5 Ways to Create Continuous Biocontrol in Greenhouses

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IPM Laboratories, Inc.

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Today’s topics
› Biological control basics
› Continuous presence of beneficiaries
› Banker Plants
› Habitat Plants
› Pollen supplementation
› Ephesia egg supplementation
› Breeding Sachets
› Spider mite banker plant research supported by SARE grant.

What are biocontrol agents (BCAs)?
Natural Enemies of pests manipulated by humans

<table>
<thead>
<tr>
<th>Microbials</th>
<th>Beneficial Nematodes</th>
<th>Beneficial Insects and Mites</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bacteria</td>
<td>AKAs Entomopathogenic Nematodes (EPNs)</td>
<td>Parasites</td>
</tr>
<tr>
<td>Fungi</td>
<td>AKAs Insect Parasitic Nematodes (IPNs)</td>
<td>Predators</td>
</tr>
<tr>
<td>Viruses</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Microsporidians</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Fundamentals of Successful Biocontrol
› Keep pest numbers low from the beginning. Biocontrol is preventative
› Right BCA’s for the pest identified
› Be sure that the biocontrols are constantly exerting pressure on the pest
› Compatible chemicals

Somewhat compatible pesticide list

Azatin (this is an Azadirachtin)
MoltX (this is an Azadirachtin)
Botanigard
Endeavor/Fulfill
Pyrethrum (Pyreth-it, Pyganic)
Pyganic (organic pyrethrum)
Floramite
Suffoil X (Mineral oil, organic)
Kontos (systemic)
Mainspring (systemic)
Avid
Conserve

Repeated applications
› One way to assure constant presence of BCAs
› Apply fresh BCAs weekly or every other week
What kinds of beneficials are released continuously?

- Nematodes, weekly for thrips
- Cucumeris, weekly or biweekly for thrips
- Predatory mites for spider mites biweekly or monthly
- Aphid parasites and aphid midges weekly or biweekly

**Thrips control with nematodes**
new and unexpected, not scientifically proven but there are 7+ years of success

Roger McLaughley
Michaels Greenhouse
2009

250 million beneficial nematodes (S. feltiae) per 1.5 A weekly for thrips control along with wetting agent, Capsil

Sprayed in high humidity, (evenings, rainy days) so the nematodes are not inactivated by drying

**Mechanized application techniques**

- Modified leafblower makes application of predatory mites for
  Spider mite and Thrips control in just minutes

**Modified Leafblower for regular application of Cucumeris for thrips**
Why Time Treatment for the First Generation?

<table>
<thead>
<tr>
<th>Pest</th>
<th>Reproduction</th>
<th>Time Period</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aphids</td>
<td>3-6 live young</td>
<td>daily</td>
</tr>
<tr>
<td>Fungus Gnats</td>
<td>100-300 eggs</td>
<td>7-10 days</td>
</tr>
<tr>
<td>Spider Mites</td>
<td>90-200 eggs</td>
<td>8-12 days</td>
</tr>
<tr>
<td>Thrips</td>
<td>25-200 eggs</td>
<td>10-21 days</td>
</tr>
<tr>
<td>Whitefly</td>
<td>8-400 eggs</td>
<td>9-40 days</td>
</tr>
</tbody>
</table>

Timing is IMPORTANT

<table>
<thead>
<tr>
<th>Time (wks)</th>
<th>Gen</th>
<th>Number</th>
<th>30% kill (70% survivors)</th>
<th>80% kill (20% survivors)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>1st</td>
<td>1000</td>
<td>700</td>
<td>200</td>
</tr>
<tr>
<td>6</td>
<td>2nd</td>
<td>5000</td>
<td>3500</td>
<td>1000</td>
</tr>
<tr>
<td>9</td>
<td>3rd</td>
<td>25000</td>
<td>17,500</td>
<td>5000</td>
</tr>
<tr>
<td>12</td>
<td>4th</td>
<td>125,000</td>
<td>87,500</td>
<td>25,000</td>
</tr>
</tbody>
</table>

Aphid Population Growth With No Natural Enemies or Pesticides and a 3-day doubling time

<table>
<thead>
<tr>
<th>Day #</th>
<th>0</th>
<th>3</th>
<th>6</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td># Aphids</td>
<td>100</td>
<td>200</td>
<td>400</td>
<td>800</td>
</tr>
</tbody>
</table>

Aphid Population Growth With No Natural Enemies or Pesticides and a 3-day doubling time

<table>
<thead>
<tr>
<th>Day #</th>
<th>12</th>
<th>15</th>
<th>18</th>
<th>21</th>
</tr>
</thead>
<tbody>
<tr>
<td># Aphids</td>
<td>1,600</td>
<td>3,200</td>
<td>6,400</td>
<td>12,800</td>
</tr>
</tbody>
</table>

Aphid Population Growth With No Natural Enemies or Pesticides and a 4-day doubling time

<table>
<thead>
<tr>
<th>Day #</th>
<th>0</th>
<th>4</th>
<th>8</th>
<th>12</th>
</tr>
</thead>
<tbody>
<tr>
<td># Aphids</td>
<td>100</td>
<td>200</td>
<td>400</td>
<td>800</td>
</tr>
</tbody>
</table>

Aphid Population Growth With No Natural Enemies or Pesticides and a 4-day doubling time

<table>
<thead>
<tr>
<th>Day #</th>
<th>16</th>
<th>20</th>
<th>24</th>
<th>28</th>
</tr>
</thead>
<tbody>
<tr>
<td># Aphids</td>
<td>1,600</td>
<td>3,200</td>
<td>6,400</td>
<td>12,800</td>
</tr>
</tbody>
</table>
The Exceptions: easy establishers

- Stratios (old name Hypoaspis) soil dweller predator mite which finds all it needs in the substrate after a single release
- Dalotia (old name Atheta) soil dweller same as the Stratios

Dalotia = Atheta (a rove beetle)... very short elytra (wing covers)

Nematode drench to new flats for fungus gnat control. Dr. John Sanderson’s study shows that these nematodes persist for many weeks.

Aphid Banker Plant

Cereal aphid plus Aphidius colemani or Aphidoletes

Habitat: ornamental peppers

- Pepper flowers are a favorite habitat of Orius
- The # of Orius is directly related to the # of pepper flowers
- The flowers offer pollen and small “rooms” to keep the Orius nymphs away from each other
Any ornamental pepper but black pearls are not flowers!

Purple Flash works particularly well

- Faster flowering
- Long bloom period

Sweet alyssum
another favorite of Orius

Habitat baskets at Baker’s Acres 2005

Outdoor habitat for beneficials includes flowers for Orius and barley aphid banker plant
Dicyphus hesperus /mullein

- Mirid bug on first year mullein plants

Ontario Ministry of Agriculture

Ontario Ministry of Agriculture

Generalist predator used for whitefly control in vegetables.

“New” predator foods

- Cattail pollen to support predatory mites
- Ephestia eggs for Orius and Dicyphus

Cattail Pollen

- Supports Swirskii
- Resistant to Botrytis
- Spread very thinly to avoid feeding thrips
- 500 g per ha (5 g / 1000 sq ft)

Ephestia Eggs

- Grain moth eggs
- Tiny eggs, about the size of pollen
- Adds a little meat to the plant diet on habitat plants
- Add some every week or 2

Breeding units

- Self–contained
- Cucumeris for thrips and broad mite
- Swirskii for whitefly & thrips & broad mite

Predator Cucumeris

Prey Grain Mite

Pat Gaines

M. Herbut
Sachets or slow release bags
Minisachets for hanging baskets.

Banks grass mite on corn to support spider mite predators
- 2016 SARE grant
- A method demonstrated by Dr. Lance Osborne in Apopka FL
- Attempted to address a need in tomatoes to have the predatory midge Feltiella establish early before spider mites start to do damage in the tomatoes.

Organic CSA near Burlington VT

Andy Jones and Jill Rotondo, BP experimenters beside nursery area

Assessing the Banks grass mite #’s

Searching for Feltiella on banker plants in tomato greenhouse
Feltiella colonized the corn briefly but appeared to prefer the beans and tomatoes.
Sandy Menasha alerted us that the Banks grass mite also attacked the beans (broad leaved plants).
The best corn (at Nathan Ludlow’s) had roots going into the ground under the pot. The corn tassled and fruited. All the over-crowded corn simply died.

For Success:
- Select the right BCA for the pest and habitat
- Release early, when the pest first gets started
- Create continuous presence
- Avoid pesticides harmful to BCAs

Acknowledgements
- SARE Grant ONE16–259–29994 Using a Novel Banker Plant System To Prevent Spider Mite Outbreaks in Protected Culture
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- IPM Labs Staff: Julie McElfresh and Zaidee Powers
Thank you!

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