2018 | THE ALMOND CONFERENCE

SPEED TALKS: POLLINATION AND BEE HEALTH

ROOM 308-309 | DECEMBER 4, 2018

california almonds
Almond Board of California

growing ADVANTAGE
The Almond Conference

Continuing Education Units (CEU's)

- **What type of CEU's are offered at conference?**
  - Tuesday – Certified Crop Advisor (CCA)
  - Wednesday – Certified Crop Advisor (CCA)
  - Thursday – Certified Crop Advisor (CCA) and Department of Pesticide Regulations (DPR)

- **Where are the CEU sign in sheets?**
  - CEU sign in sheets will be in the back of each session
  - There are separate forms on Thursday for the CCA and DPR credits

- **Special instructions for Thursday**
  - PCA's will need to pick up their scantrons in the morning before the first session of the day. They will also need to return the scantron at the end of the day to the CEU booth. This is in addition to signing in and out of each session.

Pollinator Health in California Almonds – A Collaborative Effort

Bob Curtis

Almond Board of California

AGENDA

- **Bob Curtis**, Consultant to ABC, moderator
- **Almond Board Funded Researchers**
  - Dennis vanEngelsdorp, Bee Informed Partnership
  - Brandon Hopkins, Washington State University
  - Reed Johnson, Ohio State University
  - Jody Johnson, Cullaborate
  - Billy Synk, Project Apis m.
  - Neal Williams, UC Davis
  - Elina Niño, UC Davis

Honey Bee Health

Key Almond Industry Objectives

- Assure a sufficient supply of strong hives for almond pollination by advancing bee health
- Assure almonds continue to be a good and safe place for bees

- **Speakers**
  - Dennis vanEngelsdorp, Bee Informed Partnership
  - Brandon Hopkins, Washington State University
  - Reed Johnson, Ohio State University
  - Jody Johnson, Cullaborate
  - Billy Synk, Project Apis m.
  - Neal Williams, UC Davis
  - Elina Niño, UC Davis

Ensure that almonds continue to be a good and safe place for bees

Resources

- Comprehensive “Honey Bee Best Management Practices for California Almonds”
  - With 2 “Quick Guides”: General-Decision Maker and Applicator-Specific
- Available on Almond Board website www.Almonds.com/BeeBMPs


HONEY BEE BEST MANAGEMENT PRACTICES
QUICK GUIDE FOR ALMONDS

APPLICATOR/DRIVER HONEY BEE BEST MANAGEMENT PRACTICES QUICK GUIDE FOR ALMONDS

Pesticide applications should follow these precautions to ensure both honey bee hive health and the best possible pollination of the California Almond crop:

1. **Read labels carefully and follow directions.** Do not use pesticides at bloom with label cautions that read “highly toxic to bees,” “toxic to bees,” “residual times” or “extended residual toxicity.”
2. **Before applying pesticides at any time of year, contact the county agricultural commissioner to notify beekeepers with nearby managed hives.** This is mandatory for pesticide products with “toxic to bees” label statements and recommended for all other applications, particularly during almond bloom.
3. **Water should either be covered or removed before a pest control treatment is made, or emptied and refilled after the treatment is made.** Providing clean water for bees to drink will ensure that they spend more time pollinating the crop than searching for water.
4. **Do not directly spray hives with any pesticide spray application.** Spray-rig driver should turn off nozzles when near hives for all materials applied. Spray applications that come in contact with bee hives could adversely affect bee health and the pollination of the crop.
5. **Do not hit flying bees with spray applications.** Bees that come in contact with agricultural sprays will not be able to fly because of the weight of spray droplets on their wings.
6. **Report suspected pesticide-related bee incidents** to the grower, beekeeper and county agricultural commissioner. Bee health concerns cannot be addressed without the data from these incidents.

“When a pesticide is to be applied bears “toxic to bees” statements on its label, beekeepers with hives within 1 mile of the application must be notified if they have requested notification by the applicator at least 48 hours before the planned application.

A digital version of this publication is available at Almonds.com/BeeBMPs

Also available:
Honey Bee Best Management Practices for California Almonds
Honey Bee Best Management Practices Quick Guide for Almonds

Key BMPs

Communication

- **Communication should occur between all pollination stakeholders** along the communication chain about pest control decisions during bloom
  - Agreements/contracts should include a pesticide plan that outlines which pest control materials may be used.
  - **Contact beekeepers 48 hours before pesticide application.** This includes beekeepers pollinating the orchard and beekeepers within one mile. Have the appropriate individual (e.g., applicator) use the crop management programs Agrian and CDMS, or contact Ag Commissioners directly to locate hives within a mile radius of the spray site.
- **Beekeepers should register their hives** through the Bee Where Program at https://beewherecalifornia.com/ by Jan. 1 each year or upon arrival in California. As well, note hive locations via the Bee Where program and app, and update locations with any hive movement within 72 hours of the move.
- **Report suspected pesticide related incidences to county ag commissioners as soon as possible.** Bee health concerns cannot be addressed without data from potential incidents.

Pesticide Use During Bloom

- **Avoid applying insecticides** during almond bloom until more is known, particularly about their impact on bee adults and brood (young developing bees in the hive). The one exception is *Bacillus thuringiensis* (B.t.).
- **Apply fungicides at bloom in the late afternoon and evening when, bees and pollen are not present.** This avoids contaminating pollen with spray materials and spraying bees

COMMUNICATION CHAIN

Bee Informed Partnership
Data Driven - Helping keep colonies alive

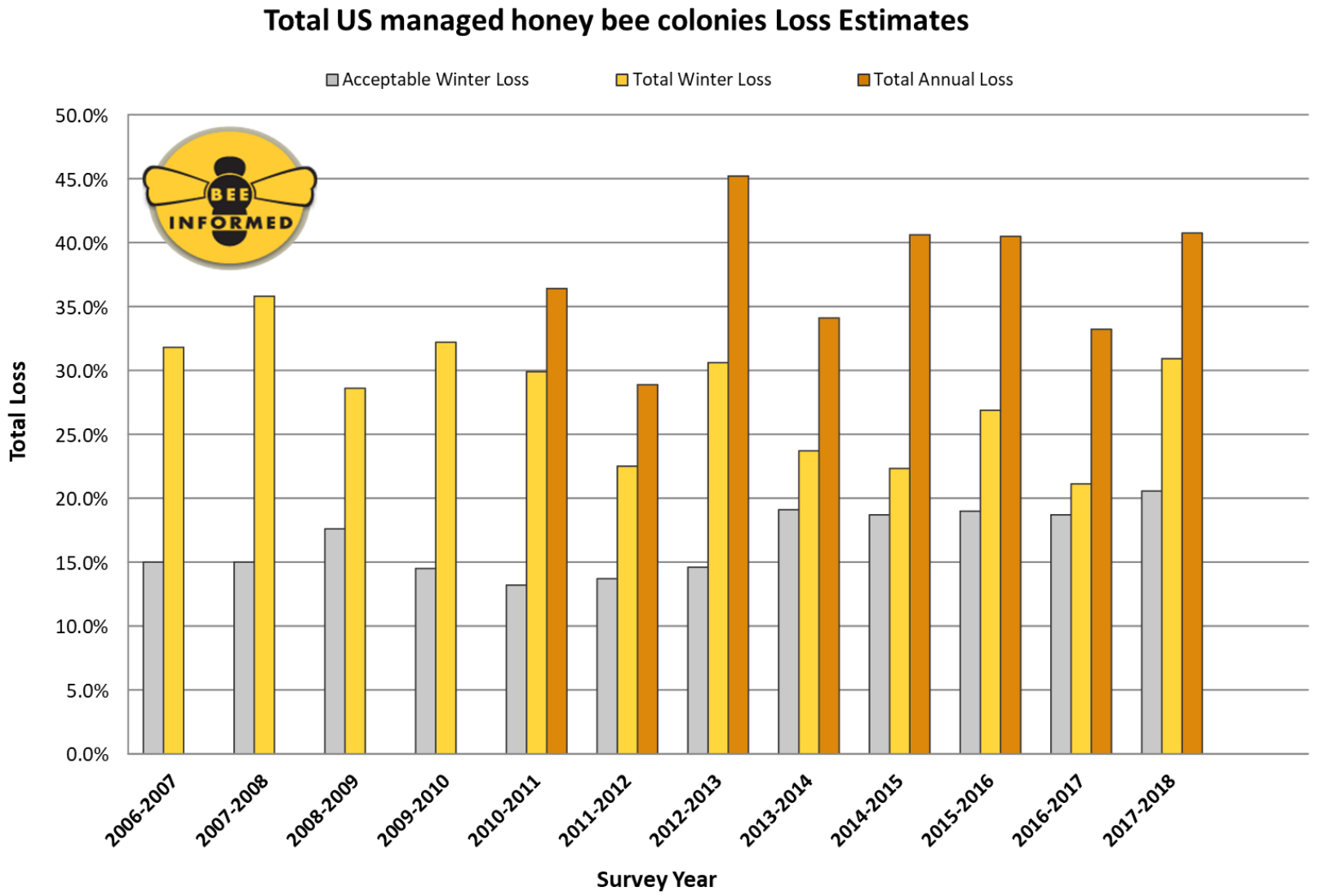
Dennis vanEngelsdorp

Bee Informed Partnership

University of Maryland

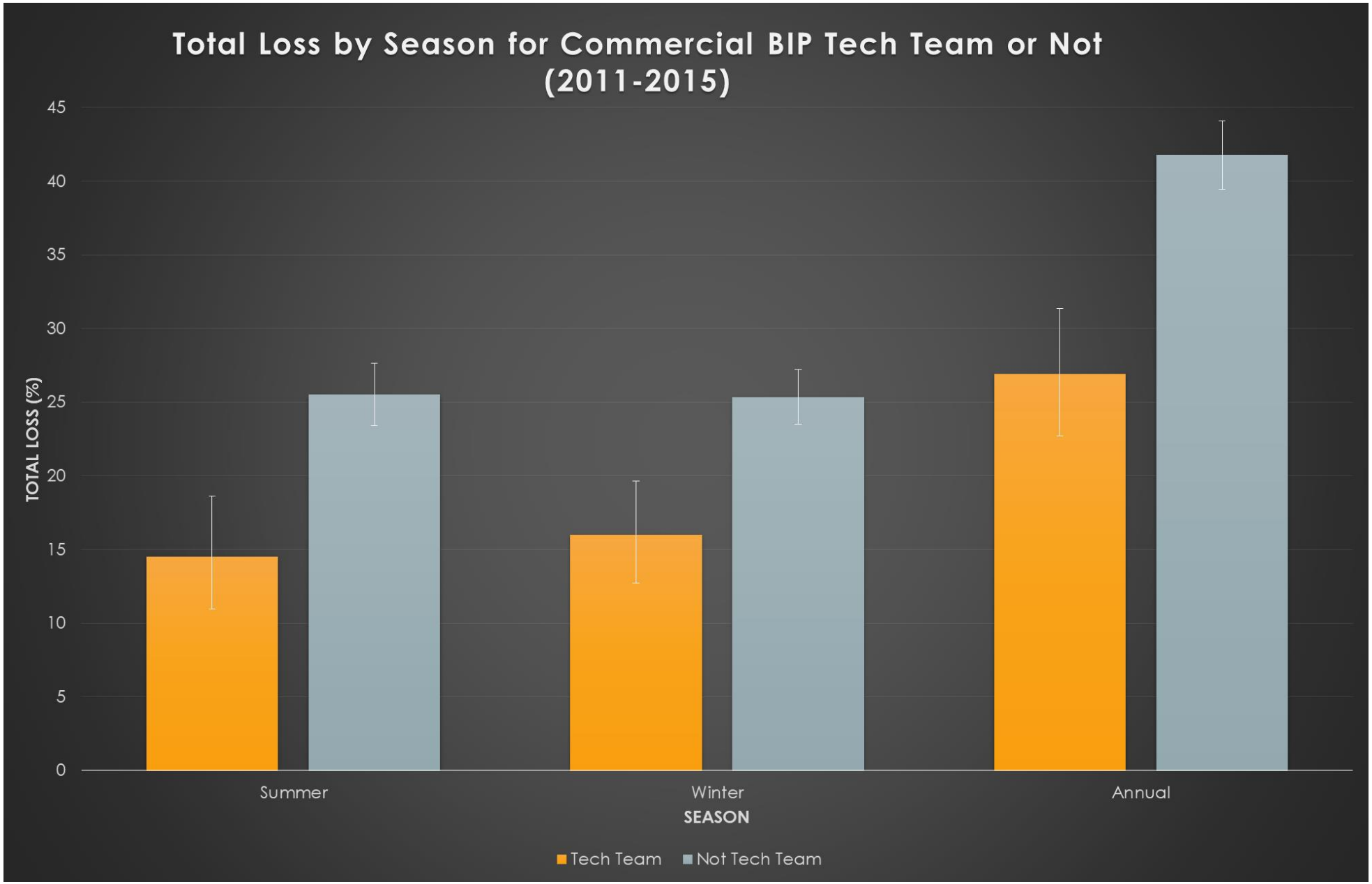
Overview of U.S. Honey Bee Health

Loss Rates



vanEngelsdorp et al., ‘07-’12; Spleen et al., ‘13; Steinhauer et al. ‘14; Lee et al. ‘15; Seitz et al. ’16; prelim ‘15-’16

Tech Teams



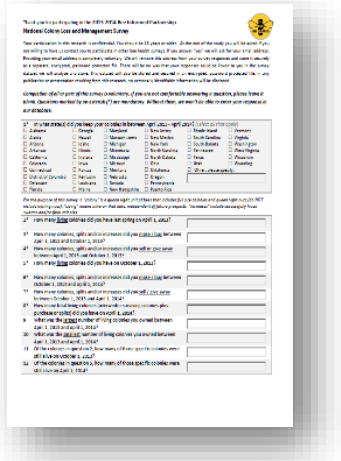
Tech team cost structure

- Costs
  - In 2014, $118,800 per TT member
  - In 2017, $90,000,per tech member

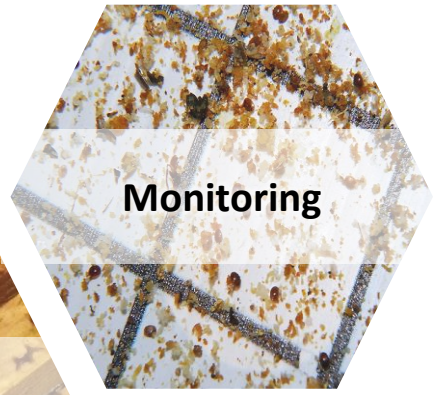
»a 24% reduction

- Income
  - 30% Beekeeper income
  - 20% Grants
  - 20% Contracts
  - 20% donations and sustaining support

Recording management practices

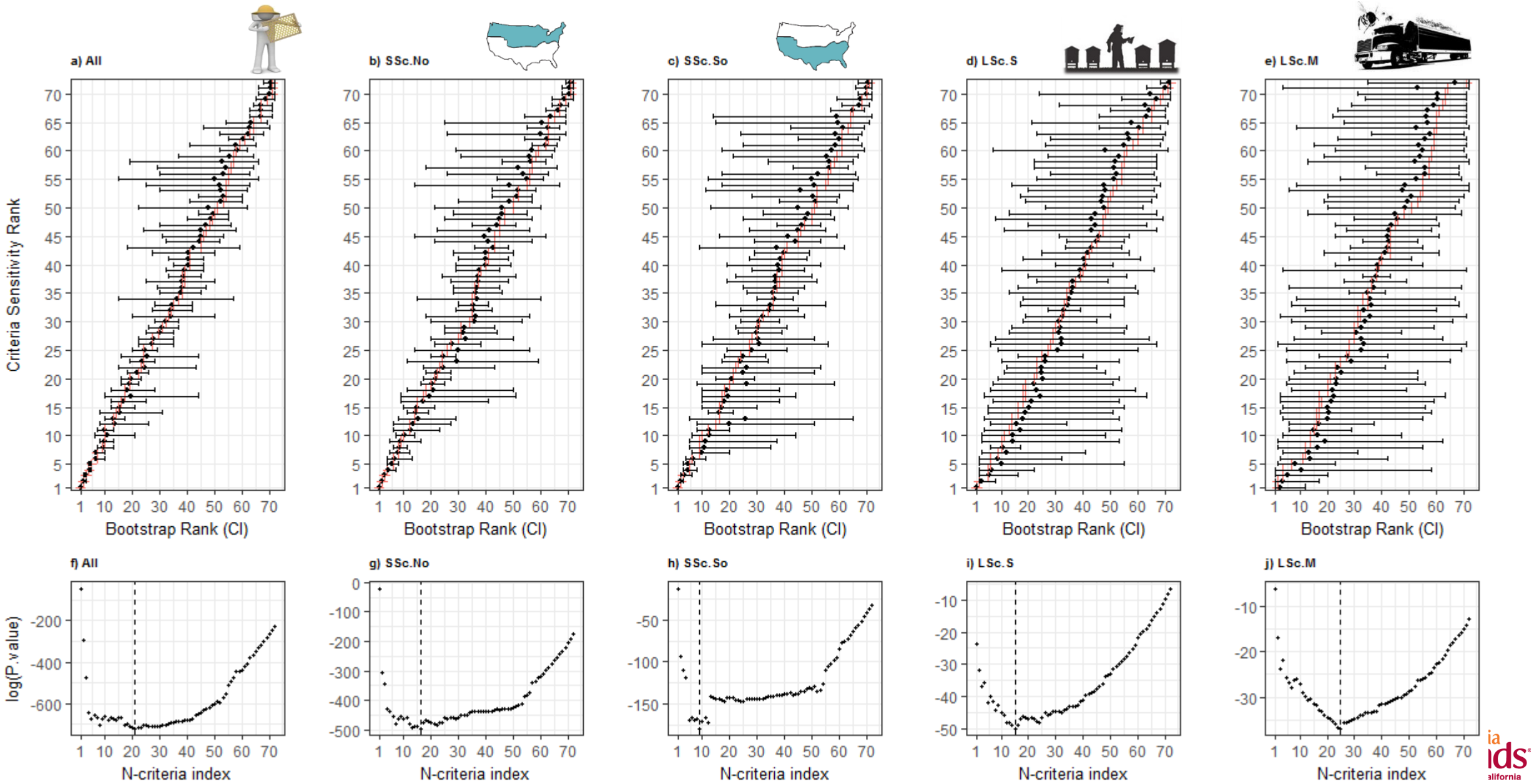


72 Criteria from 8 different domains



16

Identifying factors that matter



Top ranking management criteria

N=11,630	N=6,411	N=596	N=334
			
Action on Deadouts	Action on Deadouts	How started new colonies	Honey Produced
Varroa Treatment Y/N	How started new colonies	Honey Produced	Varroa Monitoring Technique
How started new colonies	Varroa Treatment Y/N	Varroa Products Months Count	Winter Prep
Comb Culling Technique	Honey Produced	Varroa Products Type Count	How started new colonies
Formic acid use Season	Comb Culling Technique	Varroa Treatment Y/N	Amitraz use Season

Migratory >50 (sideline and commercial)

N=334

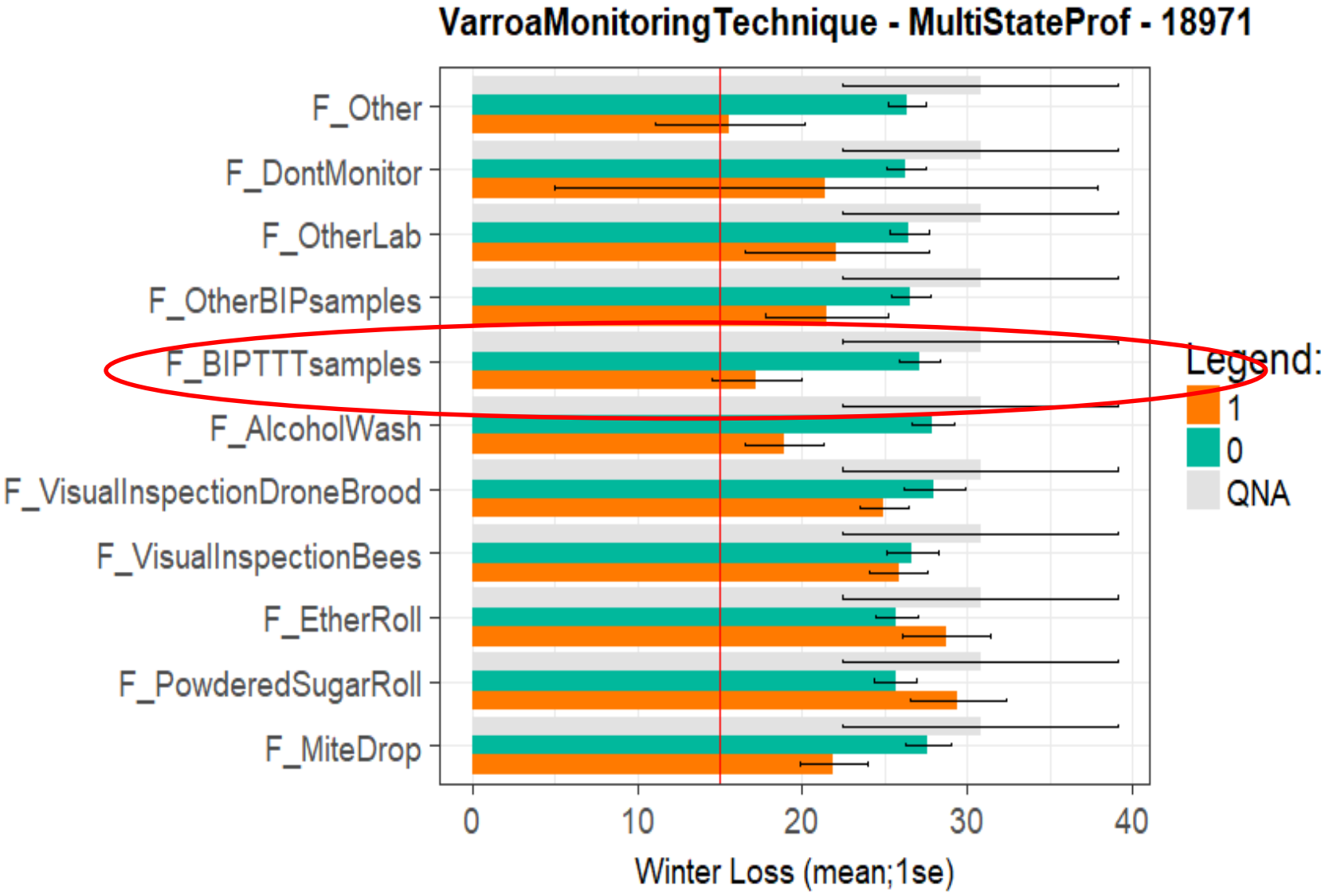
Honey Produced

Varroa Monitoring Technique

Winter Prep

How started new colonies

Amitraz use Season



Migratory >50 (sideline and commercial)

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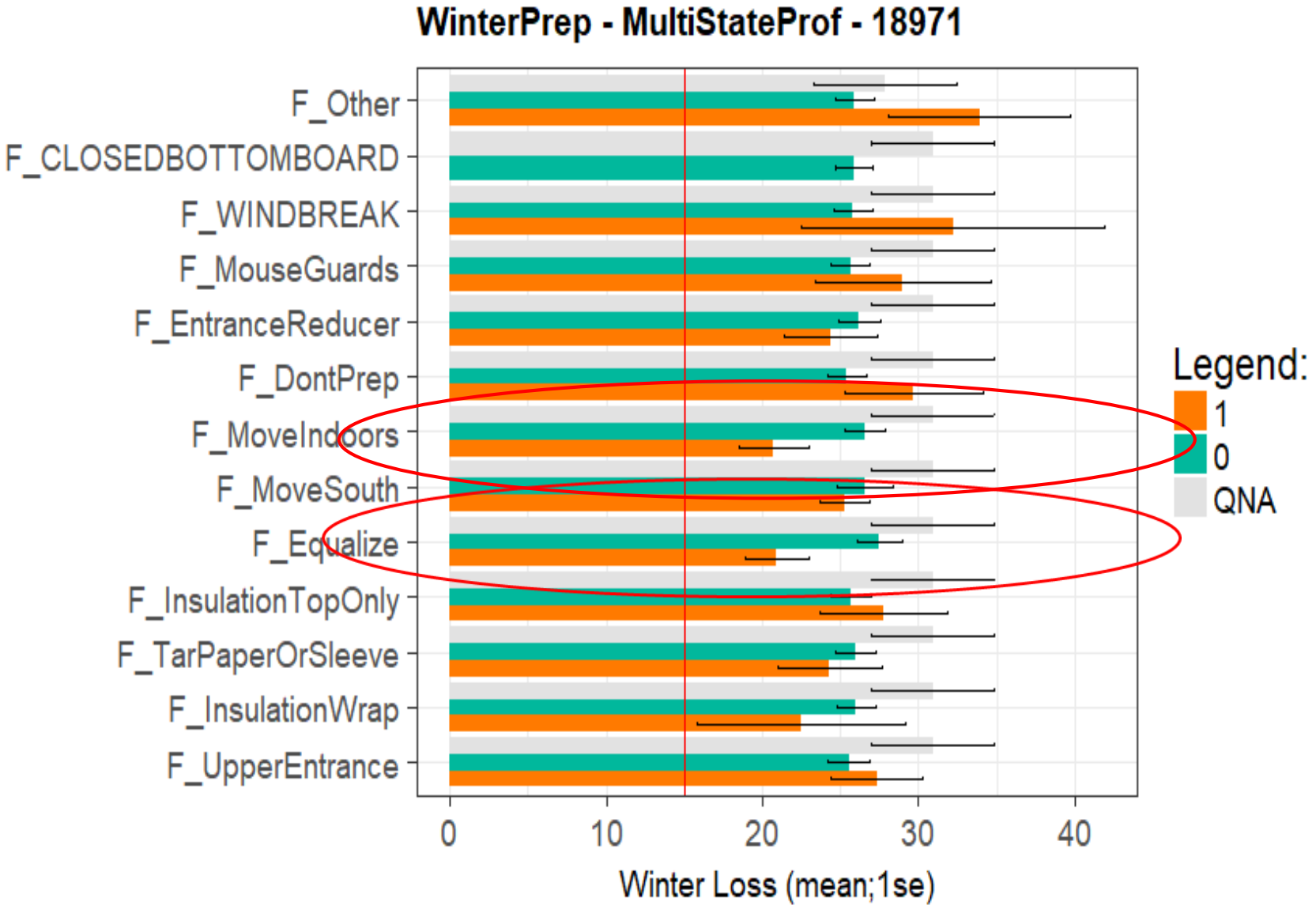
Honey Produced

Varroa Monitoring Technique

Winter Prep

How started new colonies

Amitraz use Season



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Almond Board of California

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Project Apis m.

USDA

USDA APHIS

california almonds
Almond Board of California

BURT'S BEES
Earth Friendly Natural Personal Care Products

NATIONAL HONEY BOARD

BRUSHY MOUNTAIN 1-800-BEESWAX

HONEY BEE HEALTH COALITION

AMERICAN BEE JOURNAL

BEST BEE BROTHERS

Bee Culture
The Magazine of American Beekeeping

Véto-pharma
Committed to apiculture

In collaboration with:

UNIVERSITY OF MARYLAND 18 56

UF UNIVERSITY of FLORIDA

BEE INFORMED

UC CE

OSU

vanEngelsdorp BEE LAB

Using cold storage to stabilize honey bee supply

Brandon Hopkins
Washington State University

Indoor Wintering vs Outdoor

Colony strength – indoor wintering vs outdoor			
Treatment	Frame Count (Oct 18)	Frame Count (Jan 25)	Frame Count (Feb 25)
CA room	14.4	10.7 A	14.1
Refrigerated room	14	10.9 A	15
Outside (WA)	13.9	9.2 A	10.9
Outside (CA)	14.3	5.7 B	10.8

Advantages - Indoor wintering

- No spreading disease
- No robbing
- No feeding syrup and protein patties
- Get to be home with family
- No Bee Rustling

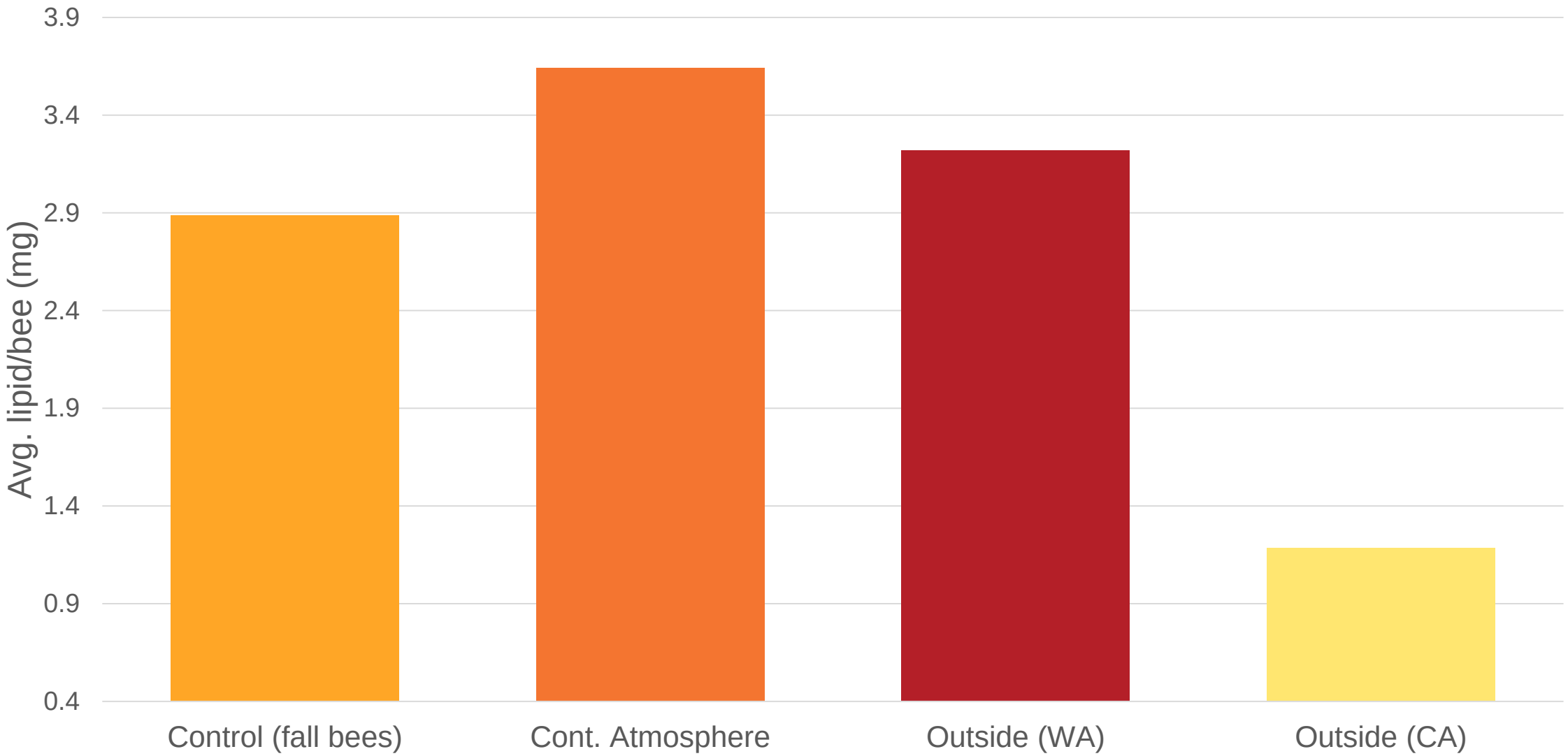
Posts by Elizabeth Warmerdam

Men Say Bee Rustling Cost Them $360,000

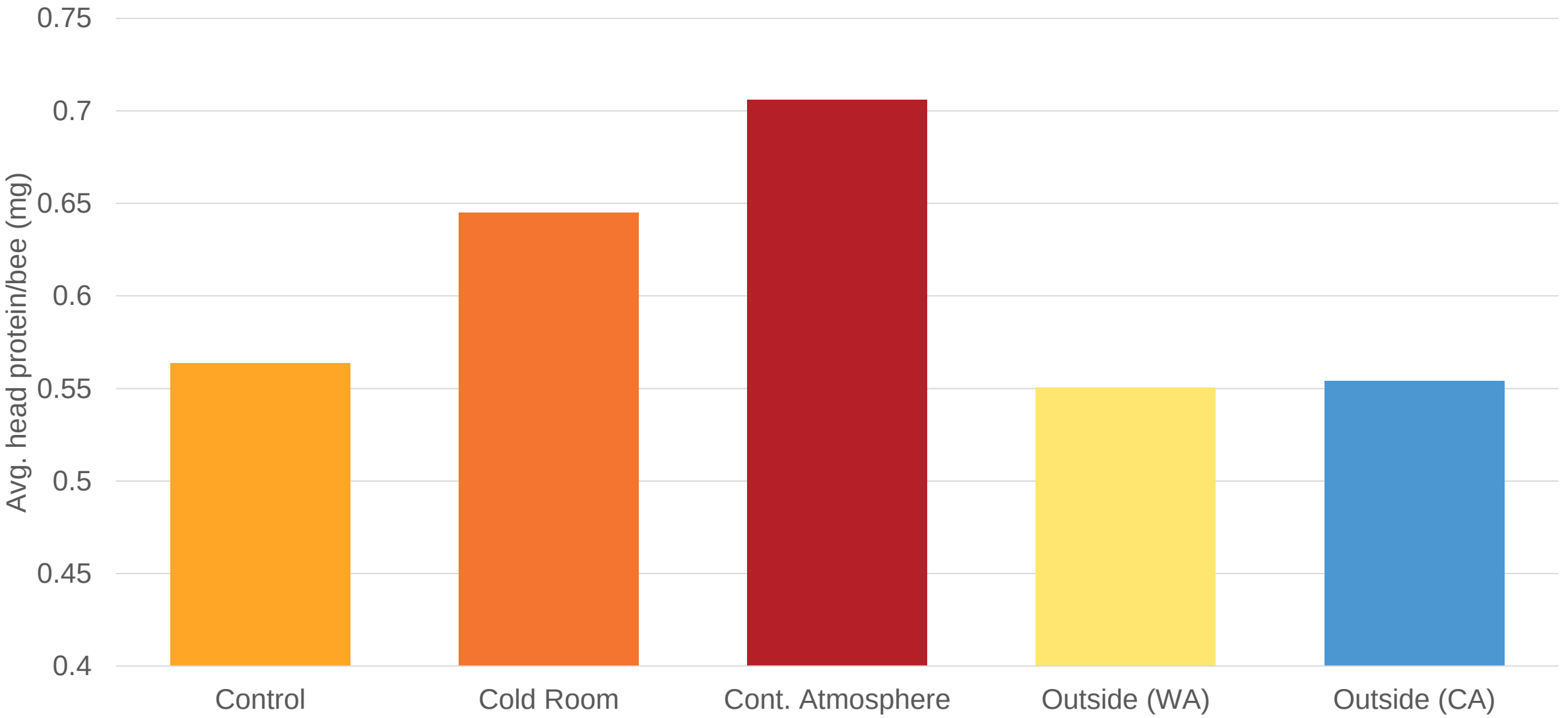
Elizabeth Warmerdam May 22, 2014

MURRIETTA, Calif. (CN) – The Riverside County sheriff's deputies helped "the Jesse James

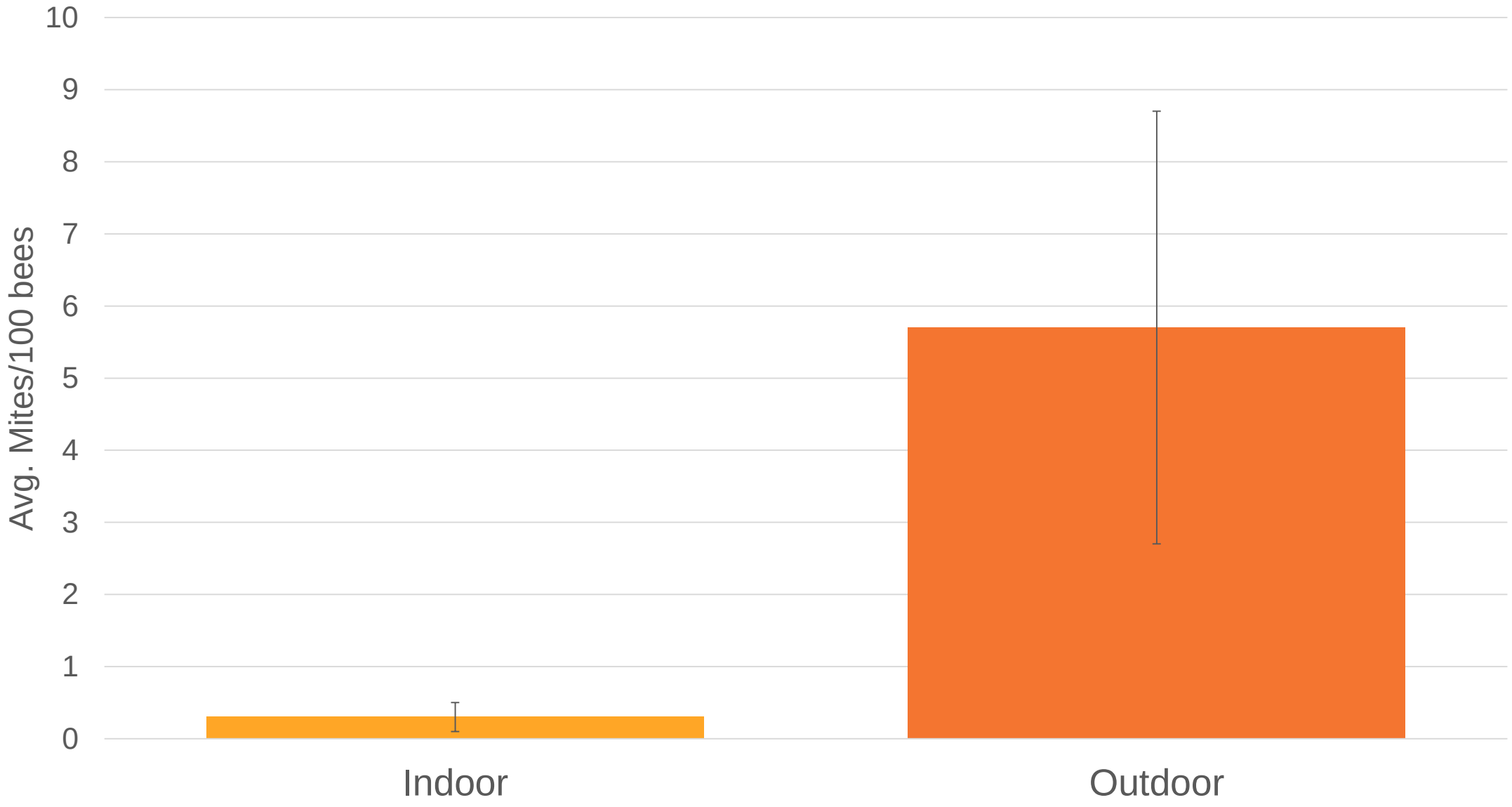
Fat Bees



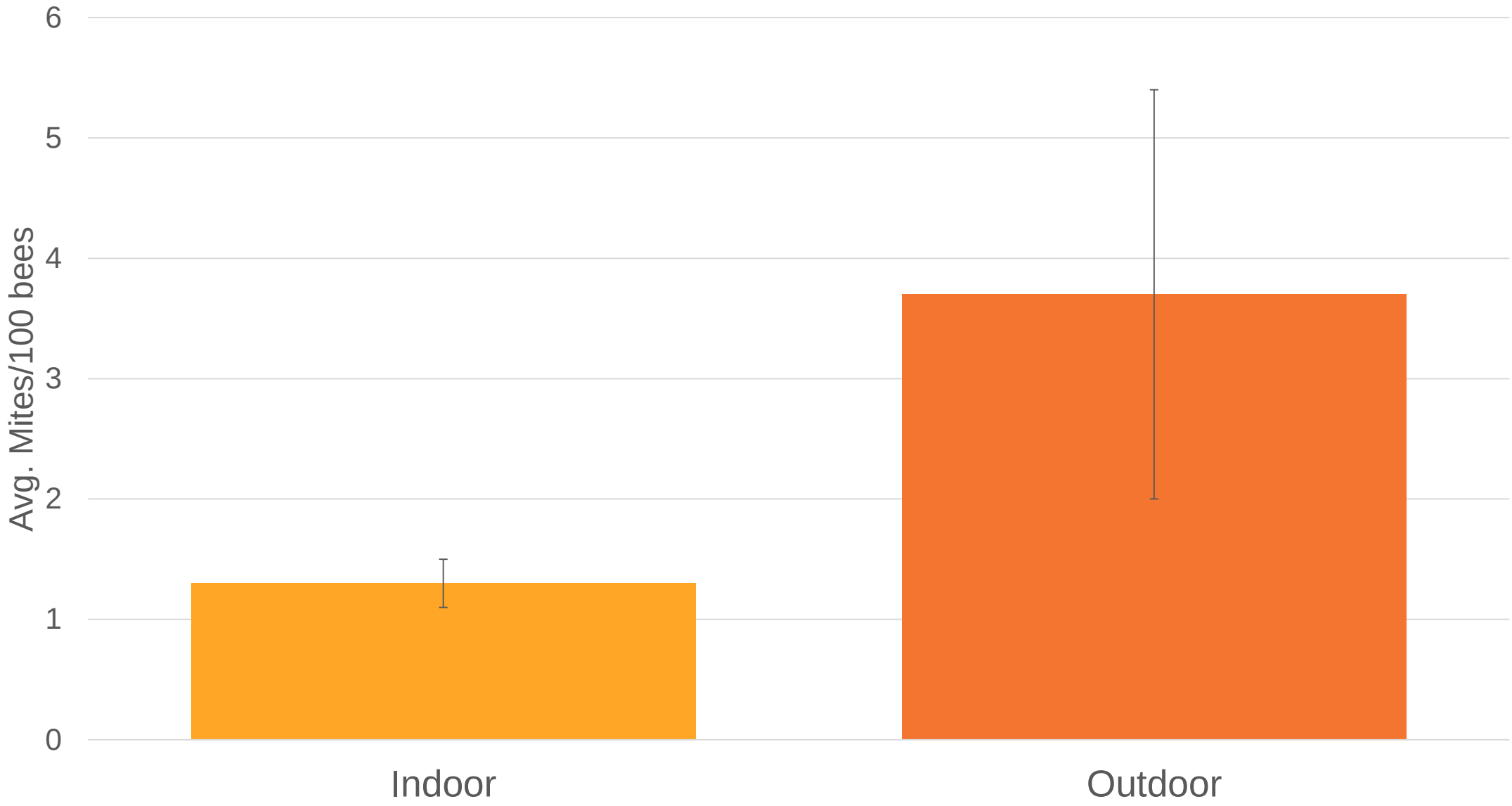
Head Protein



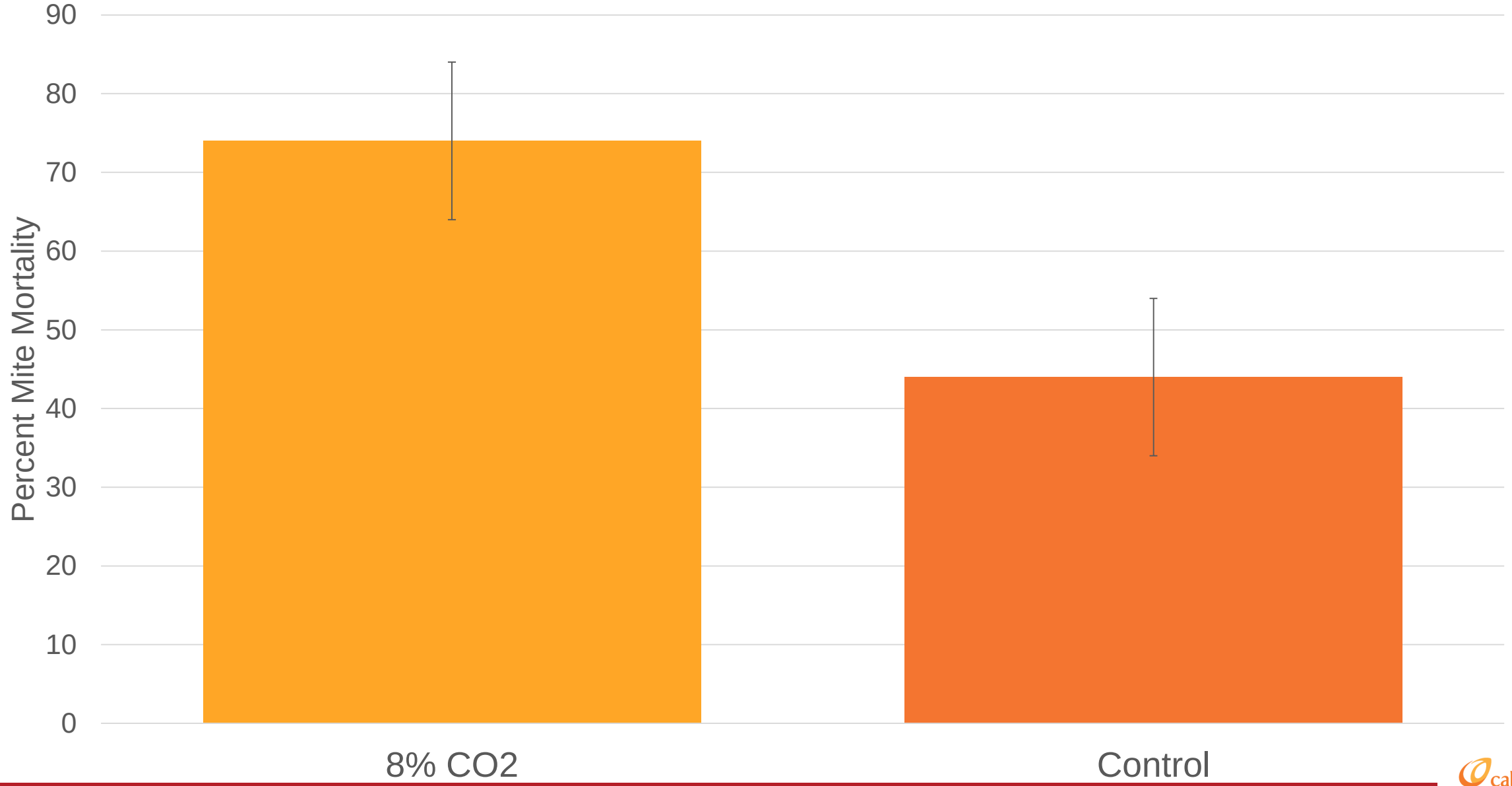
Summer Brood Break (August)



Spring Brood Break (April)



Using CO2 to kill Varroa mites



Thank You

california almonds
Almond Board of California

+

WASHINGTON
TREE FRUIT
RESEARCH
COMMISSION

Insecticide-Fungicide-Adjuvant Combinations and Honey Bee Development

Chia-Hua Lin, Hilary Kordeki, Nick Kruse, Andrea Wade, and Reed Johnson
johnson.5005@osu.edu

THE OHIO STATE UNIVERSITY

Almond Bloom

2 million honey bee colonies

1 million queens produced

Bee problems reported (pesticide related?)

Queen breeders:

- Up to 80% of queens are dying during **development** in weeks after almond bloom

Pollinators:

- Classic **adult "bee kills"** observed occasionally
- Death of late-stage brood mortality in weeks following almond bloom

Which“Bee Safe” pesticides are applied to almonds during bloom?

CalPIP Home »
My Selections

DATA SOURCE:
PUR
Pesticide Use Report

SEARCH BY DATA CATEGORY:

Date
- Year

Location
- County
- MTRS
- Zip Code

Site/Crop
- Name Search

Product
- Name Search

Chemical
- Name Search

Other Criteria
- Ag/NonAg

Format Output
Help
Contact CalPIP

CALIFORNIA PESTICIDE INFORMATION PORTAL (CALPIP)

CalPIP Home

Note: CalPIP is not able to process a full year of data without the user choosing other criteria that would limit their selections. Users who work with large PUR datasets (i.e. entire years or all products) should go to:

- Data Archives (FTP site) to download free copies (.zip files) of full years of Pesticide Use Data (1974 through most recent available), or
- DPR's Publications Order Form (PDF, 171 kb) to order the Annual Pesticide Use Report CD–ROM.

Not all CalPIP features work in all browsers. To take advantage of all features and to assure that you get the information that you need, Internet Explorer 5.5 or above with cookies and JavaScript enabled is recommended. If you receive an error like "retrieval of cached query failed" or if you experience any other problems with a page displaying, hit your browser's "Reload" button.

Introduction and Overview

Welcome to the California Pesticide Information Portal project (CalPIP). CalPIP now allows you to query from more than one data source to find information on pesticide related issues. This site delivers user-friendly Internet access to the Department of Pesticide Regulation's (DPR) extensive pesticide use and label information (PUR Data Source), Ground Water Protection Area information (GWPA Data Source, and the recently added Pesticide Regulation's Endangered Species Custom Realtime Internet Bulletin Engine (PRESCRIBE Data Source). more...

Known Issues

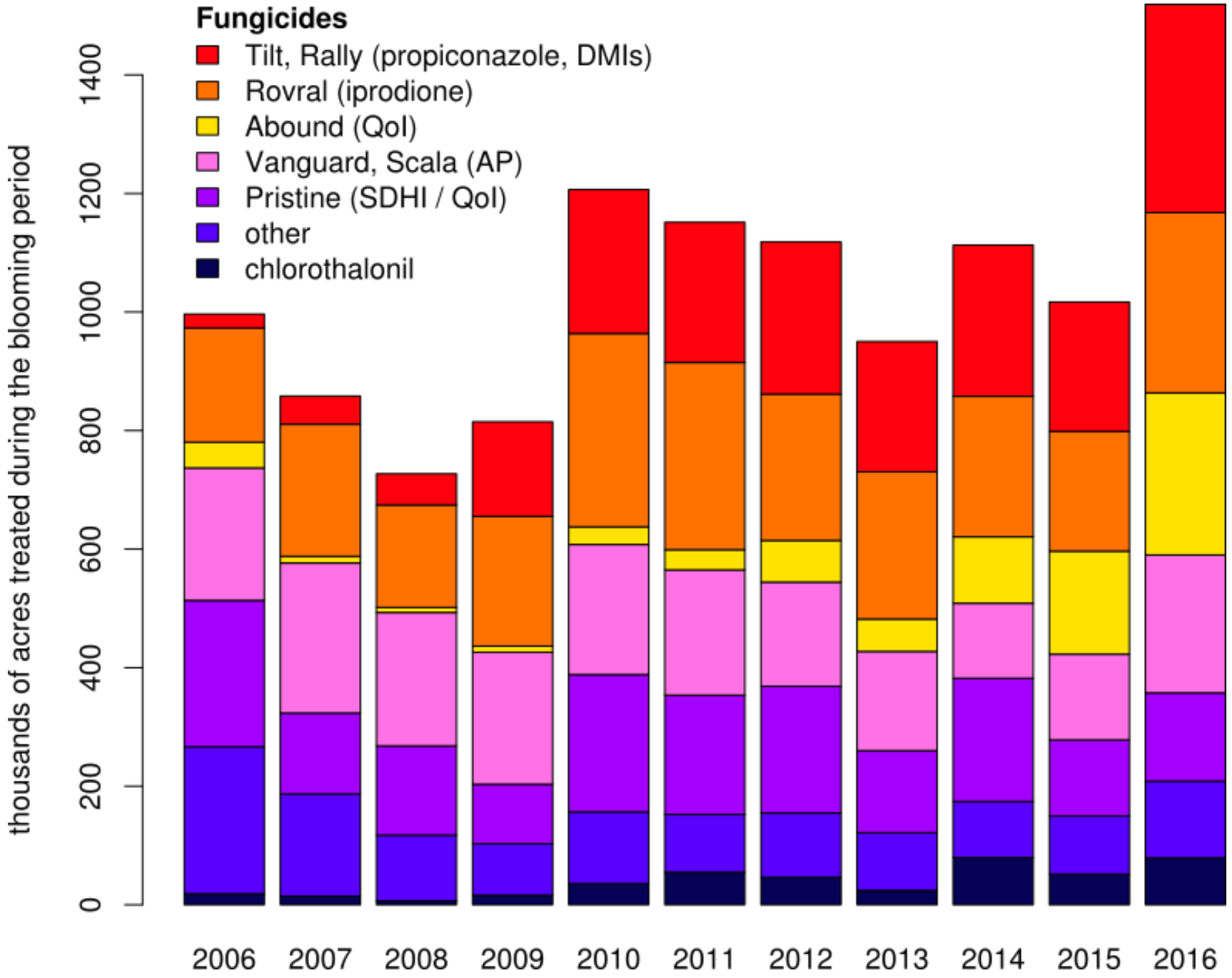
2014 Pesticide Use Report data has been added to the database.

Notes on version updates, bug fixes and known issues. more...

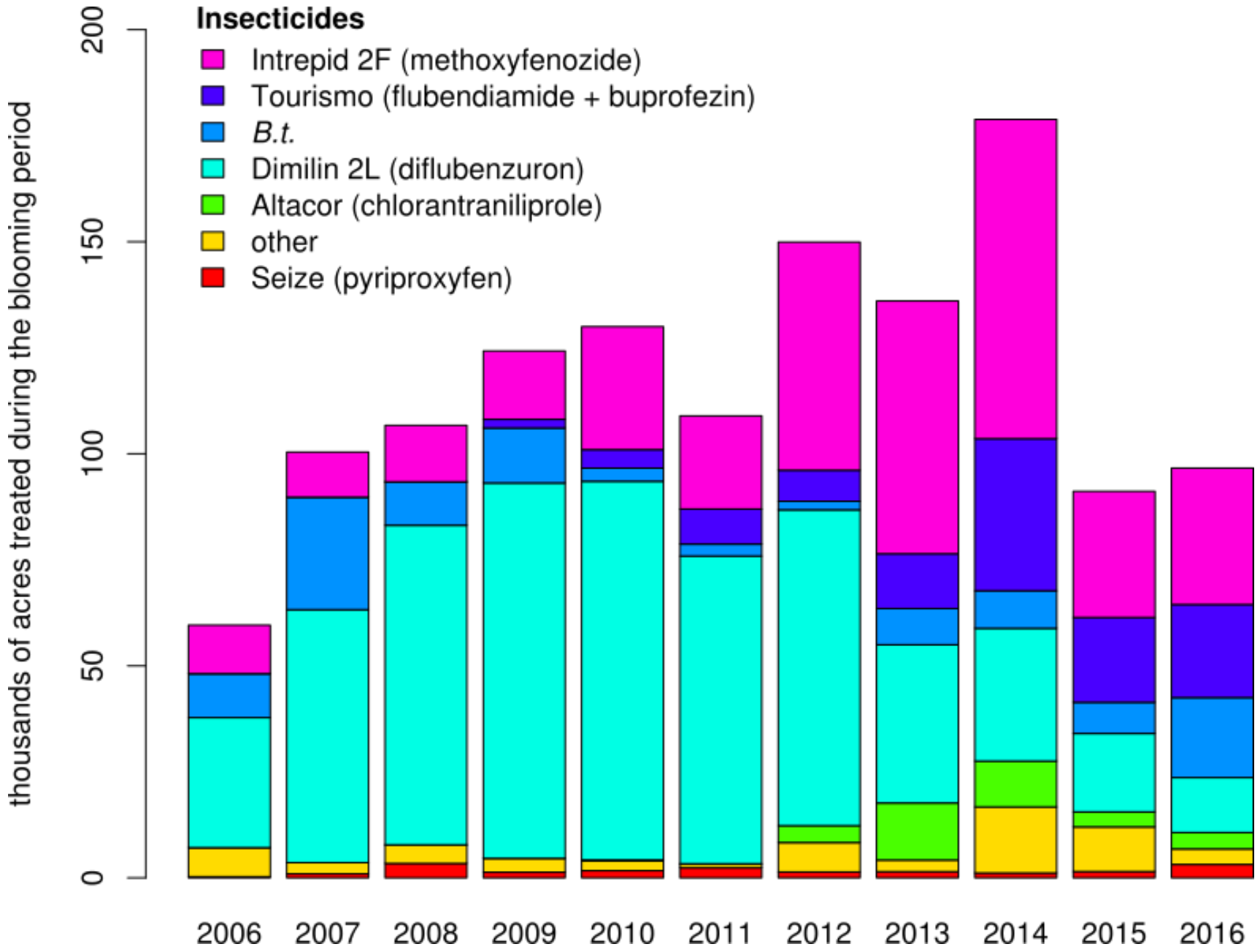
First Time Users

If this is your first visit to our site, you may want additional information to make your visit more successful. more...

About the Data Sources



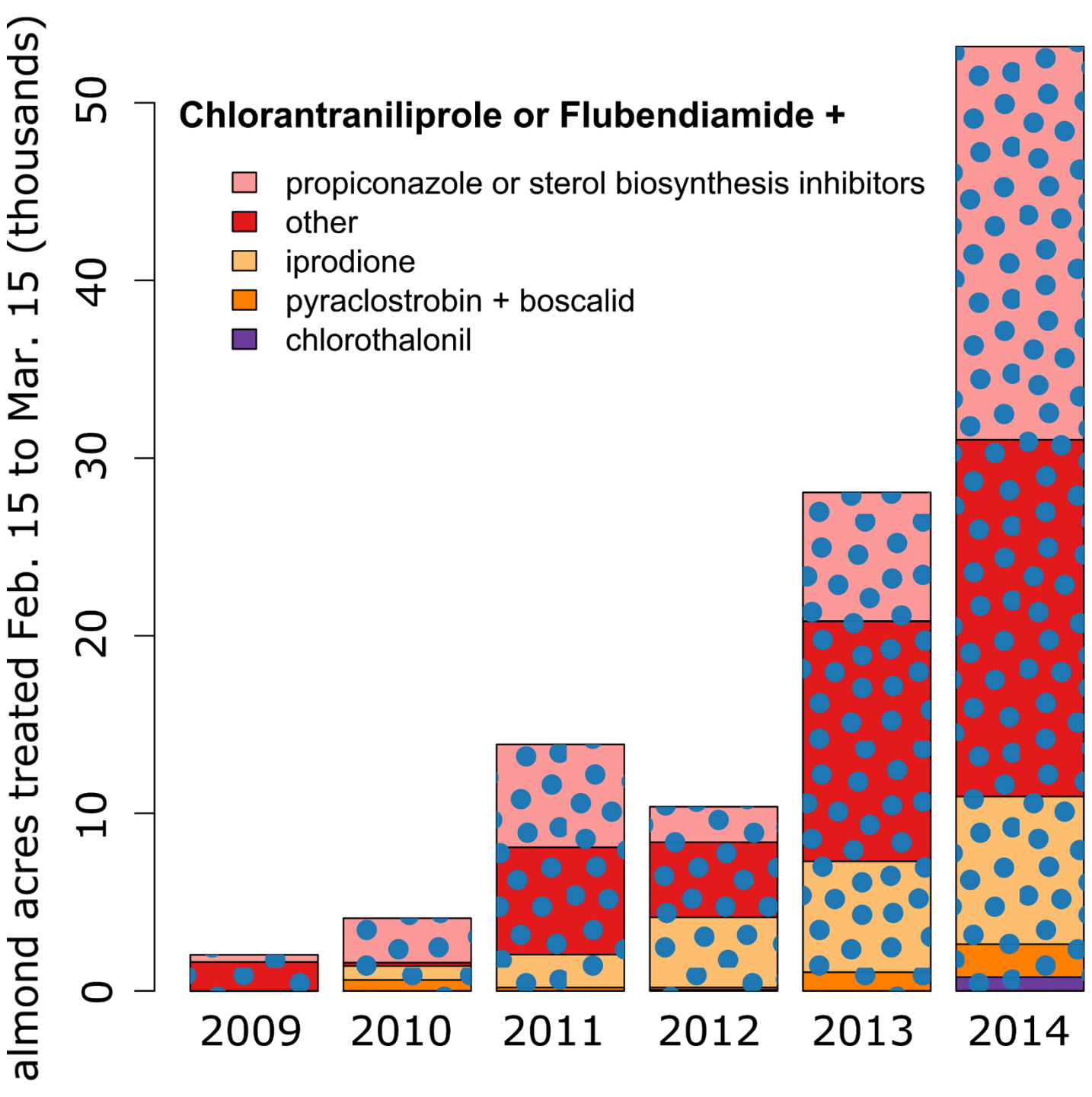
Fungicides applied during bloom (Feb. 15 to Mar. 15)



Fungicides applied during bloom (Feb. 15 to Mar. 15)

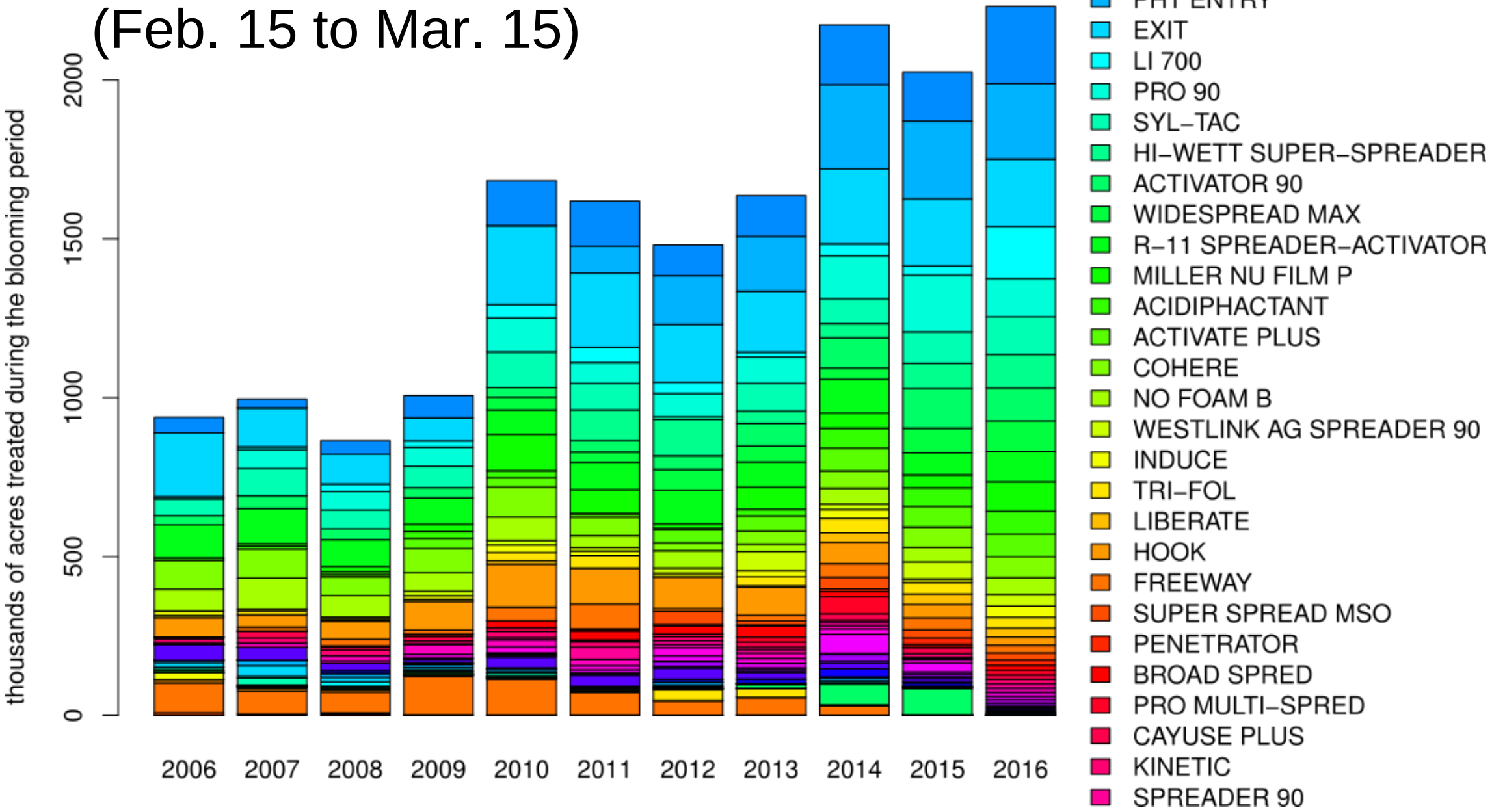
Peach Twig Borer (*Anarsia lineatella)*

Jack Kelly Clark



96% of insecticides applied during bloom are in a tank mix with a fungicide

Adjuvants applied during bloom (Feb. 15 to Mar. 15)



Dyne-Amic®

MODIFIED VEGETABLE OIL SURFACTANT BLEND

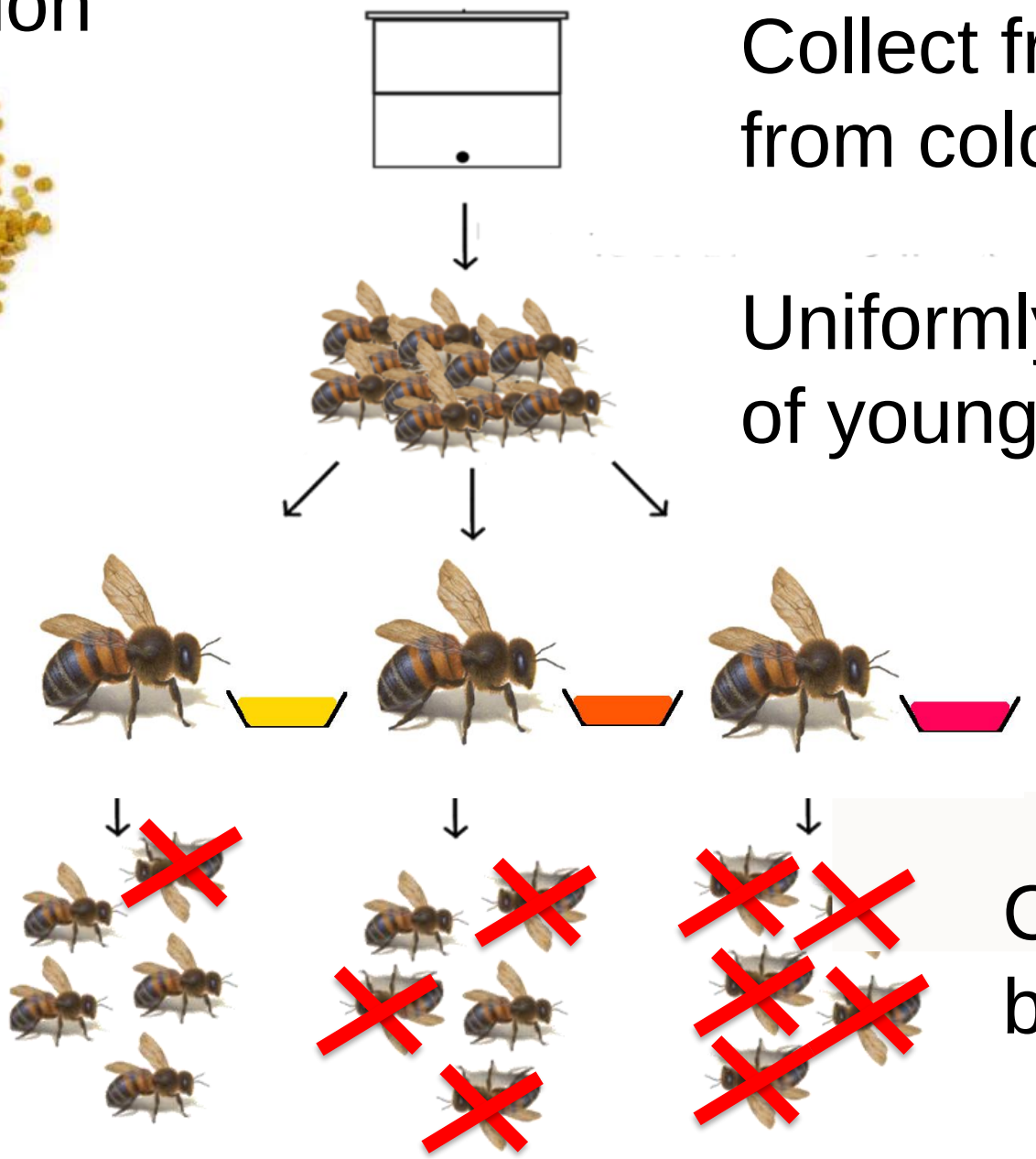
PRINCIPAL FUNCTIONING AGENTS:
methyl esters of C16-C18 fatty acids, polyalkyleneoxide modified polydimethylsiloxane, alkylphenol ethoxylate 99.0%
CONSTITUENTS INEFFECTIVE AS SPRAY ADJUVANT 1.0%
TOTAL 100.0%

All ingredients are accepted for use under CFR 40, 180.
CAS #37281-78-0, 9003-11-6

USE: May be applied by Ground, Aerial, CDA or aquatic spray equipment.
Ground, Aquatic: Use 3–5 pints per 100 gallons of spray solution.
Aerial, CDA: Use 3–5 fl. oz. in 1–5 gallons of spray solution.
Use 3 oz. in 1–3 gal. and 5 oz. above 3 gal.

	Fungicide	boscalid + pyraclostrobin (Pristine)	iprodione (Rovral)	propiconazole (Tilt)
Insecticide	**max lb. a.i. per acre**	0.344	0.5	0.225
chlorantraniliprole (Altacor)	0.099	1 : 3.47	1 : 5.05	1 : 2.27
methoxyfenozide (Intrepid)	0.25	1 : 1.38	1 : 2	1: 0.90
diflubenzuron (Dimilin)	0.25	1 : 1.38	1 : 2	1: 0.90

Oral application



Collect frame of brood from colony

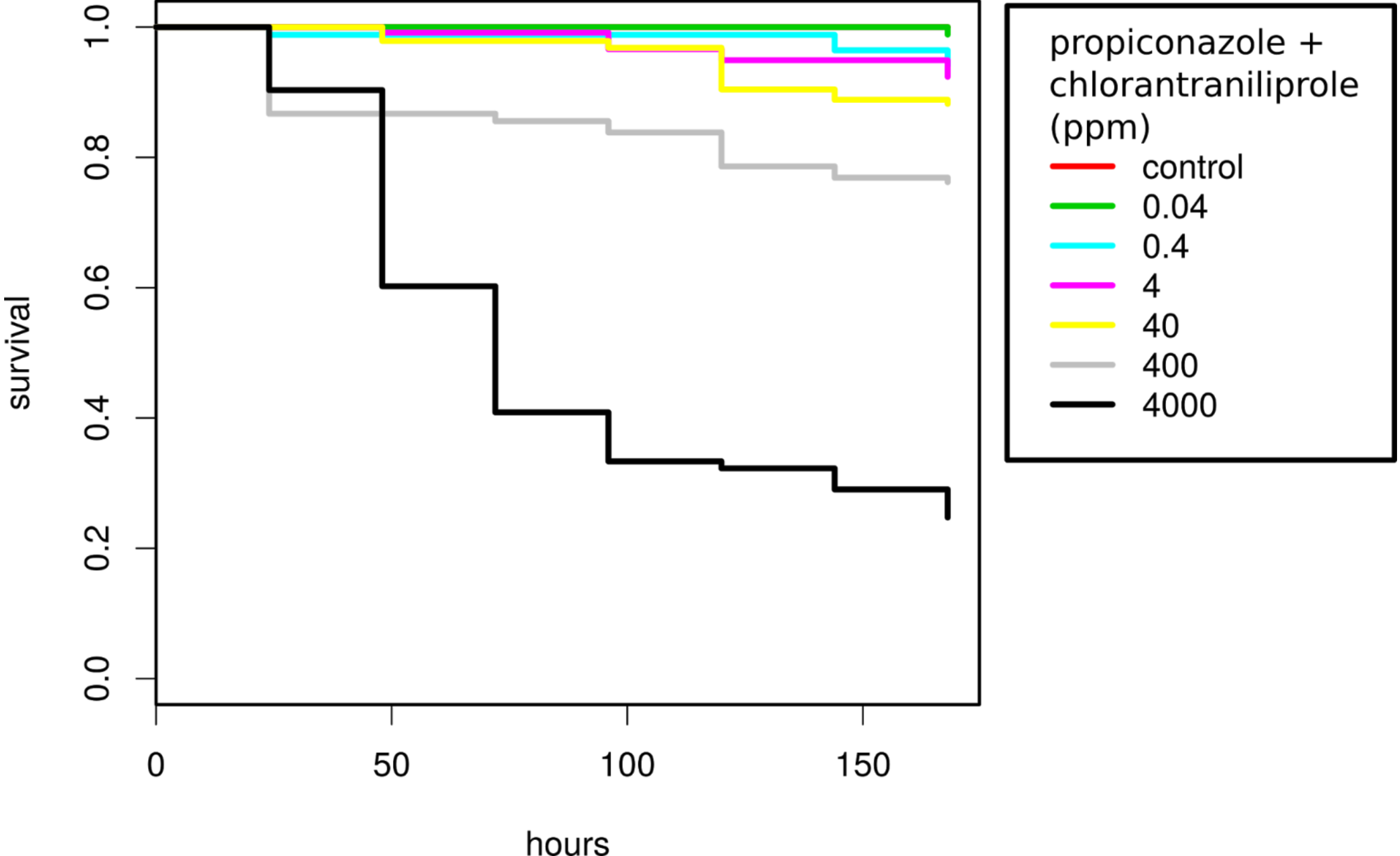
Uniformly aged cohort of young bees

Treat groups with varying doses of pesticides in pollen

Count living and dead bees daily for 7 days

Individual bees consumed ~2 mg pollen per day

	Insecticide alone	boscalid + pyraclostrobin (Pristine)	iprodione (Rovral)	propiconazole (Tilt)
Fungicide alone		> 4000 ppm	> 4000 ppm	> 4000 ppm
chlorantraniliprole (Altacor)	> 4000 ppm	> 4000 ppm	4000 ppm	4 ppm
methoxyfenozide (Intrepid)	> 4000 ppm	4000 ppm	> 4000 ppm	> 4000 ppm
diflubenzuron (Dimilin)	> 4000 ppm	4000 ppm	4000 ppm	4000 ppm


survival
1.0
0.8
0.6
0.4
0.2
0.0
0
50
100
150
hours
propiconazole + chlorantraniliprole (ppm)
control
0.04
0.4
4
40
400
4000

Plus organosilicone spray adjuvant

	Insecticide alone	boscalid + pyraclostrobin (Pristine)	iprodione (Rovral)	propiconazole (Tilt)
Fungicide alone		> 4000 ppm	> 4000 ppm	> 4000 ppm
chlorantraniliprole (Altacor)	> 4000 ppm	4000 ppm	4000 ppm	4 ppm
methoxyfenozide (Intrepid)	4000 ppm	> 4000 ppm	4000 ppm	4000 ppm
diflubenzuron (Dimilin)	> 4000 ppm	4000 ppm	> 4000 ppm	4000 ppm

Dyne-Amic

0.8% in final pollen mix

The Potter Tower

VOLUME 39, NO. 1 MARCH 1952

AN IMPROVED LABORATORY APPARATUS FOR APPLYING DIRECT SPRAYS AND SURFACE FILMS, WITH DATA ON THE ELECTROSTATIC CHARGE ON ATOMIZED SPRAY FLUIDS

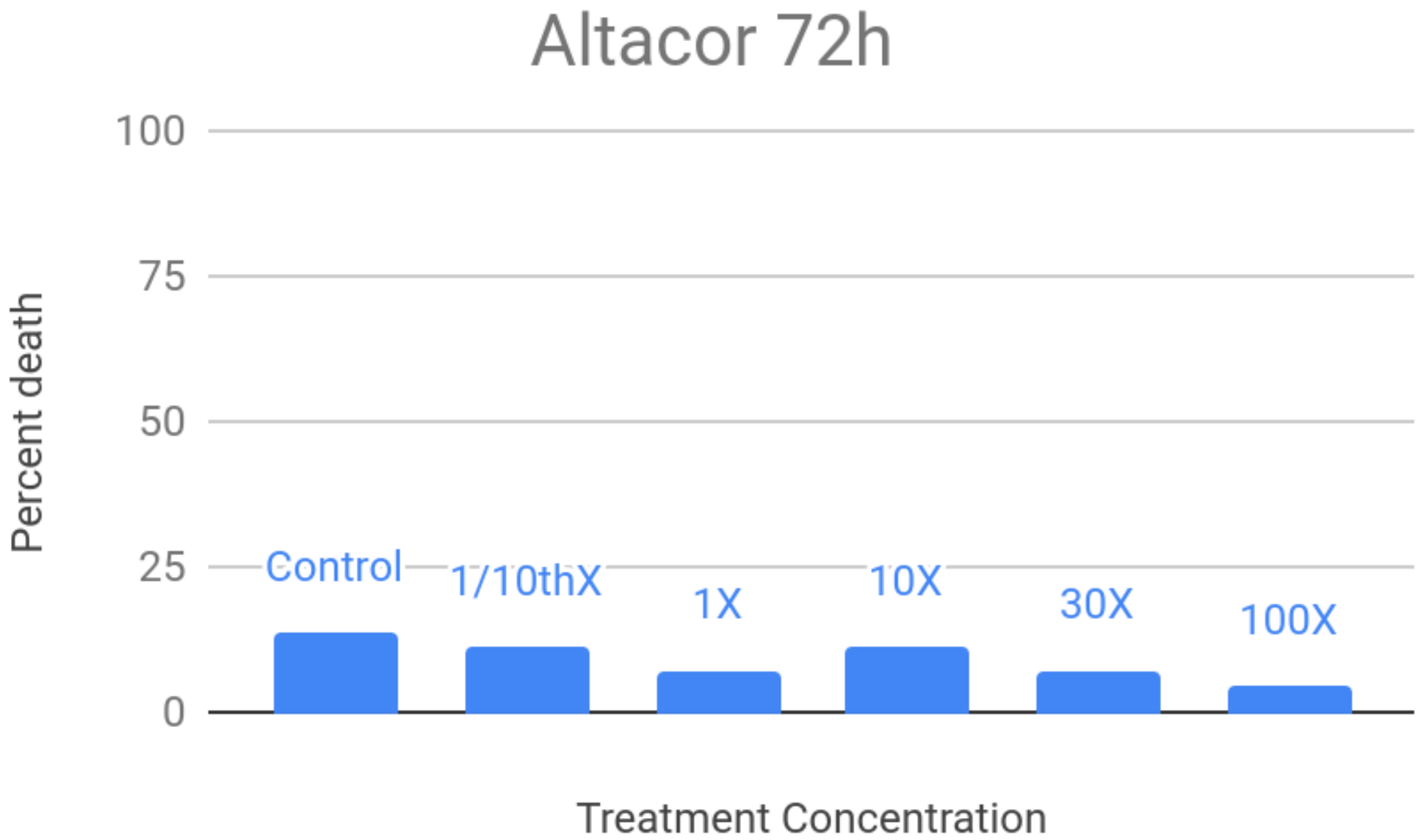
BY C. POTTER

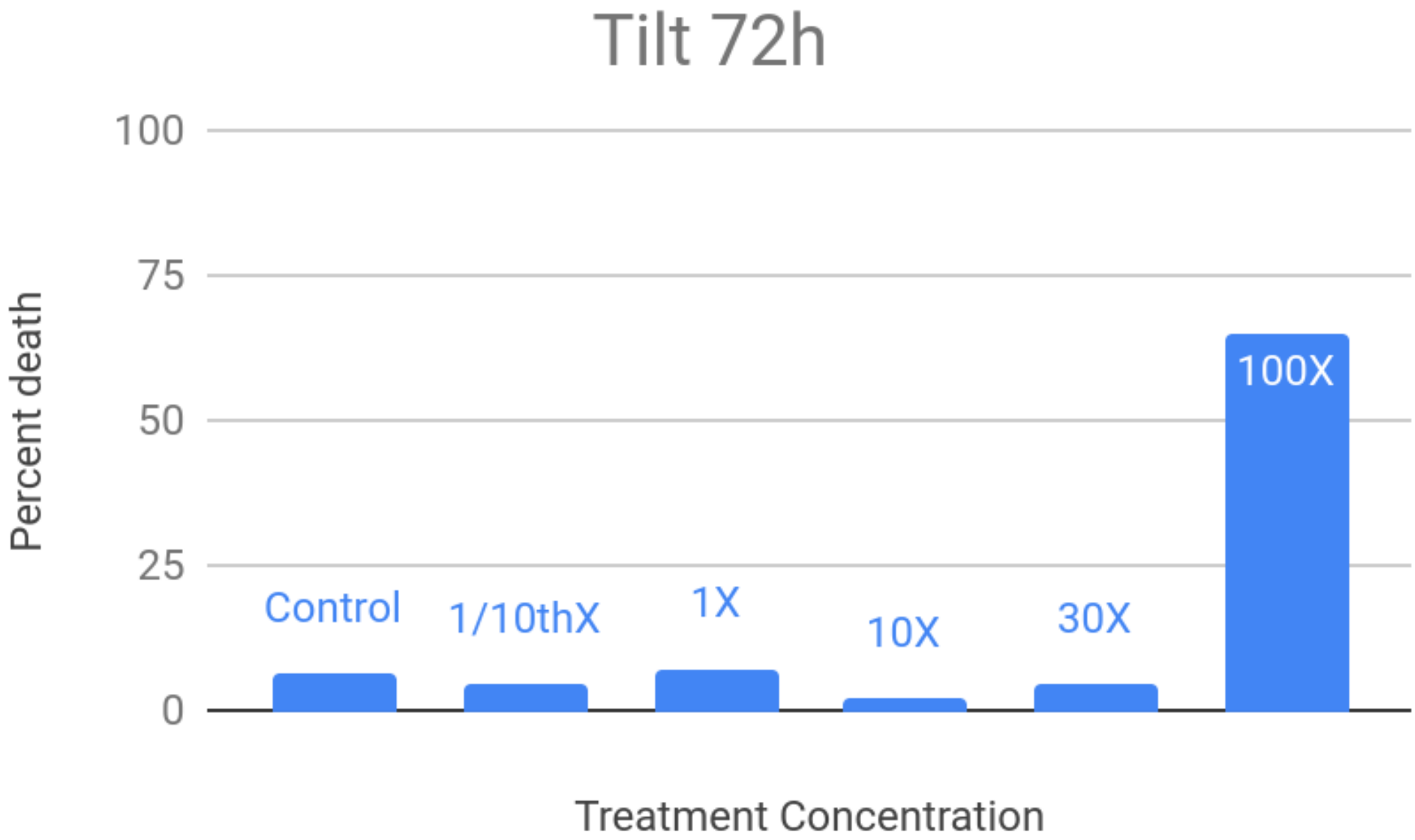
University of Rhode Island, Kingston, R.I., U.S.A., and the Department of Insecticides and Fungicides, Rothamsted Experimental Station, Harpenden, Herts

Annals of Applied Biology

Young adult bees anaesthetized with carbon dioxide

Maintain bees in incubator with 50% sucrose syrup for 72 h.


Altacor 72h
100
75
50
25
0
Percent death
Control
1/10thX
1X
10X
30X
100X
Treatment Concentration


Tilt 72h
100
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1/10thX
1X
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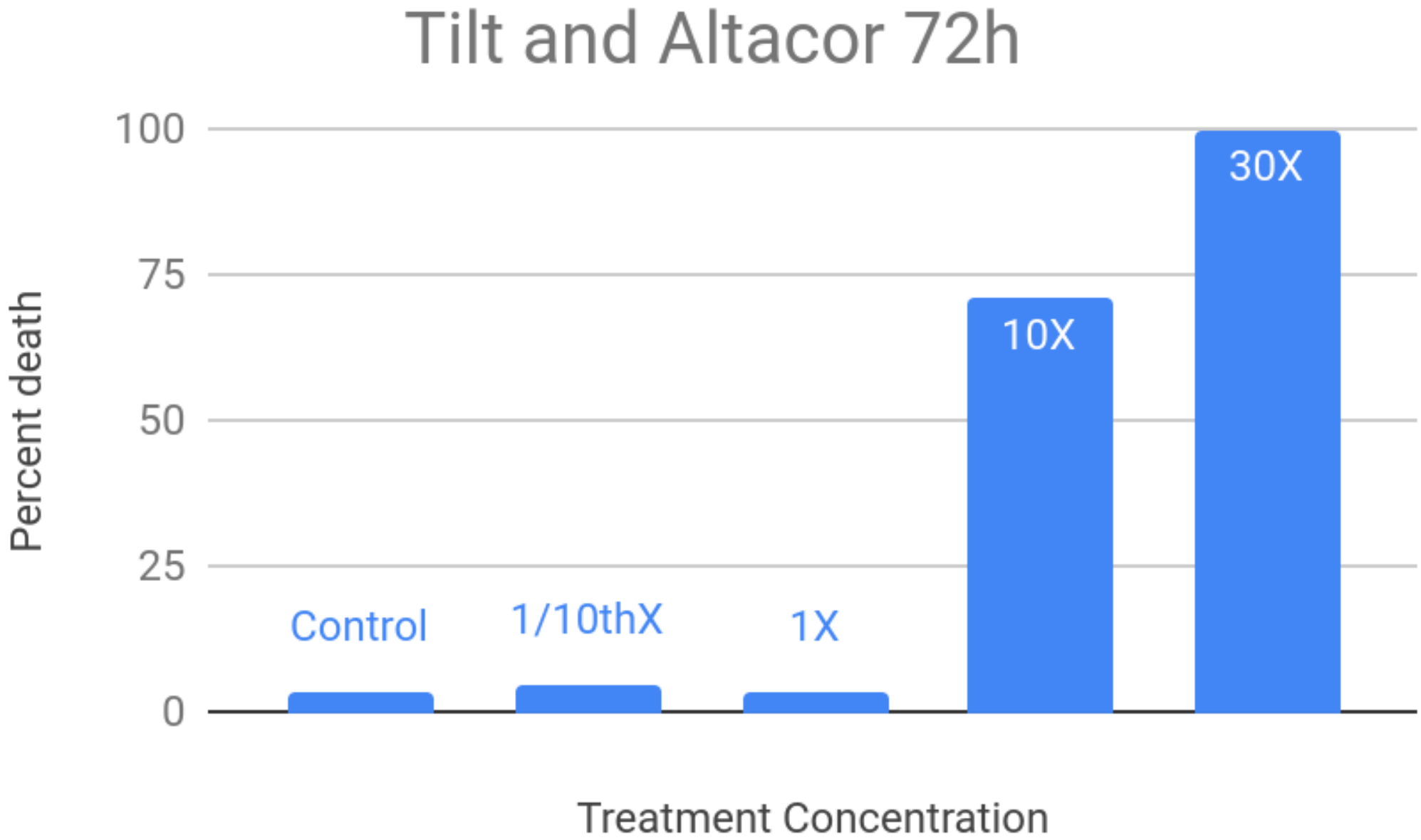
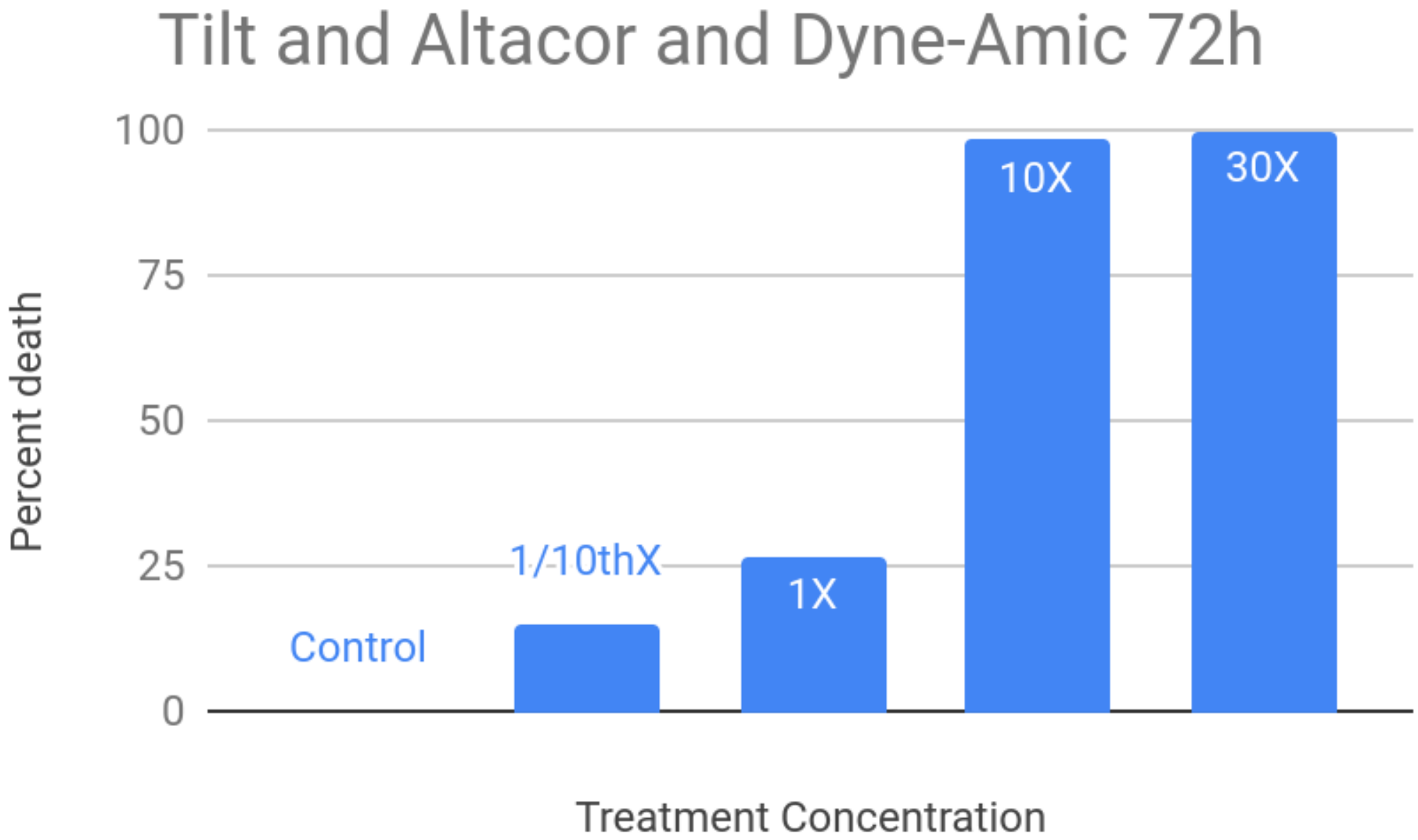
30X
100X
Treatment Concentration


Tilt and Altacor 72h
100
75
50
25
0
Percent death
Control
1/10thX
1X
10X
30X
Treatment Concentration


Tilt and Altacor and Dyne-Amic 72h
100
75
50
25
0
Percent death
Control
1/10thX
1X
10X
30X
Treatment Concentration

Journal of Apicultural Research, 2016
http://dx.doi.org/10.1080/00218839.2016.1203530

IBRA INTERNATIONAL BEE RESEARCH ASSOCIATION

Taylor & Francis
Taylor & Francis Group

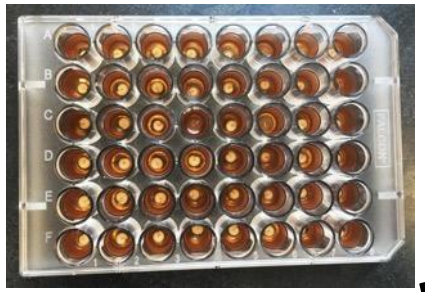
ORIGINAL RESEARCH ARTICLE

Protocol for the *in vitro* rearing of honey bee (*Apis mellifera* L.) workers

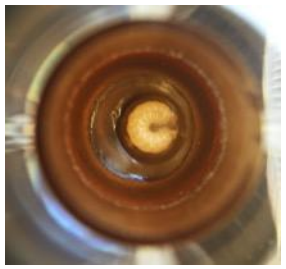
Daniel R Schmehl[a,d]*, Hudson V V Tomé[b], Ashley N Mortensen[a], Gustavo Ferreira Martins[c] and James D Ellis[a]

[a]*Entomology and Nematology Department, University of Florida, Gainesville, FL, USA;* [b]*Departamento de Entomologia, Universidade Federal de Viçosa, Viçosa, Brazil;* [c]*Departamento de Biologia Geral, Universidade Federal de Viçosa, Viçosa, Brazil;* [d]*(Current affiliation) Pollinator Safety, Bayer Crop Science, Research Triangle Park, NC, USA*

Graft young larvae from brood frames



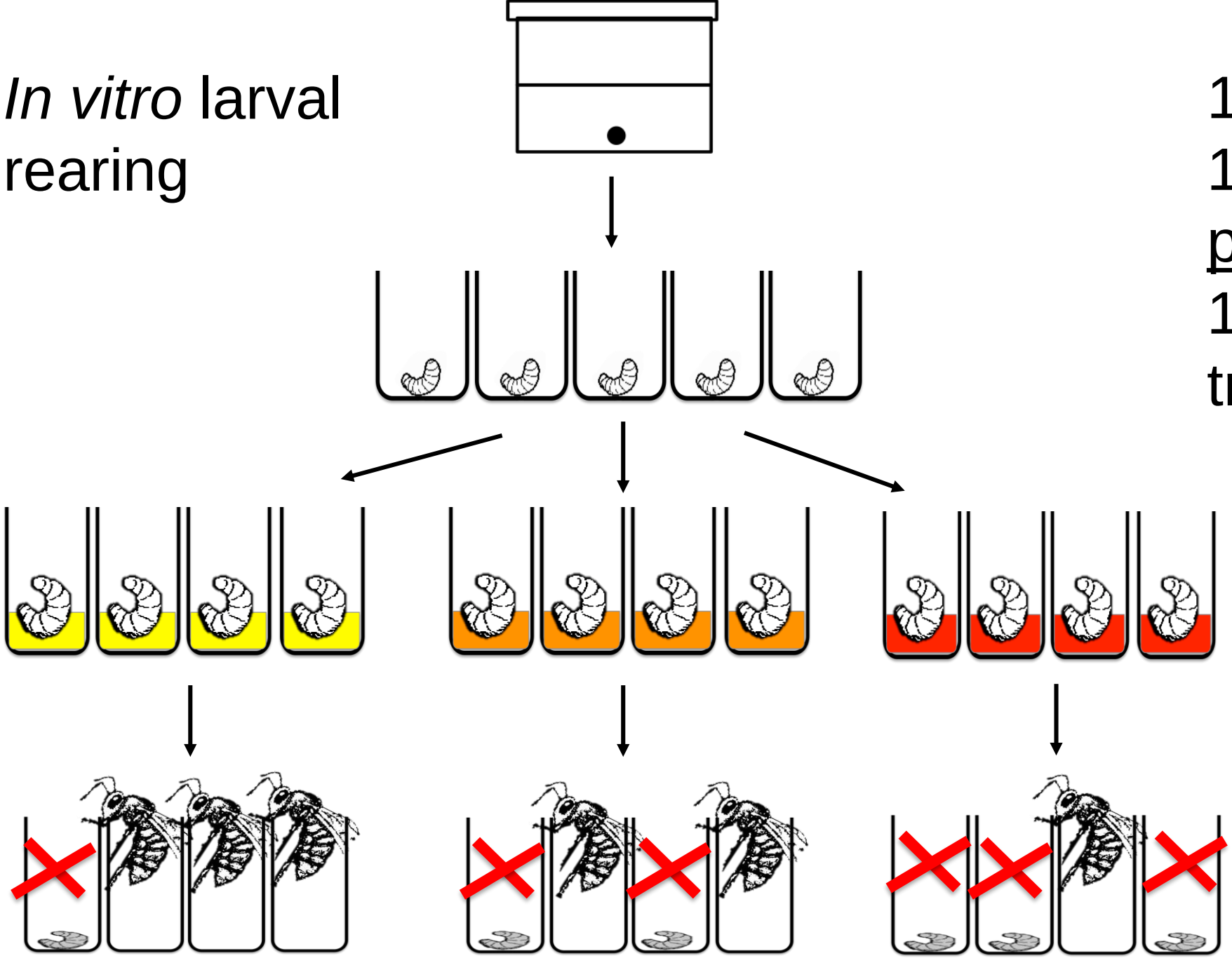
Tissue culture plates, Cells containing diet



Single exposure of pesticide top dose in diet

adult bee emergence an
mortality recorded daily

In vitro larval rearing



12 trials with
16 individuals
<u>per trial</u>
192 bees per
treatment

Fungicides alone did not affect larval development

Pristine®
Fungicide

50 ppm pyraclostrobin
100 ppm boscalid

For use in disease control and plant health in the following crops: alfalfa; Belgium endive; berries; bulb vegetables; carrot; celery; citrus fruit; cucurbit vegetables; globe artichoke; grape; hops; pome fruit; radicchio; stone fruit; strawberry; and tree nut

Active Ingredients:

pyraclostrobin*: (carbamic acid, [2-[[[1-(4-chlorophenyl)-1*H*-pyrazol-3-yl]oxy]methyl]phenyl]methoxy-, methyl ester)	12.8%
boscalid**: 3-pyridinecarboxamide,2-chloro-N-(4'-chloro(1,1'-biphenyl)-2-yl)-	25.2%
Other Ingredients:	62.0%
Total:	100.0%

* 0.128 oz (0.008 lb) of pyraclostrobin in 1 oz of product
** 0.252 oz (0.0158 lb) of boscalid in 1 oz of product

EPA Reg No. 7969-199 **EPA Est. No.**

rovral® **brand**
4 Flowable Fungicide

200 ppm iprodione

EPA Reg. No. 279-9564 **EPA Est. No.: 279-NY-1**

ACTIVE INGREDIENT:

Iprodione: 3-(3,5-dichlorophenyl)-N-(1-methylethyl)-2,4-dioxo-1-imidazolidinecarboxamide*	41.6%
OTHER INGREDIENTS:	58.4%
TOTAL	100.0%

*Equivalent to 4 Lbs. Iprodione per gallon.

FIRST AID	
IF ON SKIN OR CLOTHING	• Take off contaminated clothing. • Rinse skin immediately with plenty of water for 15-20 minutes. • Call a poison control center or doctor for treatment advice.
IF SWALLOWED	• Call a Poison Control Center or doctor immediately for treatment advice. • Have person sip a glass of water if able to swallow • Do not induce vomiting unless told by a Poison Control Center or doctor.

GROUP 3 FUNGICIDE PULL HERE TO OPEN ►

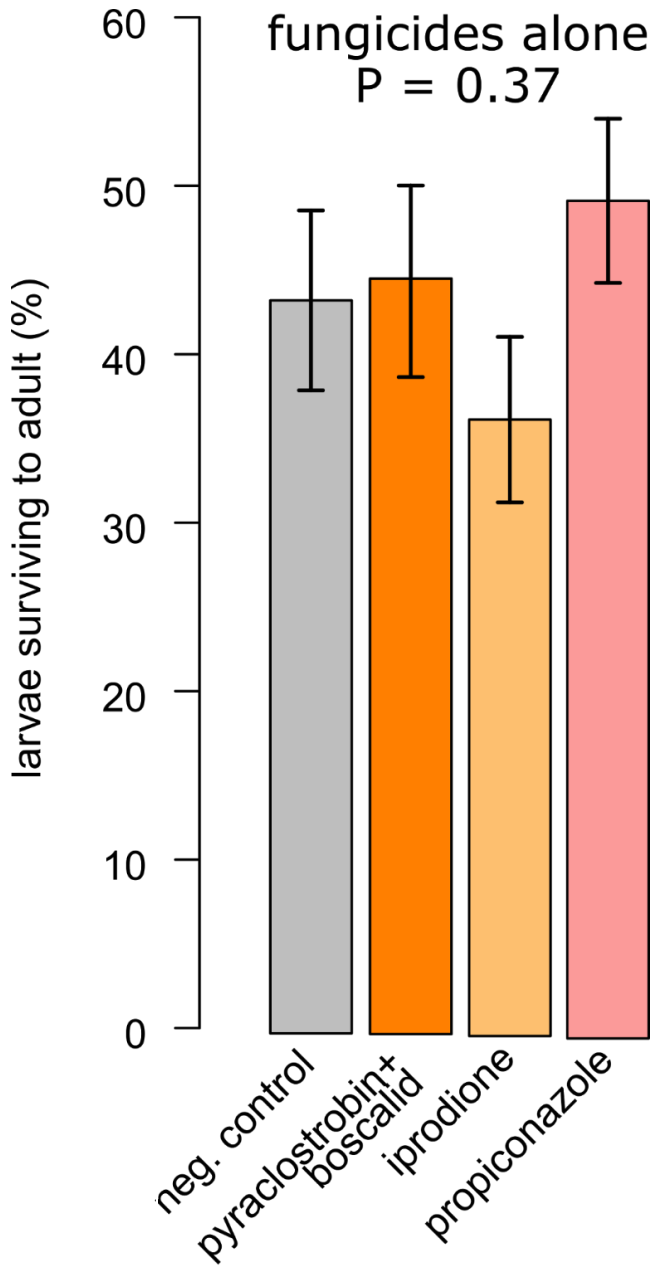
Tilt®

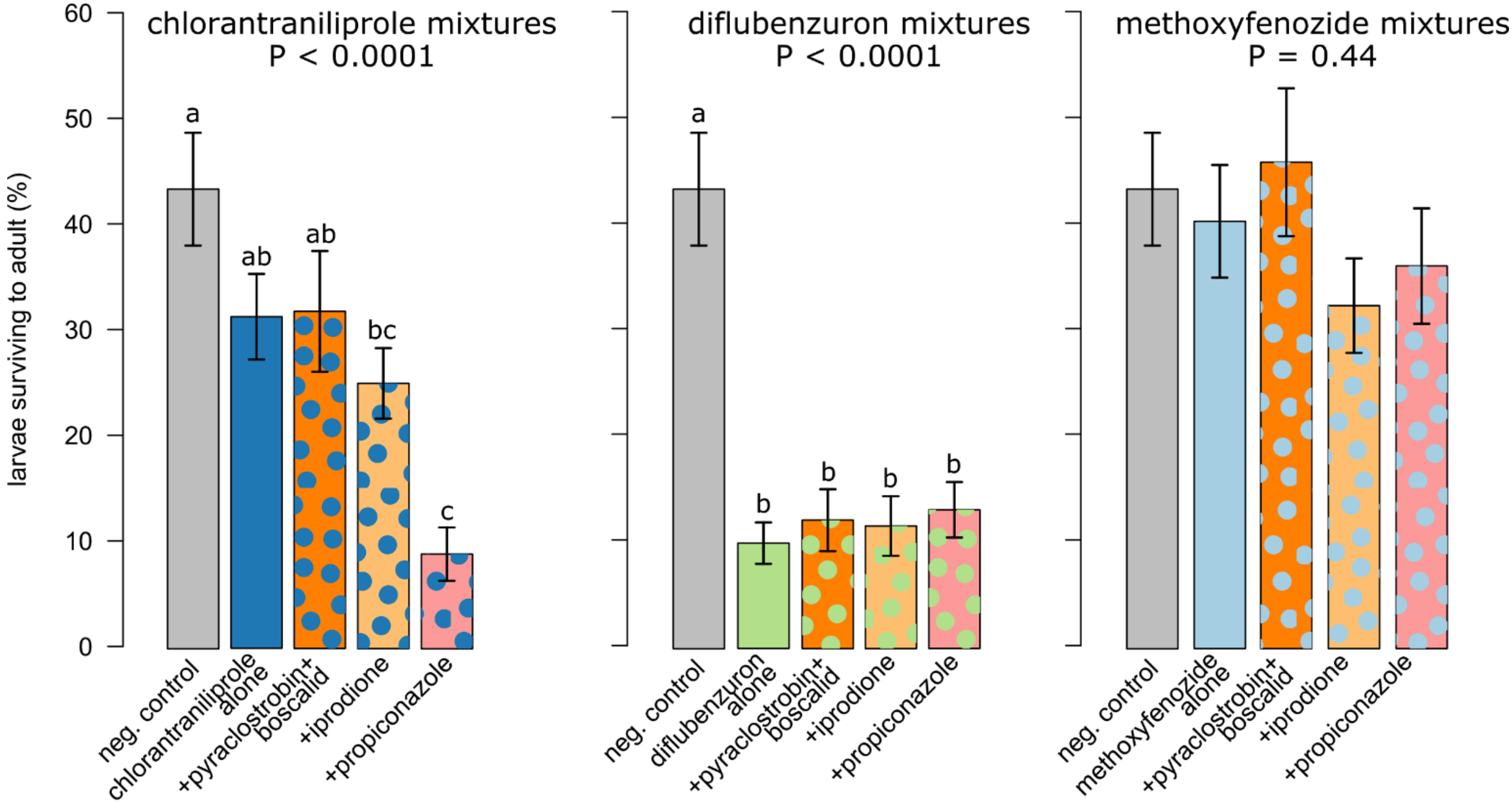
90 ppm propiconazole

syngenta

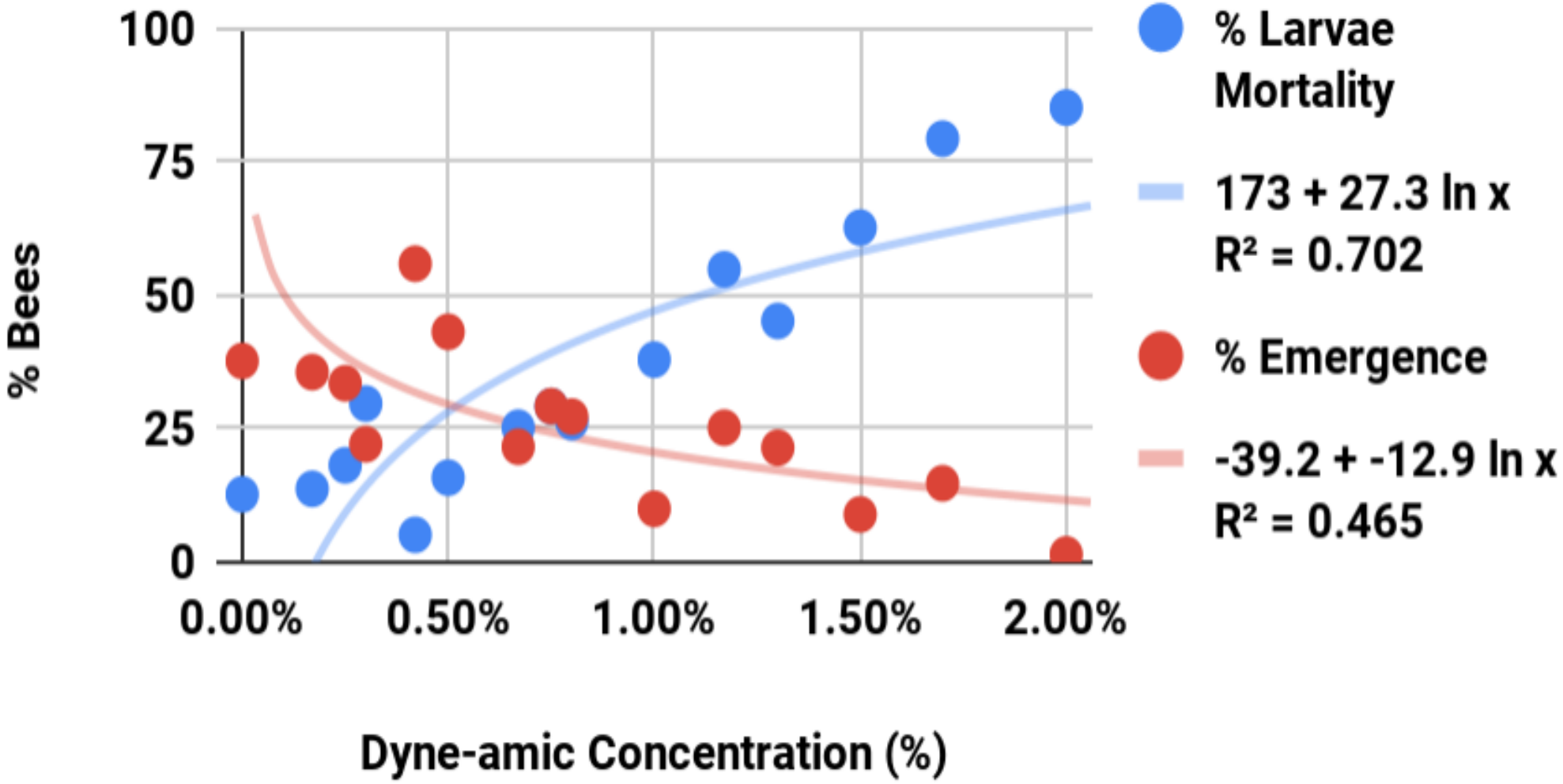
Fungicide
Broad spectrum fungicide for control of plant diseases

Active Ingredient:	
Propiconazole*:	41.8%
*Other Ingredients***:	58.2%
Total:	100.0%




chlorantraniliprole mixtures
P < 0.0001
diflubenzuron mixtures
P < 0.0001
methoxyfenozide mixtures
P = 0.44
larvae surviving to adult (%)
0
10
20
30
40
50
60
a
ab
ab
bc
c
b
b
b
b
a
neg. control
chlorantraniliprole alone
+pyraclostrobin+ boscalid
+iprodione
+propiconazole
diflubenzuron alone
methoxyfenozide alone

An adjuvant alone can kill larvae



Summary

- The combination of chlorantraniliprole (Altacor) and a DMI fungicide, propinocazole (Tilt), is toxic to worker honey bee larvae, adults and queens (see the poster session)
- Altacor + Tilt + Dyne-Amic kills adult worker bees at the field application rate
- Diflubenzuron (Dimilin 2L) kills worker and queen larvae
- The spray adjuvant Dyne-Amic by itself has the potential to kill worker larvae

- No evidence, to date, that addition of Dyne-Amic causes synergistic toxicity in pesticides that don't already have a toxic potential

Acknowledgements

College of Wooster
Andrea Wade
Bridget Gross
Emily Walker

The Ohio State University
Hilary Kordeki
Nicolas Kruse
Colin Kurkul
Ashley Cordle

Can Application Time Limit Fungicide Exposure to Honey Bees in Almonds?

Jody Johnson
Cullaborate, LLC, Baltimore MD

G. Wardell, Wonderful Orchards, Lost Hills, CA,

D. Lopez, USDA Bee Res. Lab, Beltsville, MD,

P. Snyder – Stevenson Univ., Owings Mills, MD

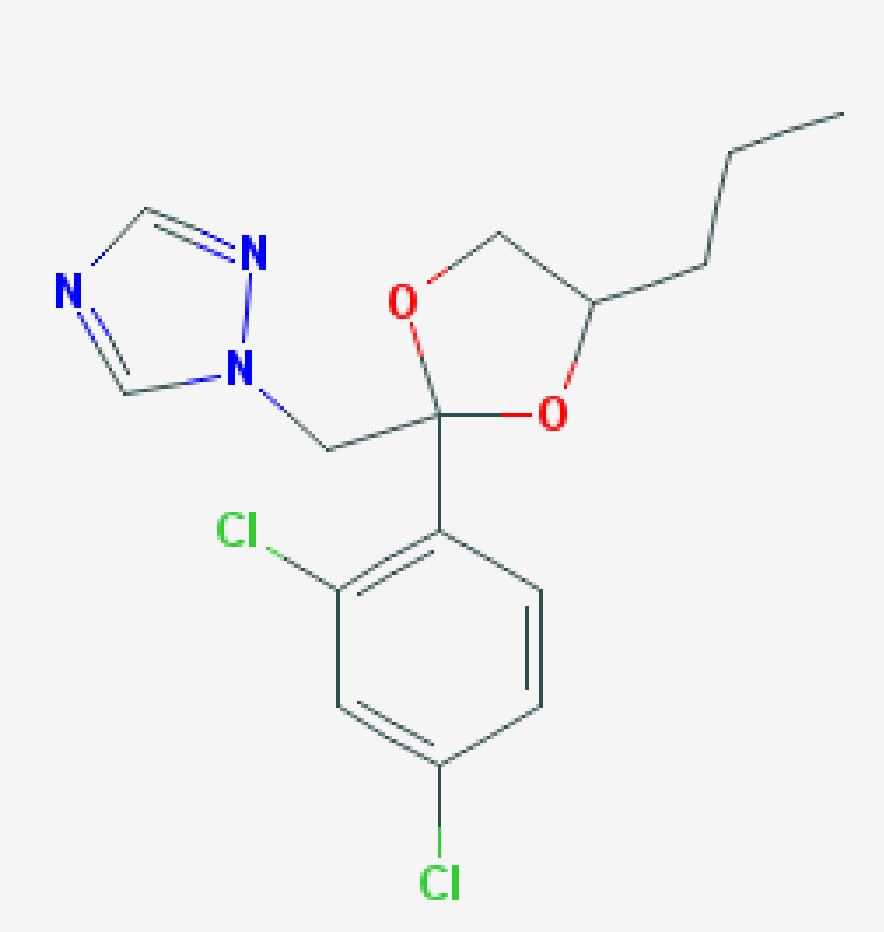
H. Boncristiani, USDA Bee Res. Lab, Beltsville, MD

J. Pettis, Pettis and Associates, LLC, Salisbury, MD

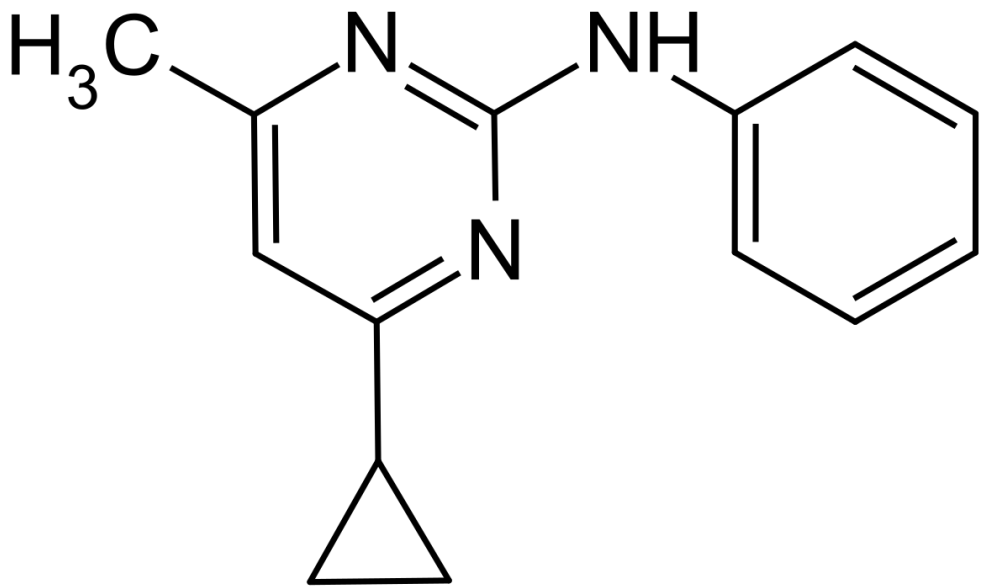
Study duration Feb 6 -12 2018

Chemical structures of fungicides used in this study

Propiconazole- Tilt (CA) (100-617-ZG ,41.80% prop)



Cyprodinil- Vanguard WG (CA) (100-828-ZB75.00% cyp)



Orchard orientation

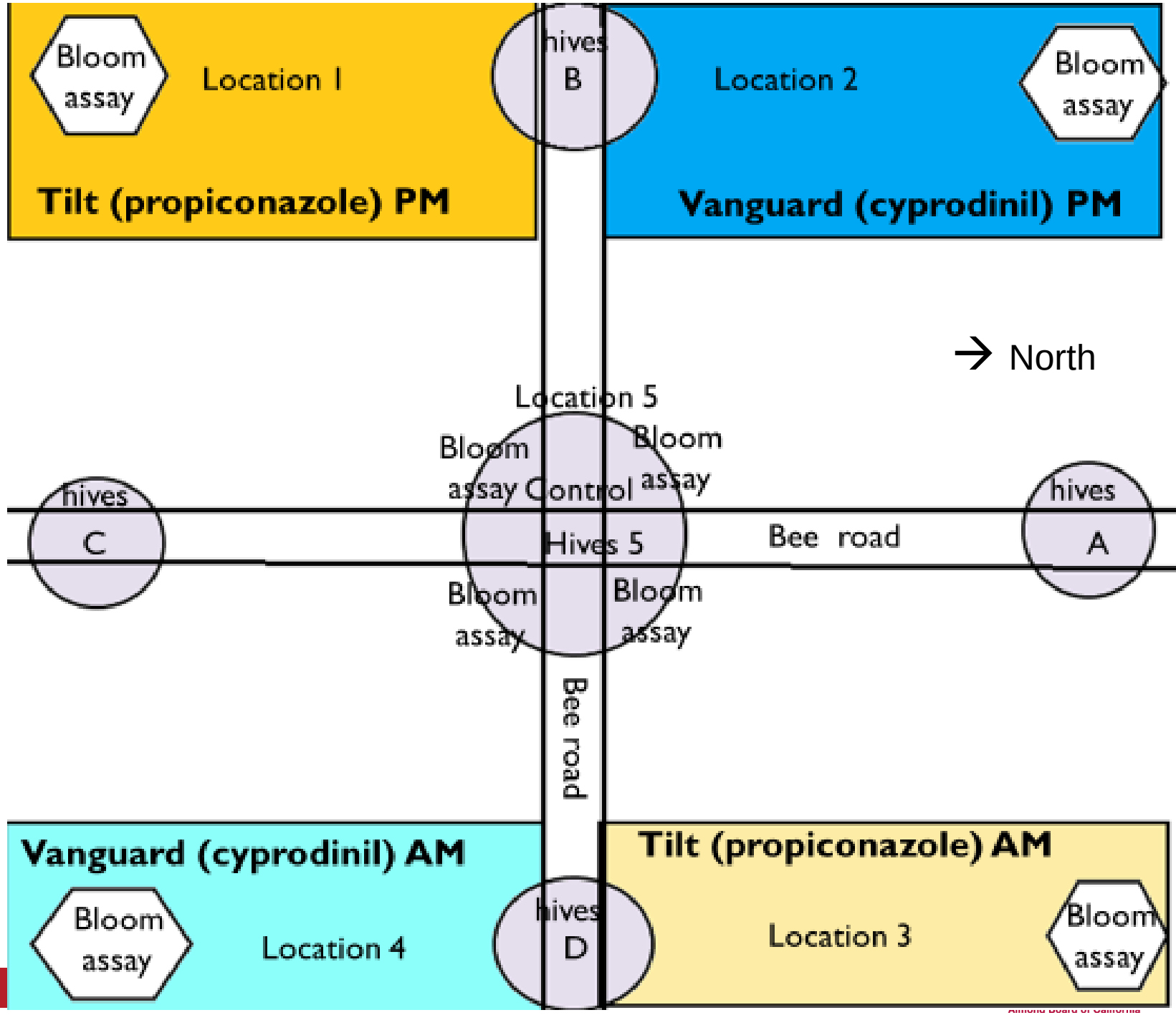
300 acres, ~ 5151ft x 2,542ft

33,950 almond trees with each tree 18 ft. apart in rows 22-24 ft. apart

600 hives along the bee roads

Prevailing winds from the northwest.

This orchard is completely surrounded by other orchards and is edged by asphalt and hard packed dirt roads



Measurements

We measured 5 metrics before and after AM and PM applications:

Forager counts of: (a) bees visiting flowers within a given area and

(b) all returning foragers to hive

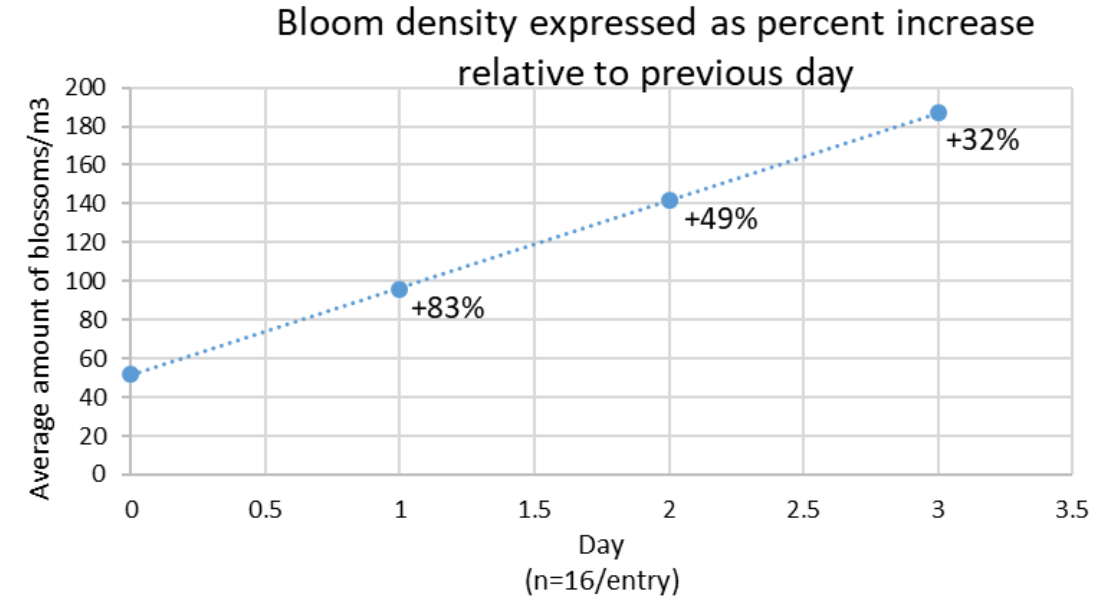
(c) pollen-bearing bees returning to hive.

Fungicide conc. in: (a) pollen sampled from anthers

(b) pollen collected at hive (traps)

As a check on conditions, we also monitored bloom progress and weather.

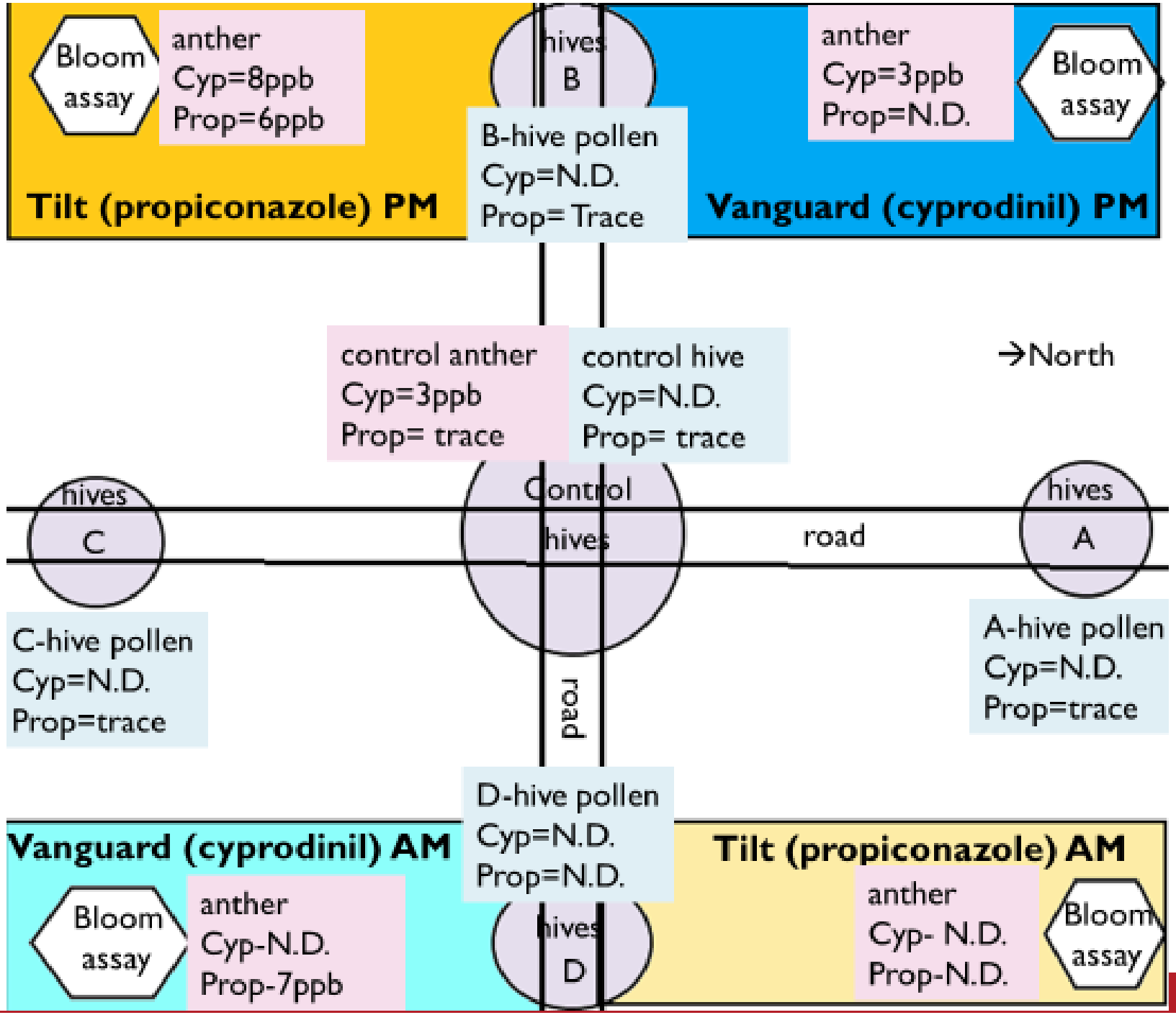
Weather was calm and consistent for study
Bloom was approaching peak bloom



Day	Highest temp °C/time	Lowest Temp °C/time	Rel. Humid. High/ low	Avg Wind Speed mph	Highest wind speed mph	% clear day	Atm Press High/low in Hg
1	23.9/13:54	10/23:54	69/32	6	14	100	29.43/29.30
2	22.2/14:54	5.6/6:54	64/17	4.9	16	100	29.49/29.21
3	15.6/14:54	5.6/3:54	73/33	5.3	11	54	29.44/29.29

Air blast rig

R-11® Spreader-Activator (2935-50142) spreader with an 8000 Ga tank and a nozzle size 16. The spray rate of the spreader was 2.5 mph.

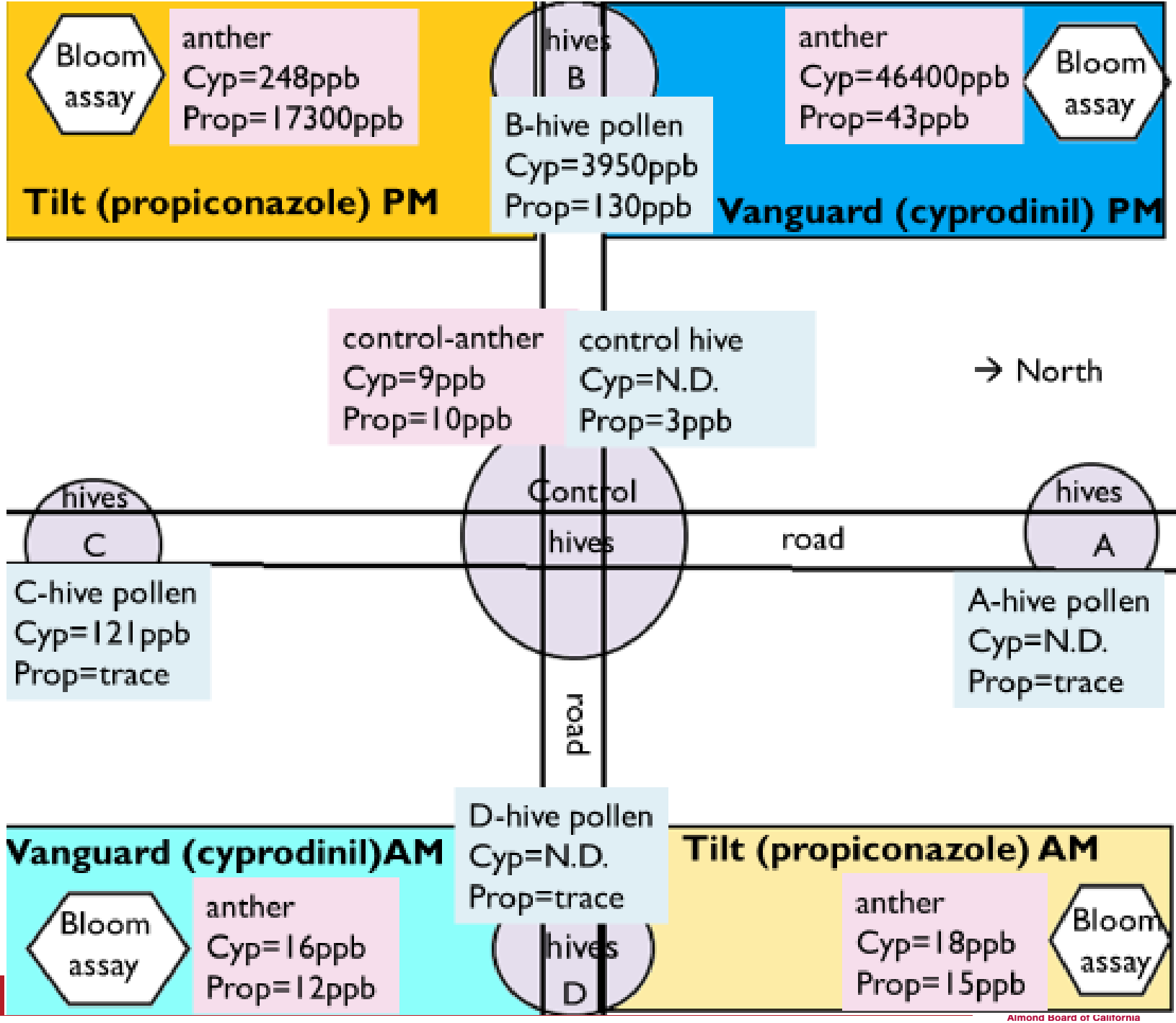


Control Day, Day 1

ppb= parts per billion
Cyp= Cyprodinil
Prop= Propiconazole
Anther= anther pollen
N.D.= not detected
LCMSMS = method to detect fungicide concentrations

The PM spray took place at 6PM on Day 1 after control data had been collected

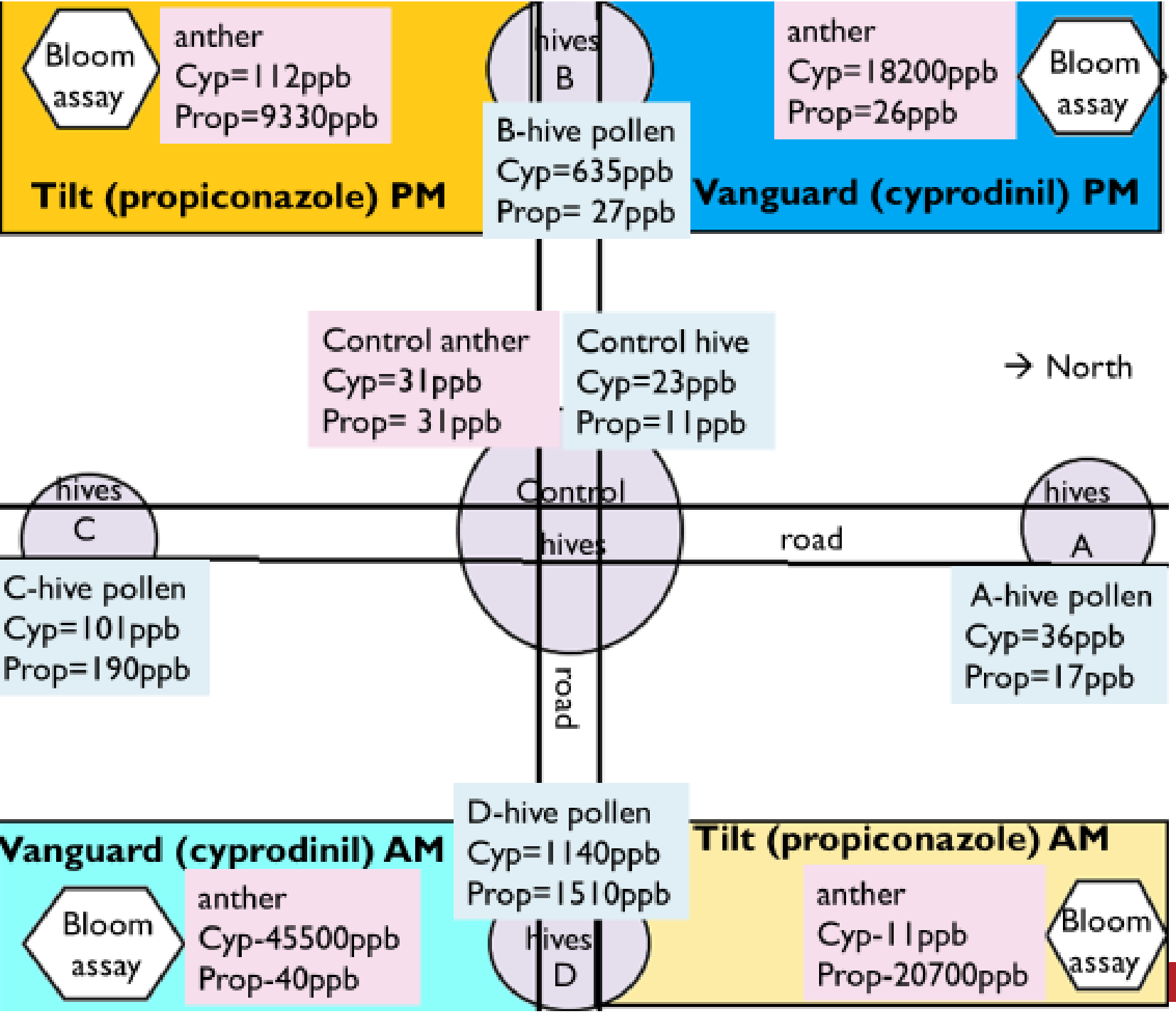
Post PM spray, Day 2



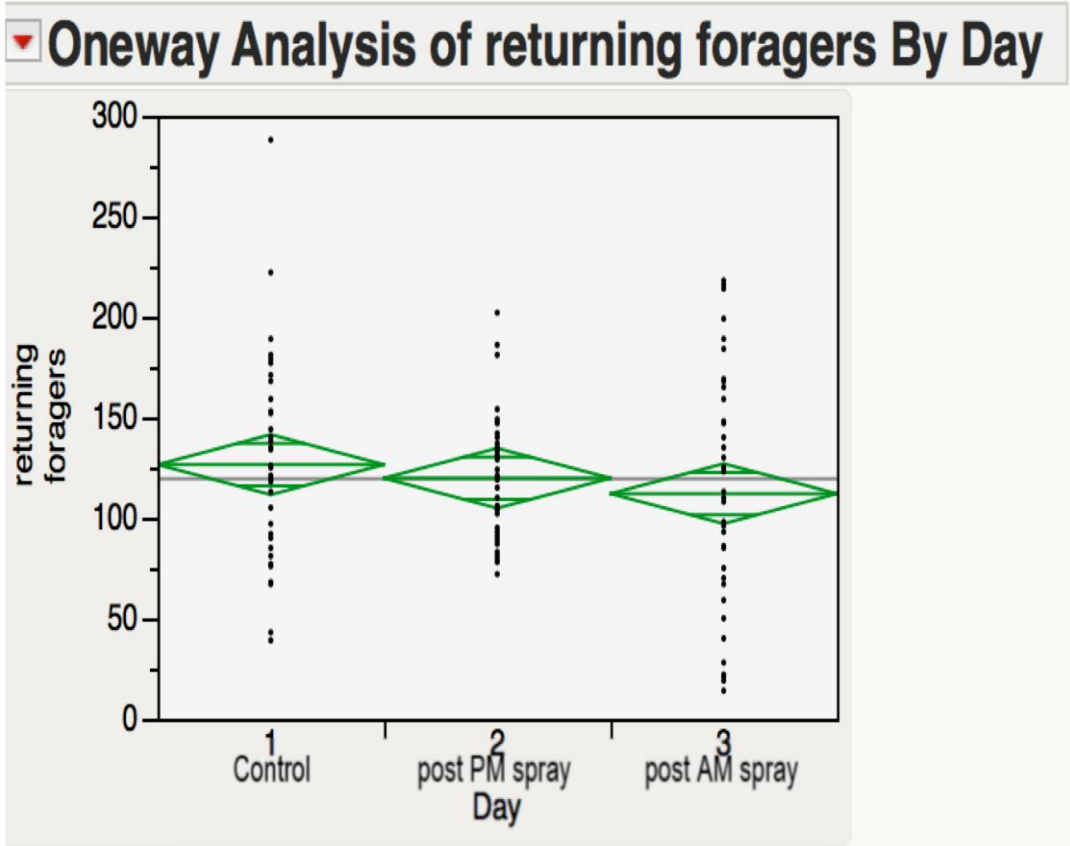
The PM spray had taken place 6pm on Day 1 (the previous evening)

Post AM spray, Day 3

The AM spray took place at 7 am on this day, Day 3



Analysis of all returning foragers was not significantly different across the three day study



Missing Rows 120

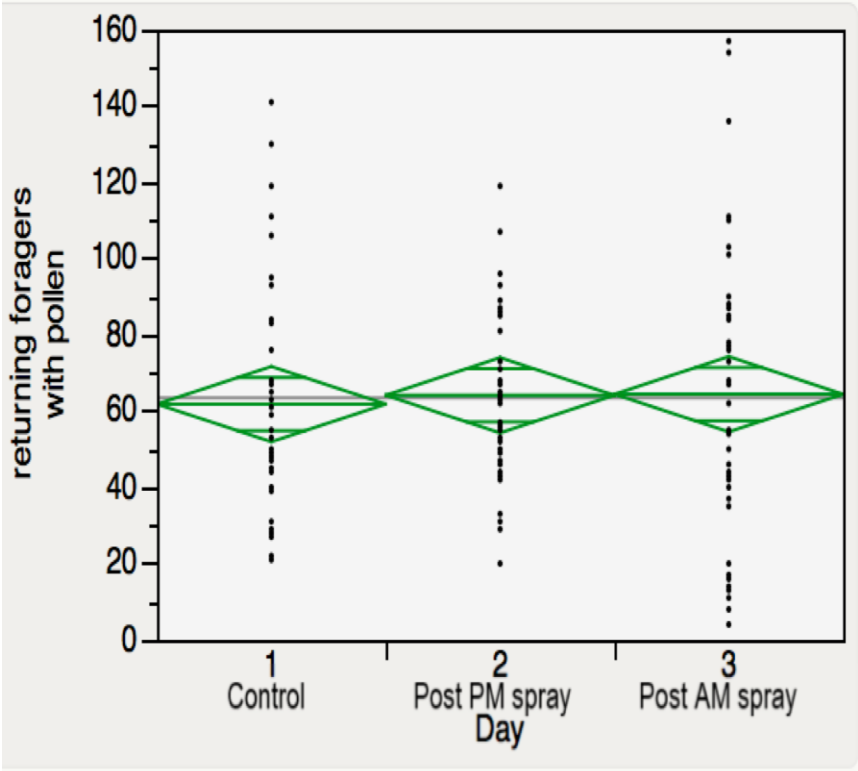
Oneway Anova

Summary of Fit

Rsquare	0.015492
Adj Rsquare	-0.00134
Root Mean Square Error	47.66069
Mean of Response	119.3833
Observations (or Sum Wgts)	120

Analysis of all returning pollen-bearing foragers was not significantly different across the three day study

Oneway Analysis of returning foragers with pollen By Day



Missing Rows 120

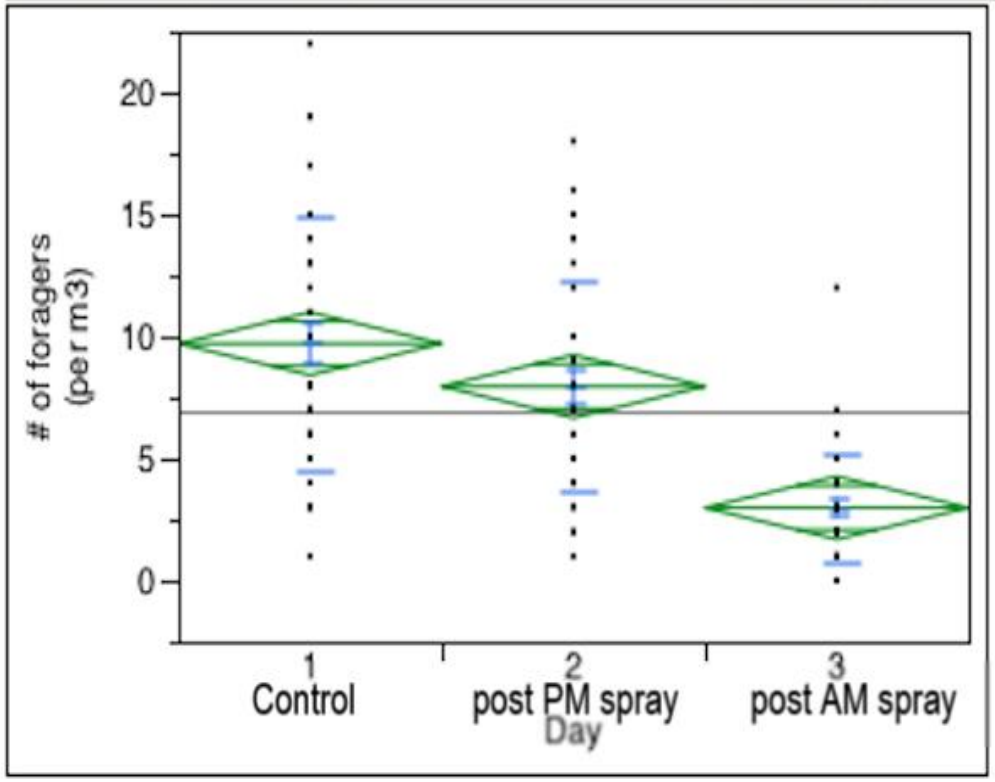
Oneway Anova

Summary of Fit

Rsquare	0.0014
Adj Rsquare	-0.01567
Root Mean Square Error	31.54381
Mean of Response	63.44167
Observations (or Sum Wgts)	120

Analysis of foragers visiting blooms was significantly different across the three day study

Oneway Analysis of # of foragers (per m3) By Day



Missing Rows 120

Oneway Anova

Summary of Fit

Rsquare	0.329101
Adj Rsquare	0.317632
Root Mean Square Error	4.119243
Mean of Response	6.875
Observations (or Sum Wgts)	120

Does application time make a difference on exposure level to bees?

Post PM Prop concentrations in blooms were 16% lower than post AM Prop concentrations.

Prop might be degrading overnight?

Over the next 24 hrs, the prop concentrations in the PM spray area dropped 46% within the PM spray area.

Post PM Cyp concentration levels in blooms were only 2% different after PM versus after AM spray.

Over the next 24 hrs, cyp concentrations in the PM spray area dropped 61% within the PM spray area.

Could the chemistries of the fungicides cause one to degrade faster in the presence of nighttime dew and the other to degrade faster in sunlight?

Did the bees respond differently to application time? Perhaps

Of the hives closest to the spray areas,

bees collected 0.75% of the post PM prop concentration on Day 2. bees collected 7.3% of the post AM prop concentration on Day 3	bees collected 8.5% of the post PM cyp concentration on Day 2 bees collected 2.5% of the post AM cyp concentration on Day 3

Hive pollen concentrations that were sampled closest to the PM spray areas decreased (84% Cyp, and 79% Prop) from Day 2 to Day 3, a result that may reflect forager avoidance learning.

Several factors may be contributing: application time, degradation rates of the fungicides, learning, changing bloom density

Thank you especially to

My field research team-Dawn Phoebe, Humberto

Almond Board of California for supporting this study!

Dr. Gordon Wardell for invaluable help and direction

Erik Wilkins, Mark Szczerba, Doug Blair, Mike Mendes, Wonderful

Elias, Uriel, Emmanuel spray team

Will Nesson

Steve Cook, Jonathan Barber, Marie Denski USDA

Debye Hunter, Bob Curtis, Gabriele Ludwig, ABC

seeds for bees®

Project *Apis m.*

Seeds for Bees: Improving bee and soil health where it matters most

Billy Synk

Director of Pollination Programs

seeds for bees®

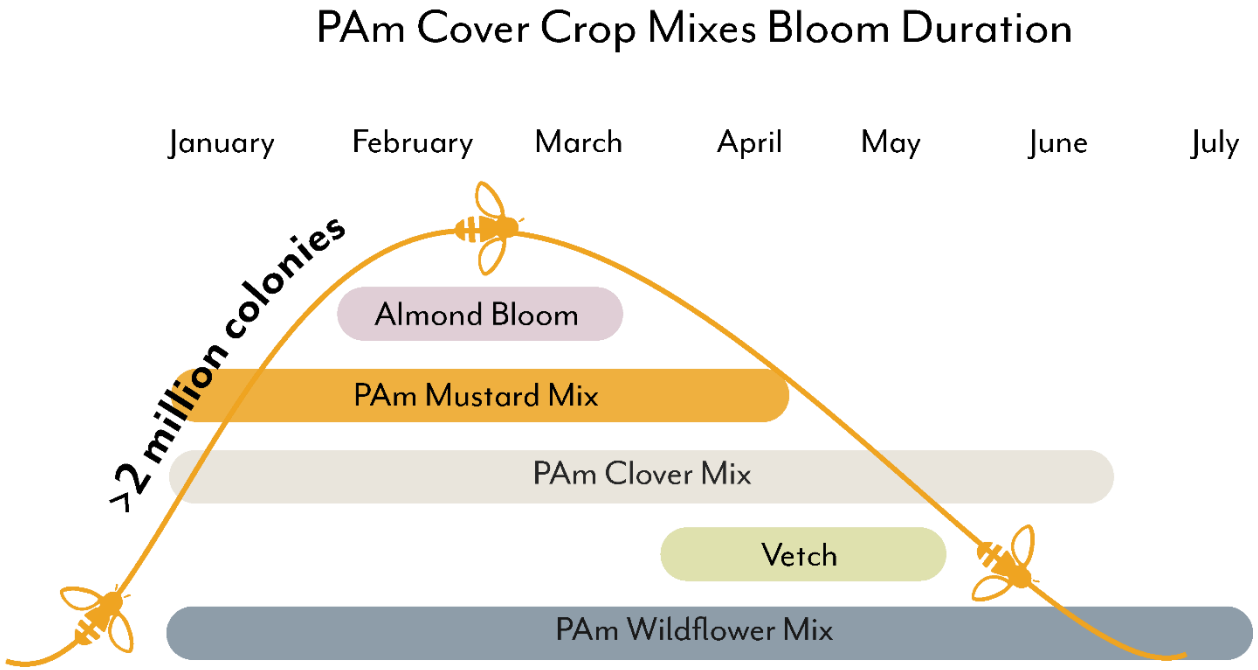
Project Apis m.

Goals for Healthy Bees, Smart Farming, and Changing Practices

1. **Feed bees** – Increase diverse, nutritious forage for honey bees pollinating California's Specialty crops.

2. **Feed the soil** –Improve soil conditions in and around orchards, farms and ranches.

3. **Educate & Assist** – Build grower, beekeeper and industry stakeholder knowledge of the benefits of cover crops by providing subsidized seed mixes and technical advice.



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Colonies provided natural forage have lower pathogen loads and higher overwinter survival than those fed protein supplements [1] .

When reared in pollen limited hives, bees communicate less efficiently thus potentially harming yield [2] .

Mustards positively affect bee population growth leading to increased forager numbers [3].

1. DeGrandi-Hoffman G., Chen Y., Rivera, R. et al. (2016) Honey bee colonies provided with natural forage have lower pathogen loads and higher overwinter survival than those fed protein supplements. Apidologie 2016 47: 186.
2. Scofield H.N., Mattila H.R. (2015) Honey Bee Workers That Are Pollen Stressed as Larvae Become Poor Foragers and Waggle Dancers as Adults. PLoS ONE 10(4): e0121731
3. Niño, Elina (2016-2017) Longitudinal Evaluation of Honey Bee Colonies on Different Forage Regimes. Almond Board of California Annual Research Report

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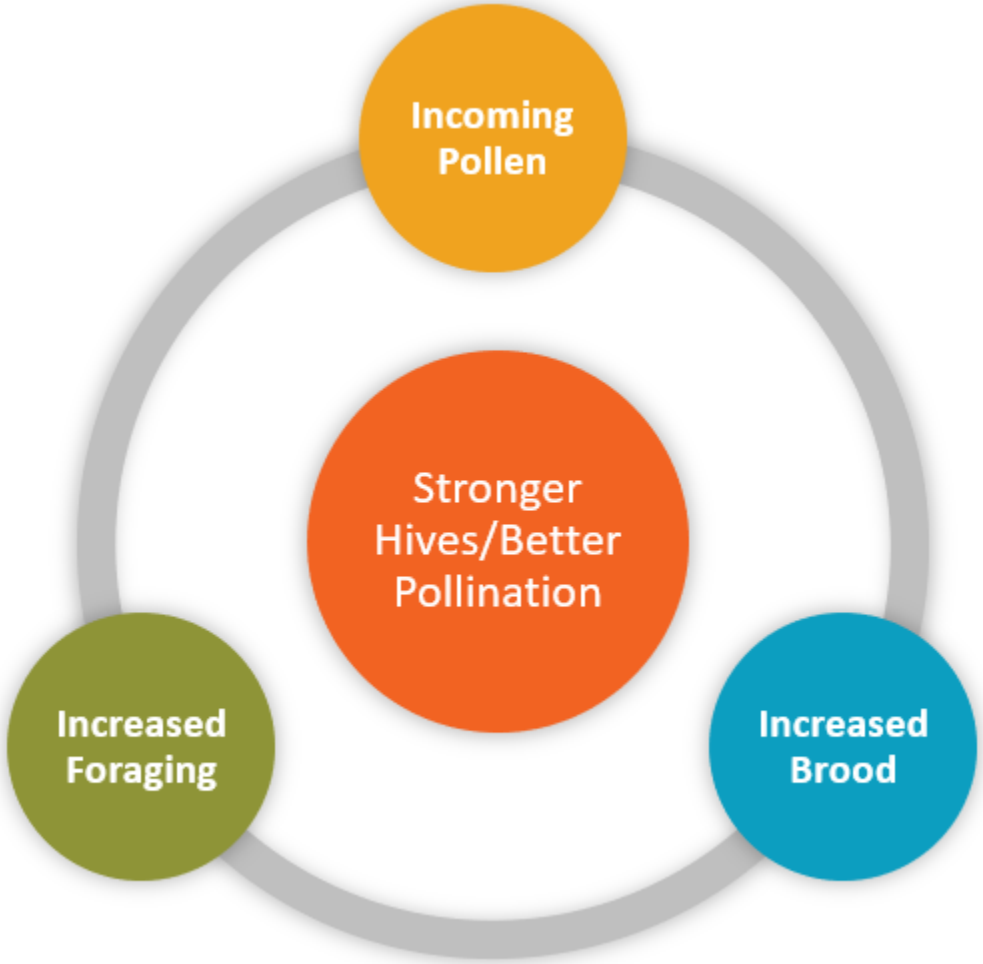
Why Should Growers Plant Bee Forage?



Project *Apis m.*

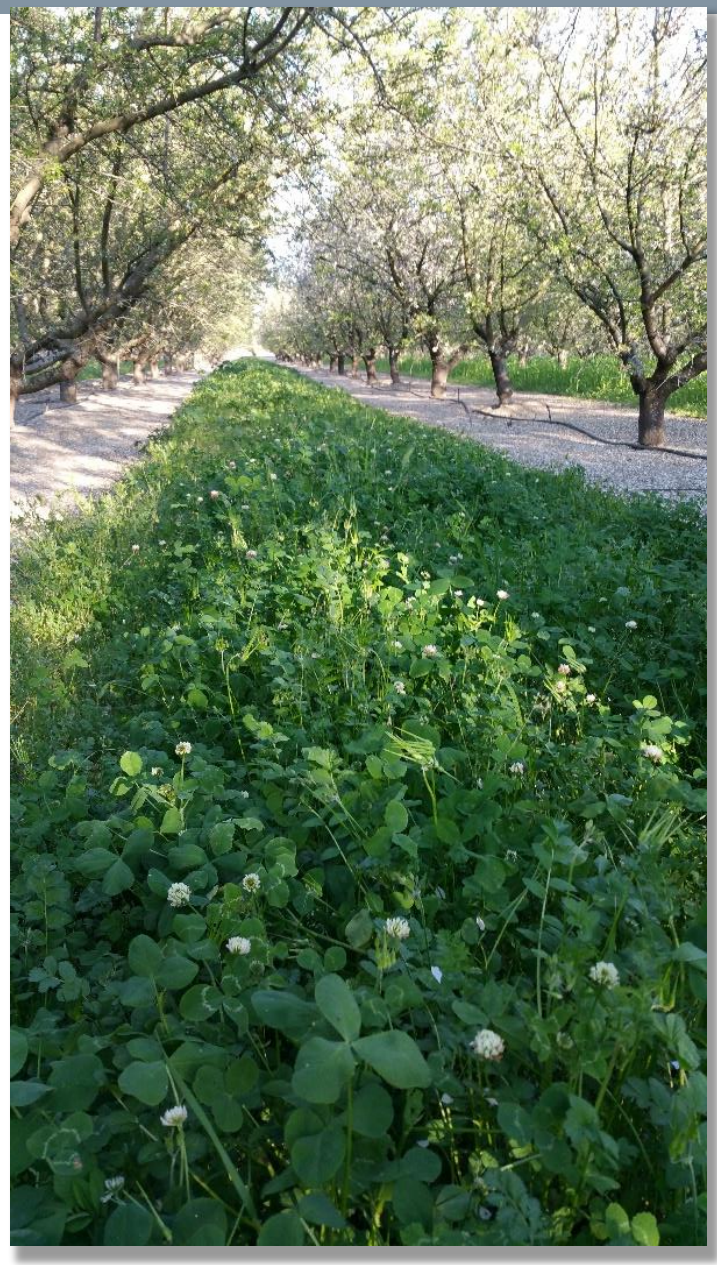
It creates a positive feedback loop!

In addition to stronger colonies, bee forage benefits include:

- Increased **organic matter**
- Prevents erosion
- Increase **water infiltration**
- Increase nitrogen
- Suppress weeds
- Suppress nematodes
- Decomposition of mummy nuts

Project *Apis m.*

1% organic matter = 19,000 gallons per acre of water holding capacity!



Project *Apis m.*

Woodland, CA January 8th 2017

Raindrops seal soil surface → runoff

Protected from raindrops → Roots assist infiltration

Photos courtesy of Tony Rolfes

Project *Apis m.*

Woodland, CA January 15th 2017 (one week later)

Sealed Soil Surface, Soil Particles Dispersed

Project *Apis m.*

Retains granular surface structure

Photos courtesy of Tony Rolfes

Soil temperature

Soil microbes begin to die at temperatures above 90°

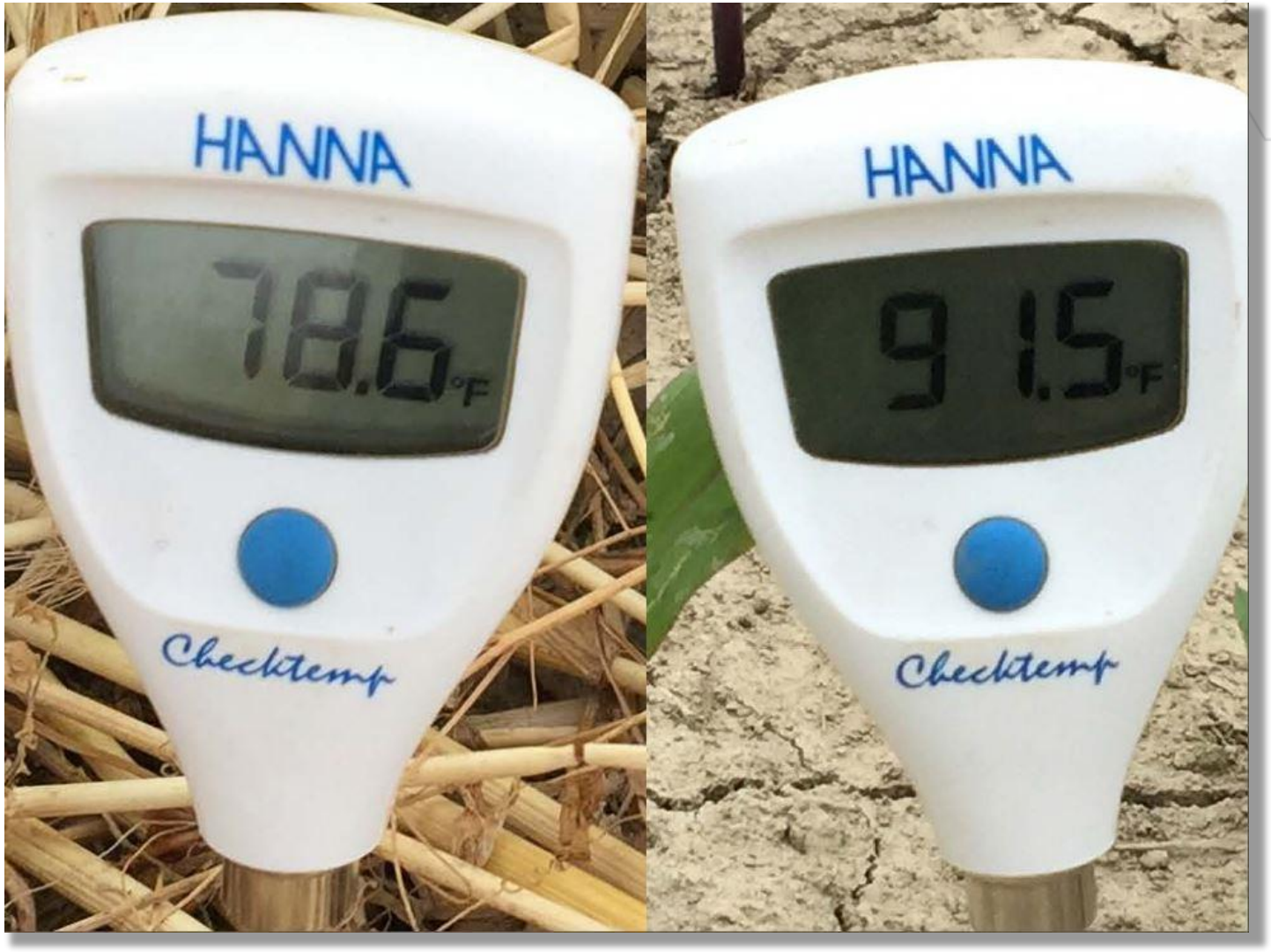


Photo courtesy of Jay Brandt. Fairfield, Ohio

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seeds for bees®

Project Apis m.

4 seed options

- PAm Mustard Mix
- PAm Clover Mix
- Woollypod Vetch
- PAm Wildflower Mix

Cost share structure

- 1st year enrollees are eligible for a $2,000 discount off their total seed purchase (50-120 acres)
- 2nd year enrollees are eligible for a $1,000 discount off their total seed purchase

Enrollees who participate for more than 2 years receive:

- wholesale pricing
- free shipping

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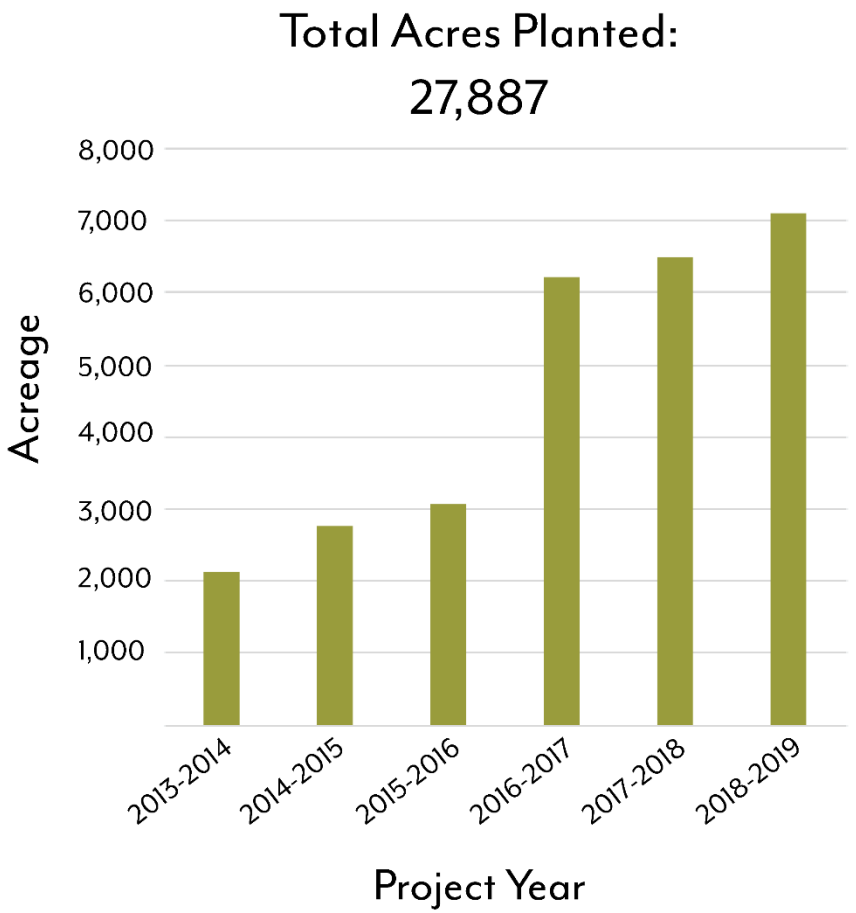
seeds *for* bees®
Project *Apis m.*

Forage program focused in California



This win-win situation benefits both beekeeper and grower.

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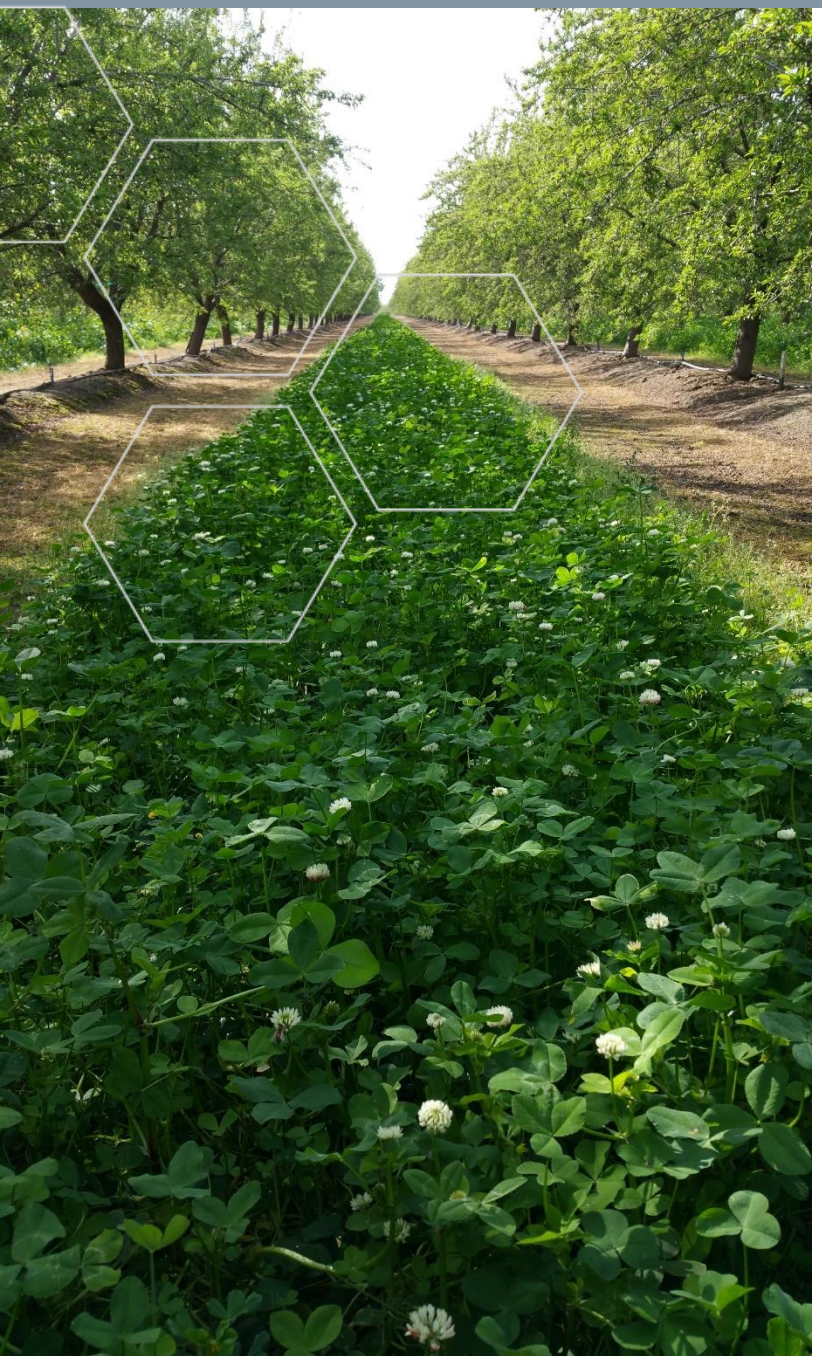

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Contact us!
Billy Synk
Director of Pollination Programs
Billy@projectapism.org
www.projectapism.org

Alternative Forage Plantings to Support Honey Bees

Flower borders and Cover crops in almond landscapes

Neal M. Williams
University of California, Davis

california almonds
Almond Board of California

Overview

Challenge for bees/beekeepers: Insufficient forage to support bees during key times of the season. Specifically preceding and following almond bloom.

Goal: Identify viable strategies to supplement forage for bees within almond landscapes.

Challenge for pollination/growers: Require reliable pollination during short bloom window. High quality visits integration of wild bees which synergize honey bee pollination.

Goal: Can floral enhancements benefit almond yield?

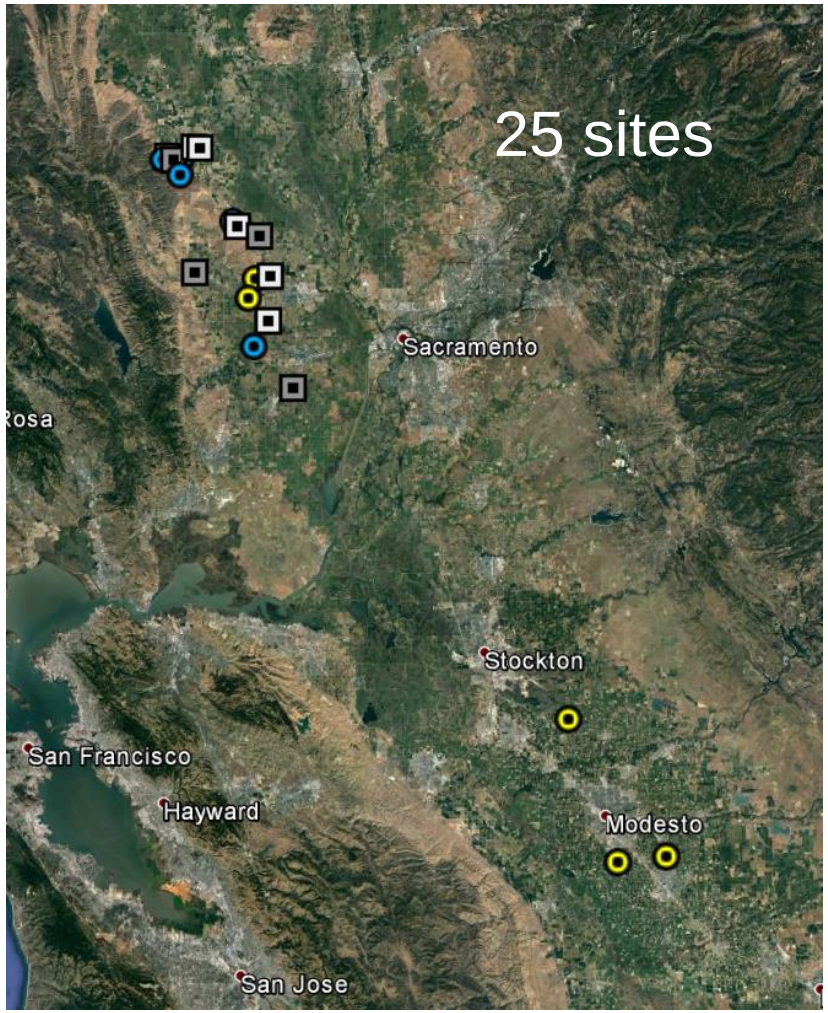
At least not compete with orchard for bee visits.

Overview: Research Aims

1. Identify bee forage planting schemes that benefit bees
   - Floral borders (2017 & 2018)
   - Cover crops (2018)
2. Identify plants that benefit bees
   - Native wildflower mix
   - Bee friendly mustard mix

Impact on Bee Health E. Niño

Floral Borders: (2017-2018) Study Locations and Site types



Mustard mix

Typical border

Wildflower mix

Riparian border

Data collected

1. Measure bloom timing of bee forage plantings

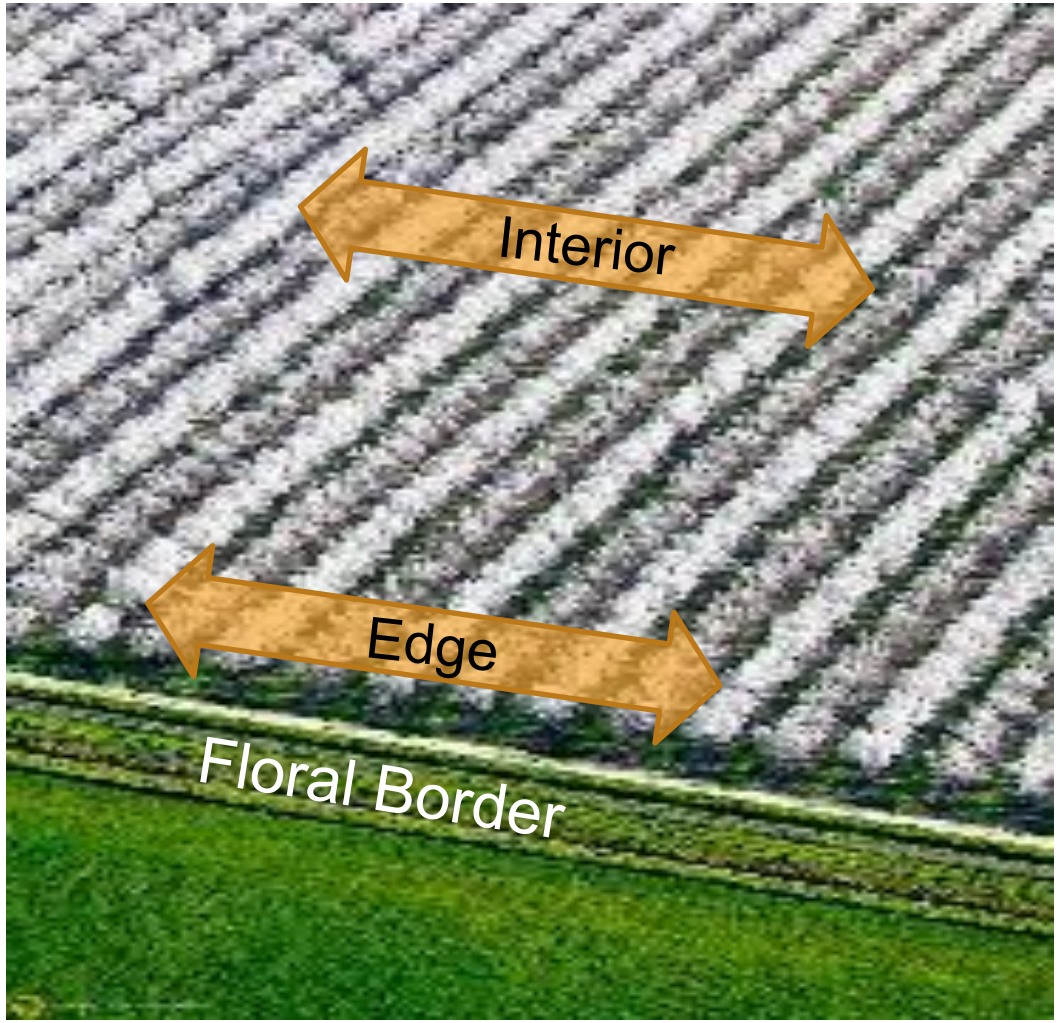
   How do forage mixes perform and can they support bees at key times of the season?

2. Document bees' use of forage plantings

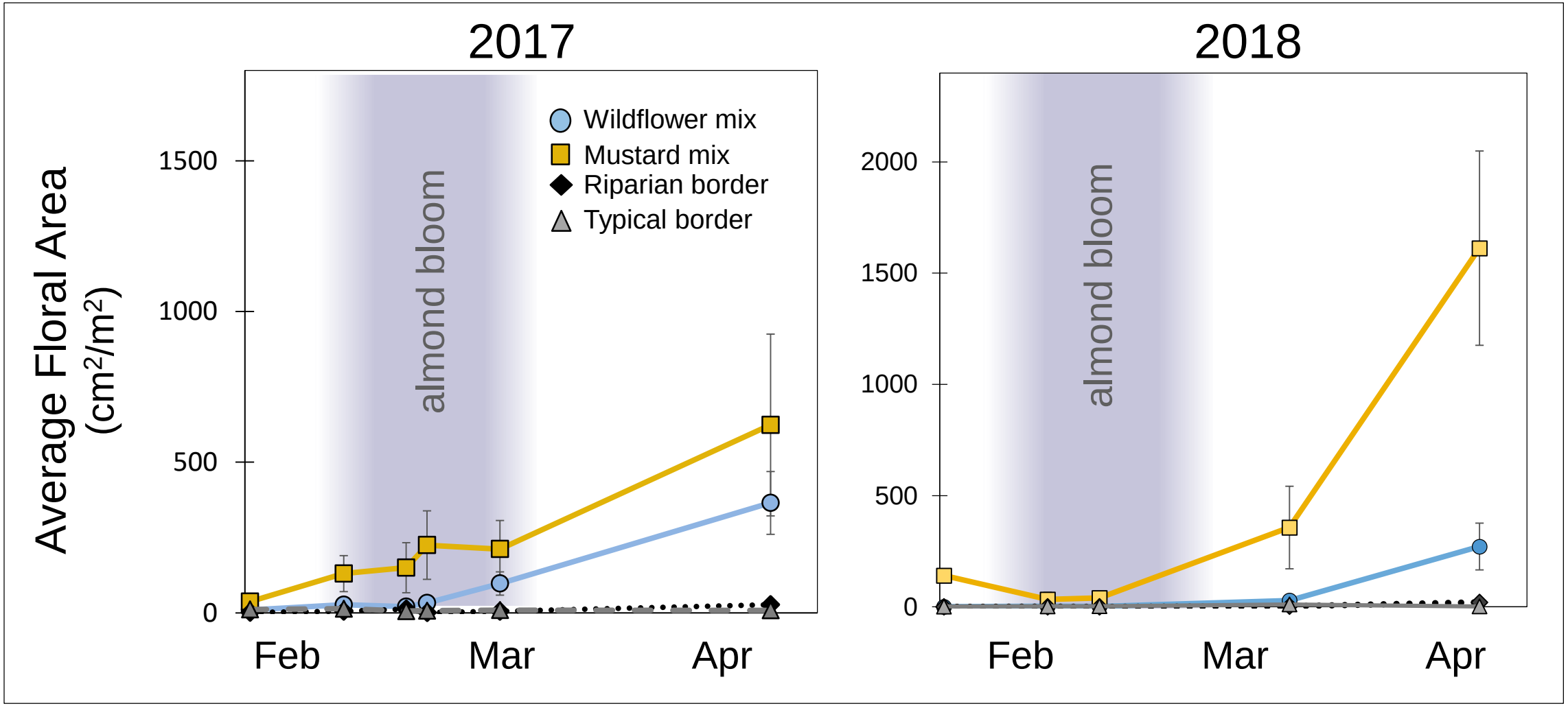
   Do bees use them?

3. Quantify impacts of forage plantings on almond yield

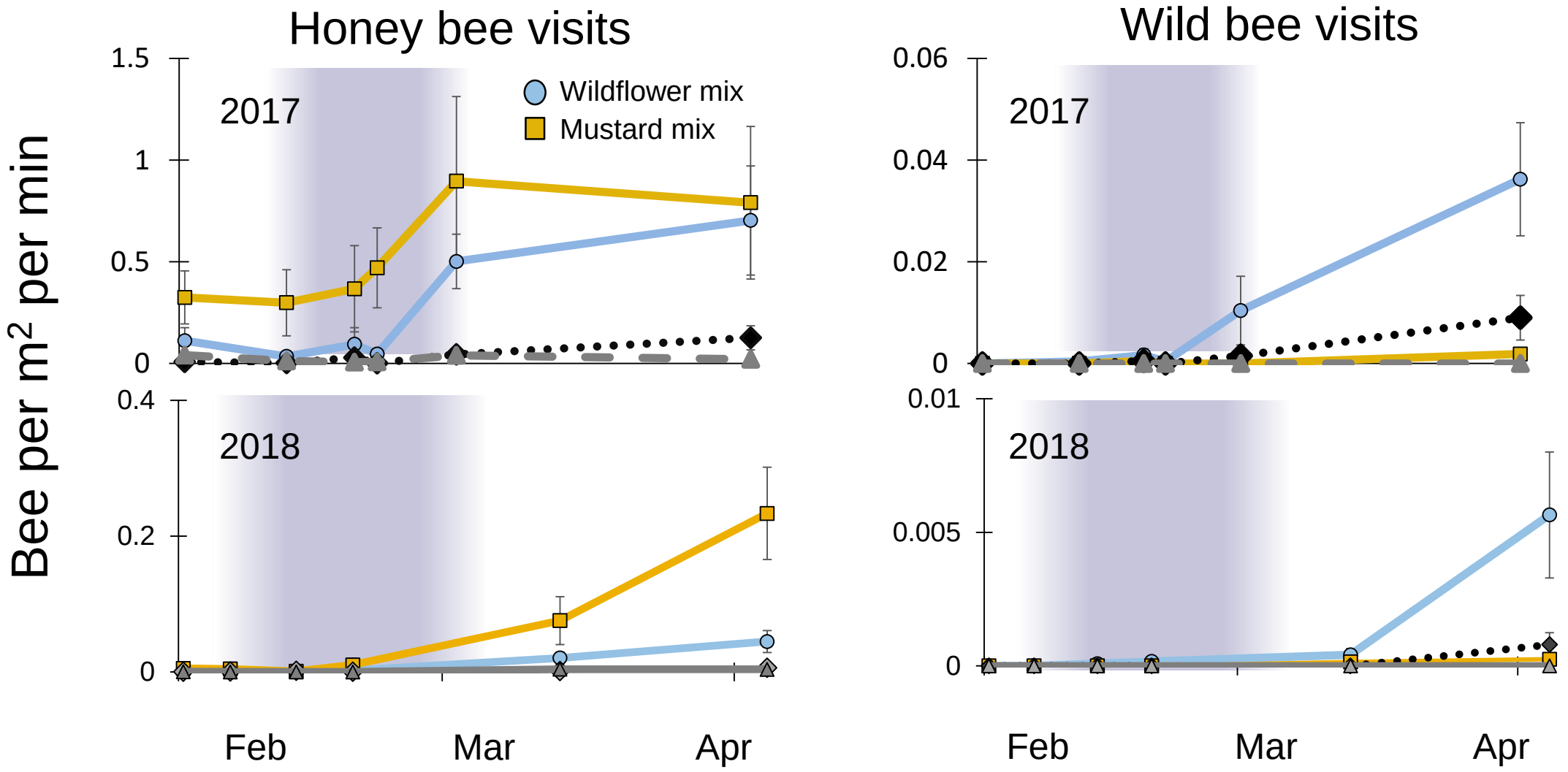
   Do plantings benefit yield and not compete with orchards?



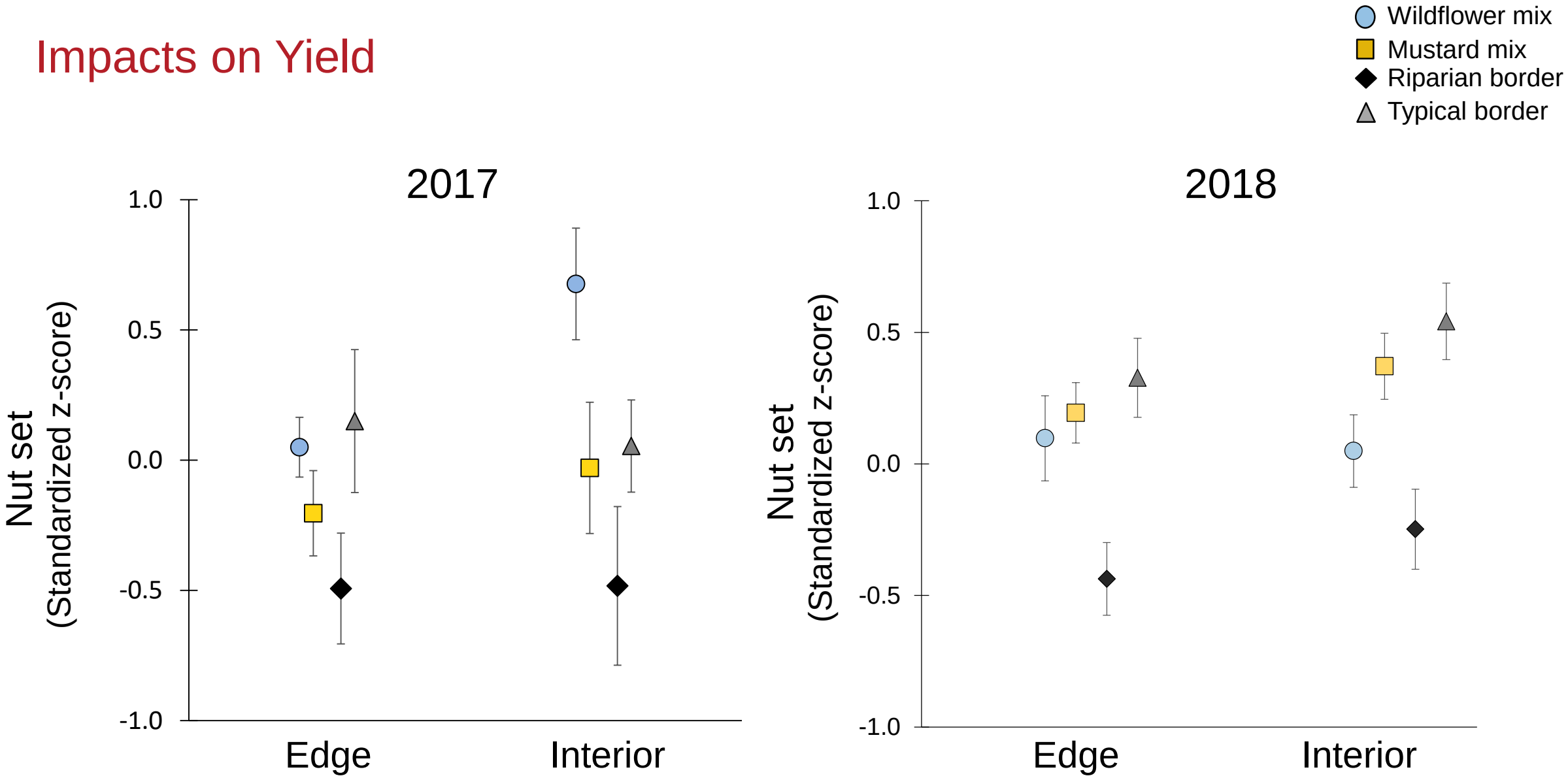
Mix Flowering Performance



Bees use of Forage Mixes



Impacts on Yield

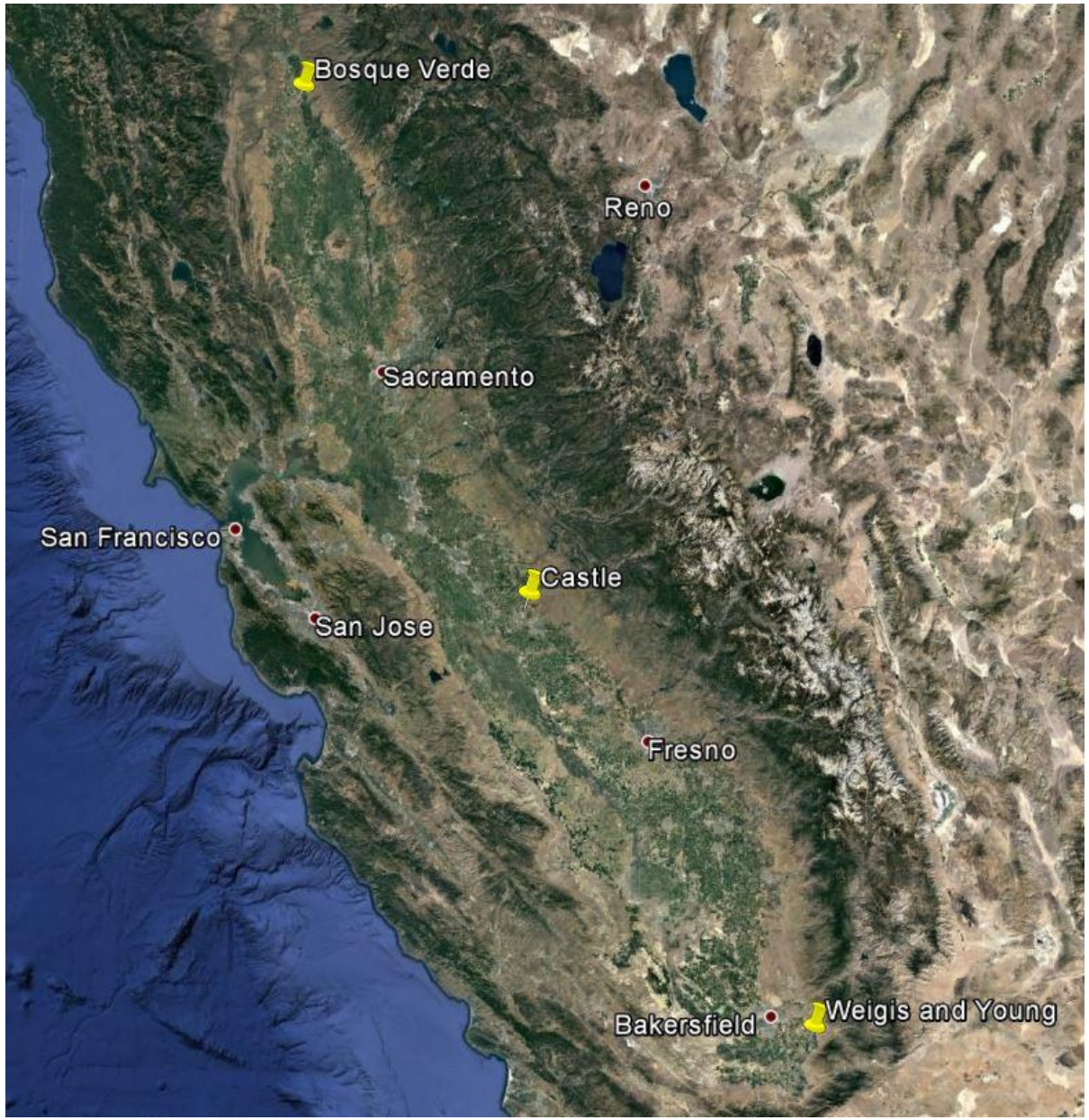


Cover Crops (2018)

- Partnering with Soils team (A. Gaudin and soils team).
- Forage planted between tree rows
- North, Central, Southern regions

2 mixes

- “Soil Health” = mustard + vetch + rye grass
- “Pollinator” = modified mustard mix
- Bare ground control
- Control orchard – spatial independence



Study Design

- Partnering with Soils team (A. Gaudin and soils team).
- Forage planted between tree rows
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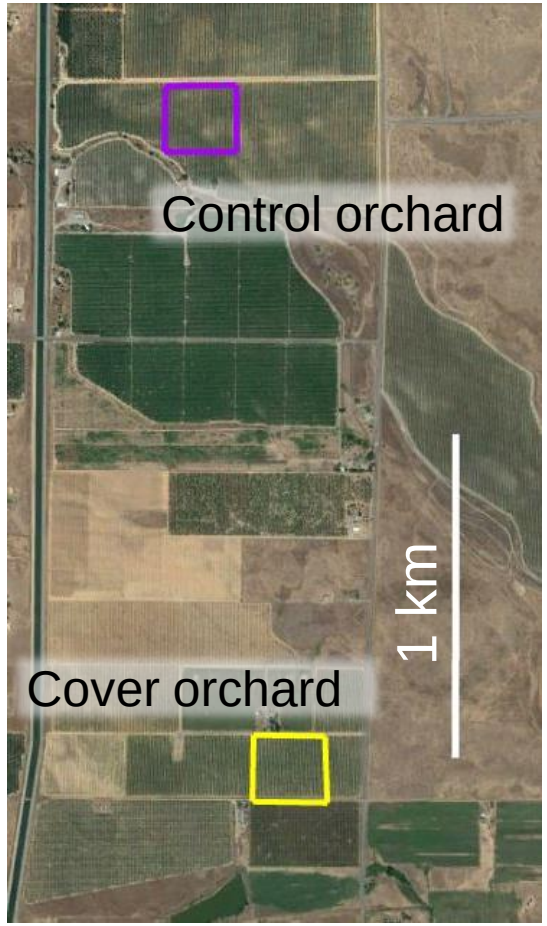


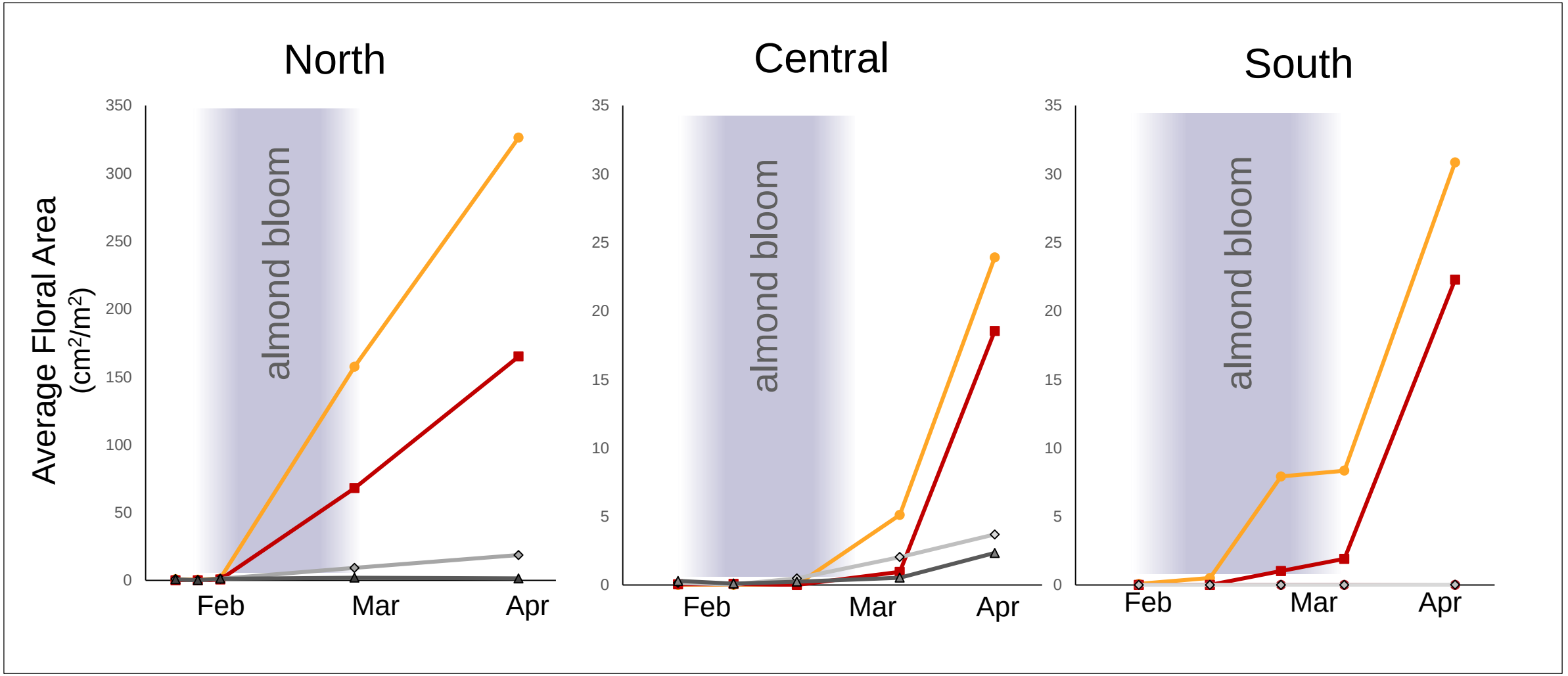
Data Collected

1. Measure bloom timing of cover crop plantings

2. Document bees' use of cover crop plantings

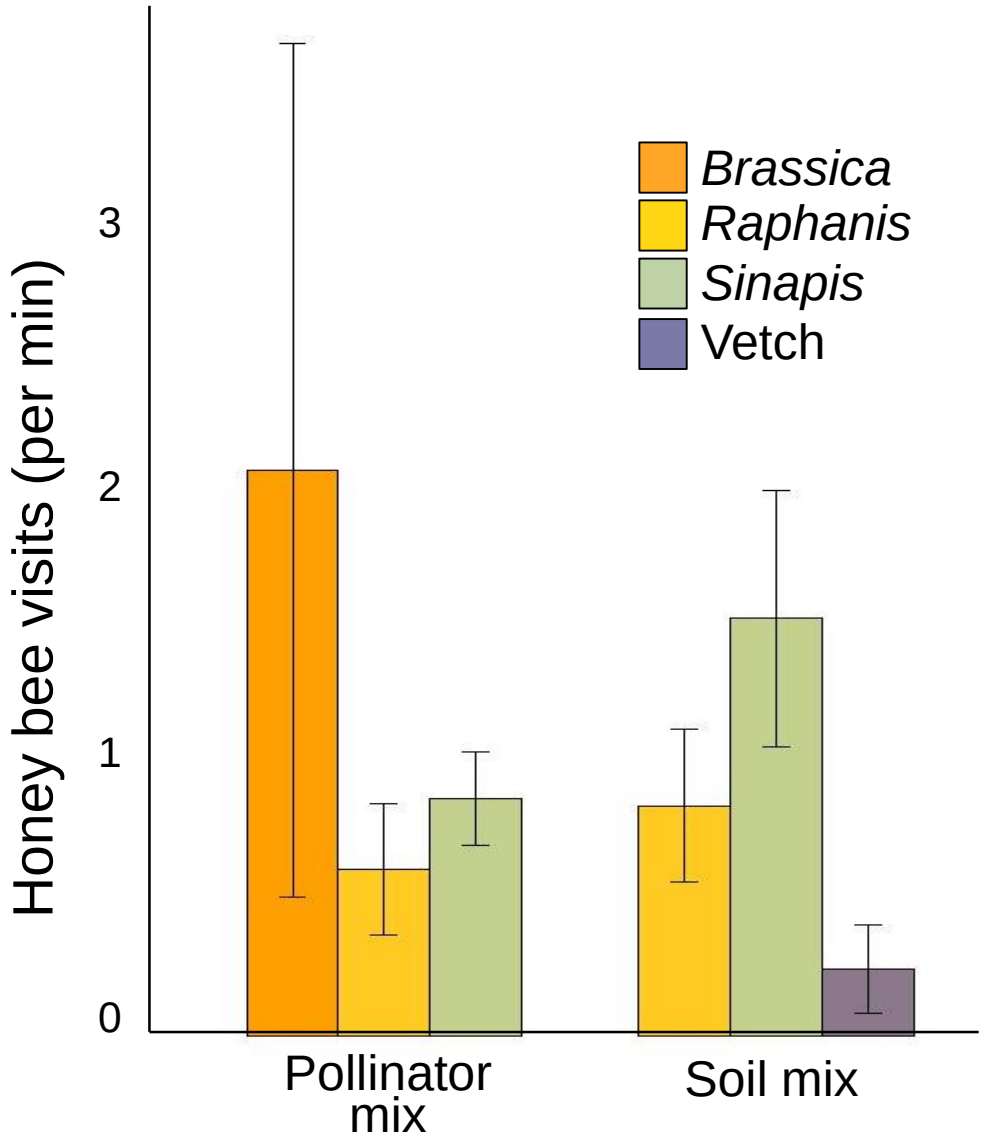
3. Quantify impacts of cover crops on almond yield

Mix Flowering Performance

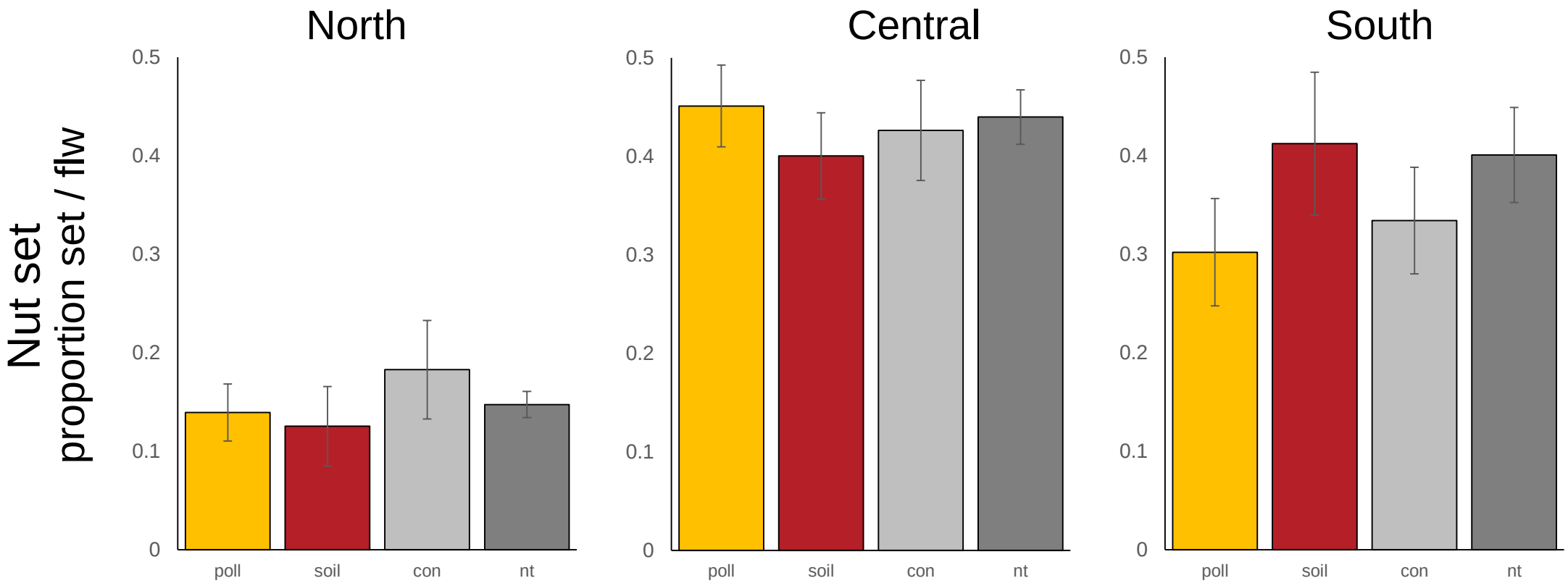


Bees use of Forage Mixes

- Honey bees used all flowering species within the mixes
- Preferred Brassica and mustards over vetch



Impacts on Yield



Continuation - Cover Crop 2019

- 2018 was a preliminary study
- Expand numbers of sites
  - 7 cover orchards
  - 7 control orchards
- Partnering with PAm – Seeds for Bees Program
- Integrated project with assessment of colony health, E. Niño , UC Davis
- Proposed addition of pest and natural enemy assessment H. Wilson, UCR

Summary

Border plantings appear to support honey bees and wild bees

Can benefit yield – no evidence of negative effect

Cover plantings also support bees

Impact on pollination and bees is to be determined

KEY: Timing of plantings is critical to achieve benefits

Thank you !

for your support

Growers

Erdman Family Farms

DH Long Farming

CL5 Ranch

T. Barrios

Shane Tucker

MAISIE JANE'S CALIFORNIA SUNSHINE

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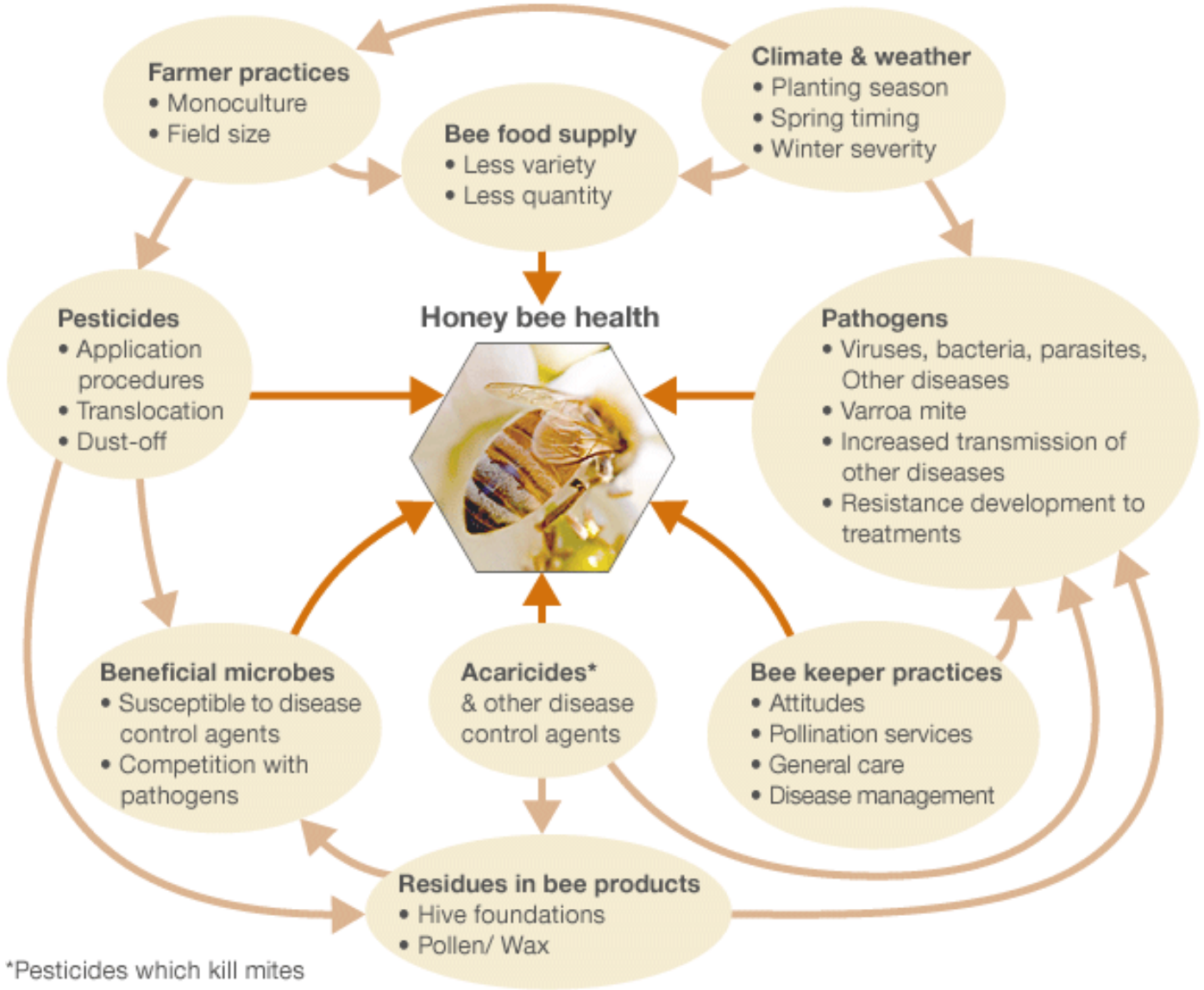
Evaluation of honey bee colonies with access to supplemental forage plantings

Elina L. Niño

UC ANR/UC Davis

california almonds
Almond Board of California

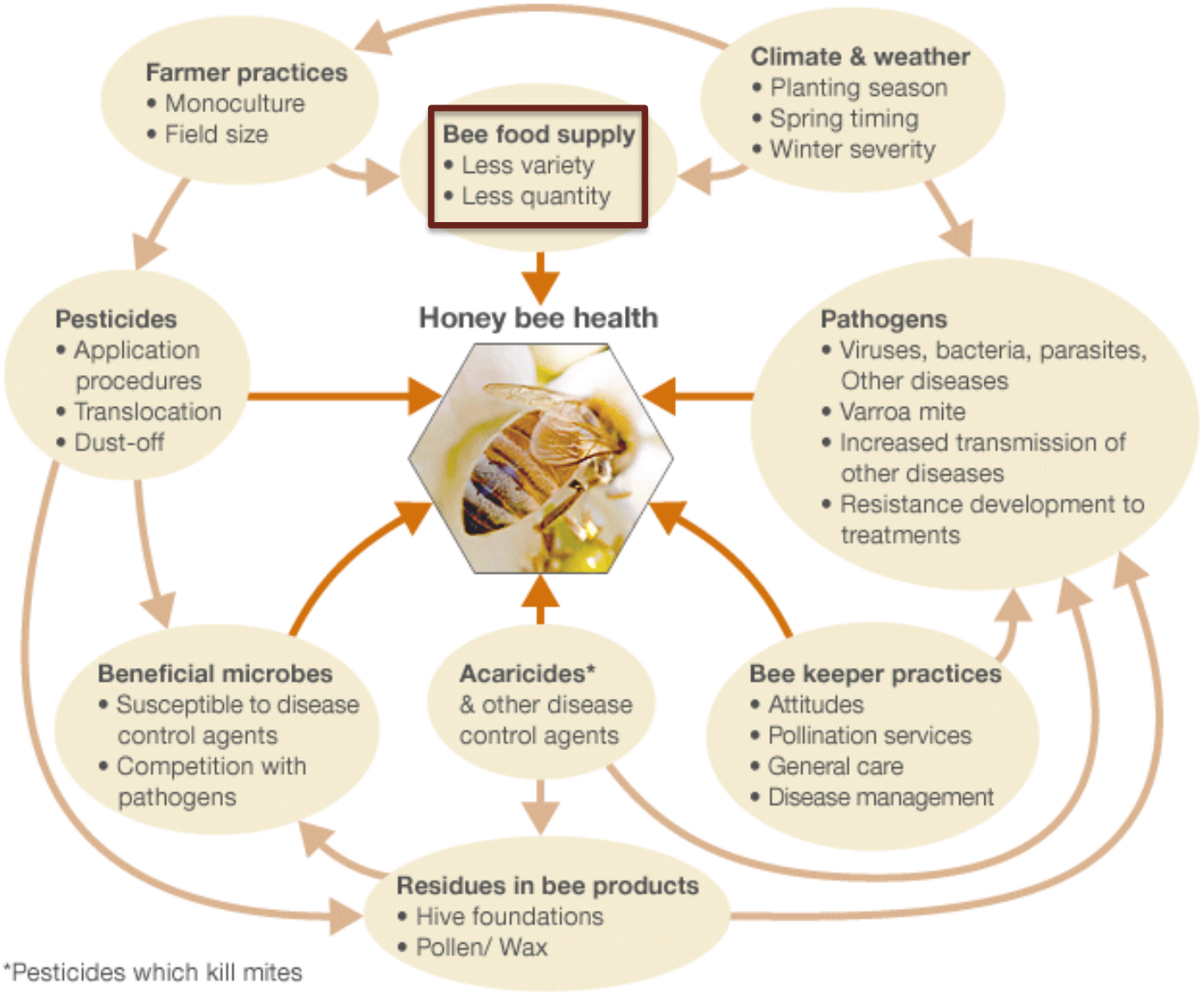
Stress factors in honey bee populations



*Pesticides which kill mites

Source: OPERA Bee health in Europe, 2013

Stress factors in honey bee populations



*Pesticides which kill mites

Source: OPERA Bee health in Europe, 2013

Value of optimal nutrition

- **Better nutrition (diversity and availability) improves immune/detox response of honey bees**
  - **Bees respond better to infections and pesticide exposure (e.g., Alaux et al. 2009; Di Pasquale et al. 2013; Schmehl et al. 2014)**

HONEY BEE HEALTH COALITION

The Bee & Butterfly Habitat Fund

A Unique Conservation Solution.

Supplemental forage mixes

Matching controls with no planted supplemental forage

2017

2 X 4 treatments/4 sites

Total of 32 colonies

2018

4 X 4 treatments/4 sites

Total of 64 colonies

- **Colonies evaluated before, during and after almond bloom for various parameters**
- **After bloom, colonies moved to a stationary site**
  - **2017: California**
  - **2018: California and Oregon**
- **Monitoring continued every 4-6 weeks**

Parameters tracked

- **Resource use, pollen ID (Williams)**

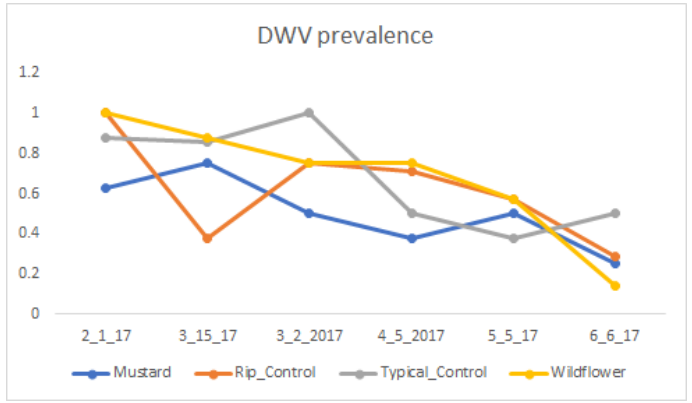
- **Colony parametars**
  - **Adult population**
  - **Brood**
  - **Varroa mite infestation**
  - **Forager collections**
    - **Pathogen load and bee gut microbiome (McFrederick)**
    - **Immune competence (Anderson)**
  - **Survival**
  - **2018: pollen pesticide analysis**

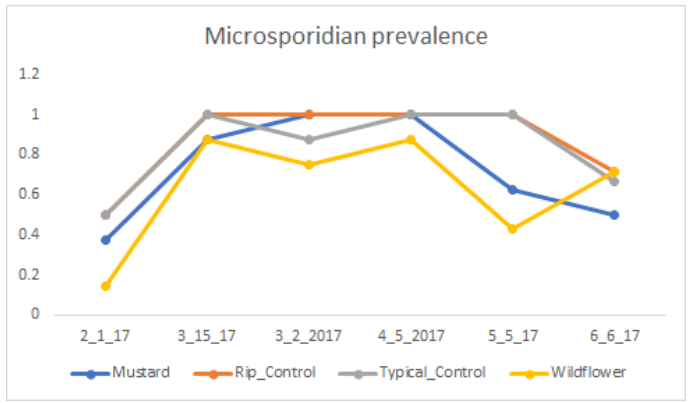
Encountered challenges both years

Highlights for 2017

- Sampling showed diversity of pollen collected (Williams)
  - Wildflower collected only after bloom

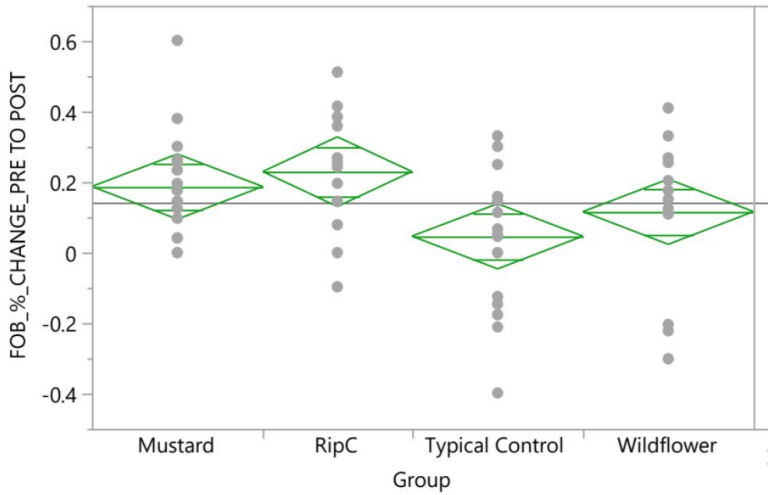
- 2017: significantly higher brood and adult population at almond bloom in mustard group; higher survival in mustard group; no differences in Varroa mite infestation



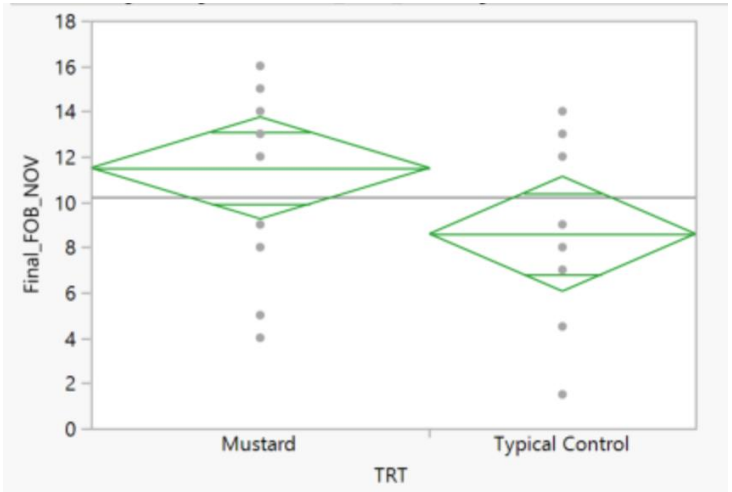


- No statistical differences in pathogen load (McFrederick)
- Immune gene expression underway (Anderson)

Preliminary results for 2018

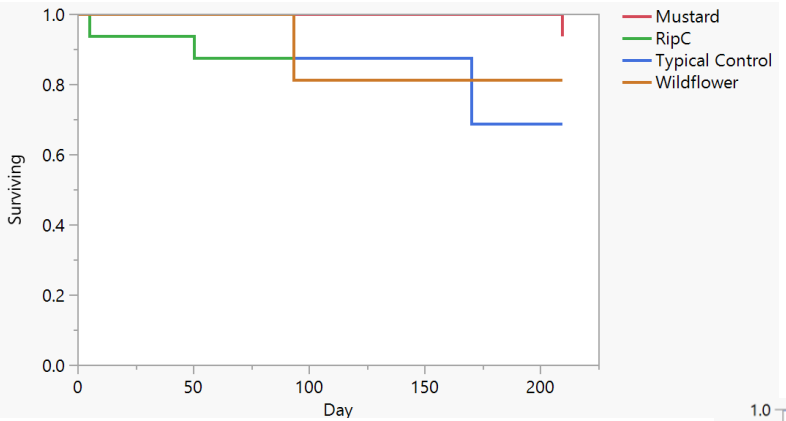


- **Percent change in adult population pre- to post-bloom (P = 0.0447)**

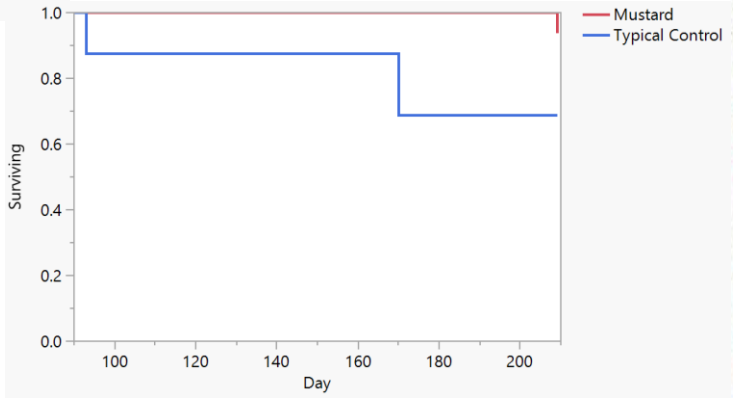


- **Frames of brood (P = 0.0441)**
- **~3 frame difference**

Preliminary results for 2018



- **Percent survival (P > 0.05) between all groups**



- **When evaluating mustard vs. its control (P = 0.05)**

- **Data from both years supports the idea that planting supplemental forage near orchards can provide immediate and longer term benefits for colonies**
- **Further analysis is underway as well as the 3rd year of the project**

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Beekeepers and growers

Funding sources, donors, volunteers

california almonds Almond Board of California

Research Poster Sessions

Tuesday, December 4
5:30 – 6:30 p.m.

Featured topics:

- Pollination and bee health
- Soil heath
- Nutrient and nitrogen management

What's Next

Tuesday, December 4 at 12:00 p.m.

- Speed Talks: Nutrient, Salinity and Soil Health – Room 308-309
- Almond Breeding: Is There a Role for New Genetic Technologies? – Room 312-313
- FSMA Scorecard: How Does Your Operation Stack Up? – Room 306-307

Tuesday, December 4 at 12:30 p.m.

- Almonds in the Global Marketplace – Room 314


Join the social media conversation at #AlmondConf

What's Next

Tuesday, December 4

- State of the Industry – Hall C at 4:15 p.m.
- Research Poster Session – Hall A+B at 5:30 p.m.

Be sure to join us at 5:30 p.m. in Hall A+B for Dedicated Trade Show Time and Opening Reception, sponsored by FMC Agricultural Solutions