Root Cellars
Post-Harvest Treatment and Low-Cost Storage of Produce

Using Root Cellars for Low-Cost Produce Storage

A root cellar can be a valuable asset to the small-farm crop producer. At one time, root cellars were the primary method of storing produce on the farm. While modern produce storage units are effective, their costs may be too high for many small-farm landowners. Typically, crop production or crop value isn’t high enough to support such an investment. A root cellar, on the other hand, can provide some storage and extend the life of produce at a low cost.

Crops that you put into the root cellar must be of high quality to start with and must be able to maintain that quality in storage under proper conditions. Crop storage in a root cellar, therefore, requires some planning and research.

Root Cellar Considerations

Following are some basic do’s and don’ts of root cellar storage:

- Select crops that can be stored in a root cellar. Choose varieties of crops that store well and maintain quality. Determine how long crops can be stored under the conditions existing in your root cellar.

- Don’t plant more than you need; it wastes money. Whatever is left over after harvest sales and can’t fit in the root cellar will be lost. When planning how much you will produce, consider the limits of the size of the root cellar and the length of time storage is possible.

- Contact your local office of Maryland Cooperative Extension to find out the proper or best way to produce, harvest, and handle various crops for storage. Crop cultivation methods have a direct effect on how long crops last in storage. Applying too much nitrogen during a growing season can have a negative impact on the storage of some crops. For example, avoid heavy applications of nitrogen fertilizer on root crops. Excess nitrogen causes watery growth that is low in carbohydrates. The result is early spoilage in storage.

- Know which crops can be stored together and which crops cannot. For example, don’t store apples with potatoes. Apples give off ethylene gas, which causes potatoes to sprout. Tomatoes, muskmelons, pears, plums, and peaches also produce ethylene gas. If you have to store potatoes with this kind of fruit, install a ventilation system in the root cellar to remove the ethylene gas.

- Know proper temperature and humidity levels for best storage; selecting crops and varieties with
good storage qualities is not enough to ensure lasting quality. Optimum—or most favorable—temperatures and humidity levels for best storage is not the same for all crops. Research and observe the limits of these optimum conditions to maintain quality in the root cellar. There are some good resources on the World Wide Web where you can obtain more detailed information on the optimum temperatures and humidity for produce. A good place to start are these three sites: http://waltonfeed.com/old/cellar4.html#storage, http://www.seedsofknowledge.com/rootcellar.html, and http://www.waushara.net/garden/storage/storage_rooms.html. Table 1, a collection of information from these websites, lists optimum storage conditions and the approximate length of storage for selected vegetables. Produce is not the only item that can be stored in your root cellar. Other items include sauerkraut, pickles, cured meats, cheese, mushrooms, and eggs. In a pinch, root cellars can sometimes serve as storm shelters.

**Planning the Root Cellar**

Many things can be used as a root cellar, such as buried barrel, drain tiles, straw bales, covered metal cans, out buildings, trenches, earth pits, basements, nooks and crannies of the house, and porch crawlways. The size and scope of your goals for the root cellar determine the type of root cellar you develop.

Most producers use available resources in developing a root cellar. For example, a basement with a dirt floor is ideal. If you prefer an outdoor root cellar, dig a hole in the side of a hill. Many things on a farm have the potential to be modified into a root cellar. When building a root cellar, consider the following factors:

**Temperature**

Temperature is the first item to consider when planning a root cellar; a thermometer, therefore, is important. Because cool temperatures slow down the respiration (breathing) process, produce needs to be kept cool. A temperature that averages between 32 and 40 degrees F will provide a good storage site. Temperatures averaging 40 to 50 degrees F will provide only short-term storage. Guard the root cellar against freezing and be sure you have at least some crude way to regulate temperature by installing good insulation and using windows, ventilators, and exhaust pipes.

**Humidity**

To store produce successfully, humidity is second in importance only to temperature. Shrinkage and drying present major problems. Remember that stored crops are no longer able to replace lost moisture through their root system. While a cool temperature slows down the crop's system, a high humidity will slow down evaporation and the loss of moisture from leaves and crop surfaces. For the

<table>
<thead>
<tr>
<th>Crop</th>
<th>Temperature (Degrees F)</th>
<th>Humidity (%)</th>
<th>Length of Time in Storage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beets</td>
<td>32-40</td>
<td>90-95</td>
<td>4-5 months</td>
</tr>
<tr>
<td>Broccoli</td>
<td>32-40</td>
<td>90-95</td>
<td>1-2 weeks</td>
</tr>
<tr>
<td>Brussels sprouts</td>
<td>32-40</td>
<td>90-95</td>
<td>3-5 weeks</td>
</tr>
<tr>
<td>Cabbage</td>
<td>32-40</td>
<td>80-90</td>
<td>3-4 months</td>
</tr>
<tr>
<td>Carrots</td>
<td>32-40</td>
<td>90-95</td>
<td>4-6 months</td>
</tr>
<tr>
<td>Cauliflower</td>
<td>32-40</td>
<td>80-90</td>
<td>2-4 weeks</td>
</tr>
<tr>
<td>Chinese cabbage</td>
<td>32-40</td>
<td>90-95</td>
<td>1-2 months</td>
</tr>
<tr>
<td>Eggplant</td>
<td>50-60</td>
<td>85-90</td>
<td>1-2 weeks</td>
</tr>
<tr>
<td>Jerusalem artichokes</td>
<td>32-40</td>
<td>90-95</td>
<td>1-2 months</td>
</tr>
<tr>
<td>Parsnips</td>
<td>32-40</td>
<td>90-95</td>
<td>1-2 months</td>
</tr>
<tr>
<td>Potatoes</td>
<td>32-40</td>
<td>80-90</td>
<td>4-6 months</td>
</tr>
<tr>
<td>Pumpkins</td>
<td>50-60</td>
<td>60-70</td>
<td>5-6 months</td>
</tr>
<tr>
<td>Radishes (winter)</td>
<td>32-40</td>
<td>90-95</td>
<td>2-3 months</td>
</tr>
<tr>
<td>Rutabagas</td>
<td>32-40</td>
<td>90-95</td>
<td>2-4 months</td>
</tr>
<tr>
<td>Squash (winter)</td>
<td>50-60</td>
<td>60-70</td>
<td>4-6 months</td>
</tr>
<tr>
<td>Tomatoes (green)</td>
<td>50-60</td>
<td>60-70</td>
<td>1-2 months</td>
</tr>
<tr>
<td>Turnips</td>
<td>32-40</td>
<td>90-95</td>
<td>4-6 months</td>
</tr>
</tbody>
</table>
most part, produce stores best at between 90 and 95 percent humidity. Though humidity is difficult to regulate in some root cellars, setting around pans of water or dampened burlap bags helps. You can also use inexpensive humidifiers.

**Ventilation**

Another important factor in the root cellar, ventilation plays an important role in regulating temperature and humidity. It can also vent odors and undesirable gases, such as ethylene, when you are storing incompatible crops such as apples and potatoes. Various methods are available for ventilating root cellars. Often ventilation is as simple as using air intake and air outlet ventilation pipes. Correct airflow is essential to the efficiency of the root cellar. When installing air vents, remember: warm air rises, cold air sinks, and you want airflow over the entire root cellar.

**Accessibility**

Make your root cellar easy for you to use. If its location isn’t convenient—if it’s too far from the house or getting to it requires climbing a ladder or shaky old stairs—the root cellar is only going to be storing dust. Also, when you’re setting up the root cellar, make it easy to clean. If it’s hard to maintain, you’re not likely to clean it often enough.

**Darkness**

Light causes some crops to lose quality and others to sprout. When exposed to light, potatoes develop a green skin that is toxic. Use a light in the root cellar so you can see, but make sure the light is off when you are not there. Any windows in the root cellar need to be shaded to exclude light.

**Drainage**

Though humidity in the root cellar needs to be high, you don’t want any of the produce in storage to become waterlogged. Be sure to provide a way for excess water to drain out of the root cellar.

**Shelves**

When building the shelving and storage bins inside your root cellar, remember that a well-run root cellar is going to be cold and damp. The materials that you select for your shelves and bins should be able to tolerate these conditions. Oak is considered to be the best wood for use in root cellars.

**Size**

How big should the root cellar be? That depends on intended use and size of your selected site. For use only by a family of four, an 8-foot by 8-foot root cellar is more than adequate. For a root cellar used as part of a small-farm business, your facility has to fulfill your short-term and long-term storage needs. To figure out your future storage needs, estimate the following: your potential crop yields, how much of your crop you will sell directly from the field, how much of the leftover crop you will store, and how much space this crop will take up in the root cellar. A good point of reference is that a 5-foot by 8-foot root cellar can hold 30 bushels of produce. Remember that a root cellar may not need to be as big as you think; a lot of produce can be stored in a small space.

**Harvest and Post-Harvest Treatment of Produce**

How well a crop lasts in storage depends on several things: how a crop is managed during the growing season, the stage of plant growth at harvest, and how the crop is handled during and after harvest.

**Preserving Product Quality**

After they are harvested fruits and vegetables continue to respire (breathe). Because this process consumes energy—the crop is no longer attached to the plant/root system—energy reserves are used, resulting in a loss of quality over time. Harvested crops are limited in how long they can be stored and retain quality. The length of time depends on the crop, the postharvest treatment, and the storage conditions. The respiration process, on the other hand, is the same for all crops and it is driven by temperature. The higher the temperature in storage, the more the crop will respire. Under storage conditions that are too warm, therefore, quality can’t be maintained for long.

**Harvesting**

Harvested produce should not be immature or over-mature. Both conditions can lead to storage problems. In addition, produce not harvested at the best time won’t have the best quality. Pre-cooling produce is a great way of rapidly slowing respiration. Pre-cooling can be as simple as spraying cold water over the produce or dipping it in water. Crushed ice spread over the produce also works. After precooling, take the produce directly to storage.

**Timing**

The old saying “timing is everything” applies to storing produce in a root cellar. Timing the harvesting of produce is critical to its storability and quality. Harvest soft fruits before frost. Hard-shelled fruits should be protected from or harvested before a heavy frost. Root crops may be left in the ground until the tops blacken. Root crops are best left as long as possible in the ground. Some root crops have a tendency to work their tops out of the soil. If this happens, covering the exposed tops with mulch will prevent a loss in quality.
Digging root crops during cold weather prolongs their storage life. The cold weather causes the crop to store more sugars and starches and less water, which is lost more easily in storage. Also, avoid digging root crops in very wet soil. The crops will be full of absorbed water and will not keep well; the harvested crops will have excess soil sticking to them, which requires extra handling to clean the muddy produce for sale. It is best to wait for dryer conditions to dig up crops.

**Cleaning**

It's not necessary to have your produce table-ready clean. A light coating of dust on root crops is perfectly acceptable. Gently brush off excess soil, but avoid scrubbing or washing roots. Produce keeps better if it isn't washed. If the crops are muddy after harvest let them dry before gently rubbing off the excess soil. Produce can be cleaned before eating.

**Handling and Selection**

Always handle produce carefully. Be careful to avoid bruising or otherwise damaging the crop. Bruised and damaged produce spoils in storage and initiates spoilage in produce next to it.

Store only the best of your crop. Cull out immature, overmature, and damaged produce. Find some other use for the culled produce.

**Curing**

Most root crops don't need curing before being placed in storage; therefore, don't expose them to the sun. White potatoes, for example, turn green in light and become toxic. Take most root crops directly from the field to storage.

However, a few root crops do require curing. Onions and garlic need about one week in the sun to dry for storage. Pumpkins and squash need about 2 weeks in the sun for their rinds to harden enough for storage. Do not skip curing for those crops that need it.

**Clipping**

Clip off the green tops of root crops before placing the crops in storage. If it is left on, the green top will cause the crop to lose water more rapidly. The green top will also rot quickly in storage, resulting in a slimy mess that will cause nearby produce to rot. Find another use for the clipped tops.

**Storage Bins**

Crates waste less space than baskets. This is especially important in root cellars where space is usually limited. Crates can be stacked on the floor or on shelves. The crates should be slatted to encourage air circulation.

**References**


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**Root Cellars: Post-Harvest Treatment and Low-Cost Storage of Produce**

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