Storing Produce

Storing Produce with Food Safety and Quality in Mind

Regular cleaning of food contact surfaces and storage facilities keeps the populations of pathogens, if present, to a minimum. While in storage, the two greatest forces going against food safety and quality are temperature and time. Excellent storage conditions and practices are key to having excellent product.

Temperature

- Whenever possible, establish zoned storage conditions according to temperature, relative humidity (RH), and ethylene requirements for different types of crops.
- Get field heat out as quickly as possible after harvest by washing or pre-cooling and assuring air flow in and around produce.
- Monitor temperature and RH regularly. Thermometers that can be seen from a high-traffic place are more likely to be read. Calibrate them on a regular schedule.
- Know the cooling capacity of your temperature-controlled storage areas. Over-stuffed coolers may overwhelm cooling systems leading to higher-than-desired temperatures and/or improper humidity.

Management

- Minimize the time between harvest and sale (aim for <72 hour unless long-term storage conditions are provided).
- Mark storage containers with chalk, tape or a label with the date of harvest, so you can pull produce from storage on a first-in, first-out basis. If applicable, use different color labels for different destinations (e.g., blue for farmers market; red for CSA).

Thinking like a Microbe!

Bacterial growth is highly dependent on temperature. Below 40°F, growth slows substantially, which is why we keep refrigerated units between 33°F and 39°F. Above 40°F, as temperature increases, bacterial growth rates also increase (more bacteria in less time) until high temperatures (like those found in a hot compost pile) start to slow and kill bacteria. To minimize bacterial growth, avoid temperatures between 40°F and 140°F. If produce is contaminated, the fewer bacteria present, the less likely your customers will get sick.

Some exceptions apply!

Listeria (see page 3) can grow at refrigerated temperatures. Be sure to disinfect coolers on a regular basis.

Produce sensitive to chilling injury is generally stored at slightly higher temperatures (50°F). Examples include eggplant, peppers, potatoes, cucumbers, beans and summer squash.

Ripe tomatoes, tomatillos, winter squash (including pumpkins) and sweet potatoes are generally stored between 55°F and 70°F.
UVM Extension Agricultural Engineer Chris Callahan’s Critical Considerations for VT Growers Storing Vegetables and Berries

Create Zoned Storage — While many are zoning (or grouping) their stored products based on optimal temperature and relative humidity (RH), it is also important to consider a zone for pre-cooling product as it comes into storage. The sudden addition of product with field heat and elevated respiration can contribute significantly to the cooling load in the room and could lead to slight warming of other crops already in storage. Consider ethylene production and sensitivity of crops; sometimes outside air exchange is required to remove the ethylene. In addition to apples, many common vegetables produce ethylene. Refer to the USDA Post-Harvest Guide for storage conditions including respiration rates and ethylene productions (see sidebar).

Measure and Monitor — Don’t assume you have the temperature and RH that you want. Check and document them daily so trends are captured. Low-tech measuring and monitoring includes wall sensors, daily checks and log book. Remote monitoring and e-mail alerts are high-tech examples.

Scout the Crops — Even with zoned storage, following storage recommendations, and measuring temperature and RH, spoilage can still occur. Conduct daily checks of stored produce to catch spoilage problems and prevent loss. Daily checks provide a chance to make storage condition adjustments. You may have to deviate from published storage recommendations for certain crops or varieties.

Check the cooler regularly —

Door Seals — From inside the cooler with the lights off and a partner outside, look around the door for light. If you see some, look closely at the seal in that area. It may need repair or replacement.

Door Closure Tightness — Even if your seals are in good condition, the door must shut snugly for the seals to work. Make sure there is no wiggle in the latch when the door is closed, and adjust as needed so it closes tightly.

Mold & Condensation — Inspect for mold and/or water condensation, as this may point to air circulation issues or air flow dead spots that need to be fixed.

Noise — Noise is energy. Be aware of new noises or more frequent operation of the compressor which can signal a significant change in the refrigeration system (a higher load, malfunction). The absence of noise can also signal a problem (i.e. compressor not functioning).

Coil Cleaning — Regularly clean air coils so that they remain clear of debris. If your system can’t reject heat (either inside the box or outside the box), you’re not cooling as effectively as you could, which means reduced efficiency, increased energy use, and possibly reduced storage efficacy leading to premature spoilage.

Mechanical Maintenance — To minimize systems failure and crop loss, have a trained

Crop Storage Resources:
New England Vegetable Management Guide: nevegetable.org/
UC Davis Post-Harvest Guide Technology Site postharvest.ucdavis.edu/
A walk-in cooler and controls for a CoolBot™ which adapts an air conditioner for use as a refrigeration system. Find information on CoolBots™ at: www.storeitcold.com/

For the latest in AgEngineering, check out Chris Callahan’s blog: www.blog.uvm.edu/cwcallah/
Includes a link to sign up for email newsletter.
For specific questions contact Chris directly:
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Cooler and Storage Area Cleaning and Maintenance

- Exclude birds, rodents, insects and domestic and wild animals from storage areas because they can introduce pathogens. If rodent traps are set in storage areas, check them daily. Do not use poison baits in food storage facilities.

- Clean storage areas and coolers as part of your regular routine.

- Avoid placing dry produce under wet produce or dripping condensers.

- Do not store allergenic foods such as milk, eggs, or soy in close proximity to produce and never above produce.

- Wash and disinfect coolers, including walls, floors and ceilings, at least once per season or more frequently if there are signs of mold or mildew or for high-traffic coolers.

Steps to Disinfecting or Sanitizing a Cooler

1. Remove all food from the cooler (best done when cooler is fairly empty)
2. Remove items that can more easily be washed and disinfected outside of the cooler (e.g., in a sink).
3. Sweep or vacuum floor litter (e.g., plant parts, fallen labels, soil etc.).
4. With soap or detergent and water, wash all cooler surfaces including shelving, starting in the back and moving towards the door. The washing step removes organic matter which can interfere with the disinfection process. Rinse.
5. Apply a sanitizer or disinfectant as per manufacturer’s instructions on the label for cleaning surfaces.

What is Listeria and how is it different from other bacteria?

Listeria is found in soil and water and can be carried by well-appearing animals that can directly contaminate meats and milk. Listeria in the environment (e.g., in soils, standing water, food processing areas) can be a source of contamination for produce.

Listeria is different from other bacteria in that it can multiply at refrigeration temperatures (<40°F). It can be killed by cooking, but because of its persistence on environmental surfaces Listeria can contaminate produce and ready-to-eat foods.

People can become ill with listeriosis after eating contaminated foods. Many will not develop illness, but those at higher risk (the elderly, people with weakened immune systems) can become very ill or die from the infection. Pregnant women are at highest risk of illness and can pass the infection on to their fetuses.