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Natural Roots Farm in Conway, MA has had good success using bird netting to protect against deer feeding this year. Photo: C. Radon

Crop conditions

The cooler and less humid weather has farmers and crops alike feeling productive and happy. The height of summer's bounty is upon us now with a big crop of melons coming in, bushels of sweet corn—coming in all at once in some places, due to warm weather a few weeks back—loads of tomatoes, and now onions and leeks on the shelves. Some bulk harvests are getting underway including the first potatoes, carrots and beets, and squash harvest is just around the corner. As fall approaches and squash is ripening, deer are starting to abandon their grassy hideaways and are moving into farm fields, where they seem to take just one bite out of each pumpkin and melon in the field. Some folks are having success using netting like bird netting or snow fencing draped over their crops in order to keep deer out of the field. Others are using repellents like Bobbex or Deer Out—remember that these must be consistently applied and reapplied as directed. If applied after deer damage has occurred, repellents likely will not repel deer from something they have already eaten. Don't forget about our farm tour next Tuesday—as well as hearing about the many ongoing research projects on the research farm, you can also learn about on-farm solar incentives from the UMass Extension Clean Energy Team. And you can chat with us about your pressing crop or farm issues or share your crop conditions over dinner! Hope to see you there!

Pest alerts

Brassicas:

Cross-striped cabbageworm. Photo: T. Kuhar

Cross-striped cabbageworms (CSCW) were spotted in Franklin Co., MA this week on red cabbage. Unlike the three other major caterpillar pests on brassicas, CSCW lays its eggs in batches (3 to 25) rather than singly. Therefore, plants with CSCW larvae are often skeletonized. Egg batches are yellow, flattened, and attached to undersides of leaves. Larvae grow to ¾"-long in 2 to 3 weeks. The caterpillars are light bluish-grey on top and green underneath, with numerous black bands across their backs and a yellow line down each side. We are still seeing lots of imported cabbageworms, diamondback moth caterpillars, and cabbage loopers as well, so regular scouting of brassicas is recommended. Spray when threshold of 15% infested is reached for leafy crops or headed crops and 35% for heading crops that have not yet formed heads.

Black rot continues to spread throughout brassica fields. Bactericides are only marginally effective; sanitation and environmental management are important for managing this disease. Do not work in fields when they are wet, and avoid overhead irrigation. Promptly incorporate crop residues after harvest to speed decomposition.

Flea beetle numbers are still high and damage is being seen on new transplants as well as established crops like Brus-

sels sprouts. Protecting young seedlings is important to avoid stunting. For recent research report on organic and conventional reduced-risk insecticide efficacy, see this report from Brassica Pest Collaborative members at Cornell Cooperative Extension: http://ag.umass.edu/sites/ag.umass.edu/files/pdf-doc-ppt/1sare_cabbage_flea_beetle_reportfinal.pdf

Cabbage aphid numbers are increasing and growers are wondering what, if anything, to spray to control them. Scout weekly to determine % infested plants, starting before harvested portions of the plant form. Treat if >10% of the plants are infested with aphids, especially after heads or sprouts begin to form. Or, select 10 leaves at 10 sites for 100 leaves per field, and treat if >20% have aphids. For conventional growers who have had persistent cabbage aphid problems on their farms, Movento (spirotetramat), although expensive and not broadly labeled, is a highly effective material with some systemic activity from foliar applications. Use a penetrating surfactant with this material. Other labeled products include several neonicotinoids, Sivanto, Closer, and Assail, as well as the more selective products Fulfill and Beleaf. Cyantraniliprole products, which are commonly used for caterpillar control in brassicas, are also fairly effective against aphids in general. Coverage of all leaf surfaces, buds and new growth included, is key. Always include a spreader/sticker. Waiting until there are heavy outbreaks or until just before harvest makes it hard to prevent loss of marketable yield.

Swede midge: While this pest is still not being reported in MA, our neighbors in NY, VT, and ME are reporting symptoms of damage now. MA growers should be on the lookout if they want to stay on top of this invasive pest, which could be spreading south from Canada. The most obvious damage is that heads of affected plants don't develop, a condition known as blinding. In kohlrabi, cavities may form in the marketed stem. For lots of photos to help you identify damage and the insect at various stages, please visit: http://web.entomology.cornell.edu/shelton/swede-midge/monitoring.html. If you suspect Swede midge damage on your farm, please contact your local Extension office for assistance.

Cucurbits:

Downy mildew: Storms this week brought moderate risk of spread of CDM from points to our south and west. To track this disease and access information about identifying symptoms and treating fields please visit: http://cdm.ipmpipe.org/. Nearby outbreaks occurred within the past week in Rhode Island (butternut squash) and Orange Co., NY (cucumber).

Angular leaf spot was confirmed on several melon varieties on one farm in MA, and is being reported from other parts of the region as well, with greater incidence than usual. 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 water, commonly in the form of splashing rain or runoff, as well as by insects or workers moving through the field. Don't work in the field when foliage is wet and work in clean sections first to avoid spreading disease. If this disease is caught early on, copper may be effective in reducing disease severity and spread.

Angular leaf spot on melon.
Photo: G. Higgins

Solanaceous:

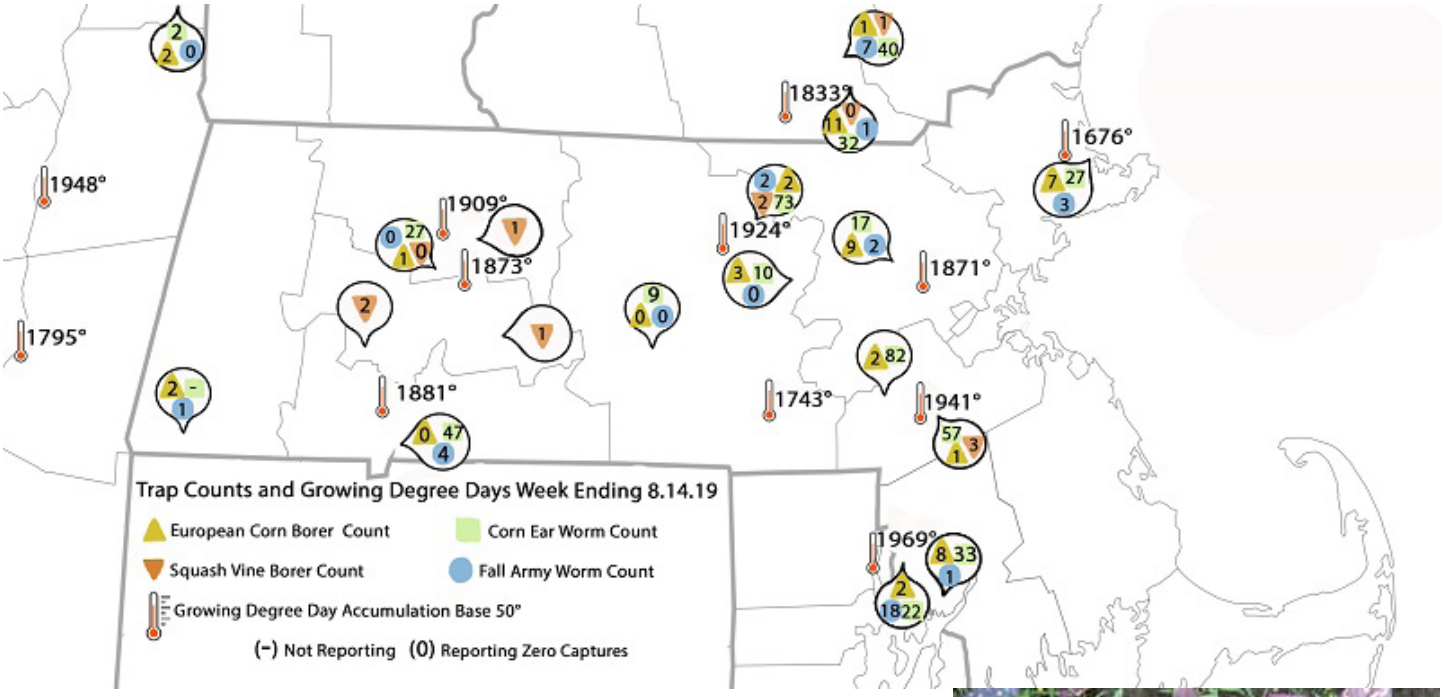
Late blight: There are no reports of late blight in New England but a new outbreak was reported this week in central PA on tomato. With recent cool nights, we're getting long periods of leaf wetness from overnight dew. These conditions favor the spread of late blight and other diseases that are already present in most tomato fields, including **early blight**, **Septoria leaf spot**, **bacterial leaf spot**, **leaf mold**, and **powdery mildew**. Spraying preventatively "for late blight" will also reduce the spread of these diseases and is therefore a good idea. Coppers are good for bacterial and fungal diseases, and many are OMRI-approved. FRAC groups 7, 9, and 11 are targeted for control of fungal diseases (e.g. early blight, Septoria leaf spot), while FRAC groups 21 (e.g. Ranman), 22 (e.g. Zing), 27 (e.g. Curzate), 28 (e.g. Previcur Flex), 40 (e.g. Acrobat 50WP, Revus, or Zampro), 43 (e.g. Presidio), and 49 (e.g. Orondis) are targeted for oomycetes like late blight. A protectant fungicide (e.g. chlorothalonil, copper, mancozeb) should be mixed together with targeted fungicides for the best control.

Sweet Corn:

Corn earworm numbers are still on the rise. We had double-digit trap counts across MA this week, with some sites nearing 100 moths (see map). Folks should be on a 3-4 day spray schedule to prevent damage to silking corn. If maximum daily temperature is below 85°F for 2-3 days, spray intervals may be extended by one day. Continue treatments until 5-7 days before final harvest or until silk is completely dry and brown.

European corn borer: 2nd generation flight is still occurring, and borers are being seen in silking corn as well as other stalky crops such as potatoes, peppers, green beans, hemp, and mums.

Fall armyworm incidence is spotty across MA but some locations are seeing >5 moths/week and patchy damage throughout the field. Spraying in whorl stage and tasseling corn with >15% plants infested with either FAW or ECB can prevent damage.



Amaranth leafminers have been causing significant damage over the past few weeks on amaranth grown as a vegetable crop. Red, green, and bicolor amaranth all seem to be equally affected. While the species of leafmining fly is not known, other leafmining flies on leafy greens can be controlled using group 5 (e.g. Entrust) or group 28 (e.g. Exirel) insecticides. Efficacy is improved if an adjuvant is included. Sprays should target the eggs and emerging larvae. Please consult insecticide labels before spraying and follow all label instructions—the label is the law.

Mining damage from leafminer larvae in amaranth. Photo: S.B. Scheufele

HARVESTING & CURING POTATOES

Potatoes harvest is beginning across the state now. As our colleagues at University of Vermont Extension like to say, "storage is a hotel, not a hospital," meaning that storage cannot improve the quality of tubers, it can only maintain quality at best. So, harvest when environmental conditions are ideal and pay careful attention to pre-harvest preparation to ensure that the highest quality potatoes come out of the field.

Optimum Environmental Conditions for Harvest

As cooler weather approaches, conditions become favorable for harvest and curing potatoes for long-term storage. Opti-

mum environmental conditions for harvest are soil temperatures of 45-65°F, tuber temperatures of 50-50°F, and soil moisture at 60% and 80% of field capacity for loam and sandy soils, respectively. This level of soil moisture ensures that soil clods are not so hard that they damage skins during harvest and not so moist that they remain stuck to potatoes as they are brought into storage. Temperatures below 45°F will increase tuber bruising and temperatures above 60°F can increase transpiration and drying of potatoes or development of disease in storage. **Vine-kill should take place about 2-3 weeks before these environmental conditions are expected.**

Potato harvest has begun!
Photo: UMass Extension Vegetable Program

Pre-Harvest Preparation

Vine killing stops tuber growth at the desired size after bulking, stabilizes the tuber solids, controls hollow heart disorder, promotes skin set, and allows for easier digging and harvesting. Vines may have died down naturally but if they are still green, mow or use a vine desiccant to kill the plants once tubers are mature. Killing vines also reduces the risk of late blight causing tuber infections, as the pathogen requires a living host to grow and produce spores.

Skin set is achieved by allowing 2-3 weeks for tuber skins to mature in the field after vine kill. During bulking, the outermost layer of potato skin is only loosely attached to underlying tissues, to allow for rapid growth of the tuber without the skin cracking. The cells in this layer are soft and easily damaged. Vine kill on mature potatoes will initiate "skin set"—the outermost layer of skin cells will begin to bind tightly to the underlying tissues and produce suberin, creating a tough, durable skin that is resistant to infection and dehydration. Good skin set greatly reduces the amount of wounding at harvest and increases the storability of tubers.

Maturity is achieved when the tuber skins are fully developed and are difficult to remove. Periodically dig a few plants to see how easily the skins peel. Sugar content is another index of maturity for processing potatoes, with both immaturity and over-maturity resulting in higher sugar levels. Mature potatoes resist bruising and have lower respiration rates than immature potatoes.

Harvest practices to prevent wounding and bruising

Check harvesting and transporting equipment before harvest begins to make sure it is working properly and does not bruise or wound tubers, and continue to inspect during harvest to determine injury points. Potatoes should not drop more than 4-6" and all equipment surfaces should be padded. Replace bare chains with rubberized links where possible, except for the primary chain. Adjust chain and ground speed so that chains are loaded to full capacity during harvest, and potatoes will "flow" rather than drop from one chain to another. In many cases, increasing ground speed helps to achieve this. Adjust the digger blade so that potatoes flow onto the upper surface of the chain rather than bumping into the front. Ensure that digger blades will cut cleanly through the soil – control weeds prior to harvest to avoid tangling, and sharpen blades before harvesting.

Curing: During the first 2-3 weeks of storage, wounds and bruises from harvest are suberized to prevent invasion of pathogens. This process is called curing, and it is essential for completing skin set.

Maintain temperatures at 50-60°F. Harvesting when pulp temperatures are already in this range is ideal. The ability to move from field to curing temperatures will depend on storage ventilation systems, varieties, availability of cooling air, and humidity controls. If potatoes are harvested during hot weather and cool off slowly, the likelihood of storage rot is increased. If active refrigeration is available, potatoes can be harvested at 62-65°F pulp temperature and cooled effectively. Storage areas with no refrigeration should not be loaded with potatoes with a pulp temperature above 60°F.

Maintain relative humidity at 85-95%. Low relative humidity will result in poor suberization. During the curing phase, tubers will lose moisture through cuts and bruises and incompletely suberized skin. As much as 2-4% of the tuber weight can be lost in the form of water during the first month in storage. If managed properly, this water loss can be minimized and, if captured, this lost moisture can be used to maintain the high relative humidity needed during curing for 3-6 hours per day. A humidifier can also be used to maintain proper humidity.

Uniform air movement is necessary during curing to remove heat from the field and from respiring tubers, to supply oxygen, and to prevent condensation within the pile. Monitor temperatures within the tuber bins or pile to avoid heat buildup, which increases tuber rot. In a through-the-pile forced air ventilation system, fans should be operated minimally—usually 1-2 hours per day provides sufficient oxygen but minimizes moisture loss.

Curing and storage must take place in the dark since even low light levels can cause development of chlorophyll (greening) and solanine, a toxic, bitter compound, in tuber skins, rendering tubers unmarketable. 1-2 weeks in low light can result in greening, and higher light levels cause faster greening.

Curing infrastructure: Curing may be accomplished within the space that will be used for storage, or in a different location. Diversified farms and those who are in the process of building up their fall/winter storage infrastructure may find it more challenging to provide the appropriate conditions for curing. On a small scale (up to about 1100 cubic feet), curing can be accomplished using a Cool-bot and humidifier in an insulated space. A combination of vents and fans to exhaust warm air and bring in cool air, controlled with relative humidity and temperature sensors, can make best use of outdoor conditions to manage the indoor environment. Good environmental control is very difficult in an open barn situation.

When tuber quality is poor: Potatoes affected by freezing injury, Pythium leak, late blight, or soft rot will break down at normal curing temperatures. If this is the case, eliminate the curing period–grade out the rot and sell immediately, or cool rapidly to 45°F with low to medium relative humidity. Questionable potato lots should be harvested closer to 55° F if they must be stored. Chilling injury is cumulative and is worse the longer the tubers are in chilling temperatures. Freezing occurs at 30°F, but chilling injury can occur after a few weeks at 32°F.

Disease Management

We still haven't seen late blight in Massachusetts this year, so it should not be an issue on tubers this fall. When late blight is around, spores can be carried by rainwater onto tubers and cause problems in storage. The pathogen can only survive on living tissue, so vine kill is key in disease management if late blight is present on the foliage. If black scurf (*Rhizoctonia* spp.) or silver scurf (*Helminthosporium solani*) are present, they will increase in severity as long as tubers remain in the soil. Wireworms can also cause tuber damage. If markets are ready or suitable storage space is available, minimize the effects of these diseases and pests by starting harvest as soon as skins are set.

If the soil is wet during harvest, soil may adhere to the tubers and promote infection by soft rot organisms. Potato fields that have been saturated with water will be especially prone to post-harvest diseases. Bacterial soft rot (*Erwinia* spp.), Fusarium dry rot, pink rot (*Phytophthora erythroseptica*), and Pythium leak are four serious tuber rotting pathogens that cause the most significant losses in storage (see "Potato Tuber Diseases" in August 24, 2017 *Vegetable Notes*). A good online resource on tuber diseases can be found at http://vegetablemdonline.ppath.cornell.edu/factsheets/Potato_Detection.htm. However, finding a photo online that looks like your problem is not the same as having a plant pathologist confirm what is on YOUR tubers! Send samples to the UMass Plant Diagnostic Lab to get an accurate diagnosis. Proper identification is key as different tuber blights require different management techniques. Grade out diseased tubers before storage as much as possible, as some diseases can spread in storage.

Cooling and Storage

After the curing period, cool tubers as soon as possible but gradually and steadily to the holding temperature. Ideal holding conditions are as follows: 80-90% relative humidity and 38-40°F for tablestock and seed potatoes, 45-50°F for chipping, and 50-55°F for French fry stock.

Sterilizing Storage

An important aspect of potato disease control in storage is providing a pathogen-free environment. All storage and potato handling surfaces should be thoroughly cleaned and disinfected prior to putting the crop in storage. Surfaces should be well-moistened with disinfectant spray. Spray bin walls until there is slight runoff. Recommended disinfectants are quaternary ammonium compounds such as Hyamine 2389. Bins or equipment treated with quaternary compounds must be rinsed with clean water before coming into contact with potatoes to be used for human consumption. Read disinfectant labels carefully regarding use on walls or floors versus use on food-contact surfaces and to determine suitability for your needs. Organic produce may not come in contact with surfaces that have been treated with quaternary ammonium compounds. Chlorine, ozone, and peroxyacetic acid are approved disinfectants for organic produce.

Sprout inhibitors may be needed, depending on storage goals, storage conditions, and cultivar. Potatoes harvested in warm temperatures will be more likely to sprout in storage. Later maturity varieties usually have a longer period of dormancy (2-3 months).

--Written K. Campbell-Nelson, M.B. Dicklow, and R. Hazzard

PRODUCE SAFETY RULE: FDA FACT SHEET ON DROPPED COVERED PRODUCE

The Produce Safety Rule of the Food Safety Modernization Act includes language that prevents the distribution of "dropped" produce—produce that has touched the ground before harvest. In response to growers' questions about this language, the FDA has released the following fact sheet clarifying the definition of the term "dropped produce" and providing some guidance on how to follow this part of the rule.

For more information about the Produce Safety Rule, see our Food Safety for Farmers website at ag.umass.edu/resources/food-safety/food-safety-for-farmers.

Tomato drops, like the ones visible in the aisle here, are considered "dropped covered produce" and cannot be distributed through the fresh market under the Produce Safety Rule. Photo: G. Higgins

What is dropped covered produce?

Dropped covered produce is covered produce that drops to the ground before harvest. Dropped covered produce does not include:

- root crops that grow underground (such as carrots);
- crops that grow on the ground (such as cantaloupe); or
- produce that is intentionally dropped to the ground as part of harvesting (such as walnuts).

Produce that grows off the ground, such as apples, and that drops to the ground before it is harvested, is considered dropped covered produce, unless it is otherwise excluded (e.g., if dropping is an intentional part of the harvesting process). For example, when an apple drops to the ground before it is harvested, it is dropped covered produce, whether or not the covered farm has already begun harvesting apples from that orchard such that the farm might consider the apple to have unintentionally fallen "during" its harvesting of the orchard. The apple in this example dropped before the apple was harvested.

Additionally, produce that grows off the ground, such as staked tomatoes, and that drops to the ground before it is harvested, is considered dropped covered produce, even if the produce is still attached to the plant when it contacts the ground.

Can I distribute dropped covered produce into the fresh market?

No. The Produce Safety Rule prohibits the distribution of covered produce that drops to the ground before harvest. However, the following produce is not subject to the requirements in the Produce Safety Rule, and therefore not subject to the dropped covered produce prohibition:

- Produce that is on the rarely consumed raw list. *This list includes: Asparagus, beans (black, great Northern, kidney, lima, navy, pinto), garden beets (roots and tops), sugar beets, cashews, chickpeas, cocoa beans, coffee beans, collards, cranberries, dates, dill (seeds and weed), eggplants, figs, ginger, hazelnuts, horseradish, lentils, okra, peanuts, pecans, peppermint, potatoes, pumpkins, sour cherries, sweet corn, sweet potatoes, water chestnuts, and winter squash.*
- Produce that is produced by an individual for personal consumption or produced for consumption on the farm or another farm under the same management; or
- Produce that is not a Raw Agricultural Commodity (RAC).

If produce drops to the ground, can it be used for food for human consumption that receives commercial processing?

Yes, if a covered farm complies with the commercial processing exemption requirements in 21 CFR § 112.2(b), produce that would otherwise be covered by the rule is eligible for exemption from other provisions in the Produce Safety Rule, including the prohibition against distributing dropped covered produce.

Produce is eligible for the commercial processing exemption if the following conditions in 21 CFR § 112.2(b) are met, including:

- The produce receives commercial processing that adequately reduces the presence of microorganisms of public health significance (e.g., processing in accordance with the requirements of the juice HACCP regulations in 21 CFR part 120; refining, distilling, or otherwise manufacturing/processing produce into products such as sugar, oil, spirits, wine, beer or similar products); and
- The covered farm discloses in documents accompanying the produce, in accordance with the practice of the trade, that the food is "not processed to adequately reduce the presence of microorganisms of public health significance."
- The Produce Safety Rule also requires that the covered farm obtain and keep certain required documentation (written assurance) from the farm's customer that provides assurances that subsequent processing that adequately reduces the presence of microorganisms of public health significance will be performed. However, FDA issued a guidance document in January 2018 indicating our intent to exercise enforcement discretion with regard to the written assurances requirements in several of the FSMA rules, including the Produce Safety Rule, while we undertake a rulemaking that takes into consideration the complex supply chain relationships and resource requirements.

When produce will receive commercial processing, does it need to be separated from other covered produce?

Yes. If you grow, harvest, pack, or hold produce that is not covered in this part (i.e., excluded produce in accordance with 21 CFR § 112.2) and also conduct such activities on covered produce, and the excluded produce is not grown, harvested, packed, or held in accordance with the Produce Safety Rule, you must take measures during these covered activities, as applicable, to:

1. Keep covered produce separate from excluded produce (except when covered produce and excluded produce are placed in the same container for distribution); and
2. Adequately clean and sanitize, as necessary, any food contact surfaces that contact excluded produce before using such food contact surfaces for covered activities on covered produce.

Published by the U.S. Food & Drug Administration at https://www.fda.gov/media/129568/download on 8/1/2019. For more information on:

- *FSMA Final Rule on Produce Safety: https://www.fda.gov/food/food-safety-modernization-act-fsma/fsma-final-rule-produce-safety*
- *Produce Safety Network: ProduceSafetyNetwork@fda.hhs.gov*

IDENTIFYING BENEFICIAL INSECTS

While scouting in the field for insect pests, also keep an eye out for the insects that are working in your favor. Your pest management decisions should be based in part on the natural controls that are already at work! It is important to be able to identify the so called 'beneficials' and their life stages that are helping you by killing pests. Many different insects either prey upon or parasitize vegetable crop pests. Some beneficials are generalists and will feed on a variety of insect species, while others are more discriminating—this is generally true of the parasitoids, which lay their eggs within the eggs or body of a specific host. The most effective natural enemies on farms tend to be those that either consume voraciously (e.g.,green lacewing larvae, which feed on aphids and many other small insects) or those that are host-specific (e.g., *Diaeretiella* spp.,a wasp that parasitizes exclusively aphids). They should have high reproductive rates and life cycles that coincide with those of their hosts or prey.

The principals of Integrated Pest Management (IPM) include capitalizing on natural controls to manage vegetable pests,

along with using cultural practices and making strategic applications of appropriate chemical controls that protect beneficials as much as possible. The goal of IPM is not to eliminate all of the pests from a crop, but to reduce the populations of pests so that they are not causing economic losses, while maintaining enough of the pest population to sustain their natural enemies.

It is often the larval stages of predators that do the bulk of the feeding; the adult stages of many beneficial species may only feed on pollen or nectar, so maintaining flowering plants—whether wildflowers at the edges of fields, or cultivated flowers interspersed within the crop—can help to provide both food and shelter for beneficial insects. To learn more about planting flowers to attract beneficial insects to your fields, please see the following:

Insectary Plants: Flower Power for Natural Enemies of Vegetable Pests by Dr. Ana Legrand, IPM Program, University of Connecticut, December 2018. https://ag.umass.edu/sites/ag.umass.edu/files/pdf-doc-ppt/insectary_plants_factsheet_legrand_0.pdf

Attracting Beneficial Insects to Reduce Cabbage Aphid Population Size, 2018 by Michele Meder, Genevieve Higgins, and Susan B. Scheufele Written December 2018. https://ag.umass.edu/sites/ag.umass.edu/files/pdf-doc-ppt/insectary_2018_report.pdf

Below are a few beneficial insects that are commonly found in farm fields in New England.

Predators

Predatory midge (*Aphidoletes aphidimyza*) larvae feed on aphids and mites. They are small (about 2 mm long), orange or yellow, legless maggots, and they feed on small insects like aphids and mites. In its lifetime, one larva can kill from 10 to 30 aphids. Adults are very small (2-3mm), delicate, mosquito-like flies with long legs and long antennae. Adults feed on honeydew (aphid excrement) and fly at night, so they're rarely seen during the day. Adults lay minute (less than 0.3 mm), orange eggs in clusters or singly around aphid colonies. Predatory midges are an important part of biological control programs in greenhouse crops and are widely sold in the U.S.

Predatory midge. Photo: A. Eaton.

Syrphid flies (Diptera: Syrphidae) (also known as hover or flower flies) larvae also feed on aphids. Larvae are 1/2 inch long and semi-transparent, with green, pink or brown coloring. Each larva can consume up to 400 aphids during development. When syprhids are abundant, aphid populations can be reduced by 70 to 100%. Adults of many syrphid species resemble bees to ward off predators but have characteristic helmet-like fly eyes. Adults are prominent pollinators, and visit flowering plants for pollen and nectar. See the article *Attracting Beneficial Insects to Reduce Cabbage Aphid Population Size*, linked to above, for more information about syrphid flies.

Syrphid fly adult (top) and larva (bottom). Photos: G. Higgins, M. Spellman

Spined soldier bug (*Podisus maculiventris*) adults feed on soft-bodied insects, including the larvae of European corn borer, diamondback moth, corn earworm, beet armyworm, fall armyworm, cabbage looper, imported cabbageworm, Colorado potato beetle, and Mexican bean beetle. With good timing, you can catch a spined soldier bug that has impaled its prey with its piercing-sucking mouthparts. One study found that a single adult consumed over 100 fall armyworm larvae in its lifetime. Adults are pale-brown to tan and about 8.5 to 13 mm long. They are shield-shaped with characteristic spurs on their "shoulders", immediately behind the head. Nymphs are round instead of shield shaped; young nymphs are red and black while older nymphs have red, black, yellow-orange and cream-colored bands and patches (see photo). Females lay hundreds of gray to gold, barrel-shaped eggs in clusters

Spined soldier bug adult (above) and nymph (below). Photo: P. Sloderbeck, Kansas State Univ., Bugwood.org

of 20-30, on leaves or twigs. Eggs hatch in 5-9 days. Growth from egg to adult lasts about 30-35 days and adults live from 1-4 months.

Lady beetle pupa - sometimes mistaken for CPB larva! Photo: J. Boucher.

Ladybeetles: There are both native (including the twelve-spotted ladybeetle *Coleomegilla maculata*) and non-native (including the multicolored asian ladybeetle *Harmonia axyridis*) species of ladybeetles, both of which prey on insect pests of vegetables. Eggs are yellow-orange, oval, and laid on-end in clusters on leaves. Larvae look, strangely enough, reptilian; they are flat, dark-colored, with long alligator-like tails, and spines covering their bodies. Ladybeetles are excellent predators of aphids but also feed on other insects including mites and scale. Adults overwinter in field edges and other sheltered locations (including in your house, in the case of the multicolored asian ladybeetle!).

Twelve-spotted ladybeetle (above) and multi-colored Asian ladybeetles (below). Photo: M. Spellman, and B. Ree, Texas A&M Univ., Bugwood.org

Green lacewing (*Chrysopa* and *Chysoperla* spp.) adults are pale green, with a slender soft body, about 1/2" long, and four delicately veined wings. Eggs are laid on filamentous stalks attached to plant tissues, often with several laid in a row. Larvae are 1/8- to 1/2-inch and long alligator-like, but skinner than ladybeetle larvae, with a flattened body that tapers at one end. Larave have long, curved mandibles that they grab their prey with. The adults of most species are not predaceous, feeding mostly on nectar and pollen. The larvae, however, are voracious predators, and will consume large numbers of a wide range of soft-bodied insects, including other lacewing larvae. Lacewings are found naturally in New England, and are also available commercially, as they are very effective at cleaning up outbreaks of aphids and other pests in greenhouses.

Clockwise from top left: Green lacewing adult (J. Berger, Bugwood.org); Lacewing eggs (L. McKeag); Lacewing larva (G. Higgins)

Parasitoids

The beneficial parasitoids that are important in vegetable crops aren't often seen, as most of them are tiny wasps. There are thousands of species of parasitic wasps, most of which are highly specialized to use a particular species or family as a host. Several species naturally occur in New England, or have been successfully introduced, and others are commercially available for release. These wasps lay their eggs in either the eggs or larvae of their hosts, where the wasp larvae feed on the insides of the host, and pupate in or on the host before emerging as adult wasps. Often what will be visible in crops to indicate parasitoid activity will be either the parasitized host or the pupating parasite.

Braconid wasp pupae within cocoons in cabbage. Photo W. Cranshaw, Colorado State Univ., Bugwood.org

Caterpillars are commonly parasitized by braconid and icheumonid wasps. The braconid wasp, *Cotesia rubecula*, was introduced to New England from China in 1988, and is now established in Massachusetts. This wasp parasitizes imported cabbageworm larvae. You may see their small white cocoons on brassica leaves. Diamondback moth eggs are parasitized by the ichneumonid wasp, *Diadegma insulare*, which is native to Eastern North America. *D. insulare* females require sources of nectar to effectively parasitize DBM, so maintaining wildflower stands near brassica fields will encourage their activity. You may be more familiar with the pupae of an-

other parasitic wasp, *Cotesia congregatus*, which lays its eggs under the skin of the tomato and tobacco hornworms. The larvae feed within the hornworms, then emerge to pupate on the surface, eventually killing the host. If you see a hornworm in your tomato crop with many white cocoons on its back, don't kill it—either leave it be, or move it to another area where it can't continue feeding, to allow the wasps to develop.

Aphid mummies. Photo: T. Smith

Aphidoletes aphidimyza *is a parasitic wasp often released in greenhouses to control aphids. Photo: J. Gross.*

Aphids also play host to several parasitic wasps that rely on the aphids' bodies to produce and feed their young. If you see puffy, tan or golden aphids among an aphid colony, these are aphids with one of these wasps pupating within, and are called aphid "mummies". Sometimes you will see a small hole in the mummy, indicating that the adult wasp has already emerged. The braconid wasp *Diaeretiella rapae* parasitizes many species of aphid, but is particularly fond of cabbage aphids. Keep an eye out for these mummies when scouting for aphid colonies to get an idea of the level of the biological control you're getting.

--Adapted by Lisa Mckeag and Genevieve Higgins from original article by Kristina Fahey and Ayana LaSalle, Stockbridge School of Agriculture students.

News: Massachusetts Tomato Contest to be Held on Tuesday, August 27th

The 35th Annual Massachusetts Tomato Contest will be held in the KITCHEN at the Boston Public Market on Tuesday, August 27th. Tomatoes will be judged by a panel of experts on flavor, firmness/slicing quality, exterior color and shape. Four categories: Slicing, Cherry, Heirloom, as well as Heaviest! Always a lively and fun event, the day is designed to increase awareness of Massachusetts grown produce.

Farmers who will join us in Boston can bring tomatoes to the market between 9:00 am and 10:45 am on Tuesday, August 27th, or can drop tomatoes off with a registration form to one of the **drop off locations on August 26th**. These tomatoes will be brought to Boston. For the complete details, including drop off locations, contest criteria and a registration form, **click here**.

Can't make it to Boston? Drop-off your tomatoes at one of the regional drop-off locations in Great Barrington, West Springfield, Worcester, Topsfield or North Easton on Monday, August 26th.

The 35th Annual Tomato Contest is sponsored by the Massachusetts Department of Agricultural Resources, New England Vegetable and Berry Growers Association, and Mass Farmers Markets in cooperation with the Boston Public Market and The Trustees.

Events

Next Tuesday! 2019 UMass Vegetable Program Research Tour

Join UMass Extension educators and specialists at the UMass Crop Research & Education Center to tour our ongoing research and participate in a roundtabe discussion. Research trials include:

- cucurbit disease management
- cabbage aphid control
- bee health and disease transmission
- cover cropping
- growing fava beans
- establishing native and non-native landscape shrubs

- wild tomato diversity and evolution
- intercellular communication in plants

When: Tuesday, August 20, 2019, 4-7pm

Where: UMass Crop Research & Education Farm, 89 River Rd., South Deerfield, MA

REGISTRATION: Please RSVP for food ordering. Click here to register for this event.

Vermont Vegetable & Berry Growers Association On-Farm 2019 Workshop Series

The Vermont Vegetable & Berry Growers Association is holding a series of nine on-farm workshops from June through November this year. For more information on all workshops in this series, please click the linked event title above.

Attendance at these events is free for members of the Vermont Vegetable & Berry Growers Association. The cost is $10 per-person for non-members, payable on-site. Refreshments will be served. Membership in the VVBGA costs $55 per farm, per calendar year. The VVBGA works with University of Vermont Extension to deliver education and applied research for its growers.

Tuesday, August 20, 4-7 pm. HeartLand Farms, 74 Gibson Rd., Hartland VT 05048. Join Brian Stroffolino for a tour and discussion of permaculture and no-till techniques on his hillside farm that has 2 acres of veggies, 1.5 acres of fruit, nuts, and berries, and a couple of high tunnels for overwintering seed crops. He produces for farmers' market and some local buyers, but is shifting to seed saving of vegetables, grains and herbs with sales through an online catalog Solstice Seeds that focuses on rare, diverse and resilient varieties. UVM Extension's Laura Johnson and Becky Maden will be present to discuss reduced-till techniques and how to manage nutrients in this unique scenario.

Questions? Contact Vern Grubinger, 802-257-7967 x303. To request a disability-related accommodation, contact Dana Rupert, 802-257-7967, three weeks prior to an event so we may assist you.

THANK YOU TO OUR SPONSORS:

Vegetable Notes. Katie Campbell-Nelson, Genevieve Higgins, Lisa McKeag, Susan Scheufele, co-editors.

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