UMASS EXTENSION

Vegetable Notes

For Vegetable Farmers in Massachusetts

Volume 26, Number 23 October 9, 2014

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CROP CONDITIONS

Polish your prettiest produce; it's fall festival season! While growers are sending select items and value-added products to agricultural fairs, they are also focused on moving the harvest out of fields and on to wholesale or storage. Still no hard frost in most parts of the state, but most warm season crops (tomatoes, peppers, eggplant, cucumbers, zucchini) are done and fields are being planted to cover crops. Some growers who were able to stave off late blight back in August with regular fungicide treatments have seen their tomato crops regrow healthy fruits and are still harvesting. One grower happily reported 'still picking mostly #1's and only a few canners'.

This week's intermittent rain has been good for helping cover crops establish, but may have hurt cabbage growers with full sized heads ready for harvest, which split after an influx of moisture. One strategy reportedly used to reduce splitting heads is to twist entire cabbage plants, breaking their roots and reducing their ability to take up water but allowing them to wait in the field a little bit longer. Finding room for curing in high tunnels and barns is still a struggle and growers are beginning their battle with rodents, sneaking into storage facilities. If high tunnels are not being used for curing squash and pumpkins, some are seeding crops for winter markets (see article this issue about winter growing in high tunnels).

Cabbage beginning to split due to excess moisture

HIGH TUNNEL SEASON EXTENSION

Public interest in purchasing locally grown food has grown immensely in recent years throughout New England and across the US. Growers have responded by keeping farm stands open longer, creating winter farmers markets, and offering various forms of 'winter shares' at CSA farms. Traditional storage practices combined with improved production technologies can be utilized to generate, store and market more food to satisfy market needs.

High tunnels (sometimes called hoop houses or field houses) are generally unheated structures that allow for growing in the ground in a warmer and more protected environment. These structures can be used to extend the growing season into late fall, winter, and early spring. There are many factors that contribute to the success of winter-time production in a high tunnel. Here are some general guidelines to consider when planting and managing extended season crops in high tunnels.

CROPS

Choose cold hardy varieties. Brassicas, alliums, umbels, and chenopods are all families that include vegetable varieties with cold hardiness. When planning your plantings and choosing seed, look for varieties that are specifically labeled to be cold hardy. In winter high tunnels, they will be subjected to sub-freezing temperatures and multiple freeze-thaw cycles. Some crops will only be in the ground for a relatively short time, while others will need longer to mature for harvest. Below are some good variety choices in each category.

Suggestions for shorter residency varieties:

- Spinach: Space, Tyee
- Brassica greens: Red Russian Kale, Tatsoi, Komatsuna, Mizuna, Green Wave

- Bok Choi: Black Summer, Mei Qing Choi
- Lettuce: Tango, Red Salad Bowl, Rouge, D'Hiver
- Claytonia

Suggestions for longer residency varieties:

- Radish: Tinto, Cherriette, D'Avignon
- Beet: Red Ace, Merlin, Touchstone Gold
- Chard: Fordhook Giant
- Leek: Tadorna
- Scallion: WhiteSpear
- Turnip: Hakurei
- Carrot: Napoli, Mokum, Nelson
- Kale: Winterbor, Redbor, Toscano, Siberian, Red Russian
- Collards: Champion
- Head Lettuce: Scyphos, Ermosa, Winter Density

Claytonia, aka miner's lettuce, is a good choice for a cold-season green

Winterbor and Red Russian kale might occupy a high tunnel all winter long

Some seed companies are beginning to market specifically to extended season growers and have sections of their catalogs dedicated to appropriate varieties and cold season growing supplies.

PLANTING SCHEDULE

"Days to maturity" are longer as the daylight hours get shorter, light intensity decreases, and temperatures drop. The date that crops are seeded, the climate in your growing zone, the microclimate both on your farm and inside of the high tunnel, and the severity of the weather in a given year will all affect plant growth and survival. Short intervals between seeding dates become longer intervals between harvest dates. Cutting lettuce and Brassica crops need to be seeded on many dates at close intervals. Full sized kale, chard, collards, spinach -- plants where you harvest just the outer leaves -- need only 1 or 2 dates. Be careful with seeding dates during the period with less than 10 hours of daylight. In New England, this is from around the second week in November to the fourth week in January. Some farmers have had success planting in this date range, but there are also reports of poor germination and early bolting. Good record keeping over the years will help you to develop a fall seeding schedule that is specific for your farm.

DEGREE of PROTECTION

In the fall, as plants become established and grow, their cold tolerance can be enhanced by keeping the tunnel sides open, even at night, and forcing them to adapt to the declining temperatures. This may seem counter to the first instinct, which is to make the most of the protective capacity of the tunnel. However, plants exposed to cold from early on will be better able to survive the sudden drops in temperature and freeze periods that are sure to come.

Once subfreezing temperatures become the norm, maximizing protection becomes important. There are ways to increase the degree of protection in your high tunnel including covering the tunnel with a thicker greenhouse plastic, using a double layer of plastic, and using floating row cover on crops inside the house. For more information on choosing the cover for your high tunnel, see this article by John W. Bartok, Jr., *Choose the right plastic film for your needs*. Inner covers are most effective when they are within a couple of feet of the plants; some crops will tolerate covers without hoops, but most growers use some kind of supports. Multiple covers can be used to protect plants during the coldest weather. High tunnels are generally heated and cooled passively with the use of ventable sides and end walls and trapping of solar heat, but supplemental heat can be used to protect from deep freezes. Portable propane heaters or wood stoves are two options.

Good ventilation and airflow are also important in managing humidity inside tunnels. Lowering humidity reduces the potential for disease, and also reduces icing of plants from condensation, which leads to leaf damage. End vents are an important tool for ventilation, even in subfreezing weather. Proper ventilation also means protecting plants from damaging winds. If plants do become frozen, protect them from cell rupture by not touching them while they are frozen. Time your

harvests for mid-day or on warmer-forecasted days to avoid touching frozen plants.

High tunnel with secondary row cover inside

PEST CONTROL

Extending the growing season for crops also means extending the potential for damage from pests. Rodents can be a big problem in high tunnels. Prevent damage by reducing year-round habitats for small animals near high tunnels. Grass should be mowed very short and perimeters should be kept weed-free. Make sure wood piles, rock piles, equipment, etc. are moved away from tunnels. Set traps inside the house all winter long.

The high tunnel environment differs from outdoors in winter: it's warmer, has less free moisture, and is more humid. As a result, different diseases are common in tunnels than are common on the same crops grown outdoors. The most effective way to prevent plant diseases in high tunnels is to manage humidity by ensuring sufficient ventilation, and running fans if necessary.

Insect pests tend to be less active in colder seasons, but problems with pests such as aphids, whiteflies, and slugs may develop. Early establishment of bio-controls or use of insecticidal soaps can be very effective. When it comes to chemical controls, use only materials that are labeled for greenhouses. Outdoors, pesticide residues break down after application by exposure to ultraviolet radiation and rainfall. Inside tunnels, plastic coverings reduce U/V and don't allow in rain, and as a result, pesticides break down differently.

For more information on high tunnels and extended season growing, including pest control, see the New England Vegetable Management Guide and this article from University of Minnesota Extension on high tunnel Integrated Pest Management. Other good resources are the UMass Vegetable Program's Winter Production, Storage and Sales site, the UMass Greenhouse Crops and Floriculture Program's webpage on High Tunnels and HighTunnels.org, a collaborative project of several U.S. Universities and growers to present and discuss information on high tunnel farming.

-compiled by L. McKeag from information by Danya Teitelbaum, of Queen's Greens Farm in Amherst and formerly of UMass Extension, as well as the sources referenced above.

GREENHOUSE INSULATION

There are several simple and inexpensive steps you can take to reduce energy use during the heating season. Here are some recommendations taken from the fact sheet Practical Ideas to Cut Your Greenhouse Energy Bill in Half by Agricultural Engineer John W. Bartok, Jr.

- Reduce air leaks by weather stripping doors, vents, and fan openings. Lubricate fan shutters frequently so that they close tight. Shut off some fans during the winter and cover openings with insulation or plastic.
- Make certain to apply two layers of poly as glazing. Choose a brand with an infrared inhibitor for the inner layer.
- Insulate the perimeter for the house below ground by installing 1 - 2 inch thick insulation board up to 2 feet below ground level will reduce the heat loss from the warm interior soil to the cold ground outside.
- Insulate sidewalls and endwalls to bench height using either a 2 inch foam board, or inexpensive aluminum-covered bubble insulation. Insulating existing structures is worthwhile. Cost of foam board insulation is about $1/sq ft with a payback of less than one heating season.
- Insulate behind sidewall heat pipes. Use insulation board or aluminum-faced building paper to radiate heat back into the greenhouse. Leave an air space next to the wall to prevent frost damage to the wall.
- Install an energy screen and save as much as 20%- 50% on heating costs. Screens trap the heat inside and reduce the heat loss surface area. Tight closures should be maintained where curtains meet sidewalls, framing or gutters. Add roll-up or drop down sidewall screens for additional savings. These can be either manual or mechanized.

- Perform yearly maintenance on boilers, burners and back-up systems. Clean and adjust furnaces and do an efficiency test run before heating season. Consider upgrading the efficiency of your system with installation of root-zone heat tubing, a high-efficiency heater or boiler, or an insulated water tank for heat storage. Cost-effective alternatives to fossil fuels are also available.

If you have more involved greenhouse retrofits in mind, but aren't sure where to begin, contact the Massachusetts Farm Energy Program at massfarmenergy.com or read up on your options in the Farm Energy Best Management Practices Guide for Greenhouses.

Additional information can also be found in the publication *Energy Conservation for Commercial Greenhouses* available from the CIT Resource Store, University of Connecticut.

-- by John W. Bartok, Jr., Agricultural Engineer, Ashford CT

POTATO STORAGE MANAGEMENT PART 2: HOLDING

Whether you're planning to store potatoes for one month or six, it's important to try to 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 brand new, state-of-the-art potato 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 plastic row cover or burlap on top.

Temperature: After harvesting and curing potatoes for storage (see September 25, 2014 issue of Vegetable Notes), tubers should be cooled down to the holding temperature. Ideally, the potatoes should be cooled slowly, ½ to 1°F per day, or a maximum of 4 to 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.

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 to 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. Air exhaust is also critical, to remove warm air.

A thermometer to monitor air temperature in pile stored potatoes

Tubers whose temperatures fluctuate along with outdoor cool and warm spells may have reduced storage 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 to 37°F (2 to 3°C); however 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 to 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 to 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 to 40°F. For seed, tubers need to be kept dormant and in a sound, viable condition.

Processing: 45 to 55°F is recommended for processing potatoes, to prevent accumulation of sugars which darken the potato during cooking. 50 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 to 65°F for one to four weeks, a process known as reconditioning.

Managing Relative Humidity

Humidity should be maintained at 90 to 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 deicer 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.

A combination hygrometer and thermometer

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.

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

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 bulk 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.

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 website on storage resources provides a view into storages built by several growers and other presentations and fact sheets on storage.

-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.

CALLING ALL WINTER GROWERS!

If you grow vegetables for sale anytime between December and April, we want to hear from you! UMass Extension, along with our project partners, are wrapping up a multi-year SARE-funded project on the state of winter vegetable production in New England. Whether you've shifted all your production over to the winter months, or you've just dabbled in using low tunnels for some early spring sales, we'd love to know how it's going. Your feedback will help guide the direction of future research projects and educational programs.

We created this short survey in survey monkey. It takes about 5 minutes to complete. Here's the link:

https://www.surveymonkey.com/s/winterVN

Thanks for your help!

-The UMass Vegetable Team (for the Northeast SARE Winter Harvest & Sales Project Partners: UNH Extension, UMass Extension, Communities Involved in Sustaining Agriculture, and Seacoast Eat Local)

VENDORS NEEDED FOR YEAR-ROUND MARKET

The Boston Public Market -- a year-round indoor market featuring local farmers, fishermen, and specialty food producers -- is seeking local growers with the capacity to provide produce year-round as permanent full-time vendors. With a focus on entirely New England-sourced products, the market will be the first of its kind in the United States when it opens next summer. To learn more about the Boston Public Market and vendor opportunities, visit www.bostonpublicmarket.org or call Tiffani Emig at 617-973-4909.

Upcoming events

Food Product Development – Beyond the Concept

Have a favorite recipe you'd like to share with the world? Join UMass Extension food safety and product development expert Amanda Kinchla for a two-day course on the practical aspects of food product development, including food safety principals, product testing, packaging, and labeling. This two-day workshop will be offered at two locations in Massachusetts:

- Eastern MA
  When: Tuesday, October 14 & Wednesday, October 15, 2014 from 6:00 pm to 9:00 pm each day
  Where: Crop Circle Kitchen, Inc., 196 Quincy St, Dorchester, MA 02121
  Contact Rosalind Freeman at 617-522-7900 or roz@cropcirclekitchen.org for more information.
- Western MA
  When: Thursday, November 13 & Thursday, November 20, 2014 from 6:00 pm to 9:00 pm each day
  Where: Franklin County Community Development Center, 324 Wells St, Greenfield, MA 01301
  Contact Nico Lustig at 413-774-7204 or nicol@fccdc.org for more information.

Farming with Nature: Improving Soil Health on Vegetable Farms

Sponsored by USDA NRCS, UMass Extension, and the Conservation Districts serving Berkshire, Hampshire, Hampden, Franklin, and Bristol Counties. This FREE program will feature:

- Featured speaker: Ray Archuleta (Ray the Soil Guy), Agronomist & Soil Health Educator USDA NRCS
- UMass graduate student, Julie Stultz Fine, on the economics of soil health, the benefits of deep zone tillage, and cover crops for soil health.
- Farmer panel and their experiences with reduced tillage, cover cropping, and crop rotations in vegetable production

Contact Sue Guiducci at 508-990-2854 or sguiducci@earthlink.net. This day-long workshop will be offered at two locations in Massachusetts:

- Western MA
  When: Wednesday, November 5, 2014 from 9:30 am to 3:30 pm
  Where: Immanuel Lutheran Church, N. Pleasant Street, N. Amherst, MA—November 5th
- Eastern MA
  When: Thursday, November 6, 2014 from 9:30 am to 3:30 pm
  Where: Bristol County Agricultural High School, 135 Center St, Dighton, MA 02715

Pollinator Health and Safety Conference

When: Thursday, November 20, 2014 from 8:00 am to 5:30 pm
Where: Portland Marriott at Sable Oaks, 200 Sable Oaks Drive, South Portland, ME 04106

The University of Maine Cooperative Extension and the Maine Department of Agriculture, Conservation and Forestry are co-sponsoring the Pollinator Health and Safety Conference to bring together farmers, bee-keepers, entomologists, policymakers and others interested in protecting pollinators. State and national experts on pollinators, bee-keeping, and pesticides will share the latest scientific research on factors affecting pollinator health and best practices for their protection.

Register by October 31, 2014: $50.00/person; after October 31, 2014: $75.00/person. DEADLINE TO REGISTER: November 14, 2014. Contact Meghan Dill, meghan.dill@maine.edu or 207.581.3878 for more information.

Approved for 7 pesticide applicator recertification credits

Greenhouse Vegetable Production in Containers

When: Wednesday, December 10, 2014 from 9:30 am to 3:45 pm
Where: Sturbridge Publick House, 277 Main Street, Route 131, Sturbridge, MA 01566

Join us for this educational program on container grown greenhouse vegetable production (tomatoes, greens and cucumbers).

- Growing Greenhouse Tomatoes and Greenhouse Cucumbers in Containers
  Rich McAvoy, University of Connecticut
- Perfecting Biocontrol in Greenhouse Vegetables
  Carol Glenister, IPM Laboratories, Locke NY
- Growing Bench-top Greens
  Brian Krug, University of New Hampshire
  Brian will talk about current UNH research including cultivars and growing methods.
- Diseases and Disorders of Greenhouse Tomatoes, Cukes and Greens
  M.Bess Dicklow, University of Massachusetts Extension Plant Disease Diagnostic Laboratory
- Grower to Grower Panel
  Brad Clegg, Four Town Farm, Seekonk, MA
  Dave Volante, Volante Farms, Needham, MA

Registration: $40 per person or $35 per person for 3 or more from same business. Includes morning refreshments, breaks and handouts. Two contact hours for pesticide recertification have been requested. Register on-line, or contact Tina Smith, 413-545-5306, tsmith@umext.umass.edu for more information.

UConn Extension: Growing Container-Grown Greenhouse Vegetables

When: Tuesday, December 16, 2014 from 9:00 am to 4:00 pm
Where: Litchfield County Extension Office, 843 University Drive, Torrington CT 06790

Topics will include growing greenhouse tomatoes, cucumbers and greens, Connecticut Grown labeling, food safety and grower to grower panel.

Contact Leanne Pundt, University of Connecticut at 860-626-6855 or leanne.pundt@uconn.edu for more information.

Vegetable Notes. Ruth Hazzard, Katie Campbell-Nelson, Lisa McKeag, Susan Scheufele, co-editors. Vegetable Notes is published weekly from May to September and monthly during the off-season, and includes contributions from the faculty and staff of the UMass Extension Vegetable Program, other universities and USDA agencies, growers, and private IPM consultants. Authors of articles are noted.