UMass Extension
# Vegetable Notes
For Vegetable Farmers in Massachusetts since 1975

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## In this issue:



*Garlic grown in a high tunnel at Flats Mentor Farm in Lancaster, MA is big and bundled for sale.*
*Photo: S. B. Scheufele*

## Crop conditions

Early summer crops are rolling in – lots of summer squash, zucchini, and cucumbers going out on the shelves in addition to leafy brassica greens and heading brassica crops and early roots like carrots and beets. Farm crews are busy harvesting while continuing to get new plants and seeds into the ground and keep up with weed and pest management. Feels like the first big downhill of the roller coaster, with crews settled in, the solstice passed, and the rhythm of countless daily tasks keeping everything rolling forward until the next big climb. We're approaching the time of year when we start to see more foliar diseases in vegetable crops, as temperatures and humidity levels rise and crop canopies become more dense. If you plan on using chemical disease controls, make time to get out into your crops to scout early, checking wet spots where diseases tend to start—starting management early on is usually important for keeping diseases under control. See the article in this issue for information on leaf spot diseases of cucurbits and the article on fungal leaf spots of tomato in the June 10 issue of Veg Notes.

## Pest alerts

### Alliums

Garlic bulb rot reports came in this week from MA and ME – **white rot**, **Fusarium basal plate rot**, and **Botrytis**. All three of these diseases are caused by fungi and can cause stunting and leaf yellowing above ground and bulb rot and signs of the fungi are visible when the plant is pulled. Garlic bulb rots are spread via garlic seed cloves so it is important to have suspected diseases diagnosed so that infected bulbs are not saved for seed. For more information on all three of these diseases, including photos, see the article in the July 9, 2020 issue of Vegetable Notes.

*Above-ground signs of garlic bulb rot.*
*Photo G. Higgins*

### Beans

**Mexican bean beetle** eggs are starting to be seen in a field where adults were found last week in Hampshire Co. MBB can be controlled using the commercially available parasitic wasp *Pediobius faveolatus*, which is available through the NJ Department of Agriculture. The NJ Dept. of Ag. is the main producer of this biological control for the US and supplies other biocontrol companies with the wasp, so ordering directly from NJ is the fastest way to receive them. The best contact for ordering this year is Alexandra Gillet, Alexandra.villiard@ag.nj.gov or 609-530-0309, who can also help answer questions about release rates and timing.

## Contact Us:

Contact the UMass Extension Vegetable Program with your farm-related questions, any time of the year. We always do our best to respond to all inquiries. **Office phone:** (413) 577-3976 *We are currently working remotely but checking these messages daily, so please leave us a message!* **Email:** umassveg@umass.edu

**Home Gardeners:** Please contact the UMass GreenInfo Help Line with home gardening and homesteading questions, at greeninfo@umext.umass.edu.

**Brassicas**

*Cabbage aphids (left) and characteristic V-shaped lesions at leaf margins caused by black rot (right).*

Cabbage aphid was found in a brassica field in Hampshire Co. this week. Cabbage aphids are green-gray and are characteristically covered by a gray waxy secretion, making them appear powdery. This pest usually only becomes a problem later in the summer, but effective management rides on early detection and action. Chemical control is recommended if >10% of plants are infested. Effective conventional materials include Fulfill, Beleaf (both selective for aphids), Movento, Assail, and Admire Pro. Include a surfactant. The most effective OMRI-listed products are insecticidal soap (e.g. M-Pede) and azadirachtin products, or a combination of the two.

Black rot was found in a brassica field in Hampshire Co. this week. Black rot is caused by a bacterium that enters the plant vascular system through hydathodes (pores along the edge of the leaf). The bacterium clogs the veins, causing them to turn black, and the surrounding leaf tissue turns yellow, commonly in a "V" shape. The pathogen can be carried on seed and can survive on crop debris for several years. Taking measures to reduce leaf wetness periods and avoiding working in fields with wet foliage can help slow the spread of the disease. Hot water seed treatment can eliminate the bacteria from the seed.

**Cucurbits**

*Symptoms of cucurbit downy mildew on the top (left) and underside (right) of a cucumber leaf. Photos: G. Higgins*

**Table 1. Squash vine borer trap captures June 23, 2021**

| Location | SVB |
|---|---|
| Deerfield | 2 |
| North Easton | 14 |
| Westhampton | 3 |
| Whately | 0 |
| Sharon | 7 |
| Leominster | 2 |

Cucurbit downy mildew (DM) was reported on cantaloupe this week in NJ, after being reported on cucumber last week. There are 2 clades or strains of cucurbit downy mildew; clade 1 infects watermelon, pumpkin, and squash and clade 2 infects cucumber and cantaloupe. At this time, it appears that watermelon, pumpkin, and squash are not at risk for DM but growers may want to consider beginning protectant fungicide applications to cucumbers and cantaloupe. DM forecasting is available here, with relative risk forecasted based on the location of outbreaks, forecasted wind patterns, and environmental conditions. While risk of disease development in New England remains low, protectant fungicides (chlorothalonil, mancozeb, copper) are recommended. When the risk becomes higher and DM is reported nearby, it is recommended to add a DM-targeted material.

Squash vine borer numbers are up from last week, with one trap in NH capturing a whopping 72 moths! 6 out of 7 MA traps captured SVB moths, ranging from 2-14 moths/trap this week (see Table 1 above). A spray, targeting the base of the plants where the moths lay eggs, is recommended when trap captures reach 5 per week for bush-type cucurbits and 12 per week for vining-type cucurbits. See the article in this issue for management recommendations. We

want to take this opportunity to say a HUGE thank you and good luck to George Hamilton, Extension Specialist from UNH, who has worked for UNH Extension since 1989 and is retiring tomorrow. George spent many years working with giant pumpkin and corn growers on pheromone trapping and has been a trusted source of information for our team. You will be missed, George!

Choanephora *sporulation on a squash flower.*

**Choanephora fruit rot** was reported in summer squash and zucchini this week. This is a common fungal disease of cucurbit fruit. The pathogen survives on crop residue in the soil and infects flowers or young developing fruit that is touching the ground. It most commonly appears during hot, wet periods and is not usually an issue after conditions dry out a bit. The fungus produces lots of fuzzy gray sporulation on fruit tips. There is no effective chemical control for this disease.

**Solanaceous**

*Early blight (left) and Septoria leaf spot (right) on tomato. Photos: Clemson Univ. USDA Cooperative Extension Slide Series, Bugwood.org and G. Higgins*

**Early blight** and **Septoria leaf spot** were seen in a tomato field in Hampshire Co. this week. Septoria causes small leaf spots (a couple mm in diameter) with small black speckles (fruiting bodies, called pycnidia, from which spores are produced) and early blight causes larger spots, often with concentric rings. Both fungal diseases start in lower leaves. For management recommendations, see the article in the June 10 issue of Vegetable Notes.

**Tomato leaf roll** was observed in high tunnel and field tomatoes this week in Hampshire Co. Leaf roll is a physiological response and is commonly a reaction to hot, dry weather. The rolled leaves provide less surface area from which water can evaporate. Lower leaves are affected first. Leaves may recover if temperatures drop or more water is provided but the condition can be permanent if hot, dry conditions persist. In high tunnel tomatoes, we recommend using more than 1 drip line per bed, in order to provide enough water to the extensive root system of the plants under hot high tunnel conditions. Leaf roll can look concerning, but does not tend to limit yields—see more about this and other physiological issues of tomatoes in the article in this issue.

*Verticillium wilt in eggplant. Photo: G. Higgins*

**Verticillium wilt** was observed in eggplant in Hampshire Co. This disease is caused by a fungus that can survive in the soil for many years. All solanaceous crops are susceptible but it is most commonly and severely observed in eggplant. *Verticillium* grows into the plant's vascular system, clogging the veins and causing leaves to turn yellow and wilt; sometimes just one side of the leaf will wilt. Management of Verticillium wilt is largely based on cultural controls; few chemical products are labeled for control. Practice long crop rotations out of solanaceous crops and don't plant eggplant into fields that are known to be infested with *Verticillium*. Some varieties are more tolerant to the disease and produce good yields despite the infection.

**Three-lined potato beetle** adults and larvae were observed on tomatillos in Hampden Co. The larvae are notable for their defense mechanism of carrying their frass on their backs. Eliminating solanaceous weeds can help reduce their numbers.

**Colorado potato beetle** larvae continue to feed in potato and eggplant crops. Resistance to both neonicotinoids and spinosads (both OMRI-listed and synthetic) have been reported this year. We saw resistance to neonicotinoids last year but resistance to synthetic spinosads is new this year. Abamectin (e.g. Agri-Mek or Reaper) is reported to be working well this year, so if you are seeing poor control with a neonic or spinosad material, try one of those.

**Sweet Corn**

**European corn borer** trap counts have dropped from last week, indicating that we are past peak flight of the first gen-

eration. Caterpillars are continuing to do damage in corn – look for small shot-hole feeding damage on leaves and sawdust-like frass in tassels. Although damage to tassels may not decrease yield, caterpillars are easy to target with pesticides when they are in the tassel, before they move down the plant and into ears, where they are protected from sprays.

Corn earworm is also being captured already in pheromone traps at some sites in MA and NH, earlier than in previous years. Once corn earworm trap captures reach above 1.4 moths/week, the trap capture number begins to dictate spray schedules, with a tighter schedule recommended when trap captures are higher. Current trap captures correlate to 5-6 day spray schedules. Corn earworm numbers can vary widely from farm to farm, so we recommend that sweet corn growers trap on their own farm. Set up traps now even if corn is not silking yet.

**Table 2. Sweetcorn pest trap captures for week ending June 23**

| Location | GDD (base 50°F) | ECB NY | ECB IA | CEW | CEW Spray Interval |
|---|---|---|---|---|---|
| **Western MA** | | | | | |
| Sheffield | 609 | - | - | - | - |
| Southwick | 784 | 0 | 0 | 1 | *no spray* |
| Whately | 852 | 2 | 2 | - | - |
| **Central MA** | | | | | |
| Bolton | 812 | 0 | 0 | - | - |
| Leominster | 809 | 2 | 0 | - | - |
| Northbridge | 723 | 7 | 0 | 2 | *6 days* |
| Spencer | 798 | 4 | 0 | 0 | *no spray* |
| **Eastern MA** | | | | | |
| Ipswich | 753 | 0 | 0 | 5 | *5 days* |
| Concord | 806 | 6 | 0 | 3 | *6 days* |
| Millis | - | 0 | 1 | - | - |
| North Easton | 793 | 0 | 0 | - | - |
| Sharon | | 0 | 0 | - | - |
| Seekonk | 903 | 1 | 0 | - | - |
| Swansea | | - | - | - | - |

- no numbers reported for this trap
N/A this site does not trap for this pest
*GDDs are reported from the nearest weather station to the trapping site

**Sap beetles** have also been reported in sweet corn this week, requiring sprays in silking corn regardless of whether or not corn earworm is present in the crop. Sap beetle adults lay eggs in ear tips and larvae feed in the kernels before dropping to the ground to pupate in the soil. Cultivars with exposed ear tips are more susceptible to damage than those with good tip cover. Sap beetles are not susceptible to the Bt toxin expressed in Bt corn so cultural controls and insecticides are crucial to management. Aggressively mow infested blocks as soon as harvest is complete. Eliminate vegetable cull piles. Efficacy trials have shown that carbaryl (Sevin), lambda-cyhalothrin (Warrior II), befenthrin (Bifenture), and methomyl (Lannate) are more effective than most other insecticides. However, carbaryl cannot be used during the early silk period while corn is shedding pollen and does not allow for hand harvesting after use.

**Multiple crops**

Hopper burn, caused by potato leafhopper (PLH) feeding, is starting to be seen in infested potato, bean, and eggplant fields. PLH adults and nymphs pierce leaves with their needle-like mouth parts to suck out plant sap, and inject a toxin while feeding, causing leaf margins to appear burned. Control PLH before hopperburn symptoms become extreme, as the damage is not reversible.

*Hopperburn on beans*

# Leaf spots of cucurbits

There are several diseases that cause leaf spots on cucurbit crops and they can often be hard to tell apart. Of course, a diagnosis from a trained pathologist in the lab is ideal, but we understand it is not always possible to test every spot you may encounter. Below are descriptions and photos of some the more common fungal and bacterial leaf spots found on cucurbit crops in MA that we hope will help you tease them apart in the field. Management practices for all of these diseases are similar—recommendations can be found at the end of the article.

**Angular leaf spot:** This disease can affect all cucurbits, but cucumbers are most commonly affected. It is caused by the bacterium *Pseudomonas syringae* pv. *lachrymans*. Angular leaf spot is usually among the first of the foliar leaf spots to show up because it is seed-borne. In past years, we have received multiple reports of angular leaf spot on the same variety of cucurbit, all early in the season, indicating that the seed was infested. Small, round, water-soaked spots appear on leaf

tissue, and expand until they are confined by veins, giving them the characteristic angular look. Under moist conditions, a milky white exudate containing bacterial cells may ooze out of the lesion on the lower leaf surface. The wet-looking spots will dry out and turn yellow-brown or the dead tissue may fall out leaving a "shot-hole" appearance. Yellowing of the leaf between lesions may occur where disease severity is high. Similarly, water-soaked spots may appear on stems and petioles, drying out to form a whitish crust. Spots can also appear on fruit, where they begin as tiny and water-soaked, but dry to form whitish, chalky, spots, rendering the fruit unmarketable. The spots on fruit can also develop into internal fruit decay. Fruit that is infected early may be deformed. Affected plants will grow poorly and produce less fruit.

*Angular leaf spot on zucchini. Spots will expand until they are trapped by leaf veins. Photo: S.B. Scheufele*

As with other bacterial diseases, outbreaks of angular leaf spot are often initiated from infected seed. Bacteria proliferate in warm, moist weather and are spread from plant to plant by splashing rain or runoff, as well as by insects or workers moving through the field.

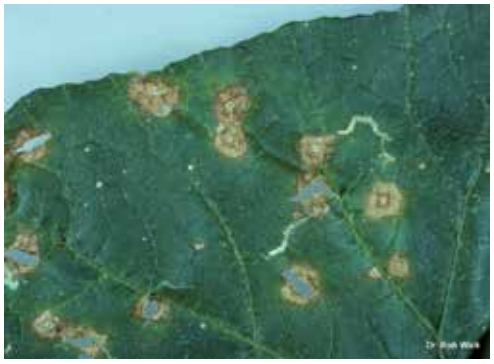
Resistant varieties are available. If you catch angular leaf spot early, copper may be effective in reducing its spread.

**Scab:** This disease is caused by the bacterium *Cladosporium cucumerinum* and can be a significant problem for summer and winter squash, pumpkin, melon, and watermelon. Lesions may occur on leaves, stems, petioles, and fruit, with fruit spots being the most damaging. Leaf spots are small, pale-yellow to white, and similarly to angular leaf spot, the dead tissue in the center of the lesion may fall out leaving a "shot-hole" appearance. Stem or fruit lesions may occur despite the absence of leaf lesions. Lesions on stems are elongate and light-colored, and if numerous may cause the internodes to shorten, giving the plant a deformed appearance. Scab lesions on fruit are sunken, irregular cavities with corky margins, and may produce a golden brown ooze which dries into brown beads. Sporulation on lesions may occur, giving them an olive-green, felt-like appearance. This disease usually occurs in mid-summer and is favored by cool, dry days and rainy or dewy nights.


*Scab on zucchini. Photo: T.A. Zitter*

Tolerant varieties of cucumber are available. Chlorothalonil, mancozeb, or polyoxin D can be used preventively, at the first sign of disease.

**Anthracnose:** This disease affects mostly melons, watermelons, and cucumbers; squash and pumpkins are less susceptible. The disease is caused by the fungus *Colletotrichum orbiculare*, which, like other anthracnose fungi, causes characteristic black, sunken lesions on affected fruit. Leaf spots are light-brown or reddish and appear near veins so may cause leaf distortion. These lesions dry out and the dead tissue may fall out, again leaving a "shot-hole" appearance. On stems and petioles, lesions are elongated and tan. Lesions on fruit are large, circular, sunken areas that turn black and may produce a pink ooze under humid or moist conditions.



*'Shot-hole' appearance of anthracnose. Photo: R.L. Wick*

The fungus can be seed-borne and also survives on crop residue or volunteer plants (maybe in your compost or cull pile). Humid, rainy weather is necessary for disease to occur. There are three races of the fungus that affect different crops. Resistant cucumber and watermelon varieties are available, but there are not resistant cantaloupe varieties.

**Alternaria leaf spot:** This disease affects all cucurbit crops but is most common on cantaloupe. The disease is caused by the fungus *Alternaria cucumerina*, which, like the *Alternaria* species that causes leaf spots in brassicas and early

*Concentric rings make* Alternaria *leaf spots look like targets. On cantaloupe. Photo: G. Holmes*

blight in nightshades, causes a characteristic target-like spot. Usually, leaf spots are small and start out as tan flecks that enlarge and merge together. These larger spots (up to a half-inch) may exhibit the concentric rings common of all *Alternaria* fungi. This disease usually occurs in mid-season and can reduce late-season fruit production. Fruit lesions may also occur as sunken lesions with dark, olive-green, felt-like sporulation present in rings. Spores are spread from plant to plant via splashing rain or overhead irrigation, as well as by insects, workers, and equipment moving through the field.

*Septoria leaf spot of cucumber. Photo: R.L. Wick.*

**Septoria leaf spot:** This disease is less common, occurring in cool summers or late-fall. Septoria leaf spot is caused by the fungus *Septoria cucurbitacearum*, which causes small, almost white, round spots on leaves and superficial, raised tan bumps on fruit. Spores are spread from plant to plant via splashing rain or overhead irrigation, as well as by insects, workers, and equipment moving through the field.

**Management:** The impacts of these bacterial and fungal diseases can all be reduced through field sanitation and use of pesticides, whether conventional or organic.

- **Start with quality seed, and/or fungicide treated seed.** If saving your own seed, avoid collecting seed from fruit with any defects.
- **Resistant or tolerant varieties** of many cucurbit crops are available for most of these diseases. Meg McGrath of Cornell University has compiled extensive lists of disease-resistant varieties of vegetable crops.
- **Use a 2-year rotation** for cucurbit fields. All of these diseases survive on crop residue in the soil, which can persist for up to 2 years.
- **Use drip irrigation** to reduce the spread of bacteria and fungal spores by overhead irrigation.
- **Don't work in affected fields when foliage is wet**, or work in unaffected sections first and infected sections last to avoid spreading disease to unaffected areas.
- **Use fungicides or bactericides when you see the first leaf spots** to slow the spread of disease. Submit a sample to the UMass Plant Diagnostic Lab so that you can choose an effective pesticide for the disease you have. Consult the cucumber, muskmelon, and watermelon or pumpkin, squash, and gourds disease sections of the New England Vegetable Management Guide for pesticide recommendations.
- **Till under crop residues promptly** after harvest is complete to encourage the quick breakdown of infected tissues.

*--Written by Susan B. Scheufele, UMass Extension*

## Squash vine borer management

Squash vine borer moths are now being caught in pheromone traps in MA and NH. We can expect to find eggs within the next few weeks. Populations vary greatly from site to site even within the same town, so only make treatments based on trap captures or observations in a specific field.

**Life stages and identification.** Squash vine borer adults are day-flying moths with a 1- to 1.5-inch wingspan, black forewings, clear hind wings, and a bright red-orange abdomen. These clearwing moths are so called because of their transparent hind wings that, when in flight, make them look like wasps. There are 1-2 generations each year in New England. First generation adults emerge mid-June to early July, and peak flight is in mid-July. Over the last few years, we have begun trapping adults in pheromone traps at 450-500 GDD base 50°F in NH and MA. A second generation in late August has been indicated by trap captures in seasons with particularly high degree day accumulation. Moths usually fly for a couple of weeks before beginning to lay eggs, and their lifecycle lasts about 60 days. Each female can lay 150-200 eggs. Eggs are small (~1mm) ovals, reddish

*Squash vine borer moth. Photo: A. Eaton*

brown in color, and are usually found singly on squash vines, within a foot of the soil. Eggs hatch in 10-15 days. Larvae are cream-colored, grow to ~1 inch long, and have a brown head capsule. Within hours of hatching, the larvae bore into stems, where they feed for 4-6 weeks before exiting to drop into soil, spin a brown cocoon, and pupate not far below the surface. They remain in the soil until the following spring, or may hatch as adults for a second flight in late summer.

*A single SVB egg on a cucurbit transplant stem. Photo: K. Campbell-Nelson*

*SVB larva within a squash stem. Photo: J. Boucher*

**Host crops and damage.** Larval feeding within vines causes leaf stems to wilt and collapse, reducing fruit yields, and can even sever a plant from its roots. Smaller plantings often suffer more injury and damage than extensive plantings because eggs are concentrated on fewer plants. Occasionally larvae will bore into fruit of hard squash and pumpkins; this most commonly occurs when a second generation of moths are laying eggs late in the summer when fruit is present. Thick-stemmed *Cucurbita* species including *C. pepo* (summer squash, zucchini, pumpkin) and *C. maxima* type winter squashes (e.g. Hubbard, Buttercup) are preferred and are most suitable for larval development. Pumpkins can sustain high infestations without yield reduction. Generally, vining plants can withstand higher infestations compared to bush-type plants, as they tend to root at the vine nodes, allowing the vine to survive despite having borers within the stem. Crops and varieties with thin stems, including Butternut squash, cucumber and melon, are considered resistant to this pest.

*SVB damage. The base of the stem of this plant was cut open to find an SVB larva feeding within.*

**Cultural strategies.** Crop rotation can be an effective strategy to reduce damage, as it will take emerging adults longer to find and lay eggs within a host crop. Move cucurbit plantings to distant fields year to year, and do not plant this year's summer squash into last fall's pumpkin field. Postharvest or spring plowing can destroy or bury pupae, and subsequently reduce populations. Row covers may prevent egg-laying, but may also interfere with pollination or increase aphid populations. Trapping data indicating the presence of adults and peak flight may help determine when row covers are necessary, so that covers can be removed for pollination when plants are at less risk of infestation. Straw mulch near the base of plants also keeps the adult moths from laying eggs, but can become a reservoir for squash bug.

**Monitoring:** Pheromone traps (Heliothis net traps work best) can be used to monitor adult flight (sources for traps and pheromone lures include Gempler's, Great Lakes IPM, Trece). Traps should be placed in a susceptible crop, with the bottom of the trap just above, but not blocked by, the plant canopy. Traps may have to be moved up as the plants grow. Once the first adult moths are captured, check the bases of stems for eggs (see photo above), sawdust-like yellow-orange frass, or entry holes of larvae. Cutting open the stem just above the hole is a good way to find out if damage has just begun or if the larvae are already well developed in the field. If the damage has just begun, it may still be early enough that a spray targeted at the base of plants will control other hatching larvae.

**Chemical control.** Targeting stems before eggs hatch and larvae as they hatch is important for effective control because the larvae are protected from sprays once they have bored deep into the stems. Use a threshold of 5 adults per trap per week for bush varieties. For vining crops like squash and pumpkins, the plants may be able to tolerate more damage and a higher threshold of 12 moths per trap per week can be used. A total of 2-3 applications 5-7 days apart targeted at the plant base may be necessary for as long as adults are being caught in traps. See New England Vegetable Management Guide for treatment options. Many of the insecticides labeled for this pest are broad-spectrum materials with high toxicity to bees and are not recommended for use during bloom when the vine borer is active. Squash bees and bumble bees may spend the night inside of blossoms, so targeting sprays at the base of plants, rather than at blossoms and foliage, can also help to protect pollinators. Several selective products labeled for cucurbits (with low or medium bee toxicity) including

spinetoram (Radiant), spinosad (Entrust), and *Bacillus thuringiensis* are labeled for squash crops and have been shown in trials to provide control when used as described above. *Bt aizawi* (Xentari) was somewhat more effective than *Bt kurstaki* (Dipel) or spinosad in some trials. These pesticides have to contact and/or be ingested by the larvae, so again, applications must be made before the larvae enter plant stems. Squash vine borer is not specifically on the label of many OMRI-listed materials, including XenTari and Entrust, but both of those products are labeled for use on cucurbit crops. In MA, a pesticide may be used against a pest that is not included on the label as long as the crop is on the label. Follow label rates for the other caterpillar pests listed on either label. Injecting entomopathogenic nematodes *Steinernema carpocapsae* into cucurbit stems near the base of the plants has been shown to be effective and the hollow moist vines are conducive to survival of the nematodes, but this is not practical for large plantings.

**Resources:**


Canhilal, R., G. R. Carner, R. P Griffin, D. M. Jackson, and D. R Alvarez. 2006. Life history of the squash vine borer, Melittia cucurbitae (Harris) (Lepidoptera: Sesiidae) in South Carolina. *The Journal of Agricultural and Urban Entomology* 23: 1–7. (Available online at: http://scentsoc.org/Volumes/JAUE/v23/1.pdf) (verified 27 June 2011).

Capinera, J.L. 2001. *Handbook of Vegetable Pests.* Academic Press, New York. 729 pp


*--Written by the UMass Extension Vegetable Program.*

## ABIOTIC DISORDERS OF TOMATO

The earliest field tomatoes are sizing up now and will soon be ripening, and high tunnel tomato harvest is already well underway. We have seen cases of blossom end rot and leaf roll in tomato already this season, and now is the time to make sure you're providing tomatoes with sufficient nutrients and consistent water to avoid some of the other disorders described in this article. All of the disorders described in this article are abiotic, meaning they are not caused by living pathogens but instead by environmental factors. In many cases, the answer to avoiding these disorders is proper fertility and consistent irrigation.

*Blossom end rot, with* Alternaria alternata *sporulation.Photo: D. Langston, Univ. of GA, Bugwood.org*

**Blossom end rot** is characterized by dark brown or black sunken areas at the blossom end of the fruit. The lesions are a direct result of a localized calcium deficiency at the blossom end. The dead tissue is initially brown or white and leathery but often becomes colonized by the saprophytic fungus *Alternaria alternata*, which only infects dead tissue and produces fuzzy black sporulation. Although calcium deficiencies in the soil are sometimes responsible for blossom end rot, much of the time, blossom end rot is the result of plant water stress. Calcium is taken up primarily through the water-conducting tissues of the plant, so when the soil is dry or the plant's roots are compromised and the plant isn't taking up water, calcium deficiencies develop. Problems can be prevented by regular watering to avoid extreme fluctuations in soil moisture. In high tunnel tomatoes, it is recommended to use more than one drip line per bed to ensure that the entire extensive root system is able to supply sufficient water to the lush foliage. Good soil drainage, mulching, and preventing root damage also help. High soluble salts, low calcium, and high cation (potassium, magnesium or ammonium) levels in the soil may also contribute to blossom end rot; other cations may out-compete calcium on soil exchange sites, making it unavailable to the plant. **Management:** Maintain sufficient, even soil moisture. Use soil nutrient testing to monitor soil soluble salts and cation ratios, and maintain adequate calcium in the soil.

*Tomato leaf roll*

**Leaf roll** is usually a reaction by the plant to conserve water by reducing the surface area from which water can evaporate. This disorder is often seen just after plants are heavily pruned under dry soil conditions, but oddly enough, leaf roll disorder also has been found to be caused by excess soil moisture coupled with extended high temperatures. If the tomato plant's top growth is more vigorous than root growth

and we are hit with a hot, dry period, the foliage may transpire water faster than the root system can absorb it from the soil, and the plant's reaction is to roll it's leaves up to reduce transpiration. Leaf rolling can also result from growing high-yielding cultivars under high-nitrogen fertility programs. Cultivars selected for high yield or early ripening tend to be the most susceptible and indeterminate cultivars are more sensitive than determinant. The good news is that leaf roll rarely affects plant growth, fruit yield, or fruit quality. Some viruses can look similar to tomato leaf roll, but if the symptoms appear suddenly, involve many of the plants in a field, and largely affects lower leaves, it is probably just physiological leaf roll. **Management:** Reduce symptoms by maintaining consistent, adequate soil moisture (~1 inch per week during the growing season, which will also help with calcium uptake, reducing blossom end rot problems). Do not prune heavily during hot, dry conditions or over-fertilize with nitrogen.

*Catfacing in heirloom tomatoes. Photo: K. Campbell-Nelson*

**Catfacing:** Tomatoes are considered "catfaced" if the blossom scar is enlarged or perforated. This can happen to both field and greenhouse tomatoes, and is more common in heirloom cultivars. Often times, the fruit becomes extremely misshapen, but fruit distortion is not necessary to classify it as catfaced. This disorder has not been extensively researched and is still not fully understood. Cold temperatures during flowering have been shown to increase incidence of catfacing, as have extreme fluctuations in night versus day temperatures. Damage from thrips to the side of the pistil of tomato flowers can also cause this disorder, and under some conditions, pruning and high nitrogen levels can increase catfacing incidence. Catfacing can increase chances of fruit becoming infected via the rough blossom scar by black mold rot, a disease caused by several different fungi. **Management:** Avoid excessive pruning and nitrogen fertilization. Avoid low greenhouse temperatures for both greenhouse tomatoes and transplants. Use cultivars that are less prone to catfacing.

*Stiching/zippering. Photo: J. Howell*

**Stitching/Zippering** is the term for when a thin, brown, necrotic scar extends from the stem to the blossom end on fruit. The longitudinal scar has small transverse scars along it, making it resemble a zipper or seam. Fruit can have one or several scars. This disorder is purely cosmetic and does not affect the edibility of the fruit, but may render fruit unmarketable. Zippering is caused by anthers (the pollen-producing flower part) fused to the ovary wall of newly forming fruit. This disorder occurs more frequently in cool weather. **Management:** Plant cultivars that are less susceptible to stitching/zippering. Avoid low greenhouse temperatures.


*Small concentric cracks (left) and radial cracking (right). Photos: G. Higgins and G. Johnson*

**Fruit cracking** can occur in several different patterns – radial cracks starting at the stem scar, concentric cracks circling the fruit shoulders, small cracks around the shoulders called "rain checking". These cracks are caused by excessive water uptake by the plant during fruit development, when interior tissues expand faster than the inflexible skin. High temperatures can make fruits more susceptible to cracking, and cultivars with large fruit tend to be more susceptible. Opportunistic fungi and bacteria can enter the fruit through cracks and cause fruit rots. **Management:** Provide even irrigation and plant cultivars with smaller fruit that are less susceptible to cracking.

*Yellow shoulder. Photo: G. Higgins*

**Yellow shoulder** is commonly caused by potassium deficiency in tomato. Recent surveying by several New England state Extensions has shown that tomatoes, especially high tunnel tomatoes, have very high potassium requirements and crops tend to

be deficient. Nutrient recommendations for high tunnel tomatoes have been overhauled in the current edition of the New England Vegetable Management Guide. Current recommendations advise growers to fertilize based on the potential yield of your crop (with indeterminate, disease-resistant cultivars planted early into heated tunnels expected to yield more than heirloom or determinate cultivars planted later). Click here to see the full recommendations in the high tunnel tomato section of the Guide. One recommendation for K fertility in high tunnel tomatoes is to apply ¼ lb of K/1000 sq. ft. through the drip every week for 10 weeks, using potassium sulfate fines. In both the field and high tunnels, the following factors can also lead to K deficiency in tomatoes: waterlogged and/or compacted soils, above-optimal nitrogen application rates, excessive application of potassium competitors, and excessively large or dense canopies. Some cultivars are also more prone to developing yellow shoulder than others; cultivars with green shoulders that lack the uniform ripening gene are more likely to develop yellow shoulders. High temperatures and sun can also cause this disorder, both by directly damaging fruit tissue and by inducing water stress that can limit the uptake of K.

**Blotchy ripening, gray wall, and internal whitening:** Blotchy ripening is characterized by yellow or orange discolored areas on tomato fruit surfaces. Tomatoes with gray wall have grayish-brown discolorations on the fruit wall and may also exhibit internal browning. Gray wall typically appears on green fruit before ripening. 'Gray wall' is the term used when the outer fruit walls turn brown or gray and collapse, compared to 'internal whitening', which refers to when the outer and inner fruit walls become white and corky. Factors that increase the severity of these disorders include cloudy weather, wet and cool conditions, high nitrogen, low potassium, and compacted soils. Good irrigation management and organic soil and nutrient management will reduce the risk of these disorders.

*Internal whitening. Photo: G. Brust*

Ripening disorders, including yellow shoulder, blotchy ripening, gray wall, and internal whitening, are most prevalent when air temperatures during mid-late stages of fruit ripening are extreme (e.g., below 60°F and/or above 90°F) or highly variable, when humidity levels remain high, and/or when these conditions prevail and light levels are low. Unfortunately, these are not uncommon conditions in New England and are largely out of our control. Tomato mosaic virus can cause similar symptoms of uneven fruit ripening and should be ruled out as the underlying cause.

Jerry Brust, IPM Vegetable Specialist at the University of Maryland, researches the management of abiotic disorders in tomato; he recommends using white plastic mulch laid early in the season to keep the crop cooler and using shade cloth on your most marketable cultivars. In over 5 years of trials, Brust's research has shown that a 30% filtering shade cloth increases marketable yields by 20-50%, depending on the year. A 4 ft-wide shade cloth covering even a quarter of the crop canopy is sufficient to achieve this increase in yield, and the cloths may be used for many years.

These disorders are irreversible in fruit that are already symptomatic, but changes to fertility and irrigation can prevent the disorder from affecting younger fruit. Take measures now to ensure that your tomatoes are receiving sufficient and consistent water and nutrients, and take note of any abiotic disorders that occur this year in order to make changes to your fertility and irrigation plan for next year.

**Sources:**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Maynard, Liz, Assistant Professor of Horticulture, emaynard@purdue.edu, 219-531-4200. "Yellow Shoulder and internal white tissue in tomatoes" Veg Crop Hotline, Purdue Extension. August 7, 2014.

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*--Compiled by Genevieve Higgins and Katie Campbell-Nelson, UMass Extension*

# News

### Let us know how you use the New England Vegetable Management Guide!

Do you use the New England Vegetable Management Guide as a resource? If so, we want to hear from you!

The authors of the New England Vegetable Management Guide want to learn more about how the guide is used, so that we can make it as useful as possible. While we are revising the guide, we have designed a short survey to better understand what YOU value in the guide. Please consider taking 5 minutes to provide your feedback and suggestions here: https://unh.az1.qualtrics.com/jfe/form/SV_9Ag68WJ1uyjreE6.

### Survey: How Can Extension Better Serve Growers with Video and Audio Resources?

Extension educators from UVM are seeking survey responses from growers about how Northeast agricultural service providers can provide support with video and audio resources. The information from this survey will support a proposal for a SARE Professional Development grant aimed at funding educational opportunities for agricultural service providers. This survey should take less than 2 minutes and we'd greatly appreciate your response!

Survey link: https://qualtrics.uvm.edu/jfe/form/SV_2oB3ROWvwWSCJoi

### Hemp pest research priorities survey

A group of hemp researchers and Extension faculty from across the US and Canada are collecting information from growers and agricultural service providers in efforts to determine the types and distributions of major disease and insect pests of hemp. Their aim is to map pests and pathogens by region and to set research priorities moving forward.

Grower survey: https://uky.az1.qualtrics.com/jfe/form/SV_6Du84alnDmH587I

Agricultural service provider survey: https://uky.az1.qualtrics.com/jfe/form/SV_eCIdn6y4UHsLVpI

# Events

### UMass Worker Protection Standard (WPS) Train-the-Trainer

**When:** Wednesday, June 30, 4-7:30 pm.

**Where:** Online

All farmworkers must receive annual training under the EPA Worker Protection Standard (WPS) if the farm where they work uses any pesticides in their crop production, **including those approved for organic production and other general use pesticides**. The agricultural worker employer is responsible for complying with all components of WPS including the training of farmworkers. This training can only be provided by an individual who has a pesticide certification license or has attended **an approved EPA WPS Train-the-Trainer workshop**, such as this one.

This training is appropriate for farmers and supervisors who want to be able to train farm employees on WPS without having to have a pesticide license. For farmers who do already have a license, 3 pesticide contact hours are available for this training.

***3** pesticide recertification credits are available for this program*

**Cost:** $60

**Registration:** Register by June 28 at 12:00pm. https://forms.gle/ZoTAdTiB7N4Wc3Lt7

### UNH North Country Lunch and Learn

UNH Extension is offering this online series, open to all but focused on growing vegetables commercially. So, grab your lunch and let's learn!

This event is free, but registration is required. Register once for all days.

- **July 7, 12-1pm:** Onions: Over Wintering and Direct Seeded
- **August 4, 12-1pm:** Brussels Sprouts: Growing and Storage

**Registration:** Click here to register for these workshops.

Questions? Contact nicholas.rowley@unh.edu or heather.bryant@unh.edu or call 603-788-4961 ext. 207

### Save the Date! In-Person UMass Summer Field Day

**When:** Tuesday, July 27, 2021, 3-7pm. Dinner at 7pm (Rain date: Thursday July 29)

**Where:** UMass Crop & Livestock Research & Education Farm, 91 River Rd, South Deerfield, MA

Come to see the newly purchased no-till transplanter in action. Also, learn about several new innovative research projects on a wide range of topics including soil health, cover crop termination strategies, summer and fall cover crop mixtures, vegetables, forages, and more. The field day includes a four-hour tour by the Vegetable and Crops, Dairy, Livestock extension teams. Dinner will be provided at the end of the tours. More details about the projects, researchers, and tours will be available in early July.

*This event will be made possible by UMass Center for Agriculture, Food, and the Environment, MDAR, Northeast SARE, the UMass Stockbridge School of Agriculture, and American Farmland Trust.*

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*Vegetable Notes. Genevieve Higgins, Lisa McKeag, Susan Scheufele, co-editors. All photos in this publication are credited to the UMass Extension Vegetable Program unless otherwise noted.*

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