Using multiple tactics to manage pests on vegetables

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Extension Entomologist
Ohio State University
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Topics

• Overview of management tactics

• Examples of common pests & options for managing them
  – Vine crops
  – Cole crops
Components of Integrated Pest Management (IPM)

• Monitoring

• Action thresholds

• Multiple tactics
  – Preventive options
  – Remedial options
IPM uses a **combination** of tactics

- Cultural
- Host Plant Resistance
- Mechanical
- Biological
- Behavioral
- Microbial
- Chemical
- Genetic
- Regulatory
IPM uses a combination of tactics

• Cultural *
• Host Plant Resistance
• Mechanical *
• Biological *
• Behavioral
• Microbial *
• Chemical *
• Genetic
• Regulatory
Cultural Controls

• Minimize infestations by choosing appropriate crop management practices
  o What crop is selected
  o Where crop is planted
  o When crop operations occur
  o How field is prepared & planted
  o How crop is maintained
• Trade-offs usually occur
Delayed planting

• **Cucumber beetle**
  – Problem if plant in mid-May
  – Less problem if plant in early June

• **Squash vine borer**
  – Same

• **Bean leaf beetle**
  – Peak populations in May, July
  – Fewer in June
Cover Crops

• Used to protect soil over winter
• Affects onion thrips
  – Overwinters in small grains
  – Does best in wheat
  – Does poorly in rye
Trap cropping

- Lure pest away from main crop to a more attractive crop
- Planting time options
  - Same time
  - 2 weeks early for trap crop
Perimeter trap crop

- Cantaloupe surrounded by Buttercup squash
Cultural control: trade-offs

Example: Straw Mulch

• Benefits
  – Moisture retention
  – Weed suppression
  – Reduces soil splash
  – Reduces fungal spore dispersal

• Makes some pest problems worse
  – cucumber beetles, slugs
Mechanical Controls

• Tactics to prevent or delay pests from infesting a site

• Tactics not needed for purposes other than pest management

• 2 types:
  – Exclusion
  – Removal
Exclusion by barriers

- Row covers **
- Netting, screening
- Paper bags
- Localized shields
- Copper barriers
- Trenches (deep furrows)
- Plant collars
- Fences
Row covers to exclude pests

• **Lightweight**
  – ‘Agri-bon 15’, ‘Insect Barrier’
  – 90% light transmission
    (vs 70-85% for heavier covers for frost protection)
  – Sources:
    • Johnny’s Selected Seed: $67. (10’ x 250’)
    • Gardens Alive: $35. (5’ x 110’)

[Image: Row covers being used on a field, showing a hand under a light cover.]
Row covers to exclude pests

- Beetles on beans
- Leafhoppers on beans
- Worms on cole crops
- Disease vectors:
  - Beetles on cucumbers (before flowering)
  - Aphids
Row covers to exclude pests

• Install on day of planting
• Remove
  – When first flowers appear (cucurbitas)
  – At final harvest (broccoli, beans)
Row covers to exclude pests

• Use with or w/o hoops
• Must be anchored tightly
Mechanical Control by Removal

- By beating/shaking
- Removal trapping
- Removal by vacuum
- Removal by hand
- By aspirator
Removal by beating or shaking

- Hold bucket under plant
- Tap plants with broom
- Then kill pests mechanically
- Repeat daily
- Works for Colorado potato beetle (adults, larvae)
Removal by aspirator

- **Aspirator** = Mouth-operated suction device
- **$8 – 14 from:**
  - BioQuip
  - Forestry Suppliers
  - Gempler’s
- **Good for flea beetles, bean leaf beetle, cucumber beetle**
Removal by hand

• **Labor intensive**

• **Target pests:**
  – Conspicuous pests
  – Pests not too active
  – In relatively restricted area

• **Examples**
  – Spinach leafminer (infested leaves)
  – Hornworms
  – Asparagus beetle (eggs)
  – Japanese beetle
Removal by sanitation

• Collect and destroy/compost:
  – Culled fruit
  – Crop residue (after harvest)

• Plant clean nursery stock
Biological Control

• Control of pest by other organisms that act as natural enemies

• Overview of common natural enemies
  – Predators
  – Parasitoids

• Tactics of biocontrol
Predators

- Develop at expense of more than one prey item
- Predator often larger than prey
- Prey usually killed & consumed quickly
Predators

• Green lacewings
• Lady beetles
• Insidious flower bug
• Damsel bugs
• Hover flies
Parasitoids

• Develop at expense of a single host
• Lay egg in or on host insect
• Host is usually killed slowly
Vertebrate predators eat insects!

- Bats
- Toads
- Birds
- Geese
- Hogs
Biological Control

• Conservation tactics
  – Avoid broad-spectrum insecticides
  – Provide refuge planting

• Augmentation tactics
  – Buy from insectary
    • Rincon-Vitova in California
  – Collect locally, then transfer
Refuge planting for natural enemies

• Adult parasitoids need nectar

• Adult predators need pollen

• Plant flowering border at field edge to enhance biocontrol
Refuge planting for natural enemies

- Phacelia
- sweet alyssum *
- nasturtium
- cilantro
- dill
Augmentation: Collect & transfer

• What to do?
  – Hunt for generalist predators
  – Collect them
  – Transfer them to crop

• Who, where, when?
  – Ladybug larvae on Spirea in May
  – Lacewings & aphid midges on apple leaves in early June
  – Damsel bugs on alfalfa, April-June
Chemical Control

• **Options:**
  – Use no chemicals
  – Use conventional insecticides
  – Use chemicals allowed for organic farms (on OMRI list)
Insect control products on the OMRI List

- **Behavioral control**
  - pheromone mating disruption
- **Microbial control**
  - viruses
  - B.t. (DiPel)
- **Smothering agents**
  - soaps
  - oils
- **Nerve poisons**
  - spinosad (Entrust)
  - pyrethrins (PyGanic)
- **Repellents**
  - kaolin (Surround)
  - neem
  - garlic
Insect control products on the OMRI List

- **Behavioral control**
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  - neem
  - garlic
Insecticides

• OMRI-listed, narrow spectrum
  – viruses (Gemstar)
  – pheromones (CheckMate-TPW)
  – bacteria ($B.t.$: Dipel)

• OMRI-listed, broad spectrum
  – soaps
  – oils
  – botanicals: neem, pyrethrins
  – fungi: Beauveria
Spinosad in ‘Entrust SC’

• **Targets:**
  – Mostly caterpillars
  – Some thrips, beetles, leafminers

• **Expensive!** ($689 for 1 quart at Johnny’s Seeds)

• **Rates 1.5 to 10 fl oz/A** (most 3 - 4 fl oz/A)
Repellent: ‘Surround’

## Surround® WP
Crop Protectant

### Cucurbit Vegetables
Such as cucumber, summer and winter squash, pumpkin, citron melon, muskmelon, and watermelon

<table>
<thead>
<tr>
<th>PEST</th>
<th>LBS/ACRE</th>
<th>APPLICATION INSTRUCTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cucumber beetle, grasshoppers</td>
<td>25-50</td>
<td>Suppression only*. Start prior to infestation, applying every 5-7 days, with the first two applications 3 days apart.</td>
</tr>
<tr>
<td>Powdery mildew</td>
<td></td>
<td>Suppression only*. Apply every 7-14 days as required to maintain coverage.</td>
</tr>
<tr>
<td>Sunburn and heat stress</td>
<td>25-100</td>
<td>See I D.</td>
</tr>
</tbody>
</table>

*If complete control is needed, consider using supplemental controls.
Microbial Insecticides

- **Bacteria**
  - B.t. (sprayable!): Dipel
- **Viruses**
  - Gemstar
- **Fungi**
  - *Beauveria bassiana* (Mycotrol, Naturalis)
- **Protozoans**
  - *Nosema* (Hopper Stopper; Nolo Bait)
- **Nematodes**
  - *Steinernema carpocapsae* (Millenium)
  - *Heterorhabditis bacteriophora* (Symbion)
What is B.t.?

- A natural soil-borne bacterium
- Species: *Bacillus thuringiensis*
- This bacterium produces crystal-like proteins that kill certain insects
- Found world-wide
- Produced by fermentation methods
- Discovered 1915; used since 1957
How does B.t. work?

• B.t. must be **eaten** by target insect
• B.t. contains **toxins** that are activated by insect’s gut enzymes
• toxins paralyze insect’s digestive tract
• feeding stops within 2 **hours** after eating B.t.
• death takes 1 - 5 days
B.t. products for caterpillar control

- DiPel (Valent)
- XenTari (Valent)
- Biobit (Valent)
- Javelin (Certis)
- Agree (Certis)
B.t. performance

• **Sometimes erratic due to:**
  – Breakdown in U.V. light
  – Reduced toxicity against older larvae
  – Incomplete spray coverage
  – Too long a spray interval

• **Best if:**
  – Target *young* larvae
  – Apply at 3-7 day intervals
  – Get thorough coverage
    • Lot of water (>35 gal/A)
    • Good pressure (60 psi)
Lab bioassays to evaluate insecticide efficacy

- Defoliation
- Mortality
## Trends in efficacy

<table>
<thead>
<tr>
<th>spectrum</th>
<th>Exc./Good</th>
<th>Good/Fair</th>
<th>Fair/Poor</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>broad</strong></td>
<td>pyrethrins + PBO</td>
<td>permethrin</td>
<td>neem seed oil</td>
</tr>
<tr>
<td></td>
<td>carbaryl</td>
<td>malathion</td>
<td>azadirachtin</td>
</tr>
<tr>
<td></td>
<td>esfenvalerate</td>
<td>pyrethrins + oil</td>
<td>capsaicin</td>
</tr>
<tr>
<td></td>
<td>lambda-cyhalothrin</td>
<td></td>
<td>garlic</td>
</tr>
<tr>
<td></td>
<td>cyfluthrin</td>
<td></td>
<td>pyrethrins</td>
</tr>
<tr>
<td></td>
<td>bifenthrin</td>
<td></td>
<td>+soap</td>
</tr>
<tr>
<td><strong>less broad</strong></td>
<td>spinosad</td>
<td>kaolin</td>
<td><strong>in red if on OMRI list</strong></td>
</tr>
<tr>
<td><strong>broad</strong></td>
<td>endosulfan</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>rotenone</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>narrow</strong></td>
<td>dicofol</td>
<td>B.T.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>soap</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>oil</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Can biological & chemical control ever be integrated?

• Use **selective** chemical
  – Kills pest but *not* natural enemies
  – Allows natural enemies to help kill pest
  – Example: B.t. (Dipel)

• Use product with very short residual activity

• Example: soap
Tactics for common pests

- Cole crops
- Vine crops
Cole Crop Pests

- Caterpillars
- Thrips
- Flea beetles
- Aphids
- Root maggots
# Tactics for cole crop pests

<table>
<thead>
<tr>
<th>Cultural</th>
<th>Biological</th>
<th>Chemical</th>
</tr>
</thead>
<tbody>
<tr>
<td>Caterpillars</td>
<td>⋄</td>
<td>⭐️</td>
</tr>
<tr>
<td>Thrips</td>
<td>⋄</td>
<td>⭐️</td>
</tr>
<tr>
<td>Flea beetles</td>
<td>⋄</td>
<td>⭐️</td>
</tr>
<tr>
<td>Aphids</td>
<td>⋄</td>
<td>⭐️</td>
</tr>
<tr>
<td>Root maggots</td>
<td>⋄</td>
<td>⭐️</td>
</tr>
</tbody>
</table>
Cole crops: 3 Caterpillar Species

- Imported cabbageworm
- Cabbage looper
- Diamondback moth
3 Caterpillar Species & their parasitoids

Imported cabbageworm

Cabbage looper

Diamondback moth

Cotesia larvae spinning cocoons

Copidosoma floridanum wasps emerging from one cocoon

Diadegma insulare oviposits on larvae

Cotesia adult wasp
Biological & microbial control of caterpillars on cole crops

• Use the microbial insecticide BT as a selective insecticide, spray or dust
  – ‘DiPel’, ‘Xentari’, etc.
  – Kills caterpillars
  – Does not kill parasitoids
  – Allows natural enemies to help kill pests

• Spinosad also easy on parasitoids

• Plant border of sweet alyssum to attract parasitoids
How are B.t. sprays most effective for cabbageworm control?

- Rate?
- Frequency?
- Time of day?
Cabbage trial, 2012

- cv ‘Bravo’
- Transplanted 18 May
- Scouted weekly for insects
- 1st spray 18 days after planting
- Sprays for 11 weeks
- Harvest 20 August
## Cabbage B.t. treatments

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Rate of Dipel DF</th>
<th>Frequency</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>2</td>
<td>Low (0.5 lb/A)</td>
<td>Every 7 days</td>
<td>daytime</td>
</tr>
<tr>
<td>3</td>
<td>Low (0.5 lb/A)</td>
<td>Every 14 days</td>
<td>daytime</td>
</tr>
<tr>
<td>4</td>
<td>High (1.0 lb/A)</td>
<td>Every 7 days</td>
<td>daytime</td>
</tr>
<tr>
<td>5</td>
<td>High (1.0 lb/A)</td>
<td>Every 14 days</td>
<td>daytime</td>
</tr>
<tr>
<td>6</td>
<td>Low (0.5 lb/A)</td>
<td>Every 14 days</td>
<td>evening</td>
</tr>
</tbody>
</table>
Cabbage B.t. trial:
Insect damage at harvest,
mean of 10 heads per plot

- high rate, 7 d, day: 1.98
- low rate, 7 d, day: 2.15
- low rate, 14 d, evening: 2.57
- low rate, 14 d, day: 2.6
- high rate, 14 d, day: 2.62
- untreated: 4.85

**P < 0.0001**
Cabbage B.t. trial:
Weight (kg) of 3 heads at harvest

- High rate, 7 d, day: 8.57 kg
- Low rate, 7 d, day: 8.53 kg
- Low rate, 14 d, evening: 7.84 kg
- Low rate, 14 d, day: 8.42 kg
- High rate, 14 d, day: 8.12 kg
- Untreated: 7.05 kg

P = 0.33
B.t. trial conclusions

• Frequency more important than rate
  – Every 7 days better than every 14 days
  – Low rate as effective as high rate

• Daytime spray as effective as evening spray
# Cabbage caterpillar calendar

<table>
<thead>
<tr>
<th>April</th>
<th>May</th>
<th>June</th>
<th>July</th>
<th>Aug.</th>
<th>Sept</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Imported cabbageworm</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Diamondback moth</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Cabbage looper</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Cabbage caterpillar calendar & response to insecticides

<table>
<thead>
<tr>
<th>April</th>
<th>May</th>
<th>June</th>
<th>July</th>
<th>Aug.</th>
<th>Sept</th>
</tr>
</thead>
</table>

**Imported cabbageworm**
- Easiest to kill

**Diamondback moth**
- Usually difficult to kill but varies with population’s history of resistance

**Cabbage looper**
- Most difficult to kill
Insecticides for caterpillar management on cole crops

<table>
<thead>
<tr>
<th>Insecticide</th>
<th>Imported cabbage-worm</th>
<th>Diamond-back moth</th>
<th>Cabbage looper</th>
<th>Natural enemies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conventional</td>
<td>Excellent control</td>
<td>Fair control</td>
<td>Good control</td>
<td>Poor survival</td>
</tr>
<tr>
<td>B.t.</td>
<td>Good control</td>
<td>Good control</td>
<td>Fair control</td>
<td>Excellent survival</td>
</tr>
</tbody>
</table>

Thus B.t. works best when diamondback moth or imported cabbageworm is dominant pest.
Insecticide Calendar

• Early & mid-season (April to July)
  – if imported cabbageworm &/or diamondback dominant
  – use only B.t.

• Mid- to late season (August)
  – if cabbage looper dominant pest
  – use Confirm, SpinTor, or Proclaim

• Late season (Sept.-October)
  – if cabbage looper dominant pest
  – use pyrethroids (Baythroid, etc.)
## Thrips on Cabbage

<table>
<thead>
<tr>
<th>Less damage:</th>
<th>More damage:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bravo</td>
<td>Azan</td>
</tr>
<tr>
<td>Fresco</td>
<td>Atria</td>
</tr>
<tr>
<td>Cheers</td>
<td>Coleguard</td>
</tr>
<tr>
<td>Titanic 90</td>
<td>Megaton</td>
</tr>
<tr>
<td>KingCole</td>
<td>Upton</td>
</tr>
<tr>
<td>Superkraut</td>
<td>Hinova</td>
</tr>
<tr>
<td></td>
<td>Krautpacker</td>
</tr>
<tr>
<td></td>
<td>Rodolpho</td>
</tr>
<tr>
<td></td>
<td>Superdane</td>
</tr>
</tbody>
</table>

Data on >80 varieties
C.Hoy, K.Scaife, M.Kleinhenz
Cultural controls for thrips

- Select thrips-tolerant variety
- Choose winter cover crop
  - Thrips do best in wheat
  - Thrips do poorly in rye
- Avoid planting near wheat
  - Thrips infestation often follows wheat harvest
Planting date & Cabbage Maggot

• Crop most susceptible if in seedling stage when new adults are laying eggs
• Emergence of the adults:
  – on different calendar dates each year
  – but always at the same time that certain well known plants are flowering

<table>
<thead>
<tr>
<th>GEN.</th>
<th>PLANT</th>
<th>AVG. BLOOM (Ohio)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>yellow rocket</td>
<td>early May</td>
</tr>
<tr>
<td>2</td>
<td>day lilies</td>
<td>late June</td>
</tr>
<tr>
<td>3</td>
<td>Canada thistle</td>
<td>early August</td>
</tr>
<tr>
<td>4</td>
<td>New England aster</td>
<td>early Sept.</td>
</tr>
</tbody>
</table>
Choose planting date to avoid cabbage maggot

• Do not **transplant** during the time that these plants are blooming
• Do not **seed** approximately 2 weeks before these plants are blooming
• Ideal time to seed is toward the tail end of bloom period, because seedlings would appear:
  – just after maggot flies disappear
  – well before the next flight begins
Managing Insect Pests in Commercial Vine Crops
Cucurbit Pests

• Cucumber beetles **
• Aphids
• Two-spotted spider mite
• Squash bug
• Squash vine borer
Cucumber beetles

Important damage:
• Chew seedlings
• Transmit bacterial wilt
• Chew on fruit surface

Less critical damage:
• Chew on flowers
• Larvae chew on roots
Natural enemy of cucumber beetles

• Parasitoid fly, *Celatoria*
• Looks like a small house fly
• Kills adult cucumber beetles
• Common in Ohio
  – Striped cucumber beetle, adults:
    • 0 to 38% in survey 13 farms, 2003 & 2004
  – Spotted cucumber beetle, adults:
    • 4% at 1 site, 2000

• We need to encourage its survival!
Beetle infected with nematodes
Cultural controls & cucumber beetles

• **Plant late (mid-June)**
  – After initial peak invasion

• **Avoid straw mulch**
  – Favors development of larvae in soil
Perimeter trap crop

- Squash more attractive than cantaloupe
Row covers

• Good in recent trials with cantaloupe
Cucumber beetles & conventional insecticides

- **Seed applied systemics**
  - FarMore FI 400 (since 2009)

- **Soil applied systemics**
  - Admire Pro (since 2000) or generics
  - Platinum 2SC

- **Foliar applied**
  - Before flowering:
    - Sevin; Pounce or other pyrethroids
  - During flowering:
    - No good choices due to honey bee toxicity
    - Never spray in morning; best in evening
Admire applied in-furrow provides excellent control of striped cucumber beetle on pumpkin seedlings
Seed Treatment

• For direct-seeded crops

• Advantages
  – Efficacy equal to in-furrow treatment
  – Convenience; easier application
  – Much lower rate of A.I. per acre
    • Compare to in-furrow:
      • ~25 times less (pumpkins at 3,000 seeds/A)
      • ~2 times less (pickles at 45,000 seeds/A)

• Control good during critical cotyledon to 2-leaf stage

• Control not lasting past 2-leaf stage
Cucumber beetle management by mass trapping
Cucumber Beetle Kairomone Trap

- Developed by Trécé Inc.
- Poison bait: cucurbitacin + carbaryl (inside trap)
- Volatile lure: mimic squash flowers
- Most effective before flowers form
Potted squash plants treated with soil drench of Admire
One trapping station = one trap & one box of 3 potted plants treated with Admire
5 traps at the edge of 1 plot
traps 20 ft apart

Last year’s pickle field
## Cucumber beetle management options

<table>
<thead>
<tr>
<th><strong>Category</strong></th>
<th><strong>Tactics</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Cultural</td>
<td>Delay planting (early June)</td>
</tr>
<tr>
<td></td>
<td>Plant early trap crop</td>
</tr>
<tr>
<td></td>
<td>Avoid straw mulch</td>
</tr>
<tr>
<td>Mechanical</td>
<td>Row cover (seedlings)</td>
</tr>
<tr>
<td></td>
<td>Early trap-out</td>
</tr>
<tr>
<td>Biological</td>
<td>Conserve parasitoid (no spray)</td>
</tr>
<tr>
<td>Chemical</td>
<td>Buy treated seed</td>
</tr>
<tr>
<td></td>
<td>Rescue spray</td>
</tr>
</tbody>
</table>
Cucurbit Pests

- Cucumber beetles
- Aphids
- Two-spotted spider mite
- Squash bug
- Squash vine borer
Aphids & Viruses on Cucurbits

• Tactics tested:
  – Stylet oil
  – Row covers
  – Reflective mulch
  – Soil-applied systemic insecticides
  – Foliar insecticides

• All helped control aphids but none affected virus

• Best hope is resistant varieties
Spider Mites

- Tolerable at low density
- Suppressed by natural predators
- Flare up in hot dry weather
- Soft control:
  - Insecticidal soap
  - Hort. Oil
- Chemical control:
  - Agri-Mek or others
Squash Bug: Biological control

• Feather-legged fly
  – *Trichopoda pennipes*
  – parasitoid
  – lays egg on adult or large nymph
  – common in Ohio

• Egg parasitoid wasps
Squash Bug: Cultural control

• Rotate with non-curcurbit crops
• Promote early growth of crop
• * Destroy crop remains
Squash Bug: Mechanical control

• Shelter trap
  – Board trap or shingle trap
  – On ground under squash plant
  – Check daily in early morning
  – Decide how to kill

• Row covers (until flower)

• Hand-pick egg masses
Squash Bug: Chemical control

• Challenges
  – Nymphs more susceptible than adults
  – Hard to contact in canopy
  – Need good spray pressure

• Insecticide choices:
  – Pyrethroids (Ambush, Asana, Baythroid, Capture, Danitol, Permethrin, Pounce) = good
  – Sevin = poor
Squash Vine Borer
Squash vine borer: trap for monitoring

- pheromone lure available to attract adult male moths
- trap helpful with timing insecticide to target hatching eggs
Squash Vine Borer: Chemical Control

• **Timing:**
  – 4 sprays, 1 week apart
  – At time of egg hatch
  – Estimate by catch of moths in trap
  – Peak hatch usually early July

• **Products:** pyrethroid (Ambush, Asana, Baythroid, Brigade, Danitol, Permethrin, Pounce) or EverGreen (pyrethrins + PBO)

• **Direct spray at base** of stems
Squash Vine Borer: Management

• Cultural
  – Plant late for main crop
  – Small planting early as trap crop

• Mechanical
  – Row covers (until flowering)

• Chemical
  – Insecticide
### Cucurbit pest management

<table>
<thead>
<tr>
<th>Category</th>
<th>Tactics</th>
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| **Cultural** | Delay planting (early June)  
               Plant early trap crop  
               Avoid straw mulch  
               Crop rotation |
| **Mechanical** | Row cover (seedlings)  
                   Shelter traps  
                   Hand-pick eggs  
                   Destroy crop remnants  
                   Early trap-out |
| **Biological** | Conserve natural enemies |
| **Chemical** | Buy treated seed |
Questions?