UMass Extension
Vegetable Notes
For Vegetable Farmers in Massachusetts since 1975

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In this issue:

Crop conditions

Microbursts swept through western Massachusetts this week on Tuesday evening, picking trees up and smashing them to bits. The storm caused power outages, blocked roads and destroyed caterpillar tunnels on at least one farm in Montague, MA (Redfire Farm). Other damage we have heard about includes a destroyed tobacco barn and lodged sweet corn. For the most part, growers are commenting on how well crops are doing this season. With higher humidity and more severe storms, we are seeing more diseases, but they seem to be localized. One disease we have found in more field tomatoes than in the past is leaf mold. Typically a high tunnel disease worsened by humidity, we have seen leaf mold in Hampshire and Franklin Cos., in MA and it is being reported region-wide. Perhaps it is time to select leaf mold resistant varieties for the field as well!

To-may-to, To-mah-to. Determinant field tomatoes are coming in by the bushel now (left). Catfacing and zippering are commonplace and even considered attractive traits in heirloom tomato varities (right). See the article in this issue about Abiotic Disorders of Tomato Photos: K. Campbell-Nelson

Bell peppers, cucumbers, and zucchinis are coming in by the truckload on some wholesale farms. Harvest crews are out as early as possible to avoid heat, but some are still working 6 to 6. Field tomatoes are starting to fill up orders as well. Onion necks are beginning to dry down and garlic is out of the field. Corn being picked now is in the sweet spot between the first generation of European corn borers and mass arrival of corn earworm, so it is relatively clean. See the article in this issue to identify those caterpillars in your corn so that you may plan a control strategy for the future, or at least educate your customers as to who those cute/creepy crawlies are.

While many of you are running amok this time of year, one farmer said to us this week "I've decided this is the time of year to plan for next year." Just as we pause to scout our crops to make short-term decisions on their wellbeing, or prepare a standard operating procedure, now is a good time to make note of the processes you are using and profitability of crops you are growing for the long-term wellbeing of your farm. You might forget how hard something was while sitting on a beach somewhere this winter on vacation. During the heat of the season, if your brain is not sun-fried, you may take some advice from the Talking Heads and "You may ask yourself, "Well, how did I get here?"" – Once in a Lifetime.

Pest alerts

Alliums:

Lots of diseases are popping up in onions, leeks, and shallots. No wonder, as these crops are reaching maturity and dying back, and hot, humid weather has been conducive for disease spread. **Fusarium basal plate rot** diagnosed on

shallots in Hampshire Co., MA, purple blotch was found in leeks Hampshire Co., MA, downy mildew was found on onions in a Franklin Co., MA field**, neck rot** was observed in one onion field in RI, and **Rhizoctonia** in garlic on one farm in Lamoille Co., VT. Proper spacing of plants and regular weeding will increase air circulation and decrease the duration of leaf wetness necessary for many diseases to infect. Field sanitation is important; remove or plow under infected plant debris after harvest. Harvest in dry weather and avoid injury to the necks. Allow onions to cure properly before leaf removal. Store at 34-38°F and humidity 65-70% in a well-aerated cooler. Control onion thrips if they are present, as plants weakened by thrips infestation are more susceptible to disease.

Basil:

Downy mildew: lots more reports across the region. On one farm in Hampshire Co., MA, a Genovese type had widespread downy mildew while 'Obsession' planted next to it was unaffected. There is a new monitoring site for basil downy mildew, which can be found here: https://basil.meas.ncsu.edu/.

Bean:

Anthracnose was diagnosed on cranberry bean in Worcester Co., MA this week. Dark spots occur on leaf veins and petioles and round sunken lesions occur on pods. Seed becomes infected and is a major source of disease, but the pathogen can also survive on crop residues in soil. Frequent, moderate rainfall, particularly if accompanied by winds or splashing rain, favor disease development. Use a 2-3 year crop rotation and consider planting resistant varieties.

Brassica:

Cross-striped cabbageworm eggs were observed in Worcester Co., MA this week, so be on the lookout for this pest to start popping up soon across the state. Unlike the three major caterpillar pests on Brassicas, the cross-striped cabbageworm (CSCW) lays its eggs in batches (3 to 25) rather than singly, so when the eggs hatch a feeding frenzy ensues. Egg batches are yellow, flattened, and attached to the lower leaf surfaces. Larvae grow to 3/4"-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.

Cucurbits:

Squash bug: nymphs are widespread and Asana wilt, which results from their feeding, is now being seen across the state. Both adults and nymphs feed by inserting their stylets (sharp, sucking mouthparts) and sucking sap from plant tissue. This interrupts xylem transport and causes wilting in leaves, stems, and vines that are beyond the feeding site. The injury may appear as light-colored areas that later turn brown and die, a condition known as "Anasa wilt". Squash bugs also feed on the fruit, causing scarring that can make the fruit unmarketable. In late summer and fall, large nymphs and new adults can damage the fruit of fall vine crops.

Drought stress is widespread across the region. Overall weather conditions have been dry in most areas and many squash and pumpkin fields are looking yellowed and wilted, or succumbing to other disease and insect damage due to their weakened state. Water one inch per week if possible to maintain a healthy crop.

Squash vine borer: Larvae are boring now in MA, causing wilt and collapse of thick-stemmed squashes and zucchini. Adults are still flying (see map) and oviposition may still be happening. Sprays targeting the base of plants where eggs are laid may still be effective at a threshold of 5 moths per trap for bush varieties and 12 for vining cucurbits.

Phytophthora capsici was confirmed in Middlesex Co., MA in a pumpkin field. This disease pops up during warm weather and periods of high moisture. See article last issue for detailed recommendations on managing this disease. All cucurbit crops can be affected, as well as peppers, beans, and tomato.

Tomato:

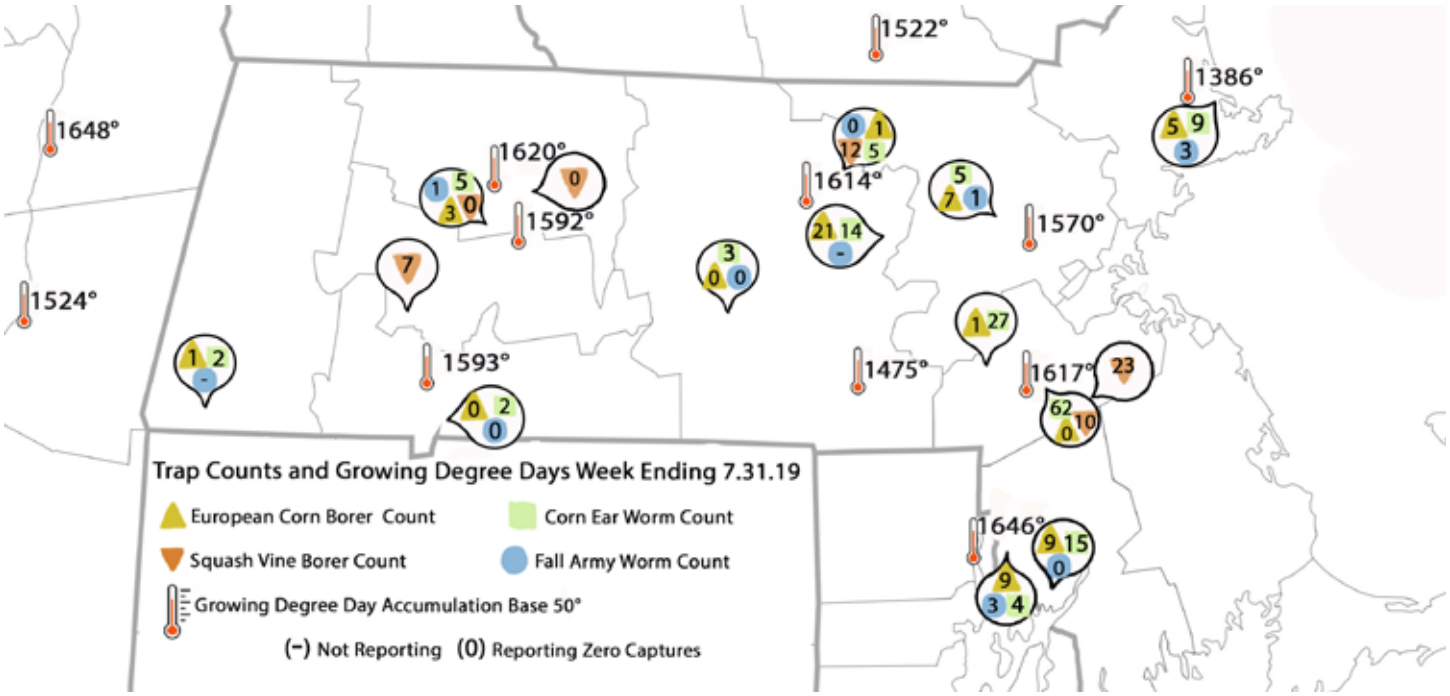
Early blight **&** Septoria leaf spot are widespread now in unsprayed field tomatoes. Tunnel diseases that require high humidity like leaf mold and powdery mildew are occurring even in the field. Gray mold in tunnels is causing ghost spots on tomato fruit. Consult the New England Vegetable Management Guide for control recommendations in the field and in greenhouses or tunnels.

Tomato hornworm is actively munching on tomato plants now. These large caterpillars typically appear in small numbers but cause impressive feeding damage. Larvae consume large amounts of foliage on peppers, tomatoes, eggplant, potatoes, and related solanaceous weeds. Scout by searching leaves for damage, frass or larvae. Often one sees defoliated stalks or the characteristic dark-green droppings (fecal pellets) before the caterpillar is located. There is no set

economic threshold for this pest in tomato. Where damage is unacceptable, or if there are high numbers, foliar sprays can be used. Use a selective material that will conserve beneficial insects--those predators and parasites are very likely keeping your aphid populations under control. Insecticides include *Bacillus thuringiensis* (Bt) kurstaki or aizawi strain (Dipel DF, Agree, or Xentari, etc.), indoxycarb (Avaunt), tebufenozide (Confirm 2F), or spinosad (SpinTor 2SC or Entrust). Several synthetic pyrethroids are also labeled (note: these could result in aphid outbreaks). Although Bt usually works best on small larvae, in this case it will work very well even against large hornworms. In peppers, any controls used for European corn borer should control hornworms.

Sweet Corn:

Corn earworm has ramped up quickly this week, with double digit trap counts in Worcester and Norfolk Cos., MA. Many growers are on a 4 day spray schedule to protect harvested corn from damage, but keep in mind that traps in fields even 1 mile apart may result in very different pest populations. It is best to use pheremone traps on your own fields rather than depend on our data alone (map). Sprays must be timed to prevent larvae from entering the ear. Control depends upon maintaining insecticide coverage on the silks—directed sprays to the ear zone provide the best control. Continue treatments until 5 to 7 days before final harvest or until silk is completely dry and brown. Use selective materials to conserve natural enemies of aphids and other pests.



Map prepared by Colin Radon, Vegetable Program Summer Scout

European corn borer second flight is underway now but numbers remain low across MA. Treatments for CEW and FAW will control ECB at this time.

Fall armyworm damage is being seen now in whorl-stage corn where caterpillars are creating ragged feeding damage to leaves and masses of sawdust-like excrement. As corn matures, larvae burrow into the side of corn ears, leaving behind frass and a large hole, and into the tip, making a mess of the kernels and rendering the ear unmarketable.

Four spotted sap beetle adult and larva

Sap beetles are causing damage to ripe ears. The larva is a white or light yellow grub that resembles a tiny, thin caterpillar or maggot. Larvae hollow out developing kernels, and damage may be found in the tip and scattered through the upper half of the ear. Research has shown that both the length and tightness of the tip cover is important to reduce infestations. Some varieties with long, tight tip cover include: Accord, Argent, Avalon, Awesome, Bon Jour, Cuppa-Joe, Easy Money, Fantasia, Ka-Ching, Precious Gem, Prime Plus, Profit, Providence and Renaissance. Insecticides may be warranted in fields with a previous history of 10% ear damage. Research in Maryland showed that ear infestation begins just after silk emerges and

that 1 or 2 applications made 3 and 6 to 7 days after silking begins is more effective than later or more applications. Insecticides will reduce the number of damaged kernels and ears but will not completely control heavy infestations. Sap beetle adults and larvae are not susceptible to the Bt toxin that is present in Bt corn. Efficacy trials have shown that carbaryl (Sevin), lambda-cyhalothrin (Warrior II), bifenthrin (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.

Celery anthracnose was confirmed in Franklin Co., MA this week in the variety 'Tango.' This disease may be seed-borne, and is then spread through the field by water and rainsplash. Warm humid weather favors disease. Some varieties are less susceptible to anthracnose including Merengo, Hadrian, Geronimo, and Balada, and fungicides (especially group 11 materials) can be used to help slow disease spread. See article from June 20th for more info.

ABIOTIC DISORDERS OF TOMATO

With stretches of cool weather earlier this season, as tomatoes began flowering and fruiting, followed by cool nights and warm days in July, and now on the verge of hot and humid August weather, tomato crops can struggle to ripen. Whether in high tunnels or the field, we have seen virtually every type of disorder this season. Here they are described with identification tips and management strategies:

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. Although calcium deficiencies are sometimes responsible for blossom end rot, much of the time, blossom end rot is the result of plant water stress. Calcium moves primarily in water-conducting tissues of the plant so when water movement is restricted, calcium deficiencies develop. Problems can be prevented by regular watering to avoid extreme fluctuations in soil moisture. Good soil drainage, mulching, and preventing root damage also help. Other soil factors may contribute to blossom end rot. High soluble salts, low calcium and high cation (potassium, magnesium or ammonium) levels in the soil out-compete calcium on soil exchange sites, making it unavailable to the plant. **Management:** Monitoring soil soluble salts and cation ratios, and maintaining adequate calcium in the soil should help.

Blossom end rot.
photo: K. Campbell-Nelson

Leaf roll is often seen just after plants are heavily pruned during 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 dry hot period, the foliage may transpire water faster than the root system can absorb it from the soil. In order to conserve water, the plant will roll up its leaves to reduce the surface area from which water can evaporate. 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 varieties 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 up-take, reducing blossom end rot problems). Do not prune heavily during hot, dry conditions or over-fertilize with nitrogen.

Tomato leafroll/curl.
Photo: C. Steinberg

Catfacing is a physiological disorder of field and greenhouse tomatoes. Tomato is considered "catfaced" if the blossom scar is enlarged or perforated. 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

Catfacing

Stiching / zippering

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 catface—heirloom tomatoes tend to be more prone to this disorder than non-heirloom varieties.

Stitching/Zippering is the term for when a thin, brown, necrotic scar extends from the stem scar all the way 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 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 varieties that are less susceptible to stitching/zippering. Avoid low greenhouse temperatures.

Yellow shoulder: Liz Maynard of Purdue Extension wrote about the following three causes of yellow shoulder in tomatoes: "Genetics: Varieties that have green shoulders in immature fruit are more likely to show the disorder. If you aren't sure whether a variety has the gene for green shoulders, check with the seed supplier, or review the tomato cultivar descriptions available from the North Carolina State University site at http://cuke.hort.ncsu.edu/cucurbit/wehner/vegcult/vgclintro.html. **High Temperatures/Sun:** Yellow shoulders are often found on tomato fruit exposed directly to the sun. On plants pruned to a single stem there may be many fruit in this situation. Loss of foliage due to disease can also expose fruit to the sun. If tomato fruit gets extremely hot it may exhibit sunscald, with the skin and flesh turning white and sunken on the exposed area of the fruit. Covering plants when the first fruit begin to ripen with shade cloth whether in the field or over a high tunnel can reduce temperature and shield fruit. **Blotchy ripening, gray wall and internal whitening:** Tomatoes with blotchy ripening ripen unevenly with yellow or orange discolored areas on their surface or shoulders. 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.

In California processing tomatoes, the disorders yellow shoulder and internal white tissue were shown to be strongly related to low fruit potassium content. Interestingly, fruit potassium content was more related to the ratio of the soil exchangeable potassium content divided by the square root of the soil magnesium content, than to soil exchangeable potassium content. The soil exchangeable magnesium content was also positively related to the disorder. Gypsum applications improved fruit quality (Hartz, 1999). See Organic Soil Fertility and Conventional Chemical Soil Testing within Organic Systems for information on organic nutrient management.

This mexican landrace has severe yellow shoulder, while other tomatoes (Sakura and BHN-589) in the tunnel show no signs of the disorder. Photo: K. Campbell-Nelson

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 varieties. 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 4ft-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. Other general recommendations for improving tomato health and avoiding abiotic disorders include maintaining a healthy root system, raising soil pH above 5.2, and providing even irrigation throughout the season (particularly during fruit set). Lastly, and probably the most important, is to manage potassium nutrition. Tomatoes are heavy users of potassium and a shortage of potassium during fruit development and ripening can lead to increased

problems with ripening disorders. Tomatoes require close to 200 lbs of K2O to grow a heavy crop.

When ripened fruit are showing these deficiencies, it's too late this season to correct any of these disorders. Identify them now to avoid making unnecessary fungicide and fertilizer applications in the future which might, in the end, lead to phytotoxicity.

--Compiled by G. Higgins and K. Campbell-Nelson from the following sources:

Brust, Jerry, IPM Vegetable Specialist, University of Maryland; jbrust@umd.edu. "Other Fruit Problems with the 2016 Tomato Crop" Weekly Crop Update, Delaware Cooperative Extension. August 26, 2016.

Johnson, Gordon, Extension Vegetable & Fruit Specialist; gcjohn@udel.edu "Blossom End Rot Now Showing Up". Weekly Crop Update, Delaware Cooperative Extension. June 26, 2015.

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.

Scott, J.W. 2014. "Zippering" and "Catfacing". Compendium of Tomato Diseases and Pests, 2nd ed., eds, J.B. Jones, T.A. Zitter, T.M. Momol, and S.A. Miller.

IDENTIFYING CATERPILLARS IN SWEET CORN

At this point in the season, all of the major caterpillar pests of corn are present in corn fields—European corn borer (ECB), corn earworm (CEW), and fall armyworm (FAW). The second ECB flight is just barely beginning in some locations and we're still seeing damage from caterpillars resulting from the first flight. CEW and FAW started arriving on storm fronts from the west and south about 3 weeks ago and 2 weeks ago, respectively, and we're beginning to see larvae and feeding damage in fields now. In the hot weather, eggs can hatch quickly, so arrival of these pests means imminent damage.

European corn borer is the first corn caterpillar pest to show up in sweet corn, as they overwinter in the Northeast. ECB moths begin emerging in May (at 375 GDD base 50°F), mate, and lay eggs, which will hatch in 4-9 days, depending on the temperature. The newly hatched larvae will move to the closest protected feeding spot—whorl, tassel, ear—and will feed for 5-7 days before boring into the corn stem or ear. 1st generation larvae will pupate and emerge as adults at 1400 GDD (usually mid- to late-July) to mate and lay eggs. The second generation will overwinter as pupae, protected inside corn stems in the field.

Adults are ¾ inch long moths, white to tan, with 2 dark, serrated lines running across the lower part of the forewings.

Eggs are laid in clusters on undersides of leaves—they are flat and overlap each other like fish scales. Eggs are white when freshly laid, becoming cream-colored then orange-tan as they mature. Before hatching, the black head capsules of the enclosed larvae are visible.

Caterpillars vary in color—from light-gray to pink—but always have small, dark spots on each body segment. They have brown head capsules, and light red-brown stripes running the length of their bodies. Mature larvae are ¾ to 1 inch long.

Where might you see ECB? Before there is silk, caterpillars bore into the tassel or stalk, the weakened stalk will often flop over and you will see flagging tops in the field. Luckily, much of the corn ripened while ECB were still attacking tassels instead of boring directly into ears. Once there is silk in the field, ECB will enter the ears through the silk channel, or bore directly into the side of the ear. You may often see them in ripening corn boring into the side of the ear next to the corn stalk.

Top to bottom: ECB adults, eggs, and caterpillar. photo: Clemson University, USDA Cooperative Extension, Bugwood.org.

Corn earworm does not overwinter in the Northeast, but instead is blown in on storms coming from the south or from western New York, where they overwinter. We usually see the first CEW adults in mid-July. Eggs are laid in silks and hatch in 2.5 to 6 days. Newly hatched larvae enter the ear through the silk channel and feed for 3-4 weeks before pupating. Although each female lays several eggs on each ear, you will only find one caterpillar

Top to bottom: CEW Adults, eggs, and caterpillars

per ear, as the small caterpillars are cannibalistic. Moths are blown in throughout the growing season, so infestations are sometimes linked to storms. Additionally, a 2nd generation of moths can emerge to mate and lay eggs.

Adults are yellow-brown moths, with a dark spot in the middle of each wing and a dark band across the bottom of each wing. Live or newly dead moths have light green eyes.

Eggs are white and round—in the silk, they look like tiny dew drops and are very hard to see.

Caterpillars vary in color, similarly to ECB—from green to pink to brown to nearly black. Alternating light and dark stripes run the length of their bodies, and they have sparse hairs covering their bodies. Each body segment has a group of 3 small dots on the side. The head capsules are always plain golden brown (compared to the head capsules of FAW, which have a Y pattern—see below).

Where would you be seeing CEW now? CEW are in ear tips—look for messy frass and/or chewed up silks.

Fall armyworm is blown northward on storm fronts, usually starting in mid-July, similarly to CEW. They don't always come in on the same storms, though. Females tend to prefer laying their eggs in whorl-stage corn. Eggs are laid on leaves and hatch in ~5 days. The larvae feed in the whorl and newly forming tassel, creating large, ragged holes in the leaves and drop big clumps of frass. Larvae feed for 15-20 days.

Adults are ¾ inch long and mottled dark gray moths, with some light spots on their wings and an obvious white area at the extreme tips of their wings.

Eggs are laid in masses on leaves and are surrounded by fuzzy hairs from the female moth.

Caterpillars are light-tan to dark black, with some longitudinal striping along their bodies. Their bodies are smooth, unlike the hairy CEW caterpillars. When viewed head on, FAW head capsules are divided by an inverted "Y", compared to the solid CEW head capsule.

Where would you be seeing FAW now? Check whorl-stage corn for large, ragged holes in the foliage, and big clumps of frass in the whorl. Often, the FAW caterpillar will be within the developing tassel. FAW will also bore into the sides of ears, similarly to ECB, and can also infest ear tips.

Top to bottom: FAW adult, eggs caterpillar. photos: Colorado State Univ., Bugwood.org

If you are noticing unacceptable amounts of caterpillar damage in your sweet corn now, take the time to identify which corn pests are present. The most effective management strategy involves attracting and trapping moths using pheromones and using trap counts for each moth to inform spraying and/or scouting schedules. Earlier in the season, when ECB is the only caterpillar pest out and about, ECB trap captures tell us when the moth flight is beginning and therefore when to scout for caterpillars in the emerging tassels and early silks. Scouting results tell growers' if they are under or over a predetermined spray threshold. Once CEW arrives, the CEW trap captures determine the spray schedule: more moths caught per week mean fewer days between sprays. For more information on managing all 3 corn cater-

Bottom: CEW head (left) FAW head with upside down y-shape (right). photo: UNH

pillar pests, see the following articles in past Vegetable Notes issues:

Corn Earworm Management

Manage Sweet Corn Pests Through Scouting & Pheromone Trapping

References:

Fall Armyworm, Corn Earworm, and European Corn Borer Factsheets, New York State IPM Program

Using IPM in the Field: Sweet Corn Insect Management Field Scouting Guide, UMass Extension

-Written by Genevieve Higgins

STANDARD OPERATING PROCEDURES

Standard Operating Procedures, or SOPs, are documents that outline how to complete a task. An SOP doesn't need to be complicated – in fact, it should be as concise as possible and provide step-by-step instructions for a specific task.

While the thought of developing standard operating procedures (SOPs) for your farm may seem daunting, or simply like a bureaucratic waste of time, these standardized protocols are simply a way to capture routine farm processes and ensure that they happen the same way each time. SOPs come up a lot when talking about produce safety and complying with the sanitation standards of FSMA's Produce Rule or 3rd-party food safety audits, but their usefulness goes well beyond jumping through food safety hoops. A well-written SOP can help you save time, train workers, manage pests, and put out a more consistent product.

How to develop an SOP

Accurately capturing all of the steps to even a simple process does require an investment of time. These steps are often stored only in a farmer's head and might have evolved over a long period of time. You might not realize all of the steps that go into a certain task or the best way to convey that information to someone else. Investing time up front will be made up by not having to spend as much time training or correcting mistakes.

Writing an SOP should start with either doing a task yourself, or watching somebody else do it, and writing down all of the steps that lead to the completion of the task. Note which tools and materials are necessary for the job, and if there are tricks that you use to make the job easier. Ask anyone who routinely performs the task to weigh in on whether you've captured the process accurately and included important details or efficiencies – workers will be less likely to follow SOPs if they know a different way to complete a task that's better for them and if they weren't involved in the process of writing it.

What tasks should SOPs be created for?

A good rule of thumb is if a task needs to be done more than twice – whether twice a week or twice a year – you should have an SOP for it. SOPs are useful when it is important that a task be completed in the same way every time, or for tasks that are complex or involve many steps that should be done in order.

SOPs are useful where there is high worker turnover and a frequent need for retraining, or if different employees are responsible for conducting trainings at different times. It is confusing for a trainee to learn Mary's way one day and Jim's the next—processes and standards of completion should be agreed upon ahead of time and adhered to.

SOPs, in combination with recordkeeping, are also important for showing that you are meeting regulatory requirements. For example, FSMA requires that covered farms avoid contamination of produce from dripping condensation in coolers, which seems like a daunting requirement to prove that you're meeting. With an SOP regarding how to effectively clean your cooler and how often to do so, and a recordkeeping log, you can easily show that any condensation forming in your cooler is unlikely to carry food-borne pathogens.

Examples of tasks that may warrant a written SOP:

- Leafy greens washing, drying and packing
- Tote washing and sanitizing

- Monitoring and changing sanitizers in wash water
- Moving animals
- Water sampling
- Greenhouse seeding
- Mixing and applying pesticides
- Sprayer calibration
- Monitoring irrigation equipment
- Any task that you want done efficiently and consistently…

Leafy greens washing is a common practice to prepate an SOP for. Photo: UMass Student Farm

A general format for an SOP might consist of the following parts:

- Title
- Objective/purpose—what task are you accomplishing and why?
- Scope—where and to whom does the SOP apply?
- Responsibility—who is responsible for making sure the task is completed?
- Materials—what specific items are needed to complete the task?
- Procedure—what are the steps to the task, in order?
- Verification/documentation—how will you verify that the procedure was completed correctly and what records will you keep?

Characteristics of good SOPs:

- **Easy and rapidly accessible to employees.** Keep SOPs posted at eye level in the relevant area. Laminating SOPs or keeping them in plastic sheet covers is often helpful. Having SOPs readily accessible also makes it easier to revise them on the spot when procedures change.
- **Able to be followed by anyone with basic knowledge.** A good way to test this is to watch someone who is unfamiliar with the task try to complete the task correctly using the SOP.
- **Written using short, direct sentences and simple words wherever possible.** Bulleted or numbered lists are usually good.
- **Use diagrams and pictures wherever appropriate.** For example, diagrams of where tools/materials belong, or pictures of how something should look at a certain step in the process.

Separate general information from instructions.

Don't micromanage. Include any details that are essential and that must be completed in the same way by any worker. Leave out unessential details.

Some examples of SOPs can be found in the Resources section at the end of this fact sheet. It's helpful to look at existing SOPs or even use them as a starting point for your own, but remember to tailor them to your own farm so that your final SOPs accurately reflect your actual processes.

SOPs and Food Safety

SOPs are particularly useful where there is a high risk for mistakes or contamination. This is why they feature so prominently in farm food safety plans. SOPs also provide a way to show that you have procedures in place to avoid produce contamination as required by the Food Safety Modernization Act (FSMA). The FMSA Produce Rule requires farms to avoid contamination of produce on many fronts, but doesn't always specify how a farm should do so. With SOPs and recordkeeping, you can show that you've established procedures to avoid produce contamination and that you are following those procedures.

SOPs can be especially helpful for food safety because while you can see an unorganized washroom or manure caked onto tractor tires, you generally cannot see contamination itself. An organized washroom and apparently clean tractor doesn't

necessarily mean that your produce is safe from contamination. With a good SOPs that address things like standing water, cleaning and sanitizing food contact surfaces, and keeping totes and tools off of the floor and protected from pests, you can have peace of mind that you've thought through common routes of contamination and established processes to avoid that – even if you can't see the contamination you're trying to avoid.

Resources

The Cornell GAPs program has good examples of SOPs relevant to the major food safety risk areas: https://gaps.cornell.edu/educational-materials/decision-trees/log-sheets-sops [2].

The University of Idaho has SOPs for all of the field procedures at their research farm to prevent the spread of a particularly noxious weed: http://ucanr.edu/sites/placernevadasmallfarms/files/140712.pdf [3]

North Carolina Extension Produce Safety: Standard Operating Procedures [4]

Penn State Extension - Standard Operating Procedures: A Writing Guide [5]

University of California Extension - Standard Operating Procedures [6]

--Written by Lisa McKeag and Genevieve Higgins

Events

Save the Date! UMass Farm Tour for 4H and Families!

Join us for an evening learning about the research being conducted this year at the UMass Crop and Animal Research Farm. We will learn about activities happening on the farm including tasting vegetable crops like cucumbers and melons, learning about honeybee health, and our herd of Belted Galloway cattle. There will also be 4H education activities and a poultry demonstration. Come out and see the farm!

When: Tuesday, August 6, 2019, 3-5:30 pm, weather permitting!

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

2019 UMass Vegetable Program Research Tour

Join us for an evening learning about the research being conducted this year at the UMass Research Farm, followed by dinner. Stay posted for an agenda in a few weeks!

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

Where: UMass Crop and Animal 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.

Thursday, August 8, 4-7 pm. Sunshine Valley Berry Farm, 129 Ranger Rd, Rochester, VT 05767. Rob Meadows and Patricia Rydle invite you to a tour their 6-acre PYO organic blueberry and raspberry farm.

Come see—and possibly try out-- their new Easy Harvester for blueberries. Rob will explain his laser and distress call systems for bird control, and we will see their farm store and cool room setup. Extension small fruit specialists Laura McDermott from Cornell and Sonia Schloemann from UMass will be on hand to answer questions, along with Vern

Grubinger. Mark Cannella, Farm Business Specialist with UVM Extension, will describe efforts to develop benchmarks for produce farms. The farm is open until 6 pm so please park so as not to compete with customers.

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.