UMass Extension
Vegetable Notes
For Vegetable Farmers in Massachusetts since 1975

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In this issue:

Crop conditions

Despite the cold, wet weather, signs of spring abound! Hot crops like cukes and tomatoes are going into high tunnels, the first of the asparagus is being harvested, and roadside stands and markets are opening up for the season–sure signs of spring! Where people can get into fields to plant, they are continuing to transplant brassicas, beets, lettuce and onions, plant seed potatoes, and direct-seed leafy greens, radishes, spinach and more. The earliest successions of cucurbits are getting ready to go out, but will benefit from holding off until the sun is forecast to come back out of hiding. This cool period may be slowing down emergence of some spring pests like maggot flies and leafminers. Normally these pests emerge over a period of several weeks, but where we had some early season warming, then some snow, then some warming, then another cold snap, we might see that bell curve stretching out–potentially leading to an increase in overlap between generations where the earliest to emerge start a second generation before the last to emerge complete their life cycles. This can make management a bit more challenging, but we'll have to wait and see how the season progresses. Currently, our seasonal accumulation of growing degree days, a measure of heat over time, puts us 0-7 days ahead of last year (Northeast Climate Center), and soil temps across the state range from 46 to 54°F.

Tomatoes are beginning to be planted out in early season high tunnels in Hampshire Co., MA.

Pest alerts

Allium: Onion Maggot first emergence occurs at 390 GDD (base 40°F), slightly later than cabbage root maggot, and is now active in many locations (Table 1). Find a weather station near you and track emergence via the NEWA onion maggot forecast model here.

Stunting, wilting, and discoloration caused by damage to roots from feeding by CRM larvae. Photo by S.Scheufele

Brassica: Cabbage root maggot eggs were found outdoors in a kale crop in Hampshire Co., MA this week. Root maggot can cause, stunting, wilting, discoloration and death of plants, leading to poor stand. On root crops larvae form tunnels on root surfaces making them unmarketable. First emergence of adult flies in the spring occurs at 288 GDD (base 40°F) and 50% emergence occurs at 450 GDD (base 40°F). Some locations in Eastern Massachusetts have already reached 50% emergence (Table 1). Adult emergence and flight may be monitored by following the NEWA cabbage maggot forecasting model: http://newa.cornell.edu/index.php?page=cabbage-magot or by using yellow sticky cards. You can scout for eggs by looking around the base of the plant for a cluster of bright white, slender, long eggs adhering to soil or stem at the soil line. Spring brassica crops should be protected with row cover or chemical treatments at the time of planting—if you see eggs now it is too late to treat chemically or use row covers, but it would be

prudent to utilize those strategies in your next plantings. Row covers will only be effective at keeping out flies if they are used in fields without pupating flies present in the soil.

Beet, Swiss Chard, and Spinach: Leafminer eggs were found outdoors in a Swiss chard crop in Hampshire Co., MA this week. Two weeks ago, leafminer damage was reported in a high tunnel in Newport Co., RI. With more spinach being grown through the winter in high and low tunnels where soil temperatures are higher, leafminer may be emerging earlier than usual in those sites. Treat when eggs are first observed, as they will hatch in 3-6 days. Once they are inside the leaf, they can no longer be effectively reached with contact insecticides, but systemic and translaminar materials may be effective. See article below for more details!

Table 1. Accumulated Growing Degree Days (base 40 F) from 1/1/16 – 5/5/16 Values based on NEWA models

Location	GDD (40° F)
Ashfield, MA	340
South Deerfield, MA	423
Waltham, MA	508
Westfield, MA	485
Seekonk, MA	568
N. Andover, MA	483
Hollis, NH	412
Burlington, VT	285

Multiple: Seed corn maggot has the earliest emergence of the maggot flies at 200 GDD (base 40°F) and peak flight (50% emergence) occurs at 360 GDD, which has been reached at most locations in MA (Table 1). Larvae feed on seeds and young seedlings of many crops (e.g. corn, beans, beets, peas, spinach, onions, cole crops). Adults are active now and prefer to lay eggs in cool, wet soil high in organic matter. Eggs hatch within 2-4 days at soil temperatures of 50°F. Row covers can help, but only if flies are emerging from other fields. Eric Sideman of Maine Organic Farming Association noted: "If you need to replant, wait at least 5 days if maggots that you find are a quarter inch long; if they are smaller than that, wait at least 10 days to make sure they have pupated and will not damage the new seeds."

LEAFMINER ON SPINACH, CHARD, AND BEET: TIME TO START SCOUTING

Spinach and beet leafminers are early-season pests that cause damage to early greens. They attack crops and weeds in the plant family Chenopodiaceae, which includes chard, beets, and spinach as well as lamb's quarters. The two fly species are very similar, however, spinach leafminer may also cause damage in Solanaceous crops such as peppers.

Larvae hatch and tunnel through the leaf tissue creating mines early on and later, big splotches.

Crop damage is caused by the fly larva that burrows and feeds between the upper and lower epidermis of the leaf. Early damage is a slender, winding 'mine' or tunnel, but as the larva feeds and grows these expand and become blotches on the leaves. The fly overwinters as a pupa in the soil and emerges in late-April and May. The adult fly— a small, gray fly 5-7 mm long—lays eggs on the undersides of host leaves. The small (<1mm), oblong, white eggs, are laid in neat clusters on the underside of the leaves. They are easy to spot if you look under the leaves. If you find tunnels, pulling the epidermis off will reveal one or several pale, white maggots. When fully grown, maggots usually drop into the soil to pupate, though they may also pupate inside the leaf. The entire life cycle is 30-40 days and there are three to four generations per season. Typically mid to late-May, late-June and mid-August are peak activity periods. After August, pupae enter overwintering phase and won't emerge until next spring.

Small, white eggs are laid in a neat row on the underside of beet, chard, and spinach leaves.

If the plants are infested early and populations are high, the losses from this pest may be great. This may be especially true when eggs on transplants in the greenhouse go unnoticed until planting in the field, resulting in infestations in row-covered crops. Treat when eggs or first tiny tunnels are noticed— see current recommendations below. There are both conventional and organic products available and in both cases an adjuvant is recommended to improve efficacy. See New England Vegetable Management Guide for more details on products (www.nevegetable.org). Many products are labeled for leafy greens

including spinach and Swiss chard but not for beets so, as always, check the labels. Some systemics are registered that may be applied to transplants or to the soil including diamides and neonicotinoids, but be sure to observe the longer days to harvest restrictions. Most of the products labeled are for foliar applications. Among the organic products available, spinosad has demonstrated efficacy when applied before egg hatch. Spinosad also has some translaminar activity, particularly when combined with a penetrating adjuvant, and may be effective against larvae in leaf mines.

Because leafminer feeds mostly on one crop family and also on many weeds including chickweed, lamb's quarters and nightshades, weed control and crop rotation are the first line of defense. Row covers can also be used to exclude flies if placed over the crop before flies are active or immediately after planting, though be sure not to cover crops in fields where susceptible crops were grown previously and where adult flies may be emerging, as they will get trapped under the row cover.

-Adapted by Ruth Hazzard and Lisa McKeag from an article by Eric Sideman, Maine Organic Farmers and Gardeners Association

SOIL TESTING IN TUNNELS

The soil in compost-amended greenhouses and high tunnel soils is somewhere between a field soil and a potting mix. In other words, the soil has been 'juiced' with extra organic matter and nutrients to meet the demands of crops that produce a lot more biomass than they typically do outdoors. That's why the results of a standard field soil test for these situations will often show nutrient levels 'off the charts' and no additional fertilization will be recommended because the target levels of nutrients are based on yield expectations in the field. In a high tunnel, crops can produce a lot more plant biomass and they grow for longer periods than in the field, requiring more nutrients to reach their yield potential. Nutrient runoff from high tunnel soils is not a concern but leaching could be a source of environmental contamination if crops are unhealthy and do not produce more biomass.

Fertility management in high tunnels depends greatly on whether the growing media is behaving more like a field soil or a potting mix, therefore it is helpful for a lab to conduct both a Modified Morgan standard soil test and a Saturated Media Extract (SME) test on the sample and pick one result for the best interpretation. The University of Maine soil lab is currently the only one in New England that offers a "Long Term High Tunnel Test" in which both tests (standard soil test and SME) are run on the same sample including nitrate, ammonium, soluble salts and organic matter. Bruce Hoskins, the UMaine soil lab director, then interprets both results side by side to determine if the soil is more like a potting mix

Table 1. Use this table to gauge whether your high tunnel test results indicate sufficient nutrients.

	Optimum and Normal Ranges		
Analysis	**Standard soil test for Field Soil[y]**	**Standard soil test for High Tunnels[z]**	**SME test for High Tunnels[z]**
pH	6.0-7.0	6.0-7.0	5.8-6.8
Organic Matter	-	8-12%	8-12%
Soluble Salts	<0.6 (1:2) dS/m	2-4 mmhos/cm	2-4 mmhos/cm
Nitrate – N	25-30 ppm	100-200 ppm	100-200 ppm
Ammonium – N	-	<10 ppm	<10 ppm
Phosphorous	4-14 ppm	20-40 ppm	1-5 ppm
Potassium	100-160 ppm	200-300 ppm	150-275 ppm
Calcium	1000-1500 ppm	-	>250 ppm
Magnesium	50-120 ppm	-	>60 ppm
Sulfur	>10 ppm	>25 ppm	25-100 ppm
Boron	0.1-0.5 ppm	0.5-1.2 ppm	0.05 -0.5 ppm
Copper	0.3-0.6 ppm	0.8-1.2 ppm	0.01 -0.5 ppm
Iron	2.7-9.4 ppm	6-10 ppm	0.3 -5.0 ppm
Manganese	1.1-6.3 ppm	4-8 ppm	0.1 – 3.0 ppm
Sodium	-	<200 ppm	<100 ppm
Zinc	1.0 -7.6 ppm	1-2 ppm	0.3 – 3.0 ppm
Aluminum	<75 ppm	-	-
Lead	<22 ppm	-	-

[y] Optimum and normal ranges based on the UMass Soil Lab for recommendations found in the New England Vegetable Management Guide: https://nevegetable.org/ [z] Optimum and normal ranges based on the UMaine Soil Lab for the long term high tunnel test: http://anlab.umesci.maine.edu/soillab_files/prices/soiltest12.pdf

or field soil and sends the appropriate result back to the grower. The UMass soil lab offers both tests, but not the interpretation appropriate for high tunnels. If you have either an SME or standard soil test from UMass for a high tunnel and need help with interpretation, contact Katie Campbell-Nelson (413-834-1090, kcampbel@umass.edu)

Why use the Modified Morgan standard soil test? If your tunnel is still less than three years old, or you have not applied organic matter annually (compost, peat, leaf mulch, manure etc.), then your high tunnel soil is still likely to behave much like field soil. Therefore, a standard soil test is appropriate. These tunnel soils typically have <8% OM and <2mmhos/cm of soluble salts. Keep in mind that results will be interpreted with the expectation for increased biomass and yields therefore optimum ranges are increased (Table 1).

Why use the Saturated Media Extract (SME) test? Often, a SME test is the most appropriate for high tunnel production because it measures what is immediately available in soluble form when plant growth is expected as soon as transplants are set into the soil and when crops will be fertigated. In addition, the SME test provides measures of soluble salts, nitrate-nitrogen and ammonium-nitrogen. These are not tested by the standard soil test, and they provide important information for tunnel fertility management. See Table 1 for optimum ranges based on the SME test.

Always test for Soluble Salts and soil Nitrate and Ammonium. Organic matter should also be included if you add it every year, otherwise, this may be tested once every 3 years. These tests may cost more, but for high tunnels, the information is worth it.

Sampling. As in the field, you want to take a representative sample consisting of a dozen or more subsamples taken throughout the tunnel. For the SME test, it is important that the soil has been moist and warm (~68-75°F) for at least a week before testing. Bring some soil into your home if needed to allow it to incubate. While the field soil test only requires a cup of soil, the SME test requires a pint of soil. Take your samples prior to adding any fertilizers or compost.

Interpretation. Whether fertigating, making foliar applications, or soil incorporating; using organic or conventional materials, there are many successful fertility strategies for high tunnel production. For example, based on an SME test, here are recommendations for growers using organic soil amendments:

	Material	Fertilizer Analysis N-P-K	Lbs of material needed/1,000 ft^2
Pounds/1,000 sq. ft needed to raise N approximately 10 ppm	Chilean nitrate	16-0-0	3.2
	Blood meal	12-0-0	4.2
	Alfalfa meal	2.5-2-2	20.1
Pounds/1,000 sq. ft needed to raise P approximately 2 ppm	Bone meal	0-15-0	26.6
	Rock Phosphate	0-3-0	133
Pounds/1,000 sq. ft needed to raise K approximately 20 ppm	Sul-Po-Mag	0-0-22-11Mg	2.6
	Potassium Sulfate	0-0-52	1.1
Pounds/1,000 sq. ft needed to raise Ca approximately 25 ppm	Calcium sulfate	(gypsum)	7.5
	Calcitic lime	(low Mag)	7.5
	Dolomitic lime	(hi Mag)	5.3
Pounds lime/1,000 sq. ft needed to raise soil pH ~1 full unit	Sandy loam	-	40
	Loam	-	80
	Clay loam or peat	-	120

Table 2: Estimated fertilizer rates to increase SME nutrient levels. Adapted from 'Greenhouse Tomatoes, Lettuce & Cucumbers, by S.H. Wittwer and S. Honma. Michigan State Univ. Press. 1979.

The key to success is monitoring moisture, pH, soluble salt (EC) and once your plants are flowering and beginning to set fruit, it's time to plan for leaf tissue sampling. It's not a bad idea to do this several times during the season, regardless of whether you suspect a nutrient deficiency. These records are valuable both within the season and for seasons to come. For tomatoes, the most critical nutrients and the ones most often on the verge of insufficiency, especially when the plants

are laden with several sets of fruit, are nitrogen and potassium. If attended to in time, these deficiencies can be corrected with fertigation.

Resources:

Grubinger, V. University of Vermont Extension. 2010, Organic Greenhouse Tomato Nutrition. https://ag.umass.edu/sites/agcenter/files/pdf-doc-ppt/Organic%20Greenhouse%20Tomato%20Nutrition.pdf

Cox, D. University of Massachusetts. How to Use pH and EC "Pens" to Monitor Greenhouse Crop Nutrition. https://ag.umass.edu/fact-sheets/how-to-use-ph-ec-pens-to-monitor-greenhouse-crop-nutrition

-Katie Campbell-Nelson, UMass Extension, and Vern Grubinger UVM Extension. Thanks to Andy Radin, URI Extension and Bruce Hoskins, UMaine Soil Lab for review

TRANSPLANT DISORDERS

-Originally published in University of Delaware Cooperative Extension's Weekly Crop Update, April 29, 2011

This is the time of the year when county agents are called to look at disorders in transplants being grown in greenhouses and when samples routinely come into our offices for diagnosis. There are many diseases of vegetable transplants that can start in the greenhouse – fungal, bacterial, and viral. Diseases should be considered first when looking at transplants. Insects such as thrips, aphids, and whiteflies also can be a problem in greenhouses and should also be considered as causes of injury. They can cause direct damage and can be vectors of virus diseases. However, many vegetable transplant disorders are not cause by pests. Some of the most common are:

High soluble salts from excessive fertilization can cause stunting and yellowing in addition to dessication. Photo by T. Smith, UMass

Excessive Stretch and Leggy Plants: This is most commonly due to too high of temperature differential in growing houses (wide differences between day and night temperatures), excessive fertilization (especially with ammonium N fertilizers), and excessive watering.

Irregular Growth: This can have many causes including differences in seeding depth, differences in tray filling, differences in watering, differences in location in the greenhouse, irregular heating in the greenhouse (hot and cold spots), and differences in media to name a few.

Salt Injury: Plant desiccation and injury due to high salts occurs commonly when fertilizer rates are too high or when dumping occurs from slow release fertilizers at high temperatures.

Leaf Scorching: This can be due to salt injury also, but can occur when plants that are overcrowded are then spaced and exposed to full light or when very tender plants are put out to harden off in windy conditions.

Leaf scorching can be caused by salt or sun injury. Photo by U. Wisconsin Extension.

Nutrient Deficiencies: Iron deficiencies are common if media pH rises above 6.3. Calcium and magnesium deficiencies are common if media pH drops below 5.2. Nitrogen deficiencies from under-fertilization are also common and also where initial nutrient charge in the media runs out.

Stunting: Poor plant growth or stunting most commonly is due to lack of nutrients in the media (media is missing initial nutrient charge). It also can be due to excessively cold greenhouse temperatures.

Ethylene Injury: Crops grown in greenhouses with propane or gas-fired unit heaters that are malfunctioning can be susceptible to ethylene injury. Ethylene (C2H4) is an odorless, colorless gas that acts as a plant hormone. Symptoms range from misshapen leaves and flowers, thickened stems, stunted growth, flower or leaf abortion to stem curling and wilting.

-Gordon Johnson, Extension Vegetable & Fruit Specialist, University of Delaware Cooperative Extension

Transplants become leggy when the difference between day and night temperatures is too big. You can manipulate that temperature difference to prevent stretching or to hold plants that should be transplanted but cannot be due to weather or field conditions. Photo by. S.Scheufele

Transplant Height & Hardening Off

At this time of year growers are anticipating planting vegetable transplants in the field. Greenhouse and outside weather factors can contribute to transplant growth and quality, and when plants can get out into the field. Transplants may be at the perfect growth stage to plant into the field, but if reoccurring rains prevent field preparation or the ability to get into a prepared field to plant then transplants need to be held. Holding back plants and preventing them from getting too tall can be a challenge. In some crops plant growth regulators can be used. However, in vegetable crops there are few growth regulators labeled or that work well.

Another way to control plant height that is less risky is using the DIF method (the difference between day and night temperatures in the greenhouse). In most greenhouse heating programs the greenhouse will be much hotter in the day than in the night. The greater this difference the more the plants will stretch and grow tall. By reducing this temperature difference or even by reversing it to have higher night temperatures you can greatly reduce stem elongation. The critical time period is the first 2-3 hours after sunrise. Lowering temperatures to 50-55°F for 2-3 hours starting just before dawn, and then going back to 60-70°F during the day can keep plants shorter and stockier. This method does not work well for all transplants and is mainly for controlling height in tomato transplants.

Another method is mechanical movement of plants by brushing them over the tops two times a day with a pipe or wand made of a soft or smooth material. Be careful to gently do this so as not to damage softer plants like squash, cucumber and pepper. Reducing watering and fertilizer is also a method in controlling plant growth. However, be sure not to reduce water or fertilizer so much that it causes plant injury. Besides reducing growth, limiting watering and fertilizer just before planting is part of the hardening off process. It is good to expose plants to lower daytime temperatures and wind to strengthen stems. Just be sure to not put them out in high wind situations and temperatures that are too cold—this can cause damage. Placing them in an overhang area or shed may be a good idea if weather is too harsh. If the greenhouse has roll up sides or ends that can be removed to expose plants to wind and outside temperatures, hardening can take place in the greenhouse. To begin hardening transplants, reduce the amount of water used, lower temperatures and stop fertilizing plants. Starter fertilizer can be used a day or two before planting or if using a waterwheel transplanter. It is best to add a soluble starter fertilizer to the tank water.

When hardening off vine crops, tomatoes, peppers, or eggplants, do not lower the temperatures for hardening more than 5°F below the recommended minimum growing temperature. Tomato, pepper, broccoli, cabbage and cauliflower are best hardened off at temperatures around 60°F. Cucumber, squash, melon, and eggplant are best hardened off at around 65°F. Cold-tolerating transplants like lettuce can be hardened off at temperatures as low as 40°F. Even though cole crops like broccoli and cauliflower survive cold temperatures, they should not be hardened right away to cold temperatures after leaving the greenhouse to prevent bolting and buttoning of the crop later during head formation.

- Reprinted from Plant & Pest Advisory, a Rutgers Cooperative Extension Publication.

Events

EPA Worker Protection Standard Train-the-Trainer Courses for Organic and Non-Certified Pesticide Users

When: Thursday, May 12th, 2016 from 8am to 11am
Where: Hadley Farms Meeting House, 41 Russell Rd, Route 9, Hadley, MA 01035

All farmworkers must be trained under the EPA Worker Protection Standard (WPS) if your farm uses any pesticides, including those approved for organic production and other general use pesticides. The agricultural worker employer is responsible for complying with all components of WPS including the training of farmworkers. This training can only be provided by an individual who has a pesticide certification license or has attended an approved EPA WPS Train-the-Trainer workshop.

The train-the-trainer workshops are 3 hours long and will be held in Pittsfield, Hadley, Marlborough and East Wareham. The registration fee is $28.00 per person. Participants will received the EPA WPS How to Comply Manual, WPS Pesticide Record Keeping book, EPA WPS Safety Poster, EPA WPS Trainer's Manual, Certificate of Attendance, and the ability to train farmworkers in WPS.

For information on registering for these workshops please refer to our website at www.umass.edu/pested

Please contact Natalia Clifton, UMass Extension , 413-545-1044 or email nclifton@umass.edu

Sponsored in part by the UMass Extension Risk Management/Crop Insurance Education Program.

Special Topics for Pesticide Applicators

When: Wednesday June 15th, 2016 from 1:15pm to 3:30pm
Where: Doubletree Hotel, 11 Beaver Street, Milford, MA 01757

This two hour program will provide two recertification contact hours for all categories of pesticide licenses, Natalia P. Clifton, UMass Extension will discuss a variety of timely topics of importance to pesticide applicators. Topics will include EPA regulatory changes impacting pesticide applicators, events involving pesticide impacts on non-target organisms, resources for pesticide toxicity and environmental impact information, pesticide poisoning incidents, and the new draft MA state pollinator protection plan. Two pesticide contact hours for licenses in all Massachusetts categories. Contact hours are valid for equivalent categories in all New England states. The registration fee is $35.00 per person. Online registrations include an additional service fee.

For information on registering for these workshops please refer to our website at www.umass.edu/pested

Please contact Natalia Clifton, UMass Extension , 413-545-1044 or email nclifton@umass.edu

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