UMass Extension
Vegetable Notes
For Vegetable Farmers in Massachusetts since 1975

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In this issue:

Crop conditions

Growers scrambled to get harvests out of the field this week before the rains came. While inconvenient for harvesting, the rain is welcomed for establishing cover crops. Twenty two tons (a full tractor trailer) of rye seed will be planted to one cover crop-loving farm this coming week. A good 2 inches fell in Eastern MA and 1 inch in Central MA on Wednesday morning with more expected the rest of the week. No longer irrigating, farmers are putting away irrigation pipes and taking up plastic. Seasonal workers are being let go now as the main harvests have come in.

A few warm, sunny days last week resulted in a harvest of 22 bushels of summer squash and zucchini on one farm this Wednesday; a record for them this time of year! Where fungicide programs for downy and powdery mildew have been maintained, even cucumbers are holding up for harvest this week. Also harvesting now for fresh market is cabbage, broccoli, cauliflower, kale, carrots and beets. Tomatoes, eggplant and peppers are still coming in, though this is likely the last wave of these crops with colder days and nights setting in. Corn is available in some places for a few more days. Mostly a great pumpkin year, one grower commented this week, except that woodchucks seemed to take a bite out of the largest ones in the field! The dry fall has held off diseases for the most part, but if your carrots are looking suspicious, see the article this issue on identifying carrot diseases.

This pick-your-own field in Central MA has not been seeded with additional pumpkins for pickers, it's just very productive!

For some, wholesale accounts established well and they are still selling tomatoes at $21.50 per 20lb box. Road side stands are slowing down and starting to close for the season. Farmers are ready to take a break and are booking their tickets for winter vacations!

Identifying diseases of carrots

Carrot acreage is on the rise in New England, as more growers target expanding, year-round markets. Carrots can be affected by many bacteria, fungi and nematodes in the field and in storage. Foliar diseases may cause lower yields due to loss of photosynthetic area, difficulty in harvest if the tops are weakened, and lower marketability if the carrots cannot be sold in bunches. Root diseases can lower yields of fresh eating carrots and can spread in storage, drastically reducing yields brought to later markets. Root diseases are caused by soil dwelling organisms and therefore their incidence may vary considerably from farm to farm. Proper disease identification will help you to prevent future outbreaks by adjusting crop rotations accordingly, and prevent moving infested soil from field to field. Some of the major carrot disease symptoms are described below. If you are noticing foliar or root symptoms like those described, send a sample to your state diagnostic lab to confirm, and take steps to protect current and future crops. See the UMass Diagnostic Lab website for their sample submission instructions.

Alternaria Leaf Blight (*Alternaria dauci and A. radicina*) symptoms first appear along leaflet margins as greenish-brown, water-soaked lesions which enlarge, turn brown to black, and often develop a yellow halo. Older leaves are more susceptible to infection. When about 40% of the leaf is infected, the leaf yellows, collapses, and dies. Dark, elongate lesions are common on petioles, and can quickly kill entire leaves. *A. radicina* causes similar foliar symptoms but can also produce a dry, mealy, black decay known as black rot on carrot roots held in storage.

photo: D.B. Langston

Bacterial Leaf Blight (*Xanthomonas campestris pv. carotae*) symptoms appear primarily on leaf margins as small, yellow, angular leaf spots which expand, turn brown to black with a yellow halo, and become dry and brittle. Leaflets may become distorted and curled. Symptoms can extend into petioles, produce a yellow-brown, gummy exudate, and occur on flower stalks. Infected umbels can be completely blighted and seed infection can occur—use treated seed to prevent introducing this disease.

Root Knot Nematode (*Meloidagyne hapla*) forms galls or root thickenings of various sizes and shapes. Growth of infected carrots is patchy and uneven and severely infected carrots exhibit forking, galls, hairiness, and stubby roots. When soil populations of *M. hapla* are high symptoms include stunted plants, uneven stands, premature leaf death, and branches and swellings on both lateral and tap roots. Marketable yield is reduced by deformities, size reduction, branches, and knobs. *M. hapla* persists in the soil and has a very wide host range so rotation is difficult but monocots are non-hosts so small grains and corn as well as resistant varieties of tomato and bean can be grown in rotations to reduce population size.

photo: R.L. Wick

Black Root Rot (*Thielaviopsis basicola*) occurs primarily in storage when conditions are not ideal and temperature and humidity are too high. The fungus causes superficial, irregular black lesions which occur in a random pattern. The discoloration, caused by masses of dark brown to black chlamydospores, is limited to the epidermis. The pathogen rapidly invades wounded tissue and is favored by long post-harvest periods without cooling so careful harvest and immediate cooling and storage can minimize disease impact.

photo: R.L. Wick

White Mold (*Sclerotinia sclerotiorum*) affects many vegetable crops but carrots are particularly susceptible, especially late in the season and during storage. The fungus may be present in soil, storage areas or containers. Symptoms include characteristic white mycelial growth and hard, black sclerotia (overwintering structures), which can been seen on the crown of infected carrots. In storage, the disease is characterized by a soft, watery rot with fluffy white mycelia and black sclerotia present. Sclerotia can persist in soil for many years and the fungus has a very wide host range making this disease difficult to manage. Grasses and onions are non-hosts that can be used in long rotations and a commercially available biocontrol organism (trade name Contans) has been shown to be effective in parasitizing overwintering sclerotia. Contans should be incorporated into infested soils in the fall if a susceptible crop must be planted there next year.

photo: W.M. Brown

Cavity Spot and Root Dieback (*Pythium spp.*). Infections from *Pythium spp.* can occur during early root development and are favored by moist soil conditions. Root dieback symptoms appear as rusty-brown lateral root formation, or forking and stunting; symptoms that can be easily confused with damage from nematodes, soil compaction or soil drainage problems. Cavity spot often shows up later in the season near harvest. Horizontal, sunken lesions varying in size from 1 to 10 mm appear on the surface of the root and can provide an ingress for secondary fungal or bacterial infections.

photo: S. Livingston

Crown Rot (*Rhizoctonia carotae*). Early symptoms are horizontal dark brown lesions around the root crown. As the crop matures the tops may die in patches in the field and as the disease progresses lesions join to form large, deep, rotten areas on the top part of the root. *R. carotae* can also cause crater rot and violet root rot but these diseases are less common in MA. Disease is favored by moist conditions so planting on ridges, harvesting early and without wounding, cleaning equipment and maintaining clean and proper storage conditions may minimize impact.

Scab (*Streptomyces spp*.) can cause both raised and sunken, dry, corky lesions on the carrot root, however, symptoms are rarely severe enough to cause major losses in yield or crop marketability. Avoid planting carrots in alkaline soils, which are known to favor the incidence of scab, or in potato fields with high incidence of scab, as the disease may be caused by the same organism in carrots.

-- by S.Scheufele, UMass Vegetable Program

POTATO STORAGE

Whether you're planning to store potatoes for one month or six, it's important to try and provide the best combination of conditions for maintaining optimum quality. This can be tricky; every crop is different, as are each fall's weather and harvest conditions. Whether you are storing in pallet bins, grain sacks, or bulk piles, it's important to know what conditions you are aiming for, even if you can't always achieve them in practice. Fortunately, vegetables in general and potatoes in particular are somewhat forgiving in their tolerance to less than 'ideal' conditions. Light, temperature, humidity and ventilation all need adjustment in potato storage, and achieving the desired conditions in these areas is covered in this article.

Paul and Kevin Jekanowski and crew are loading up their storage facility in Hadley, MA

Light: Darkness is key**.** Even modest amounts of low light cause greening. If potatoes are in a multi-purpose storage where lights are on often, or the room is not fully darkened most of the time, cover the bins or pile to keep out light, without cutting off ventilation. One solution is to use bulk bins with open bottoms, with black pallet wrap around the sides, and punched opaque plastic row cover or burlap on top.

Temperature: After harvest and curing potatoes for storage (see September 17, 2015 issue of Vegetable Notes), tubers should be cooled down to the holding temperature. Ideally, the potatoes should be cooled slowly, ½-1° F per day, or a maximum of 4-5° F per week. It's helpful to place a temperature sensor in the center and on top of the pile or bin to monitor tuber temperature, in addition to monitoring air temperature in the storage and outdoors.

A thermometer to monitor air temperature in pile storage.

Potatoes are most commonly cooled using outdoor air, but this should be managed carefully. For the best use of outdoor air, place temperature sensors inside and outside the storage, with thermostats and switches wired in series to bring air in with fans only if inside temperature is above, and outside temperature is below your desired set point. Use outdoor air that is no lower than 3-5° F below the tuber temperature. Through-the-pile (or through-the-bin) ventilation achieves rapid cooling, but may cause dehydration unless a humidifier is used.

Tubers whose temperatures fluctuate along with outdoor cool and warm spells may have reducedstorage life and quality. Fluctuations in temperature may also lead to condensation in the pile. If the temperatures in the top and center of the pile are above the outside air temperature, then ventilate the storage. When night temperatures are warm (in the 50's and lower 60's) and there is not enough ventilation through the pile, the temperature in the pile can get into the 70's or even 80's. Heating is generally not needed in potato storage due to the heat of respiration from the potatoes, though insulation in walls and roof is important. Significant heat can also be lost through leakage around doors, windows and open doors during use.

The holding temperature should be suited to your market goals and to achieve the desired balance among respiration rates, sprouting, disease development, and transformation of starch into sugars such as glucose. Respiration rates are lowest at 36-37°F (2-3°C); and at temperatures below 45°F, conversion of starch to sugar increases. Tuber rots increase greatly above 50°F. References and grower experiences don't all agree on the ideal temperatures for different uses, but the recommendations below are found in several reliable sources.

Tablestock (no sprout inhibitor) and seed stock: 38-40°F. This is the optimum temperature range for inhibiting sprouting. Some growers report that they can hold at 36°F for fresh market sales during the winter months. For diversified farms, this may allow them to store other root crops and cabbage in the same storage room as potatoes, if infrastructure is limited.

Tablestock (with sprout inhibitor): 40-45°F. If the humidity is kept high and sprout inhibitors are used, potatoes stored at 45°F will maintain quality similar to those stored at 40°F.

Seed potatoes: 38-40°F. For seed, tubers need to be kept dormant and in a sound, viable condition.

Processing: 45-55°F is recommended for processing potatoes, to prevent accumulation of sugars which darken the potato during cooking. Fifty to 55°F is recommended for chipping, although this varies with cultivar. High sugar levels can be lowered if the temperature is slowly elevated to 55-65°F for one to four weeks before processing. This is known as reconditioning.

Managing Relative Humidity

Humidity should be maintained at 90-95% throughout storage life to prevent dehydration and shrinkage and reduce pressure bruising. Given high relative humidity (RH) inside and low RH and temperature outside during the winter months, adequate insulation in walls and roof is important to avoid condensation. Below are two options for adding humidity.

A humidifier with a capacity to deliver about one gallon of water per 1,000 cubic feet per minute (CFM) is usually adequate. Centrifugal and misting humidifiers introduce water into the atmosphere in small particles. These small water particles are easily absorbed by the cool air and effectively increase RH. These systems are the most reliable and effective, however they are also the most expensive. There are several models and sizes available to fit individuals' specific needs.

Chris Callahan at UVM Extension developed a simple DIY auto-fill humidifier using a five gallon bucket, a tank de-icer for heat, and a fan. Details on this humidification system can be found at Callahan's blog.

Introducing water into the storage area is another option for increasing relative humidity. It is the cheapest but also the most unreliable and inconsistent, and can lead to unsanitary conditions. Methods for spreading water on the floor can be simple or fancy. One example is to use the condensate from the evaporator coil and direct it via tube to the floor, and spread evenly using drip tape as with trickle irrigation. Other options are to pour water on the floor, wet burlap bags, or use overhead greenhouse irrigation to spray water. Again these are the cheapest methods but are not ideal due to sanitary issues and their inconsistency.

Measuring Relative Humidity

Digital hygrometers are the easiest tools for measuring relative humidity. They are easy to read, and tend to be precise. However, they can be out of calibration or give false readings, especially at higher relative humidity levels (>90%) like those needed in potato storages. Sling psychrometers are simpler mechanical hygrometers. They use two thermometers to measure dry-bulb and wet-bulb temperatures; the difference between these temperatures is used to determine the specific relative humidity of the atmosphere. Digital hygrometers should be checked against a sling psychrometer to measure their accuracy. If a digital hygrometer were off by 5%, you will know this by calibrating it against a sling psychrometer and have a better idea of the actual RH of the storage.

A combination hygrometer and thermometer

Ventilation

The ventilation system is the heart of the storage, controlling temperature and humidity by ventilating, recirculating and blending air. These systems range from manual to totally automatic. Convection currents cause heat to rise through the

pile or bins. An exhaust fan is placed so that it removes warm air from the top of the storage. Intake fans and openings should be adjustable to control the amount of air being drawn in. It is important that air is allowed to flow around and through the potatoes, whether they are stored in piles or in bins. For bulk storage, air should be directed from the bottom of the pile towards the top, which requires a ventilation system that is built into the floor or laid down during piling. For storage in bins, the air should be directed to flow through the bins either from bottom to top or side to side (see Belyea presentation, below, for details on how a bottom-to-top system can be designed). This allows for consistent temperatures and relative humidity throughout the storage and thus consistent tuber conditions.

Charlie Tangerini in his storage facility with insulation and ventilation overhead in Millis, MA

Further Reading:

See Chris Callahan's blog at the UVM Extension website for further information and tools on calculating exhaust needs and fan exhaust system specifications.

For an excellent review of storage design with a lot of detail in terms that non-engineers can understand, see the presentation by Stephen Belyea, storage engineer with the Maine Dept. of Agriculture, Food and Rural Resources.

The UMass Vegetable Program website on winter production and storage includes a view into storages built by several growers and other presentations and fact sheets.

-- By Ruth Hazzard and Luke Doody, UMass Extension. Resources include Dale Moyer's (Suffolk Co CES, Riverhead, NY) chapter on Potato Storage Management in Potato Production in the Northeast, edited by C Hollingsworth, D. Ferro and W. Coli 1986; USDA Handbook 66; and potato growers including Paul and Kevin Jekanowski, Jekanowski Farm, Hadley MA, and Rob Johanson, Goranson Farm, Dresden ME.

GREENHOUSE CLEAN-UP AND BIOCONTROL

Originally published in UMass Floriculture's Greenhouse Update on September 3, 2015

It is best to clean greenhouses now rather than to waiting until just before you start your spring production. This helps eliminate over-wintering sites for pests in unheated greenhouses, especially if the winter is unseasonably warm. Remove all leftover plants, weeds and debris and clean the floor of spilled soil and organic matter. Check areas around furnaces and alongside walls, and remove those small weeds that are often overlooked. Repair tears in worn weed barriers. If replacing worn weed barriers, do not place gravel on top of the weed mat as it traps spilled media and holds moisture, creating an ideal environment for weeds, diseases, insects and algae. Now is also a good time to correct any drainage problems and low spots in greenhouses.

The pre-emergence herbicide, indaziflam (Marengo®) is labeled for use on greenhouse floors in empty greenhouses. You must wait 24 hours before introducing plant material into the empty greenhouse after applying this material.

Biocontrols will not clean up existing, out of control pest populations. However, if a greenhouse is cleaned of weeds, old plants and debris, biocontrols may help prevent pests from overwintering especially during a warm fall. Here are some biocontrol options for two-spotted spider mites, aphids, thrips and whiteflies.

Two spotted spider mites: Predatory mites such as *Phytoseiulus persimilis, Neoseilus californicus, Amblyseius andersonii, Neoseilus (Amblyseius) fallacis* and the predatory midge larvae, *Feltiella acarisuga* are commercially available. Rove beetles (predatory ground beetle) and *Stratiolaelaps scimitus* (a type of predatory mite) will feed upon spider mites that have moved off of plants to find crevices in the greenhouse where they go into dormancy.

Aphids: Discard existing banker plants with established populations of *Aphidius* this month. Their effectiveness may be reduced in the late summer when *Aphidius* is often attacked by different species of naturally occurring parasitic wasps (called hyperparasites). These hyperparasites migrate into greenhouses from outdoors until hard frosts occur. They will

continue to reproduce in *Aphidius* wasps by laying an egg inside the aphid (which is parasitized by *Aphidius*), within or near the egg of the parasitic wasp (*Aphidius*). These hyperparasites can disrupt the effectiveness of an aphid biological control program using *Aphidius spp*. in banker plant systems and will lessen aphid control throughout the fall and winter.

It is difficult to distinguish adult hyperparasites from parasites. The shape of the exit holes of parasitized aphid mummies may be used as an indicator. Aphid parasites, such as *Aphidius spp.* leave a round exit hole with a smooth edge in the aphid mummy. Hyperparasites make an exit hole that is not exactly round with jagged margins. For some good photos of these exit holes, and more information on aphid hyperparasites, see this UVM fact sheet Hyperparasites of Aphid Predatory Wasps.

New banker plants can be placed into the greenhouse after hyperparasites no longer migrate in from outdoors and existing populations in the greenhouse have died. *Aphidius* (*Aphidius matricariae*, *A.colemani*, *A.ervi*) do not diapause (become dormant) in response to short days and can be released once greenhouses are free from hyperparasites. [*Ed., parasitoid wasps are most effective at controlling aphids at 77°F. For information on the use of biological controls for aphids in minimally-heated or unheated greenhouses which will continue to be used for greens production, see this fact sheet from Cornell Extension on Aphid Management in Winter Tunnel Greens.*]

The predatory midge *Aphidoletes aphidimyza*, is also effective for aphids and is not susceptible to hyperparasites, but will diapause when daylength is less than 16 hours. Low light affects the larva when it goes into its pupal stage. However, *Aphidoletes* can be released to clean up a few aphids, but they will not reproduce successfully for ongoing management without supplemental light. Low light diapause can also be overridden by temperatures of 78°F or higher. So *Aphidoletes* can be used in warmer greenhouses even with short day length and low light. *Aphidoletes* overwinter as larvae in cocoons in the soil and pupate and emerge as adults in spring. Most eggs are laid during the first few days after emergence.

Thrips: The predatory mite *Amblyseius cucumeris* can be used for thrips during September and October. In a recent newsletter, IPM Laboratories recommended releasing the soil-dwelling rove beetles and *Stratiolaelaps scimitus* (predatory mite) that are effective against pupae in the soil. Both of these predators are active at cool temperatures (50°F).

Whiteflies: Good weed management and the absence of plant material should eliminate whiteflies from the greenhouse, however whitefly parasites such as *Eretmocerus emericus* (for use against silverleaf whitefly) or *Encarsia formosa* (for use against greenhouse whitefly) can be released.

--Tina Smith, UMass Extension and Leanne Pundt, UConn Extension

REVISED EPA WORKER PROTECTION STANDARDS

The EPA has released the final revisions to the Worker Protection Standards (WPS). Read the revised rule at their updated website: http://www2.epa.gov/pesticide-worker-safety. Changes include annual mandatory worker and handler training (previously required only every 5 years) with recordkeeping requirement, expanded training content, introduction of a pesticide handler minimum age requirement, and expanded requirements for personal protective equipment (PPE). A comparison of the new and old rules is summarized in this table: COMPARISON OF THE NEW PROTECTIONS TO THE EXISTING PROTECTIONS. Compliance with most provisions of the new rule will be required in December of 2016.

REGULATORY REVIEW LISTENING SESSIONS

On March 31st, 2015 Governor Baker issued Executive Order #562 commissioning a complete and comprehensive review of every existing Executive Branch regulation in the Code of Massachusetts Regulations (CMR). MDAR has scheduled the following general listening sessions for next week at the indicated locations to provide interested stakeholders information on the regulatory review process, and to provide an opportunity for the public to comment on any or all of the regulations. If there are any proposed changes to the regulations, full public hearings will be conducted specific to those regulations.

General Listening Sessions for MDAR Regulations:

Date: Monday, October 5th
Time: 4pm – 6pm
Location: DFW, Richard Cronin Building; 1 Rabbit Hill Road, Westborough, MA 01581

Date: Tuesday, October 6th
Time: 4pm – 6pm
Location: 100 Cambridge Street, Boston, MA 02018 2nd Floor - Conference Rooms A, B & C

Date: Thursday, October 8th
Time: 4pm – 6pm
Location: Smith Vocational Agricultural School, 80 Locust Street, Northampton, MA 01060

In addition, comments on regulations may be uploaded at: http://www.mass.gov/anf/regreview.html. Questions, contact Alisha Bouchard, alisha.bouchard@state.ma.us.

Grants for Farmers

Greener Fields Together (GFT) engages farmers, distributors, foodservice operators and retail locations in efforts to work toward safer produce from seed to fork. GFT is offering grants in the amount of $3,000 – $10,000 for a number of categories including Food Safety and Good Agricultural Practices (GAP) improvements, certification assistance, infrastructure development, and marketing / communications. Applicants must be GFT members or submit paperwork for membership by **October 25th, 2015**. For more about this grant opportunity and to apply click here: http://www.greenerfieldstogether.com/cultivating-change

Northeast SARE is offering farmer grants for commercial producers who have an innovative idea they want to test using a field trial, on-farm demonstration, marketing initiative, or other technique. A technical advisor--often an extension agent, crop consultant, or other service professional--must also be involved. Projects should seek results other farmers can use, and all projects must have the potential to add to our knowledge about effective sustainable practices. Grants are awarded up to $15,000 and the application deadline is **November 12th, 2015**. Click here for the application: http://www.nesare.org/Grants/Get-a-Grant/Farmer-Grant

Events

Twilight Meeting: Nutrient Management, Soil & Crop Fertility

Postponed to October 9th!

When: Friday, October 9, 2015 from 4pm to 6pm

Where: Langwater Farm, 209 Washington St, North Easton, MA

This year's Twilight Meeting will focus on nutrient management from the bottom up and will feature:

- Explanation of new statewide nutrient management regulations which will go into effect on December 5, 2015 by MDAR
- Cover crop-based fertility and on-farm composting at Langwater Farm by farmer Kevin O'Dwyer
- Compost analysis and interpretation by Katie Campbell-Nelson
- Weed management by Rich Bonanno

Langwater Farm is a 50 acre certified organic farm in Southeastrern MA run by Kevin O'Dwyer. Before starting Langwater in 2010, Kevin was head grower at Ward's Berry Farm in Sharon, where he started farming at age 14.

Demystifying Sanitizers Workshop

When: Tuesday, October 20, 2015 from 2pm to 5pm

Where: Edgewater Farm, 246 NH-12A, Plainfield, NH 03781

The current food safety best practice recommendation for *all* growers (whether you are GAPs certified, will fall under FSMA or not) is to use sanitizer in your wash water. But knowing which product to use, how to use it, calculate the appropriate amount, dispense it safely and monitor the efficacy can be tricky! At this hands-on workshop you will practice all of these steps with both bleach and a peroxyacetic acid-based sanitizer and have help figuring out how to apply them to your set-up. There is no fee for this workshop. **Registration is limited to 18 participants.**

Register at: http://sanitizersworkshop.eventbrite.com or call Cheryl Herrick at 802-656-5459

To request a disability-related accommodation to participate in this program, please contact Cheryl Herrick at 802-656-5459 by September 29, 2015 so we may assist you.

Registration deadline: Tuesday, October 6

For more information on using sanitizers in wash water, see: Using Sanitizers in Wash Water.

The 2015 New England Vegetable and Fruit Conference

When: Tuesday, December 15 to Thursday, December 17, 2015

Where: Radisson Hotel – The Center of New Hampshire, 700 Elm St, Manchester, NH 03101

New England Vegetable & Fruit Conference and Trade Show includes more than 25 educational sessions over 3 days, covering major vegetable, berry and tree fruit crops as well as various special topics. A Farmer to Farmer meeting after each morning and afternoon session will bring speakers and farmers together for informal, in-depth discussion on certain issues. There is also an extensive Trade Show with over 100 exhibitors.

This conference is special because it is put together with close collaboration between growers and Extension from across the region. The steering committee gathers the best speakers from within our region and across the country to tell you about the latest innovations and advances in the fruit and vegetable industry. Almost every session includes both farmers and research or extension personnel, so you are getting the "best of both worlds."

Registration will open soon!

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