Managing thrips on lettuce, aphids on broccoli, and the new invasive pest Bagrada bug on cole crops

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Western flower thrips *Frankliniella occidentalis*

**Second instar larva**

**Adult morphs**

**Feeding damage**

**Necrotic spots by tomato spotted wilt virus**
Lettuce - experimental design

Treatments

1. Untreated control
2. Assail 30 SC (acetamiprid) 4 oz + DyneAmic (NIS) 0.1% v/v
3. Radiant SC (spinetoram) 8 fl oz + Dyne Amic 0.25%
4. BotaniGard 22 WP (*Beauveria bassiana*) 2 lb + DyneAmic 0.125%
5. Torac 15 EC (tolfenpyrad) 21 fl oz + DyneAmic 0.25%
6. Torac 15EC 21 fl oz + Lannate SP 0.75 lb + DyneAmic 0.25%
7. NNI-1171 21 fl oz (new ai) + DyneAmic 0.25%

Spraying 50* gal/acre at 70 psi with flat fan nozzle
(*100 gpa for BotaniGard)

Plot size 5 rows, 5.33’ wide 10’ long bed replicated 4 times

Planted on April 6, 2012

Treated on May 16 and 24 and June 6, 2012
Thrips populations during the study

- Untreated
- Acetamiprid
- Spinetoram
- B. bassiana
- Tolfenpyrad
- Tolfen.+Metho.
- NNI-1171

Number of thrips/plant vs Dates
Thrips after each spray application

Number of thrips/plant

- Untreated
- Acetamiprid
- Spinetoram
- B. bassiana
- Tolfenpyrad
- Tolfen.+Metho.
- NNI-1171

- Pre-treatment
- After I Spray
- After II Spray
- After III Spray

Data labels indicate statistical significance.
Thrips before and after the spray applications

- Untreated
- Acetamiprid
- Spinetoram
- B. bassiana
- Tolfenpyrad
- Tolfen.+Metho.
- NNI-1171

Number of thrips/plant

- Pre-treatment
- Post-treatment

Comparison: a, b, c
Percent change in thrips after treatment

- Untreated
- Acetamiprid
- Spinetoram
- B. bassiana
- Tolfenpyrad
- Tolfen.+Metho.
- NNI-1171
Conclusion

- Thrips numbers were significantly lower in chemical treatments compared to untreated control.

- Tolfenpyrad alone and with methomyl provided good control.

- Microbial control also has a potential for thrips management.
Cabbage aphid and green peach aphid

Cabbage aphid, *Brevicoryne brassicae*

Green peach aphid, *Myzus persicae*
Broccoli-experimental design

Treatments

1. Untreated control
2. Assail 30 SC (acetamiprid) 4 oz + DyneAmic (NIS) 0.1% v/v
3. BotaniGard 22 WP (*Beauveria bassiana*) 2 lb + DyneAmic 0.125%
4. Torac 15 EC (tolfenpyrad) 21 fl oz + DyneAmic 0.25%
5. Pyrifluquinazon 3.2 fl oz + DyneAmic 0.25%
6. NNI-1171 21 fl oz (new ai) + DyneAmic 0.25%
7. Closer (sulfoxaflor) 1.5 fl oz + DyneAmic 0.25%
8. Closer 2.0 fl oz + DyneAmic 0.25%

Spraying 50* gal/acre at 70 psi with flat fan nozzle (*100 gpa for BotaniGard*)

Plot size 5 rows, 5.33’ wide 20’ long bed replicated 4 times

Planted on July 31, 2012

Treated on September 5 and 25, 2012
Aphid populations during the study

- Untreated
- Acetamiprid
- B. bassiana
- Tolfenpyrad
- Pyrifluzinazon
- NNI-1171
- Sulfoxaflor 1.5
- Sulfoxaflor 2.0

Number of aphids/plant

Pre-treatment | I-3DAT | I-7DAT | I-13DAT | II-3DAT | II-7DAT | II-12DAT
--- | --- | --- | --- | --- | --- | ---
0 | 1 | 2 | 3 | 4 | 5 | 6
Cabbage aphids

Number of cabbage aphids/plant

- Untreated
- Acetamiprid
- B. bassiana
- Tolfenpyrad
- Pyrifluquinazon
- NNI-1171
- Sulfoxaflor 1.5
- Sulfoxaflor 2.0

Pre-treatment
I-3DAT
I-7DAT
I-13DAT
II-3DAT
II-7DAT
II-12DAT

Number of cabbage aphids/plant
Green peach aphids

Number of green peach aphids/plant

- Untreated
- Acetamiprid
- B. bassiana
- Tolfenpyrad
- Pyrifluquinazon
- NNI-1171
- Sulfoxaflor 1.5
- Sulfoxaflor 2.0

Pre-treatment
- I-3DAT
- I-7DAT
- I-13DAT
- II-3DAT
- II-7DAT
- II-12DAT
Aphids after each spray application

- Untreated
- Acetamiprid
- B. bassiana
- Tolfenpyrad
- Pyrifluquinazon
- NNI-1171
- Sulfoxaflor 1.5
- Sulfoxaflor 2.0
Aphids before and after spray applications

- Untreated
- Acetamiprid
- B. bassiana
- Tolfenpyrad
- Pyrifluquinazon
- NNI-1171
- Sulfoxaflor 1.5
- Sulfoxaflor 2.0

Comparison of aphid counts before and after spray applications. Bars with different letters (a, b) indicate statistically significant differences.
Percent change in aphids after treatment

- Percent change after treatment

- Untreated
- Acetamiprid
- B. bassiana
- Tolfenpyrad
- Pyrifluquinazon
- NNI-1171
- Sulfoxaflor 1.5
- Sulfoxaflor 2.0
Cabbage aphids before and after spray applications
Percent change in cabbage aphids after treatment
Green peach aphids before and after spray applications

![Graph showing the number of green peach aphids/plant pre-treatment and post-treatment for different treatments.](image-url)
Percent change in green peach aphids after treatment

- Untreated
- Acetamiprid
- B. bassiana
- Tolfenpyrad
- Pyrifluquinazon
- NNI-1171
- Sulfoxaflor 1.5
- Sulfoxaflor 2.0

Percent change after treatment:
Conclusions

• Cabbage and green peach aphids responded differently to treatments.

• Sulfoxaflor provided good control for both aphid species.

• *B. bassiana* provided good control of green peach aphids which was similar to some chemical treatments
Bagrada bug, *Bagrada hilaris*

Order: Hemiptera
Family: Pentatomidae (Stink bugs)

Origin: Africa

Distribution: Asia and Europe and now in Arizona and California

Host plants: Mainly cruciflers. Also infests malvaceous, leguminaceous, cucurbits, and graminaceous plants

London rocket, wild mustards, pepperweed, and others
In Los Angeles County in 2008.

**California:** Kern, Imperial, Los Angeles, Monterey, Orange, Riverside, San Diego, Santa Barbara, San Luis Obispo, and Ventura Counties

**Arizona:** Yuma, La Paz, Maricopa, and Pinal Counties

**New Mexico:** Luna, Socorro, Valencia, and Santa Fe Counties

Nevada, Utah, and Texas
Bagrada bug-Host range

**Brassicaceae**: Alyssum, arugula, broccoli, cabbage, cauliflower, collards, cress, kale, radish, rutabaga, turnips, etc.

**Cucurbitaceae**: Cantaloupes and watermelons

**Graminaceae**: Corn, millets, and wheat

**Leguminaceae**: Various legumes

**Malvaceae**: Cotton and okra

**Rosaeae**: Strawberry

**Solanaceae**: Potato
Bagrada bug-Biology

Eggs

- Barrel-shaped, laid singly or in small groups on plant surface or in soil
- Each female lays up to 95 eggs
- Whitish and turn orange with age
- Hatch in 3-6 days
Bagrada bug-Biology

Nymphs
• There are five nymphal instars
• Newly emerged nymphs are reddish orange and develop white and black markings with time
• Nymphal stage lasts for 2-3 weeks

Ta-I Huang, Univ Arizona
Adults
• They are 1/5-1/3” long and 1/8-1/6” wide
• Black with orange and white markings
• Females are larger than males
Bagrada bug-Biology

Harlequin bug vs. Bagrada bug
Bagrada bug-Damage

Suck the plant juices with their needle-like mouthparts.

Stippling with necrotic spots, stunted growth, loss of apical dominance, formation of multiple heads and plant death.
# Bagrada bug - Chemical control

## 2012 Small plot broccoli trials at Yuma Ag Center (John Palumbo and Ta-I Huang)

<table>
<thead>
<tr>
<th>Treatment</th>
<th>1-Day After Treatment</th>
<th>3-Days After Treatment</th>
<th>5-Days After Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bifenthrin</td>
<td>0.0 b</td>
<td>0.5 d</td>
<td>2.3 b</td>
</tr>
<tr>
<td>Methomyl</td>
<td>1.8 b</td>
<td>2.5 bcd</td>
<td>4.0 ab</td>
</tr>
<tr>
<td>Chlorpyrifos</td>
<td>1.5 b</td>
<td>1.5 cd</td>
<td>3.0 ab</td>
</tr>
<tr>
<td>Clothianidin</td>
<td>0.5 b</td>
<td>4.0 ab</td>
<td>5.0 a</td>
</tr>
<tr>
<td>Dinotefuran</td>
<td>0.5 b</td>
<td>2.0 bcd</td>
<td>6.8 a</td>
</tr>
<tr>
<td>Acephate</td>
<td>0.5 b</td>
<td>3.5 abc</td>
<td>4.0 ab</td>
</tr>
<tr>
<td>Untreated control</td>
<td>7.3 a</td>
<td>5.8 a</td>
<td>6.8 a</td>
</tr>
</tbody>
</table>
# Bagrada bug—Control

## 2012 Small plot broccoli trials at Yuma Ag Center (John Palumbo and Ta-I Huang)

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<tr>
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<td>0.0 b</td>
<td>1.3 bc</td>
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</tr>
<tr>
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<td>0.0 b</td>
<td>1.0 c</td>
<td>4.0 a</td>
</tr>
<tr>
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<td>0.8 b</td>
<td>5.0 ab</td>
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<td>6.8 a</td>
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</tr>
</tbody>
</table>
# Bagrada bug—Non-chemical control

<table>
<thead>
<tr>
<th>Active Ingredient</th>
<th>Product*</th>
<th>Application Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Beauveria bassiana</em> strain GHA</td>
<td>Mycotrol O®</td>
<td>1 qrt/100 gal</td>
</tr>
<tr>
<td><em>Metarhizium brunneum</em> strain F 52</td>
<td>Met 52 ®</td>
<td>1 qrt/100 gal</td>
</tr>
<tr>
<td><em>Isaria fumosorosea</em> strain FE9901</td>
<td>NoFly ®</td>
<td>28 oz/100 gal</td>
</tr>
<tr>
<td><em>Chromobacterium subtsugae</em> strain PRAA4-1</td>
<td>Grandevo®</td>
<td>3 lb/100 gal</td>
</tr>
<tr>
<td>Pyrethrins + potassium salts of fatty acids</td>
<td>Safer Yard &amp; Garden Insect Killer®</td>
<td>Ready-to-use</td>
</tr>
<tr>
<td>Essential oil blend</td>
<td>Rid-Bugs®</td>
<td>60 ml/gal</td>
</tr>
</tbody>
</table>

*Verify label status before using any of these materials*
Bagrada bug-Non-chemical control

*B. hilaris* on treated broccoli

Fungus emerging from surface-sterilized cadavers

Martin, Palumbo, Dara, and Natwick 2013
Bagrada bug - Non-chemical control

*B. hilaris* killed by *B. bassiana*

*B. hilaris* killed by *M. brunneum*

*B. hilaris* killed by *I. fumosorosea*

Martin, Palumbo, Dara, and Natwick 2013
Bagrada bug-Non-chemical control

Percent infection/mortality

- Untreated
- Mycotrol-O: *B. bassiana*
- Met 52: *M. brunneum*
- NoFly: *I. fumosorosea*
- Grandevo: *C. subtsugae*
- Safer: Pyrethrins + Insecticidal soap
- Rid-Bugs: Essential oils

Martin, Palumbo, Dara, and Natwick 2013
Bagrada bug-Cultural control

• Consider removing weed hosts
• Ensure transplants and other nursery materials are free of Bagrada bugs before planting
• Cultivate to destroy bugs and eggs in the soil; research on effectiveness has not been completed
• Exclusion: row covers may prevent damage but research on effectiveness has not been done
• Shred and disc crop immediately after harvest
• Rotate to a non-host crop
Bagrada bug-Monitoring

• Look for Bagrada bug the morning after transplanting when the sprinklers are off.
• For direct-seeded cole crops, look for bugs as soon as seedlings emerge.
• Continue monitoring weekly until the 5- to 6-leaf stage in direct seeded and transplanted crops.
• After the 5- to 6-leaf stage, laboratory and field research show most plants can tolerate Bagrada bug feeding without significant injury or yield loss.
  ▪ Monitor mid-morning to late afternoon (10 a.m.–4 p.m.) when temperatures are near or above 86°F
  ▪ Look for fresh feeding on cotyledons and young leaves; look for wilted seedlings
  ▪ Look for bugs on plants underneath cotyledons and leaves, on the stem at the soil surface, in cracks in the soil, and under dirt clods
  ▪ After insecticide applications look carefully on the soil for dead bugs (bugs blend in with the soil and also play dead when disturbed)
Bagrada bug-Thresholds

- Prevent adults from feeding on plant terminals and small cotyledons in order to establish a quality stand.

- One adult per ten-foot row of seedlings or transplants causes stand loss or unacceptable plant damage.

- For transplants, chemigate at the first sign of damage or when adults are found.

- For direct-seeded crops, chemigate when seedlings first emerge.

- When stands are established, apply an insecticide when bugs or fresh damage is readily observed.

Martin, Palumbo, Dara, and Natwick 2013
Bagrada bug-Video

http://www.youtube.com/watch?v=gSj3AZoJIRM
Acknowledgments

**Growers**
Frank Costa
San Ysidro Farms

**Technicians**
Thomas Crottogini
Pedro Villela

**Pesticide Industry**
Curt Engle
Pedro Hernandez
Jesse Richardson

**Pest infestations**