Department of Horticultural Science

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POSTHARVEST HANDLING AND COOLING OF FRESH FRUITS, VEGETABLES, AND FLOWERS FOR SMALL FARMS

Part II: Cooling

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Field heat should be removed from fresh fruits, vegetables, and flowers as quickly as possible after harvest. Each commodity should be maintained at its lowest safe temperature. Cooling and storage requirements for specific commodities are presented below, in NC Cooperative Extension Service Publication AG-414-1, and USDA Agricultural Handbook No. 66.

Proper postharvest cooling can:

- Suppress enzymatic degradation (softening) and respiratory activity
- Slow or inhibit water loss (wilting)
- Slow or inhibit the growth of decay-producing microorganisms (molds and bacteria)
- Reduce the production of ethylene (a ripening agent) or minimize the commodity's reaction to ethylene

In addition to protecting quality, postharvest cooling enhances marketing flexibility by making it possible to market fruits, vegetables, and flowers at more optimum times. The ability to cool and store commodities minimizes the need to market immediately after harvest. This can be an advantage for high-volume growers as well as pick-your-own (P-Y-O) operators and those who wish to supply restaurants and grocery stores.

Field heat removal method choices depend on several factors, including:

- **Temperature of commodity** – when harvested.
- **Nature of the commodity(ies)** – type of product (e.g., leafy greens, flowers, fruit) respiration rate(s), cooling requirements, lowest safe temperature, tolerance of exposure to water.
- **Product packaging requirements** – box, bin, or bag; because packaging materials and design configurations affect method and rate of cooling.
- **Product flow capacity** – volume of commodities which must be handled per unit of time will determine the appropriateness of cooling methods and systems.
- **Mix of commodities** – compatibility depends on their **nature** with regard to sensitivity to odors and volatiles, such as ethylene.
- **Economic constraints** – construction and operating costs vary among methods; expense must be justified by volume and/or price increases related to cooled products.
- **Market requirements or expectations** – e.g., top-icing broccoli.

Common Produce Cooling Methods

Room Cooling – Placing commodities in an insulated room equipped with refrigeration

units to chill the air. This method can be used with most commodities, but is slow compared methods discussed below. Used refrigerated truck bodies make excellent small storage rooms.

Forced-air cooling – Used in conjunction with a cooling room is effective for most packaged commodities, and is 75 to 90% faster than room cooling. Fans should be equipped with a thermostat that automatically shuts them off as soon as the desired product temperature is reached. **Do not operate forced-air fans after the commodity has been cooled to its optimum temperature.** A low-cost, portable, forced-air pallet cooling system has been developed for small quantities of a commodity (see reference).

Hydrocooling – Can be used on most commodities that are not sensitive to wetting. Water removes heat about 5 times faster than air, but is less energy efficient. Mechanical refrigeration is the most efficient method of cooling water. A thermal storage immersion hydrocooler system can be economically fabricated for various volume needs. Ice in water will also provide a source of coolant. Used, stainless steel bulk farm milk coolers may be excellent options for some growers. If hydrocooling water is recirculated, it should be chlorinated to minimize disease problems.

Top or liquid icing – May be used on a variety of commodities and is particularly effective on dense and palletized packages that are difficult to cool with forced air. Because of its residual effect ice methods work well with high respiration commodities such as sweet corn and broccoli. One pound of ice will cool about three pounds of a commodity from 85 ^{0} to 40 ^{0}F.

Refrigerated trucks are not designed to cool fresh commodities. They can only maintain the temperature of loaded products, so **cool commodities before loading.**

Alternate Cooling Sources

Field heat removal is a function of exposing products to an environment which has a temperature lower than that of the commodity. When the above-mentioned cooling methods are neither practical nor expedient to employ, alternatives that will often suffice, especially for smaller volumes of commodities, include the following:

- **Well water –** Temperatures are usually in the 50 ^{0} to 60 ^{0}F range.
- **Night-time –** Air temperatures are usually cooler from sundown to sun-up, good time to harvest some commodities.
- **Streams –** Water temperatures are usually cooler than air, especially if flowing from mountains. Test to be certain that this water is free of contaminants.
- **Altitude –** If easily accessible, higher elevations can provide cooling.
- **Cellars/Caves –** Generally maintain fairly constant, cooler-than-air temperatures.
- **Discarded truck bodies, etc.** – Can be buried in hillsides for storage of some commodities.
- **Shade –** If refrigeration is not available, at least keep commodities from warming up.
- **Time of harvest –** Mornings are preferred, when commodities are usually coolest.

Cooling and Storage Requirements of North Carolina Commodities

Commodity	Suitable Cooling Method(s)*	Optimum Temp. ^{0}F	Freezing** Temp. ^{0}F	Optimum Humidity %	Normal Storage Life
Apples	R,F,H	30-40	29	90-95	1-12 months
Asparagus	H,I	36	31	95-100	2-3 weeks
Beans, snap	R,F,H	40-45	31	95	7-10 days
Beans, butter	R,F,H	37-41	31	95	5-7 days
Beets, topped	R	32	30	98-100	4-6 months
Blueberries	R,F	32	30	90-95	2 weeks
Brambles	R,F	32	30	90-95	3-5 days
Broccoli	I	32	31	95-100	2 weeks
Cabbage	R,F	32	30	98-100	1-6 months
Cantaloupes	H,I	32-40	30	95	2 weeks
Cucumbers	F,H	45-50	31	95	2 weeks
Eggplant	R,F	45-54	31	90-95	1 week
Green onions	H,I	32	30	95-100	3-4 weeks
Herbs	R	37-38 #	31	95-100	5-7 days
Leafy greens	H,I	32	30	95-100	1-2 weeks
Okra	R,F	45-50	29	90-95	7-10 days
Peaches	F,H	32	30	90-95	2-4 weeks
Peas	F,H	32	31	95-98	1-2 weeks
Peas, field	F,H	40-41	30	95	6-8 days
Peppers	R,F	45-50	31	90-95	2-3 weeks
Potatoes	R,F	38-40	31	90-95	5-8 months
Squash, soft-shell	R,F	45-50	31	95	1-2 weeks
Strawberries	R,F	32	31	90-95	5-7 days
Sweet corn	H,I	32	31	95-98	5-8 days
Sweetpotatoes	R	55	31	90	6-12 months
Tomatoes, pink	R,F	46-50	31	90-95	1 week
Turnips	R	32	30	95	4-5 months
Watermelons	R	50-60	31	90	2-3 weeks

* R = room cooling; F = forced air cooling; H = hydrocooling; I = icing

** CAUTION: Chilling injury may occur in some commodities at 10 ^{0} to 20 ^{0}F above freezing

\# Optimum for most herbs; basil 48 ^{0} to 50 ^{0}F, arrugula 35 ^{0} to 37 ^{0}F.