2017 THE ALMOND CONFERENCE

RESEARCH UPDATE: PEST MANAGEMENT AND POLLINATION

Room 312-313 | December 7 2017

california almonds
Almond Board of California

growing ADVANTAGE
The Almond Conference

CEUs – New Process

Certified Crop Advisor (CCA)

- Sign in and out of each session you attend.
- Pickup verification sheet at conclusion of each session.
- *Sign in sheets are located at the back of each session room.*

Pest Control Advisor (PCA), Qualified Applicator (QA), Private Applicator (PA)

- Pickup scantron at the start of the day at first session you attend; complete form.
- Sign in and out of each session you attend.
- Pickup verification sheet at conclusion of each session.
- Turn in your scantron at the end of the day at the last session you attend.

Sign in sheets and verification sheets are located at the back of each session room.

AGENDA

- **Sebastian Saa**, Almond Board of California, moderator
- **Andrea Joyce**, UC Merced
- **Jhalendra Rijal**, UC Cooperative Extension
- **Kristen Tollerup**, UC Cooperative Extension, Kearney Ag Station
- **Sean Halloran**, UC Riverside, Dept. of Entomology
- **Greg Browne**, USDA-ARS
- **Florent Trouillas**, UC Davis
- **Themis Michailides**, UC Davis/Kearney
- **Bob Johnson**, UC Davis
- **Reed Johnson**, The Ohio State University
- **Diana Cox-Foster**, USDA-ARS-PWA Pollinating Insect Research Unit
- **Judy Wu-Smart**, University of Nebraska-Lincoln
- **Dennis vanEngelsdorp**, University of Maryland

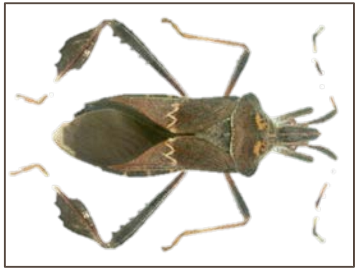
UNDERSTANDING AGGREGATION BEHAVIOR OF THE LEAFFOOTED BUG, *LEPTOGLOSSUS ZONATUS*

Andrea Joyce
University of California Merced

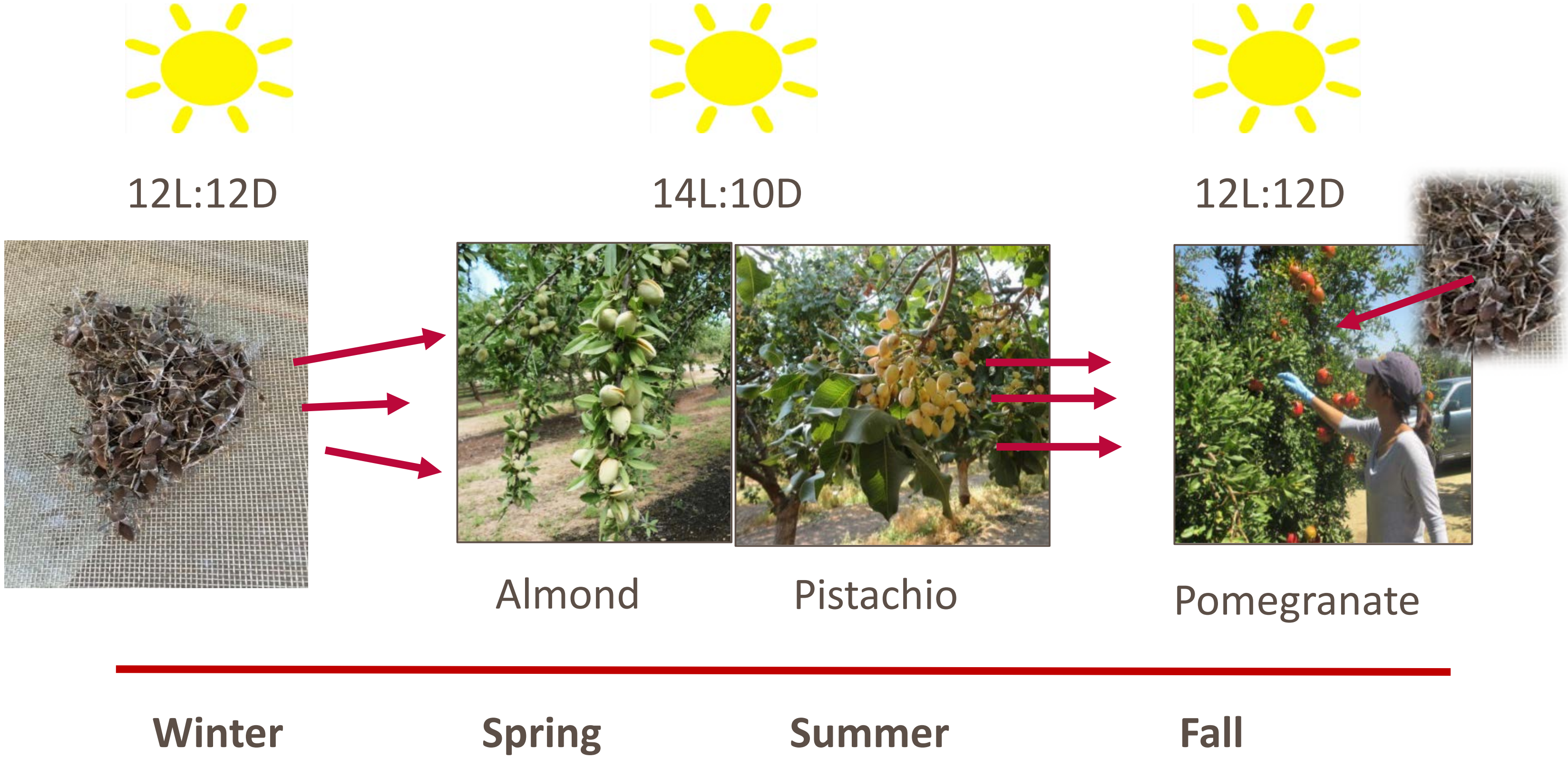
LEAFFOOTED BUGS AND ALMOND DAMAGE

- *Leptoglossus zonatus*
  - Large insect with several generations per year
  - Nymphs are orange and they aggregate
  - Has become more abundant than *L. clypealis*
    - Two genetic types of *L. zonatus*- it may be invasive

      (Joyce et al. 2017)
  - *L. zonatus* is difficult to detect and to sample
  - Damage from *L. zonatus* feeding
    - April-May: Almonds have clear sap ('gummosis')
    - May-June-July: Feeding causes kernel damage
    - Few insecticides are effective for *L. zonatus*
    - Research is underway on plant and insect based attractants



AGGREGATION AND DISPERSAL BEHAVIOR OF *L. ZONATUS*



RESEARCH OBJECTIVES

Objective 1:

- Determine which factors result in formation of aggregations or attraction of *L. zonatus* under lab conditions
  - Attraction of Adult *L. zonatus* investigated in Lab Wind Tunnel
    - 1a: Determine Age of Insects to Use for Experiments
    - 1b: Determine Relative Attraction of Adults to Odor Combinations

Objective 2:

- Determine which factors result in formation of aggregations or attraction of *L. zonatus* in the field

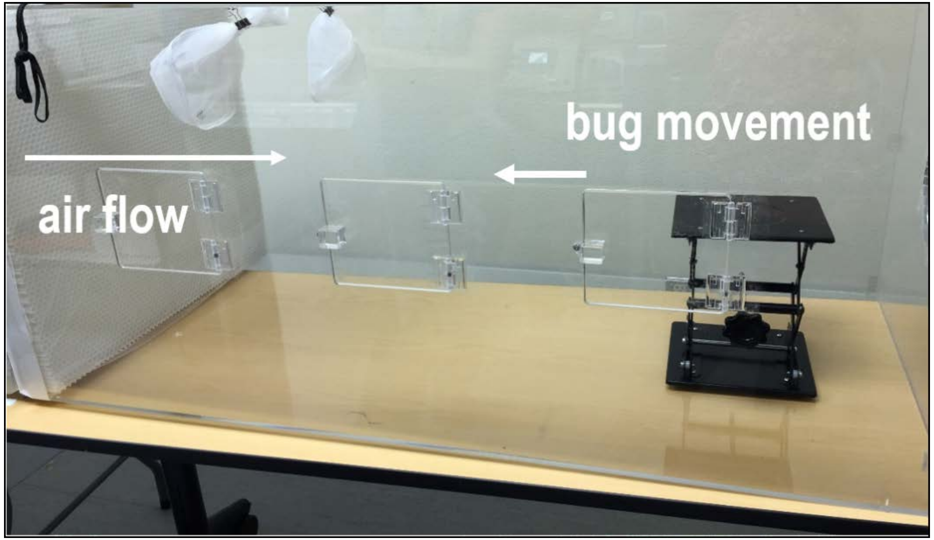
Objective 3:

- Determine which factors result in dispersal of *L. zonatus* from aggregations under lab and field conditions

DUAL-CHOICE ATTRACTION EXPERIMENTS IN WIND TUNNEL

Objective 1:
Determine which factors/cues result in formation of aggregations or attraction of *L. zonatus* in lab

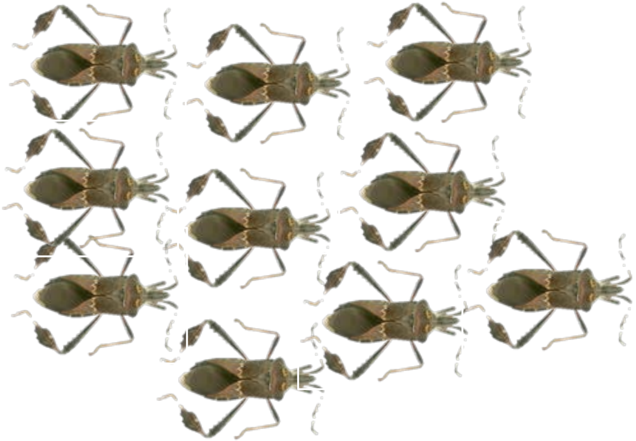
Methods:
-Nymphs isolated, and raised into virgin adults
-Male and Females were caged in separate rooms
-4 week old unmated Male & Female adults used
-All trials included almond branches
-Insects used for only one trial
-Each trial 15 min., 25 or more trials per Exp.



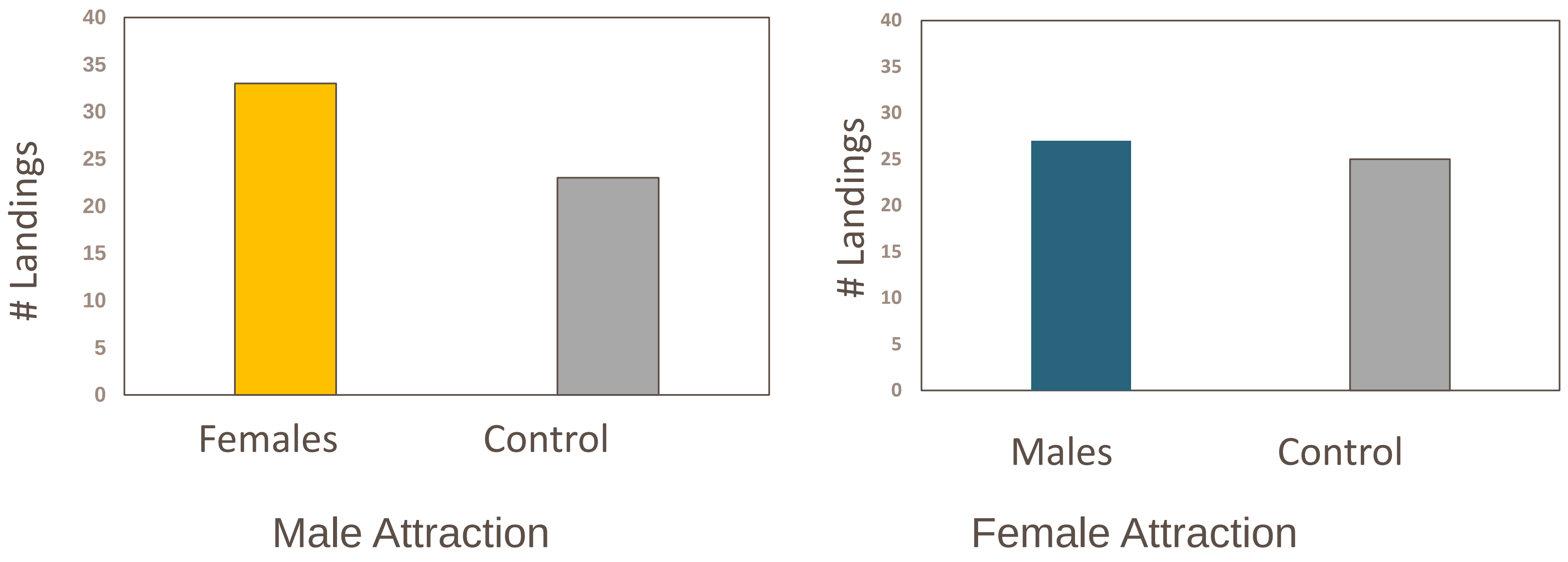
Comparisons
1. Are males attracted to females?
2. Are females attracted to males?
3. Male attraction to male vs. female
4. Female attraction to male vs. female
5. Male attraction to mating pairs vs. females
6. Male attraction to mating pairs vs. controls

EXAMPLE: ATTRACTION EXPERIMENTS IN WIND TUNNEL

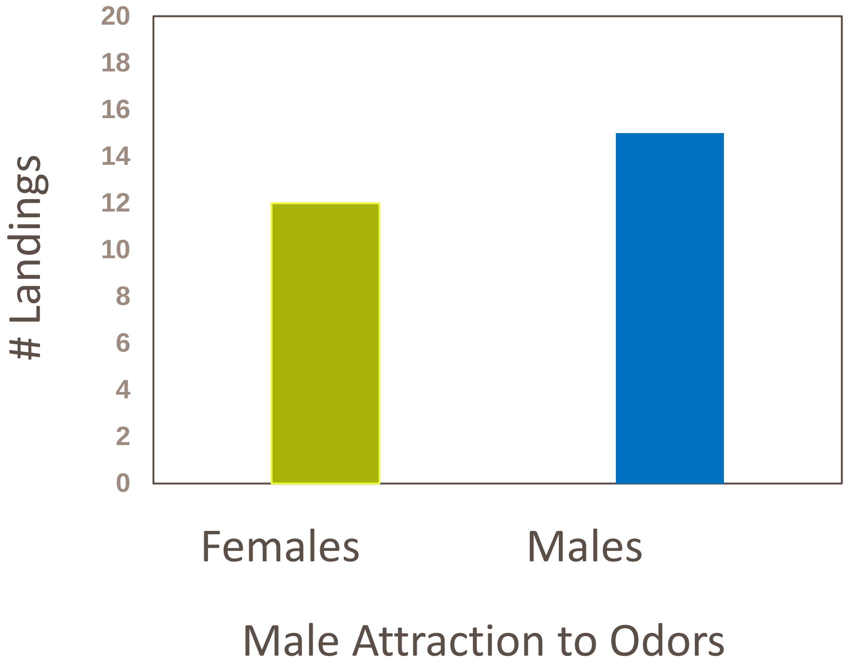
- Interested in *Flight of LFPB to an Odor Source*
- Lab Experiments run before Field Experiments, to Determine Most Attractive Odors
- Example, **Experiment 1**
  - 2 Odor Sources in Wind Tunnel
    - 10 Females on Almond Branch vs. Control Almond Branch
  - Males released, observed 30 min.
  - Recorded:
    - Number of landings on odors
    - Time spent on odors
    - Time elapsed until flying to an odor source

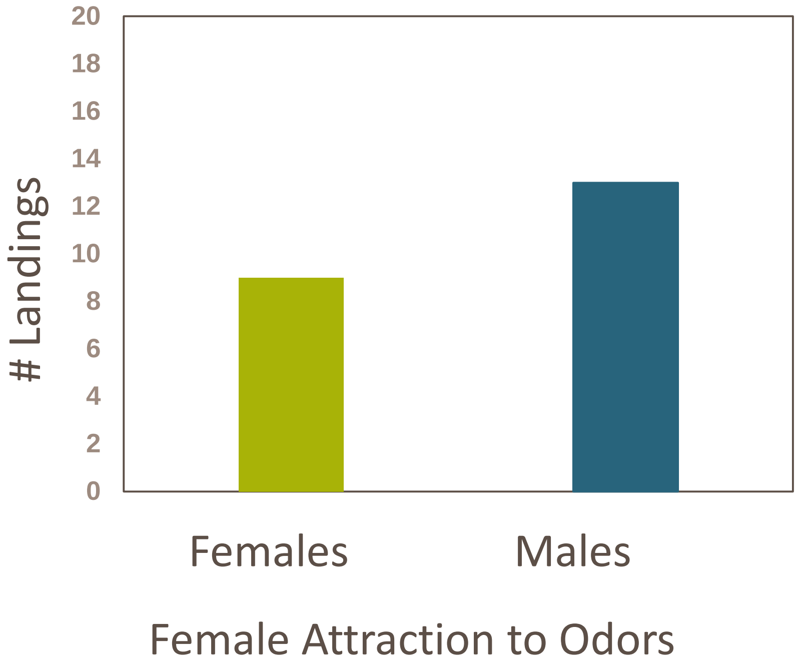


ATTRACTION EXPERIMENTS IN WIND TUNNEL

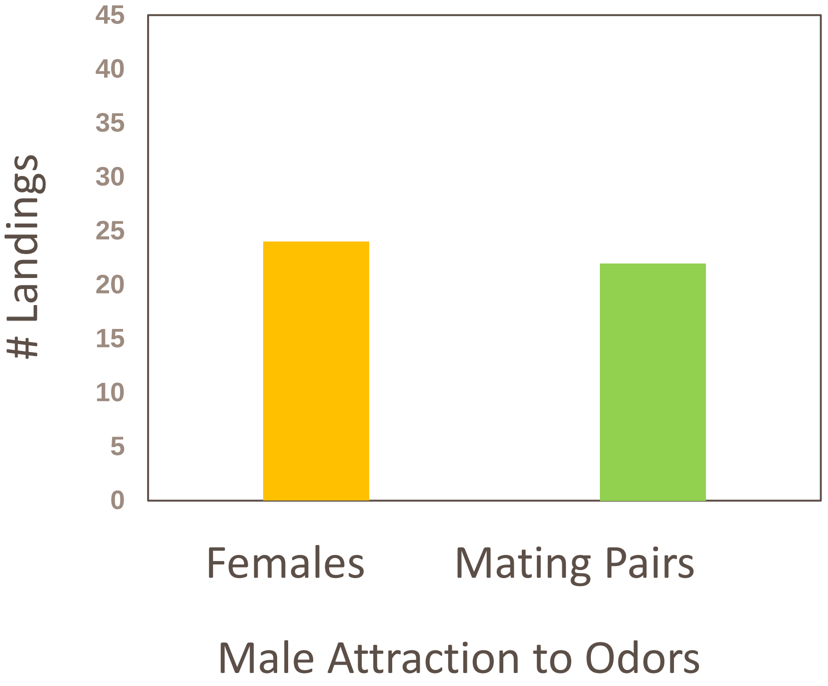


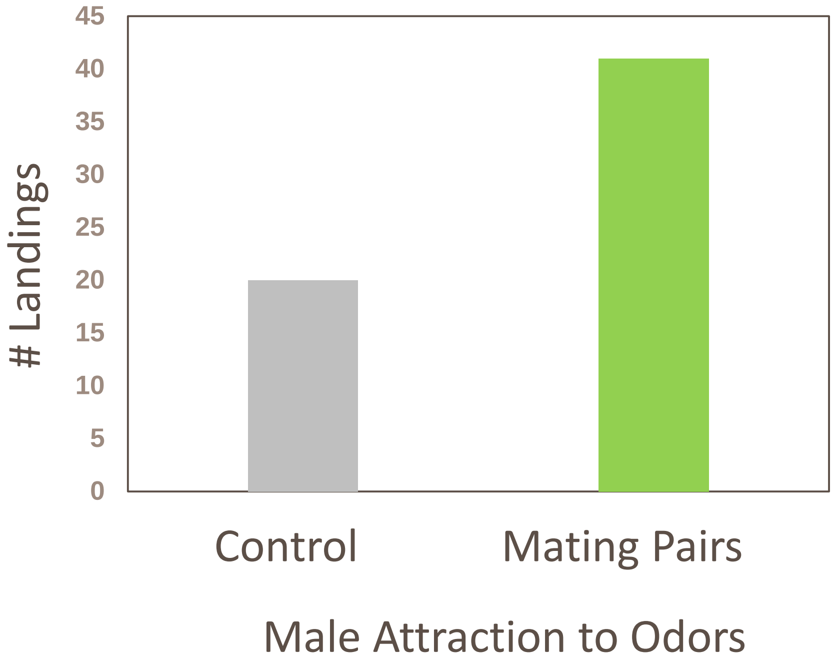
ATTRACTION EXPERIMENTS IN WIND TUNNEL





ATTRACTION EXPERIMENTS IN WIND TUNNEL





CONCLUSIONS AND FUTURE WORK

- *L. zonatus* adults at least 3 weeks old are sexually attractive
- Sexually mature females attracted males
- Now finishing attraction to Mating Pairs in Wind Tunnel
- Field traps with adults insects will be tested in spring
- Dispersal from Aggregations will be Monitored and Associated with temperature

ACKNOWLEDGEMENTS

The Almond Board of California

Danny Hernandez

Apurba Barman

Eunis Hernandez

and Cassandra Strizak at UC Merced

DEVELOPING SAMPLING METHODS FOR PRE-SEASON MITE DETECTION IN ALMONDS

Jhalendra Rijal[1] and Kris Tollerup

[1]UC Cooperative Extension-Stanislaus, Modesto, CA

[2] UC Kearney Agriculture Research and Extension Center, Parlier, CA

MITES IN ALMOND ORCHARDS

- There are three types of mite species reported in almonds
  - European red mites
  - Brown almond mites
  - Webspinning spider mites (two-spotted, pacific, strawberry)
- Webspinning is one of the major arthropod pests in almonds
- Mite feeding causes stippling, yellowing, and falling off of leaves from the trees
- During winter, spider mites overwinter in orchard floor and move back to the trees in spring/early summer

Webspinning spider mites

Brown mites

European red mite

PROJECT OBJECTIVES

- Characterize mite overwintering locations in the soil in relation to tree trunk
- Determine the soil depth in which overwintering mites are abundant
- Identify the time of the year in which spider mites are moving from soil to the trees (using trunk-band traps)



PROJECT OBJECTIVES

Characterize mite overwintering locations in the soil in relation to tree trunk

- 3 sites (Stanislaus and Fresno)
- Collected winter soil samples and processed (From one site: 7 samples each of 12 trees)
- ~1 square foot area and top 2-inch deep soil
- Additional soil sample from the surface

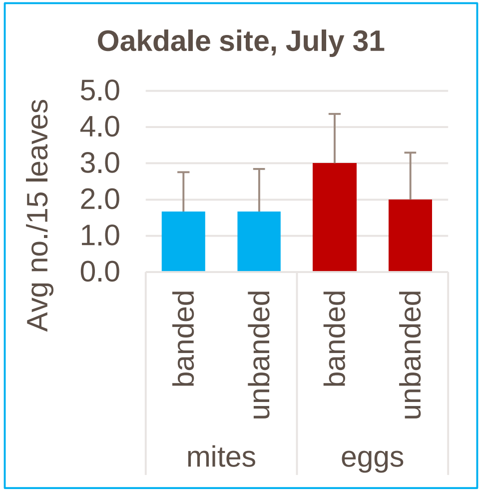
PROJECT OBJECTIVES

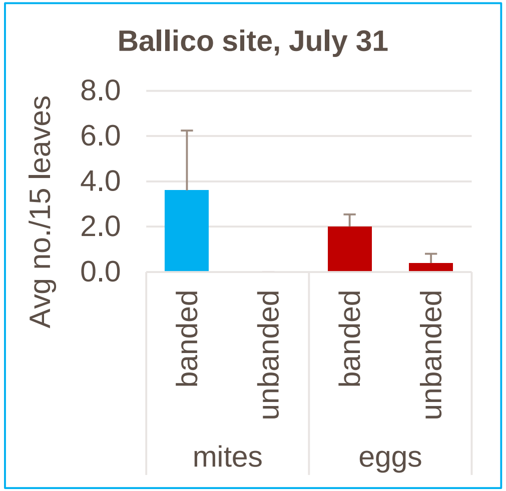
Identify the time of the year in which spider mites move from the soil to the trees using band traps

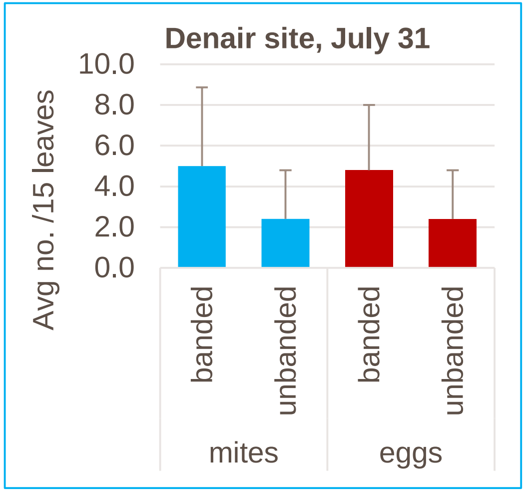
- 5 sites (Stanislaus, Merced and Fresno Counties)
- We used tree-band trap design that was used in the past (Zalom et al. 1995) with some modifications
- NSJV (Oakdale, Denair, Ballico, UCCE): Traps placed between 30 March-3 July (3-5 times)
- SSJV (Five Points): 6 April – 30 June (6 times)
- Traps were evaluated in the lab under microscope

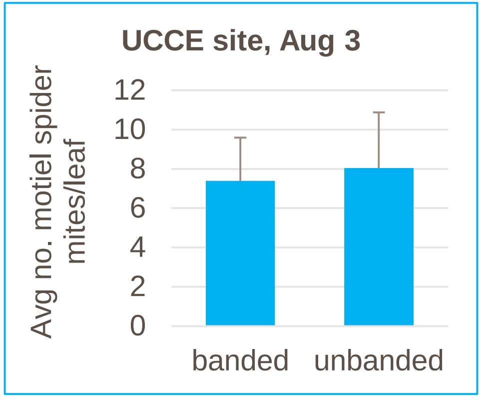
No spider mites were recovered from the tree-bands, instead brown-looking mites (very close to almond brown mites) were recovered. Positive ID: Clover mite, *Bryobia praetiosa*

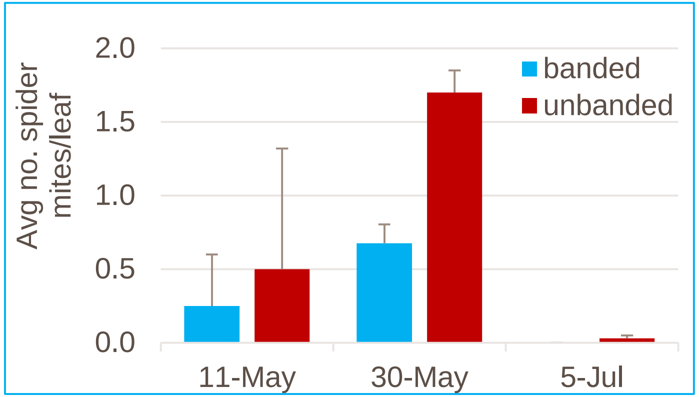
WEBSPINNING SPIDER MITES FROM LEAF SAMPLES



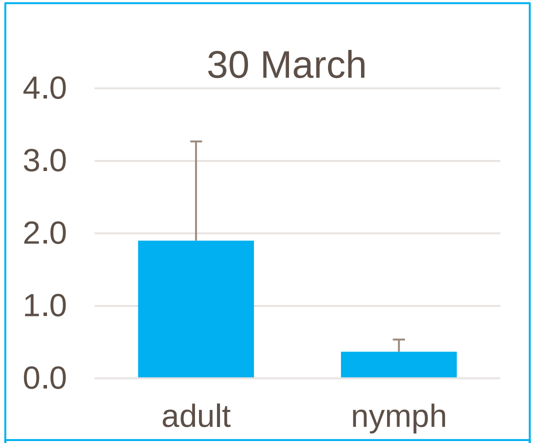


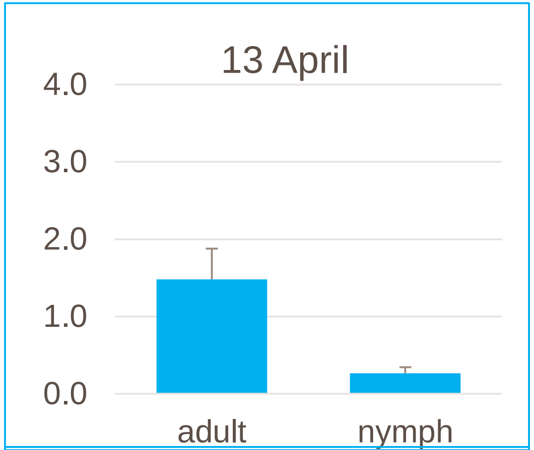


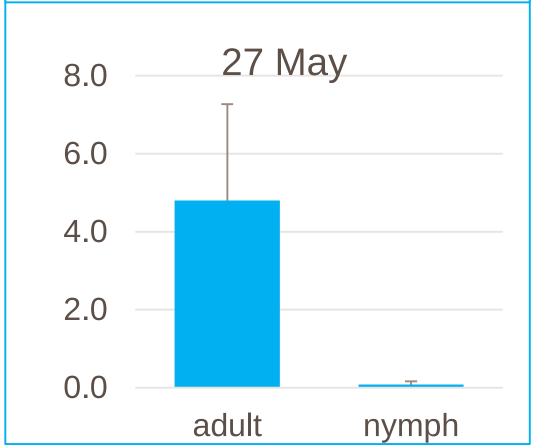


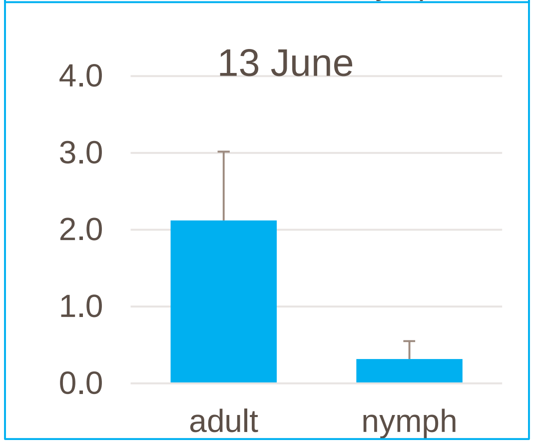


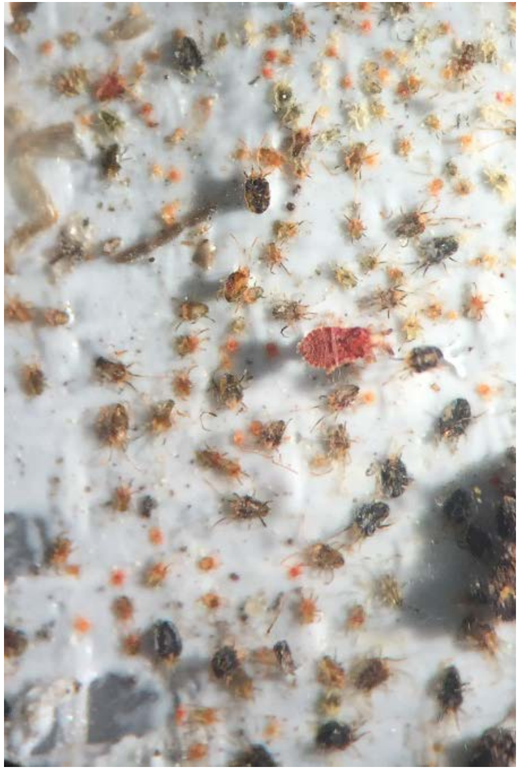
AVG. MITES/CM TREE-BAND FROM OAKDALE SITE, NSJV



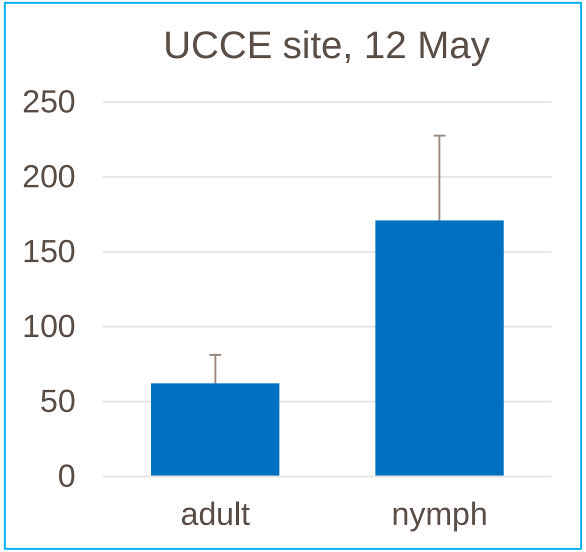


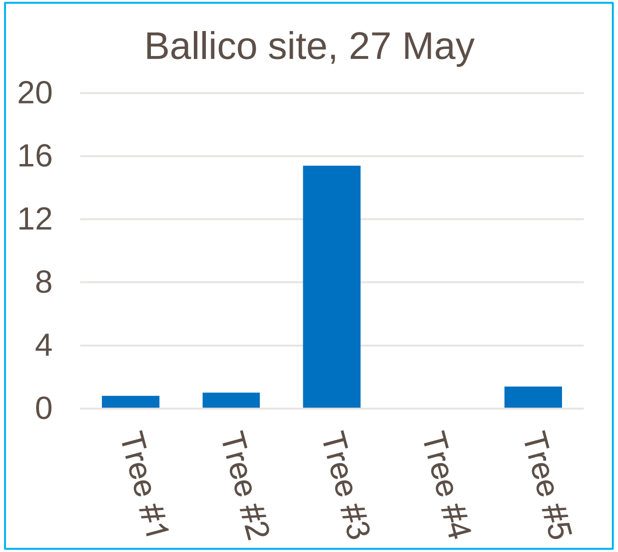


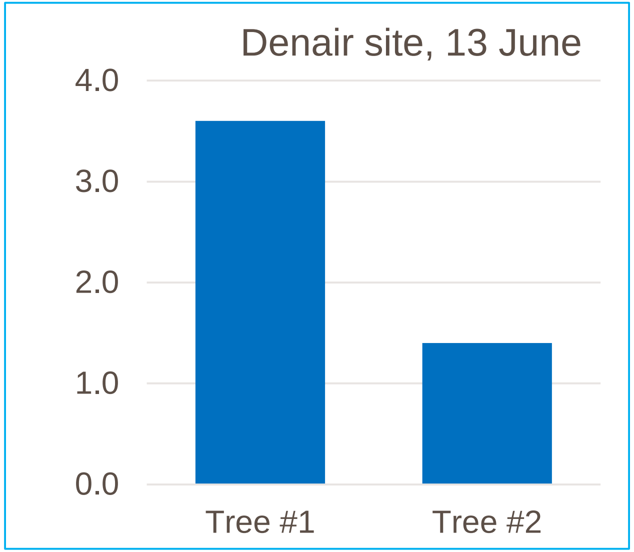




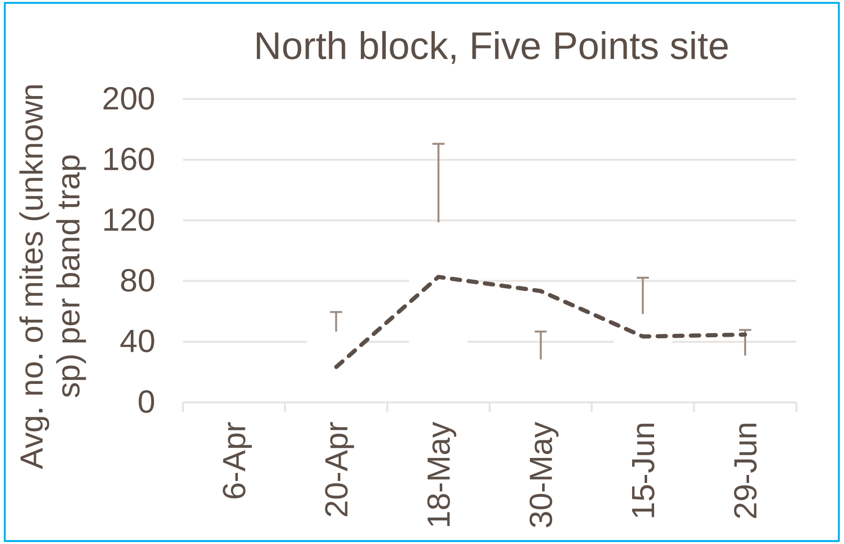
AVG. MITES/CM TREE-BAND FROM 3 SITES, NSJV

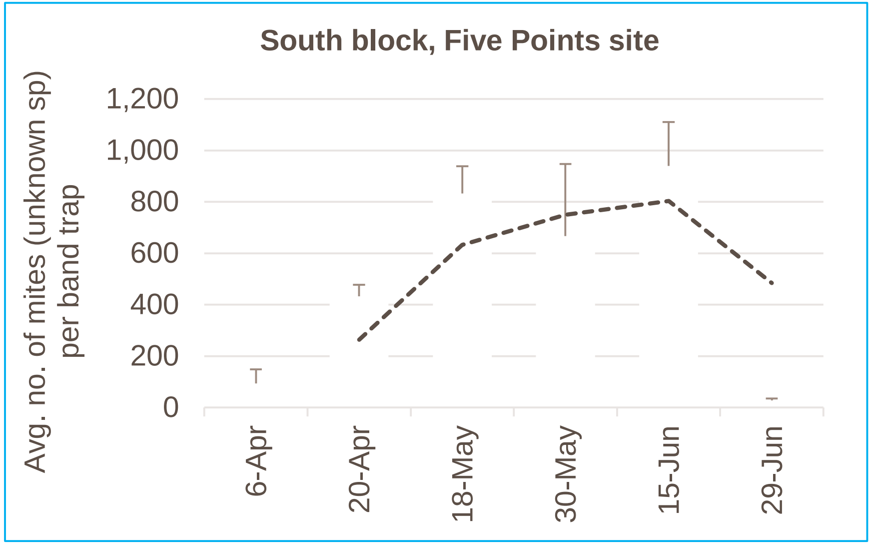






AVG. MITES/CM TREE-BAND FROM FIVE POINTS, SSJV





CONCLUSION AND RECOMMENDATION

- Overwintering mites were not recovered from soil samples (surface to the 2-inch deep, from different distance from the tree (base, 3 ft, 6 ft), and also from tree-band traps.
- Substantial number of “brown mites” were recovered from the tree-band traps, most likely clover mite, *Bryobia praetiosa* (based on initial identification)
- Use of tree-band traps (i.e., 2-inch wide duct tape encircling the tree trunk) from late February- April should help in detecting brown mite presence in the orchard.

IMPROVING INTEGRATED PEST MANAGEMENT OF SPIDER MITES ON ALMOND

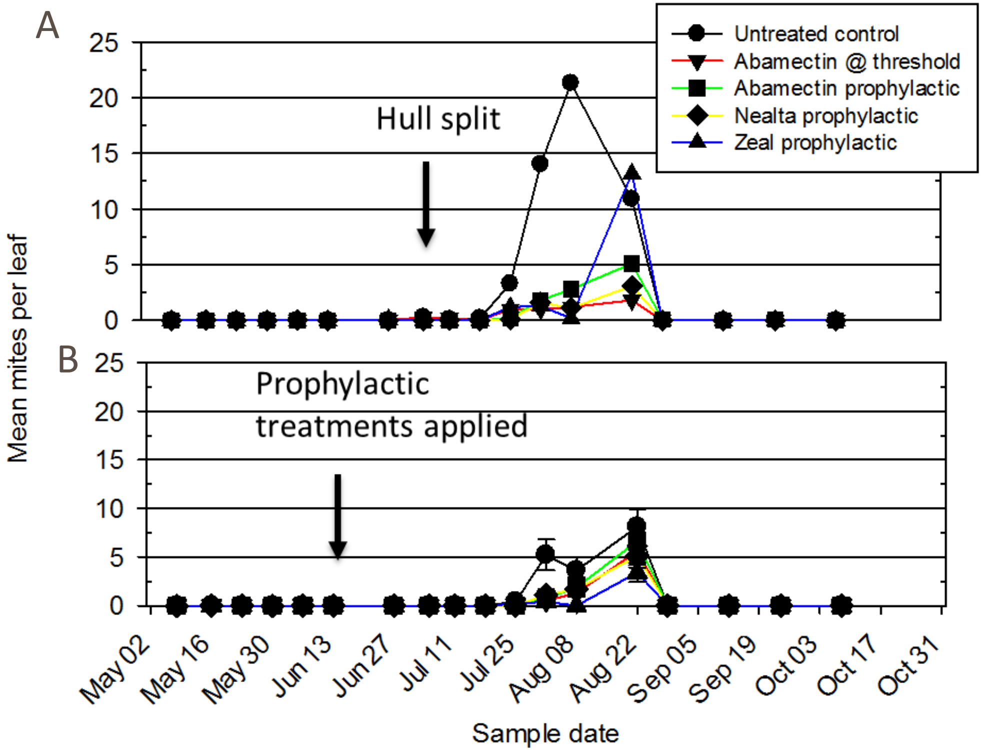
Kris Tollerup, UC Cooperative Extension, Area IPM Advisor, Kearney Ag Station, Parlier

MITICIDE APPLICATION TIMINGS: ARE PROPHYLACTIC SPRAYS EFFECTIVE?

- Experiments
  - Plots each ~17 acre at Wonderful Orchards.
  - Treatments: Abamectin, Nealta, and Zeal.
  - Monitored from May to Oct. (2016), and May to Sept. (2017).
  - Monitored for natural enemies (2017).
  - Collected field populations of Pacific mite and evaluated for abamectin resistance using laboratory bioassays.

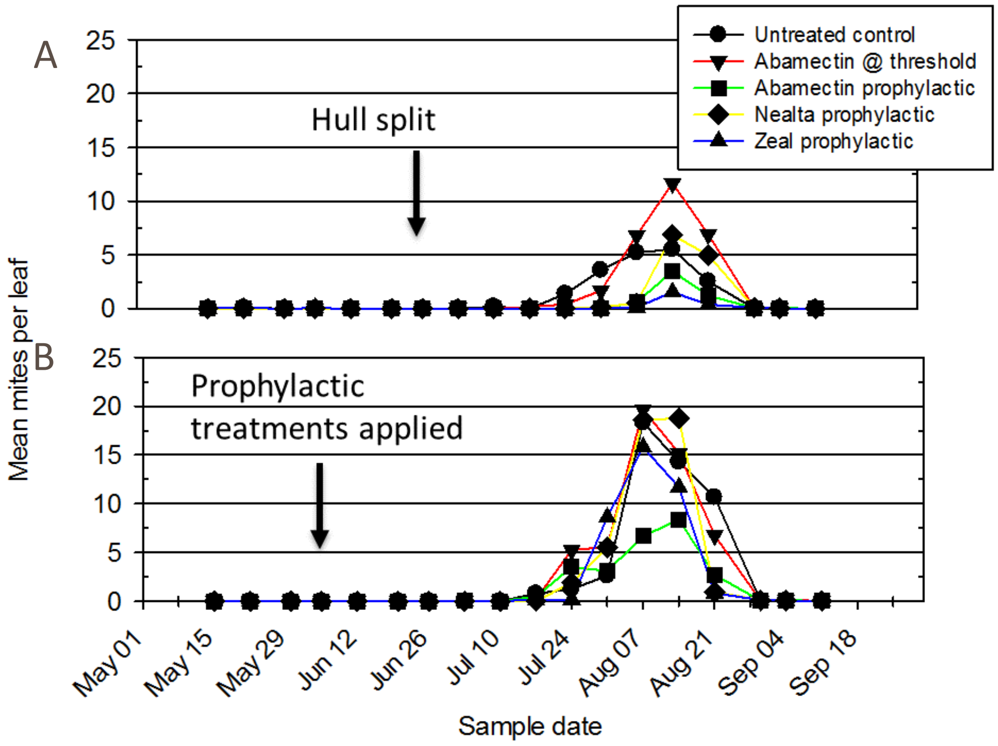
MITICIDE APPLICATION TIMINGS: ARE PROPHYLACTIC SPRAYS EFFECTIVE?

- Results 2016
  - Mean spider mites, sites A and B.



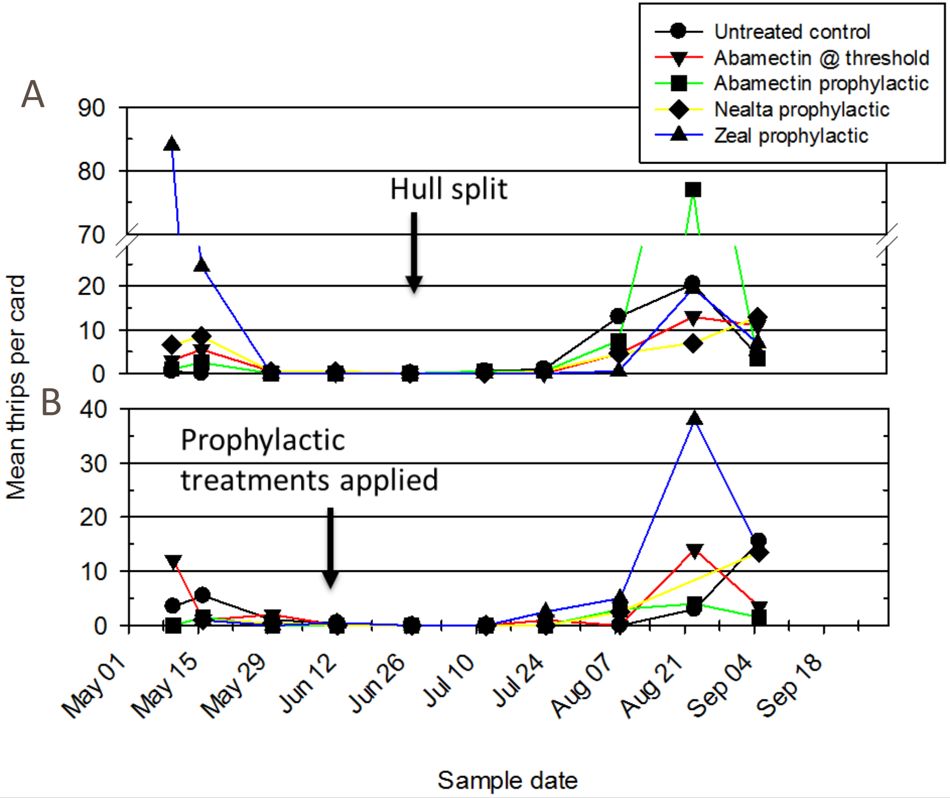
MITICIDE APPLICATION TIMINGS: ARE PROPHYLACTIC SPRAYS EFFECTIVE?

- Results 2017
  - Mean spider mites, sites A and B.



MITICIDE APPLICATION TIMINGS: ARE PROPHYLACTIC SPRAYS EFFECTIVE?

- Results 2017
  - Mean sixspotted thrips/yellow sticky card, sites A and B.



HAVE SPIDER MITE POPULATIONS IN THE SJV DEVELOPED RESISTANCE TO ABAMECTIN?

- Results, field-collected mites from 7 locations, 2017

Population	Location	Species
SUS1	University of California, Kearney Ag Station	*T. pacificus*
SUS2	University of California, Davis, Zalom laboratory	*T. urticae*
TULCO1	Tulare, Tulare Co	*T. pacificus*
KERCO1	Corcoran, Kern Co	*T. pacificus*
KERCO2	McFarland, Kern Co	*T. pacificus*
FRSCO1	Navelencia, Fresno Co	*T. pacificus*
FRSCO2	Fresno, Fresno Co	*T. pacificus*
FRSCO3	Raisin City, Fresno Co	*T. pacificus*
FRSCO4	University of California, Westside Field Station	*T. pacificus*

HAVE SPIDER MITE POPULATIONS IN THE SJV DEVELOPED RESISTANCE TO ABAMECTIN?

- Results, laboratory bioassays, 2017

Population	n	Slope (SEM)	X^2	LC50 (95% CL), ppm	Resistance ratio
SUS1	445	1.33 (0.17)	59.8	0.39 (0.27 - 0.52)	-
SUS2	593	1.38 (0.15)	90.6	0.38 (0.30 - 0.49	-
FRSCO1	945	1.50 (0.16)	84.1	1.16 (0.98 - 1.14)	**2.97**
FRSCO2	216		0.15		
FRSCO3	610	0.72 (0.14)	27.9	6.24 (3.63 - 12.77)	**16**
FRSCO4	375	2.04 (0.44)	20.96	1.96 (1.5 - 3.19)	**5.02**
KNGSCO1	469		2.08		
KERCO1	382		0.59		
TULCO1	376	0.53 (0.21)	6.71	5.11 (1.83 - 2375)	**13.1**

ATTRACTANTS FOR LEAFFOOTED BUG

Sean Halloran[1], Tessa Shates[1], Kent Daane[2], Houston Wilson[1], Jocelyn Millar[1]

[1] Department of Entomology, University of California, Riverside, CA 92521
[2] Department of Env. Sci. Policy, and Management, University of California, Berkeley, CA, 94720

POTENTIAL CHEMICAL AGGREGATION CUES:

1. “Alarm” & Defensive Secretions (both sexes)

2. Summer-form long-range aggregation pheromones (male only?)

3. Overwintering aggregation pheromones (both sexes?)

http://www.westernfarmpress.com/tree-nuts/almond-growers-urged-watch-leaffooted-bug

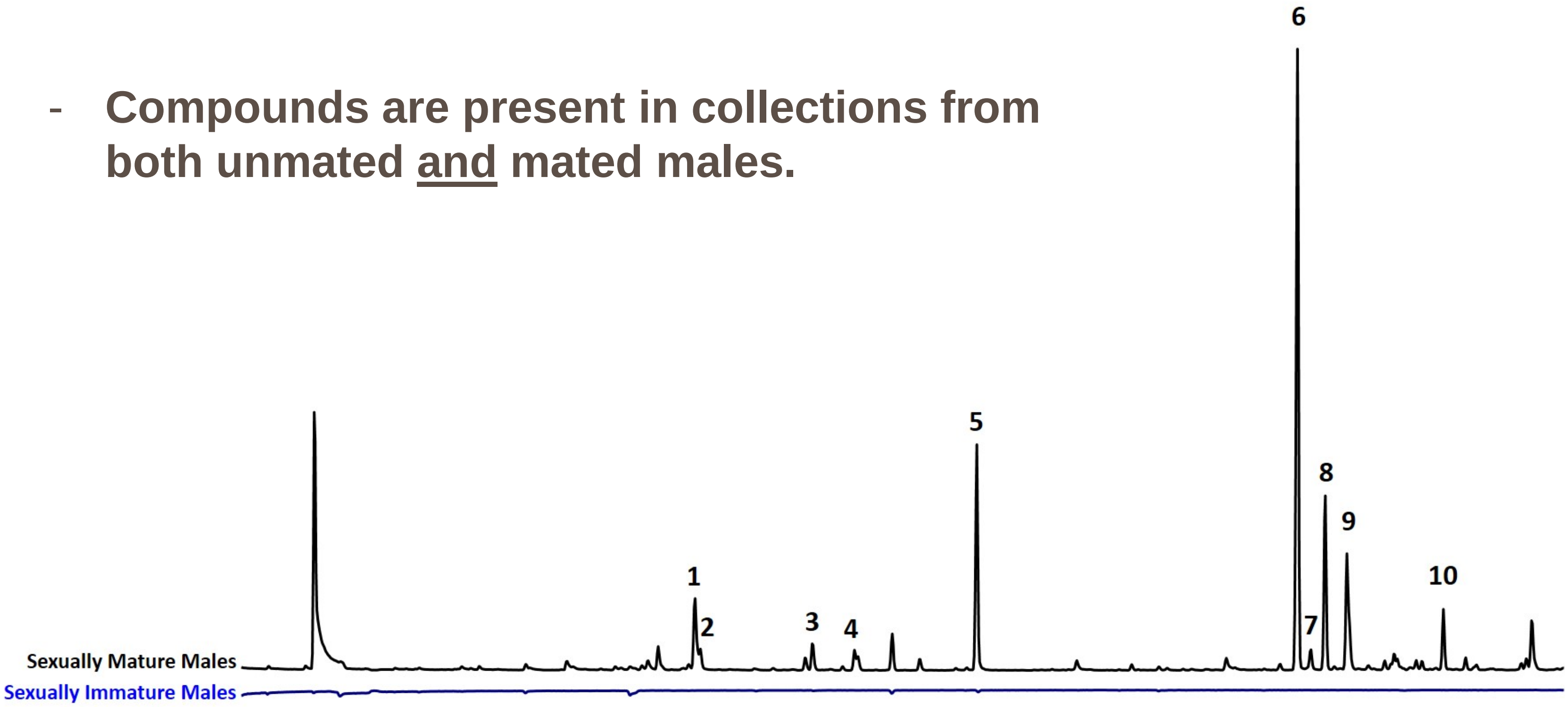
COLLECTION OF *LEPTOGLOSSUS ZONATUS* VOLATILES

- Treatments aerated:
    - Male or Female
    - Sexually immature
    - Sexually mature unmated
    - Sexually mature mated
    - Individuals or groups

- Collections were carried out over 24 hour periods

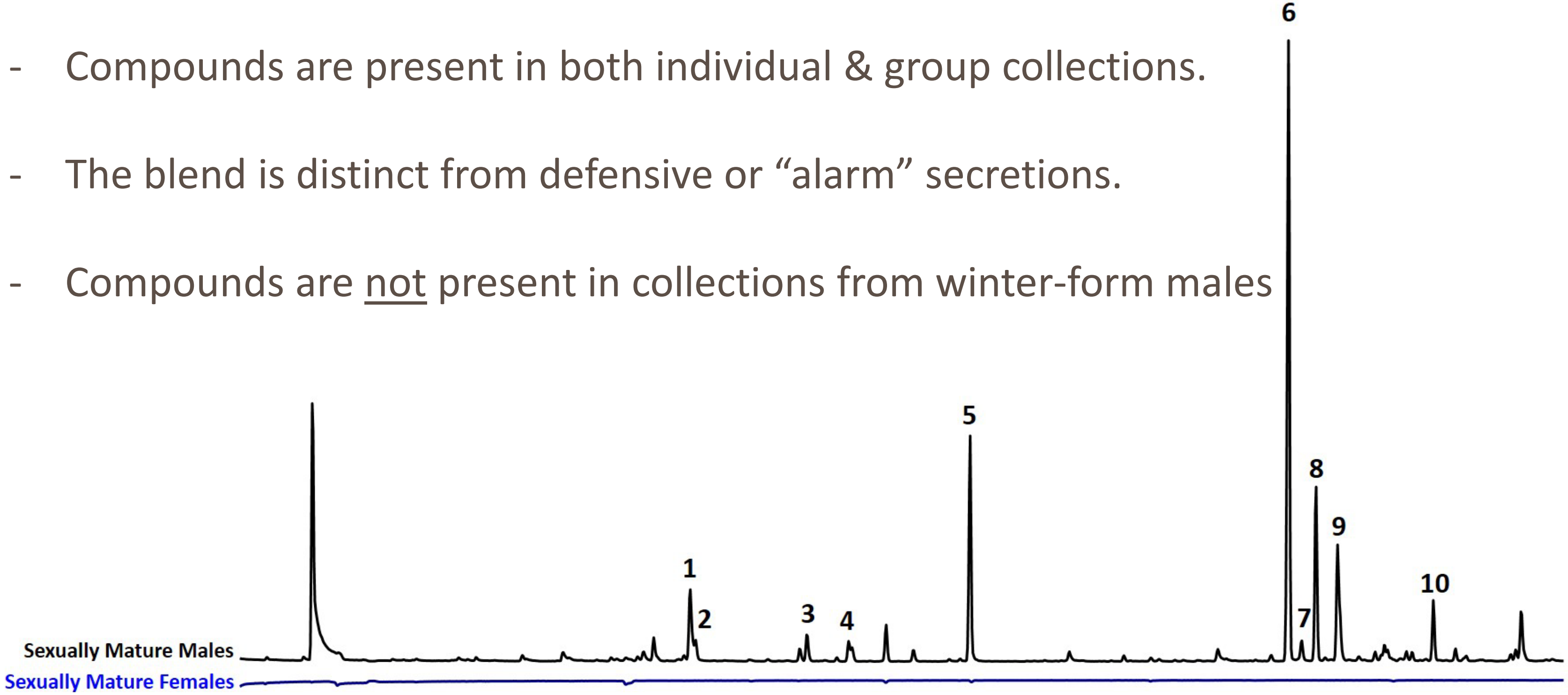
SEXUALLY MATURE MALE *L. ZONATUS* RELEASE A DISTINCT VOLATILE BLEND

- **Compounds are present in collections from both unmated and mated males.**

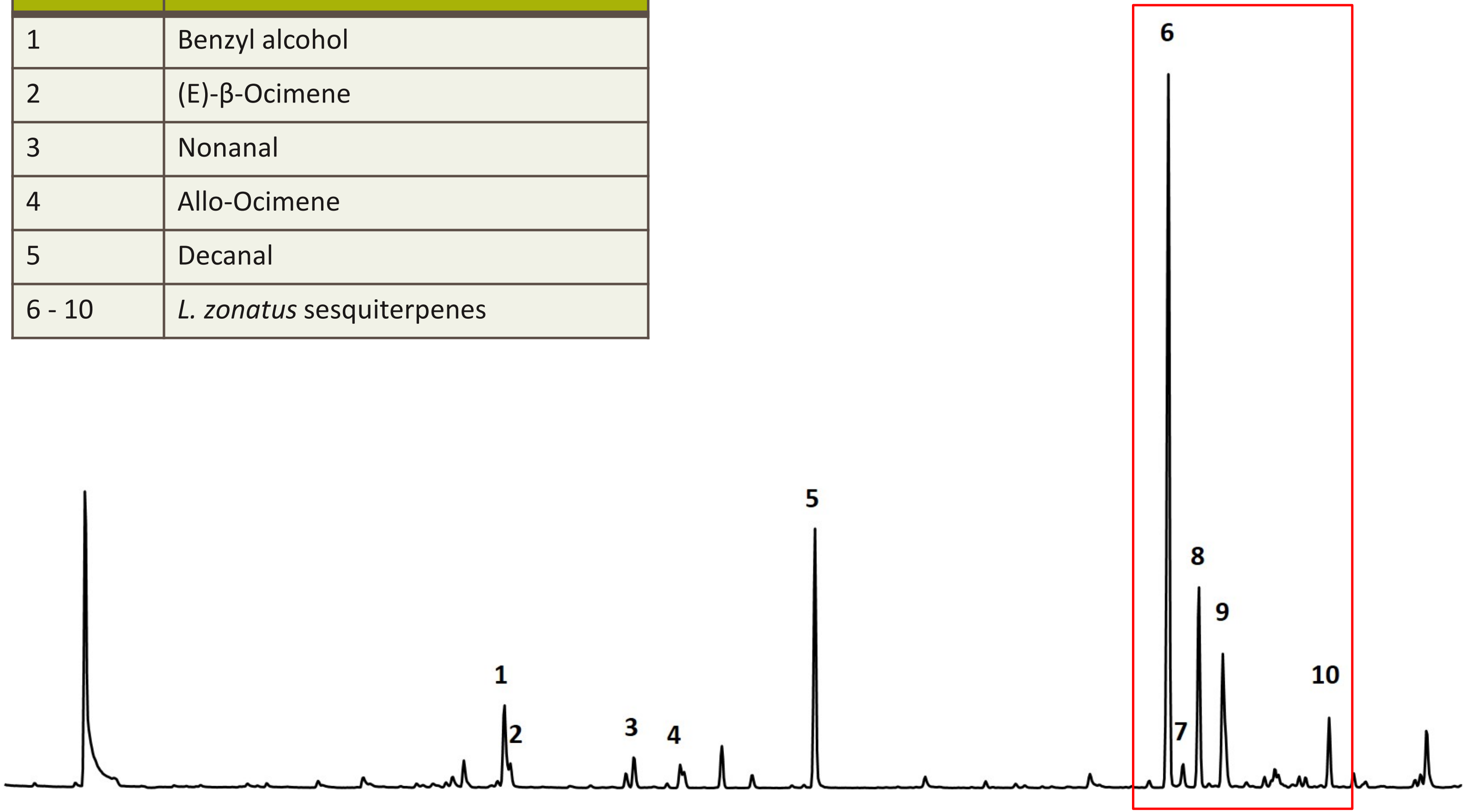


THE MATURE MALE VOLATILE BLEND IS DISTINCT FROM SEXUALLY MATURE FEMALES

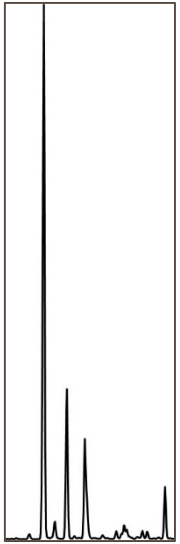
- Compounds are present in both individual & group collections.
- The blend is distinct from defensive or “alarm” secretions.
- Compounds are <u>not</u> present in collections from winter-form males

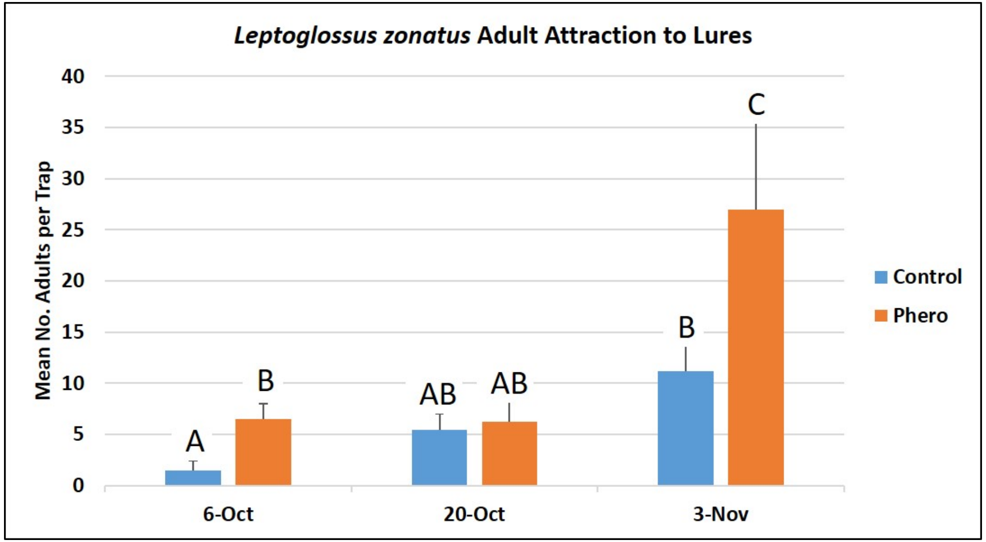


Peak #	Identity
1	Benzyl alcohol
2	(E)-β-Ocimene
3	Nonanal
4	Allo-Ocimene
5	Decanal
6 - 10	*L. zonatus* sesquiterpenes



FIELD BIOASSAY SHOWS *L. ZONATUS* ATTRACTION





ONGOING WORK…

- Analysis of cuticular hydrocarbons of winter and summer males & females (see poster)
  - *L. zonatus* & *L. clypealis*
- Obtained *L. clypealis* colony for repeating these experiments
- Male ventral abdominal gland dissections

ACKNOWLEDGEMENTS

- Jeff Aldrich
- Steve McElfresh

- We gratefully acknowledge funding from the Almond Board and the Administrative Committee for Pistachios for financial support of this work.

Diagnostics and Non-Fumigant Management Approaches for Prunus Replant Disease

Greg Browne and Amisha Poret-Peterson
USDA-ARS, Davis, CA

Cooperating:
Natalia Ott, Wisnu Wicaksono, Brent Holtz, Mohammad Yaghmour, Gurreet Brar, Amelie Gaudin, Mae Culumber, Andreas Westphal, David Doll, Bruce Lampinen, Sam Metcalf, Mike Stanghellini

Acknowledgements:

- Almond Board of California
- California Department of Pesticide Regulation
- TriCal, Inc.
- Wonderful Orchards
- California State University, Fresno
- Kearney Research and Education Center

california almonds
Almond Board of California

Objective 1. Diagnostics for replant disease

- **Successive almond plantings are subject to replant challenges** that suppress growth and productivity.
- **Replant disease** (growth suppression induced by soil microbial complexes) can be a key replant challenge, depending on site.
- **Additional factors** can include old orchard residues, pests and pathogens, soil texture and fertility, rootstocks, preplant soil treatments, including fumigation.
- **Goal is molecular diagnostics and knowledge that support integrated management of replant disease and contributing factors.**

Replant growth suppression in non-fumigated control plot (foreground) vs. healthy growth in fumigated plot (background). Site not impacted by nematodes.

Approach: Objective 1, Diagnostics for Replant Disease.

Roots, soil collected pre- and post-plant.

Multiple trials, orchards

"Pipeline" for PCR and HTS of DNA and RNA from bacteria, fungi, oomycetes

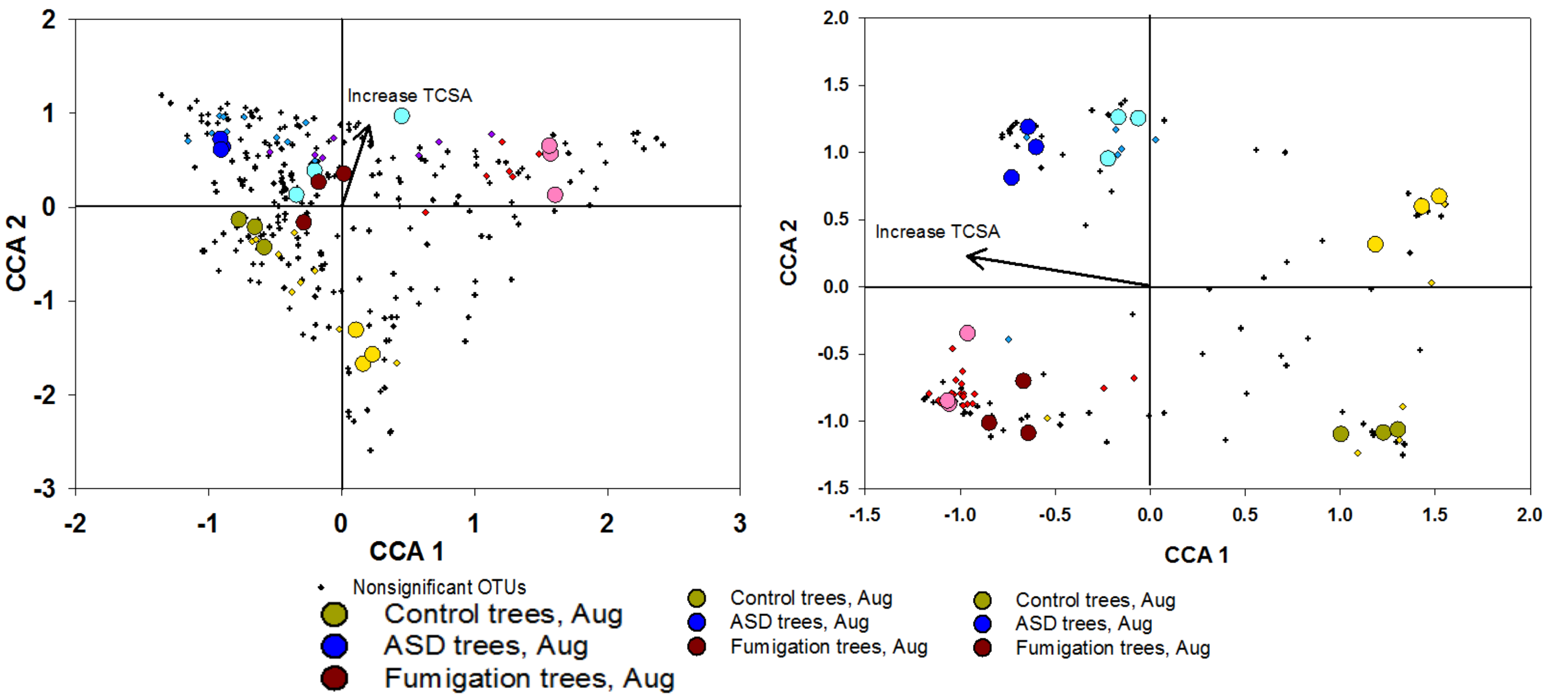
DNA, RNA extraction, purification → PCR Amplification of diagnostic regions from the DNA, RNA → High-throughput sequencing (HTS) of the diagnostic regions → Bioinformatics e.g., quality control, statistical analysis

Identification of organisms and markers well-linked to replanted orchard performance; quantitative verifications

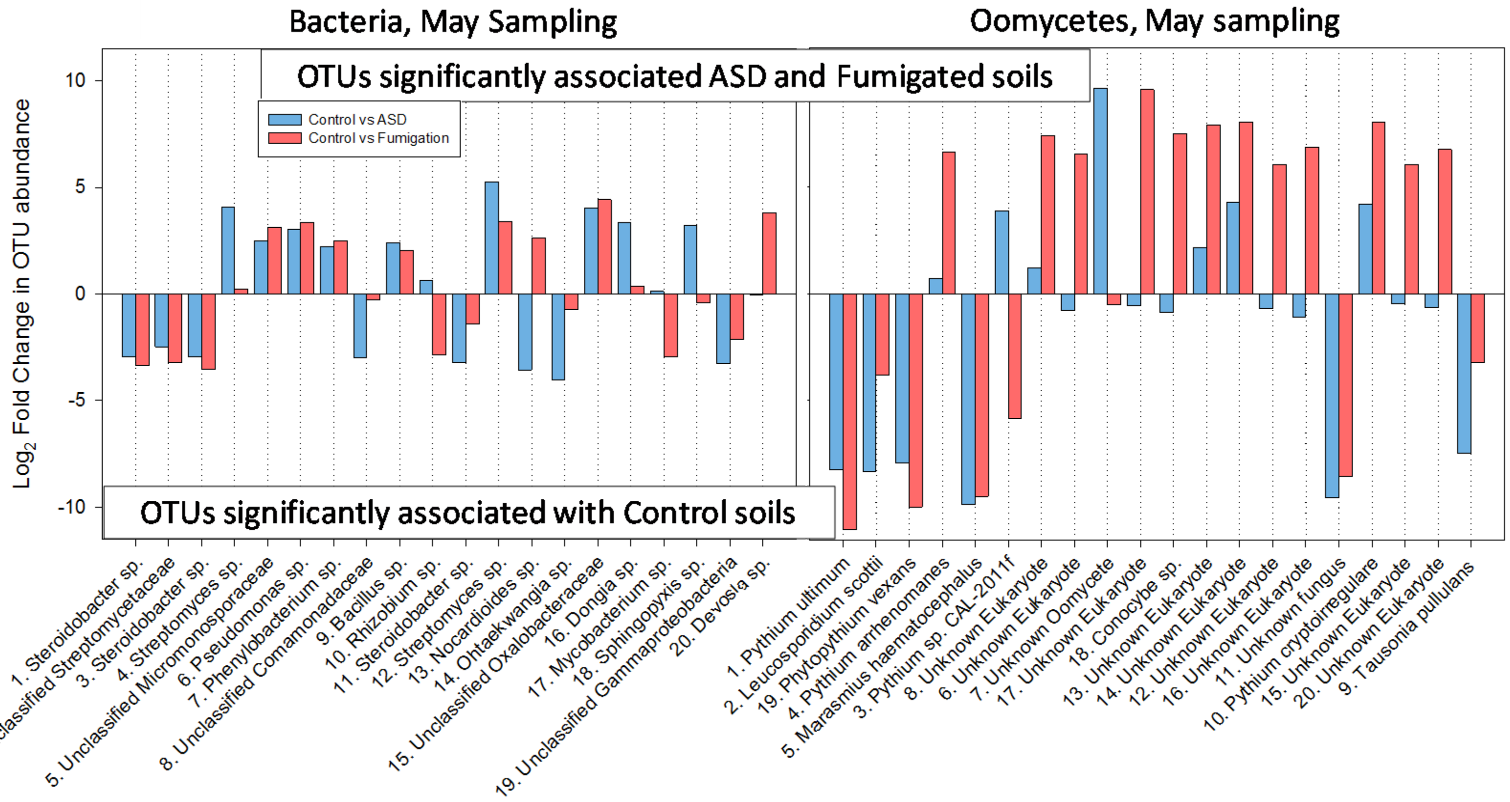
Validation (culturing, pathogenicity testing, orchard trials)

Canonical correspondence analysis, relating organism abundances to tree growth

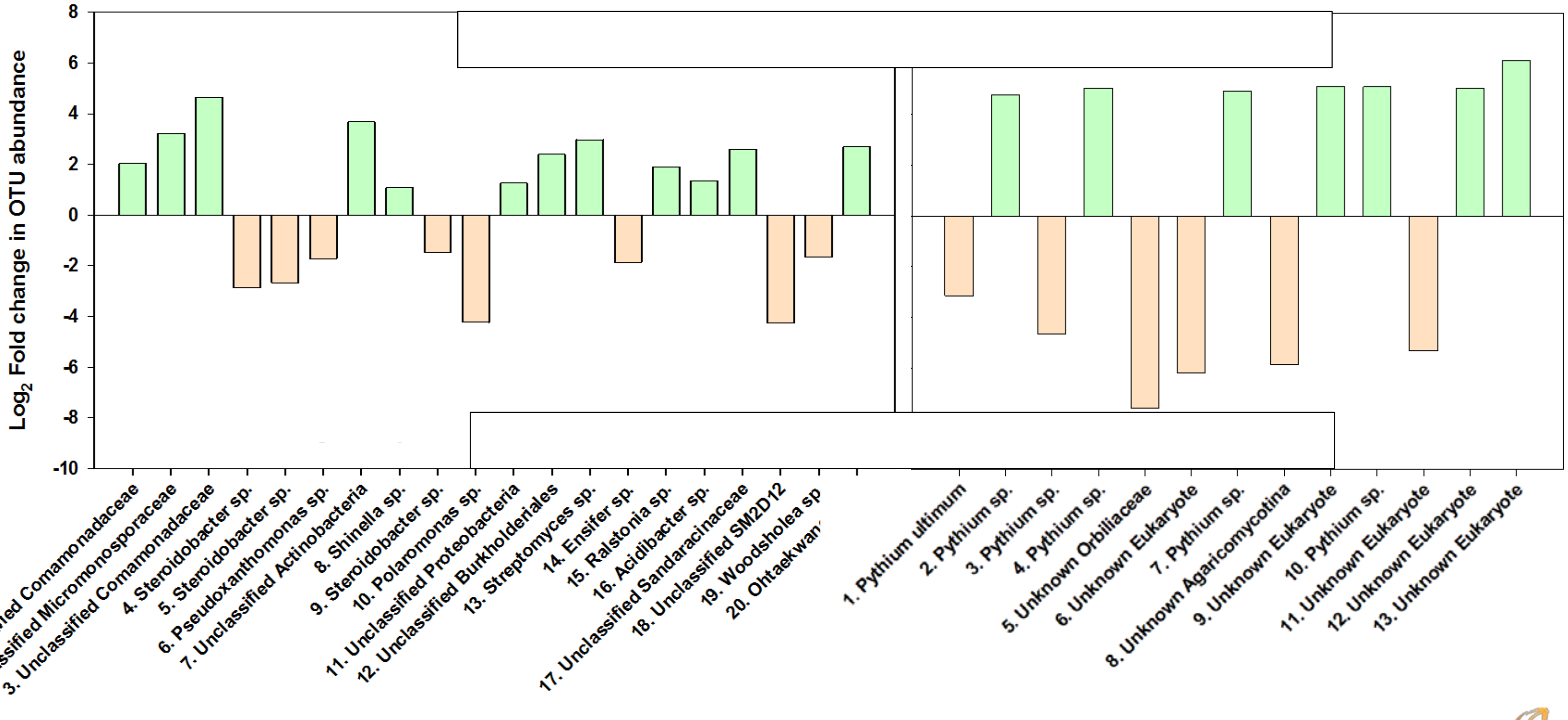
From K



DESeq2 analysis, relating specific organism abundances to tree growth



From CA orchard replant soil study:
DESeq2 analysis of PRD-inducing vs non-PRD-inducing orchard soils

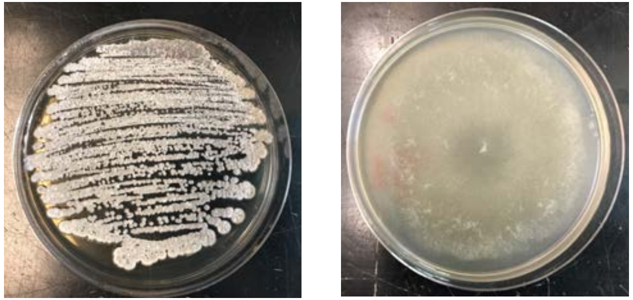


Progress, Objective 1, diagnostics for replant disease.

Among samples from nine orchard replant soils in Sacramento and San Joaquin Valley, we found (in and on roots from greenhouse & field trials):

Associated with orchard growth suppression:
- *Steroidobacter* sp. (several OTUs)
- Streptomycetaceae bacterium (1 OTU)
- *Pythium ultimum*
- *Ceratobasidum* sp

Associated with growth stimulation:
- Treatment-specific, many OTUs in fumigation and ASD treatments
- Most diverse in ASD treatments



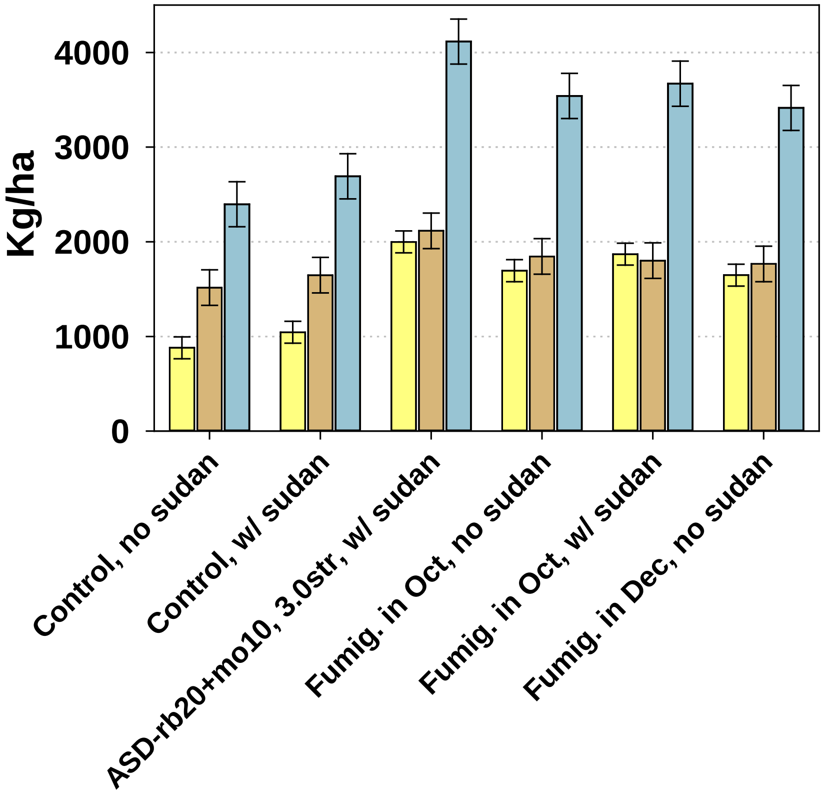
- **Culturing**
- **Pathogenicity testing**
- **Quantitative PCR**
- **Orchard sample testing**

Objective 2. Non-fumigant management approaches for replant disease.
Our focus is anaerobic soil disinfestation (ASD) = biosolarization.

- **Orchard replant trials w/ ASD:**
  - 2013: Parlier (2)
  - 2014: Parlier (2)
  - 2016: Parlier (2) & Kern Co. (4)
  - 2017: CSUF (2)
- **Treatments among trials include:**
  - Fumigation standards (strip and GPS-spot)
  - Nine alternative carbon substrates, three almond hull/shell substrate rates.
  - Factorial combinations of water, tarp, substrate, whole orchard recycling (+/- ea.)
  - Supplementary nitrogen (+/-)
  - Rootstocks of Nemaguard and Hansen 536
- **Goal is ASD efficacy & practicality for least real cost.**




Yield summary, representative first-generation ASD replant trial, Parlier

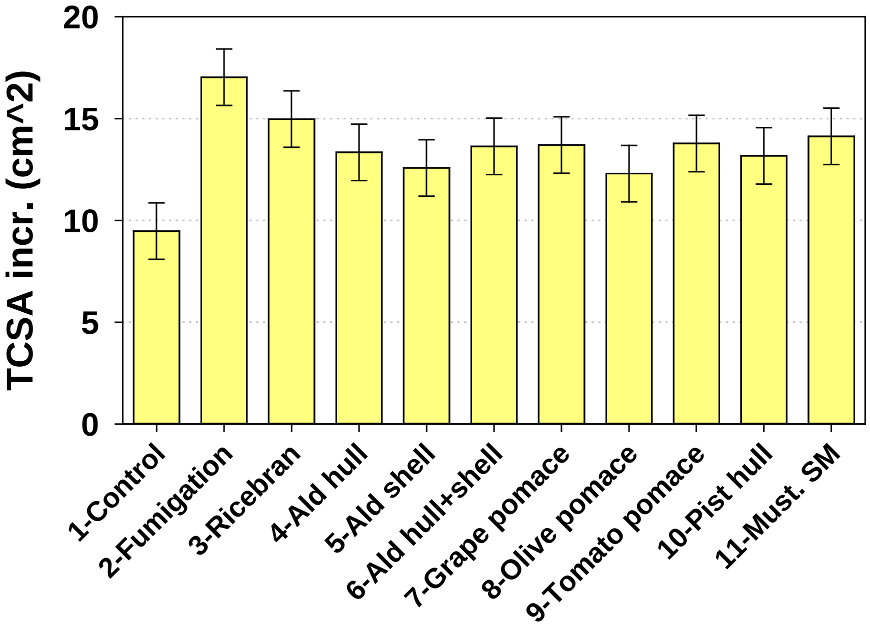


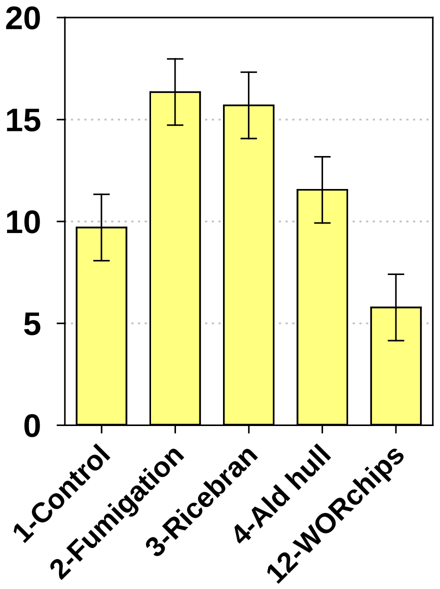
Carbon substrates that we are testing for ASD

Ground carbon source	Estimated $ / ton	Rate Tons / trt. ac.	Estimated material $ / ac for "50% strips"	Trials that include
Mustard seed meal	$1,700	3	$2,550	Parlier
Rice bran	$283	9	$1,274	CSUF, Parlier, Kern
Almond hull	$192	9	$864	Parlier
Tomato pomace	$185	9	$833	CSUF, Parlier
Grape pomace	$155	9	$698	Parlier
Pistachio hull	$150	9	$675	Parlier
Olive pomace	$115	9	$518	Parlier
Almond hull/shell, "pollinator"	$104	9	$468	CSUF, Parlier, Kern
Almond shell	$80	9 to 16	$360 to 640	CSUF, Parlier

First-year growth responses 2016-17 Parlier trial

Stunted tree growth in foreground vs. improved growth in background.





Conclusions

- Advances in high throughput sequencing and bioinformatics affording better understanding of replant disease; we are pursuing prediction.
- ASD can prevent PRD, further testing justified
- Optimization trials underway, now include nematode-infested as well as PRD-inducing orchard settings.
- Almond hull / shell, & multiple additional, economical carbon sources promising for ASD, being tested.
- Whole orchard recycling-ASD interactions appear important, being examined.

Thank You!!

Please visit our poster for details and meet research team members

california almonds
Almond Board of California

TRUNK AND SCAFFOLD CANKER DISEASES

Florent Trouillas

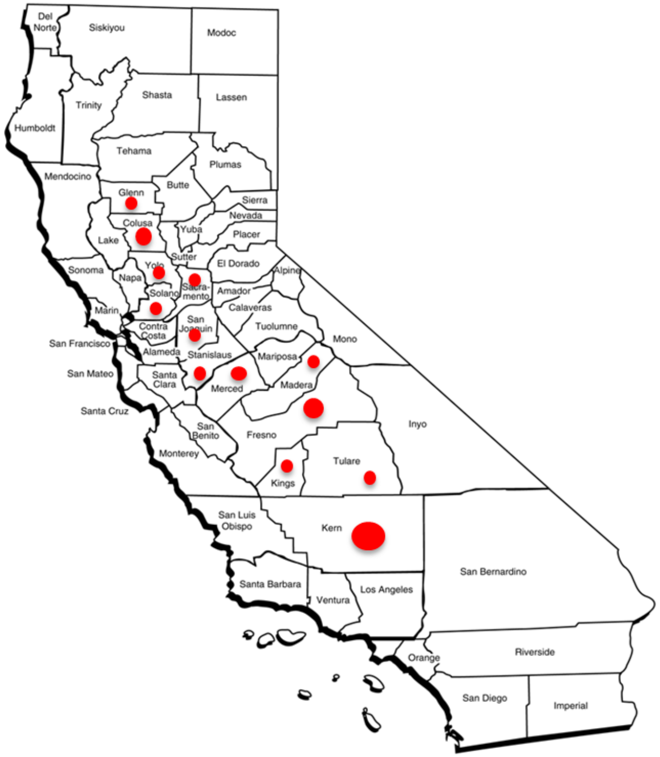
ALMOND CANKER DISEASES

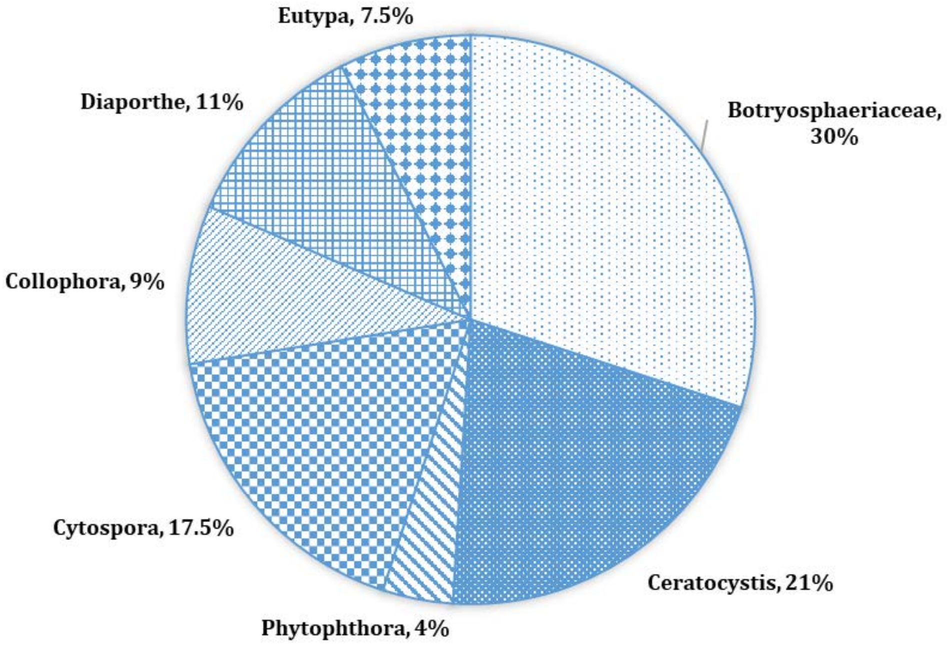







2015-2016 SURVEYS





PATHOGENS ASSOCIATED WITH CANKER DISEASES

Botryosphaeriaceae

- *Botryosphaeria dothidea*
- *Neofusicoccum mediterraneum*
- *Neofusicoccum vitifusiforme*
- *Neofusicoccum parvum*
- *Neofusicoccum arbuti*
- *Diplodia seriata*
- *Diplodia mutila*
- *Dothiorella iberica*
- *Macrophomina phaseolina*
- *Spencermartinsia viticola*
- *Neoscytalidium dimidiatum*

26 fungal species!

Ceratocystis fimbriata

Collophora hispanica
Collophora paarla

Cytospora eucalypti
Cytospora sorbicola
Cytospora sp. 1
Cytospora sp. 2
Cytospora sp. 11
Cytospora sp. 13

Diaporthe australafricana
Diaporthe eres
Diaporthe rhusicola

Eutypa lata

Phytophthora cinnamomi
Phytophthora cactorum

INFECTION COURT

- Infections occurs at wounds caused by cultural practices

Scaffold selection

Harvest

Maintenance pruning

INFECTION COURT

- Most infections occurs at pruning wounds

Botryosphaeria

Ceratocystis

Eutypa

Cytospora

INFECTION COURT

- Early infections at pruning wounds near the trunk can lead to tree death


MANAGEMENT OF ALMOND CANKER DISEASES

- Preventive approach
- Prevent disease establishment in the early years
- Promote good establishment of almond orchards
- Protect pruning wounds following scaffold selection
  - Protect wounds on the trunk
  - Protection must be adapted to the diversity of fungi causing cankers

PRUNING WOUND PROTECTION TRIALS

- Three trials in commercial orchards
- Up to 21 products tested:
  - Fungicides (FRAC groups 1, 3, 7, 9, 11, 33, M3, M5)
  - Bio-fungicides
  - Biological control agents
  - Wound sealants, paints
- Tested again multiple fungal isolates:
  - *Ceratocystis fimbriata, Eutypa lata, Cytospora* sp.*, Botryosphaeria dothidea, Diplodia mutila, Neofusicoccum mediterraneum, Neofusicoccum parvum, Neoscytalidium dimidiatum*

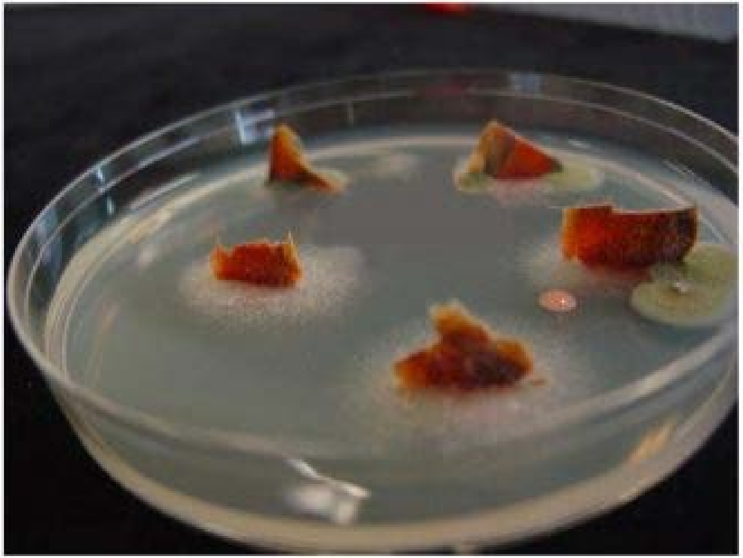
PRUNING WOUND PROTECTION TRIALS

- List of compounds that were tested:

#	Products	active ingredient(s)	FRAC	Class	Type
1	Water (control)				Control
2	EXP1	*Trichoderma atroviride*			biocontrol
3	Pruning wound sealant	acrylic paint (brand: Tanglefoot)			sealant
4	CropSeal	wax			sealant
5	Ziram	ziram	M3	Carbamate (DMDC)	fungicide
6	Bravo	chlorothalonil	M5	Chloronitrile	fungicide
7	Quash	metconazole	3	DMI-triazole	fungicide
8	Luna Experience	fluopyram/tebuconazole	3 & 7	DMI-triazole/SDHI	fungicide
9	Merivon	pyraclostrobin/fluxapyroxad	7 & 11	SDHI/QoI	fungicide
10	Topsin M	thiophanate-methyl	1	MBC	fungicide
11	Inspire Super	difenoconazole/cyprodinil	3 & 9	DMI-triazole/AP	fungicide
12	Quadris Top	difenoconazole/azoxystrobin	3 & 11	DMI-triazole/QoI	fungicide
13	Pristine	pyraclostrobin/boscalid	7 & 11	SDHI/QoI	fungicide
14	Exp2	thyme oil			biofungicide
15	Exp3	neem oil			biofungicide
16	Quilt Xcel	propiconazole/azoxystrobin	3 & 11	DMI-triazole/QoI	fungicide
17	Fontelis	penthiopyrad	7	SDHI	fungicide
18	Viathon	tebuconazole/phosphonate	3 & 33	DMI-triazole/phosphonate	fungicide
19	Luna Sensation	fluopyram/trifloxystrobin	7 & 11	SDHI/QoI	fungicide
20	Abound	azoxystrobin	11	QoI	fungicide
21	Rally	myclobutanil	3	DMI-triazole	fungicide
22	Indar	febuconazole	3	DMI-triazole	fungicide

PRUNING WOUND PROTECTION TRIALS

- Methodology:
  - Pruning, treatment of pruning wounds with fungicides and inoculation with pathogens
  - Rating for fungal recovery (presence/absence) 3 months after treatment



PRUNING WOUND PROTECTION TRIAL 1

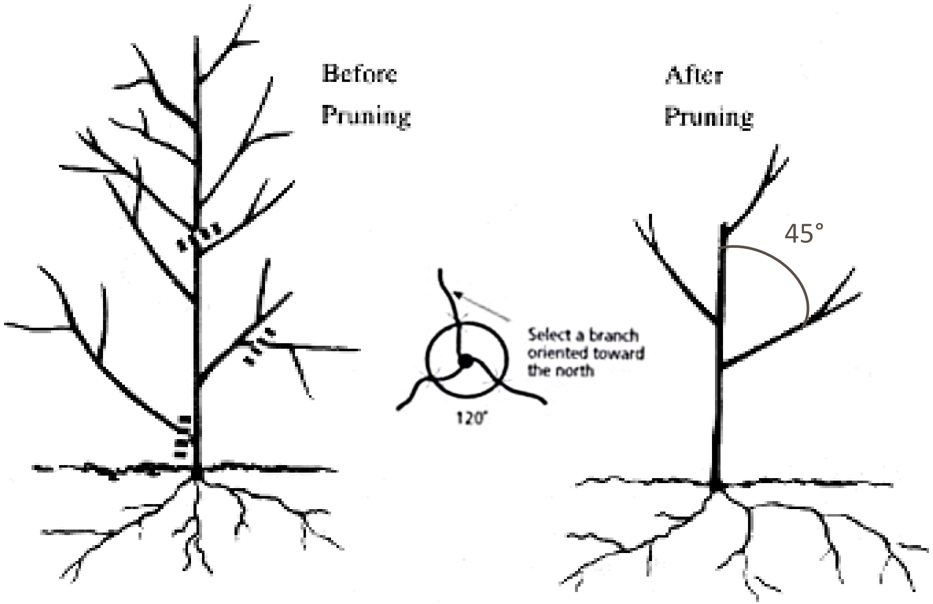
Product	*Cytospora sp.*	*Eutypa lata*	*C. fimbriata*	*B. dothidea*	*N. parvum*	*N. mediterraneum*	*Neosc. dimidiatum*	Avg. recovery
Control	25	75	50	50	100	50	50	57.1
fluopyram/tebuconazole	75	25	25	25	0	25	25	28.6
pyraclostrobin/fluxapyroxad	50	25	25	0	25	50	50	32.1
thiophanate-methyl	0	0	0	0	0	0	0	0
metconazole	25	50	0	0	25	50	50	28.6
difenoconazole/cyprodinil	25	75	0	0	0	25	25	21.4
difenoconazole/azoxystrobin	100	0	0	0	0	0	100	28.6
myclobutanil	50	25	0	0	25	0	50	21.4
vegetable oil #1	100	100	0	75	50	75	50	64.2
vegetable oil #2	75	25	0	50	100	75	100	60.7
vegetable oil #3	100	100	0	100	100	100	100	85.7
Avg. recovery	56.8	45.4	9.1	27.3	38.6	40.9	54.5	

PRUNING WOUND PROTECTION TRIAL 2

	Cytospora	*Eutypa*	*B. dothidea*	*N. parvum*	*N. mediterraneum*	*Neosc. dimidiatum*	*D. mutila*	Avg. recovery
Control	75	75	100	100	100	100	100	92.9
Vegetable oil 1	100	100	100	100	100	100	100	100
Vegetable oil 2	100	100	100	100	100	50	100	92.9
Trichoderma atroviride	0	0	75	0	25	0	50	21.4
metconazole	100	25	33	0	75	75	100	58.3
thiophanate-methyl	50	0	50	25	25	50	25	32.1
acrylic paint	75	50	75	100	100	100	100	85.7
natural wound sealant	100	25	100	100	50	75	75	75
myclobutanil	100	75	75	75	100	100	100	89.3
fenbuconazole	100	75	100	100	75	100	100	92.9
penthiopyrad	100	50	75	100	100	75	100	85.7
difenoconazole/cyprodinil	100	75	25	100	75	100	100	82.1
fluopyram/trifloxystrobin	75	75	33	25	100	100	50	65.4
propiconazole/azoxystrobin	75	25	50	25	75	100	100	64.3
tebuconazole/phosphite	100	75	25	25	50	100	75	64.3
fluopyram/tebuconazole	75	75	100	25	100	100	75	78.6
chlorothalonil	100	50	75	75	75	75	100	78.6
difenoconazole/azoxystrobin	75	50	50	0	50	50	100	53.6
pyraclostrobin/fluxapyroxad	75	50	0	25	25	75	50	42.9
pyraclostrobin/boscalid	75	75	25	75	75	100	75	71.4
azoxystrobin	75	50	75	100	100	75	100	82.1
ziram	75	100	100	100	100	75	100	92.9
Avg. recovery	81.8	58	65.5	62.5	76.1	80. 7	85.2	

MANAGEMENT GUIDELINES FOR ALMOND CANKER DISEASES

- Appropriate scaffold selection
- Protect pruning wounds following scaffold collection



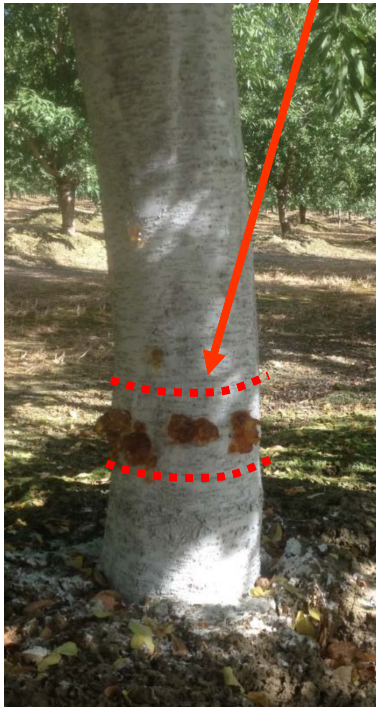
Band Canker Early Detection

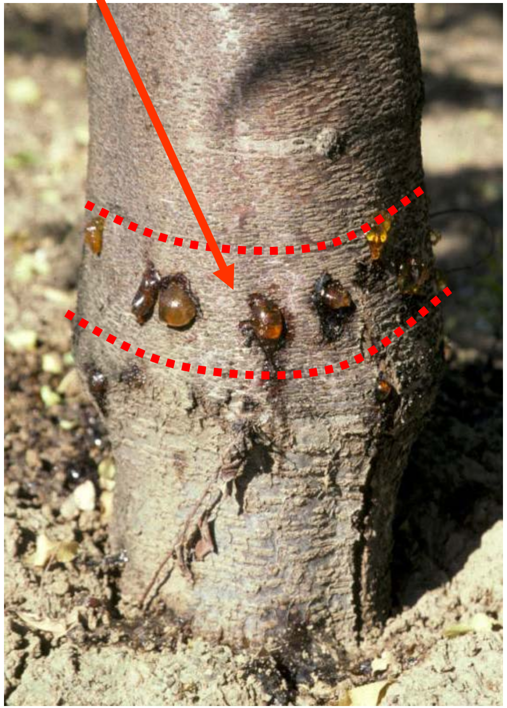
Themis J. Michailides[1]

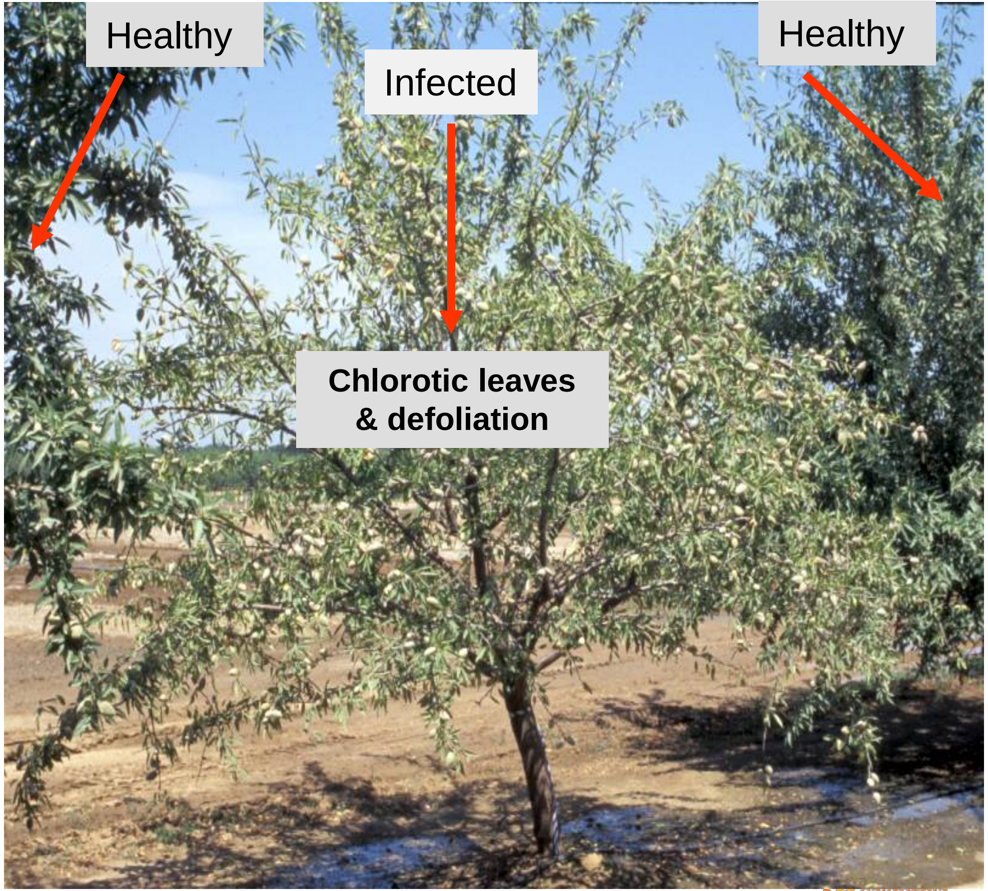
Y. Luo[1], R. Duncan[2], C. Taylor[3], D. Lightle[4]
& F. Niederholzer[5]

[1] University of California, Davis
Kearney Agricultural Research and Extension Center
[2] UCCE Stanislaus County
[3] Bayer U.S. LLC
[4] UCCE Glenn/Butte/Tehama Counties
[5]UCCE Yuba/Sutter/Colusa

“band” canker = a canker disease







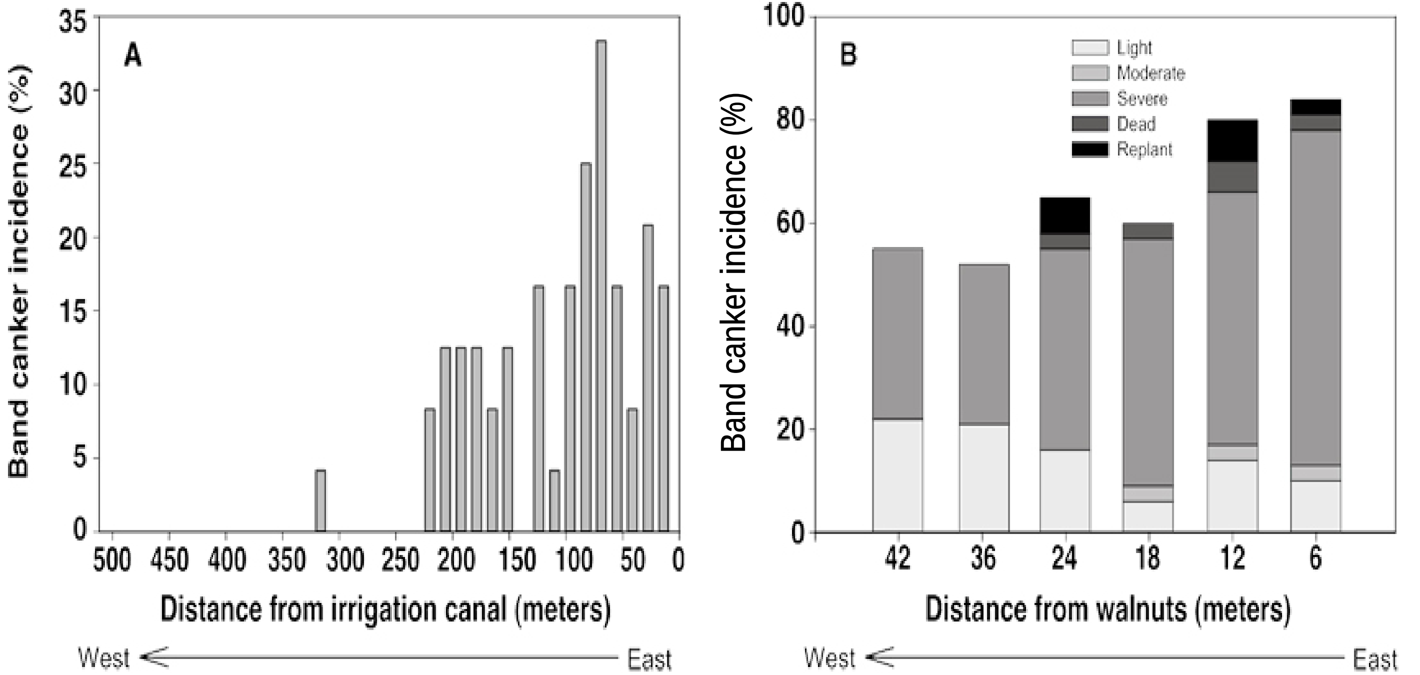
Infection via growth cracks and pruning wounds

Species of *Botryosphaeriaceae* that cause band canker in almond & canker and blights in pistachio and walnut

Fungal species	Almond	[redacted]
Neofusicoccun nonquaesitum (new species)	+	
Neof. parvum	+	
Macrophomina phaseolina	+	
Neof. mediterraneum	+	
Botryosphaeria dothidea	+	
Diplodia seriata	+	
Dothiorella sarmentorum	+	
Lasiodiplodia theobromae	+	
Neoscytalidium dimitiatum	+	

Inderbitzin et al. (2010), *Mycologia* 102(6):1350-1368; Chen et al. (2014), *Plant Disease* 98:636-652; Chen et al (2014), *Fungal Diversity* 67:157-179

Spread of band canker from a source of pathogen's inoculum



A, 3-yr-old Nonpareil/Padre; inoculum source: riparian trees and water canal

B, 5-yr-old Nonpareil/Aldrich/ Peerless; source: a 15-yr-old walnut orchard.

<u>Recently</u>: Young almond orchard with tree gaps due to killing by band canker

Band (Bot) canker all over the trunk

almond

Young almond orchard with gaps due to Botryosphaeria canker

Definition

Latent infection (true latency):

A parasitic relationship that eventually induces macroscopic symptoms

A quantitative PCR (*q*PCR) assay developed to quantify latent infection levels for six canker-causing pathogen groups:

Six pair primers for quantifying DNA of:

***Phomopsis* spp., *Botryosphaeria dothidea, Lasiodiplodia* spp., *Cytospora* spp., *Neofusicoccum* spp., *Diplodia* spp.**

Luo et al. (2017), *J. of Applied Microbiology* 122:416-428

californiaalmonds Almond Board of California

The steps of the quantitative PCR molecular technique:

1. Sample collection and processing

Pencil sharpener

2. Grinding and DNA extraction

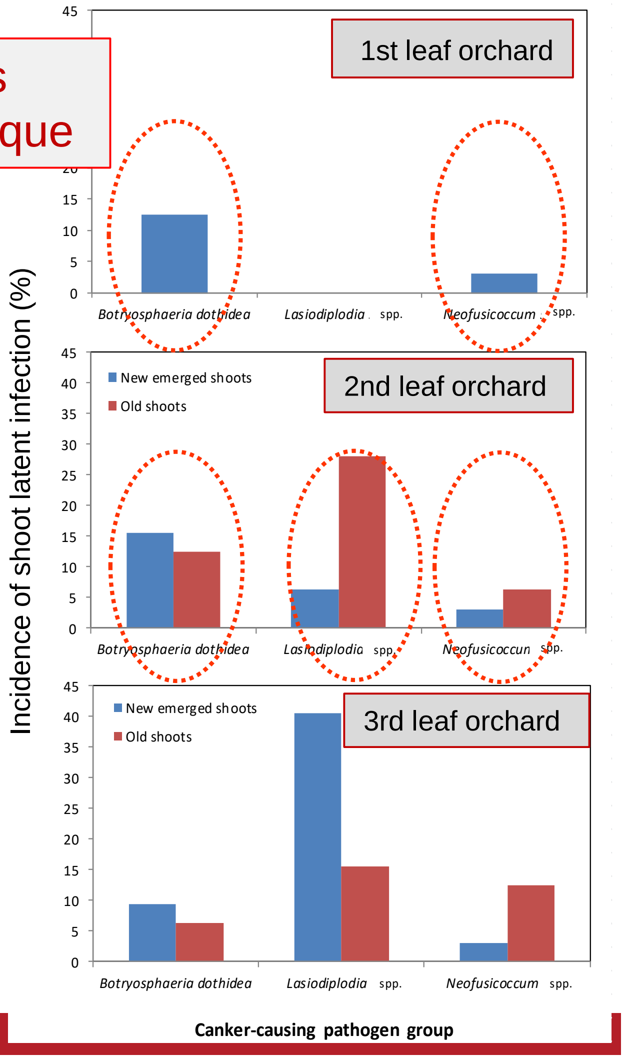
3. Quantitative PCR assay

Sample	weight (g)	Dilution	Ct	calculation of fg		total fg	/weight	MS(a)
PAN4-1	0.32	60	36.47	2.194821	156.6105	4698.316	14682.24	4.17
PAN4-2	0.34	60	36.62	2.150466	141.4054	4242.162	12476.95	4.10
PAN4-3	0.33	60	N/A	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!
PAN4-4	0.36	60	36.03	2.324929	211.3144	6339.431	17609.53	4.25
PAN4-5	0.29	60	36.62	2.150466	141.4054	4242.162	14628.15	4.17
PAN4-6	0.4	60	36.54	2.174122	149.3214	4479.641	11199.1	4.05
PAN4-7	0.32	60	35.65	2.437295	273.7127	8211.382	25660.57	4.41
PAN4-8	0.3	60	38.18	1.689174	48.88482	1466.545	4888.482	3.69
PAN4-9	0.34	60	38.29	1.656647	45.35728	1360.718	4002.113	3.60
PAN4-10	0.36	60	39.03	1.437829	27.40495	822.1485	2283.746	3.36
PAN4-11	0.27	60	37.79	1.804497	63.75247	1912.574	7083.608	3.85
PAN4-12	0.31	60	36.88	2.073584	118.4633	3553.9	11464.19	4.06
PAN4-13	0.35	60	37.21	1.976003	94.62437	2838.731	8110.66	3.91
PAN4-14	0.38	60	37.68	1.837024	68.71064	2061.319	5424.524	3.73
PAN4-15	0.42	60	36.78	2.103154	126.8101	3804.304	9057.868	3.96
PAN4-16	0.39	60	36.38	2.221434	166.5076	4995.227	12808.28	4.11
PAN4-17	0.28	60	36.17	2.283531	192.1016	5763.048	20582.32	4.31
PAN4-18	0.3[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3702.743	3.57

4. Data analysis

Results

Incidence of latent infection of young symptomless almond shoots using the quantitative *q*PCR technique



Conclusions:

1. The uniform pattern of band canker (or Bot canker) occurrence in very young orchards suggests that either the disease (inoculum) might have been brought along with the young planted trees or infections started as soon as trees were planted.
2. For the first time, we showed that we could detect the band canker pathogens in newly-developed and 1-year-old shoots in very young trees showing no disease symptoms.
3. Suggestion that trees need to be protected at a very young age (even at nurseries?). More research to come…

Please visit poster #79

Acknowledgment: Funding by the **Almond Board of California**

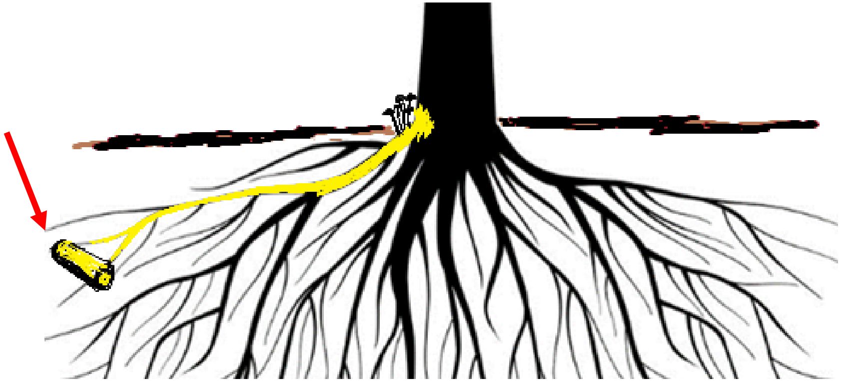
Cooperators in the past: Joe Connell, Rick Buchner, John Edstrom, and William Krueger

GANODERMA BUTT ROT

Bob Johnson and Dave Rizzo

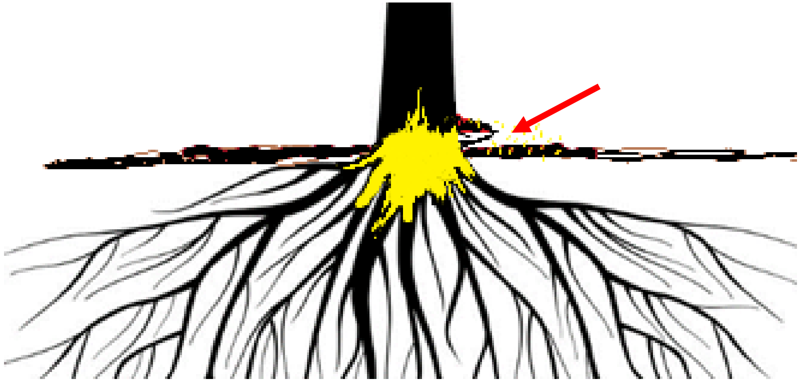
Armillaria root rot

- Decays cambium and sapwood eventually girdling tree
- Kills tree standing
- Spreads via root contact
- Wounding not necessary



Ganoderma butt rot

- Decays heartwood and sapwood reducing structural stability
- Tree killed at windfall
- Spread via airborne spores
- Requires wounding



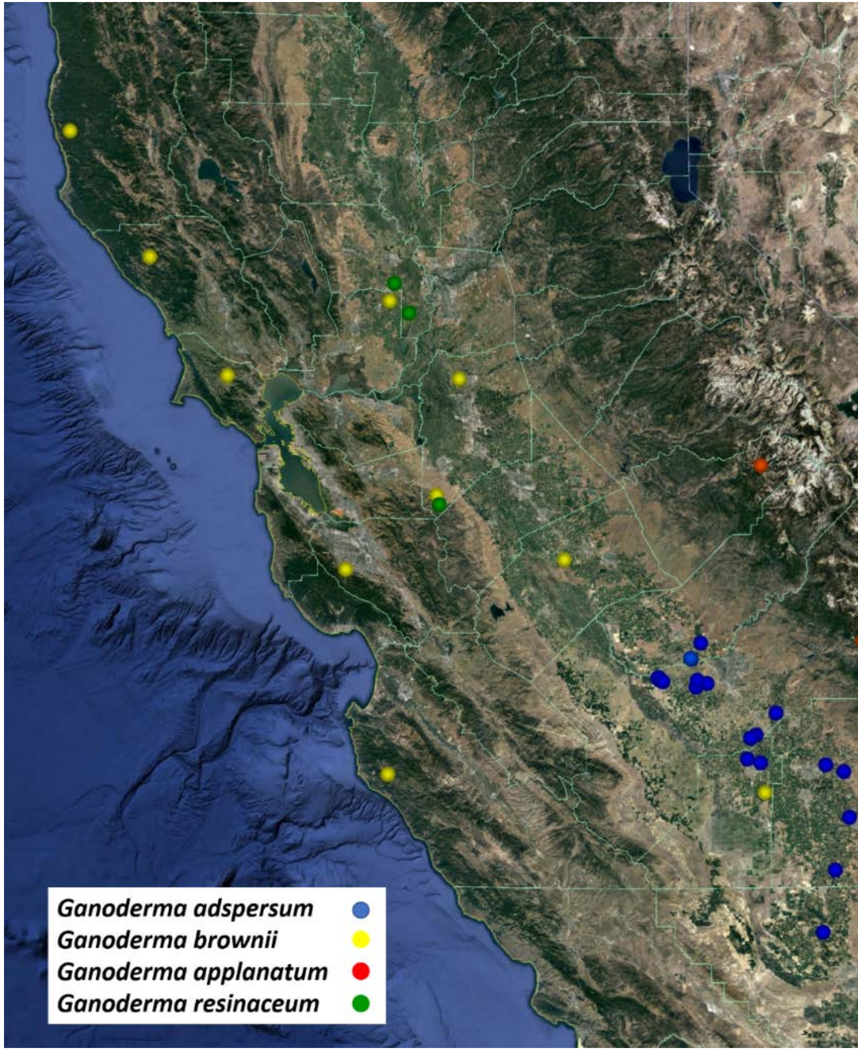
GANODERMA SPECIES IN ALMOND

brownii and lucidum (resinaceum)

- Endemic to CA
- Occur sporadically throughout orchard
- Generally non-aggressive on healthy trees

adspersum

- Previously unknown in CA and North America
- Able to overcome tree response
- Infection incidence tends to be high
- Orchards as young as 6
- Known range is limited
- Potential to spread



HARVEST PROBABLY DRIVES INFECTION AND SPREAD

Shaking

- Wounds to lower trunk and roots at or below soil line

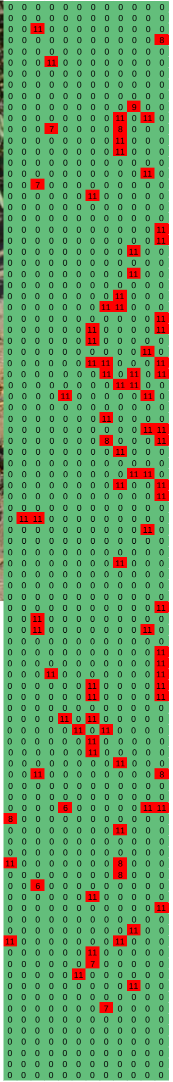
Sweeping

Pickup

- Spore dispersal

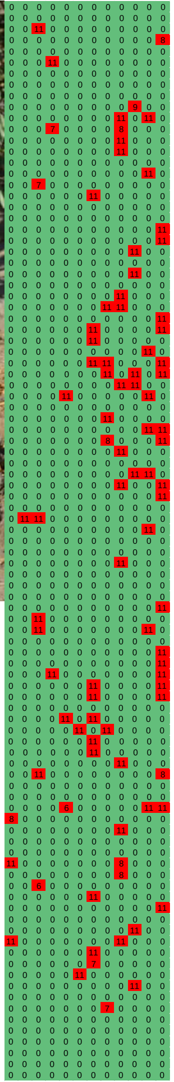
Irrigation

- Spore percolation into soil
- Spore germination



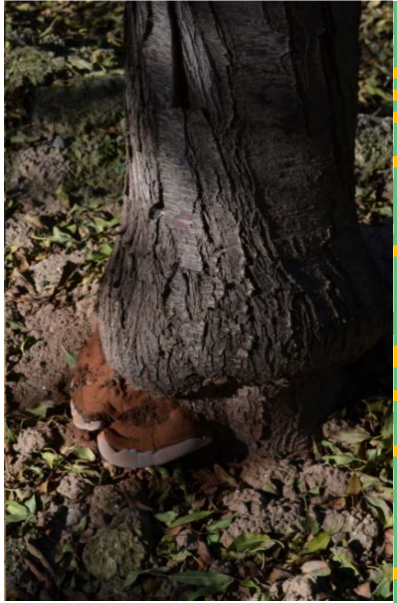
Missing trees
8%

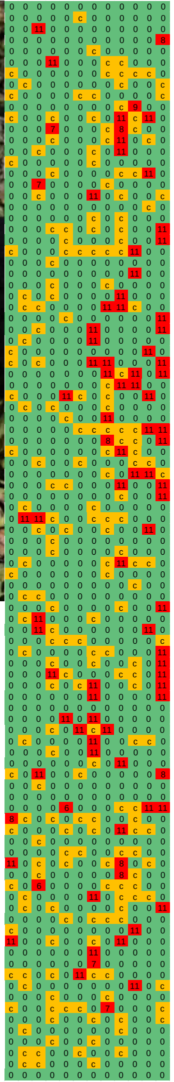
Decay related windfall 10th and 11th leaf ~ 85%



Missing trees
8%

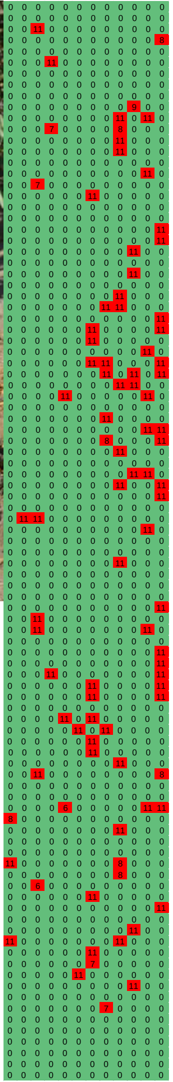
Decay related windfall 10th and 11th leaf ~ 85%





Fruiting bodies 20%

15% of conks sporulating at harvest



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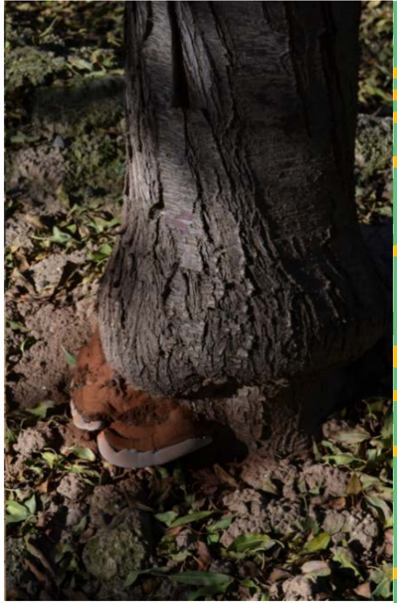
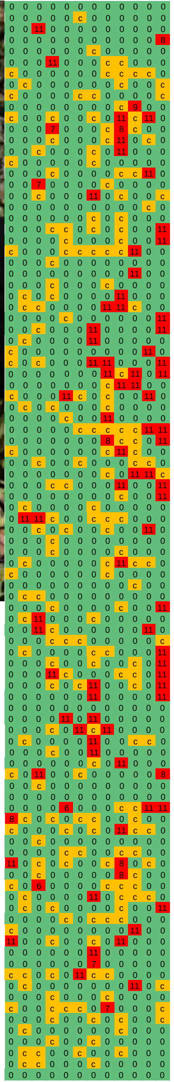
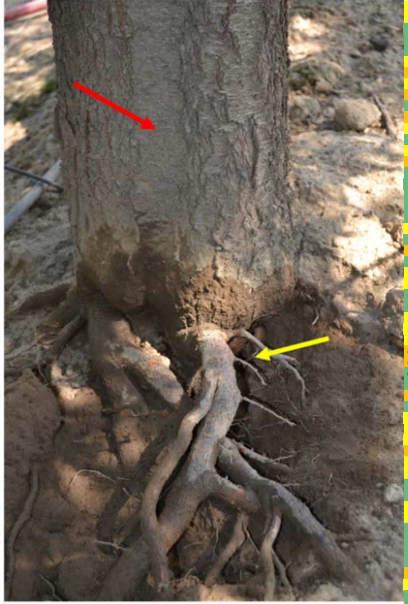
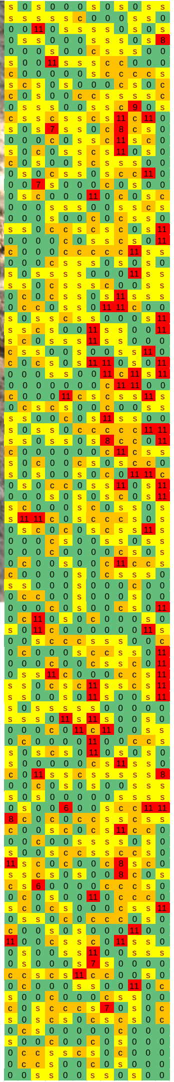




Fruiting bodies
20%

15% of conks sporulating at harvest





Other symptoms
35%

Flattened strip on trunk, leaning, scion sprouting

CONTINUED WORK

- Continued surveys
- Rootstock screening
- Inoculum sources/ spore monitoring
- Replant questions
- Control strategies
- Other predisposing factors

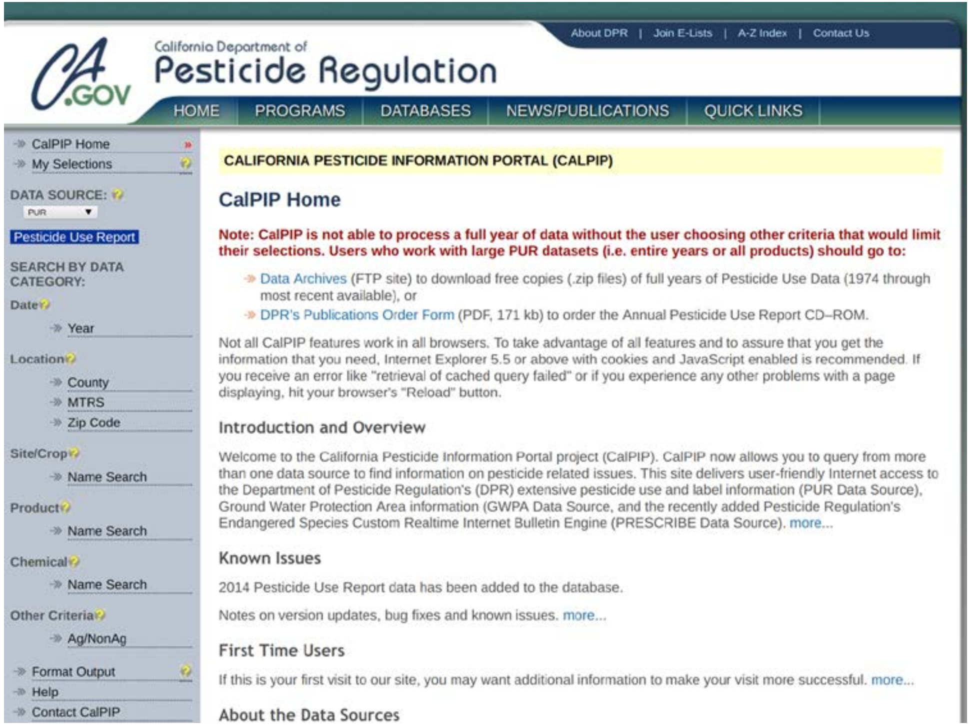
Thanks:

- Rizzo lab
  - Ian Good
- UCCE farm advisors
- Almond Board of California
- California Dried Plum Board

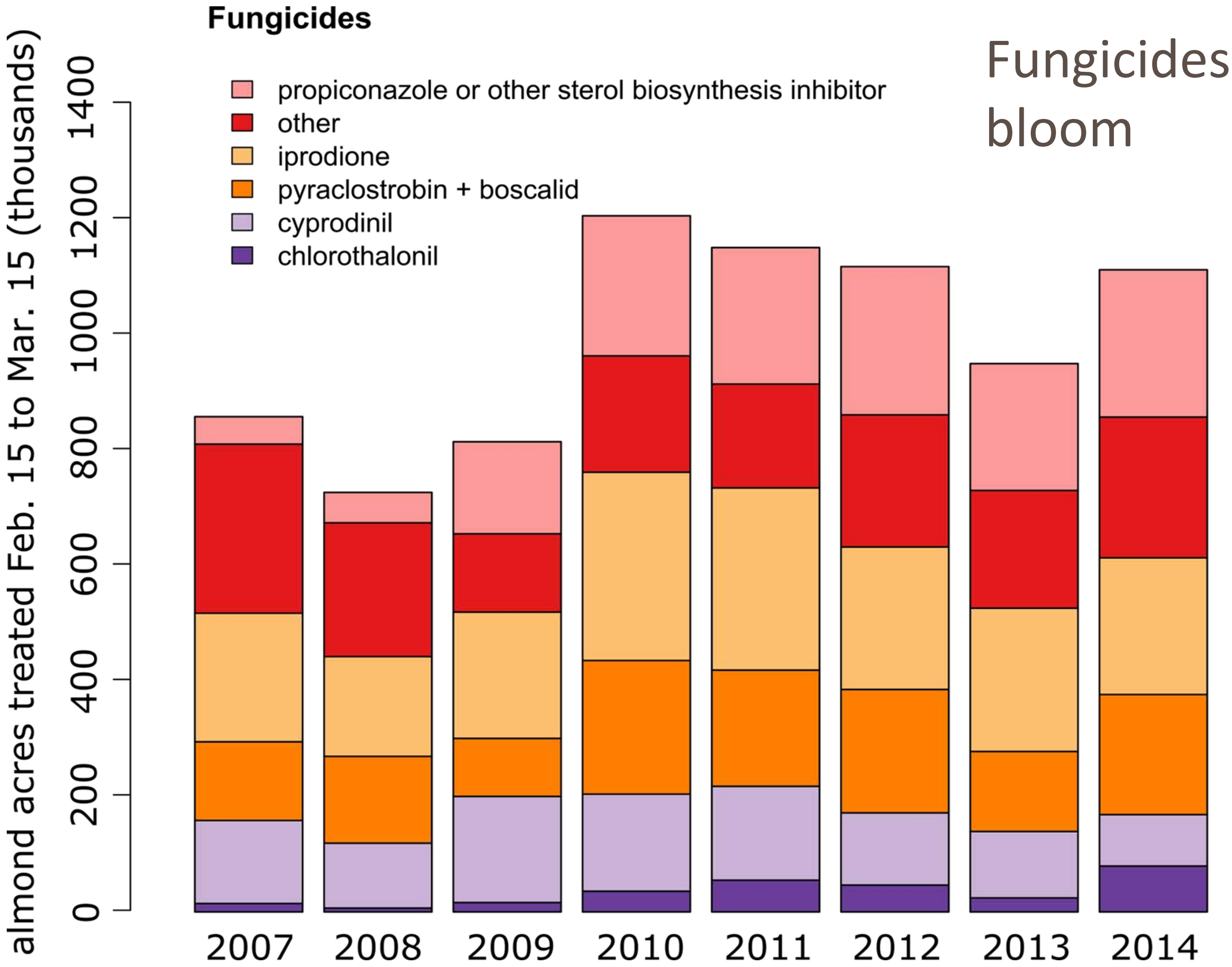
BLOOM SPRAY EFFECTS ON BEE HEALTH

Chia-Hua Lin and
Reed M. Johnson

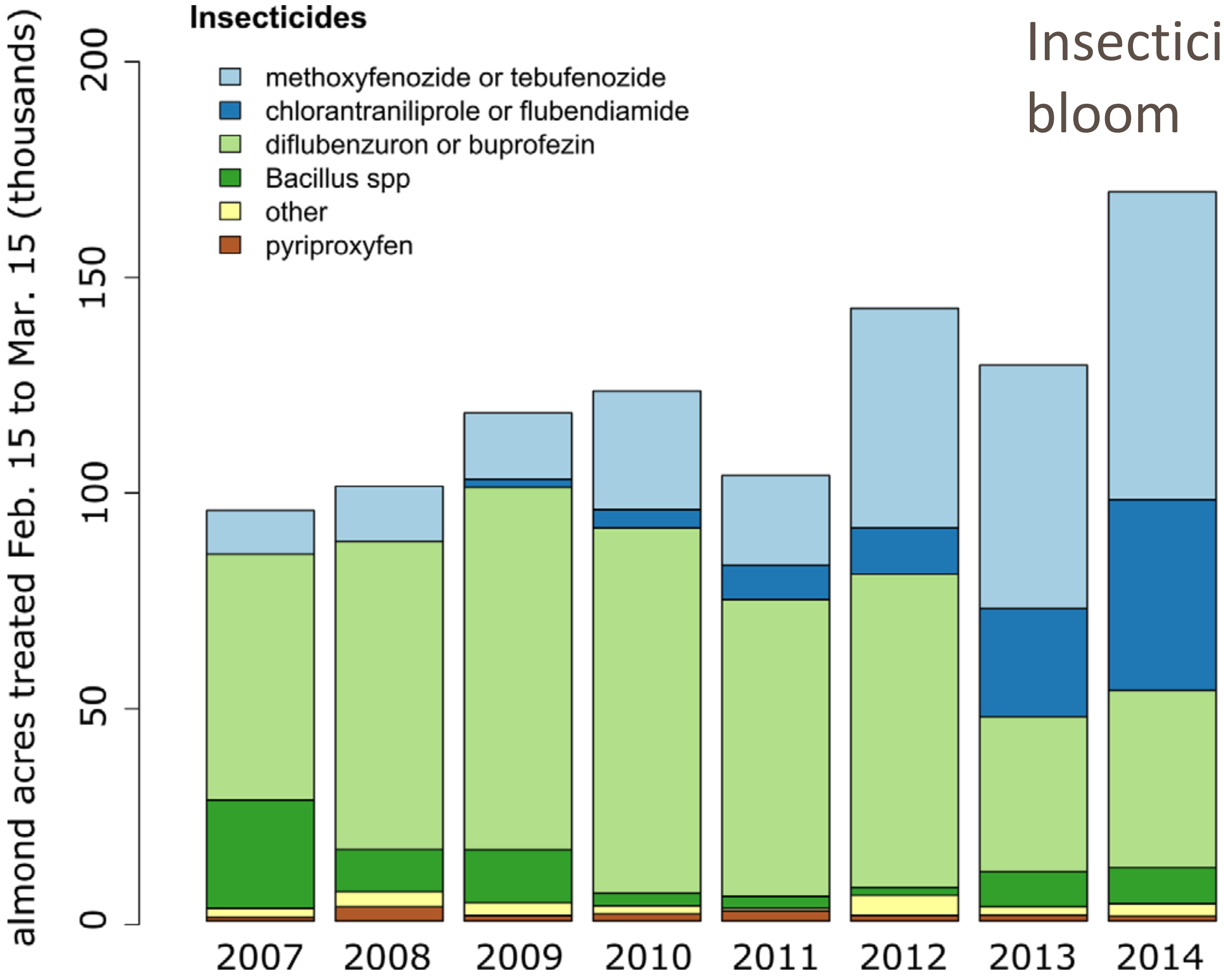
“Bee Safe” pesticides applied to almonds during bloom

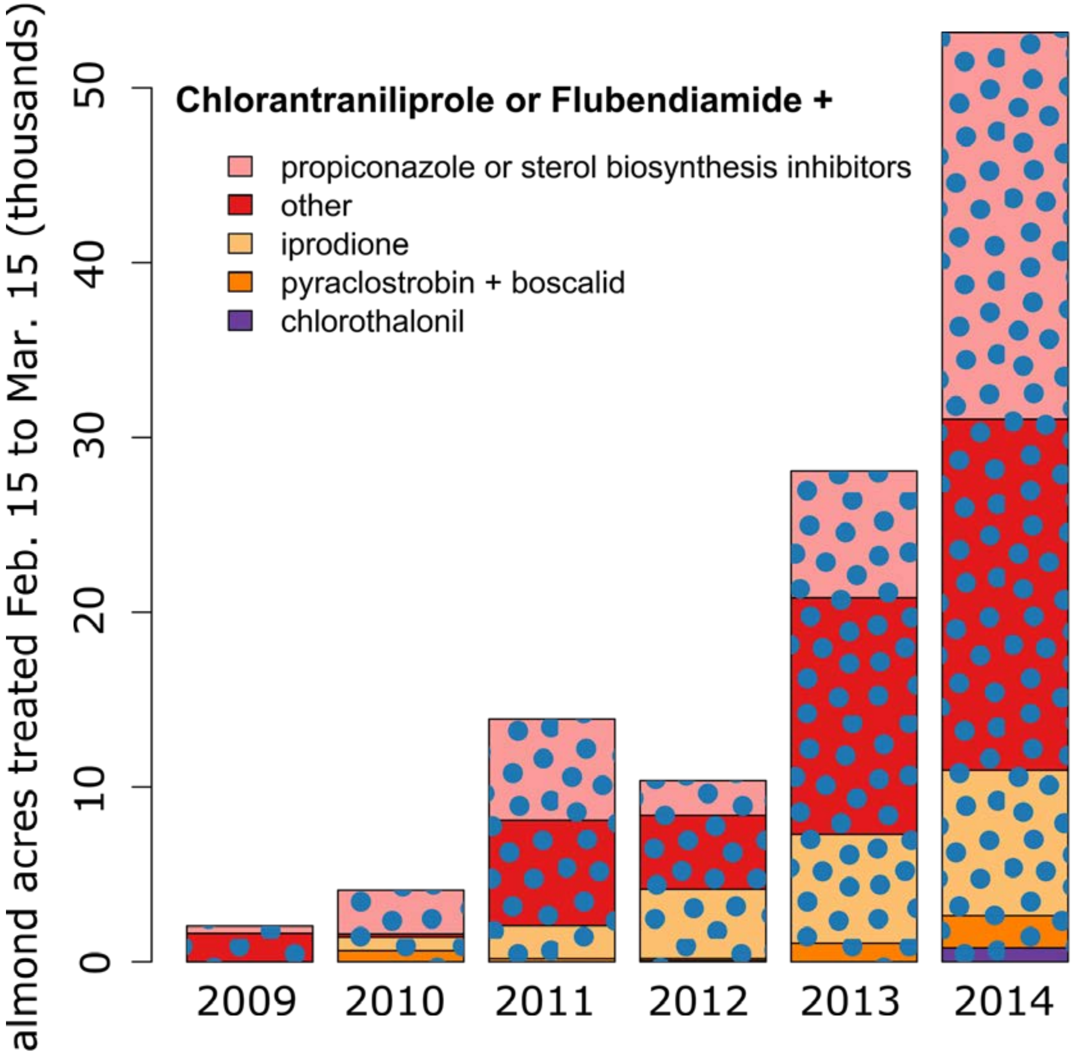


Fungicides applied during bloom



Insecticides applied during bloom





Nearly all insecticides applied during almond bloom are tank mixes with fungicides

Bee problems reported (pesticide related?)

Queen breeders:

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

Pollinators:

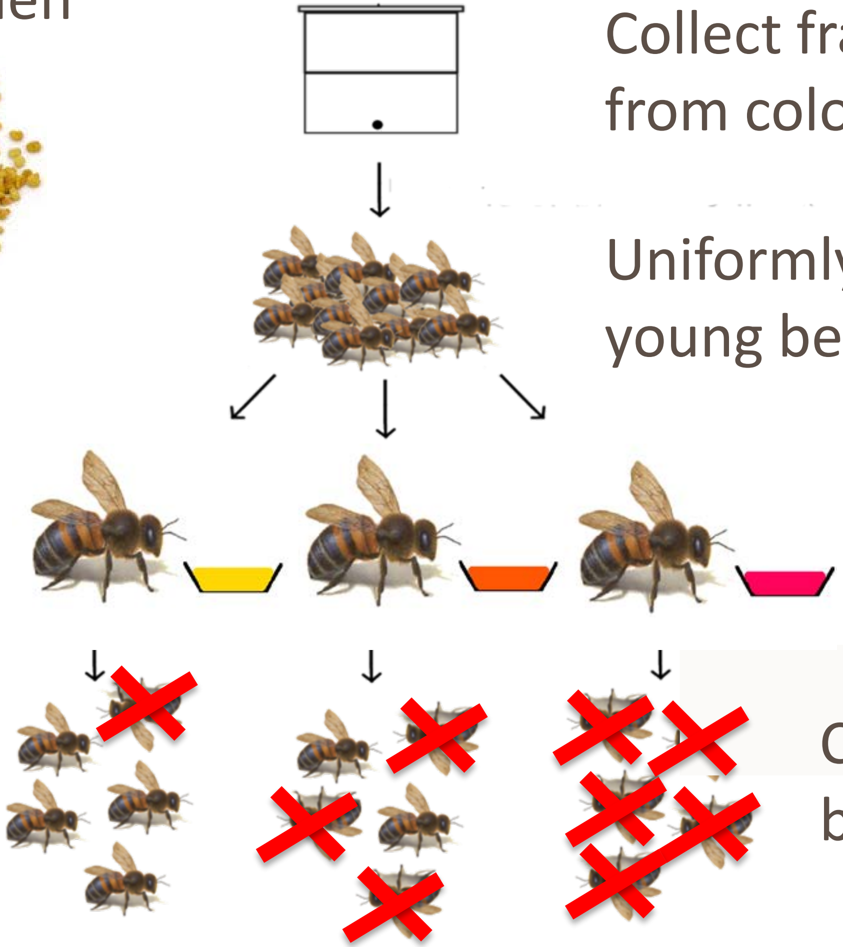
Classic **adult "bee kills"** observed occasionally

Death of late-stage brood mortality in weeks following almond bloom

Tested insecticides and fungicides in combination at maximum label rates

	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
		ratio of insecticide : fungicide		

Feeding in pollen



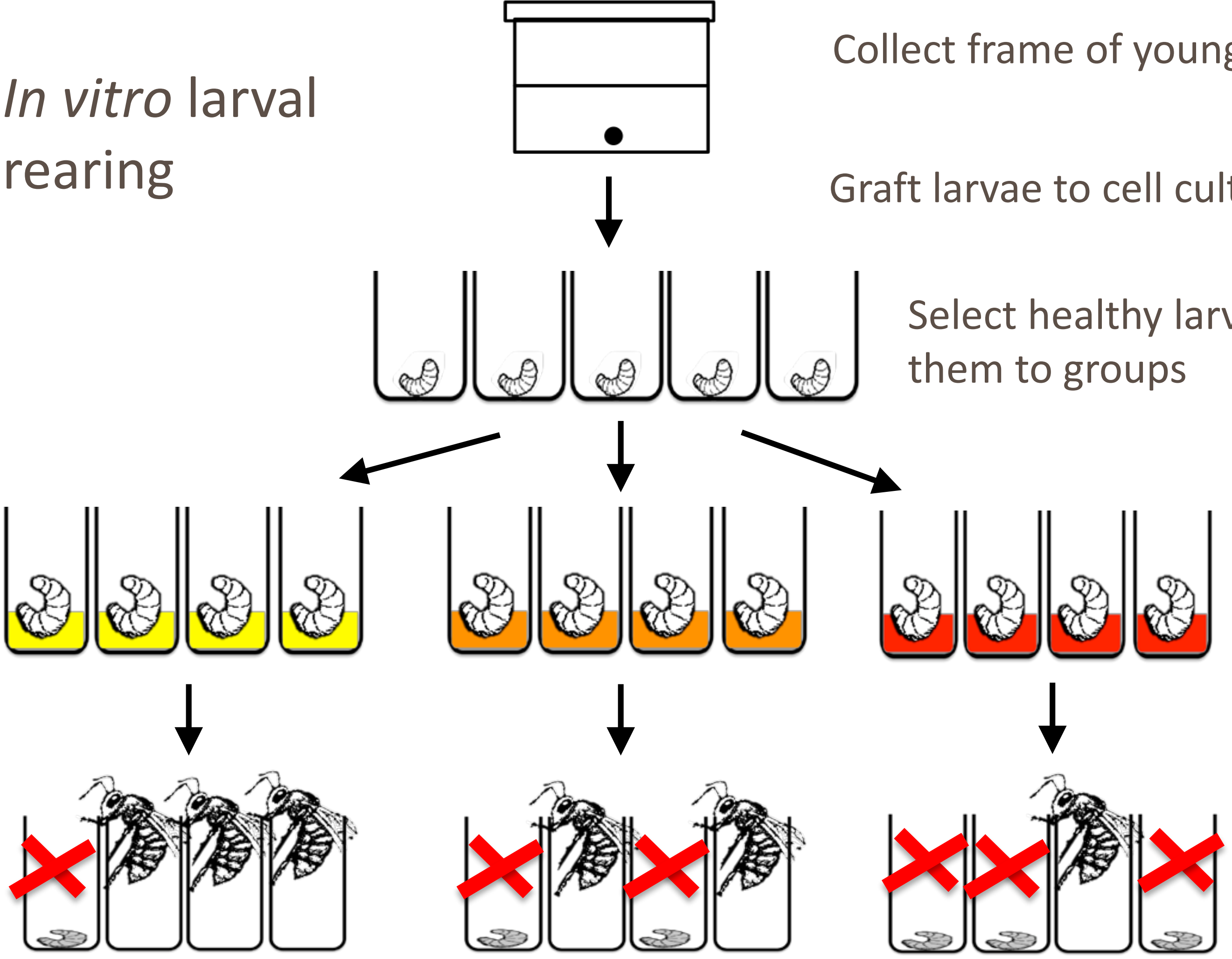
Collect frame of brood from colony

Uniformly aged cohort of young bees

Treat groups with varying doses of pesticides in pollen

Count living and dead bees daily for 7 days

In vitro larval rearing



Collect frame of young brood

Graft larvae to cell culture plates

Select healthy larvae and randomly assign them to groups

Treat groups with insecticides, fungicides, or insecticides + fungicides dissolved in royal jelly diet

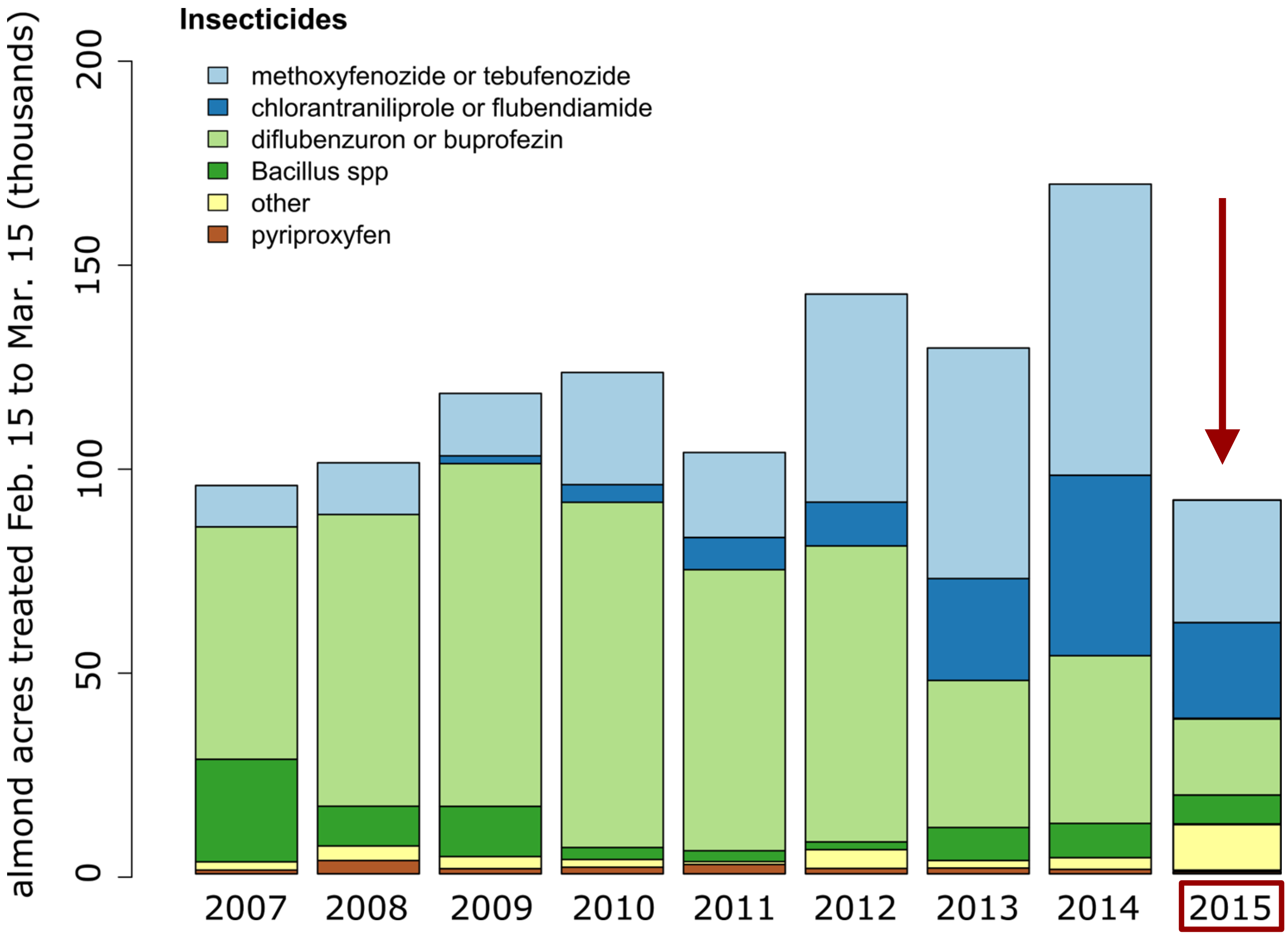
Record adult emergence

CONCLUSIONS

1. Honey bee larval development is affected by **diflubenzuron** (Dimilin)
2. Adult survival and larval development is affected by **chlorantraniliprole + propiconazole or iprodione** (Altacor + Tilt or Rovral)

HONEY BEES AND INSECTICIDES

All parties involved in almond pollination and/or applying pesticides should follow the precaution of not applying insecticides during bloom. Bee losses appear to have occurred in almonds as a result of tank-mixing insecticides with bloom-time fungicides. While the losses could have other causes, there is a scientific basis for concern; this is based on field experience that is being substantiated with controlled studies.[6,7] Currently, most bee label warnings are only based on adult acute toxicity studies; however, recent information indicates some may be harmful to young developing bees in the hive (bee brood). Until recently, the U.S. EPA has not required data for possible effects on bee brood. Foragers bring back pollen to the hive, which is fed to the bee brood. Insecticide residues have been detected in this pollen. The term 'insecticide' includes insect growth regulators, also known as IGRs.



Insecticides applied during bloom reduced nearly 50% in 2015

PLANNED WORK

Effect of **spray adjuvants** on insecticide and insecticide+fungicide toxicity

Compare:

1. Adult worker feeding exposure
2. Adult worker direct spray
3. Larval worker development
4. Larval queen development

ACKNOWLEDGEMENTS

College of Wooster
Andrea Wade
Bridget Gross
Emily Walker

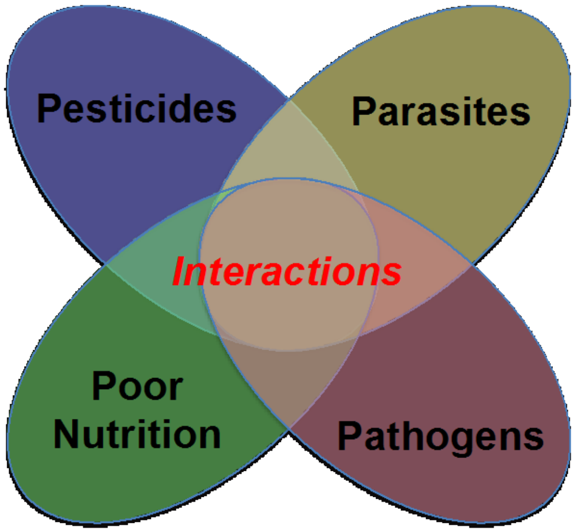
The Ohio State University
Colin Kurkul
Ashley Cordle
Juan Quijia-Pillajo
Luke Hearon
Natalia Riusech
Rodney Richardson
Eric Percel

IMPACT OF PESTICIDES AND SPRAY ADJUVANTS ON BEE HEALTH AND DEVELOPMENT

Dr. Diana Cox-Foster, Research Leader

USDA-ARS-PWA Pollinating Insects Research Lab, Logan, UT

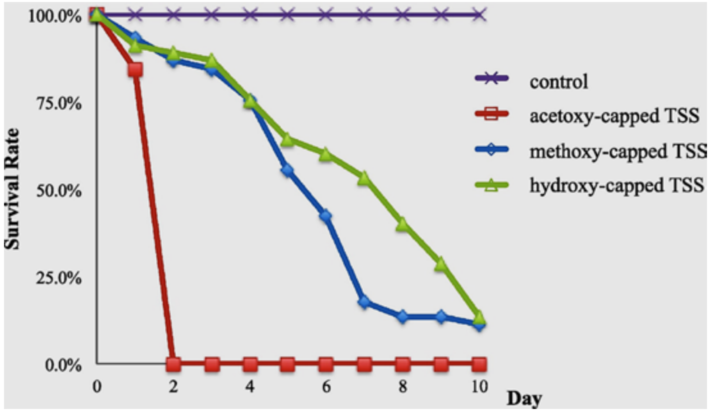
DECLINING POLLINATOR POPULATIONS: THE FOUR P'S WHICH ONE TO BLAME *OR SHOULD WE BLAME ALL FOUR?*

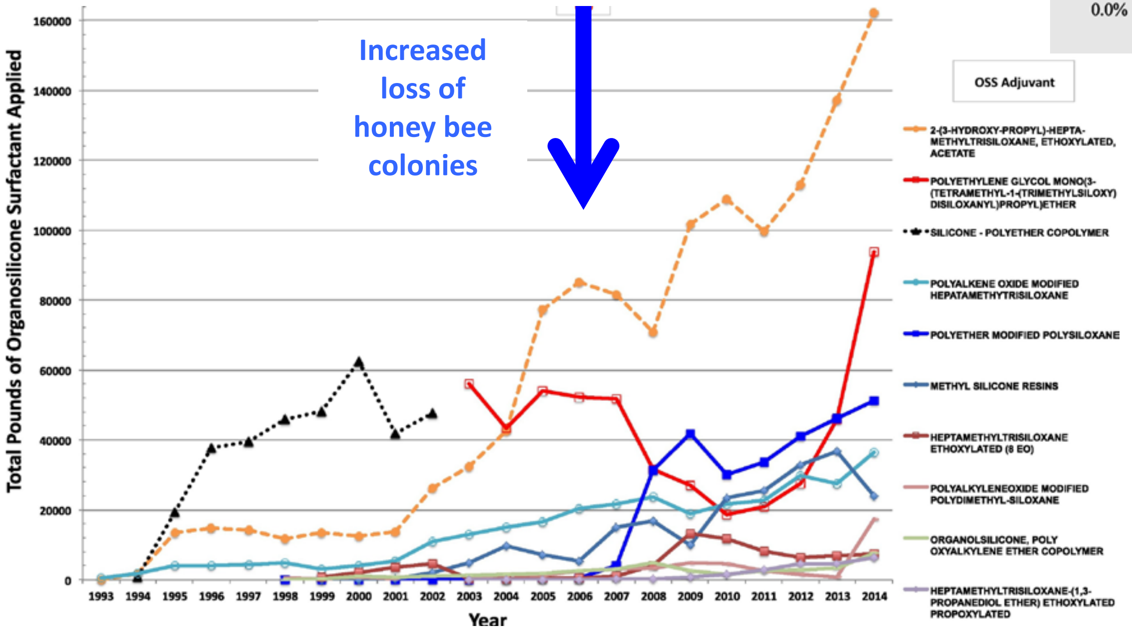


For this project:

- ***Ask how Propiconazole (Tilt), Chlorantraniliprole (Altacor) and organosilicone adjuvants impact honey bee health and colony survival***
- Use micro-colonies to detect impacts.
- A Microcolony lacks the colony resilience seen in larger colonies, where a significant loss of individuals can be tolerated for the survival of the "superorganism"
- Look at key points in colony health: queen health, brood production, growth of colony over time, pathogen levels

OSS'S DIFFER IN TOXICITY TO BEES, WITH INCREASED USE OF MOST TOXIC OSS IN CA SINCE 2000



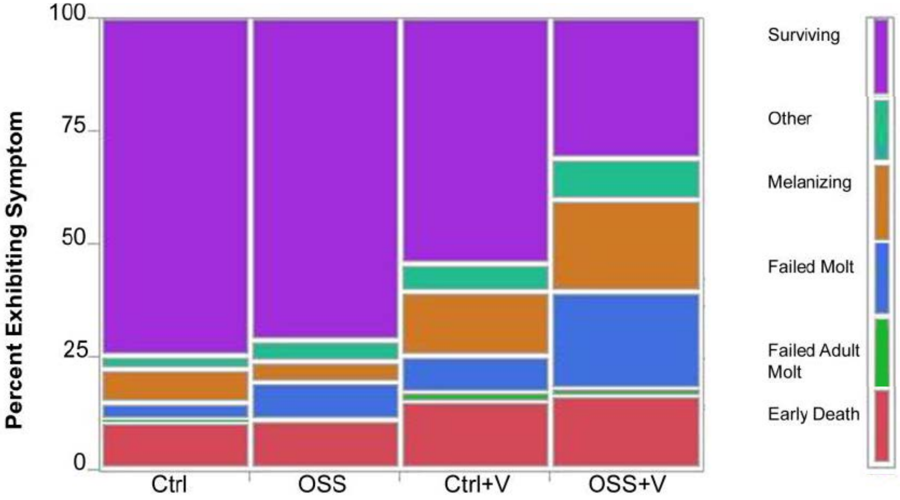


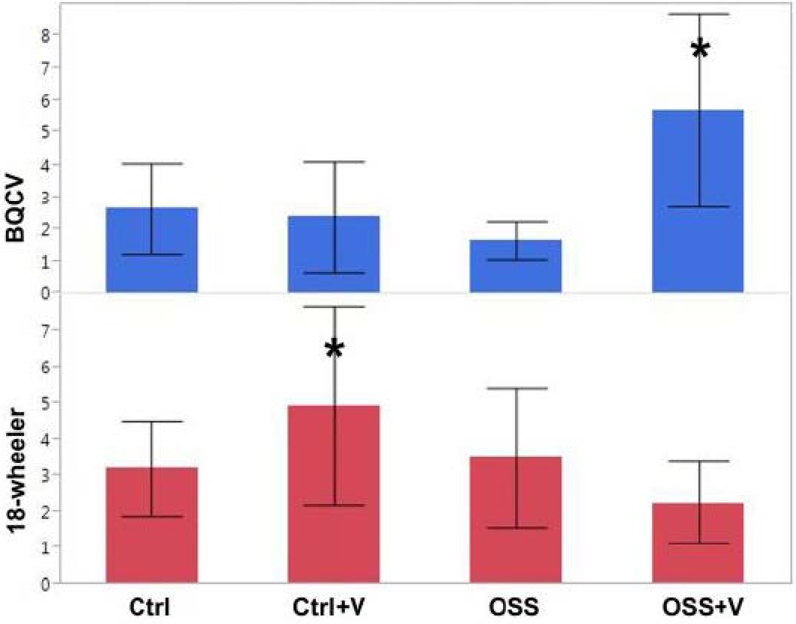
Data on OSS use from the California Pesticide Information Portal Project (CalPIP) in pesticide use databases.

Chen J, Fine JD, Mullin CA. 2018. Are organosilicon surfactants safe for bees or humans? Sci Total Environ. 612:415-421.

NOT JUST AN ACTIVE INGREDIENT ISSUE - ORGANOSILICONE ADJUVANTS ALSO AFFECT VIRAL INFECTIONS

JULIA FINE, DIANA COX-FOSTER, AND CHRIS MULLIN, NATURE SCIENTIFIC REPORTS, JANUARY, 2017





COLONY SURVIVAL FOLLOWING PESTICIDE EXPOSURE DEPENDS UPON SIZE OF COLONY

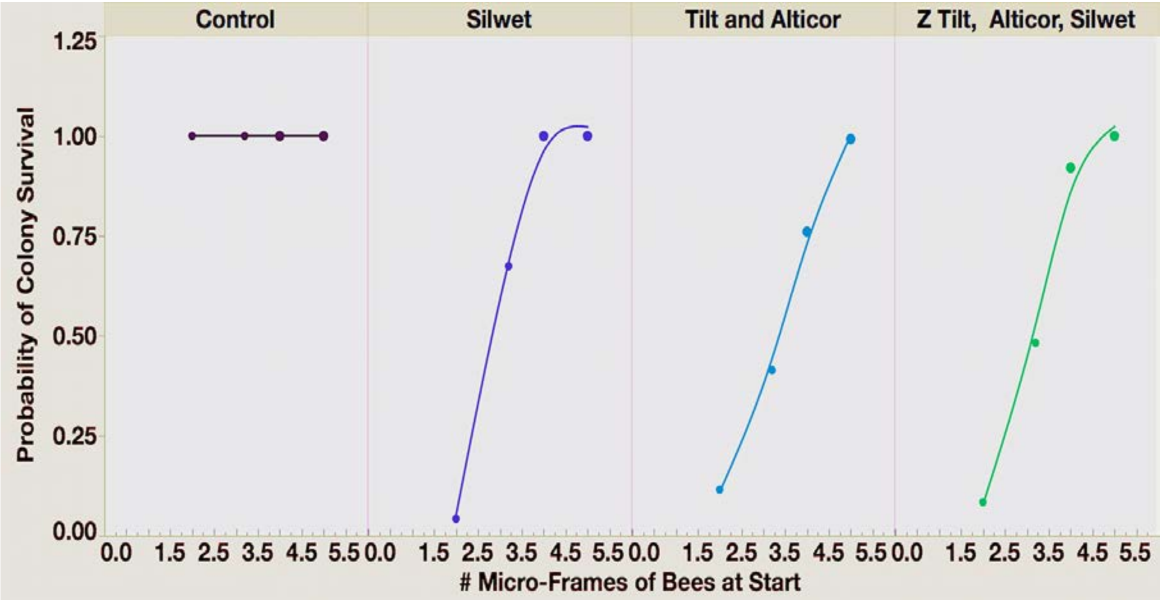
Distribution	AICc	BIC	
Frechet	128.86851	127.83839	Best

Whole Model Test

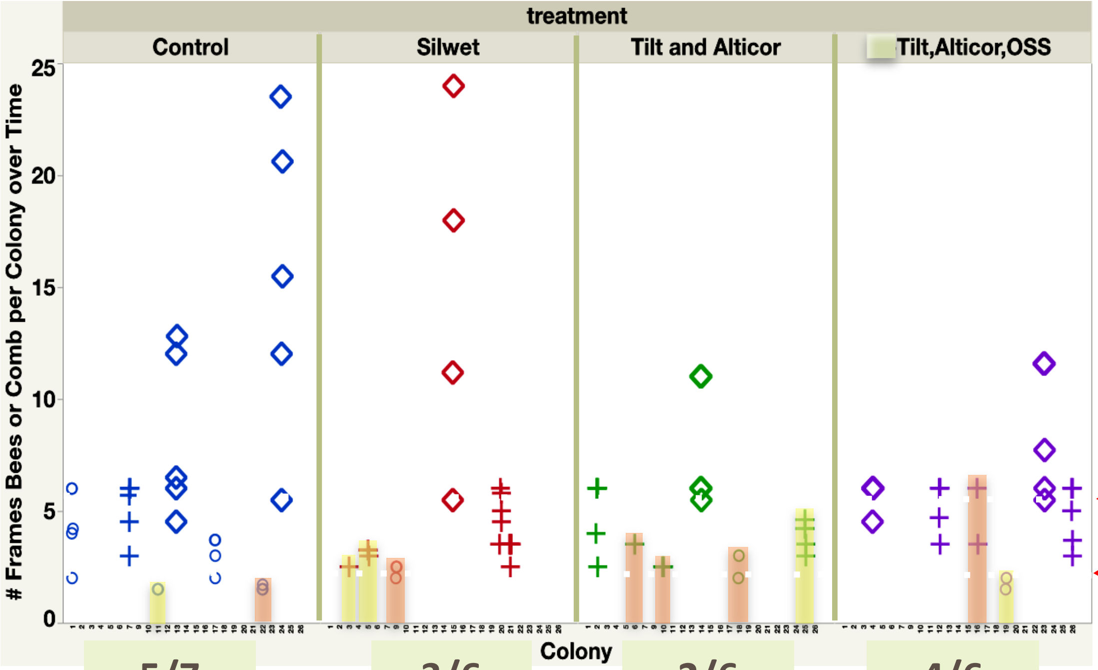
ChiSquare	DF	Prob>Chisq
25.9522	7	0.0005*

Effect Likelihood Ratio Tests

Source	Nparm	DF	L-R ChiSquare	Prob>ChiSq
Treatment	3	3	9.76934124	0.0206*
Initial Size	1	1	23.8948274	<.0001*
Initial Size*Treatment	3	3	5.98747362	0.1122



PESTICIDES HAVE AN IMPACT ON QUEENS AND COLONIES FUNGICIDE/INSECTICIDE MIXTURE (PROPICONAZOLE (TILT), 150 PPB A.I.; CHLORANTRANILIPROLE (ALTACOR),3 PPM A.I.) AND ADJUVANT (ORGANOSILICONES (OSS) OR SILWET, 40 PPB)



Starting Strength
- 1
- 2
- 3

Queenless

Swarm

Colony Resilience

Lower Tolerance Limit

5/7 colonies survived	3/6 colonies survived	2/6 colonies survived	4/6 colonies survived

Parametric survival analysis, Weibull distribution, with censor. Whole Model Test (ChiSquare =21.0382, DF 11, Prob>Chisq 0.0330) (Effect summary: Starting strength p=0.00010, Treatment p=0.05534, Treatment X strength p=0.99811)

SUMMARY OF FINDINGS AND FUTURE QUESTIONS

- ***Summary*:**
    - Pesticides (Tilt, Alticor, and OSS adjuvants) do impact colony health
- ***Remaining questions-***
    - *What concentrations of OSS do bees encounter in almond pollen and nectar?*
        - OSS adjuvants can be used up to 1-5% in tank mixes. Recommended usage for IPM ranges from 300 ppm to 5000 ppm in one spray. If used multiple times/season, it is not known what the bees will encounter.
            - 2017 samples of pollen (a limited number) did have detectable OSS at levels **higher** than used here in these experiments
            - Question about the breakdown of OSS's over time- Does it occur and how fast?
        - Fate of OSS in soil and plants is unknown and the breakdown rate may be limited
            - Is there a carry over from year to year?
        - Can other adjuvants be used in place of OSS for improved pest and disease control?
        - Collaborators added: **Dr. Bill Doucette**, Environmental toxicologist, Utah State University, and **Dr. Joel Siegel**, USDA-ARS-PWA, San Joaquin Valley Agricultural Sciences Center, Parlier, California

CURRENT RESEARCH & EXTENSION THROUGH THE UNL BEE LAB

Judy Wu-Smart

Department of Entomology

jwu-smart@unl.edu

402-472-8696

POLLINATION SERVICES BY INSECTS

Butterflies, beetles, flies, and BEES! = pollinate plants that shape the landscape for other wildlife

Honey bees = over 100 agricultural crops (fruits, veggies, nuts)

1/3 of our diet is dependent on pollination by insects

$19 billion in added crop value

Wild bees = pollinate native plants & are more efficient for some crops

Honey bee colonies in canola

Andrena bee on blueberries
Photo by: Rufus Issacs

Monarch on milkweed
Photo by: Columbia Science

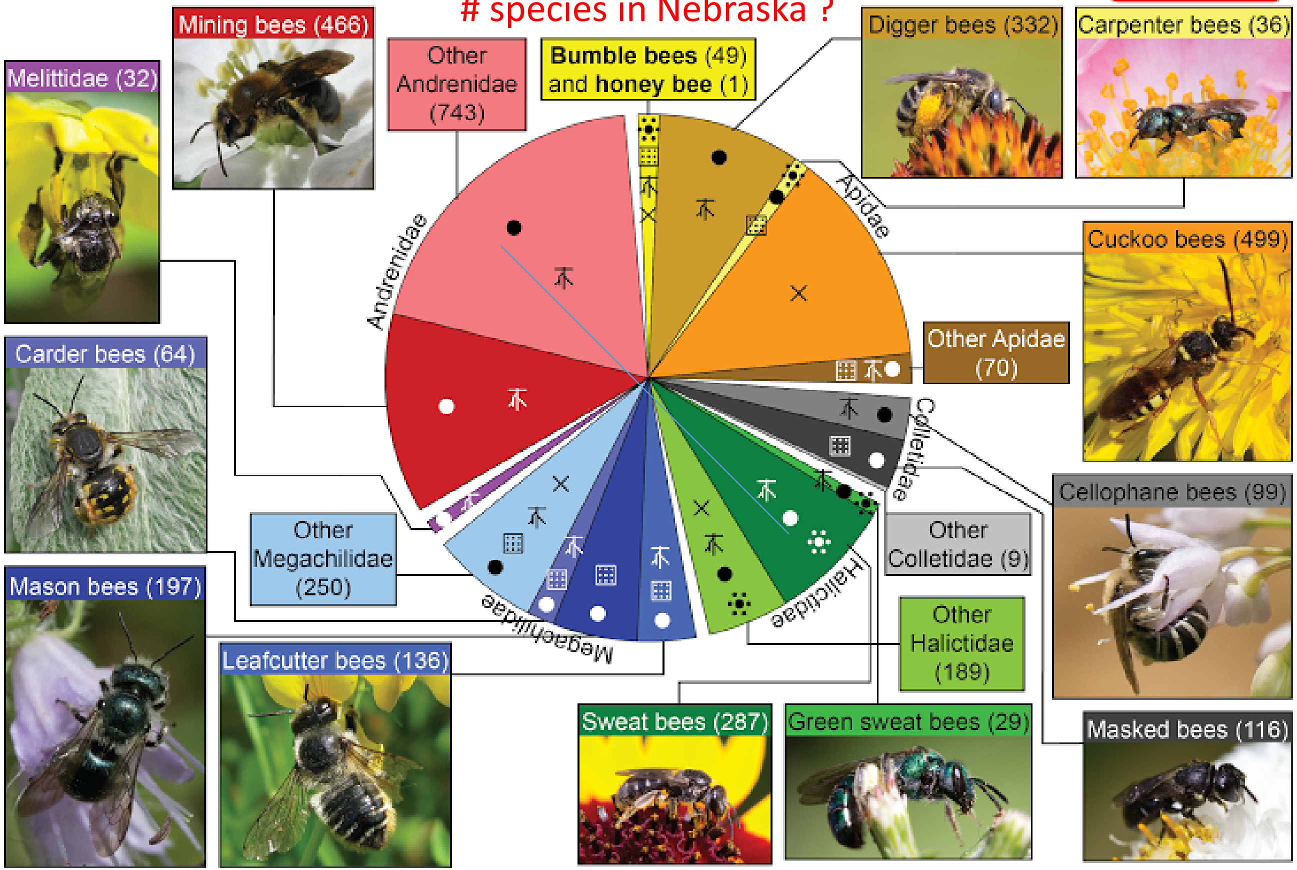
Data source: Ascher and Pickering 2014. DiscoverLife bee species guide and world checklist. http://www.discoverlife.org/mp/20q?guide=Apoidea_species

Over 20,000 species worldwide

~4,000 species in US

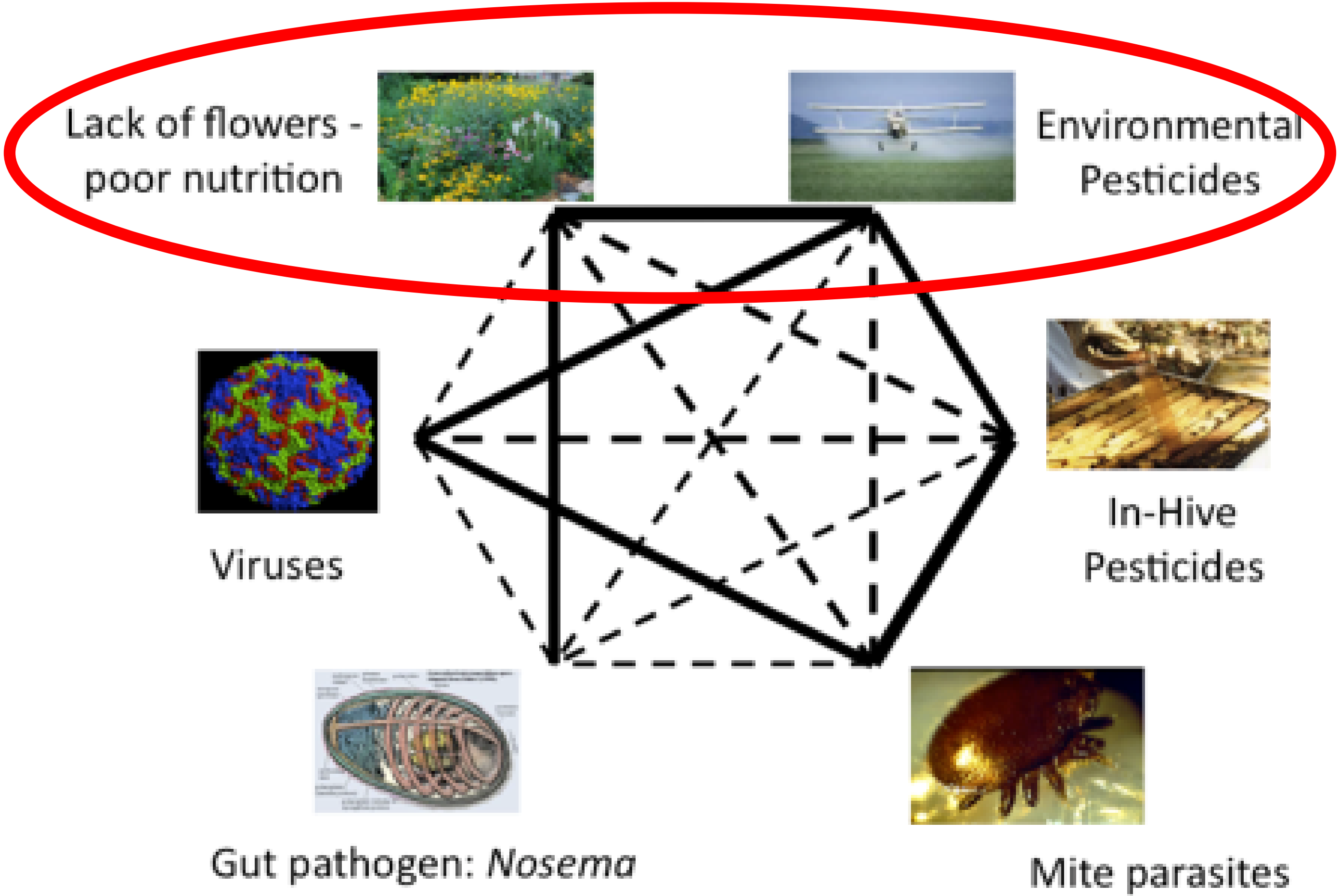
species in Nebraska ?

Social · Solitary · Ground-nesting · Cavity-nesting · Nest parasites

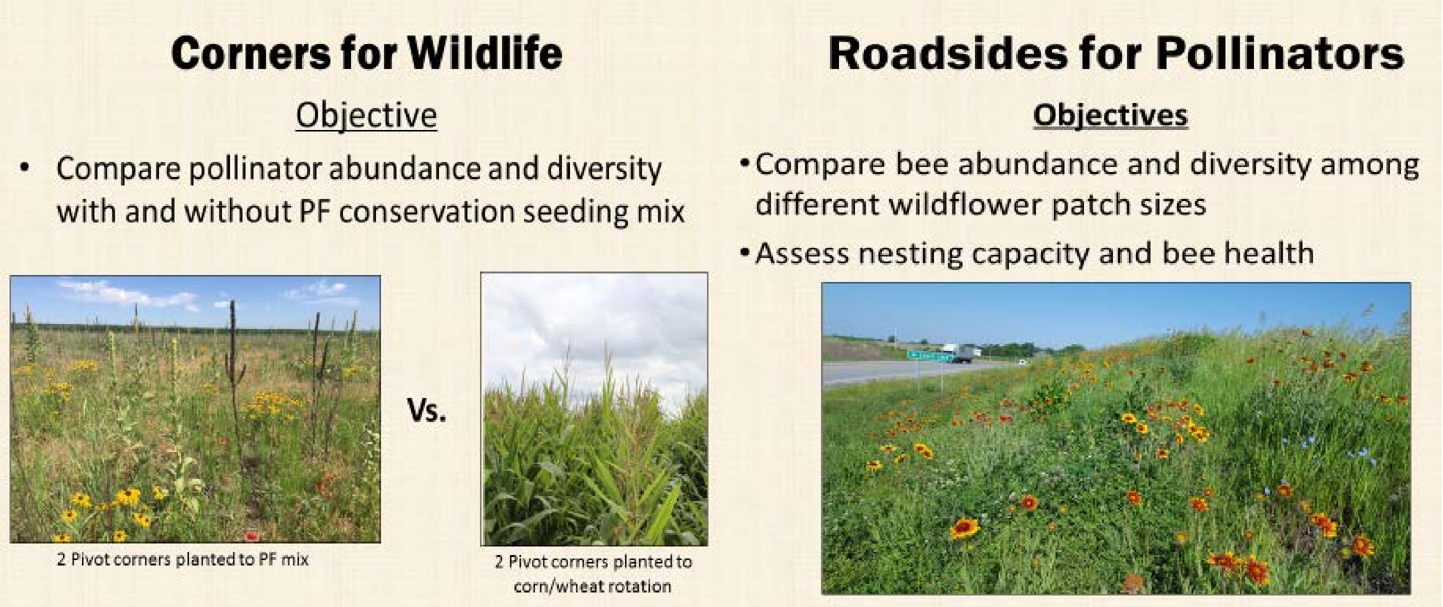


By Joel Gardener

WHY HONEY BEE COLONIES ARE DYING

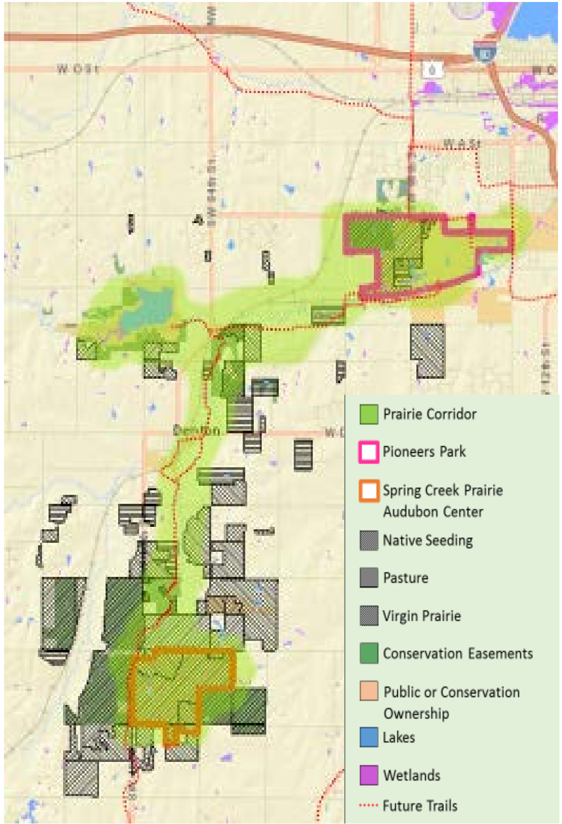


PLANTING HABITAT FOR POLLINATORS ON MARGINAL LANDS IN NEBRASKA



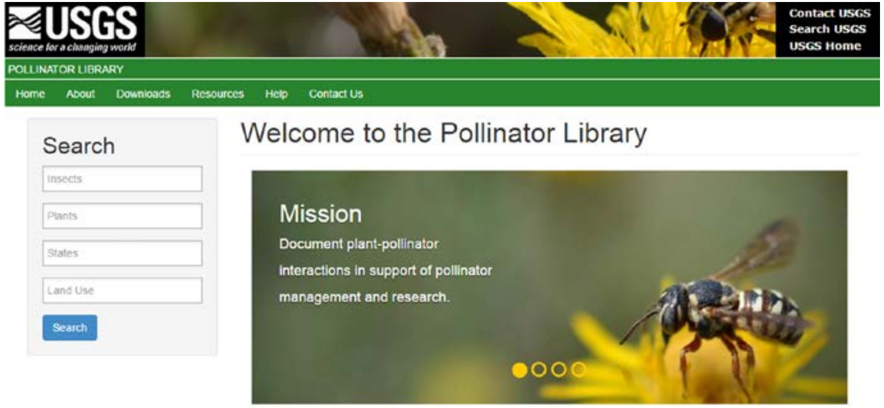
Kayla Mollet,
MS student

PLANT-POLLINATOR INTERACTION SURVEYS AMONG VARIOUS LANDSCAPE MANAGEMENT PRACTICES IN NEBRASKA PRAIRIES



Forb & bee surveys
all along Prairie Corridor

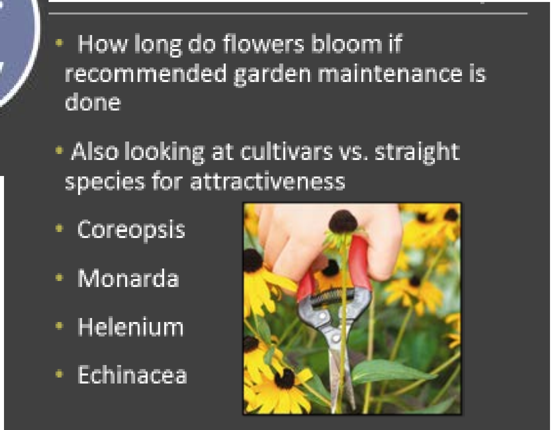
Katie Lamke,
MS student



RESEARCH AND EXTENSION IN URBAN GARDENS AND URBAN BEES

http://entomology.unl.edu/pollinator-habitat-certification

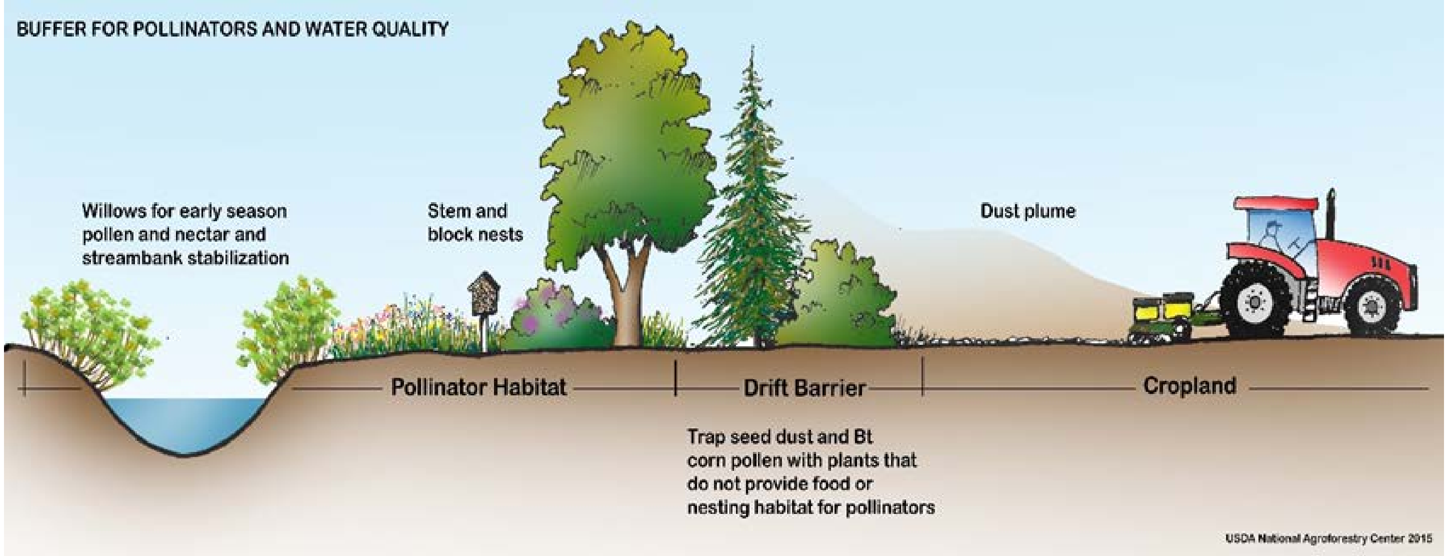
Natalia Bjorklund
PhD student &
Extension Educator



LANDSCAPE ENHANCEMENTS TO REDUCE PESTICIDE DRIFT & INCREASE FORAGE FOR POLLINATORS IN AGRICULTURAL FIELDS

Drift from:
Neonicotinoid insecticides (Spring)
Bacillus thuringiensis embedded pollen (Fall)

Surabhi Vakil,
PhD student



VIRAL TRANSMISSION AMONG BEES IN DIFFERENT LANDSCAPES

Are viruses more prevalent among social honey bees and bumble bees compared to solitary bees?

Are enhanced landscapes potentially increasing viral transmission between managed honey bees and wild bees?

Tuğçe Karaçoban,
MS student

Nebraska Beneficial Insect Protection Efforts

UNL is lead on this effort but has expanded beyond pollinators

Goal:

To ensure Nebraska maintains a robust agricultural economy and healthy beneficial insect communities

-enhanced habitat
-reduced pesticide exposure
-improved educational/extension/outreach



Nebraska Beneficial Insect Protection Efforts

Beyond pollinators...

Focus: Safeguarding ecosystem functions

- **Pollination services (bees, butterflies, beetles)**
- **Pest control (natural enemies)**
- **Nutrient cycling (dung/carrion beetles, soil dwellers)**
- **Bioindicators (aquatic insects)**




Nebraska Beneficial Insect Protection Efforts

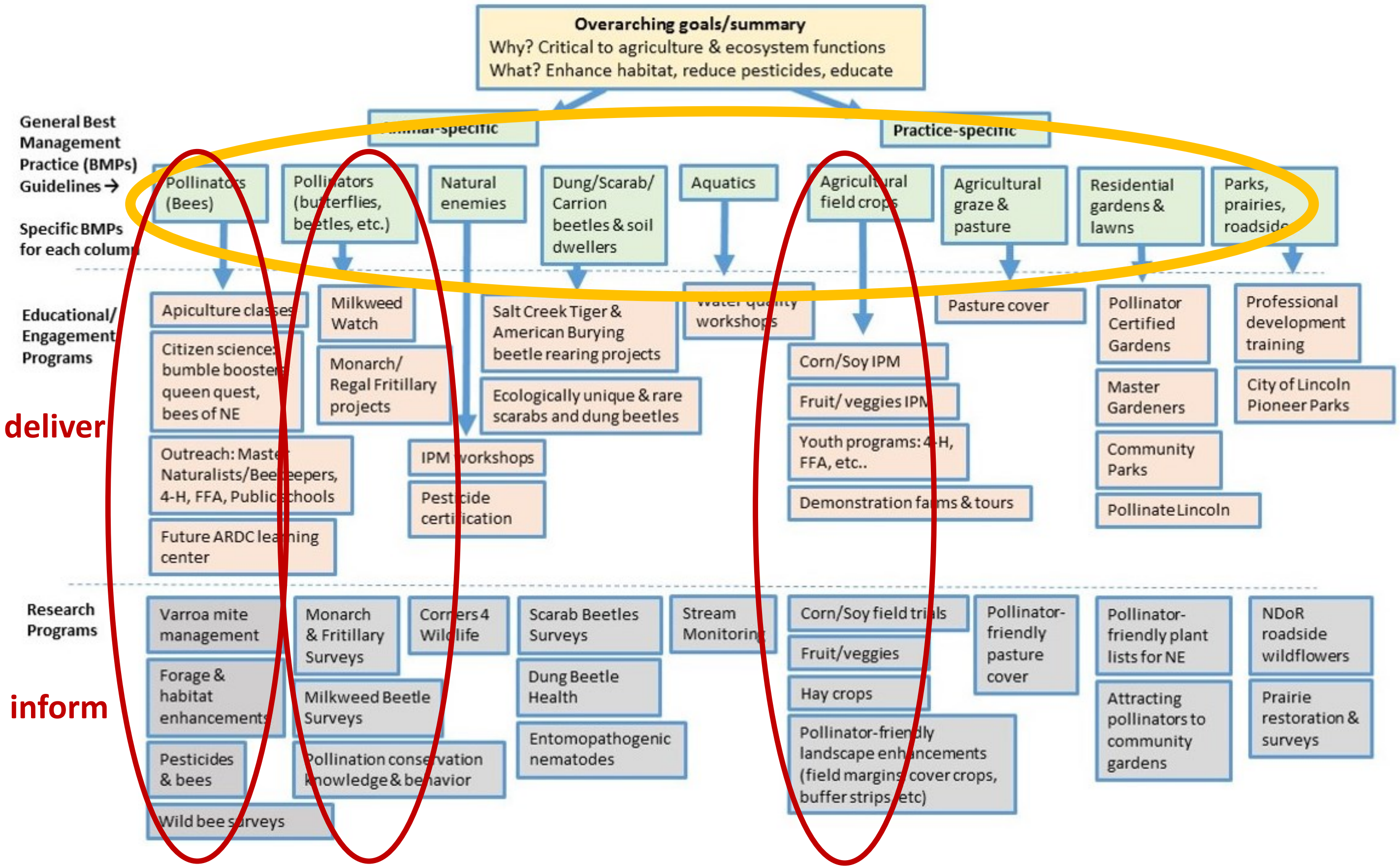
Beyond pollinators...

Focus: Enhancing landscapes for beneficial insects

- Agricultural fields (corn/soy, fruits, vegetables, etc..)
- Graze & pasture (pasture cover)
- Residential spaces (gardens & lawns)
- Open spaces (prairies, parks, roadsides)




Nebraska Beneficial Insect Protection Efforts



Nebraska Beneficial Insect Protection Efforts

Interactive Web-based Library:
- Centralized location for resources
- BIPP = "living document" which will be available and continually improved on online
- Educational resources: curricula, teaching kits, plant lists, instructional guides, and other social media links
- Research publications, Neb guides, etc..
- Notifications of extension workshops and outreach events
- Contacts for organizations and partners: to improve recruitment

Target audience: educators, homeowners, land managers, researchers, nature enthusiasts, pesticide applicators, policy makers

P-IE Science Policy Field Tour

Balancing Pest Management and Pollinator Health
August 22-24, 2017

The P-IE Section Governing Council has received exuberant positive feedback from membership and stakeholders on the planned Science Policy Field Tour. Verbal commitments have been received by stakeholders aligned to public service agencies, policymakers, NGOs, beekeeping organizations, and crop protection and commodity groups. We anticipate the tour will provide opportunities to exchange novel ideas and gain knowledge to shape pest management and pollinator protection policies into the future.

ENTOMOLOGICAL SOCIETY OF AMERICA
Plant–Insect Ecosystems Section

Join the conversation on Twitter!

IN THIS SECTION

Medical, Urban, & Veterinary Entomology (MUVE)

Physiology, Biochemistry, and Toxicology

Plant-Insect Ecosystems

P-IE Awards

P-IE Science Policy Field Tour

Systematics, Evolution, and Biodiversity Section

Leader Resources

THANK YOU !

Judy Wu-Smart
Department of Entomology
jwu-smart@unl.edu
402-472-8696

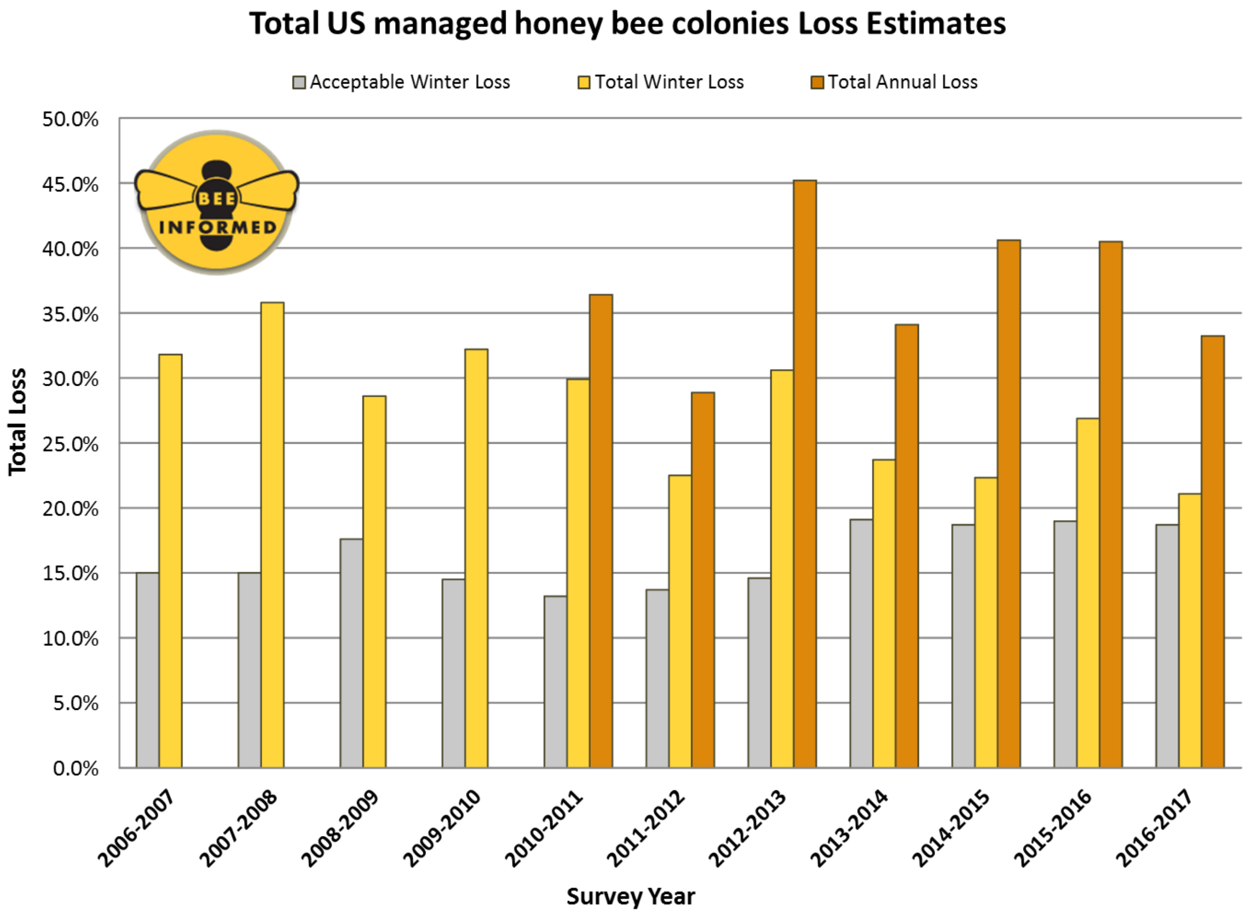
TECH TRANSFER TEAMS SERVING COMMERCIAL BEEKEEPERS

Dennis vanEngelsdorp
Bee Informed Partnership
University of Maryland

OVERVIEW OF U.S. HONEY BEE HEALTH

Dennis vanEngelsdorp
Bee Informed Partnership
University of Maryland

BEE INFORMED


Total US managed honey bee colonies Loss Estimates
Acceptable Winter Loss
Total Winter Loss
Total Annual Loss
BEE
INFORMED
50.0%
45.0%
40.0%
35.0%
30.0%
25.0%
20.0%
15.0%
10.0%
5.0%
0.0%
Total Loss
2006-2007
2007-2008
2008-2009
2009-2010
2010-2011
2011-2012
2012-2013
2013-2014
2014-2015
2015-2016
2016-2017
Survey Year

http://www.u213mt.com


100%
FUN


Project Apis m.

Project Apis m.

california almonds™

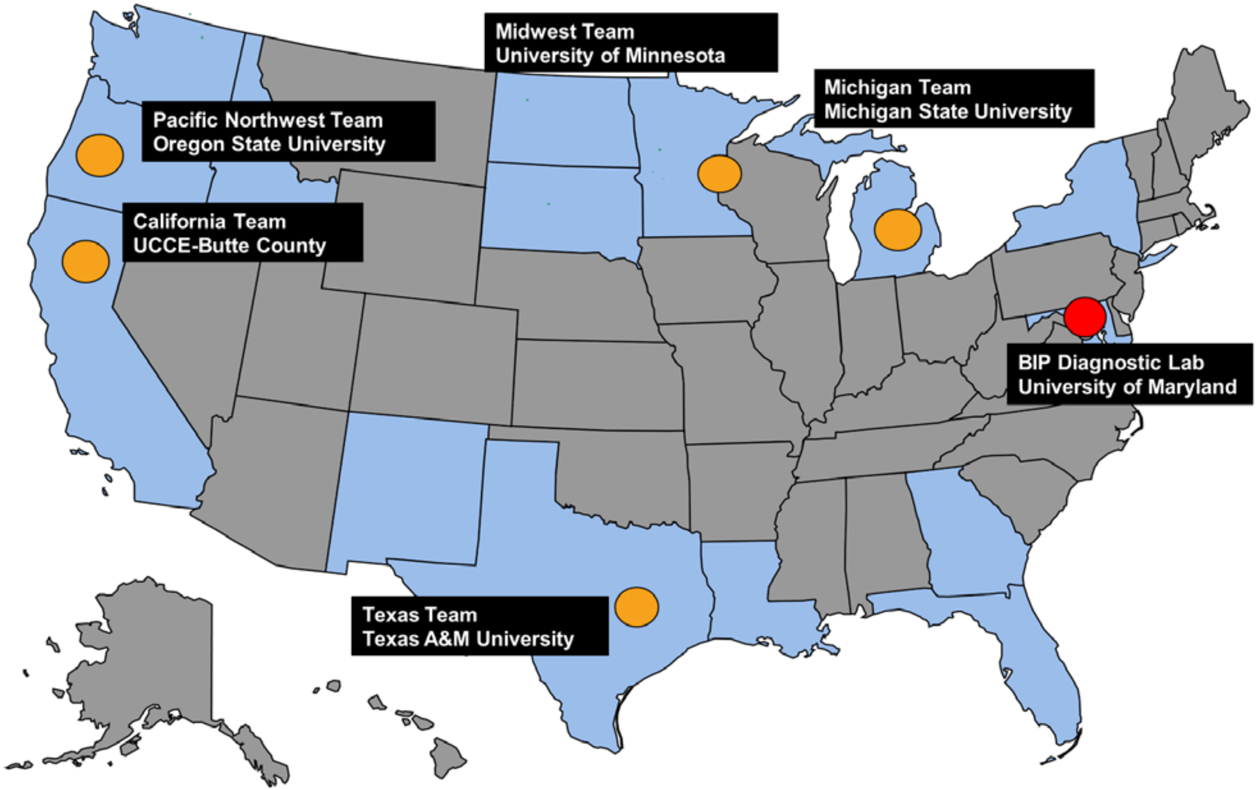
Almond Board of California

Tech Teams

- BIP works with ~100 beekeepers who manage over 417,302 colonies, representing 25% of colonies needed for almond pollination

Tech team cost structure

- Costs
  - In 2014, $118,800 per TT member
  - In 2017, $90,000,per tech member
    - »a 24% reduction
- Income
  - 50% Beekeeper income
  - 25% Contracts
  - 25% grants, donations and sustaining support


Midwest Team
University of Minnesota
Michigan Team
Michigan State University
Pacific Northwest Team
Oregon State University
California Team
UCCE-Butte County
BIP Diagnostic Lab
University of Maryland
Texas Team
Texas A&M University

Bee Informed Partnership
TechTeam Inspection Report

beeinformed.org

Beekeeper: **MW-CA** Report date: **10/24/16**

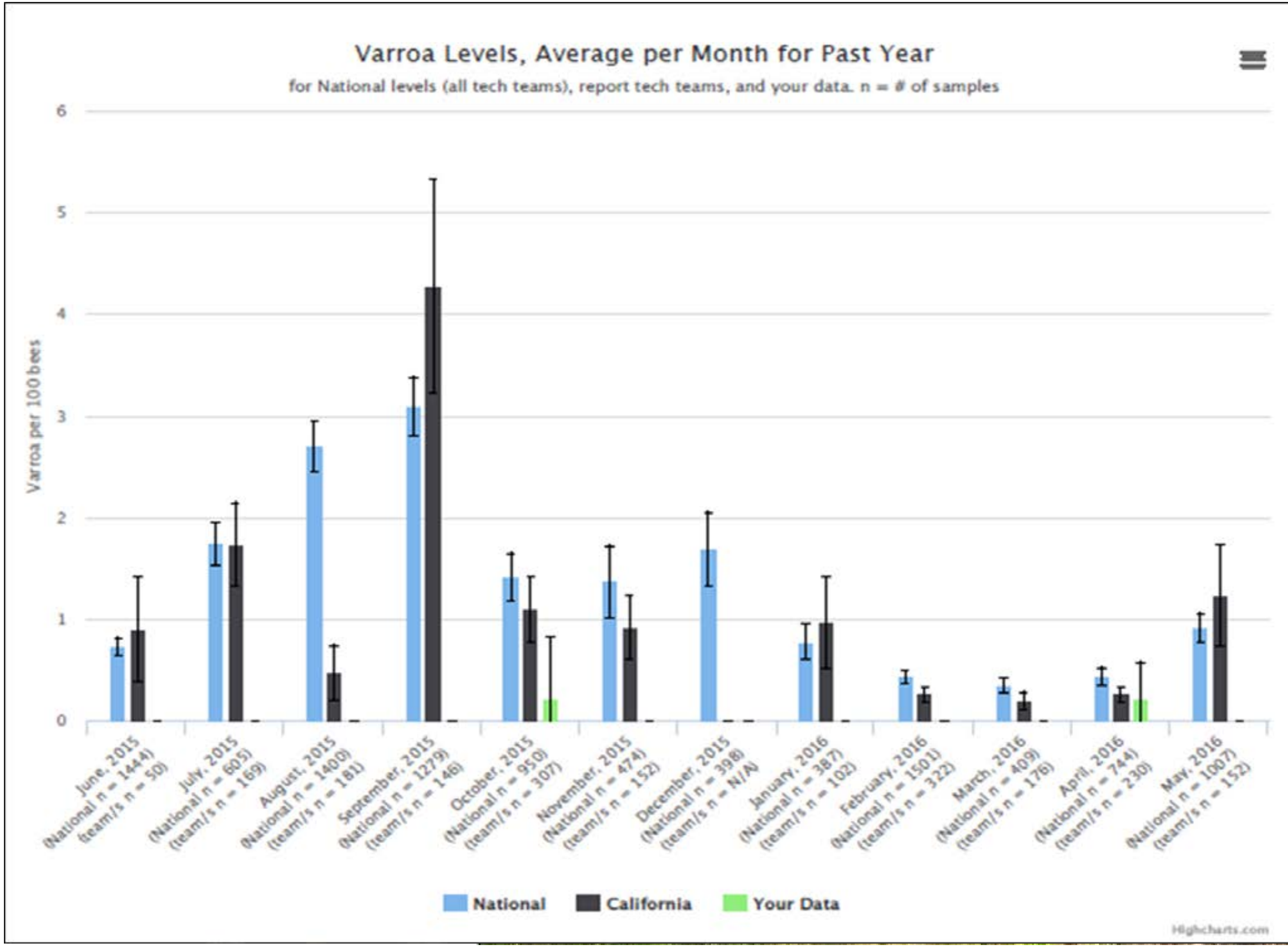
Sample Events for this Report						
Collection Date	**Apiary Name**	**Latitude**	**Longitude**	**State**	**Sampler**	**Apiary Notes**
April 21, 2016	Ranch Yard	.	.	CA	Mikey Mann	.
April 21, 2016	House	.	.	CA	Mikey Mann	.

Apiary Summary Varroa and Nosema
(n= number of colonies sampled)
***Locations listed above occuring more than once are combined.**

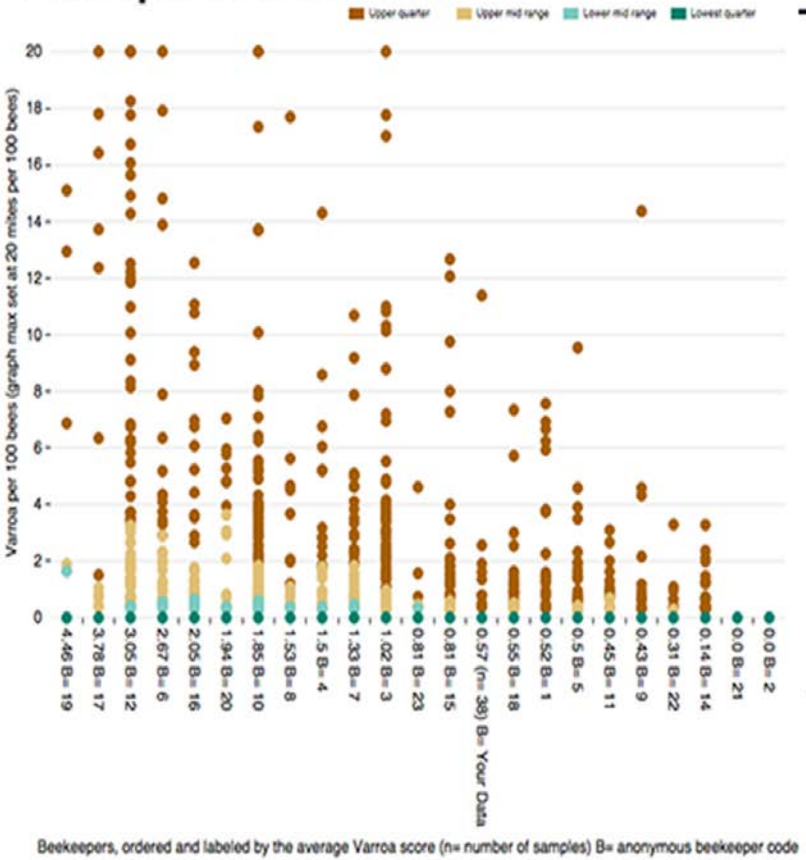
Apiary Name	Varroa Average Mites / 100 Bees	Varroa Minimum - Maximum	Nosema Average Millions of Spores / Bee	Nosema Minimum - Maximum	Frames of Bees Average	Frames of Bees Minimum - Maximum
House	0.04 (n=6)	0.0 - 0.26	0.57 (n=6)	0.05 - 1.2	12.75 (n=6)	11.5 - 14.0
Ranch Yard	0.32 (n=9)	0.0 - 2.56	1.12 (n=9)	0.0 - 2.45	9.0 (n=9)	7.0 - 14.0

≡ Sort...

collection date	apiary name	colony num	colony type nuc	hive body	queen status	frames of bees	brood pattern	disease	color	notes	uncapped removing	percent removed	varroa per 100 bees	million spores per bee	samples taken
April 21, 2016	House	1437	Field	2D	QR	12.0	4.5	.	3.5		100	99	0.00	1.1	varroa, nosema, hygienic
April 21, 2016	House	1436	Field	2D	QR	11.5	3.0	CDB	3.5		99	94	0.26	1.2	varroa, nosema, hygienic
April 21, 2016	House	1435	Field	2D	QR	14.0	4.75	.	3.75		100	99	0.00	0.5	varroa, nosema, hygienic
April 21, 2016	House	1434	Field	2D	QR	13.0	4.5	.	4.0	Y15	88	73	0.00	0.1	varroa, nosema, hygienic
April 21, 2016	House	1433	Field	2D	QR	13.5	5.0	.	3.75	Y24	96	89	0.00	0.3	varroa, nosema, hygienic



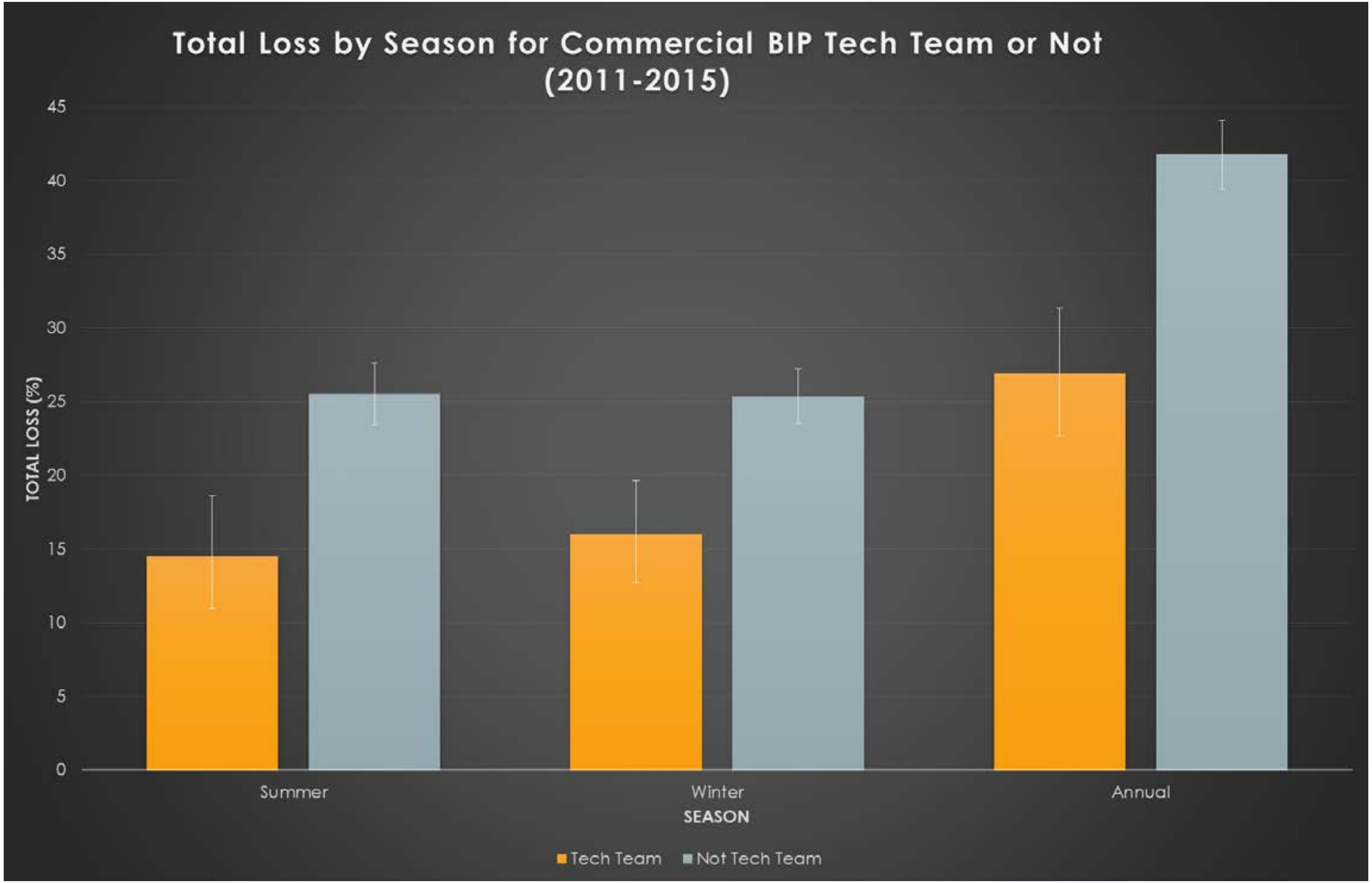
Example Scatter Plot



The color of the points indicate the quarter range of values per beekeeper. For example, the point where orange meets yellow is the median (or the middle) of the data. The green values are in the top 25% of the data for that beekeeper.

Points indicate the measure on the hive, however multiple hives with the same value are hidden

Each column represents a beekeeper. The average value for that beekeeper is also given, along with the number of samples for your data.


Total Loss by Season for Commercial BIP Tech Team or Not (2011-2015)
TOTAL LOSS (%)
0
5
10
15
20
25
30
35
40
45
Summer
Winter
Annual
SEASON
Tech Team
Not Tech Team

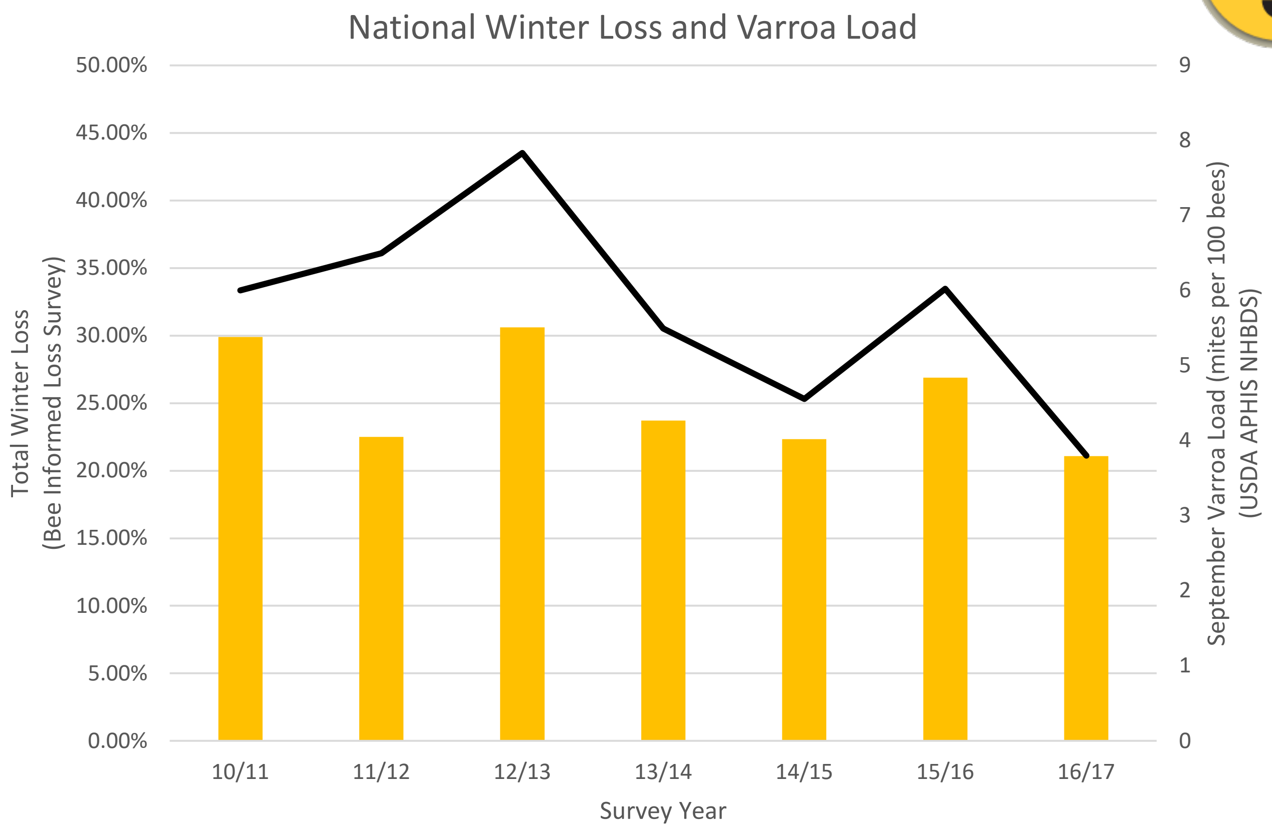
IMPACT OF TTT INVESTIMENTS

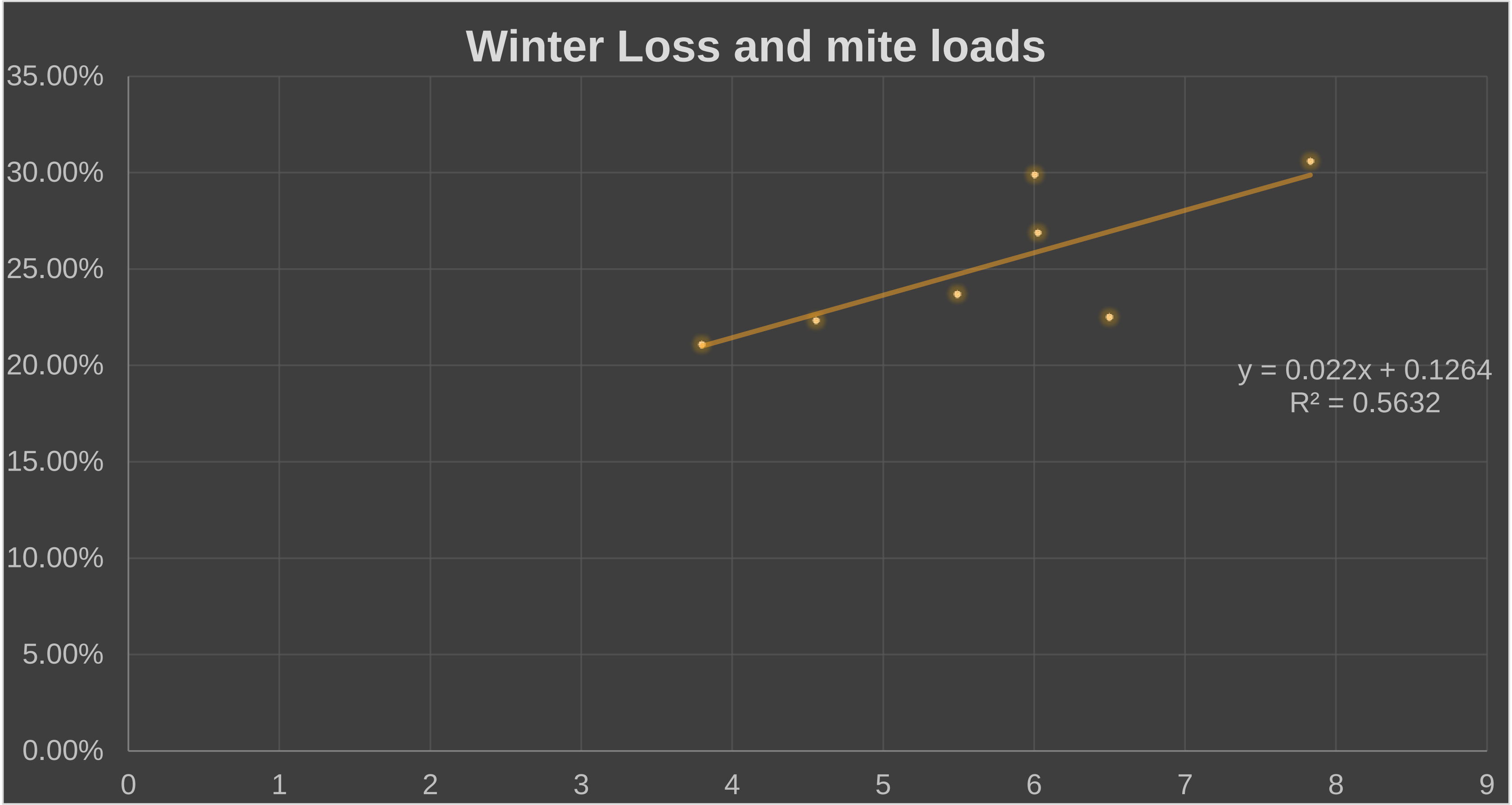
- Considering 13 point savings in Beekeepers engaged in BIP tech teams
  - Represents ~48,000 more colonies in Almond orchards

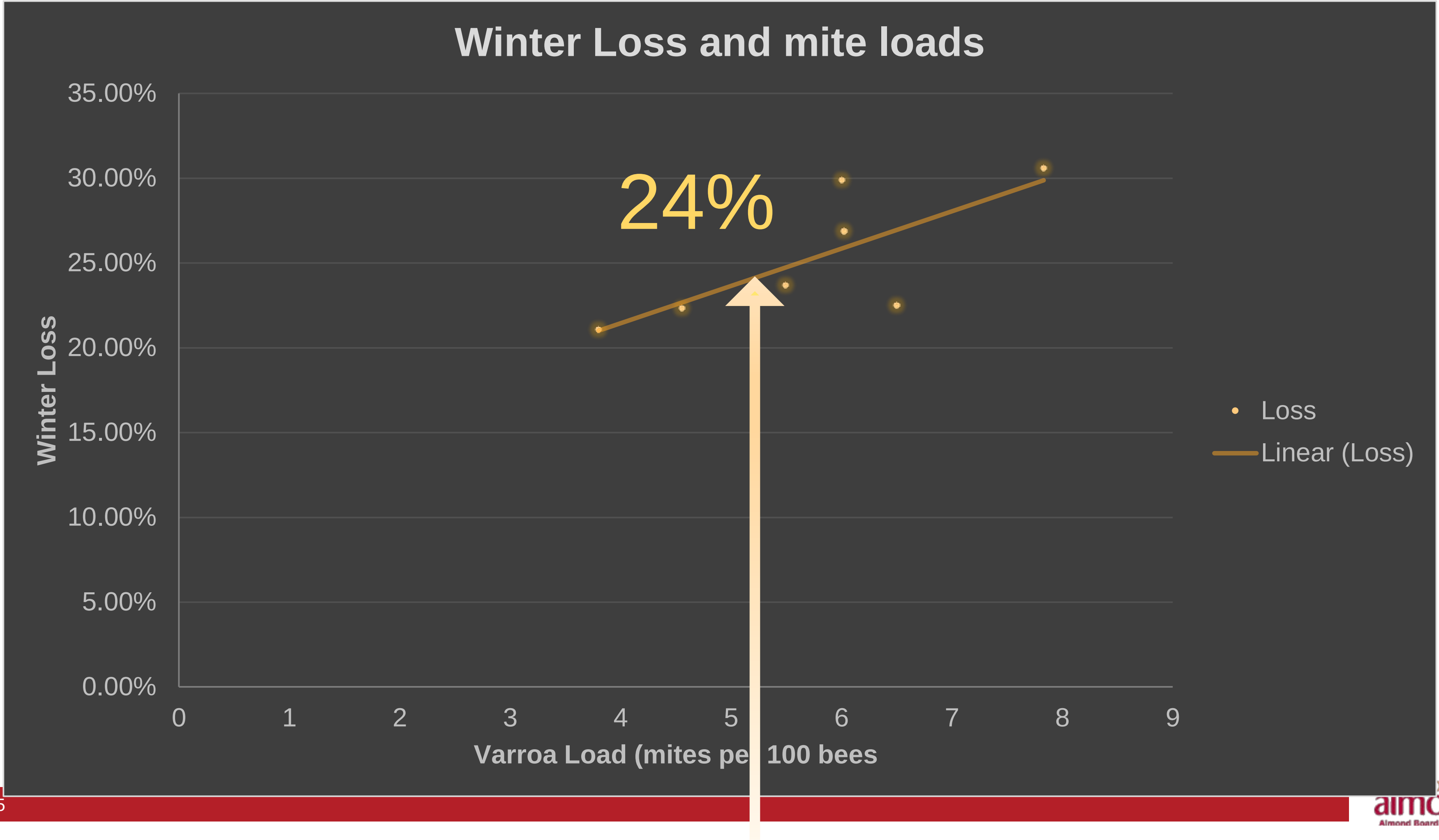
$1 invested =

$2.26 in return

September: The Month to watch




Winter Loss and mite loads
35.00%
30.00%
25.00%
20.00%
15.00%
10.00%
5.00%
0.00%
0
1
2
3
4
5
6
7
8
9
y = 0.022x + 0.1264
R² = 0.5632


Winter Loss and mite loads
35.00%
30.00%
25.00%
20.00%
15.00%
10.00%
5.00%
0.00%
Winter Loss
0
1
2
3
4
5
6
7
8
9
Varroa Load (mites per 100 bees
24%
Loss
Linear (Loss)

Thank you to our Sponsors:

In collaboration with:

CEUs – New Process

Certified Crop Advisor (CCA)

- Sign in and out of each session you attend.
- Pickup verification sheet at conclusion of each session.
- *Sign in sheets are located at the back of each session room.*

Pest Control Advisor (PCA), Qualified Applicator (QA), Private Applicator (PA)

- Pickup scantron at the start of the day at first session you attend; complete form.
- Sign in and out of each session you attend.
- Pickup verification sheet at conclusion of each session.
- Turn in your scantron at the end of the day at the last session you attend.

Sign in sheets and verification sheets are located at the back of each session room.

What's Next

Thursday, December 7 at 10:45 a.m.

- ABC Partners Addressing Bee Health – Room 312-313
- Surveying the Legal Risk Landscape – Room 314
- India: Celebrating Traditions – Room 306-307
- Insect Pest Management Update – Room 308-309
- Unified Services for Solar Construction and Maintenance in the Almond Industry, Almond Stage in Hall A+B, presented by Sunworks, Inc.

Research Poster Sessions

Wednesday, December 6
3:00 p.m. – 5:00 p.m.

Featured topics:
- Irrigation, nutrient management
- Breeding
- Soils, if related to organic matter input
- Sustainability, irrigation improvement continuum, life cycle assessment, dust
- Food quality and safety

Thursday, December 7
1:30 p.m. – 2:30 p.m.

Featured topics:
- Insect and disease management
- Fumigation and alternatives
- Biomass (including biochar-related efforts)
- Pollination
- Almond Leadership Program

2017 Research Update Book

- Pickup your copy at the ABC Booth in Hall A+B
- Includes a one-page summary of every current ABC-funded research project

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