UMass Extension
Vegetable Notes
For Vegetable Farmers in Massachusetts since 1975

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In this issue:

Farmers are great multitaskers! - Here's Kevin O'Dwyer from Langwater Farm scouting for vine borers while attending to his phone call.

Crop conditions

Across the state, garlic is hanging and curing nicely during this dry, warm weather. Peppers and eggplants are starting to pour in, and everyone is anxiously watching the first colored bells and field tomatoes as they ripen, while some folks are already harvesting. The first of the sweet corn is starting to be picked in the Berkshires. One nice thing about all this dry weather is the lack of fungal diseases, which require long periods of leaf wetness, and carrot and beet foliage is looking beautiful as ever. In most years, we would discourage overhead irrigation to prevent disease development, but this year, overhead irrigation will help plant tissues stay cool. Some crops continue to struggle—potatoes seem especially hard hit this year, with vines dying back early due to drought stress. The bit of rain that came last week gave folks a bit of relief, and a chance to sow some direct-seeded fall crops like carrots, beets, and turnips. Some have even begun seeding for winter production! Have some bare fields now? Looking for a cover crop that will germinate in high heat? Try sun hemp, sorghum sudan grass, or millet. With little rain in the forecast again and higher temperatures this weekend, the order of the day continues to be keeping up with harvest and irrigation needs, but folks seem to have found their stride and are happily riding the summer wave.

Pest alerts

Alliums: Downy mildew and purple blotch were confirmed on onions in Bristol Co., MA last week. The crop was 2 weeks from harvest, but due to the rapid development and potential for downy mildew to spread, the farmer harvested the infected section of the field for fresh market sales. Downy mildew causes pale yellow-greenish to brownish, irregular patches to form on leaves (photo). Where the pathogen has girdled a leaf it will collapse. Downy mildew can spread very quickly and purple blotch, caused by *Alternaria porri*, often invades secondarily. Purple blotch, as the name suggests, causes a purple-gray lesion with concentric rings to form on infected leaves (photo). Without microscopic inspection, the two diseases can be confused or one overlooked.

Allium downy mildew. Photo, K. Campbell-Nelson

Alternaria purple blotch. Photo, K. Campbell-Nelson

Basil downy mildew (BDM) was confirmed in Worcester Co., MA last week, but was reported as being present for several weeks prior. More reports of BDM have come in from Middlesex, Bristol, and Franklin Cos., MA this week as well. The variety 'Eleonora' is reportedly still disease free in some locations, although, resistance has only been shown to last a week or two longer than more sensitive varieties such as 'Genovese'. See article this issue for more on management of this disease.

Cucurbits: Still no **cucurbit downy mildew** in MA but the

disease has been confirmed in Lancaster Co., PA this week. Storms coming from the south or west mean we need to keep our eyes open. We planted a downy mildew sentinel plot to monitor for disease in different cucurbit crops, and this week we picked our first winter squash! **Squash vine borer**: there has been a dip in trap captures and boring larvae were observed in early planted acorn squash plants in Franklin Co., MA. In a treated field in Bristol Co., MA that had over 30 moths last week and several eggs on young winter squash, this week we captured only 9 moths, and no signs of damage were seen. Treating *one week after* the threshold of 5 moths were caught for non-vining crops and 12 moths for vining crops seems to have worked!

Solanaceous: **Verticillium wilt** was confirmed on eggplant in Franklin Co., MA. The pathogen has a very wide host range including many vegetables and some weeds such as velvetleaf and ragweed and also forms hardy resting structures called microsclerotia, allowing it to persist in the soil for as many as 14 years. Growers should follow a 4 to 5-year crop rotation to non-hosts such as corn or other grains and infected plants should be removed from the field. Grafting eggplant to tomato rootstock with verticillium resistance is also an option. Early symptoms of **septoria** and **early blight** are being seen in tomatoes in Hillsborough Co., NH and Bristol Co., MA. after rain storms. While high temps and no rain generally means low risk for foliar diseases, cooler nights mean that more dew will accumulate as daytime temperatures increase. Tomato and potato canopies may also be dense, creating cooler, wetter environments where diseases can flourish. Check the late blight Decision Support System or the NEWA Pest Forecasts for tomato and potato diseases for location-specific spray recommendations.

Sweet Corn: **Fall armyworm** trap captures have started to climb in NY and NH but not in MA, yet **Corn earworm** trap captures remain low (Table 1). These 2 pests typically blow in on storm fronts though possible from slightly different directions. Corn earworm has been higher in southern and eastern parts of the state this year while fall army worm is just starting to appear in western and northern regions. The second flight for **European corn borer** will begin soon once we reach 1400 GDD base 50°F (Table 2) and the **Western bean cutworm** should reach 75% emergence at 1,536 GDD base 50°F. While we captured 3 WBC in a Sheffield trap and 1 WBC in South Deerfield, this pest has not established itself widely in the state. **European corn borer** (ECB) trap captures catches remain low, and we are finding many look-alike carrot seed and gypsy moths in traps. These are not a pest of corn and should not be counted among catches for ECB. Here is a guide from the University of New Hampshire Extension for identifying moths found in sweet corn traps: https://extension.unh.edu/resources/files/Resource002122_Rep3133.pdf

* When not given here, refer to the New England Vegetable Management Guide for scouting thresholds and treatment options.

Accumulated Growing Degree Days (°F): 1/1/16 - 7/20/16

Location	GDD (base 50F)
Western, MA	
Ashfield	1103.7
South Deerfield	1263.6
Pittsfield	1059.4
Central, MA	
Bolton	1277.9
Northbridge	1183.8
Phillipston	1107.1
Eastern, MA	
Ipswich	1114.9
Sharon	1324.9
Waltham	1307.7
Seekonk	1361.9
Hollis, NH	1219.8
Burlington, VT	1324
Newport, RI	1189.3

Corn pest weekly total trap catches for week of 7/14/16 to 7/20/16

Location	ECB	FAW	WBC	CEW	Spray Interval for CEW
Western, MA					
Sheffield	1	1	0	0	*No spray*
South Deerfield	0	0	1	1	*No spray*
Whately	0	0	-	1	*No spray*
Central, MA					
Bolton	1	0	-	0	*No spray*
Leominster	1	-	-	8	*4 days*
Eastern, MA					
Concord	9	0	-	0	*No spray*
Haverhill	7	0	-	0	*No spray*
Ipswich	2	1	-	2	*6 days*
Millis	0	-	-	0	*No spray*
Seekonk	19	-	-	21	*4 days*
Swansea	5	-	-	25	*4 days*
Tyngsboro	2	0	-	0	*No spray*
NH					
Litchfield	0	3	0	0	*No spray*
Hollis	4	12	0	2	*6 days*
Mason	0	1	0	0	*No spray*
Cortland Co., NY	0	19	3	0	*No spray*

European corn borer (ECB), Fall armyworm (FAW), Western bean cutworm (WBC), Corn earwom (CEW)

APHIDS AND VIRUSES

Aphid populations have been reaching outbreak proportions in some fields and tunnels due to hot dry weather this season. Aphids can cause a lot of damage, distorting leaves and draining plants of sap, but they can also transmit certain viruses, including all of the potyviruses like cucumber mosaic virus, bean common mosaic virus, and potato virus Y. If you have an aphid problem in your field, it's important to identify the species of aphid present so that you can order the proper parasitoids if you are using biocontrol or apply the correct systemic-, oil-, or soap-type pesticide.

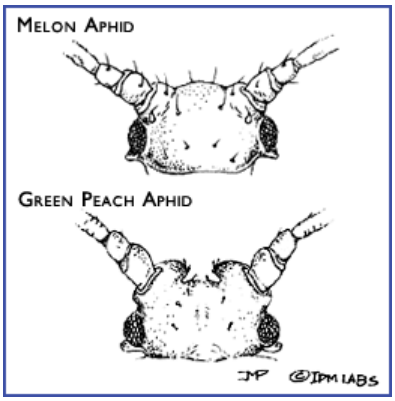
Virus Transmission. Viruses are classified as non-persistent, semi-persistent, or persistent, depending on the length of time the insect vector can retain infectious virus particles, which can range from minutes or hours (non-persistent), to days (semi-persistent), and to life-time or even inheritance by the insect progeny (persistent). Most of the aphid-transmitted viruses we encounter in the Northeast are non-persistently transmitted by many species of aphid, meaning that the aphids acquire and spread virus particles quickly. Aphids probe plants as they move throughout and between fields to determine whether or not a plant is their preferred host. Even this quick probing on non-host crops can be enough for an aphid to spread the virus. Aphids can pick up virus particles anywhere along their path and are very efficient at spreading them, often causing 100% of the crop to be affected. Where the goal of aphid control is in reducing spread of viruses, systemic insecticides such as imidacloprid or thiamethoxam should not be used, as they cause increased muscle twitching and more probing. Insecticidal soaps and horticultural oils do not have this effect because the insect is smothered in place. Once a virus is transmitted into a plant, it is there to stay, though fruit may not be affected if the virus was transmitted after pollination occurred. Mechanical transmission of viruses from plant to plant may also occur via movement of plant sap by equipment or workers (e.g., during pruning or harvesting). Some viruses can be seed-borne and others may overwinter on weed hosts.

Green peach aphids.
Photo, UC Statewise IPM Project

Melon aphids with mummies.
Photo, M. Spellman

Aphid Species

Green peach aphids *(Myzus persicae)* can be distinguished from the melon/cotton aphid by the length and color of the cornicles (the pair of tube-like protrusions extending from the end of the abdomen – see image). Green peach aphids have long (approximately the length of the body) cornicles and only the tips are black. In addition, the head has a distinct indentation at the base of the antennae. Hosts include peach, apricot, and over 200 species herbaceous plants including vegetables and ornamentals.

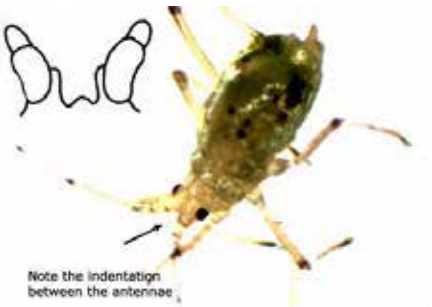


Melon vs. green peach aphid.
Photo, IPM Labs

Melon/cotton aphids *(Aphis gossypii)*: have short cornicles (approximately 1/3 inch or 8 mm, or the width of the body) that vary in color from light yellow to very dark green (making them appear black). The antennae are typically shorter than the body. Melon/cotton aphids do not have a distinct indentation at the base of the antennae like the green peach aphid. Its host range includes many vegetables such as pepper, eggplant, spinach, asparagus, okra, and it is particularly damaging on cucurbits.

Foxglove aphids (*Aulacorthum solani*) have green flecks at the base of their cornicles. In addition, they have black markings on their leg joints and antennae. Foxglove aphids tend to fall off plants when disturbed and they can cause severe leaf distortion, more so than the green peach ormelon/cotton aphid. This aphid has many hosts including foxglove,

Foxglove aphid.



Foxglove aphid antennae shape.
Photo and diagram, L. Pundt.

lettuce, potato, clover and bulbs.

Potato aphids (*Macrosiphum euphorbiae*) may be difficult to identify because their sexual forms produce both green and pink aphids. However, a good distinguishing characteristic is their speed; potato aphids move more quickly than other aphid species. These aphids complete 2-6 generations on their winter host of rose plants before moving on to their summer hosts, which include potato and tomato. Therefore, potato aphids are not typically seen in tunnels until later in the season but they have been reported as a growing problem among high tunnel tomato growers, so it's a good idea to keep an eye out for them early on.

Potato aphids.

Cabbage aphids (*Brevicoryne brassicae*) are common on brassicas, and are especially problematic on Brussels sprouts, where they get into buds. They are becoming more common or emerging earlier where brassica greens are grown throughout the winter in tunnels. Mature females are greyish green with dark heads and cornicles. They are approximately 2 mm long. They are not found on plants outside of the brassica family.

Cabbage aphids.
Photo, UC Statewide IPM Project

Bean aphids (*Aphis fabae*) affect various legumes and flowers. The bean aphid has a dark green to black body between 2 and 2.6 mm long with white appendages. Its body is matte and not shiny like the cowpea aphid.

Root aphid: There are many species of root aphid, but the most common among vegetable crops belong to the genus *Pemphigus*. Root aphids overwinter as eggs and infest plants in the spring and fall. They may be misidentified as mealybugs because they are covered with white wax, although they are smaller than mealybugs. Root aphids have reduced cornicles resembling rings, which are located on the end of the abdomen. These cornicles are difficult to see with the naked eye, but can be seen when magnified.

Bean aphids.
Photo, UC Staewide IPM Project

Prevention

Once a virus becomes visible in your crop there is no cure or chemical treatment, so prevention is essential. Furthermore, the severity of disease caused by viruses is usually determined by the timing of infection—the earlier infection occurs, the greater the impact on plant growth, fruit symptoms, and fruit set. Delaying the onset of infection by several weeks can have a dramatic effect on the amount of damage.

Cultural Practices

- Start with certified virus-free seed, as some viruses can be seed-borne in particular crops.
- Where possible, do not grow ornamental plants and vegetable transplants in the same greenhouse, as viruses often have wide host ranges including vegetables, ornamentals, and woody plants and may be introduced on infected plugs.
- Plant resistant cultivars. Many resistant varieties are available in a variety of crops including cucumber, summer squash, and melons. Resistance to viruses is derived from traditional breeding as well as through genetic engineering, while some species are naturally resistant to certain viruses.
- Cover the crop with floating row covers in the spring to prevent the early influx of virus-carrying aphids. Be careful with this tactic, as aphid populations can develop quickly under row cover if already present when the crop is covered, and row covers will exclude beneficial insects that might otherwise help control aphid populations. Make sure plants are not already infested before you apply row covers.
- Reflective mulches can repel aphids. Though slightly more expensive, they may be cost-effective if viruses are a chronic problem.
- Keep fields as weed-free as possible as many weeds can serve as alternative hosts.
- Remove wild cherry trees from around fields to make the area less attractive to green peach aphids. Prunus species (peaches, cherries, etc.) are attractive to green peach aphids. The green peach aphid is not the only aphid that trans-

mits viruses, but it is important because it can vector a wide range of viruses.

- Handle plants as little as possible, clean tools frequently, and work in clean fields first and affected fields last to minimize mechanical transmission of viruses by workers and equipment
- Remove and destroy affected plants to prevent a source of virus for further infections.

Insecticides. Because many viruses are transmitted non-persistently (rapidly) during probing, systemic insecticides generally DO NOT act quickly enough to prevent infection or control disease spread. Systemic materials are usually considered the most effective insecticides available for aphid control because they are taken into the plant tissue and remain there until ingested by aphids during feeding, providing residual protection from otherwise hard to reach pests. However, when probing a leaf an aphid is not feeding and does not ingest plant sap or insecticide. In fact, the presence of these insecticides may actually stimulate aphids to probe more quickly, and to move from plant to plant more rapidly. This can increase the spread of non-persistently transmitted viruses in various crops. When trying to control aphids where viruses may be present or where you hope to reduce the spread of virus in a crop, mineral oil or soap-based sprays are the best choice. These materials smother aphids and act as a repellent, deterring aphids from feeding. Unfortunately, this method can be costly and unreliable as you need thorough coverage and repeated applications.

Biocontrol. Predators such as ladybeetle, lacewing, predatory midge and syrphid fly larvae can do a great job cleaning up aphid outbreaks—the larvae just chew them all up. Releasing predators into a tunnel or field, or planting insectaries to support adult lacewings, syrphids, and ladybeetles can help lower the population of aphids on your farm. Parasitic wasps can also help control aphid populations. These tiny wasps lay an egg within the aphid body, and as the egg hatches and the wasp larva grows it consumes and kills the aphid, leaving behind an aphid "mummy". You must know what species of aphid present if you'd like to order parasitic wasps, as there are certain species of wasps that control only certain species of aphid (see table). This is most effective in greenhouses but may be a useful tool in an integrated aphid control program.

-UMass Vegetable Program

MANAGING DOWNY MILDEW OF BASIL

The first reports for 2016 of basil downy mildew have been confirmed in several counties in Massachusetts. Preventively applied fungicides can provide control of this disease with regular, timely applications. Reports of observations of the disease are being requested to support a monitoring program. To report your observations and see those of others, please see this shared document: https://docs.google.com/spreadsheets/d/1cLrXIQfPjPa0z1Bw6LRYdvjYhz7-5HXkmfCQM-nJrvko/edit#gid=0. Physical samples are also being requested, to help researchers understand the strains of the pathogen and their occurrence throughout the US, and to help us refine management practices. For information on shipping samples, please contact Shouan Zhang at the University of Florida by e-mail (szhang0007@ufl.edu) or phone (305-246-7001 ext. 213).

Aphid mummies, parasitized by Aphidius parasitoid.
Photo, T. Smith

Disease Spread. Basil downy mildew is caused by the oomycete, *Peronospora belbahrii*. It is an obligate parasite, meaning that it cannot survive outside of a living host. It does not produce overwintering oospores, but survives from year to year on living plants where basil production occurs year round, such as in Florida. From these sites the pathogen spreads via wind-dispersed sporangia that can travel great distances due to their dark pigmentation, which protects them from UV radiation. There is also evidence that the disease can be spread by contaminated seed, though we do not yet understand how this occurs and how important contaminated seed is as a source of primary inoculum.

Symptoms. Early symptoms can easily be mistaken for a nutritional deficiency. Infected leaves develop diffuse, but vein-delimited yellowing on the top of the leaf and a characteristic fuzzy, dark gray growth on the underside of the leaves, which may be mistaken for soil splashed onto the leaf under-surface, however, close inspection with a hand lens will show the sporangia. More photographs of the signs and symptoms are available at: http://vegetablemdonline.ppath.cornell.edu/NewsArticles/BasilDowny.html.

Management Recommendations for 2016

Symptoms of downy mildew: diffuse yellowing on upper leaf surface (top) and fuzzy, dark sporulation on underside of leaf (bottom).

Purchase seed or transplants from reliable sources. We know that the pathogen may be seed-borne, but the mechanisms involved are not well known and testing is difficult. Since *Peronospora belbahrii* requires a living host, it cannot be grown in a lab culture, making it more difficult to test for presence of the pathogen on or in seed. It is possible to test seed for the presence of pathogen DNA, but this test only tells you if sporangia of the pathogen were present, not whether those sporangia are viable and infective, potentially leading to false positives. Seed testing of any pathogen is only a proxy, since you can't test all of your seed, only a small portion of it. Any sample you submit for testing may not be wholly representative of the seed lot, leading to false negatives. Therefore, our recommendation is to buy seed from a trusted source. Talk to your seed supplier about how the seed was produced, if it has been tested, and also if the variety exhibits any resistance to the pathogen.

Grow your transplants yourself and keep a careful eye on them. Look on the undersides of leaves for sporulation. Monitor pathogen spread and watch for early symptoms. Once detected, if the disease is not widespread remove infected plants or seedling trays and begin chemical control, or try to harvest and sell plants immediately, before symptoms worsen. Researchers on Long Island report that excellent control of downy mildew can be achieved with conventional fungicides applied weekly on a preventive schedule, but control was greatly reduced when applications were started after detection. If the symptoms are widespread and severe, destroy the crop immediately to stop spread of the disease to other plantings on your farm or to other farms in your area. Do not buy transplants that were grown in large nurseries in the south where the disease starts earlier. If you do buy transplants, inspect them carefully before purchasing and if you find any signs of disease report it to the store manager or call your local Extension service.

Plan to plant and harvest early. The pathogen tends to arrive in MA around mid-July. In 2014, the disease was confirmed here earlier (June 22) because of early, widespread distribution of infected plants from nurseries farther south. Keep track of where the disease is being found via pest alerts in Veg Notes and via the basil downy mildew monitoring program spreadsheet linked above.

Do whatever you can to reduce humidity and leaf wetness:

In the greenhouse:

- Heat and vent greenhouses–especially when warm days are followed by cool nights–to reduce relative humidity, prevent dew formation and condensation, and reduce the leaf wetness period
- Use fans to improve air flow in greenhouses
- Water in the morning, or use sub/drip-irrigation rather than overhead

In the field:

- Plant in well-drained sites with good air circulation
- Orient rows parallel to the prevailing winds
- Control weeds
- Increase plant spacing
- Harvest/prune so as to improve airflow through/around plants if practical

Relative susceptibility of basil cultivars: Field trials conducted in southern New Jersey in 2009 determined that all sweet basil (*Ocimum basilicum*) cultivars such as 'Genovese,' 'Italian large leaf,' 'Poppy Joe' and 'Nufar' are very susceptible to downy mildew. The least susceptible basils included the lemon and spice types such as *O. x citriodorum* and *O. americanum*, cultivars, 'Lemon Std', 'Lemon', 'Lime', 'Spice', 'Blue Spice' and 'Blue Spice Fl'. There are no cultivars with resistance to basil downy mildew.

Efforts to breed new basil varieties with resistance to downy mildew are ongoing at Rutgers University, where researchers Rob Pyne and Andy Wyenandt continue to make crosses and evaluate breeding lines in the field. Rob and Andy are excited about some recent breakthroughs they have made and look forward to having stable breeding lines with good resistance and classic, sweet basil flavor within the next few seasons.

There is at least one commercially available variety with "intermediate" resistance being sold by Johnny's Seeds called 'Eleonora'. The variety is a cross of Thai basil and sweet basil. Thai basil has a higher disease tolerance, while sweet basil has the more generally desirable flavor, though some of that spicier Thai basil flavor does carryover in this cross. 'Eleonora' also has flatter leaves and a more open habit which will reduce disease favorability of the environment right around the plant and contribute to disease tolerance.

Resistant varieties are one important piece of the puzzle, but will need to be used as part of an integrated management plan incorporating cultural practices and chemical controls to effectively manage this disease.

Chemical control: Pay close attention to labels! Basil is a minor crop and is not always found on pesticide labels, and there are differences in registrations for use in field versus greenhouse production. Some products have supplemental labels for use on basil.Research trials have shown that the phosphite fungicides (eg. K-Phite, Prophyt, Fungi-phite) are among the most effective chemical controls. Other effective materials include mandipropamid (eg. Revus), cyazofamid (eg. Ranman), and azoxystrobin (eg. Quadris). All of these except Quadris can be used in both field and greenhouse – Quadris is labeled for field use only. OMRI-approved products labeled for basil downy mildew include MilStop, OxiDate, Actinovate, Regalia, Trilogy and Double Nickel LC. There is not strong efficacy data for these materials and they should be used as part of an integrated plan. Be sure to make applications preventatively (follow pest alerts) and keep up regular sprays.

In 2014 the UMass Extension Vegetable team evaluated 4 different copper products alone and in rotation with Regalia and saw no differences from the untreated control for any of the products. Copper products may be more effective in a year in which disease pressure is not so high, and if the first spray is made as soon as the plants are moved outdoors. Cueva is labeled for use on basil against downy mildew.

It is the grower's responsibility to read and follow label instructions and be sure that a product is registered for use on the crop, and in the greenhouse. The label is the law and any recommendations made here are superseded by the label.

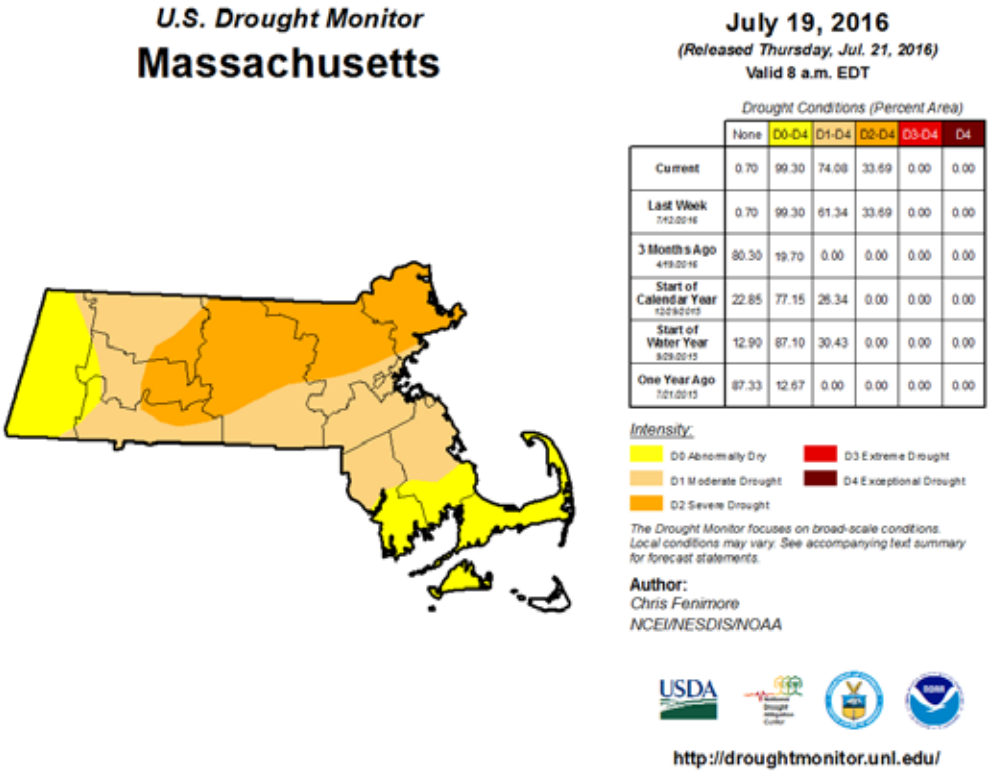
–Susan B. Scheufele, Robert L. Wick and M. Bess Dicklow, UMass Extension; thanks to Rob Pyne and Andy Wyenandt at Rutgers University, and Margaret T. McGrath, Cornell University. Updated for 2016 by L. McKeag.

CONSERVE WATER AND IRRIGATE YOUR CROPS!

According to USDA data, Massachusetts topsoils are 25% drier so far this month than the 10 year average (NEWA). As most of Massachusetts is still in a moderate to severe drought (see map next page), you may be wondering what effects the lack of moisture and high temperatures may be having on your crop and what you may do to conserve the available irrigation water that you have. Some of the symptoms of heat and drought stress you may already be noticing include poor germination of successionally seeded crops, reduced tuber yields in early potatoes, smaller peppers with thinner walls, smaller ears of sweet corn, or corn without tips filled due to low pollen production, and sunburn or scald on leaves, fruits and stems. Drought can contribute to other physiological nutrient related disorders like blossom end rot of tomatoes and peppers, tipburn in brassicas and lettuce, or hollow heart in brassicas and potato.

Gordon Johnson from University of Delaware Extension has written about the effects of hot and dry soils on vegetable crops: *In dry soils, roots produce Abscisic Acid (ABA). This is transported to leaves and signals to stomate guard cells to close. As stomates close, transpiration is reduced. Without water available for transpiration, plants cannot dissipate much of the heat in their tissues. Heat also affects stomatal function. During periods of high heat (90-100°F) there is a large difference between the moisture in the air and the amount of moisture the air can hold. This water vapor pressure deficit as well as windy conditions leads to rapid water loss from crops causing leaf stomates to close, limiting cooling, spiking leaf temperatures, and leading to tissue death (when internal plant temperatures reach 115°F).*

But fear not, Johnson also recommended some remedies for protecting crops against high heat: *The major method to reduce heat stress is by overhead watering, sprinkling, and misting for improved water supply, reduction of tissue tempera-*



	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	0.70	99.30	74.08	33.69	0.00	0.00
Last Week 7/12/2016	0.70	99.30	61.34	33.69	0.00	0.00
3 Months Ago 4/19/2016	80.30	19.70	0.00	0.00	0.00	0.00
Start of Calendar Year 12/29/2015	22.85	77.15	26.34	0.00	0.00	0.00
Start of Water Year 9/29/2015	12.90	87.10	30.43	0.00	0.00	0.00
One Year Ago 7/21/2015	87.33	12.67	0.00	0.00	0.00	0.00

ture, and lessening of the water vapor pressure deficit. Mulches can also help greatly. You can increase reflection and dissipation of radiative heat using reflective mulches or use low density, organic mulches such as straw to reduce surface radiation and conserve moisture.

Most vegetables need 1-2 inches of soil moisture per week to yield crops. The most important times to provide adequate water are during crop establishment, flowering, and sizing up of fruits or tubers. Take note that crop yield and quality decrease even before symptoms of wilt are seen. A low cost moisture sensor (Hansen, Spectrum Technologies, Irrometer) can be used to conserve water while keeping your soils at water holding capacity. Two moisture sensors may be used in each field to manage irrigation: one placed to a 6-inch depth and one placed to the rooting depth of your crop (Table 1). Many vegetable fields have a plow pan 9-12 inches deep which may restrict the rooting depth so dig to find the actual penetration depth of your crop roots before placing a moisture sensor. Carol MacNeil of Cornell Extension noted that sandy soils have lower water holding capacity and should be irrigated more frequently with less water, while silt loams or high organic matter soils have a higher water holding capacity and can be irrigated less frequently with more water each time. You may notice this year that fields which have been cover cropped for many years or have been in reduced or no-till are faring better than others.

Table 1. Potential rooting depth of a mature crop in soils without severe compaction

1-1.5ft	Lettuce and onions
1-2ft	Brassicas, potatoes, tomatoes, peppers, cucumbers, mellons
2-4ft	Beans, carrots, eggplant
3-6ft	Winter squash, pumpkins, asparagus

Depending on the soil texture in your field (Table 2), irrigate when your moisture sensor is at 25% depletion and bring the moisture level in the rooting area for your crop up to field capacity for your soil type. Here is an example using drip irrigation of how to determine gallons of water needed to irrigate a crop:

1. **Soil Type:** I have a sandy loam which holds 1.3 inches of available water per foot of soil depth (Table 3).
2. **Rooting depth:** my cucumbers have a rooting depth of 1 ft (Table 1, or dig and find out).
3. **Bed feet:** I have 10 rows of cucumbers at 200 ft. each. Thus, 10 x 200 feet = 2,000 linear feet
4. **Wetted diameter of bed:** 24 inches for my sandy loam based on observation from drip irrigation emitters. 24-inch moisture width = 2 ft.
5. **Area under irrigation:** I have 2,000 linear feet x 2 ft. of wetted diameter = 4,000 square ft. or 0.1 acres (4,000/43,560 square feet per acre) to irrigate.
6. **Water needed to reach water holding capacity:** rooting depth is 1 ft. x 1.3 inches water per ft. = 1.3 inches water/ft/

Table 2. Water holding capacity of major soil types at field capacity (after gravitational water drains through)

Soil Texture	Inches/Feet
Sands	0.5-1.0
Sandy Loams	1.0-1.5
Loams	2.0-2.5
Silt Loams	2.4-2.6
Clay Loams	2.0-2.5

Table 3. Tensiometer set points, in cbars, for soil moisture conditions on various soil textures.

Soil Texture	Field Capacity[1]	25% Depletion[2]
Sandy Loam	5-10	10-15
Loams	10-15	22-30
Silt Loams	15-20	25-35
Clay Loams	25-40	40-50

[1]Soil saturated, no irrigation required.
[2]Of the available water capacity in the effective rootzone (see Table 2).

acre. **Crop wetted volume:** 1 acre-inch of water = 27,000 gallons (this is a conversion factor, a given). So, 27,000 gal x 1.3 inches = 35,100 gallons needed for full water holding capacity of my sandy loam per acre. We only have to irrigate 0.1 acres, so, 0.1 x 35,100 = 3,510 gallons needed.

7. **How much to irrigate:** If we turn on the irrigation when the moisture meter reaches 10-15 cbars (25% depletion for a sandy loam from Table 2), we would need to apply 3,510 gals (full soil capacity) X 25% (depletion of soil capacity in the effective rooting zone) = 878 gals to apply.

8. **When to stop irrigating:** when the readings of both the shorter and deeper moisture sensor drop to 5-10 cbars range for a sandy loam. It is not necessary to continue irrigating until the readings reach 0, this would mean that your soil has reached saturation and is no longer able to hold the moisture.

-By K. Campbell-Nelson, UMass Extension, Vegetable Program.

Resources:

'Irrigation Scheduling and Tensiometer Tips' by Henry G. Taber, Department of Horticulture, Iowa State University. Updated: May 2010. http://www.iowaproduce.org/irrigation-scheduling-and-tensiometer-tips

'How High Heat Affects Vegetables and Other Crop Plants' by G. Johnson, University of Delaware Cooperative Extension. Weekly Crop Update. Vol 19:13 June 17, 2011. https://agdev.anr.udel.edu/weeklycropupdate/?p=3203

'Irrigation: A New Game in a Hot, Dry Year!' by Carol MacNeil, Cornell Vegetable Program. VegEdge. Vol 12:13. July, 13, 2016.

Events

IPM Field Walks

In this series, learn to identify and scout for vegetable pests and select integrated pest management strategies that work for you, whether you are an experienced farmer, or just starting out, organically certified or not! We will use pheromone traps to monitor pests, use a microscope to identify plant pathogens, and learn to scout in multiple vegetable crops with UMass Extension Vegetable Program staff Katie Campbell-Nelson, and Plant Diagnostician Angie Madeiras. Scouting will be followed by a discussion of effective control strategies with growers in attendance. Bring a hand lens if you have one.
Supported in part by funding provided by USDA-NIFA Extension Implementation Program, Award No. 2014-70006-22579

** *All field walks have been approved for 2 pesticide credits in the vegetable category*

August 2nd, 4-6pm
Red Fire Farm, 184 Meadow Rd, Montague, MA 01351
Farmer: Ryan Voiland

Questions? Contact: Katie Campbell-Nelson, kcampbel@umass.edu, 413-545-1051.

Cocktail Cover Crops: Trials and Techniques

When: Monday, July 25th, 2016 from 1:00pm to 5:00pm

Where: Many Hands Organic Farm, 411 Sheldon Rd Barre, MA

Multi-species cover crop cocktails can create synergistic ecological benefits for your farm or garden - enhancing biodiversity, efficiently capturing and recycling nutrients, and sequestering carbon in the soil. This workshop will explore how to select, mix, and establish various cover crop mixtures. We will also discuss assessment and quantifying how your cover crop practices are impacting soil health. **Instructors:** Ray Archuleta, NRCS Conservation Agronomist Greensboro, NC; Brandon Smith, NRCS Northeast Region Team Leader for Soil Health Division; Masoud Hashemi Associate Professor UMass Stockbridge School of Agriculture; Julie Rawson NOFA/Mass executive director.

Cost: NOFA/Mass Member - $38 (walk-in $43) Non-member - $50 (walk-in $55)

Pre-registration is recommended. For more information contact Dan Bensonoff, Education Events Organizer, at dan@nofamass.org or 860-716-5122.

Twilight Meeting: Equipment for Mechanical Cultivation & Product Washing and Packing

When: Wednesday, August 10, 2016 from 4pm to 6pm

Where: Tangerini's Spring Street Farm, 139 Spring St, Millis, MA 02054

Tangerini's Farm is a 65-acre farm located in Millis, Ma. Produce is marketed through a 500 member CSA, an on-site farm stand, farmers' markets, food coops and wholesale buyers. Over the last two years, with support from an MDAR Food Safety Improvement Program grant, they have developed a washing and packing area to prepare all their produce. They will demonstrate the use of many pieces of equipment including wash tanks, barrel washer, bunch washer, onion topper and a conveyer system. They will discuss the flow of produce in the packing area as well as how it is stored. They will also show off some new investments and innovations in their cultivation equipment.

Lisa McKeag, from the UMass Vegetable Program, will also provide an update on the roll-out of the Food Safety Modernization Act (FSMA) in Massachusetts.

Contact Lisa McKeag at lmckeag@umext.umass.edu or 413-577-3976 for more information.

Sponsors

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