Spotted Wing Drosophila in Berry Crops: The Pest, and the B.C. Experience

Alberta Farm Fresh School
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Acres of three main berry crops in southwestern British Columbia

- Highbush blueberries: 22,240 acres
- Summer raspberries: 2,965 acres
- Strawberries: 741 acres

Total berry acreage: 26,000 acres

- 110 million lbs blueberries harvested per year
- 20 million lbs raspberries harvested per year
- 5 million lbs strawberries harvested per year
SWD life cycle: 4 stages

Dispersal: pest is moved in infested fruit, or adults fly (natural spread)

SWD life cycle: 8-14 days/ generation, up to 4 generations/ yr in BC

Infested fruit is of poor quality and not marketable.

Eggs laid in ripe fruit

Male

Female

Larvae develop in ripe fruit

Fruit softens and collapses as larvae feed and grow in ripe fruit
*Drosophila suzukii* female, ovipositor

Egg laying device, used for cutting into fruit, which causes fruit to become contaminated with larvae, soften, and collapse.

Enlarged, showing serrated edges

No spots on wings
SWD males: one spot on each wing

2-3 mm long, same size as other vinegar/fruit flies.
Biology tidbits from Japanese references:

- Adults emerge in morning
- Flies will walk at 10°C, **most active at 20°C**, less active at 30°C.
- Adults live for 21-99 days, but **fall-emerged adults overwinter and live until spring**.
- Over-wintering begins in November at 5°C in sheltered places.
- Flies lay ~2 eggs per fruit, 7-16 per day, ~384 eggs per female. Eggs can be laid April-Nov in ripe fruit.
Observations

• Urban areas and grocery stores do not appear to be a source for new infestations.

• Newly emerged males do not have wing spots. It takes a few hours for spots to show up.

• All life stages may be present at once (overlapping generations).

• **Freezing** (in a freezer) will kill larvae and flies.

• Refrigeration does not kill larvae in fruit.
SWD damage

- holes where eggs were laid and fruit softening/bruising
Fruit leaks, collapsed, with small pin-prick holes. Leaky and soft.

8 days after collection at 20°C (room temp)

Infested ➔

Not Infested ➔

Leaky and soft.
SWD Impact

• Estimated economic losses based on maximum reported yield losses (in 2009 in CA, OR, and WA):
  – from 20-50% for berries.
  – In B.C., estimate 1-3 insecticide applications needed regions and crops that have SWD. More sprays needed in warmer (more southerly) areas.

• Movement to new areas (Dispersal):
  – via infested fruit.
  – Some natural spread expected.

• Not a regulated pest anywhere except Australia and New Zealand.
SWD Distribution

• First identified in August 2008 in California.
• By July 2009, in Florida, Oregon and Washington.
• September-October 2009, SWD was confirmed in British Columbia, and caused crop loss in berries.
• Present also in Europe
• Continues to spread
Spotted Wing Drosophila - *Drosophila suzukii*

Survey Status

Map views: 2008 to present alltime 2010 2009

Download: this map summarized data

- Established by Consensus
- Being Eradicated
- Eradicated
- Found
- Not Found

2009

Spotted Wing Drosophila - *Drosophila suzukii*

Survey Status

Map views: 2008 to present all time 2010 2009

Download: this map

- Established by Consensus
- Being Eradicated
- Found
- Established by Survey
- Eradicated
- Not Found

Detected in eastern states and Canada
From Pest Tracker, National Agriculture Pest Information Service (NAPIS), Cooperative Agriculture Pest Survey (CAPS) survey. 2009 to present.

(Missing the positive in Provo, Utah).

**Survey Status of Spotted Wing Drosophila - Drosophila suzukii**

**All years**

[Map showing survey status of Spotted Wing Drosophila across the United States.]
SWD present in both coastal and interior zones (and causing crop damage)
Cold Tolerance: Could SWD establish in Alberta?

• SWD overwinters in Ontario and eastern USA, and Okanagan and eastern Washington.
• Detections in Utah (Provo area).
• Overwinters as adult flies.
• Finds protected areas to ‘hunker down’.
• Survives refrigeration at all life stages.
• North American SWD appears to have lower cold threshold than Japanese flies.
Acknowledgements:

- Industry:
  - Grower/ Industry Cooperators
  - BC Blueberry Council
  - Raspberry Industry Development Council
  - Strawberry Growers Association
  - E.S. Cropconsult Ltd., and others

- Government resources:
  - Growing Forward/Biosecurity and Traceability
  - Developing Innovative Agri-Products Initiative (DIAP)
  - British Columbia Ministry of Agriculture
  - Agriculture and Agri-Food Canada

Field staff: Carolyn, Kristine, Krista, June, Anita
Monitoring Methods

For SWD flies:
1. **Cup traps**, baited with apple cider vinegar, checked weekly.

For fruit infestation:
1. **Float-out larvae in solution**
2. **Incubate ripe fruit** - collect ripe fruit, incubate it in flat ventilated dishes for 15+ days at 21°C, freeze, and count emerged SWD flies.
‘Fruit dunk’ or ‘larvae float-out’ method to monitor for larvae in fruit:

• Fruit quality assessment before shipping.
• Useful for raspberries and blueberries, not as useful for strawberries.

<table>
<thead>
<tr>
<th>Effective Solutions</th>
<th>With 4 L water</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Brown Sugar</td>
<td>0.7 kg Rogers Golden (brown) sugar</td>
</tr>
<tr>
<td>2 White sugar</td>
<td>0.7 kg granulated Rogers sugar</td>
</tr>
<tr>
<td>3 Table salt</td>
<td>0.25 kg table salt</td>
</tr>
</tbody>
</table>
# Fruit known to host SWD in 2010-2012 in coastal BC

Info from BC Ministry of Agriculture survey

<table>
<thead>
<tr>
<th>Fruit Type</th>
<th>Hosts 2011-2012</th>
<th>Did NOT detect SWD in fruit in 2011-2012:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cascara, <em>Rhamnus purshiana</em></td>
<td>Fig, <em>Ficus</em></td>
<td></td>
</tr>
<tr>
<td>Black raspberry, <em>Rubus leucodermis</em></td>
<td>Red huckleberry, <em>Vaccinium parvifolium</em></td>
<td></td>
</tr>
<tr>
<td>Indian Plum, <em>Oemleria cerasiformis</em></td>
<td>Japanese flowering dogwood, <em>Cornus</em></td>
<td></td>
</tr>
<tr>
<td>Wild <em>Prunus</em> spp. (i.e. Pincherries)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

SWD will utilize a wide variety of hosts for oviposition. New hosts continue to be found each year in BC and other regions.
# Some Wild Hosts of SWD of interest: 2012 survey

<table>
<thead>
<tr>
<th></th>
<th>#SWD / 100 fruit</th>
<th>date first picked</th>
<th>date first detected</th>
<th>Last pick</th>
</tr>
</thead>
<tbody>
<tr>
<td>Salmonberry</td>
<td>14</td>
<td>June 6</td>
<td>June 6</td>
<td>July 25</td>
</tr>
<tr>
<td>Red Elderberry</td>
<td>2</td>
<td>June 20</td>
<td>June 27</td>
<td>Aug 1</td>
</tr>
<tr>
<td>Indian Plum</td>
<td>3</td>
<td>June 27</td>
<td>July 4</td>
<td>July 4</td>
</tr>
<tr>
<td>Thimbleberry</td>
<td>5</td>
<td>July 4</td>
<td>July 25</td>
<td>Aug 1</td>
</tr>
<tr>
<td>Blackberry</td>
<td>87</td>
<td>Aug 8</td>
<td>Aug 8</td>
<td>Sept 9</td>
</tr>
</tbody>
</table>
Wild hosts get more infested as season goes on
(Fraser Valley wild fruit survey, BC, 2011)

Average number of SWD flies

- Red elderberry (10 fruit clusters)
- Salal (50 fruit)
- Blackberry (50 fruit)
Identified as SWD Hosts:

Indian Plum

Photos: Mark Sweeney, BC Agri
Oregon Grape

Salal

http://www.for.gov.bc.ca/dqc/landscape_pics.htm

Photo: Bugwood 5427289
Area wide trapping for SWD adults:

• The bait (apple cider vinegar) is a general attractant and not specific to SWD,

• Ripe fruit will out-compete the traps for flies.  

HOWEVER,

• *Traps are a useful detection tool*,

And recommended for

*Learning about SWD in Your area.*
Area-wide monitoring projects during spring to fall occurred in coastal BC blueberry and raspberry crops in 2010, 2011, and 2012.
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Average number of SWD caught in traps in hedgerows, berry field edges, and 50 m within fields, Dec 2011-Feb 2012

- Winter traps, 10 day trap check interval

Bar chart showing:
- Mean # SWD per trap in hedgerows
- Mean # SWD per trap on field edges
- Mean # SWD per trap within fields 50m+

Average # SWD per trap

Dec 16-27: 40
Dec 27-Jan 6: 80
Jan. 6-Jan. 23: 40
Jan. 23-Feb. 2: 10
Feb. 2-Feb. 13: 5
Feb. 13-Feb. 23: 1

384 Winter traps, 10 day trap check interval
Hedgerow characteristics

Delta hedgerow site:
• maximum mean trap catch 317 SWD flies, Nov 8, and NO flies Dec 30

Surrey hedgerow site:
• maximum mean trap catch 4554 SWD flies, Oct. 28, and 120 SWD flies Dec 30.

Photos: Kristine Ferris
Trapping for SWD in Blackberry Hedges bordering berry fields, Winter 2012-13 Fraser Valley

- Cold weather (freezing) causes drop in #s.
- Shifting to female bias by Dec 28.
- Spring: must look for females in traps.
Pick early, pick clean, and pick often.

- *Old hanging fruit gets loaded with SWD!*

- Keep picking intervals as short as possible,
  1. Particularly from late July through late August (BC).
  2. and from mid-pick onwards (regardless of variety or crop).

Photo: Mark Sweeney, BC Agri
Hang Time: Days 4 & 8 after beginning of colouring had fewer SWD flies emerge than fruit harvested on days 12 & 16. Optimal picking time for Bluecrop under normal conditions is day 8-10 after colouring.

Comparison of SWD infestation levels at different hang times (Blueberry, var. Bluecrop)

<table>
<thead>
<tr>
<th>Days</th>
<th>% Brix</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>10.5</td>
</tr>
<tr>
<td>8</td>
<td>12.0</td>
</tr>
<tr>
<td>12</td>
<td>12.0</td>
</tr>
<tr>
<td>16</td>
<td>13.0</td>
</tr>
</tbody>
</table>

- Average # SWD flies per 40 fruit sample
- Columns with different letters are significantly different from each other, p<0.05
Harvest and Handling:

- ‘Soft sorters’ at processing will pick out many potentially infested fruit.

- **Freezing** will kill larvae and flies,

- Cool immediately to maintain fruit quality
  - SWD will decrease fruit quality quickly (soften, leaky) if not.

*Refrigeration (>0.5°C) will not kill all SWD.*
Cold treatment: 75% decrease in SWD emergence after 5 days of cooling (one study only). *Does not eradicate SWD.*

Is cold treatment a useful tool for blueberries? Possibly, but more work needs to be done.
## RISK: Fruit Damage to berry crops in BC

<table>
<thead>
<tr>
<th>crop</th>
<th>SWD detected in fruit?</th>
<th>Dates</th>
</tr>
</thead>
<tbody>
<tr>
<td>June bearing strawberry</td>
<td>Some in late crop</td>
<td>June-July</td>
</tr>
<tr>
<td>Early raspberry</td>
<td>No</td>
<td>June</td>
</tr>
<tr>
<td>Mid to late raspberry</td>
<td>Yes</td>
<td>July-Aug</td>
</tr>
<tr>
<td>Early blueberry</td>
<td>No</td>
<td>July</td>
</tr>
<tr>
<td>Mid blueberry</td>
<td>Yes</td>
<td>Late July-Aug</td>
</tr>
<tr>
<td>Late blueberry</td>
<td>Yes, not as much as mid blueberry</td>
<td>August</td>
</tr>
<tr>
<td>Ever-bearing strawberry</td>
<td>Yes</td>
<td>August</td>
</tr>
<tr>
<td>Fall raspberry</td>
<td>Yes</td>
<td>August-Sept</td>
</tr>
<tr>
<td>blackberry</td>
<td>Yes</td>
<td>August-Sept</td>
</tr>
<tr>
<td>Grapes</td>
<td>No</td>
<td>Sept-October</td>
</tr>
</tbody>
</table>
Management Summary

• Focus on sanitation
• Utilize monitoring tools and resources, stay informed.
• Harvest early, clean, and often.
• Spray on time for the crop, date, and pest pressure.

Anticipate SWD, plan for it, and don’t be caught off guard!
SWD Biology, prevention, management, monitoring info:

• BC Ministry of Agriculture:  
  http://www.agf.gov.bc.ca/cropprot/swd.htm

• Ontario Ministry of Agriculture  
  http://www.omafra.gov.on.ca/english/crops/insects/drosophila.html

• Oregon State University:  
  http://horticulture.oregonstate.edu/group/spotted-wing-drosophila

Questions?