New Developments You Can Use from Biocontrol Research

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Common Mite Predators for Thrips (Whiteflies) on Foliage
N. cucumeris – pollen, thrips, various mites
Can only attack 1st instar thrips; older thrips defend themselves!

SO,
Need LOTS of cucumeris to increase the chances of killing 1st instars before they become 2nd instars.
Diet Range

A. swirskii – pollen, thrips, various mites, AND whitefly eggs & crawlers

Also can only successfully attack 1st instar thrips
Temperature & Predaceous Mites

N. cucumeris – cool temperatures

A. swirskii – cool temperatures but especially warm temperatures

Cucumeris is more cost-effective for cool temperatures; cucumeris is less expensive than swirskii
Western Flower Thrips

Release Methods for cucumeris/swirskii
Two Basic Formulations

Broadcast Formulation

Slow-release bags
How to check for shipment quality of predaceous mites

Use for:
* Hypoaspis
* N. cucumeris
* A. swirskii
* Phytoseilulus persimilis
* N. californicus
* etc.
Tips on using sachets

Keep sachets up off wet soil or other wet conditions

Place one sachet per pot and at least one per tray:
  Place sachets in contact with foliage
  Dispersal from plant to plant will increase once canopies are touching. Consider broadcasting if canopies aren’t touching

  To reduce cost, limit sachets to crops/cultivars that are most susceptible to thrips rather than all pots in the greenhouse.

Keep sachets shaded:
  hangers – inside canopy
  stakes – beneath canopy

If shade is not possible, consider broadcast or sprinkle releases.
Nematodes (Steinernema feltiae)

Controls:
Attacks lots of insects, mostly in soil (i.e., Fungus gnat larvae, soil-dwelling pupating thrips)

Type:
nematode

Characteristics:
• microscopic
• need water film to swim
• enter insect through body openings; release bacteria that kill
Nematodes

\((\text{Steinernema feltiae})\)

Sold as:

- NemaShield
- Nemasys
- Scanmask
- Entonem
- Steinernema-System
Harmful Conditions for Nematodes

Dry substrate
  - Desiccation, impaired mobility

UV light

High chlorine in water (tap water usually OK)

Incompatible pesticides
  In spray tank (residues)
  In growing mix
Pesticide compatibility with insect-killing nematodes

Links to compatibility charts:


<www.beckerunderwood.com/media/products/resources/nemasys_chemicalCompatibility_ce5c68a44e94e.pdf>

Carbamates are especially harsh on nematodes

Don’t mix with fertilizer solution
Checking Nematode “Quality”

• Place a very small sample of nematodes on a small plate or petri dish.
• Put 1 drop of water on sample.
• Wait a few minutes, and then observe them with lens or microscope.

Dead Nematode

Live Nematode

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Many greenhouse businesses are relying on weekly nematode applications for fungus gnat control and to aid in thrips control.

Great YouTube video at UMass Floriculture:

Using Beneficial Nematodes to Manage Pests in Greenhouses
Nematode persistence in growing mix:

How long will nematodes remain active?

J. Sanderson, E. Shields, A. Testa, L. White
Nematode persistence in media:

3 strains of *S. feltiae*
Single initial drench
Then add 30 FG larvae
after 0, 1, 2, 3, 4, 6, or 8 weeks
Count subsequent adults per trap after 2 weeks
Nematode persistence in media: Greenhouse test

Important note! Pots were sub-irrigated in trays
We found that a single drench of nematodes may remain effective for at least 8 weeks

May reduce need for frequent re-applications, and save money

HOWEVER…
Nematode persistence in media:

HOWEVER, the pots were sub-irrigated. Overhead watering *may* wash nematodes out of the pots. Tests are underway.
Nematodes & Thrips Pupae
Thrips pupa after infection

Nematode
Speaking of beneficials for soil-dwelling pests...

Atheta/Dalotia
Speaking of beneficials for soil-dwelling pests…

“Atheta Boxes”
- Plastic container with drainage holes, window screen covering exit holes on sides
- Inch or two of growing mix, moistened
- Small amount of trout food or turkey-rearing crumbs on top of mix
- Add 50-100 beetles
- Cover and place in greenhouse
- Check for beetles weekly and keep moist but not soggy
Aphid Biocontrol
“Colemani” (Aphidius colemani)

Controls:
Small aphids such as green peach aphid

Type:
Wasp (parasitoid)

Characteristics:
• about the size of a fungus gnat
• shiny black with clear wings
• parasitizes aphids (“mummies”) straw-colored and round (may have a round exit hole at the end of the mummy)
**Aphidius “ervi”**  
*(Aphidius ervi)*

**Controls:**  
Large aphids such as foxglove aphid and potato aphid

**Type:**  
Wasp (parasitoid)

**Characteristics:**  
- about twice the size of *A. colemani*  
- shiny black with clear wings  
- parasitizes aphids ("mummies") straw-colored and round (may have a round exit hole at the end of the mummy)
Banker Plants for Aphid Beneficials

**Components:**
- Barley plants
- “Grain aphids” (monocots only)
- Aphid parasitoids

**Advantages:**
Continuous production of parasitoids for continuous crop protection
Avoids cost of weekly shipments and releases of beneficials - serves as an “in-house insectary”
Complication of Foxglove and Other Aphids:

- **A. colemani** is not effective against foxglove aphid
- **A. ervi** is effective against foxglove aphid
- But **A. ervi** is not effective against GPA
- Release 2 kinds of wasps?
- Want a biocontrol program with a natural enemy that attacks BOTH aphids.
Most companies sell mixtures of aphid wasps

- colemani and ervi
- colemani, ervi, and Aphelinus

Might begin with colemani, then use a mixture if foxglove appears? Banker plants for colemani and ervi are not compatible.
Aphidoletes: A generalist aphid predator

- Biobest: “Aphidoletes System”
- Koppert: “AphidEnd”
- Applied Bio-nomics: “Aphidoletes”

- Sold as pupae; hatch in 2-5d
- Adults NOT predaceous, lay eggs in aphid colonies
- Larvae eat aphids
  - bite them in the kneecaps!
  - inject a paralyzing toxin
Benefits:

- Unlike parasitic wasps, **not** specific to certain aphid species; **generalist** aphid predator
- Good searching capacity
- Kill more than they consume
- “furtive predator”
Aphidoletes aphidomyza
Pupae mixed in vermiculite in trays, blister packs, bottles
Use “sentinel plants” for monitoring aphid biocontrol.

Look for mummified aphids, beneficials, killed aphids.
Use “sentinel plants” for monitoring aphid biocontrol.

Look for aphids killed by Aphidoletes.
Investigations of *Aphidoletes aphidimyza* for control of multiple aphid pests

Sarah Jandricic, Ph.D., Cornell
J. Sanderson, Cornell
S. Wraight, USDA-ARS
BIOLOGICAL CONTROL OF MULTIPLE APHID SPECIES USING APHIDOLETES

GPA

FGA

Aphidoletes
LOCATION of the aphid colonies is VERY important FOR aphidoletes’ effectiveness.

Division of plant “locations”: Left: top, middle, or bottom leaves; Right: plant centre (growing point).
92% of eggs laid on growing points (regardless of aphid species there)

56% on bottom leaves

67% on growing points
Aphid control with Aphidoletes on Spring floral crops

- GPA is usually well controlled
- FGA is not always well controlled, because the aphids often occur too low in the plant canopy
Adult *Aphidoletes* females suspended from spider web, waiting to mate.
**Aphidoletes Release Method**
Make containers with some screen for ventilation
Add slightly moistened tray of pupae
Suspend cotton threads/spider webs across inside lid
Close bucket and wait for adults to emerge
Place buckets into greenhouse, in shade, open and let them disperse
Fertilizer Effects on Aphid Population Growth and Biocontrol

John Sanderson, Entomology
Neil Mattson, Horticulture
Elizabeth Lamb, NYS IPM Program
Cornell University, Ithaca, NY
Fertilizer Options

- Traditional liquid feed
- Controlled-release/slow-release
- Organic

Climbing fertilizer prices and potential legislation regulating nitrogen & phosphorus runoff has increased greenhouse grower interest in reducing fertilizer inputs. Slow release fertilizers can reduce nutrient leaching (Mattson, unpublished).

Growers are also interested in organic production practices.
What about aphids?

- Common greenhouse pest
- Phloem feeders, so nutrients in plant sap are crucial to them
- Different fertilizer treatments may affect the amount of nutrients available to aphids
- *Common notion: the more fertilizer, the more aphids, right?*
Seven Fertilizer Treatments

1 - Unfertilized control (water only)
2 - water soluble fertilizer (WSF) low rate - 50 ppm N constant liquid feed
3 - water soluble fertilizer (WSF) high rate - 150 ppm N constant liquid feed
4 - Controlled release fertilizer (CRF) low rate - Osmocote Bloom 12-7-18 (1.75 pounds per cubic yard)
5 - Controlled release fertilizer (CRF) high rate - Osmocote Bloom 12-7-18 (3.5 pounds per cubic yard)
6 - Organic granular fertilizer (OGF) low rate - Verdanta EcoVita 7-5-10 (3 pounds per cubic yard)
7 - Organic granular fertilizer (OGF) high rate - Verdanta EcoVita 7-5-10 (6 pounds per cubic yard)
Methods

- Plants (peppers or pansies) grown from seed for 4-6 weeks, all fertilized the same
- Transplanted into 4 inch pots; grown under one of the seven fertilizer treatments for two weeks
- 3 adult female aphids of either foxglove aphid or green peach aphid added to each plant; allowed to reproduce for 2 weeks
- All aphids on all plants counted at end of 2 weeks
On peppers:

- Fertilizer regime affected aphid population growth
  - Liquid feed promotes more aphids
- GPA populations grew larger than FGA populations
- The pattern of aphid population growth due to fertilizer regime was similar for both aphids
On pansies:

- Fertilizer regime did not dramatically affect aphid population growth
- GPA populations again grew larger than FGA populations
- The pattern of aphid population growth due to fertilizer regime was similar for both aphids
Conclusions

- Plant responses to the fertilizer treatments differed. Peppers were affected by fertilizer treatment much more than pansies.
- Regardless of fertilizer treatment, GPA populations grew much larger than FGA.
- Both aphids responded in a similar pattern to the fertilizer treatments, though GPA numbers were higher.
- *More fertilizer doesn’t necessarily lead to more aphids*.
  May be plant-specific.
Next Step

- Effects of fertilizer treatments on outcome of biological control

Does biocontrol success vary with fertilizer regime?
Methods

- Both green peach aphid (GPA) and foxglove aphid (FGA)
- Both peppers and pansies
- Two fertilizer treatments:
  - Liquid feed at 75ppm (via capillary mat)
  - Osmocote at 58g/ft.³ of mix (tapwater in cap. mat)
Methods

Cages

- Two plants per 4-plant plot infested with 3 female aphids
- Reproduce for 10 days
- Two female wasps or Aphidoletes released per plot

Small greenhouse
Conclusions

- For Green Peach Aphid,
  Both A. colemani and Aphidoletes provided good control
  Fertilizer treatment did not affect successful biocontrol
  Biocontrol was successful on both peppers and pansies
Conclusions

- For Foxglove Aphid,
  - A. ervi provided good control
  - Aphidoletes did not provide sufficient control
  - Fertilizer treatment did not affect successful biocontrol with A. ervi; effect was unclear for Aphidoletes
Thanks for Your Attention!