

Rt. 5 Box 423 • Livingston, KY 40445

# Root Cellars

*ASPI Technical Series*

## INTRODUCTION

Here at ASPI, we have been actively experimenting with year-round gardening techniques, however, the fact remains that despite the success of seasonal extenders (cold frames, hotbeds, greenhouses, etc.), the variety of crops which will grow well in cold temperatures is limited. To fully utilize the peak growing season and to greatly increase the diversity of flavors on your winter table, we suggest short and long term storage of produce for later use.

Root cellars of various designs have been in use for centuries. They provide convenient, economical storage of unprocessed root crops, fruits and leafy vegetables. After the initial construction, cellaring is much less resource intensive than either canning or freezing. Living appropriately involves providing as much for oneself as possible. A combination of organic intensive gardening, seasonal extenders, drying, root cellaring and canning or freezing (for cooked or selected quickly perishable vegetables and fruits) can insure safe, nutritious food for a family all year round. This is a valuable and rewarding part of the simplified life.

## CLIMATE

The secret to successful root cellaring is climate control. There are three factors which are significant to long term storage of produce. These include: humidity, temperature and ventilation. Of these, temperature is the most important and humidity is the most difficult to control. The requirements for storage varies widely among various fruits and vegetables. For example -- onions, sweet potatoes and garlic require warm dry temperatures, while apples, roots (carrots, potatoes, turnips, etc.) and greens need to be kept cold and damp. The chart on page 5 will be helpful in determining where and how to store your produce. The root cellar is designed to store produce requiring cold, damp conditions.

### *Temperature*

Ideally a root cellar should be kept at a constant temperature ranging between 32 and 40° F. Temperatures of 50° F will allow for short term storage of certain vegetables. Any lower than 32° F will freeze the produce and higher than 430 - 50° F will allow them to spoil. Temperature also plays a part in maintaining the consistent high humidity which is necessary. Constant temperatures are maintained by

insulation of the cellar and through ventilation to admit cold air and exhaust warm. Soil is an excellent insulator and we suggest that if possible the cellar should be earth sheltered or otherwise use soil in the construction. Thermometers are helpful in controlling the temperature. One which reads minimum/maximum values can help keep you aware of the variations within the cellar.

### *Humidity*

The humidity in a root cellar should fall within the range of 85 - 95%. Less than 80% will cause the vegetables to dry out and shrivel. At greater than 95% moisture begins to collect on the walls, shelves and produce which results in moldy and rotting vegetables. Remember that there is a direct relationship between temperature and humidity levels. Cool air absorbs less moisture than warm, thus a very slight drop in temperature can result in an increase in humidity and condensation. A hygrometer, which measures humidity, can help avoid extreme variations. There are several steps to maintaining good humidity. Once more the earth-sheltered or excavated cellar has the advantage. The natural moisture within soil helps maintain constant humidity. If possible the cellar should have an earth floor covered with gravel. On occasions

## ROOT CELLAR TYPES

when the humidity drops the gravel can be sprinkled with water. In cellars with cement or stone floors open pans of water can be set out or the vegetables can be draped with wet cloths. Root crops do very well stored in bins of damp sawdust or sand.

### Ventilation

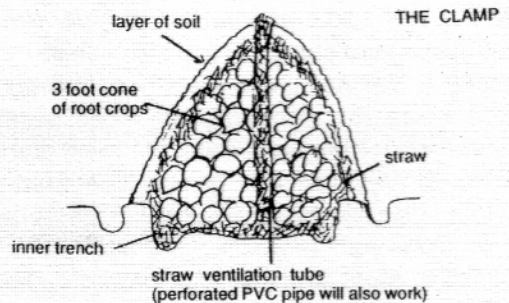
Proper ventilation will make maintenance of the necessary temperature and humidity possible. In addition moving air will remove odors and the ethylene oxide given off by some ripening produce. Air circulation is controlled through two vents (valves), intake and exhaust. Because cold air is heavier than warm the ideal positioning of the vents would have the intake toward the floor on an exterior (preferably north facing) wall and the exhaust just below the ceiling on a sheltered wall. This of course would be impossible for an excavated (dug-in) root cellar. In that case both vents would come through the ceiling (See Figure ). Because earth is a poor conductor of heat and has natural moisture, an excavated root cellar would be easier to maintain at constant temperature and humidity, making ventilation less of a concern.

If you are converting a basement room to a root cellar an existing window on an exterior wall can be easily converted to a vent. Remove the panes from the window and divide it into two equal openings (either horizontal or vertical). Attach a small wooden door to one opening. Insulate and weatherstrip this door. In the other opening place an air duct which extends down to approximately one foot above the floor. Fill in around this duct with insulation. Place a sliding door in the duct. (If the openings are horizontal place the duct in the lower one.) Screen the outside of both openings. When the doors are opened (probably at night) cold air will enter the duct and push warm air from the room out the door. Minimize daytime opening of the window because of light. Root cellars need to be kept as dark as possible. Inside the cellar bins, crates and other containers should be elevated. In addition a small space should be left between the shelves and the wall to allow for maximum circulation of air.

Produce can be stored in a variety of structures.

### In the garden storage

Perhaps the simplest method of root cellaring is done without a root cellar. Root crops particularly can be left in the garden until one or two light frosts and then covered with a heavy layer of hay or bagged leaves for much of the winter. Other methods of in-ground storage include mounds or trenches. Cabbage and celery do well if planted in trenches covered with a board and a thick layer of hay. Many of our Appalachian grandparents can remember storing produce in earthen mounds (called "clamps"). A small pit is dug with a drainage ditch around it. A vertical layer of straw is placed in the middle of the mound running from bottom to top for ventilation. Produce (root crops, apples, etc.) is mounded to 2 - 3 feet. This mound is covered with a thick layer of straw and finally packed with dirt (being sure to leave the straw ventilation tube uncovered). These mounds can be opened only once so make several small ones. Also, although it is convenient to store several types of produce together be cautious. Never store vegetables and fruits together and always store strong smelling vegetables (turnips, cabbage, etc.) separately.



In "No Root Cellar Root Cellaring" (Hamilton, 1993) it is suggested that produce be stored for winter in a permanent cold frame surrounded by hay bales. This would probably work but we would rather use our cold frame to grow fresh greens and store our produce elsewhere.

An interesting storage method somewhere between temporary and permanent is the above ground hay bale structure. This is simple a rectangle of hay bales partially filled with hay. Produce is placed inside and other bales are



allow the greatest contact with the cold from the outside. The other walls can be made of plywood or whatever is available, however use cedar or other rot-resistant wood for framing because of the damp conditions. The interior walls and ceiling should be covered with polyethylene and if desired a rot resistant wall covering. Place both vents on the exterior wall. An earth and gravel floor is not advisable in this structure because of the difficulty in drainage.

### CONSTRUCTION TIPS

There are several important things to remember when building a root cellar.

\* Do not build a storage area larger than you will need. If you are renovating an already existing basement and it is too large block off a portion of the room. The climate within the root cellar will be carefully controlled. A structure that is too large will not only waste materials and space but will require more effort to keep at the desired conditions.

\* Plan the storage area for maximum efficiency. Temperatures near the ceiling will be warmer, so short term produce can be stored there. Several types of containers can be considered for storing the vegetables. These include bins, bushel baskets, crates, and for cabbages and celery long boxes with several inches of dirt so they can be rooted.

\* When possible use native or recycled materials.

\* Since a root cellar must be kept dark do not build any windows. With existing structures insulate the windows and board them over. (See Ventilation).

\* Placing a light in the root cellar (with the switch near the door) is a great help. The best choice is a normally closed spring-loaded switch mounted in the door jamb. This light then comes on when the door is opened and goes off automatically when the door is shut. This avoids the perhaps costly mistake of forgetting to turn off the light (as often happens with children). Light for more than a very short time in the cellar can speed up spoilage of produce.

### HINTS FOR STORING PRODUCE

In reference to storage life there are three classes of vegetables and fruits: quickly perishable (green beans, peas, corn, greens, etc.), perishables (broccoli, cauliflower, cabbage, onions), and keepers (root crops, pumpkins, squash, celery). The chart on page \*\* lists common fruits and vegetables with their storage life and ideal storage conditions.

\* Leave root crops in the ground as long as possible. Early harvest and storage in warm weather is a common cause of quick spoilage in cellar-stored produce. The night temperatures need to be moderately cool before placing the harvest in the root cellar.

\* Do not store onions or garlic in the root cellar. These vegetables need warmer, dry conditions. Instead, allow them to dry then braid the tops and hang them in the kitchen or pantry.

\* Do not store canned items in the root cellar. The damp condition will cause the lids to rust.

\* Never store damaged, bruised, over ripe or insect infested produce. This will spoil quickly and rot undamaged produce stored with it. Select the fruits and vegetables carefully, canning, freezing, or drying any that look suspicious. Handle the produce carefully to avoid unnecessary bruising or damage.

\* If it is possible, store vegetables and fruits separately. Unpleasant tastes and odors can be picked up from the strong smelling varieties. If separate storage is not feasible, packing produce in damp sand, straw, etc. can reduce the possibility of odor transfer, as well as extending storage life.

\* Root crops do well stored in perforated cellophane bags (reduces shriveling), wet sand, straw or moist soil. Head lettuce, leeks and endive, cauliflower, brussels sprouts and broccoli should have their roots placed in boxes of dirt. Occasional watering should keep them producing for up to 4 months.

used for a top. In all but extremely cold weather ventilation can be provided with stones placed under the top bales. Remove these if the temperature drops to freezing.

### Permanent structures

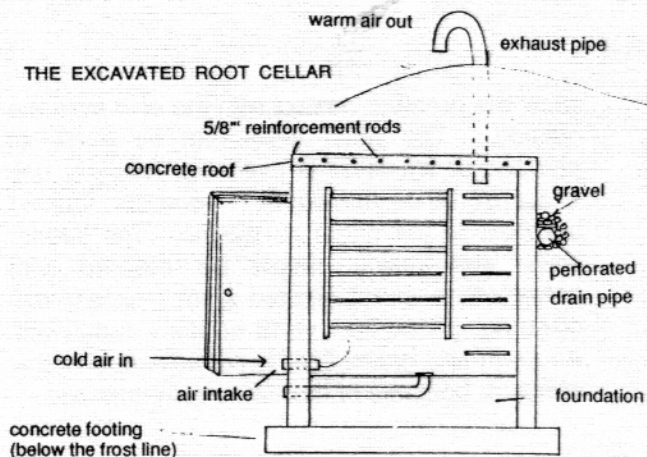
While in-the-garden storage is very economical and simple, once the weather becomes colder many people may find it troublesome to have to run out to the garden to dig a potato or pull up a carrot. Also, for larger harvests the mounds and pits may not provide enough storage space. Permanent root cellars can take a variety of forms ranging from separate dirt and rock cemented compartments which are semi or totally underground to partitioned off sections of existing basements.

### Excavated (Dug-in) and Earth Sheltered Cellars

When building a root cellar in a hill or in the ground try to place it on the north side of the house. Dig a hole large enough for the structure, but not too large because any excess space around the cellar will have to be backfilled. Remember to place the footer below the frost line and to dig down a little extra where the door will be. This extra will be filled with gravel to the footer level.

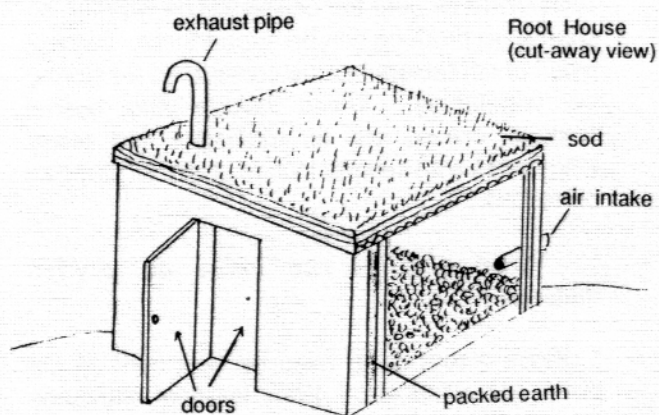
With any earth sheltered cellar drainage is of maximum importance. This will keep the walls from collapsing due to the expansion and contraction from freezing and thawing of water-laden soil. Run pipe from a drain in the floor to the outside, making the floor a little higher than external soil. After backfilling the soil around the concrete walls to about two feet below the surface lay a perforated drainpipe around the back of the cellar, extending all the way around the sides at a slope to daylight. This pipe should be placed in a bed of gravel and the top covered with plastic or other waterproof material to clogging of the holes. This will drain water away from the back of the cellar.

If possible dug-in cellars should have poured concrete roofs reinforced in the lower portion with rebar. Once the concrete has set (3-7 days) the exterior of the roof should be covered with rigid styrofoam insulation and a layer of plastic (6-mil polyethylene). A layer of dirt is then added and grass planted to prevent erosion.



### The Root House

In cases where an excavated cellar is not desired or possible consider a root house. This is a small above-ground building made of logs, or other wood. The structure has double walls with a two-foot space between that is filled with tightly packed soil. If the house is made of logs, sod is used to fill between the logs to keep the earth from falling out. The roof is made of sturdy poles laid close together. It is covered with a sandwich of sod, 18 inches of dirt and finally sod on top. The structure has an earthen floor which is drained in the same manner as the excavated root cellar.



### Basement Room

Possibly the simplest storage space to construct is the converted basement room. There are advantages and disadvantages to the approach. A basement is more conveniently located allowing one to avoid a cold walk across a frozen yard to the cellar. However, care must be taken to properly insulate the inside walls and ceiling of this space as the warmth from the house will make it more difficult to keep the temperature low. The cellar needs at least one external wall (preferably underground and north facing) to



## Storage Conditions for Various Vegetables and Fruits

Vegetable/Fruit	Ideal Storage Temperature ( ° F)	Ideal Storage Humidity (%)	Storage Life
<b>Moderate - Warm and Dry</b>			
hot peppers	50 - 60	60 - 70	3 - 6 months
pumpkins	50 - 55	70 - 75	2 - 3 months
squash (winter)	50 - 55	70 - 75	3 - 6 months
sweet potatoes	55 - 60	60 - 70	4 - 6 months
tomatoes (green)	55 - 70	60 - 70	4 - 6 months
<b>Cool and Dry</b>			
dried peas & beans	32 - 40	60 - 70	indefinitely
garlic	35 - 40	65 - 70	5 - 8 months
onion	32	65 - 70	6 - 7 months
<b>Cool and Moist</b>			
cantaloupe	40 - 50	85 - 90	1 - 4 weeks
cucumbers	40 - 50	85 - 90	1 - 4 weeks
eggplant	40 - 50	85 - 90	1 - 4 weeks
sweet peppers	40 - 50	85 - 90	2 - 3 weeks
tomatoes (ripe)	40 - 50	85 - 90	1 - 4 weeks
watermelon	40 - 50	85 - 90	1 - 4 weeks
<b>Cold and Moist</b>			
apples	32 - 40	80 - 90	4 - 6 months
cabbage (late)	32 - 40	80 - 90	4 - 6 months
cauliflower	32 - 40	80 - 90	6 - 8 months
endive	32 - 40	80 - 90	2 - 3 months
escarole	32 - 40	80 - 90	2 - 3 months
grapes	32 - 40	80 - 90	1 - 2 months
pears	32 - 40	85 - 90	2 - 5 months
potatoes	38 - 40	85 - 90	5 - 8 months
<b>Cold and Very Moist</b>			
beets	32 - 35	93 - 95	1 - 3 months
carrots	32 - 35	90 - 95	4 - 6 months
celery	32 - 35	90 - 95	2 - 3 months
parsley	32 - 35	90 - 95	2 - 6 months
Jerusalem artichokes	31 - 32	90 - 95	2 - 5 months
leeks	32 - 40	90 - 95	2 - 6 months
kohlrabi	32 - 40	90 - 95	2 - 5 months
radishes (winter)	32	90 - 95	4 - 5 months
salsify	32 - 40	90 - 95	2 - 3 months
turnips	32	90 - 95	4 - 5 months

## Preparing Produce for Storage

Check carefully for any damaged produce.

Cut away any greenery (except pumpkins and squash, where a small stem should be left).

Remove any excess soil from the roots. Washing the produce is unnecessary and may speed up spoilage.

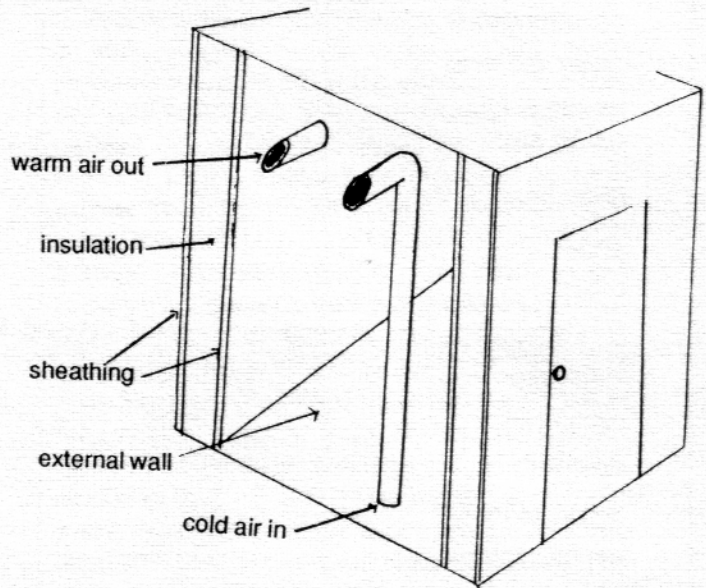
Arrange produce loosely in containers. Leave space between containers to allow air to move freely through the storage area.

Place the containers with produce needing warmer temperatures toward the top of the room and those requiring cold toward the floor. Place short-term produce toward the front of the cellar, because it will be used first.

Look over the produce occasionally and remove any that is spoiled.

Check carefully during extremely cold weather when produce may freeze. Keep the vents closed and if necessary (in rare cases) provide an additional heating source.

## Converted Cellar Room (cut-away view)



## REFERENCES

Bubel, Mike and Nancy, 1991, "The Year-Round Harvest", in Mother Earth News, August/September, Issue 127, pp. 74-82.

"Economical Storage in a Root Cellar", 1984, in Living on Less, Mother Earth News, Inc. Hendersonville, NC, pp. 110.

Hamilton, Eric, 1991, "No-Root-Cellar Root Cellaring", in Backhome, Fall, pp. 58-60.

Marks, Vic, 1973, "Store Your Fruits and Vegies", in Cloudburst: A Handbook of Rural Skills and Technology, Cloudburst Press of America, Seattle, WA, pp. 26-45.

Matlack, Fred, 1992, "Build a Root Cellar", in Organic Gardening, November, Volume 39 Number 8, pp. 34-35.