Potatoes: Harvest and Storage, Part I

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Potato acreage has been increasing in recent years; the 2012 Ag Census reports that in MA both acreage and the number of farms growing potatoes has doubled since 2007. The increase includes farms that focus on potatoes as well as diversified farms gearing up for more fall and winter sales. While potato production ranges from less than one to over 1,000 acres per farm, the needs of the crop are pretty much the same.

Harvesting potatoes for immediate sale has been underway for many weeks, but we are approaching the time when harvest for longer term storage will begin. As we move into early October, conditions are favorable for harvest and curing of potatoes for storage -- soils are cool but not too cold; they may be dry or moist but are not, at the moment, soggy; and air temperatures have been ranging from around 40 to 65 so can be used assist with managing storage temperatures for curing and cooling the tubers. Most potato vines have died back or been killed, so skins have set.

Storage never improves tuber quality. Effective potato storage provides an environment to maintain the best possible tuber quality and appearance until potatoes are sold. This requires careful harvesting practices, followed by attention to the successive stages of storage: curing, cooling, holding, and removal. Below is a checklist to help get potatoes into the 'holding' phase of storage. More details on holding and removal will follow in the October issue of Vegetable Notes.

Preparing the storage

An important aspect of potato pest control is to provide a pathogen-free storage environment. All storage and potato handing equipment surfaces should be thoroughly cleaned and disinfected prior to handling and placing the crop into storage. Surfaces should be well moistened by the disinfectant spray. Spray bin walls until there is a slight runoff. Recommended disinfectants are quaternary ammonium compounds such as Hyamine 2389. Bins or equipment treated with quaternary compounds must be rinsed with clean water before coming into contact with potatoes to be used for human consumption. Read labels carefully regarding use on walls or floor versus use on 'food contact surfaces' and to determine suitability for your needs. Organic produce may not come in contact with surfaces that have been treated with quaternary ammonium compounds. For more resources on organically approved sanitizers, see reference 4 below.

Pre-harvest practices: maturity, vine kill, skin set

Maturity is indicated by the ability of the tuber skin to resist skinning during harvest. Generally this is achieved through natural or managed vine desiccation (vine kill). Sugar content is a maturity index for processing potatoes, with both immaturity and over-maturity resulting in higher sugar levels (see Reference 3).

Vine killing stops tuber growth at the desired size, stabilizes the tuber solids, controls hollow heart disorder, promotes skin set and allows for easier digging and harvesting. Vines may have died down naturally but if they are still green, mechanical (mowing or vine beating) or chemical methods or a combination of the two can be used to kill potato vines. Desiccation of vines also kills late blight spores, reducing the possibility of late blight tuber infection at harvest.

Skin set. Allow two the three weeks for tuber skins to mature in the field after vine kill but before harvest. Most tuber diseases require a wound to infect potatoes and good skin set greatly reduces the amount of wounding at harvest and increases the storability of tubers.

Sprout inhibitors may be needed, depending on storage goals, storage conditions, and cultivar. Later maturity varieties usually have a longer period of dormancy (2-3 months).

For more details on vine kill, sprouting management, and other aspects of potato harvest and storage see New England Vegetable Management Guide, http://nevegetable.org/crops/varieties-13

Harvest practices to prevent wounding and bruising.
Efforts that reduce bruising during harvest are cost-effective. Check harvesting and transporting equipment before harvest begins, to make sure it is working properly and does not bruise or wound tubers, and continue to inspect during harvest to determine injury points. Potatoes should not be allowed to drop more than 4" to 6" and all equipment surfaces should be padded. Replace bare chain with rubberized links on all chains except the primary chain. Adjust chain and ground speed so that chains are loaded to full capacity during harvest, so that potatoes will 'flow' rather than drop from one chain to another. In many cases increasing ground speed helps achieve this. Avoid drops > 6 inches during all transfers and handling.

Temperatures of the fleshy interior of tuber (tuber pulp) temperatures around 60-65°F make the potatoes less susceptible to bruising and wounds compared to lower temperatures. Avoid harvesting at temperatures lower than 45 degrees as this increases the occurrence of bruising.

Since curing is done at 50-60°F, harvesting when pulp temperatures are in that range is ideal. The ability to move from field to curing pulp temperatures will depend on storage ventilation systems, varieties, availability of cooling air, and humidity controls. If potatoes are harvested during hot weather and cool off slowly, the likelihood of storage rot is increased. If active refrigeration is available, potatoes can be harvested at 62 to 65°F pulp temperature and cooled effectively. Storage areas with no refrigeration should not be loaded with potatoes with a pulp temperature above 60°F. Time your harvest when outdoor cooling air is available to allow ventilation with 3 to 6 hours of fresh air per day.

Curing.
The curing period, often referred to as suberization or wound healing, is one of the most critical storage phases. The curing period is also essential for the thickening and setting of the skin. This will increase tuber resistance to moisture loss and minimize entryways for rot-causing disease organisms. Wound healing is dependent on temperature and relative humidity. **Maintain temperatures in the range of 50-60°F with a relative humidity of 95% for 10 to 21 days.** A low relative humidity will result in poor suberization and the formation of a starchy layer over the bruise preventing healing. Weight loss is highest during the curing phase due to a combination of moisture losses from cuts and bruises and high respiration rates. As much as 2-4% of the tuber weight can be lost in the form of water during the first month. If managed properly, this water loss can be minimized, and can also be used to one's advantage as a means of maintaining a high relative humidity needed during the wound-healing process.

Uniform air movement is necessary during the curing process to remove heat of respiration and field heat, to supply oxygen, and to prevent condensation within the pile. Monitor temperatures within the tuber bins or pile to avoid heat buildup which increases tuber rot. Humidity should also be monitored. If available, a humidifier should be used to maintain the ventilating air at a relative humidity of 95%. Where a humidifier is not used, naturally occurring humid air can be used for ventilation, for 3 to 6 hours per day. In a through-the-pile forced air ventilation system, fans should be operated minimally, usually only 1 to 2 hours per 24 hours providing sufficient oxygen but minimizing moisture loss.

Curing may be accomplished within the space that will be used for storage, or in a different location. Diversified farms and those who are in the process of building up their fall/winter storage infrastructure may find it more challenging to provide the conditions for this step. On a small scale (up to about 1100 cubic feet), curing can be accomplished using a Cool-bot and humidifier in an insulated space. A combination of vents and fans to exhaust warm air and bring in cool air, controlled with RH and temperature sensors, can make best use of outdoor conditions to manage the indoor environment. Good environmental control is very difficult in an open barn situations.

Since even low light levels can cause development of chlorophyll (greening) and bitter, toxic glycol-alkaloids that render tubers unmarketable, all curing and storage should take place in the dark. Higher light levels cause faster greening, but 1 to 2 weeks in low light results in greening.

When tuber quality is poor. Potatoes affected by freezing injury, Pythium leak, late blight or soft rot will break down at normal curing temperatures. Eliminate the curing period, grade out the rot and sell immediately, or cool rapidly to 45 with low to medium RH. Questionable potato lots should be harvested closer to 55° F if they must be stored. Freezing occurs at 30°F, but chilling injury can occur after a few weeks at 32°F. Note that fields that were flooded by river water are considered contaminated and should not be harvested.

Disease management

Late blight spores can be carried by rainwater onto tubers and cause problems in storage but are only produced on live tissue, hence vine kill is key in disease management if late blight is present on the farm. If black scurf (*Rhizoctonia* spp.) or silver scurf (*Helminthosporium solani*) are present they will increase in severity as long as tubers remain in the soil. Wireworms can also cause tuber damage. If markets are ready or suitable storage is available, avoid these diseases and pests by starting harvest as soon as skins are set.

If the soil is wet during the harvest, soil may adhere to the tubers during harvest and promote infection by soft rotting organisms. Potato fields that have been saturated with water will be especially prone to post-harvest diseases. Bacterial soft rot (*Erwinia* spp.), *Fusarium* dry rot, pink rot (*Phytophthora erythroseptica*), and *Pythium* leak are four serious tuber rotting pathogens that cause the most significant losses in storage (see Potato Tuber Diseases in August 14, 2014 Vegetable Notes). A good online resource on tuber diseases can be found at http://vegetablemdonline.ppath.cornell.edu/factsheets/Potato_Detection.htm#Click2. However, finding a photo online that looks like your problem is not the same as having a plant pathologist confirm what is on YOUR tubers! Send samples to the UMass Plant Disease Diagnostic Lab (413-545-3209) to get an accurate diagnosis as different tuber blights need different management and proper identification will allow for better management practices and prevention next year.

Grade out diseased tubers *before* storage as much as possible. The longer they are mixed with healthy tubers, the higher the chance of disease spread.

Cooling and Storage. After the curing period, cool potatoes gradually and steadily to the holding temperature suited to your goals: 80-90% RH and 38-40 F for tablestock potatoes, seed potatoes, 45-50F for chipping, and 50-55 F for French fry stock. The upcoming October issue of Vegetable Notes will more details on storage.

--updated by R Hazzard, K. Campbell-Nelson, S. Scheufele and M.B Dicklow. Sources include 'Potato Storage Management: Curing and Cooling' by S. Menasha, Vegetable/Potato Specialist, LI Fruit and Vegetable Update 2012 & 2014, CE-Suffolk County; New England Vegetable Management Guide; Potato Production in the Northeast: A Guide to Integrated Pest Management, Chapter 5 by Dale D. Moyer 'Potato Storage Management'; and USDA Handbook 66, Potato.

Further resources;

1. For 2012 USDA Ag Census data by state: http://www.agcensus.usda.gov/Publications/2012/Full_Report/Census_by_State/
2. Potato postharvest disease control: "Application Equipment for Potato Post-Harvest Disease Control" (http://www.umext.maine.edu/onlinepubs/PDFpubs/2443.pdf) by Steven B. Johnson, University of Maine Cooperative Extension.
3. USDA Handbook 66, Potato. http://www.ba.ars.usda.gov/hb66/potato.pdf
4. Approved Chemicals for Use in Organic Postharvest Systems, Adapted by eXtension.org from: Silva, E. 2008. http://www.extension.org/pages/18355/approved-chemicals-for-use-in-organic-postharvest-systems#.VCRGMBbiuRk