



UMass
Extension

Vegetable Notes

For Vegetable Farmers in Massachusetts since 1975



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IN THIS ISSUE:

- Crop Conditions
- Pest Alerts
- Cover Crop Mixtures for Fertility & Weed Control
- Identifying Potato Tuber Diseases & Disorders
- Fall Cabbage Maggot is Active
- Sulfur, Calcium, and Boron for Cole Crops
- Events
- Sponsors

CROP CONDITIONS

When it's as hot as it has been this past week, we see a lot of damage to seedlings (or even mature crops that wilt during the hottest parts of the day) planted into black plastic. A few growers we've been working with have been experimenting more with white plastic for crops planted in July or later, which reflects more light and therefore does not cause as much soil warming as black plastic—you can really see the difference in these two rows of fall cukes planted side by side (photo). Much like these cukes, the heat and humidity this week have left many growers feeling wiped out, and ready for fall. And it looks like they may have their wish! Cooler temperatures and wet weather are forecast for the next several days—this will provide a much needed break for growers and crops alike. Of course there's always a trade-off—cooler, wet, and overcast weather means optimum conditions for late blight, which has been confirmed this week on tomato in Franklin Co., MA. Now is a good time to get out and

apply protective sprays on susceptible crops for destructive diseases. Especially at risk are tomato and potato for late blight, and cucumbers, butternut squash, and pumpkins for cucurbit downy mildew. Given that late blight is being reported on tomato AND potato this year and conditions will be favorable for disease spread and growth, some growers may want to mow or vine-kill potatoes which are at or near maturity, to avoid the chance of tuber infection. In southeastern MA, a grower reports that it has been a good growing season over all. His fall root crops are looking good except for the germinating carrots which took a beating from the 3 inches of rain they got several weeks ago, washing herbicide down through the soil instead of remaining on the surface. Spring onions are all out and fall storage onions are about 2 weeks from harvest in the southeast. As days begin to get shorter, farm crews shrink in size with students heading back to school, and your attention begins to shift towards fall, we hope you take a moment to pause and marvel at all of the wonderful food you've produced, tricks you've learned, and systems you've improved this year!! We are thinking about fall too, but before the busy season is over we have one more field walk planned next Tuesday at Hurricane Flats in



Side-by-side beds: the cucumbers on black plastic (left) are showing signs of heat stress, while those on white plastic (right) are standing tall. Photos by S. Scheufele.

South Royalston, VT!

PEST ALERTS

[Vegetable scouting sheets](#) can be found on the UMass Extension Vegetable Program website. When not given here, refer to the [New England Vegetable Management Guide](#) for scouting thresholds and treatment options.

Brassica: [Cabbage aphid](#) infestations have been heavy in areas of Western MA and now are being reported in Chittenden Co., VT causing severe curling and twisting of kale, cabbage and Brussels sprouts leaves. Growers are reporting presence

of aphid mummies indicating the activity of beneficial parasitoids. Syrphid fly larvae, predators of aphids, have also been seen in a brassica field in MA. However in fields



Alternaria on Brussels sprouts leaf

with severe infestation, using a drop nozzle sprayer with combinations of insecticidal soap, neem, pyrethrum and a surfactant has been successful. Onion thrips seen feeding on a kale crop adjacent to a mid-harvest onion field in Hampshire Co., MA. Incorporating residues of older successions is important for avoiding [alternaria leaf spot](#) in the future (reported causing significant damage in fields in Washington Co, RI). Summer infections can spread into fall plantings if field sanitation practices are not followed.

Sweet Corn: The second generation of [European corn borer](#) larvae have begun feeding in Chittenden Co., VT, where GDD (base 50°F) is 1857 (the second flight begins around 1400 GDD; first eggs at 1450 GDD; and egg hatch at 1550 GDD). When moths are active during silking, eggs are laid on leaves near the ear and larvae move directly into the ear by tunneling through the husk or down the silk channel. All locations in the Northeast should be scouting for caterpillar damage from the second generation of ECB now. [Corn earworm](#) trap captures are high in Southeastern MA where spray intervals are down to 4 days. See article earlier this season on [Corn Earworm Management](#). [Fall armyworm](#) captures are more varied with a few hot spots around the state capturing numbers high enough to warrant scouting for this pest and treating at a threshold of 15% combined damage including ECB. There are likely three to 4 more successions of corn left in MA with some growers picking until October, though harvests will drop off after Labor Day.

Cucurbit: [Cucurbit downy mildew](#) was newly confirmed this week on cucumber in Worcester Co., MA but still not in VT or RI where scouts have also been on the lookout. In MA, if you have not done so already, it is time to switch over to using downy mildew specific materials to protect cucurbits, rotating between classes of fungicides for resistance management. Products with good to excellent efficacy against downy mildew (with FRAC codes) include: Ranman (21), Previcure Flex (28), Revus (40), Presidio (43), or Zampro (45+40). Track occurrence of the disease here: <http://cdm.ipmpipe.org/scripts/map.php>. [Powdery mildew](#) is caused by two organisms, *Podosphaera xanthii* (Px) and *Golovinomyces cichoracearum* (Gc). In the past, Gc was considered to be the primary causal organism of powdery mildew. However, in recent years, Px is more commonly reported worldwide. Different races of Px and Gc exist (making resistance to fungicides a real problem in some areas). Also, these different races may express themselves with different symptoms such as chlorotic spotting (reported in Franklin Co., MA and Washington Co., RI this week) instead of the traditional whole-leaf powdered sugar look. Mow down older successions after harvest and protect younger plants with fungicides. Effective materials are different from those used against downy mildew. There are many good options for conventional and organic systems including: Torino, Quintec (rated very effective), Group 3 (Procure, Rally, Tebuzol, Folicur, Inspire Super), or Group 7 (Pristine, Fontelis, Luna), as well as Zing!, Milstop, Kaligreen, Sulfur, and Oxidate. [Squash bugs](#) are heavy especially in no-till fields where the adults like to seek shelter in surface residues. Rip out, chop up and turn under (if not practicing no-till) first and second plantings of summer squash and zucchini now in order to rid the field of squash bug and [squash vine borer](#) for next year. Traps in NH caught 1 or fewer SVB this week, while in MA 4 were caught in Amherst and 8 in Barnstable. Any newly emerging adults will be first generation for this year and will be more of a threat to pumpkin fruit

Location	FAW	ECB	CEW	Spray Interval for CEW
Western MA				
Hadley	na	1	na	na
South Deerfield	4	8	5	5 days
Sheffield	na	1	2	6 days
Whately	3	8	2	6 days
Central & Eastern MA				
Millis	na	0	2	6 days
Sharon	na	2	28	4 days
Swansea	na	4	11	4 days
NH				
Litchfield	19	3	1	no spray
Hollis	3	0	0	no spray
Burlington, VT	1	24	na	na

Accumulated Growing Degree Days (F): 1/1/15 – 8/18/15	
Location	GDD Base 50°F
Pittsfield, MA	1620.2
S. Deerfield, MA	1910.1
Northboro, MA	1884.3
Dracut, MA	1961.1
Boston, MA	2008.8
Sharon, MA	1982.8
Seekonk, MA	2022.5
Burlington, VT	1956.3
Middletown, RI	1824.6

than stalks.

Many fungal fruit rots of cucurbits are being reported now in several New England states. In RI: alternaria on Charante melon. Fancy melons are great for sales but can be trouble in the fields. In VT: Gummy stem blight, plectosporium, and anthracnose. In NH: scab in low spray fields, and in MA: plectosporium, scab, and anthracnose. [See article in last week's issue](#) for cultural practices to help you protect future plantings from these diseases. Again, residue management is important for keeping many of these pathogens from building up inoculum, so chop up and turn under older successions now if possible.

Solanaceous: [Late blight](#) was confirmed on tomato by the UMass Disease Diagnostic Lab in Franklin Co., MA this week at a higher elevation where conditions have remained conducive to infection (high humidity and 60-80°F); still no confirmation of the disease in RI although scouting continues. See the [MA late blight DSS](#) for preventive spray intervals. Track progression of the disease here: <http://usablight.org/map>. [Two-spotted spider mite](#) in greenhouses now will become a problem again next spring if steps are not taken to clean up infestations before fall. Populations explode during hot weather, taking just 8 days to develop from egg to adult at 77-95°F. See the recent Greenhouse Floriculture pest message to learn more: <http://negrthouseupdate.info/updates>. [Powdery mildew](#) and [fulvia leaf mold](#), normally greenhouse diseases, have been reported in fields in Bristol, Franklin, and Hampshire Cos., MA and in Chittenden Co., VT on field tomatoes. There are 12 races of leaf mold but resistance in tomatoes is not bred across races. So, keep track of varieties with leaf mold this year and don't grow them again. Fulvia is not well-controlled with copper. One RI grower has achieved excellent control with Inspire Super (a mixed group 3 and 9 fungicide which is better for resistance management than a group 3 fungicide applied alone). **Bacterial canker** was confirmed in pepper in Vermont causing total crop loss. It was likely seed-borne. This is the first report of this disease on pepper in New England.



Late blight on Juliet tomato

LOW-RESIDUE COVER CROP MIXTURES FOR SPRING FERTILITY AND WEED CONTROL

The more we learn about soil biology, the more appealing cover crops become. Good yields are inextricably linked to healthy soil, and healthy soil is created by growing plants. Plants, be they cash crops or cover crops, provide soil protection from damaging effects of rain and wind. Living roots feed soil organisms, which in turn release nutrients to crops. So how do we cultivate living plants during the off season? We have about six months of the year to use cover crops to enhance soil health and subsequent crop health.

There are many cover crops to choose from, each with different benefits, from erosion control to nitrogen scavenging. But if you want to maximize the paybacks provided by cover crops, plant a mixture! Cover crop functions and benefits are multiplied and diversified by a mixture of species.

My research has looked at low-residue cover crop mixtures, including forage radish, which provide the advantages of a warmer soil in the spring and an accessible seedbed as compared to a traditional rye cover crop. The goal is to develop a sustainable production system for early sweet corn in the Northeast by integrating the benefits of forage radish cover crops and no-till production.

Fall-planted forage radish (aka tillage radish) efficiently scavenges residual nitrate from the soil after a main season cash crop. The fleshy taproot rapidly depletes soluble soil nitrogen at depths from 150 to 180 cm, exceeding the capability of the more commonly used rye. Large root channels created by the radish provide excellent water infiltration and warmer soil temperature for early planting. The seedbed following forage radish is relatively

Cover crop mixtures can provide:

- + Diversity in soil biology
- + Nutrient scavenging
- + Weed suppression
- + Improved C:N ratio
- + Erosion control
- + Increased biomass
- + Forage
- + Adaptation to soil & weather conditions

weed-free and residue-free, therefore optimal for direct seeding in a no-till system.

One of the disadvantages of forage radish is that it has a low Carbon to Nitrogen ratio (C/N ratio), and as a result it decomposes quickly in the spring. If the Nitrogen released by decomposition is not synchronized with the N demand of the corn, then it is lost and is money down the drain. Planting a mixture of cover crop species will adjust the carbon to nitrogen ratio, increasing biomass, and slowing the rate of N release.

In this research, two mixtures of forage radish cover crop were selected to compare the effects of forage radish and cover crop mixtures on weed suppression and synchrony of decomposition to meet crop demand for N. No cover crop and 100% forage radish were planted for controls. All of the species in these cover crop mixes are winter-killed in New England, which was intentional to simplify spring management.

Treatments:

- **Forage radish:** 7 lbs/acre
- **Oat/Forage radish:** 50 lbs/acre oats + 3 lbs/acre radish
- **Pea/Oat/Forage radish:** 45 lbs/acre peas + 30 lbs/acre oats + 2 lbs/acre radish
- **No cover crop**

Cover crops were seeded on August 23, 2014. Now is a good time to plant any of the cover crops discussed in this article. The above rates were based on the following ratios: 100% forage radish, 70% oats/30% forage radish, and 30% peas/40% oats/30% forage radish by weight. Forage radish is a highly competitive crop, so smaller percentages were used in mixes to assure growth of the other species. Peas are known to be weak competitors, so the proportion of peas was increased.

Cover crop biomass was measured just prior to winter-kill in mid-November 2014. Soil samples were taken at regular intervals from fall 2014 through summer 2015 to measure N cycling. Fall and spring weed biomass were measured. Sweet corn tissue samples were taken when plants were 12 inches tall, and at post-harvest to analyze the nutritional status of plants according to the the cover crop treatment. Sweet corn was harvested on July 30, 2015 and yield is being assessed.

Results:

Forage radish (FR) and Pea/Oat/FR had similar biomass yields around 4800 lbs/acre of dry weight. Oat/FR had the highest yield of 5700 lbs/acre of dry weight (Fig. 1). If you're looking to increase organic matter, this high yield of biomass is a great payoff when you consider that the cover crop seed is relatively inexpensive at \$29/acre (see Figure 3 for seed cost estimates).

Forage radish is generally known to have a low C/N ratio, but in this experiment there weren't significant differences between cover crop treatments. The C/N ratio of forage radish was 24:1, while oat/FR was 25:1 and pea/oat/FR mixes were 22:1. Overall, these cover crop mixtures had low nitrogen content (between 1.5 to 2.2% N by weight), which raises the C:N ratio. Pea/Oat/FR mixes did not show significant benefit from nitrogen fixation by the peas.

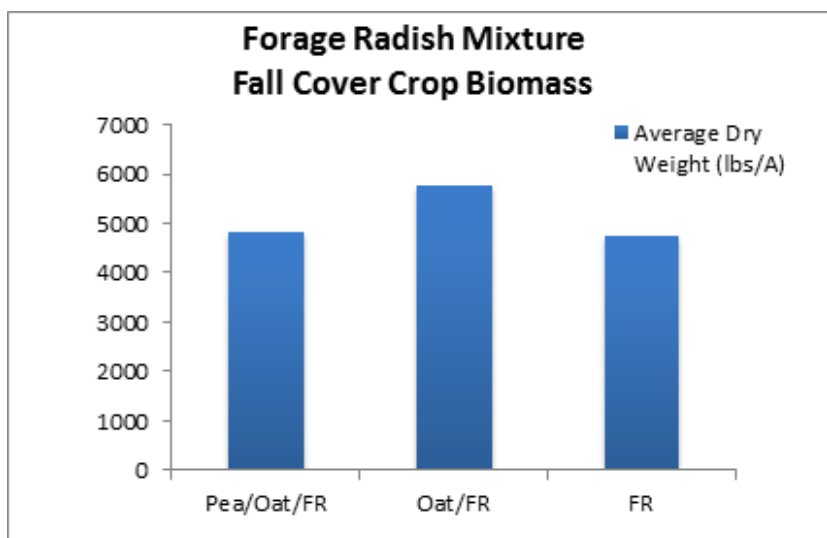


Figure 1. Fall Cover Crop Biomass

Soil tests showed what much prior research has revealed: in late November all cover crop treatments had scavenged significant soil nitrate compared to the no cover crop plots. All three cover crop treatment soil showed 2 ppm remaining nitrate, while the no cover crop treatment soil indicated 25 ppm nitrate. In mid-May 2015 the FR plots had 30% more available soil nitrate than the Pea/Oat/FR and Oat/FR plots, and 70% more nitrate than no cover crop plots. However, by mid-June soil tests indicated that all cover crop treatments had similar levels of soil nitrate. Plant a cash crop in May to take advantage of this cover cropping strategy.

Weed suppression was best

Spring Weed Biomass per Cover Crop

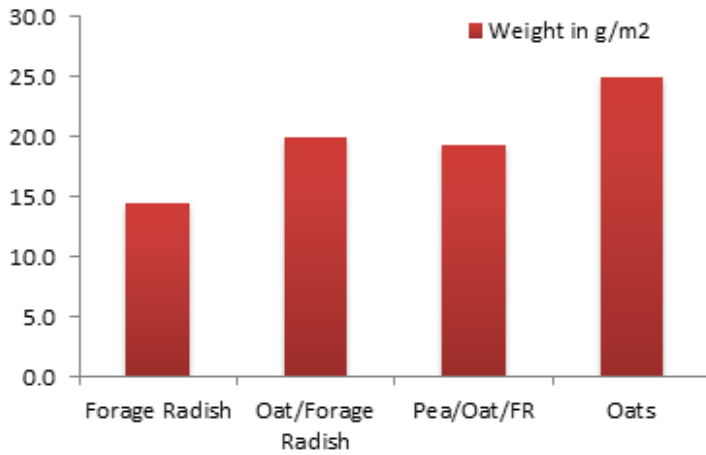


Figure 4. Weed biomass by cover crop.

achieved by forage radish alone in both fall and spring. In mid-November 2014, forage radish achieved almost total weed suppression while both Pea/Oat/FR and Oat/FR had 3 times the weight of weeds. However, the no cover crop treatment had 54 times the weed biomass compared with FR.

In late April 2015, FR still has the least weed biomass, followed by Pea/Oat/FR, then Oat/FR, with Oat alone being the least weed suppressive. (Fig. 2).

Seeding and Cost Benefits:

Calculating seeding rates for cover crop mixtures is not an exact science, but there are some really good guidelines out there. An excellent resource was recently published on extension.org, entitled “Making the Most of Mixtures: Considerations for Winter Cover Crops in Temperate Climates” (White, C. et al, 2015). It provides a step-by-step approach to selecting species, evaluating their benefits and competitiveness, and determining seeding rates. A link to the article is provided at the end. An additional resource is a free cover crop calculator available at <https://greencoverseed.com/smartmix>. In general, you want to use at least half the seeding rate of the recommended monoculture rate, and even less if you have two similar species (for example, two grasses). Use a minimum of 30 lbs/acre of total seed.

Cover crop mixtures can be a cost-effective and productive way to fine tune and increase the benefits of your cover cropping practices (Fig. 3) in order to build soil health, provide weed control, and cycle nutrients for next season’s crop!

Resources:

- Clark, A. 2007. Managing cover crops profitably, 3rd edition. Sustainable Agriculture Network, Beltsville, MD. (Available online at: <http://www.sare.org/SARE-Nationwide/Learning-Center/Books/Managing-Cover-Crops-Profitably-3rd-Edition>)
- White, C., et al, 2015. Making the Most of Mixtures: Considerations for Winter Cover Crops in Temper-



Complete fall weed suppression by forage radish cover crop in October (foreground).



Forage radish residue and weed suppression in mid-April 2015.

Cover crop species	Seeding rate- drilled (lbs/ac)	Seed price (\$/lb)	Seed cost per acre
Oats	100	\$0.40	\$40
Rye	90	\$0.25	\$23
Vetch/ Rye	20/ 60	\$2.00/ \$0.25	\$55
Forage radish	7	\$3.00	\$21
Oat/Forage radish	50/3	\$0.40/ \$3.00	\$29
Pea/ Oat/ Forage radish	40/30/2	\$1.20/ \$0.40/ \$3.00	\$66

ate Climates. [Online]. Available at: <http://www.extension.org/pages/72973/making-the-most-of-mixtures:-considerations-for-winter-cover-crops-in-temperate-climates#conclusions>

- Green cover seed smart mix calculator. [Online]. An online tool to create custom seeding rate blends of many different species. Available at: <https://greencoverseed.com/smartmix>

-by Julie Stultz Fine, graduate student, UMass Extension Crop, Dairy, Livestock Program

IDENTIFYING POTATO TUBER DISEASES & DISORDERS

Potato harvest is underway for fresh eating, direct-market sales and for some early processing varieties. There are many diseases that affect potato tubers so as you begin to sort through your potato harvest this year, take a moment to check for disease symptoms. Proper identification will help you decide which tubers will store well and which should be sold as tablestock, and will give you a better idea of which soil-borne diseases are present in your fields, to help improve future cultural practices, including field rotations.

Common Scab (*Streptomyces* spp.) produces tan to dark brown, circular or irregular lesions which are rough in texture. Scab may be superficial (russet scab), slightly raised (erumpent scab), or sunken (pitted scab). The type of lesion is dependent on potato cultivar, tuber maturity at infection, organic matter content of soil, strain of the pathogen, and the environment. Common scab is controlled or greatly suppressed at soil pH levels of 5.2 or lower, though a closely related *Streptomyces* sp. known as acid scab can survive down to 4.0.

Early blight (*Alternaria solani*) usually affects potato foliage but tuber infections can also occur. Tuber lesions are dark, sunken, and circular often bordered by purple to gray raised tissue. The underlying flesh is dry, leathery, and brown. Lesions can increase in size during storage and tubers become shriveled.

Fusarium Dry Rot (*Fusarium* spp.) causes internal light to dark brown or black dry rot of the potato tuber. The rot may develop at an injury site such as a bruise or cut. The pathogen penetrates the tuber, often rotting out the center. Extensive rotting causes the tissue to shrink and collapse, usually leaving a dark sunken area on the outside of the tuber and internal cavities.

Black Dot (*Colletotrichum coccodes*) On potato foliage symptoms are nearly indistinguishable from early blight and on tubers it produces tiny black sclerotia (fungal resting structures). Symptoms on tubers can be easily mistaken for silver scurf.

Silver Scurf (*Helminthosporium solani*) affects only tuber periderm (skin). Lesions are initiated at the stolon end as small pale brown spots which may be difficult to detect at harvest but will continue to develop in storage. In storage, lesions may darken and the skin may slough off and many small circular lesions may coalesce to form large affected areas. Tubers may also become dried out and wrinkled due to excessive moisture loss in storage.

Black Scurf and Rhizoctonia Canker (*Rhizoctonia solani*) Black scurf is purely cosmetic and does not reduce yield, even in storage. Irregular, black hard masses on the tuber surface are overwintering structures (sclerotia) of the fungus. Presence of these sclerotia may be minimized by harvesting tubers soon after vine-kill and skin set. While the sclerotia themselves do not cause damage, they allow the pathogen to survive in the soil and serve as evidence of its presence. In cool, wet soils, *R. solani* can cause dark, sunken lesions on underground sprouts and stolons. These lesions can cut off the supply of nutrients, killing tubers, or can reduce the transfer of starches to the tubers, reducing their



Common scab causes rough, circular spots that can be superficial, raised, or sunken. Photo by RW Samson.



Early blight lesions can spread in storage. Photo by S. Jensen.



Dry rot causing dark sunken spots on the inside and outside of tubers. Photo by C. Averre.



*Black scurf symptoms are evidence that *R. solani* is present in soil. Photo by G. Holmes.*



Rhizoctonia solani causes cankers on stems and stolons and sometimes lenticels. Photo by Clemson

size. Cankers can also form on the tubers themselves, usually at the stolon or in lenticels. Cankers on tubers which can be small and superficial but may be large, sunken and necrotic.

Pink Rot (*Phytophthora erythroseptica*) and **Pythium Leak** (*Pythium* spp.) Pink rot infections start at the stolon end and result in rotten and discolored periderm with a clear delineation between healthy and diseased tissue. When exposed to air, tuber flesh turns pink and then brown-black. *Pythium* spp. that cause leak infections invade tubers through harvest wounds and continue to develop in transit and storage. Infections result in internal watery, gray or brown rot with well-defined red-brown lines delineating healthy and diseased tissue.

Late Blight (*Phytophthora infestans*) affects potato foliage and tubers. Foliar symptoms start with brown to black, water soaked lesions on leaves and stems which produce visible white sporulation at the lesion margins under humid conditions. Whole plants and fields may collapse rapidly. Tuber infection is initiated by sporangia from foliage being washed down into the soil and usually begins in wounds, eyes, or lenticels. Lesions are copper brown, red or purplish and white sporulation may occur on tuber surfaces in storage or cull piles. Infected tubers are susceptible to infection by soft rot bacteria which can turn entire bins of potatoes in storage into a smelly, rotten mass.

Black Heart is physiological disorder caused by lack of oxygen during storage which causes the tissue to die from the inside out and turn black. The condition is not reversible but if you notice it quickly and correct your storage conditions you can prevent the whole crop from being affected.

Potato Virus Y can cause necrotic ring spots on tubers, depending on which strain of the virus is present, which potato variety is grown, and the time of infection. Affected tubers have roughened rings of darker brown or reddened skin. Necrosis beneath the rings may extend into the tuber flesh. Necrotic symptoms in tubers often increase after storage. Potato varieties vary in their susceptibility to PVY and the symptoms they exhibit on foliage and on tubers; Yukon Gold is particularly susceptible to tuber necrosis. If you think you are seeing symptoms of PVY on foliage or tubers, please contact Sue at sscheufele@umext.umass.edu.

Brown Center and Hollow Heart are internal physiological disorders of potato which often occur together. Brown center is an area of dead pith cells which turn brown, while hollow heart is a star or lens shaped hollow area in the center of the tuber. These disorders make cut fresh-market tubers unattractive and can reduce repeat sales. Severe hollow heart negatively impacts the quality of chip-processing potatoes and can result in shipments not making grade. Both disorders are related to stress, and occur at a higher incidence when growing conditions abruptly change during the season. Brown center and hollow heart effects likely form during tuber initiation but could also form during tuber bulking. If the disorder occurs during the early part of the season, then it is most often preceded by brown center and forms in the stem-end of the tuber, while late-forming hollow heart usually occurs near the bud-end with no brown center symptoms occurring. Conditions such as when soil temperatures are less than 56°F for 5–8 straight days, or when available soil moisture is greater than 80% cause brown center to start forming. Incidence of brown center and hollow heart also increases with periods of stress because of high or low moisture levels, especially if heavy water applications follow a period of stress because of low moisture levels. Large tubers are more prone to develop the disorder, so using closer spacing and making sure not to have too many skips in the row can reduce incidence of brown center and hollow heart. There are also



Pink rot causes rubbery, discolored lesions. Internal tissue turns pink after exposure to air. Photo by UMN Extension



Coppery brown late blight lesions. The disease can spread in storage and affected tubers are very susceptible to soft rot bacteria. Photo by RW Samson.



PVY ring spot lesions on Yukon Gold tubers. Photo by potatovi-



Hollow heart. Photo by B. Phillips.

differences in the susceptibility of potato varieties; ‘Atlantic’, a widely grown potato for chip processing, is relatively susceptible to both disorders. In ‘Russet Burbank’, susceptibility to both brown center and hollow heart is highest soon after tuber initiation when the tubers are small.

- by Sue Scheufele, UMass Extension Vegetable Program

FALL CABBAGE MAGGOT IS ACTIVE

Cabbage root maggot (CRM) has four successive generations over the season at this latitude, and has late-season flights that typically peak in mid-August and again in mid-September. Although, some growers this year have reported CRM damage all season long. One grower lost his fall cauliflower planting to root maggot just a few weeks ago, while adjacent broccoli survived. Larval feeding can cause root injury in fall brassicas, especially in the marketed roots of radishes, turnips, daikon and rutabagas. Scarring of the surface and tunneling through the root reduce marketability. The timing of controls is more difficult than in spring crops, because the timing of the flight is more difficult to pinpoint than in the spring, and there are two flights during the growth period of fall crops. Root crops are often planted before the fly is active and roots are subject to larval feeding damage later in crop growth. The organophosphate insecticides (diazinon, chlorpyrifos) that are labeled for use against maggot flies need to be applied before, during or shortly after planting, as pre-plant incorporated applications, as transplant or furrow drenches, or as directed sprays right after planting; fortunately these products have long residual periods in the soil, but there is no option for rescue treatments.



Turnips damaged by root maggots. Photo by Illinois Extension.

New chemistry is available for maggot control with the newly labeled, reduced-risk diamide product Verimark (cyantraniliprole) which can be applied as a transplant drench, furrow drench, or through drip. It is systemic and works best when taken up by the roots. Verimark is labeled for leafy brassicas, including cabbage and broccoli (*Brassica oleraceae*) etc., Chinese cabbage, bok choy, and greens, but not for root crops like radish, turnip or rutabaga. It has shown very good control of CRM in UMass trials in spring cabbage.

CRM models on the NEWA forecast system suggest that peak flight of the third generation occurred around August 12th, which means that larvae may be active now. The fourth flight is likely to begin by early-September, when many root crops will be partly grown. Another tool that was developed in western NY based on research done in the 1980's correlates flowering of wild plants with CRM flights. This showed that onset of flowering of Canada thistle and goldenrod correlates with the third generation flight, and New England aster with the fourth generation flight. You may also look for eggs at the base of the stem to determine presence of CRM.

While row covers are a valuable tool in spring, the added heat and reduced light has been shown to reduce good root quality and yield in turnips and rutabagas. If row covers are used, select a non-heating type like Proteknet and apply before crop emergence or immediately after transplanting, to ensure that aphids are not trapped under the cover—protected from all the natural enemies in the field, aphid populations can explode under the cover.

Rotation is an important tool: adult flies do not migrate long distances, but will move into nearby fields (<400m) which see a spike in adult flight after a nearby field has been harvested and in spring fields that are planted near fall brassica crops. Longer distance rotations will reduce populations.

If you have experienced damage from CRM in spring or fall planted brassicas, please answer a few short questions to help us get a new and effective OMRI-approved product labeled for CRM control. Follow this link: <https://www.surveymonkey.com/r/3X5F7WS>.

- by Ruth Hazzard, UMass Extension Vegetable Program

SULFUR, CALCIUM, AND BORON FOR COLE CROPS

-Originally published in University of Delaware Cooperative Extension Weekly Crop Update, 8/14/15

Apart from recommended NPK fertility programs, growers of cabbage, broccoli, cauliflower, Brussels sprouts, kale, and collards need to pay attention to sulfur, calcium, and boron in their cole crop fertility programs

In vegetable crops, sulfur removal is generally in the 10-20 lb/A range. Mustard family crops (cole crops such as cabbage and broccoli, mustard and turnip greens, radishes) remove between 30 and 40 lbs/A of sulfur.



Most of the sulfur in the upper part of the soil is held in organic matter. Upon mineralization, sulfur is found in the soil as the sulfate ion (SO₄⁼) which has two negative charges. The sulfate ion is subject to leaching, especially in sandy textured soils (loamy sands, sandy loams). It does accumulate in the subsoil but may not be available for shallow rooted vegetables. *Tipburn on cauliflower. Photo by Univ. of Minnesota.*

Sulfur can be added by using sulfate containing fertilizers such as ammonium sulfate, potassium sulfate, and K-mag (sulfate of potassium and magnesium). It is also a component of gypsum (calcium sulfate). In liquid solutions, ammonium thiosulfate is often used as the sulfur source. Sulfur is also found in manures and composts. For example, broiler litter has about 12-15 lbs of sulfur per ton.

Calcium deficiency is most commonly seen as tipburn of cauliflower, cabbage, and Brussels sprouts. This problem can cause severe economic losses. Tipburn is a breakdown of plant tissue inside the head of cabbage, individual sprouts in Brussels sprouts, and on the inner wrapper leaves of cauliflower. It is a physiological disorder which is associated with an inadequate supply of calcium in the affected leaves, causing a collapse of the tissue and death of the cells. Calcium deficiency may occur where the soil calcium is low or where there is an imbalance of nutrients in the soil along with certain weather and soil nutrient conditions, such as high humidity, low soil moisture, high potash or high nitrogen all of which can reduce calcium availability. Secondary rot caused by bacteria can follow tipburn and heads of cauliflower can be severely affected. Some cabbage and cauliflower cultivars are relatively free of tipburn problems.

Cabbage varieties with good resistance to tipburn include Artost, Blue Vantage, Bobcat, Cecile, Emblem, Green Cup, Megaton, Padok, Platinum Dynasty, Quick Start, Royal Vantage, Solid Blue 780, Superstar, Thunderhead, and Vantage Point. Check with your seed supplier for tipburn ratings for other varieties.

Controlling tipburn starts with managing liming so that soil pH is above 6.0. Avoid using only ammonium forms of nitrogen, and ensure an adequate and even supply of water. Adjust planting date so that head maturation occurs during cooler temperatures. Plant a cultivar that is less susceptible to the disorder. In general, calcium foliar sprays have not been shown to be effective for controlling tipburn incidence.

Cole crops have a high boron requirement. Symptoms of boron deficiency vary with the cole crop. Cabbage heads may simply be small and yellow. Most cole crops develop cracked and corky stems, petioles and midribs. The stems of broccoli, cabbage and cauliflower can be hollow and are sometimes discolored. Cauliflower curds become brown and leaves may roll and curl. It is important to note that cole crops are also sensitive to boron toxicity if boron is over-applied. Toxicity symptoms appear as scorching on the margins of older leaves.

It is recommended in broccoli and kale to apply 1.5-3 pounds of boron (B) per acre in mixed fertilizer prior to planting. In Brussels sprouts, cabbage, collards and cauliflower, boron and molybdenum are recommended. Apply 1.5-3 pounds of boron (B) per acre and 0.2 pound molybdenum (Mo) applied as 0.5 pound sodium molybdate per acre with broadcast fertilizer. Boron may also be applied as a foliar treatment to cole crops if soil applications were not made. The recommended rate is 0.2-0.3 lb/acre of actual boron (1.0 to 1.5 lbs of Solubor 20.5%) in sufficient water (30 or more gallons) for coverage. Apply foliar boron prior to heading of cole crops.

-by Gordon Johnson, Extension Vegetable & Fruit Specialist; gcjohn@udel.edu

EVENTS

IPM Field Walk

When: Tuesday, August 25, 2015 from 3:30pm to 6pm

Where: [Hurricane Flats](#), 975 S. Windsor St. South Royalton, VT

Join us to learn how to scout for disease and insect pests in the field and discuss effective organic control strategies with farmer Geo Honigford, Ann Hazelrigg and Gabriella Maia (UVM Disease Diagnostic Laboratory) and Katie Campbell-Nelson (UMass Extension Vegetable Program). Sponsored by Vermont Vegetable and Berry Growers Association and NOFA-VT. Bring a hand lens if you have one. This series is funded in part by a Northeast IPM Center grant.

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