Insect Pests of Vegetables & Fruit in Home Gardens

Celeste Welty
Extension Entomologist
February 2018
Common pests: i.d. & management

- Veg specialist pests (12)
- Generalist pests on veg & fruit (6)
- Fruit specialist pests (9)
Vegetable specialist pests

– Cucurbits (4 pests)
– Cole crops (2+ pests)
– Tomato etc. (2 pests)
– Beans (2 pests)
– Spinach (1 pest)
– Asparagus (2 pests)
– Corn (2 pests)
Cucumber beetles

Striped cucumber beetle

Spotted cucumber beetle
Cucumber beetles

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

Less critical damage:
• Larvae chew on roots
• Adults chew on flowers
Bacterial wilt of cucurbits

- **Vectored by cucumber beetles**
  - Transmitted in feces
  - Enters via wound in plant (such as feeding wound)

- **Hosts:**
  - Well-known killer of cukes & melons
  - Recently adapted to kill squash & pumpkins (but slower)
Cucumber beetle management

• For beginners
  – Mechanical control
    • Screen or row cover (seedlings)
  – Chemical control
    • Spray with carbaryl, permethrin, or pyrethrins+PBO,

• For advanced gardeners
  – Cultural control
    • Early trap crop (Turks Turban or Blue Hubbard squash)
  – Biological control
    • Conserve parasitoids (by no spray)
  – Behavioral control
    • Kairomone trap
Striped cucumber beetle tested on pumpkin leaves, 7/5/05; 4 replicates/treatment, 5 beetles/replicate

Damage rating after 48 hours:
- rotenone: D
- permethrin: CD
- endosulfan: C
- carbaryl: C
- pyrethrins+PBO: C
- azadirachtin: B
- garlic: AB
- neem seed oil: AB
- capsaicin: A
- water (control): A

% Mortality after 48 hours:
- rotenone: A
- permethrin: A
- endosulfan: A
- carbaryl: A
- pyrethrins+PBO: A
- azadirachtin: B
- garlic: CD
- neem seed oil: CD
- capsaicin: C
- water (control): D
Spotted Cucumber Beetle

tested on pumpkin leaves, 9/21/2006
3 replicates/treatment, 3 beetles/replicate

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### Damage Rating after 48 Hours

- **esfenvalerate**
- **pyrethrins+PBO**
- **carbaryl**
- **endosulfan**
- **permethrin**
- **pyrethrins+oil**
- **rotenone**
- **spinosad**
- **water (control)**
- **azadirachtin**
- **pyrethrins**
- **neem seed oil**
- **pyrethrins+soap**
- **malathion**

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Damage Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>D</td>
<td>CD</td>
</tr>
<tr>
<td>BCD</td>
<td></td>
</tr>
<tr>
<td>ABC</td>
<td></td>
</tr>
<tr>
<td>AB</td>
<td></td>
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<tr>
<td>A</td>
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</tbody>
</table>

*P = 0.0088*

### Mortality after 48 Hours

- **esfenvalerate**
- **pyrethrins+PBO**
- **carbaryl**
- **endosulfan**
- **permethrin**
- **pyrethrins+oil**
- **rotenone**
- **spinosad**
- **water (control)**
- **azadirachtin**
- **pyrethrins**
- **neem seed oil**
- **pyrethrins+soap**
- **malathion**

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Mortality Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>AB</td>
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</tr>
<tr>
<td>B</td>
<td></td>
</tr>
<tr>
<td>A</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td></td>
</tr>
</tbody>
</table>

*P = 0.0001*
Squash vine borer

- Infests squash, gourd, pumpkins
- Plants often die by July
Squash vine borer

- Infests squash, gourd, pumpkins
- Plants often die by July

larva is a caterpillar that bores into stem

cocoon in soil overwinter

wilting leaves are symptom of infestation

adult is a day-flying moth, lays eggs in late June to mid-July
Squash Vine Borer: Management

• Cultural
  – Till soil to destroy pupae
  – Plant late for main crop
  – Small planting early as trap crop

• Mechanical
  – Row covers (until flowering)

• Chemical
  – Insecticide
Squash vine borer

• **Chemical control:**
  – During egg hatch period, **early July**
  – Direct at **base** of stems
  – Minimum 2 sprays 1 week apart
  – Maximum 4 sprays 1 week apart, late June to late July
  – permethrin or esfenvalerate or pyrethrins+PBO
Squash bug

- **Damage:**
  - Suck sap from stems, leaves, fruit
  - Can kill plants
  - Nymphs can feed in large groups

- **Natural enemies:**
  - 1 fly species attacks adult
  - 2 wasp species attack eggs
Squash Bug: Management

- **Cultural control**
  - Rotate with non-cucurbit crops
  - Promote early growth of crop
  - * Destroy crop remains

- **Mechanical control**
  - Row covers (until flowering)
  - Hand picking, especially eggs
  - Shelter traps: board or shingle
Squash bug

*Not registered for use on squash
Test question

• It’s late July and my **cucumber** plant is dying
  – What caused it?
  – What can I do about it?

• It’s late July and my **squash** plant is dying
  – What caused it?
  – What can I do about it?
3 Caterpillars on cole crops

- Imported cabbageworm
- Cabbage looper
- Diamondback moth
3 Caterpillars on cole crops & their parasitoids

- Imported cabbageworm
- Cabbage looper
- Diamondback moth

- *Cotesia* larvae spinning cocoons
- *Cotesia* adult wasp
- *Copidosoma floridanum* wasps emerging from one cocoon
- *Diadegma insulare* oviposits on larvae
Integration of Chemical Control & Biological Control

• Depends on choosing a selective insecticide
  – Kills caterpillars
  – Does not kill parasitoids
  – Use B.T. microbial insecticide
    • ‘DiPel’ etc.
  – Spinosad also easy on parasitoids
• Plant border of sweet alyssum to attract parasitoids
Cross-striped cabbageworm

- Spinosad: E
- Pyrethrins+PBO: E
- B.T. spray: E
- B.T. dust: E
- Carbaryl: DE
- Bifenfthin: CD
- Silicon dioxide+pyrethrins: BC
- Water: BC
- Pyrethrins+oil: B
- Neem oil: B
- Acetamiprid: B
- Azadirachtin: A

Damage rating:
- 0: A
- 1: BC
- 2: BC
- 3: BC
- 4: BC
- 5: BC
- 6: BC

P < 0.0001
9/29/2009
3 reps
3 larvae/dish

% Mortality:
- 10: A
- 20: ABC
- 30: ABC
- 40: AB
- 50: BC
- 60: BC
- 70: BC
- 80: BC

CSCW
9/29/2009
P = 0.05
Row covers
Cabbage maggot

- Turnip, radish, other cole crops
- **Symptoms:**
  - Seedlings wilted, stunted
  - Holes or tunnels in roots
- **Life cycle:**
  - Adult fly lays egg at stem base
  - Larvae feed for 3 weeks
  - 3-4 generations per year
- **Control:**
  - Choose planting date to avoid egg peak
  - Cardboard collars on stem
Colorado potato beetle

- **Damage**: chewed leaves
  - By adults & larvae
  - Potato, eggplant, tomato
- **2 generations/year**
- **Control**:
  - Hand pick (knock in bucket)
  - Plant potato early or late but not both
  - Spray larvae with spinosad
Eggplant flea beetle

- Chew many small holes in leaves
- Damage critical to seedlings
- Management:
  - Hand-picking (aspirate) daily
  - Insecticides or repellents
- Similar species on:
  - Cabbage (2 species)
  - Potato
Removal by aspirator: Eggplant flea beetle
Bean beetles

- **Bean leaf beetle:**
  - Adults chew holes through leaves, pods
- **Mexican bean beetle:**
  - A true lady beetle
  - Larvae skeletonize leaves
- **Cultural control:**
  - Exclusion (row covers)
  - Plow after harvest
- **Chemical control:**
  - Sevin or pyrethrins+PBO
Bean Leaf Beetle

<table>
<thead>
<tr>
<th>Product</th>
<th>Damage Rating</th>
<th>Soybean leaf 7/26/07</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>pyrethrins+PBO</td>
<td>D</td>
<td></td>
<td></td>
</tr>
<tr>
<td>pyrethrins+oil</td>
<td>D</td>
<td></td>
<td></td>
</tr>
<tr>
<td>lambda-cyhalothrin</td>
<td>D</td>
<td></td>
<td>&lt; 0.0001</td>
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<tr>
<td>rotenone</td>
<td>D</td>
<td></td>
<td></td>
</tr>
<tr>
<td>permethrin</td>
<td>D</td>
<td></td>
<td></td>
</tr>
<tr>
<td>bifenthrin</td>
<td>D</td>
<td></td>
<td></td>
</tr>
<tr>
<td>carbaryl</td>
<td>D</td>
<td></td>
<td></td>
</tr>
<tr>
<td>esfenvalerate</td>
<td>D</td>
<td></td>
<td></td>
</tr>
<tr>
<td>cyfluthrin</td>
<td>D</td>
<td></td>
<td></td>
</tr>
<tr>
<td>spinosad</td>
<td>C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>malathion</td>
<td>C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>pyrethrins+soap</td>
<td>B</td>
<td></td>
<td></td>
</tr>
<tr>
<td>azadirachtin</td>
<td>AB</td>
<td></td>
<td></td>
</tr>
<tr>
<td>capsaicin</td>
<td>AB</td>
<td></td>
<td></td>
</tr>
<tr>
<td>water</td>
<td>A</td>
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</tbody>
</table>

% Mortality

P < 0.0001
Field trial on snap beans
(bean leaf beetle + spotted cucumber beetle)

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Beetle Damage Rating</th>
<th>Significant Comparison</th>
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<tbody>
<tr>
<td>rotenone</td>
<td>D</td>
<td>CD</td>
</tr>
<tr>
<td>pyrethrins</td>
<td>CD</td>
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</tr>
<tr>
<td>carbaryl</td>
<td>CD</td>
<td></td>
</tr>
<tr>
<td>permethrin</td>
<td>CD</td>
<td></td>
</tr>
<tr>
<td>azadirachtin</td>
<td>CD</td>
<td></td>
</tr>
<tr>
<td>capsaicin</td>
<td>BC</td>
<td>BC</td>
</tr>
<tr>
<td>neem seed oil</td>
<td>BC</td>
<td></td>
</tr>
<tr>
<td>endosulfan</td>
<td>AB</td>
<td>AB</td>
</tr>
<tr>
<td>spinosad</td>
<td>AB</td>
<td></td>
</tr>
<tr>
<td>garlic</td>
<td>A</td>
<td></td>
</tr>
<tr>
<td>untreated check</td>
<td>A</td>
<td></td>
</tr>
</tbody>
</table>

*P = 0.0001*
Spinach leafminer & beet leafminer

• Adult fly lays eggs
  – On leaf underside
  – in early spring
• Maggots feed inside leaf, 1-2 weeks
  – Narrow mine when young
  – Large blister-like mines when older
• Pupate in soil
• Several generations per year
• Hand pick infested leaves, early
Common asparagus beetle

Spotted asparagus beetle
Asparagus beetles

• **Common asparagus beetle**
  – Adults feed on spears
  – Adults lay eggs on spears
  – Larvae feed on leaves

• **Spotted asparagus beetle**
  – Adults feed on spears
  – Larvae feed in berries
Asparagus beetles

• Management
  – Hand picking
  – Insecticides or repellents
Corn worms

1. European corn borer
   - Damage at tip or shank or side
   - Two generations per year
   - Damage in June & August
   - Worm appearance:
     • dark brown head
     • body with rows of flat spots
     • body without microspines
2. Corn earworm

- Damage at ear tip only
- Damage usually mid-August & later
- Worm appearance:
  - light brown head
  - body with long stripes
  - body covered with short microspines
Trap to Monitor Corn Earworm

- Pheromone lure
- Attracts male moths
- Highly effective
- Reports posted on web
Corn Worm Management

- **Planting date:**
  - Early & late plantings difficult
  - Middle plantings easiest

- **Traps for monitoring**
  - Excellent for corn earworm
  - Good for European corn borer

- **Chemical control:**
  - BT for 1st generation borer
  - Oil + BT in ear tip for earworm
  - Spinosad for both pests

- **Biocontrol:**
  - Encourage generalist predators
  - *Trichogramma* egg parasitoid
Veg & fruit generalist pests

- Aphids
- Mites
- Whiteflies
- Slugs
- Japanese beetle
- Brown marmorated stink bug
Aphids

**Appearance:**
- Small, soft, 2 ‘tailpipes’
- Every species with winged & wingless forms

**Damage:**
- Suck sap
- Cause leaf puckers
- Deposit honeydew
- Transmit viruses
Aphids

• **Common species:**
  – Potato aphid (tomato)
  – Green peach aphid (lettuce, pepper)
  – Melon aphid (cucurbits)
  – Rosy apple aphid (apple)
  – Green apple aphid (apple)
Aphid control

- Encourage natural enemies by avoiding use of broad-spectrum insecticides
- Suffocate with spray of insecticidal soap
- Reflective mulch to prevent colonization by winged aphids
Potato Aphid

tested on tomato leaves, 10/3/2006
3 replicates/treatment, 10 aphids/replicate

![Bar chart showing the mortality of Potato Aphid after 24 hours for different treatments.](chart.jpg)

- Soap: A
- Pyrethrins + PBO: A
- Esfenvalerate: AB
- Lambda-cyhalothrin: ABC
- Oil (Mite-X): BCD
- Malathion: BCD
- Carbaryl: BCD
- Pyrethrins: BCD
- Endosulfan: BCD
- Rotenone: BCD
- Azadirachtin: BCD
- Cyfluthrin: BCD
- Water (control): BCD
- Permethrin: CD
- Pyrethrins + oil: CD
- Pyrethrins + soap: CD
- Neem seed oil: D

\[ P = 0.0037 \]
Two-spotted spider mite

- Often overlooked
- Often mistaken for disease
- Build up in hot dry weather
Two-spotted spider mite: identification

- Tiny (1/60 inch)
- White with 2 black spots
- 8 legs
Two-spotted spider mite: hosts

- Tomato
  - Yellow blotches
- Bean
  - White stippling
Two-spotted spider mite: hosts

- Watermelon
  - Yellow blotches
  - Brown lesions
Two-spotted spider mite: diagnosis

- Fine webbing on leaf underside
- Scout by tapping leaf over paper, look for moving specks
- Early diagnosis for good control
Spider mite management

- Tolerable at low density
- Conserve natural predators
- Overhead irrigation can help
- Soft control:
  - Insecticidal soap
  - Hort. Oil
Two-spotted spider mite

tested on snap bean leaves, 10/26/05;
3 replicates/treatment, 30 mites/replicate
Whiteflies

- Suck sap
- Life stages:
  - Adult
  - Egg
  - Crawler (1\textsuperscript{st} instar)
  - Sessile nymphs
  - Pupa

- Damage done by nymphs from leaf undersides
- Control by soap sprays
Whiteflies: size

- Need magnifier to see immatures on underside of leaves
Whiteflies: hosts

tomato

Photo by C. Welty

squash

Photo by C. Welty

beans

Photo by C. Welty

lettuce

Photo by C. Welty
Whiteflies: injury symptoms

leaf scorch

sooty mold
Whiteflies: insecticides

• Best controlled by neonicotinoids
  – acetamiprid
  – imidacloprid
  – Be sure to know pre-harvest interval
Slugs

• Not insects!
• Evidence:
  – Chew leaves, stems
  – Ragged holes & tunnels
  – Leave slime trails
• Behavior:
  – Feed mostly at night
  – Hide during daytime
  – Eggs laid in fall
  – Favored by moisture, thick mulch
Slug Control

- **Cultural**
  - Lower plant density
  - Delay fall mulching
  - Remove debris around field

- **Mechanical**
  - Board traps

- **Control by border of abrasive material**
  - Diatomaceous earth (not rainfast)

- **Chemical**
  - Baits on soil around plants
Slug control by baits

• Metaldehyde (Bug-Geta, etc.)
  – Kill slugs by over stimulating mucous
  – Prevents damage
  – Toxic to dogs
  – Works best when temp. warm
Slug control by baits

- **Iron phosphate** (Sluggo, Slug Magic, etc.)
  - Light brown; less visible to pickers
  - Safe to humans, animals, natural enemies
  - Less rapid toxic effect
  - Stop the slugs from feeding
  - Eventually leads to their death
Japanese beetle

- Attacks many crops:
  - Grape
  - Raspberry
  - Blueberry
  - Plum
  - Peach
  - Sweet corn
  - Beans
- Expect start in early July
Japanese beetle

- Insecticides
  - Sevin (carbaryl)
  - pyrethrins + PBO
- Traps
  - can bring in MORE beetles
  - Do not place close to crop
### Results of Insecticide Tests in Laboratory Bioassays

#### Japanese Beetle

<table>
<thead>
<tr>
<th>Compound</th>
<th>Damage Rating</th>
<th>% Mortality</th>
</tr>
</thead>
<tbody>
<tr>
<td>rotenone</td>
<td>E</td>
<td>A</td>
</tr>
<tr>
<td>esfenvalerate</td>
<td>DE</td>
<td>A</td>
</tr>
<tr>
<td>pyrethrins+PBO</td>
<td>DE</td>
<td>A</td>
</tr>
<tr>
<td>carbaryl</td>
<td>CDE</td>
<td>A</td>
</tr>
<tr>
<td>lambda-cyhalothrin</td>
<td>CDE</td>
<td>A</td>
</tr>
<tr>
<td>permethrin</td>
<td>CDE</td>
<td>A</td>
</tr>
<tr>
<td>cyfluthrin</td>
<td>CDE</td>
<td>A</td>
</tr>
<tr>
<td>bifenthrin</td>
<td>BCDE</td>
<td>A</td>
</tr>
<tr>
<td>malathion</td>
<td>BCD</td>
<td>A</td>
</tr>
<tr>
<td>pyrethrins+soap</td>
<td>BC</td>
<td>A</td>
</tr>
<tr>
<td>pyrethrins+oil</td>
<td>B</td>
<td>A</td>
</tr>
<tr>
<td>water</td>
<td>A</td>
<td>C</td>
</tr>
<tr>
<td>azadirachtin</td>
<td>A</td>
<td>C</td>
</tr>
<tr>
<td>spinosad</td>
<td>A</td>
<td>C</td>
</tr>
<tr>
<td>capsaicin</td>
<td>A</td>
<td>C</td>
</tr>
</tbody>
</table>

- **Grape leaf**
- **6/28/07**
- **P < 0.0001**

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**Note:** The damage rating scale and % mortality are indicative of the severity of insecticide effectiveness.

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**Figure Details:**

- The chart on the left shows the damage rating for each compound on grape leaf.
- The chart on the right shows the % mortality for each compound.
Brown marmorated stink bug

- Invading Ohio since 2007
BMSB detection in Ohio: in at least 50 of 88 counties as of 2017

BMSB first reported in Ohio's 88 counties:
- red: 2008-2011, N = 9
- blue: 2012-2014; N = 31
- green: 2015-2017; N=10
Brown marmorated stink bug

- Attacks fruits & seed pods
- Also nuisance pest: invades homes in autumn
Hosts of Brown Marmorated Stink Bug

- **Fruit crop hosts:**
  - Peach, apple, pear, cherry, Asian pear
  - Raspberries, blackberries, grapes

- **Vegetable crops**
  - Sweet corn
  - Peppers
  - Tomatoes

- **Agronomic crops**
  - Soybean
  - Corn
Brown marmorated stink bug: injury

corn
pepper
tomato
beans
Brown marmorated stink bug: injury on tree fruit

peach

apple

Tracy Leskey, USDA, 2010
Note differences in size & shape in pinned specimens side-by-side
Mechanical control of stink bugs

- Lightweight row covers
- The preferred tactic in small plantings
# Stink bug control in gardens

<table>
<thead>
<tr>
<th>Category</th>
<th>Ingredient</th>
<th>Common brand</th>
</tr>
</thead>
<tbody>
<tr>
<td>pyrethroids</td>
<td>bifenthrin</td>
<td>Ortho Max Bug-G-Gon Lawn &amp; Garden Insect Killer</td>
</tr>
<tr>
<td></td>
<td>permethrin</td>
<td>Bonide Eight Insect Control Veg Fruit &amp; Flower</td>
</tr>
<tr>
<td></td>
<td>cyfluthrin</td>
<td>Bayer Advanced Garden, Triple Action Insect Killer for Lawns &amp; Gardens</td>
</tr>
<tr>
<td></td>
<td>gamma-cyhalothrin</td>
<td>Spectricide Triazicide Insect Killer Once &amp; Done!</td>
</tr>
<tr>
<td>neonicotinoid</td>
<td>acetamiprid</td>
<td>Ortho Max Flower Fruit &amp; Vegetable Insect Killer</td>
</tr>
<tr>
<td>deterrent</td>
<td>kaolin</td>
<td>Surround At Home</td>
</tr>
<tr>
<td>for nymphs, not adults</td>
<td>spinosad</td>
<td>Bonide Captain Jack’s Deadbug Brew</td>
</tr>
</tbody>
</table>
Fruit specialist pests

- Raspberry (1 pest)
- Apple (2 pests)
- Peach (2 pests)
- Apple + peach (2 pests)
- Cherry (1 pest)
- Strawberry (1 pest)
Spotted wing Drosophila

• Looks like common vinegar flies on overripe, fallen, decaying fruit

• But the new species attacks healthy ripening fruit

• Invading mainland USA since 2008
Fruit injury by Spotted wing Drosophila

raspberry
blueberry
strawberry
grape
cherry
peach
Hosts of Spotted wing Drosophila

- **Early**: cherries
- **Mid**: raspberries, blueberries, blackberries
- **Late**: grapes
- strawberry, peach, plum
- cherry tomato

Photo by Martin Hauser
Management of spotted wing Drosophila

• Sanitation
  – Strongly recommended!
  – Destroy leftover fruit
  – Easier said than done
  – Do every 2 days
  – Culls in clear plastic bags in sun, 1 week
  – Or bury culls 2 ft deep
Insecticides for SWD in garden raspberries & blackberries

Allowed, and PHI manageable:
• Very effective
  – spinosad, 3-day pre-harvest
  – bifenthrin, 3-day pre-harvest
  – bifenthrin + zeta-cypermethrin, 3-day PHI
• Effective
  – malathion, 1-day pre-harvest
• Moderately effective
  – acetamiprid, 1-day pre-harvest
• Efficacy uncertain but likely good
  – pyrethrins + PBO, 0-day pre-harvest
Representative brand names

• **spinosad:**
  – Captain Jack’s Deadbug Brew (Bonide)
  – Entrust (Dow)

• **bifenthrin:**
  – Ortho Bug B Gon Max Lawn & Garden Insect Killer

• **bifenthrin + zeta-cypermethrin:**
  – Ortho Bug B Gon Insect Killer for Lawns & Gardens

• **acetamiprid**
  – Ortho Flower Fruit & Veg. Insect Killer Concentrate

• **pyrethrins + PBO**
  – Garden Safe: Fruit & Vegetable Insect Killer
Codling moth

- The key pest in apple fruit (& pears)
- Young larva enters fruit, tunnels to seeds at core
Codling Moth
Life cycle

1st generation in May/June

2nd generation in July/August
Mechanical controls of codling moth

• Trunk bands
• Fruit bagging
Trunk bands: the idea

• Larva exits fruit
• Crawls under bark scale to pupate
• Bands offer shelter
• Destroy the shelter!
Trunk bands:
4 - 6” corrugated cardboard on trunk & main branches
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<table>
<thead>
<tr>
<th>Target</th>
<th>Install</th>
<th>Remove &amp; destroy</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st generation</td>
<td>mid-May</td>
<td>Late June</td>
</tr>
<tr>
<td>2nd generation</td>
<td>mid-July</td>
<td>November</td>
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Fruit bagging

• Supplies:
  – 2-layer Japanese bags
  – Or brown paper bags + twist ties
Fruit bagging

- Install on fruit ½ - ¾” diameter (~2 – 3 weeks after petal-fall)
- Remove 2 weeks before harvest
- Labor intensive!
Cultural controls of codling moth

• Sanitation:
  – Scrape cocoons from picking crates, fences

• Host reservoir elimination:
  – Cut down abandoned trees
Insecticide for codling moth?

• Calendar approach:
  – Spray every 2 weeks from petal-fall until harvest (= 9 sprays)

• IPM approach:
  – Use 2 sprays @ 2 generations
  – 1\textsuperscript{st} spray at 1\textsuperscript{st} egg hatch
  – 2\textsuperscript{nd} spray 14 days later
When do codling moth eggs hatch?

- Hatch begins:
  - 2 to 3 weeks after moths begin to fly
  - Memorial Day +/- 1 week
  - 250 degree-days (base 50°F) after moths begin sustained flight

- Use pheromone trap for moth flight
- ‘Biofix’ is date sustained flight begins
Insecticides for codling moth

- **Organic**
  - spinosad
  - B.t.
  - kaolin
  - azadirachtin + pyrethrins

- **Conventional**
  - carbaryl
  - malathion
  - acetamiprid
  - esfenvalerate
  - gamma-cyhalothrin

- **Natural but not OMRI**
  - pyrethrins + PBO

shorter lived & more selective (narrow spectrum)

longer lived & less selective (broad spectrum)
‘Multi-purpose fruit spray’?
(for insect + disease control)

- malathion + carbaryl + captan
  - Bonide Fruit Tree Spray Concentrate
  - Gordon’s Liquid Fruit Tree Spray
- pyrethrins + sulfur
  - Bonide Citrus, Fruit & Nut Orchard Spray
- pyrethrins + PBO + extract of neem oil
  - GreenLight Fruit Tree Spray Concentrate
  - Ferti-lome Fruit Tree Spray
- lambda-cyhalothrin + pyraclostrobin + boscalid
  - Bonide Fruit Tree & Plant Guard Concentrate
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  Beware fruit thinning for 30 days after bloom
  Only organic option
kaolin: ‘Surround At Home’
Apple maggot: damage

• A key pest in northern USA
• Not a pest in southern USA
• Variable in latitude of Ohio
Apple maggot: life stages

- Adult fly lays egg on fruit
- Larva tunnels through fruit
- Pupate in soil
Apple maggot: mechanical control

- Adult female fly attracted to round red object
- **Sticky ball trap**: 1 trap per 100 real fruit
- ‘Tanglefoot’
- Clean with mineral spirits
- Optional: fruit volatile lure
Apple maggot: chemical control

- Spray **every 2 weeks** in July & August
- **Products:**
  - acetamiprid
  - carbaryl
  - esfenvalerate
  - spinosad
Oriental Fruit Moth

- 1\textsuperscript{st} & 2\textsuperscript{nd} broods: tunnel in terminal shoots
- 2\textsuperscript{nd} & 3\textsuperscript{rd} broods: tunnel in fruit
Oriental Fruit Moth in Peaches

Control Options:

• Prune flagged terminal shoots in spring

• Insecticide
  – permethrin, malathion, or Sevin
  – Most important to apply at petal-fall
  – Additional applications in all remaining cover sprays
Borers in peach trees

• **Peachtree borer**
  – Attack healthy tree at soil line
  – One generation per year

• **Lesser peachtree borer**
  – Attack injured scaffold branches
  – Two generations per year
Cultural control of borers

• Train trees to form wide angles
• Promote healthy trees
• Avoid practices that injure bark
  – Over load of fruit
  – Improper pruning
  – Mowing injury
  – Fertilizing
  – Damage during harvest
Mechanical control of borers

- ‘Worming’
- Effective
- Insert knife or wire into entry hole
- Smash the larvae!
- Do in early spring or late fall
- Practical in small plantings
Chemical control of borers

- Dip bare roots before planting new trees
- Insecticide drench (start year 2)
  - **Preventive** via residual action
  - **Curative** via fumigant action
- Target on tree:
  - Soil line for peachtree borer
  - Trunk & scaffolds for lesser PTB
Chemical control of borers

- Recent cancellation of bark drench by chlorpyrifos or endosulfan
- Foliar spray to control adult borer:
  - spinosad
    - Bonide’s Captain Jack’s Deadbug Brew
  - permethrin
    - Bonide’s Eight
  - lambda-cyhalothrin
    - Bonide’s Fruit Tree and Plant Guard Concentrate
Plum curculio

- **External damage from egg-laying**
  - On apples
  - On plum, peach, cherry, blueberry

- **Internal damage from larvae tunneling**
  - In plum, peach, cherry, blueberry
  - Not in apple
Plum curculio: adult

- Hides during day
- Active at night
- Active when >65°F, humid, calm
- Falls when disturbed
Plum curculio: external damage

- Egg-laying scar: crescent
- Late-season feeding damage: ragged hole
Plum curculio: control

• Not many effective tactics
• Mechanical:
  – Limb jarring (‘beating’) on first warm humid nights near petal-fall
• Chemical:
  – permethrin at petal-fall
  – kaolin (‘Surround’) at petal-fall & weekly for 2 more weeks
San Jose scale

- Sucking pest
- Injures fruit & bark
- Overwinters on bark
- Disperses to fruit in crawler stage
San Jose scale: control at **dormant** stage

In late winter or early spring:

- Use **oil** to smother the overwintering population on bark
- Or use **lime sulfur**
San Jose scale: details about oil spray

- Best **before buds swell**
- When temperature **above freezing** within a day of application
- Horticultural spray oil
- Apply **dilute** (2 oz oil in 100 oz water); spray to run-off, cover all bark
San Jose scale:
post-bloom control by insecticide

• Target crawler stage
• Choices:
  – malathion
  – carbaryl (Sevin)
  – insecticidal soap
San Jose scale: When are crawlers crawling?

• Start about 4-6 weeks after bloom (early June in mid-Ohio)
• Emergence lasts several weeks
San Jose scale: How to know when crawlers are crawling?

• Use black sticky tape (electrical tape)
• Wrap sticky-side out around branch
• Look for tiny bright yellow crawlers
Cherry Fruit Fly

- Similar to apple maggot
- Female fly lays eggs on fruit for 3-4 weeks in June and July
Cherry Fruit Fly

• Mechanical control by traps
  – Yellow sticky traps baited with ammonium
• Chemical control
  – Insecticide targets adult flies
  – carbaryl or spinosad or permethrin
  – Apply within 1 week of first fly emergence
  – Every 10 days from June to harvest
Tarnished plant bug

• Causes fruit deformities:
  – Strawberry:
    • Apical seediness
    • Hollow seeds
  – Peaches:
    • ‘Catfacing’
  – Apples
    • ‘Dimples’
Tarnished plant bug

- Adults feed in flower
- Nymphs feed on flower & fruit of strawberry
Tarnished plant bug

• Cultural control by weed management
  – Weeds are also host plants
  – Especially weeds that flower early (before strawberries bloom)

• Chemical control before & after bloom
  – permethrin
  – pyrethrins + PBO
Which fruit crops have fewest pests?

- Blueberries
- Blackberries
- Red raspberries
- Ever-bearing strawberries
- Black raspberries
- Strawberries (June-bearing)
- Grapes
Info on vegetable & fruit pest management

u.osu.edu/pestmanagement/

Questions?

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