for pistachios and walnuts, he discussed an olive breeding program with the committee, and proceeded to explain the process, suggesting it could start modestly with low funding and a short-term commitment. Patrick and Cliff Beumel will prepare a formal proposal for an olive breeding program with specific dollar figures and expected outcomes.

VII. OTHER BUSINESS

None

VIII. ADJOURNMENT

Chairman Matt Lohse adjourned the meeting of the Research Committee at 2:35 p.m.

Todd W. Sanders
Executive Director
Olive Oil Commission of California

<u>SUMMARY OF MOTIONS FOR OCTOBER 7, 2025</u>

MOTION 10-7-25 #1 APPROVED

MOVED by MABEN, duly seconded by FAGUNDES, and unanimously carried THAT the minutes of May 13, 2025, and June 17, 2025, be approved as presented.

****INFORMATION ONLY****

FROM: OOCC RESEARCH COMMITTEE

SUBJECT: 2026 STRATEGIC PLAN

BACKGROUND:

The OOCC Research Committee needs to discuss the 2026 Strategic Plan.

****ACTION REQUIRED****

FROM: OOCC RESEARCH COMMITTEE

SUBJECT: 2025-2026 RESEARCH PROJECTS

BACKGROUND: The Research Committee requests that all funded research projects provide interim progress reports. The following pages include interim updates for the currently funded projects. Representatives from Land IQ will be present on the call to discuss and outline next steps. In addition, Becky Wheeler Dykes has submitted a revised research proposal that reflects a change in project scope. This updated proposal will require committee review and approval. It does not increase the amount originally allocated to the project. The proposal is included in the packet following the interim reports.

2025-2026 RESEARCH PROJECTS

Researcher	Project	Amount
Jim Adaskaveg*	Epidemiology and Management of Olive Knot Caused by Pseudomonas Savastanoi pv. Savastanoi	$7,500
Joel Kimmelshue	Land IQ Acreage	$34,700
Becky Wheeler-Dykes	Developing an Understanding of Sap Analysis for Nutrient Management in Olives Grown for Oil	$35,534
	Total * budget estimate; actual budget pending on results	

*Project co-funded by the California Olive Committee.

ANNUAL REPORT - 2025
California Olive Committee (COC) and California Olive Oil Committee (COOC)

Project title: Epidemiology and management of olive knot caused by *Pseudomonas savastanoi* pv. *savastanoi*

Principle investigator: Dr. J. E. Adaskaveg **Cooperating:** H. Förster and D. Thompson

Institution: Department of Microbiology and Plant Pathology, University of California, Riverside, CA 92521

Introduction

Pseudomonas savastanoi pv. *savastanoi* (*Psv*), the causal agent of olive knot, is a serious disease of olives (*Olea europaea*) worldwide. The pathogen enters through wounds and causes knots, tumors, and galls mostly on trunks, branches, and twigs. Severe infection may lead to tree defoliation, dieback, and reduced vigor, which ultimately lowers fruit yield and quality. *Psv* can survive epiphytically on olive trees, but the main source of inoculum are bacteria inside knots. Large quantities of bacterial ooze can be exuded when knots become wet. This exudate is disseminated by rain, wind, insects, birds, or human activity. The opportunistic pathogen invades wounds from natural leaf abscission, frost, and hail, as well pruning and harvesting. After entering its woody host, the pathogen induces knot formation through the production of indoleacetic acid (IAA) and cytokinins. In California, infections occur mostly during the rainy season (late fall to spring), but knots do not develop until new growth starts in the spring. Infections can occur at low temperatures (-5°C) and thus, wetness is the main limiting factor for the disease. None of the currently grown olive cultivars is resistant to the pathogen.

Control of olive knot is difficult, and growers rely on applications of copper-based bactericides as the only effective foliar treatment. Manual application of cresol- and xylenol-based compounds (e.g., Gallex) to individual knots can eliminate the pathogen but is too labor-intensive on a commercial scale and is phytotoxic when applied as an air-blast foliar treatment. Copper has been extensively used in olive production for many years for the control peacock spot and olive knot. Reliance on a single active ingredient has led to our detection of copper resistance in *Psv* strains in some commercial olive orchards. Still, the incidence of copper resistance is currently very low, accounting for only 2% of the strains collected in a survey of olive growing regions in California. When Cu-resistant strains were inoculated to Arbequina and Manzanillo olive wounds, copper provided reduced or no control as compared to inoculation with a sensitive strain. Therefore, there is a potential risk of copper resistance spreading with the continued sole use of copper. Additionally, copper treatments have become under increasing regulatory scrutiny due to potential environmental contamination of soil and watersheds. This necessitates the development of new bactericides.

In numerous studies over the last years, kasugamycin was the most effective new treatment for preventing olive knot on naturally formed leaf scars and wounds created by hedging or harvesting or artificially in inoculation studies. Kasugamycin was first federally registered on pome fruits, followed by registrations on cherry and walnut. Registration on olive, peach, and almond is pending at EPA. The olive submissions of kasugamycin, oxytetracycline, and dodine (Syllit) to the EPA were done through the IR-4 program in 2020 with PRIA dates of 2022 for all three bactericides. Kasugamycin, oxytetracycline, and dodine would greatly complement current copper sprays and could be used in rotation or mixtures with copper. Unfortunately, EPA is still revising registration requirements as of fall 2025. Syllit obtained Federal registration, but the registration is still pending CA-DPR approval. Additional studies were conducted to potentially improve use of these antibiotics by adding reduced rates of copper or food-grade antimicrobials (nisin and ε-poly-L-lysine) that are exempt from tolerance. The fungicide dodine has been reported to have bactericidal properties when used at low labeled rates. Since it is being registered for peacock spot, it was evaluated as a bactericide alone and in combination with copper, antibiotics, and food-grade antimicrobials with some success.

We continued to evaluate the field performance of new treatments. We are currently working with a registrant to formulate the food additive ε-poly-L-lysine (EPL) in a mixture with cinnamaldehyde as part of an ongoing process to develop new GRAS bactericides for olive knot control. We previously demonstrated a synergistic effect in enhancing efficacy of this mixture compared to the single ingredients. The registrant is currently identifying consistently active sources of the two mixture components. Formulation strategies also the addition of adjuvants to prevent photo- or UV-degradation. In 2023/24 and in 2024/25, we also evaluated additional treatments that may be approved for organic registration. These included natural products and a new formulation of Kasumin, Kasumin 8L, that can be registered as an organic treatment because the inert ingredients are all organically approved in contrast to the 2L formulation. Additionally, we evaluated potassium phosphite (PO_3) treatment and showed that its effect on direct or indirect bactericidal activity is limited.

RESEARCH OBJECTIVES

1) **Evaluate new bactericides against *Psv*: GRAS food additives, natural products, and other experimentals** (see Table 1)
   a) Laboratory in vitro sensitivity studies: plant extracts, nisin and Ɛ-poly-L-lysine (EPL) mixed with capric/caprylic acids (Dart) or other products.
   b) Field efficacy studies with new bactericides in comparison with kasugamycin and copper for the management of olive knot.
      i) Optimize the efficacy of oxytetracycline and kasugamycin in mixtures with dodine, low rates of copper in traditional (e.g., Kocide, Champ) or new formulations with low copper concentrations (e.g., Cueva, CS2005), or natural products as compared to the antibiotics or copper by themselves to ensure guidelines can be provided to the industry for optimal performance once they are registered.
      ii) Food preservatives, natural products, biocontrols alone or in combinations and sanitizers (Virus-Shield) and systemic acidifying phosphonates (e.g., phosphite) registered as fungicides.
2) **Continue to support the registration of the antibiotics kasugamycin and oxytetracycline**
   a) We continue to support these bactericides, but the date of registration is unknown due to EPA involvement with the Endangered Species Act (ESA).

PLANS AND PROCEDURES

1. A. In vitro evaluation of food additive compounds as bactericides at selected concentrations in agar dilution assays against bacterial pathogens. Materials were prepared for in vitro evaluation. Some materials were dissolved in 50% ethanol (Benzoic acid), some were sonicated in water (Epigallocatechin gallate), while some were readily dissolved in water (Hydroxytyrosol) and diluted to 100, 250, 500, or 1000 ppm. Bacterial cultures were prepared as 70% OD600 and were streaked on to amended agar plates and evaluated for growth after 2 days using a scale of 0 = no growth to 3 growth similar to the untreated control plates. The experiment was done twice and averaged for both experiments.

1. B. Evaluate new bactericides, food additives, GRAS sanitizers, and other experimentals against *Psv.* Greenhouse and field (at UC Davis) studies were done on Arbequina and Manzanillo olives. Lateral wounds on 1-2-year-old twigs were made using a scalpel by removing the bark and exposing cambial tissue. Leaf scars were made by pulling off leaves from the same twigs. Treatments were sprayed onto wounds, allowed to air-dry, and spray inoculated with *Psv* (2×10^7 cfu/ml). After 2, 3, and 4 months, lateral wounds were assessed for three twigs of each of three or four replicate plants/treatment. The efficacy of treatments was assessed as the percent incidence based on knots forming on treated, inoculated wounds as compared to wounds that were treated with water and inoculated (i.e., controls).

2) Continue to support the registration of the antibiotics kasugamycin and oxytetracycline. An inter-commodity and industry group continued to work with the Minor Crop Farmer Alliance to recommend an EPA policy change towards the use of antibiotics in plant agriculture. Additionally, we continued to work with a USDA working group to address CODEX initiatives for establishing policies on all antibiotic use in agriculture including animal and plant uses. We attend the IR-4 Food Use Workshop and meet with EPA to discuss the registration status of all submissions including kasugamycin, oxytetracycline, and other materials such as dodine.

RESULTS AND DISCUSSION

1A. In vitro evaluation of food additive compounds as bactericides at selected concentrations in agar dilution assays against bacterial pathogens. Table 1 summarizes potential food grade bactericides in the development of a combination product to fight bacterial diseases of plants. Benzoic acid was the most bactericidal inhibiting growth of all the bacterial pathogens evaluated in this experiment at concentrations above 250 ppm. The two other bactericides had variable results dependent on the species being evaluated. Epigallocatechin gallate was highly toxic to *P. savastanoi, X. a.* pv. *juglandis,* and *X. a.* pv. *pruni* at concentrations of 500 and 1000 ppm; whereas Hydroxytyrosol was only highly inhibitory to *P. savastanoi* and *X. a.* pv. *juglandis* at 1000 ppm.

In vitro toxicity of Summit Agro bactericides in amended agar studies Sept 25

		Conc.	Growth rating				
No.	**Bactericide**	**(ppm)**	***amylovo***	***. syringae***	***savastan***	***arb. prur***	***rb. juglan***
1	Control	---	3.0	3.0	3.0	3.0	3.0
2	Benzoic acid	100	3.0	3.0	3.0	3.0	3.0
		250	0.0	0.5	0.0	0.0	0.0
		500	0.0	0.0	0.0	0.0	0.0
		1000	0.0	0.0	0.0	0.0	0.0
3	Epigallocatechin Gallate	100	3.0	2.3	1.0	2.0	2.0
		500	3.0	2.0	0.4	0.8	0.8
		1000	2.0	1.5	0.1	0.3	0.4
4	Hydroxytyrosol	100	3.0	3.0	3.0	3.0	3.0
		500	3.0	2.5	1.0	3.0	2.5
		1000	3.0	2.0	0.5	1.8	0.8

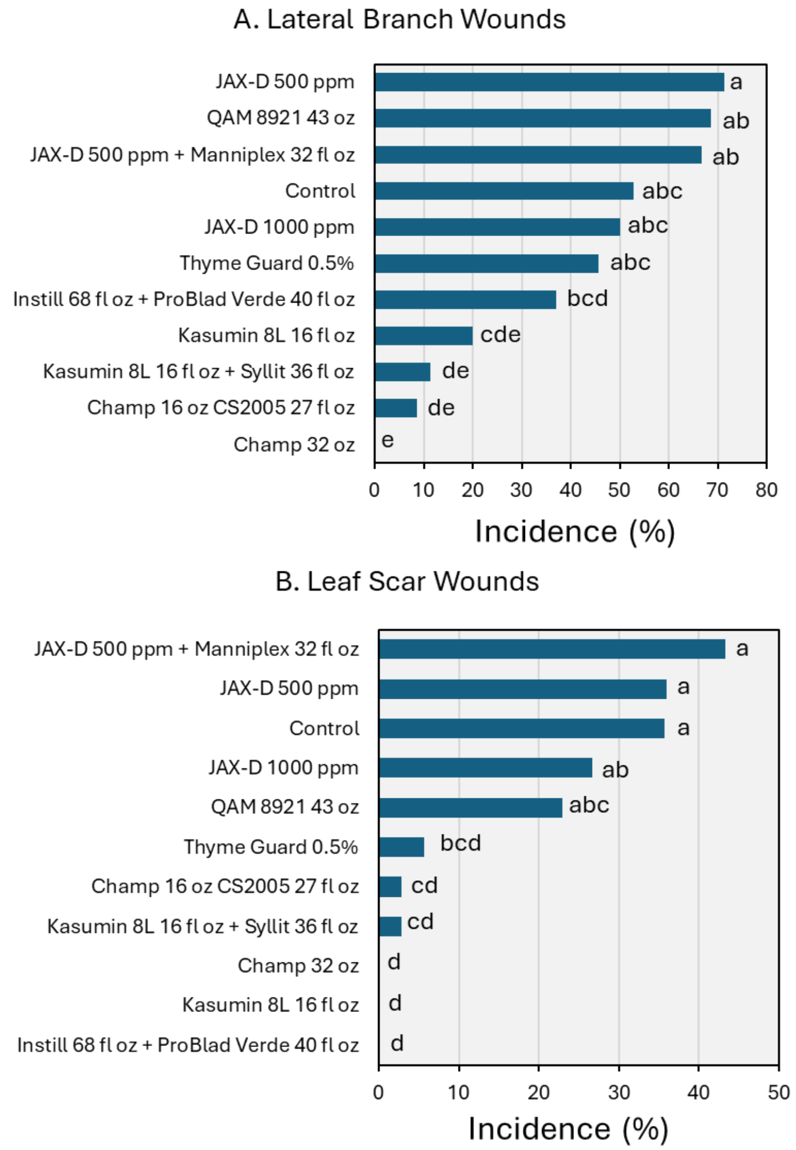
BA dissolved in 50% EtOH. EG was sonicated in water.
Added bactericides to nutrient agar, then streaked bacterial suspensions (OD600 70%).
Rated plates for growth after 2 days from 0 (no growth) to 3 (growth as in control).
Data are the average of two experiments.

1B. Evaluate new bactericides, GRAS food additives, and other experimental compounds against *Psv*. Efficacy studies with inoculated olive twigs were conducted in the greenhouse and field using new bactericides by themselves or in selected mixtures, and efficacy was compared to copper. Additional field studies that were initiated in the fall of 2024 and spring and summer of 2025. Knot development after inoculation can take up to 9 months to be visible. As in previous years, efficacy of some treatments was sometimes not consistent between repeated studies on different cultivars, even when done at the same time and using the same treatment and inoculum preparations. Still, in field studies, treatments containing copper products or kasugamycin ranked among the most effective in all four studies (Figs. 1,2). A mixture of a reduced rate of **copper** hydroxide (Champ) with copper sulfate (CS 2005) was statistically similarly effective as a higher rate of copper hydroxide (Fig. 1 – both studies; Fig. 2 – both cultivars). Thus, the Champ WG treatment at 32 oz contains 16 oz MCE, whereas the treatment with Champ at 16 oz + 27 fl oz of SC 2005 contains approximately 10 oz MCE. This amounts to a significant reduction in copper and complies with EPA goals in reducing copper accumulation from agricultural and industrial use in the environment and is a step towards more environmentally minded pesticide use.

The organic 8L formulation of **Kasumin** mostly performed with high efficacy, and in mixture with Syllit, efficacy was sometimes improved (Fig. 1A); whereas in other trials they were equivalent (Figs. 1B, 2A,B). We previously demonstrated the value of **Syllit** as an important mixture component also for copper and oxytetracycline, and our results validate the request for registration of these compounds on olive. Syllit is also a fungicide and is effective against olive leaf spot. Therefore, its registration on olive will allow for mixtures with copper, fungicides, and antibiotics for the management of olive leaf spot and knot. The federal label for dodine was approved by EPA in 1/2024 but the CA-DPR registration is still pending.

Instill mixed with ProBlad Verde is and organic treatment that showed high efficacy in preventing olive knots against leaf scar inoculations (Fig. 1B) but was less effective against lateral branch wound inoculations (Fig. 1A). A new formulation of the **food preservative EPL mixed with cinnamaldehyde (JAX-D)** performed inconsistently and in general performed poorly in 2025 trials (Figs. 1 and 2). Formulation of this mixture is ongoing. In amended agar studies in 2024 using five bacterial tree fruit pathogens from California, including *Psv*, significant differences in in vitro toxicity were found between two formulations of EPL and three formulations of cinnamaldehyde that varied by bacterial species. These results indicate that in designing an agricultural mixture formulation (i.e., JAX) by the registrant, consistent sources of the two mixture partners must be used. The registrant is re-formulating that may include benzoic acid or other ingredients for 2026 trials. We will continue working with the registrant and once a consistent formulation is identified, we will come back to the olive boards of California to finalize the efficacy data with field trials. **Other biological treatments** evaluated in 2025 included Thyme Guard containing thyme oil and the *Acacia* sp. extract QAM but were inconsistent (i.e., QAM and Thyme Guard – Fig. 1B) or with low or no efficacy (Fig. 1A).

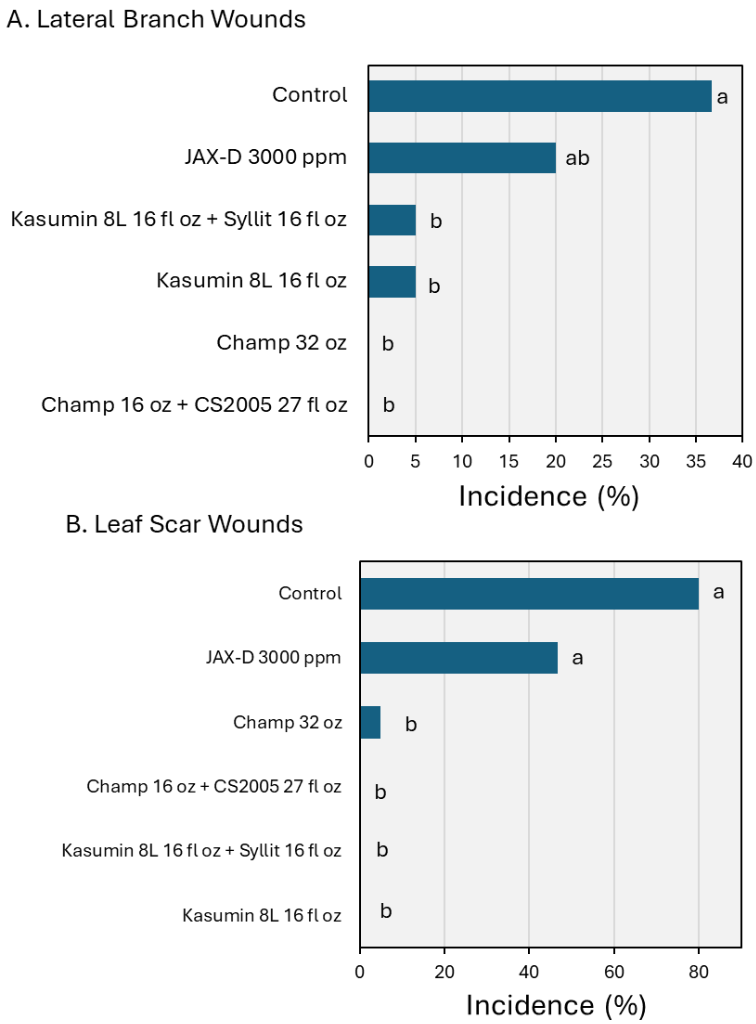
Fig. 1. Evaluation of new bactericides for management of olive cv. Arbequina knot after inoculation with *Psv* - Field studies at UC Davis 2024/25



In summary, among new treatments for the management of olive knot, the organic 8L formulation of Kasumin performed consistently well in both 2024 and 2025 seasons, and efficacy was sometimes improved when mixed with Syllit or Vacciplant. The food preservative EPL in mixture with cinnamaldehyde has promise, and an improved formulation may increase efficacy and consistency. Thus, we will continue our evaluations. None of the other biological treatments presented in this and previous years' reports resulted in commercially acceptable efficacy.

Crop Safety. In multiple field trials with kasugamycin (Kasumin 2L and 8L) and oxytetracycline (e.g., FireLine) we have not observed any phytotoxicity to table olive (e.g., Manzanilla, Gordal Sevillano) or olive oil (e.g., Arbequina, Arbosana, Koroneiki) cultivars evaluated. This also includes mixtures of the antibiotics with other products such as dodine (Syllit), capric/caprylic acids (Dart), or the food preservatives in olive orchards at UC Davis and UC Riverside. Additionally, studies were conducted in different years and at different times of the year such as after harvest (Nov.), mid-winter (Jan.-Feb.), or at leaf drop (early April), thus demonstrating no interactions under different environments.

Fig. 2. Evaluation of new bactericides for management of olive knot on cv. Arbequina after inoculation with *Psv* - Field studies at UC Riverside 2024/25



Continue to support the registration of the antibiotics kasugamycin and oxytetracycline. Registration of oxytetracycline (Fireline) and kasugamycin (Kasumin) is supported by the registrants (AgroSource and UPL, respectively) for full registration. EPA, however, delayed the review of oxytetracycline due to COVID-19, more recently due to the Endangered Species Act (ESA) requirements and policies on antimicrobials. The PRIA date for both antibiotics was again changed and postponed with no new PRIA date set. The latest information is that the antimicrobial resistance (AMR) studies organized by the EPA demonstrated that the use of antibiotics in agriculture does not lead to resistance in human bacterial pathogens because the genes involved in pathogenesis are completely different between human and plant bacterial pathogens. Moreover, agricultural uses are external and not internal as with human medications against bacterial pathogens. The external uses on plants are short lived due to environmental degradation (hydrolysis, UV light, micro-organism activities, etc.) and short persistence. We encourage the California Olive Boards for table and oil to meet with EPA and request legislative support from our congressional leaders in an effort to register oxytetracycline (Fireline) and kasugamycin (Kasumin) as tools for combating bacterial diseases of plants and specifically olive. When applications were made after harvest, before winter freezes, and at leaf drop (spring), IR-4 residue studies indicated 0 levels at harvest (11 months to 5 months before harvest).

Syllit was federally registered on olive as of 1/2024 and the state registration is pending. The goal is to have Syllit used in a mixture with Kasumin or copper products similar to copper-mancozeb or Kasumin-mancozeb treatments on walnut with higher efficacy and preventing the selection of pathogen resistance to these bactericides. Syllit is also effective against olive leaf spot.

TECHNICAL MEMORANDUM

Olive Oil Commission of California – Interim Report: Olive Mapping

PREPARED FOR:	Mary McDonnell/Olive Oil Commission of California
PREPARED BY:	Joel Crowther/Land IQ Casey Gudel/Land IQ Joel Kimmelshue/Land IQ

Introduction

Land IQ was awarded a research grant through the Olive Oil Commission of California (OOCC) for the purpose of mapping the acreage of olives grown for oil including summaries by age, county, and planting system.

Project Update

This is an interim project update. The final deliverables for this work will include oil olive mapping, age of each grove, planting system, and a web map to view and edit results.

While Initial mapping has been completed and is available through a web application, Land IQ is looking to the OOCC and its industry representatives to review these interim mapping results and verify groves used for oil production that Land IQ has preliminarily classified.

Olive Mapping

Land IQ utilized its 2024 Department of Water Resources mapping as the base mapping for this project. The Land IQ mapping conducted for the DWR currently includes the crop category of olives, which does not differentiate between table olives and olives for oil. Land IQ started with this olive mapping and also leveraged our team's agronomic knowledge, ground truth data, Department of Pesticide Regulation's Pesticide Use Reports, image analysis, county crop reports, and remote sensing techniques to further refine the classification. One area of refinement was identifying specific planting systems (hedgerow or traditional), as initial indicators of those grown for olive oil or table olives. The dataset reflects standing olive acreage at the end of the 2024 water year (September 30, 2024).

Once the mapping was completed, further analysis was conducted to determine the age of the crop using a backwards looking time series analysis on available imagery as far back as 1984.

Web Mapping Application

Land IQ has developed a web mapping application to view olive mapping, as well as age and planting system. The web mapping application allows users to edit the attribute of 'Grove Use' to further refine results. Some examples of the web mapping tool are included below (Figures 1-5).

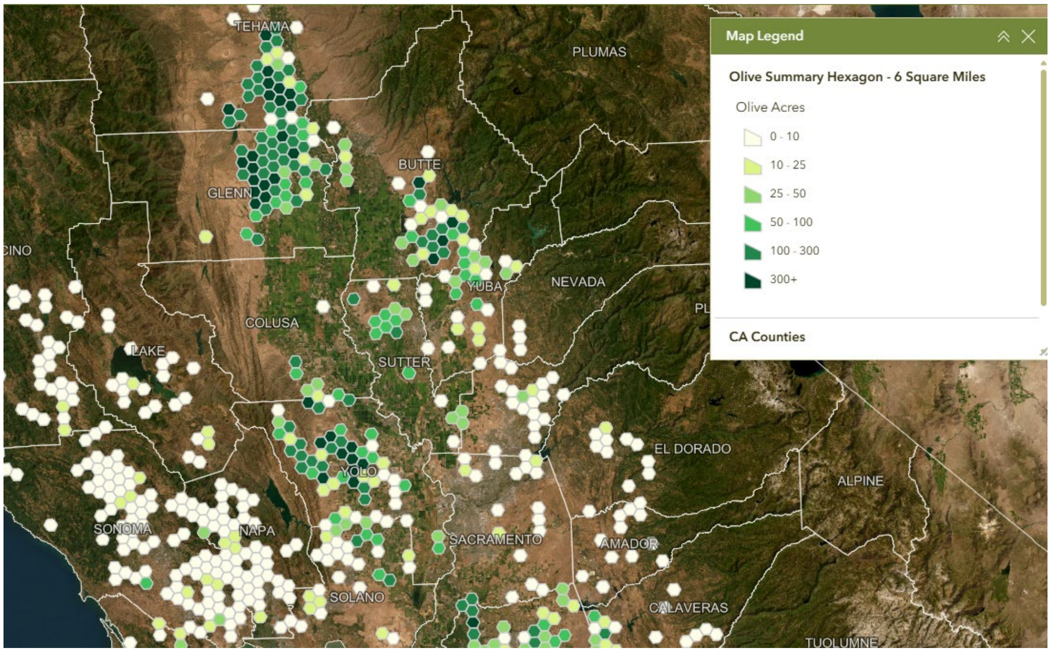


Figure 1. Mapping Results

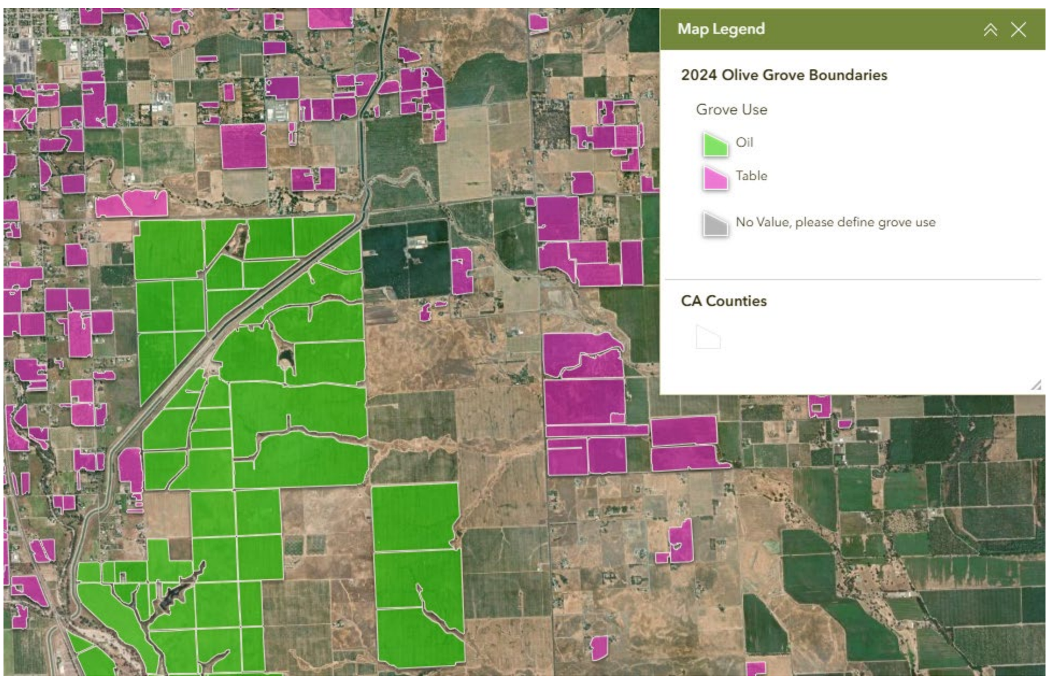


Figure 2. Zoomed in Field Boundaries

Figure 3. Attributes of Mapping

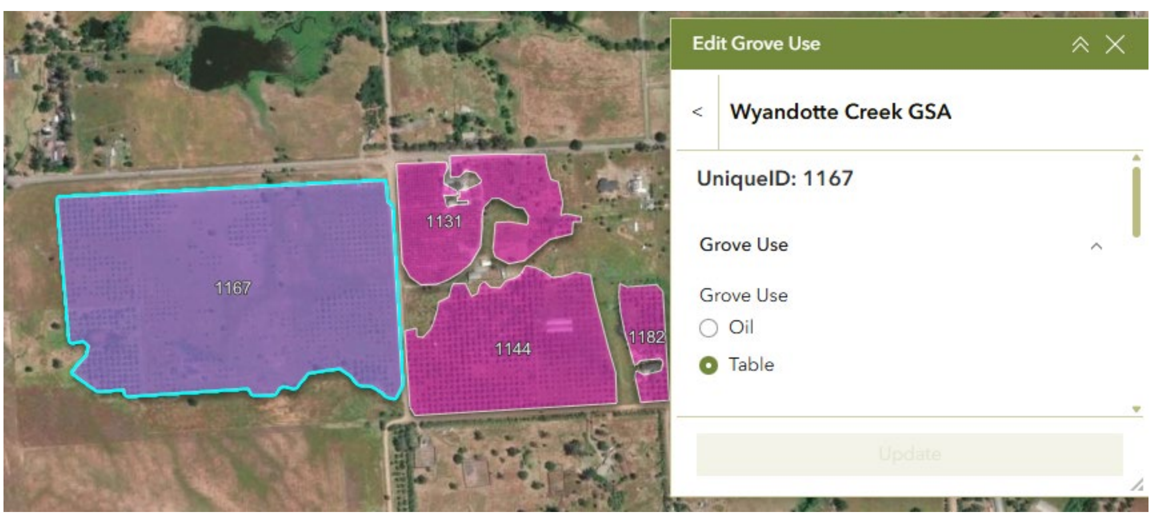


Figure 4. Editing Function

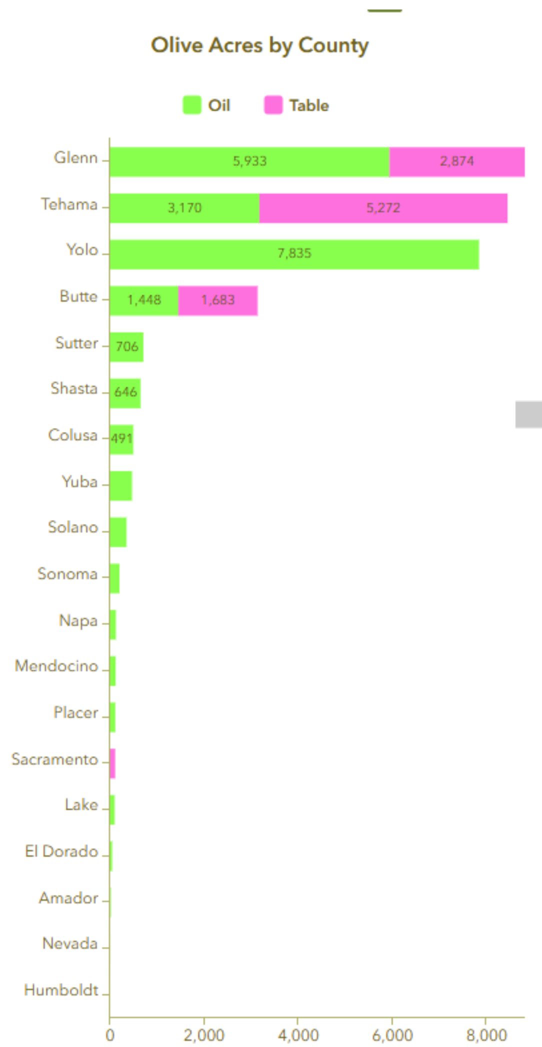


Figure 5. Charting Function

Project Title:

Developing an Understanding of Sap Analysis for Nutrient Management in Olives Grown for Oil

Principal Investigator(s) (PI):

Becky Wheeler-Dykes
Orchard Systems Farm Advisor
UC Cooperative Extension, Glenn County
PO Box 697, Orland, CA 95963
530-884-9313
bawheeler@ucanr.edu

Co-Investigator/Other Personnel:

Guadalupe Tejeda
Orchard Systems Lab Assistant
UC Cooperative Extension, Glenn County
PO Box 697, Orland, CA 95963
gtejeda@ucdavis.edu

Objective(s) of Proposed Research:

1. Confirm inaccuracy of handheld sap analysis devices through repetitive lab testing and statistical analysis of resulting data.
2. Evaluate the potential of commercially available handheld NIR measuring device for industry members to get real time feedback on plant nutrition by comparing NIR handheld data to conventional commercial laboratory leaf tissue analysis.
3. Compare conventional laboratory leaf tissue analysis nutrient level data between old and new olive leaves and determine the statistical significance of that difference.

Justification and Importance of Proposed Research:

This proposal is a request for change in scope to the project titled 'Developing an Understanding of Sap Analysis for Nutrient Management in Olives Grown for Oil'. The project was approved for funding by the Olive Oil Commission of California in their 2025 Request for Proposals for Research.

Original proposal scope and narrative:

The use of sap analysis to provide real-time feedback on nutrition management programs has been optimized for many crops, particularly in vegetable and greenhouse production. The use of handheld devices has given growers the ultimate ability to make instant management decisions and gain understanding of the impact of fertilizer applications. While some published research exists extolling the value of xylem sap analysis in olive (Anguita-Maeso et al, 2021), no standardized protocols that are feasible for and accessible to the average grower are publicly available.

Research by Erel et al (2008) has shown that macronutrients levels in olive trees are critical in maintaining productivity, including flowering intensity, fruit set, and total yield. Trees deficient in Nitrogen (N) and Phosphorous (P) in particular failed to produce maximum fruit loads; correcting the deficiencies increased yields appreciably. Ensuring adequate plant nutrition during flower bud induction is also critical for optimizing yield potential (Fabbri and Benelli, 2000). Alternate bearing, a key challenge in olive production, also affects the nutritional status of trees (Bedbabis et al, 2017). Understanding the differential nutritional needs of olive trees and properly fertilizing in on- vs. off-years may play a key role in mitigating alternate bearing, as additional nutritional supplementation is necessary to adequately support crop loads while maintaining flower bud induction capacity for the following year (Kour et al, 2018).

On the other hand, excess nutrients can have negative effects on crop load and oil quality. Excess N can lead to reduced polyphenol content and oxidative stability of the olive oil (Fernandez-Escobar et al, 2006). Increased N applications are not shown to have a positive effect on yield, fruit size, oil content or vegetative growth – essentially applying unnecessary N is just an expensive mistake that lowers oil quality (Fernandez-Escobar et al, 2000).

Current recommendations for leaf tissue analysis only describe sampling once per year and submitting samples to a commercial lab for testing. However, this process can be time-consuming and expensive, and results take time to process and analyze before being returned to growers. With the advent of such handheld devices as the LAQUAtwin series produced by Horiba Industries, growers have the ability to check the nutrient status of their orchards at any time. However, for these devices to be useful, the data output must be correlated with known nutrient status ranges (deficient, sufficient, excessive). Additionally, standardized sampling and processing protocols must be developed to ensure consistent and accurate results.

Proposal for change in scope:

After having conducted this proposed experiment multiple times, it was determined not to be a viable source of data due to the ineffectiveness of the sap extraction device and the inaccuracy of the sap analysis kit used. A new avenue that is being looked into for the future of this project is to evaluate the use of a handheld near-infrared reflectance (NIR) device to provide real-time, in-field evaluation of olive leaf nutrition results. The validity of this information will be determined by comparing it to conventional commercial laboratory leaf tissue analysis. The proposed work also intends to compare nutrient levels between old and new leaves determining if significant differences occur. The usefulness of handheld NIR device data hinges on accurate standardization of NIR readings against conventional laboratory tissue analysis as is currently used by decision-makers in olive management (Comino et al., 2018; Fernández-Cabanás et al., 2008; León & Downey, 2006; Rotbart et al., 2013).

This new proposal will evaluate whether handheld NIR instruments have any potential as a real-time in-field measure of tree nutrition and stress. The results of this project will be a recommendation to engage in a full project to develop the standardized curves needed by growers and PCAs in order to utilize data generated by a handheld NIR device. This proposed revision of scope outlines the procedures that are necessary to confirm the inaccuracy of handheld plant sap nutrient measurement devices and to evaluate the potential of handheld NIR devices.

Staffing is already sufficient to perform this work. The proposed change in scope can be accomplished with the balance of funds remaining from the originally proposed project. The funds will be used to purchase the handheld NIR instrument (Senseen Nutriscope) and pay for the associated commercial leaf tissue analyses. We do not anticipate the change of scope requiring an extension of the project timeline.

Procedures to Accomplish Objective(s):

Objective 1:

Confirm inaccuracy of handheld sap analysis devices through repetitive lab testing and statistical analysis of resulting data.

- Leaves will used in the extraction device to extract as much sap as possible
    - i. The volume of sap extracted will be used four different times per leaf sample
        1. Sap at 100% strength will be tested twice for all sensors
        2. Sap at 50% strength (diluted) will be tested twice for all sensors
    - ii. Total of 80 data sets

Monthly samples of Arbequina leaves will be collected, depending on the objective on hand is the number of leaves needed for the sample. Samples for sap analysis will be immediately sprayed with deionized water to prevent desiccation and kept cool until they can be processed indoors. Samples will be analyzed for Nitrate, Phosphorus, Potassium, Calcium, and Sodium using the TestAgro NutriCheck LAQUAtwin Kit. This kit has been selected because of its common use in other crops for on-farm sap analysis and its availability to growers.

Objectives 2 & 3:

Evaluate the potential of commercially available handheld NIR measuring device for industry members to get real time feedback on plant nutrition by comparing NIR handheld data to conventional commercial laboratory leaf tissue analysis.

Compare conventional laboratory leaf tissue analysis nutrient level data between old and new olive leaves and determine the statistical significance of that difference.

- Old and new leaves from 60 Arbequina trees will be scanned in the field from the different varieties
    i. Results will be recorded and compared to commercial lab leaf tissue analysis results.
    ii. After scanning, samples of old and new leaves will be collected and submitted to a commercial laboratory for conventional tissue testing.
    iii. Data will be analyzed to evaluate
        1. How well data from the NIR device correlates with data from the conventional leaf tissue testing.
        2. How much conventional leaf testing values differ between old and new leaf tissues and whether this difference is valuable for growers to know in their own fields.

The total of sixty sampled trees for comparative analysis will likely be done over different days in order to obtain a variety of nutrient levels over the remaining period of the project.

<u>Literature Cited</u>:

Anguita-Maeso, M., Haro, C., Montes-Borrego, M., De La Fuente, L., Navas-Cortés, J. A., & Landa, B. B. (2021). Metabolomic, ionomic and microbial characterization of olive xylem sap reveals differences according to plant age and genotype. *Agronomy*, *11*(6), 1179.

Bedbabis, S., Rouina, B. B., Camposeo, S., Clodoveo, M. L., Gallotta, A., Palasciano, M., & Ferrara, G. (2017). Alternate bearing affects nutritional status and net assimilation rate of an irrigated olive grove under arid conditions. *Acta Scientiarum Polonorum Hortorum Cultus*, *16*(2), 95-106.

Comino, F., Ayora-Cañada, M. J., Aranda, V., Díaz, A., & Domínguez-Vidal, A. (2018). Near-infrared spectroscopy and X-ray fluorescence data fusion for olive leaf analysis and crop nutritional status determination. *Talanta*, *188*, 676–684. https://doi.org/10.1016/j.talanta.2018.06.058

Dag, A., Ben-David, E., Kerem, Z., Ben-Gal, A., Erel, R., Basheer, L., & Yermiyahu, U. (2009). Olive oil composition as a function of nitrogen, phosphorus and potassium plant nutrition. *Journal of the Science of Food and Agriculture*, *89*(11), 1871-1878.

Erel, R., Dag, A., Ben-Gal, A., Schwartz, A., & Yermiyahu, U. (2008). Flowering and fruit set of olive trees in response to nitrogen, phosphorus, and potassium. *Journal of the American Society for Horticultural Science*, *133*(5), 639-647.

Esteves, E., Locatelli, G., Alcon Bou, N., Soranz Ferrarezi, R. (2021). Sap Analysis : A Powerful Tool for Monitoring Plant Nutrition. *Horticulturae 2021*, 7, 426.

Fabbri, A., & Benelli, C. (2000). Review Article Flower bud induction and differentiation in olive. *The Journal of Horticultural Science and Biotechnology*, *75*(2), 131-141.

Fernández-Cabanás, V. M., Garrido-Varo, A., Delgado-Pertiñez, M., & Gómez-Cabrera, A. (2008). Nutritive evaluation of olive tree leaves by near-infrared spectroscopy: Effect of soil contamination and correction with spectral pretreatments. *Applied Spectroscopy*, *62*(1), 51–58. https://doi.org/10.1366/000370208783412663

Fernández-Escobar, R., Beltrán, G., Sánchez-Zamora, M. A., García-Novelo, J., Aguilera, M. P., & Uceda, M. (2006). Olive oil quality decreases with nitrogen over-fertilization.

Fernandez-Escobar, R., Sÿnchez-Zamora, M. A., Uceda, M., & Beltran, G. (2000, September). The effect of nitrogen overfertilization on olive tree growth and oil quality. In *IV International Symposium on Olive Growing 586* (pp. 429-431).

Kour, D., Bakshi, P., Wali, V. K., Sharma, N., Sharma, A., & Iqbal, M. (2018). Alternate bearing in olive-a review. *Int. J. Curr. Microbiol. Appl. Sci*, *7*, 2281-2297.

León, L., & Downey, G. (2006). Preliminary studies by visible and near-infrared reflectance spectroscopy of juvenile and adult olive (*olea europaea* L.) leaves. *Journal of the Science of Food and Agriculture*, *86*(6), 999–1004. https://doi.org/10.1002/jsfa.2448

Rotbart, N., Schmilovitch, Z., Cohen, Y., Alchanatis, V., Erel, R., Ignat, T., Shenderey, C., Dag, A., & Yermiyahu, U. (2013). Estimating olive leaf nitrogen concentration using visible and near-infrared spectral reflectance. *Biosystems Engineering*, *114*(4), 426–434. https://doi.org/10.1016/j.biosystemseng.2012.09.005

Turktas, M., Inal, B., Okay, S., Erkilic, E. G., Dundar, E., Hernandez, P., ... & Unver, T. (2013). Nutrition metabolism plays an important role in the alternate bearing of the olive tree (Olea europaea L.). *PloS one*, *8*(3), e59876.