Protecting Pollinators and Natural Enemies in the Orchard

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Why is Protecting Good Bugs Good?

- Orchards are complex interacting systems
- As perennial crops pest problems can persist
- Intense spray programs can flare secondary pests
- IPM is advanced in orchard systems and we have tools to enhance beneficial insects
- Restrictions on insecticide labels - ***need to know how to balance bees and predators with pest management***

Tree fruit pollination

Peaches

- Self-fertile and can self-pollinate by wind
  - May benefit from bee pollination
- Extra-floral nectaries → resource for bees

Apples

- Self-incompatible → own pollen will not produce fertilized seeds or fruit
- Pollen must move across varieties
  - Bees cross-pollinate flowers as they move throughout the orchard

Courtesy of B. Blaauw

Bee pollinators

- Bees are most active early to mid-morning
- Honey bees are often brought into orchard
- Native bees are more/equal effective pollinators than honey bees on a per-visit basis
- Studies at Penn State and Wisconsin:
  - Apple fruit set was not significantly higher at orchards with managed honeybees
  - Fruit set significantly increased with the species richness of native, wild bees

Courtesy of B. Blaauw

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Ground nesting bees

bumble bees

digger/miner bees

long-horn bees

sweat bees

Courtesy of B. Blaauw

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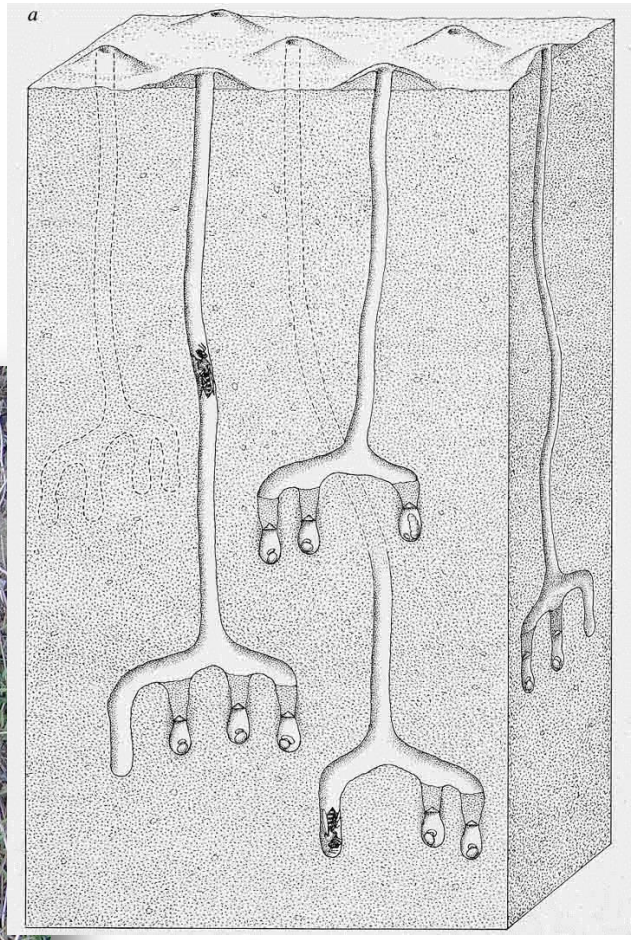
Ground nesting bees:

miner/digger, long-horn, and sweat bees



Courtesy of B. Blaauw

Pesticides and Bees

Exposure pathways

- Direct spray
  - Contact from crop
  - Contact from drift
- Ingestion of pesticide
  - Pollen and nectar
    - Crop flowers
    - Extrafloral nectaries (peaches)
    - Understory weeds

THE NEW EPA BEE ADVISORY BOX

On EPA's new and strengthened pesticide label to protect pollinators

PROTECTION OF POLLINATORS

APPLICATION RESTRICTIONS EXIST FOR THIS PRODUCT BECAUSE OF RISK TO BEES AND OTHER INSECT POLLINATORS. FOLLOW APPLICATION RESTRICTIONS FOUND IN THE DIRECTIONS FOR USE TO PROTECT POLLINATORS.

Look for the bee hazard icon  in the Directions for Use for each application site for specific use restrictions and instructions to protect bees and other insect pollinators.

This product can kill bees and other insect pollinators.

Bees and other insect pollinators will forage on plants when they flower, shed pollen, or produce nectar.

Bees and other insect pollinators can be exposed to this pesticide from:

- Direct contact during foliar applications, or contact with residues on plant surfaces after foliar applications
- Ingestion of residues in nectar and pollen when the pesticide is applied as a seed treatment, soil, tree injection, as well as foliar applications.

When Using This Product Take Steps To:

- Minimize exposure of this product to bees and other insect pollinators when they are foraging on pollinator attractive plants around the application site.
- Minimize drift of this product on to beehives or to off-site pollinator attractive habitat. Drift of this product onto beehives can result in bee kills.

Information on protecting bees and other insect pollinators may be found at the Pesticide Environmental Stewardship website at:
http://pesticidestewardship.org/pollinatorprotection/Pages/default.aspx

Pesticide incidents (for example, bee kills) should immediately be reported to the state/tribal lead agency. For contact information for your state/tribe, go to: www.aapco.org. Pesticide incidents can also be reported to the National Pesticide Information Center at: www.npic.orst.edu or directly to EPA at: beekill@epa.gov

Alerts users to separate restrictions on the label. These prohibit certain pesticide use when bees are present.

The new bee icon helps signal the pesticide's potential hazard to bees.

Makes clear that pesticide products can kill bees and pollinators.

Bees are often present and foraging when plants and trees flower. EPA's new label makes it clear that pesticides cannot be applied until all petals have fallen.

Warns users that direct contact and ingestion could harm pollinators. EPA is working with beekeepers, growers, pesticide companies, and others to advance pesticide management practices.

Highlights the importance of avoiding drift. Sometimes, wind can cause pesticides to drift to new areas and can cause bee kills.

The science says that there are many causes for a decline in pollinator health, including pesticide exposure. EPA's new label will help protect pollinators.

EPA

Read EPA's new and strengthened label requirements: http://go.usa.gov/jHH4

Active ingredient	Common name	Class	Toxicity
Bacillus thuringiensis	BT	Bacterium	Non-toxic
Chromobacterium subtsugae	Grandevo	Bacterium	Toxic
Carbaryl	Sevin	Carbamate	Highly toxic
Methomyl	Lannate	Carbamate	Highly toxic
Kaolin clay	Surround	Clay	Non-toxic
Chlorantraniliprole	Altacor	Diamide	Non-toxic
Thiophanate-methyl	Incognito, Topsin	Fungicide	Non-toxic
Captan	Captan, Captec	Fungicide	In lab toxicity
Copper hydoxide	Champ, Kocide	Fungicide	Toxic
Copper sulfate + lime	Bodeaux Mixture	Fungicide	Highly toxic
Methoxyfenozide	Intrepid	IGR	Non-toxic
Spirotetramat	Movento	Mitocide	Toxic
Thiacloprid	Calypso	Neonicotinoid	Low toxicity
Acetamiprid	Assail	Neonicotinoid	Toxic
Clothianidin	Belay, Clutch	Neonicotinoid	Highly toxic
Dinotefuran	Venom, Scorpion	Neonicotinoid	Highly toxic
Imidacloprid	Admire, Provado	Neonicotinoid	Highly toxic
Thiamethoxam	Actara, Endigo, Voliam	Neonicotinoid	Highly toxic
Chlorpyrifos	Lorsban	Organophosphate	Highly toxic
Phosmet	Imidan	Organophosphate	Highly toxic
Indoxacarb	Avaunt, Steward	Oxadiazine	Highly toxic
Beta-cyfluthrin	Baythroid, Leverage	Pyrethroid	Highly toxic
Bifenthrin	Brigade, Capture	Pyrethroid	Highly toxic
Cyflurin	Baythroid, Leverage	Pyrethroid	Highly toxic
Esfenvalerate	Asana	Pyrethroid	Highly toxic
Fenpropathrin	Danitol	Pyrethroid	Highly toxic
Lambda-cyhalothrin	Warrior, Voliam	Pyrethroid	Highly toxic
Permethrin	Ambush, Permastar	Pyrethroid	Highly toxic
Zeta-cypermethrin	Mustang Maxx, Hero	Pyrethroid	Highly toxic
Spinetoram	Delegate	Spinosyn	Toxic
Spinosad	Entrust	Spinosyn	
Cydia pomonella granulosis	Cyd-X	Virus	

Fungicides

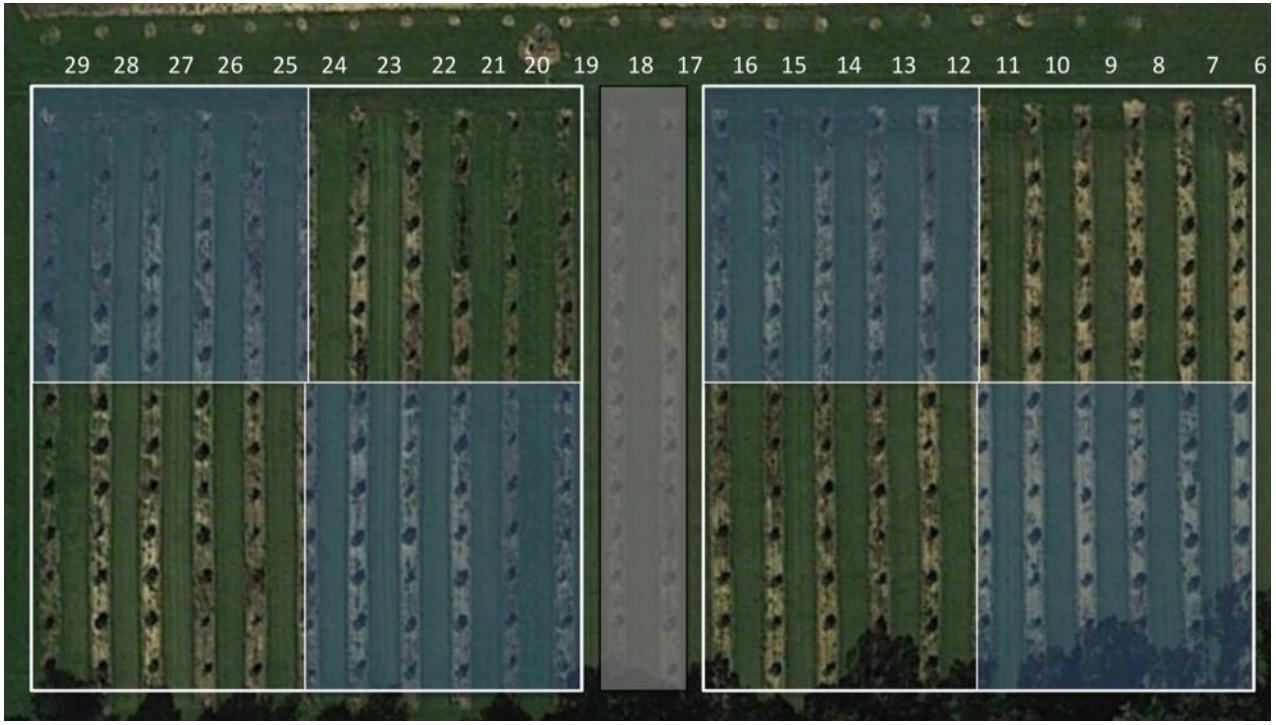
Neonicotinoi

Pyrethroids

Courtesy of B. Blaauw


Statewide IPM Project
2000 Regents, University of California

Can we reduce pesticide exposure to foraging bees?

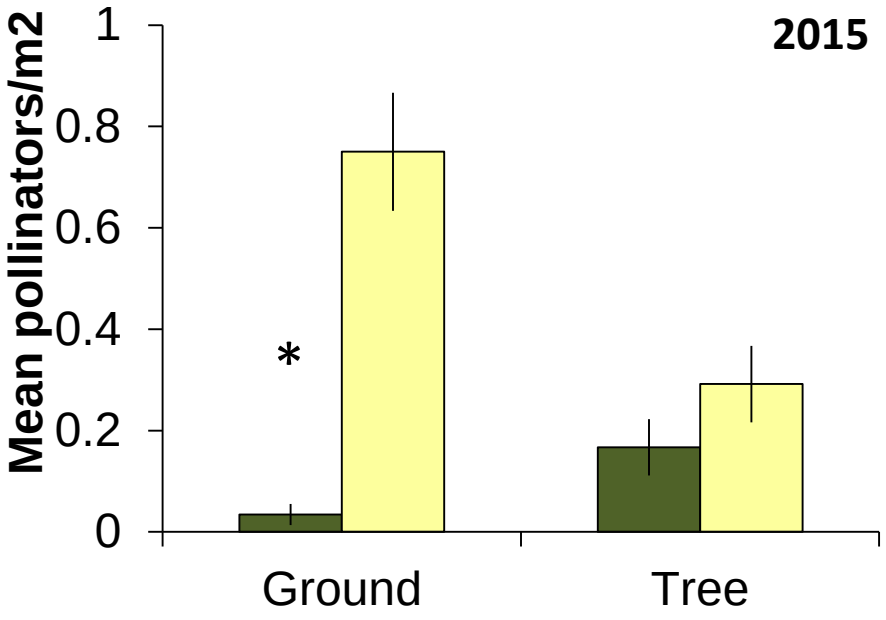


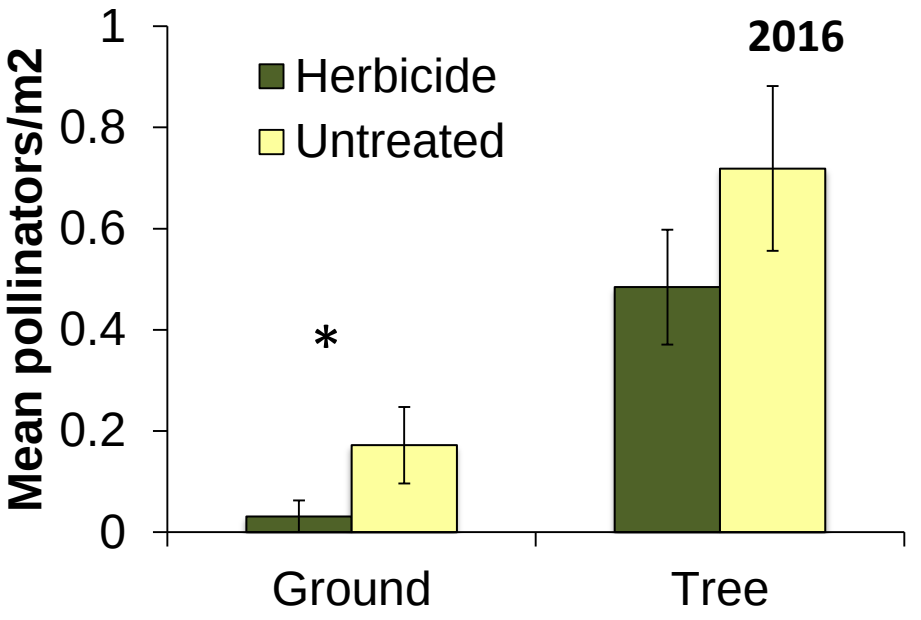
Herbicide application

Applied Stinger herbicide to remove flowering weeds in peach

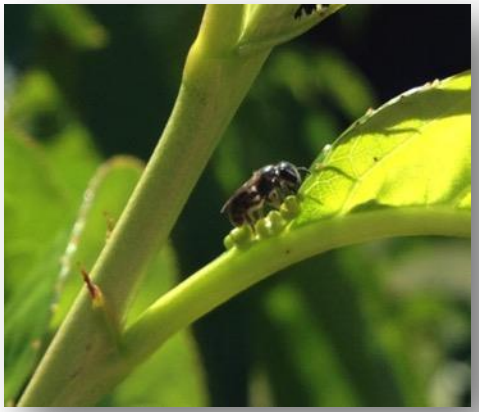
- Sampled bees in row middles and in trees
- 3 sampling periods – June, July, August
- 2015 & 2016

Where there were flowers there were bees

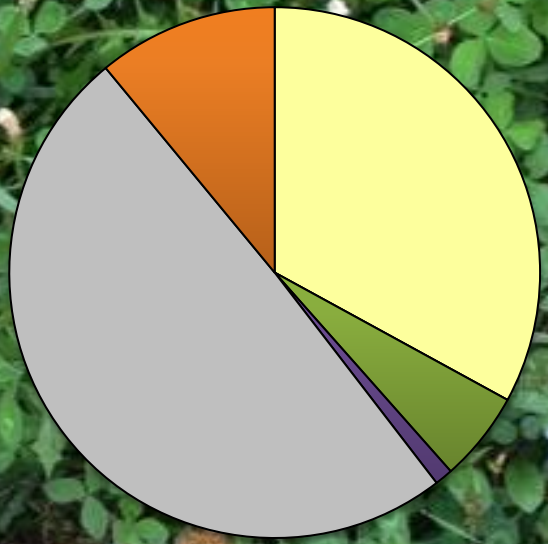




- White clover was dominant flowering weed
- Primarily Halictidae

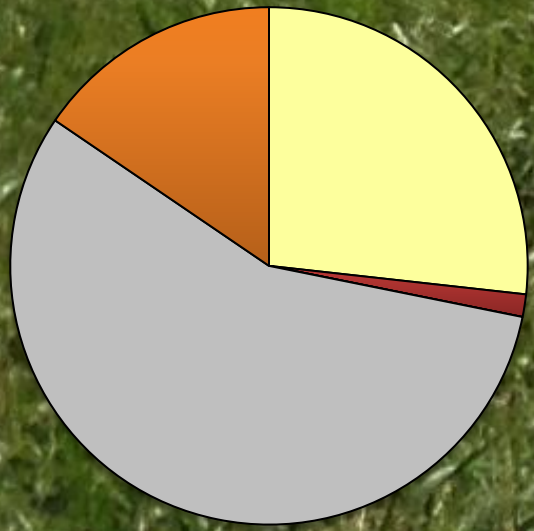


Bee Community 2016



Peach Canopy

- Honey Bee
- Yellow-faced Bee
- Mason Bee
- Bumble Bee
- Sweat Bee
- Hoverfly



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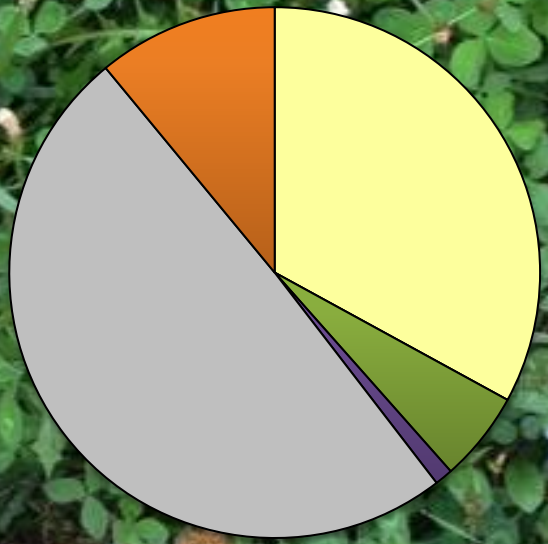

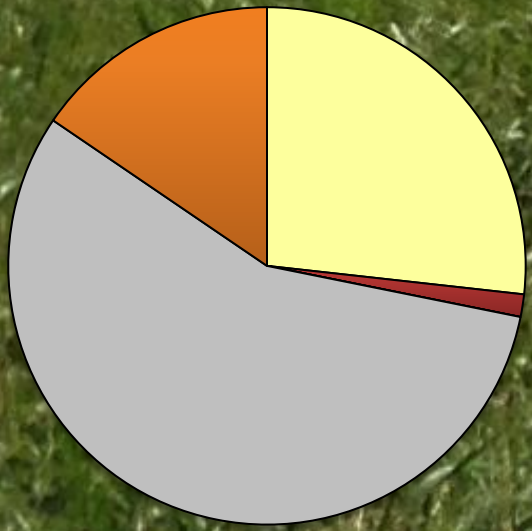

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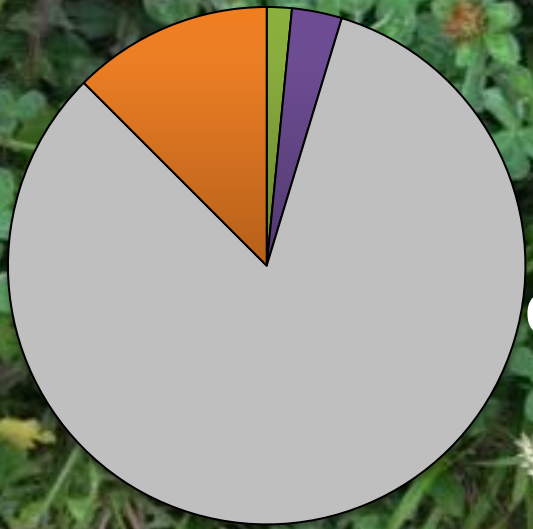
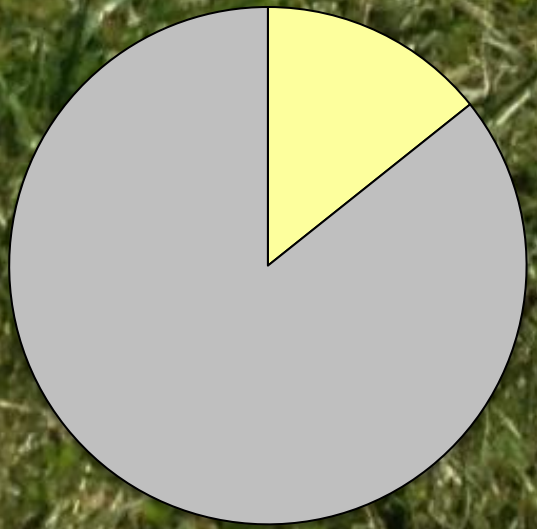


Orchard Row Middle



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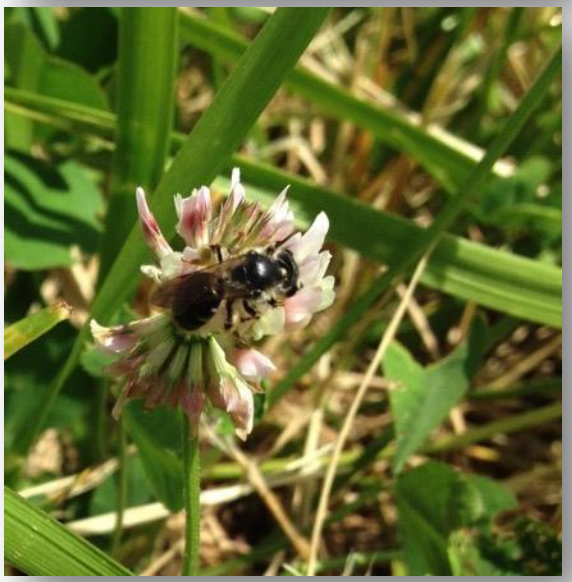
Protecting Pollinators

Bloom

- Do not spray insecticides during bloom
- Follow the label – spray when bees are not active
- Use materials wisely

In-season

- Reduce flowering weeds within orchards
- Do not apply insecticides to natural and wooded borders
- Bee populations can be supported with insectary plantings
- Can we manage orchards better?



Balancing the Good and Bad Bugs

- ✔ Managing ground cover
  - Works in peaches
  - Also controls TPB
- Mating disruption for internal worms
  - Predation on 26 - 46% of OFM eggs
  - Generalist predators increase
- Attract & Kill for BMSB
- Border sprays for BMSB
  - IPM-CPR

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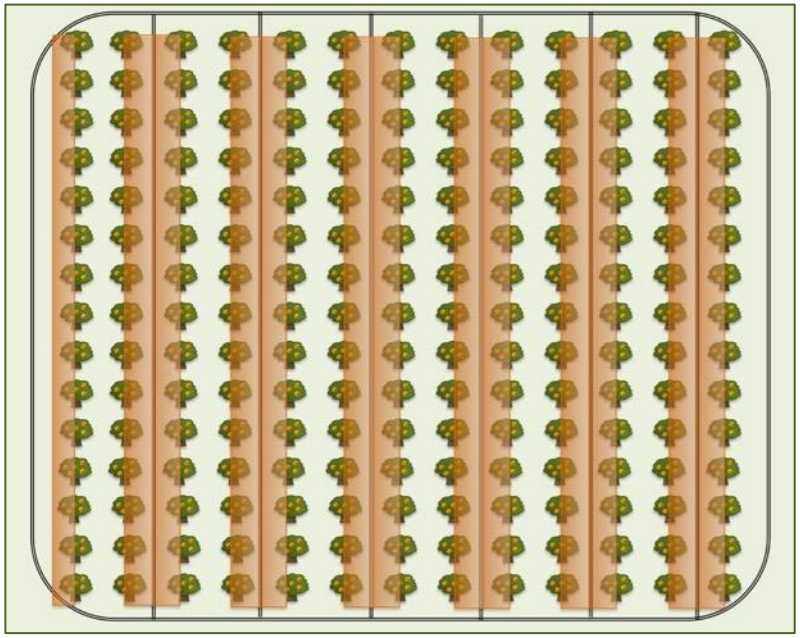
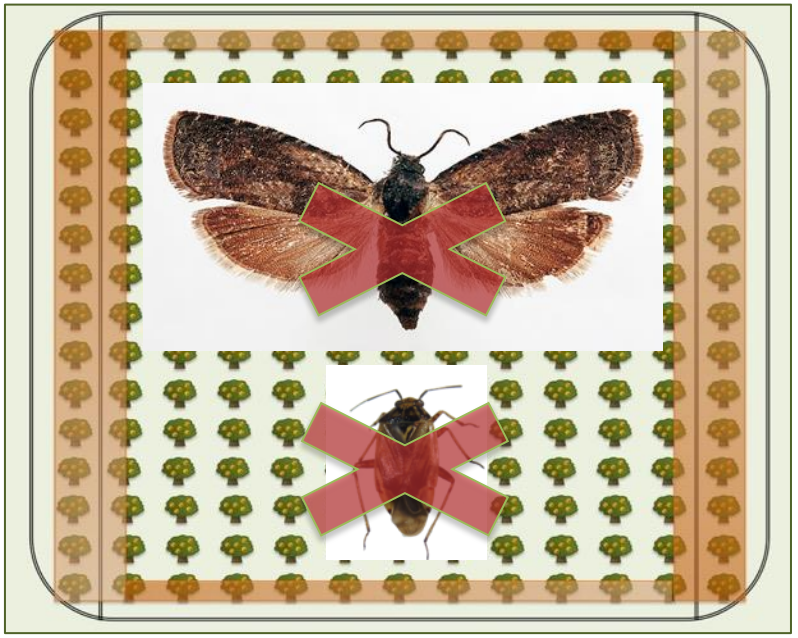
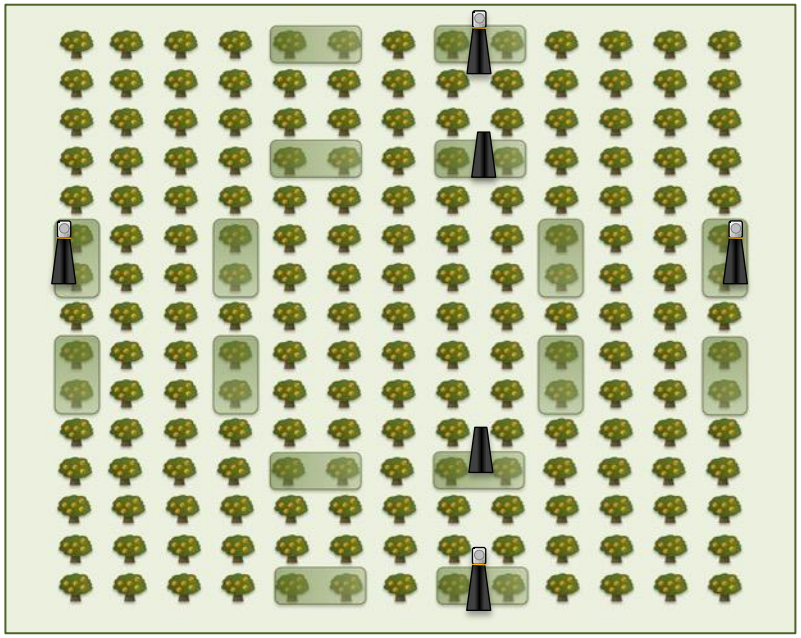
IPM-Crop Perimeter Restructuring

- Mating disruption + groundcover management + border sprays for BMSB
- Compare to grower standard insecticide application for key pest management in peach orchards
    - Effect on peach damage
    - Natural enemy response







- Standard: whole block or ARM sprays
- IPM-CPR: perimeter + first full row
- Weekly insecticide applications beginning late-May (140 DD_{57}) or threshold-triggered
- Pheromone trap based monitoring
- Harvest sample for injury assessment

Pesticide application

Sampling sites

Pyramid monitoring trap

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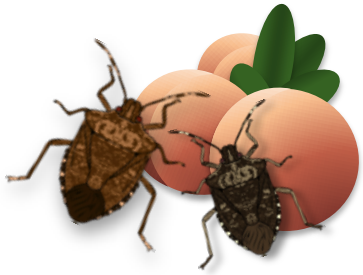
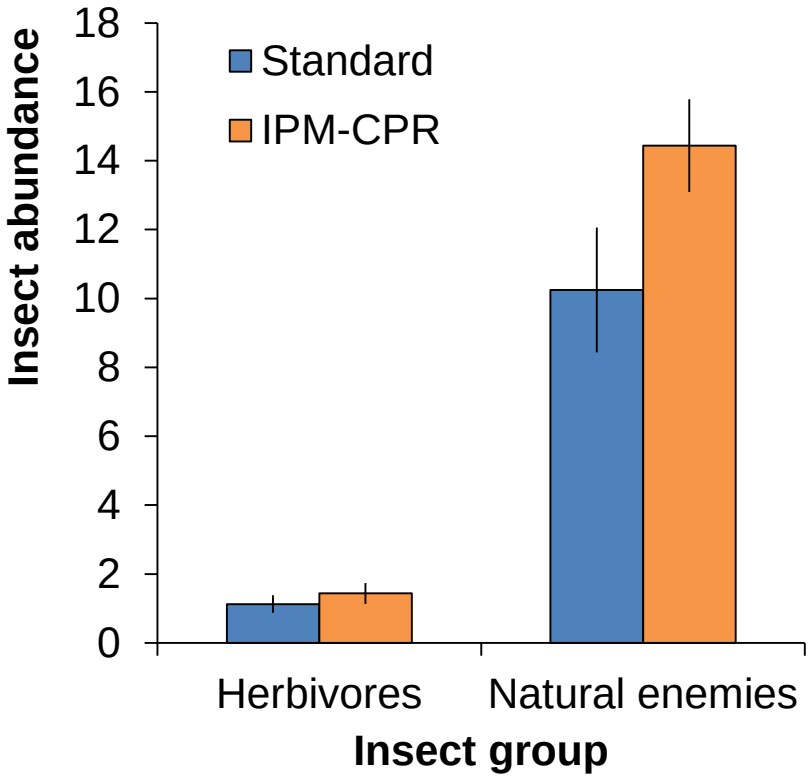
Stink Bug Injury in Peaches



Impact on Predators

- In peaches, IPM-CPR positively impacted natural enemies
  - More diverse community
  - Higher predation on BMSB egg masses



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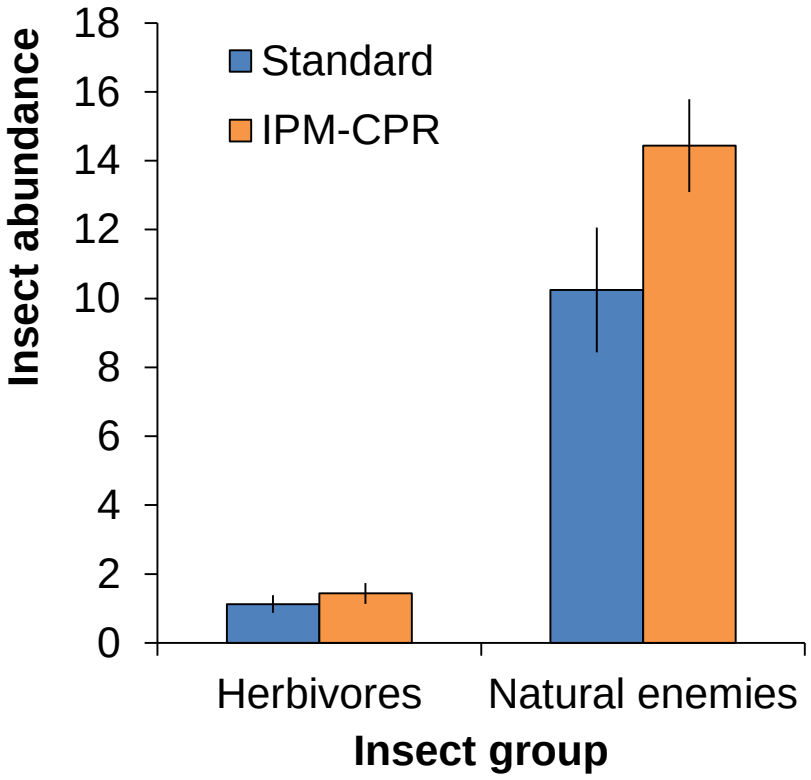

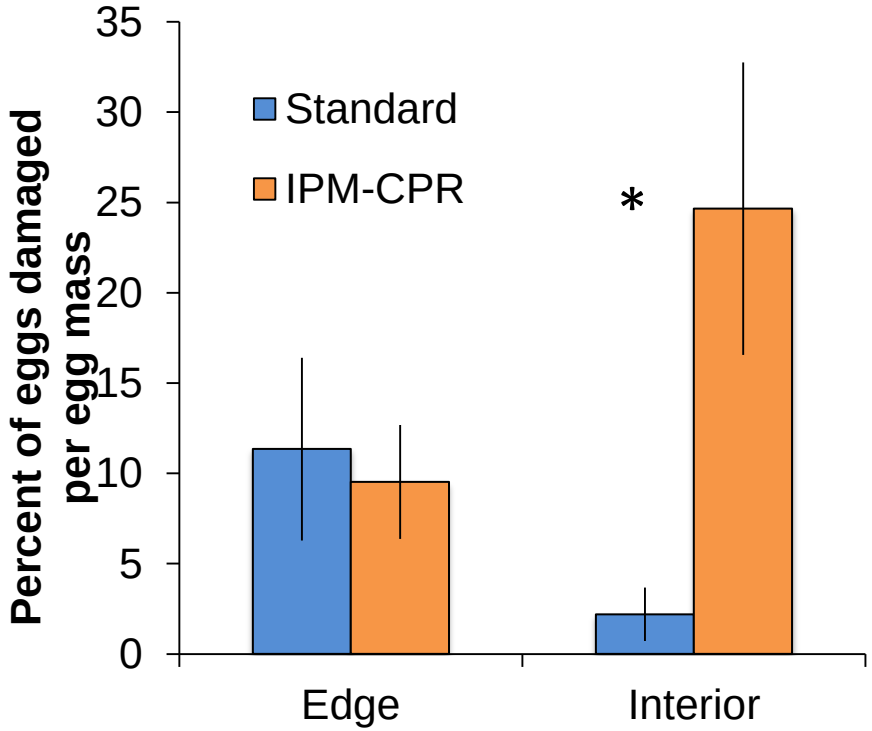

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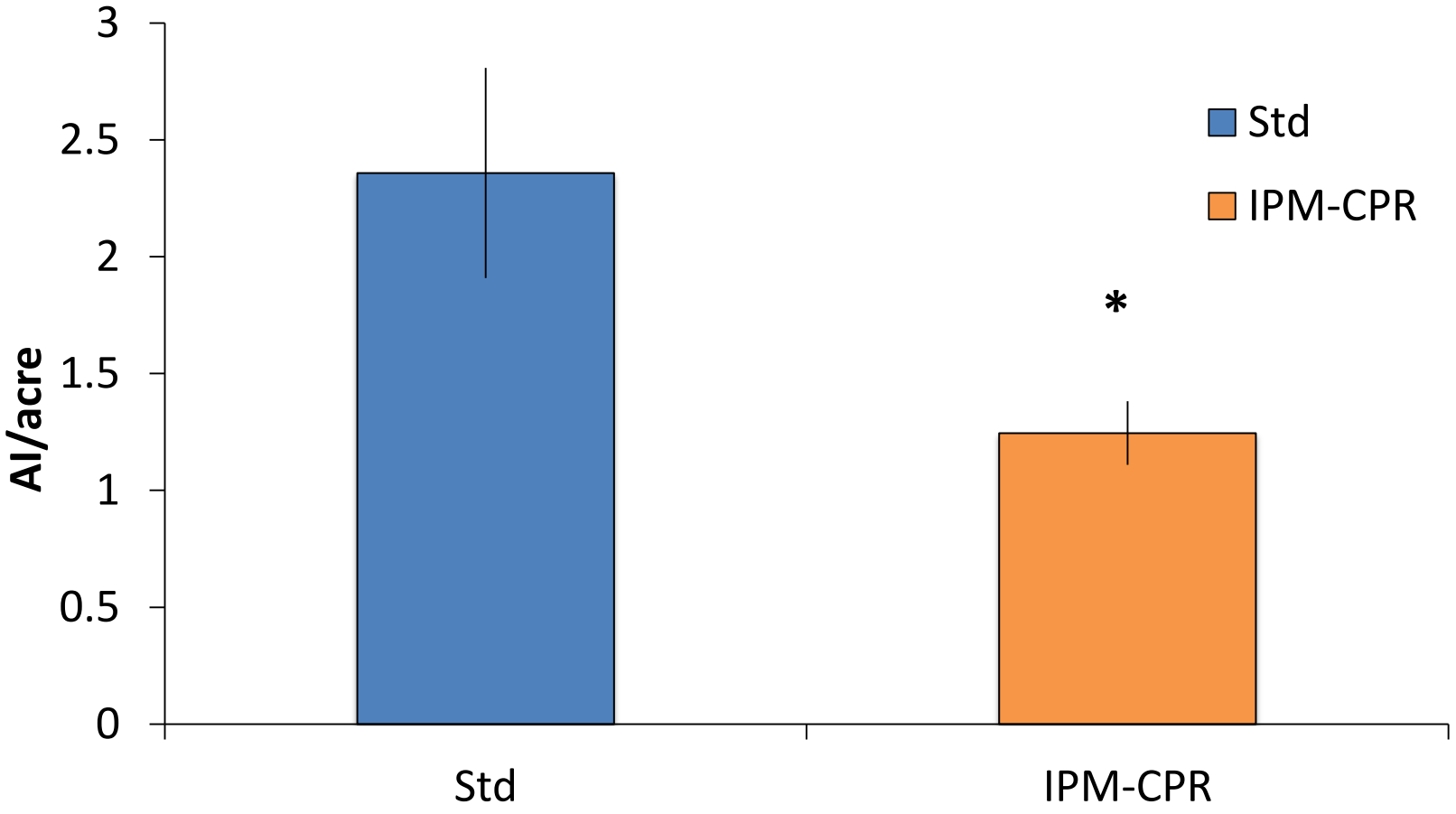
Active Ingredient Applied in Peach

No relationship between size of border and amount of AI or % damage



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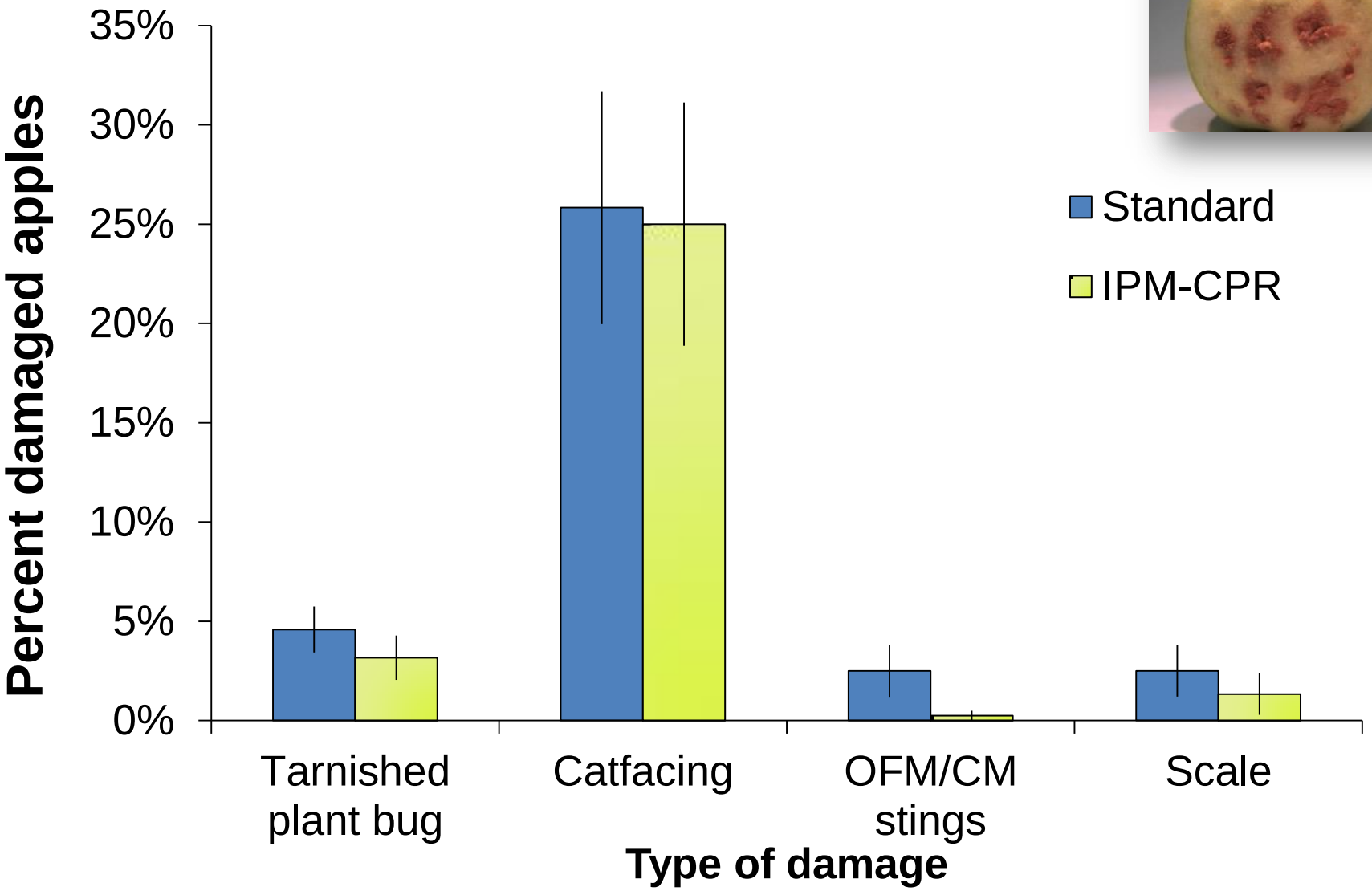
IPM-CPR in Apple 2014



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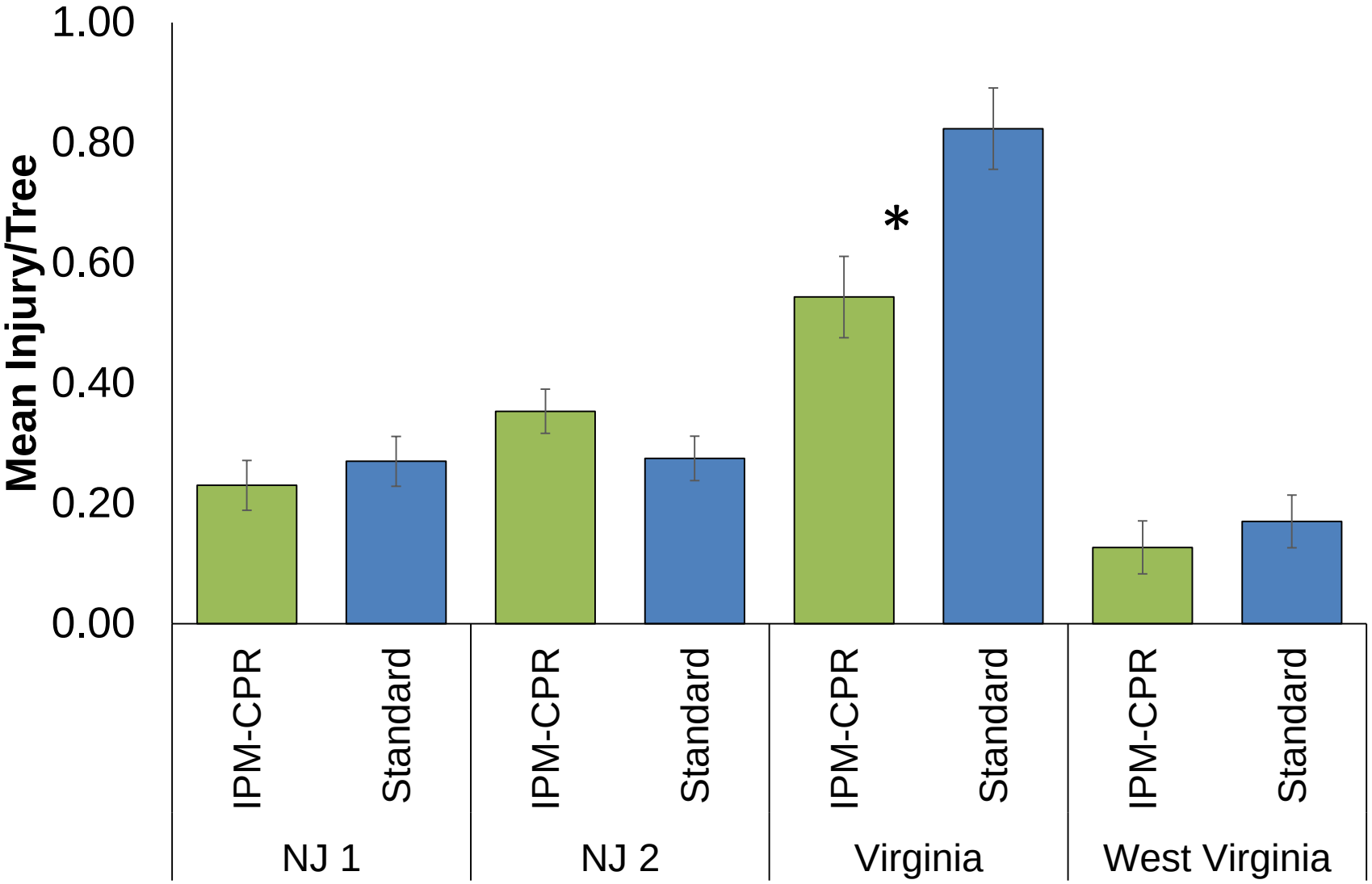
Injury at Harvest in Apple- 2016



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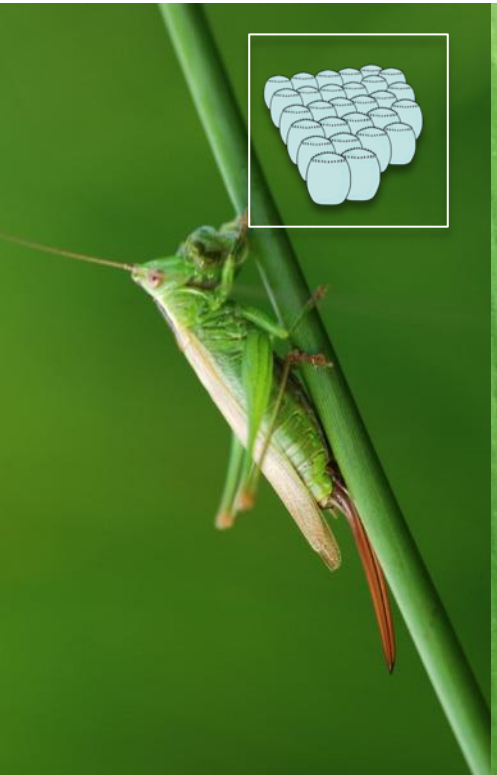
Impact on Predators

- In peaches, IPM-CPR positively impacted natural enemies
  - More diverse community
  - Higher predation on BMSB egg masses
- USDA ARS found 5.4% predation on BMSB eggs in apple
- 15% of field collected predators had fed on BMSB



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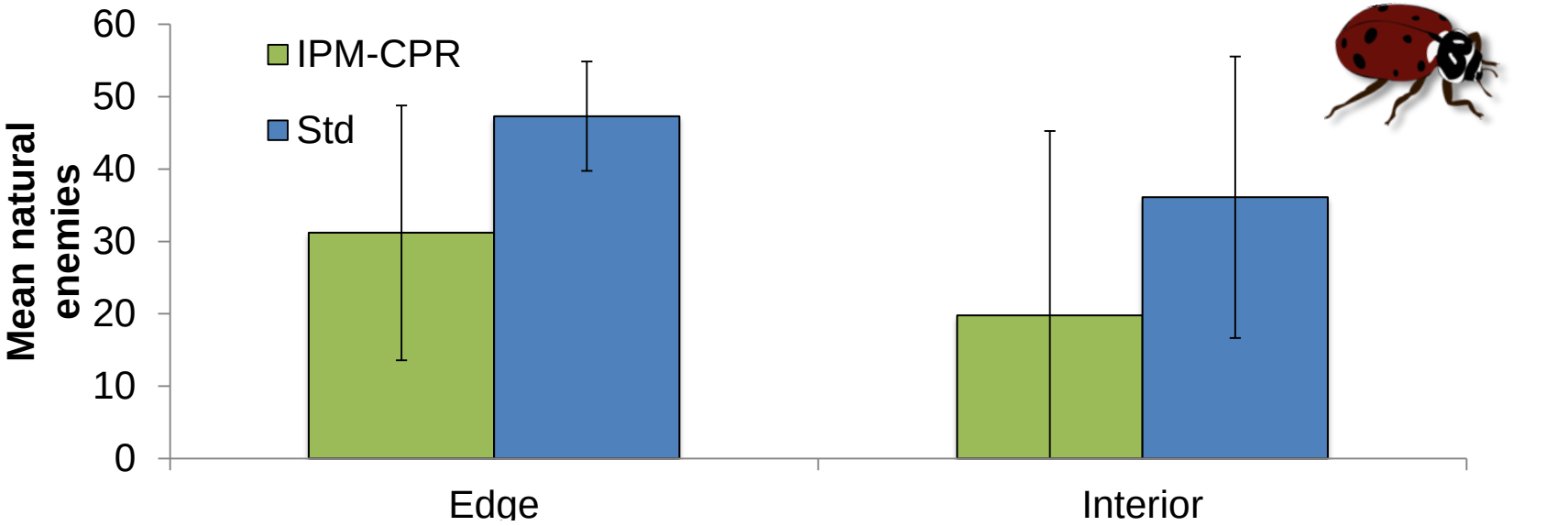
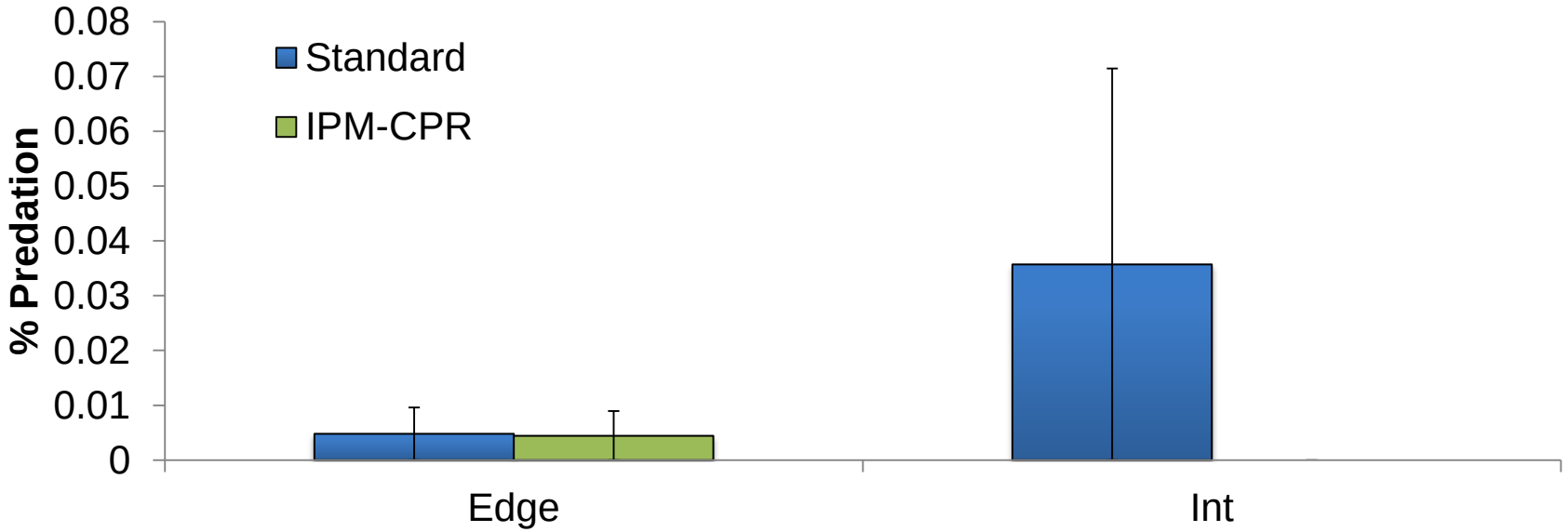
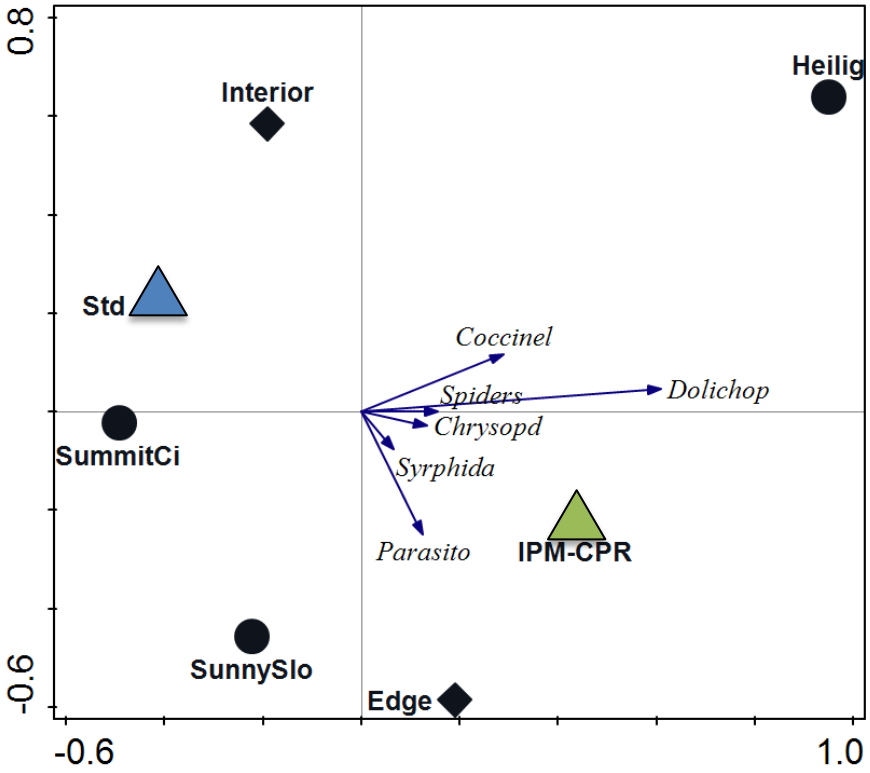
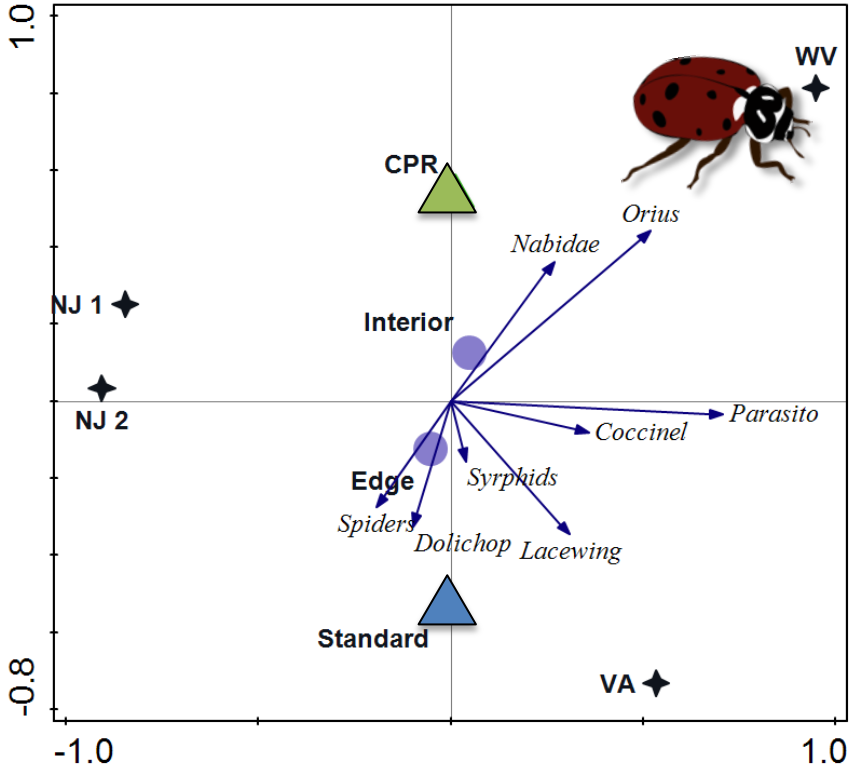
Predator Impact in Apples 2016





Apple 2014 & 2016





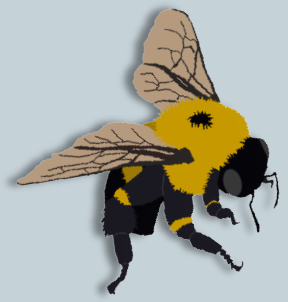
2014:

Border sprays + mating disruption + ground cover management positively influenced predators

Fewer wooly apply aphids

2016: We saw a trend towards IPM-CPR positively impacting predators but management tactics were not different

How Can We Best Integrate Management Practices?



Ground Cover Management:

- Controls tarnished plant bug
- Reduces foraging in the groundcover (peaches)
- Fewer bees foraging in the canopy (peaches)

Pollinators:

✓ Selective insecticide application

✓ Insectary strips

Reduce the Area Sprayed:

- Attract & Kill and IPM-CPR reduce the area of the orchard sprayed and equal injury as standard
- Border sprays increased predator abundance and impact in peach
- In apples this effect was not as strong

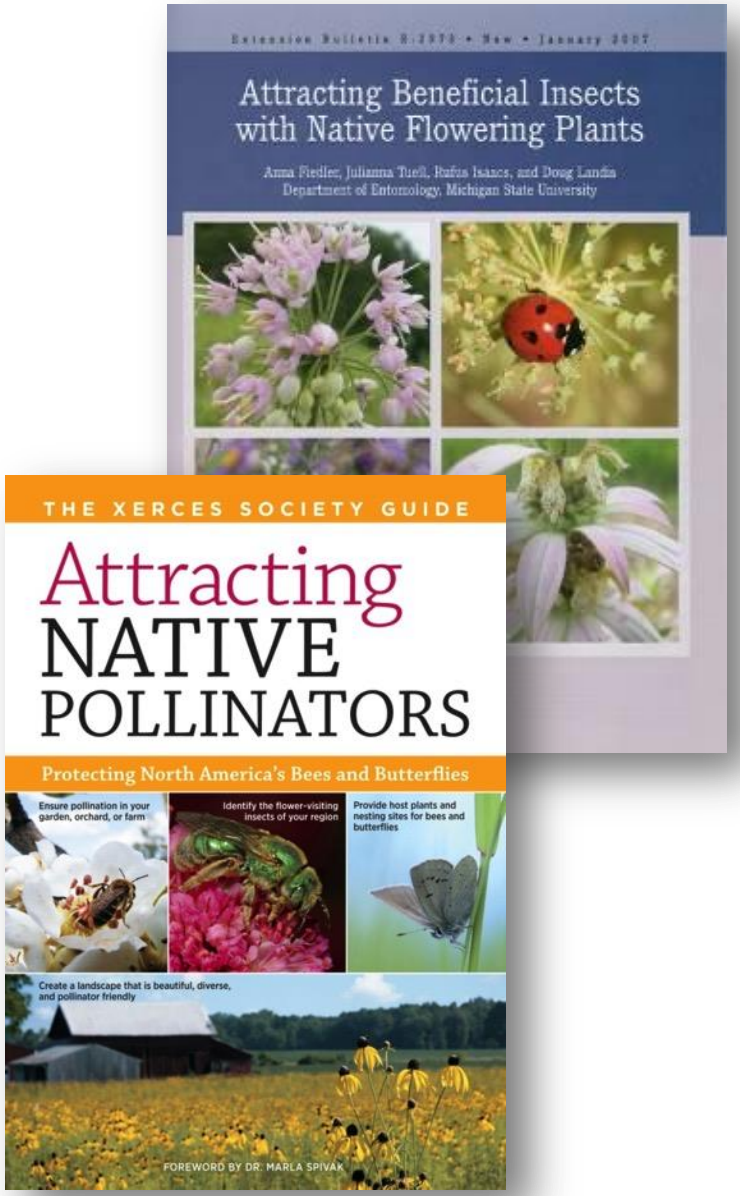
SCRI: 2011-51181-30937
CPPM

ONE-13-190
ONE-14-217

- Tracy Leskey USDA & Chris Bergh VT
- Dean Polk – Rutgers IPM Program
- Clement Akotsen-Mensah (postdoc)
- Meghin Rollins, Gabe Batzli, Marissa Apolonia, Marina Perez

For more information…

- Bee research at Rutgers
  http://winfreelab.com/outreach/
- Wild pollinators of Eastern Orchards
  https://entomology.cals.cornell.edu/extension/wild-pollinators
- Native Plants for Bees
  www.nativeplants.msu.edu
- Pollinator Partnership
  www.pollinator.org
- Xerces Society
  www.xerces.org



Commonly recommended flowering plants

- Annuals:
  - Sweet alyssum
  - Buckwheat
  - Purple tansy



- Perennials:
  - Sand coreopsis
  - Golden Alexanders
  - Blue lobelia
  - Milkweed
  - Cup plant
  - New England aster






Courtesy of B. Blaauw