Seasonal phenology and overwintering status of spotted wing drosophila, *Drosophila suzukii*, in Wisconsin

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Spotted Wing Drosophila (SWD)
Life Cycle of the Spotted Wing Drosophila

*Drosophila suzukii* (Matsumura)

- **Pupation**: 4-15 days
  - Inside or outside of fruit
- **Eggs**: 12-72 hours
  - 350+ eggs in a lifetime
- **Three Larval Instars**: 5-7 days
- **Adults**: 20-30 days

*Photo credit: Cornell University, Department of Horticulture*
Hosts in Wisconsin
U.S. SWD Distribution Map

Source: Hannah Burrack, 2014. NC State University
Monitoring

• SWD phenology and biology
  – First/Last Detection
  – Population peak
  – Multi-generational
• Seasonal adaptations
Seasonal Adaptations

• Cold stress cues changes in physiology and behavior

• Survival strategies
  – Migration
  – Freeze avoidance
  – Freeze tolerance

http://www.naturenorth.com/winter/frozen/Ffrozen2.html
# Seasonal Adaptations: Spotted Wing Drosophila

<table>
<thead>
<tr>
<th>When</th>
<th>Seasonal fluctuations, early spring, late fall</th>
</tr>
</thead>
<tbody>
<tr>
<td>Where</td>
<td>Overwintering sites such as bark, lichen, decaying fruit (cultivated/wild), and mulch</td>
</tr>
<tr>
<td>How</td>
<td>In temperate regions migrate, reproductive diapause, or freezing avoidance</td>
</tr>
</tbody>
</table>
OBJECTIVES

• SWD phenology
  – First & last occurrence
  – Population density
• Seasonal morphs
  – Presence & abundance
    • Location
• Reproductive output
  – Immature & mature eggs
    • Seasonal morph
Methods: Field Experiments

- SWD Trapping
  - 2014 & 2015
  - May to Nov/Dec
- Yeast-sugar baited traps
- Landscape study *(Pelton et al. 2015)*
- 2 Locations at 6 farms
  - Raspberry
  - Woods
Methods: Lab Processing

- Counted and sexed weekly
- Sub-sampled
  - 10 females per location
  - biweekly
- Seasonal morph
  - 1023 females
  - Location
- Dissections
  - 531 females
  - Presence of immature eggs
  - # of mature eggs
OBJECTIVES

1) SWD Phenology
2) Winter-morph
3) Reproductive Output

![SWD Phenology Graph]

- **SWD per trap (mean)**
- **Sampling Year (2014)**

- **Males**
- **Females**

- **LAST**
- **PEAK**
- **FIRST**

**OBJECTIVES**
OBJECTIVES

1) SWD Phenology
2) Winter-morph
3) Reproductive Output

Pelton et al. 2014 Unpublished
• First detection
  – June/July
• Peak detection
  – 3rd week September
• Last detection
  – Mid-November
• Different population dynamics between location
1) SWD Phenology

2) Winter-morph

3) Reproductive Output

Male Winter-morph

Male Summer-morph

Female Winter-morph

Female Summer-morph
OBJECTIVES

1) SWD Phenology

2) Winter-morph

3) Reproductive Output
1) SWD Phenology
2) Winter-morph
3) Reproductive Output

Hypothesis: Woodland traps will have a higher winter-morph proportion than raspberry traps

P > 0.05; Not significant
1) SWD Phenology
2) Winter-morph
3) Reproductive Output

- Seasonal morphs
- Summer-morph
  - July-Mid-August
- Winter-morph
  - >60% by October
- Location
  - No difference between Raspberry and Woods

OBJECTIVES

September 9th
OBJECTIVES

1) SWD Phenology
2) Winter-morph
3) Reproductive Output

[Bar chart showing the presence of immature eggs (proportion) from July 16, 2014, to November 5, 2014.]
OBJECTIVES

1) SWD Phenology
2) Winter-morph
3) Reproductive Output

Hypothesis: The presence of immature eggs is dependent on seasonal morph

<table>
<thead>
<tr>
<th>Morph</th>
<th>Absence</th>
<th>Presence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Summer</td>
<td>126</td>
<td>249</td>
</tr>
<tr>
<td>Winter</td>
<td>104</td>
<td>52</td>
</tr>
</tbody>
</table>

\[ X^2 (1, N = 531) = 47.72, p < 0.001 \]
OBJECTIVES

1) SWD Phenology
2) Winter-morph
3) Reproductive Output

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**Summer-morph**

**Winter-morph**

**Mature Eggs**

**Optimal Temperature:**
- 68-77 F
- 66-73 F
- 40-59 F
OBJECTIVES

1) SWD Phenology
2) Winter-morph
3) Reproductive Output

Hypothesis: Summer-morphs will have more mature eggs than winter-morphs

<table>
<thead>
<tr>
<th>Morph</th>
<th>Mature Eggs (mean)</th>
<th>Count</th>
<th>± SE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Summer</td>
<td>3.03</td>
<td>375</td>
<td>0.29</td>
</tr>
<tr>
<td>Winter</td>
<td>0.08</td>
<td>156</td>
<td>0.05</td>
</tr>
</tbody>
</table>

\[ H = 84.918, \text{ d.f.} = 1, p = 2.2e^{-16} \]
OBJECTIVES

1) SWD Phenology
2) Winter-morph
3) Reproductive Output

• Immature eggs
  – Presence of immature eggs different between morphs

• Mature eggs
  – Average number of mature eggs different between morphs
Discussion

• Current Research
  – Seasonal morph present in fall
  – Higher population in woods but not proportion
  – Reproductive diapause in females

• Future Research
  – Early spring & reproductive output
Special thanks to everyone in the Guédot lab and all the growers, faculty, WI DATCP, and county agents who participate in SWD monitoring.

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