

# Landscape Pest ID and IPM

## Earth-Kind Landscape Short Course

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# Human Ag. in Constant battle with little aliens



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# Agricultural History

## The Green Revolution

- Between 1940's - 1960's
- "saved over a billion people from starvation"
- high-yielding varieties of cereal grains
- Expansion of irrigation infrastructure



- Modernization of management techniques
- Distribution of hybridized seeds, synthetic fertilizers, and pesticides to farmers

Norman Borlaug

# Agricultural History



# Agricultural History | Invasive species

502 Records  
\$ billions in economic impact

Spotted Wing Drosophila  
Estimated revenue loss in 2008  
\$511.3 million

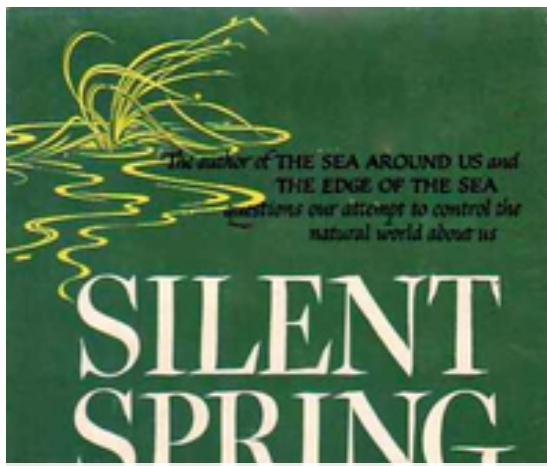
# Agricultural History



# Agricultural History



# Integrated Pest Management



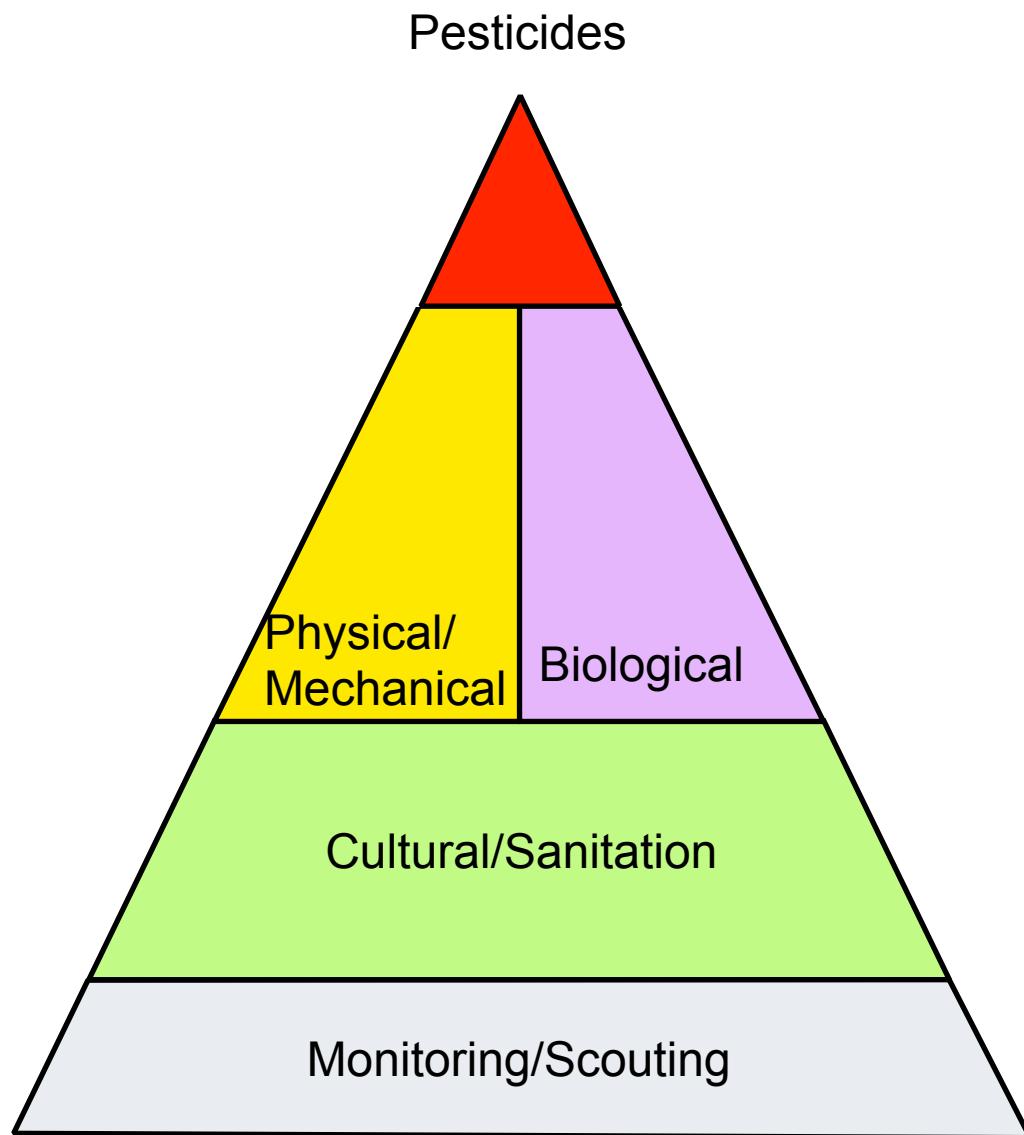
"Why should we tolerate a diet of weak poisons, a home in insipid surroundings, a circle of acquaintances who are not quite our enemies, the noise of motors with just enough relief to prevent insanity? Who would want to live in a world which is just not quite fatal?"

1970's

USDA creates nationwide IPM program in Land  
Grant Universities

# Integrated Pest Management

- Minimize impact on the environment
- Minimize impact on human health
- Maintain or increase soil fertility
- Long-term pest management
- Prevent pesticide-resistant pests
- Strives to maximize long-term returns/savings



# Insects

## Freeze Tolerance



Photo: [Andrew Rothstein](#)

Wooly Bear  
-4

*Ips acuminatus*  
-29 F

## Freeze Avoidance



Photo: Maja Jurc, University of Ljubljana, [bugwood.org](#)

UGA2103050

# Monitoring/Scouting

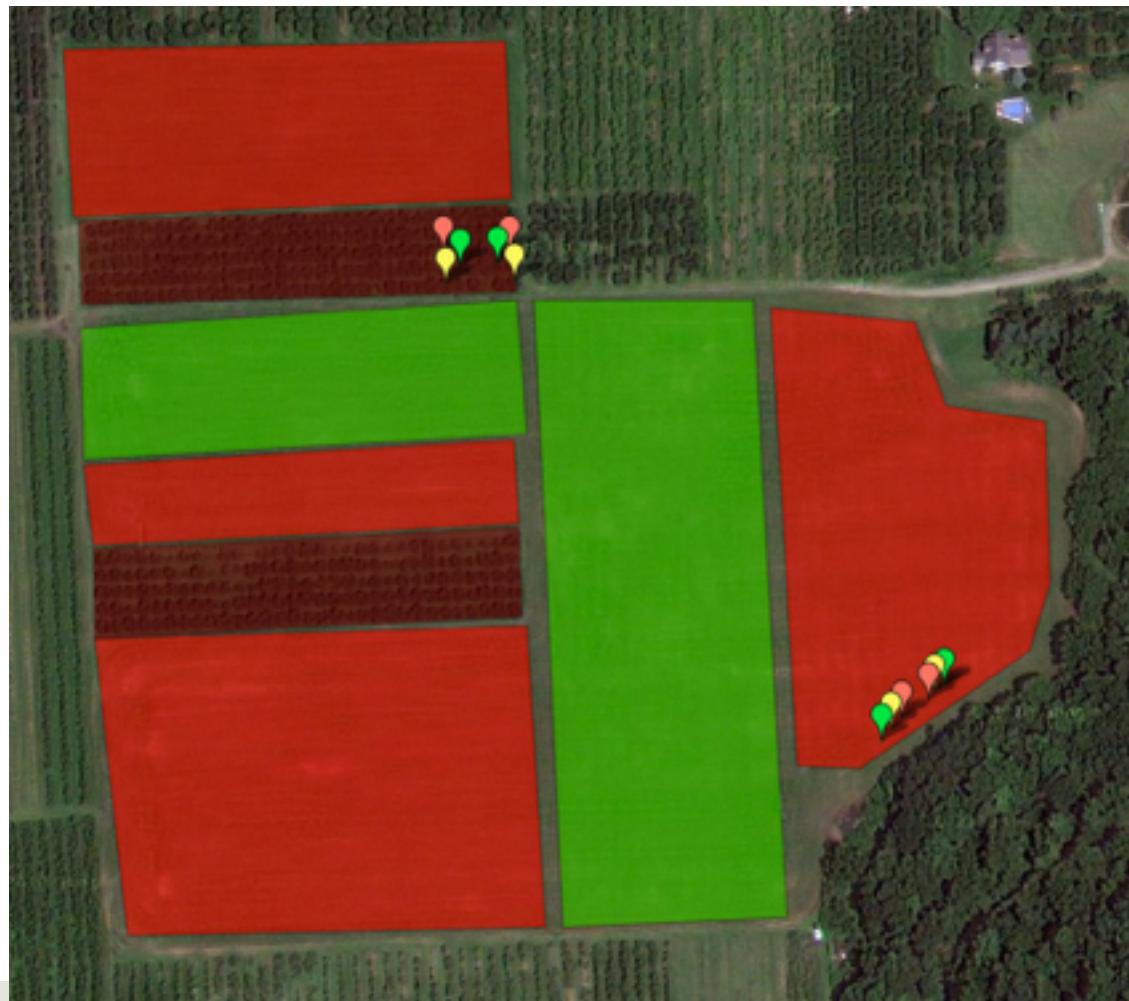
**PM Units**

*Presence-absence*

*Indicator plants*

*Traps/Lures*

*Control efficacy*



# Monitoring/Scouting

**PM Units**

*Presence-absence*

*Indicator plants*

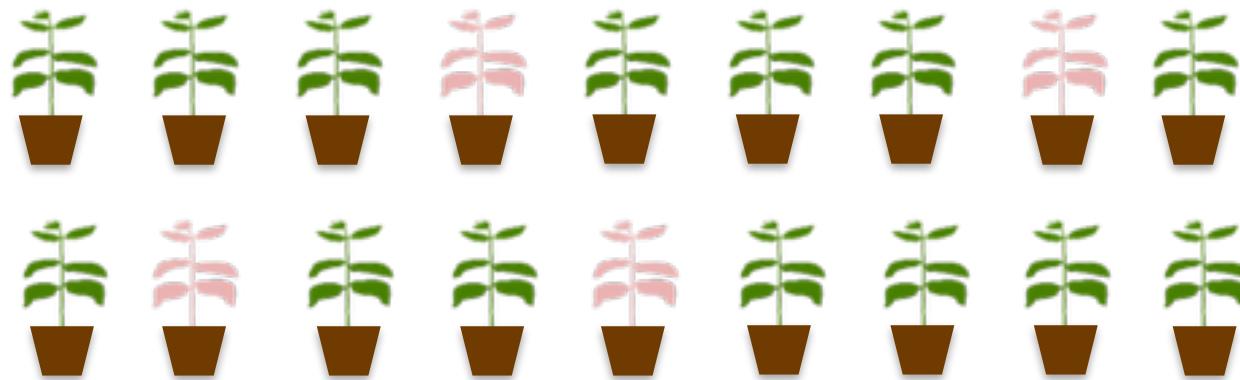
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# Monitoring/Scouting

PM Units	Presence-absence	Indicator plants	Traps/Lures	Control efficacy
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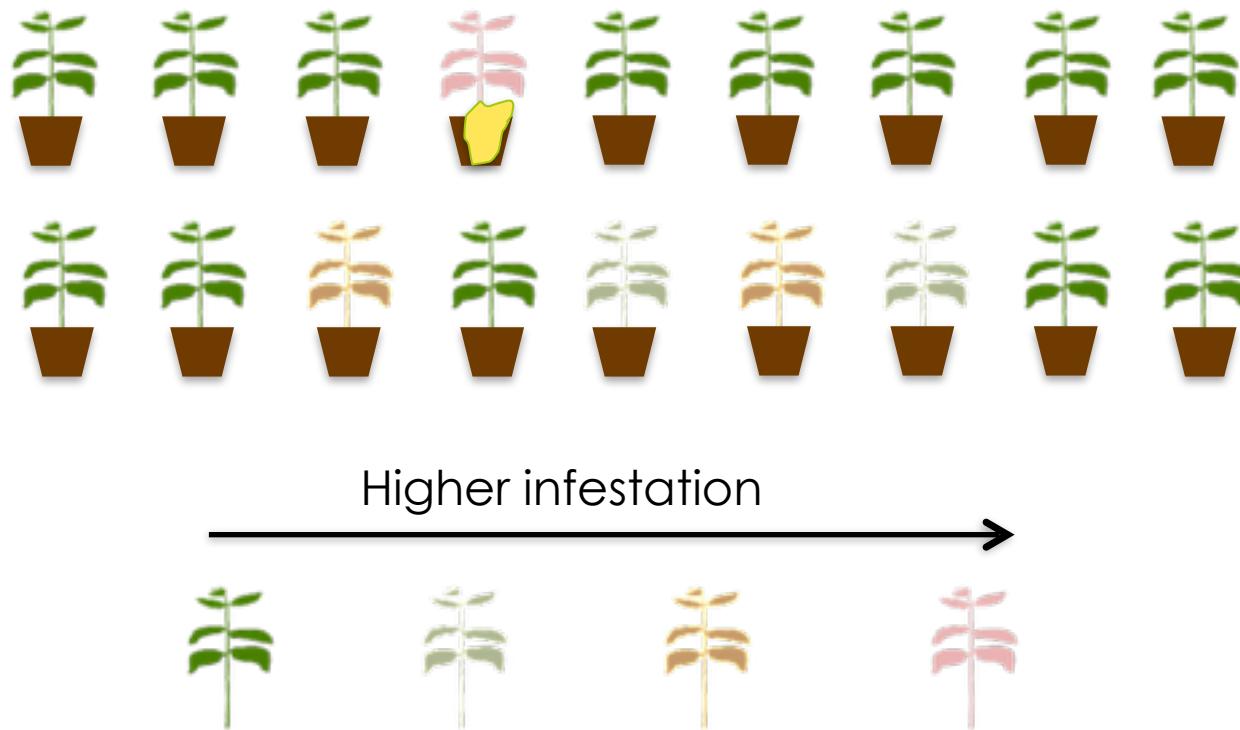


$$1/6 = 17\%$$

$$4/20 = 20\%$$

# Monitoring/Scouting

PM Units	Presence-absence	<b>Indicator plants</b>	Traps/Lures	Control efficacy
----------	------------------	-------------------------	-------------	------------------



# Monitoring/Scouting

**PM Units**

**Presence-absence**

**Indicator plants**

**Traps/Lures**

**Control efficacy**



# Monitoring/Scouting

PM Units

Presence-absence

Indicator plants

**Traps/Lures**

Control efficacy



# Monitoring/Scouting

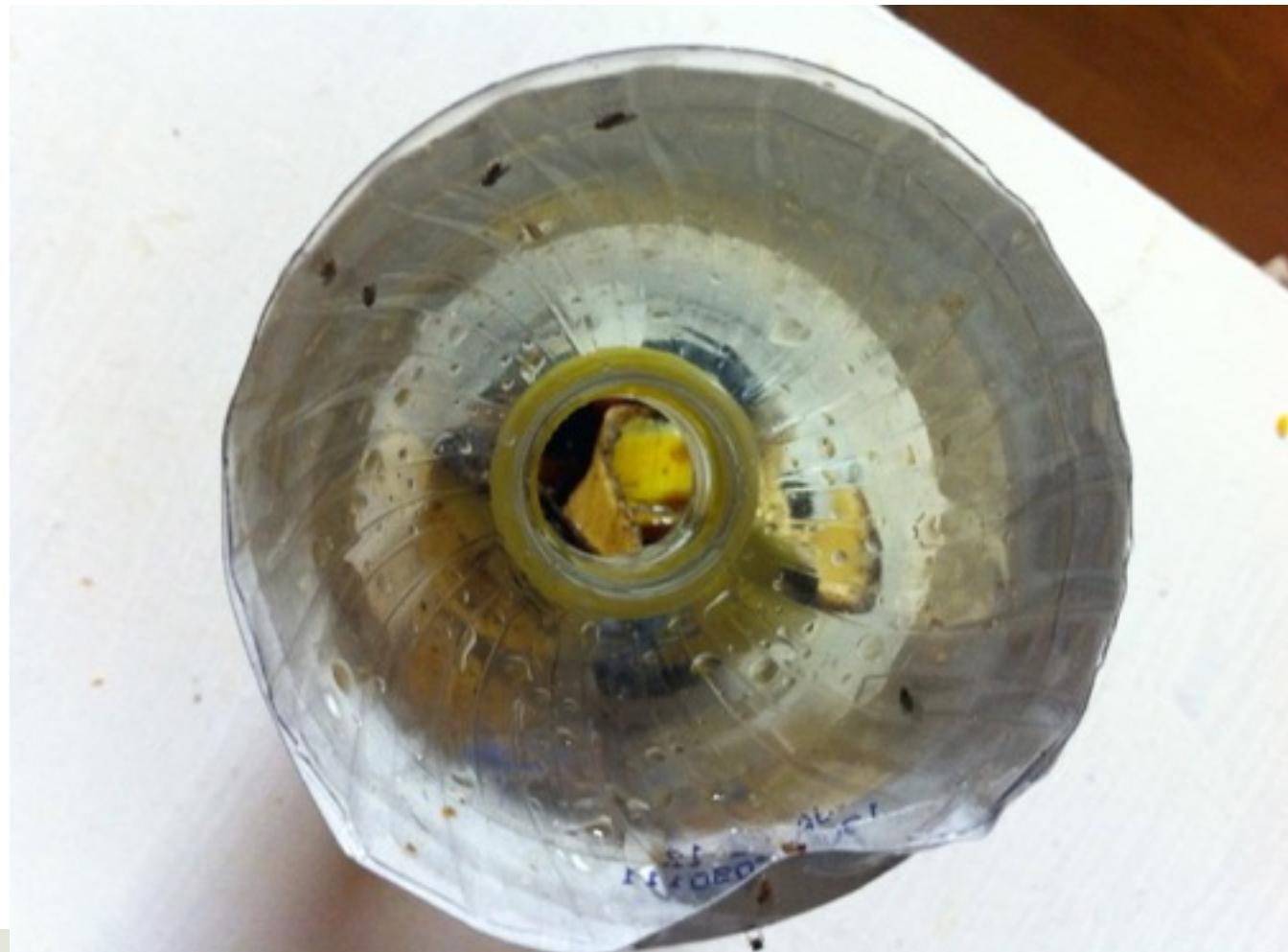
**PM Units**

**Presence-absence**

**Indicator plants**

**Traps/Lures**

**Control efficacy**



# Monitoring/Scouting

PM Units

Presence-absence

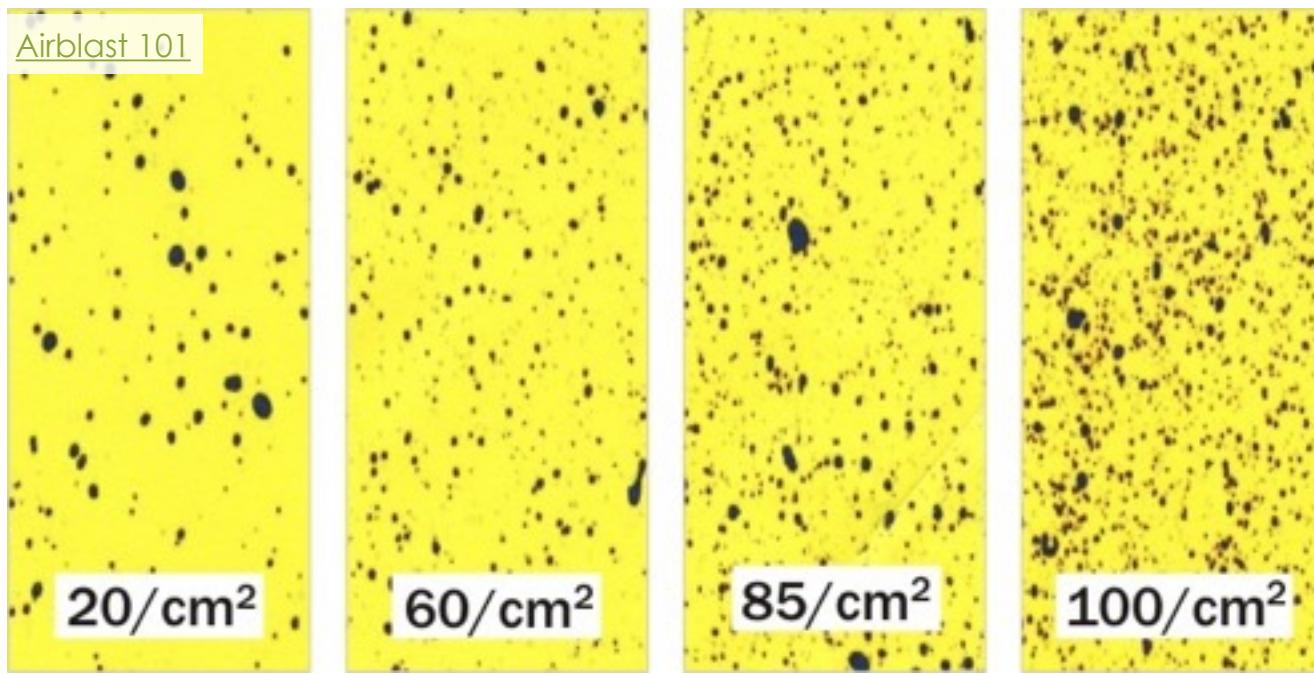
Indicator plants

**Traps/Lures**

Control efficacy

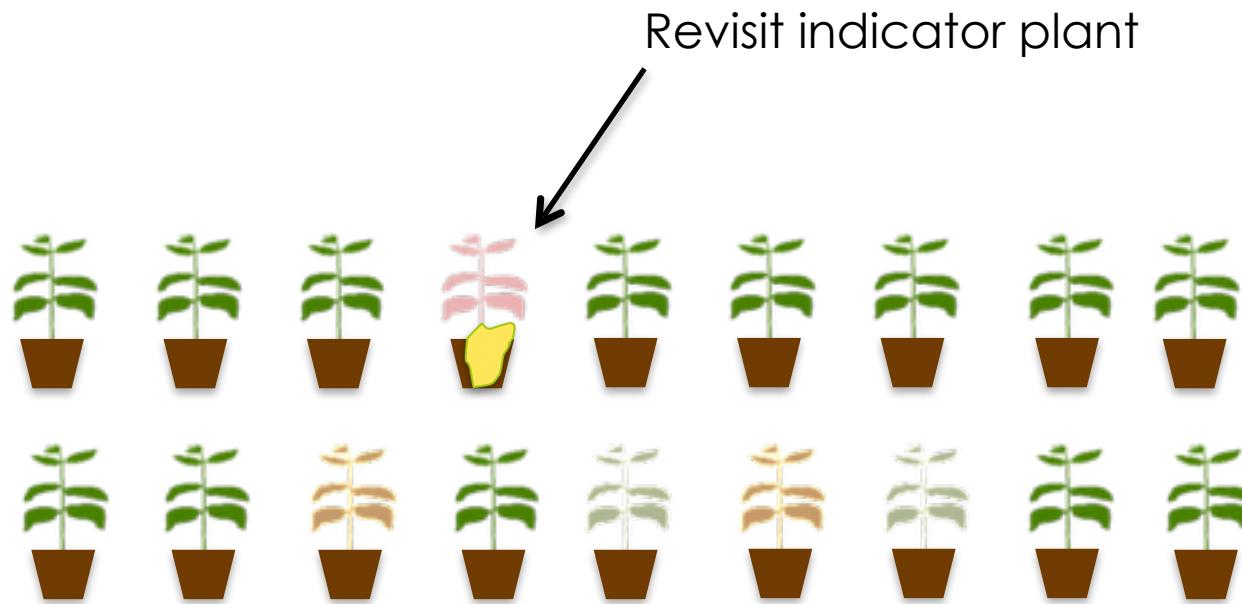


# Monitoring/Scouting



# Monitoring/Scouting

PM Units	Presence-absence	Indicator plants	Traps/Lures	Control efficacy
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Defoliating

Skeletonization

Sucking

Boring

Mining

Gall

# Types of Damage

Defoliating

Skeletonization

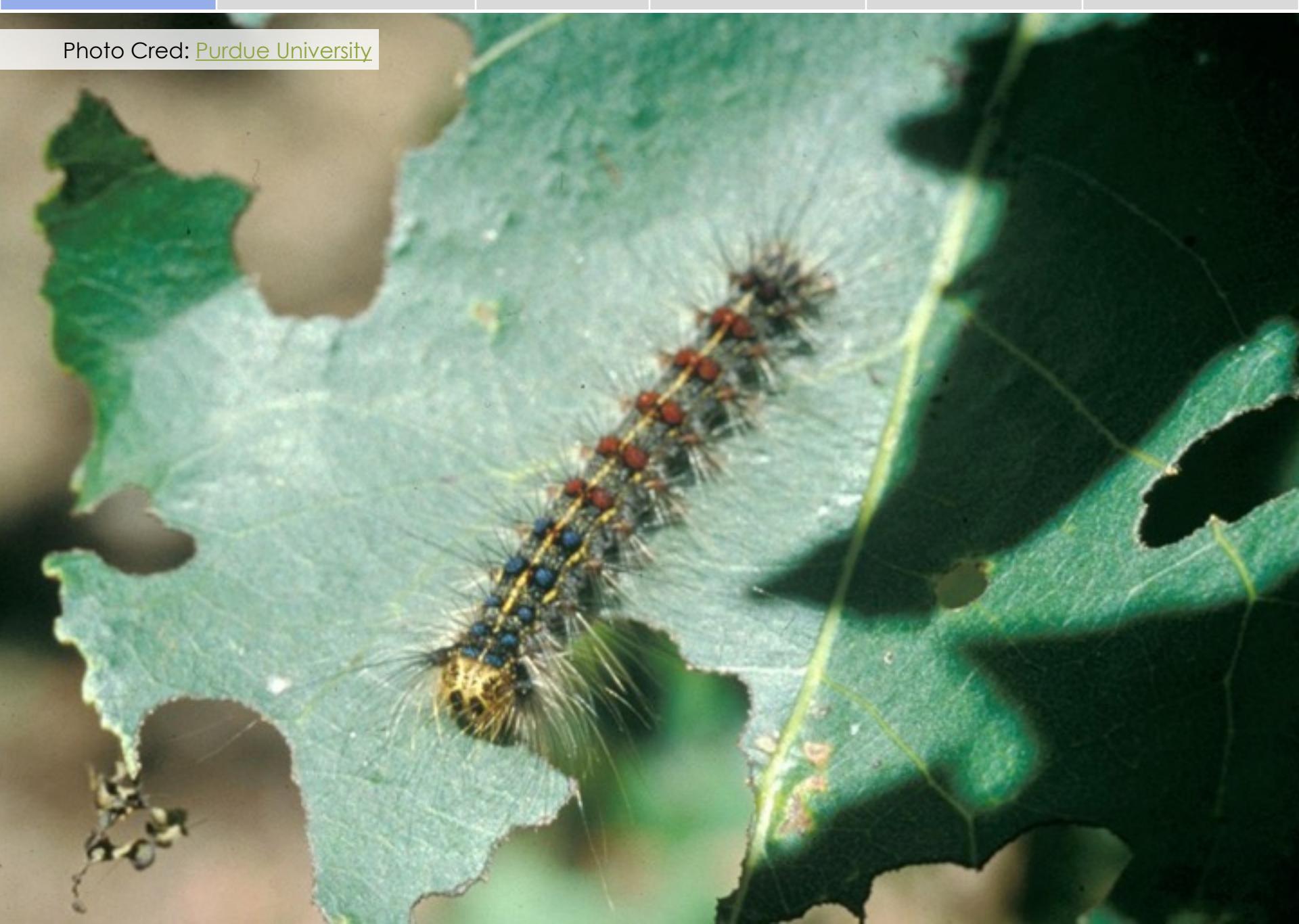
Sucking

Boring

Mining

Gall

Photo Cred: [Purdue University](#)



Defoliating

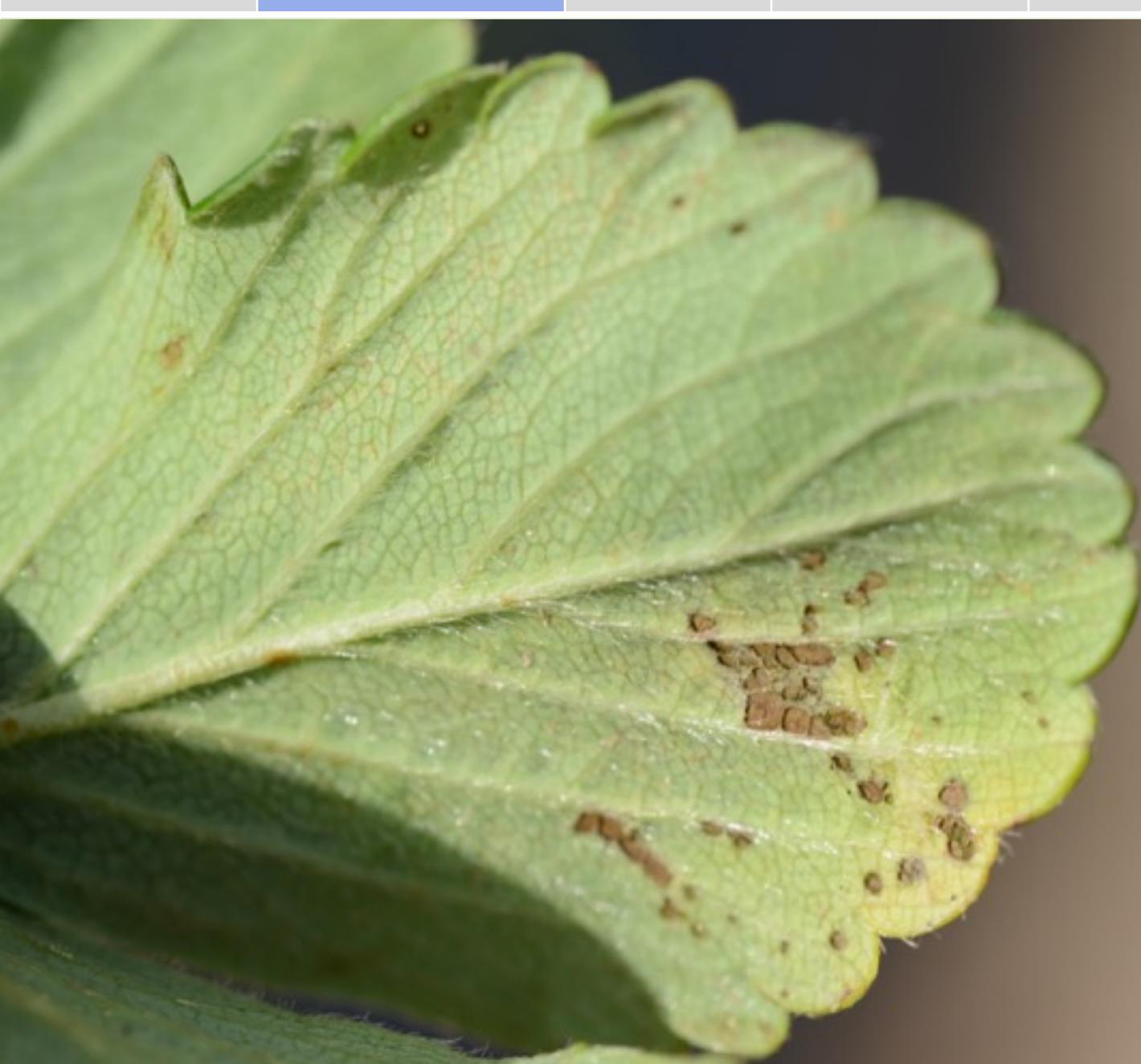
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Boring

Mining

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Defoliating

Skeletonization

Sucking

Boring

Mining

Gall



Defoliating

Skeletonization

Sucking

Boring

Mining

Gall

Photo Cred: [Utah State University](#)



Defoliating

Skeletonization

Sucking

Boring

Mining

Gall



Defoliating

Skeletonization

Sucking

Boring

Mining

Gall



Defoliating

Skeletonization

Sucking

Boring

Mining

Gall

Photo Cred: Chuck Bargeron, University of Georgia, Bugwood.org



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Defoliating

Skeletonization

Sucking

Boring

Mining

Gall

Photo Cred: [New Hampshire Garden Solutions](#)



Defoliating

Skeletonization

Sucking

Boring

Mining

Gall



Photo Cred: [Wikimedia](#)

Defoliating

Skeletonization

Sucking

Boring

Mining

Gall



UGA1121014

# What are they?

Lepidopterans

Hemipterans

Diptera

Neuroptera

Trombidiformes

Psocoptera

Coleopterans

Hymenoptera

Orthoptera

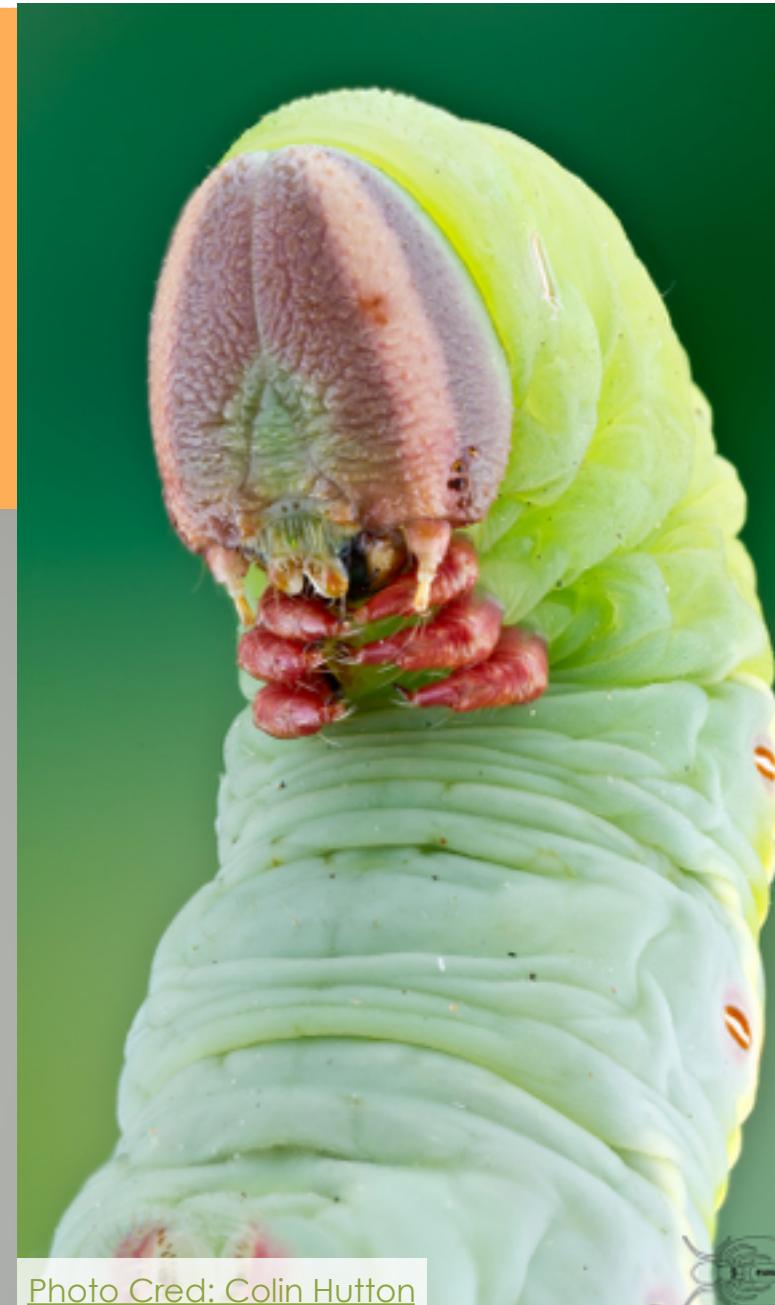
Thysanoptera

Tylenchida

# Lepidoptera

AKA: caterpillars, moths & butterflies

- Caterpillars of moths and butterflies
- **Defoliators**, leaf rollers, leaf miners, tent caterpillars, cutworms



[Photo Cred: Colin Hutton](#)



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Photo Cred: [John R. Meyer](#)

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Photo Cred: [University of Nebraska](#)



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Photo Cred: Allen Knutson & Mike Merchant

# Lepidoptera

- Pollinators
- Feed on invasive weeds



## Coleoptera AKA Beetles

Beetles

Scarabs

Grubs

Wireworms

Weevils



Photo Cred: [Illinois extension](#)

## Coleoptera AKA Beetles

Beetles

Scarabs

Grubs

Wireworms

Weevils



Photo Cred: Pat Porter

## Coleoptera AKA Beetles

Beetles

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Photo Cred: [livingwithinsect.wordpress.com](http://livingwithinsect.wordpress.com)

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Photo Cred: Allen Knutson & Mike Merchant

## Coleoptera AKA Beetles

Wireworms

Lady beetles

Ground Beetles



## Coleoptera AKA Beetles

Wireworms

Lady beetles

Ground Beetles

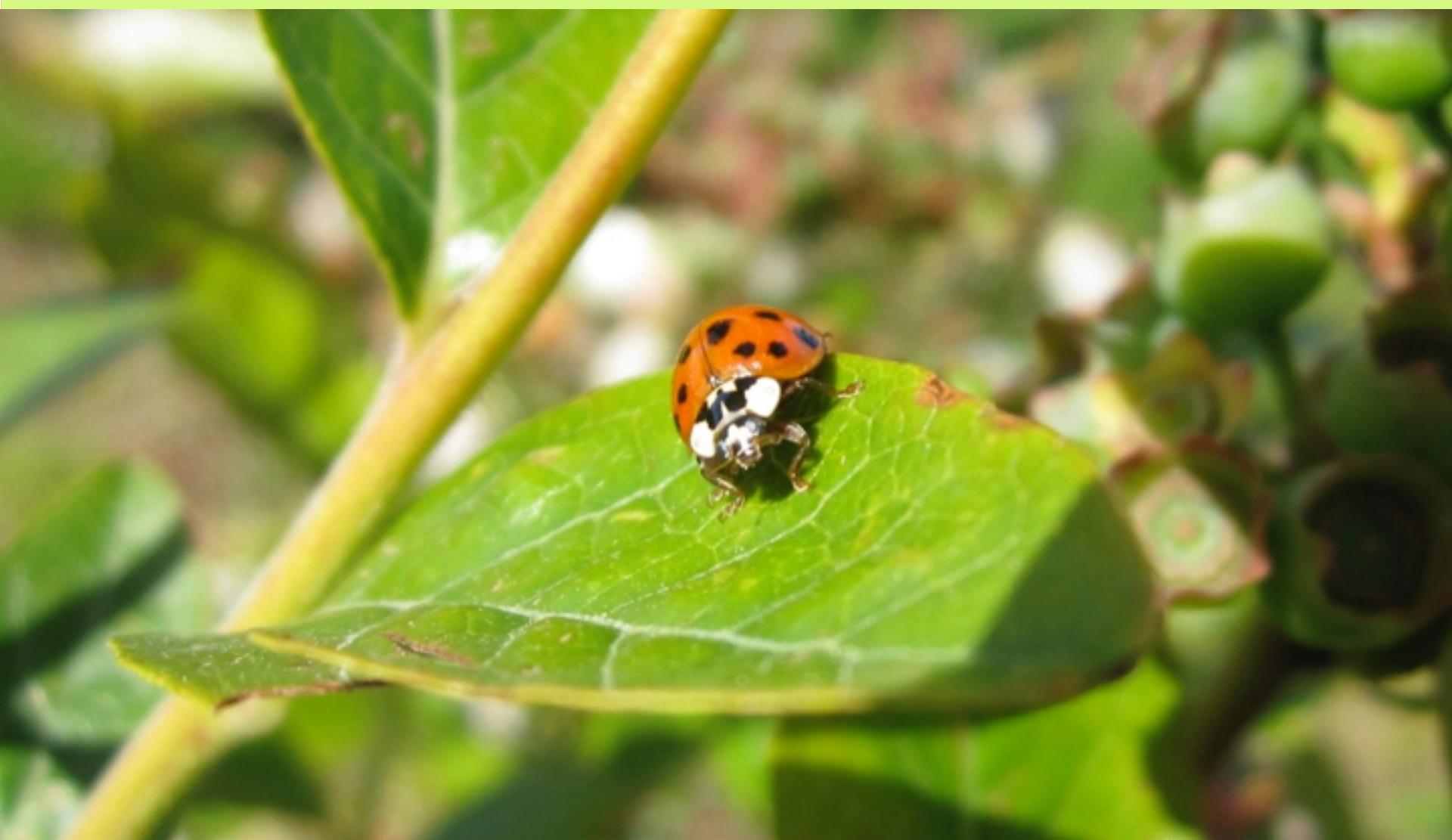


## **Coleoptera** AKA Beetles

Wireworms

Lady beetles

Ground Beetles



## Coleoptera AKA Beetles

Wireworms

Lady beetles

Ground Beetles



## Coleoptera AKA Beetles

Wireworms      Lady beetles      Ground Beetles



## Hemiptera AKA plant sucking insects

Aphids

Mealy bugs

Chinch bug

Lygus bug

Brown Marmorated SB

Cicada

Scale

Whiteflies

Plant/Leaf bug





Photo Cred: [Steve Wilson](#)

Photo Cred: [Paul Bertner](#)



Photo Cred: [Charles Chien](#)



# What to look for?



[Leps](#)[Coleo](#)[\*\*Hemi\*\*](#)[Hym](#)[Dip](#)[Orth](#)[Neur](#)[Thys](#)[Trom](#)[Tylen](#)[Psoco](#)

## Hemiptera



## Hemiptera AKA plant sucking insects

Aphids

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<http://davesgarden.com/members/palmbob/>  
Unauthorized Use Prohibited

## Hemiptera

Photo Cred: Jeffrey Lotz



UGA5194068

## Hemiptera AKA plant sucking insects

Aphids

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Lygus bug

Brown Marmorated SB

Cicada

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Whiteflies

Plant/Leaf bug



Photo Cred: USDA

## Hemiptera AKA plant sucking insects

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Brown Marmorated SB

Cicada

Scale

Whiteflies

Plant/Leaf bug



Photo Cred: Someone at Agrilife

## Hemiptera AKA plant sucking insects

Aphids

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## Hemiptera AKA plant sucking insects

Aphids

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Scale

Whiteflies

Plant/Leaf bug



## Hymenoptera AKA bees, wasps, and ants

Red/Black imported fire ant

Sawflies

Horntails

Texas leafcutter ant

Gall wasps



Photo Cred: Tami New

## Hymenoptera AKA bees, wasps, and ants

Red/Black imported fire ant

Sawflies

Horntails

Texas leafcutter ant

Gall wasps







## Diptera AKA flies

Gall midges

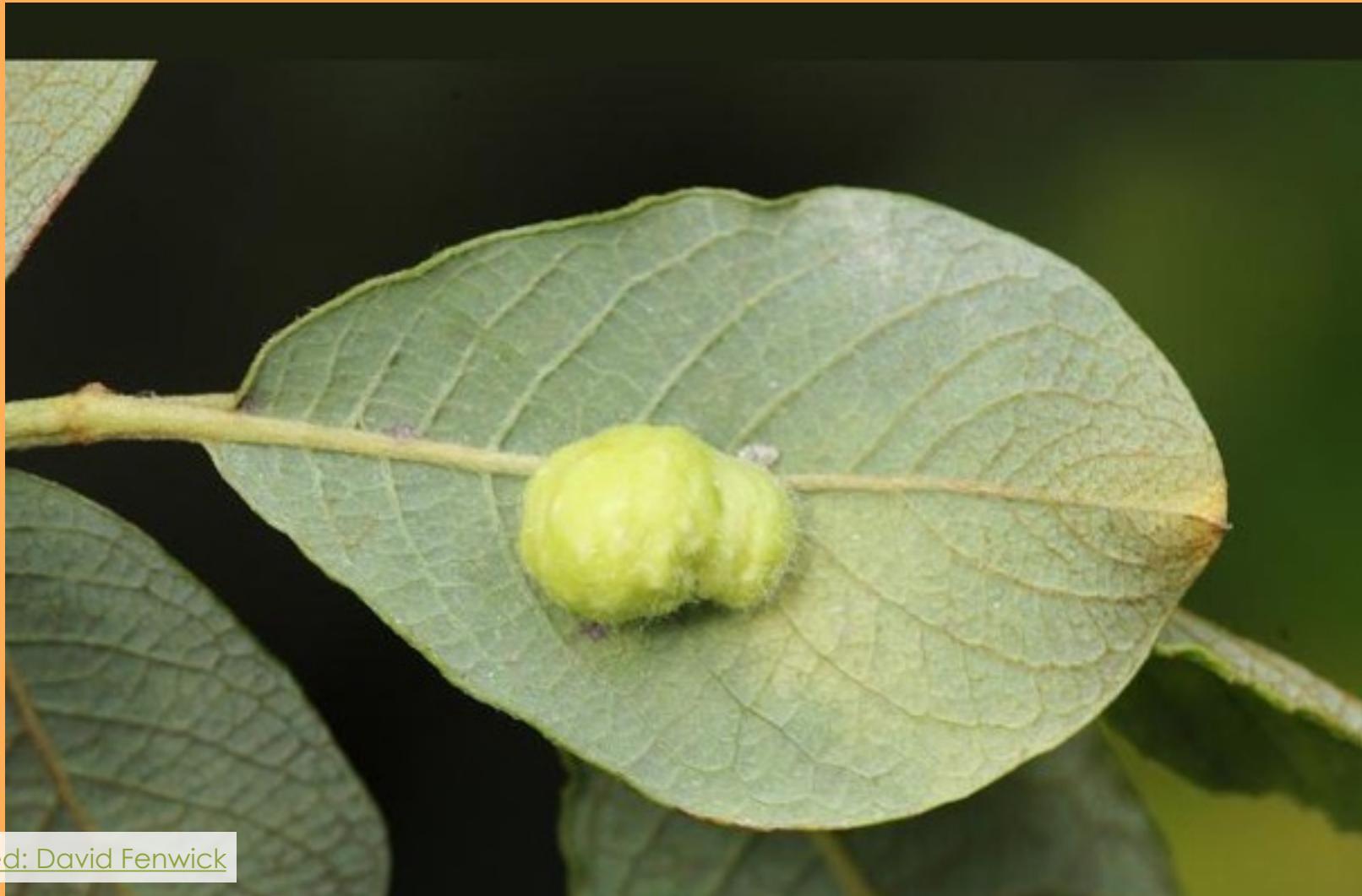
Fungus gnats

Fruit flies

Leaf miners

Stem/seed borers

Root/seed maggots



## Diptera AKA flies

Parasitoids

Predators



G106-34

Photo Cred: [Agrilife](#)

## Diptera AKA flies

Parasitoids

Predators



**Orthoptera** AKA Grasshoppers Locusts Katydid Crickets



Photo Cred: Mindy Brown

**Orthoptera** AKA Grasshoppers      Locusts      Katydid      Crickets



© Emanuele Biggi

[Photo Cred: Emanuele Biggi](#)

**Orthoptera** AKA Grasshoppers Locusts Katydid Crickets



## Neuroptera

### Green Lacewing



Photo Cred: [Juli Lawrence](#)

## Neuroptera

### Green Lacewing

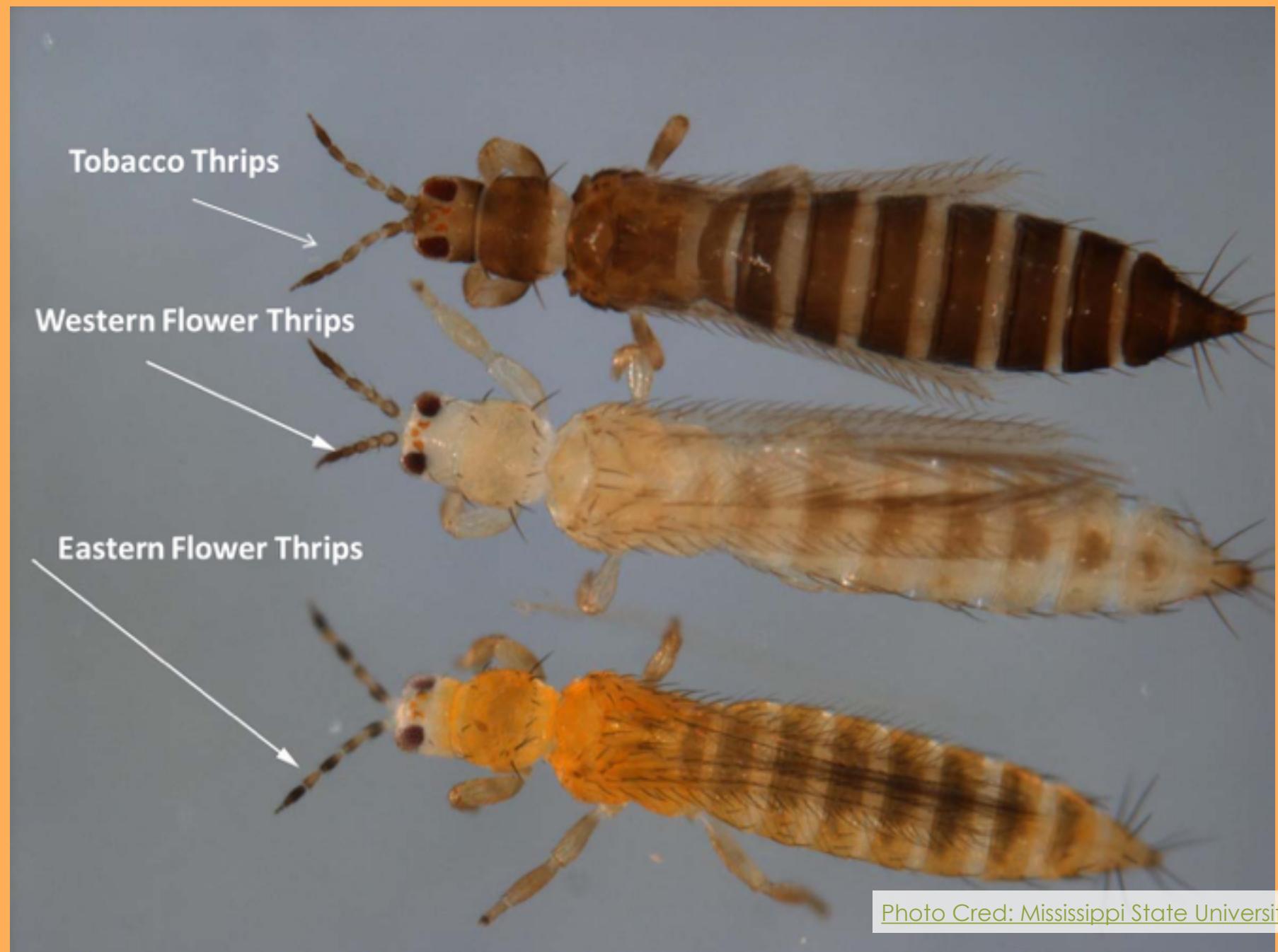


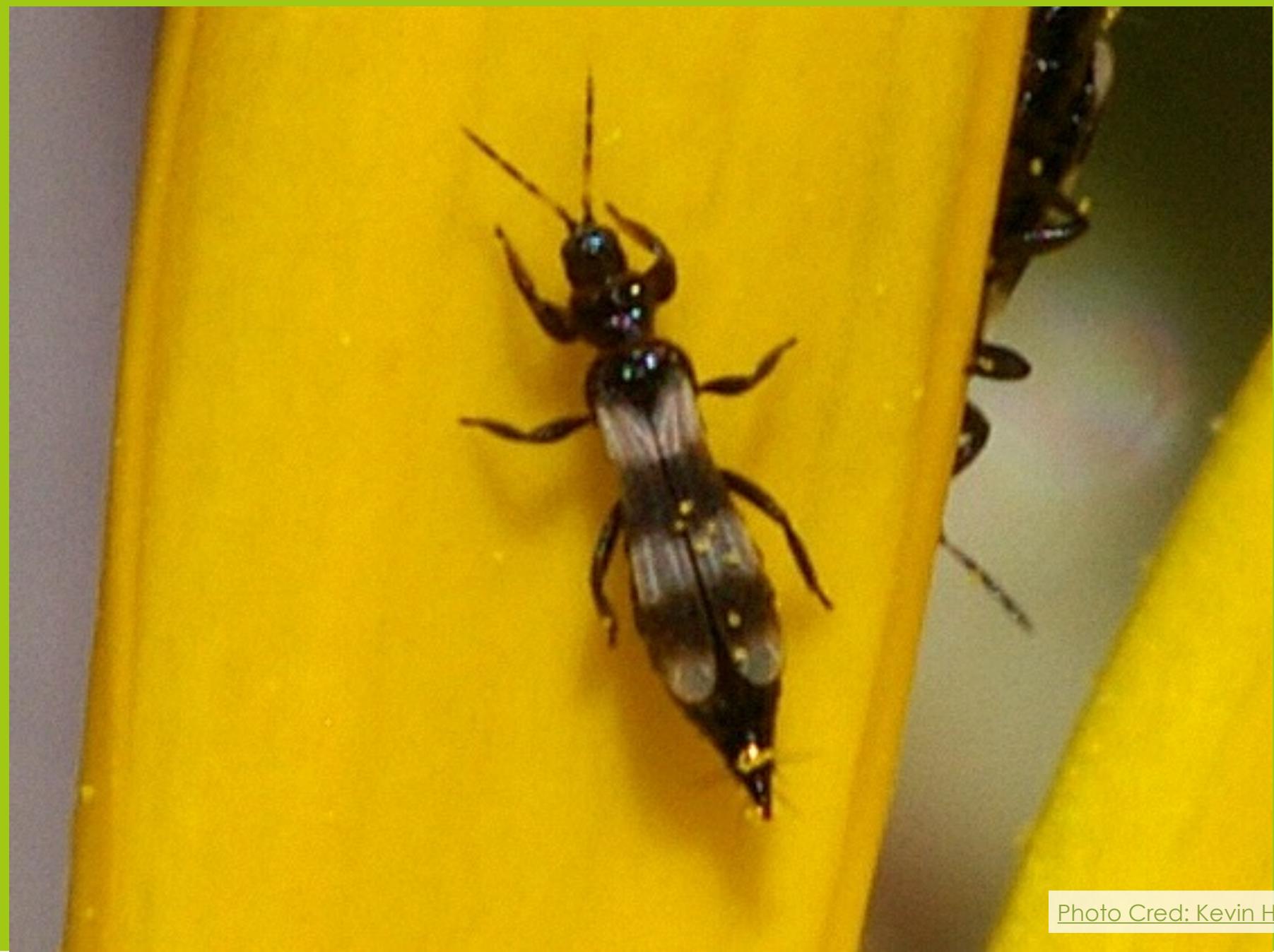
Photo Cred: Peter J. Bryant

## Thysanoptera Thrips



[Photo Cred: Yard Farm](#)





## Trombidiformes

Spider mites

Bedbugs

Gall mites



## Trombidiformes

Spider mites

Bedbugs

Gall mites



Photo Cred: Allen Knutson & Mike Merchant



Photo Cred: ForestryImages.org 5

## Trombidiformes

Spider mites

Bedbugs

Gall mites



Photo Cred: Gilles San Martin

**Trombidiformes**

Spider mites

Bedbugs

Gall mites



Photo Cred: Robin Rosetta

## Trombidiformes

Spider mites

Bedbugs

Gall mites



[Photo Cred: Robin Rosetta](#)

**Trombidiformes**

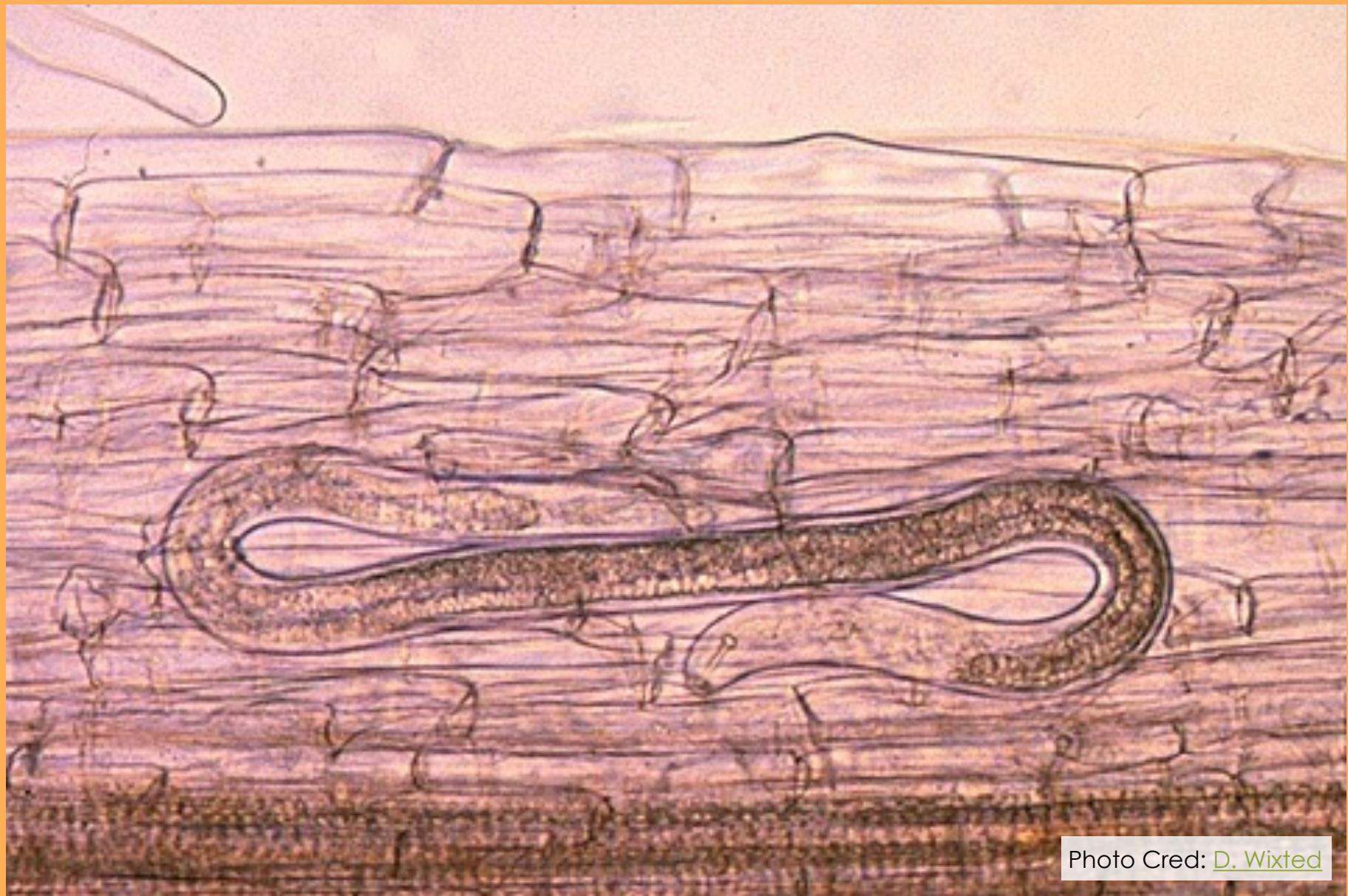
Predatory mites



Photo Cred: IITA

**Tylenchida**

Plant parasites

Photo Cred: [D. Wixted](#)

## Tylenchida

Insect parasites



Photo Cred: Scott Johnson

## Psocoptera

“Bark lice”



# What are they?

Lepidopterans

Hemipterans

Diptera

Neuroptera

Trombidiformes

Psocoptera

Coleopterans

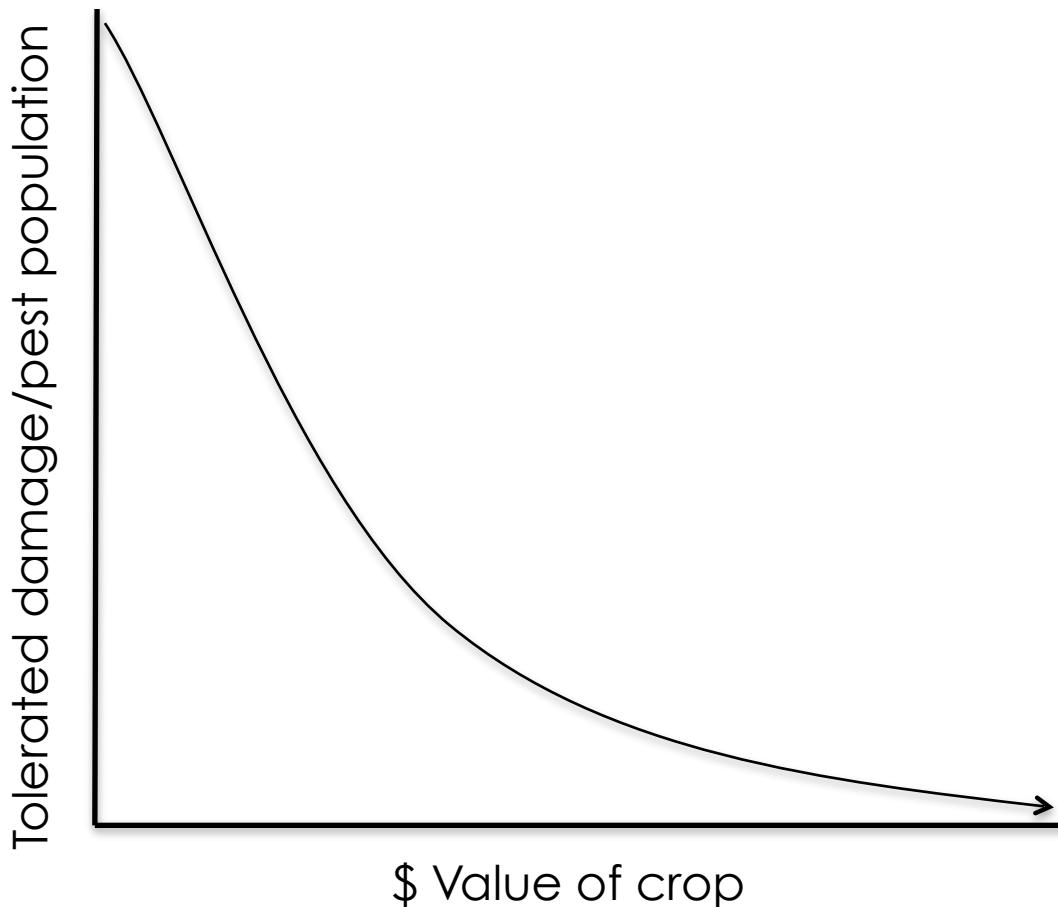
Hymenoptera

Orthoptera

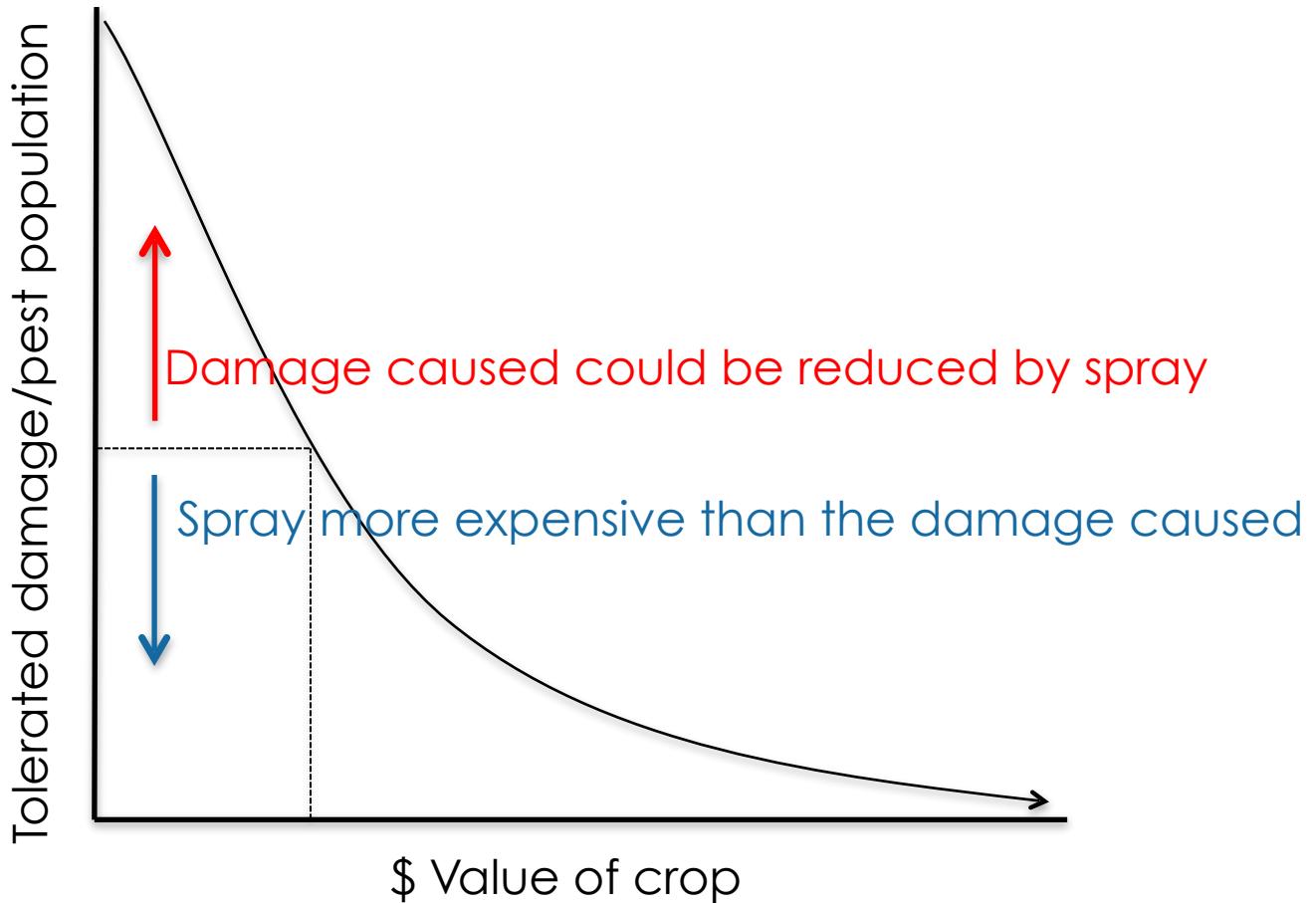
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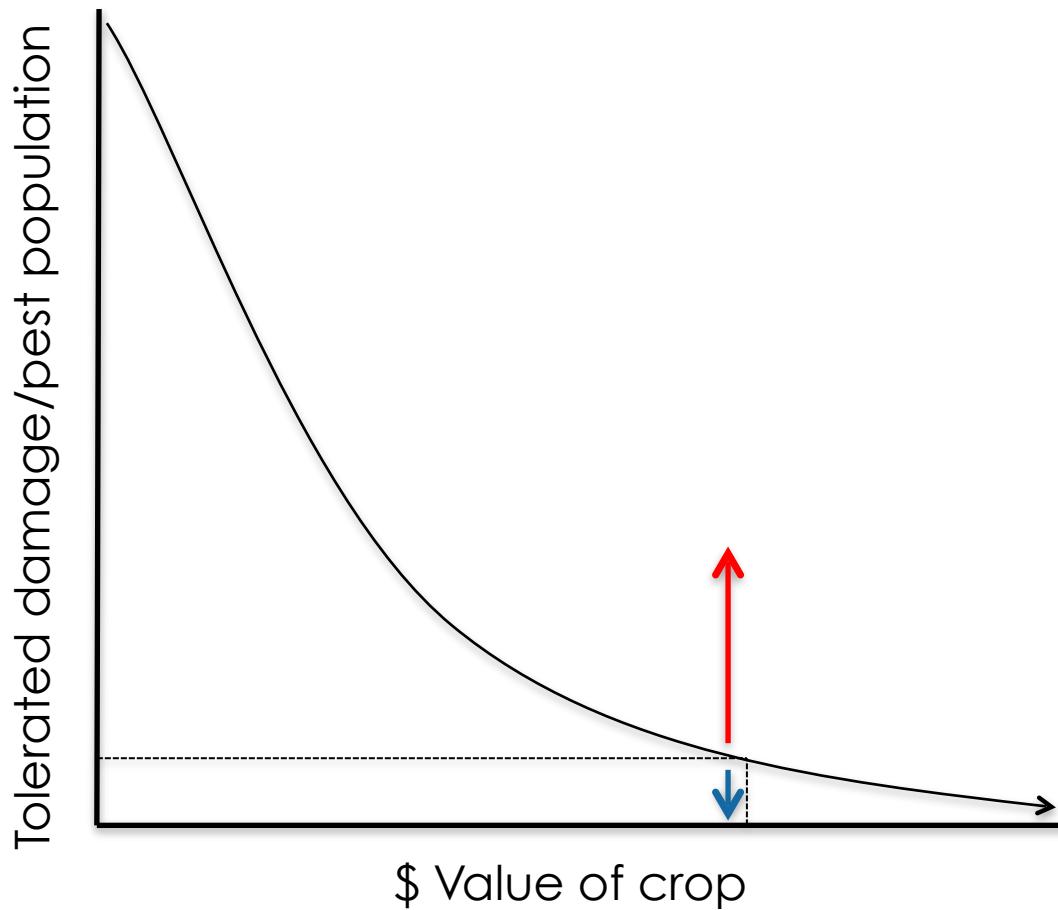
# Economic Thresholds



# Economic Thresholds



# Economic Thresholds





# Cultural/Sanitation

- ❑ Keep a clean environment
- ❑ Remove weeds/alternative hosts
- ❑ Reduce unnecessary moisture
- ❑ Companion planting
- ❑ Banker Plants
- ❑ Trap Plants
- ❑ Crop Rotation
- ❑ Nutrient management
- ❑ Plant defense



# Physical/Mechanical

- ❑ Hand weed
- ❑ Hand remove insect pests
- ❑ High pressure water spray
- ❑ Exclusion nets and barriers
- ❑ Pitfall traps
- ❑ Yellow sticky cards

# Cultural & Mechanical Control

Sanitation



# Cultural & Mechanical Control

## Companion planting

**Efficacy of three natural substances against onion aphid (*Aphis pomi*) De**

**Geer, Al Marigold (*Tagetes erecta* L.) as an attractive crop  
Effect o to natural enemies in onion fields**

**patula n coloniza es**

**Beata Janko Cravo-de-defunto (*Tagetes erecta* L.) como cultura**

**atrativa para inimigos naturais em cultivo de cebola**

<sup>1</sup> Department of  
Kraków, Poland

1-425

<sup>2</sup> Department of  
29 Listopada  
in Krakow,

**Luís Cláudio Paterno Silveira<sup>I</sup>; Evoneo Berti Filho<sup>II, \*</sup>; Leonardo Santa  
Rosa Pierre<sup>II</sup>; Fernanda Salles Cunha Peres<sup>III</sup>; Julio Neil Cassa  
Louzada<sup>IV</sup>**

in Krakow,

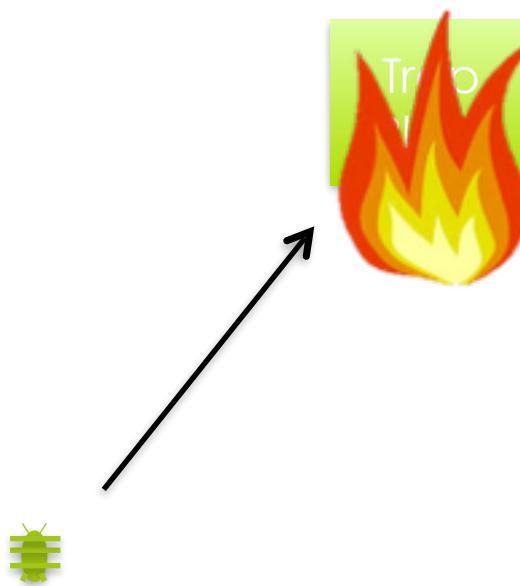
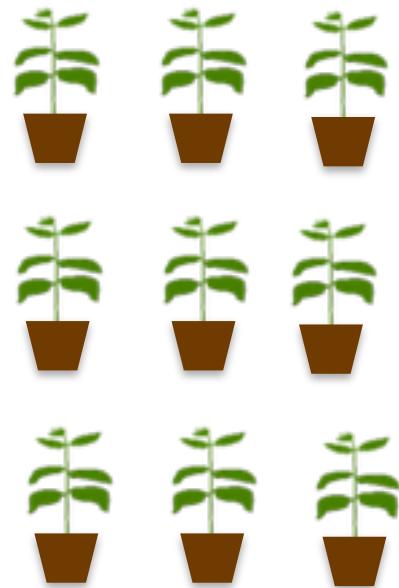
39%±12% (ci

±2)% of

the substances tested was found at highest concentration.

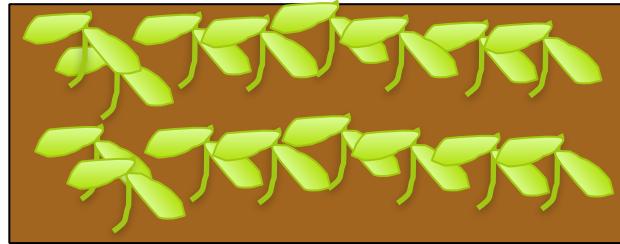
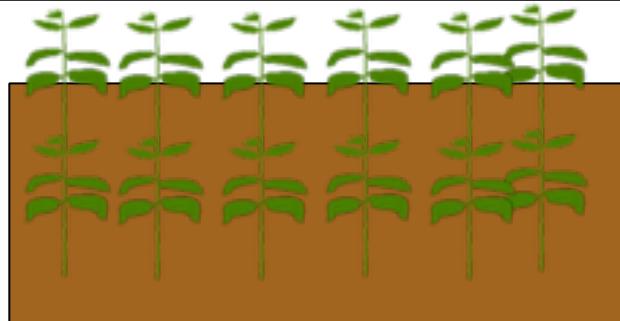
# Cultural & Mechanical Control

## Trap Plants



# Cultural & Mechanical Control

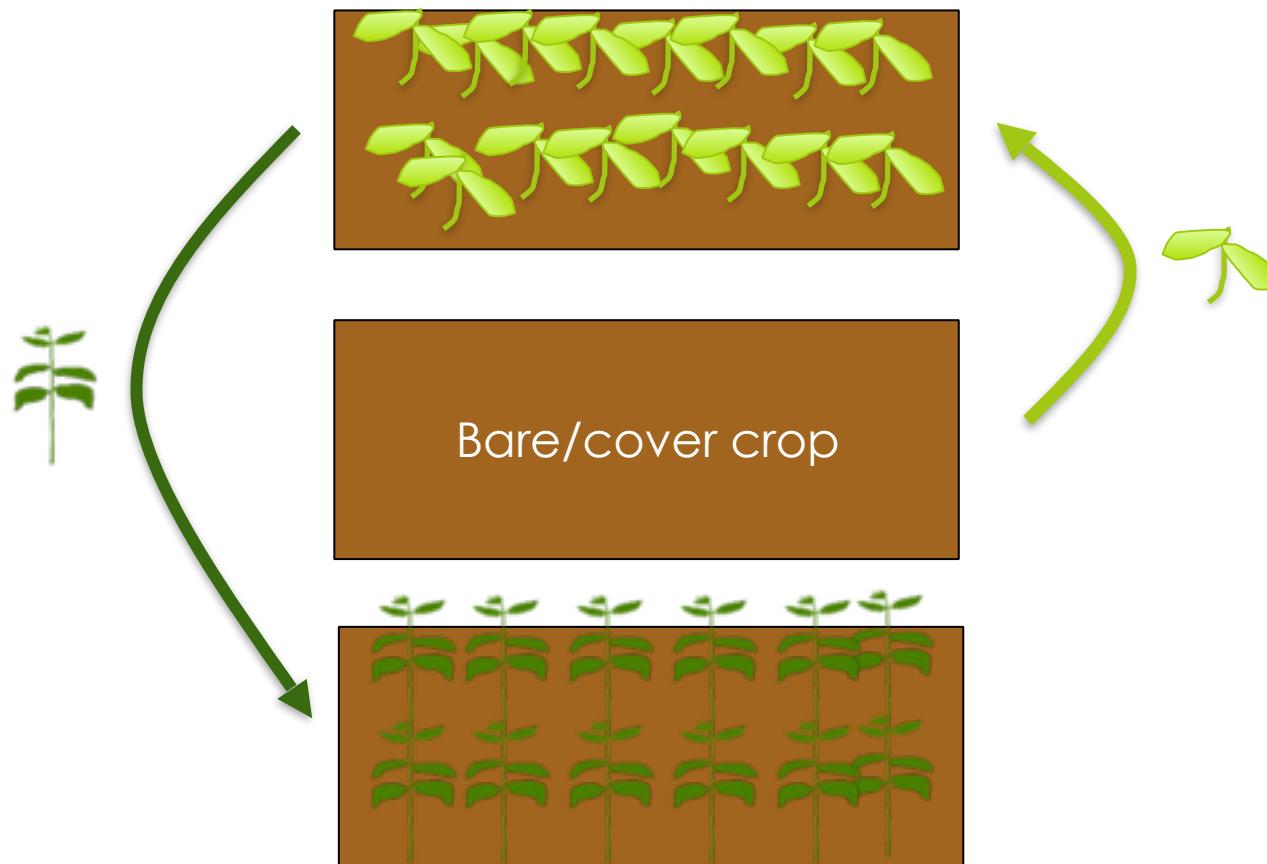
Crop rotation



Bare/cover crop

# Cultural & Mechanical Control

Crop rotation



# Cultural & Mechanical Control

Mechanical removal



# Cultural & Mechanical Control

## Exclusion





# Biological

- ❑ Conservation
- ❑ Classical
- ❑ Augmentation
- ❑ Rear/purchase and release
- ❑ Insect pathogens (i.e. *Bt*)
- ❑ Pheromone traps/mating disruption
- ❑ Sterile Insect Release

# Biological Control

## Conservation, Classical and Augmentation

Conservation	Classical	Augmentation
<ul style="list-style-type: none"><li>• <b>Conserve natural enemies</b></li><li>• <b>Reduce sprays</b></li><li>• <b>Better timed sprays</b></li><li>• <b>Keep natural enemy habitats and alternative hosts</b></li></ul>	<ul style="list-style-type: none"><li>• <b>Introduce an 'alien' predator for control of an invasive pest</b></li><li>• <b>Establish predator-prey interaction</b></li></ul>	<ul style="list-style-type: none"><li>• <b>Supplemental release of natural enemies</b></li><li>• <b>Inundative vs. inoculative</b></li></ul>

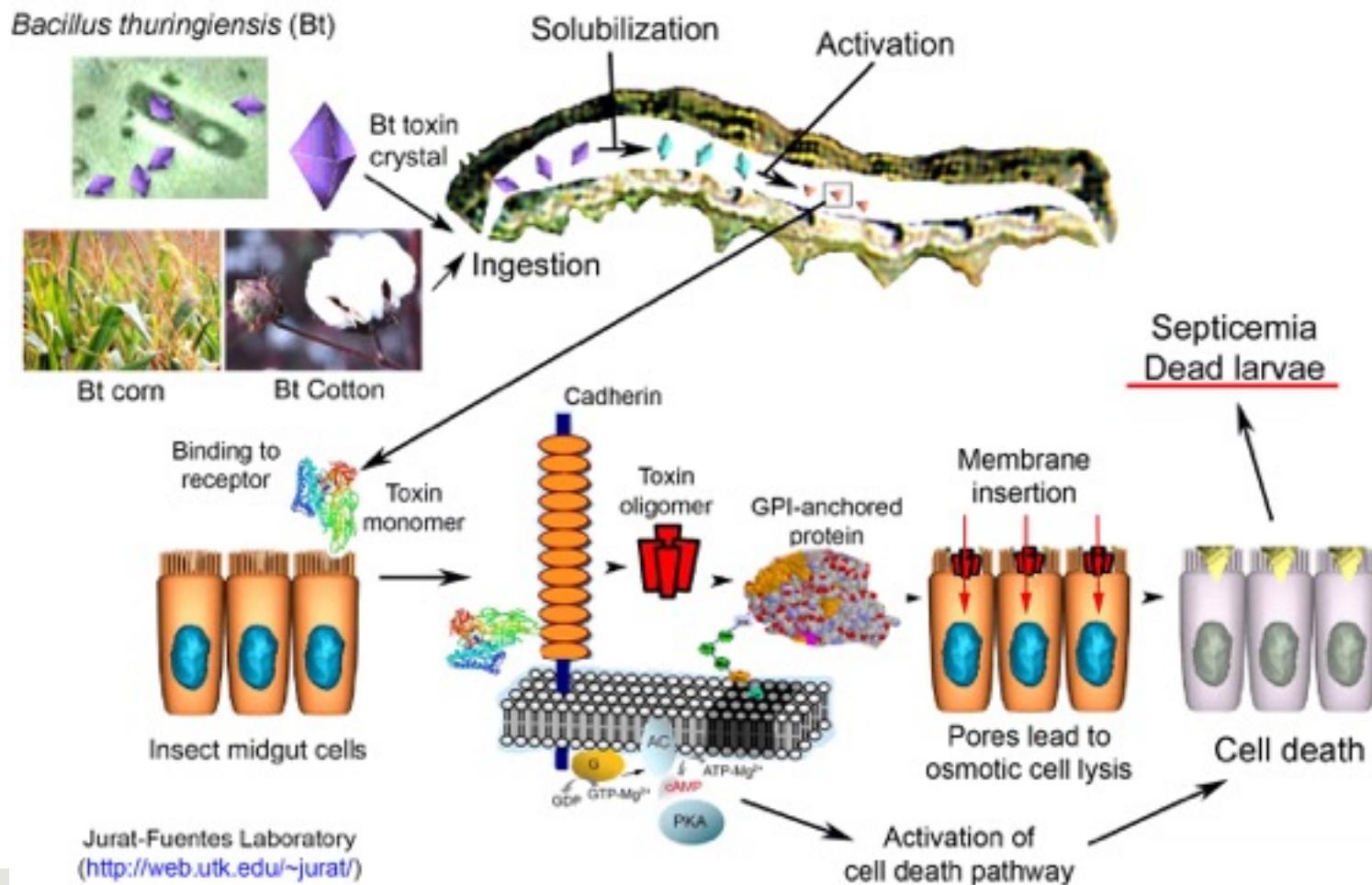
# Biological Control

Release of natural enemies



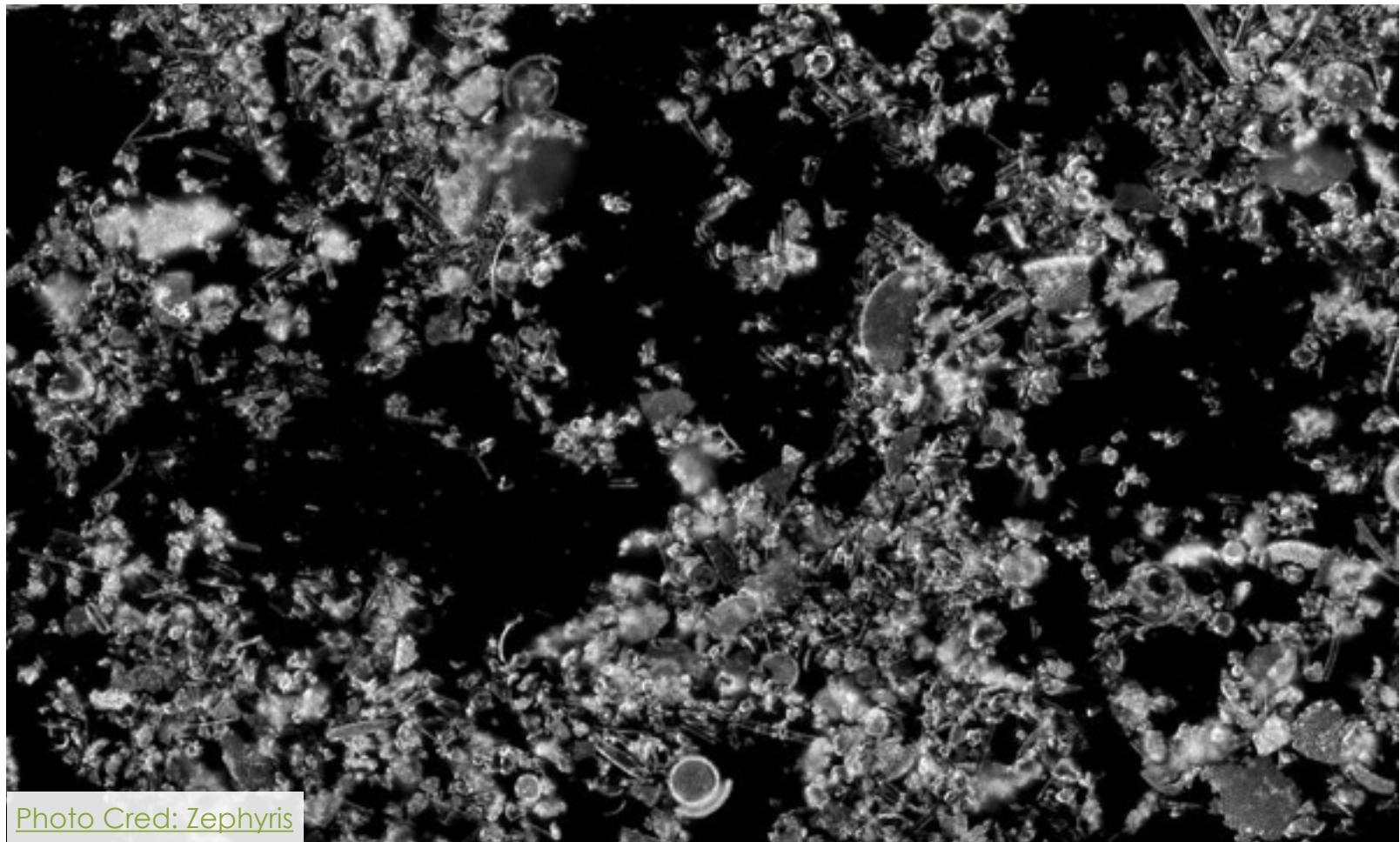
# Biological Control

## Bt spray/GMO Bt



# Biological Control

Oils, soaps, and diatomaceous earth



[Photo Cred: Zephyris](#)

# Biological Control

## Vendors of North America

Six-Legged Aggie

HOME NEWS RESOURCES ABOUT CONTACT 

### Biological Control

Vendors of Beneficial Organisms in North America | [University of Kentucky](#)

### Software Tools

#### Free Software [ReadCube](#) | Application for researching, downloading, organizing, and marking up PDFs. Can

connect to Word to generate citations. Premium features include syncing papers across all devices.

[Mendeley](#) | Similar to ReadCube in function, Mendeley is for organizing research papers, PDFs and generating organized references tables. Allows for creation of an online profile, so you can take your paper titles/information with you on any device or computer away from the office. Allows for free syncing of paper titles across devices.

[Open Office](#) | Alternative solution to the Microsoft Office suite. Open-source.

[VirtualBox](#) | Virtual Machine software for running other operating systems within your current OS, similar to [Parallels](#) and [vmware](#). Great for those few applications that don't run on your current operating system. Disclaimer: requires a copy of the operating system which you are wanting to install.

[WineBottler](#) | Can turn some .exe (PC executable files) into .app files to run on an OSX (apple)

# Biological Control

## Biological control agents



Parasitic wasps (aphid)



Predatory mite  
(mites)



Parasitic wasp  
(whitefly)

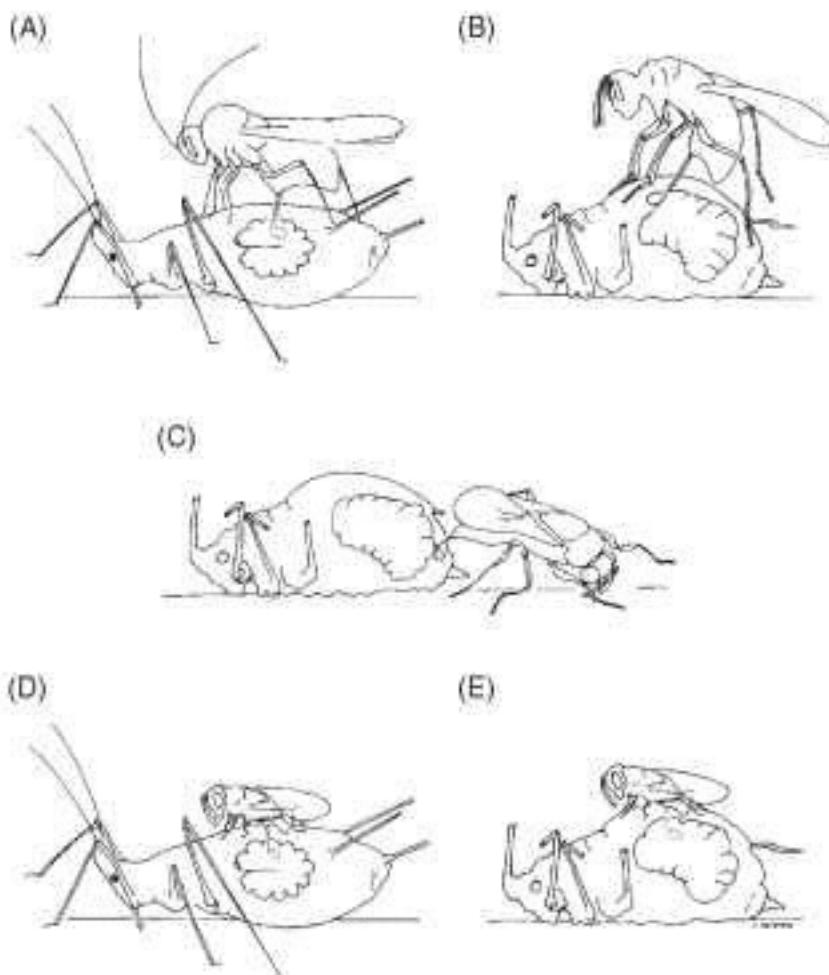


Predatory mite (thrips)



Predator (aphids/other)

# Hyperparasitism



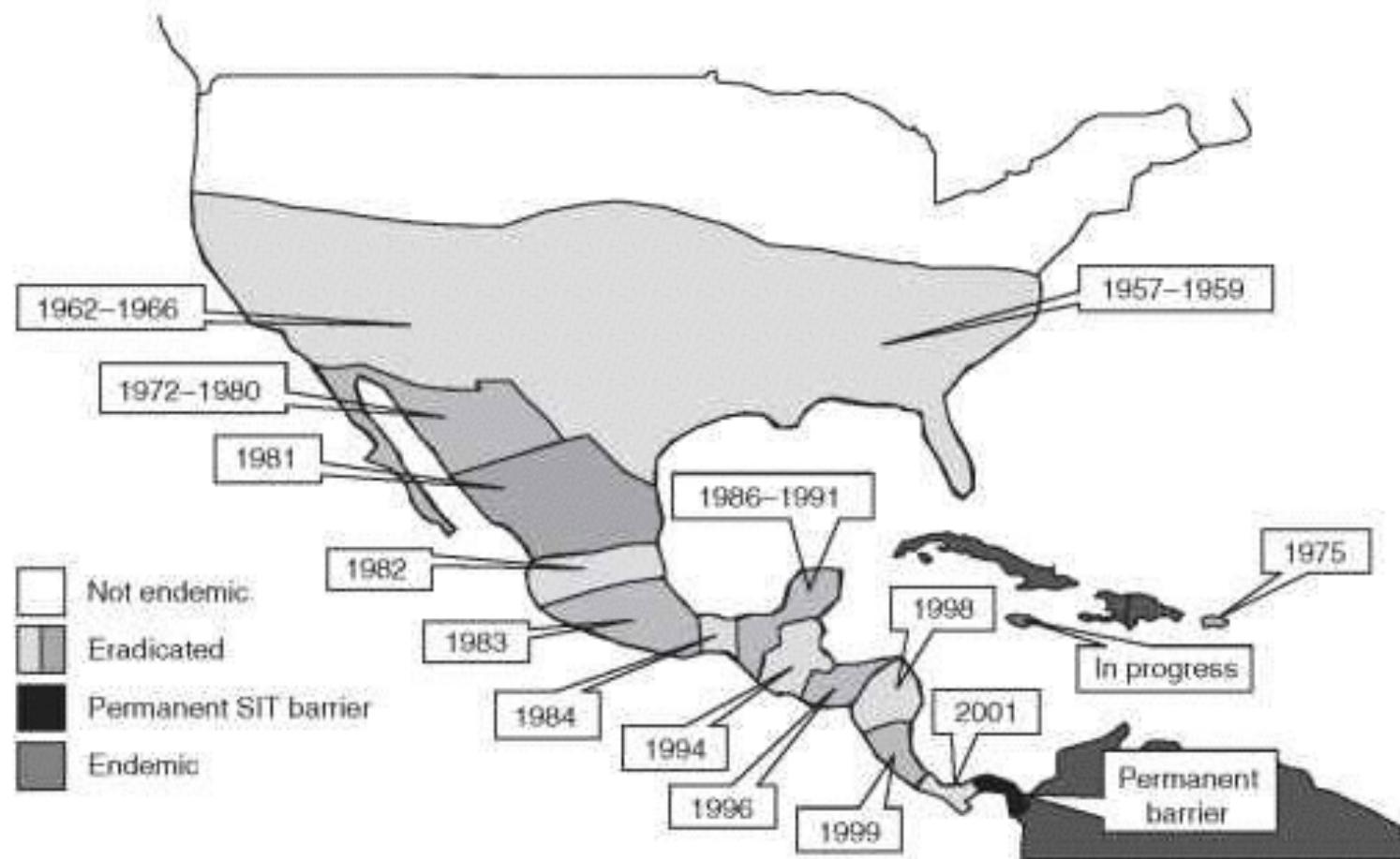
Sullivan 1988

# Sterile Insect Release



Photo: John Meyer

# Sterile Insect Release



# Pesticide

- Spot spray/treatment
- Chemical rotation
- Selective
- Non-persistence
- Timing
- Monitor spray coverage

# Chemical Control

## Role of chemical control in IPM

Yes	No
<ul style="list-style-type: none"><li>• <b>Use judiciously based on monitoring data</b></li><li>• <b>Time sprays to prevent harm to beneficials</b></li><li>• <b>Time sprays for effectiveness</b></li><li>• <b>Use low persistence high specificity pesticides</b></li><li>• <b>Target infestation area only if infestation is localized</b></li><li>• <b>Rotate chemicals to prevent resistance</b></li></ul>	<ul style="list-style-type: none"><li>• <b>Spray based on calendar spray schedule</b></li><li>• <b>Spray when flowers are in bloom</b></li><li>• <b>Spray them when you see them</b></li><li>• <b>Spray with the most effective pesticide over and over again</b></li><li>• <b>Feed your plants pesticides for breakfast, lunch and dinner (and dessert, if they deserve it).</b></li></ul>

# Insecticide Label

- Label is a legal document.
- Read and follow directions to be safe, effective and legal.



# Safe and Effective Use

- Active ingredient
- Amount to use
- Pre-harvest interval



Slide information courtesy of Dr. Allen Knutson and Dr. Mike Merchant

# Insecticide Label

- Can only apply to sites listed on label
- Lists pests for which product is effective
- Lists cautions, storage and disposal restrictions
- EPA Registration

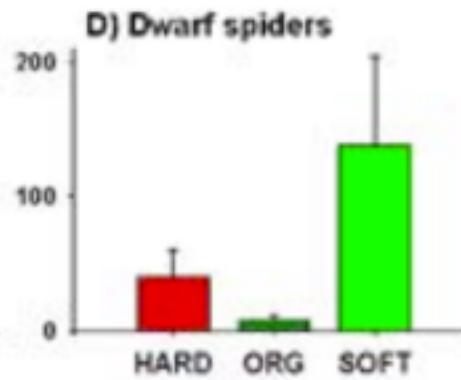
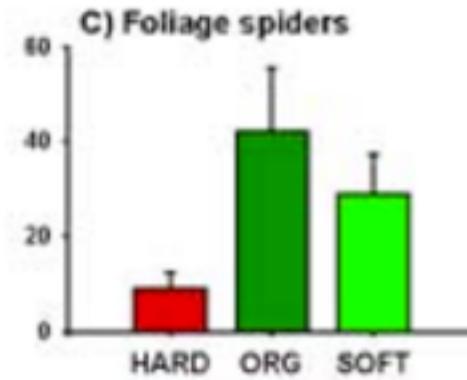
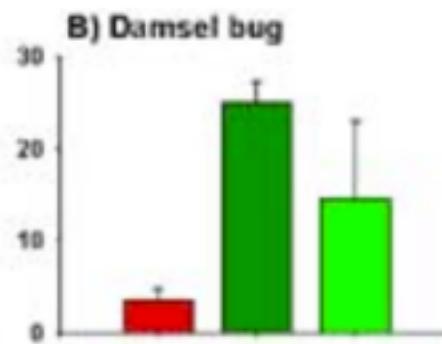
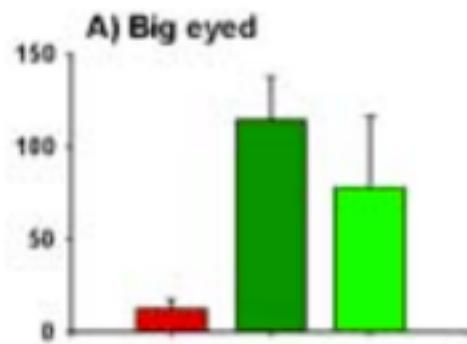


# Common vegetable crop insecticides

- ❑ Insecticidal Soaps
- ❑ *Bacillus thuringiensis*
- ❑ Spinosad
- ❑ Oils (i.e. neem)
- ❑ Pyrethrins and Pyrethroids
- ❑ Malathion
- ❑ Carbaryl
- ❑ Bait Formulations

# Chemical Control

Soft and Selective chemicals



# Chemical Control

Soft and Selective chemicals

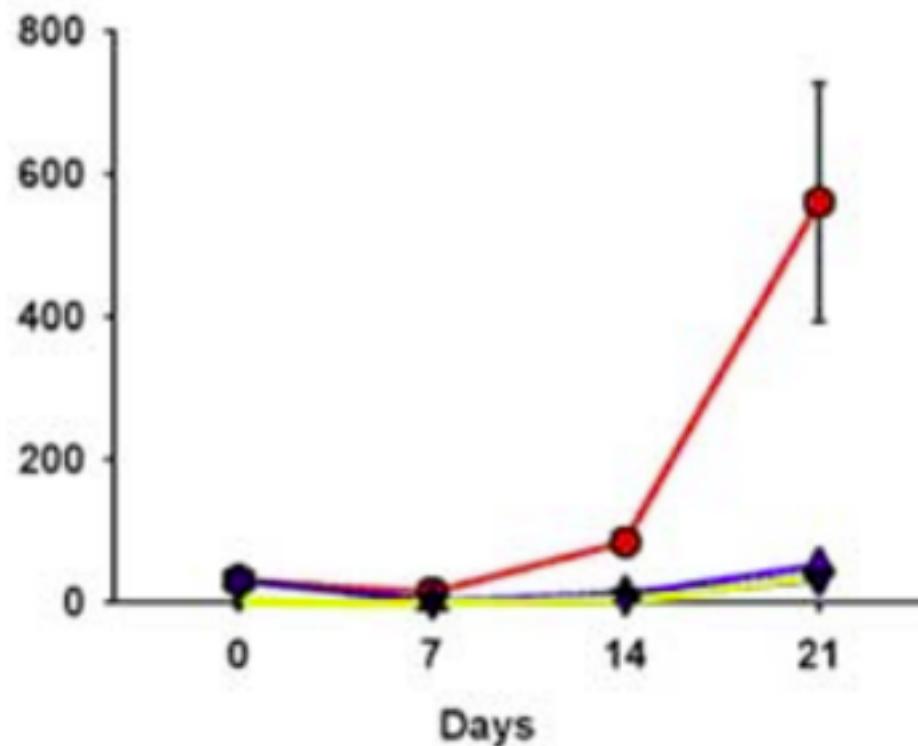


Figure 3. Green peach aphid populations in large field cages with predators removed (red), average predator densities (purple), or with high predator densities (yellow). Predators used were at densities typical of fields treated with soft pesticides

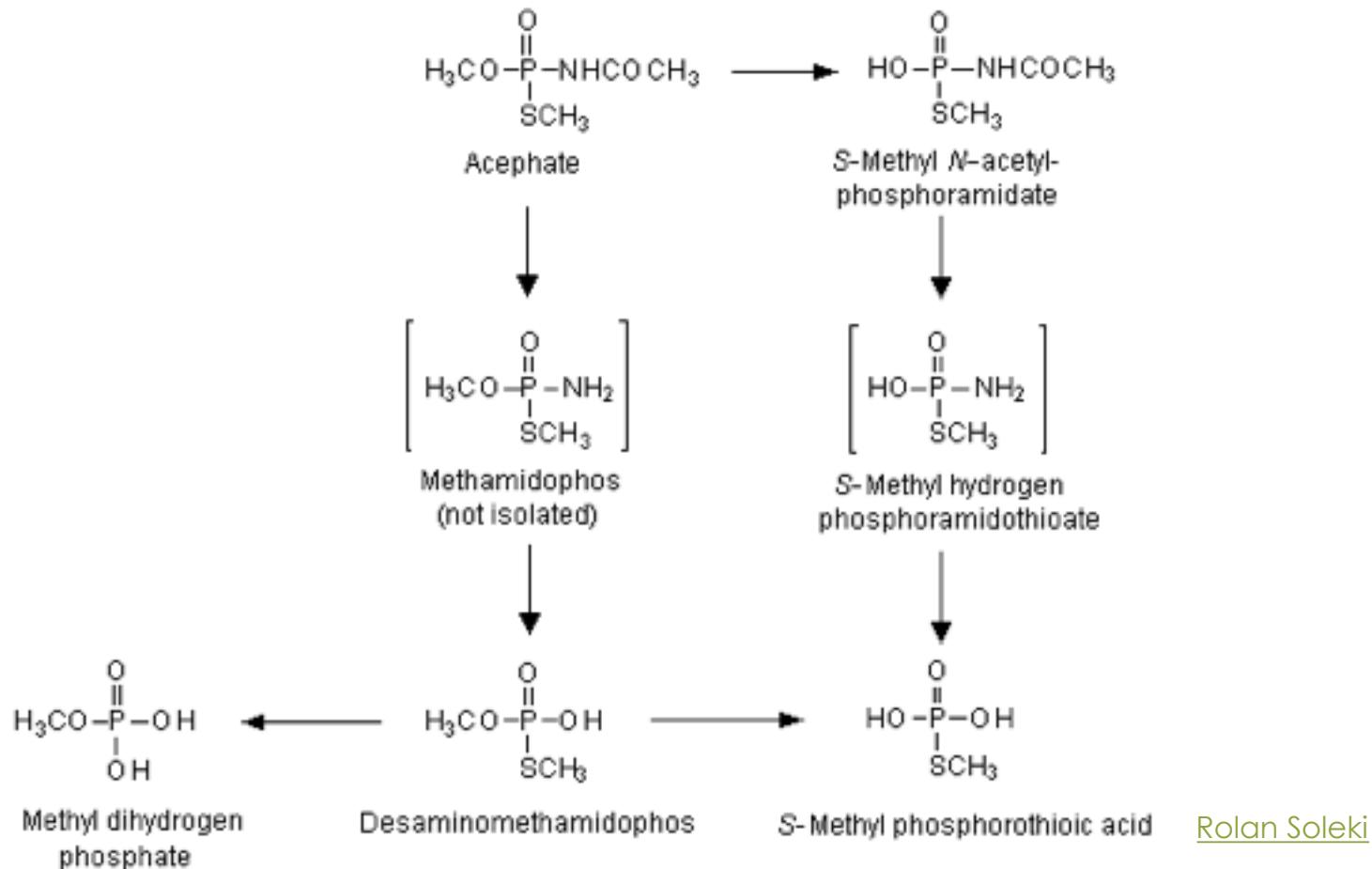
# Chemical Control

## Low Persistence

- ❑ Residue
- ❑ Residual Effectiveness
- ❑ Half-Life
- ❑ Breakdown product

# Chemical Control

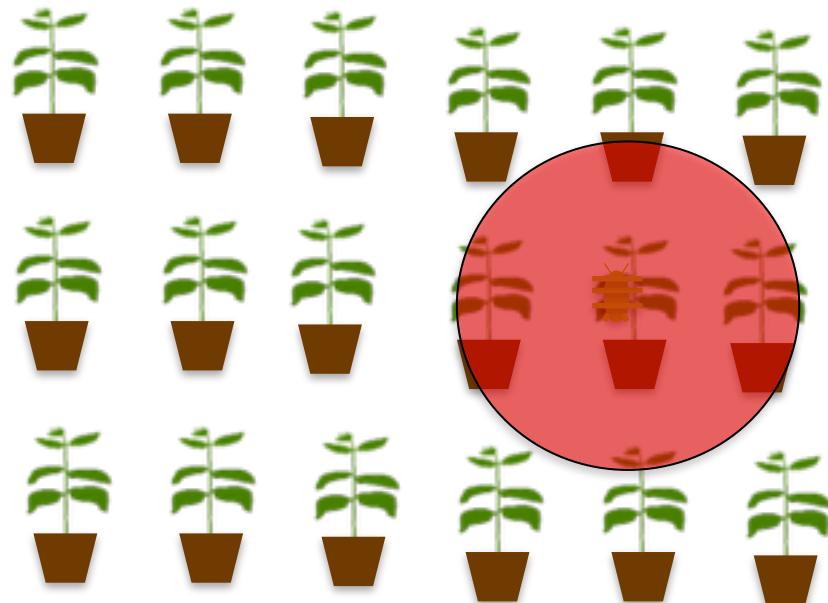
## Low Persistence



Rolan Soleki

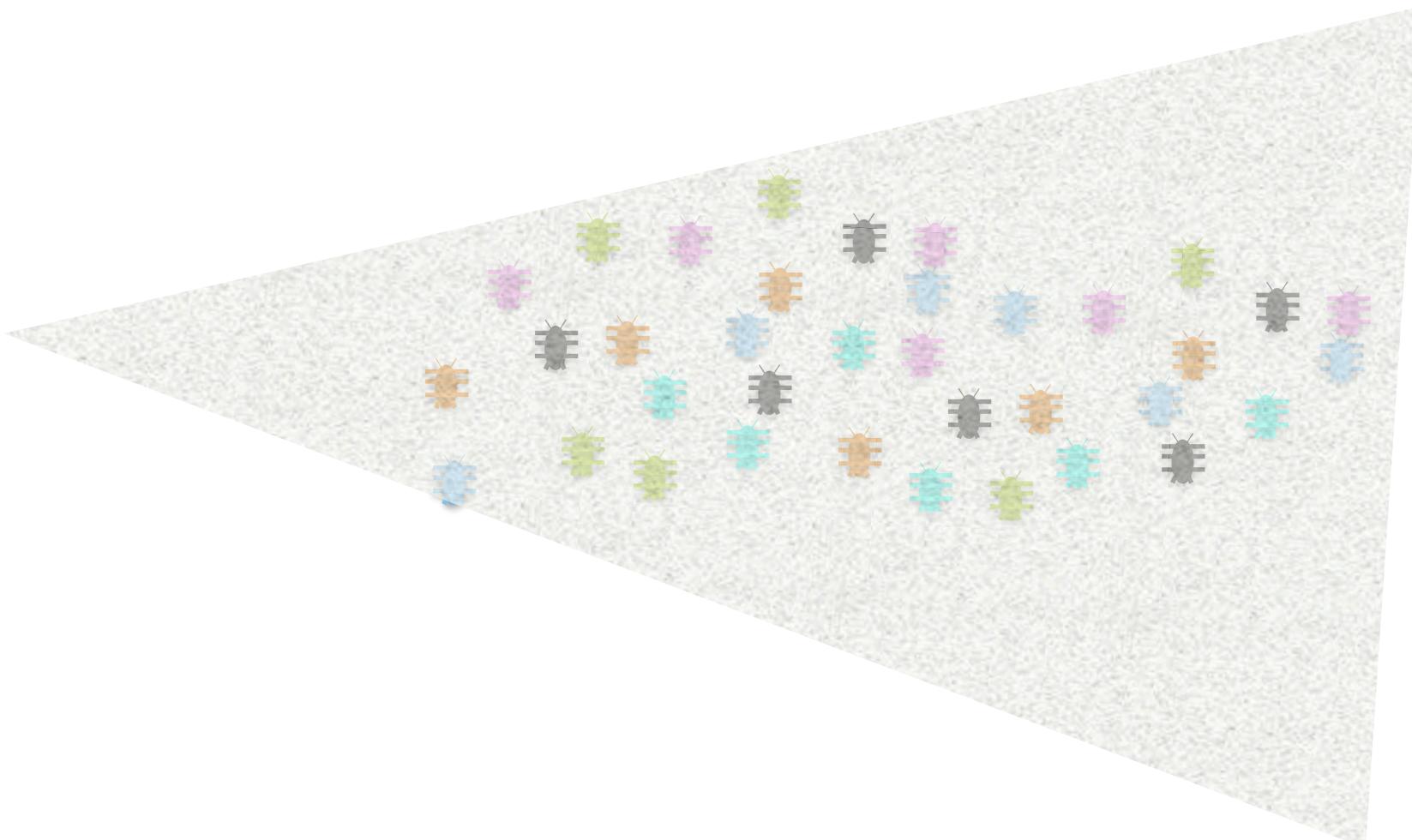
# Chemical Control

Spot spray/treatment



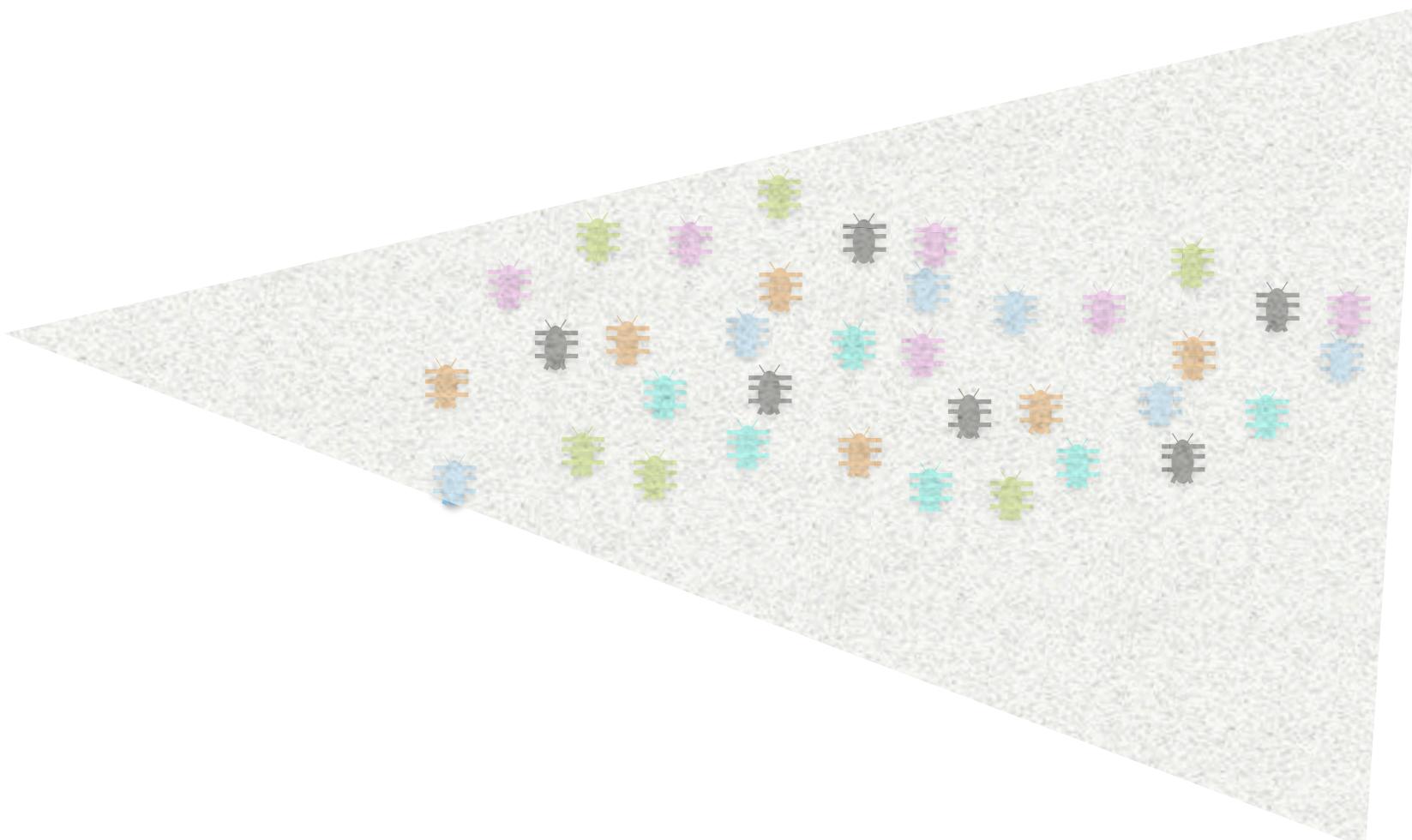
# Chemical Control

Chemical rotation



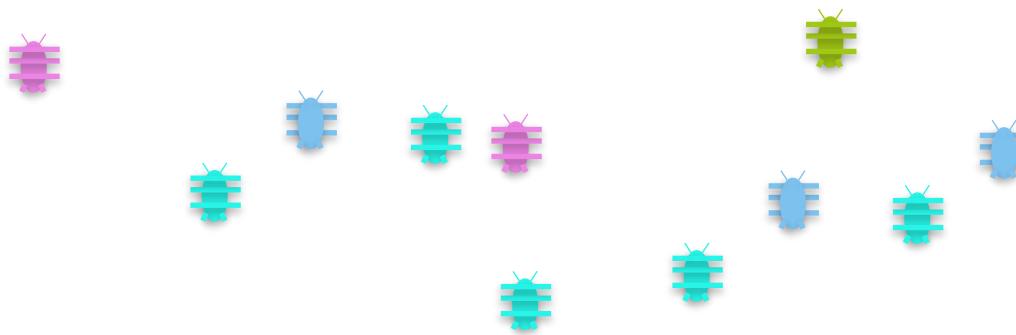
# Chemical Control

Chemical rotation



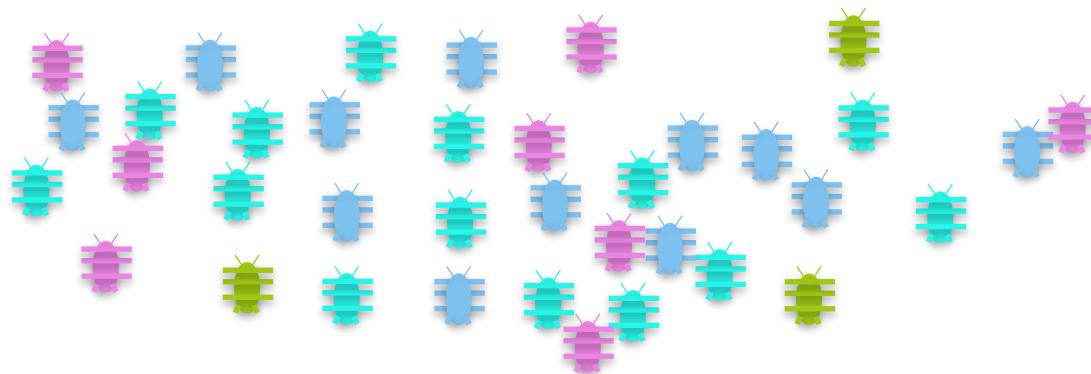
# Chemical Control

Chemical rotation



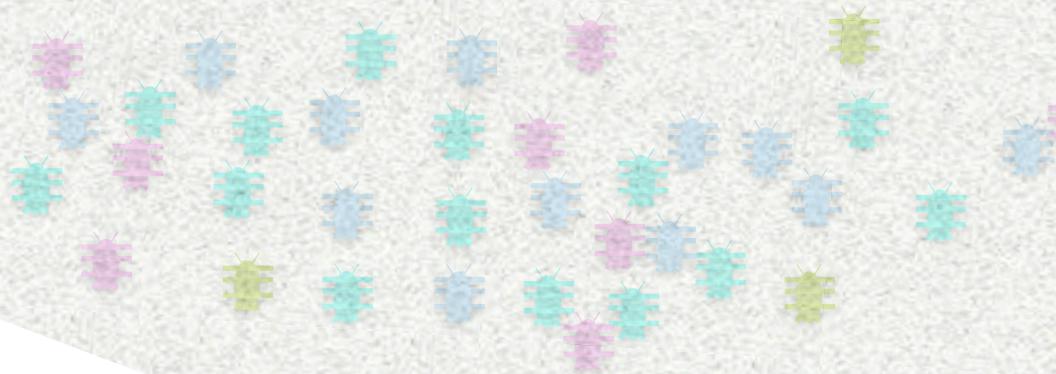
# Chemical Control

Chemical rotation



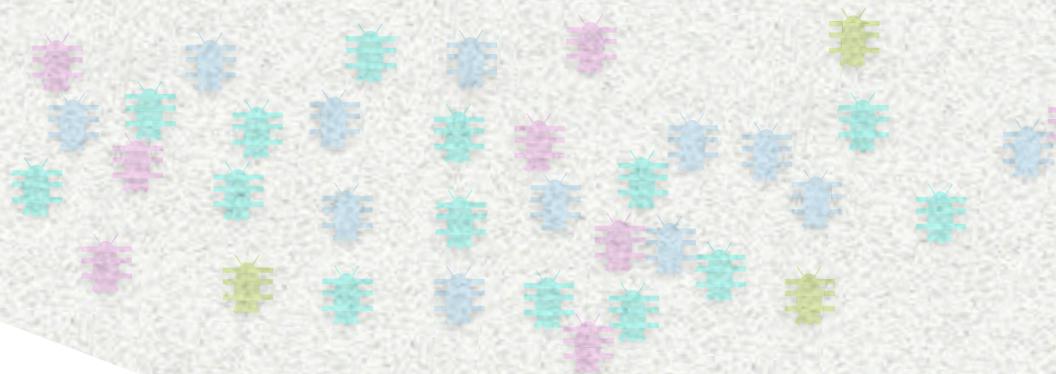
# Chemical Control

Chemical rotation



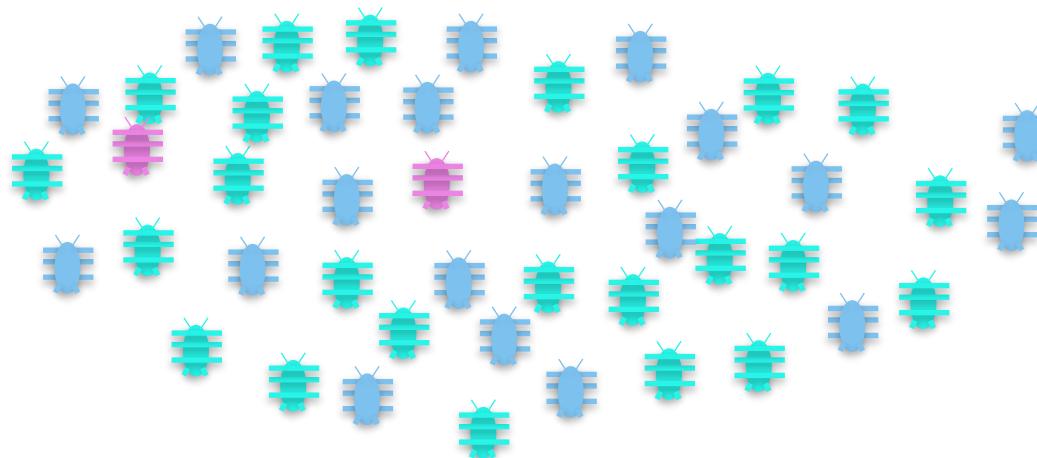
# Chemical Control

Chemical rotation



# Chemical Control

Chemical rotation



# Insecticide Resistance Action Committee

# Landscape Pest ID and IPM

## Earth-Kind Landscape Short Course

### Questions?

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