

Biological Control of Arthropod Pests in High Tunnels and Greenhouses

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Entfact-327

Production of vegetables in protected environments, high tunnels and greenhouses, is very different than in the field. Many of the pests that we typically need to manage in the field are relatively uncommon, while some species that we rarely need to manage in the field are the key pests in these protected environments that require management. Groups of pests most commonly needing management on vegetables in high tunnels and greenhouses include whiteflies, thrips, aphids, fungus gnats, and mites. Within each of these types of pests there can be one or more species. Proper identification is critical to the success of a biological control program.



Figure 1. Green lacewing larva feeding on aphids. (Photo: Ric Bessin)

Producers of tomatoes and other vegetables in high tunnel or greenhouse production systems need to manage several key arthropod pests to maximize their yields and profits. An environmentally and economically sound management system for these pests is based on the following components:

- *Sanitation* – cultural controls which includes screening ventilators and weed control in and around structures. Removal of heavily infested plants if infestations are localized.
- *Biweekly Monitoring* – visual inspection of plants (focus on the undersides of leaves) and sticky cards. Try to set aside a specific time of the week for monitoring so that this activity becomes part of your routine. Use a standard method (number of plants

sampled in a specific way) so that you can compare pest levels from one date to other weeks or years. Yellow sticky cards should be placed just over the height of the plants and checked weekly. They will need to be replaced when they become covered with debris, typically once every 2 weeks.

- *Recognize developing pest problems early* – including correct identification. Be familiar with the common pests in their various life stages. Most of these are very small, so a hand lens is usually needed. The publication ID-235, IPM Scouting Guide for Common Problems of High Tunnel and Greenhouses Vegetables, can help with pest identification.
- *Release beneficial species* (natural enemies and pollinators) – monitor effects and consult with extension specialists and suppliers. Beneficial species do not act like insecticides and require management. They also do not completely eliminate the pest.
- *Anticipate pest problems* based on previous crop history and be ready to order beneficial species. Suppliers typically ship beneficial organisms early in the week to avoid weekends.
- *Maintain records* of scouting and management information.



Figure 2. Use sticky cards to monitor pests (Photo: Ric Bessin)

The first step in managing any problem is to first properly identify the problem. Once it has been identified, in this instance an arthropod pest, then management information becomes available through your local extension office or the internet. If you cannot identify the problem, take a sample or good quality image to your local county extension agent. This service is available at no charge for the citizens of Kentucky. Entfact-001, available online,

provides advice on taking a sample and a good insect photo. If the county agent is not able to identify the problem, the sample will be sent to UK for identification. There are insecticides or miticides available for control/suppression of arthropod pests in high tunnels and greenhouses. However, many of the insecticides we can use in the field are prohibited in high tunnels and greenhouses. For purposes of pesticide applications, high tunnels are considered greenhouses in the state of Kentucky. If you use biological control, you must be careful when selecting and using insecticides (miticides) as many insecticides may also kill the beneficial insects and mites. Selective insecticides, such as those containing Bt, are more compatible with biological control (please see Entfact-306).

If a grower plans to use biological control for management of arthropod pests in a high tunnel system, the following items need to be considered when making a decision:

Considerations

- Best to begin biological control when pests are at low densities. Will not work if pest numbers are high.
- Requires more management in terms of identification and monitoring of both pest and beneficial activity.
- Will not eliminate pests, but keeps them at very low levels when successful.
- Different pest groups usually require different types of natural enemies to be released.
- Proper identification of pest species is critical.

Advantages

- Reduces insecticide use.
- Self-sustaining in that they reproduce and potentially provide control over an extended period; many of these biological control organisms can fly, so they will distribute themselves within a high tunnel or greenhouse structure.
- If pest problems do develop, they buildup more slowly.
- May result in higher profits.
- No human exposure to insecticides, thus there are no requirements for record keeping, personal protective equipment (PPE), restricted entry intervals (REI), or pre-harvest intervals (PHI)

There are several species of biological control organisms that are commercially available and highly effective against arthropod pests attacking Kentucky tomato production systems. To be successful using beneficial species, release rates and timing need to be matched with pest populations in your greenhouse/high tunnel. Your county agent or supplier of the beneficial organisms can help you with this. It is also best to avoid releasing beneficial insects during the middle of the day. Either late afternoon or early morning is a better time for release and

establishment of natural enemies. When receiving a shipment of natural enemies, always check to see that they arrive in good condition, otherwise call the supplier for a replacement.

One big difference between high tunnels and greenhouses is ventilation. Most high tunnels have passive ventilation through side walls that are opened up while greenhouse have smaller windows and fans to move the air actively. Beneficial insects typically have a winged stage and can disperse easily. High tunnels can be fitted with screens, but care should be taken not to reduce airflow with very fine screens.

Commercially Available Biological Control Organisms

Spider Mites

Two species of predatory mites (*Phytoseiulus persimilis*) and (*Amblyseius fallacis*) have been shown to be very effective for two-spotted spider mites. If your structure has a history of tomato russet mite infestations – release *A. fallacis* predatory mites. The predatory mite (*Amblyseius swirskii*) is an effective predator of broad mites. A small predatory lady beetle species can also be purchased for mite suppression (*Stethorus punctillum*)

Aphids

Predatory lacewings can be released for aphid suppression. Also available is a predatory fly (*Aphidoletes aphidimyza*). A number of species of stingless wasps (aphid parasitoids) are commercially available for several different aphid species. For example, *Aphidius colemani* was released in a Kentucky greenhouse for suppression of melon aphids and provided season long suppression of this aphid pest. Important to know the species of aphid pest to determine the most appropriate species of stingless wasp to release.



Figure 3. Adult stingless wasps have emerged from these aphid mummies. This life stage indicates that the wasp has successfully parasitized the aphid host. (Photo: Ric Bessin)

Sorghum banker plants have been used to sustain aphid parasitoids in greenhouses as the aphid species attacking

sorghum do not attack greenhouse vegetables and the grain aphids on sorghum support the parasitoids.

Fungus Gnats

Cultural controls – avoid over-watering and standing water. Commercially available biological control organisms include entomopathogenic nematodes, predatory mites, and a bacterial-derived insecticide (Gnatrol)

Thrips

At least two species of predatory mites are reared by insectaries and can be purchased for release against thrips - *Neoseiulus (Amblyseius) cucumeris* and *Amblyseius swirskii*. *Amblyseius swirskii* is also used to control mites.



Figure 4. Predatory mite feeding on a thrips. (Photo: Ric Bessin)

Whiteflies

Correct identification of the species of whitefly infesting your structure is critical in selecting a biological control organism. At least two species of tiny stingless wasps can be purchased for release against whiteflies – *Encarsia formosa* (greenhouse whitefly) and *Eretmocerus eremicus* (silverleaf or sweetpotato whitefly). A predatory lady beetle (*Delphastus catalinae*) can also be released for whitefly suppression.



Figure 5. Parasitized whitefly nymphs (black scales) which will produce a new generation of stingless wasps. White nymphs are not parasitized (Photo: David Cappaert, Bugwood.org).

Additional Sources of Information:

University of Connecticut Biological Control Success in Greenhouse Tomatoes

<http://ipm.uconn.edu/documents/raw2/Biological%20Pest%20Control%20Success%20in%20Greenhouse%20Tomatoes/Biological%20Pest%20Control%20Success%20in%20Greenhouse%20Tomatoes.php?aid=45>

White, J. A. and D. Johnson. 2012. University of Kentucky Entfact-124: Vendors of microbial and botanical insecticides and insect monitoring devices.

<http://www.ca.uky.edu/entomology/entfacts/ef124.asp>

White, J. A. and D. Johnson. 2010. University of Kentucky Entfact-125: Vendors of beneficial organisms in North America.

www.ca.uky.edu/entomology/entfacts/ef125.asp

Inclusion in the following list of sources of information does not imply any endorsement nor does exclusion imply any criticism of suppliers or their products.

Applied Bio-nomics <http://www.appliedbio-nomics.com/>

Tomato Greenhouse Tomatoes: Guidelines for Biological Control. Applied Bio-nomics Ltd. Sheet 410 <http://www.appliedbio-nomics.com/wp-content/uploads/410-tomato.pdf>

Koppert Biological Systems <https://www.koppert.com/> and <https://www.koppert.com/products/products-pests-diseases/>

Rincon Vitova Insectaries <http://www.rinconvitova.com/>