UMass Extension

Vegetable Notes

For Vegetable Farmers in Massachusetts since 1975

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In this issue:

Many farms like this one in western MA experienced devastating flooding this week. Reach out to us and to MDAR if you have experienced flooding losses!

Crop Conditions

The big news this week, at least for farmers in the Pioneer Valley, is of course the flooding that resulted from heavy rains here and in Vermont and that caused the Connecticut, Deerfield, and Mill Rivers to rise over their banks. UMass Extension and the MDAR Produce Safety Team have been visiting affected farms and providing guidance as to next steps. If your farm suffered losses from the recent storms and you haven't already reached out to UMass or MDAR, please do so now, so that we can assess the extent of the damage and collect information that may be used to inform decisions about recovery resources. You can email the MDAR Director of Produce Safety, Michael Botelho, at michael.botelho@mass.gov, or the UMass Extension Veg Team's Sue Scheufele at sscheufele@umass.edu.

It's important to know that if flood water—water that overflows from rivers, lakes, or streams—contacts the edible portion of a crop, the crop is considered adulterated by FDA and cannot be sold for human or animal consumption. This law is outside of the FSMA Produce Safety Rule and applies to all food crops, regardless of whether they're likely to be eaten raw. Flood waters may contain chemicals and pathogenic microbes that can contaminate produce or farm fields. Both UMass and the University of Vermont Extensions developed resources after the flooding caused by Tropical Storm Irene in 2011 that may be helpful today for answering growers' questions about which crops might be safe to harvest, when fields can be replanted, and how to manage flood-affected soils.

- UMass Extension: Flooded Crops—Food Safety and Crop Loss Issues
- UVM Extension: Frequently Asked Questions about Handling Flooded Produce

Additional resources compiled by the Northeast Center to Advance Food Safety can be found here. If financial support or additional guidance becomes available, we'll be sure to share it with Veg Notes readers.

Those of you not dealing with flooding are still dealing with pretty saturated fields, as rain continues to fall across the state. The wet conditions are making it difficult to get into fields to do field prep, lay plastic, plant, spray, and cultivate, so planting schedules are getting a bit off. We are also seeing a lot more disease issues cropping up and crop yield and quality may be affected— see Pest Alerts for more information. With all this water around it feels strange to be gearing up for a Twilight Meeting on irrigation, but our new normal is bouncing between weather extremes, and unfortunately folks need to be prepared for both drought and flooding! We hope to see many of you at Warner Farm this evening—find details in the Events section.

Contact Us:

Contact the UMass Extension Vegetable Program with your farm-related questions, any time of the year. We always do our best to respond to all inquiries. **Office phone:** (413) 577-3976 **Email:** umassveg@umass.edu

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

Pest alerts

With the wet, warm weather, foliar diseases of many crops are likely developing in fields. We have several articles on common diseases of certain crop groups – check them out for help identifying a disease that may be in your crop.

- Fungal Leaf Diseases of Tomato
- Bacterial Diseases of Tomato and Pepper
- Leaf Spots of Cucurbits
- Cercospora Leaf Spot of Beets and Swiss Chard
- Foliar Diseases of Onion

Alliums

Witches brooming, when side shoots develop in garlic, was reported this week from two farms. This is when side shoots develop from the garlic head, or each clove in the developing head produces a shoot. Witches brooming is not well understood, but is believed to be caused by mechanical injury to the growing bulb, winter injury, seed clove storage below 40°F, and water stress during clove formation. These two cases may have been caused by freeze injury to sprouts that were at a specific emergence stage during the May 18 freeze event. Normal winter conditions do not usually cause witches brooming, even if cloves have already sprouted by late winter (as they often do).

Witches brooming in garlic.

Brassicas

Black rot was seen this week on kale in Franklin Co. Black rot is caused by the bacterium *Xanthomonas campestris* pv. *campestris*, which enters the plant vascular system through hydathodes (pores along the edge of the leaf). The bacterium clogs the veins, causing them to turn black, and the surrounding leaf tissue turns yellow, commonly in a "V" shape. The pathogen can be carried on seed and can survive on crop residue for several years. Seed can be treated with hot water to eliminate the pathogen. Avoid working in fields when foliage is wet to slow the spread of black rot. Copper (organic options available) and mancozeb applied preventatively can provide control.

Black rot on cabbage

Cucurbits

Table 1. Squash vine borer trap captures for week ending July 12	
Whately	0
Leominster	1
North Easton	52
Sharon	25
Westhampton	3

Downy mildew on the underside of a cucumber leaf. Photo: G Higgins

Downy mildew was reported in southern NH last weekend, and in northern VT and north-eastern NY this week, all on cucumber. We have not yet seen symptoms in our cucurbit downy mildew sentinel plot in South Deerfield, but it's likely that CDM is present in MA or arriving soon. All cucurbits are susceptible to this disease, with cucumbers and melons most at risk. Growers should now add targeted fungicides to spray programs. The ideal spray program is a protectant tank-mixed with a targeted material, rotating between 2 classes of targeted materials. Protectants include mancozeb, chlorothalonil (effective against powdery mildew also), and copper. Recommended targeted materials include Orondis (FRAC Group 9), Omega (29), Ranman (21), Zampro (40 + 45), Zing! or Gavel (22), Ariston, Curzate, or Tanos (27), and Previcur Flex (28). Presidio (43), Revus, and Forum (40) are no longer recommended because of known resistance. *If you suspect downy mildew in your cucurbits, please let us know (umassveg@umass.edu or 413-577-3976) so that we can confirm it and help track this important disease!*

Nightshades

Bacterial leaf spot was reported in pepper in Franklin Co. this week. Bacterial leaf spot symptoms begin as small brown spots on pepper foliage. Spots expand and coalesce and can cause significant defoliation, which then leads to sunscald of fruit. The bacteria can be carried on pepper seed and can survive in the soil on crop debris. Hot water seed treatment can eliminate the pathogen from seed. There are 11 identified races of bacterial leaf spot (0-10). There are resistant varieties; success using resistant varieties requires growing a variety with resistance to the race present in your crop, which requires identifying the race(s) present with lab testing. X10R™ varieties provide intermediate resistance to all strains. Chemical control is often ineffective.

Bacterial leaf spot on pepper. Photo: WVU Extension

Early blight on tomato. Photo: Clemson Univ, USDA Cooperative Extension Slide Series, Bugwood.org

Early blight is present in field tomatoes in Hampshire Co. Early blight is caused by a fungus that overwinters on crop reside and splashes onto lower leaves to cause infection mid-summer. Symptoms begin as brown lesions on lower leaves that expand, often forming concentric rings. Symptoms move up the plant as the disease develops. Fungicide sprays must be preventative. See the tomato disease section of the New England Vegetable Management Guide for labeled materials.

Multiple crops

Phytophthora blight is being reported in pepper Maine this week, and it's likely present in MA as well, with more expected to develop in peppers and cucurbits with this week's rain and flooding. See the article in this issue for more information.

Tarnished plant bug is being reported in high numbers throughout the region. TPB feeds on a wide range of plants and particularly likes alfalfa; on diversified vegetable farms it is mostly an issue on strawberries and lettuce. TPB is not generally a seriously damaging pest unless the vegetation surrounding crop fields is serving as a source of large populations and the crop offers more succulent feeding than the surrounding fields. Avoid planting lettuce near abandoned, weedy fields or alfalfa crops. While alfalfa may serve as a trap crop, mowing alfalfa may cause TPB to leave mowed fields for nearby vegetables causing TPB populations to increase. See the appropriate crop insect control section of the New England Vegetable Management Guide for labeled pesticides.

Tarnished plant bug adult. Photo: S. Bauer

Sweet Corn

Sap beetles. We have received several reports of high sap beetle pressure this week. Control of heavy sap beetle infestations requires both cultural and chemical controls. Varieties with exposed tips are more susceptible to infestation. Chop infested blocks immediately after harvest; for heavy infestations, plowing residue under is ideal. Eliminate cull piles near fields, as adults also feed on rotting fruit. Sap beetles are not susceptible to the Bt toxin. The most effective insecticides are carbaryl (e.g. Sevin), lambda-cyhalothrin (e.g. Warrior II), bifenthrin (e.g. Bifenture), and methomyl (e.g. Lannate). Make 1-2 applications, 3 and 6-7 days after silking begins. Additional later sprays do not increase control, but you may be spraying effective materials for caterpillar control anyways after this point. Carbaryl should not be used while corn is shedding pollen and corn cannot be hand-picked after applying carbaryl.

European corn borer trap counts are higher in a few locations this week, indicating that the start of the 2nd flight may be starting (the GDD model predicts the start of the 2nd flight at 1400 GDDs, and locations around the state are at 1006-1182 as of yesterday). If corn earworm trap captures do not warrant a pesticide spray, scout corn for ECB caterpillars and spray if 15% of the crop is infested. **Corn earworm** continue to be captured in pheromone traps across the state, with 14/18 trapping locations on a 4-day spray schedule.

Table 2. Corn earworm spray intervals based on Heliothis trap moth captures

Moths per night	Moths per week	Spray interval
0 - 0.2	0 - 1.4	no spray
0.2 - 0.5	1.4 - 3.5	6 days
0.5 - 1	3.5 - 7	5 days
1 - 13	7 - 91	4 days
Over 13	Over 91	3 days

Table 3. Sweetcorn pest trap captures for week ending July 12

Location	GDD* (base 50°F)	ECB NY	ECB IA	FAW	CEW	CEW Spray Interval
Western MA						
Feeding Hills	1186	0	0	0	15	4 days
Southwick		0	0	0	14	4 days
Granby	1111	10	0	0	14	4 days
Whately	1182	0	0	-	3	6 days
Central MA						
Leominster	1193	0	0	0	22	4 days
Lancaster		11	0	0	11	4 days
North Grafton	1009	18	1	0	14	4 days
Spencer	1093	0	0	0	45	4 days
Eastern MA						
Bolton	1094	0	0	-	-	
Concord	1064	4	0	0	18	4 days
Haverhill	1100	6	0	0	12	4 days
Ipswich	1006	2	0	0	5	5 days
Millis	-	3	2	-	14	4 days
North Easton	1123	0	0	0	20	4 days
Sharon		0	0	-	6	5 days
Sherborn	1113	5	0	0	20	4 days
Seekonk	1047	1	0	0	17	4 days
Swansea		0	0	-	37	4 days

- no numbers reported for this trap
N/A this site does not trap for this pest

*GDDs are reported from the nearest weather station to the trapping site

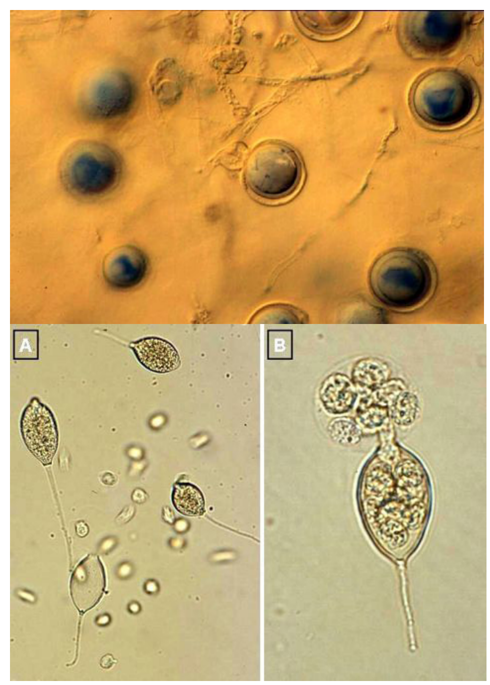
MANAGING PHYTOPHTHORA BLIGHT

The last few weeks of heavy rainfall and flooding have resulted in the perfect environmental conditions for the soil-dwelling pathogen *Phytophthora capsici*, which causes significant disease in cucurbits and pepper. *P. capsici* can also causes disease in tomato, eggplant, beans, and some weeds (e.g. purslane, eastern black nightshade, and Carolina geranium). Warm, wet conditions with frequent rainstorms, like the recent weather, favor disease development. Symptoms vary by crop and may be easily confused with other diseases like bacterial wilt or abiotic issues such as waterlogging. Be on the lookout for the symptoms described below and submit suspect plants or fruit to the [diagnostic lab] in order to get a proper ID. This will prevent you from moving the pathogen around your farm and from planting susceptible crops in infested fields in future years. There is also a lot you can do now to manage the disease on your farm.

Phytophthora fruit rot on pumpkin, with white sporulation beginning to form. Photo: M.T.McGrath

Phytophthora crown rot beginning in pepper. Photo: LI Horticultural Research & Extension Center

Symptoms. Many of you are probably all too familiar with the symptoms of Phytophthora blight on cucurbit fruit. Symptoms on other vegetable crops can be quite different from those on cucurbits. On squash fruit, *P. capsici* causes firm, round, water-soaked lesions that develop white mycelial growth that resembles powdered sugar under warm, moist conditions. Cucurbit plants, especially non-vining varieties, can also develop crown rot where whole plants or vines wilt suddenly and eventually the whole plant collapses. Symptoms on **pepper** are distinctly different – plants become infected with *P. capsici* via their roots and develop a crown rot that causes darkening of roots and stems and permanent wilt of foliage, while stems remain rigid. Pepper fruit remains attached to the upright stems but may eventually develop dark, water-soaked lesions that can spread to the whole fruit, giving it a soft, wrinkled appearance. On **tomato**, *P. capsici* causes 'buckeye rot' on fruit where it comes in contact with the ground. Small brown spots on fruit expand into large, round or oblong lesions with alternating rings of light- and dark-brown discoloration. The lesions are initially firm, with smooth margins but eventually become soft. Phytophthora blight has been confirmed more recently on **lima** and **snap beans** in the field and on **soybean** under lab conditions. These crops had previously been considered non-hosts. Bean pods develop water-soaked lesions that develop diffuse, white sporulation. Bean stems and crowns can also be affected; plant collapse in low-lying areas of fields is common.



Top: Oospores of P. capsici. *Photo: M. Babadoost.*

Bottom: P. capsici *sporangium releasing mitle zoospores (left) and sporangia with zoospores (right). Photo: M. Babadoost*

Disease Cycle. *P. capsici* is not a true fungus, but a fungal-like organisms called an oomycete. It persists in soil for many years as thick-walled resting spores called oospores. These long-lived oospores can be spread throughout the field during tillage or cultivation, and they can be spread between fields or farms on infested soil clinging to tractor or truck tires, harvest buckets, workers' boots, or discarded infected fruits. During wet conditions, oospores germinate and produce asexual, short-lived sporangia that contain 20-40 zoospores. Zoospores are motile spores that swim towards host roots or fruit and infect. The resulting lesion will then produce more sporangia and zoospores that can be spread by surface water, rain, or splashing water. One infected spaghetti squash is estimated to produce 44 million sporangia with the potential to release 840 million zoospores. This accounts for the rapid, above-ground spread of disease within a field or a season. Outbreaks often start in low-lying or poorly drained areas of fields, where oospores are triggered to germinate and swimming zoospores are able to find hosts. Waterlogging alone can also cause stunting and plant death, making it important to obtain accurate diagnoses so that you know which of your fields are infested with *P. capsici*. Importantly, water run-off from an infested field may contaminate surface water sources used for irrigation. This has been well-documented in irrigation ponds and rivers in NY and MI.

Collapsing and dead plants, killed by Phytophthora capsici.

Cultural control: These practices can be effective in helping to prevent outbreaks and manage *P. capsici* once it is present. Cultural controls will likely not be enough to completely avoid the disease if planting susceptible crops into infested soil, but can be used in combination with fungicide applications to minimize damage.

Minimize standing water. Plant cucurbits in well-drained soils, and minimize hardpans and plowpans by subsoiling or chisel plowing before planting. Do not plant in areas with poor drainage, and avoid over-irrigating. You can plant bush-type cucurbits in raised beds covered with plastic mulch to prevent contact with the soil; this method is less effective with vine-type plants, since they will grow beyond the beds. More details about this can be found in this Cornell Cooperative Extension Fact Sheet from Meg McGrath.

Crop rotation: A minimum crop rotation of 3-4 years is recommended, although oospores can live for much longer than that and fields that have been out of susceptible crops for >5 years have had outbreaks in recent years. Planting non-hosts into infested fields for any number of years is useful—each year an infested field is planted with a non-host, the number of surviving oospores will be reduced. Non-host crops include brassicas, umbelliferous crops (carrots, celery, celeriac, parsley, cilantro, dill), alliums, and small grains. Tolerant pepper varieties are available if crop rotation is impossible (see this list from Meg McGrath). Similarly, pumpkin varieties with hard shells, such as 'Lil Ironsides' or 'Apprentice' have been shown to be significantly less susceptible to disease than similar varieties with conventional, soft rinds.

Cover crops can be used to help mitigate the effects of *P. capsici*, as the addition of soil organic matter stimulates the growth of beneficial microbes. A healthy soil microbial community can reduce plant pathogen activity by outcompeting them for space and nutrients, by direct parasitism of plant pathogens, by producing antibiotic compounds that slow pathogen growth, and by stimulating the plants' natural defense systems.

Biofumigation: Research has shown that brassica cover crops (especially mustards) release glucosinolates and other compounds as they break down that are toxic to microorganisms, including plant pathogens. Plant pathogens are not always great soil competitors, so this "biofumigation" allows beneficial microorganisms to repopulate the soil. In order to get the highest release of glucosinolates, the brassica cover crop should be fertilized. At termination, incorporate the brassica residues by chopping and rototilling, followed by cultipacking and irrigating just before the crop is planted. Allelopathy can be a concern for some sensitive crops when using this system. For more detailed info check out this factsheet from Cornell University.

In-season management steps. Plan on harvesting from clean fields before you go into infested fields with tractors, trucks, workers, and bins. Take time to wash equipment when moving between fields to remove soil or crop residues that may contain sporangia or oospores. Ideally, do not leave infected fruit in fields or in cull piles. If a *P. capsici* infection is isolated and caught early, removing the infected plant material from the field and harrowing a border of healthy, unaffected plants around the area can prevent the disease from spreading. If the infested area is large and plant material cannot be removed from the field, till it under deeply. There is a 2-6 day lag period between infection and symptom expression so if you suspect *P. capsici* is present, hold fruit for a few days before sending large wholesale shipments out to avoid their being returned due to rot.

Chemical control. Fungicides can be used effectively and economically to reduce the impact of disease on yield, though none will provide sufficient protection to be used as the sole management strategy—they must be part of an integrated program including cultural controls. For many row crops, applying fungicides through trickle irrigation (if allowed by product label) can help control crown rot. In vining crops, foliar applications will also be needed later to protect developing fruit, which may be resting on infested soil. Foliar applications can be difficult to make effectively because of dense canopy. Air-assisted nozzles may help improve coverage. *P. capsici* has the ability to develop resistance to targeted fungicides, so resistance management strategies like mixing targeted fungicides with protectant fungicides and rotating modes of action with every application, are extremely important. Some populations of *P. capsici* have become resistant to Ridomil (mefenoxam), which has been used extensively in the past to drench plants in the early season. Thus, Ridomil may no longer be effective in fields where it has been used repeatedly. Instead, you can treat transplants or seedlings with a drench treatment of a phosphorous acid fungicide such as ProPhyt, K-phite or Fosphite, which have been shown to be effective as soil or foliar applications. Other effective, targeted materials include:

Orondis: Oxathiapiprolin is a **newer active ingredient** which has demonstrated **excellent efficacy** against oomycete pathogens including *P. capsici*. Two formulations are labeled for Phytophthora blight: Orondis Gold 200 and Orondis Ultra. Orondis Opti is not labeled for Phytophthora blight.

Orondis Gold 200 (oxathiapiprolin): *FRAC 49, PHI 0d, REI 4 hrs.*
At-planting soil applications only for Phytophthora blight. Foliar applications of other FRAC-49 containing products is prohibited after soil applications.

Orondis Ultra (oxathiapiprolin + mandipropamid): *FRAC 49+40, PHI 0d, REI 4 hrs.* Also labeled for cucurbit downy mildew. Make no more than 2 consecutive applications. See label for further restrictions.

Ranman *FRAC 21, PHI 0d and REI 12hrs.*
Can be used beginning before symptoms occur for a maximum of 6 applications.

Omega FRAC 29, *PHI 7 days (squash, cucumber), 30 days (melon, pepper) REI 12 hrs.*
Apply no more than 7.5 pts/A to a crop or 4 applications if applied at highest label rate of 1.5 pts/A. Omega is more expensive than other fungicides.

Forum *FRAC 40, PHI 0d, REI 12 hrs.*
Can be used on all cucurbit crops at 6 oz/A every 5 to 10 days, depending on disease pressure, beginning when plants are 4-6 inches high for a maximum of 30 oz or 5 applications. It must be used in a tank mix with an effective fungicide that has a different mode of action (non-Group 40 fungicide).

Tanos *FRAC 11+27, PHI 3d, REI 12hrs.*
Labeled at 8-10 oz/A for a maximum of 4 applications. Tanos must be tank-mixed with a protectant fungicide like copper, chlorothalonil or mancozeb. Follow a strict alternation with no consecutive applications of Tanos.

Gavel *FRAC 22+M3, PHI 5d, REI 48 hrs.*
Labeled for use at 1.5–2.0 lb/A every 7 to 10 days or when conditions are favorable for disease for a maximum of 8 applications.

Presidio and **Revus** are other materials that would make good choices for managing Phytophthora blight in cucurbit crops. Be aware, though, that while Phytophthora blight and cucurbit downy mildew are both caused by the same type of pathogen and thus are sensitive to similar targeted fungicides, Presidio and Revus are no longer recommended for downy mildew because that pathogen has developed resistance to these materials. These materials do still work for Pytophthora blight and are also labeled for pepper and eggplant.

More detailed information about additional fungicides labeled for control of Phytophthora blight is available in this Cornell Cooperative Extension fact sheet.

For organic growers, there are several soil-applied materials labeled for use in controlling *Phytophthora* species including *P. capsici*, and while they may not work as well as targeted synthetic fungicides, they can reduce disease severity and improve yield. 2013 trials conducted by Dr. Mary Hausbeck at Michigan State University found that BioTam, Serenade Soil, and Actinovate Ag all significantly reduced plant death and increased yield relative to the untreated control. Each product was applied as a soil drench at the base of yellow squash plants grown on black plastic. When she used these biofungicides in rotation with a synthetic fungicide, Presidio, she got even better control, indicating these materials could be used as rotational tools in conventional spray programs. The full report from these trials is available here.

Management of *Phytophthora* begins with prevention. Be aware, informed, and proactive. If infections occur, a program that includes multiple control strategies can reduce the pathogen population size over time.

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

Short term summer cover crops

The last month has been stormy and wet, with extreme rainfall across the region and devastating flooding in western MA this week. In cover cropped fields that are waterlogged or flooded, the roots of those cover crops are doing their job, holding onto the soil and preventing or slowing down erosion. On dryer land of course, cover crops also shade out weeds, preventing them from going to seed. There are several good legume and non-legume cover crop choices for planting now and throughout July that grow rapidly in the summer heat. When planting mixtures in the summer, select equally vigorous crops (similar height and growth rate) so they will not compete and shade each other out. For example, Jean-Paul Cortens of Roxbury Farm in Kinderhook, NY likes a mix of 50 lbs/A sunn hemp, 10 lbs/A Japanese millet, 5 lbs/A sunflower, and 50 lbs/A cowpea or field pea.

Legumes

Cowpea (*Vigna unguiculata*), also known as black-eyed or southern pea, is fast-growing with peak biomass often reached in 60 days. It also tolerates drought and heat. Cowpeas can fix up to 100 lbs N/A with biomass of 3000-4000 lbs/A. It breaks down rapidly after incorporation. Cowpeas also can be harvested in the immature pod stage as a fresh legume. *Drill at 40-50 lbs/A and broadcast at 70-100 lbs/A*.

Sunn hemp. Photo: T. Jones

Sunn hemp (*Crotalaria juncea*) is a tropical legume (not related to other hemps) and has great potential in our humid, tropic-feeling summers. Sunn hemp can produce a lot of biomass (3-4 tons/A in MA). It is a high nitrogen-fixing legume and can contribute over 100 lbs N/A to a following crop. Sunn hemp grows very fast in the summer, reaching 6 feet or taller in 8 weeks. Allow sunn hemp to grow 1-3 feet tall, then mow it and let it regrow. If allowed to get too tall, the stems will become tough and fibrous and will not decompose rapidly. This crop is an excellent companion for sorghum sudangrass, which can also be mowed to keep it from getting too fibrous. Sunn hemp is a day length-sensitive crop; it will grow anytime during the summer, however it will not flower and go to seed until the days start getting shorter in very late summer. Seed is mostly sourced from Hawaii at this point and may be expensive, but the N contributions may be worth it! *Drill 20-30 lbs/A*.

A field of crimson clover. Photo: M. Ng

Crimson clover (*Trifolium incarnatum*) is a beautiful cover crop that is a great choice for a short-term summer cover or perhaps seeded between plastic rows to reduce splash and erosion and suppress weeds. It is not typically considered an overwintering cover crop in

Massachusetts, but in a 2016 UMass Extension cover crop research trial, it overwintered well on four MA farms. It is fairly resilient and tolerates well-drained soils, heat, drought, and low fertility soils. Shade tolerance makes this cover crop a good choice for mixes. Depending on coverage, it can fix 70-150 lbs N/A. *Drill 10-20 lbs/A, and broadcast at 12-24 lbs/A*.

Non Legumes

Sorghum sudangrass (*Sorghum bicolor x S. sudanense*) is a cross between grain sorghum and sudangrass. It is a warm-season annual grass that grows well in hot conditions and produces a large amount of biomass. Its thick root system and high biomass makes it useful for soil building. Sorghum sudangrass can reach 6-12 feet tall, but should be mowed when it reaches 2-3 feet tall to prevent it from becoming fibrous and difficult to manage. Mowing also encourages root growth. Unmowed sorghum sudangrass will winterkill but the tough residue can be difficult to manage in the spring. Brown midrib types will decompose more quickly because they have less lignin. Expect 3-4 tons of biomass addition per acre in MA. Because it is a grass, to get the most growth you will need to add nitrogen fertilizer (40-80 lbs/A), which will be cycled on to the next crop. Sorghum sudangrass is very effective at suppressing weeds and has been shown to have allelopathic and biofumigant properties useful for nematode management. *Drill 35-40 lbs/A or 40-50 lbs/A broadcast.*

Phacelia (*Phacelia tanacetifolia*), also known as blue or purple tansy, is a good cover crop for use in rotation on vegetable farms because it is not in the same family as any major vegetable crops. This fast-growing cover crop is best to seed in mid-summer. While it does not have a deep taproot, phacelia is a wonderful soil aggregator in the top 2 inches. Beneficial insects including parasitoids and pollinators are attracted to the fuzzy purple-blue flowers. This cover crop will winterkill at 15°F. *Seed at 1 lb/A drilled and 3 lb/A broadcast.*

Forage-type pearl millet (*Pennisetum glaucum*) or **Japanese millet** (*Echinochloa* spp.) have similar functions as summer cover crops: they grow rapidly but are easier to manage than sorghum sudangrass. They also produce less biomass than sorghum sudangrass. Both millets grow about 4-6 feet tall and have similar seeding rates. They are well-adapted to sandy and/or infertile soils and do well in the summer heat. Forage types are better adapted for soil improvement than grain types. To get the most growth, you will need to add nitrogen fertilizer (40-80 lbs/A). Pearl millet has been shown to suppress some nematodes. Forage pearl millet can make a good mulch for late-summer plantings of no-till or strip-till crops. *Seed at 12-15 lbs/A drilled or 15-20 lbs/A broadcast*.

Buckwheat (*Fagopyrum esculentum*) is a great choice if weed suppression is your main goal. It can be sown as early as May 20, but will put on more growth if seeded after June 1. As a broadleaf plant, it covers the ground earlier than grass cover crops, and out-competes weeds. A good stand of buckwheat attracts beneficial insects, improves soil tilth, and produces more biomass than any other cover crop in the short time it grows, but doesn't do well if the plow layer is compacted. It scavenges phosphorus from the soil and makes it available to subsequent crops. Buckwheat does well even in low nitrogen or low phosphorous soils, without additional fertilizer. Buckwheat decomposes quickly after incorporation. Mow or incorporate when the planting begins flowering to avoid seed production and volunteers. *Drill at 50 lbs/A or broadcast at 70 lbs/A.*

A field of buckwheat in flower.

Additional Information

Summer Soil Improving Crops for Vegetable Rotations, Gordon Johnson, Extension Vegetable and Fruit Specialist, University of Delaware.

Cover Crop Guide for New York Vegetable Growers. From Cornell Cooperative Extension. This site includes cover crop profiles as well as a cover crop decision tool, where you can get crop recommendations based on your management goal, planting time, and cover crop duration.

Cover Crops: What a Difference a Few Weeks Makes! Results from Cornell Organic Cropping Systems Trials.

Cover Crop Periodic Table

--UMass Extension Vegetable Program

Forced air cooling on the farm

--Written by Chris Callahan and Andy Chamberlain, University of Vermont Extension; introduction paragraphs by L. McKeag, UMass Vegetable Program. Originally published on the UVM Extension Ag Engineering blog on October 9, 2018 and June 17, 2019.

Precooling vegetables as quickly as possible after harvest and before crops go into storage helps reduce respiration and preserve product quality. Some common precooling techniques, including top-icing or hydrocooling—whether with a cool water dunk or more sophisticated equipment such as a rinse conveyor—involve direct contact with water. This water can present a food safety risk if it's contaminated with pathogens that can cause foodborne illness, either because the source water was contaminated or because contaminated product was exposed to the same water as other produce. Also, dunking warm produce in cold water creates the conditions for infiltration. The temperature gap causes a pressure differential that pulls water (and any pathogens that might be in it) into submerged produce. Because water presents contamination risks, the FSMA Produce Safety Rule requires that postharvest water be tested to ensure that it's free of generic *E.coli*, an indicator of fecal contamination, and that dunk tank or recirculated water be managed to reduce cross-contamination risks.

Some growers may be looking for other precooling methods that reduce their use of postharvest water. One option is forced air cooling, which uses cold air instead of water to remove heat. While commercial forced air coolers might be large and expensive, the engineers at UVM Extension developed designs for pallet- and crate-sized models that farmers can build on their own. This article describes their trials with these models, which showed that product was cooled 1.2-2.2 times faster than cooler storage alone. Note that not all cooling methods are appropriate for every crop. See Table 16 in the New England Vegetable Management Guide for information by crop that includes recommended cooling methods, storage temperatures and sensitivity to chilling injury.

A commercial forced air cooler in a produce distribution facility

The preservation of quality in fresh market and storage crops on small and medium-sized farms in the Northeast depends on the rapid reduction of pulp temperature and maintenance of relatively low temperatures to slow metabolic respiration.

There is strong foundational work showing that rapidly reducing the temperature at the start of the cold chain increases product quality when delivered to the consumer. Postharvest handling is critical for fresh produce farmers and the markets they sell to. Effort and expense invested in growing fruits and vegetables can be wasted without good handling practices at and following harvest (Gross 2014). Consumers expect the best from fresh produce. Quality and freshness are ranked with high importance among consumers. Farmers market respondents respectively rank quality (63%) and freshness (59%), as highly important factors in their buying decisions. Nearly 87% of the respondents indicated that availability and quality of fresh produce affected their decision about where to purchase (Gorindasamy 2002).

Precooling involves flowing a controlled, chilled fluid (air or water) over the product to improve heat transfer for removal of field heat to depress respiration and initiate the cold chain.

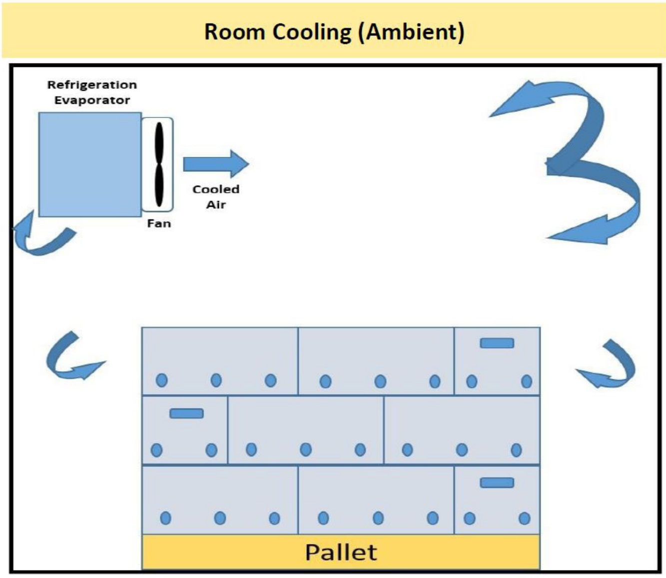


Figure 1. Produce packed in cartons, lugs, or other containers will not cool rapidly even when placed in a cooler. The cold air does not have sufficient velocity or pressure to pass into the center of the pallet or even to the center of a single carton, even when the containers have vented sides. Heat removal from the produce depends on conduction through produce and cartons which is slow. Figure: UVM Extension

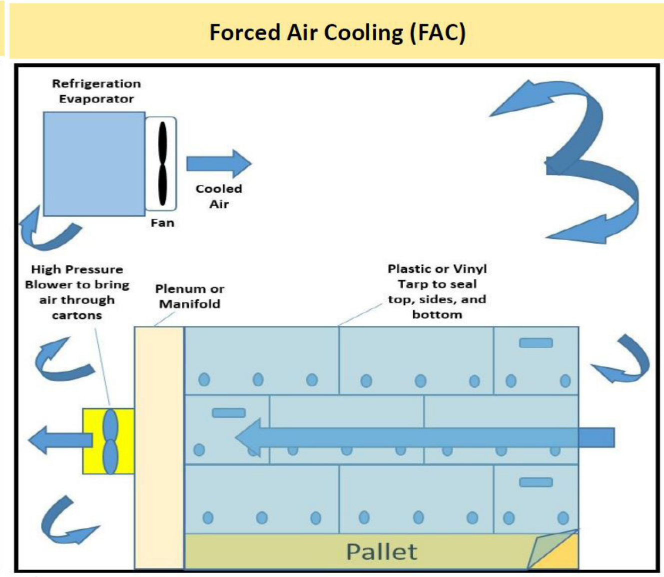


Figure 2. Using a high-pressure blower, cool air can be pulled through cartons of produce to remove field heat and reduce prodcut temperature to storage temperature more quickly. The heat removal rate from the produce is enhanced due to increased convective cooling in addition to conduction. This lowers respiration and leads to improved quality- Figure: UVM Extension

Precooling

One of the most important postharvest factors influencing quality is temperature. Temperature directly impacts the rate of metabolic respiration and associated decay. Produce which is not cooled quickly degrades in quality (Sargeant 1991). Table grapes, for example, deteriorate more in 1 hour at 90 °F then in one day at 39 °F or one week at 32 °F (Thomson *et. al* 2008). Lower quality leads to a decrease in sales, inefficient use of storage space, and wasted labor due to the time taken to grow, clean, and store product that doesn't sell. Coolers are a good addition to most farms but fall short of meeting optimal precooling needs. When produce is packed in boxes, stacked on a pallet and directly placed into a cooler, cooling time will be a minimum of 24 hours and may take many days. (Thompson *et. al* 2008).

One method to reduce cooling time is through forced air cooling (FAC). In FAC systems, refrigeration cools a space and blowers are set in position to actively draw the cold air through the produce. The cooling time drops from 24 hours to 10 hours or less when using a static cold room due to the increased air flow (increased convective heat transfer) (Thompson *et. al* 2008, Boyette 1989).

Attempts have been made at smaller scale pre-coolers to reduce field heat at harvest in absence of coolers (Thompson and Spinoglio 1996). Retrofitting a cargo container with insulation and cooling with a large capacity air conditioner was also explored (Boyette & Rohrbach 1990). This forced-air cold room offered space for many pallets of produce but it still took many hours to reduce the temperature internally, especially for the boxes on pallets in the center of the container. The key is integrating both cooling and air flow effectively (see Figures 1 & 2).

A mobile forced air cold box mounted on a trailer was constructed and demonstrated in Florida (Talbot and Fletcher 1993) aimed at farms growing produce on 5-50 acres. This unit could be self-built. Experiments showed that grapes could be cooled by 15 °F per hour. For denser produce like melons and tomatoes, the cooling times were longer. The construction cost at that time was close to $5,000.

We have built prototype FAC's for a single, fully or partially loaded pallet (figure 2) and also a 1-3 carton (either bulb crate or 1 1/9th bushel box) "counter-top" model. These precooling systems used simple lumber frames, plywood plenums, axial blowers and polyethylene film plastic to direct cold room air directly over produce to remove field heat. The construction details of these units are provided below.

Floor Pallet Model: go.uvm.edu/palletcooler **Counter Top Model:** go.uvm.edu/countertopfac

A countertop forced air cooler for 1-3 cartons of product. Photo: UVM Extension

A floor pallet forced air cooler.
Photos: UVM Extension

Field Trial Results.

Last summer we performed a series of precooling trials using the small-scale forced air coolers described above to cool eggplant, watermelon, strawberries, blueberries, zucchini, and roasting peppers. The forced air cooling was done in parallel with standard room cooling and was shown to result in cooling rates ranging from 1.2 to 2.2 times faster than room cooling. This test demonstrated the feasibility and benefit of simple forced air cooling systems to smaller scale farms.

Methods. As a result of the willingness of partner farms to collaborate in these trials, the following crops were tested: eggplant, watermelon, strawberries, blueberries, zucchini, and roasting peppers.

In each trial, two batches of the crop with roughly equivalent mass were harvested into standard cartons or bins based on the practice of the farm. One batch was cooled using room cooling—allowing the product to cool as it would when simply set in the walk-in cooler or CoolBot room. The other batch was cooled using a forced air cooling system built from one of the two plans referenced above. The batches were cooled in parallel with a target of reaching 7/8 of the optimal storage temperature for each crop ("7/8 temperature").

Product temperature was monitored in each batch using an insertion probe thermocouple and a data acquisition system with a 3 second sampling period. These data were used to fit a cooling rate curve using an exponential decay model and minimizing the error between the model and the actual data. The cooling rate curves were used to estimate 7/8 cooling time for larger, more dense crops or those that did not reach 7/8 temperature during the time allowed for the test.

Results. The table on the next page summarizes the observed cooling rate of each crop comparing room cooling to forced air cooling. The results from each crop are provided in individual PDF files, linked to on the next page.

Conclusion. Forced air cooling was demonstrated using two simple systems designed to be built on farm with readily available materials. The method was applied to six crops and demonstrated a cooling rate 1.2 to 2.2 times faster than room cooling achieved. The use of forced air cooling, directing cool room air over packed product, is a common practice in larger production systems and this trial illustrates its feasibility for smaller scale farms.

	Room Cooling		Forced Air Cooling (FAC)		FAC is __ times faster than Room Cooling
Crop	Time to 7/8 Temperature (hr)	Cooling Rate (°F/min)	Time to 7/8 Temperature (hr)	Cooling Rate (°F/min)	
Blueberries	6.9	0.18	1.8	0.39	2.2
Eggplant	3.2	0.32	1.5	0.47	1.5
Peppers	1.6	0.15	0.5	0.19	1.2
Strawberries	5.0	0.18	1.5	0.24	1.3
Watermelons	28.9	0.10	14.4	0.17	1.6
Zucchini	1.9	0.09	0.8	0.15	1.7

Trial Results by Crop	
Zucchini	Watermelon
Peppers	Eggplant
Blueberries	Strawberries

Acknowledgments

Thanks to **Clear Brook Farm**, **Adam's Berry Farm**, and **Jericho Settlers Farm** for participation in this trial.

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News

USDA Announces NEW Resilient Food Systems Infrastructure (RFSI) Grant Program

USDA has announced the Resilient Food System Infrastructure (RFSI) grant program, a program created to work with states and tribal governments across the US with the goal of developing and administering coordinated initiatives to build resilience across the middle-of-the-food-supply-chain within the states. MDAR will work in partnership with USDA to make competitive subawards to support infrastructure in the middle-of-the-supply-chain for domestic food and farm businesses and other eligible entities.

MDAR is currently seeking input from agricultural stakeholders to determine funding priority areas for the RFSI grant program in Massachusetts. MDAR will be holding a Listening Session to gather stakeholder feedback. This Listening Session will be held on Monday July 24th from 6:00 pm – 8:00 pm. Here is the link to register for the Listening Session.

Additionally, MDAR is soliciting feedback for RFSI funding priorities through an online survey, which can be found here.

For more information, please visit MDAR's Resilient Food Systems Infrastructure (RFSI) webpage. MDAR is currently in the planning process for this grant program. MDAR expects to release a Request for Response (RFR) for competitive Infrastructure Grant proposals in Fall 2023. More information will be provided including project requirements, allowable and unallowable costs, evaluation criteria, and project submission when the RFR is released. If you have any questions about the RFSI program, please contact Keri.Cornman@mass.gov.

Document Your Losses in the Massachusetts Freeze Event Impacts Survey!

The freeze events of February 3-4 and May 18, 2023, had significant impacts on agricultural sectors including tree fruits, berries, vegetables, ornamentals, and others. Now that losses are evident for most crops, UMass Extension and our partners* hope to generate timely reporting on losses at the state and regional levels. If you produce agricultural crops (including nursery stock) and you experienced crop losses due to the February 3-4 deep freeze and/or the May 18th freeze, please report them by filling out this survey. **SURVEY DEADLINE: July 31.**

This data will help document the extent of crop and economic losses and will inform the public and decision-makers who may be considering actions that would provide emergency funds to Massachusetts producers. Some growers may also receive insurance payments or be eligible for low-interest FSA loans or other USDA disaster programs. However, data from these programs will take many months to report, and may under-report losses in some sectors. Producers should also report losses to their local FSA office as soon as the extent of the damage can be assessed--this survey is not intended to take the place of reporting to FSA.

Your Data and Privacy will be protected. Please see details in the opening page of the survey and on the final page, where you may choose to provide and share contact information if you wish. No crop loss data at the individual farm level will be shared.

*Partners include: USDA Farm Services Agency, USDA Risk Management Agency, MA Department of Agricultural Resources, MA Farm Bureau Federation, MA Food System Collaborative, MA Fruit Growers' Association, New England Vegetable and Berry Growers Association, Community Involved in Sustaining Agriculture (CISA), Southeast MA Agricultural Partnership (SEMAP), and Berkshire Grown.

If you have questions about this survey, please contact cclay@umext.umass.edu.

Events

Twilight Meeting: Irrigation Systems and Management at Warner Farm

When: THIS EVENING! Thursday, July 13, 4:00 pm - 6:00 pm

Where: Warner Farm, 23 South Main Street, Sunderland, MA, United States

Registration: Free! Click here to register.

Warner Farm, a CSA and wholesale farm as well as the home of Mike's Corn Maze, located in Sunderland, MA, has been developing its irrigation capacity since the late 1970s. The farm's rich sandy loam has been growing fruit and vegetable crops for centuries and as a changing climate brings changing precipitation patterns to New England, Warner Farm is poised to respond effectively in times of drought.

Join CISA, the UMass Extension Vegetable Program, and Dave Wissemann of Warner Farm on July 13th at 4:00pm for an up close look at how they are optimizing their water resources and water distribution systems to ensure the sustainable production of crops throughout the season and in the face of increasingly uncertain growing conditions. The workshop includes a farm walk to see irrigation equipment and set up and a detailed explanation of how the farm's systems are designed and maintained. Following the farm walk, join us for further discussion and some locally produced drinks and snacks.

Twilight Meeting: Sawyer Farm Reduced-Till Perennial Clover Trials

When: Thursday, July 20, 4:00 pm - 6:00 pm

Where: Sawyer Farm, 19 Sawyer Road, Worthington, MA, United States

Registration: Free! Click here to register.

Over the past several seasons, farmers at Sawyer have been experimenting with different ways to plant row crops into perennial white clover and reduce tillage using a series of innovative practices. Join Sawyer Farm's Lincoln Fishman for a close look at transplanter shoe adaptations designed to reduce soil disturbance and weed competition in perennial clover and cash crop production. Berkshire Conservation District will also display their no-till drill seeder, which is available for rentals and can be used for mixed or single species applications from clovers and orchard grass to rye and soybeans.

This in-person workshop will be followed with an on-farm networking opportunity. The workshop will take a close look at the system and the research underway with UMass through a SARE Partnership Grant, and is part of CISA's 2023 Adapt Your Farm to Climate Change Webinar and Workshop Series: On-farm Climate Change Adaptation Case Studies from western Massachusetts.

This event is co-sponsored by CISA and the UMass Extension Vegetable Program.

Twilight Meeting at Parlee Farms

When: Tuesday, August 15

Where: Parlee Farms, 95 Farwell Rd, Tyngsborough, MA 01879

Join UMass Extension to hear about pumpkin varieties grown at Parlee Farms, as well as sweet corn IPM and automated irrigation systems. 1 pesticide credit available.

South Deerfield Research Farm Field Day and Vegetable Twlight Meeting

When: Wednesday, August 16, 3-5 pm

Where: UMass Amherst Crop and Animal Research and Education Farm, 91 River Rd., South Deerfield, MA

Come hear about active research going on at the farm, including Vegetable Program trials on heat mitigation strategies, cucumber and basil downy mildew resistant varieties, sprayer technology, and more! We'll also have a presentation on automated irrigation systems from Toro. Up to 2 pesticide credits available.

Twilight Meeting at Heart Beets Farm: Sweet potato production and fall pest management

When: Thursday, September 21, 4-6pm

Where: Heart Beets Farm, 181 Bayview Ave, Berkley, MA 02779

Join UMass Extension to hear about sweet potato production at Heart Beets Farm, and to learn timely info about fall pest management. 1.5 pesticide credits.

Eastern MA CRAFT Meeting: Geothermal Water Use and Good Agricultural Practices at Farmer Dave's

When: Saturday, October 21, 4-6pm

Where: Farmer Dave's, Dracut, MA

We will take a tour of their solar and geothermal systems and the reuse of the geothermal water for hoop house irrigation. Lisa McKeag from UMass Extension will share about a project the farm is involved in to assess pre- and post-harvest agricultural water quality for food safety. She'll talk about the results of water samples taken at the farm in 2022-23 and give an update on current food safety regulations related to agricultural water.

Thank you to our 2023 Sponsors!

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