

# Managing Insect Pests on Urban Farms



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OSU Extension

Integrated Pest Management Program



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# Objectives

- Discuss basics of pest management
  - Cultural, biological, & pesticide
- Show approaches to pest management in specific vegetables



# Integrated Pest Management

- Combines the best control tactics to...
  - Keep pests at an acceptable level
  - Reduce pesticide use
  - Minimize environmental impacts
  - Minimize human exposure
- Does not rely on a single tactic more than others



# Integrated Pest Management

## 5 basic steps

Based on Information

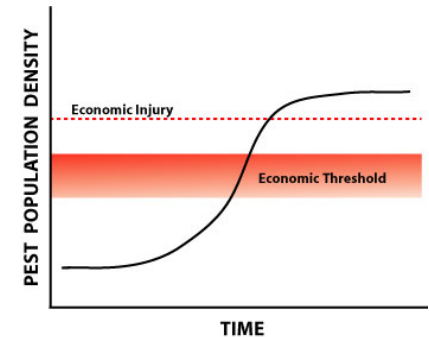
**1. Monitoring**



**2. Identification**



**3. Thresholds**

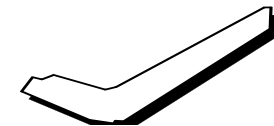


**4. Action Plan**



<http://jph12.wikispaces.com/>

**5. Evaluation**



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# Integrated Pest Management Pillars

1. **Cultural control** – Non-chemical tactics used to reduce pest pressure



2. **Biological control** - Using natural enemies & diseases to reduce certain pests



3. **Chemical control** – Use of pesticides (insecticides, herbicides, and fungicides) to reduce pests



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# Cultural Controls

- **Plant Genetics / Hybrids**
- **Rotation**
- Sanitation
- Planting time
- Mechanical
- **Exclusion (Row Covers)**
- Mulches (Organic & Inorganic )
- **Traps (sticky & pheromone)**
- **Trap crops**



# Genetic Resistance

- Disease packages (genes) to withstand specific fungal, viral, bacterial, or nematode attack

Tomato Resistance Codes	
(AB)	Early Blight
(AS)	Alternaria Stem Canker
(F)	Fusarium Wilt
(F2)	Fusarium Wilt (Races 1 & 2)
(F3)	Fusarium Wilt (Races 0, 1 & 2)
(FOR)	Fusarium Crown and Root Rot
(L)	Gray Leaf Spot
(LB)	Late Blight
(LM)	Leaf Mold
(N)	Nematodes
(PL)	Corky Root Rot
(PM)	Powdery Mildew
(PST)	Bacterial Speck
(TMV)	Tobacco Mosaic Virus
(ToANV)	Tomato Apex Necrosis Virus
(ToMV)	Tomato Mosaic Virus
(TYLCV)	Tomato Yellow Leaf Curl Virus
(V)	Verticillium Wilt

HR: = High Resistance IR: = Intermediate Resistance

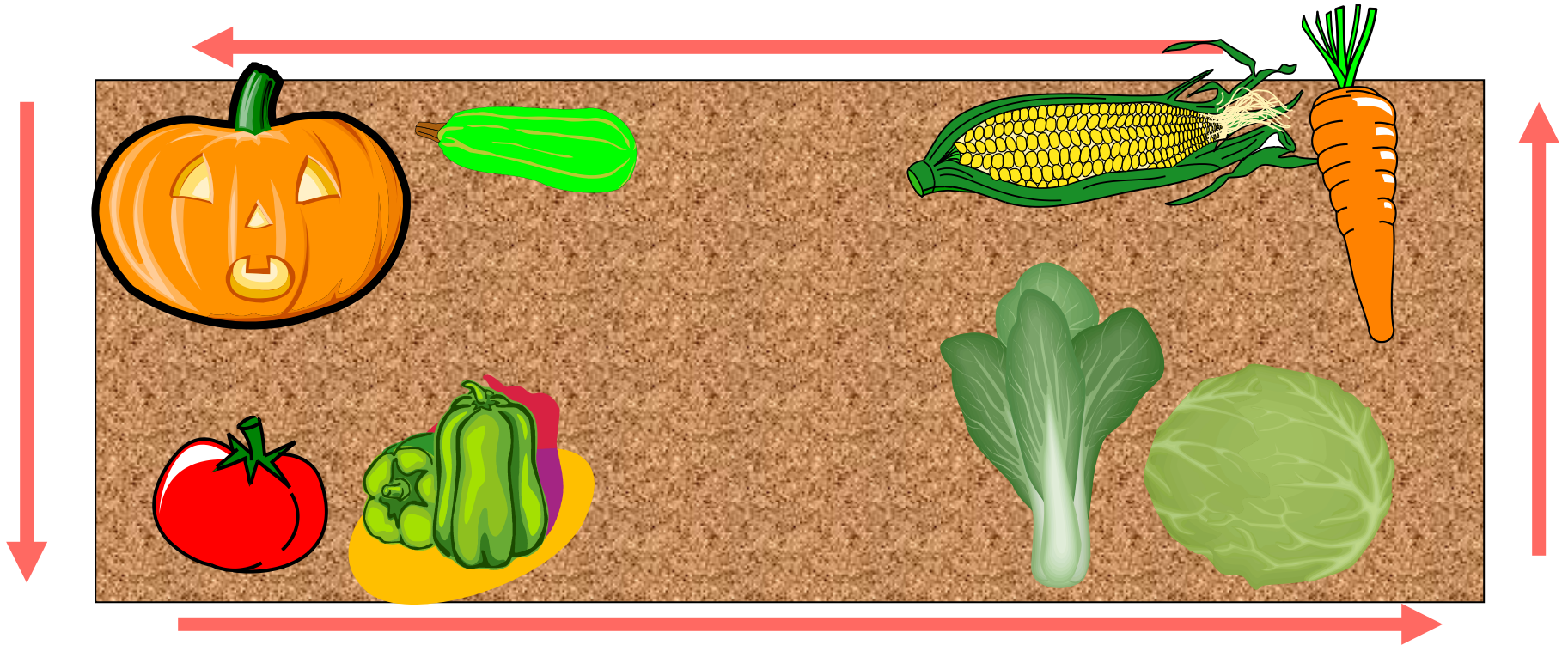
Spinach Resistance Codes	
(DM)	Downy Mildew
(Cv)	Cladosporium Leaf Spot
HR: = High Resistance IR: = Intermediate Resistance	
Summer Squash Resistance Codes	
(CMV)	Cucumber Mosaic Virus
(PM)	Powdery Mildew
(PRV)	Papaya Ringspot Virus
(WMV)	Watermelon Mosaic Virus
(ZYMV)	Zucchini Yellow Mosaic Virus
HR: = High Resistance IR: = Intermediate Resistance	
64-6697	Johnnyseeds.com



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# Rotation

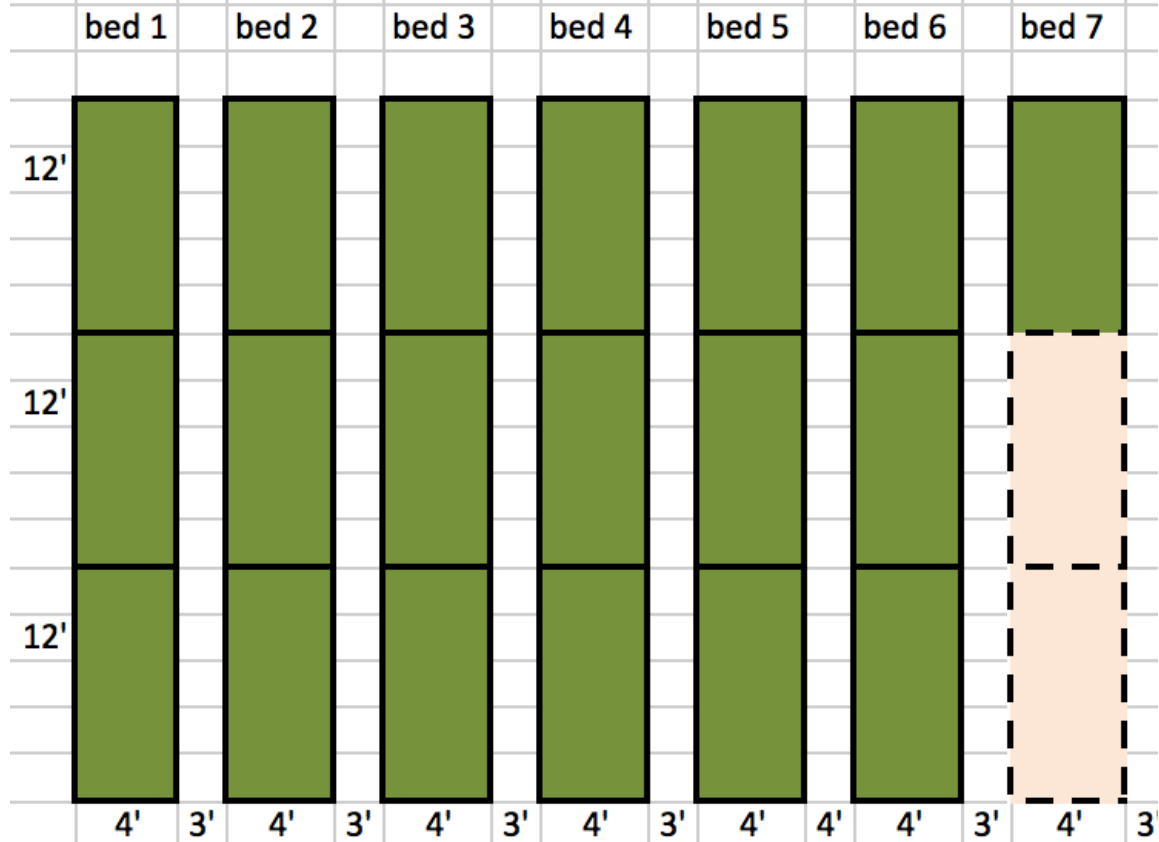
- Break up Disease & Insect life cycles
- Move crops around, be aware of families
  - Cole, Solanaceous, Cucurbits, Legumes, etc.





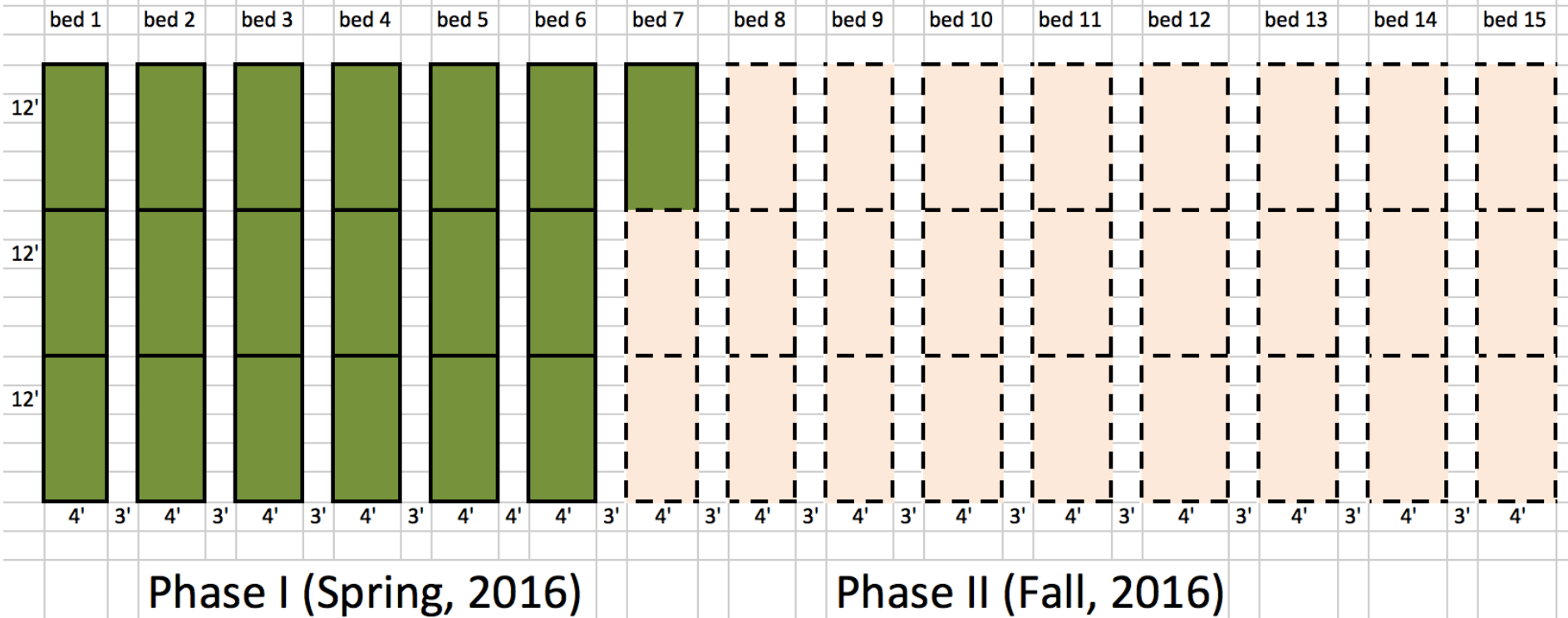


## Abandoned FACTORY



Phase I (Spring, 2016)

## Abandoned FACTORY



# Rotation

Break up Disease & Insect life cycles

- Cabbage, Greens in 2016. What were the major pests?

- Flea beetles and cabbage aphid

- What beds were these crops planted in?

- Eggplant in 2016. What was the major pest?

- Flea beetles

- What beds was this crop planted in?



# Exclusion - Row Covers

Remove IF crop needs pollination or heat stress!!





# Row Covers

- E**xclude insect pests
- I**ncrease plant growth (heat), protect from frost

**Weed control** can be a major issue **inside RC**

- Choose fields w/ reduced weed pressure
- Black plastic
- Card board, Newspaper
- Weed screen/fabric



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# Row Covers

Row Cover and  
Weed Control



No Row Cover or  
Weed Control



No Row Cover, but  
Weed Control



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# Trap crops

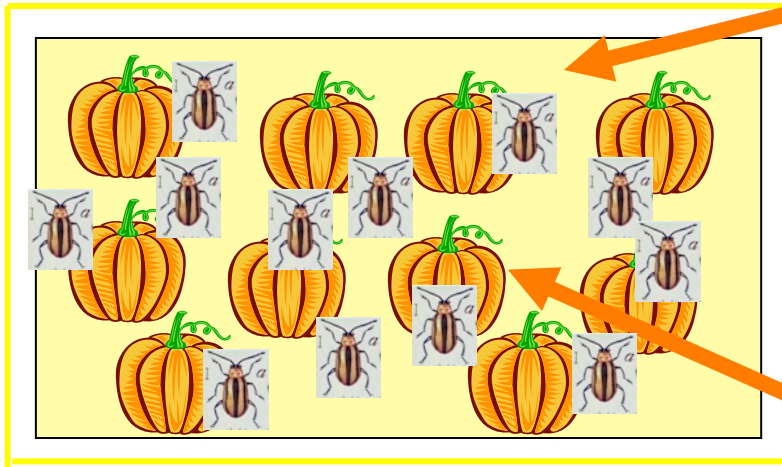
Using plants to manipulate insect behavior

- Lure insects away from main crop
- Concentrate insects in an area to be treated
- Reduces the need to spray whole field
- Reduces impact on beneficial arthropods
- Can have mixed results



# NO Trap Crop

pumpkin crop



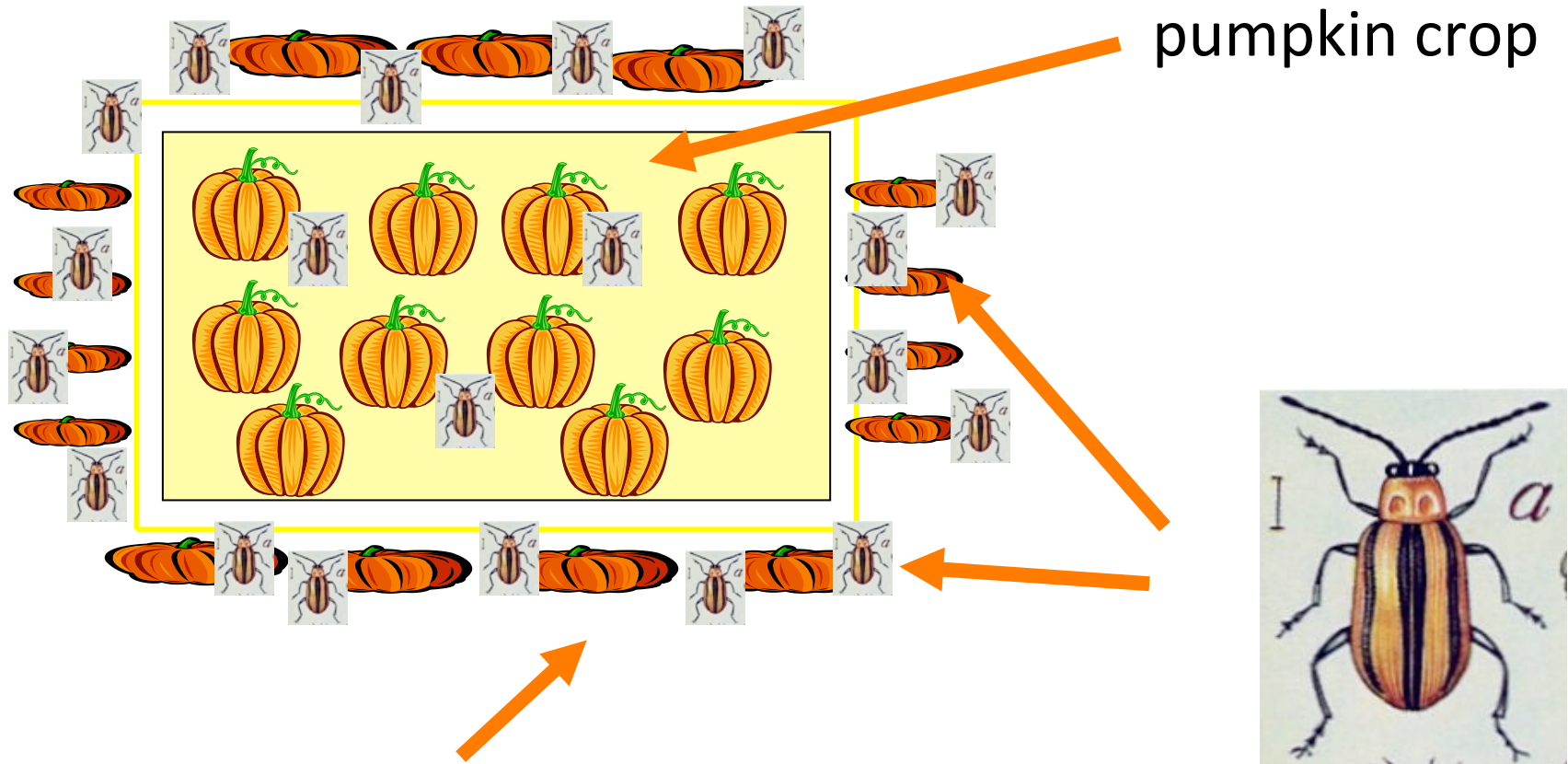
SCB like pumpkin, can vector  
Bacterial wilt to seedlings...bad



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# With Trap Crop



perimeter trap crop of blue hubbard is highly attractive to beetles...

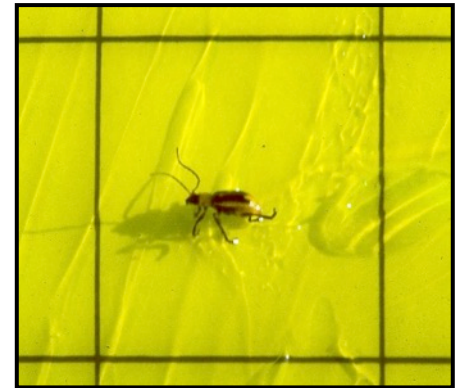
# Traps

In general...

- Work 24/7
- Good early warning system for some insects

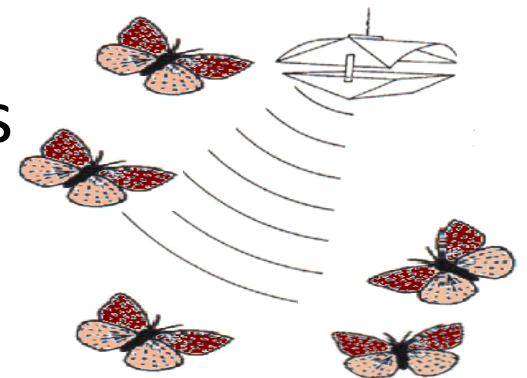
## **Sticky Traps**

- Used for monitoring
- Trap beneficial and pest insects



## **Pheromone Traps**

- Used for monitoring specific insects
- Trigger more intense scouting





# Traps



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# Pheromone Trap Pests

Fall armyworm – late

True armyworm – early

Corn earworm – mid to late

European corn borer – early to late

\* Cabbage looper – mid to late

\* Diamondback moth – mid to late

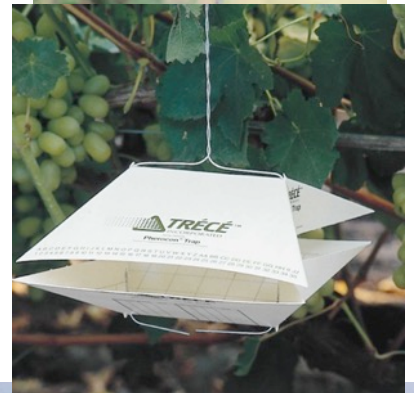
Black cutworm – early

Beet armyworm – mid to late

Variegated cutworm – mid to late

Western bean cutworm – mid to late

\* Brown marmorated stink bugs – early to late

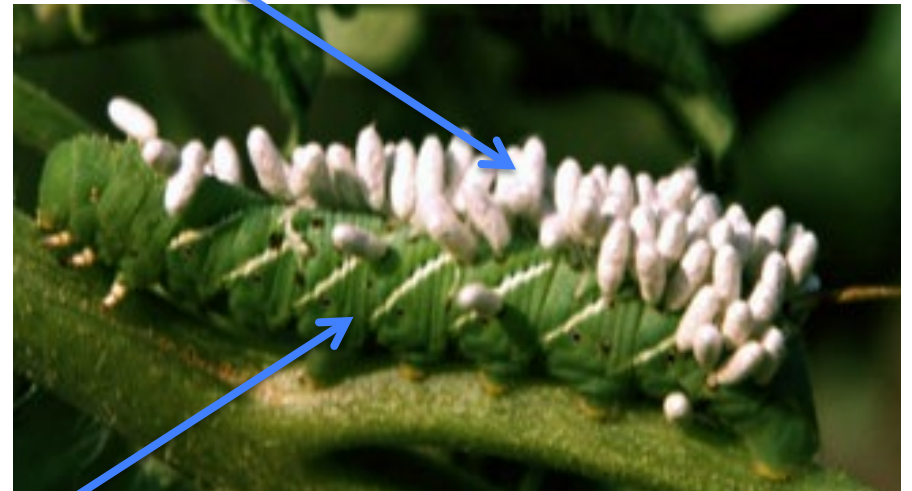


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# Biological Control

- Using a pest's natural enemies to control it

Natural Enemy



Pest



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# Biological Control

## Conservation

- Recognize beneficial insects & arthropods
- Use targeted insecticides when possible

## Encouragement

- Plant flowers as a nectar & pollen source

## Augmentation

- Lacewings, Praying Mantids, Parasitic Wasps, etc.
- Best in enclosed areas





# Refuge planting for natural enemies



**sweet  
alyssum**

**Phacelia**



**nasturtium**



**cilantro**

**dill**





# Natural Enemies?



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# Natural Enemies

## Ladybugs



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Iowa State University



# Natural Enemies

## More Ladybugs



# Natural Enemies

## Green lacewings





# Natural Enemies

## Praying mantids



# Natural Enemies Ground beetles



Iowa State University



Rick Weinzeirl



Midwest Vegetable Insect Manual



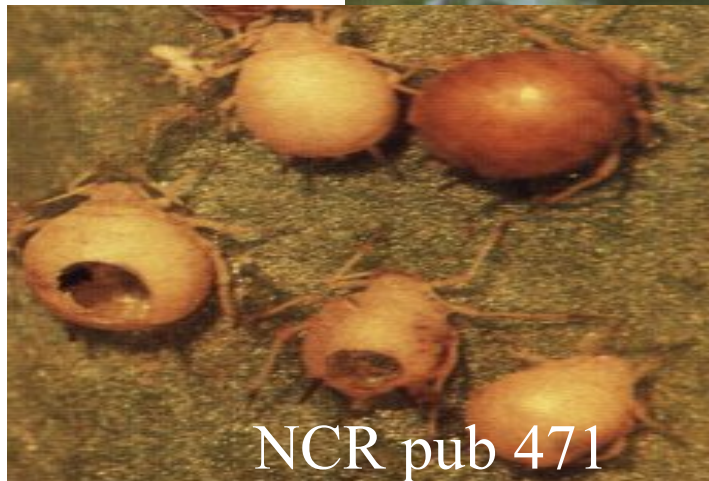
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# Natural Enemies

## Parasitoid Wasps

Attack aphids



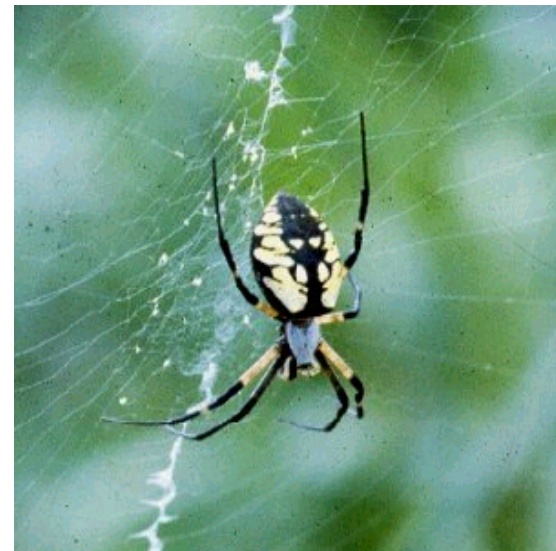
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# Natural Enemies

## Spiders



Audobon's Insects & Spiders



# Natural Enemies

## Parasitoid Flies

Attack eggs & caterpillars



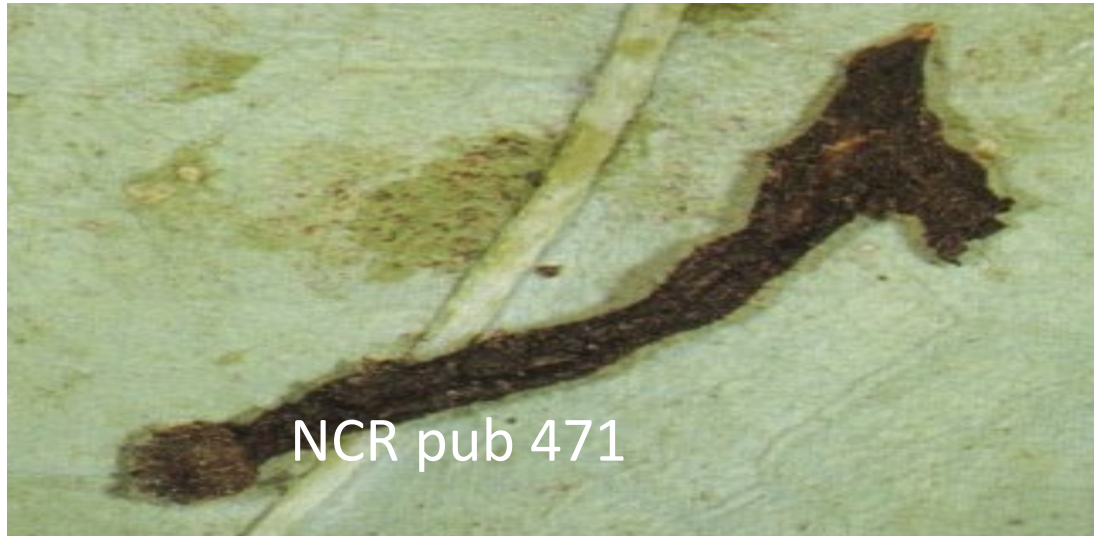
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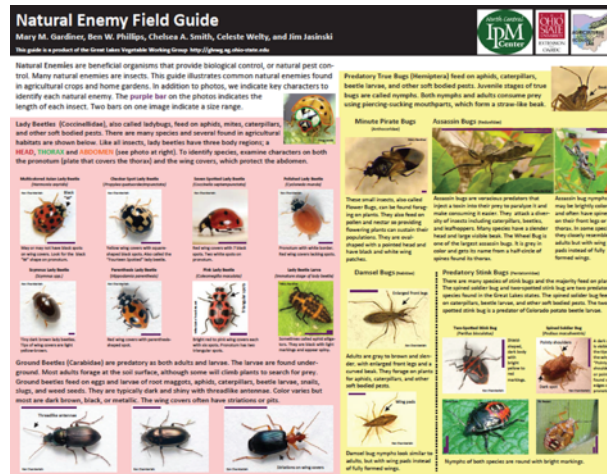
# Natural Enemies

## Fungi, Bacteria, Viruses



# Natural Enemies Resources

- ID Factsheet



- YouTube video (25 min)
  - OARDC natural enemies





# Natural Enemies at TURF





# Natural Enemies at TURF





# Natural Enemies at TURF





# Natural Enemies at TURF



# Chemical Control

## Insecticides for Garden Food Crops

### Class (Chemical names / Products)

- Carbamates (Sevin)
- Organophosphates (Malathion)
- Pyrethroids (Permethrin, Bifenthrin)
- Neonicotinoids (Imidicloprid, Acetamiprid)
- Microbials (Bt, Spinosad)
- Botanical (Neem, Azadirachtin, Pyrethrum)
- Soaps & Oils
- Elemental (S, Cu)



Pesticide License = RUP

# Pyrethrums, ins, and oids

- **Pyrethrum** – raw, unrefined insect killing active ingredient extracted from chrysanthemum flower heads
- **Pyrethrin** – refined Pyrethrum
- **PBO** – Piperonyl butoxide, synergist
- **Pyrethroid** – synthetic pyrethrums or pyrethrins, longer lasting, higher activity



# Pyrethroids: now 5 for food crops

*new*



permethrin

Esfenvalerate\*

bifenthrin

cyfluthrin

lambda-

cyhalothrin

# Insecticides of natural origin

Microbials (from micro-organisms)

- *B.t. (bacteria)*
- Spinosad (bacteria)
- *Beauveria* (fungus)

# What is Bt?

*Bacillus thuringiensis* (Bt)

- Common Soil Bacterium
- Used by organic growers for decades
- Harmless to Vertebrates
- Harmful to Certain Insect Groups
  - Moths, Beetles, Mosquitoes & Flies
- Insects Killed by ICP
  - (Insecticidal Crystal Protein)



# Bt's Mode of Action

- Bt insecticide sprayed on plant
- Insect Ingests Bt
- ICP Released into Insect's Midgut
- ICP Causes "Ulcers" in Midgut
- Insect Stops Feeding
- Internal Bleeding Results in Death

Which set of ears would you buy at the market?



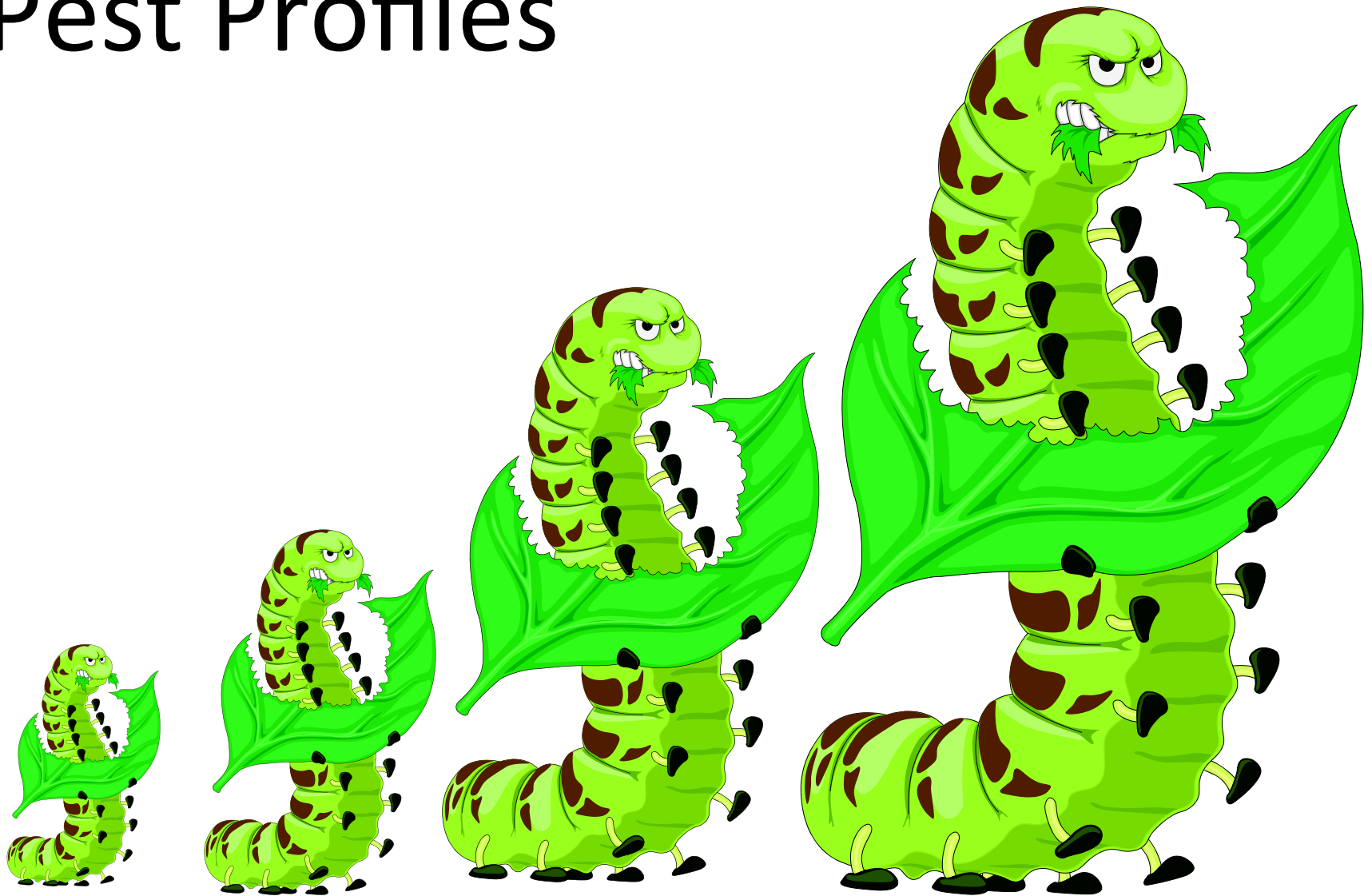
Which set of ears were sprayed w/ insecticide?



Neither, sweet corn on left is transgenic (Bt)



# Pest Profiles



# Key Pests on Vegetable Crops

## **Tomato**

Tomato fruit worm  
Variegated cutworm  
Hornworms  
Stink bugs  
Aphids  
CO potato beetle  
Slugs

## **Cole Crops**

Imported cabbageworm  
Cabbage looper  
Diamondback moth  
Aphids/Leaf miners  
Stink bugs  
Flea beetle  
Thrips  
Swede midge

## **Cucurbits**

Squash bugs  
Aphids  
Striped cucumber beetle  
Spotted cucumber beetle  
Squash vine borer

## **Pepper**

Eur. Corn borer  
Stink bugs  
Aphids  
Flea beetle

## **Sweet Corn**

Eur. Corn borer  
Fall armyworm  
Corn earworm  
Stink bugs  
Aphids  
Flea beetles  
Japanese beetles  
Corn rootworms

## **Potato**

CO potato beetles  
Cutworms  
Potato leaf hoppers  
Wireworms  
Aphids  
Flea beetle

## **Salad Greens**

Aphids  
Slugs  
Leaf miners  
Black cutworm  
Variegated cutworm  
Cabbage loopers  
Flea beetles  
Leafhoppers

## **Sweet Potato**

CO potato beetles  
Potato leaf hoppers  
Wireworms  
Aphids  
Flea beetle

# General Pests: Slugs

**Monitor** – jagged leaf feeding, fruit feeding, slime trails

**ID** - Soft bodied, slimy creature





# General Pests: Slugs

## Cultural

- BEER filled pie plates ...sometimes



Source: [Copper Tape vs Slugs](http://stores.ebay.co.uk/Homeware-Takeaway)

- Copper Strips – A shocking experience...sometimes

<http://www.gardenmyths.com/>



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# General Pests: Slugs

## Cultural

- Dry out area – add sand?
- Diatomaceous Earth- reapply after rain
- Alternative remedies: cedar chips, egg shells, coffee grounds, and pine needles??



# General Pest: Slugs

## Biological

- Ground beetles, song thrushes, toads, frogs, insects...



## Chemical

- Slug baits (Metaldehyde), Iron phosphate (Sluggo)





# General Pests: Aphids

## Monitor

- On stems, branches, & underside of leaves
- Feed on all types of plants
- Can cause growing tip to curl



## ID

- Small soft bodied insects w/ sucking mouth parts
- Suck plant juices, excrete honeydew, may cause black sooty mold
- Vector viruses



# General Pests: Aphids

## Cultural Controls

- Choose virus resistant varieties if possible
- Consider syringing or wiping off with glove
- Row covers
- Early Planting



# General Pests: Aphids

## Bio-controls

Lady Beetles

Parasitoid Wasps





# General Pests: Aphids

## Bio-controls: Lacewings



# General Pests: Aphids

## Chemicals

- Acetamiprid - systemic
- Soap and oil products
- Conserves beneficial insects





# Pest Management for Tomato



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# Pest: Hornworms

## Monitor

- Chewed foliage, fruit, and frass
- Look for missing canopy and fresh frass

## ID

- Large green worm w/ slashes or chevrons



# Pest: Hornworms

**Cultural:** Pick mature caterpillars off of plant

**Biological:** Don't kill if parasitoid pupal cases are found on caterpillar (*Cotesia* sp.)  
-bird & hornet predators



**Chemical:** Bt (if small), Spinosad, Pyrethroids,

# Pest: Other Caterpillars

yellow striped armyworm, tomato fruit worm, variegated cutworm

## Monitor

- Larvae in fruit, sides and bottom
- Pheromone traps  
TFM, VCW

## Identify

- Which worm is it?  
Doesn't really matter,  
all treated the same

## Cultural Control

- Pick worms out / cull fruit



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# Pest: Other Caterpillars

yellow striped armyworm, tomato fruit worm, variegated cutworm

## Bio-control

- Ground beetles, parasitoids, birds

## Chemical

- Pyrethrin + PBO, Pyrethroids, Bt



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# Pest: Stink Bugs

## Monitor

- Foliage, Green and Red fruit

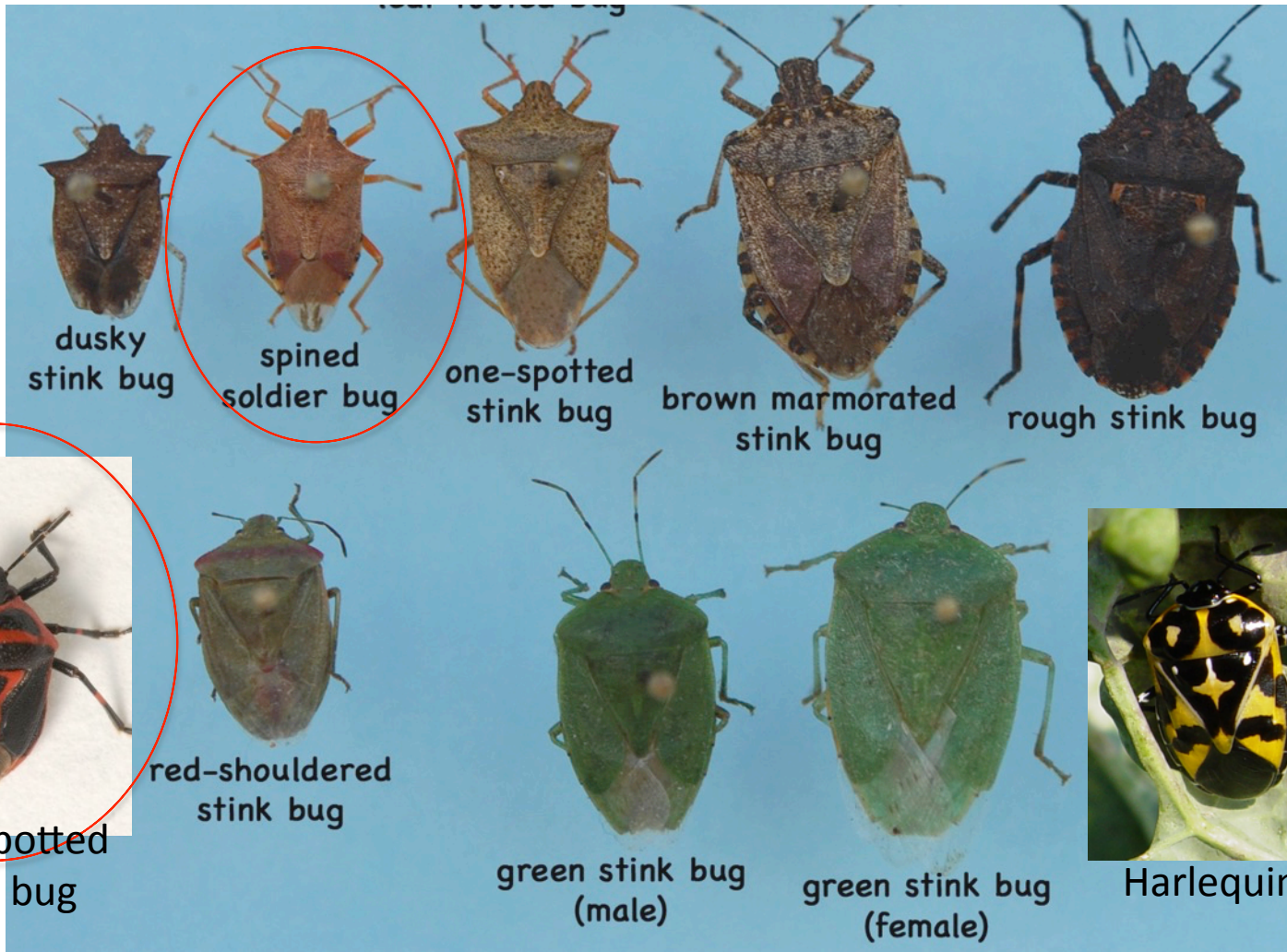


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# Pest: Stink Bugs

**Identification** – Most bugs are pests. Two are beneficial.





# Brown marmorated stink bug



# Pest: Stink Bugs

## Cultural Control

- Pick bugs off
- Cull fruit if damage really significant
- Use traps to monitor



## Biological Control

-stink bugs, parasitoid wasps, spiders

## Chemical control

-Pyrethroids, Acetamiprid, Spinosid for nymphs



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# Pheromone trapping study

- Pyramid vs pipe; Black vs yellow; Plain vs netted





# Action thresholds: Tomato

<i>Pest</i>	<i>Threshold</i>	<i>Insecticide</i> <span style="color: red;">updated</span>	
		<i>Natural</i>	<i>Synthetic</i>
aphids 	>1 colony/leaflet & no natural enemies	Soap, oil, pyrethrins+PBO	acetamiprid (Ortho Bug-B-Gone), imidacloprid (Bayer Fruit, Citrus, Vegetable)
hornworms 	>10% defoliation	B.t. (Dipel)	Spinosad (Bonide Capt. Jack), L-cyhalothrin (Bonide Caterpillar killer)
Fruitworm 	Any larvae in fruit	B.t. (Dipel)	Spinosad (Bonide Capt. Jack), L-cyhalothrin (Bonide Caterpillar killer)
stink bug 	Damage on >10% or fruit  	pyrethrins + PBO	L-cyhalothrin (Bonide Beetle/Caterpillar killer)

# Pest Management in Cole Crops



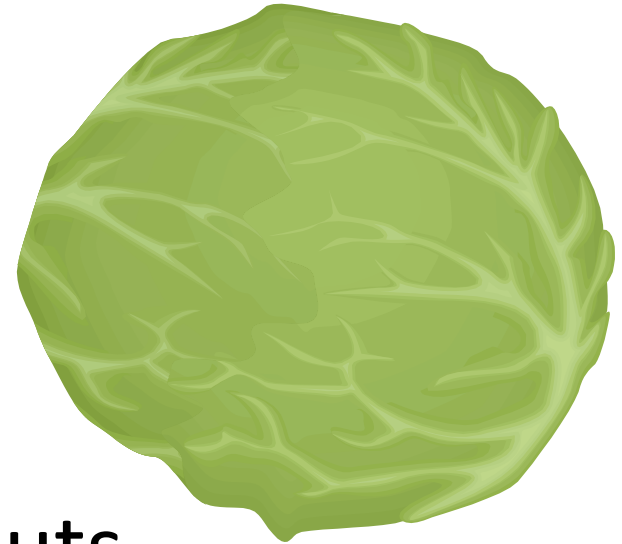
Cabbage

Broccoli

Brussel sprouts

Cauliflower

Collards



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# Pests: Cole Caterpillar Complex



**Monitoring:** Look at leaves and heads  
Feeding on leaves bad;  
feeding on heads bad



Cross striped cabbageworm  
[ Picture by D. Matthew ]



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# **Pest:** Imported Cabbageworm butterfly



**ID:** Small fuzzy green worm



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# Pest: Cabbage looper



**ID:** Large green looping worm



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# Pest: Diamondback moth



**ID:** Small very active green caterpillars



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# Pests: Cole Worm Complex

## Cultural Controls

- Floating row covers - excludes butterflies; leave on whole season
- Hand picking - inspect for natural predators / disease
- Destroy plants soon after harvest

## Biological Controls of Complex

Many natural predators and parasitoids in Ohio



# **Pest: Cabbage Worm**

## **Biocontrols and Natural Enemies**



*Pteromalus* spp.- Pupa

*Trichogramma* spp. – Eggs

*Cotesia* sp. - Larva

# Pest: Cabbage Looper

## Biocontrol & Natural Enemies



*Copidosoma*  
sp. – Egg  
parasite

*Copidosoma*  
sp. egg  
divides inside  
host, resulting  
in 1000's  
parasitoids



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# Pest: Cabbage Looper

## Biocontrol & Natural Enemies

- *Voria* sp., tachinid fly
  - Larva
- *Cotesia* sp., parasitoid wasp
  - Larva
- Predators
  - Wasps, lacewings, syrphid larva, ground beetles



# Pest: Diamondback moth

## Biocontrol & Natural Enemies



University of Florida



Management Guide

*Diadegma insulare* – Larva

*Cotesia* sp. & *Microplitis* sp. - Larva



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# Pest: Diamondback moth - Biocontrol



Parasitized



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*Diadegma insulare* – Larva



# Pest: Imported Cabbageworm - Biocontrol



# Pest: Cole Caterpillar Complex

## Chemical Controls

- Use Bt first - works best on small caterpillars
  - Less disruptive to other beneficial arthropods
- Spinosad, pyrethrins + PBO, pyrethroids, carbaryl
- DBM may be resistant to synthetic insecticides



# Pest: Flea Beetle Complex

## Monitoring

- adults emerge in spring, feed on cole, solanaceous & other veggie seedlings
- damage resembles small holes or gouges in leaf tissue
- monitor using sticky traps



Whitney Cranshaw, Colorado State University, Bugwood.org



Typical flea beetle damage (Photo Credit: John Obermeyer)



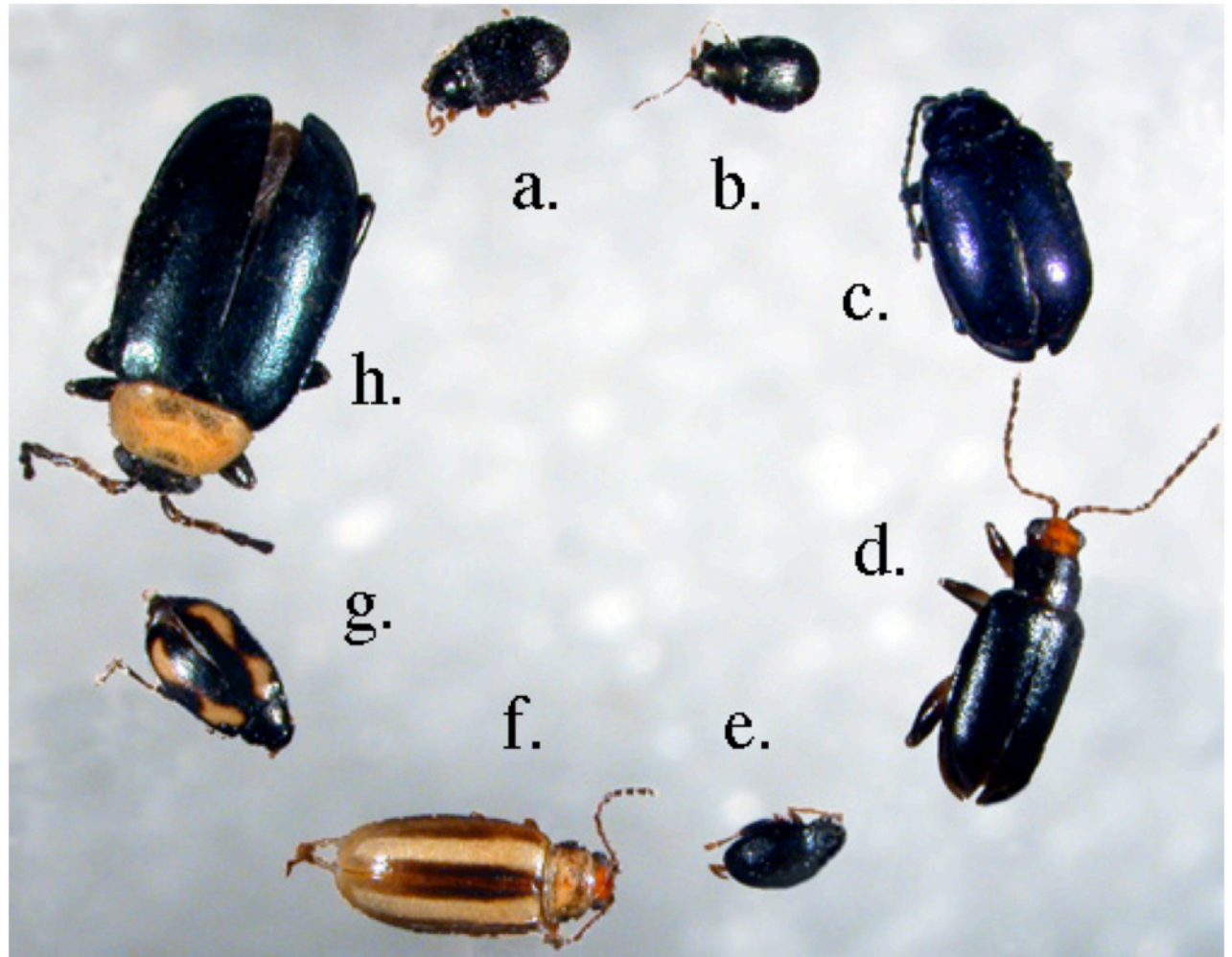


# Pest: Flea Beetle Complex

## Identification

-small black beetles that  
“jump” when  
distrurbed

-1/16<sup>th</sup> inch



Flea Beetles Found in Indiana. a) Potato Flea Beetle: *Epitrix cucumeris* (Harris); b) Corn Flea Beetle: *Chaetocnema pulicaria* (Melsheimer); c) Grape Flea Beetle: *Altica chalybea* (Illiger); d) Red-Headed Flea Beetle: *Systema frontalis* (Fabricius); e) Sweet Potato Flea Beetle: *Chaetocnema confinis* (Crotch); f) Palestriped Flea Beetle: *Systema blanda* (Melsheimer); g) Striped Flea Beetle: *Phyllotreta striolata* (Fabricius); h) Spinach Flea Beetle *Disonycha xanthomelas* (Dalman) (Photo Credit: John Obermeyer)



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# Pest: Flea Beetle Complex

Table 1. The most common Brassica feeding flea beetles found in North America.

Brassica Feeders	Scientific Name	Reported to Damage	Distribution
Crucifer flea beetle	<i>Phyllotreta cruciferae</i>	Brassicaceae family	Northern US
Horseradish flea beetle	<i>Phyllotreta armoraciae</i>	Horseradish, occasionally damages cabbage, radish and turnip	Northern US and usually east of the Rockies
Striped flea beetle	<i>Phyllotreta striolata</i>	Brassicaceae family	Eastern and Pacific regions of the US
Western black flea beetle	<i>Phyllotreta pusilla</i>	Brassicaceae family, occasionally damages beet, lettuce and potato	Western US

<http://articles.extension.org/pages/72972/managing-cruciferous-and-solanaceous-flea-beetles-in-organic-farming-systems>

# Pest: Flea Beetle Complex

Table 2. The most common solanaceous feeding flea beetles found in North America.

Solanaceous Feeders	Scientific Name	Reported to Damage	Distribution
Eggplant flea beetle	<i>Epitrix fuscula</i>	Eggplant and potato	Eastern US
Palestriped flea beetle*	<i>Systema blanda</i>	Very wide host range	Primarily a pest in warmer areas of the US
Potato flea beetle	<i>Epitrix cucumeris</i>	Potato, tomato and other members of Solanaceae family	East of the Rockies
Tobacco flea beetle	<i>Epitrix hirtipennis</i>	Eggplant, pepper, potato, tomato and other members of Solanaceae family	Warmer areas of the US
Tuber flea beetle	<i>Epitrix tuberis</i>	Potato, especially potato tubers	Pacific Northwest
Western potato flea beetle	<i>Epitrix subcrinita</i>	Potato and other members of Solanaceae family	Western US



# Pest: Flea Beetle Complex



Typical flea beetle damage (Photo Credit: John Obermeyer)

## Thresholds

- **Crucifers**—crucifer and striped flea beetles: treat if at seedling stage (up to six true leaves) and >1 flea beetles/plant
- **Leafy vegetables** in seedling stage—crucifer, spinach, and striped flea beetles: treat if beetles are common on most plants and defoliation >30%
- **Pepper and eggplant**—eggplant, tobacco, palestriped, and potato flea beetles: treat if plant <3 inches tall and two flea beetles/plant; treat if 3-6 inches tall and four flea beetles/plant; treat if >6 inches tall and eight flea beetles/plant



# Pest: Flea Beetle Complex



Typical flea beetle damage (Photo Credit: John Obermeyer)

## Thresholds

- **Potato**—potato flea beetle: treat if >50 flea beetles/25 sweeps
- **Tomato**—palestriped and potato flea beetles: treat if >30% defoliation
- **Sweet corn** (Stewart's wilt-susceptible varieties, less than “knee high”)—corn flea beetles: treat if 6 or more corn flea beetles/100 plants.



# Pest: Flea Beetle Complex

## Cultural



Typical flea beetle damage (Photo Credit: John Obermeyer)

**-Trap cropping** (Italian or Japanese eggplant, or Chinese giant mustard) – match flea beetle to trap crop

Rotation, Row covers, Delay early planting, Yellow sticky cards

## Biological –low levels

– native parasitoid, *Microctonus vittatae*, adult flea beetles

-Lacewing larvae, big eyed bugs (*Geocoris* spp.), and damsel bugs (*Nabis* spp.), Steinernematid and Heterorhabditid nematodes, *Beauveria bassiana*





# Pest: Flea Beetle Complex



Typical flea beetle damage (Photo Credit: John Obermeyer)

## Chemicals

- Systemic seed treatment (imidacloprid)
- Carbaryl, Cyfluthrin, Esfenvalerate, Permethrin, Spinosad




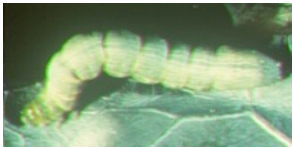



# Flea Beetle Resources

- <http://articles.extension.org/pages/72972/managing-cruciferous-and-solanaceous-flea-beetles-in-organic-farming-systems>
- <http://extension.entm.purdue.edu/publications/E-74.pdf>
- <http://extension.entm.purdue.edu/publications/E-21.pdf>
- <http://entomology.osu.edu/welty/ppt%20pdf/PepperPestMgmtFeb05.pdf>
- <https://u.osu.edu/pestmanagement/files/2014/12/OhioPepper2013FinalReport-2ademy7.pdf>
- <http://www.nysipm.cornell.edu/factsheets/vegetables/misc/fb.pdf>



# Action thresholds: Cole Crops

<i>Pest</i>	<i>Threshold</i>	<i>Insecticide</i> <span style="color: red;">updated</span>	
		<i>Natural</i>	<i>Synthetic</i>
Flea beetles 	(Variable) >5 beetle holes per leaf & >5 beetles per plant	pyrethrins + PBO	carbaryl (Sevin), L-cyhalothrin (Bonide Beetle killer)
Caterpillars: <ul style="list-style-type: none"> <li>■ Imported cabbageworm</li> <li>■ Diamondback moth</li> <li>■ Cabbage looper</li> </ul>   	>1 larva/plant  >2 larvae/plant  >0.5 larva/plant	B.t. (DiPel)	L-cyhalothrin (Bonide Caterpillar killer), Spinosad (Bonide Capt. Jack)
Aphids 	>1 colony/leaf	soap	Acetamiprid (Bug-B-Gone)



# Pest Management in Cucurbits

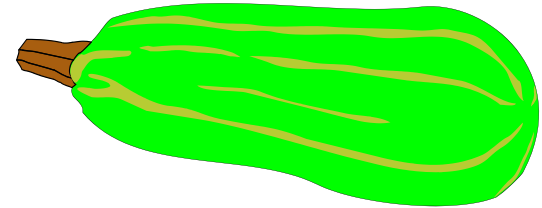
Cucumbers

Zucchini

Melons

Pumpkin

Squash



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# Pest: Squash Vine Borer

## Monitor

- Look for moth flying around crop
- Wilting vines, frass at plant base

## ID

- Moth looks like a wasp mimic
- Larva looks like a white caterpillar/grub



# Pest: Squash Vine Borer

## Cultural controls

- Use row covers
- Set pheromone traps for adults around mid June
- If vines are wilting, split vine to remove borer, rebury

## Biological Control - None

## Chemical control

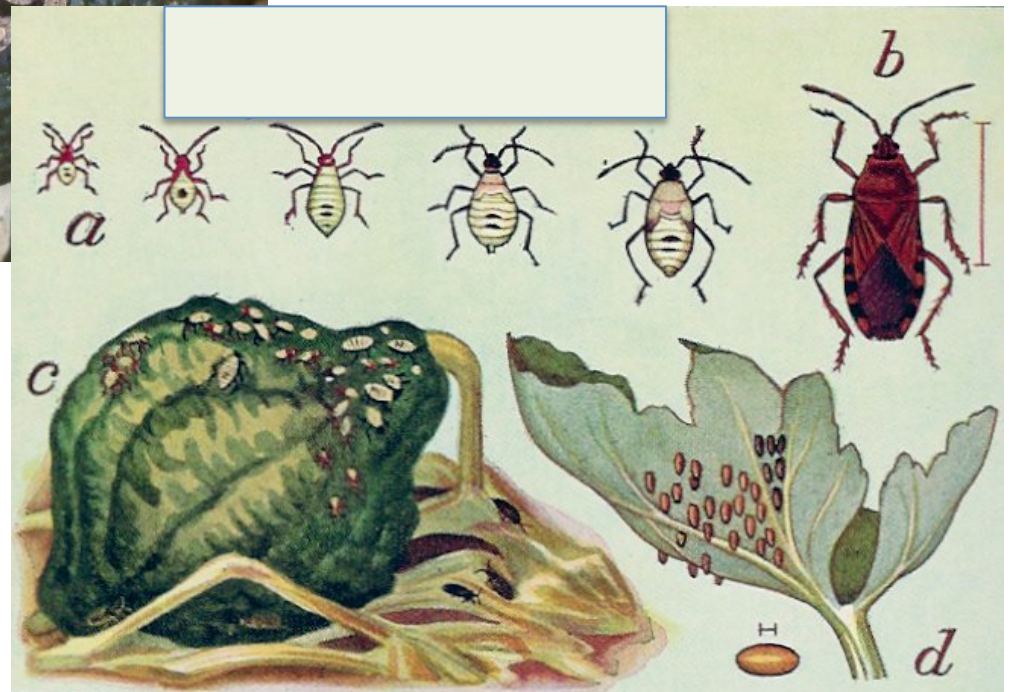
### Pyrethroids

- Treat when adult flight peaks in pheromone trap (late June)
- Spray 2-4 times for the next 4-6 weeks at base of plants





# Pest: Squash bugs



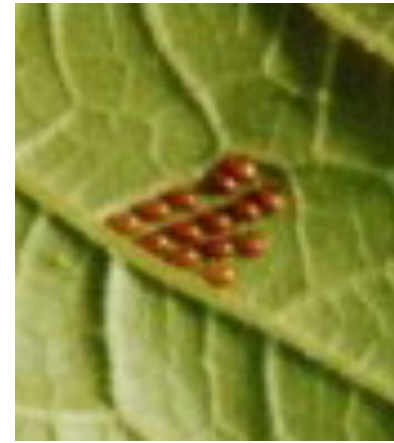
# Pest: Squash bugs

## Monitoring

- Tops and bottoms of leaves, stems, petioles, fruit

## Identification

- Rusty colored eggs laid in clumps of 15-25
- Grayish nymphs, clumped
- Brownish Gray adults





# Pest: Squash bugs

## Cultural

- Row Covers
- Crush and removed eggs/nymphs/adults
- Destroy plant material after harvest



## Biocontrol

- *Trichopoda* tachinid fly
- Attacks adults



## Chemical Control

- Spinosad, Pyrethrins + PBO, Imidicloprid



# Pest: Cucumber beetles



**Striped**

**Spotted**



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# Pests: Cucumber beetles & Rootworms

## Monitoring

- Inspect the plant - protect seedlings from leaf feeding & bacterial wilt (cotyledon to 4<sup>th</sup> leaf)
- Protect fruit rind

**Identification** - yellow and black beetles

**Striped**



**Spotted**



**Western CR**



**Northern CR**



# Pest: Cucumber beetles



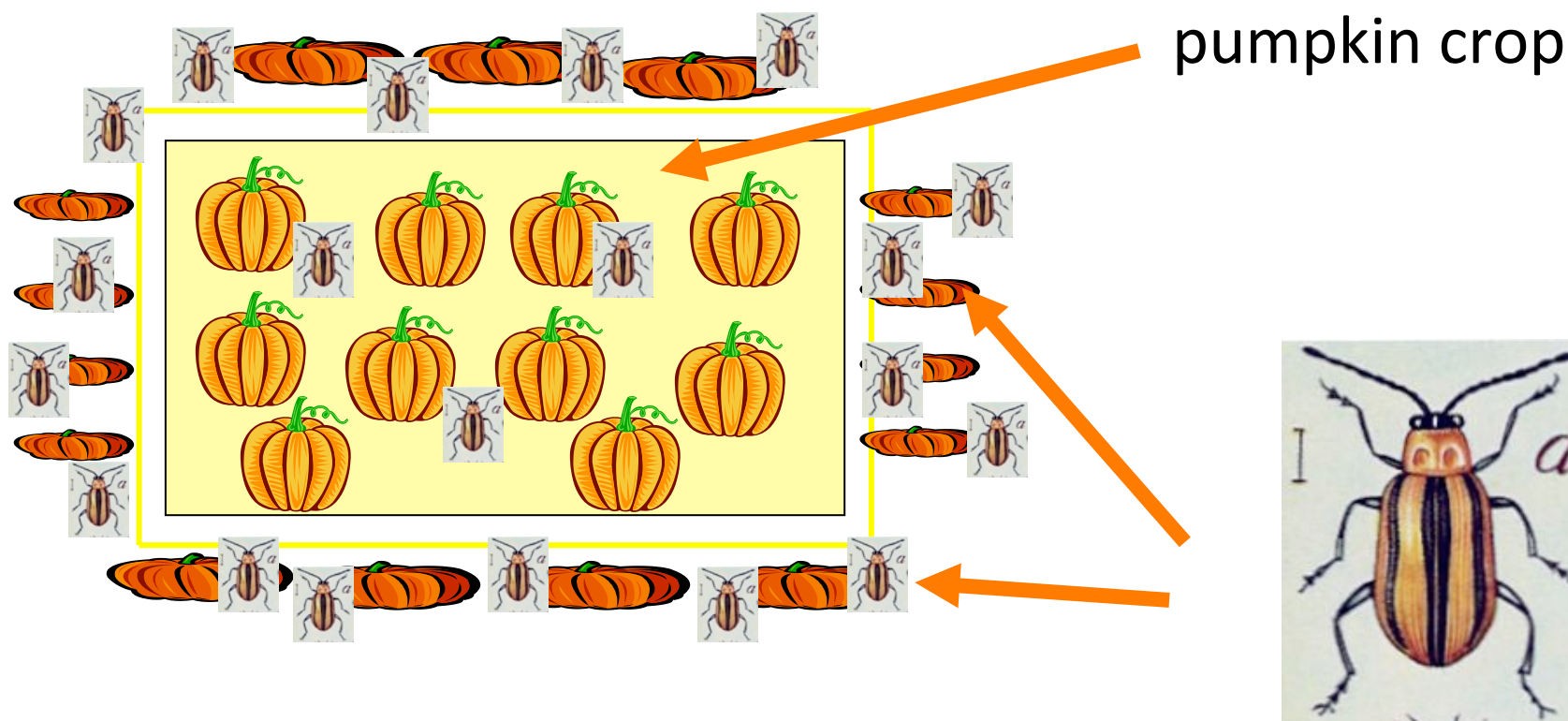
## Cultural Control

- Consider transplants around mid June to avoid early season defoliation
- Consider direct seeding around 2<sup>nd</sup> to 3<sup>rd</sup> week of June
- Use row covers to protect seedlings
- **Trap crop** early using blue hubbard squash





# Perimeter Trap Crop

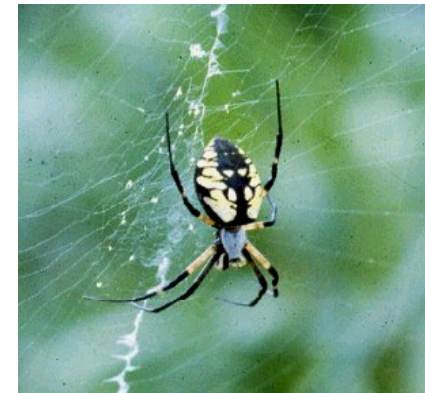
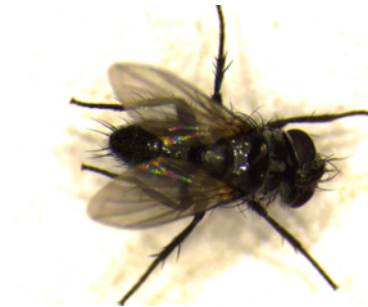


perimeter trap crop of blue hubbard is highly attractive to beetles...treat perimeter

# Pest: Cucumber beetles

## Biological Control

- Fly parasitoid (*Celatoria*)
- Spiders



Audubon's Insects & Spiders

## Chemical

- Pyrethroids, pyrethrins + PBO, imidicloprid, carbaryl

# Pest: Aphids



Vector viruses – WMV, CMV  
Secrete honeydew  
Food Contaminant



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# Pest: Aphids

## Monitoring

- arrive mostly in mid-late July
- tough to control **prior** to vectoring virus

## Cultural

- Row covers, Early planting

## Biological

- Ladybugs, Lacewings, Parasitoid Wasps




## Chemicals

- Soap, Acetamiprid, pyrethroids + PBO



# Action thresholds:

## Pumpkin, Cukes, Zukes, Squash, Melons

<i>Pest</i>	<i>Threshold</i>	<i>Insecticide</i> <span style="color: red;">updated</span>	
		<i>Natural</i>	<i>Synthetic</i>
Squash vine borer 	Preventive sprays as soon as moths active using pheromone trap (1 spray/wk for 4 wks)	pyrethrins + PBO	L-cyhalothrin (Bonide Caterpillar killer)
Cucumber beetles 	>0.5 beetle/leaf (cotyl-1st) >1 beetle/leaf (2 <sup>nd</sup> -4 <sup>th</sup> ) Feeding on maturing rind	pyrethrins + PBO	carbaryl (Sevin), imidacloprid (Bayer Fruit, Citrus, Vegetable)
Squash bug 	>1 egg mass/plant (treat nymphs)	pyrethrins + PBO	L-cyhalothrin (Bonide Beetle killer) imidacloprid (Bayer Fruit, Citrus, Vegetable)

# Pest Management in Potatoes

Univeristy of Minnesota, Dept. of Ent



C. Welty

Damag



C. Welty

Larvae of the Colorado potato beetle on tomato.



# Pest: Colorado Potato Beetle

**Monitor** – for adult emergence in late spring

- egg laying and larvae on leaf tissue late spring / early summer
- 2 generations per year

**ID** – striped adults, orange eggs and slug like larvae feeding on leaves



Larvae of the Colorado potato beetle on tomato.



# Pest: Colorado Potato Beetle

**Threshold** – up to 30% defoliation in vegetative stage OK; 10% defoliation during flowering reduces yield, some defoliation (10-30%) after flowering OK



# Pest: Colorado Potato Beetle

**Cultural** – pick larvae and adults off and toss into bucket soapy water

- Plant **early** – avoid 2<sup>nd</sup> generation larvae feeding, digging potatoes at time of emergence
- Plant **late** – short photoperiod stimulates reproductive diapause, few eggs and larvae
- Don't plant both early and late
- Rotate planted area as far as possible
- Plant alternate years to reduce pressure
- Flame beetles off plants





# Pest: Colorado Potato Beetle

- **Biocontrol**– ladybugs feeding on CPB eggs
- Two spotted stink bugs feeding on larvae
- **Chemical** options-treat seed pieces with neonic in-furrow
- larvae with Bt var. *tenebrionis* and spinosad
- adults with Asana, permethrin, other pyrethroids may not be effective



J. Ogrodnik



# Other Potato Pests

## Wireworms

- Larvae of click beetles
- Attracted to lay eggs in grass
- Live in soil for several years
- Feed on potato tubers; bait in field



Frank Peairs, Colorado  
State University,  
Bugwood.org

## Aphids

- Vector Poty viruses (Y) & other viruses
- Cause Necrotic Ringspot
- Virus transferred in seconds of bite
- Plant early? Genetics



# Pest Management in Peppers



**Bell pepper planting**

Photo by Robert Holthouse



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# Pest: European Corn Borer

## Monitoring (fruit present)

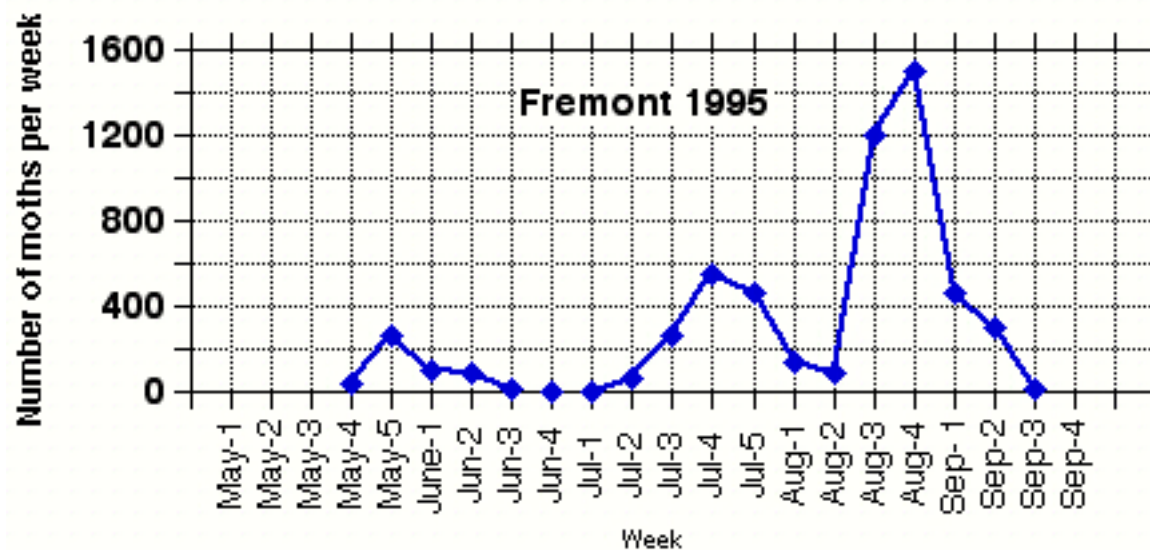
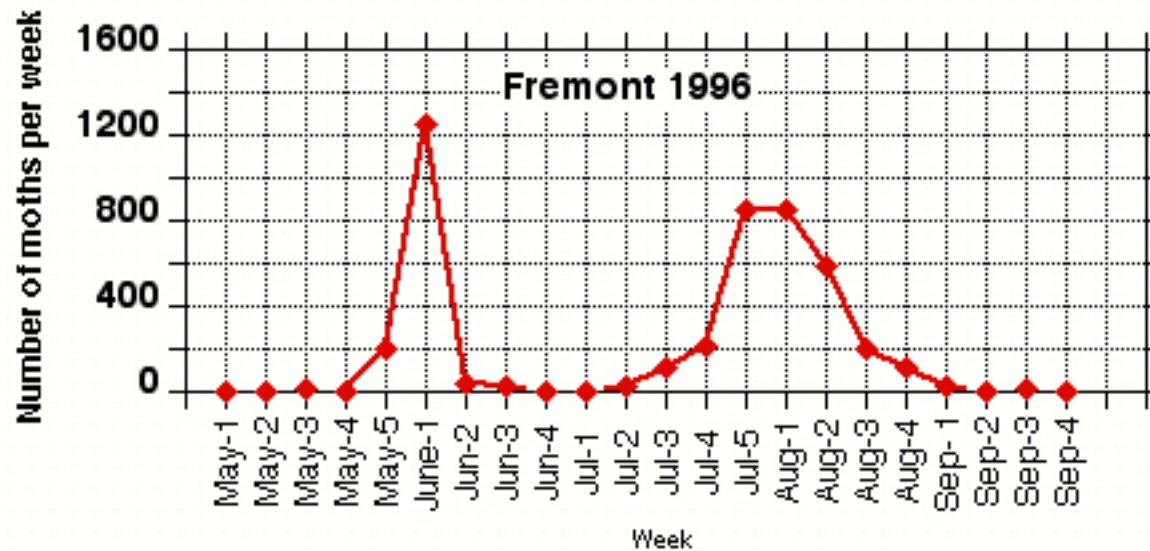
- Pheromone traps for 2<sup>nd</sup> / 3<sup>rd</sup> generation
- Damage near cap, hard to see
- Usually detected when fruit is cut open
- Mostly an issue with Bell's, but hot peppers too



Entry hole of European corn borer  
in sweet red bell pepper.



# ECB: 2 vs 3 generations



# Pest: European Corn Borer

## Identification

-moths for  
pheromone traps



Female

Male

-tan/cream colored  
larvae

- < 3/4"



European corn borer larva in jalapeño pepper.



# Pest: European Corn Borer

## Cultural

- Early planting to avoid 2<sup>nd</sup>/3<sup>rd</sup> generation
- bell's more preferred than other peppers
- Fruit are present, what else is green in the area?

## Biological

- Egg Masses: Pink and Multi-colored ladybugs (adult & larvae), also Trichogramma parasitoids
- Larvae once protected inside fruit, none

## Chemicals

- Javelin & Dipel (2x/wk), Esfenvalerate, Mustang, Spintor, etc.



*Trichogramma nubilale* wasp  
(C. E. Mason).



# Pest: Stink Bugs

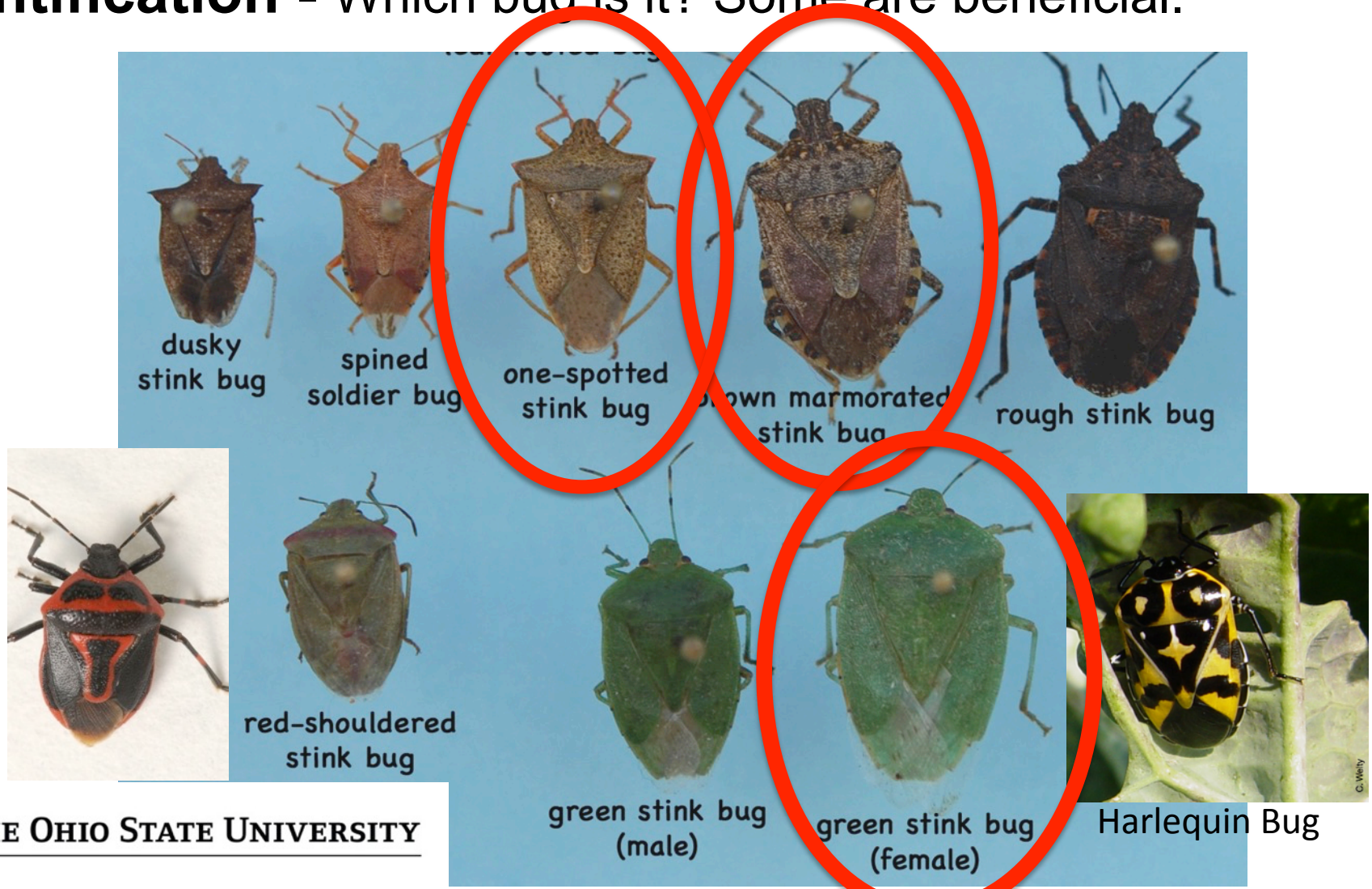
## Monitoring

- Visual scouting foliage
- Look for cloudy spot on green or red fruit
- Mostly an issue with Bell's



# Pest: Stink Bugs

**Identification** - Which bug is it? Some are beneficial.



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# Pest: Stink Bugs

## Cultural Control

- Pick bugs off
- Cull fruit if damage is significant

## Biological Control




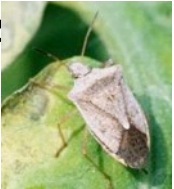
- stink bugs, parasitoid wasp, spiders

## Chemical control

- Pyrethroids, Acetamiprid, Spinosid for nymphs



# Action thresholds: Peppers

<i>Pest</i>	<i>Threshold</i>	<i>Insecticide</i> <span style="color: red;">updated</span>	
		<i>Natural</i>	<i>Synthetic</i>
aphids 	>1 colony/leaflet & no natural enemies	Soap, oil, pyrethrins+PBO	acetamiprid (Ortho Bug-B-Gone), imidacloprid (Bayer Fruit, Citrus, Vegetable)
potato flea beetle  <small>Whitney Cranshaw, Colorado State University, Bugwood.org</small>	(variable) If defoliation is severe to small plants; plant <3 inches tall and two flea beetles/plant	pyrethrin+PBO	acetamiprid (Ortho Bug-B-Gone) Bayer Fruit, Citrus, Vegetable Spinosad (Bonide Capt. Jack)
Eur. corn borer  <small>Phil Sloderbeck, Ka Bugwood.org</small>	7 moths / week pheromone trap (Aug-Sep)	B.t. (Dipel)	acetamiprid (Ortho Bug-B-Gone) Permethrin (Eight Vegetable, Fruit & Flower Conc.) Spintor & Entrust
stink bug 	First sighting or Damage on >10% or fruit	pyrethrins + PBO	acetamiprid (Ortho Bug-B-Gone) Venom, Danitol