

Storing Vegetables and Fruits at Home

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Reviewed by Virginia "Val" Hillers, Extension Food Specialist,
Department of Food Science and Human Nutrition,
Washington State University

Many vegetables and fruits can be stored in pits, cellars or basements without refrigeration during cool fall and cold winter months. Successful storage, however, depends on providing the right temperature, humidity, and ventilation.

Outdoor Storage

Produce that requires cool-to-cold moist surroundings can be stored outdoors. All outdoor storage has the disadvantage of being unaccessible sometimes and subject to damage by rodents and other vermin. A well-drained location is essential to prevent excessive accumulation of water.

Usually the produce must be insulated for protection from frost and fluctuating temperatures. Insulating materials commonly used are straw, hay, dry leaves, corn stalks, or wood shavings, and some soil. Be sure that the insulating materials used are not contaminated with pesticides.

In-Garden Storage

It is possible to leave some root crops, such as carrots, turnips, and parsnips in the garden where they grew, for part or all of the winter. (See fig. 1.) After the ground begins to freeze in the late fall, cover the root crops with a foot or more of mulch—straw, hay, or dry leaves. Do not place mulch on warm soil because doing so will cause vegetables to decay rapidly. Wait until the ground is cold.

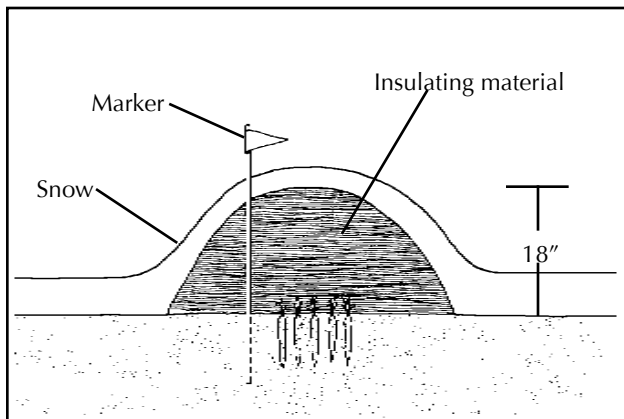


Figure 1. In-garden storage.

Produce can be difficult to dig out of the frozen ground, but it will not be adversely affected until the temperature around the roots drops to 25°F or less. Carrots are damaged at about 25°F, but parsnips can stand somewhat lower temperatures.

If rodents are a problem, it may be wise to store produce in a buried container or an indoor storage area. One gopher can consume a whole row of carrots left in the ground.

Parsnips, horseradish, and turnips actually improve in flavor by light freezing. At temperatures between 28°F and 34°F, the starch changes to sugar.

Other crops, such as beets, cabbage, Chinese cabbage, cauliflower, celery, endive, cos or romaine lettuce, kale, leeks, and onions can withstand the early light frosts and can be stored for several weeks under a heavy mulch.

Mounds, Pits

Mounds or pits are a very economical way to store cabbage and root crops, such as carrots, beets, celeriac, kohlrabi, rutabagas, turnips, and winter radishes. (See fig. 2.)

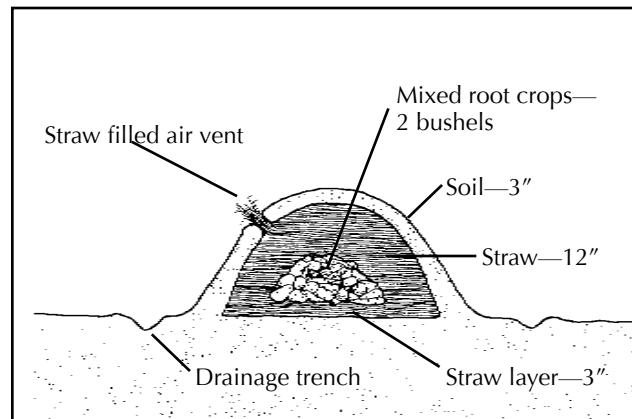


Figure 2. Mound storage.

Select a well-drained location, and cover the ground with an insulating mulch. Making a shallow excavation (from 6 to 10 inches deep) and placing the produce partly below the surface will ensure better frost protection, but it will also increase the danger of excess water. Place mulch over vegetables. A ditch around the storage perimeter will help remove surface water.

Vegetables keep very well in pits and mounds, but once these storage areas are opened all the produce should be removed. After it's removed, the produce will keep for 1 or 2 weeks at most. It does not keep as long after removal from storage as will freshly harvested produce.

Root crops can be mixed, but should be separated with mulch to prevent cross-transfer of odors. (See "Separating Fruits and Vegetables," ahead.)

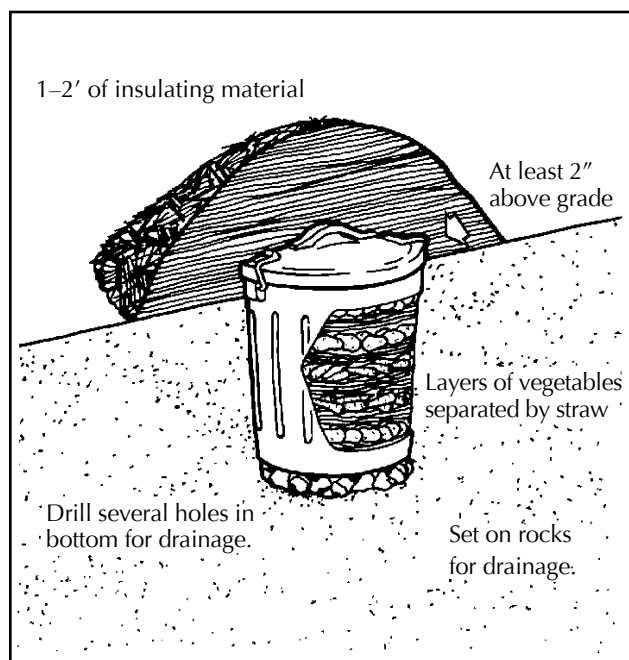


Figure 3. Buried trash can storage.

Buried Containers

A 20-gallon trash can, buried in the ground, makes a convenient and economical storage for many kinds of vegetables. Metal cans are more rodent proof than plastic. (See fig. 3.)

Several holes should be made in the bottom to facilitate drainage. The container must be free of substances that might give off-flavor to the produce. **Never use drums or containers that might have held pesticides or other chemicals.**

An insulated box or other container can be buried in a well-drained area. Buried containers are more easily opened and closed than mounds and trenches. This type of storage could be located in a breezeway, shed, or garage for easier access and greater frost protection. However, if you plan to store food in or near a garage, you must more carefully wrap and protect the produce from car fumes, which produce easily picks up. (See fig. 4.)

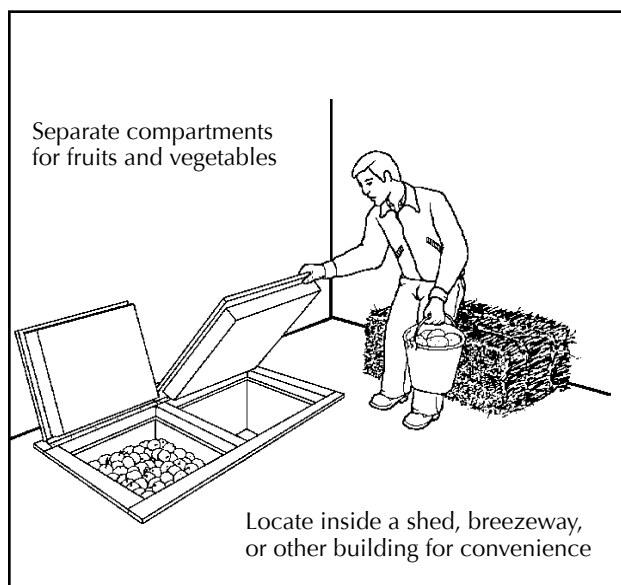


Figure 4. Buried insulated box storage.

Indoor Storage Area

There are many areas in dwellings that naturally provide, or can be adapted to provide a variety of temperature and moisture conditions for storage. These include the attic, unheated rooms, the basement, or cellar. (See fig. 5)

Assess your own storage possibilities. Use a thermometer to monitor temperatures. Any spot that is sufficiently and evenly cool (32°F–60°F) can be adapted for some type of food storage. The relative humidity of these locations will also affect what type of produce can be stored.

Even basement window wells can be converted to small storage areas. They can provide cool, moderately moist conditions and can be used to store some types of apples or a variety of root crops. But be sure to separate the produce properly. (See “Separating Fruits and Vegetables,” ahead.) Insulate produce with bales of hay or straw.

A pantry or unheated room is useful for short-term storage of potatoes and onions, and long-term storage of spices, vegetable oils, nuts, and commercially

canned goods. Low storage temperatures extend the shelf life of dried foods, such as dried beans, herbs, dried fruits and vegetables, and the life of other products, such as coffee, flour, rice, pasta, and cereals.

Use containers with tight-fitting lids to keep humidity low and rodents and insects out. Guard against freezing when storing in unheated areas.

A warm storage area, such as an attic, can be a good environment in the fall for drying herbs, beans, walnuts, or hickory nuts.

Basement

A well-ventilated basement with central heating is generally dry and has a temperature range of 50°F to 60°F. It may be used for ripening tomatoes and for short-term storage of pumpkins, winter squash, potatoes, sweet potatoes, and onions.

If you will be storing only a small amount of produce, an old refrigerator placed in one corner of the basement may be an excellent investment. It can be used for storing head lettuce, cauliflower or cabbage, or apples.

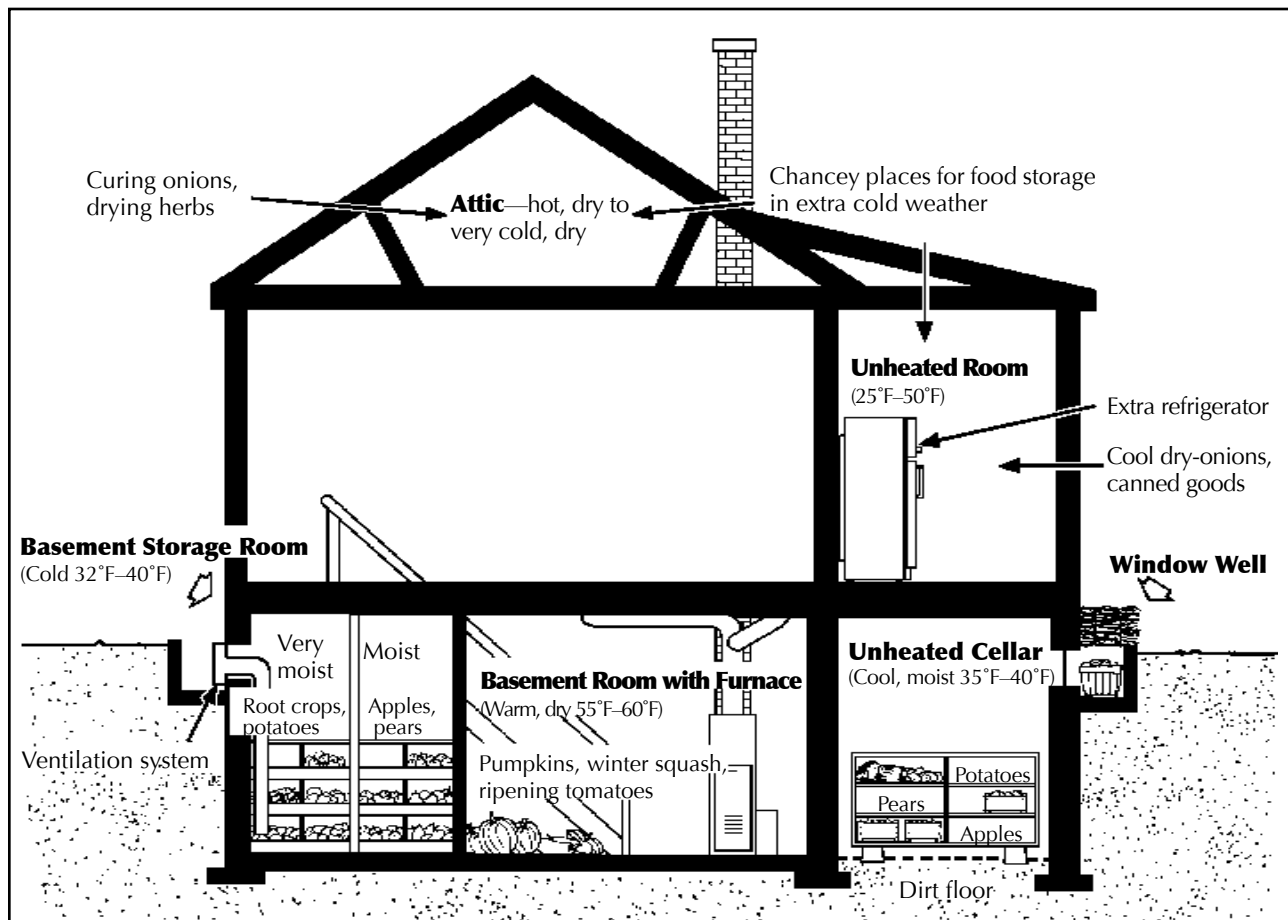


Figure 5. Areas in a house that could be used for storage.

Basement Storage Room

For long-term storage over winter you will need to partition off a room and insulate it to control temperature and moisture.

Build a storage room on the north or east side of the basement, if practicable, and make sure there are no heating ducts or pipes running through it. You will need at least one window for cooling and ventilating the room. Two or more windows are desirable, particularly if the room is divided for separate storage of fruits and vegetables.

A room 4 x 4 x 6 feet is large enough for most households. An area 6 x 7 x 7 feet will hold approximately 30 bushels of produce—5 bushels per month for 6 months. An area 8 x 10 x 7 feet will hold approximately 60 bushels of produce—10 bushels per month for 6 months. (See fig. 6)

To deter rodents, carefully install sheathings or screens on the partition walls so there are no openings at the floor or ceiling. Young mice can crawl through a quarter-inch hole. (See fig. 7)

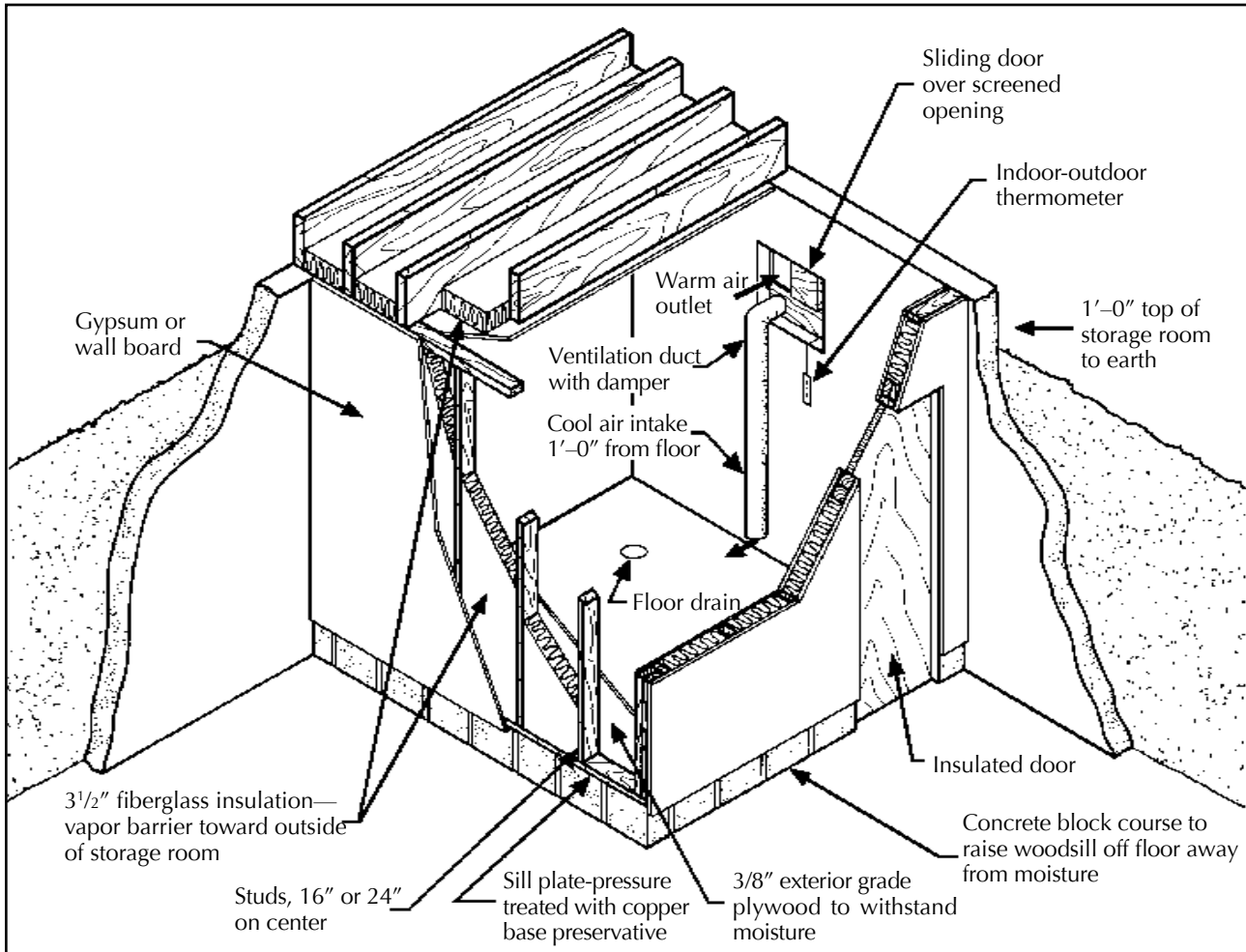


Figure 6. Basement storage.

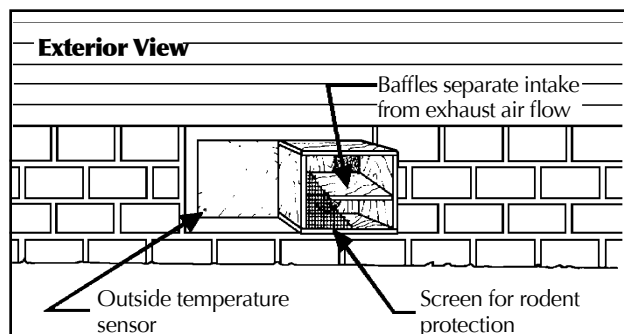


Figure 7. Basement storage ventilation system.

Managing a Storage Area

Regulating the Temperature

Proper temperatures are critical to long-term storage of vegetables and fruits. Improper temperatures, whether too cool or too warm, can cause rapid deterioration of produce quality.

Two reliable thermometers (preferably that record minimum and maximum temperatures) should be used to observe and regulate storage temperatures carefully. Place one thermometer in the coldest location of the basement or cellar, and place the other thermometer outdoors. Regulate storage temperature by opening and closing doors, windows, or other openings used as ventilators.

Outdoor temperatures well below 32°F are necessary to cool storage air to 32°F and to maintain that temperature. Once cooled to 32°F, the temperature will rise again if ventilators are closed, even when outdoor temperature is about 25°F. Close ventilators tightly whenever the outdoor temperature is higher than the storage temperature. Watch indoor and outdoor temperatures closely. In most regions, daily adjustment of ventilators is usually necessary to maintain desired storage temperatures.

The danger of overventilating during subfreezing weather is that stored products will freeze if you are not careful. For example, in a study made of an insulated storage cellar partly above ground, full ventilation both day and night was necessary to maintain a temperature of 32°F if outdoor temperatures ranged between 18°F and 30°F during the day and dipped to 10°F at night. If minimum temperature at night, with normal air movement, was 8°F for 5 or 6 hours, the storage temperature dropped to 30°F. During a night of high wind, however, a minimum of 12°F cooled the cellar to 30°F.

Keep a pail of water in the storage area in very cold weather; water will freeze before the crops. However, very low temperatures can cause chilling injury to some produce, like potatoes, and leave them unusable or increase decay.

Maintaining Proper Moisture

The proper humidity level is also very important to long-term storage and maintenance of good quality produce. This is generally measured as relative humidity, which is the percentage of moisture in the atmosphere at a given time as related to the maximum amount (100%) that could be retained at that temperature. A humidity level of 95% is almost rainfall and rather difficult to achieve indoors.

A relative humidity of 90%–95% is very moist and good for storage of potatoes and other root crops. A relative humidity of 60%–75% is dry and good for storage of pumpkins and other squash.

Two ways of maintaining proper humidity are first, to use water to raise the humidity of the storage air, and secondly, to use ventilated polyethylene bags and box liners. Moisture can be added to storage air by

sprinkling the floor frequently, by placing large pans of water under fresh-air intake vents, by covering the floor with wet materials such as straw or odorless sawdust, or by a combination of these methods. However, these strategies will not prevent shriveling of root crops.

The easiest and most effective way to control moisture loss in root crops and in certain other crops is to put them in polyethylene bags or box liners. Cut many $\frac{1}{4}$ - to $\frac{3}{8}$ -inch holes in the sides of the bags or liners to permit ventilation. Tie the bags and fold over the tops of box liners, but do not seal them.

Excessive humidity is conducive to mold and decay organisms, if water droplets are allowed to form on the surface of the product. Plastic bags and liners used for moisture retention should always be perforated at regular intervals to permit air circulation and prevent condensation.

Sanitation

At least once a year, remove all containers from the storage area and clean and air them in the sun. The room itself should also be thoroughly aired, cleaned and washed down with a disinfectant, such as diluted chlorine bleach (1 cup bleach mixed with 9 cups water), to kill off any molds or bacteria that could lie dormant and ruin future crops.

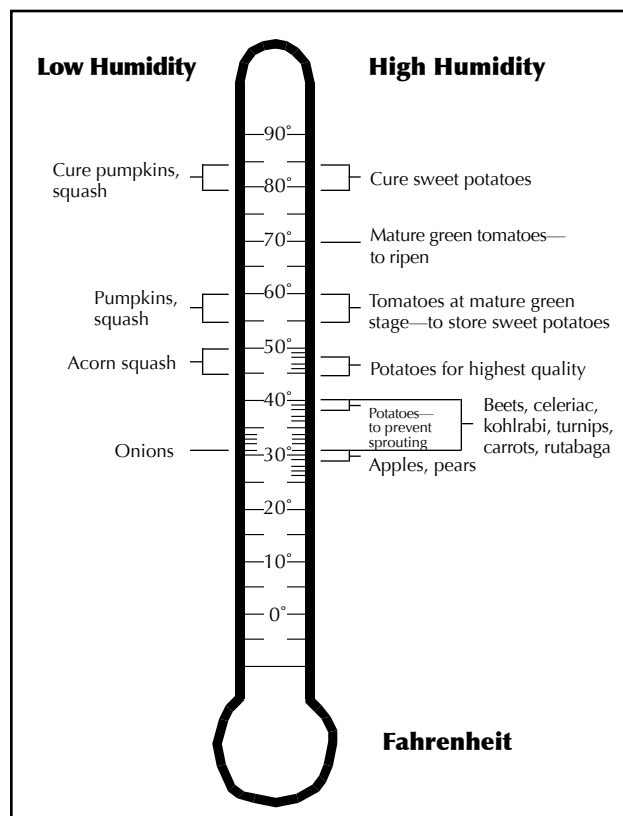


Figure 8. Vegetable-Fruit temperature and humidity storage guide.

Handling Vegetables and Fruits

Vegetables and fruits that are to be stored should be handled carefully to prevent damage. Give special attention to containers that you use for harvesting and storing. Use containers that have smooth inner surfaces. Protruding wire staples in baskets and hampers are particularly damaging.

Lightweight tub buckets and plastic-coated stave baskets (egg baskets) are good containers for harvesting. If the soil is sandy, rinse the containers frequently to reduce skin breaks.

Standard apple boxes and lug boxes used for shipping tomatoes, grapes, and nectarines are good storage containers. Slatted crates can be made easily from wooden melon crates.

Discard all crushed, cut, or decaying vegetables and fruits. If damaged or infected garden products are placed in storage, serious losses from decay are likely to occur.

See that vegetables and fruits have as little field heat as possible when you put them in storage. Harvest in early morning, or let the crops cool outdoors overnight before storing them.

Harvest during dry weather, not too soon after a rain, and allow the surface of the product to dry, since wet produce is very much more susceptible to disease. Handle carefully when harvesting and preparing for storage in order to keep bruising to a minimum.

Waxing vegetables for home storage is not recommended, although wax has been used for several years on certain fresh vegetables and fruits to improve their sales appearance and to reduce moisture loss.

Separating Fruits and Vegetables

If a large quantity of fruits and vegetables is going to be stored, it is advisable to separate the storage areas or add a central partition in a basement storage area to make two storage areas. Ideally, each area should have its own ventilation system. At least, store fruits and vegetables as far away from each other as possible. Wrapping fruits individually also helps to prevent cross-transfer of odors.

Do not store apples with potatoes or carrots. Ethylene gas produced by apples can cause potatoes to sprout and carrots to become bitter. Potatoes cause apples to take on a musty flavor. Cabbage and turnips can give their odors to celery, pears, and apples. Cabbage, kale, rutabagas, turnips, and winter radishes give off strong odors that could spread through a house, and, therefore, should be stored in outdoor storage areas only.

Figure 9 gives the average storage time for commonly stored fruits and vegetables. Tables 1 and 2 give details for preparation and storage of fruits and vegetables.

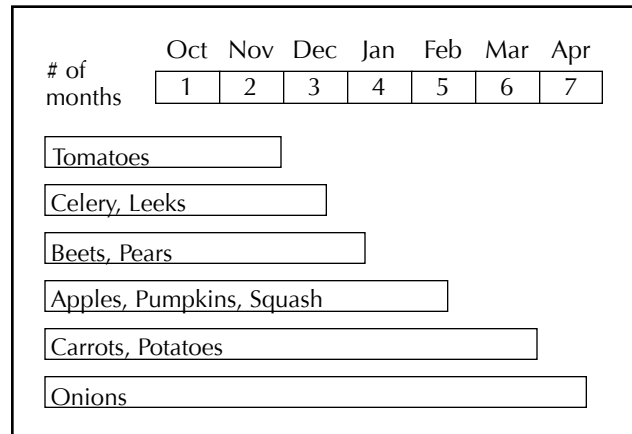


Figure 9. Average storage duration for commonly stored produce.

Table 1. Fruit preparation and storage.

Fruit	Preparation	Storage Conditions		
		Temperature F°	Humidity*	Storage Life
Apples	<p>Store loosely wrapped in plastic bags with lots of holes, in boxes, cellars, or insulated boxes in outbuildings at a temperature as close to 32°F as possible. Apples ripen about 4 times as fast at 50°F than at 32°F and become overripe rapidly at 70°F.</p> <p>Pick apples when mature but still hard. <i>Do not mix</i> apples that have glassy spots in flesh (water core, overripe or injured) with good apples.</p> <p>Length of storage depends on variety. Best for home storage are late maturing varieties: Winesap, Rome Beauty, Northern Spy, Newton.</p> <p>Do not store apples with cabbage, carrots, turnips, or potatoes; apples will pick up off-flavor or cause changes in the vegetables.</p>	32–35	Very Moist	<p><i>Late Season</i> Winesap 5–7 months Granny Smith 5–7 months Rome Beauty 4–5 months Northern Spy 4–5 months <i>Mid-Season</i> Yellow Newton 5–6 months Red Delicious 3–4 months <i>Early Season</i> McIntosh 2–4 months Jonathan 2–3 months Golden Delicious 2–3 months</p>
Grapes	Grapes readily absorb odors from other vegetables and fruits. Store alone away from other produce.	32	Moist	4–6 weeks
Pears	<p>Harvest when mature but still hard and very green; ready to pick when they change from deep green to pale green.</p> <p>Wrap individually in tissue paper and store in cardboard boxes lined with perforated plastic. Store with apples.</p> <p>If held too long or ripened at too high a temperature, they will break down and become rotten on the inside.</p>	31	Very Moist	<p>Bartlett 1–2 months Winter Pears (d’Ajou, Bosc, Comice) 2–3 months</p>

*Relative humidity: Very moist = 90%–95%; Moist = 80%–90%; Dry = 60%–75%.

Table 2. Vegetable preparation and storage.

Vegetable	Preparation	Storage Conditions		
		Temperature F°	Humidity*	Storage Life
Cabbage	After first frost, pull with root attached. Store in outdoor storage areas (pits, garbage cans, cellars) with soil around roots. Do not store in basement because cabbage odor will spread through house. Do not store with celery, endive, apples, or pears, which pick up cabbage flavor.	32	Very moist	3–4 months
Cauliflower	Cut off root. Leave protective outer leaves. Wrap and pack with loose moist sand in outdoor storage area, because it gives off strong odors. Or store in refrigerator in the basement.	32	Very moist	1/2–1 month
Late celery	Mulch in the garden until hard frost. Pull with root ball attached. Store upright close together in moist sand or soil. Tie leaves of endive together to help blanching. Do not store with cabbage. Store kale only in outdoor storage area, because it gives off odors. All others can be stored in a storage room.	32	Very moist	1–3 months
Chinese cabbage				
Endive				
Kale				
Leeks				
Root Crops	All can be stored in garden by mulching with 1 foot of hay or straw if there are no rodents. Parsnips, salsify and horseradish can withstand freezing but are injured by alternate freezing and thawing. Dig as needed.	32–40	Very moist	3–4 months
Rutabagas				
Turnips				
Winter radishes				
Beets	Store rutabagas, turnips, and winter radishes only in outdoor storage areas because they give off odors. Other root vegetables can be stored in basement storage room. Dig when soil is dry. Cut plant tops 1/2 inch above crown. Store in layers of moist sand, peat, or sphagnum moss or in polyethylene bags with about four 1/4-inch holes. Storage at 45°F causes them to sprout new tops and become woody. Store in the lowest areas of basement storage area (usually coldest, moistest).			
Carrots				
Celeriac				
Horseradish				
Parsnips				
Salsify				
Onions	Onions must be mature and dry to keep well. Ones with thick necks and those grown from sets are hard to keep. Before storing, spread on newspapers out of sunlight in a well-ventilated place to cure for 2–3 weeks or until skins are papery and roots completely shriveled and dry. Store in a cool, dry, well-ventilated place, such as an attic, or in an unheated room in well-ventilated containers like mesh bags.	32	Dry	5–8 months
Garlic				
Peppers, hot	Dry by threading mature fruit onto a string and hang in a well-ventilated place. Peppers should not touch each other.	32–50	Dry	1 year

Table 2 (continued).

Vegetable	Preparation	Storage Conditions		
		Temperature F°	Humidity*	Storage Life
Potatoes	Late varieties can be held longer than early ones. Harvest after vines have died down and when ground is dry. Cure in darkness at 45°F-60°F for 10-14 days after harvest. Then store at 40°F in basement storage area. Lower temperatures tend to result in overly sweet flavor. Remove sprouts as they appear. Sprouting indicates too high storage temperature or may be caused by gas from apples. Do not store potatoes and apples together. Apples will become musty. As optimum temperature for potatoes is higher than for most root crops, store them high up in the cellar.	35-40	Very moist	4-9 months
Pumpkins Most winter squash	Harvest when mature before frost. The skin on mature fruit is hard and impervious to thumbnail scratching. Leave 1 inch of stem. Cure for 10 days at 80°F-85°F (usually near a furnace) to harden rinds and heal surface cuts. At 50°F or below they are subject to chilling damage. Above 60°F they become stringy.	55-60	Dry	2-3 months
Acorn squash	Do not cure acorn squash like other squash; they become orange and stringy at 80°F.	45-50	Dry	1-2 months
Tomatoes Red sweet peppers (mature green)	Pick from vigorous vines. Sort tomatoes for ripeness. Pack green tomatoes one or two layers deep in shallow boxes or trays for ripening. Separate with layers of paper or individually wrap each tomato. At 55°F mature green tomatoes will ripen slowly in 25-28 days. At 65°F-70°F tomatoes will ripen faster-in about 14 days. Store in unheated room or airy cellar.	55-70	Moist	4-6 months

*Relative humidity: Very moist = 90%-95%; Moist = 80%-90%; Dry = 60%-75%.



Adapted from *Home Storage of Fruits and Vegetables*, publication NRAES-7, by Susan Mackay, Cornell University, 1979; and from *Storing Vegetables and Fruits in Basements, Cellars, Out Buildings, and Pits*, publication HG 119, Science and Education Administration, USDA, 1978.

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