Exploiting stink bug migration: The intersection of chemical, physical, and behavioral control methods
Washington Species

There are approx. 50 species of stink bugs in Washington State

Red-Shoulder Stink Bug
*Thyanta pallidovirens*

Conchuela Bug
*Chlorochroa ligata*

Consperse Stink Bug
*Euschistus conspersus*
Life Cycle

May-July
14-40 eggs/cluster

Aug-July
Dormant: Oct-April

Jun-Aug (5 instars)
Habitat

Washington native stink bugs remain in natural vegetation for the majority of their lives.
Behavior

Migration into orchards is associated with vegetation senescence.

Photo: J. Hepler

Photo: A. Marshall
Current Management

Existing practices consist of broad-spectrum insecticide sprays.

Photo: Ken Gray

Photo: E. Beers

Photo: A. Marshall

Photo: A. Marshall
Objectives

Obj. 1: Determine when and how stink bugs migrate into orchard.

Obj. 2: Examine mechanical exclusion as a control tactic.
Obj.1: Determine timing, directionality, and height of stink bug migration.

• 2018: Constructed 5 - 6 x 13ft sticky barriers.

• Record stink bugs weekly by height from Jun – Sep, 2018-19.
2018 Results

Stink Bug Seasonal Direction

- Veg-Orch
- Orch-Veg
- Spray Date
2018 Results

Orch-Veg Migration Height

Avg. Stink Bug CID/Plot

0.75 A
1.92 A
3.08 A
4.25 A
5.42 A
6.58 A
7.75 A
8.92 A
10.08 A
11.25 A
12.42 A (ft)

0.23 0.58 0.94 1.30 1.65 2.01 2.36 2.71 3.07 3.43 3.78 (m)
2018 Results

Veg-Orch Migration Height

Avg. Slink Bug CID/Plot

Height: 0.75, 1.92, 3.08, 4.25, 5.42, 6.58, 7.75, 8.92, 10.08, 11.25, 12.42 (ft)

Bars indicate significant differences at the 0.05 level.
2019 Results

Veg-Orch Migration Height

Avg. Stink Bug CID/Plot

Height:
- 0.75 (0.23 ft)
- 1.92 (0.58 ft)
- 3.08 (0.94 ft)
- 4.25 (1.30 ft)
- 5.42 (1.65 ft)
- 6.58 (2.01 ft)
- 7.75 (2.36 ft)
- 8.92 (2.71 ft)
- 10.08 (3.07 ft)
- 11.25 (3.43 ft)
- 12.42 (3.78 ft)

Categories:
- A
- AB
- B
Obj.2: Evaluate efficacy of shade net barriers to exclude migrating stink bugs.

- Constructed 4 -150 x 12 ft (45.72 x 3.65 m) shade net barriers with flaps.
Experimental Design

3 treatments: 1. Netting with deltamethrin infused flaps
   2. Netting with non-insecticidal flaps
   3. No net control.

Sampled vegetation and orchard weekly from Jun – Sep 2018-19

Photo: A. Marshall
**Orchard:**
- Beat sheet sample 10 trees, 4 times each, in each sample area.
- Sum all stink bugs by life stage and species.

**Vegetation:**
- Beat sheet sample for 8 minutes.
- Sum all stink bugs by life stage and species.
2018 Results

**Stink Bug Adults**

- **Vegetation** vs. **Orchard**

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Avg. CID Stink Bug Adults/plot</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deltamethrin</td>
<td>AB</td>
</tr>
<tr>
<td>Plain Netting</td>
<td>A</td>
</tr>
<tr>
<td>Control</td>
<td>B, a</td>
</tr>
</tbody>
</table>
2018-2019 Tarp Samples
2018-2019 Target Results

Pentatomidae (Stink Bugs)

![2018-2019 Target Results](image)

### Graph Details
- **Y-axis:** Mean stink bug CTD per tarp
- **X-axis:** Deltamethrin, Pearl, Control
- **2018** and **2019** conditions compared
- **Bars:** Data representation for each condition
- **Letters:** A, B, C indicate significant differences

**Note:** Image credit: A. Marshall
2018-2019 Non-Target Results

Beneficial Insects

![Bar chart showing mean beneficial insect CID per tarp for Delhathrin, Pearl, and Control treatments for 2018 and 2019. The chart includes photos of beneficial insects.](Image)

- Photo: Neelendra Joshi
- Photo: Jean-Jacques Milan
- Photo: Sean McCann
- Photo: Robert Whyte
- Photo: Jeff Vendsel
1. Stink Bugs migrate at multiple times.
   - Treatment times are important

2. Physical barriers at orchard borders have the potential to provide season long stink bug exclusion.
Non-Target Effects

Insecticide netting is non-selective and orchard borders are a refuge for many beneficial insects.

Photo: A. Marshall

Photo: A. Marshall
BMSB in Washington Update
Whatcom  
Skagit  
Snohomish  
King  
Kitsap  
Pierce  
Thurston  
Cowlitz  
Clark  
Skamania  
Yakima  
Klickitat  
Benton  
Franklin  
Walla Walla  
Douglas  
Chelan  
Snohomish  
Pierce  
Clallam  
Jefferson  
Grays Harbor  
San Juan  
Island  
Ferry  
Okanogan  
Lincoln  
Spokane  
Kittitas  
Grant  
Adams  
Whitman  
Douglas  
Franklin  
Garfield  
Asotin  
Clallam  
San Juan  
Island  
Wahkiakum  
Clark  
2012
A Landscape-Level Pest

Migrates frequently between unmanaged habitat and orchards.

Photos by J. Hepler
Loosely modeled after early versions deployed in PA

Black deltamethrin netting draped over a 2.5m wooden planting stake, zip-tied at intervals for security against wind

Baited with 3 Dual-Lure BMSB pheromone lures

Plastic tarp collection sheet
The Poncho Trap: A Novel Attract-and-Kill Trap Design

1. Sewn-in arrestment flaps
2. Retention tubs with collection funnels
3. Dark coloration
Experimental Design

• 10 Replicates in CRBD
• Trap Contents collected 4 times from August-October
• Pre-harvest fruit evaluations
  - Visual inspections of fruit on trees; proportion with ‘stink bug damage’ recorded with clickers
• Harvested fruit evaluations
  - 10 fruit/tree from 8 trees in each treatment
  - Fruit placed in cold storage for ~3 mo.
  - Stink bug damage to be evaluated via dissection
Attract-and-Kill Field Trial

Trap Spacing: 30m
Total Rep Length: 300m
Trt. Length: 100m

Sticky trap spacing: 10 m, centered at midpoint of treatment
Sticky traps: 15 m from border row trees
AK Trial Results: LLIN Trap Captures

Mean Trap Captures: LLIN Traps

Mean BMSB / trap / inspection date

A

B

Ghost

Poncho
AK Trial Results: Treatment Effects on BMSB Intrusion

BMSB Orchard Intrusion: Sticky Trap Counts

Mean BMSB / trap / inspection date

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Trap Count</th>
</tr>
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<tbody>
<tr>
<td>Ghost</td>
<td>A</td>
</tr>
<tr>
<td>Poncho</td>
<td>A</td>
</tr>
<tr>
<td>Check</td>
<td>A</td>
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Acknowledgements

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Questions

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