



Trap Cropping, Indicator Plants and Banker Plants as IPM tools in High Tunnels



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Integrated Pest Management in High Tunnels

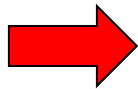
- Plant resistance
- **Cultural control**
 - Prevention
 - Exclusion
- **Biological control**
 - Predators
 - Parasitoids
- Pest Monitoring
- Insecticides



Integrating cultural and biological controls of insect pests and mites can greatly expand the number of effective options in our IPM toolbox

IPM and cultural controls (field)

- Host plant resistance
- Transplanting
- Crop rotation
- Crop density / spacing
- Soil quality management
- Sanitation
- Farmscaping/habitat manipulation
- Trap cropping
- Cover crops
- Use of mulches
- Intercropping
- Alter planting / harvest dates



Natural enemies

- Predators (e.g., beetles & predatory bugs)
- Parasitoids (parasitic wasps, some flies)
- Pathogens (viruses, bacteria, fungi)



Caterpillar killed by *Beauveria bassiana*, a fungal pathogen



Healthy caterpillar

Caterpillar killed by a virus



The top caterpillar was killed by *Bacillus thuringiensis* (**Bt**), a naturally occurring bacterial disease of insects.



Aphid parasitoid

Biological control is proactive

Specialists

- Releases of parasitic wasps and/or predatory insects need to be done earlier in the season (based on pest monitoring)
- Normally, several releases need to be done (based on calendar)
- Usually, released biological control agents are expected to perform without provisioning them with anything other than the prey / host they are supposed to attack
- It takes time for results to be visible



Aphid Parasite, *Aphidius ervi* - 250 Mummies
SKU: 1001001

Use this aphid parasite to prevent outbreaks of larger aphid species in greenhouse environments.

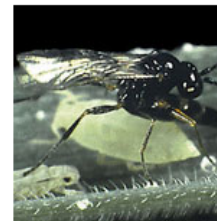
SHIPS VIA PRIORITY OVERNIGHT ON TUESDAY ONLY. MINIMUM 7 DAY PROCESSING. ORDERS RECEIVED BY TUESDAY, 5PM MST WILL SHIP THE FOLLOWING TUESDAY. FOR DELIVERY ONLY. NOT AVAILABLE IN STORE.

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\$80.00

Qty.

Add to Cart



Aphid Parasite, *Aphidius colemani*
SKU: 1101301-G

Use in greenhouses or in the field to prevent outbreaks of aphid populations.

SHIPS VIA PRIORITY OVERNIGHT ON TUESDAY ONLY. MINIMUM 7 DAY PROCESSING. ORDERS RECEIVED BY TUESDAY, 5PM MST WILL SHIP THE FOLLOWING TUESDAY. FOR DELIVERY ONLY. NOT AVAILABLE IN STORE.

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Fungus Gnat Predator
SKU: 1154002-G

Use these beneficial mites to control fungus gnat larvae, thrips pupae and springtails in the soil.

OVERNIGHT SHIPPING REQUIRED. SHIP'S FEDEX OVERNIGHT ON WEDNESDAYS ONLY. FOR DELIVERY ONLY. NOT AVAILABLE IN STORE. SEE SHIPPING DETAILS FOR MORE INFORMATION.

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Mite Predator, *Amblyseius swirskii*
SKU: 1101310-G

Excellent beneficial mite for warmer growing conditions!

SHIPS ON TUESDAYS ONLY VIA FEDEX PRIORITY OVERNIGHT. REQUIRES PROCESSING TIME OF UP TO 7 DAYS. FOR DELIVERY ONLY. NOT AVAILABLE IN STORE.

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Mite Predator, *Amblyseius andersoni*
SKU: 1101320-G

Excellent choice for pre-emergent control of mite infestations!

SHIPS VIA FEDEX OVERNIGHT ON TUESDAYS ONLY. SEE SHIPPING INFO FOR DETAILS. FOR DELIVERY ONLY. NOT AVAILABLE IN STORE.

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One example

Marshall, MO, January 2012



01/04/2012 14:52

Marshall, MO 2012

- Aphid outbreak
- Parasitic wasps present but not enough to control aphid population
- Purchasing and releasing more wasps or predatory insects not feasible
- Needed to suppress aphids to allow wasps to 'catch up'
- Recommended application of OMRI-listed insecticidal soap
- Soap killed most healthy aphids and did not affect the mummies. Outbreak controlled



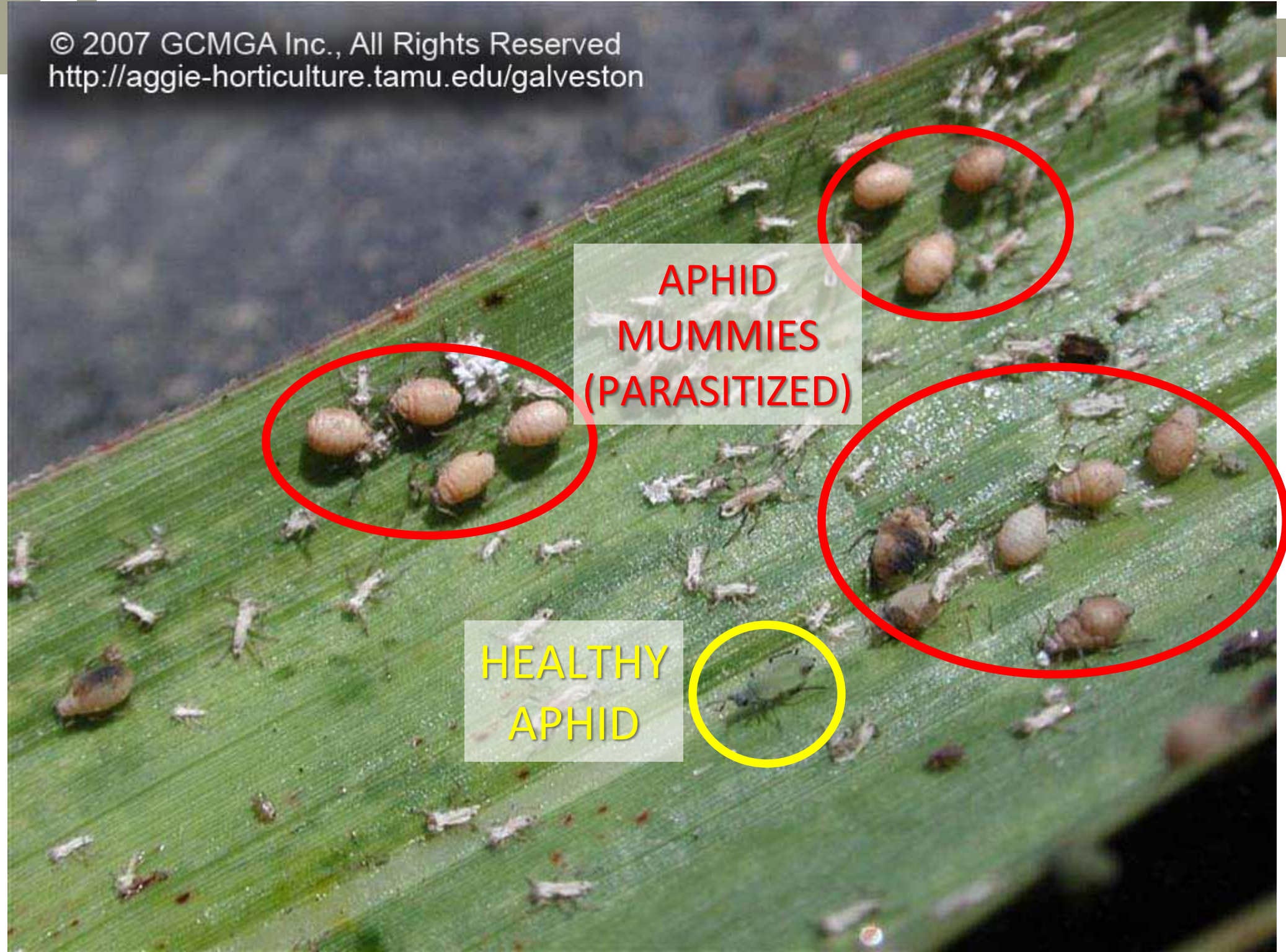
Having flowering plants likely provided nectar to parasitic wasps



Collecting leaves with aphid mummies after spraying insecticidal soap to assess potential negative effects on parasitic wasps

APHID
MUMMIES
(PARASITIZED)

HEALTHY
APHID



Spider Mite Biocontrol

Phytoseiulus persimilis

- Aggressive predator, can also eat pollen
- Needs RH over 75% and temperature of 68F
- Only eats Spider Mites
- Cost: \$35.00 for 2,000 predatory mites (<http://www.arbico-organics.com>)

Amblyseius californicus

- Also a predator, but not as aggressive
- Eats mites, thrips, and pollen
- Needs RH over 75% and temperature of 68 degrees Fahrenheit
- Cost: ?? Source: ??





Trap Cropping

*Using very attractive plants to pull insect
pests away from cash crop*

Trap Cropping: what is it?

- Blue Hubbard and Red Kuri Hubbard squash: very attractive to cucumber beetles and squash bugs
- Four years of successful research and demonstrations under field conditions have proved the effectiveness of trap cropping for cucumber beetle and squash bug control (both conventional and organic systems)
- Cucumber beetles have no natural enemies, so **trap crop plants need to get insecticide sprays**



Aggregations of spotted cucumber beetles on young Blue Hubbard squash (trap crop)



Trap Cropping: cucumber beetles

Since 2011, Jose Fonseca (St. Peters, MO) has minimized cucumber beetle damage to seedlings (in a hoophouse).

Experimented with trap crops (Blue Hubbard squash) transplanted outside high tunnel in 2014 and 2015

- Imidacloprid (**systemic**) applied to trap crops in pots
- Imicacloprid also applied to transplanted trap crops outside high tunnel
- 3-5 weeks of protection



Trap Cropping: Spider mites

- Bush beans can be used as trap crops for spider mites in tomatoes
- The beans attract the spider mites and show damage very quickly, which will help with monitoring
- Once pest spider are present, release predatory mites (*Phytoseiulus persimilis*) to the beans at an approximate ratio of 1 to 100
- The bush beans will become **banker plants**, reproducing *P. persimilis* some of which will disperse to attack mites
- Cost? Ca. \$ 35 for 2,000 *P. persimilis*



Bush Bean Trap Crop for Spider Mites in Tomatoes



UC Statewide IPM Program
© 2003 Regents, University of California

Predatory mite, *Phytoseiulus persimilis*, attacking a two-spotted spider mite.

Trap Cropping: Thrips

- **Marigolds** are very attractive to thrips and also support natural enemies such as Minute pirate bug (*Orius insidiosus*) by providing pollen
- Thrips Predator Mites (*Neoseiulus cucumeris*) (\$ 48.50 for 50,000 mites) can also be released to feed on thrips larvae
- **Ornamental pepper (var. Black Pearl)** is very attractive to aphids and thrips, and also provide pollen to *O. insidiosus*.
- Since pepper plants germinate and grow slowly, plants need to be started well in advance to be used as banker plants.
- Minute pirate bugs hunt better in peppers (cash crop) than in tomatoes because of trichomes (sticky hairs) present in tomato leaves



H.G.I.C., U of MD

Minute pirate bug, *Orius insidiosus*, praying upon a thrips.



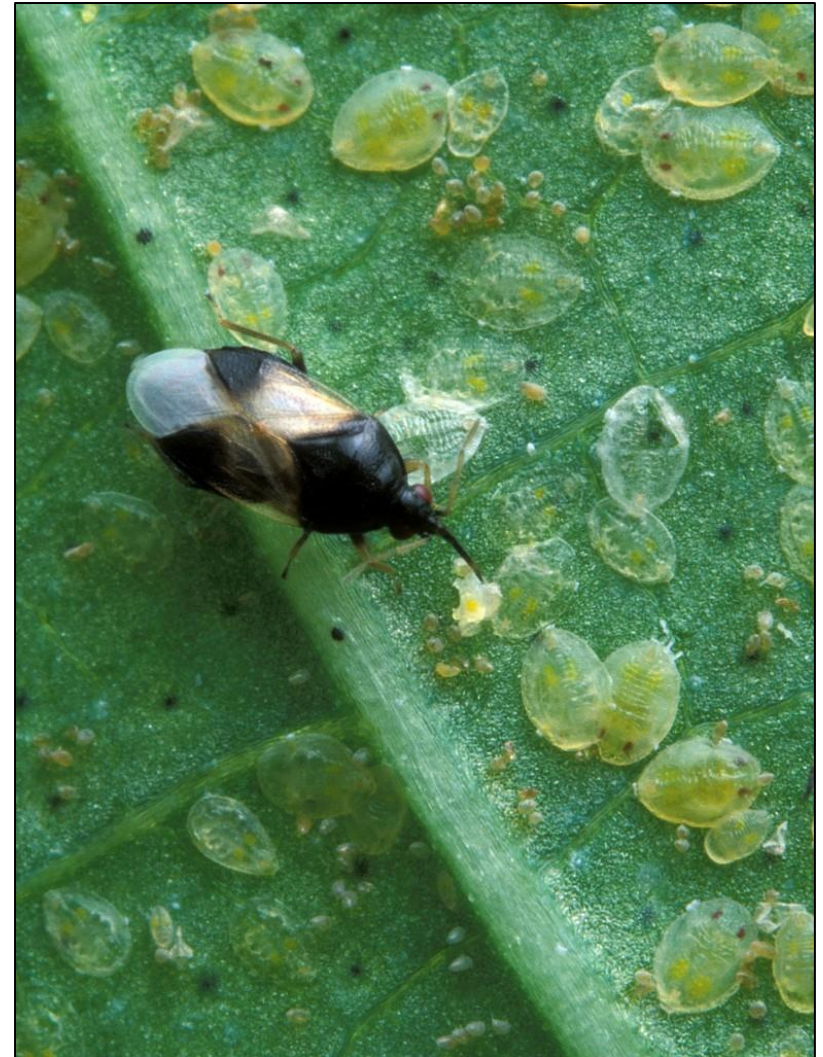
Tomato leaf surface - covered in trichomes (red) which secrete oil and hairs. Both structures protect the plant against pests

Trap Cropping: Whiteflies

(not tested in tomatoes yet [?])



Eggplant as trap crop for whiteflies in Poinsettia



Released Minute pirate bug, *Orius insidiosus*, feeding on whitefly nymphs



Cornell University
Cooperative Extension



Eggplants inoculated with *Encarsia formosa* for control of greenhouse whitefly and *Eretmocerus mundus* for control of Bemisia whitefly



Banker Plants

*Mini-rearing system for natural
enemies of pests*

APHIDS

Pest of most vegetable crops



Green Peach Aphid *Myzus persicae*
Others – cotton & potato aphids, etc.

Biol. Control agents



Predatory midge
Aphidoletes aphidimyza



Lacewings
Chrysoperla rufilabris



Ladybeetles
Hippodamia convergens



Minute pirate bugs
Orius insidiosus



Parasitic wasps
Aphidius testaceipes

Courtesy of Dr. Tom Coudron
(USDA-ARS)

Non-crop plants that provide alternative hosts for parasitoids, prey for predators, or plant-based resources such as nectar and pollen for omnivores

Why banker plants?

The expense associated with frequent shipments of natural enemies is not sustainable for most small diversified vegetable growers. So, helping beneficials reproduce is a great option to reduce costs.

- Natural enemies are ‘released’ from banker plants continuously to control the “real” pests on cash crops at no expense to growers.
- Barley, wheat, or other small grains to raise **(non-pest) grain-specific aphids (e.g., Bird cherry aphid)**
- These aphids, in turn, attract beneficial insects which can control populations of other types of “pest” aphids within the tunnel



Parasitized
aphids on wheat
banker plants



Cornell University
Cooperative Extension



Aphid Banker Plant System for Greenhouse IPM, Step by Step

Prepared by Margaret Skinner¹, Cheryl F. Sullivan¹ & Ronald Valentin²

¹University of Vermont Entomology Research Laboratory
661 Spear Street, Burlington, VT 05405-0105

²Biobest USA, Inc.
2020 Fox Run Road, RR 4
Leamington ON N8H 3V7 CN Canada



If you buy the wasps:

Rate: ~ 1 wasp/100 sq ft.

Cost: 2.5 cents per sq. ft.

Source: North Carolina State Univ.





Contents lists available at SciVerse ScienceDirect

Biological Control

journal homepage: www.elsevier.com/locate/ybcon



Minute Pirate Bug

Influence of banker plants and spiders on biological control by *Orius insidiosus* (Heteroptera: Anthocoridae)

Sarah K. Wong, Steven D. Frank*

North Carolina State University, Department of Entomology, Campus Box 7613, Raleigh, NC 27695, USA

- 12 hoop houses producing native and ornamental grasses
- Insect pests: Western Flower Thrips and two-spotted mites
- Banker plant: Black Pearl Pepper



© 2010 Pam Penick



Picture: Southern SARE

- More than **twice as many** thrips were recorded in the control treatment houses than in the banker plant treatment houses
- More than **six times as many** spider mites in the control houses than the banker plant treatment houses

On-going research in Vermont: habitat pots (made up of sweet alyssum, beans, marigolds and lantana) to provide **pollen and nectar** to parasitic wasps and predatory insects



Sweet alyssum, in high tunnel tomatoes to support commercially available natural enemies such as *Orius insidiosus* and *Aphidoletes aphidymiza* (predatory insects) and *Aphidius colemani* (parasitic wasp)

Indicator Plants

Plants very susceptible to plant diseases (transmitted by insect vectors), thus they provide early warning

Intermixing tomatoes and potted ornamentals in the same tunnel can lead to viral disease problems





Tomato spotted wilt virus is common on ornamentals and can be transmitted by thrips to tomato / pepper plants

Indicator plants: Petunia

- One challenge: Thrips are resistant to many pesticides
- Petunias (cultivars Calypso, Super Blue Magic and Summer Madness) are very susceptible to tomato spotted wilt virus (TSWV) and Impatiens Necrotic Spot Virus (INSV), both of which are transmitted by Western Flower Thrips
- Just four days after infection, local brown lesions form around feeding sites indicating infection
- Infected petunia plants do not serve as source of virus
- But care must be taken to ensure they don't become a source for a pest outbreak



Place petunia indicator plants in areas with higher thrips populations (based upon sticky card counts).



Growers can use petunias to monitor for **TSWV** and **INSV** quickly without having to check the whole crop