



# High Tunnel Vegetable Crops: Designing a Scouting Plan

Scouting for insect and mite pests and their natural enemies in high tunnels is the cornerstone for successful integrated pest management (IPM).

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It provides critical information about the presence of pests, enabling growers to determine when and how to manage them and assess treatment efficacy. Designing a standardized scouting plan that fits the needs of the grower is the first step. This article describes how to create a scouting plan for insect pests and their natural enemies in high tunnel vegetables using strategies such as sticky cards, plant inspections and plant-mediated IPM systems.

Because many pests are small and hidden in crevices, plant damage is often the first and easiest sign of a pest. Therefore it is important to know what normal plant growth looks like for the crop so you can spot abnormal growth. It is also valuable to learn the symptoms and signs of common pests. For example, leaves that are cupped or deformed are often signs of aphid feeding. If abnormal plant growth appears, they can be matched with typical feeding damage of a specific pest, and the plant can be inspected to search for the culprit. If you see curled up leaves, look on the undersides of the leaves where aphids often feed.



By knowing what a healthy plant looks like, you can detect pest problems when abnormal growth appears. New growth on this pepper plant is abnormal and triggers an investigation to the cause. Photo: Elsa Sánchez, Penn State

**Learning how to identify the different stages of an insect pest and their natural enemies is critical. Sometimes the adult can look very different from the immature stage. Knowing what the egg stage**

looks like allows for early detection of an emerging pest issue. It can get a bit complicated. Some natural enemies attack when they are in the immature stage (syrphid flies), others as adults (parasitic wasps), and still others in either the immature or adult stage (Lady beetles).

Record keeping is strongly recommended to keep track of when pest outbreaks occur, pests are attacked by natural enemies and to assess the effectiveness of a treatment. It starts with developing simple scouting forms. Information found on forms include the scouting date, information about the high tunnel (crop, etc.), number of plants to inspect, pest type and number, natural enemy type and number, and a plant damage rating. Sample scouting forms can be found on these web sites:

[Vegetable IPM Scouting Forms - Rutgers University](#)

[New England Pest Scouting Network](#)

These forms should serve as a starting point. You'll want to adapt them to your operation, including your management style (do you have a low or high threshold for treatment, for example), farming practices (organic, conventional, IPM, etc.), and how pests are managed (biocontrols, pesticides, etc.). Other records to keep include maps of the tunnels with types and cultivars of plants grown and IPM strategies used. The species of pest and its host plant, your personal tolerance for that pest and how you manage them will determine your action thresholds. An action threshold is the pest level that you consider high enough to warrant treatment. For example, your action threshold for using natural enemies may be lower than for insecticides.

Every employee who works with the crop over the growing season should become familiar with key pests and their natural enemies so they can share information with the manager. Personnel availability and time of year determines how often to scout. When starting out, you might want to scout each tunnel once a week. With experience you may change the frequency. More frequent scouting should be conducted when transplants are set or when seedlings emerge. Later in the season, every other week can suffice until plants are removed from tunnels. A set monitoring routine is ideal, however, whenever the plants are handled, scouting should be practiced.

Useful tools for scouting include a hand lens, sticky cards, flags or flagging tape, laminated white paper, bags and/or vials, and a camera. The hand lens allows you to magnify small items. A 10X magnification is sufficient for seeing most small insects. When using a hand lens, to focus, place the hand lens close to your eye (start off with a finger width) and move your head and the hand lens close to the item you wish to magnify.



To focus, keep the hand lens close to your eye and the object you want to magnify. Photo: Elsa Sánchez, Penn State

**Sticky cards are useful for determining the presence of flying insects. They can be used to capture thrips, winged aphids, whiteflies, fungus gnats, cucumber beetles, flea beetles, hover flies, parasitic wasps and more. Common colors for sticky cards are yellow and blue; with yellow being attractive to most insects and blue to thrips. Sticky cards can be placed within or just above the crop canopy. They can be secured to bamboo stakes with binder clips. Decide where to place them (within or above the plant canopy) based on the types of insect pests you expect to capture. You may decide to place them in both locations. Start out placing 1 sticky card per 100 feet of row and adapt the number of cards to your situation.**



High tunnel cucumbers with a yellow sticky card placed above the plant canopy. Photo: Elsa Sánchez, Penn State

Replace sticky cards periodically when they get dirty. If you do not change them each time you scout, use a black waterproof marker to circle pest insects that are of interest. You can place sticky cards between sheets of clear plastic (like inside a baggie) to easily view insects at a later date. It's important not rely only on sticky cards for monitoring. Insects, such as aphids, show up on cards

after they developed wings, commonly in response to overcrowding on an infested plant. By the time they appear on cards, it may be too late, indicating a severe infestation on the crop.



High tunnel peppers with a sticky card placed within the plant canopy. Photo: Elsa Sánchez, Penn State



Scouting should start when seedlings emerge, as in this tunnel, or when transplants are set. Photo: Cheryl Frank Sullivan, University of Vermont

Plant inspections are needed to find non-winged pests such as spider mites and insects that have not reached high enough levels on the crop to be detected on sticky cards. It's useful to scout two types of plants: random plants and flagged plants. For random plants, arbitrarily select plants to scout that represent the crop mix in the high tunnel. If you are growing different types of vegetables in your tunnel, scout plants of each type. If you are growing different cultivars of vegetables, it's important to make sure they are all represented in the plants you scout. A starting point is to scout 1 plant in each 20 feet long section of row, which equals 5 plants in a 100 feet long row, for spring and summer crops including tomato, pepper, eggplant, and cucumber. Start out scouting 2 plants in each 20 feet long section of row or 10 in a 100 feet long row for leafy greens. As with the frequency of scouting events, the number of plants you scout will be adapted to your situation. As an example, one year we were scouting a high tunnel with many types and cultivars of sweet and hot peppers. One cultivar of sweet peppers was more susceptible to aphids than the others in the tunnel, but only comprised a very small section of the bed. Our scouting plan missed an outbreak of aphids on that cultivar. We adjusted our scouting plan to be sure to sample a few plants randomly of every cultivar avoid missing future outbreaks.



When scouting choose plants to represent the different types and cultivars of crops growing in the high tunnel. Photo: Elsa Sánchez, Penn State

**If high pest populations are found on any random plants, mark them with a flag or flagging tape. This is a reminder to come back and check that plant during the next scouting event and to mark areas that may warrant treatments. You don't need to flag all plants with pests, only a few to help determine if your management treatments are working. This allows for monitoring numbers of natural enemies relative to pests or determining efficacy of a pesticide application.**





This pepper plant has an abundance of aphids, predatory maggots and mummies (aphids turned brown from a developing parasitic wasp within). Photo: Cheryl Frank Sullivan, University of Vermont

Each pest has a preference for where within a plant to colonize. In addition to scouting a representative number of plants throughout a tunnel, it's also important to look within individual plants. This means scouting the tops and bottoms of leaves, both old and new growth. We recently completed a research project investigating the use of biocontrols for aphid management in high tunnel vegetables. For that project, we scouted by visually dividing tomato plants into upper, middle, and lower sections and then examining the upper and lower surfaces of three leaves in each of those sections. For lettuce, we'd divide plants into outer, middle, and center sections and also examine three leaves in each section.



Tapping a borage plant over a laminated sheet of white paper. Note that the paper does not need to be laminated to work. Photo: Elsa Sánchez, Penn State

Tapping plants, especially flowering plants, over a laminated white sheet of paper is a quick method for dislodging insects from blossoms or foliage. This is particularly effective for thrips that tend to hide within the blossoms.

Plant-mediated IPM systems are plants used in conjunction with other strategies, such as scouting, used to attract and/or sustain pests and their natural enemies. Common examples are trap/indicator plants and habitat plants. Trap/indicator plants are plants that are more attractive to pests than the crops grown. Yellow marigolds are a great way to detect thrips and sometimes spider mites. They are particularly useful early in the season when they are the only plant flowering. Bush beans are commonly used as a trap plant for spider mites. Spider mites tend to infest plants near tunnel edges and structures where they may have overwintered. Placing bean plant around those structures, helps detect them early, before they become a problem. Habitat plants, such as alyssum, are a great way to promote the establishment of natural enemies and encourage them to come inside high tunnels. They provide pollen and nectars to parasitic wasps and syrphid flies. Caution should be used to make sure these systems are not attracting too many unwanted pests. Another reason why routine scouting should be exercised.



Habitat and trap plantings of alyssum, bean and marigold in high tunnel tomatoes are used to monitor for pests and attract natural enemies. Photo: Cheryl Frank Sullivan, University of Vermont

As a general rule, when using natural enemies, it is essential to properly identify what species of pest you have. Many natural enemies such as parasitic wasps of aphids are host specific, attacking a narrow range of species. When you are unsure of the identity of an insect you should collect several individuals and place them in a bag or vial or take a clear picture of it. Bags/vials and/or pictures can be sent to your local Extension Educator for identification. Penn State University's Department of Entomology also has an Insect ID Lab which can be reached at 814-865-3256.

Over time, your scouting plan will be adapted to reflect your specific operation and your experiences. The time it takes to scout an area will be shorter as you gain experience compared to when you start. Allow time to fine-tune your plan and continuously train employees to always be on the lookout. The key is to find the pests early, before they become a problem.