High and Dry

Growing Vegetables in Northern New England High Tunnels

THE UNIVERSITY OF VERMONT EXTENSION

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WELCOME to the third issue of *High and Dry: Growing Vegetables in Northern New England High Tunnels,* a quarterly newsletter linking growers, researchers, and agricultural service providers to enhance protected crop production. This issue focuses on pest issues you are likely to experience in your high tunnel crops over the summer growing season.

Sadly, it hasn't been as dry as we would hope in some parts of our region and we extend our condolences to all those who experienced recent flood losses. It is heartbreaking to see all the hard work over the past few months wash away before your eyes. Below are resources which may be helpful to you and your families:

- The University of Vermont Extension System has developed a website to help farmers who have experienced damage due to this disaster, **https://www.uvm.edu/extension/disaster-resources**.
- The Vermont Government website is **https://floodready.vermont.gov/help-after-flooding**.
- NOFA VT is also supporting Vermont farmers affected by the July 2024 floods, **https://www.nofavt.org/about/blog/supporting-our-farms-through-july-2024-flooding-together**.
- Farmers can access free mental health support at **https://www.farmfirst.org/get-our-help**.
- The Vermont Community Foundation established the Vermont Flood Response and Recovery Fund in 2023 and continues that fundraising in response to 2024 flooding, **https://vtfloodresponse.org/**.
- In New Hampshire, farmers are advised to contact their county USDA Farm Service Agency (FSA) office to report losses. The N.H. Department of Agriculture, Markets and Food also have an ongoing program called Farmer Mental Health Support Program, which might be particularly helpful at this difficult time, **https://www.agriculture.nh.gov/divisions/agricultural-development/fmhp.htm**.

We hope you are weathering this recent storm. Please let us know if there is something we can do to help.

This newsletter is a collaborative effort among the University of Vermont (UVM), the University of New Hampshire (UNH), and others to support high tunnel growers — especially new ones who are still learning the ropes of this technology. Our goal is to provide information and resources to help your high tunnel crops thrive! Don't hesitate to reach out to the team listed on the last page with any questions or ideas for future topics. This work is funded by the Northeast Sustainable Agriculture Research and Education (NE-SARE) program and the Extension programs of UVM and UNH.

Menaces in the Cucumber Patch: Cucumber Beetles

Somaiyeh Ghasemzadeh, Margaret Skinner and Cheryl Frank Sullivan, University of Vermont Entomology Research Laboratory

What You Need to Know

Two species of cucumber beetles are commonly found on your crops; the spotted cucumber beetle and the striped cucumber beetle.

The adult striped cucumber beetle *(Acalymma vittatum)* has a yellow body with 3 black stripes. The adult spotted cucumber beetle *(Diabrotica undecimpunctata howardi)* has a yellow body with 12 black spots. The larva of the spotted cucumber beetle is also known as the southern corn rootworm and feeds on seeds in the field as well as cucurbits.

Cucumber beetles and larva. Photos (top to bottom): C. Butler, C. Sullivan, S. Bauer, USDA Agricultural Research Service, Bugwood.org

Both species are small beetles measuring about a ¼ inch long with a black head. The larva is around ½ inch long, white, and wormlike with a brownish head and three pairs of legs. Larvae feed on the roots and stems below ground while the adults mostly consume foliage and stems early in the season and move to the flowers when they develop. They also feed on the fruit, creating wounds that allow rot diseases to enter. Feeding by both species weakens plants and when populations are high or when the plants are small, these beetles can completely defoliate the crop.

The striped cucumber beetle is also able to transmit bacterial wilt *(Erwinia tracheiphila)*, which will quickly kill the entire plant once infection occurs.

In the Northeast, weather is unpredictable and many crops are now grown in high tunnels rather than in the field.

Cucumbers are one of those crops and are a prime target for cucumber beetles. As our climate changes, these pests can present problems both in the spring on the young plants and later in the summer on mature flowering plants and fruit.

Damage

Larvae feed on the roots and underground stems of cucurbits. They weaken the root system and reduce plant vigor which causes stunted growth or wilting. Adults feed on the foliage, consuming leaves and tender stems. Heavy infestations can defoliate plants, making them susceptible to stress and reducing their ability to photosynthesize. This feeding activity is detrimental particularly up to the third true-leaf stage. They also target fruits and flowers, leaving the blossoms tattered and fruit scarred. This feeding affects the appearance and marketability of the fruit and may lead to premature rotting. These insects are primarily pests of small plants so adults may recur in the crop later in the summer and can cause significant fruit damage then.

Life Cycle

Striped cucumber beetles overwinter as adults in plant debris and leaf litter around the field or in crevices of the high tunnel. They emerge in the spring when the soil temperature reaches 55°F. They congregate around a variety of early flowering plants to mate and then seek host plants where they lay eggs in the ground at the base of cucumber, squash, melon, and other cucurbit plants. Eggs hatch into larvae which feed on the plant roots and then pupate. It takes 40 to 60 days from egg to adult. There can be 1 to 3 generations per year. Environmental factors like temperature and day length influence the timing and duration of each life stage. They are good fliers and readily move between different host plants, facilitating the spread of infestations, and transmission of bacterial disease as well.

Spotted cucumber beetles are not believed to overwinter in our northern climates. These beetles migrate up from southern locations arriving in the Northeast by mid-late summer. It is possible that they could survive in a heated high tunnel. (If you see any in early spring, please let us know.)

Key Management Strategies

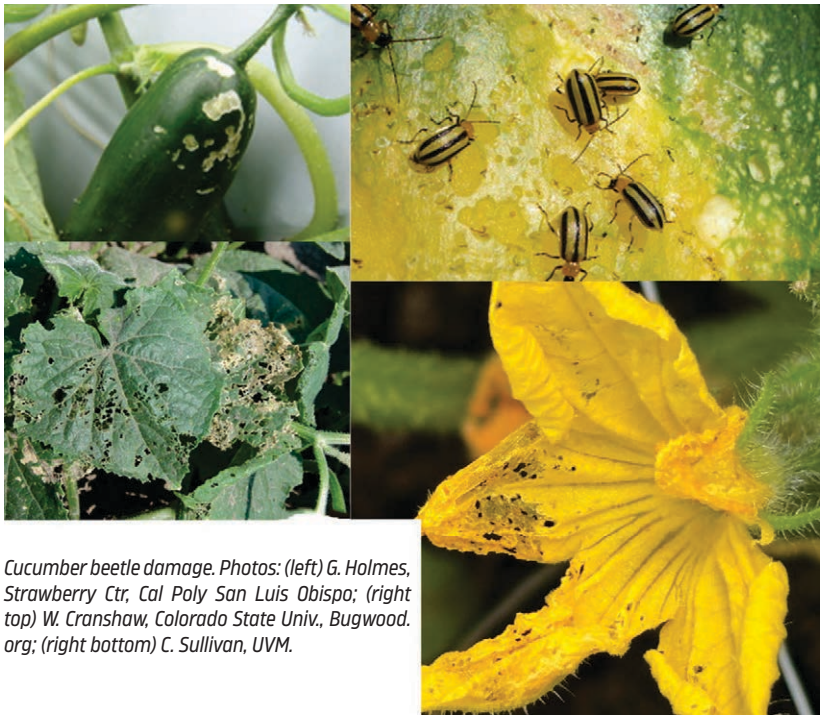
Various cultural, mechanical, and insecticidal options are available to manage these pests:

- **Protect young plants with netting** early before the adults emerge.
- **Screen your high tunnel or install row covers.** Just like clothing shields us from mosquitoes, crop plants benefit from protection. Many growers cover all openings (sides and vents) with netting to exclude insects. Mesh with a pore size of 0.72 × 0.97 mm is effective at excluding cucumber beetles, but smaller mesh sizes may be necessary for other pests. Alternatively, cover seedlings in the high tunnel with floating row covers. The covers should be free of rips or holes and must be secured to the ground to prevent beetles from sneaking in. Netting edges can be held down with water-filled hoses, sandbags or by burying the edge with a layer of soil. If you are growing varieties that need pollination, remember to ***remove the row covers*** when the plants begin to flower.
- **Remove or roll up the netting when plants bloom** if the crop requires pollination. Otherwise, leave the netting on for as long as possible to protect the plants.
- **Remove crop debris and weeds** in and adjacent to the high tunnel in the fall/at the end of the season. This reduces their overwintering habitat close to where you will plant next year's crop.
- **Consider using transplants rather than direct seeding**. This reduces exposure of the small plants to damage at a stage when they are particularly tender. However, some growers report less damage with direct sowing, though it hasn't been confirmed by research. Share your experiences with us if you can.
- **Monitor the crop/scout plants over the season.** This should be done at least once each week. Crop monitoring alerts you to high populations of cucumber beetle, incidence of bacterial wilt, and other developing issues (e.g., spider mites and powdery mildew). Inspect plants, particularly the undersides of leaves and along the edges of the tunnel. Check for beetles, other pests, and signs of wilt disease. Yellow sticky traps may be used to monitor for flying pests. Plants with signs of infection should be removed as soon as possible. Economic thresholds depend on the age of the plant and susceptibility of the variety to disease.
- **Apply an insecticide or crop protectant if populations are high.** Cucumber beetles are hard to manage with insecticide sprays because they are so mobile and a contact pesticide may not be effective. There are also issues with their impact on non-target beneficials and pollinators. Kaolin-based products (e.g., Surround®, Acti-min, etc.) are Organic Materials Review Institute (OMRI) listed crop protectants registered for cucumber beetle. Growers report using it on young plants which are particularly vulnerable to beetle feeding. Product may need to be reapplied at least once if beetle populations are found in high numbers. If applied later in the season, it may be necessary to wash treatment off before the fruit is harvested. Several insecticides are registered for this pest, including pyrethrin- and neem-based products, and conventional chemical insecticides. Because of concerns for their impact on beneficials and insecticides, this option should be considered as a last result. A list of registered pesticides for cucumbers is available in the New England Vegetable Guide (**https://nevegetable.org/crops/insect-control-7**).

Cucumber beetles are a persistent pest in our high tunnel crops, but with cultural and physical control strategies, their impact can be minimized to obtain a bumper crop.

Additional references:

- High Tunnel Cucumber Production Guide (Purdue University Extension): **https://extension.entm.purdue.edu/publications/ID-521/ID-521-W.pdf**
- National Center for Appropriate Technology: **https://attra.ncat.org/publication/cucumber-beetles-organic-and-biorational-integrated-pest-management/#5**
- University of Florida: **https://entnemdept.ufl.edu/creatures/VEG/BEAN/striped_cucumber_beetle.html**



Cucumber beetle damage. Photos: (left) G. Holmes, Strawberry Ctr, Cal Poly San Luis Obispo; (right top) W. Cranshaw, Colorado State Univ., Bugwood.org; (right bottom) C. Sullivan, UVM.

Summer Diseases in High Tunnels

Ann Hazelrigg, UVM Plant Diagnostic Clinic

Harvest of tunnel crops is in full swing and with heat and humidity, full canopies and the stress of fruit production, diseases can become an issue. There are a couple of abiotic disorders that are common in a tomato high tunnel: blossom end rot and Magnesium deficiency. **Blossom end rot** results in dry, sunken, brown areas on the blossom end or bottom of the fruit. The cause of this rot is due to insufficient calcium in the fruit despite having sufficient calcium in the soil, stems or leaves. The disorder is linked to water stress in the plant from inadequate water, frequent and large variations in relative humidity, or a high level of salts. Typically, the first fruit is affected and then the plant seems to resolve it. Some cultivars may be more susceptible than others. **Magnesium deficiency** appears first on the lower leaves as interveinal chlorosis — yellowing of leaf tissue between the green veins of older leaves. Purplish-brown spots can also appear on the affected leaves. The deficiency typically exists in the plant, not in the soil, and the disorder rarely results in yield reduction. Although many growers choose to ignore the issue and prune off those lower symptomatic leaves, Magnesium deficiency is easily corrected by applying an organically approved Epsom salts fertilizer (magnesium sulfate) through the drip or watering directly onto plant rows.

Blossom end rot on tomato. Photo: Brenda Kennedy, UKY, Bugwood.org

For more information on high tunnel tomato fertility see **https://www.uvm.edu/vtvegandberry/factsheets/OrganicGreenhouseTomatoNutrition.pdf** .

Magnesium deficiency on lower tomato leaves. Photo: Bruce Watt, University of Maine, Bugwood.org

The main foliar disease this time of year is leaf mold. The fungus causes yellow spots on the upper leaf surface with the corresponding area on the leaf underside covered by purplish brown spores. The pathogen favors humid conditions so anything you can do to increase air circulation and ventilation will help minimize the disease. Cultivars vary in resistance.

Leaf undersides showing infection by leaf mold pathogen, Passalora fulva. Metin Gulesi, Bugwood.org

Several canker diseases can become an issue high tunnel tomatoes in the height of summer. If you see wilting in plants, first check the emitters to see if there is an irrigation issue. If all is fine, check lower in the plant to look for white fluffy mold or brown sunken areas on the stem. The white fluffy mold is diagnostic

for Sclerotinia, a common canker fungus that can be an occasional problem in high tunnels, especially in low, wet areas. The fungus produces long term overwintering structures, sclerotia, within the mold or in the stem, so if you see the disease in your plant, cut it off at the base and remove it from the tunnel. Both **gray mold** (Botrytis) and **Alternaria** (Early Blight) fungi can cause brown cankers/dead areas on stems. The fruiting bodies of the gray mold fungus visible on any dying parts of the plant. Alternaria cankers would typically appear to have a target or bullseye appearance. These would be indicative of very high humidity in the house and anything you can do to increase air circulation and ventilation to drive down humidity will help. **Bacterial canker** is the most serious canker disease in tomatoes and shows up when there is a heavy fruit load in the plant. This bacterial pathogen can be seedborne and causes black streaking on the stems and internal discoloration in the vascular system. You can check for the internal browning by cutting into the stem lengthwise to see the discoloration. If suspected, I often encourage growers to send a sample to the Clinic for confirmation. The bacteria are easily spread through pruning cuts and can quickly move through a tunnel. Cut off any infected plants at the base and remove them from the house and destroy. Keep a close watch on adjacent plants to make sure it has not spread.

Alternaria canker with target appearance . Paul Bachi, University of Kentucky Research and Education Center, Bugwood.org

Vascular discoloration due to bacterial canker.. Paul Bachi, University of Kentucky Research and Education Center, Bugwood.org

Fluffy white mold caused by Sclerotinia sclerotiorum. Photo: Meg McGrath, Cornell University

The Costs and Benefits of Exclusion Netting for High Tunnel Production

Becky Maden, UVM Extension Vegetable Nutrient Management Specialist and Heather Bryant, UNH Extension Field Specialist

The use of exclusion netting in high tunnels is increasingly popular as a reliable pesticide-free method of crop protection. Costs of insect netting may be daunting for growers, but the longevity, durability, and effectiveness of netting may make the investment worthwhile. For growers in the Northeast, netting is most commonly used to protect high tunnel cucumbers from striped cucumber beetles *(Acalymma vittatum)* and fruit crops from spotted wing drosophila *(Drosophila suzukii)* and netting can also be used to exclude other pests that do not over winter in tunnel soil, such as imported cabbage worm *(Pieris rapae)*. In a recent Appropriate Technology Transfer for Rural Areas (ATTRA) blog post, one New Hampshire farmer described netting two tunnels for just under $450, and increasing cucumber sales by about $1,500.

Photo: Becky Sideman, UNH 1

While insect netting is an excellent option for tunnel pest control, there are important tradeoffs to consider. First, netting reduces airflow and can subsequently increase the temperature in the tunnel, which can lead to blossom drop, sunburned fruit, and other abiotic conditions. Less airflow and hotter temperatures can also create a more favorable environment for diseases. Finally, although insect netting keeps out unwanted pests, it also excludes beneficial insects and natural predators. One recent study noted an increase of aphids and spider mites in a netted tunnel.

It's important to note that because netting excludes pollinators, varieties grown in a tunnel using netting must be parthenocarpic, meaning they create fruit without pollination. Ironically, if these crops are pollinated, the fruit can be misshapen and unmarketable. This makes growing a mix of crops in a netted tunnel potentially challenging since some tunnel crops require or benefit from pollination. It's also important to pay special attention to tunnel pest populations in a netted tunnel since native biocontrol will be limited. On the other hand, spending your money on introduced bio-controls is a good investment as pests will not escape a netted tunnel!

Screen size is an important consideration when selecting exclusion netting. Allow for the largest possible opening to optimize air flow while still excluding the problem pest. Cucumber beetles are large pests, so a larger screen size (0.16 mm 2) which allows for better ventilation will exclude them. Smaller mesh sizes which restrict more airflow are appropriate when smaller pests like spotted wing drosophila are a concern. Keep the netting tightly sealed around the edges of tunnels and covering vents, louvers, and doors. Cucumber beetles and other pests have a sneaky way of finding entry into houses, so creating vestibule type entries and creating protocols for staff working in the tunnels may be important to make the most of your investment in netting.

More work is needed to help better identify tradeoffs and best practices for exclusion netting in a high tunnel system. However, if insect pressure — particularly striped cucumber beetle — is your main high tunnel cucumber challenge, the installation of exclusion netting on tunnels growing crops susceptible to certain pests may be a simple and chemical-free way to reduce risk.

References and resources

- Birnstihl, D., 2022. Insect Netting for Spray-Free Insect Control on Small Farms, **https://attra.ncat.org/insect-netting-for-spray-free-insect-control-on-small-farms/**.
- Ingwell, L.L. and I. Kaplan, 2019. Insect Exclusion Screens Reduce Cucumber Beetle Infestations in High Tunnels, Increasing Cucurbit Yield, Journal of Economic Entomology, Volume 112, Issue 4, Pages 1765–1773, **https://doi.org/10.1093/jee/toz060**.
- Riggs, Dale-Ila, 2014. The use of insect netting on existing bird netting support systems to exclude spotted-wing Drosophila from a mature small-scale commercial highbush blueberry planting. **https://projects.sare.org/sare_project/fne14-813/**.

Report from Quebec: Greenhouse Growing Across the Border

Becky Maden, UVM Extension Vegetable Nutrient Management Specialist

Greenhouse growing in Quebec has always held a mythical allure for me: how do they produce such consistently beautiful produce year-round at an even higher latitude than Vermont? This past month, Cheryl Sullivan (newsletter co-editor) and I had the chance to tour some greenhouses with a group of Extension professionals and farmers from Vermont, New Hampshire, and Maine. Jacques Thériault, an agronomist from Climax Conseils in Quebec, graciously spent two days touring us to some of the farms he works with. We wanted to see systems and techniques used in operations of a similar scale to those in the Northeast U.S. and bring information back to share with growers. Below are a few key takeaways from our trip which can provide fodder for your daydreams when tunnel work feels especially laborious this season.

Mullein banker plants to support Dicyphus hesperus in tomatoes. Photo by C.F. Sullivan, UVM

1. **Automation systems are powerful.** Environmental controls were one of the main commonalities among the farms we visited. Most farms we visited were small, with less than a half-acre under cover, but there was significant investment in the physical structures and systems used to manage them. The first greenhouse we visited was a three-bay gutter tied greenhouse, with roughly 20,000 square feet of hydroponic tomatoes, cucumbers, pole beans, peppers, and lettuce. Nearly everything was controlled by a $45,000 automation system including water, fertility, ventilation, CO_2, and temperature. The justification for automation is powerful on two levels: First, the quality of the crops is unparalleled since the environment is optimized for plant growth. Our group marveled at the perfectly spaced trusses of tomatoes, straight glossy cucumbers, and pepper plants (wow!) that were fifteen feet high with leaves bigger than my head! Second, automation allows growers the freedom of spending time off the farm and still monitoring conditions with controls managed remotely from phones. This can also free up considerable mental space, allowing the grower to focus on other important aspects of the business. While we were warned repeatedly about the importance of multiple back-up systems, none of the growers we met were nostalgic for the good ol' days of manual controls.

2. **Rails, wheels, and platforms improve efficiency.** In most of the greenhouses we visited, rails (think mini train tracks) between beds accommodated harvest carts and platform lifts for easy crop access and efficient harvest. Some operations run warm water through the rails to serve the dual purpose of providing heat while also enabling efficient crop care. One farmer emphasized that having a well-functioning electric lift could turn a multiple-hour job of pruning and lowering plants into a 10-minute job. With these types of labor savings, a $15,000 piece of equipment seems like an excellent investment. Likewise, harvest carts that travel down the rails make harvest and transport very quick and ergonomic.

3. **Plant management can "steer" productivity.** There is a big emphasis on combining environmental controls with pruning techniques for optimal productivity. This means balancing vegetative with reproductive needs of the plant to maintain consistent fruit over the course of a long greenhouse growing season. In particular, CO2 management was something all the growers talked about. Since plants require CO2 for photosynthesis, additional CO2 can help boost plant growth, especially during times of year when there is abundant sunlight, making CO2 a limiting factor in photosynthesis. Although the growers we met use a CO2 burner, there was some discussion of using compost piles, which are actively respiring CO2 as a more ecological way to enhance the growing environment.

4. **Beneficials are relied upon for pest management.** Biocontrols were used in every greenhouse! Most greenhouses had a good balance of natural enemies to pests and the plants looked beautiful. The high adoption of banker plant systems was a real standout. Notably, the "aphid banker plant system" that supports the parasitic wasp *Aphidius colemani* for green peach and melon aphid suppression, and mullein to support the predatory bug *Dicyphus hesperus. Dicyphus* is used mostly for whitefly management, but it also attacks spider mites, thrips, and other small pests. The drawback to using the mullein system is that it takes 4 to 5 months for it to establish prior to starting the spring crop

We took in a lot of information during a short time in Quebec which left me wondering: what would our industry here look like if we felt less constrained by both the economic and environmental costs of high-tech greenhouse systems? In the short-term, it is exciting to consider ways to immediately apply information we learned in Quebec such as pruning practices and crop steering techniques. In the longer term, it may be worth considering if there is an opportunity for growers to expand tunnel crop diversity, build structures to grow year-round, and adopt higher tech systems? As the climate crisis becomes more acute, expanding our vision of local agriculture is critical, and greenhouses may play a key role in helping us grow into the future.

Pest Detectives

The first step for effective IPM is correctly diagnosing the pest and/or disease. This will help you develop an effective biological control release plan or pesticide treatment. Don't hesitate to call on your state Plant Diagnostic Clinic specialists for help.

The easiest thing to do is take a close-up picture of the pest or disease symptoms. Here's the information you need to tell the specialist:

- Estimate the extent of the problem (severity of the damage, numbers of insects, where it is in the tunnel, and how widespread).
- Determine which crops are affected.

Contact your state Plant Diagnostic Clinic and they will either ID it based on the image or ask you to send a sample. If you need to send in a sample:

- Collect 2 to 5 infested/infected leaves and damaged plant parts.
- Keep samples in a cool dark place but don't refrigerate them.
- Send specimen in a crush-proof container with the sample form (available from lab website).

Maine: Maine Pest Management Unit, extension.diagnosticlab@maine.edu, 207-581-3880 or 800-287-0279 (in Maine), **https://extension.umaine.edu/diagnostic-lab/contact-us/**
New Hampshire: UNH Plant Diagnostic Clinic, unh.pdl@unh.edu, 603-862-3043, **https://extension.unh.edu/agriculture-gardens/pest-disease-growing-tools/plant-diagnostic-lab**
Vermont: UVM Plant Diagnostic Clinic, Ann Hazelrigg, Ann.Hazelrigg@uvm.edu, 802-656-5421, **https://www.uvm.edu/extension/pdc**

Use Tissue Tests for Mid-season Nutrient Check-up

Becky Maden, UVM Extension Vegetable Nutrient Management Specialist

Nutrient management in high tunnels is distinct from the field for many reasons. Many crops have higher nutrient demands due to intensive planting and will produce for a long duration. Tunnel soils behave differently since they do not receive rainfall and are often only watered through drip irrigation. Soil testing (we recommend the UMaine high tunnel soil test or UNH High Tunnel test) in early spring is an excellent way to predict what nutrients the crops are predicted to need, but actual plant uptake can differ than predictions.

One way to calibrate the outcomes of your fertilization practices and correct nutrient deficiencies is through the use of tissue tests, also called leaf analysis or foliar analysis. Leaf tissue analysis is useful if you suspect deficiencies in crops due to leaf discoloration or poor fruit production. Tissue testing is also useful to check if critical nutrients such as nitrogen (N), phosphorus (P), potassium (K), calcium (Ca), and magnesium (Mg) are at sufficient levels. If levels aren't sufficient, fertilizer can be added by topdressing, side dressing, or fertigation. However, don't overlook other potential causes of nutrient deficiency such as incorrect pH, inadequate soil moisture, root disease, or insect infestation.

How to sample:

- Collect composite samples from the youngest fully expanded leaves on 30 plants around the tunnel. For tomatoes, sample just three leaflets at the tip of the leaf rather than removing an entire leaf.
- If no foliar sprays have been applied, place leaflets in paper bag for shipping. If sprays applied, at any time previously in the season when the leaflets may have been present, then they must be swirled in distilled water for 15 to 30 seconds and patted dry.
- Air dry to remove any surface moisture, then ship leaves in paper bags via priority mail.

Where to send samples:

- Dairy One tissue test, Ithaca, N.Y. For most fruits, the results come with Cornell recommendations. Optimal ranges for many crops are listed. $30.
- Penn State tissue test, with recommendations for many crops including greenhouse tomatoes. $24.
- UMaine Analytical Lab. No recommendations provided. $30.
- UConn Soil Nutrient Analysis Lab. $30.
- UNH Soil Testing Service. Recommendations by crop are included. $30.

Tissue samples are one way to get a glimpse of what your plants are taking up from the soil. However, it's important to remember that crop quality and yield are the most important outcome from your nutrient management practices. Tissue tests are one more piece of information to help guide mid-season nutrient management and/or inform next year's. For recommendations or guidance, reach out to Becky Maden, rebecca.maden@uvm.edu.

Is That Really a Bumblebee?

Margaret Skinner, UVM Extension Entomologist

It is always reassuring to see lots of bumblebees visiting our flowering crops. But is that really what they are?

This spring I noticed an abundance of what I believed were garden variety bumblebees pollinating my blueberries. Upon closer inspection I realized in fact they were carpenter bees, probably *Xylocopa virginica.* Both of these types of bees are often similar in size (around ½ to 1 inch long), but carpenter bees have a black shiny abdomen whereas bumble bees are furry all over. Are carpenter bees a friend or foe? It all depends.

Carpenter bees are great pollinators, so that's good. However, they are serious structural pests when they take up residence in unpainted wood around the home or farm. Unlike a bumblebee which has a queen who generally makes her colony in the ground, a carpenter bee is essentially solitary. The female chews a round hole in bare wood (a post, deck, barn edging, or trees, etc.). She makes a tunnel in which she lays her eggs, provisioning each cell with a ball of nectar and pollen. Because of their pollination benefits, some gardeners install 4 × 4-inch untreated softwood posts to attract carpenter bees to the growing area. The posts serve as a substrate for the bees to build a nest. If a carpenter bee takes up residence in the bare wood of your barn, it is best to discourage the activity promptly before they become established, either by screening the area or using a wasp spray.

To learn more about important pollinators, check out the "Do You Know Your Five?" pollinator support factsheet series at **https://www.uvm.edu/extension/pollinator-support-resources.**

Saffron: What a COOL Idea!

Margaret Skinner, UVM Research Professor

UVM scientists are studying the potential of saffron as a high-value crop for diversified farmers. It can be grown throughout the Northeast and across much of the U.S. in plant hardiness zones 4 through 8. Saffron is the dried orange stigmas of a fall-blooming perennial crocus *(Crocus sativus)*. U.S. growers sell their locally-grown saffron for $40 to $75 per gram, which is over $1,000 per ounce. The high cost reflects the labor involved with harvesting the flowers, separating the stigmas, and drying them. The good thing about saffron is that it blooms in October/November, when most of other field work is done.

Thinking about planning saffron? Now is the time to order saffron corms, which are planted in August and September, and then bloom 40 days later. They will continue to produce flowers for several years after planting. Saffron isn't a golden goose for farmers, but it can contribute to revenues with a high value product. Learn more about saffron cultivation at **https://www.uvm.edu/~saffron/** or contact Margaret at mskinner@uvm.edu.

Summer is Sizzling for Spider Mites

Cheryl Sullivan, Research Assistant Professor, UVM
Margaret Skinner, Research Professor/Extension Entomologist, UVM

Fig. 1. Spider mite adults. Photo by Frank Peairs, Colorado State University, Bugwood.org

No one wants to face an onslaught of spider mites *(Tetranychus urticae)* 'SM' on their crops, but eventually, it's bound to happen. SM are small (~1.2 mm or less) and females and nymphs have large, dark patches on each side of their bodies (Fig. 1). SM live in colonies on the undersurfaces of leaves. Heavily infested leaves have a yellow, spotted (stippled) appearance and are covered with webbing (Fig. 2). Once infestations reach this stage, they can become difficult to manage, especially with pesticides, because of the protection webbing affords them.

SM love hot and dry weather. The key to successful SM management is **prevention** and **early detection.** If SM are present on your tunnel crops this season, expect to see them again in late spring next year. SM hibernate in fall in protected cracks and crevices. They turn a red-orange color during this time. Fall tunnel clean-up of crop residues, weeds, etc. will help remove lingering populations. When temperatures become favorable, SM re-emerge and infest plants closest to their overwintering spaces. An early season application of *Stratiolaelaps scimitus* (formerly known as *Hypoaspis miles),* a soil-dwelling predatory mite, along the tunnel edges can help reduce overwintering SM. Planting bush beans (Fig. 3) along tunnel edges or interspersed throughout are a useful trap plant and aid in early SM detection. SM can hitch rides from tunnel to tunnel via workers carrying out day to day activities. If an infestation flares up, set up a plan to minimize worker movement from infested to un-infested tunnels.

Cucumber, tomato, pepper, and eggplant can all succumb to SM attack. When considering natural enemies, it's important to realize that not all perform equally on each plant. For example, certain predatory mites are less effective as a preventative on tomatoes because the plant has many glandular hairs that secrete substances. These reduce the mite's searching ability and can even be toxic. Each predatory mite species has a range of conditions (temperature and humidity) in which they perform best. The table below

Fig. 2. Infestation of SM on eggplant (top). Webbing with SM on cucumber (bottom). Photos by C.F. Sullivan, UVM.

from IPM labs summarizes the predatory mite's optimal environments for SM management. Two mites stand out as SM preventatives, especially on cucumber and pepper. *Neoseiulus (= Amblyseius) californi-*

cus) is a predatory mite with a strong preference for SM. It also feeds on other mites, thrips larvae, and pollen when SM are absent. They are available as loose products to sprinkle on plants or as hanging sachets. This species tolerates hot and dry conditions. *Neoseiulus (= Amblyseius) fallacis* is another predatory mite with a wide prey range that is more tolerant of lower temperatures.

Fig. 3. Bean trap plant in tomatoes (left). Patch of stippling from SM feeding (right). Photos by C.F. Sullivan, UVM.

As soon as the first SM hotspots are found, there are a few "go-to" predators that specialize in knocking them back. The first is the predatory mite *Phytoseiulus persimilis*. The second is a midge, *Feltiella acarisuga* whose larvae (maggots) kill and eat SM. The advantage of the midge is that it can fly to find hotspots and forage well on hairy leaves, a bonus for crops like tomato where *Persimilis* has a hard time searching due to the dense and sticky leaf hairs. Finally, there is a lady beetle called the "Spider Mite Destroyer" *(Stethorus punctillum)*. They will eat all SM life stages and are efficient SM hotspot finders. They also do the best in high temperature, low humidity conditions where *Persimilis* tends to fail.

Insecticides are most effective when SM populations are low. Biorationals like neem oil, azadirachtin, pyrethrins, horticultural oil and insecticidal soaps can kill and suppress mites. Numerous products are available. Refer to the New England Vegetable Guide for information about pesticide products for specific crops. Always read the label and follow the directions because they may require multiple applications at specific time intervals to be effective.

The following are some general SM predator-use guidelines as an example of when and how many to use. It's important to realize that release rates are situational and product variable. Rates depend on several factors including crop type and growth stage, tunnel size, the infestation level (or not), time of year, producer and more. Some suppliers include crop-by-crop suggestions (i.e., Crop Solutions, Koppert; Crop Recommendations, Applied Bio-nomics). Call your supplier for their specific recommendations or check out the web resources for their products (if available).

Natural Enemy	Timing/Infestation Level	No. individuals/ft²	Release Frequency	Source
Neoseiulus californicus	Preventative - Hotspot	0.5 – 2 (for sachets, use 1 per plant if canopy not touching)	Regular to foliage (weekly as needed). Sachets breeding systems are viable for 4-5 weeks.	Beneficial Insectary*
Neoseiulus fallacis	Preventative - Hotspot	0.2 – 1	Once per season in long term crops.	Applied Bio-nomics
Phytoseiulus persimilis	Hotspot	0.6 – 10 (loose product)	Weekly until control achieved.	Plant Products
	Hotspot	0.4 (sachet)	Weekly until control achieved. Sachets not a breeding system.	Koppert*
Stratiolaelaps scimitus	Pre-planting (preventative)	25	Once per season along tunnel edges to soil.	Applied Bio-nomics
Others				
Feltiella acarisuga	Hotspot	0.01 – 0.025	At least 2, 1-week apart	Sound Horticulture
Stethorus punctillum	Hotspot	0.1 (or 100–200/hotspot)	Weekly for 3-4 weeks.	Applied Bio-nomics

**Website provides video instructions on release of biocontrol products.*

What Can the USDA Do For YOU?

The USDA Natural Resources Conservation Service (NRCS) has many programs to support growers to adopt conservation stewardship practices that increase crop resiliency and develop wildlife habitat. This may include erecting a high tunnel or planting a cover crop. Contact your local NRCS service center for details. You can find the NRCS office in your area by searching this site: **https://www.nrcs.usda.gov/about**.

The deadline for applying for these programs in Vermont is August 23, 2024. Read more on the NRCS High Tunnel Initiative at **https://www.nrcs.usda.gov/programs-initiatives/eqip-high-tunnel-initiative**.

The High Tunnel Production Toolkit

Visit the High Tunnel Production Toolkit online! The website is geared for new high tunnel producers across the Vermont, New Hampshire and Maine, tri-state region, but growers of all experience levels will benefit from these resources.

The project is funded by Northeast SARE and led by the University of Vermont in collaboration with the University of New Hampshire.

The toolkit has factsheets and presentations; lists workshops, seminars and events; and provides a list of resources from other institutions and agencies.

https://go.uvm.edu/high-tunnel

Tell Us About Your Ticks!

Ticks and tickborne diseases are increasing in Vermont and you, your workers, and animals are at high risk of exposure. UVM researchers are gathering information from agricultural producers about ticks and how you deal with them. Results will enable them to design useful resources for producers to reduce the risk of tick bites. The survey should take 5-10 minutes to complete. Also, check out the VT-TIC (UVM Tick Information Center) site. Please forward this along to others!

Complete the survey at:
https://qualtrics.uvm.edu/jfe/form/SV_00nshllEvEdmldc

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