
THE ALMOND CONFERENCE
50
YEARS

50 YEARS of The Almond Conference

THANK YOU
TO THE ALMOND CONFERENCE 2022
METAL SPONSORS!

PLATINUM — AMVT LLC IMPROVING THE PROCESS — The Almond Conference

GOLD — BORRELL — The Almond Conference

SILVER — TOMRA — The Almond Conference

EMERALD — QCIFY — The Almond Conference

TITANIUM — BAYER — The Almond Conference

BRONZE — HORN AC HORN MANUFACTURING — The Almond Conference

COPPER — SATAKE — The Almond Conference

NICKEL — ANYSORT U.S.A — The Almond Conference

STEEL — MILLER A HUBER COMPANY — The Almond Conference

COBALT — THE AG CENTER — The Almond Conference

Whither Pest Management?

December 8, 2022

Moderator: Gabriele Ludwig (ABC)
Speakers: Julie Henderson (CA Department of Pesticide Regulation)
Jesse Roseman (ABC)
Sean Halloran (UC Riverside)
Jim Adaskaveg (UC Riverside)

california almonds®
Almond Board of California

California Department of Pesticide Regulation

JULIE HENDERSON, DPR DIRECTOR

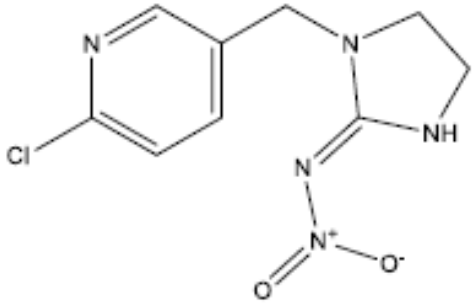
ADVANCING OUR MISSION

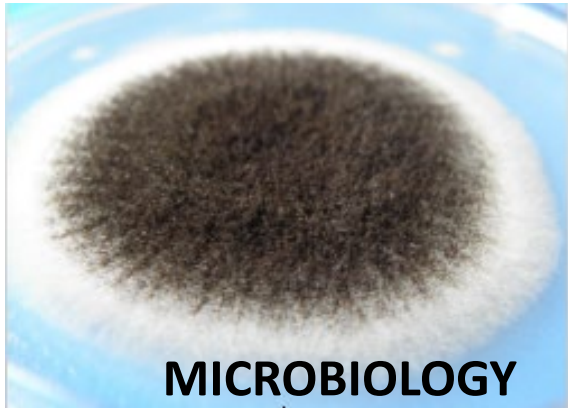
Our Mission

We protect human health and the environment by regulating pesticide sales and use, and by fostering reduced-risk pest management.

Continuous Evaluation

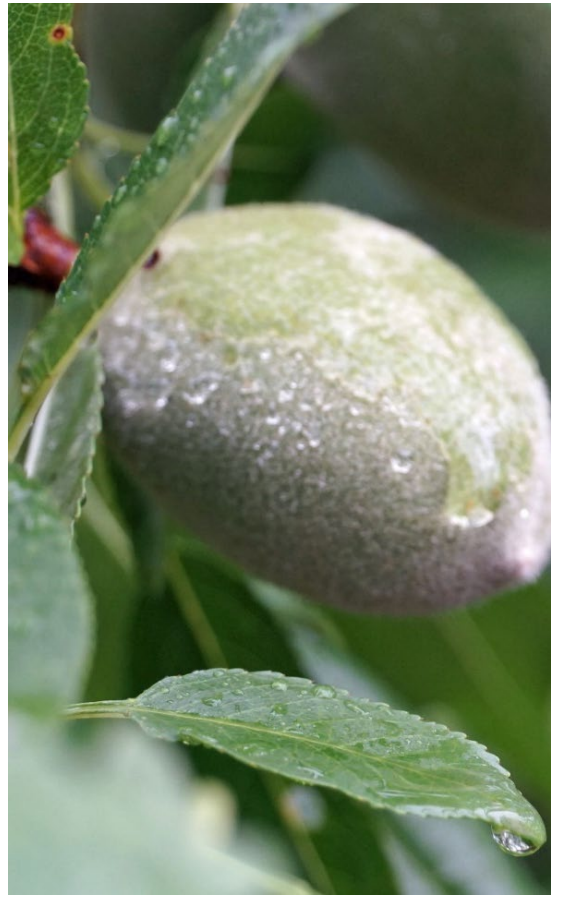
CHEMISTRY





The Future is Sustainable Pest Management



Sustainable Pest Management Workgroup

- **Goal**: Systemwide transition to sustainable pest management (SPM)
- **Charge:** Recommend pathways and ambitious, targeted, measurable goals to transition to SPM
- **Timeline**: Roadmap to be released in January 2023; and department will host public comment period

Critical Next Steps

DPR Integrated Pest Management Support

- 2021 - $5.5 million in awarded grants
- 2022 - $4.65 million available in funding announced
- Ongoing – Research and Alliance Grants
- DPR Integrated Pest Management Achievement Awards

Mill Assessment, Funding for the Future

DPR initiated a legislatively-funded, stakeholder-engaged study to identify potential mill fee design options for sustainable, long-term funding and to incentivize safer, more sustainable pest management.

Priorities: Statewide Notification System

- **Goal: Provide the public with advance, transparent and equitable access to information about pesticide applications**
- Updates:
  - Pilot projects launched in 2022 in four counties
  - Focus groups, webinars and workshops conducted in 2021 and 2022 to collect public feedback
- Timeline:
  - Anticipate noticing regulation in early 2023
  - Anticipate implementation in 2024

Priorities: 1,3-D Regulation

- DPR introduced proposed regulations in November to significantly reduce acute and cancer risks associated with the use of 1,3-D.
- Pilot projects conducted in 2020-21 with County Agricultural Commissioners and pesticide applicators.
- Regulations will require control measures that reduce exposure to degree comparable to Totally Impermeable Film (TIF) tarps.

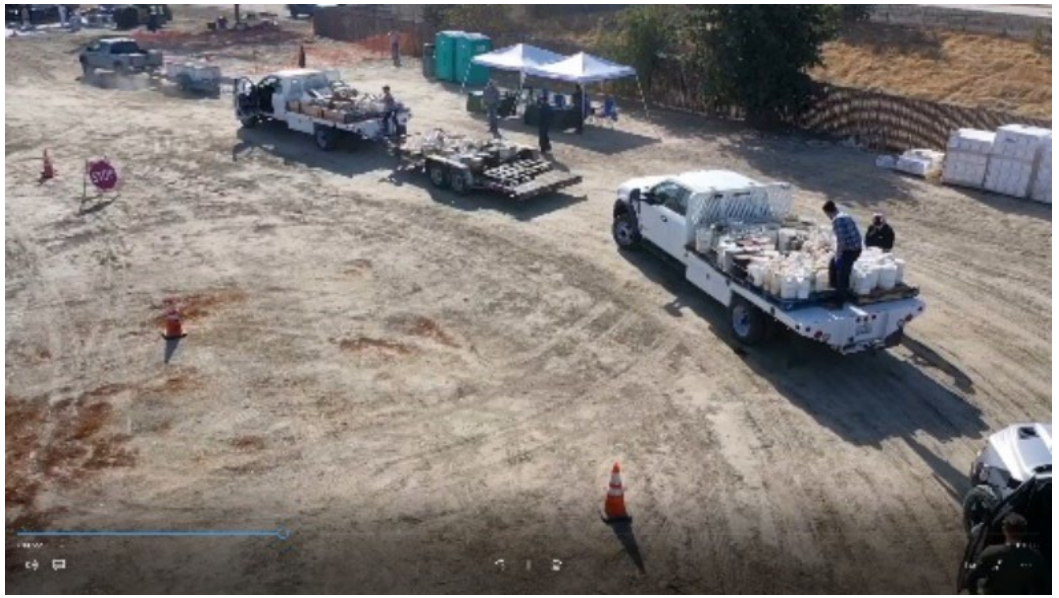
Priorities: Neonicotinoids Regulation

- In February 2022, DPR proposed regulations to restrict the use of neonicotinoids to protect bees.
- The regulation proposes limits on how and when neonicotinoids can be used in agricultural settings.
- The proposed regulation will be effective on January 1, 2024.
- DPR is evaluating risks associated with the use of neonics in non-agricultural settings.

Pesticide Collection Events – 2022

DPR initiated a series of legislatively-funded pesticide collection events in partnership with County Agricultural Commissioners in 2022.

The goal of these programs is to provide a no-cost disposal for growers and constituents to increase the collection and destruction of unused pesticide products.



C&T Regulations

- In 2017 U.S. EPA set stronger standards for applicators of restricted use pesticides
- California must meet the revised standards set by U.S. EPA
- Changes to DPR's pesticide applicator certification program and regulations are being made to meet revised standards

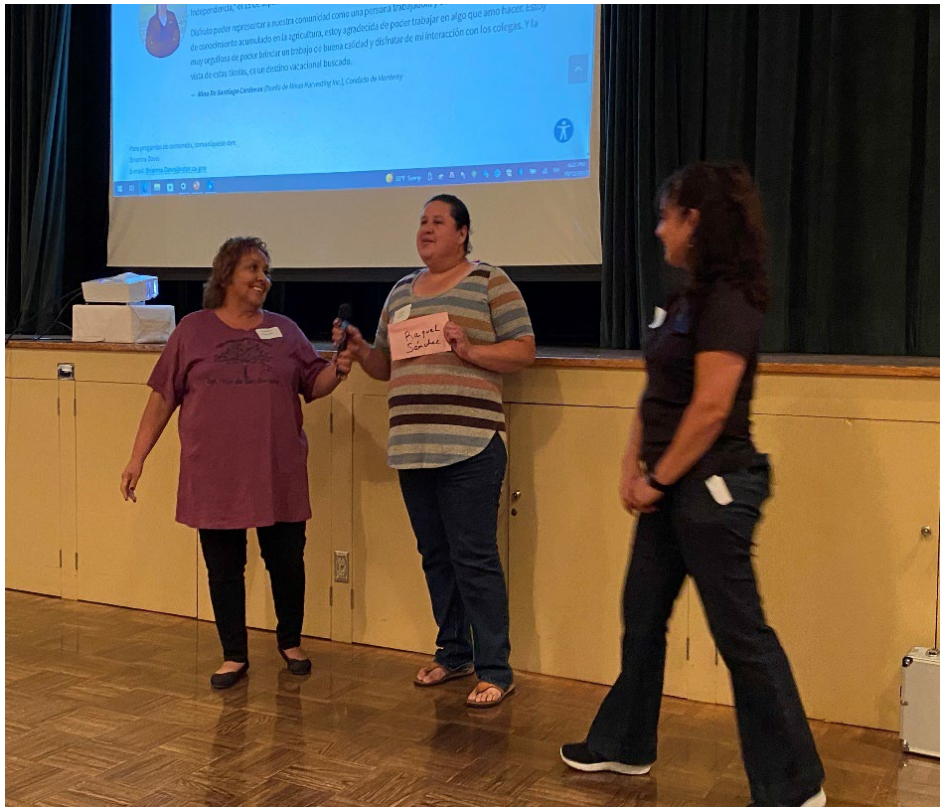
California C&T Regulations

May 2022 – C&T Regulatory Changes Were Published for Public Comment

July 2023 – Anticipated Approval and Finalization of C&T Regulatory Changes by the Office of Administrative Law (OAL)

January 1, 2024 – Anticipated Effective Date of C&T Regulatory Changes

Priorities: Ongoing Stakeholder Engagement



Priorities: Expanding Outreach on Department's Role

- Website redesign
- Broad communication of full scope of work of the department
- Engaging with key stakeholders as a part of the process, including through listening sessions conducted this summer

Thank you!

www.cdpr.ca.gov

50 Year Anniversary

The Almond Conference

Promoting Small Farm Use of Navel Orangeworm Mating Disruption Using Online Mapping and Neighborhood Management

12/8 | Jesse Roseman

california almonds®
Almond Board of California

Thanks to the partners and funders of this project

Partner individuals and organizations:
- Almond Board of California
- Mel Machado, Blue Diamond Growers
- Jhalendra Rijal, PhD, University of California Cooperative Extension
- Joel Kimmelshue, PhD, Land IQ

Funding provided by:
- California Department of Pesticide Regulation Pest Management Alliance Grant

Additional thanks to participating growers and PCAs, researchers, and others that may provide advice and suggestions

UC CE

california almonds

LAND IQ

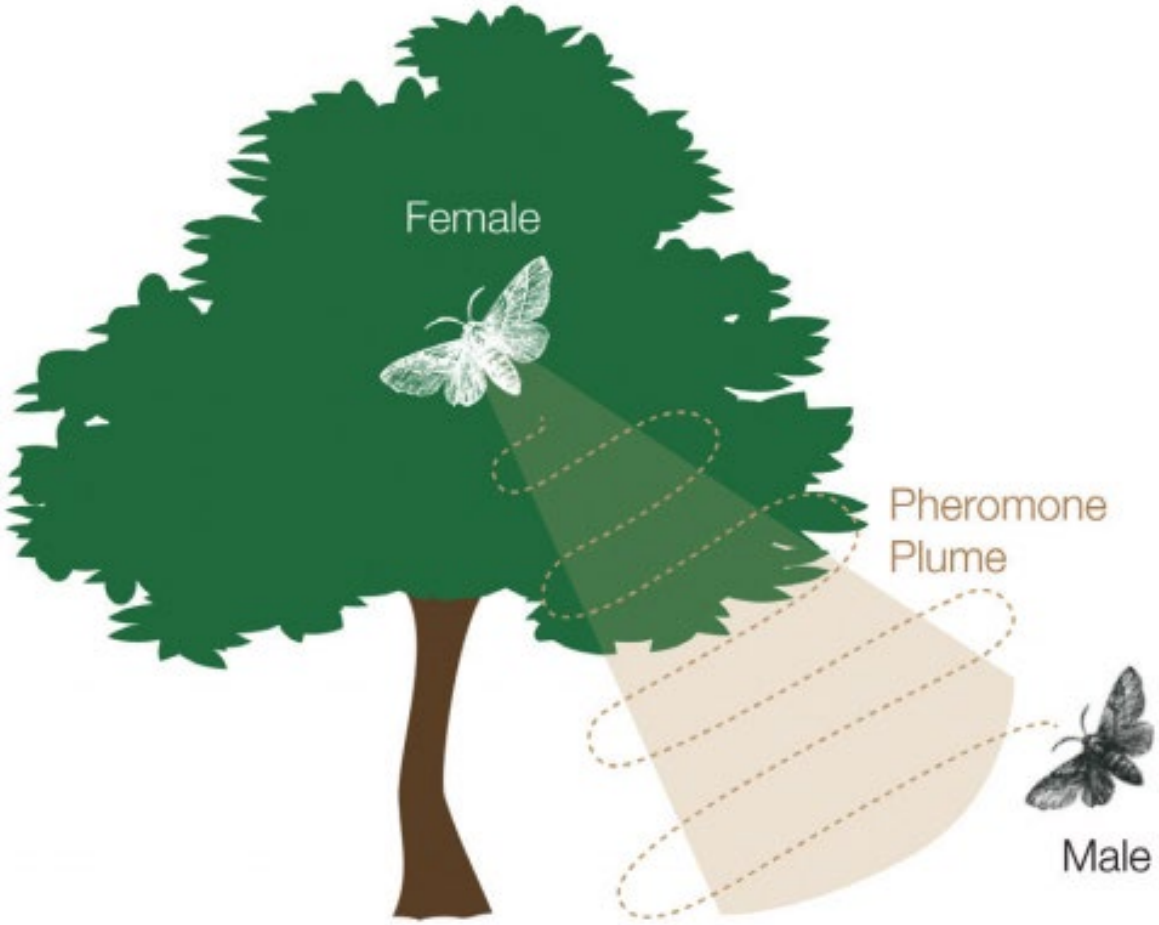
BLUE DIAMOND ALMONDS

dpr California Department of Pesticide Regulation

This project was funded by the Department of Pesticide Regulation. The contents may not necessarily reflect the official views or policies of the State of California

Mating Disruption
– a behavioral insect control method

Release of the synthetic pheromone (into the orchard) to inhibit the male moth's ability to locate and mate with the female moth

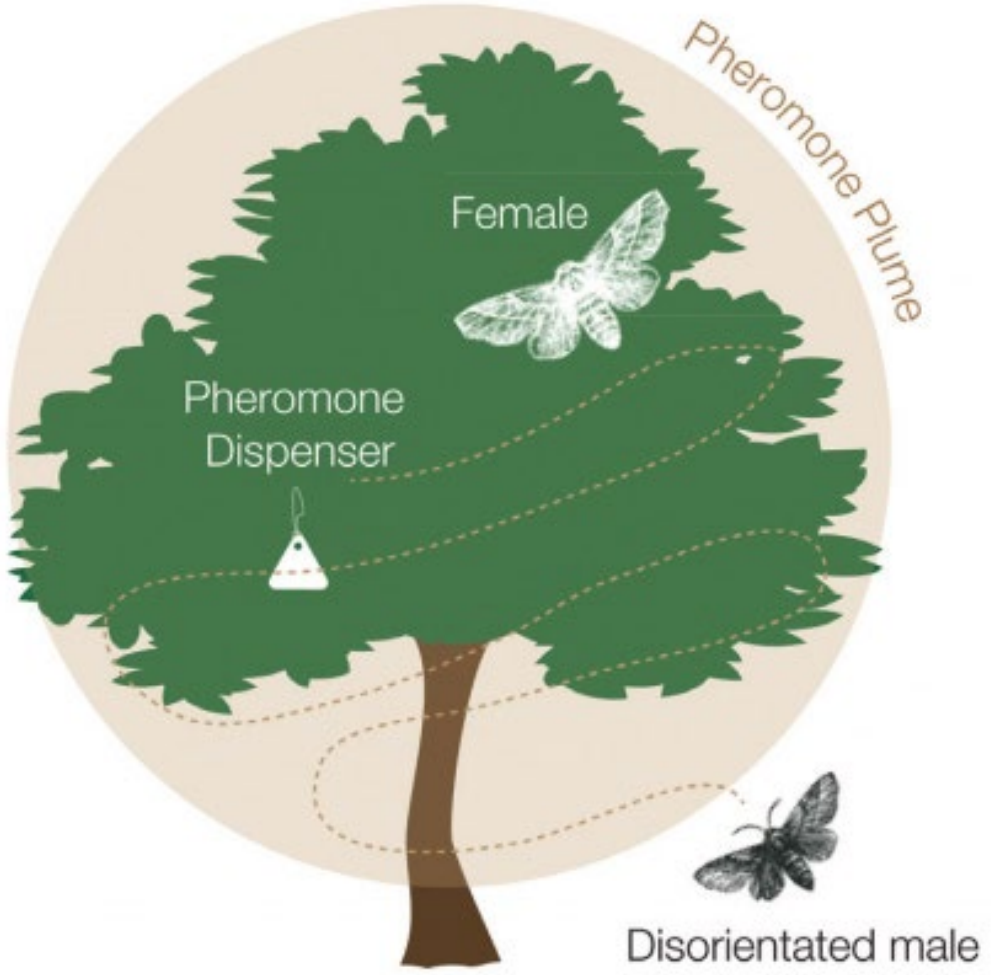


NO mating disruption pheromone

https://insectscience.co.za/x-mate/

Mating Disruption
– a behavioral insect control method

Release of the synthetic pheromone (into the orchard) to inhibit the male moth's ability to locate and mate with the female moth



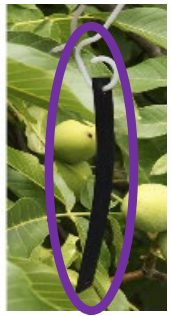
UNDER mating disruption pheromone

https://insectscience.co.za/x-mate/

Commercially Available Mating Disruption Products for NOW

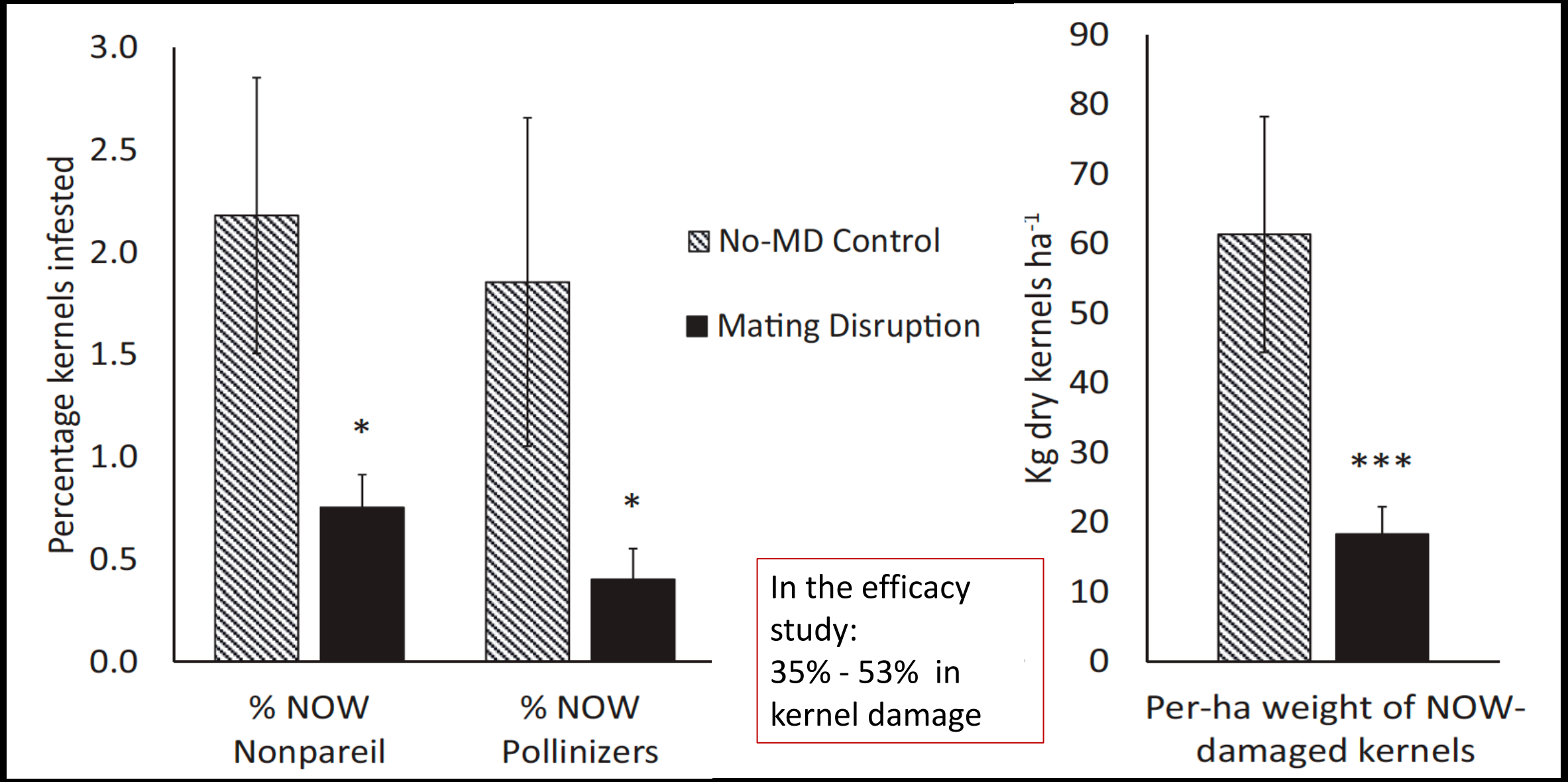
Youtube video on NOW Mating Disruption Tools

Youtube video on NOW Monitoring Tools

		Units/ Acre:	Estimated Cost/Unit*	Unit Type	Installation & Maintenance	In-season Field Checks	Organic Option **
ISOMATE® MIST Pacific Biocontrol ISOMATE		1	$100-$110	Active Aerosol	Grower	Yes	No
SEMIOS NOW® semios		1	$115-$160	Variable Rate Aerosol	Vendor	Yes	Yes
CHECKMATE PUFFER® Suterra®		1	$105-$110	Active Aerosol	Grower	Yes	Yes
CIDETRAK® NOW MESO™ TRÉCÉ INCORPORATED		15-28	$95-$105 (@ 20 unit/acre rate)	Passive Dispensers	Grower	No	Yes

SOURCE: Almond Board Handout

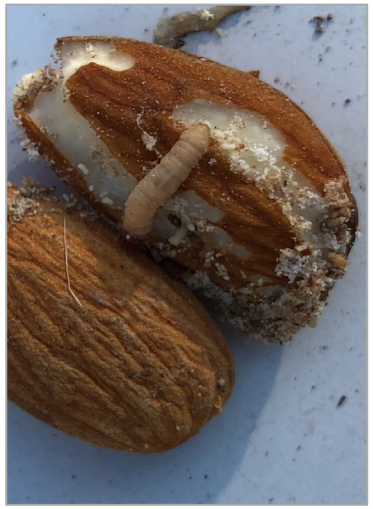
2017-2018 Summary (North & South SJV)



Haviland, Rijal et al. , 2021

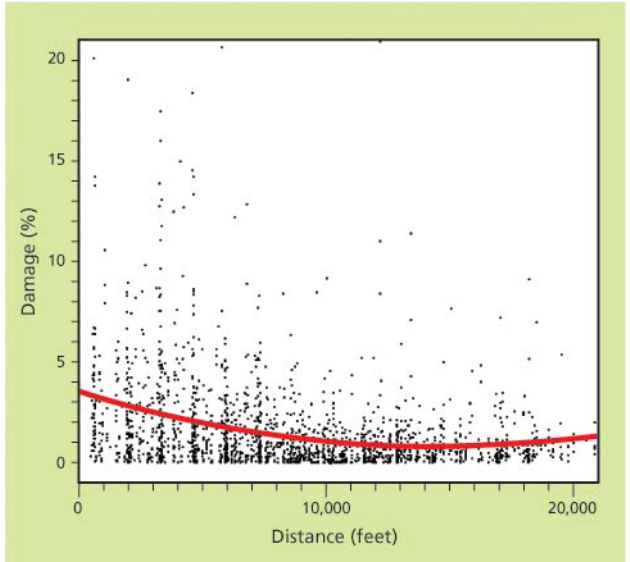
NOW Integrated Pest Management (IPM) at Field Level

- Effective monitoring
- Orchard sanitation
- Timely harvest
- *Mating disruption*
- Insecticides



WHY NEIGHBORHOOD MANAGEMENT? (aka area-wide)

- Drought drives periods of increased NOW pressure
- Expand adoption of Mating Disruption, including smaller contiguous blocks
- Potential for improved regional monitoring
- Manage pesticide resistance
- Improve pesticide application efficacy and coverage
- Joint approach to IPM incentive funding
- Increase sanitation rates in all crops
- Improve education and outreach on NOW MD and IPM
- NOW pest in multiple crops



Influence of pistachios as far away as 3 miles from the center of almond blocks
Higbee and Siegel (2009)

Promoting Small Farm Use of Navel Orangeworm Mating Disruption Using Online Mapping and Neighborhood Management

GOAL

Increase the use of navel orangeworm (NOW) mating disruption (MD) among growers of almonds, walnuts and pistachios, particularly in smaller parcels

WHY

Research has shown a 35 to 53 percent reduction in NOW damage when MD is used in blocks as small as 40 acres, while the rate of damage reduction in larger blocks is as much as 78%

WHAT

An online tool at *agneighbors.com* to help drive area-wide effective and voluntary MD adoption, across multiple crops and farm sizes

HOW

- On-line tool development led by Land IQ
- PCAs and growers invited to identify parcels they manage on a map, whether they currently use MD, and through participation, express interest in forming a NOW Neighborhood Management Block.
- In areas where interest among growers reaches 40 contiguous acres or more, participants will be notified that there is a match with their neighbors.
- Growers may qualify for NRCS incentive funds to deploy IPM practices including MD.
- Coordinating meetings between growers, PCAs and NRCS, to increase adoption through use of NRCS cost-share incentives.

UC CE

california almonds

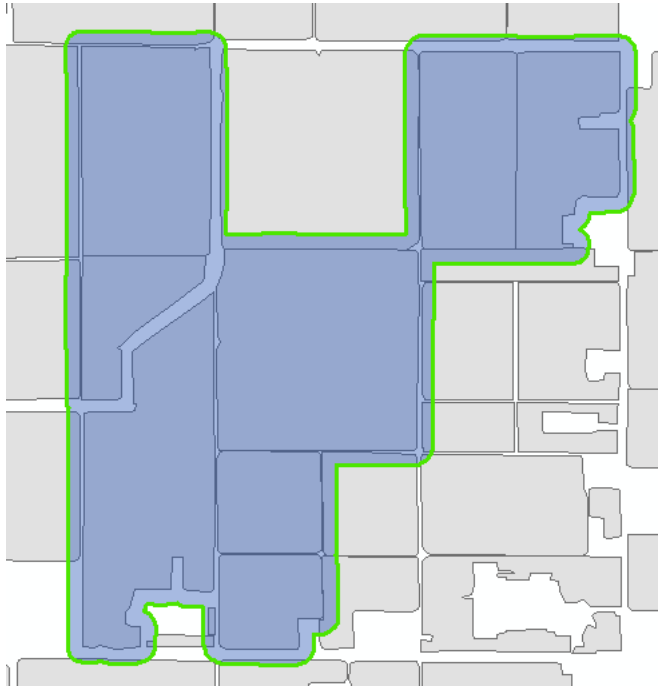
LAND IQ

BLUE DIAMOND ALMONDS

dpr California Department of Pesticide Regulation

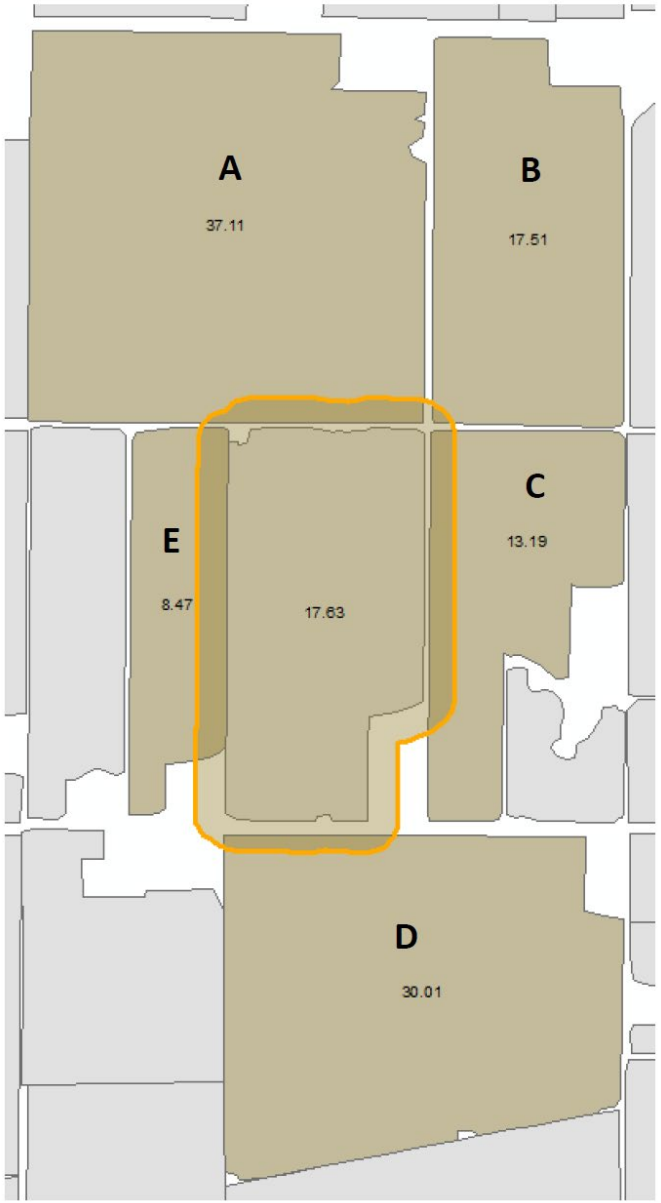
This project was funded by the Department of Pesticide Regulation. The contents may not necessarily reflect the official views or policies of the State of California

How neighborhood blocks are determined using GIS tool



PASSING BLOCK OF ORCHARDS

- Combined acreage equals or exceeds 40 acres
- Interested neighbors with 100 feet



Participating orchards
17.63 acres

Potential additions
A. 37.11 Acres
B. 17.51 Acres
C. 13.19 Acres
D. 30.01 Acres
E. 8.47 Acres

POTENTIAL BLOCK

- Main orchard does not qualify, but the inclusion of orchards within the 100 ft rule would qualify for the 40 acres and greater.
- Neighboring orchards would require additional outreach to landowners, as they have not yet indicated interest in the program

Promoting Small Farm Use of Navel Orangeworm Mating Disruption Using Online Mapping and Neighborhood Management

PROGRESS

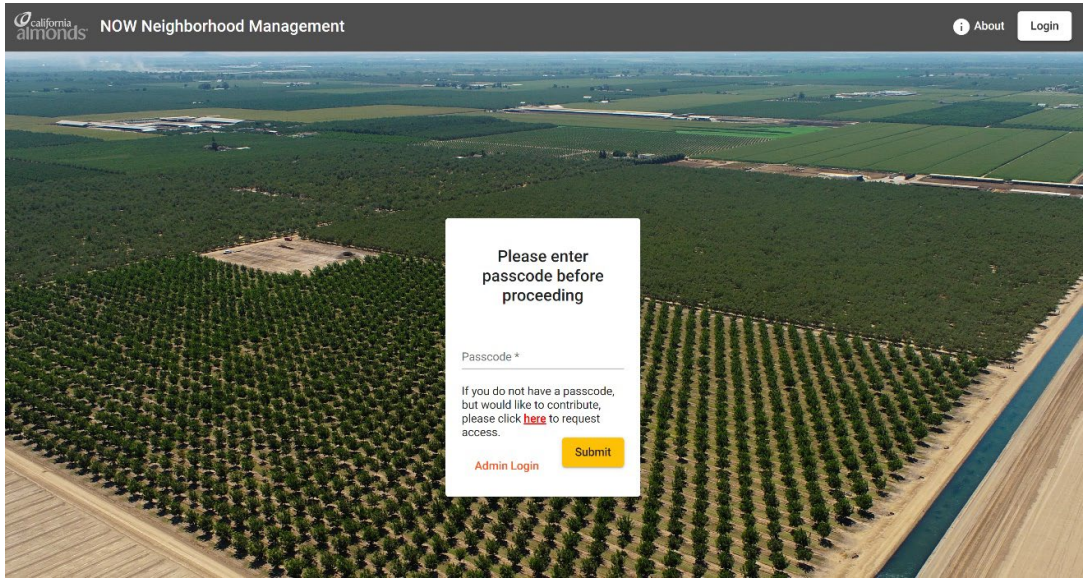
- Kickoff meeting May, 2022
- Tool created and used by growers and PCAs in pilot area of west Modesto

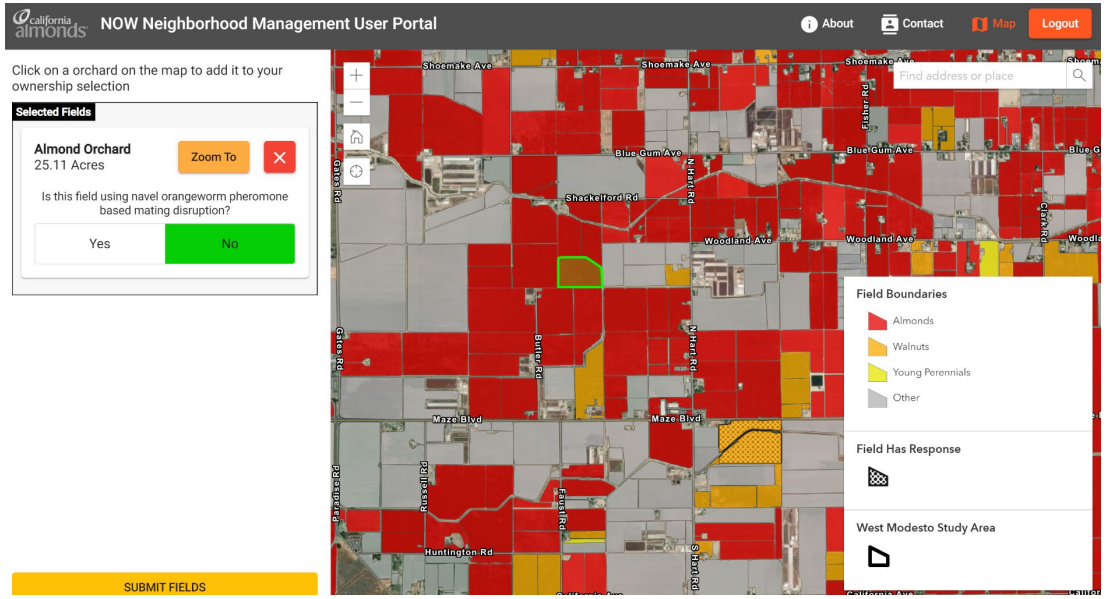
NEXT STEPS

- Analyze pilot results, notify participants where there's interest in a potential neighborhood block
- Hold meeting in January 2023 with participants and NRCS

VALLEY-WIDE AVAILABILITY

- Announcement of availability at TAC'22
- On-line tool use will be available December 2022 –April 2023 to all almond, pistachio and walnut growers and PCAs
- In areas of greatest contiguous grower interest, an additional outreach area will be identified, to hold grower meetings, including NRCS





Natural Resources Conservation Service (NRCS) Incentive Support

IPM CONSERVATION PRACTICE 595

- Improved documentation developed in partnership between NRCS, UCCE and Almond Board

NRCS PARTICIPATION IN PROGRAM

- In identified areas, project partners will help coordinate and facilitate meetings between participating growers, PCAs and NRCS field staff

Conservation Practice 595
Conservation Pest Management System

USDA NRCS U.S. Department of Agriculture Natural Resources Conservation Service

UNIVERSITY OF CALIFORNIA AGRICULTURE & NATURAL RESOURCES UC IPM Statewide Integrated Pest Management Program

Documentation for use of Integrated Pest Management (IPM) Program including Mating Disruption for Navel Orangeworm (NOW) Control in Almonds

All guidance based on University of California Integrated Pest Management Program Guidance

NRCS does not provide pest management recommendations. All NRCS Pest Management Conservation System assistance is guided by the University of California Integrated Pest Management Program.

Please refer to UC IPM guidance (Almond / Agriculture: Pest Management Guidelines / UC Statewide IPM Program (UC IPM) (ucanr.edu)) for information to guide year round IPM in almonds, including information about chemical suppression methods (e.g. pesticide use) and management of mode of action and product choices to avoid development of pest resistance.

It is the responsibility of the producer to be aware of county and state regulations regarding pesticide application and to engage the services of a licensed pest management professional as necessary.

This document outlines core elements of an IPM based approach to Navel Orangeworm control in almond found here: Navel Orangeworm / Almond / Agriculture: Pest Management Guidelines / UC Statewide IPM Program (UC IPM) (ucanr.edu). See the above link or consult a UC IPM specialist for additional information. This practice may also be used to address a different pest/disease issue, please ask for assistance to prepare documentation for use of this practice with a different pest or in a different crop.

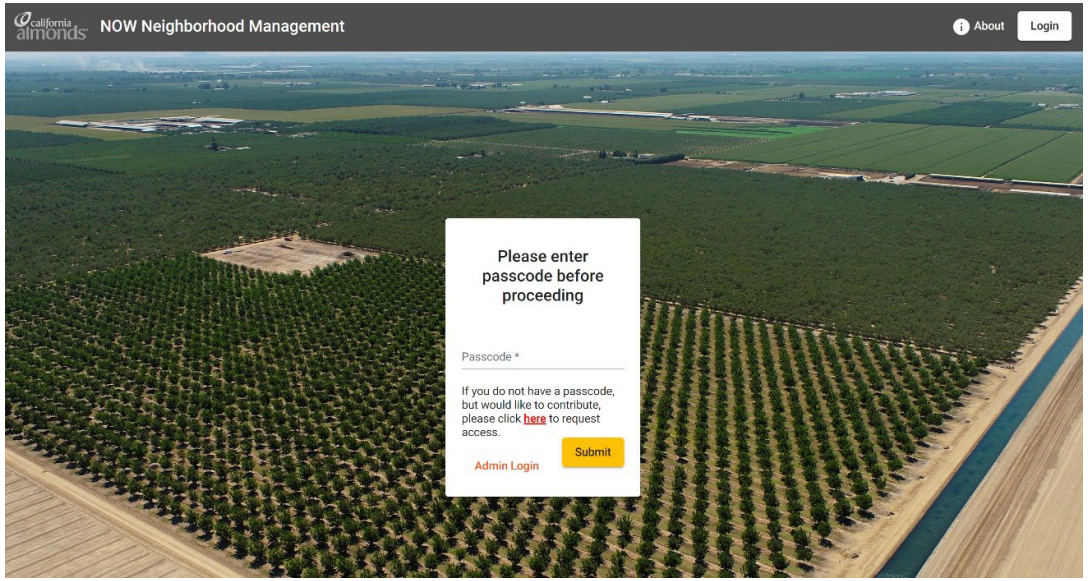
By providing the information requested in these documents, you will allow an NRCS planner to include Pest Management Conservation System (Conservation Practice 595) in your Conservation Plan, and to verify that you have completed the core elements of an IPM program to control NOW in an almond orchard, as agreed upon to receive financial assistance via Farm Bill Programs including Environmental Quality Incentives Program (EQIP) and Conservation Stewardship Program (CSP).

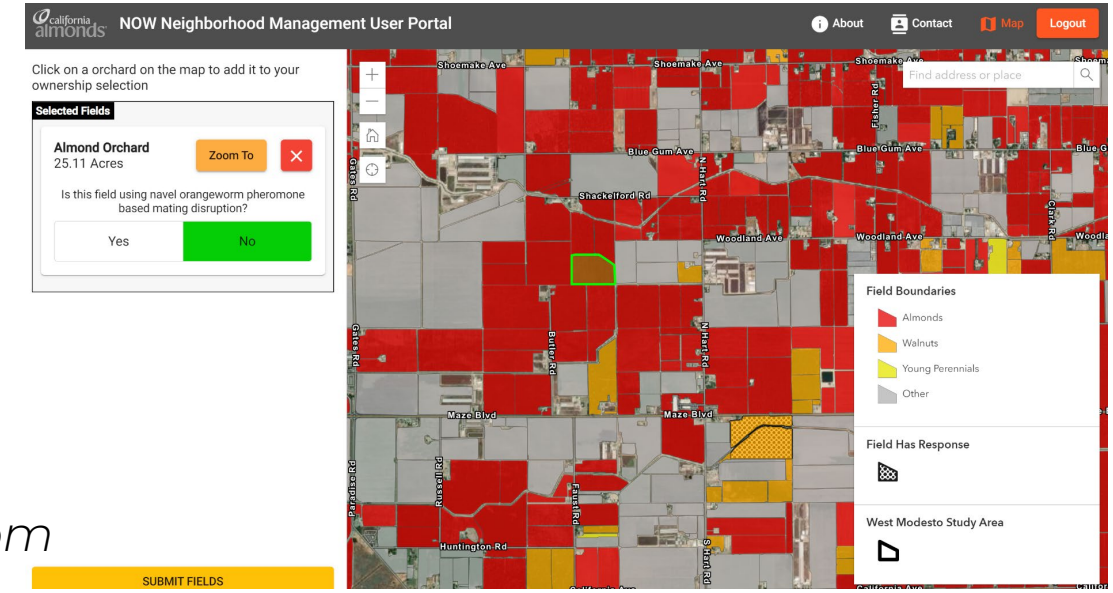
For questions, please contact your NRCS Conservation Planner:
(NRCS STAFF WORKING DIRECTLY WITH THE CUSTOMER WILL INSERT THEIR CONTACT INFORMATION HERE, I ALSO THINK WE SHOULD INCLUDE THE AREA LEVEL LEAD FOR THE PRACTICE)

Thank you for your stewardship efforts!
Implementation Requirements for NRCS Conservation Practice 595

Promoting Small Farm Use of Navel Orangeworm Mating Disruption Using Online Mapping and Neighborhood Management

AGNEIGHBORS.COM





Passcode: ***nowmd***

Contact: Jesse Roseman, jroseman@almondboard.com

Pheromonal attractants for leaffooted bugs

Sean Halloran, Jocelyn Millar, Houston Wilson, Kent Daane

ADMINISTRATIVE COMMITTEE for PISTACHIOS

california almonds
Almond Board of California

OUTLINE

1. INTRODUCTION

2. COLLECTION AND ANALYSIS OF PHEROMONE

3. SYNTHESIS OF PHEROMONE COMPONENTS

4. FIELD TEST RESULTS

5. SUMMARY

1. INTRODUCTION

- *Leptoglossus* spp. are chronic problem in California nut crops.
- Migrate into crops rapidly, monitoring is crucial to deploy timely control measures.
- Available monitoring methods: visual inspection and beating tray sampling.
- Can we develop pheromone-based monitoring methods for leaffooted bugs?

The enemy:

Known and suspected chemical signals used by LFB

Three or more types of pheromones, with different functions

- Alarm and defensive secretions (both sexes)
- Aggregation pheromones for bringing sexes together
- Pheromones for overwintering aggregations (??).

Preliminary work:

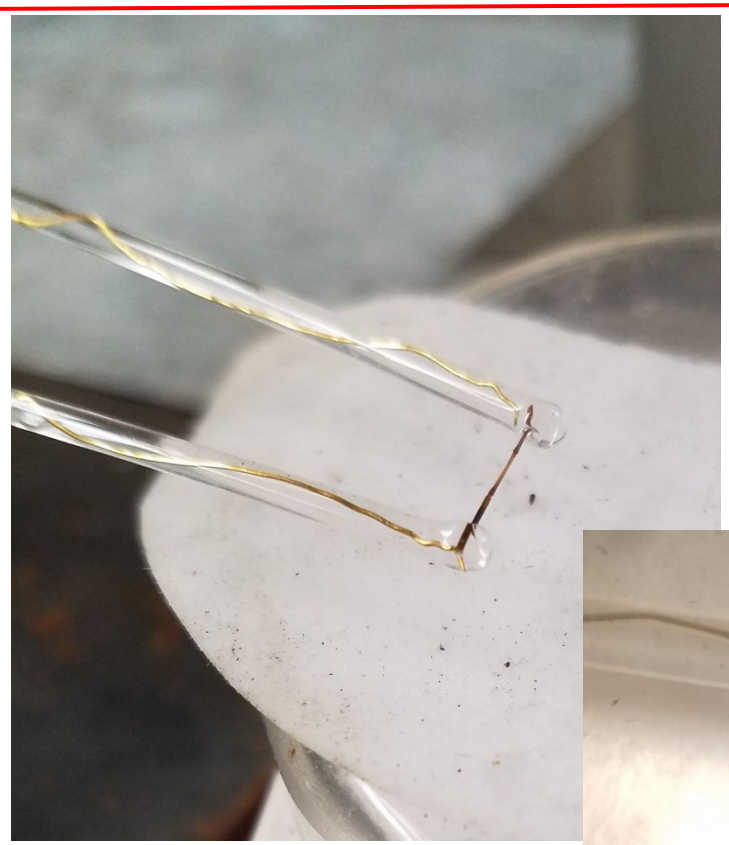
- Summerform LFB males attract and court females
- Summerform males produce sex-specific chemicals
  - Sesquiterpenes, aldehydes, esters
- Cross vane panel traps coated with fluon are effective traps

2. COLLECTION AND ANALYSIS OF PHEROMONE.

- Establish large lab colonies of known age and mating status
- Collect odors from both sexes:
  - Sexually immature
  - Sexually mature mated
  - Sexually mature unmated
  - Individuals and groups

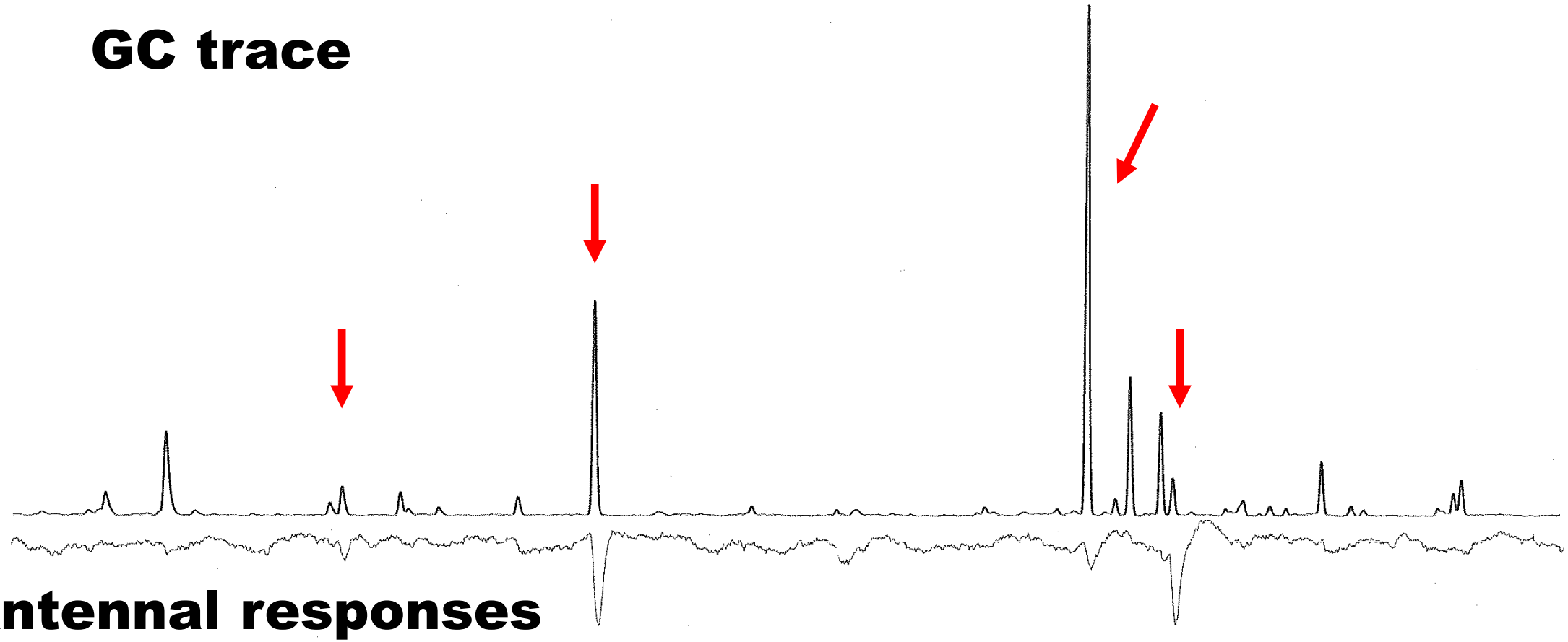
GC-EAD Analysis

- Extracts are split between the flame ionization detector & the insect antenna.
- Antenna is inserted into electrodes that record antennal response.
- Antenna will respond to compounds in the extract.



Analysis of male extracts.

- Gas chromatography-electroantennogram detection

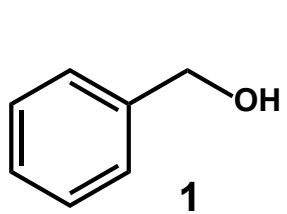


Compounds produced by males

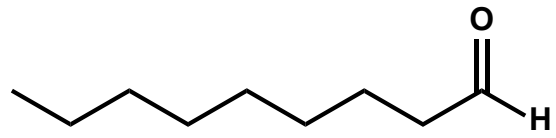
- Produced ONLY by sexually mature summerform males
- Produced by both mated and unmated males
  - Males mate multiple times
- Produced by single males and males in groups

Identification of compounds

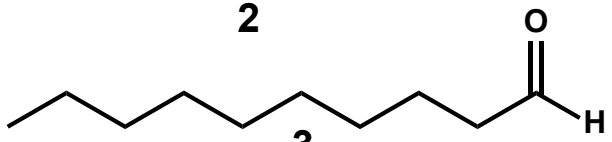
Chemicals identified in *L. zonatus* extracts



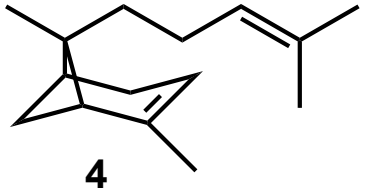
1



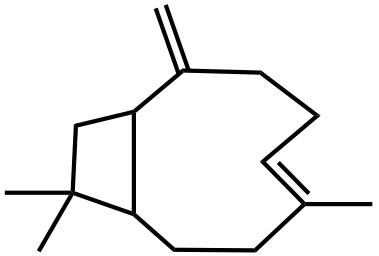
2



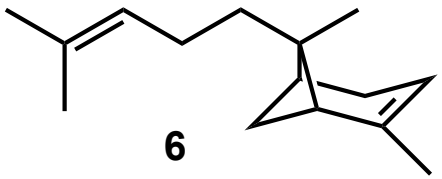
3



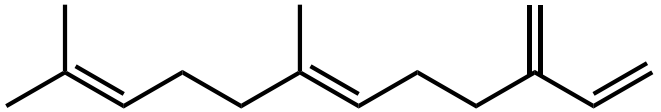
4



5

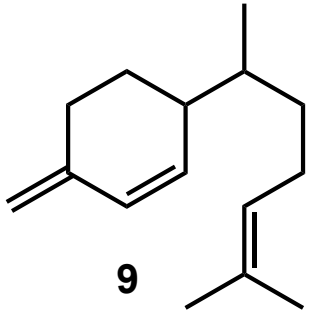


6



7

Compound 8?

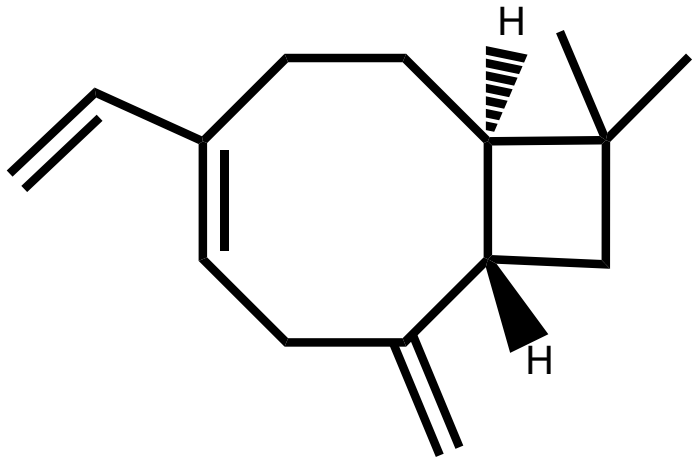


9

Identification of mystery compound 8: 2 years of work

- Combine collections from ~ 6 months, isolate a few micrograms.
- NMR analysis narrows to six possible structures
- Synthesize our best guess (15 steps): incorrect ☹ ☹
- Collect and isolate another, larger sample from more months of collection
- Better NMR analysis gives one structure

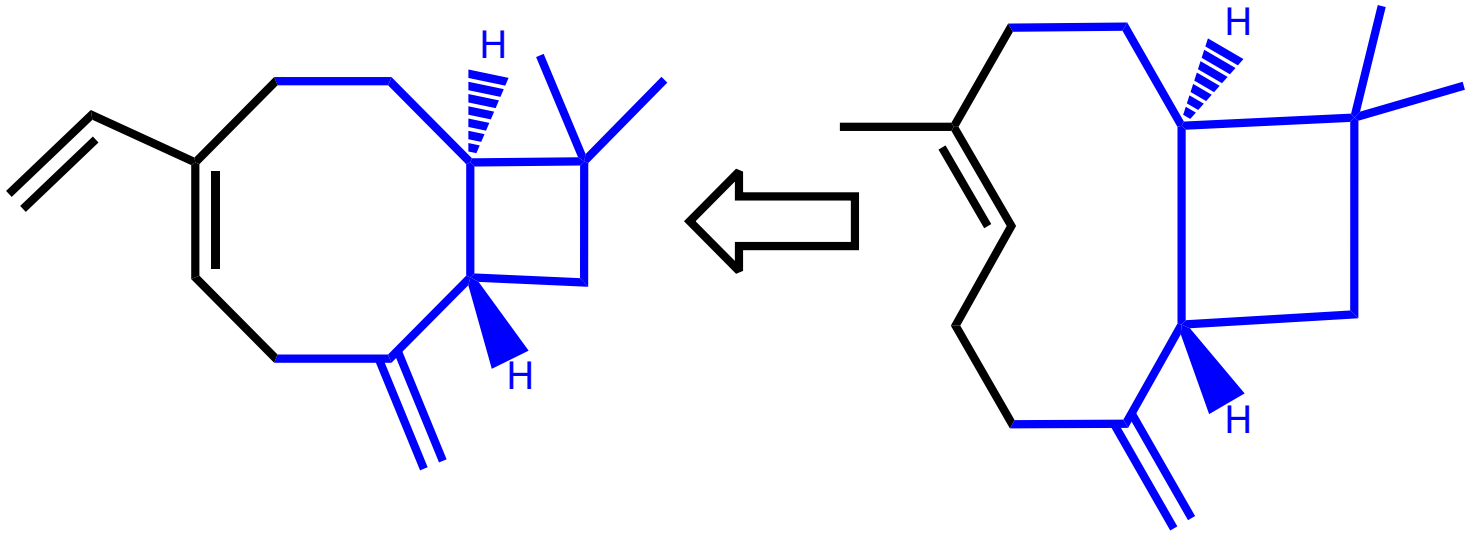
Mystery compound: Leptotriene.



- Compound new to science

  → Sesquiterpene hydrocarbon structure

Synthetic strategy to make leptotriene

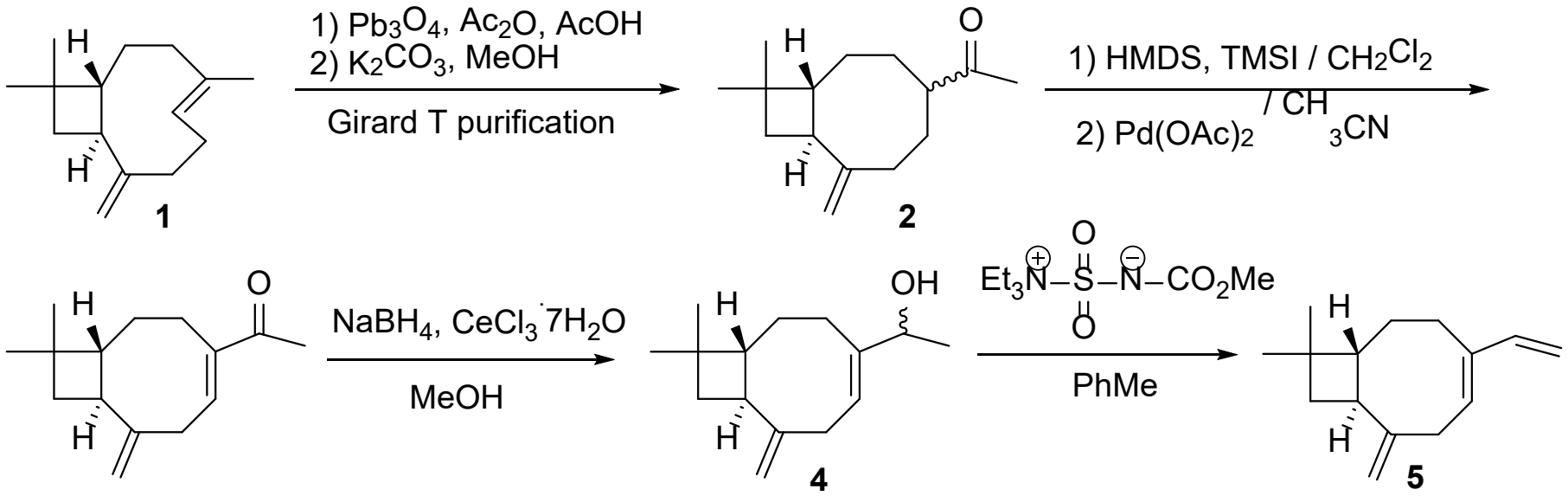


Mystery compound
"LEPTOTRIENE"

Common plant compound,
beta-caryophyllene

- Can we take advantage of cheap *beta*-caryophyllene as a starting material?

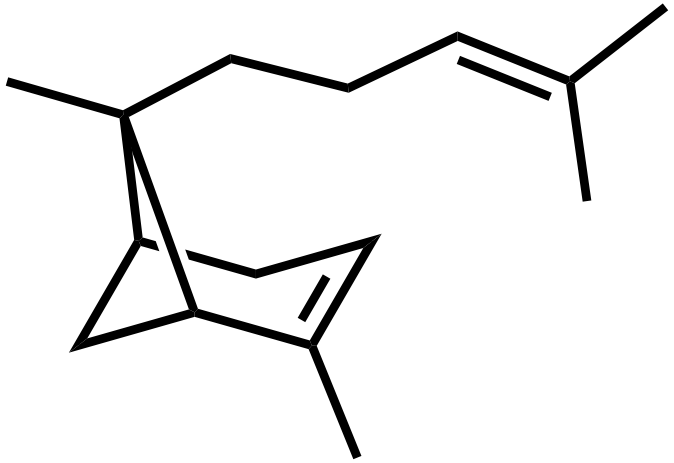
3. Synthesis of leptotriene.



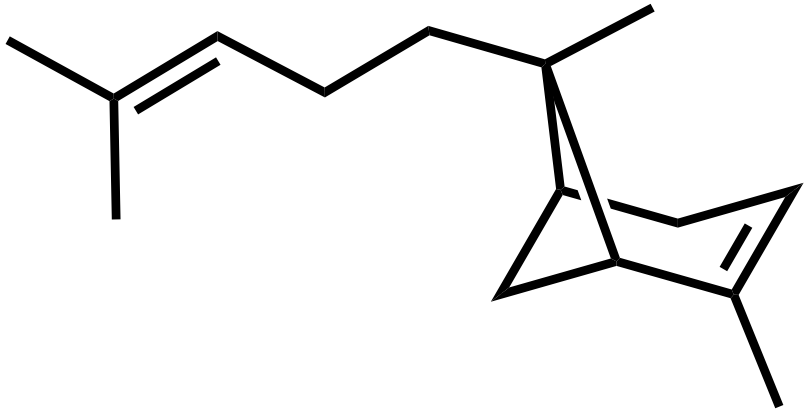
- Pros:
  - Short (4 steps) synthesis from cheap starting material
- Cons:
  - Overall yield ~1%
  - Requires very expensive reagents (e.g., palladium acetate)

3. Synthesis of other components

- Two other compounds that stimulate antennal responses

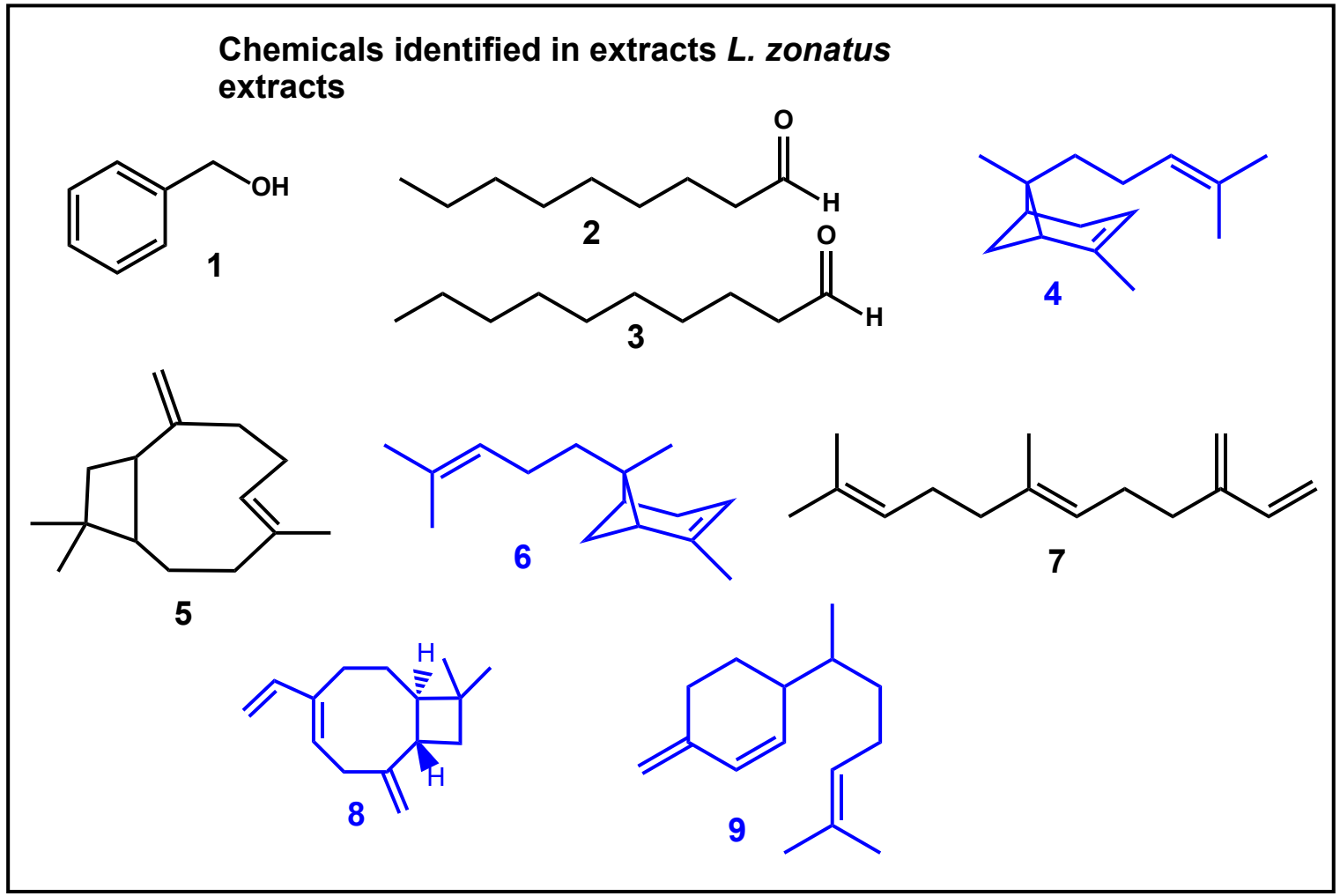


cis-beta-bergamotene
Developed new synthesis



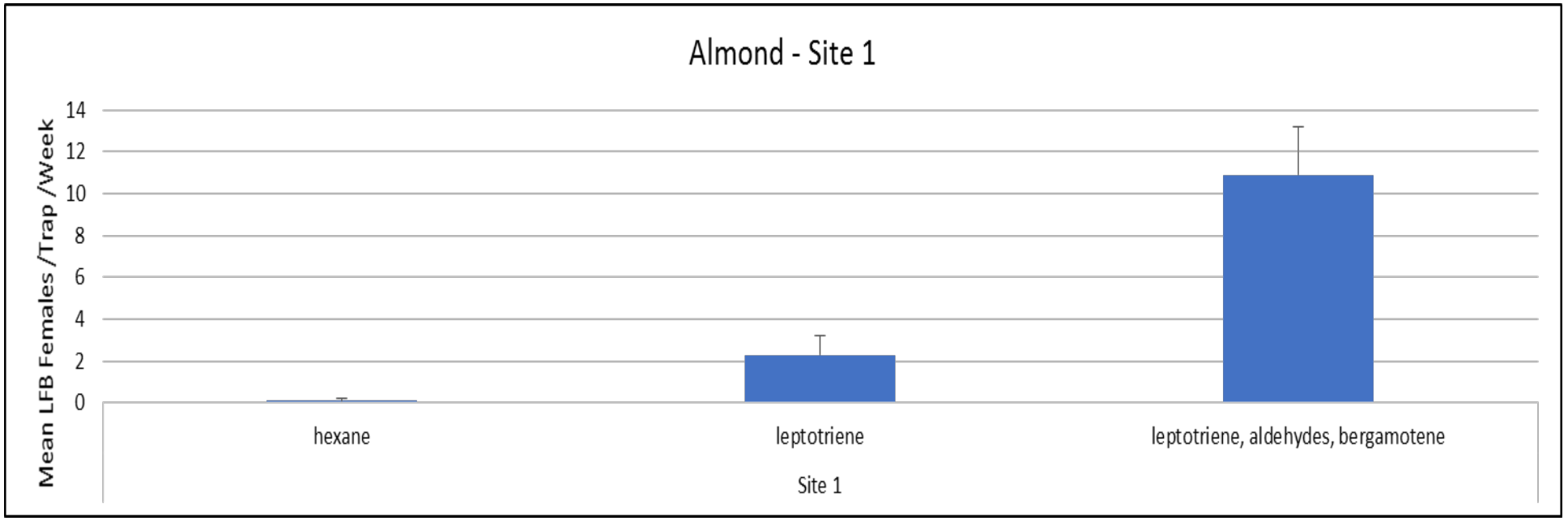
trans-beta-bergamotene
Isolated from horseweed oil

Bottom line: all male produced compounds finally available for testing



4. SELECTED FIELD TEST RESULTS, 2022.

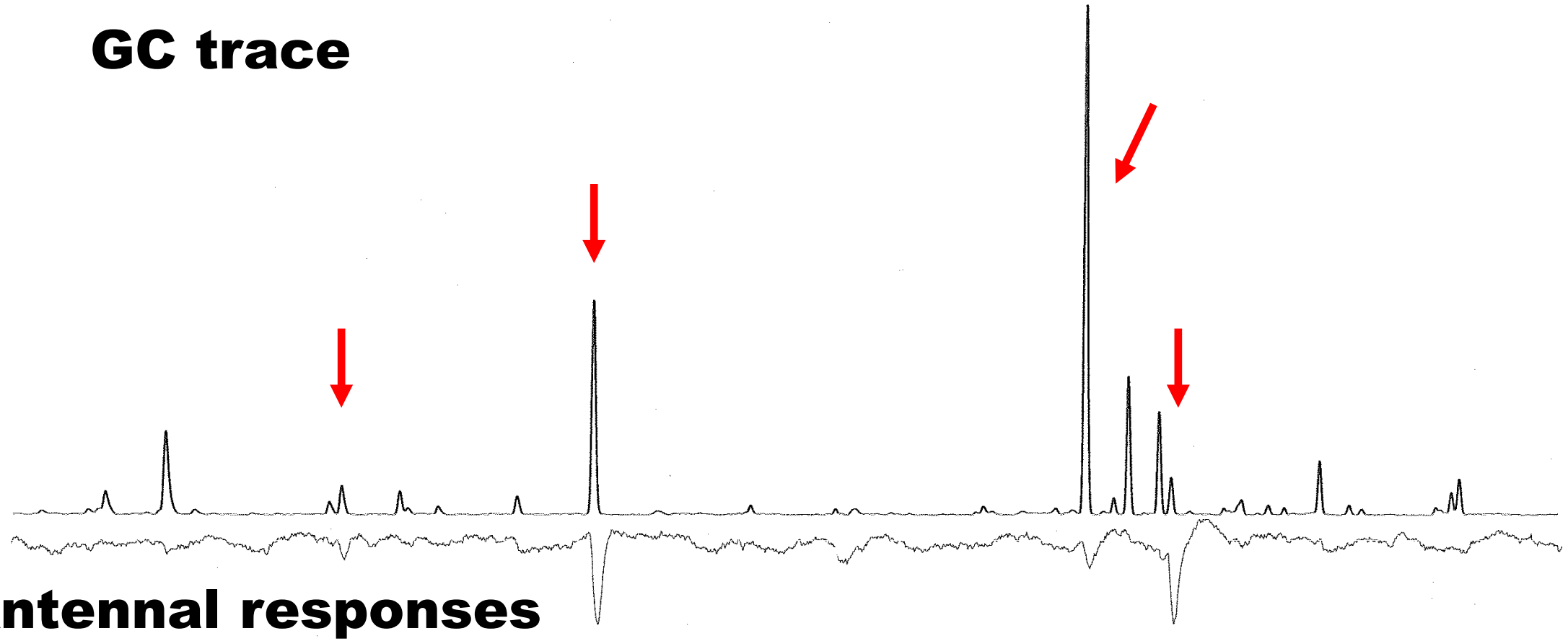
- Is the pheromone a single compound, or a blend?
  - Almonds, April-May, 5 reps, black panel traps



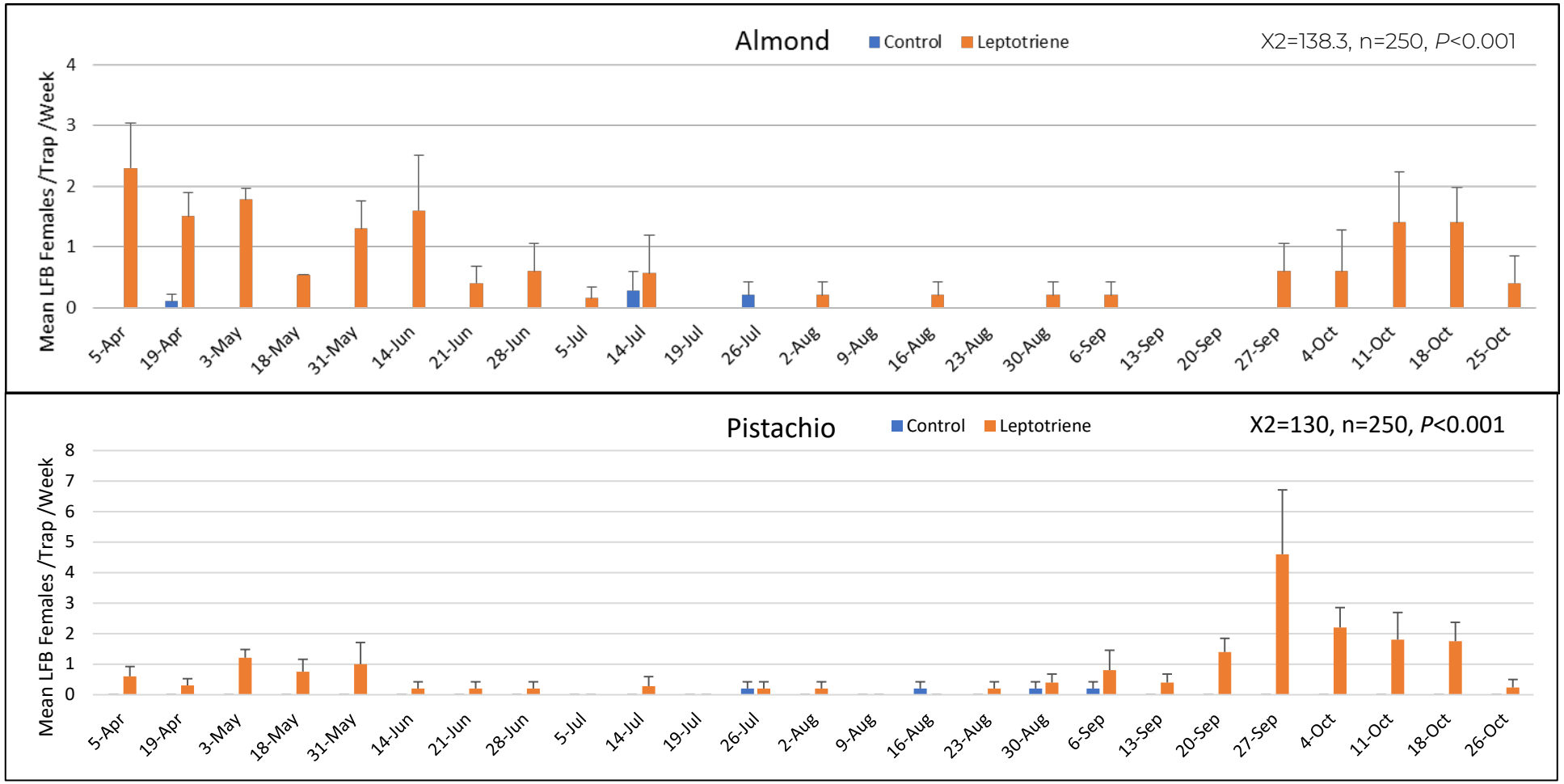
- Leptotriene weakly attractive by itself
- Synergized by one or more other components

Reminder: At least 4 compounds elicit antennal responses.

- Gas chromatography-electroantennogram detection

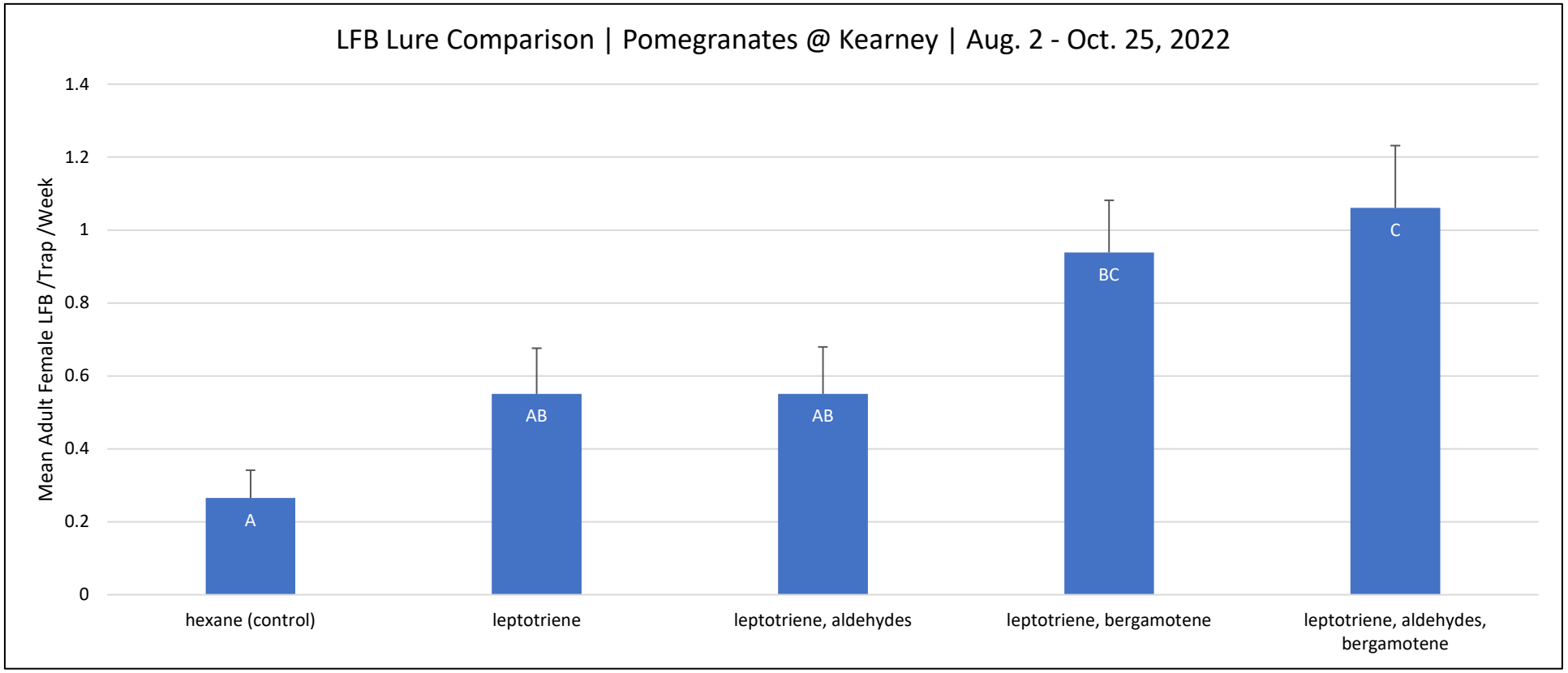


Seasonlong monitoring with leptotriene alone.



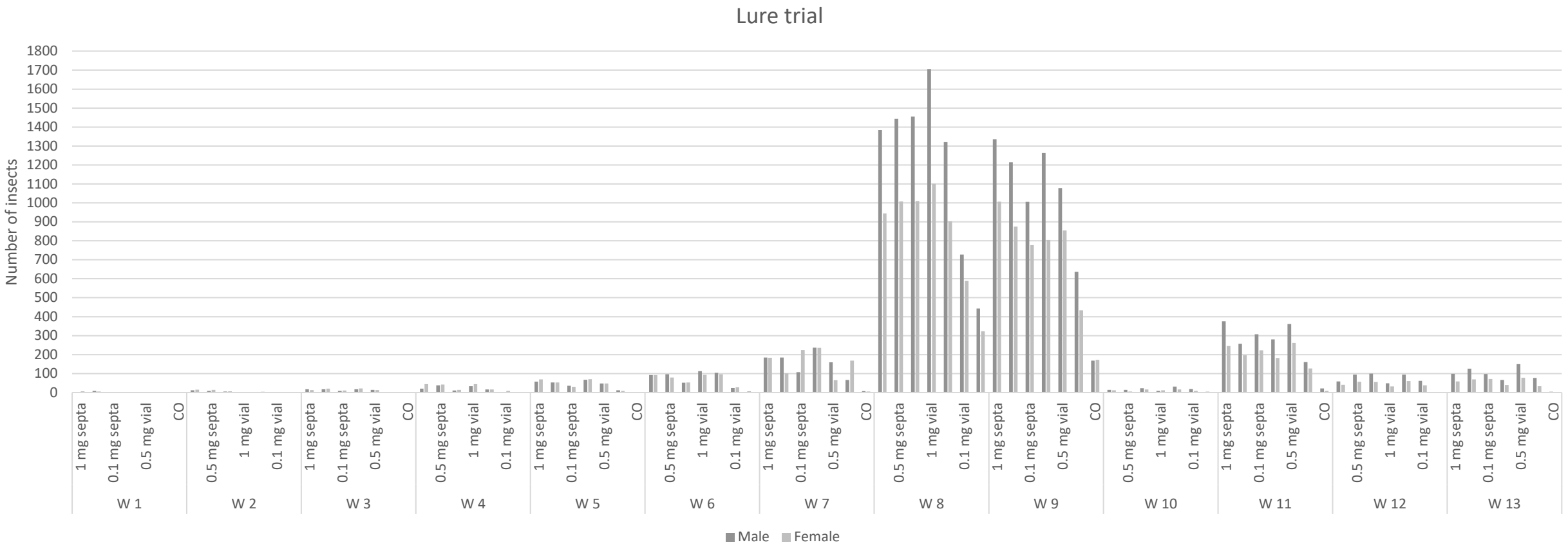
- Leptotriene alone is weakly attractive seasonlong

Testing blends in pomegranates.



- Blend consistently more attractive than leptotriene alone
- Any blend without leptotriene is not attractive (data not shown)

Trapping *Leptoglossus occidentalis* in Europe



- Leptotriene key component of the lure
- > 20,000 bugs trapped seasonlong

5. SUMMARY.

- All crucial components of the *L. zonatus* pheromone have been identified and synthesized
- Effective traps identified
- Operational details of pheromone blend and dose may still need to be optimized
- Pheromone components likely to be expensive
- Key component leptotriene is shared by related species

Acknowledgements.

- Project was jointly and equally funded by:
  - Almond Board of California
  - Pistachio Research Board

The Future of Fungal and Bacterial Disease Management of Almond

12/08/22 - Dr. J. E. Adaskaveg

california almonds®
Almond Board of California

Forecasting Diseases

california almonds®
Almond Board of California

Flower, foliar, fruit, and root/crown diseases of almond

Brown rot blossom blight

Green fruit rot/Jacket rot

Shot hole

Bacterial spot

Bacterial blast

Anthracnose

Scab

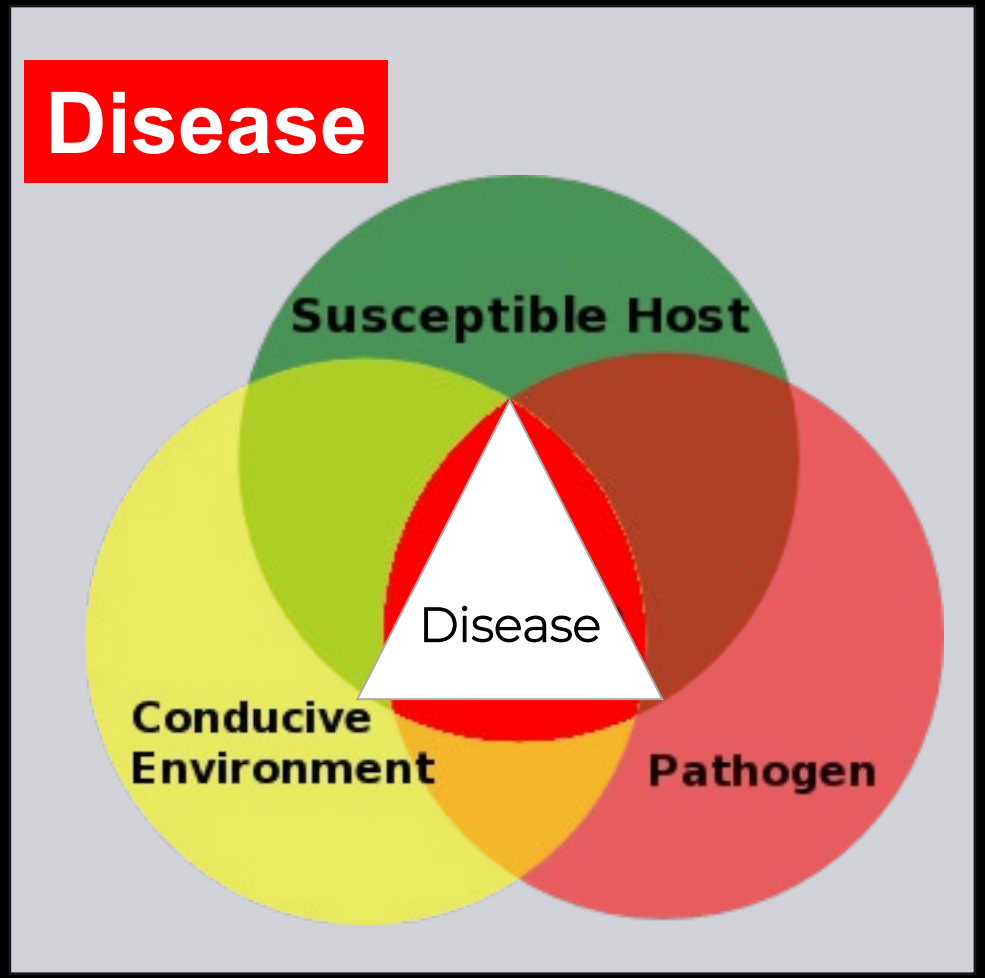
Alternaria leaf spot

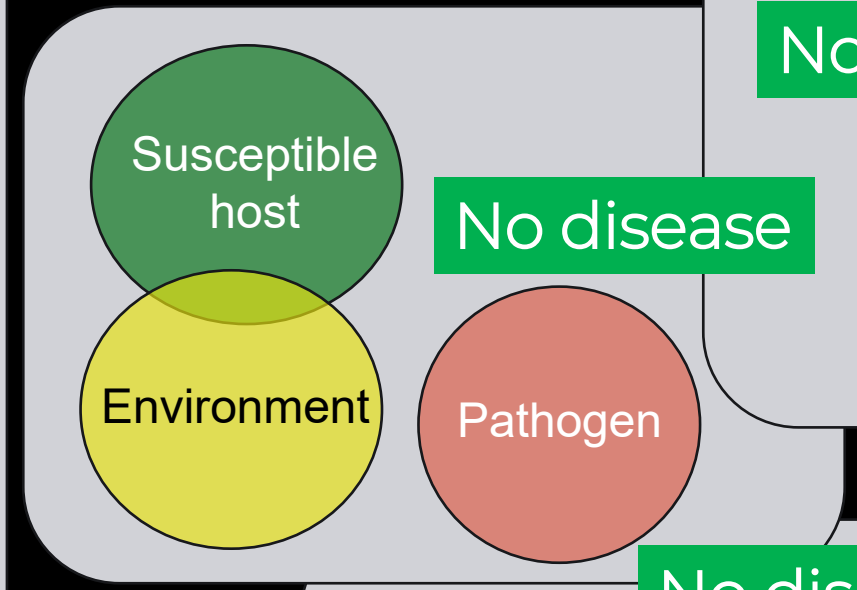
Rust

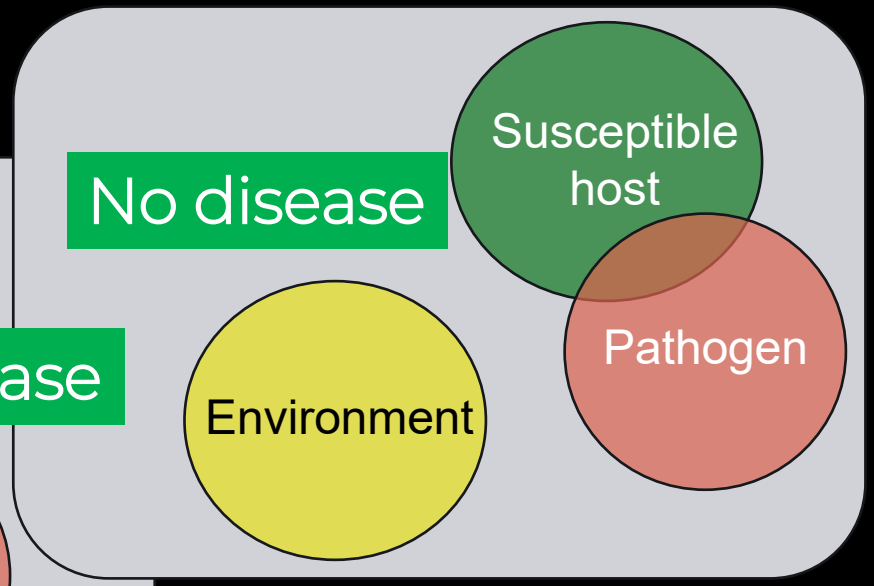
Hull rot

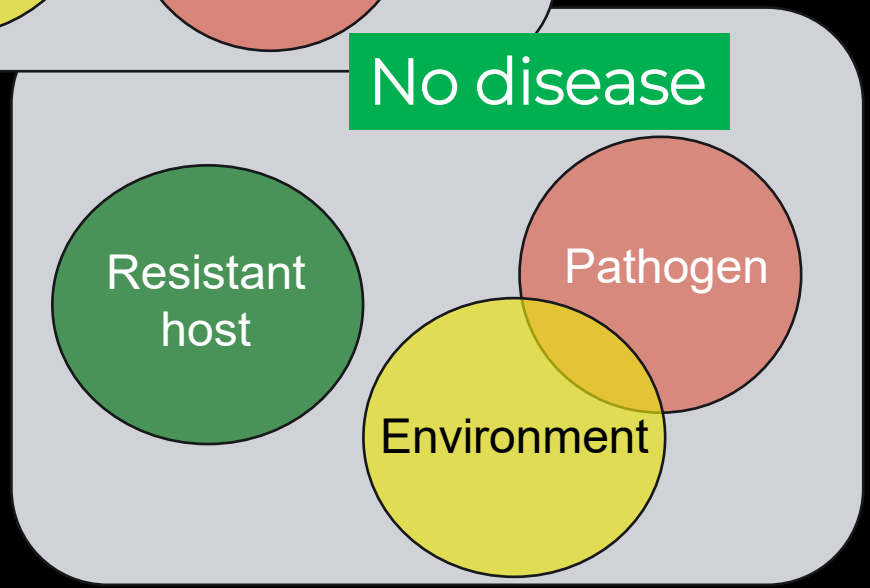
Phytophthora root and crown rot

Foundation of Plant Pathology: *The Disease Triangle*









Forecasting models based on the disease triangle: Identifies favorable conditions for infections

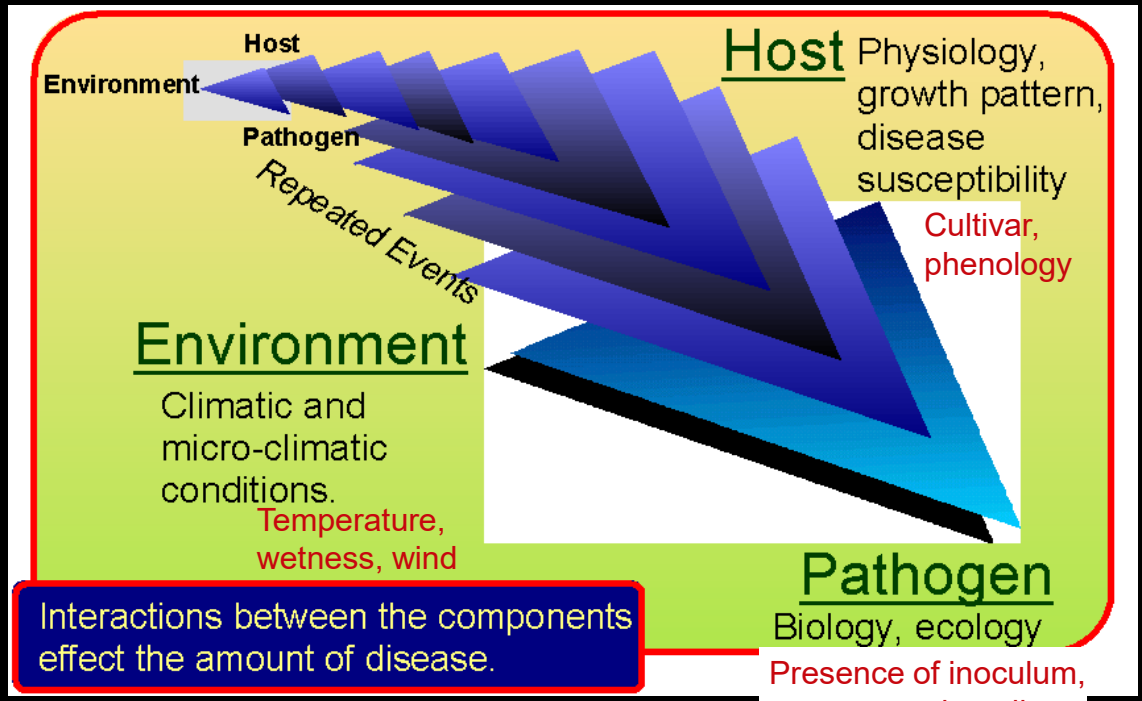
Models for disease management:

- ***Conventional calendar-based programs*** **- Time of year**
- ***Host phenology-based programs -***

  Host developmental stage only - Brown rot model-I
- ***Inoculum-based programs - (threshold levels)***

  Presence of primary inoculum - Rust model
- ***Environmental-based programs -(inoculum always present)***

  Microclimate only – Alternaria leaf spot DSV model
- ***Mixed programs -***
  - **Inoculum/environmental based – Anthracnose, Scab, Shot hole models**
  - **Host phenology/Environmental-based - Brown rot model-II, XanthoCast, and Bacterial Spot models**



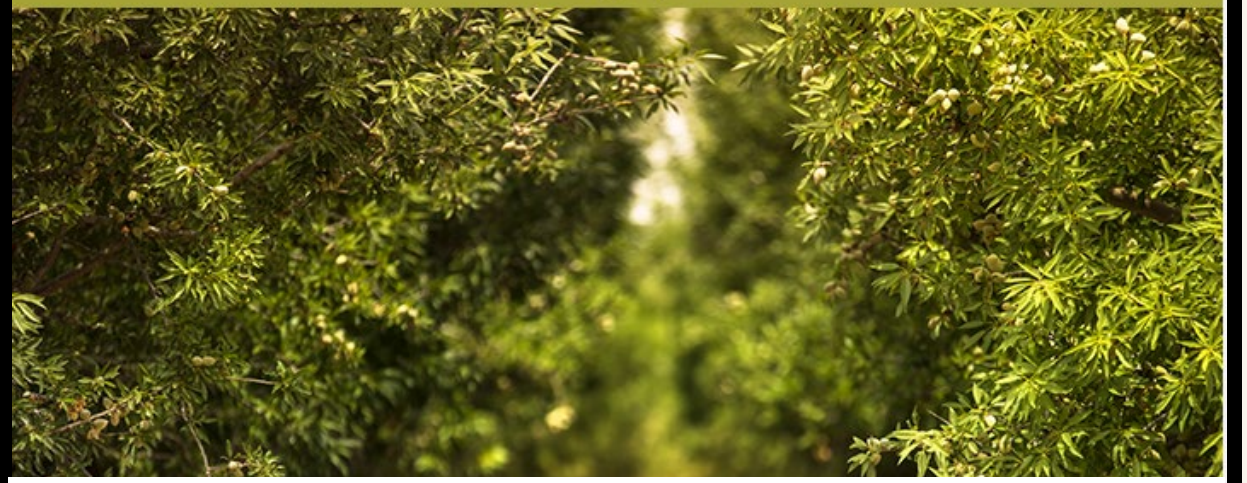
Environmental and host components of the triangle can give clues of which pathogens may be encountered.

Almond Board of California <industry@almondboard.com> and Semios Precision Agriculture <https://semios.com/>

IN THE ORCHARD

california almonds

May 27, 2022



No.	County	Region	Anthracnose (date, value, level), 5-day index summary (risk)^	Bacterial spot (date, value, level), 7-day index summary (risk)^
1	Butte	West	0	0
2	Colusa	East	0	0
3	Fresno	Central	0	0
4	Fresno	East	0	0
5	Fresno	West	0	0
6	Kern	Central	0	0
7	Kern	East	0	0
8	Kern	West	5-26 (5.59) High risk; 7-day index= 13.4 to 5.59, decreasing	0
9	Madera	Central	0	0
10	Merced	Central	0	0
11	Stanislaus	Central	0	0
12	Stanislaus	East	0	0
13	Stanislaus	West	0	0

Disease Pressure Low for Most, West Kern County the Exception

According to the Disease Risk Forecast, disease pressure remains low for most of the state. There is a high risk for anthracnose in Western Kern County. Growers can track live conditions through the online portal to get the latest information.

LEARN MORE

california almonds

Why Almonds Almond Industry Tools & Resources

Regionalized Disease Forecasts – A pilot program

Disease risk forecasts for 5 counties based on regional in-orchard/near-orchard weather data and disease modeling. Powered by Semios(R) precision farming platform, the data is logged and then summarized by UC Riverside's Dr. Jim Adaskaveg.

See 7-day disease risk predictions for multiple diseases on the link below. Looking at the website allows growers to see up-to-date predicted disease risks. The combination of the disease prediction tool, along with the weekly interpretation by The University of California, will hopefully allow growers to make more nuanced disease management decisions. To view live conditions and modeling, visit the portal below and use **Almondboard2022** as the password.

Visit live portal

Almond Board of California - Disease Forecasts in cooperation with the University of California

california almonds

Why Almonds Almond Industry Tools & Resources

Regionalized Disease Forecasts – A pilot program

Disease risk forecasts for 5 counties based on regional in-orchard/near-orchard weather data and disease modeling. Powered by Semios(R) precision farming platform, the data is logged and then summarized by UC Riverside's Dr. Jim Adaskaveg.

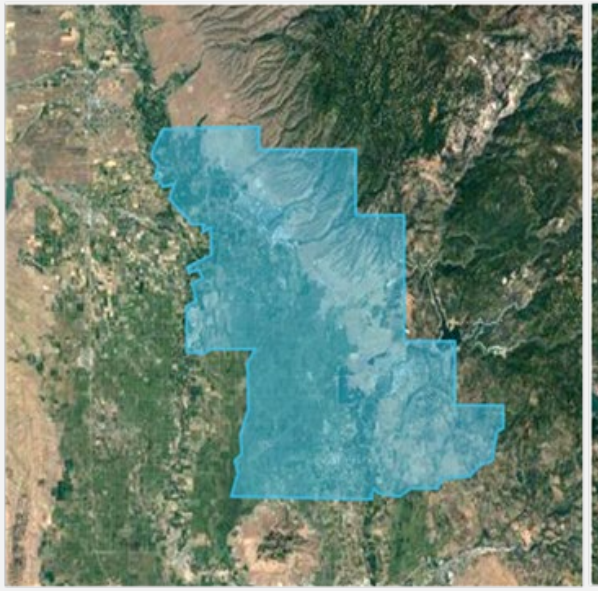
See 7-day disease risk predictions for three diseases on the link below. Looking at the website allows growers to see up-to-date predicted disease risks. The combination of the disease prediction tool, along with the weekly interpretation by The University of California, will hopefully allow growers to make more nuanced disease management decisions. To view live conditions and modeling, visit the portal below and use **Almondboard2022** as the password.

Almond Board of California <industry@almondboard.com>

Visit live portal

← **Website and password**

Butte West



Colusa East

Fresno Central

Fresno East

ABC - Disease Forecasts in cooperation with Semios-Precision Agriculture and the University of California

Diseases of importance for different seasons are shown

Table 1. Daily risk assessment disease forecasts - 5-26 to 6-1-2022

No.	County	Region	Anthracnose (date, value, level), 5-day index summary (risk)^	Bacterial spot (date, value, level), 7-day index summary (risk)^	Alternaria leaf spot (date, value, level), 7-day index summary (risk)^
1	Butte	West	0	0	5-26 to 5-27 (1, 1) Low risk; 7-day index = 2, increasing
2	Colusa	East	0	0	5-26 to 5-28 (1, 1, 1) Low risk; 7-day index = 3, increasing
3	Fresno	Central	0	0	0
4	Fresno	East	0	0	0, Low risk; 7-day index= 2 to 1, decreasing
5	Fresno	West	0	0	0
6	Kern	Central	0	0	0, Low risk; 7-day index= 4 to 3, decreasing
7	Kern	East	0	0	0
8	Kern	West	5-26 (5.59) High risk; 7-day index= 13.4	0	0
9	Madera	Central	0	0	0
10	Merced	Central	0	0	0
11	Stanislaus	Central	0	0	0
12	Stanislaus	East	0	0	0
13	Stanislaus	West	0	0	0

Industry Advisory - Summary for Selected Almond Growing Regions

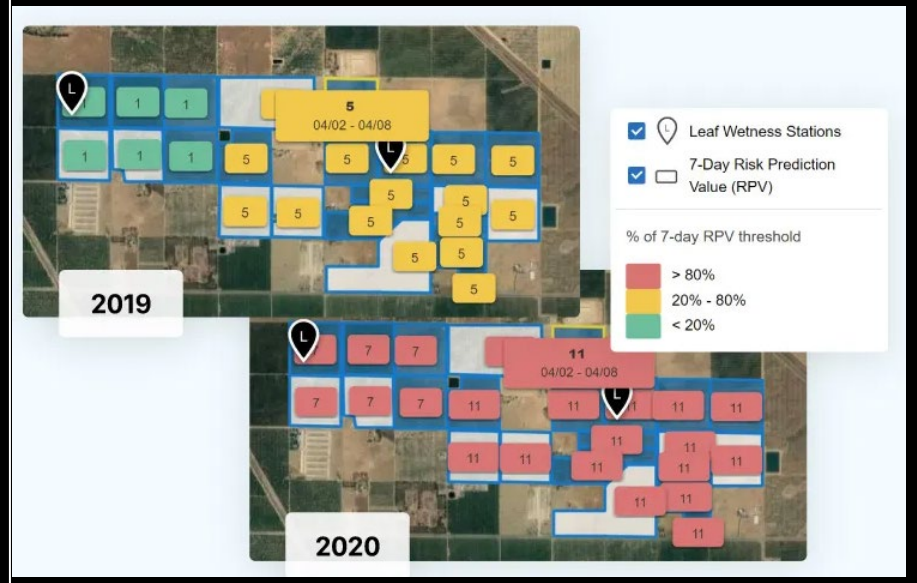
For the coming week, zero risk is forecasted for bacterial spot in all regions (Table 1). Anthracnose is forecasted with a high risk in Kern-W with accumulated risk at 5.59 on 5-26 due to forecasted precipitation (1.34 mm). All other regions have 0 risk for anthracnose. For Alternaria leaf spot, most regions will have zero risk; low risk is forecasted for Butte-W and Colusa-E with accumulated daily wetness hours of 2 h and 3 h, respectively, for the week ahead.

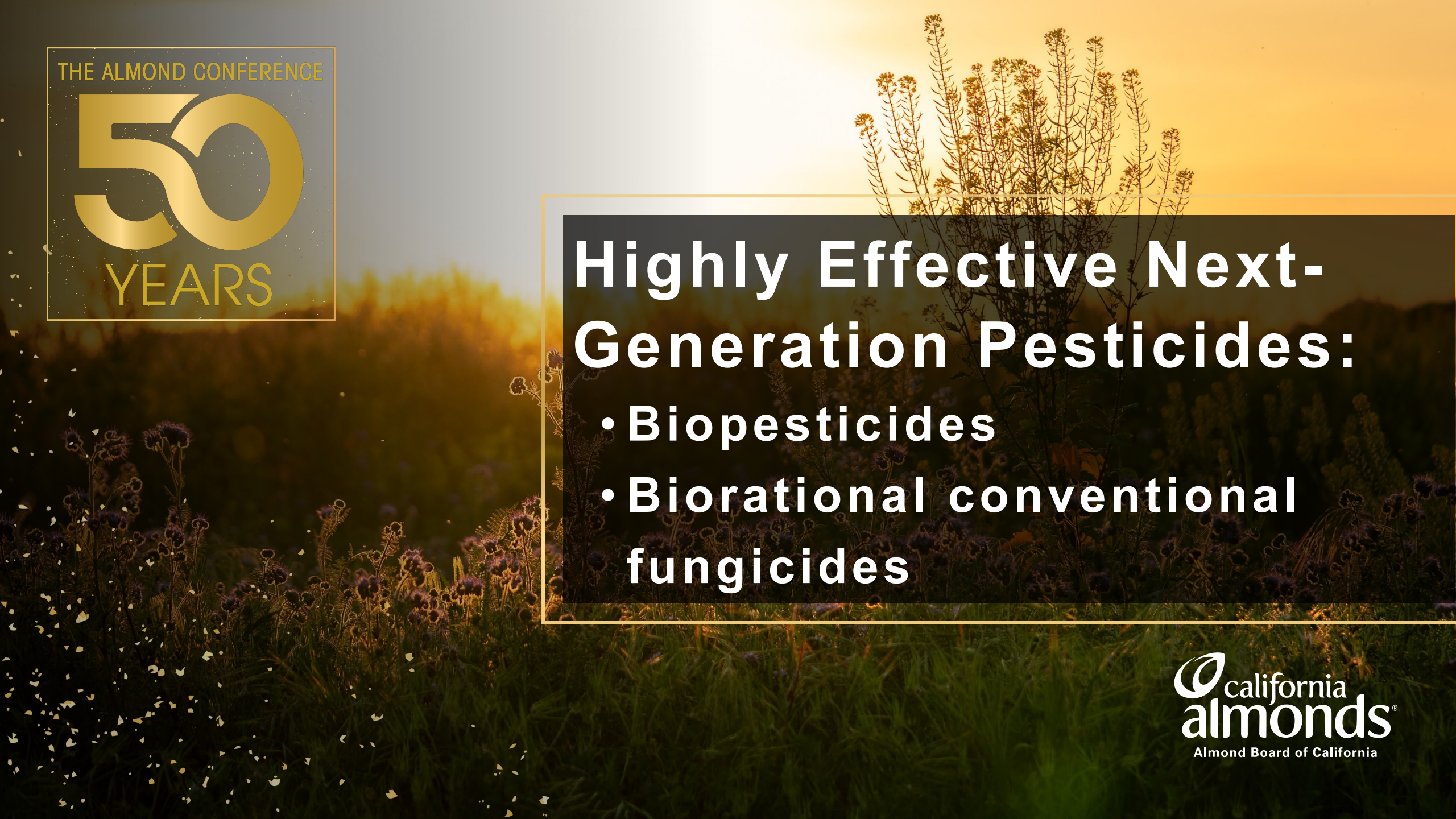
Forecasted temperatures are remaining relatively cool to moderately warm (17.4 to 29.4C) in all regions for the next week. Low precipitation is only forecasted for Kern-W for the coming week and this triggered the anthracnose high risk alert that is precautionary. Overall, disease pressure will be low for most almond growing regions of the state.

ABC - Disease Forecasts in cooperation with Semios-Precision Agriculture and the University of California

Benefits of Precision Agriculture for Disease Management

- **Regional disease forecasts**
  - Pinpoint microclimatic conditions for your orchard with multiple data-loggers in each region
  - Know what to expect 7 days ahead of time
- **Models specific for each major disease that require timely management practices:**
  - Anthracnose, Alternaria leaf spot, Brown rot, Leaf rust, Hull rot (i.e., Hull split), Shot hole, etc.
- **Assists in decision-making processes:**
  - Optimizes timing of fungicide applications and disease control
  - Minimizes unnecessary applications
  - Saves on expenditures





Highly Effective Next-Generation Pesticides:

- Biopesticides
- Biorational conventional fungicides

california almonds®
Almond Board of California

Moving to biofungicide and biorational-conventional fungicides

Fungicides for Managing Almond Diseases

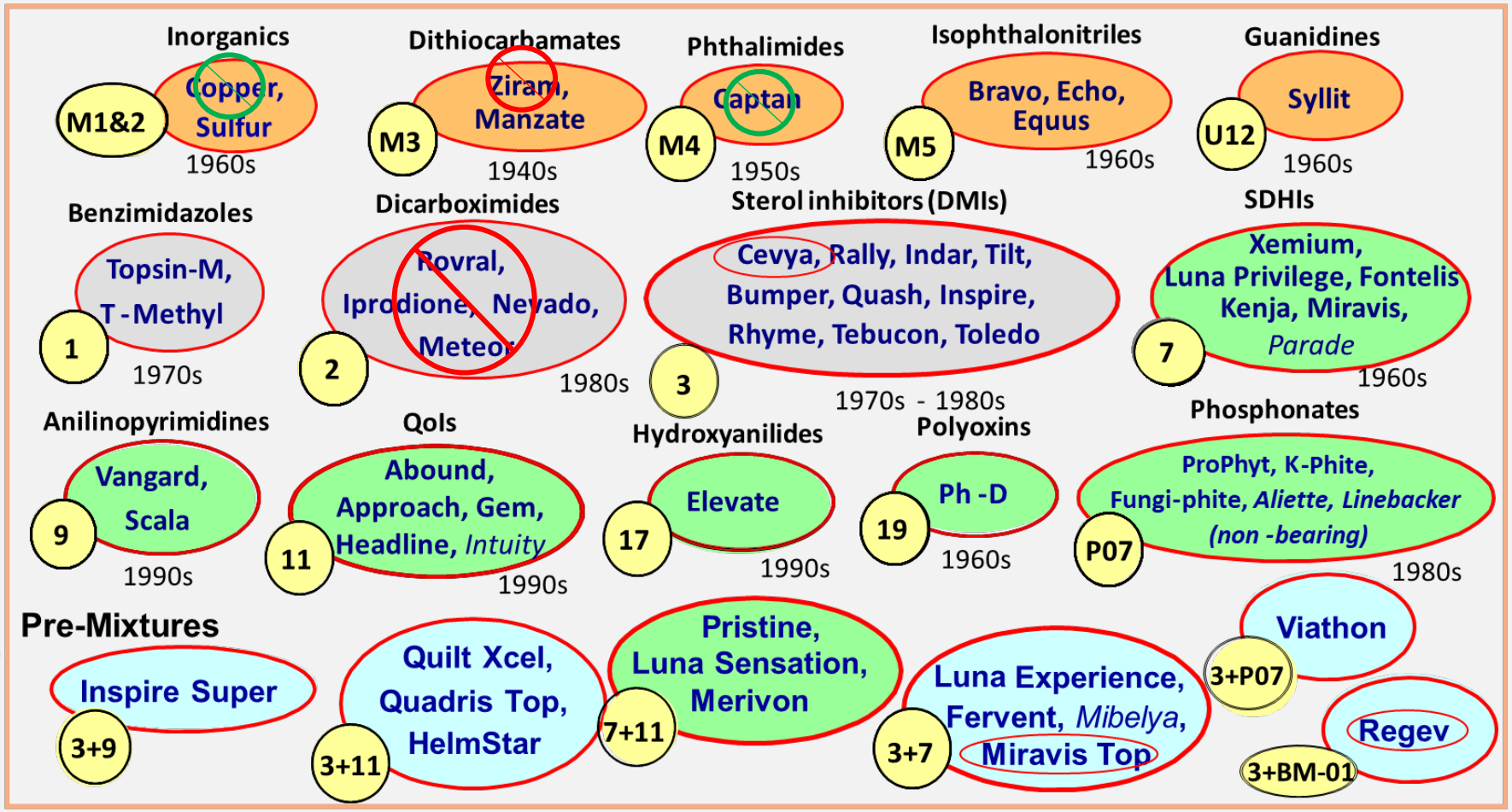
Inorganics and Conventional Synthetics

New:

Cevya (2021-22)
Regev (2021-22)
Miravis Duo (2022)

Ongoing:

Miravis Prime, Parade, Mibelya, others



©Adaskaveg et al. 2022

= Restricted usage

= Potentially cancelled

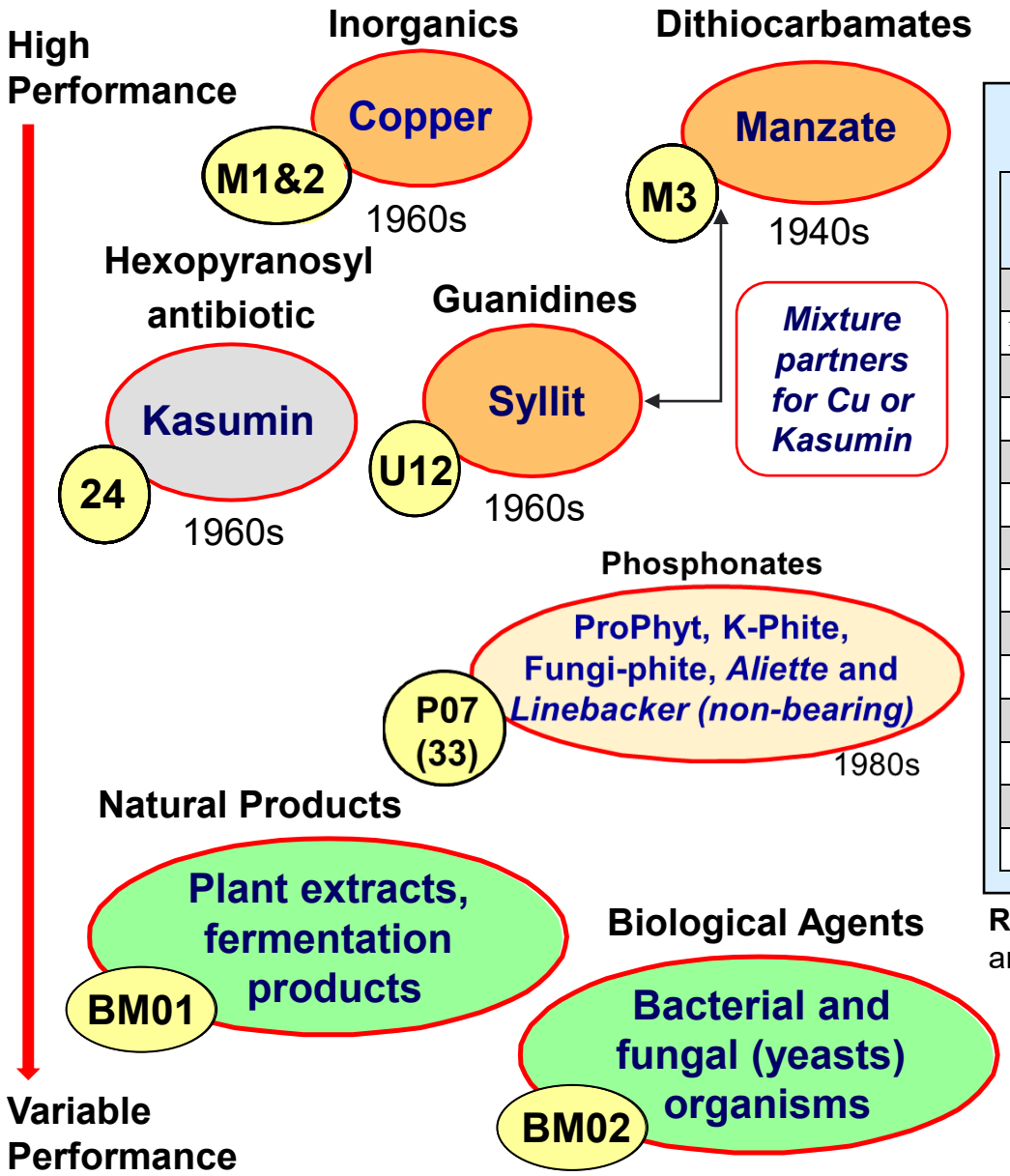
Multi-site conventional

Metal-based, environmentally persistent

Single-site, biorational

Carbon-based, environmentally non-persistent, some are biopesticides (Ph-D) others mixed with plant extracts (Regev)

Bactericides for managing foliar bacterial diseases of almond



BM01 and BM02 Products

Trade name	Biological or natural product (FRAC code)[1]	Bacterial blast	Bacterial spot
Blossom Protect	*Aureobasidium pullulans* (BM 02)	NL	NL
Double Nickel 55	*Bacillus amyloliquefaciens* D747 (BM 02)	NL	2
Serifel	*B. amyloliquefaciens* MBI600 (BM 02)	NL	2
Serenade	*B. subtilis* QST 713 (BM 02)	NL	3
Aviv	*B. subtilis* IAB/BS03 (BM 02)	NL	ND
Dart	capric and caprylic acids (BM 01)	NL	3
ProBlade Verde	Banda de *Lupinus albus* (BM 01)	NL	3
Kasumin	kasugamycin (24)[1]	4	4
Oxidate, Perasan	peroxyacetic acid (oxidizer)	NL	2
Howler	*Pseudomonas chlororaphis* strain AFS009 (BM 02)	NL	3 (NL)
Regalia	*Reynoutria sachalinensis* (P 05, BM 01)	NL	3
Actinovate AG	*Streptomyces lydicus* (BM 02)	NL	2
Guarda	Essential oil (BM 01)	NL	3
Vintec	*Trichoderma atroverde* (BM 02)[6]	NL	0 (NL)

Rating: 5 = excellent and consistent, 4 = good and reliable, 3 = moderate and variable, 2 = limited and/or erratic, 1 = minimal and often ineffective, 0 = ineffective, NL = not on label, and ND = no data.

A greater need for consistently, high-performing products

Managing Phytophthora diseases of almond with new modes of action

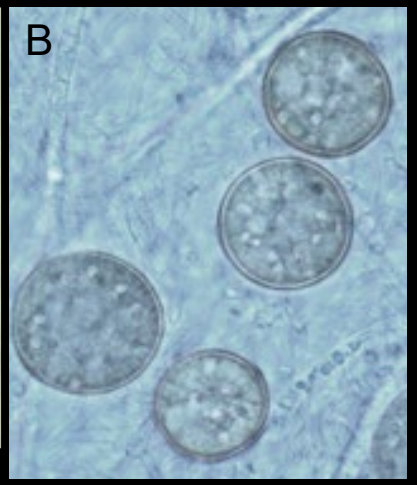
A case study of future directions with biorational conventional fungicides

Phytophthora diseases of almond



Trunk cankers

Root rot




Tree death

'Crotch' cankers

A) Oospore of *P. cactorum*. B) Chlamydospores of *P. parasitica*. C,D) Sporangia of *P. cactorum* releasing zoospores in Fig. D.

Phytophthora disease management strategies in almond

- **Cultural practices:**
  - Use tolerant rootstocks (Mariana 2624 most tolerant)
  - Establish orchards in well-drained soils
  - Manage irrigation (shorter than 24-h irrigations)
- **Soil fumigation/nematicides:**
  - Pre-plant fumigants and post-plant nematicides
- **Fungicides:**
  - Field applications (mefenoxam, potassium phosphite)
  - Resistance detected to mefenoxam, potassium phosphite (> 30 years of usage)
  - Several **new fungicides** in development; oxathiapiprolin was recently registered.

Management of Phytophthora diseases

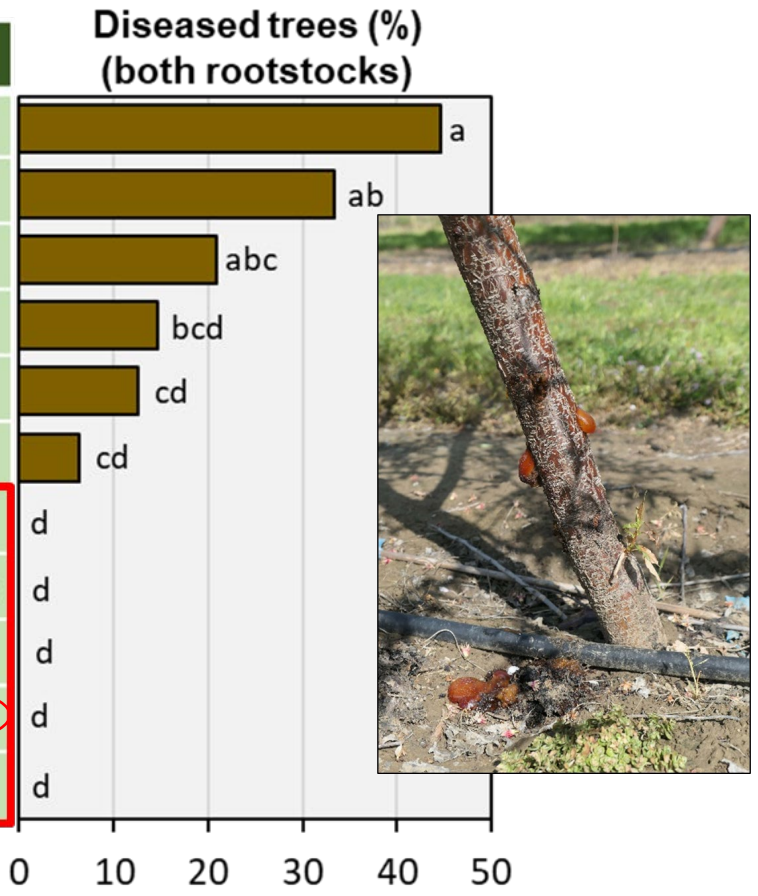
Registered and new fungicides proposed for use on almond

	Common name	Trade name	FRAC	Registration Status
Older fungicides	Metalaxyl, mefenoxam	Ridomil Gold	4	☑
	Fosetyl-Al, PO_3	Various	P07 (33)	☑
New Fungicides	Ethaboxam	Elumin	40	☑
	Fluopicolide	Presidio	43	☑
	Mandipropamid	Revus	22	
	Oxathiapiprolin	Orondis	49	☑

☑ = pending registration, currently in the IR-4 program

New fungicides for management of Phytophthora crown rot of Nonpareil almond on Hansen or Nemaguard rootstocks - UC Davis

Treatment	Rate(/A)
Control	---
Ridomil Gold 480SL	16 fl oz
Elumin	10 fl oz
Revus 250SC	8 fl oz
Orondis - 200 OD	2.4 fl oz
Presidio + Elumin	6 + 10 fl oz
Prophyt	64 fl oz
Prophyt + Ridomil Gold	64 + 16 fl oz
Presidio	6 fl oz
Orondis - 200 OD	4.8 fl oz
Orondis - 200 OD	9.6 fl oz



Phytophthora spp.	Mo. of isolates	EC_{50} value ranges			
		Mefenoxam	Oxathiapiprolin	Ethaboxam	Fluopicolide
P. cactorum	7	0.009 - 0.023	0.0005 - 0.001	0.026 - 0.088	0.104 - 0.229
P. chlamydospora	1	0.017	0.0003	0.053	0.035
P. cinnamomi	5	0.007 - 0.038	0.0002 - 0.0004	0.006 - 0.017	0.041 - 0.078
P. citricola / complex	14	0.061 - 0.155	0.0003 - 0.0006	0.083 - 0.258	0.027 - 0.047
P. gonapodyides	4	0.004 - 0.015	0.0002 - 0.0005	0.007 - 0.047	0.026 - 0.072
P. lacustris	2	0.003 - 0.004	0.0002 - 0.0004	0.054 - 0.137	0.015 - 0.025
P. megasperma	4	0.01 - 0.013	0.0003 - 0.0005	0.04 - 0.079	0.082 - 0.24
P. niederhauserii	24	0.012 - 0.209	0.0001 - 0.0004	0.031 - 0.105	0.041 - 0.067
P. obscura	1	0.003	0.0003	0.033	0.018
P. rosacearum	2	0.105 - 0.122	0.0002 - 0.0004	0.06 - 0.089	0.06 - 0.08
P. syringae	16	0.002 - 0.041	0.0002 - 0.0004	0.017 - 0.13	0.021 - 0.318
Total	80				

Diseased trees developed severe crown rot and trunk cankers. Re-isolations determined that symptoms were caused by *P. cactorum*.

- ***Oxathiapiprolin, fluopicolide, and ethaboxam represent three new modes of action and have EC_{50} values equal to or lower than those of mefenoxam.***
- ***Oxathiapiprolin is 10X to 1000X more active than other fungicides allowing low field rates.***
- ***All three are/will be labeled for chemigation.***

Highly effective, low-rate, chemigated Phytophthora fungicides with biorational characteristics

- **Oxathiapiprolin** is a new reduced-risk fungicide with a unique mode of action that has extremely high activity specifically against all *Phytophthora* species (recently registered in CA).
- Other new modes of action are in development: **fluopicolide, ethaboxam** (currently in IR-4 GLP residue studies), and possibly **mandipropamid** for nursery use. Each contain a new active ingredient with a different MOA and will set new standards in safety and disease control.
- Resistance to mefenoxam and phosphites in other crops emphasizes the need to have rotations with different MOAs.

The Future of Disease Management of Almond – "*Fiat Lux*"

Changes in pest management strategies are inevitable, but the process has to be patiently selective toward highly effective biorational products (which is ongoing) and not impetuous for "change for changes sake"...


THANK YOU
THE ALMOND CONFERENCE
50
YEARS