

Getting the Most Out of Your Crops: Postharvest Tips and Tricks for Harvesting, Cooling and Storing Produce

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Quality cannot be
improved
after harvest,
only maintained.

High quality produce results from:

- Sound production practices
- Proper handling during harvest
- Appropriate postharvest handling & storage

Quality starts with variety selection:

- Firmness
- Uniformity
- Disease & pest resistance
- Shelf-life
- Flavor



Match the variety to your market & needs!

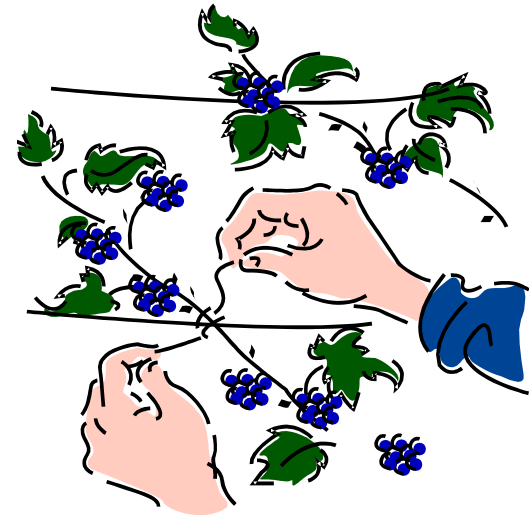
Environmental factors that affect quality:

- Soil type
- Temperature
- Frost
- Rainy weather at harvest



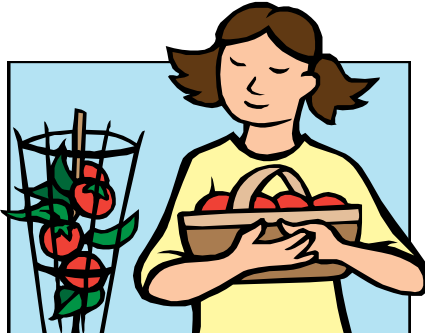
Cultural practices that affect quality:

- Plastic vs. bareground
- Trellising
- High tunnels
- Tools and equipment
- Irrigation practices
- Postharvest handling



When is it time to harvest?

- Most crops are harvested based on size and maturity
- Many crops will have better quality and shelf-life if picked *slightly* immature
- Too early = insufficient size, poor sugar content and vitamins
- Too late = too much fiber, conversion of sugars into starches, decrease in plant productivity, potential to attract pests



Ripeness & Maturity

Pick immature

- Green bell pepper
- Cucumber
- Summer squash
- Snapbeans
- Sweet pea
- Okra
- Eggplant
- Sweet corn

Pick mature (vine ripe)

- Tomatoes
- Red peppers
- Muskmelon
- Cantaloupe
- Watermelon
- Winter squash
- Pumpkin
- Dry beans

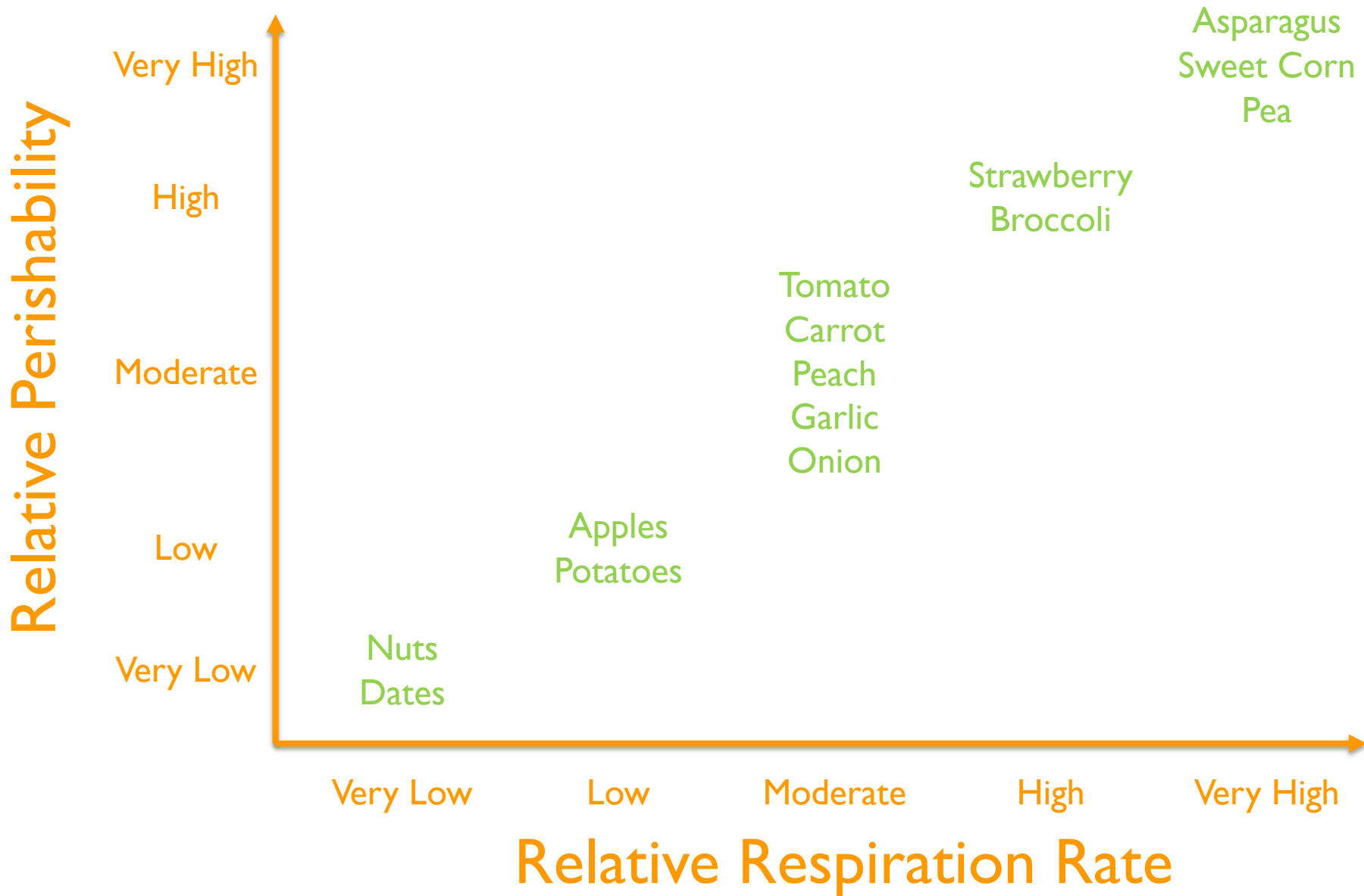
Postharvest handling

- Respiration
- Transpiration
- Temperature
- Relative humidity



Respiration

- Process by which food reserves are oxidized to produce energy to keep the fruit or vegetable alive
- Results in deterioration (loss of nutrients, changes in texture and flavor, weight loss)
- Respiration rates vary by commodity
- Once harvested, the clock is ticking!



Transpiration

- The process of losing water to the environment
- After harvest, produce can no longer obtain water through the roots of the plant
- Water loss causes wilting, shriveling and softening, as well as loss of weight, crispiness, juiciness, nutritional quality and flavor

Relative Humidity

- Measure of degree to which the air is saturated with water vapor
- Rate of water loss depends on:
 1. The relative humidity difference between the intercellular structure and the surrounding air
 2. The surface characteristics of the produce
- For most vegetable crops, high RH (80-95%) = longer shelf-life, but can encourage disease
- Cool temps and sanitation can help prevent disease
- Buckets of water and humidifiers can increase RH

Temperature

- Most important factor in maintaining quality!
- Remove or prevent field heat as much as possible
- Remember fruits and vegetables are ALIVE:
 - Heat increases water loss and respiration and reduces storage life and quality
 - The higher the storage temperature, the shorter the shelf-life



Harvest tips



- Harvest in the morning hours
- But... harvest dry...
- Keep produce out of the sun!
- Handle with care- bruising reduces quality
- Move to cold storage ASAP
- Don't mingle damaged produce with high quality produce
- Use clean and sanitized harvest bins
- Handle no more than necessary (field pack)



Real. Life. Solutions.

Field Packing

- Reduce steps in handling chain = reduce potential damage (impact, compression and abrasion)
- Good for soft fruits, leafy crops (berries, lettuce, spinach)
- Reduce contact of container with soil
- A small cart can reduce the amount of bending & lifting for the picker



Shade and Mobility

Golf carts
Hand carts
Trailers
Lightweight
stands
Pop-up tents



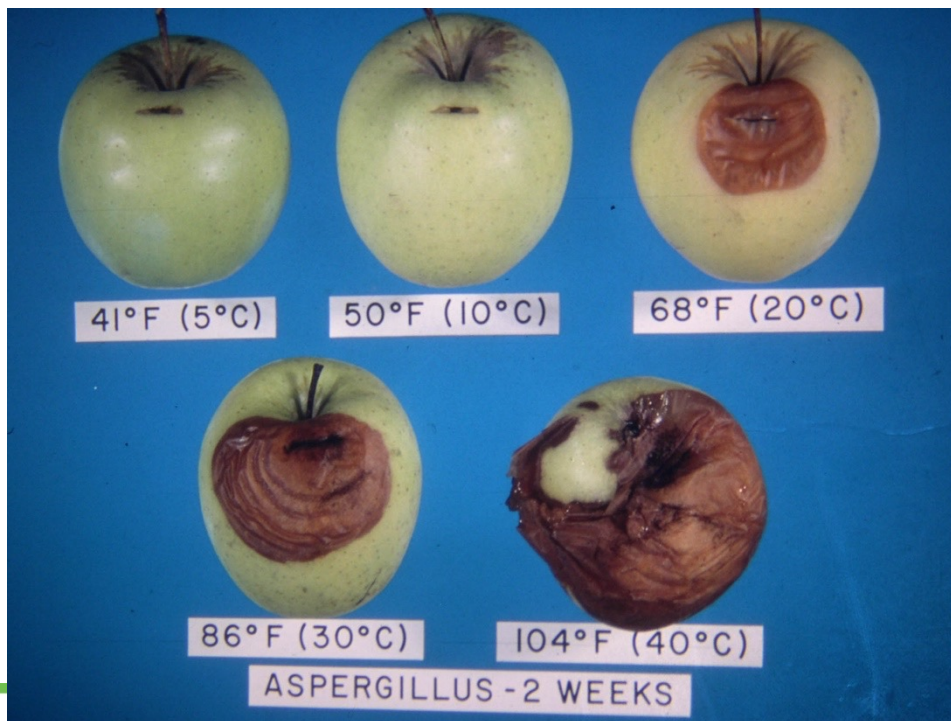
Don't Harvest Until You Need Them!

- Root crops (carrots, beets, turnips) can be left in the ground through winter, if mulched 1-2" thick.
 - Not if soil freezes solid!
 - Cool temps also improve the flavor of these crops.



Room Cooling

- Will prolong shelf-life from hours to weeks
- Want large enough to handle projected back ups of product



Room Air Conditioner Unit for Cooling

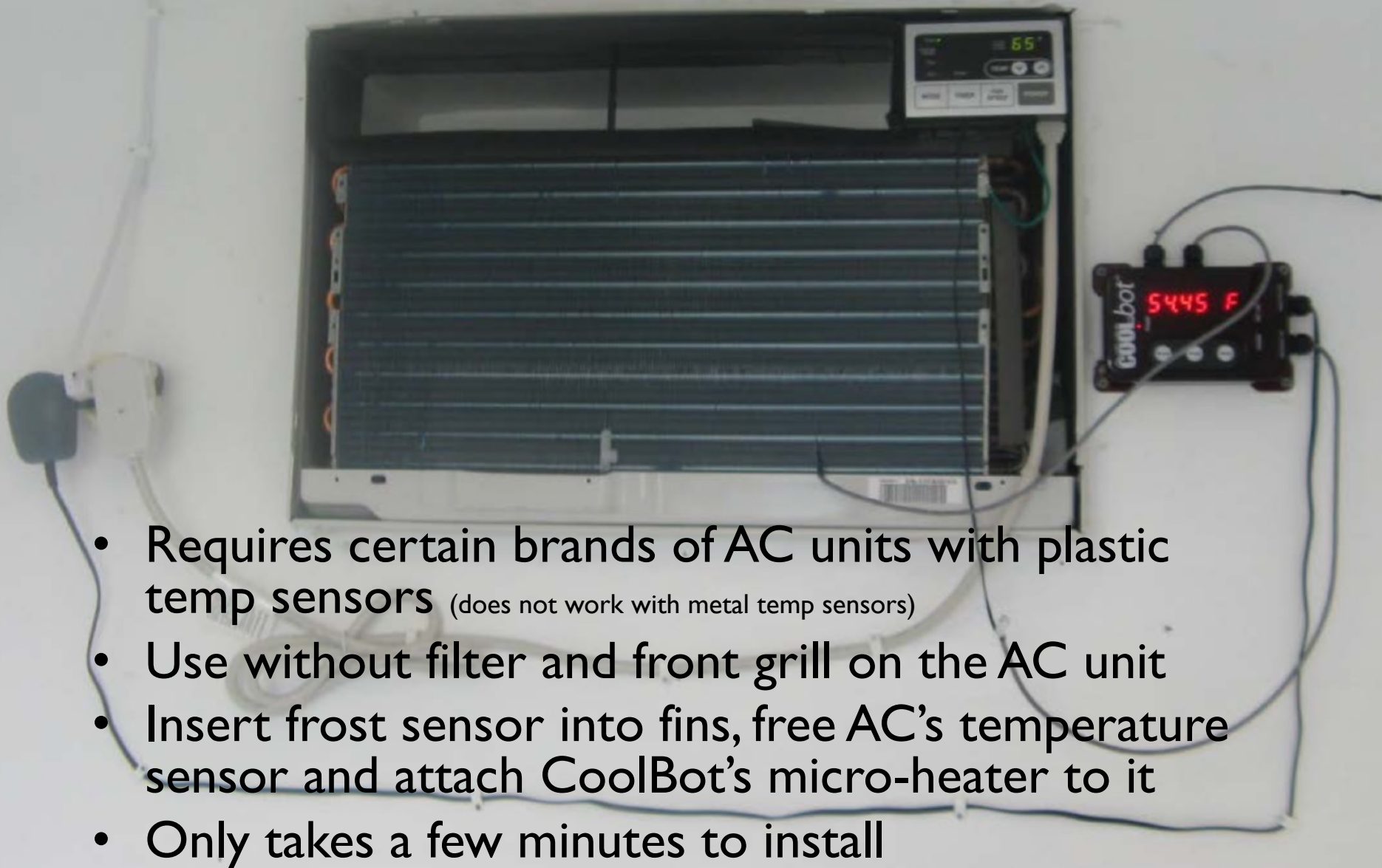
- Advantages
 - Low cost
 - Easy to install
- Disadvantages
 - Coils will freeze up if you attempt to cool below about 60 degrees
 - Those who are electrically inclined can overcome this, but it's cumbersome to rig up and hard to maintain

Coolbot



- Overcomes limitations of air conditioner
- From Store it Cold, LLC¹
 - About \$350 + AC unit
 - Newer CoolBot Pro with WiFi connectivity and mobile app (\$399)
- Prevents freeze up by cycling compressor on and off based on sensor readings of room temp and frost on cooling coils and by 'fooling' the AC's temperature sensor with a tiny micro-heater
- Can cool to 33 degrees with sufficient capacity AC unit
- Simple digital controls and readout, and simple to install

¹Mention of a trademark, proprietary product or firm does not constitute an endorsement and does not imply approval to the exclusion of other suitable products.



- Requires certain brands of AC units with plastic temp sensors (does not work with metal temp sensors)
- Use without filter and front grill on the AC unit
- Insert frost sensor into fins, free AC's temperature sensor and attach CoolBot's micro-heater to it
- Only takes a few minutes to install



Can be iced

**Damaged by direct
contact with ice**

Asparagus
Beets
Broccoli
Cantaloupes
Carrots
Cauliflower
Green Onions
Leafy Greens
Radishes
Spinach
Sweet Corn
Watermelon

Strawberries
Blueberries
Raspberries
Tomatoes
Squash
Green Beans
Cucumbers
Garlic
Okra
Bulb Onions
Romaine Lettuce
Herbs



Chilling Injury

- Some vegetables best stored between 45-55 °F
- Both time + temperature determine extent of injury
- Highly sensitive crops: basil, cucumbers, eggplant, pumpkins, summer squash, okra and sweet potatoes
- Moderately sensitive crops: snap beans, muskmelon, peppers, winter squash and tomatoes
- Symptoms: pitting, discoloration, failure to ripen, susceptible to decay



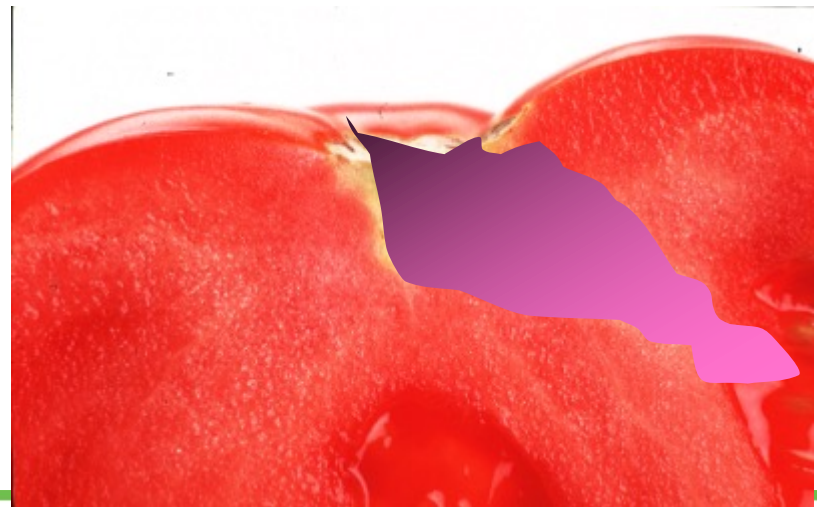
Washing

- Washing prior to marketing is essential for many vegetables
- Need a plentiful source of clean water
- Change water often
- Brushing may be necessary for root crops (potatoes, beets, carrots)
- Thoroughly drain leafy greens before bagging/storing-
better yet, don't get them wet!
- Don't wash damaged or diseased produce
- Water should have a sanitizer



Bacteria can enter the stem scar with improper handling or wash water management

Fruit pulp must be <10 °F warmer than water temperature to prevent infiltration.



Crops NOT to wash before market:

- Berries
- Spinach (unless overly dirty)
- Basil
- Summer squash



How long will they last?



Storage of Fresh Produce

Storing produce at the proper temperature is critical to obtaining the longest shelf-life. Table 1 provides the optimal storage temperature and shelf-life for each commodity. If a crop is stored at higher than ideal temperatures, the shelf-life will be reduced. Similarly, if a crop is stored at a lower than ideal temperature, freezing or chilling injury could compromise the shelf-life.

Table 1. Fruit and vegetable storage conditions and shelf-life.

Crop	Ideal Storage Temperature (°F)	Shelf-Life at Ideal Storage Temperature
Apples	30-40	1-12 months
Asparagus	32-35	2-3 weeks
Beans, Butter/Lima	37-41	5-7 days
Beans, Snap	40-45	7-10 days
Beets, Topped	32	4-6 months
Blackberries	31-32	2-3 days
Blueberries	31-32	1-2 weeks
Boysenberries	31-32	2-3 days
Broccoli	32	10-14 days
Brussels sprouts	32	3-5 weeks

Storage Temperatures

Cooler #1 (at 32 °F)

- Asparagus
- Beets
- Carrots
- Crucifers
- Lettuce
- Ripe muskmelon
- Onion
- Parsley
- Spinach
- Radishes
- Sweet corn

Cooler #2 (at 50 °F)

- Green beans
- Cucumbers
- Eggplant
- Sweet peppers
- Potatoes
- Pumpkins
- Summer squash
- Ripe tomatoes
- Watermelon
- Winter squash

Ethylene

- Promotes ripening and susceptibility to disease
- Damaged and diseased crops produce high levels of ethylene
- Don't store ethylene producers with sensitive crops!



Ethylene producers:

- Apples
- Apricots
- Avocadoes
- Ripening bananas
- Cantaloupe and honeydew
- Peaches
- Pears
- Persimmons
- Plums
- Quinces
- Tomatoes



Ethylene sensitive:

- Asparagus
- Snapbeans
- Broccoli
- Brussels sprouts
- Cabbage
- Carrots
- Celery
- Cucumbers
- Eggplant
- Lettuce
- Sweet potatoes
- Okra
- Bell peppers
- Summer squash
- Spinach



Acknowledgements + Resources

- Small-Scale Postharvest Handling Practices, Kitinoja, L. & Kader, A.A., 1994, University of California, Davis, CA
- Cornell University, National GAPs Program:
<https://gaps.cornell.edu>
- ATTRA Postharvest Handling of Fruits and Vegetables:
<https://attra.ncat.org/product/postharvest-handling-of-fruits-and-vegetables/>
- Locally Grown Produce Series: Storage of Fresh Produce:
<https://extension.tennessee.edu/publications/Documents/SP768-F.pdf>
- UC Davis Postharvest Produce Fact Sheets:
http://postharvest.ucdavis.edu/Commodity_Resources/Fact_Sheets/
- Growing for Market- Designing and building a storage facility (subscription required): <https://www.growingformarket.com>

More Resources

- CoolBot: <https://www.storeitcold.com>
- NCSU Pack N' Cool: <https://plantsforhumanhealth.ncsu.edu/2012/08/20/pack-n-cool/>
- Low Cost Cold Storage, John Wilhoit: https://ag.purdue.edu/extension/Documents/SmallFarms%20Documents/SFC%202016%20Presentations/CoolingEquipment_Wilhoit_SFC_2016.pdf
- NCSU Cool and Ship: <https://content.ces.ncsu.edu/cool-and-ship-a-low-cost-portable-forced-air-cooling-unit>
- USDA PortaCooler: <https://ncfreshproducesafety.ces.ncsu.edu/wp-content/uploads/2014/03/Portacooler-USDA.pdf? fwd=no>
- REMOTE Walls: <http://cchrc.org/remote-walls/>

Thank you!

Questions?

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