Sustainable Pest Management Strategies Using Insectary Settings for Insect Pest Management and Solarization Mulch for Weed Control

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Our Goal: Non-chemical based IPM

Why a need for using non-chemical based IPM?

- Environmental hazard (bees, aquatic invertebrates)
- Low biodiversity
- Pesticide treadmill
- NOP Sunset list
National Organic Program – Sunset list

Several organic insecticides such as sulfur, horticultural oil, insecticidal soap, and even insect pheromone and sticky traps for insect management are on the National Organic Program (NOP) Sunset list due on 27 Jun, 2017.

(http://www.ams.usda.gov/AM Sv1.0/getfile?dDocName=STELPRDC5096045)
Outlines

Non-chemical based insect pest management (3 Case Studies)
- Hydroponic green onion
- Hydroponic pak choi
- Terrestrial green onion

Solarization for weed control
Plants that attract insects, either by producing abundant flowers with pollen and nectar for beneficial insects, or by luring insect pests away from the cash crop.

Hoverflies on buckwheat

Sunn hemp flowers attracts Lycaenidae butterflies that drawn Trichogramma wasps to lay eggs on the Lepidopteran eggs.
Case Study 1: Hydroponic Green Onion

Insectary

Control

Wasp nesting block

Buckwheat

Sunn hemp

Reflecting board
Wasps Nesting Block

Keyhole wasp

http://bugguide.net/node/view/241212

Buckwheat just started flowering

Number of nests/box

2/7/13 2/21/13 3/7/13 3/21/13 4/4/13 4/18/13
• Reflective (metallic) board is most effective in reducing thrips damage.
• Synchronize buckwheat flowering (3-week after planting) to onion planting
Case Study 2: Hydroponic Pak Choi Trial
Insect Pests

- Diamondback moth (DBM) larva
- Imported cabbage worm larva
- Imported cabbage web worm larva
- Aphids
Results on Insect Pests

- **Caterpillar damage**
  - Graph showing the number of caterpillars per plant over time (July 18 and July 25).
  - Three groups: Insectary, Metallic, and Control.
  - The Insectary group shows the highest number of caterpillars, followed by Metallic, and then Control.

- **Aphids**
  - Graph showing the ranking of aphids per plant over time (July 18 and July 25).
  - The Aphids group shows the highest ranking, with the Control group having the lowest ranking.

- **Caterpillar damage (%)**
  - Graph showing the percentage of caterpillar damage per plant over time (July 18 and July 25).
  - The Insectary group has the lowest percentage of caterpillar damage, followed by Metallic, and then Control.

- **Whitefly**
  - Graph showing the number of whiteflies per plant over time (July 18 and July 25).
  - The Insectary group shows the highest number of whiteflies, followed by Metallic, and then Control.
Beneficial Insects

Trichogramma wasp

Parasitized aphids

Evidence of the DBM parasitoid wasp

Hoverfly larvae eating an aphid

Spiders

Hoverfly eggs among aphids
Results on Beneficials

- Insectary plots –
  - more aphid parasitoids, less aphids,
  - Less caterpillars, caterpillar damage pak choi \((P < 0.05)\).
Insectary box:
• yielded similar to other treatments despite losing one row of crop for buckwheat plants.
• had less unmarketable pak choi than the other treatments.
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- Solarization for weed control
Case Study 3: Terrestrial Green Onion
Case Study 3:
Terrestrial Green Onion

1) Sunn hemp & Insectary

Sunn hemp (SH) for 9 weeks, no till with flail mower
Case Study 3: Terrestrial Green Onion

2) Solarization (Sol)

Till & Solarized for 11 weeks (1 µm thick, UV protected clear plastic)

3) SH + Solarization (SHSol)

Solarization for 1 month + SH grown for 7 wks
No-till with flail mower

Green onion planted into cut solarization mulch
Case Study 3: Terrestrial Green Onion

4) Bare ground (BG)
Tilled prior to planting + Organic sprays for thrips:

- Entrust (spinosad)
- Pyganic (pyrethrum)
- Trilogy (neem)
Effects of Insectary Settings and Sol on Thrips Damage

- SH + insectary suppressed thrips equivalent to organic insecticides sprays.
- Solarization suppressed thrips damage initially, but not effective throughout the whole onion crop.
Sunn hemp cover crop increased onion yield.
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- Solarization for weed control
Solarization Temperature Scheme in Hawaii

6-Week Solarization

Maximum temperature (°C)

107°F

(Wang 2011)
Case Study 3: Terrestrial Green Onion

Weed Treatments
• SH = Spray GlyStar (a.i. glyphosate).
• BG received 2 times glyphosate prior to 8/15/13.
• Hand weed in Sol, SolSH and BG (after 8/15/13).

Solarization (Sol or SHSol) made manual weed removal feasible.
Cost of Weed Management

• GlyStar cost $65.49/2.5 gal (approximately cost $0.20/fl oz), ~ $0.03/min
• Assuming labor cost $8.50/hour, i.e. $0.14/min
• Cost of solarization mulch = ~$550/acre (4-ft row spacing)

<table>
<thead>
<tr>
<th>9/12/13</th>
<th>Cost ($)/plot</th>
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<tbody>
<tr>
<td>SH</td>
<td>0.28</td>
</tr>
<tr>
<td>SHSol</td>
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<tr>
<td>Sol</td>
<td>0.49</td>
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<tr>
<td>BG</td>
<td>0.74</td>
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No-till SH also reduced weed seed bank overtime.
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