Postharvest Handling –
Best Practices for Cooling and Storing Okra and Eggplant

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Proper postharvest handling and storage of horticultural crops is an important factor in reducing losses and providing the best quality product to consumers. Controlling the temperature of the crop and also the time spent at less-than-optimal temperatures are the most important aspects of extending shelf life.

Key principles of postharvest handling

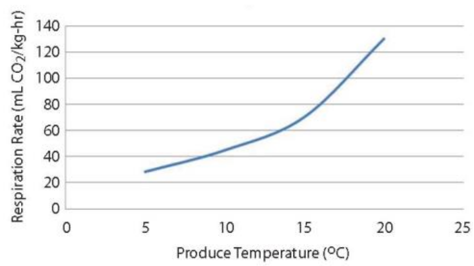


Figure 1. Respiration rate vs. produce temperature for typical horticultural produce such as okra or eggplant

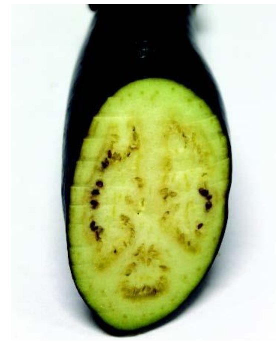
- Reducing the initial temperature of crops as quickly as possible after harvest to close to their optimal storage temperature is a crucial factor in maintaining quality.
- As produce temperature rises, so does the respiration rate (RR) of the crop (see Figure 1). The higher the respiration rate, the shorter the shelf life of the product.
- As horticultural products cool, their rate of temperature drop slows over the cooling time (see Figure 2 below).
- Initial cooling after harvest using a rapid cooling system will reduce RR quickly. Effective cooling involves achieving temperature uniformity across the mass of produce. The cooling system should be adjusted to the specific crop characteristics (see Specific handling procedures below).

General best practices to avoid postharvest quality loss

- Harvest in the morning when it is cool.
- Keep the product out of direct sunlight.
- Move the product to the sorting facility as soon as possible in order to remove damaged and diseased produce.
- Cool the product rapidly as soon as possible after harvest using an appropriate cooling method.
- Minimize rough handling of crop.

Chilling injury

Most warm weather fruit vegetables, including okra and eggplant, are chilling sensitive and are subject to chilling injury, making them generally unsuitable to long-term storage. Chilling injury is a physiological disorder associated with exposure to temperatures that are lower than the optimal recommended range for a crop. It is a common problem when handling tropical and subtropical crops. Although storage at low temperatures is common to prevent weight loss in many susceptible crops, temperatures below the ideal range will cause chilling injury in eggplant and okra.



Symptoms of chilling injury in eggplant can include browning of the pith and/or seeds. Here, mild damage is evident on eggplant stored below optimal temperature at 8°C for 5.5 days (Image by Kimberley Cathline). For more chilling injury images, visit:http://ucanr.org/sites/postharvest/pfvegetable/EggplantPhotos/

Freezing injury is also a concern and is initiated in eggplant at -0.8°C and freeze damage occurs at -1.8°C or below in okra.

See University of California Davis (UC Davis) crop links below for photos of chilling injury and properly stored world crops.

Notes on chilling injury

- It is not the same as freezing.
- It is cumulative and may be initiated in the field prior to harvest if temperatures drop below a particular crop's sensitivity threshold.
- Symptoms in okra may include discoloration, pitting, decay and water-soaked lesions.
- Symptoms in eggplant may include browning of seeds and flesh, surface bronzing, pitting, and calyx discoloration.

Specific handling procedures for okra and eggplant

Optimal temperatures, storage times, and relative humidity levels for okra:

- Temperature: 7°C – 10°C
- Relative Humidity: 95% – 100%
- Very good quality can be maintained for up to 7 to 10 days depending on the specific variety

Chilling injury symptoms in okra after 5.5 days stored below optimal temperatures at 2°C followed by 1 day in air at 20°C. Evidence of water-soaked lesions and discoloration are present (Image by Kimberley Cathline). For more chilling injury images, visit: http://ucanr.org/sites/postharvest/pfvegetable/OkraPhotos/

Optimal temperatures, storage times, and relative humidity levels for eggplant:

- Temperature: 10°C – 12°C
- Relative Humidity: 90% – 95%
- Storage of eggplant is generally less than 14 days depending on the specific variety, as visual and sensory qualities deteriorate rapidly

Both okra and eggplant are susceptible to bruising and compression injuries. Chilling and injury-enhanced rots are a common cause of postharvest loss in okra and eggplant. To prevent such losses, handle these crops with care at the harvest and storage stages and avoid over-packing containers.

Cooling system recommendations

Initial cooling of horticultural crops can be accomplished through a variety of systems. Forced-air cooling is effective at removing field heat and is used successfully across a wide variety of crops including okra and eggplant. Forced-air cooling is the most adaptable cooling method and can be used across a greater range of products than any other cooling method. This type of cooling system forces cold air through containers of produce, quickly removing field heat and thus reducing the respiration rate. The room cooling method, which is much slower at removing field heat and is generally used for crops that have a long storage life, can result in excessive water loss for perishable crops. Walk-in coolers can easily be modified to incorporate forced-air tunnels with the use of fans and partitions. For more information on forced-air cooling please see OMAF Factsheet 98-031 http://www.omafra.gov.on.ca/english/engineer/facts/98-031.htm

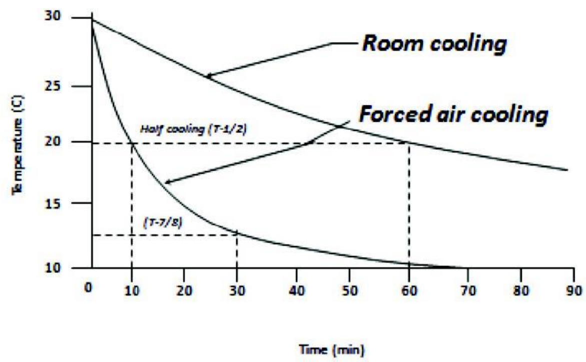
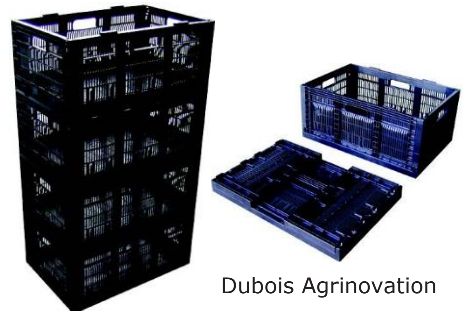


Figure 2 - Cooling method comparison. Half-cooling is the time that it takes to cool a product half-way from its initial temperature to the temperature of the cooling medium. In this example, forced-air cooling, using air at 10°C, reduces the horticultural produce to 20°C in a half-cooling time (T-1/2) of 10 minutes, as compared to requiring six times longer for room cooling, or 60 minutes.

Basic Forced-Air Cooling System. Using a forced-air system, stacks of produce containers are placed on either side of an open middle aisle as shown above, with an exhaust fan at one end. The aisle and open end are covered with canvas to form a tunnel. The fan pulls cold air from the cold room through the containers (and produce), then into the tunnel and to the fan to quickly remove the field heat from the produce. Note that the pull of the air by the fan should cause the canvas to ‘suck’ tightly against the tunnel as it is important to ensure the cooling air goes through the containers of produce and does not ‘shortcircuit’ somewhere else on its way towards the fan (image by Clément Vigneault, Horticulture Research and Development Centre).

Choosing the right produce boxes or bins

The container used for cooling and storage is also an important factor in effective cooling. Containers should allow for airflow across the product. The smaller the percentage of opening area in the container, the slower the cooling rate. The shape of the containers is also important. Avoid containers that taper at the bottom as air will then take the path of least resistance and travel through gaps created in between the stacks of containers, rather than forcing air to the openings in the containers and across the product.



Dubois Agrinovation

An example of ideal horticultural produce cooling and storage crates e.g. SmartCrate™ by Dubois Agrinovation.

Further reading

University of California–Davis Postharvest Resources:

- Summary of UC Davis Postharvest Publications - http://postharvest.ucdavis.edu/libraries/publications/
- Summary of UC Davis Postharvest Libraries - http://postharvest.ucdavis.edu/libraries/
- Okra specs - http://postharvest.ucdavis.edu/pfvegetable/Okra/
- Eggplant specs - http://postharvest.ucdavis.edu/pfvegetable/Eggplant/
- Tomatillo specs - http://postharvest.ucdavis.edu/pfvegetable/tomatillo
- Chili Pepper specs - http://postharvest.ucdavis.edu/pfvegetable/ChilePeppers/

Dytrade.com

Clément Vigneault

Improper storage containers such as those with tapering (left) and small openings (right) make it difficult to cool the produce rapidly.

Ontario Ministry of Agriculture and Food (OMAF) Postharvest Resources:

- Tunnel Forced-Air Coolers for Fresh Fruits & Vegetables by Hugh W. Fraser, P.Eng. - http://www.omafra.gov.on.ca/english/engineer/facts/98-031.htm
- Troubleshooting Cold Storage Problems by Hugh W. Fraser, P.Eng. - http://www.omafra.gov.on.ca/english/engineer/facts/94-083.htm
- Sizing and Laying Out a Short-Term (Summer) Refrigerated Storage for Fruits and Vegetables by Hugh W. Fraser, P.Eng. - http://www.omafra.gov.on.ca/english/engineer/facts/92-124.htm

Sources

Kader, A.A. (2002). Postharvest technology of horticultural crops (3r ed.). University of California, Agriculture and Natural Resources, Publication 3311, 535p.

Cantwell, M. & Suslow, T. Okra: Recommendations for maintaining postharvest quality. University of California–Davis. Retrieved from: http://postharvest.ucdavis.edu/pfvegetable/Okra/

Cantwell, M. & Suslow, T. Eggplant: Recommendations for maintaining postharvest quality. University of California–Davis. Retrieved from: http://postharvest.ucdavis.edu/pfvegetable/Eggplant/