Managing SWD & Other Small Fruit Insects

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Outline

• SWD Damage and Detection

• Pre-Harvest Management Tactics

• Post-Harvest Management Tactics

• Scarab Beetles in Blueberries and Brambles
Spotted Wing Drosophila

Photos: Dr. Martin Hauser
Damage to Cherries
Damage to Blueberries
Damage to Blackberries
Damage to Raspberries
SWD Monitoring

Remember adult trap captures tend to be noticeable after there are larvae in fruit.

Adult traps are very hard to process.

Probably some earlier damage but not enough to be noticeable.
IPM tactics for SWD

• Chemical Controls
  – Insecticides

• Cultural Controls
  – Avoidance/host plant resistance
  – Sanitation
  – Exclusion
  – Habitat manipulation

• Biological Controls
  – Predators/parasitoids
Insecticides only target adults
Insecticides

If fruit is already infested, surviving larvae will replace the adults.
Insecticides

Pyrethroids and Pyrethrins (IRAC activity group 3A)
  e.g. Asana, Danitol, Mustang Maxx, Pyganic*

Spinosyns (IRAC activity group 5)
  e.g. Delegate, Spintor, Entrust*

Diamides (IRAC activity group 28)
  e.g. Exirel (only on cherries and blueberries)

Organophosphates (IRAC activity group 1B)
  e.g. Diazinon, Malathion, Imidan

Carbamates (IRAC activity group 1A)
  e.g. Sevin, Lannate

*OMRI approved for organic production
Rainfastness

0.8 inches of rain on treated bushes 1 day after application

Data From Rufus Isaacs Michigan
CA commercial raspberries: 100-200 gallons of carrier water per acre

NC commercial brambles: 30-50 gallons of carrier water per acre

Carrier water is important for coverage!
Preventing Infestation?

Few of these products show rainfastness

Must get good coverage, avoid rain, and apply frequently
Insecticides

Products for SWD are broad spectrum
Secondary Issues

Damage natural enemy populations and cause secondary pest issues

E.g. mites, scales, white flies
Pollinators

Insecticides are harmful for pollinators

Many can kill pollinators on contact, and may also have sub-lethal effects
Primary Routes of Pesticide Exposure

2014 EPA regulations to minimize exposure to bees and other pollinators changed insecticide labels
Example “Old” Insecticide Labels

DIRECTIONS FOR USE

It is a violation of Federal Law to use this product in a manner inconsistent with the labeling. Do not apply this product in a way that will contact workers or other persons, either directly or through drift. Only protected handlers may be in the area during application. For any requirements specific to your State or Tribe, consult the agency responsible for pesticide regulation.

ENVIRONMENTAL HAZARDS

This pesticide is extremely toxic to fish and aquatic invertebrates. Do not apply directly to water, or to areas where surface water is present, or to intertidal areas below the mean high water mark. Do not apply when weather conditions favor drift from treated areas. Drift and runoff from treated areas may be hazardous to aquatic organisms in neighboring areas. Do not contaminate water when cleaning equipment or when disposing of equipment washwaters.

This product is highly toxic to bees exposed to direct treatment or residues on blooming crops or weeds. Do not apply this product or allow it to drift to blooming crops if bees are visiting the treatment area.

WILDLIFE PROTECTION IS EVERYONE’S RESPONSIBILITY
Protection of Pollinators

“New” pollinator protection language now on 4 foliar neonicotinoid (Group 4A) and newer Group 28 insecticides

From Admire Pro Label (Foliar imidaclorpid)
See individual crops for specific pollinator protection application restrictions. If none exist under the specific crop, for foliar applications, follow these application directions for crops that are contracted to have pollinator services or for food/feed & commercially grown ornamentals that are attractive to pollinators:

FOR CROPS UNDER CONTRACTED POLLINATION SERVICES

Do not apply this product while bees are foraging. Do not apply this product until flowering is complete and all petals have fallen unless the following condition has been met.

If an application must be made when managed bees are at the treatment site, the beekeeper providing the pollination services must be notified no less than 48-hours prior to the time of the planned application so that the bees can be removed, covered or otherwise protected prior to spraying.
**Example: Strawberries**

### STRAWBERRY – FOLIAR

<table>
<thead>
<tr>
<th>Pests Controlled</th>
<th>Rate fluid ounces/Acre</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aphids</td>
<td></td>
</tr>
<tr>
<td>Spittlebugs</td>
<td></td>
</tr>
<tr>
<td>Whiteflies</td>
<td>1.3</td>
</tr>
</tbody>
</table>

**Strawberry – Foliar Application Restrictions**

- Pre-Harvest Interval (PHI): **7 days**
- Minimum interval between applications: **5 days**
- Maximum ADMIRE PRO SYSTEMIC PROTECTANT allowed per crop season: **3.9 fluid ounces/Acre** (0.14 lb Al/A);

Do not apply during bloom or within 10 days prior to bloom or when bees are foraging.
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Interpretation

FOR FOOD CROPS AND COMMERCIALGROWN ORNAMENTALS NOT UNDER CONTRACT FOR POLLINATION SERVICES BUT ARE ATTRACTIVE TO POLLINATORS

Do not apply this product while bees are foraging. Do not apply this product until flowering is complete and all petals have fallen unless one of the following conditions is met:

- The application is made to the target site after sunset
- The application is made to the target site when temperatures are below 55°F
- The application is made in accordance with a government-initiated public health response
- The application is made in accordance with an active state-administered apiary registry program where beekeepers are notified no less than 48-hours prior to the time of the planned application so that the bees can be removed, covered or otherwise protected prior to spraying
- The application is made due to an imminent threat of significant crop loss, and a documented determination consistent with an IPM plan or predetermined economic threshold is met. Every effort should be made to notify beekeepers no less than 48-hours prior to the time of the planned application so that the bees can be removed, covered or otherwise protected prior to spraying.

Maryland will eventually make a list
Bees are actually foraging in the area to be treated at the time of treatment.
Interpretation

For crops that do not drop all petals when bees are no longer foraging on the crop.

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Must be after sunset and below 55°F for ENTIRE duration of treatment
FOR FOOD CROPS AND COMMERCIALY GROWN ORNAMENTALS NOT UNDER CONTRACT FOR POLLINATION SERVICES BUT ARE ATTRACTIVE TO POLLINATORS

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Criteria to determine when an imminent threat exists and is documented would need to be determined by applicator in consultation with Cooperative Extension, crop consultant, certified crop advisor, or a state recognized pest management model/tool.
IPM tactics for SWD

• Chemical Controls
  – Insecticides

• Cultural Controls
  – Avoidance/host plant resistance
  – Sanitation
  – Exclusion
  – Habitat manipulation

• Biological Controls
  – Predators/parasitoids
Maryland Fruit

Populations get worse later in the season

![Graph showing population changes over time for different fruit types: Strawberry, Tart Cherry, Blueberry, Black Rasp, Blackberry, Red Rasp. The x-axis represents dates from May 21 to October 8, and the y-axis represents total SWD adults (3 traps). Peaks in population are observed for each type, indicating a seasonal trend.]
Maryland Fruit

Frost

- Cherries
- Blueberries
- Blackberries
- Primocane Red Raspberries
- Floricane Red Rasp.
- Black Rasp.
- Strawberries
- Day Neutral Strawberries

Highest Risk for SWD Damage
Avoidance

Plant varieties that avoid the period of highest pest pressure

Early to mid season varieties
IPM tactics for SWD

• Chemical Controls
  – Insecticides

• Cultural Controls
  – Avoidance/host plant resistance
  – Sanitation
  – Exclusion
  – Habitat manipulation

• Biological Controls
  – Predators/parasitoids
Sanitation

On farm sources of SWD
Sanitation

Remove and destroy cull fruit, pre- and post- harvest fruit, and harvest frequently
Destroyed?

Composting may not be enough

Bury (2’ deep), freeze, heat, or remove off site
IPM tactics for SWD

- Chemical Controls
  - Insecticides

- Cultural Controls
  - Avoidance/host plant resistance
  - Sanitation
  - Exclusion
  - Habitat manipulation

- Biological Controls
  - Predators/parasitoids
Exclusion

Feasible and economic?

USDA-OREI study
IPM tactics for SWD

• Chemical Controls
  – Insecticides

• Cultural Controls
  – Avoidance/host plant resistance
  – Sanitation
  – Exclusion
  – Habitat manipulation

• Biological Controls
  – Predators/parasitoids
Habitat Manipulation

Can pruning or mulching reduce SWD populations?

USDA-OREI study and study with B. Butler
H. Burrack Lab Blackberry Study

Where does SWD infestation most commonly occur in blackberries?

*Fruit sampled weekly, August through October at two locations*

\[\text{Canopy} \quad \text{Inner} \quad \text{Mid edge} \quad \text{Lower edge}\]

\[\text{\( \approx 15 \text{ in.} \) (38.1 cm)}\]

\[\text{\( \approx 22 \text{ in.} \) (50.8 cm)}\]

\[\times = \text{Trellis wire}\]
H. Burrack Lab Blackberry Study

Infestation by location - minimally managed site
Aug. 14 - Oct. 8 2014

Larvae per berry

Canopy Inner Lower edge Mid edge

NC STATE UNIVERSITY
Infestation by location - highly managed
Sept. 17 - Oct. 1 2014

Larvae per berry

Canopy: c
Inner: a
Lower edge: bc
Mid edge: b
Where does SWD infestation most commonly occur in blackberries?

Infestation rate highest in fruit within blackberry canopy.

- Canopy
  - ~15 in. (38.1 cm)
  - ~22 in. (50.8 cm)
- Inner
- Mid edge
- Lower edge

= Trellis wire
IPM tactics for SWD

- **Chemical Controls**
  - Insecticides
- **Cultural Controls**
  - Avoidance/host plant resistance
  - Sanitation
  - Exclusion
  - Habitat manipulation
- **Biological Controls**
  - Predators/parasitoids
Biological Controls

Some wasp parasitoids and predatory insects

Currently not providing control
Economic Threshold??

How many SWD are market detectable?

Not sure....
Outline

• SWD Damage and Detection ✔

• Pre-Harvest Management Tactics ✔

• Post-Harvest Management Tactics

• Scarab Beetles in Blueberries and Brambles
Post Harvest Management

Are there ways to manage SWD post harvest?
Methods for cold temperature experiments

Fruit infested and held to reach desired life stage for experiments

At least 24 treatment replicates and 8 control replicates were conducted for each life stage

Exposed in commercial scale cold room at 35F for 72 hrs
First instar larvae in raspberries were not impacted by storage at 35F for 72 hrs, but other life stages were impacted.
No eggs survived to pupation in blueberries held at $35F$ for 72 hrs, but some of all other life stages did.

No significant difference in survival for first and second instar.
Development took 3 days longer in cold treated fruit, meaning larvae did not develop at 35F.

Development was faster in raspberries than in blueberries.
Preliminary Results

Some died after 72 hrs at 35F

Did not develop further during that period
Consumer Detectable?

Keep fruit cool
• SWD Damage and Detection ✔

• Pre-Harvest Management Tactics ✔

• Post-Harvest Management Tactics ✔

• Scarab Beetles in Blueberries and Brambles
Adult Scarab Beetles

1/2” long by 1/4” wide
Japanese Beetle
Popilla japonica

3/8” long by 1/8” wide
Oriental Beetle
Exomala japonica

1” long by 1/2” wide
Green June Beetle
Cotinis nitida
Oriental beetles rarely feed as adults.
Adult Damage Blueberries

Japanese beetles can consume leaves and fruit
Adult Damage Brambles

Japanese beetles can consume leaves and fruit
AND
Green June beetles feed on fruit
Larval Scarab Beetles

Japanese Beetle: Popilla japonica - 1” long
Oriental Beetle: Exomala japonica - 1” long
Green June Beetle: Cotinis nitida - 2” long
Larval Damage

White grubs of all species feed on roots

May cause damage in young blueberry plantings
Japanese Beetle Life Cycle

- **Lay eggs in July in moist soil**
- **Hatch in late summer**
- **Pupate in spring**
- **Emerge in mid-June**
- **Lay eggs in July in moist soil**

*One generation per year*
Maryland Fruit

Frost

Blueberries

Blackberries

Primocane Red Raspberries

Floricane Red Rasp.

Black Rasp.

May | Jun | Jul | Aug | Sep | Oct | Nov
Maryland Fruit

Highest Risk for Adult Beetle Damage

- Primocane Red Raspberries
- Blackberries
- Blueberries

Frost

May  Jun  Jul  Aug  Sep  Oct  Nov
Japanese Beetle Life Cycle

- Lay eggs in July in moist soil
- Hatch in late summer
- Pupate in spring
- One generation per year
- Emerge in mid-June
- Lay eggs in July in moist soil

Pupate in spring

Hatch in late summer

Emerge in mid-June

Lay eggs in July in moist soil
Maryland Fruit

Frost

- Blueberries
- Blackberries
- Primocane Red Raspberries
- Floricane Red Rasp.
- Black Rasp.

May Jun Jul Aug Sep Oct Nov
Maryland Fruit

Frost

Highest Risk for White Grub Damage

Blueberries
Blackberries
Primocane Red Raspberries
Floricane Red Rasp.
Black Rasp.

May
Jun
Jul
Aug
Sep
Oct
Nov
IPM tactics for Scarabs

• **Chemical Controls**
  – Insecticides

• **Cultural Controls**
  – Avoidance
  – Sanitation
  – Exclusion

• **Biological Controls**
  – Predators/parasitoids
Insecticides for Adults

Carbamates (IRAC activity group 1A)
  e.g. Sevin, Lannate

Organophosphates (IRAC activity group 1B)
  e.g. Malathion, Imidan

Pyrethroids (IRAC activity group 3A)
  e.g. Asana, Danitol, Mustang Maxx

Neonicotinoids (IRAC activity group 4A)
  e.g. Assail, Actara, Provado

Diamides (IRAC activity group 28)
  e.g. Altacor, Exirel
“Good Control”

Carbamates (IRAC activity group 1A)
  e.g. **Sevin**, Lannate

Organophosphates (IRAC activity group 1B)
  e.g. Malathion, Imidan

Pyrethroids (IRAC activity group 3A)
  e.g. Asana, **Danitol**, Mustang Maxx

Neonicotinoids (IRAC activity group 4A)
  e.g. Assail, Actara, **Provado**

Diamides (IRAC activity group 28)
  e.g. Altacor, Exirel
“Moderate Control”

Carbamates (IRAC activity group 1A)
  e.g. Sevin, Lannate

Organophosphates (IRAC activity group 1B)
  e.g. Malathion, Imidan

Pyrethroids (IRAC activity group 3A)
  e.g. Asana, Danitol, Mustang Maxx

Neonicotinoids (IRAC activity group 4A)
  e.g. Assail, Actara, Provado

Diamides (IRAC activity group 28)
  e.g. Altacor, Exirel
OMRI Approved Insecticides Adults

Pyrethrins (IRAC activity group 3A)
  e.g. Pyganic

Azadiractin (IRAC activity group unknown)
  e.g. Aza-direct

Provide some control
Insecticides for Grubs

Neonicotinoids (IRAC activity group 4A)

e.g. Admire
IPM tactics for Scarabs

• Chemical Controls
  – Insecticides

• Cultural Controls
  – Avoidance
  – Sanitation
  – Exclusion

• Biological Controls
  – Predators/parasitoids
Avoidance-Japanese Beetle Adults

Some varieties are more attractive

Bluecrop

Heritage

Check first, will still feed on others
Avoidance - Japanese Beetle Adults

Moist soil and grassy sites are attractive
Avoidance - Japanese Beetle Adults

Plants like Virginia creeper, wild grape, and sassafras are magnets.
Avoidance - Japanese Beetle Adults

Attract beetles over a distance
Avoidance - Japanese Beetle Adults

farm attractiveness

Traps tend to increase damage near the trap
Sanitation

Remove and destroy cull fruit, pre- and post- harvest fruit, and harvest frequently

Over-ripe fruit attracts Green June beetles in initially
Sanitation

Beetles aggregate, remove and destroy them.

Evening and early morning they are less active.
Exclusion

Could use a fine meshed bird netting
IPM tactics for Scarabs

• Chemical Controls
  – Insecticides

• Cultural Controls
  – Avoidance
  – Sanitation
  – Exclusion

• Biological Controls
  – Predators/parasitoids
Adult Biocontrol

Some animals will feed on them

E.g. grackles, starlings, shrews, moles, skunks
Adult Biocontrol

Some insects will also feed on them
Adult Biocontrol

Winsome flies parasitize adult Japanese beetles

*Istocheta aldrichii*
Grub Biocontrol

Parasitic nematodes are a commercial option

Short shelf life, must follow directions
Grub Biocontrol

Steinernema glaseri and Heterorhabditis bacteriophora

Do better when soil is irrigated during treatment
Grub Biocontrol

Potentially could be used in grassy row middles and field borders
Michigan research suggests controlling grubs reduces damage for the first few weeks of next season.
Japanese Beetles

Good fliers, will keep coming in from surrounding areas
Japanese Beetles

Tend to have high populations regionally depending on the year
Questions?