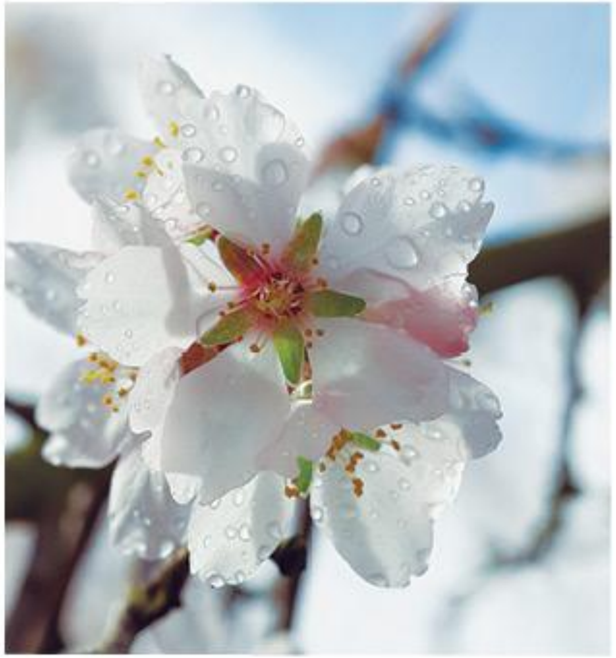
Research Updates



growing
ADVANTAGE
The Almond Conference

Monitoring the Adult Navel Orangeworm Moths with Pheromone and Host-Plant Volatiles

Ring T. Cardé, Entomology

University of California, Riverside

Collaborators:

- Brad Higbee, Paramont Farms
- Robbie Girling, University of Southampton
- Jocelyn Millar, UC Riverside
- Walter Leal, UC Davis
- Bedoukian Research
- Tom Larsen, Suterra
- John Beck, ARS-USDA
- Bas Kuenen, ARS-USDA

Monitoring the Adult Navel Orangeworm Moths with Pheromone and Host-Plant Volatiles

Objectives:

- Define the complete pheromone (ratios) in wind tunnel and field assays

- Determine how pheromone is dispersed in orchards

- Develop a lab assay to help establish which blend of the identified volatiles form the host plant mediates female host location.

The 4 verified components of the NOW pheromone

(11*Z*,13*Z*)-hexadecadienal
(3*Z*,6*Z*,9*Z*,12*Z*,15*Z*)-tricosapentaene
(11*Z*,13*Z*)-hexadecadien-1-ol
(11*Z*,13*E*)-hexadecadien-1-ol

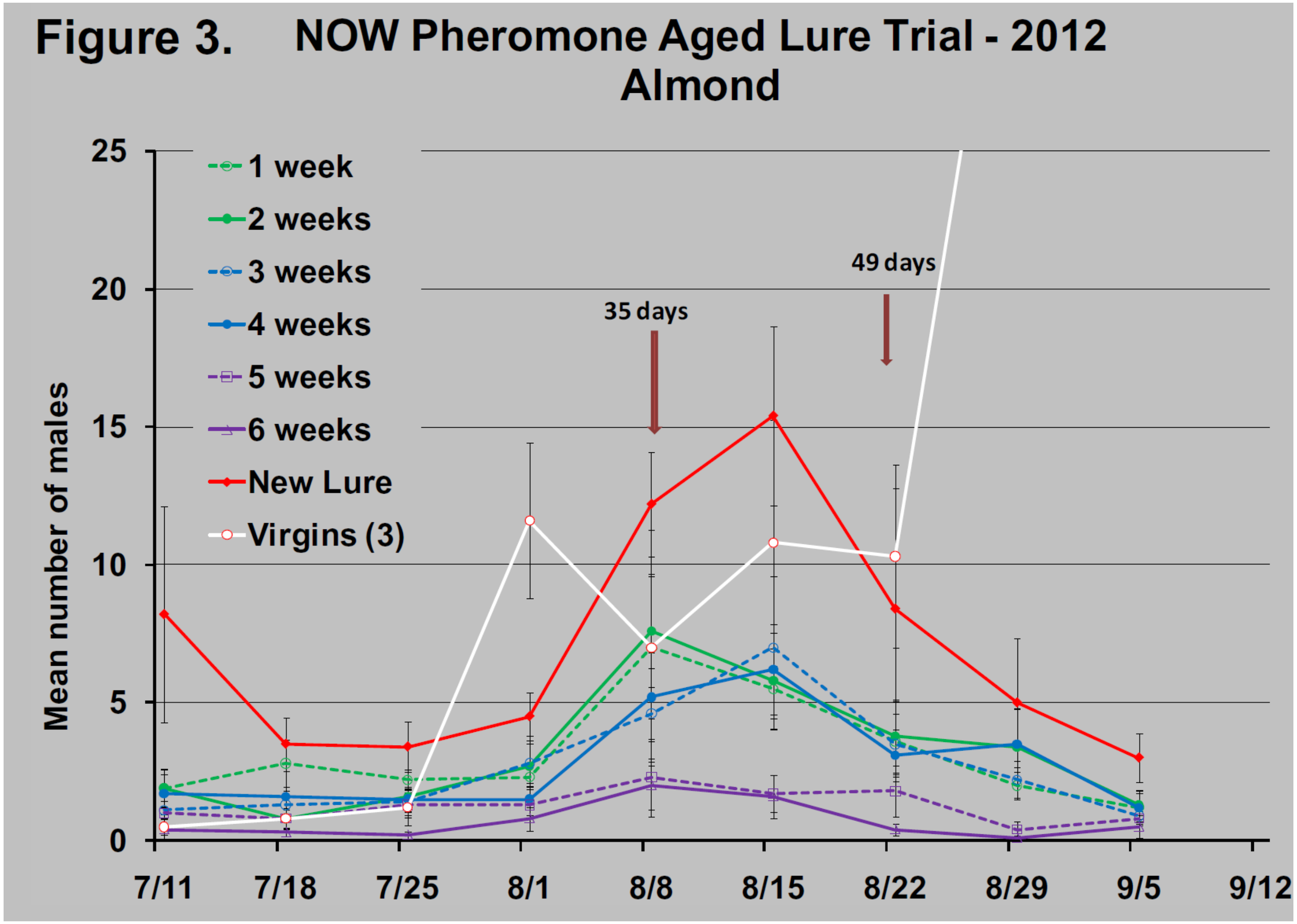
Possible inhibitors?

Tested the 3 geometrical isomers of the aldehyde (ZE, EZ and EE)—not inhibitory

Tested the acid of the aldehyde—not inhibitory

Figure 1. Mean (± se) number of NOW males captured in modified wing traps baited with synthetic sex pheromone or virgins over 13 weeks in 2012. Replicates were spaced 120 ft apart and traps within replicates were spaced 60 ft apart. Traps were checked and virgins replaced 2x/week.

Figure 3. Mean (± se) number of NOW males captured in delta traps baited with 4 component, 2 mg lures, aged from 0-6 weeks, or virgins over 13 weeks in 2012. Replicates were spaced 120 ft apart and traps within replicates were spaced 60 ft apart. Traps were checked and virgins replaced 1x/week.



Outstanding questions

Why are females somewhat more attractive than synthetic lures?—should be the other way around.

Are there missing components?—we are testing several new candidates.

Is the lure now available suitable for replacing females in monitoring programs?

Monitoring Adult Navel Orangeworm with Host Plant Volatiles

John J. Beck

Research Chemist

USDA-ARS

The Premise:

Navel Orangeworm is attracted to damaged almond

The Goal:

Formulate a blend of host plant volatiles with the ability to attract navel orangeworm

The Project:

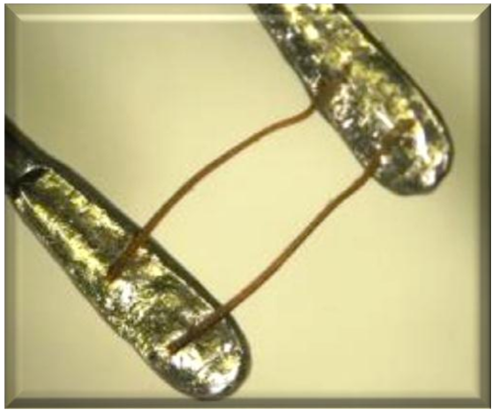
Collect host plant volatiles from almond & pistachio

- *Ex situ*
- *In situ*
- Ambient
- Aflatoxin contaminated
- Fungal spores present
- Varying stages of development

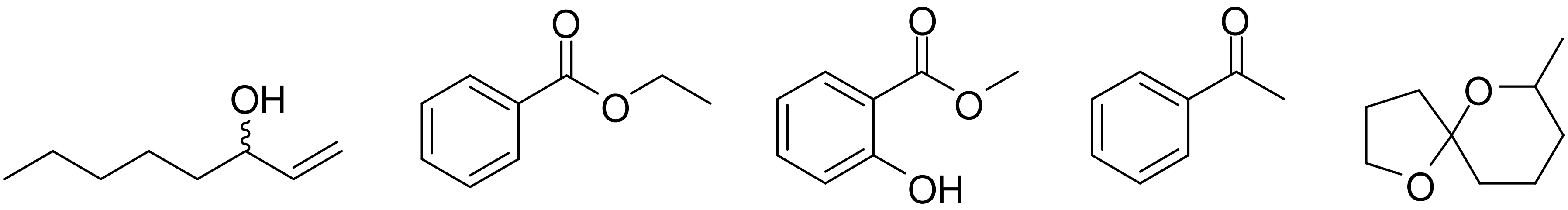
The Project:

Bioassay to help determine candidate volatiles and blends

- Electroantennographic analysis
- General screening
- Does not distinguish between attractant and repellent

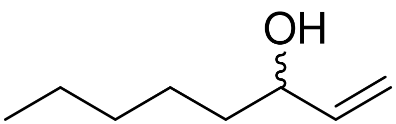


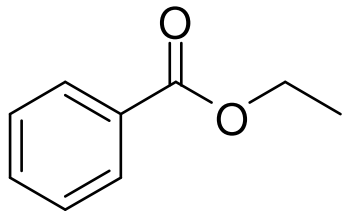
The Blend:

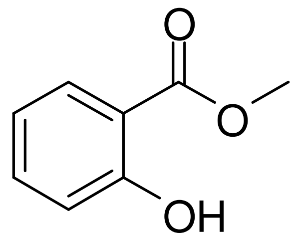


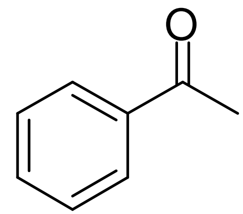
Identified volatiles associated almond hull split and almonds contaminated with fungi

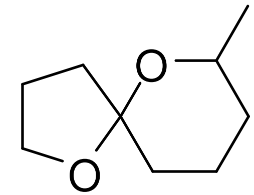
The Blend:


12


4


4


1


1

EtOAc as solvent

200 mg/2 mL

Season-long field trapping study

The Results (2011):

JOURNAL OF AGRICULTURAL AND FOOD CHEMISTRY

Article

pubs.acs.org/JAFC

Hull Split and Damaged Almond Volatiles Attract Male and Female Navel Orangeworm Moths

John J. Beck,*,† Bradley S. Higbee,‡ Douglas M. Light,† Wai S. Gee,† Glory B. Merrill,† and Jennifer M. Hayashi†

Adult navel orangeworm captures of blend compared to those of almond meal

J. Agric. Food Chem. 2012, 60, 8090−8096

The Results (2011):

Orchard	Treatment	Moths Captured		
		NOW Total	Female	Male
Almond	Blend	155	59	96
	Meal	20	19	1
	Blank	2	1	1
Pistachio	Blend	32	20	12
	Meal	2	2	0
	Blank	0	0	0

The Results (2011):

Orchard	Treatment	Moths Captured NOW Total	Female		Male
Almond	Blend	155	59	x 3	96
	Meal	20	19		1
	Blank	2	1		1
Pistachio	Blend	32	20	x 10	12
	Meal	2	2		0
	Blank	0	0		0

The Results (2011):

Orchard	Treatment	Moths Captured		
		NOW Total	Female	Male
Almond	Blend	155	59	96
	Meal	20	19	1
	Blank	2	1	1
Pistachio	Blend	32	20	12
	Meal	2	2	0
	Blank	0	0	0

No comparison

The Results (2012 preliminary):

Orchard	Treatment	Moths Captured (2012)			
		NOW Total	Female		Male
Almond	Blend	540	285		255
	Blend (membrane)	70	29	x 8	41
	Meal	40	33		7
	Blank	3	1		2
Pistachio	Blend	107	66		41
	Blend (membrane)	51	16	x 2	35
	Meal	29	25		4
	Blank	0	0		0

The Results (2012 preliminary):

Orchard	Treatment	Moths Captured (2012)			
		NOW Total	Female	Male	
Almond	Blend	540	285	255	
	Blend (membrane)	70	29	41	x 36
	Meal	40	33	7	
	Blank	3	1	2	
Pistachio	Blend	107	66	41	
	Blend (membrane)	51	16	35	x 10
	Meal	29	25	4	
	Blank	0	0	0	

The Results (2012 preliminary):

growing ADVANTAGE The Almond Conference

Orchard	Treatment	Moths Captured (2012) NOW Total	Female		Male
Almond	Blend	540	285		255
	Blend (membrane)	70	29	- x 1	41
	Meal	40	33		7
	Blank	3	1		2
Pistachio	Blend	107	66		41
	Blend (membrane)	51	16	- x 1	35
	Meal	29	25		4
	Blank	0	0		0

The Results (2012 preliminary):

Orchard	Treatment	Moths Captured (2012) NOW Total	Female		Male
Almond	Blend	540	285	x 9	255
	Blend (membrane)	70	29		41
	Meal	40	33		7
	Blank	3	1		2
Pistachio	Blend	107	66	x 4	41
	Blend (membrane)	51	16		35
	Meal	29	25		4
	Blank	0	0		0

The Results (2012 preliminary):

		Moths Captured (2012)			
Orchard	**Treatment**	**NOW Total**	**Female**	**Male**	
Almond	Blend	540	285	255	x 6
	Blend (membrane)	70	29	41	
	Meal	40	33	7	
	Blank	3	1	2	
Pistachio	Blend	107	66	41	x 1
	Blend (membrane)	51	16	35	
	Meal	29	25	4	
	Blank	0	0	0	

The Results (2012 preliminary):

Orchard	Treatment	Moths Captured (2012)			
		NOW Total	Female	Male	
Almond	Blend	540	285	255	
	Blend (membrane)	70	29	41	x 5
	Meal	40	33	7	
	Blank	3	1	2	
Pistachio	Blend	107	66	41	
	Blend (membrane)	51	16	35	x 1
	Meal	29	25	4	
	Blank	0	0	0	

The Take-Away:

Blend attracts more adult moths than almond meal

Blend more effective in almonds

Interesting dynamics

- Crop variance
- Neat vs. EtOAc

More work to do…

Thank you:

Multidisciplinary Project

Insect and Mite Research

Frank G. Zalom

Professor and Extension Entomologist

Dept. of Entomology

UC Davis

Research Objectives

- Evaluate efficacy and May treatment timing of diamide insecticides against peach twig borer
- Evaluate efficacy and May treatment timing of insecticides against navel orangeworm
- Relationship of cultivar and field damage occurrence to navel orangeworm success
- Determine potential for *Blattisocius keegani* (Acari: Ascidae) as a biological control for navel orangeworm

May Peach Twig Borer Control

Mean (±SD) peach twig borer shoot strikes per tree, Manteca, 2012

Treatment	Rate	Application date [2]	PTB strikes/tree* Mean ± SD	
Control	NA	NA	5.83 ± 2.76	A
Dipel	1 lb	5/7/12 + 5/17/12	2.17 ± 1.83	B
Lorsban [1]	4 pt	5/14/12	1.67 ± 1.63	BC
Belt SC [1]	4 oz	5/14/12	1.00 ± 1.10	BC
Tourismo [1]	14 oz	5/14/12	1.00 ± 1.26	BC
Altacor [1]	4 oz	4/26/12	0.67 ± 0.82	BC
Altacor [1]	4 oz	5/14/12	0.50 ± 0.84	C
Altacor [1]	4 oz	5/17/12	0.67 ± 1.03	BC
Cyazypyr 10SE [1]	13.5 oz	5/14/12	0.50 ± 0.84	C
Cyazypyr 10SE [1]	16.9 oz	5/14/12	0.33 ± 0.52	C

* Means followed by the same letter do not differ significantly at *P*=0.05 by Student's t-test following arcsine transformation.

[1] Dyne-Amic added @ 0.25%% v/v

[2] PTB biofix date, 4/19/2012

May Navel Orangeworm Control

Mean (±SD) navel orangeworm infested mummies, Manteca, 2012

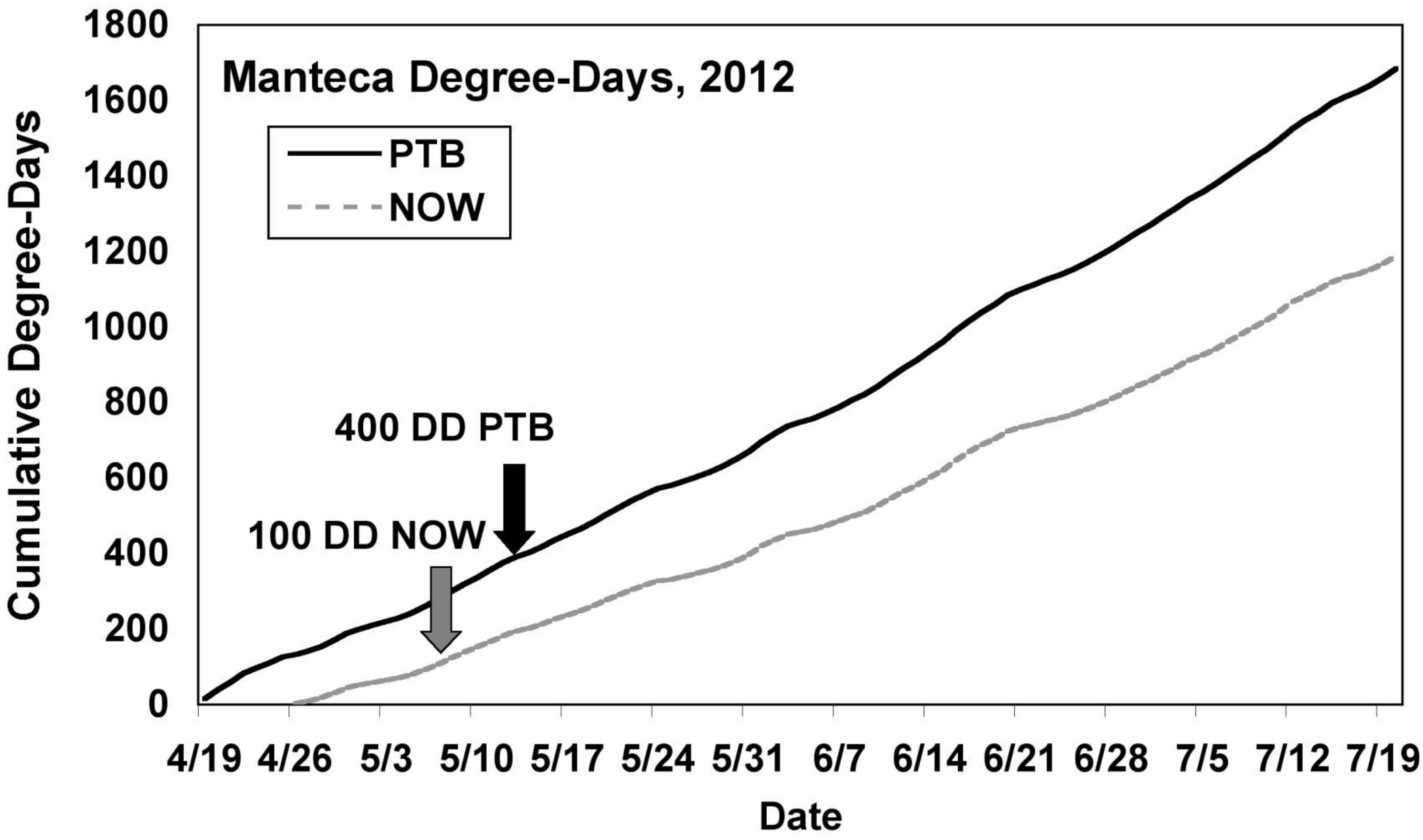
Treatment	Rate/ Acre	Chemical	Treatment date [2]	Degree-days	Percent damage Mean ± SD*
Control					2.7 ± 3.2 A
Cyazypyr [1]	13.5 oz.	cyazypyr	5/7	109 NOW	0.0 ± 0.0 D
Cyazypyr [1]	16.9 oz.	cyazypyr	5/7	109 NOW	0.0 ± 0.0 D
Altacor [1]	3 oz.	chlorantraniliprole	5/7	109 NOW	0.0 ± 0.0 D
Altacor [1]	4 oz.	chlorantraniliprole	4/26	0 NOW	0.5 ± 1.7 CD
Altacor [1]	4 oz.	chlorantraniliprole	5/7	109 NOW	0.5 ± 1.7 CD
Altacor [1]	4 oz.	chlorantraniliprole	5/14	402 PTB	0.0 ± 0.0 D
Belt [1]	4 oz.	flubendiamide	4/26	0 NOW	0.0 ± 0.0 D
Belt [1]	4 oz.	flubendiamide	5/7	109 NOW	1.2 ± 2.6 BCD
Belt [1]	4 oz.	flubendiamide	5/14	402 PTB	0.0 ± 0.0 D
Tourismo [1]	10 oz.	flubendiamide & buprofezin	5/7	109 NOW	0.6 ± 1.9 CD
Tourismo [1]	14 oz.	flubendiamide & buprofezin	5/7	109 NOW	0.0 ± 0.0 D
Intrepid [1]	16 oz.	methoxyfenozide	5/7	109 NOW	0.0 ± 0.0 D
Dimilin 2L [1]	12 oz.	diflubenzuron	5/7	109 NOW	2.2 ± 2.9 AB
Dipel	1 lb.	Bt	5/7 & 5/17	109 NOW+10 days	1.6 ± 2.6 ABC
Dipel	1 lb.	Bt	5/14 & 5/24	402 PTB+10 days	0.0 ± 0.0 D
TriTek	1 gal.	mineral oil	5/7 & 5/17	109 NOW+10 days	2.2 ± 2.9 AB
TriTek	2 gal.	mineral oil	5/14 & 5/24	402 PTB+10 days	1.2 ± 2.4 ABCD
Lorsban[1]	4 pt.	chlorpyrifos	5/7	109 NOW	0.0 ± 0.0 D

* ANOVA statistics, *F*=3.1868, df=18, 198, *P*<0.000. Means followed by the same letter do not differ significantly at *P*=0.05 by Student's t-test following arcsine transformation.

[1] Dyne-Amic @ 0.25% v/v

[2] PTB biofix date, 4/27/2012

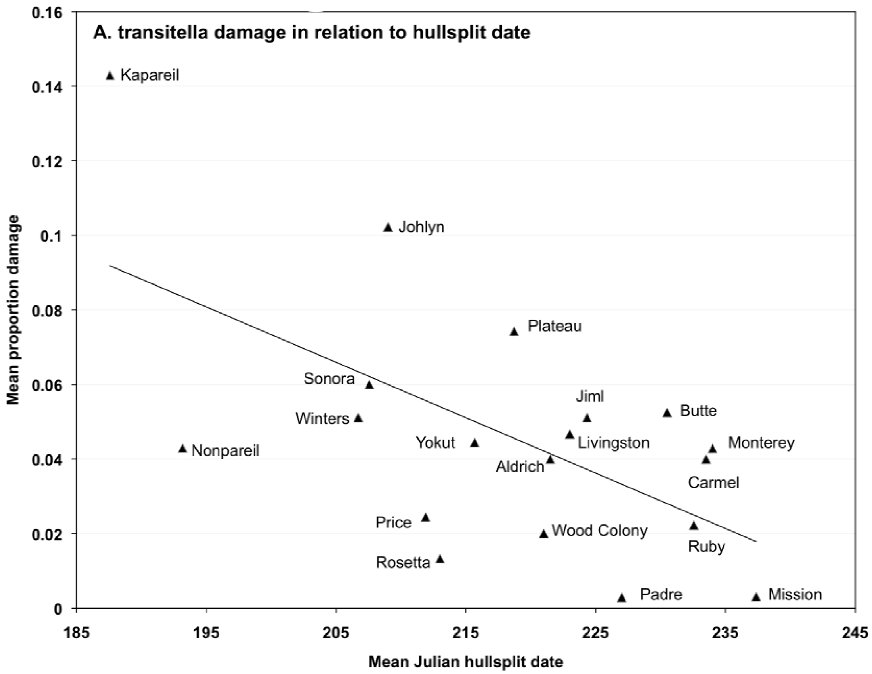
May Spray Timing

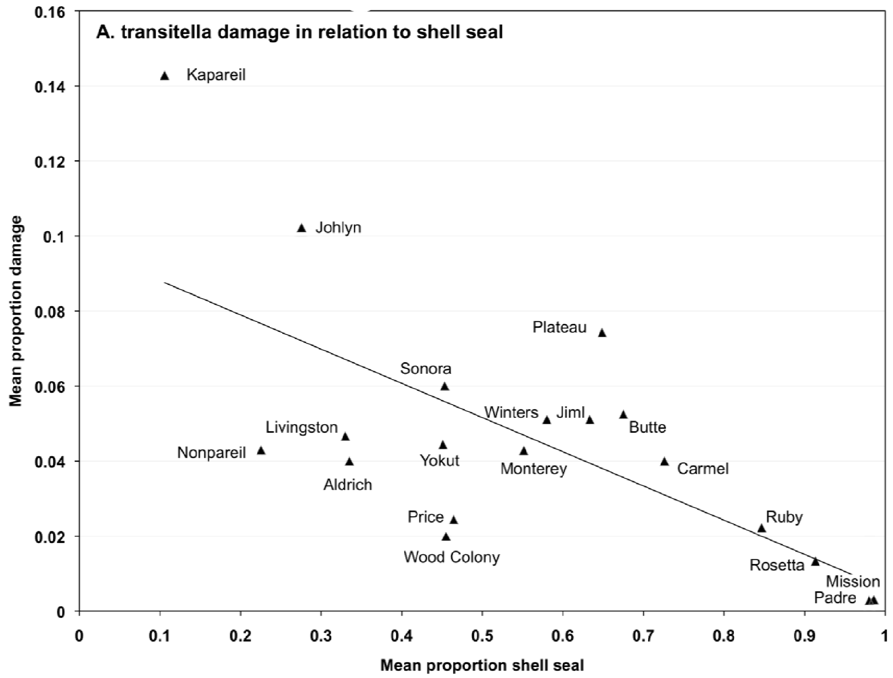


Cumulative degree-days from navel orangeworm and peach twig borer biofix dates at Manteca, 2012

Cultivar and NOW Success

NOW cultivar damage based on our previous work:



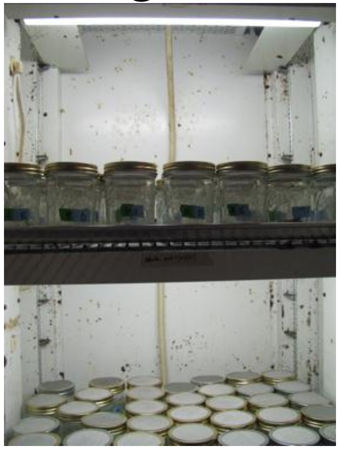


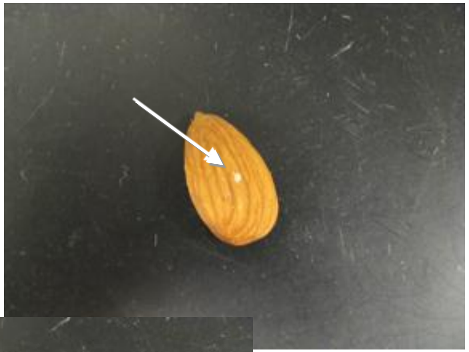
Hamby, K.A., Gao, L.W., Lampinen, B., Gradziel, T., and F.G. Zalom. 2011.

Cultivar and NOW Success

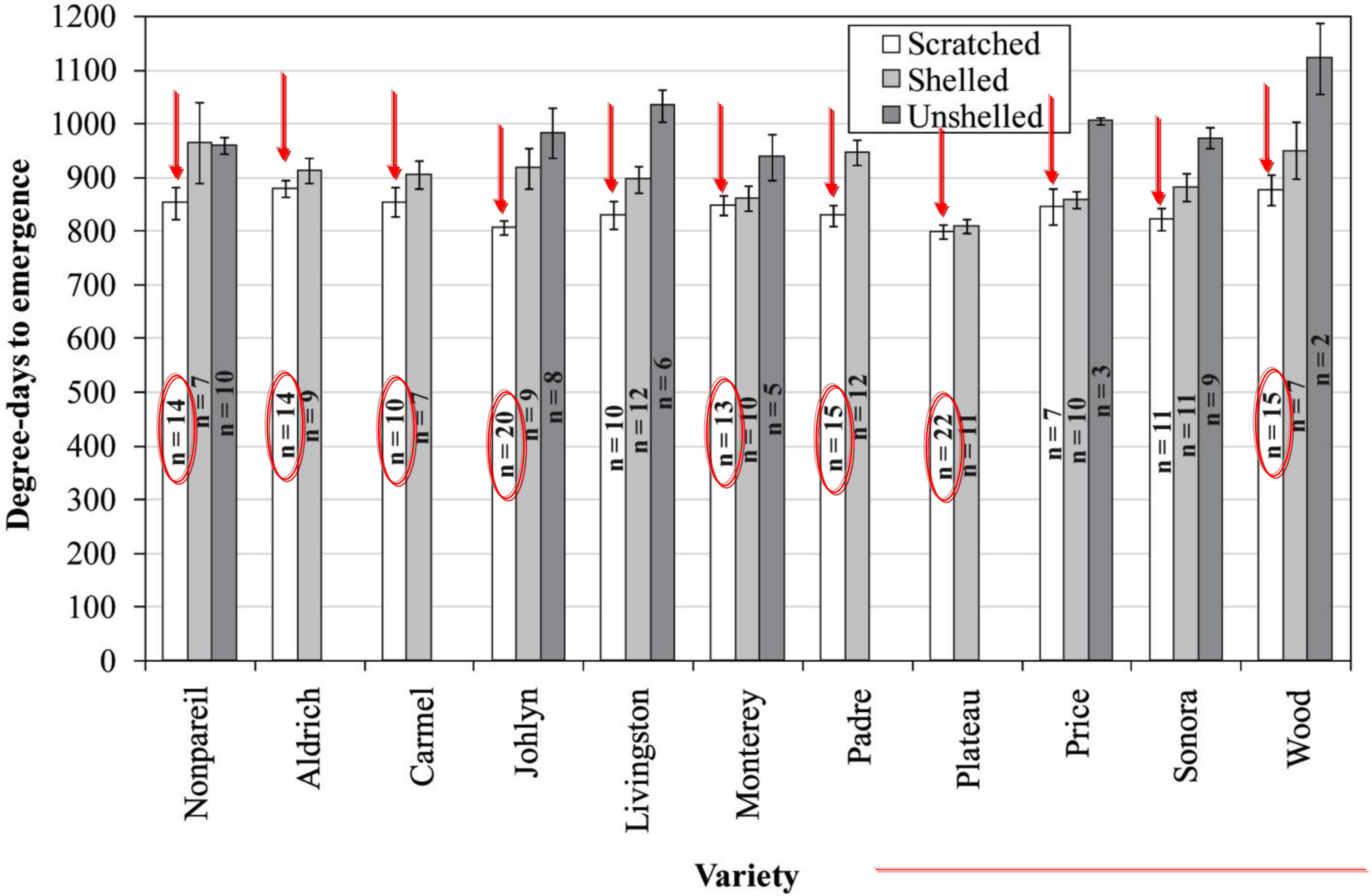
NOW cultivar damage differences?

- Nuts hand-poled from trees at the harvest timing of 11 cultivars at the Delta College RAVT site
- 10 nuts of each variety placed into jars and infested with 20 1st instar NOW larvae
- Treatments = 1 mm scratch through pellicle, shelled (not scratched) and unshelled
- Placed in growth chamber at 25^{o}C
- Checked daily for adult emergence





NOW female degree-days to emergence and total female moths emerging

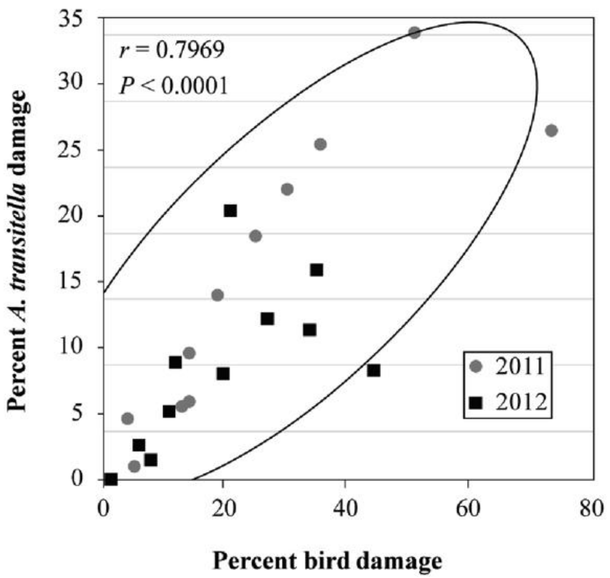


Cultivar and NOW Success

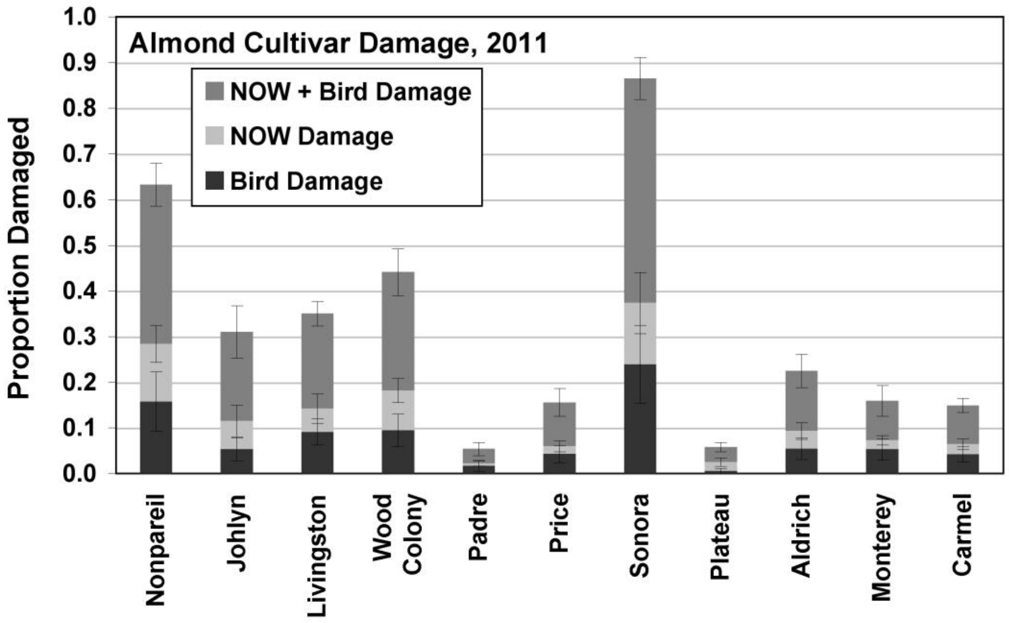
NOW cultivar damage differences?

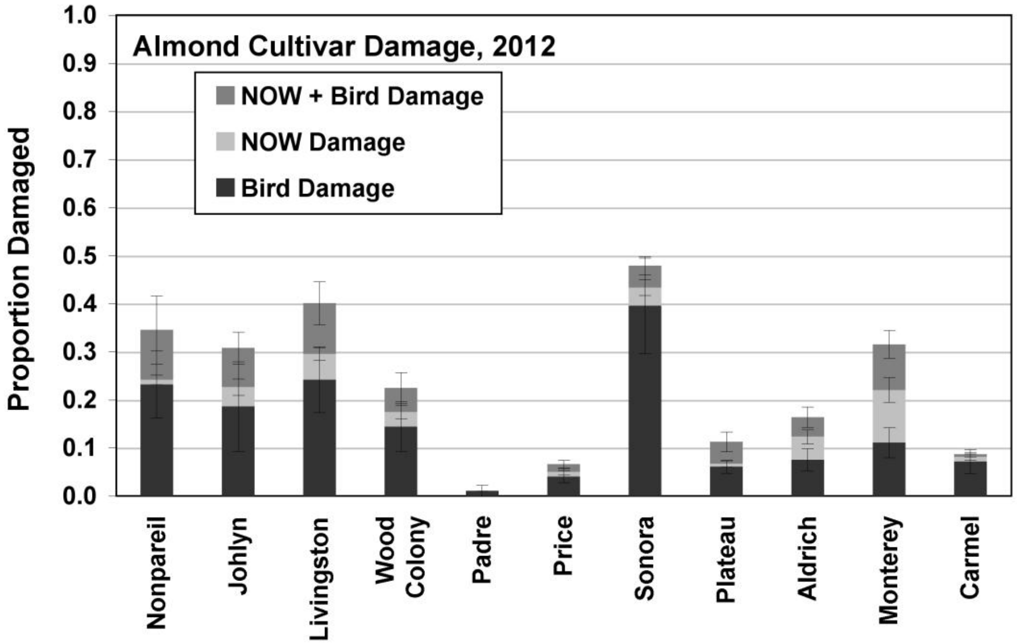
- Nuts hand-poled from trees at the harvest timing of 11 cultivars at the Delta College RAVT site
- 20 nuts of each variety (x 10 reps) were hot-glued to vegetable-mesh strands
- Strands randomly hung in Nonpareil rows in the Manteca orchard following harvest of all cultivars (late October)
- Strands collected before the first rains and re-deployed after first eggs were detected in egg traps
- Strands collected again at new crop hullsplit, and hand-cracked to determine NOW infestation

Percent NOW and bird damage for each cultivar, 2011 and 2012



Positive correlation between bird damage and navel orangeworm infestation:
$r^2 = 0.7969$, n = 22, $p < 0.0001$)





Blattisocius keegani

- A predatory mite (Family: Ascidae) found feeding on NOW eggs in a lab colony
- Can be mass-reared on *Ephestia* eggs
- Can it survive and disperse in the field?
- Can it disperse on NOW?

Blattisocius keegani

Field releases on egg cards and on NOW in 2011 and 2012

- Can it survive and disperse in the field? Yes - mites were recaptured on egg traps in release trees for 2 days following releases on egg cards (eggs were generally all consumed after 2 days), and on egg traps in non release tree for 2 weeks following the last of 3 releases (July 14, 2011)
- Can it disperse on NOW? Yes - 6 of 400 released female NOW carrying on mites were recaptured in wing traps baited with NOW egg traps containing almond presscake for up to 9 days following releases

Arthropod Pest Management in the Lower San Joaquin Valley

David Haviland

Entomology Farm Advisor

UC Cooperative Extension

Kern Co.

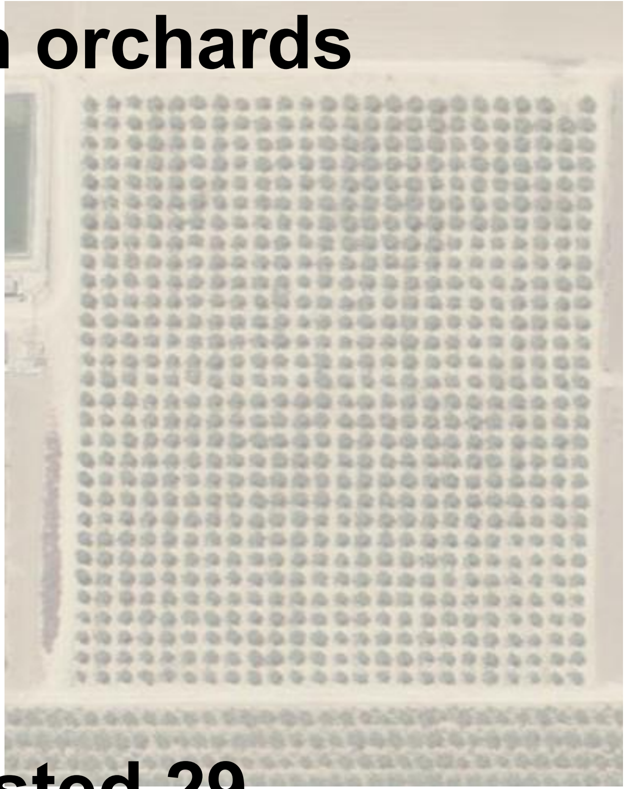
Establish Research Infrastructure

Research with unregistered pesticides is best done in experimental research orchards

- crop destruct not an issue
- no risk of overspray
- manipulate pest density
- untreated checks

Two orchards in the SJV

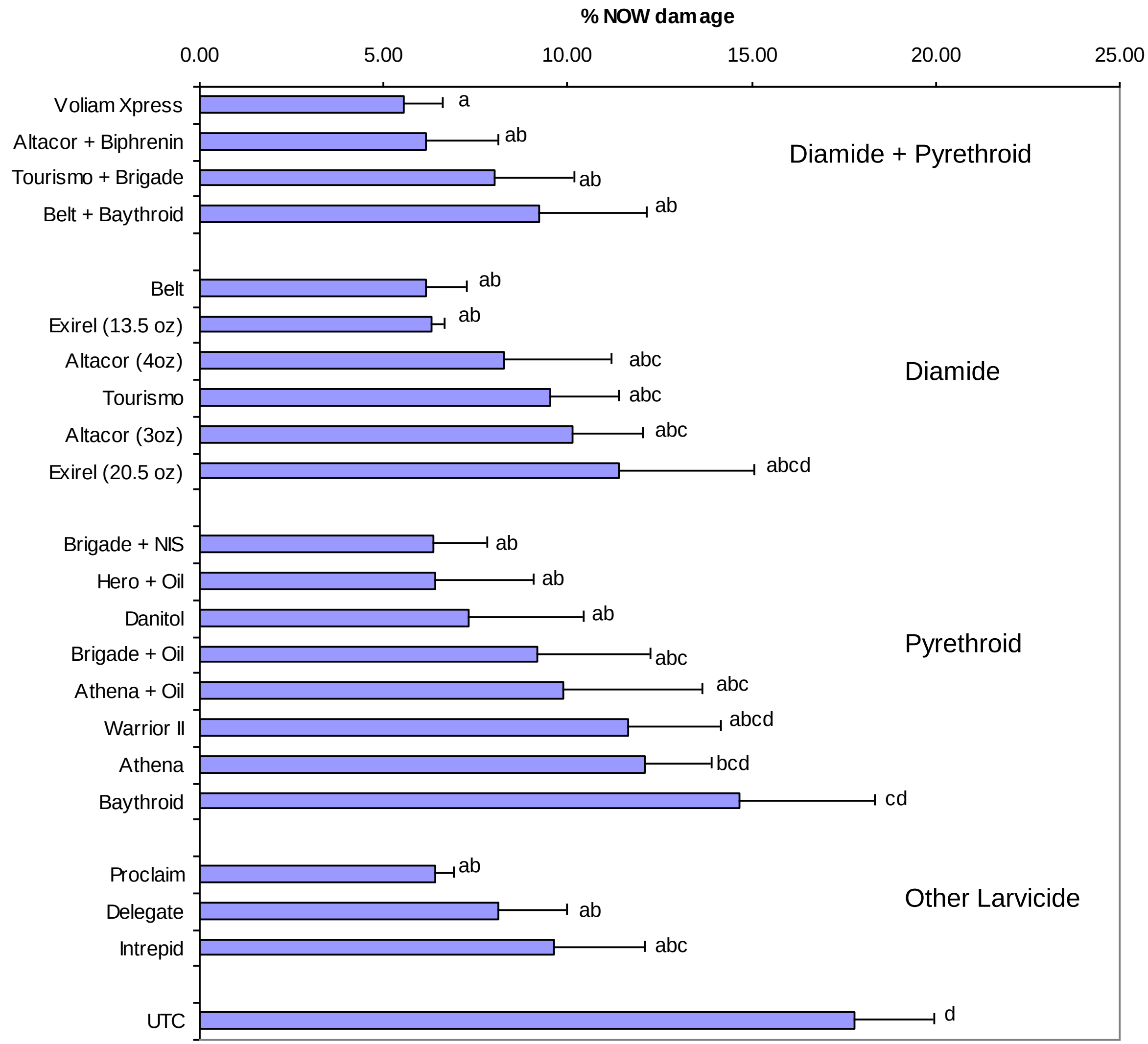
- Fresno Co., 5 acres, 5th leaf
- Kern Co., 7 acres, 4th leaf



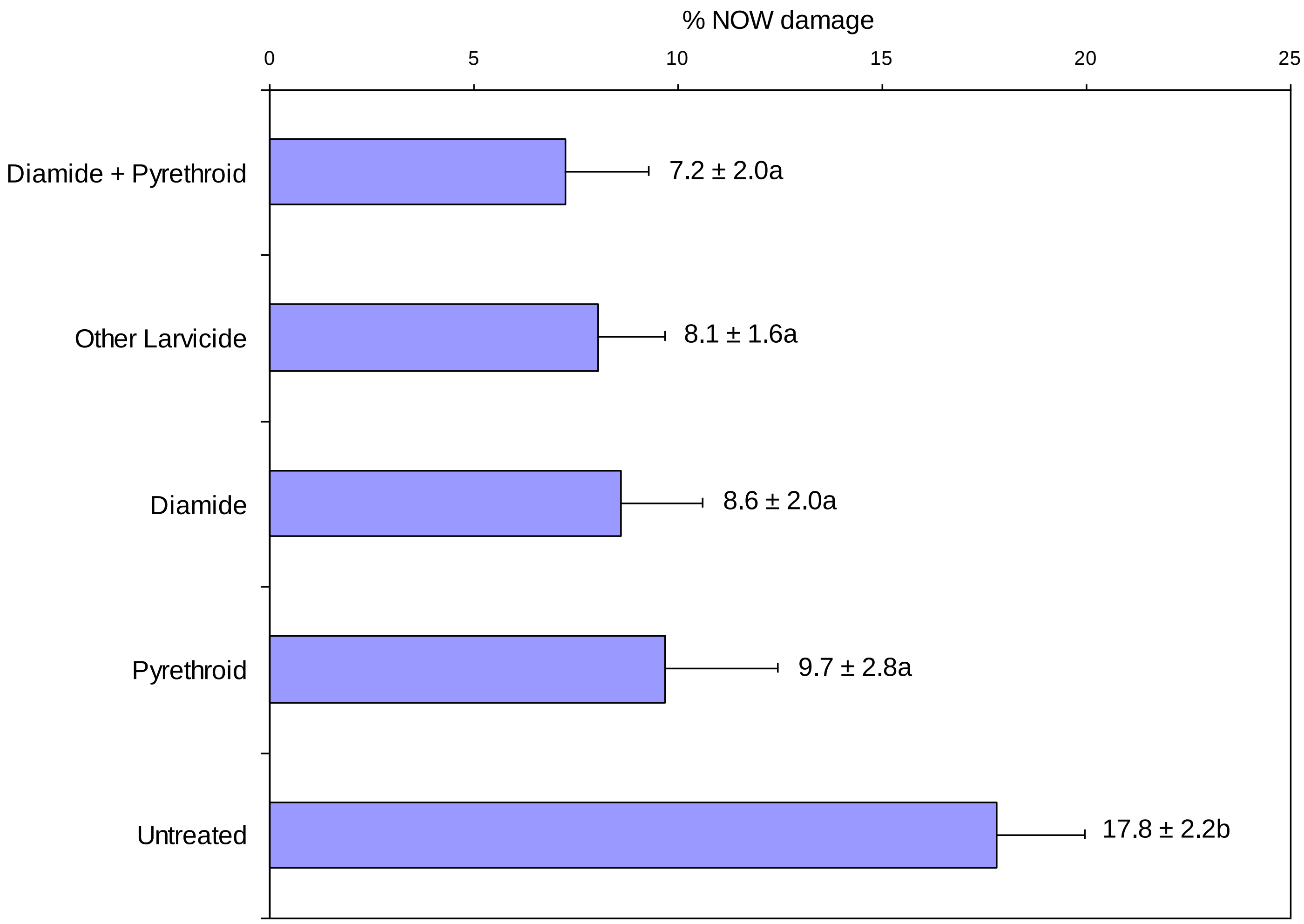
To date these orchards have hosted 29 insecticide, miticide and herbicide trials

Navel Orangeworm

- 2012
- Fresno Co.
- 22 treatments
- 6 blocks Nonpareil
- Appl. 19 Jul
- Harv. 23 Aug
- ~400 nuts/tree

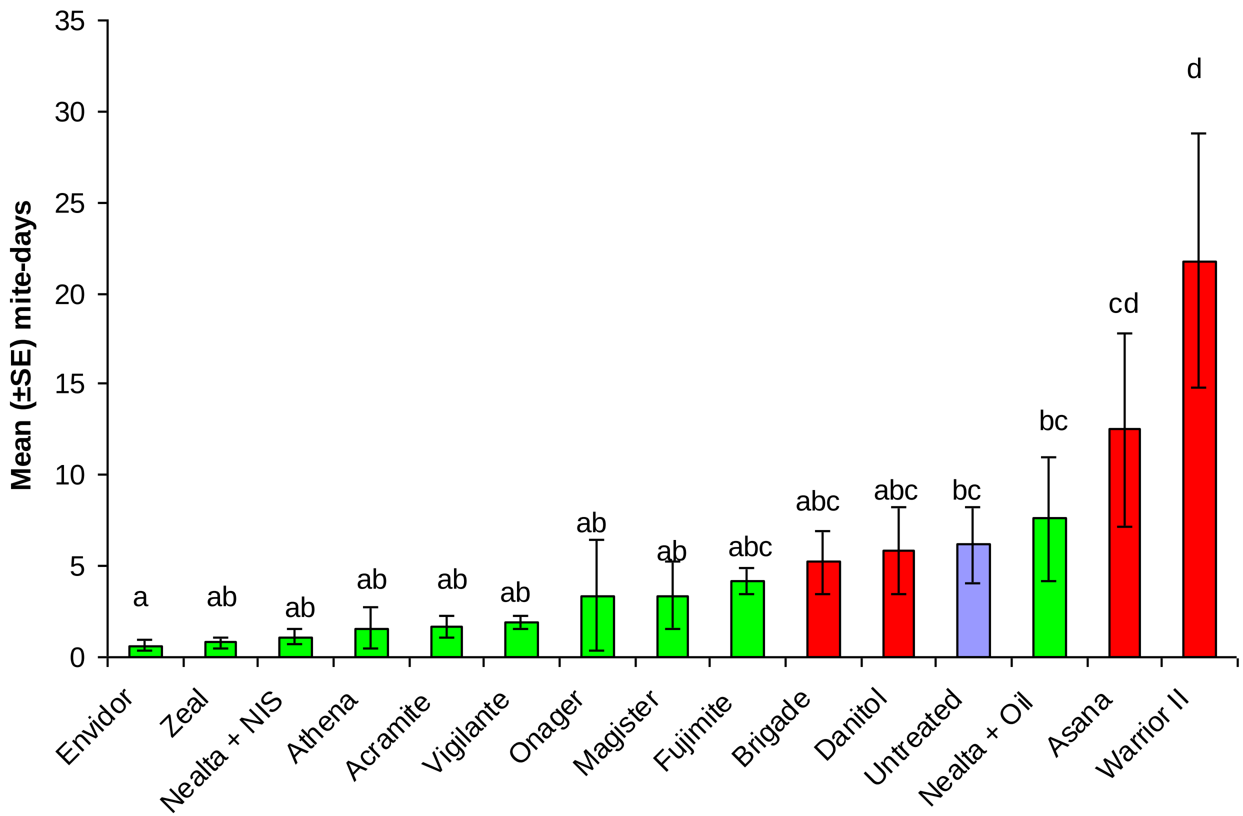


Navel Orangeworm

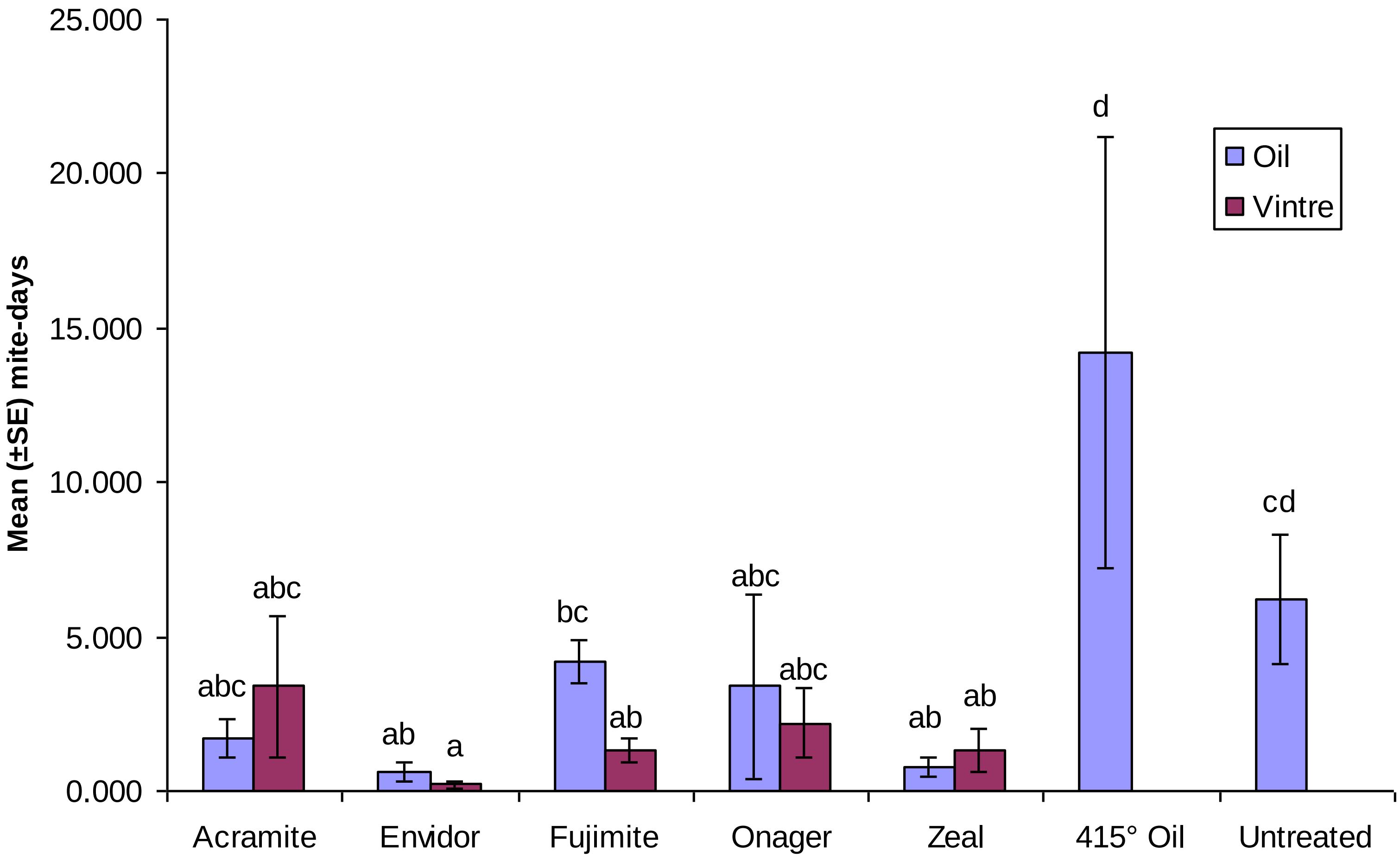


Spider Mites

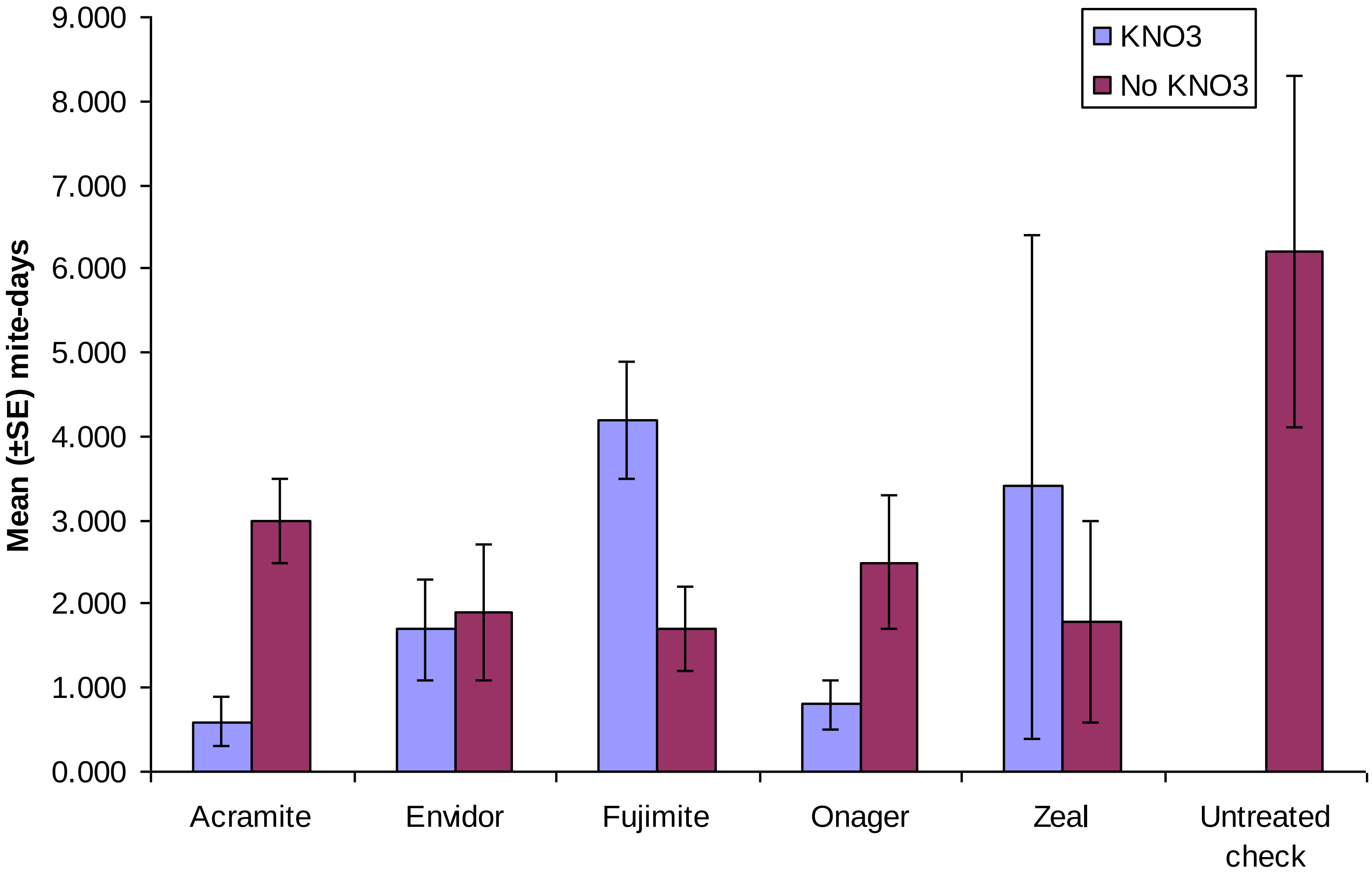
- **Multiple trials**
- **Tank mixes**
- **KNO3 as an additive**
- **Vintre as an alternative to 415 Oil**
- **Newer products**
  - **- Vigilant**
  - **- Nealta**
  - **- Athena**
  - **- Magister**
- **Effects of pyrethroids on mites**



Spider Mites

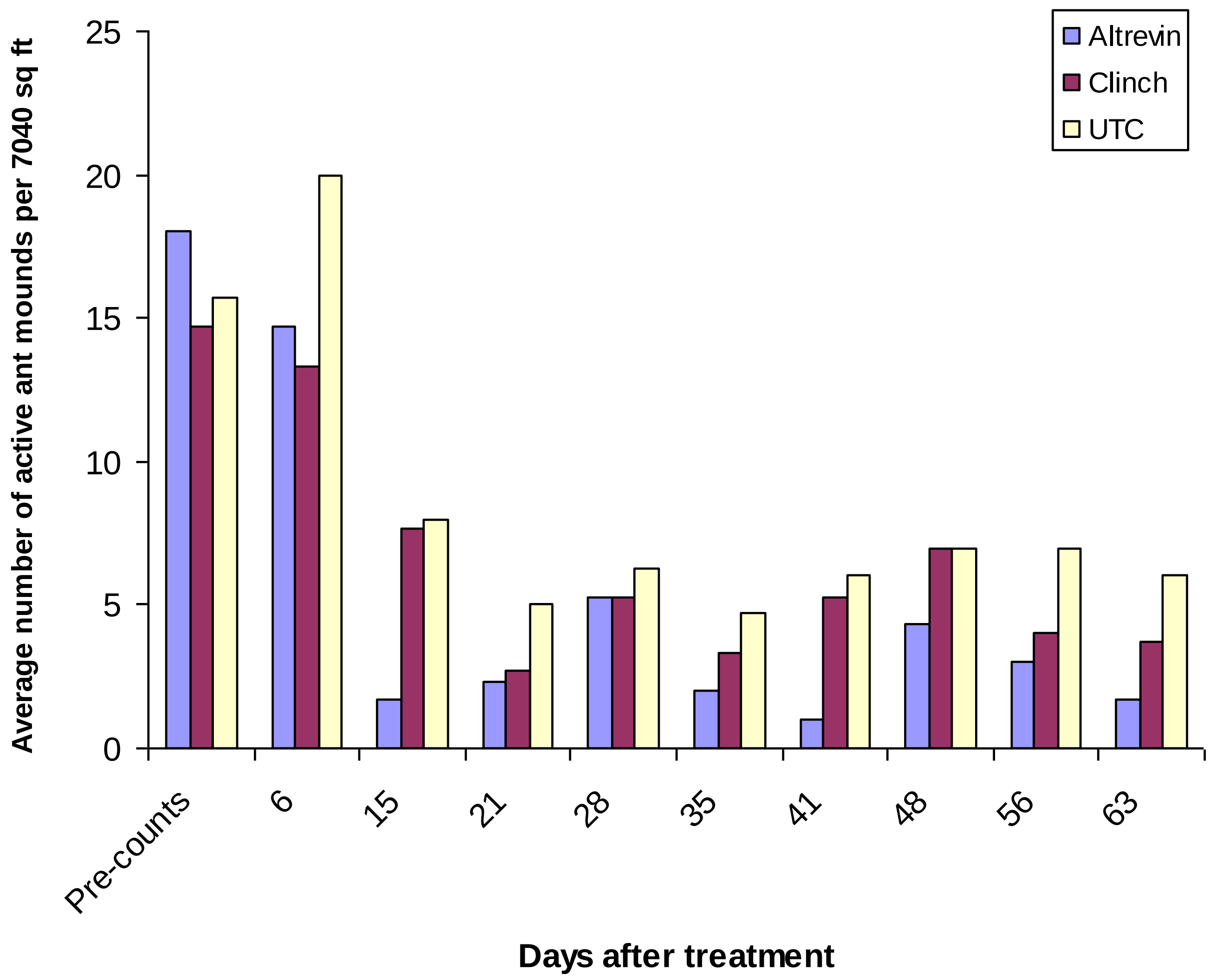


Spider Mites



Southern Fire Ant

- **2012**
- **Ant bait trial**
- **Evaluate new quicker-acting bait for use closer to harvest**
- **Ants and mounds evaluated through 63 DAT**



Conclusions

Excited to have two established orchards

2011-12 Research Report

- Five miticide trials
  - KNO3
  - Field use of Vigilant
  - 415 Oil vs. Vintre
  - New pyrethroid affect on mites
  - New miticide screening
- Three navel orangeworm trials
  - Parlier, Five Points, Shafter

2012 Research Poster

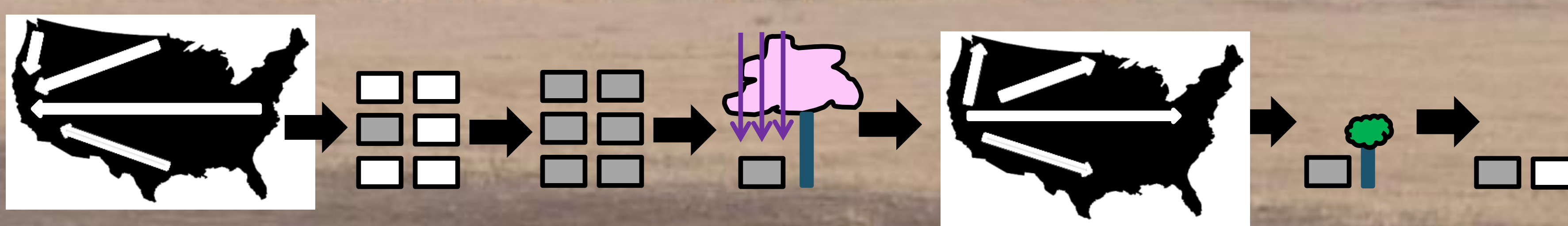
- Summaries of a subset of trials
- Remaining trial reports in progress
- Please come chat with me about bugs

Fungicide Impact on Honey Bee Development

Louisa Hooven
Research Associate
Department of Horticulture
Oregon State University

Almonds are the first stop in the annual pollination cycle for US honey bees

- Most beekeepers leave almonds with healthy happy bees
- Some beekeepers report die offs in the holding yards
- Some beekeepers report problems with honey bee development during or after almonds



Do laboratory results translate to the field?

Iprodione (Rovral)

Found in pollen and wax

Toxic to larvae in laboratory studies

Chlorothalonil (Bravo, Echo, Dachonil)

Found in pollen and wax

Toxic to larvae in laboratory studies

Ziram (Ziram)

Requires special testing, unknown if accumulates

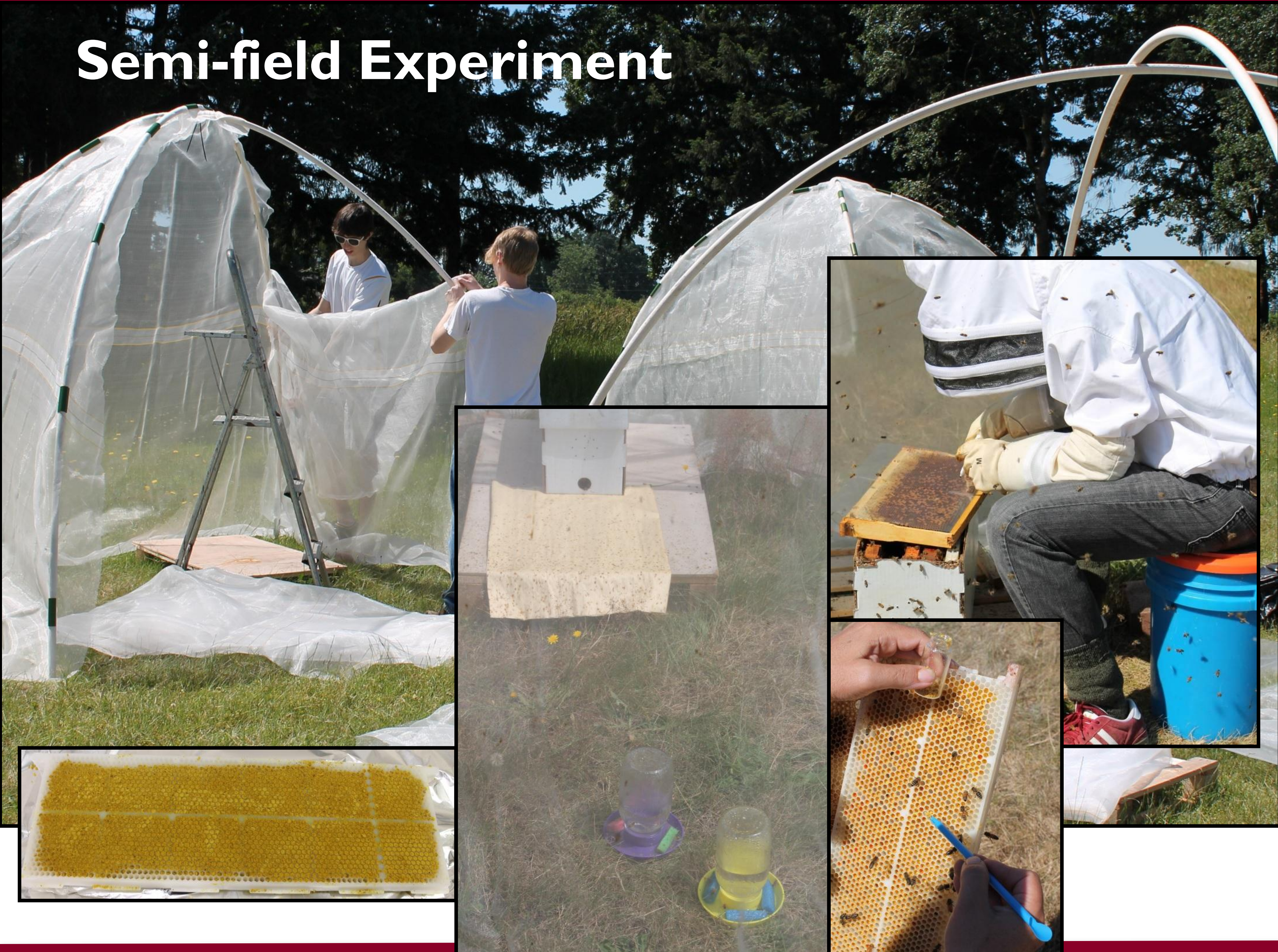
Toxic to larvae in laboratory studies

Boscalid/Pyraclostrobin (Pristine)

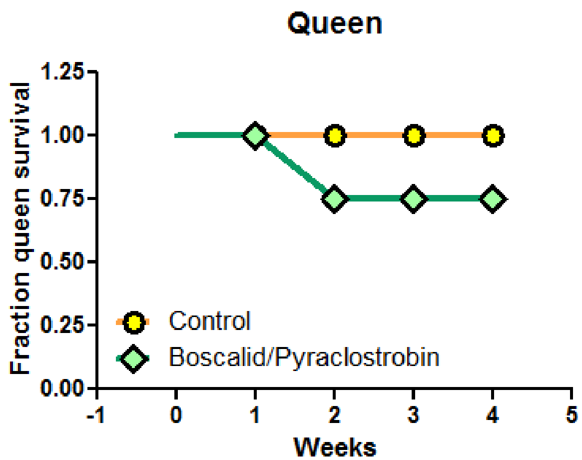
Found in pollen and wax

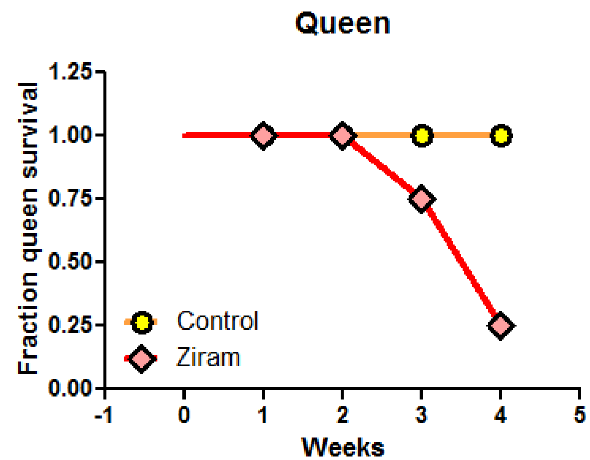
Guilty by association?

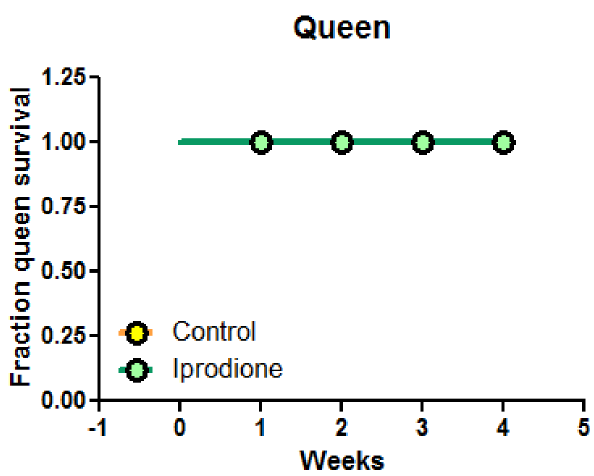
Semi-field Experiment

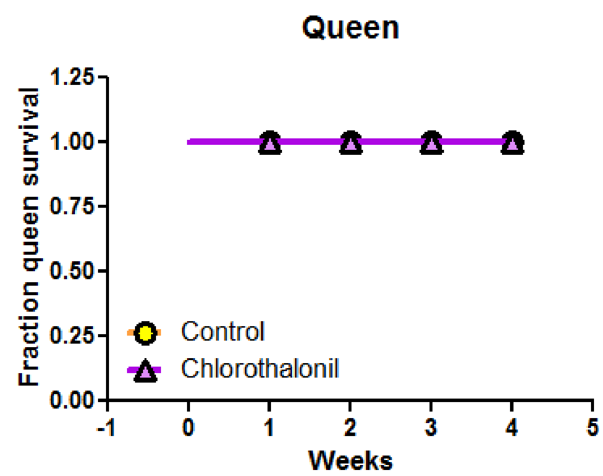


Queen Mortality

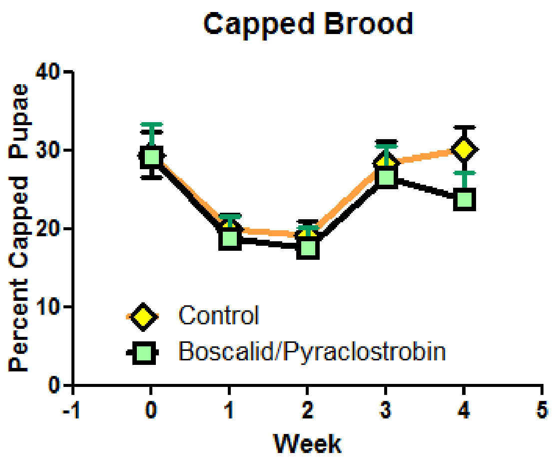


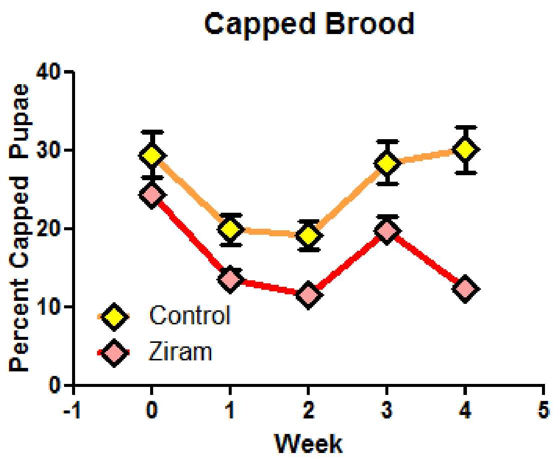


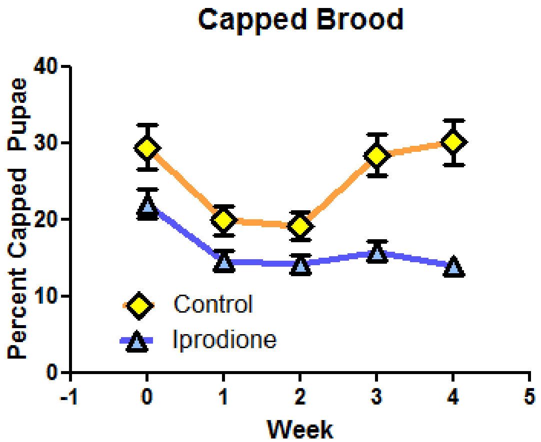


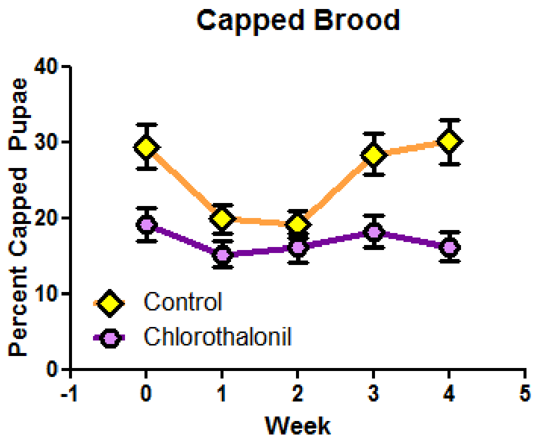


Colony Growth

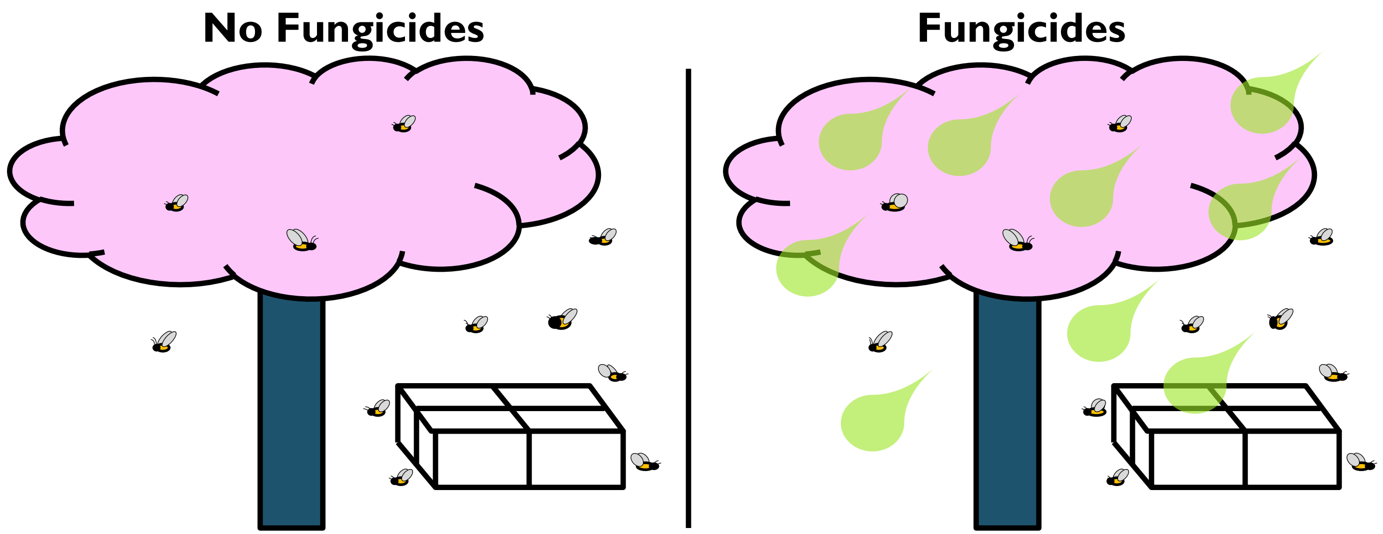








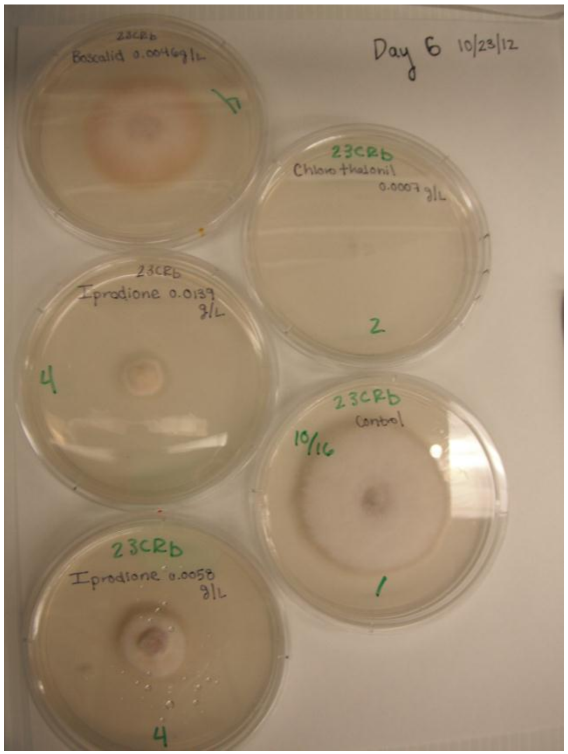
Not quite that black and white

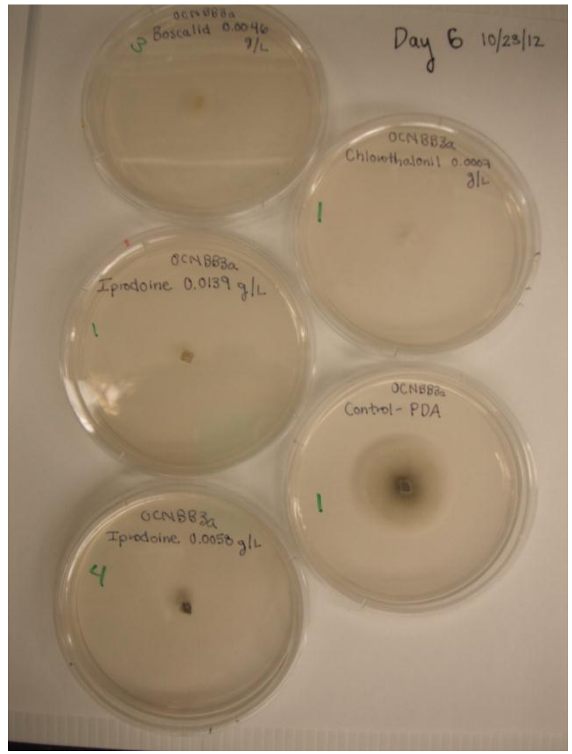


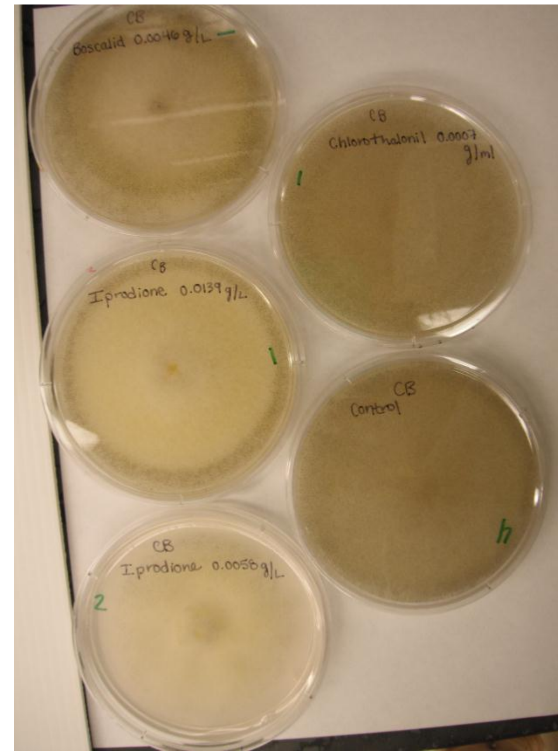
- These experiments need to be repeated
- Actual exposure levels are unknown
- Timing of fungicide sprays and placement of hives may contribute

How do fungicides affect bees?

growing ADVANTAGE The Almond Conference







Acknowledgements

Collaborator:

Ramesh Sagili
The OSU Honey Bee Laboratory
Department of Horticulture
Oregon State University

Undergraduates:
Melissa Andreas
Russell Jerstrom,
Craig Bohan
Stevan Jeknic
Elizabeth Records
Ann Bernert

USDA SCRI Team:

Jim Adaskaveg
UC Riverside

Eric Mussen
UC Davis

Environmental Chemistry
Kim Anderson
Dept. of Toxicology
Oregon State University

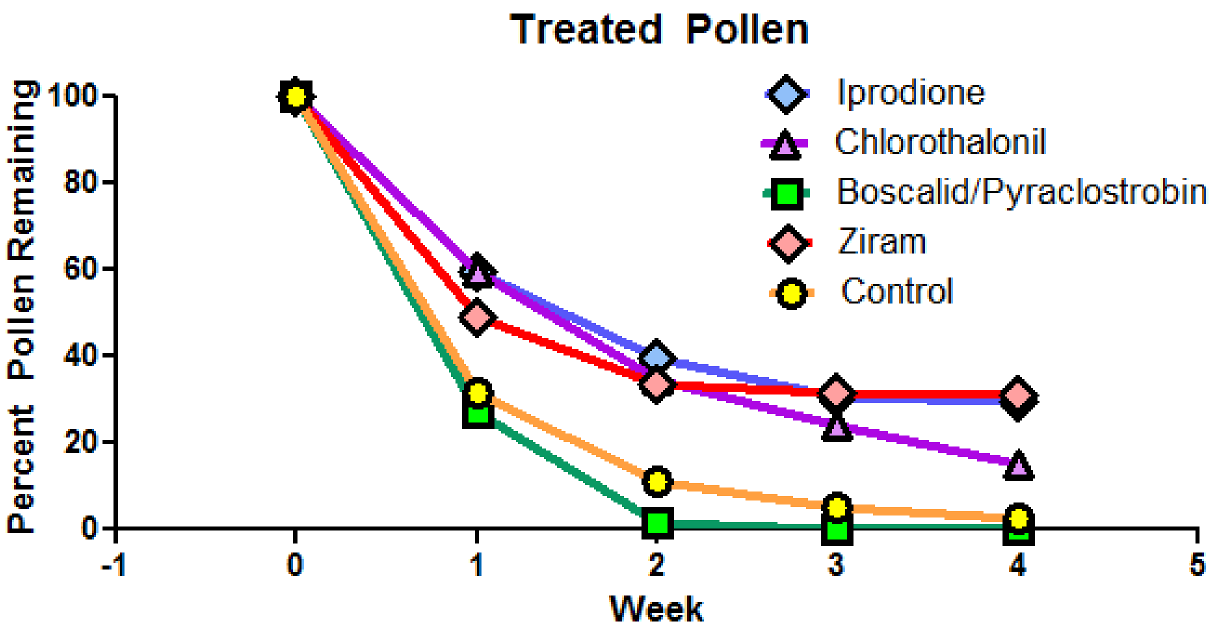
Funding:
Almond Board
National Honey Board

growing ADVANTAGE The Almond Conference

"Our treasure lies in the beehive of our knowledge. We are perpetually on the way thither,
being by nature winged insects
and honey gatherers of the mind."

Nietzsche

Consumption of Pollen



Importation and Preservation of Germplasm for US Honey Bee Breeding and Stock Improvement

Walter Sheppard and Susan Cobey

Department of Entomology

Washington State University

Pullman, WA

Almonds and Bees – Overseas Origins

growing ADVANTAGE
The Almond Conference

A. mellifera diversity

Endemic in Africa, Europe and Central Asia

28 recognized subspecies

A subset of these honey bee subspecies were brought to North America and form the basis for current populations in the United States

Subsp.	Origin	Arrival
mellifera	Europe	1600's
ligustica	Europe	1859
lamarckii	Africa	1866
carnica	Europe	1877
cypria	Middle East	1880
syriaca	Middle East	1880
caucasica	Europe	1880-1882
intermissa	Africa	1891
scutellata	Africa	1990

1922 Honey Bee Act

Restricted further importation of honey bees into the U.S. in an attempt to keep out tracheal mites


1859
A m ligustica


© World Sites Atlas (sitesatlas.com)
SLOVENIA
Ljubljana
Zagreb
CROATIA
Trieste
Rijeka
Pécs
Subotica
Osijek
Novi Sad
Geneva
Monte Rosa 4634 m
Trento
Bolzano
Belluno
Udine
Varese
Como
Bergamo
Aosta
Monza
Brescia
Vicenza
Treviso
Novara
Milan
Verona
Venice
Padua
Grenoble
Vigevano
Pavia
Piacenza
Rovigo
45°
Turin
Asti
Alessandria
Parma
Ferrara
FRANCE
Reggio nell'Emilia
Bologna
Modena
Cuneo
Genoa
Ravenna
Imola
Savona
Massa
Forli
La Spezia
Pistoia
Rimini
San Remo
Prato
Lucca
SAN MARINO
Nice
MONACO
Pisa
Florence
Ancona
Aix-en-Provence
Livorno
Arezzo
Fabriano
Marseille
Ligurian Sea
Toulon
Siena
Perugia
Foligno
Piombino
Ascoli Piceno
Grosseto
Teramo
Terni
Pescara
Viterbo
L'Aquila
CORSICA (Fr.)
Civitavecchia
Guidonia
Vasto
VATICAN CITY
Tivoli
ITALY
Rome
Campobasso
San Severo
Manfredonia
Aprilia
Latina
Foggia
Barletta
Benevento
Molfetta
Caserta
Cerignola
Bari
Naples
Avellino
Altamura
Salerno
Matera
Brindisi
Castellammare di Stabia
Potenza
Taranto
Lecce
Porto Torres
Sassari
Nuoro
SARDINIA (Italy)
40°
Oristano
Tyrrhenian Sea
Castrovillari
Quartu Sant'Elena
Cagliari
Cosenza
Crotone
Lamezia Terme
Catanzaro
Mediterranean Sea
Ionian Sea
Palermo
Messina
Trapani
Bagheria
Reggio di Calabria
Marsala
Mt. Etna (vol.) 3369 m
Mazara del Vallo
Caltanissetta
Catania
Sicily
Agrigento
Gela
Siracusa
Vittoria
Ragusa
Bizerte
Jijel
Skikda
Annaba
Tunis
Banja Luka
Belgrade
BOSNIA &
HERZEGOVINA
SERBIA
Sarajevo
Split
MONTENEGRO
Adriatic Sea
Podgorica
Prizren
Tiranë
ALBANIA
GREECE
20°

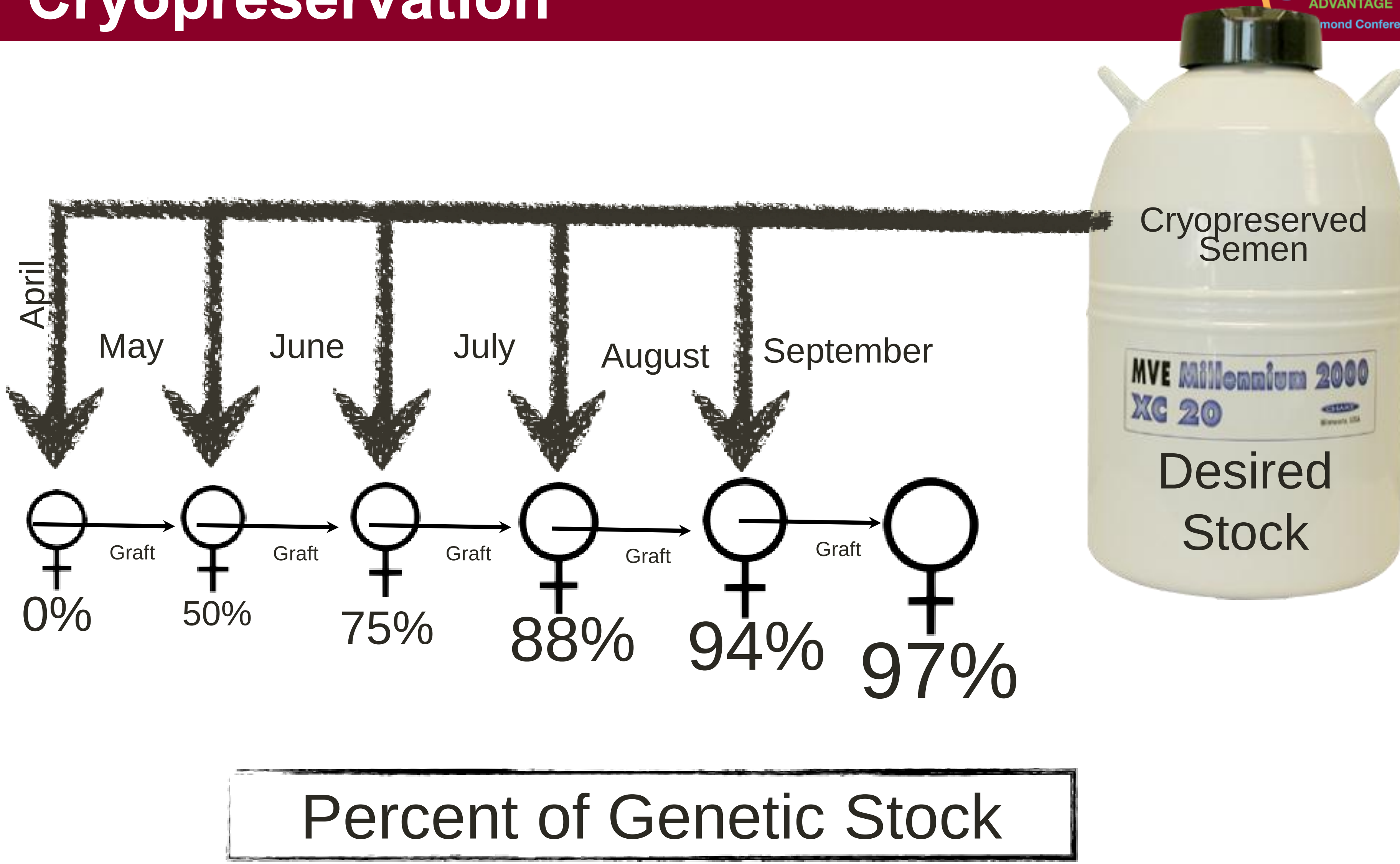

CRA
CONSIGLIO PER LA RICERCA
E LA SPERIMENTAZIONE
IN AGRICOLTURA
CRA-API UNITA' DI RICERCA
DI APICOLTURA E BACHICOLTURA
RESEARCH UNIT FOR APICOLTURE AND SERICOLTURE
SEDE DI REGGIO EMILIA


SLIDES
44

Semen Collection


BIONICHE
FREEZE CONTROL
CRYOBATH
BIONICHE
TEMPERATURE (°C)
ALARM
DATA
FREEZE CONTROL
CL-3300
Paused

Potential for Cryopreservation

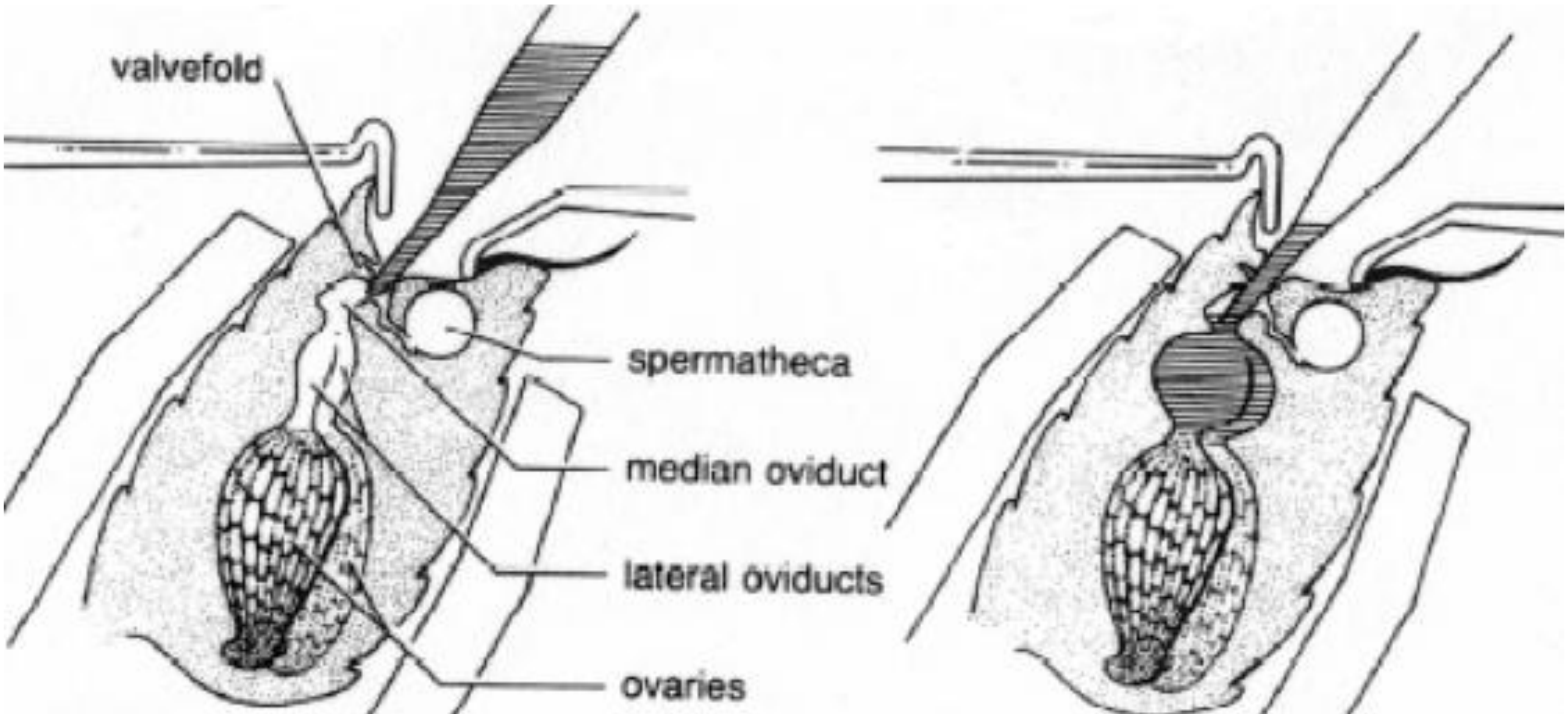


Instrumental Insemination

Semen thawed

Straws fit directly into the insemination system

Each queen inseminated with 5 µL semen



- **Isolated mating station at Smoot Hill Ecological Preserve**
- **Released by USDA-APHIS after virus analysis**
- **CA Bee Breeders/ Honey Bee Tech Team – distribution to industry**

Steps toward utilization of honey bee genetic resources

Import germplasm of three honey bee subspecies for selection and breeding purposes

Collaborate with queen producers on stock maintenance / breeding program - honey bee tech team

Cryopreserve imported and “top-tier” domestic germplasm in a genetic repository

Tech Transfer Teams– Improve Honey Bee Health and Stocks

Rob Snyder

Crop Protection Agent, Entomologist

University of California Cooperative Extension

Bee INFORMED

University of California Agriculture and Natural Resources

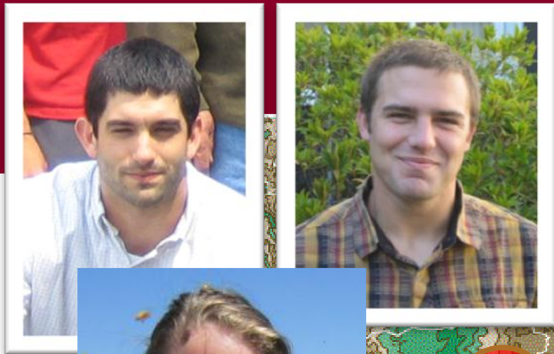
Making a Difference for California

USDA NIFA

United States Department of Agriculture
National Institute of Food and Agriculture

Tech Transfer Teams

growing ADVANTAGE
The Almond Conference



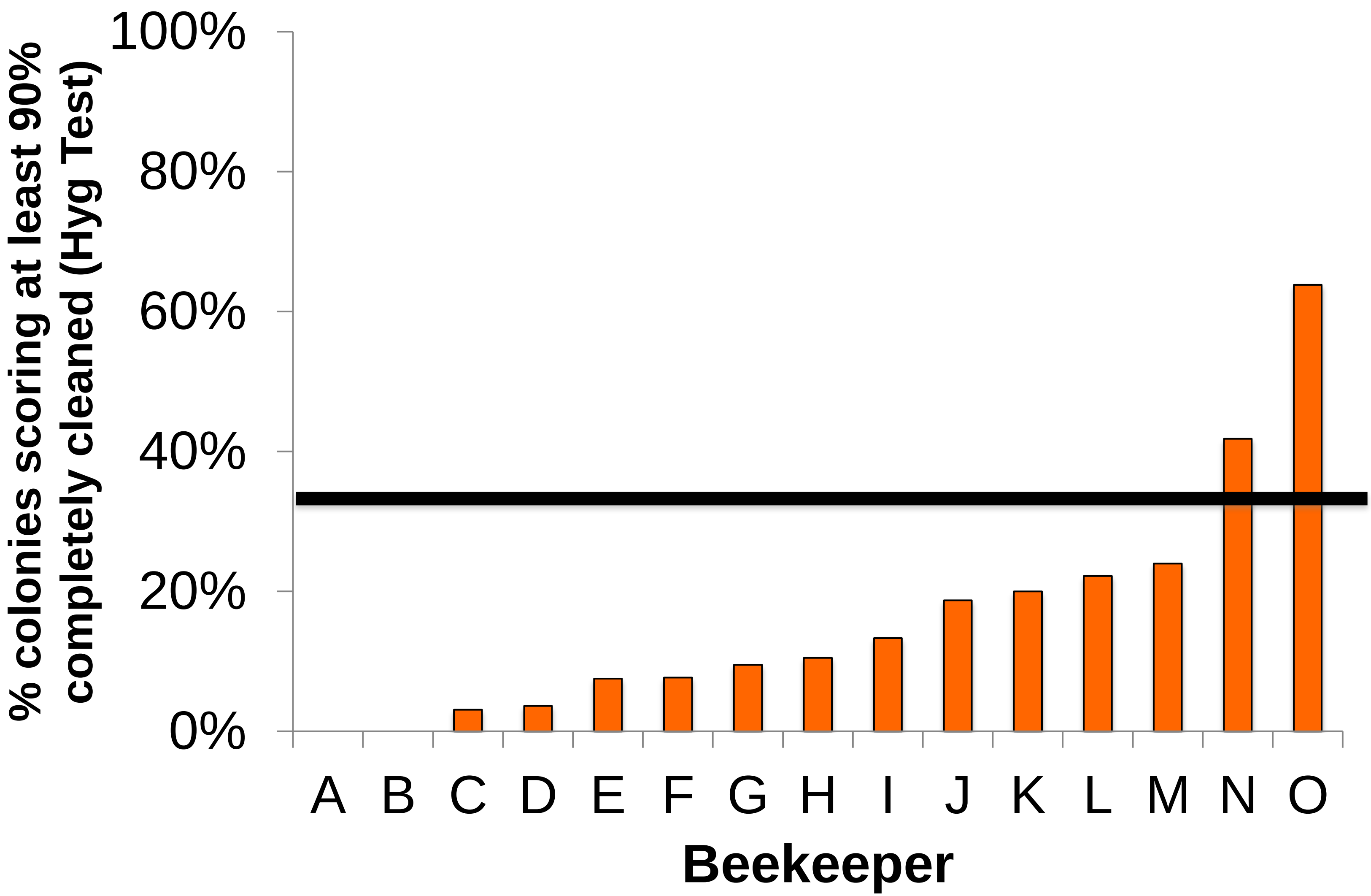

Future Tech Transfer Teams

Breeding resistant stock: Hygienic Behavior

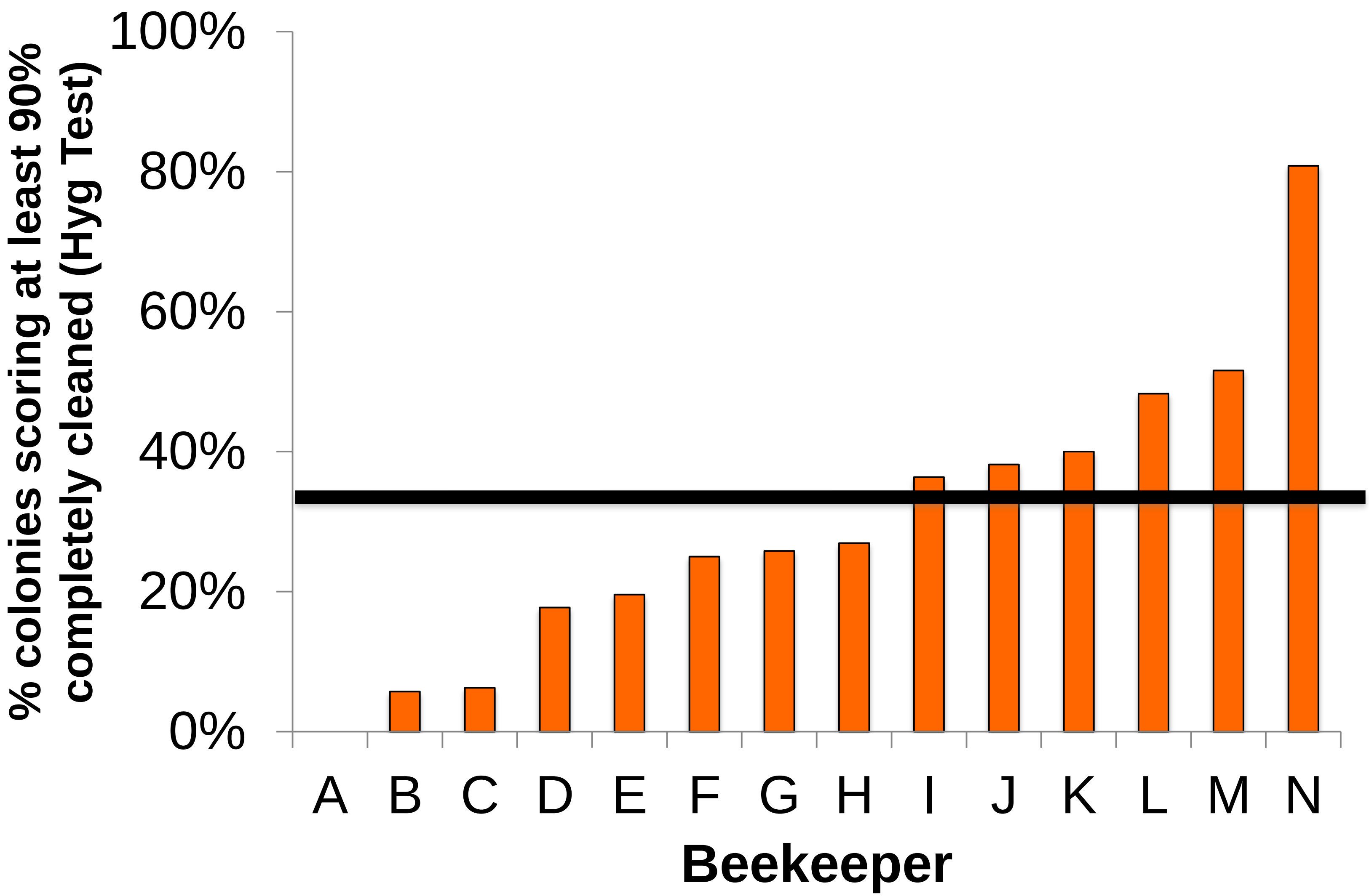
growing ADVANTAGE
The Almond Conference

Freeze-kill 160 worker pupae, and return in a 24 hour time period to assess the colonies ability to uncap and remove dead brood from cells.

Hygienic Testing: January – March 2011

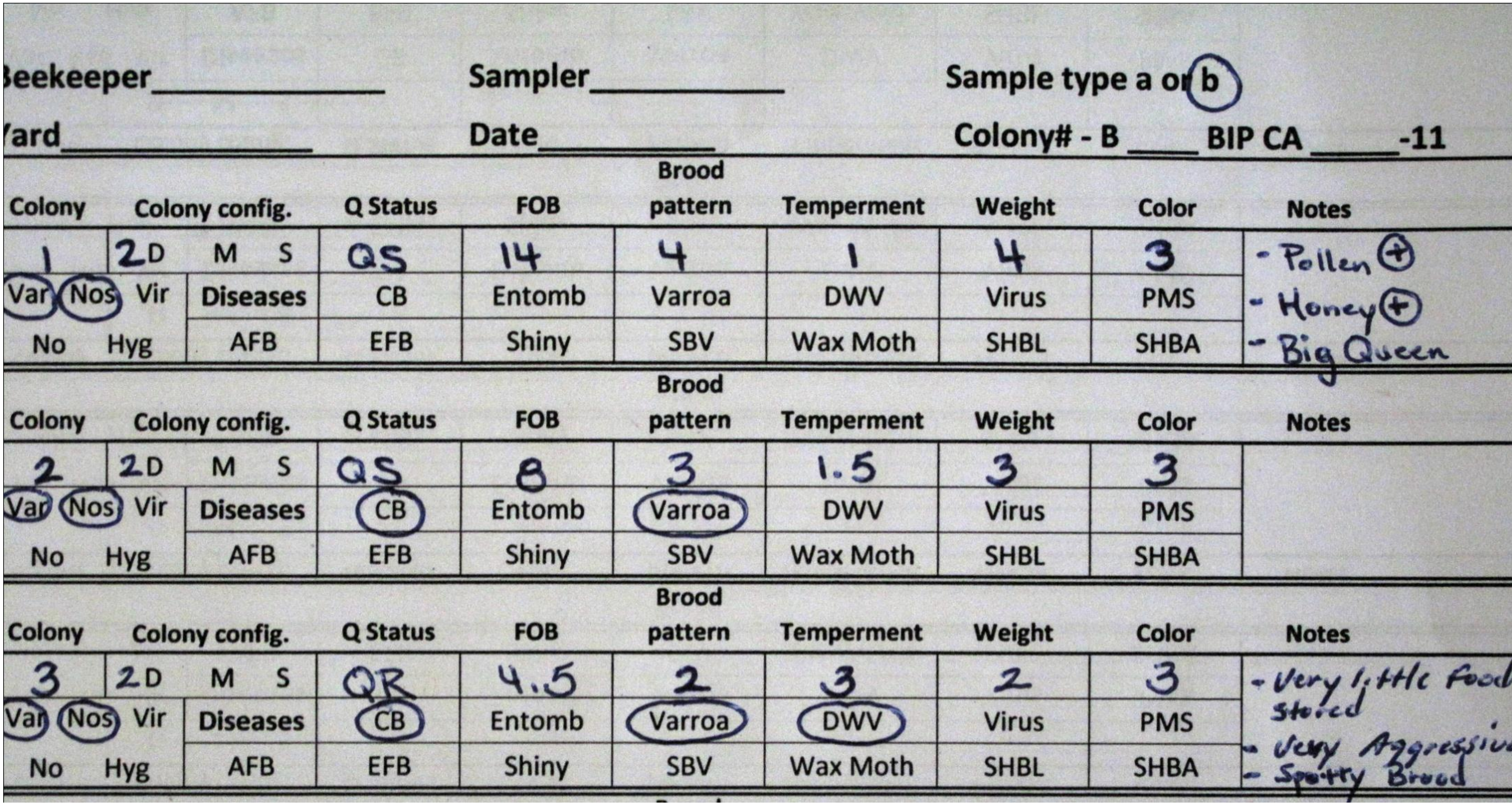


Hygienic Testing: January – March 2012



Longitudinal Monitoring: Hive assessments

growing ADVANTAGE
The Almond Conference



Beekeeper______________ Sampler____________ Sample type a or (b)

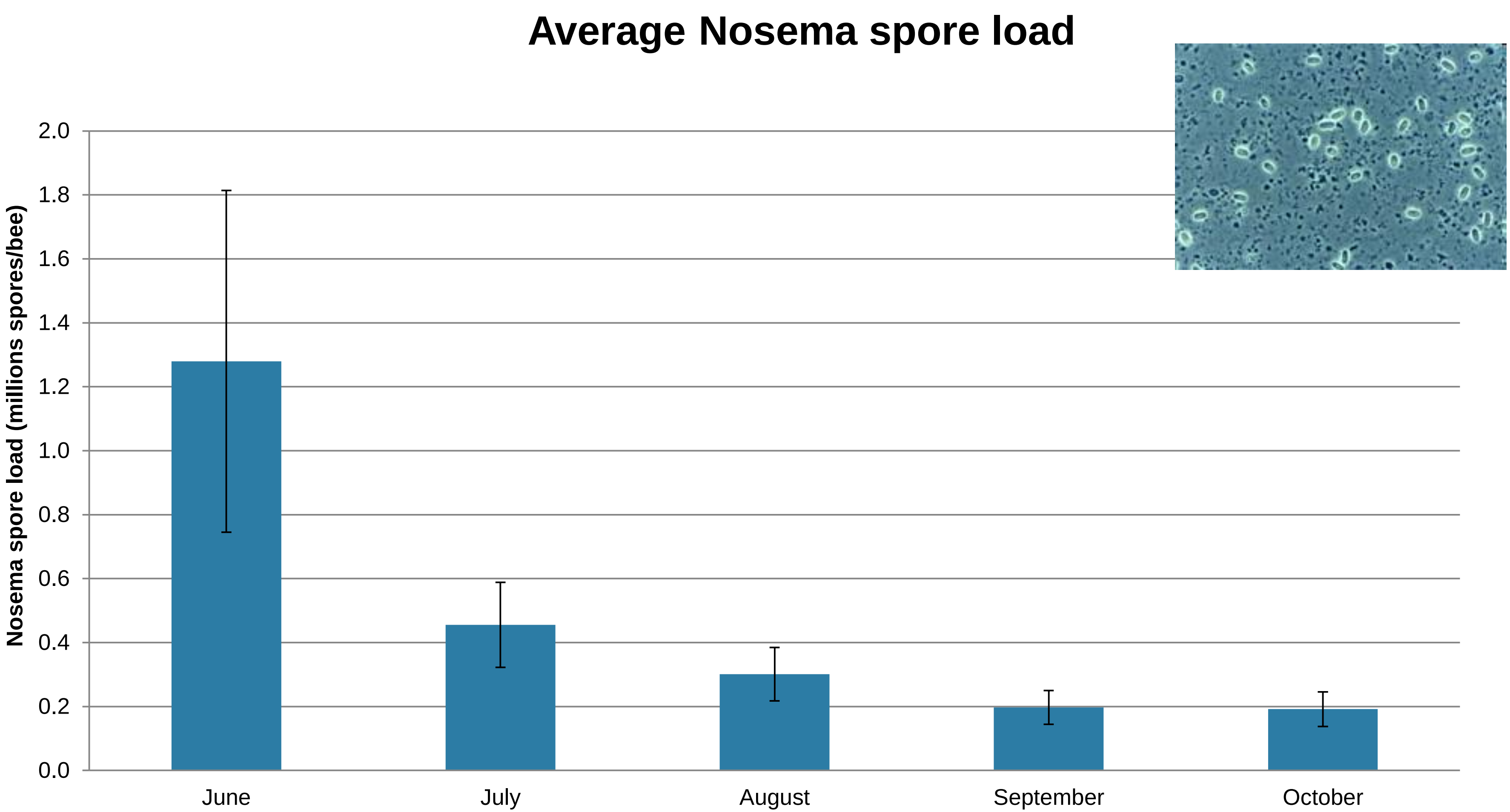
Yard______________ Date__________ Colony# - B ____ BIP CA _____-11

Colony	Colony config.			Q Status	FOB	Brood pattern	Temperment	Weight	Color	Notes
1	2D	M	S	QS	14	4	1	4	3	- Pollen (+)
(Var)	(Nos)	Vir	Diseases	CB	Entomb	Varroa	DWV	Virus	PMS	- Honey (+)
No	Hyg		AFB	EFB	Shiny	SBV	Wax Moth	SHBL	SHBA	- Big Queen

Colony	Colony config.			Q Status	FOB	Brood pattern	Temperment	Weight	Color	Notes
2	2D	M	S	QS	8	3	1.5	3	3	
(Var)	(Nos)	Vir	Diseases	(CB)	Entomb	(Varroa)	DWV	Virus	PMS	
No	Hyg		AFB	EFB	Shiny	SBV	Wax Moth	SHBL	SHBA	

Colony	Colony config.			Q Status	FOB	Brood pattern	Temperment	Weight	Color	Notes
3	2D	M	S	QR	4.5	2	3	2	3	- Very little food stored
(Var)	(Nos)	Vir	Diseases	(CB)	Entomb	(Varroa)	(DWV)	Virus	PMS	- Very Aggressive
No	Hyg		AFB	EFB	Shiny	SBV	Wax Moth	SHBL	SHBA	- Spotty Brood

Nosema Load in N. Cal.



The Team





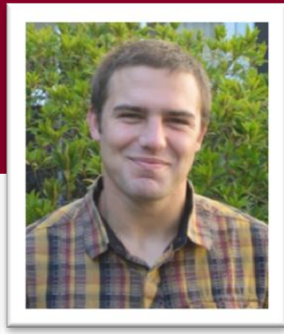


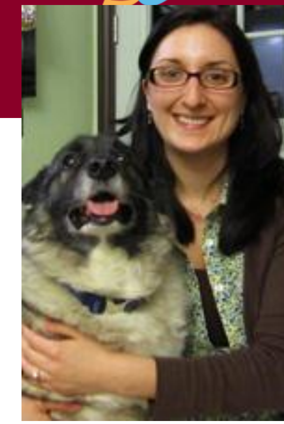
















Sign Up!

Participate!

Bee INFORMED

BeeInformed.org

Chris Heintz

Planting Honey Bee Forage Crops In and Around Almond Orchards

growing ADVANTAGE
The Almond Conference

CALIFORNIA STATE BEEKEEPERS ASSOCIATION SINCE 1889

Project Apis m.

Multiple Funding Sources are Making this Possible!


When our 1.6 million honeybee colonies arrive in California….
2012 Heintz Lost Hills, CA


To pollinate the 800,000 acres of almonds...

We want honeybees to have available forage resources!

What we are doing on Honeybee Forage

- Identifying seed mixes for fall and spring
- Sourcing seed suppliers
- Initiating forage plots throughout California
- Seeking out public lands for bee pastures
- Justifying economical & ecological benefits for growers
- Leveraging grant funding – corporate funding
- Conducting nutritional analyses of seed mixtures
- Communicating thru media coverage: tv, print & internet

WHAT WE HAVE LEARNED

Project Apis m.

Early Lessons Learned

- Native wildflower seeds are cost prohibitive to do on a large scale
- Long-term, clover/vetch and mustards will be important plant species for honey bees
- Emergence will be highly dependent upon water supply
- One hurdle will be sustaining the project after 3 year cost-assistance expires
- Start outreach to growers earlier in the summer

Project Apis m.

Taking Forage Project to the Next Level

- 2010 SCB Grant 2012 SCB Grant
- UC Davis and CSU Fresno assistance
- Bayer – specialty oilseed crops, water stress test
- Monsanto – keying in on almond growers specifically

BAYER

MONSANTO


Monsanto goal:
In 3 years, 10% of all almond growers are involved in the Seeds for Bees project
MONSANTO
© 2008 Heintz, almond

Value Created

- Improve honey bee nutrition
- Improve floral diversity
- Prepare strong colonies for time of greatest need
- Contribute to almond production and yield
- Expand number of growers and acreage growing honey bee forage
- Improve soil quality, build soil nitrogen & organic matter, improve water penetration, decrease runoff
- Insectaries for beneficials
- Positive, with visual appeal


Contact us at ProjectApis@gmail.com
& visit our booth in Pollination Pavilion
© 2012 Heintz
PAm's FOCUS

Honey Bee Colony Density and Almond Nut Set

F.A. Eischen, R.H. Graham, R. Rivera, G. Wardell

The rise in colony rental prices has caused some almond growers to reduce the number of colonies per acre. This stud examined the impact lowered colony density has on pollinati and harvestable nuts.

Measuring colony density

Colony density was measured two ways: a) the nominal density is the number of colonies set around an orchard;

b) the effective density is based on the number of colonies set around the orchard plus the number of colonies within 1.5 miles of the test orchard. The distance a colony is from a particular tree plays a large role in the portion of foragers from that colony that is likely to visit it. About 50% of all almond pollen/nectar foraging occurs within a quarter of a mile of the colony--90% within 1.5 miles.

Simulating poor weather

- During the 2011 season we simulated poor flight conditions by limiting access to blossoms for varying lengths of time.
- This was done using a pollinator exclusion device.
- Colony density on two pairs of orchards was varied.

Percent pollination for softshell cultivar Fritz: early bloom 20-23 Feb 2011

Bee exposure (hours or days)	n (trees)	One colony/acre	Two colonies/acre
0 (negative control)	10	1.1 a	0.9 a
0.5 hrs	20	19.2 a	33.9 b
1.0 hrs	20	28.4 a	36.9 b
2.0 hrs	20	34.4 a	41.8 b
4.0 hrs	20	39.8 a	53.0 b
1 day	20	41.8 a	52.4 b
2 days	20	55.4 a	61.0 b
3 days	20	52.4 a	70.7 b
Positive control-low	20	68.0 a	76.2 b
Positive control-high	20	62.8 a	72.4 b

growing ADVANTAGE The Almond Conference

Varying colony density. 2012

- **During the 2012 season we varied the colony density on 9 pairs of orchards (Low and higher densities. In the following tables, we only show the late variety pairs.)**

- **We took videos of bees foraging in these orchards to determine if bee behavior differed on the flowers .**

Percent of pollination for late varieties. 2012

Ranch:	Colonies/acre	Butte	Padre	Mission
Wegis	1.0 colony	27.9 a	34.6 a	---
Wegis	1.5 colonies	44.9 b	47.4 b	---
King	1.08 colonies	55.0 a	61.9 a	---
King	1.33 colonies	53.6 a	53.0 b	---
King	2.16 colonies	68.5 b	65.7 a	---
Premiere	1.75 colonies	65.4 a	56.7 a	40.5 a
Premiere	2.5 colonies	71.3 a	66.5 b	48.8 b
SVF	2.0 colonies	44.8 a	37.9 a	54.1 a
SVF	3.0 colonies	58.4 b	49.5 b	58.7 a

Percent of total flowers that produced a harvestable nut: Late varieties. 2012

Ranch, Colonies/acre	Butte	Padre	Mission
Wegis, 1.0	23.5 a	28.4 a	---
Wegis, 2.0	30.8 b	30.9 b	---
King, 1.0	36.0 a	43.4 a	---
King, 1.33	38.0 ab	32.7 b	---
King, 2.16	43.0 b	39.6 a	---
Premiere, 1.75	41.3 a	31.2 a	28.0 a
Premiere, 2.5	42.1 a	34.2 a	32.2 a
SVF, 2.0	18.5 a	19.2 a	18.3 a
SVF, 2.5	35.9 b	25.2 b	22.7 b

Conclusions 2011

- Increased flower exposure to bees increased % set (pollinated)
- More pollination occurred with 2 colonies/acre than with 1 for the early cultivars.
- Pollination levels were substantially higher for early cultivars than for hardshells.
- The rate at which flowers were pollinated was fastest at the start of exposure.
- Fritz was pollinated at faster rate than Nonpareil.
- A greater percentage of Fritz flowers were pollinated than Nonpareil.

Conclusions 2012

- Most high density orchards had significantly higher pollination than low density orchards (60% early varieties; 66% late varieties)
- When differences between a pair of orchards were below about 6%, we did not detect a significant difference (range 1.2 - 20.2%)
- Video recordings found that foragers in high bee density blocks remained on a flowering branch longer than foragers in low density blocks.
- Foragers in high density orchards visited significantly more flowers on a branch than those in the lower density orchard.

Conclusions 2012 (con’t)

- Single visits to a Nonpareil and Fritz flower resulted in 4.6 and 24.0% pollination, respectively

- If our sampling procedure for harvestable nuts is predictive, then many of the high density orchards had a significant increase in nut production.

Many Thanks

- Scientific Ag (Joe Traynor)
- Almond Board
- Project Apis m.
- Wegis Farms
- South Valley Farms
- Preimere Farms
- King Ranch
- Paramount Farms
- Many beekeepers
- USDA Area Wide Project

Honey Bees and Colony Strength Evaluation - *An Online Training*

Shannon C. Mueller, Ph.D.

Agronomy Farm Advisor

UC Cooperative Extension

Fresno County

Honey Bees & Colony Strength Evaluation

growing ADVANTAGE
The Almond Conference

Features

- Series of Narrated PowerPoint Slide Sets
- Interactive Quizzes
- Skills Practice

Honey Bees & Colony Strength Evaluation

Benefits

- Individuals/organizations can take advantage of training at their convenience
- Modular approach requires short blocks of time for each section
- Can re-visit training modules/skills practice as necessary
- Easily expanded and updated

Honey Bees & Colony Strength Evaluation

Target Audience

- Apiary Inspectors
- Beekeepers
- Commodity producers who rely on honey bees for pollination

Honey Bees & Colony Strength Evaluation

Goals and Objectives

Improve understanding of

- Basic bee biology
- The hive and hive organization
- Colony strength evaluation procedures
    - Bee Suit Basics
    - Using a Smoker
    - Selection of Hives for Inspection
- Other things you might see in a hive or apiary (and why)

Project Support

- Grants and Donations
  - Almond Board of California
  - Project *Apis m.*

- Gifts of Time and Expertise
  - Beekeepers
  - Bee Brokers
  - Apiary Inspectors
  - County Ag Commissioners

Honey Bees & Colony Strength Evaluation

Why is this important?

- Understanding the colony evaluation process improves consistency of inspections, helps make contract expectations clear, and may reduce misunderstandings.
- Colony strength evaluations help almond producers make sure they are getting what they pay for in terms of numbers of colonies at a strength specified in the pollination contract.
- The inspections also help ensure that beekeepers are appropriately compensated for their additional expense in providing quality hives for spring pollination.

Honey Bees & Colony Strength Evaluation

Access the Online Training at

- http://ucanr.edu/colonystrength

- Modules can be viewed in any order and revisited at any time

Recent Advances in Blue Orchard Bee Management for Almond Pollination

Theresa Pitts-Singer
Research Entomologist
USDA ARS Pollinating Insects Research Unit

Recent Advances in BOB Research

Blue Orchard Bee, *Osmia lignaria*

- Effects of Cavity & Box Numbers on Bee & Nut Yields
- Use of Attractants for Nest Establishment
- Effects of Fungicides on Nesting Behavior
- Mass Production of Bees

Effects of Cavity & Box Numbers on Bee & Nut Yields

Effects of Cavity & Box Numbers on Bee and Nut Yields

	Low Density	High Density
Total cells	45,695	70,981
Overall Sex Ratio	2.7	2.4
% Live Adults	60.5%	57.3%

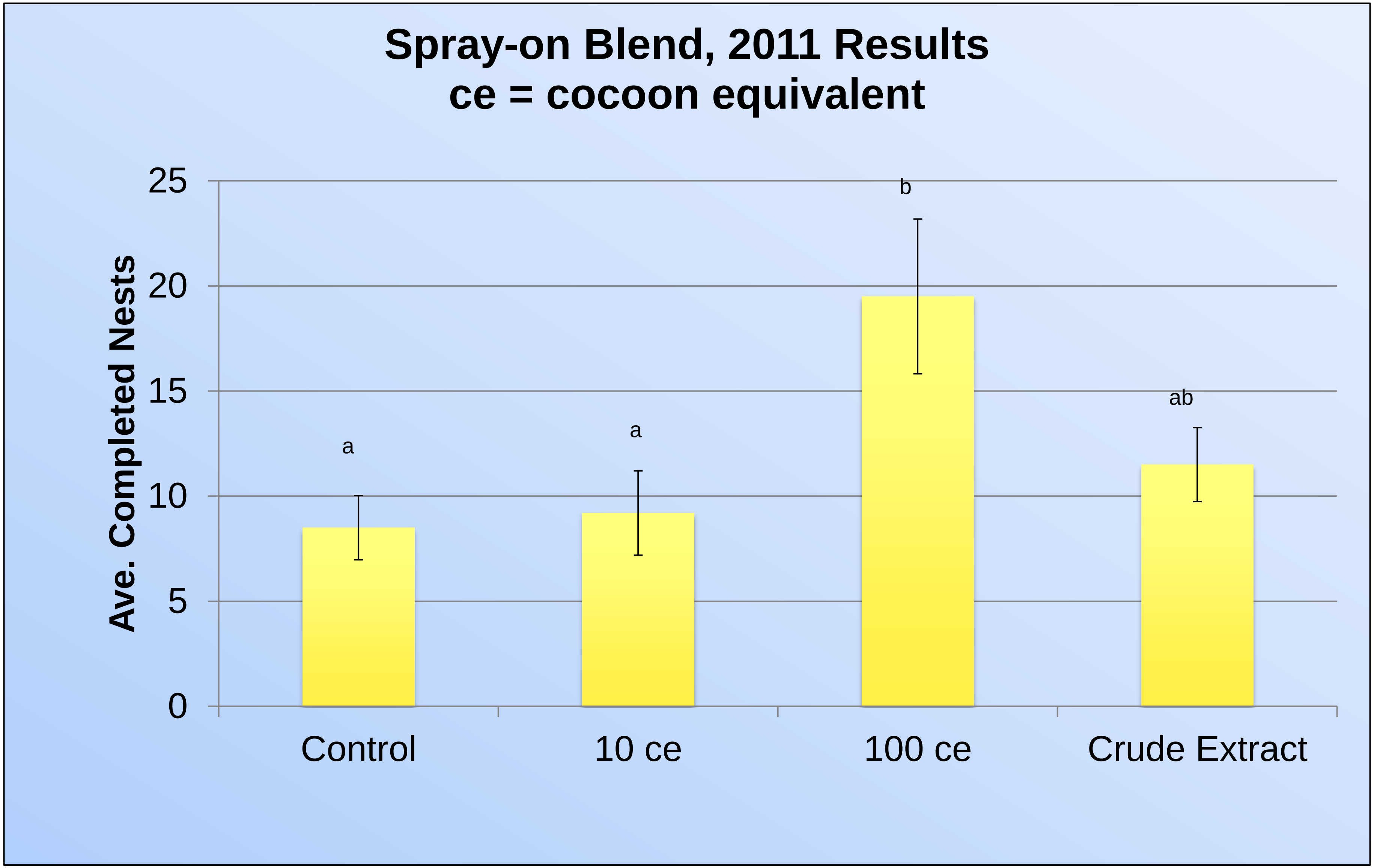
	Low Density	High Density
Total nuts	87,256	95,659
Ave. nut size	1.08	1.05

Use of Attractants for Nest Establishment

2010-2012

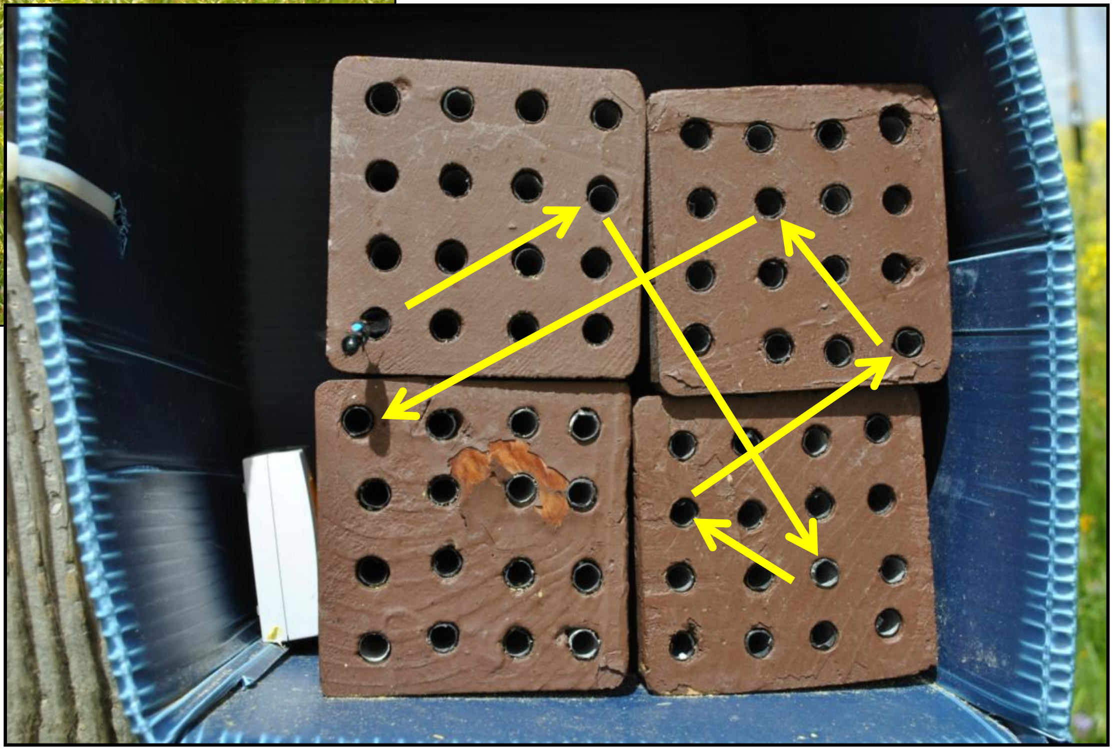
Trials in CA Almonds & UT Apples

Use of Attractants for Nest Establishment



Effects of Fungicides on Nesting Behavior

growing ADVANTAGE The Almond Conference



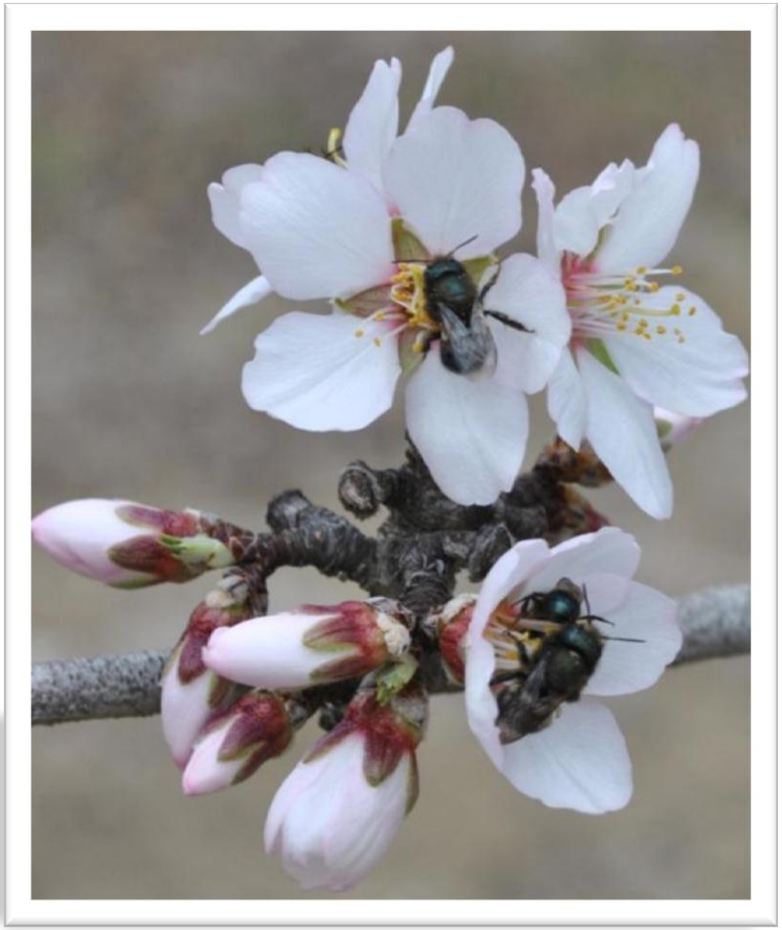
Effects of Fungicides on Nesting Behavior

		Week 1 (Pre-spray)		Week 2 (1st Spray)		Week 3 (2nd Spray)	
		Mean attempts		Mean attempts		Mean attempts	
Treatment	N	Own nest hole	Other holes	Own nest hole	Other holes	Own nest hole	Other holes
Water (control)	16	0[a]	1.67[b]	0[a]	1.06[a]	2.05[a]	2.96[a]
Surfactant (control)	18	0[a]	0[a]	1.20[b]	1.31[b]	2.33[a]	2.77[a]
Rovral Rovral	16	1.50[b]	2.33[c]	2.63[c]	3.52[c]	3.67[b]	4.63[b]
Pristine Pristine	17	0[a]	0[a]	2.41[c]	5.13[d]	2.18[a]	4.81[b]
Rovral Pristine	14	0[a]	1.75[b]	1.94[c]	4.07[c]	2.93[c]	4.71[b]
Pristine Rovral	13	1.67[b]	1.50[b]	3.71[d]	4.23[c]	2.98[c]	4.46[b]

Mass Production of Bees

Mass Production of Bees

Blue Orchard Bees



Almond Crop Forecasting

Neil Willits
Senior Statistician
Department of Statistics
UC Davis

UCD Research Project
USDA NASS Production Forecast Methods

Cooperative Research Agreement

- Almond Board of California
- Statistics Department
  University of California, Davis
- USDA/NASS

UCD Research Project
USDA NASS Production Forecast Methods

growing ADVANTAGE
The Almond Conference

Objectives:

- Explore Statistical Characteristics of Current Methods
- Identify Potential Enhancements & Alternate Survey Procedures
- Improve Precision of Nonpareil Forecast

Example: Random Path Sampling

Trees are selected randomly and the nuts are counted along a *random path*

- **Branches are selected randomly**
- **Larger branches are more likely to be sampled**
  - **Pr{choose branch} ≈ CSA.**
- **Then nut count is expanded to estimate total nuts on the entire tree.**

Example: Random Path Sampling

Trees are selected randomly and the nuts are counted along a *random path*

Example: Random Path Sampling

Trees are selected randomly and the nuts are counted along a *random path*

- Branches are selected randomly
- Larger branches are more likely to be sampled
  - Pr{choose branch} ≈ CSA.
- Then nut count is expanded to estimate total nuts on the entire tree.
  - For this to work, you need nuts proportional to CSA, or
  - $\ln(\text{nuts}) = b0 + \ln(\text{CSA})$.

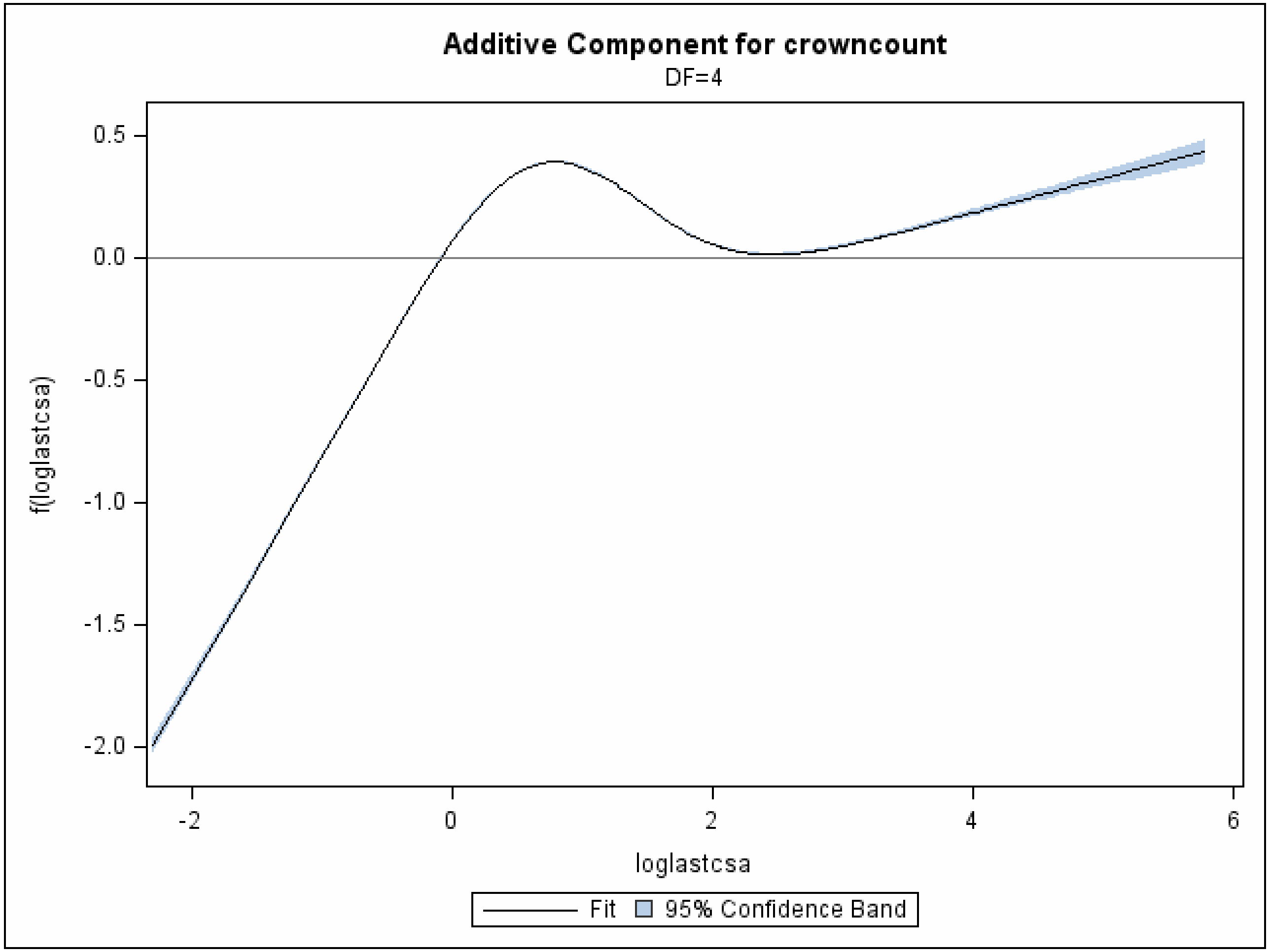
Example: Random Path Sampling

What ***is*** relationship between ln(nuts) and ln(CSA)?

- Assumed to be linear.
- Analysis: Generalized additive models (GAMs) using terminal branches only.
- Many pictures (graphs) of this relationship (overall, adjusting for tree age / variety , by variety
- (All look pretty much the same.)

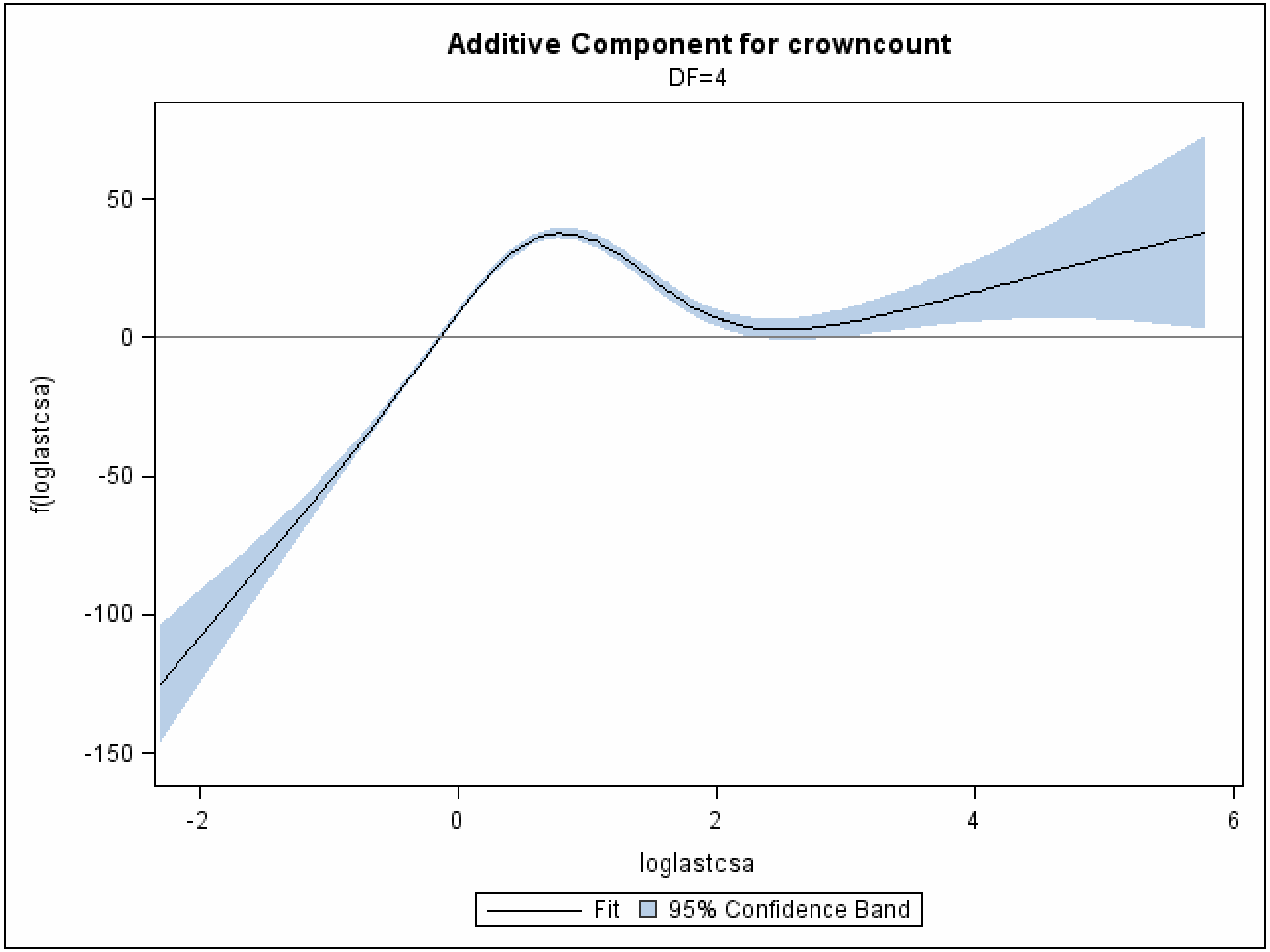
Example: Random Path Sampling

ln(nuts) and ln(CSA) – using all data



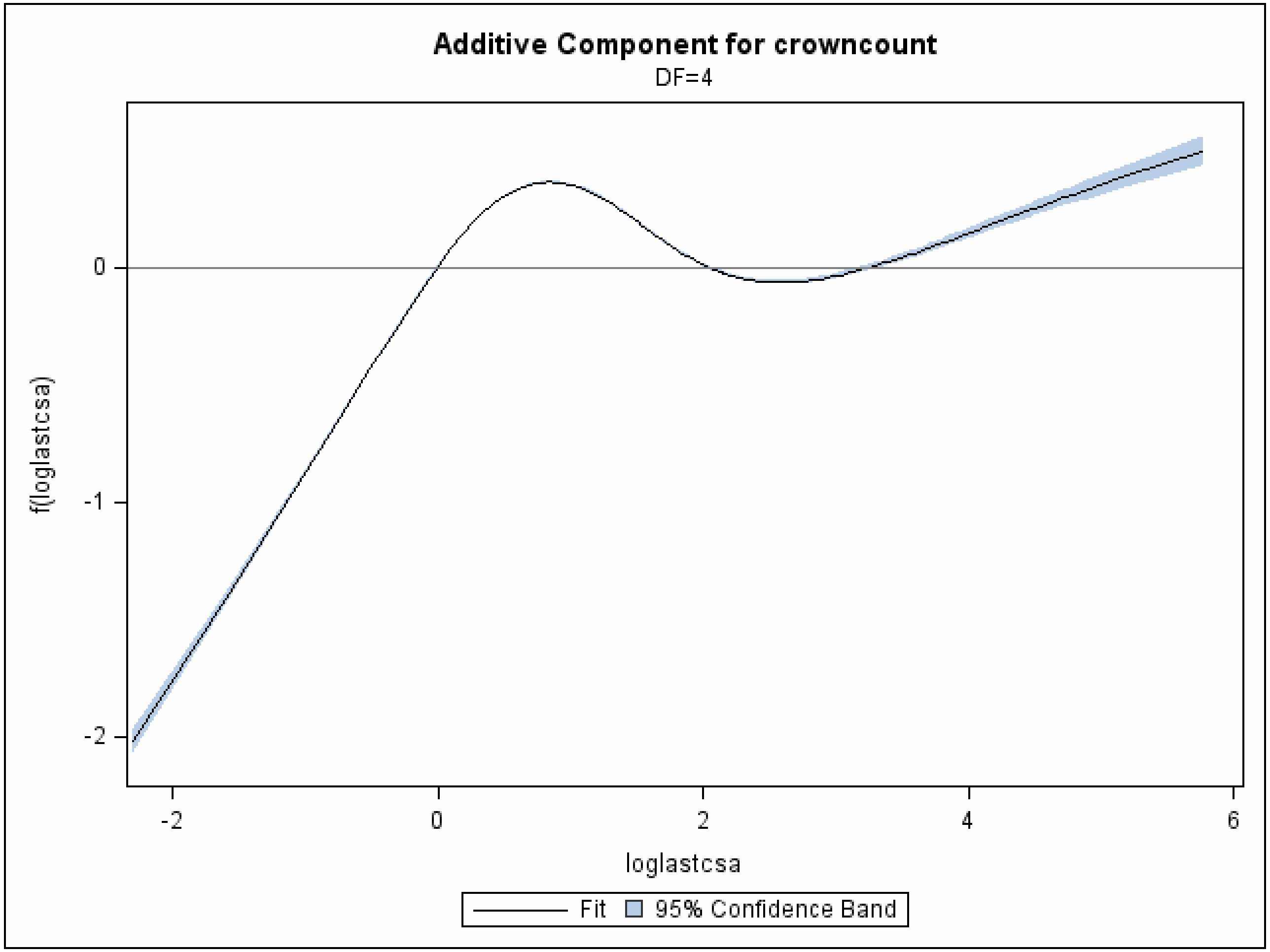
Example: Random Path Sampling

ln(nuts) and ln(CSA) – all data, better error bars



Example: Random Path Sampling

ln(nuts) and ln(CSA) – Nonpareil only



Example: Random Path Sampling

Preliminary conclusions

- There may be opportunities to improve current formula.
- Should more weight be given to large terminal branches?