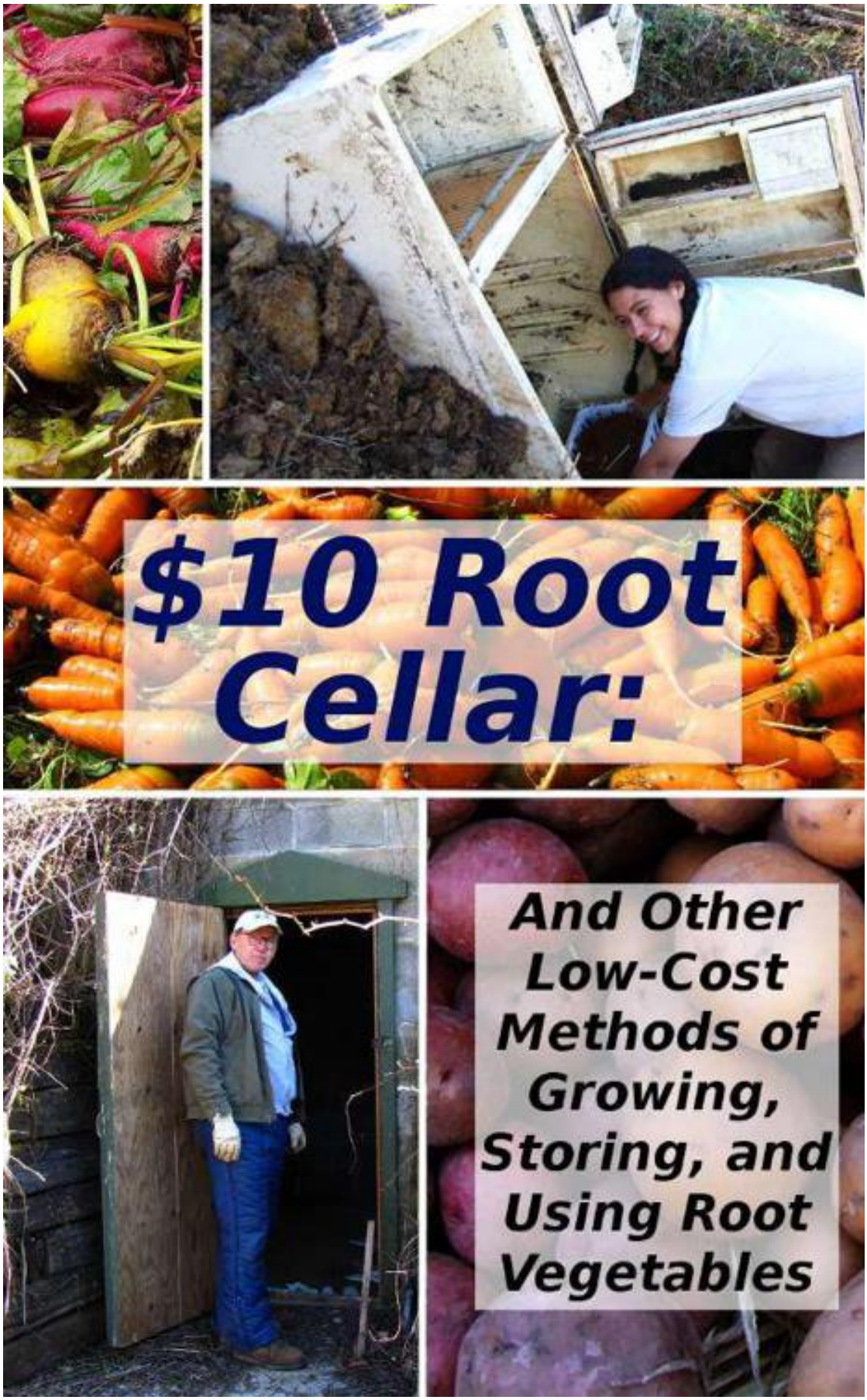
$10 Root Cellar:

And Other Low-Cost Methods of Growing, Storing, and Using Root Vegetables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Volume 3 in the Modern Simplicity series

by Anna Hess

Visit my blog at www.waldeneffect.org or read more about my books at www.wetknee.com.

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Introduction

Why roots?

The Potato Eaters*, by Vincent Van Gogh, 1885, is currently located in the Van Gogh Museum in Amsterdam.*

> *You see, I really have wanted to make it so that people get the idea that these folk, who are eating their potatoes by the light of their little lamp, have tilled the earth themselves with these hands they are putting in the dish, and so it speaks of manual labor and—that they have thus honestly earned their food. I wanted it to give the idea of a wholly different way of life from ours—civilized people."*
> – Vincent Van Gogh, in an 1885 letter about his painting *The Potato Eaters*

The perceived link between peasants and potatoes was widespread during the nineteenth century and caused many upper-crust English people to eschew the lowly spud. Over time, the stigma associated with root crops seems to have vanished, which is lucky for us since potatoes, carrots, and other roots make such useful additions to the self-sufficient homesteader's

garden and pantry.

Root vegetables are easy to grow and provide plenty of calories per square foot.

If you're interested in maximizing the number of calories you can grow in a small space, roots often win over grains, and roots have the additional benefit that they don't require threshing and winnowing. In addition, if stored properly, root vegetables will often last all winter, providing vitamins that quickly disappear from frozen, canned, and dried foods.

On a more personal note, my husband and I found that once we started growing all of our own vegetables, carrot sticks became a winter staple since we yearned for the crunch of something fresh in January, February, and March. If your homesteading experience is anything like ours, you'll quickly find at least one (or more likely several) roots that make your life easier, tastier, and cheaper. Each year, you'll harvest more and more roots, and will soon will be faced with the conundrum of where to store your every-growing bounty over the winter. The purpose of this book is to make the storage of your root crops so simple and cheap that even Van Gogh's Potato Eaters could

afford to follow suit.

How to store vegetables without canning, freezing, or drying

Types of storage vegetables

Vegetable	Optimal storage conditions	My storage conditions	My storage location
beets	32 - 40°F, 90 - 95% humidity	cool, moist	not applicable
cabbage	32 - 40°F, 80 - 90% humidity	cool, moist	fridge root cellar
carrots	32 - 40°F, 90 - 95% humidity	cool, moist	fridge root cellar
garlic	32 - 50°F, 60 - 70% humidity	warm, dry	kitchen shelf
onions	32 - 50°F, 60 - 70% humidity	warm, dry	kitchen shelf
parsnips	32 - 40°F, 90 - 95% humidity	cool, moist	fridge root cellar
potatoes	32 - 40°F, 80 - 90% humidity	cool, moist	fridge root cellar
sweet potatoes	50 - 60°F, 60 - 70% humidity	warm, dry	kitchen shelf
turnips	32 - 40°F, 90 - 95% humidity	cool, moist	not applicable
winter squash (including pumpkins)	50 - 60°F, 60 - 70% humidity	warm, dry	kitchen shelf

Storage vegetables (including roots, winter squash, and some others) are crops that will last for several months without canning, freezing, or drying. The table above breaks up common storage vegetables into two categories: warm, dry storers, and cool, moist storers. This is obviously a generalization since carrots like it wetter than cabbages and pumpkins like it warmer than onions, but most homesteaders will be doing well to simply

find one cool, damp spot and one warm, dry spot for their storage crops.

Warm, dry storers can be maintained over the winter in a slightly cool part of your house that doesn't freeze but also isn't excessively wet. We keep butternut squash and garlic on shelves right in the kitchen, and they carry us through until spring. Although I won't be writing anything else about warm, dry storers in this book, I do heartily recommend these crops, having found that sweet potatoes generally produce more calories per square foot than white potatoes in our neck of the woods. To read more about vegetables that can be stored on the kitchen shelf, check out *Weekend Homesteader: October*.

Inside our refrigerator root cellar in late December, carrots are crisper and sweeter than they ever were at this time of year in the electrified fridge.

Cool, moist storers are the type of vegetables I'll focus on for the rest of this book since they keep well in a root cellar. Although each vegetable has slightly different optimal temperature and humidity conditions, most prefer levels just above freezing when the air is nearly saturated with water.

In a pinch, you can keep cool, moist storers for a little while in a closet or other low-temperature part of your house, but they'll quickly begin to shrivel. Alternatively, if you only have a few, potatoes and carrots store well in the crisper drawer of the fridge covered with a damp dish towel. Be sure to re-moisten the towel once a week, or whenever you take a vegetable out of the drawer.

As you become more self-sufficient, though, you'll soon run out of places to keep cool, moist storers in the average house. Luckily, a low-energy solution exists—the root cellar. If you dig deep enough and provide adequate ventilation, the earth provides cool and moist conditions with no work on your part, and adequate air flow keeps molds from forming despite the damp. Finally, screening all openings prevents incursions by critters who would gladly eat your hard-earned food. If you're careful to keep these design factors in mind, a root cellar can maintain roots that like cool, moist conditions (along with cabbages, many fruits, and even scionwood for fruit tree grafting) in peak condition all winter long.

The trouble is that a quality root cellar usually costs thousands (or at least hundreds) of dollars to construct, making root crops much less economical. This book suggests alternative ways to maintain cool, moist conditions for your overwintering root crops at a significantly lower price.

Introducing the refrigerator root cellar

A $10 structure gives us room to store plenty of winter carrots, cabbages, and potatoes with little expenditure of electricity.

My husband and I started our homestead from scratch. With gardens to plant, water lines to bury, chickens to pasture, and a trailer to bring up to living standards, we didn't have much time or money to put toward a root cellar.

At first, the lack was no big deal. Even though our gardens have always been just on the edge of too big for me to handle, it took us six years to reach the point where we were growing enough carrots and other storage vegetables to have fresh food throughout the winter. In the early years, I had no problem storing any winter crops that liked it cool and moist in our normal refrigerator.

Part of the 2012 storage vegetable harvest.

When the 2012 harvest came in, though, it was clear the vegetables weren't all going to fit in the crisper drawer. We needed a root cellar…and fast.

My inventive husband, Mark, was way ahead of me. In 2009, he'd created a cheap, homemade root cellar out of a junked refrigerator and $10 worth of spare parts, but the project had growing pains. A heavy rain caused the earth to slump and knock the structure over, and we didn't have enough storage vegetables at the time to make it worth our while to dig the fridge free and tweak the design. Three years later, a wheelbarrow-load of carrots was enough to put Mark back on the job, and soon he'd built the fridge root cellar described in this book.

So what is a refrigerator root cellar? More than just an insulated box, it mimics the conditions in a real root cellar—plenty of air flow, high humidity, constantly cool (but not freezing) conditions, and no expenditure of electricity. (I'll explain later how we use a light bulb or small space heater to ensure the contents don't freeze during the coldest nights, so a small amount of electricity might be used.)

Although we can't use our fridge root cellar as a storm shelter,

it beats many basement root cellars in terms of cool winter temperatures, and the small size means we can easily build a separate structure for apples (which shouldn't be stored with potatoes). Plus, the project takes a piece of trash out of the waste stream and turns it into a useful homesteading tool—the essence of Modern Simplicity.

However, a fridge root cellar might not be the right choice for everyone. That's why the the third chapter of this book profiles more-traditional root-vegetable storage techniques like spring houses, room-size root cellars, and storage mounds. If you use a technique I haven't listed, I hope you'll drop me an email at anna@kitenet.net and I'll share your input with future readers of this book.

Safety

The final topic I want to cover before telling you how to build a fridge root cellar is safety. There are two issues you'll need to consider—chemicals and kids.

You've probably heard about small children climbing into a fridge then being unable to reopen the door from the inside, leading to their eventual death by suffocation. Luckily, this problem is only a factor for refrigerators built before 1958, at which point the mechanical latching mechanism was replaced with a magnetic seal that is easily opened by anyone who can apply at least fifteen pounds of pressure to the door. While a child probably wouldn't suffocate inside a refrigerator root cellar (since you'll be adding several ventilation holes), it's still a good idea to remove the latching mechanism from pre-1958 fridges before putting them into place.

Since such old fridges are becoming less and less common, the most likely safety issue you'll come across with your own project is chemicals. Before the 1990s, freon was used to keep refrigerators cold. Freon isn't toxic to people, but it does help rip holes in the ozone layer if it escapes from your fridge, so refrigerator manufacturers changed over to a less-toxic suite of chemicals in the 1990s.

If your refrigerator was built during the freon era, you'll need to make a judgment call about whether any freon is left in the copper lines behind your fridge and in the condenser. Technically, the EPA doesn't allow you to cut these lines even if you're sure all of the freon has already leaked out (which is often the case if your fridge is still running but is not keeping cool). If you're able to remove the cooling coils without puncturing them or disengaging them from the condenser, this is your best option—dispose of the freon-filled coils during one of the hazardous waste days most municipalities host a few times per year. On the other hand, you may decide that you're less likely to release the refrigerants by leaving the coils in place and sequestering any escaped gases in the soil while the fridge is being buried.

Those two safety issues aside, building and using a fridge root cellar is simple and fun. Read on to plan and build your own!

Fridge root cellar

How to make a refrigerator root cellar

Planning the orientation

The second-generation fridge root cellar.

My husband wasn't the one who initially came up with the idea of turning an old fridge into a root cellar—we'd read about refrigerator root cellars in several places before embarking on our own adventure. However, none of the authors in question seemed to have experimented with the conversion themselves, and we soon learned there was a lot more to turning a refrigerator into a root cellar than simply digging a big hole and throwing the junked fridge in.

A vertical orientation makes it much easier to access the contents of your fridge, but you'll need to be sure there's plenty of room for the door to swing open.

Our first decision was orientation of the refrigerator. Most diagrams show a refrigerator buried on its back, in essence turning it into a structure like a chest freezer. While that method does require less engineering, we've learned that hard-to-access parts of our homestead don't see much use. Kneeling down on the cold, sodden ground to wrestle a refrigerator door upright sounded like a recipe for ignoring those storage vegetables until spring, so Mark opted to install the fridge upright into the side of a hill.

Digging the hole

Mark dug into the side of a hill to provide a spot for the fridge.

This is the part of the project where you might need to get creative depending on the lay of your land. The optimal location is in the side of a north-facing hill that will shade the fridge from the sun and will allow you to bury the entire structure with the least amount of digging. Even a south-facing hillside would work, though, especially if you plant a pine tree or other evergreen in front of the root cellar for year-round shade.

If your homestead is entirely flat, you're in for more digging (and will need to make sure you don't chose a location with high groundwater). You can dig a hole as deep as the fridge is tall, widening the excavation enough to create steps for access and room for the fridge door to swing open. Alternatively, you can dig perhaps half that depth, using the soil to mound up around a partially buried fridge. The latter won't keep the internal temperature quite as constant, but will be much less work.

Ventilation holes under the fridge provide extra air-flow.

As I mentioned in the previous chapter, air flow is extremely important to keep vegetables from rotting in the root cellar. Mark used post-hole diggers to create two holes in the bottom of the excavated pit. Then he placed a couple of cement blocks (on which the fridge will rest) on either side of the holes, creating a larger air cavity underneath the refrigerator's bottom.

Dismantling the fridge

Our junked fridge, ready to be disassembled.

For best results, you'll want to spend a bit of time disassembling and ventilating your fridge before putting it into the ground. Any fridge will do—we used one that had died and been replaced, but if you don't have a failed fridge on hand, a trip to the dump might be in order.

Dismantling the cooling system of your fridge will give you parts for other projects.

It's not essential to take out the motor and cooling system from your fridge, but this extra step will make the fridge lighter and easier to handle and will also provide parts for other projects. The dismantling step doesn't take long with a few screwdrivers or with a hand-held drill.

The bare back of the fridge.

The photo above shows what the back of your fridge should look like when you're done.

Ventilating the fridge

Holes in the bottom of the fridge allow air to come up from underground.

Your next step is to create a flow of air from the cavity under the fridge, up past your vegetables, and out the top. Start by drilling lots of holes in the bottom of the fridge. The exact drill size doesn't matter, but larger is better than smaller.

Screening the holes prevents critters from eating your vegetables.

You're creating a food-filled larder that never freezes, perfect for mice, voles, and insects to move into. To prevent critters from eating your winter food, screen the holes on the bottom (and any other holes you find or create in the fridge) with old window screens or with rolls of screening you can buy at any hardware store. Mark screwed our screen in place, but liquid nails would also do the trick.

A metal rack divides the freezer and fridge compartments without restricting air flow.

If your fridge has a solid divider between the fridge and freezer compartments, that needs to go. You'll probably be able to put one of the fridge's metal shelves into this spot to make storage easier without restricting air flow. Similarly, the crisper drawer should come out, as should any solid divider above it.

Be sure to provide a capped ventilation pipe.

A ventilation pipe coming out the top of the fridge will complete the air cycle. You can use whatever kind of pipe you have on hand; just draw around the pipe to mark the part of your fridge roof to remove. A large drill bit will create a hole large enough to insert a jigsaw, and the saw can then be used to cut out the circle. With corrugated drainage pipe like the one we used, you don't even need to secure the pipe—just insert it far enough into the hole so the larger ribs hold the pipe in place.

Once you've installed your ventilation pipe, be sure to perforate the top with many small holes and cover them with screen, then cap the whole thing with some kind of waterproof lid so water doesn't flow in. A little water running down your ventilation pipe is no problem, but you don't want gallons to leak inside during every rain.

Burying the fridge


Our 2009 experiment didn't take the weight of the earth into consideration. Don't repeat this design!

This is the step where we failed the first time around, so you get to learn from our mistakes. The photos above show the initial design, with wooden wings bolted onto the fridge to hold back loose earth, and with the fridge sitting as level as it would in a house. What we didn't realize in 2009 is that all of the loose earth behind the wings would slump during heavy rains and push the whole fridge over.


What happens if you don't take the power of the earth seriously.

It’s extremely disappointing to have your fridge root cellar collapse a month after construction. What was even worse was trying to pry the waterlogged fridge back upright three years later once it had completely filled with water.

Extracting the slumped fridge was hard work.

We decided to be extremely careful the second time around to prevent the problem from reoccurring, so we doubled the price of our root cellar to about $20 with the purchase of mobile home anchors. We also opted to lean the root cellar backwards a bit and to leave off the wings in further efforts to prevent another collapse. Without the wings, we weren’t able to mound earth up over the entirety of the sides, but losing a bit of the insulative power of the dirt was worth it for a fridge that wouldn’t fall over.

Mobile home anchors (on the left) might be overkill. If so, the smaller and cheaper anchor on the right (often available as a dog tie-down in big box stores) might suffice.

In addition to the anchors, you'll need some heavy wire, a turnbuckle, and a U-bolt.

For best anchorage, you'll want to drive the anchors into undisturbed soil and to attach them to the side (rather than the back) walls of the fridge. As an engineer friend explained, "Refrigerator walls are often sandwich constructions of plastic or metal sheets with polyurethane or polystyrene foam in between. These sandwiches, as a rule, do not like out-of-plane loads. It's better to put the load in plane with the side walls."

Despite heavy rains, our fridge root cellar hasn't moved an inch since we changed the orientation and added anchors. If you skimp on some of these anchoring steps and your root cellar still holds up, I hope you'll email anna@kitenet.net and let us know so we can prevent later experimenters from going to excess trouble.

Maintaining temperature

Before mounding extra dirt around the root cellar, temperatures rose to 54 inside during a warm week. Low humidity wasn't a problem.

You may recall that optimal root cellar temperatures range from just above freezing up to 40 degrees Fahrenheit. In the midst of the fall harvest frenzy, we initially mounded dirt only lightly around the sides of the fridge and didn't cover the top, with the result that warm days brought inside temperatures up to the low 50s.

The more earth you can pile on your fridge, the better.

Another round of earth-moving (plus some winter rye sown on top to hold the loose earth in place) did a much better job. By this time, we were seeing outside highs around 70 and lows in the low 20s and noticed that the ground was freezing solid for days on end in areas shaded by our north-facing hill. Inside the fridge root cellar, temperatures ranged from 34 to 36.

If you've got extra space, jugs of water can provide thermal mass to keep the contents of the fridge from changing temperature quickly. The jugs can also double as emergency drinking water if you follow the tips in Weekend Homesteader: November.

It's possible our fridge would have stayed unfrozen with no additional manipulations, but 34 felt too close for comfort, so we

worked a little harder to ensure our harvest would be edible all winter. First, I added jugs of drinking water in the freezer compartment as thermal mass. Since water requires a lot of energy to change temperature, the jugs mitigated any rapid warming and cooling trends inside the fridge root cellar.

To install a light bulb in your fridge, drill a hole in the side wall, run a cord through the hole, and wire a plug into the end. For best results, seal around the cord with silicone so insects and water can't creep in.

Next, Mark added a light bulb attached to a thermocube. The thermocube is an inexpensive electronic device that turns on whatever's plugged into it at 35 degrees Fahrenheit and turns that load off at 45 degrees. We installed a kill-a-watt meter behind the thermocube so I could keep track of how often the light bulb went on, and I discovered that the temperature in the root cellar dropped below 35 degrees for about half an hour per night when the outside temperature was in the low-to-mid teens. At higher temperatures, the fridge root cellar operated perfectly with no electrical heat source.

A small space heater turned out to be more energy-efficient than a light bulb.

The light setup is sub-optimal since storage vegetables keep best in darkness and since the whole point of a root cellar is storage without using electricity. Even though our root vegetables seemed able to handle the light for an hour or two per winter (eating up less than 2 kilowatt-hours of electricity), Mark is still working on a better solution. In late winter, he plugged a small space heater into the thermocube in place of the light bulb, and sure enough, the space heater seemed like an even more efficient use of electricity. While the bulb would kick on for half an hour on the coldest nights, the space heater must have only operated for seconds or minutes based on the recorded energy usage.

What do you do if the power goes out and record lows are forecast? Luckily for you, we dealt with exactly that scenario during the fridge root cellar's test winter. The obvious solution was to bring the contents of the root cellar into the kitchen and cover them with damp towels for a couple of days until the cold spell passed us by.

We haven't had to put any effort at all into manipulating the humidity—it stayed around 99% from the beginning. As a result, I've been thrilled to find that carrots in the refrigerator root cellar maintain their crisp freshness for months, much better than they do in the crisper drawer of our indoors fridge. In fact, as I finished the first draft of this book in late April, those carrots were still quite edible (although starting to grow roots and small leaves). The fridge root cellar definitely did its job.

Next steps

Our fridge root cellar is a work in a progress, and I'll be sure to revise this book with updates when I have more data. (Amazon will send you an alert at that time and you'll be able to read the revised version of this book for free.) So far, winter conditions within the root cellar seem to have been near-perfect, although summer temperatures were higher than I'd like, ranging from 69 to 83 degrees. However, since there aren't many root crops that require summer storage, high summer temperatures may not be a problem on our homestead.

Meanwhile, we have other experiments on the horizon. We'd like to compare a chest freezer buried coffin-style to the refrigerator root cellar—how much more painful will it be to kneel on the ground and reach down to retrieve the contents, will the air flow patterns be as good, and will the temperature inside be much more constant? We may build some earthworks (not attached to the fridge) to allow us to mound up more dirt on the sides of the existing fridge root cellar, and those of you living further north might consider stacking bales of straw against the exposed door for extra insulation.

So far, though, we're very content with the fridge root cellar as-is. It was cheap and easy to build and the carrots and cabbages we ate out of it were crisp, sweet treats on cold December (and January, February, March, and April) days. If you're not convinced, don't despair—the next chapter suggests other root storage options that have definitely stood the test of time.

Other storage options

History of root cellars

In *Root Cellars in America: Their History, Design and Construction 1609-1920*, James Gage makes the argument that root cellars were a British permutation of a traditional Native American design. Although some reports suggest that ancient Australians buried yams in pits in the ground and that Etruscans stored wine in the soil, large-scale food storage in the earth doesn't appear to have been common outside the Americas. In Great Britain, for example, a mild climate made it possible for grains and dairy products to be kept in lofts, and root crops were often simply left in the fields and harvested as needed over the winter. When colonists reached what would become the United States, though, these traditional techniques turned out to be problematic—our climate was too hot in the summer for loft storage and too cold in the winter for field storage.

Re-creation of a corn storage pit at Sunwatch Indian Village in Dayton, Ohio.

Luckily for us, Native Americans had already figured out a solution to the storage problem. The Sunwatch Indian Village historical site shows how villagers stored their corn for the winter around 1200 AD in large, grass-lined storage pits. Each family of six-to-eight people had their own pit, which would hold 500 or more pounds of corn.

While we're on the topic of Native American storage techniques, it's worth noting that the corn crib was probably their invention as well. These raised, ventilated storage buildings were found on most American family farms until recently since they stored the year's corn crop in a dry spot, out of the reach of critters. Lining the inside with hardware cloth in modern times does an even better job of keeping rodents and raccoons at bay. The crib-within-a-crib design shown above solved the raccoon problem for our neighbor.

European settlers soon took to pit storage, sometimes digging simple pits like the Native Americans had under the floors of their homes. At other times, pits became large cellars, or even separate buildings like many root cellars are today. By 1767, the term "root cellar" had gained enough momentum that it saw its

first instance in print (in an ad for the sale of a New York farm), and the idea had also traveled back across the Atlantic to help Europeans preserve their food better at home.

Very low-tech storage options

Carrots overwintering in the ground in our garden were barely edible by spring. Other climates may have more success with this method.

As the history in the precious section suggests, the lowest-tech methods of root storage have variable success depending on your climate. Most haven't worked well for us here in zone 6, but I've heard good reports from other parts of the country, so I'll detail some of the more interesting options below.

One technique is to keep vegetables that can handle a light freeze (like cabbages and carrots) right in the garden just as the British colonists did at home before reaching the Americas. The year we left carrots in the ground (mulched heavily) for the winter, our natural freeze-thaw cycle pushed many out of the soil, where they froze and rotted. The carrots that survived until spring turned woody with lots of fibrous roots and were barely edible (although this was largely due to waiting too long to harvest the roots—overwintering carrots should be dug before the first top growth begins in the spring). You may have better luck with this technique if you live far enough south that the ground never freezes solid, or far enough north that the ground freezes

once and stays frozen, and if you don't have a lot of voles living under your mulch.

A clamp is a traditional way of storing potatoes in the southern United States.

Another method we tried with little success was a potato clamp. Straw, mounded earth, and a ventilation pipe combine to produce a mini-root cellar, but we live a little too far north for a clamp to provide sufficient frost-protection for potatoes. If I were going to try another clamp, I might fill it with carrots (which can handle a light freeze) and would tweak the design so the base was sunken a few inches into the ground and the pipe came out the side rather than the top. I might also consider making several small clamps so I would only need to disturb each one a single time, although, in *The Self-Sufficient Life and How to Live It*, John Seymour recommends building extra-large clamps so that the roots on the outside protect the interior. Either way, I wouldn't recommend building a clamp in zones colder than 6, although those of you living in zone 7 or warmer might give it a shot.

I haven't had personal experience with simply burying

vegetables directly into the ground, but my father reports this was a common technique in the 1950s where the Appalachians run into the Midwest in West Virginia and Ohio. He recalls a neighbor burying cabbages in a trench, head down and roots left above the soil as a locational marker, while another neighbor buried celery for the winter in a similar manner. Even containers of ice were often stored in pits in the ground to be used as summer refrigerants.

Aimee Leforte stores her carrots in containers of damp sand in the bottom of her closet.

The sand keeps the carrots crisp from October through April.

If you have a cool closet, you can follow the lead of Aimee Leforte, who uses plastic storage bins and sand to emulate root cellar conditions. She wrote:

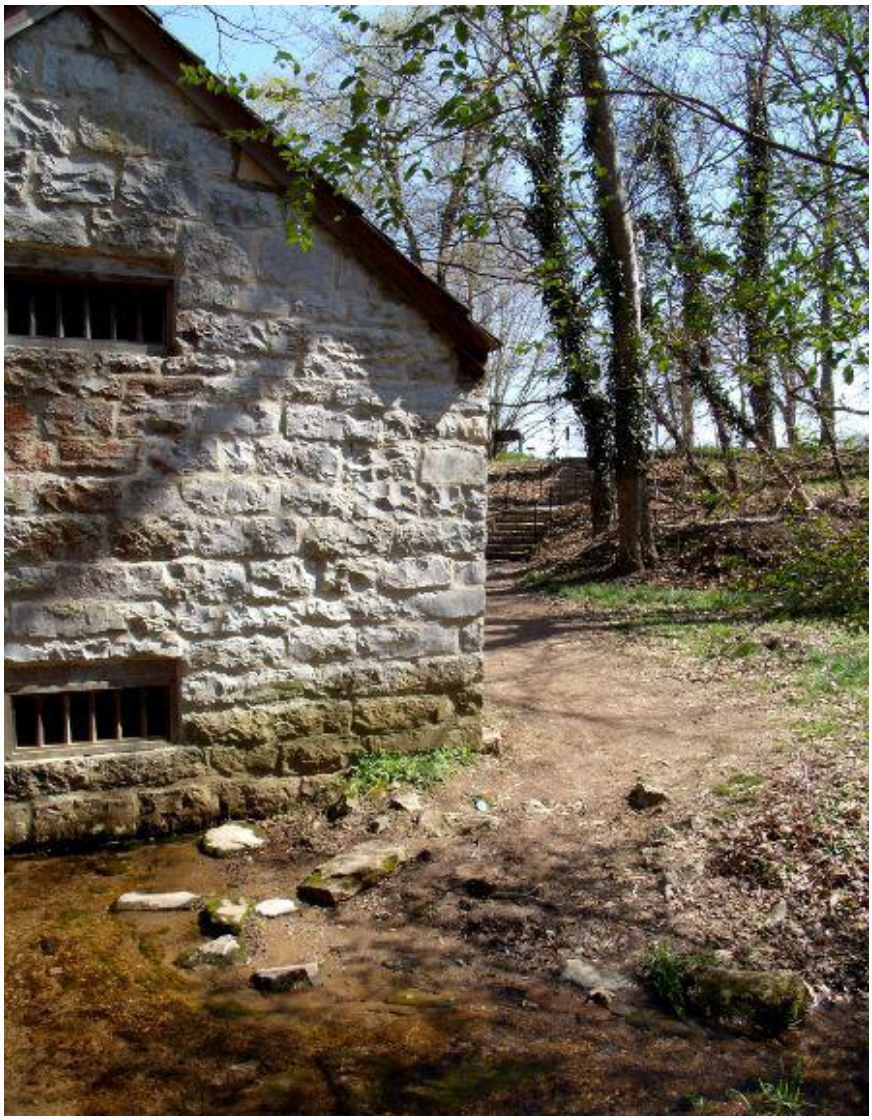
> "Even though my house was built in 1918, there is no formal root cellar or even the remnants of one. Instead I have experimented, with fantastic results, using a downstairs closet and totes of sand.
>
> "This particular closet has two walls that are also outer walls, and two walls that are inner walls. I have found in the late fall and winter that this closet is fairly cold, but definitely above freezing. If I had to guess I would say its in the 40-45 degree range; I haven't actually measured it.
>
> "With carrots, parsnips, and turnips, I have taken each and topped them. Then I will take a tote and layer the bottom with slightly-dampened sand. Layer in a layer of veggies so that they are not touching. Add sand to build up a layer, mist lightly with water, then add veggies again. I do this several times until the tote is 3/4-of-the-way full. I add the lid and store in the bottom of the closet.

> "Every once in awhile, I'll check to see how they are doing. I've never had any go bad until at least late March, and have had farmer's market carrots from October clear until mid April.
>
> "I think that this method, and a little experimentation, would work well for anyone who has a crawlspace, closet, or attached garage. Very simple to do. And I already had both the sand and totes, so for me it was free. But to buy these items you may have less that $15 to 20 dollars to set up one fair-size tote."

Similarly, Carol Deppe (author of *The Resilient Gardener* and a major potato-eater) reports good results with storing potatoes in paper bags in her garage. She lives in the Pacific Northwest where winters are wet and cool, which keeps her garage at about 45 to 55 degrees Fahrenheit with 90% to 98% humidity. Deppe simply fills paper grocery bags with about ten to fifteen pounds of potatoes apiece and rolls the top closed, which keeps the tubers fresh until spring.

The trick with making any of these simple root storage methods work for you is to understand your own conditions. Do you have a location in your house that stays damp and cool but above freezing? How about in the garden? The trade-off is usually less time and money invested in building your root storage location, compared to more time spent monitoring and tweaking the conditions so your crops don't spoil.

Spring houses



This photo of the spring house at The Hermitage in Tennessee was taken by mikebfotos and is used under a Creative Commons License. http://www.flickr.com/photos/mikebfotos/5536814846/.

Sometimes known as a "dairy," spring houses were common in parts of the U.S. where water naturally wells up out of the earth. Small houses are built on top of the springs, with concrete or rock channels diverting the water to the outdoors. The combination of the high-thermal-mass rock and the earth-cooled water keeps foods placed near or in the spring cool.

Food can be lowered into a hand-dug well for cool storage.

Although you could probably store root crops in a spring houses, these structures were more often used to keep milk or meat cool in the summer rather than to keep vegetables from freezing in the winter. If you're not lucky enough to have a nearby spring but do have a hand-dug well, you can also lower containers of perishables down into a well to get the same effect, but be sure the contents won't spill and sully your water.

Root cellars

The whole shebang

If you don't have a spring or well handy, and clamps and refrigerator root cellars aren't working for you, it might be worth building a more serious root cellar. If so, I highly recommend hunting down some other resources to design your structure. The case studies below are included to give you an idea of the investment (and reward) to expect from creating certain types of root cellars, rather than as blueprints and building guides.

Cave root cellar

Frank primarily uses his root cellar to store homegrown potatoes.

Our neighbor, Frank Hoyt Taylor, took advantage of the backhoe rented by a friend for grading a house site to dig a root cellar into his north-facing hillside. When the excavation was completed, it became clear that Frank had opened a hole into a

cave, so he decided to gain some extra geothermal cooling by running pipes from the back of his root cellar into the cave.

Frank's root cellar is built into a north-facing hillside.

Frank started with a sixteen-inch-wide and eight-inch-deep, reinforced-concrete footer, then added eight-inch block mortared together without any reinforcement. The root cellar was initially built a couple of feet in from the earth bank, then after the concrete had cured for a month, dirt was pushed up against the walls. The finished structure has inside dimensions of ten feet by nine feet by eight feet tall (at the highest point).

The ceiling consists of between-three-and-four inches of concrete reinforced with rebar and remesh.

Before pouring the concrete, Frank built a plywood form, then

laid down a couple of leaves on top to create imprints in the finished ceiling.

The ceiling consists of reinforced concrete poured onto a plywood frame. Like the walls, the ceiling also had earth pushed over top after curing.

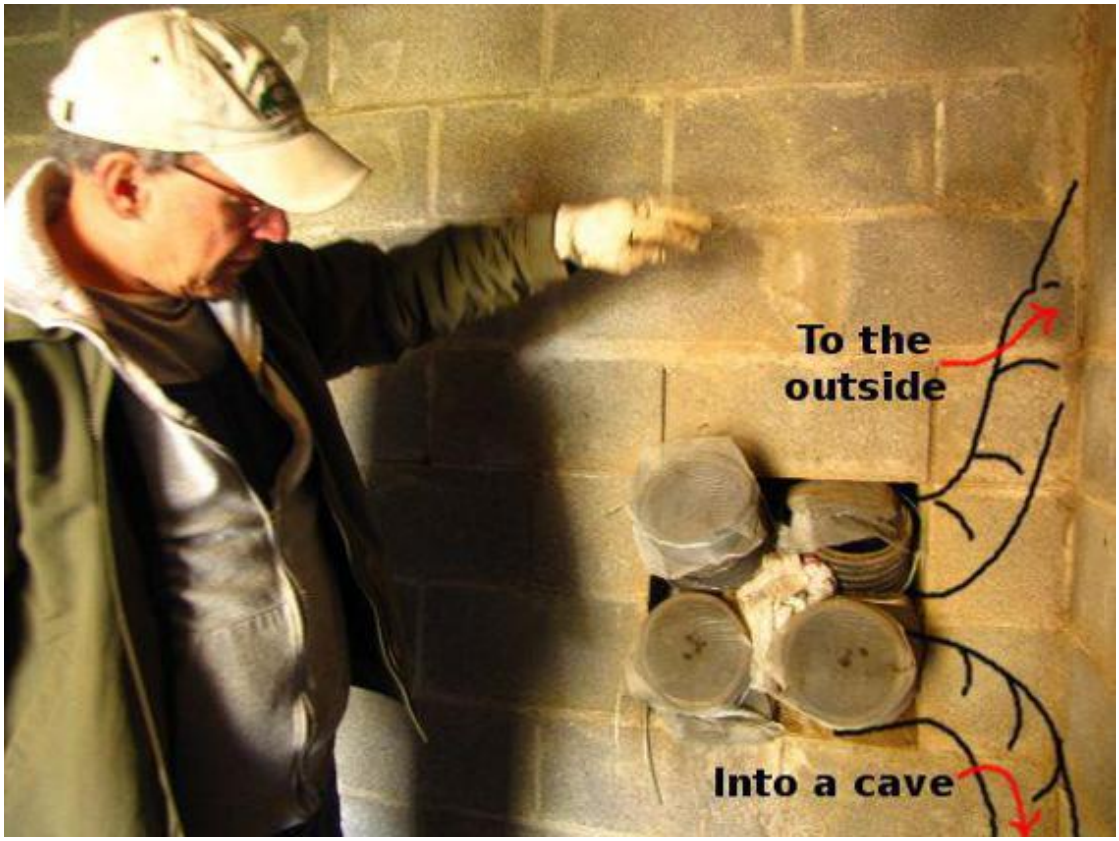
Two railroad ties running perpendicular to the rest hold the bank supports in place. A rebar pierces and connects each perpendicular tie with the one above and below it.

To allow partial coverage of the front wall with earth, Frank built a retaining wall out of railroad ties. He placed two ties perpendicular to the rest and pinned them in place with rebar in order to counteract the force of the earth and ensure the wall won't fall in over time.

This homemade door is made from plywood sandwiching a 2.25-inch-thick piece of foamboard insulation.

Most of the front wall isn't insulated by soil, so Frank added a layer of foam insulation on the inside.

To keep the temperature inside the root cellar constant, Frank built an insulated wooden door, then added foamboard insulation to the inside of the front wall. Although summer temperatures may rise and winter temperatures lower, the cave root cellar stays steady for most of the year between 50 and 55 degrees. Ice does occasionally form on the inside of the exposed front wall.



The cool-air intake pipes are channeled in two different directions—two tap into a cave while two go directly to the outside.

The real beauty of Frank's root cellar is the way he has created a very low-budget geothermal system by tapping into a naturally-occurring cave. The cool-air intake involves four drainage-tile pipes, two of which go directly to the outside and two of which dip into the cave. Unfortunately, the outside-air pipes were crushed when the backhoe pushed soil up against the back of the root cellar, so Frank feels the root cellar could benefit from more ventilation. He is considering adding vents at the bottom of the wooden door, but is happy with the outlet vent at the top of the cellar.

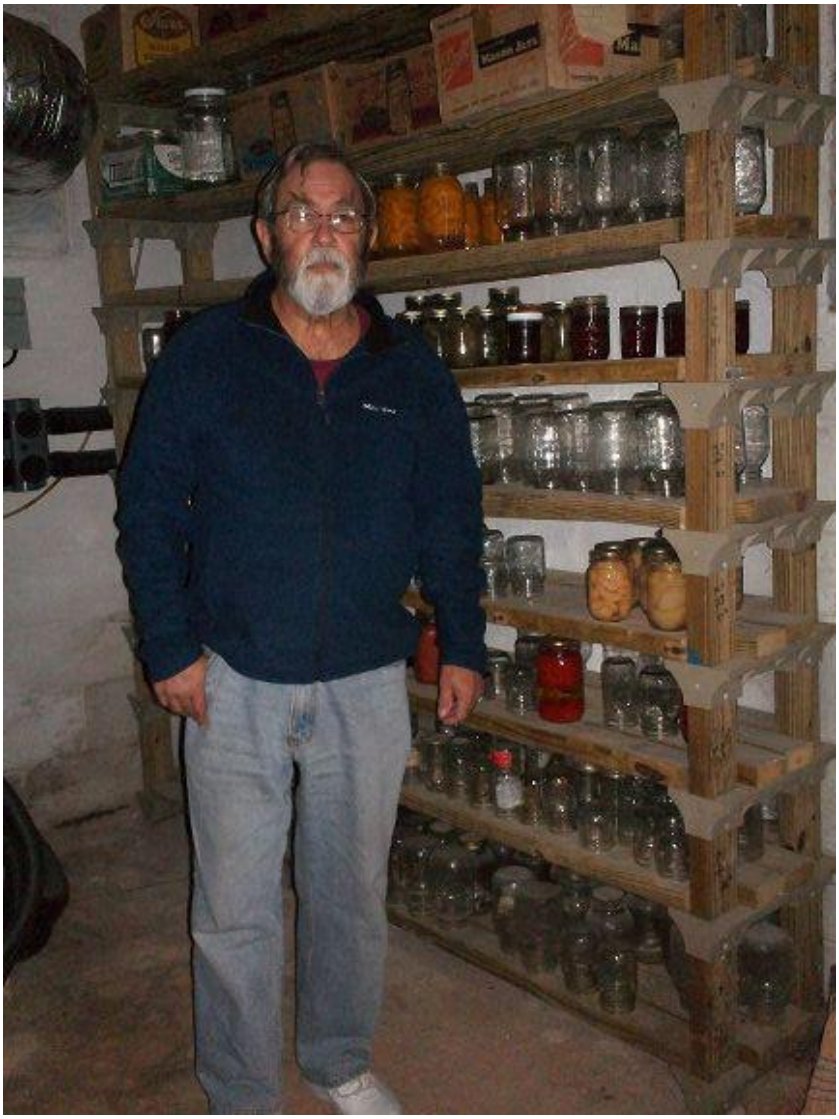
Frank built the root cellar with the help of his friend Jim around 2003. The pair didn't keep track of their labor (which was extensive) and didn't have to pay for the backhoe since it was already on-site. Those caveats aside, they estimate they built their cave root cellar for about $200.

With so many potatoes on hand, Frank doesn't mind losing a few to the mice.

The root cellar is over-sized for its current task of storing homegrown potatoes, but it is clearly doing a good job since the potatoes were still in good shape when I came to take photos in early March 2013. The shelving along one side of the root cellar can currently hold up to 14 bushels of potatoes, and Frank has considered building an air-tight partition down the middle of the cellar to allow him to store apples on the other side. He grows far more potatoes than he can eat, so doesn't mind losing a few to mice.

Frank enjoys the way cave salamanders share space with homegrown potatoes, and he notes that the structure could double as a tornado shelter if necessary. When the backhoe-driver came to check up on the cellar a few months after construction, he opined "That root cellar is worth a fortune," and Frank agrees.

Basement root cellar



Canned goods share space with root crops in this basement cellar.

My father's most recent root cellar was constructed as a basement to a new room he added to his South Carolina home a few years ago. The 14-by-12-foot cellar added about $3,000 to the cost of the structure, a figure which includes both materials and labor. The walls are block, the floor is poured cement, and stairs lead up to the dwelling above.

Root cellars in the basement of a building have both pros and cons. On the positive side, it's very easy to walk down into the basement to grab a handful of carrots, which makes the structure see more use than standalone cellars sometimes do. In addition, you don't have to install a separate roof on the in-house cellar, which cuts costs.

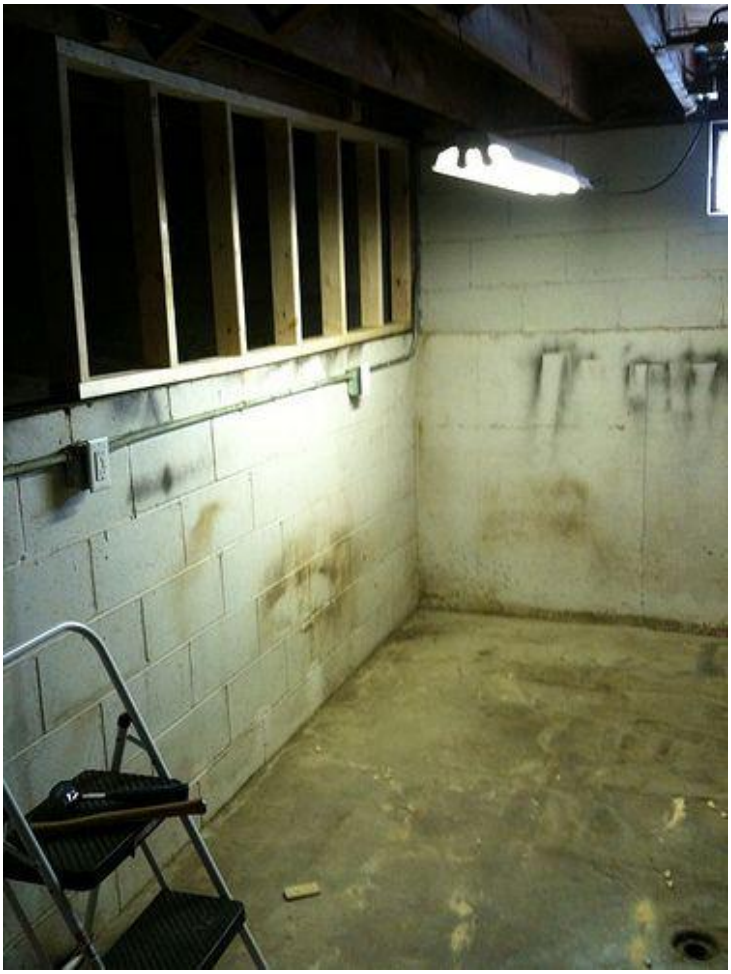
However, basement cellars often have sub-optimal temperature

and moisture conditions. Most builders don't want the upstairs to be damp, so they seal moisture out of the cellar, leading to conditions a bit too dry for the best long-term root storage. In addition, heated air from upstairs may drift down to warm your roots.

My father kept track of his root cellar conditions for the first year and notes that average temperatures were around 40 degrees in the winter, although interior lows did sometimes drop to 35. Extremely-hot South-Carolina summers have raised basement temperatures into the low 70s on the middle shelf, although it's always a bit cooler near the ground and warmer near the ceiling.

It was impossible to build a root cellar into a hill in his South Carolina location, but my father fondly recalls a former root cellar built in that manner. The walls were built from cinder blocks, the door was insulated steel, and the roof was a six-inch concrete slab that doubled as a patio. The contents were moist but not wet, and although he never recorded the temperature, carrots, potatoes and canned goods never spoiled in his in-hill larder. Perhaps his words are only a rose-tinted view of the past, but my father termed that older structure "the perfect root cellar."

Basement cut-off



Emily's original basement included an eight-foot-by-eight-foot area that she decided would make a good root cellar.

If you already have a basement, you may be able to convert a small section over to root-cellar conditions at a minimal cost. Emily Springfield spent $220 creating a root cellar in her Michigan (zone 5b) basement. By opening and closing the window to the outdoors, she could keep potatoes and other root vegetables in good shape all winter long.

Separating the root cellar area from the rest of the basement required Emily to build one large wall and one small wall.

"The basement had an area eight feet wide with a casement window in the foundation," Emily wrote. "Then there was a four-foot-tall wall separating the full basement from the crawl space. So I built a wall across the eight-foot space (this had the door in it), and filled in the space between the half-wall and the rafters. I added insulation, plywood paneling, light and shelves, and that was pretty much it."

Fiberglass insulation in the ceiling prevented house warmth from seeping down into the root cellar.

Emily used pieces of rigid-foam insulation to block off the area between the ceiling joists "so air won't flow in sideways through the batts. This also looks a lot neater."

Emily was able to buy most of her construction materials used, keeping project costs to a minimum. The table below shows where her money went:

Materials	**Cost**
Door and hardware (used)	$45
3 sheets of 3/4-inch, rigid insulation	$50
2 rolls of fiberglass insulation	$15
2 sheets of 1/4" plywood	$30
Low-temperature fluorescent light. (The original light	$15

wouldn't turn on when temperatures dropped below 40 degrees Fahrenheit.)	
Lumber for shelves	$35
1 gallon Killz paint	$15
Tape, "button" nails, Liquid Nails, etc. (Nails with plastic washers were used to hold up the rigid-foam insulation.)	$15
Total	**$220**

The majority of the foam insulation was used to insulate the walls.

This paneling was later taken down to prevent the growth of mold.

After filling the area between the wall studs with foam insulation, Emily covered the outside with used paneling and the inside with plywood. "But I had to take the paneling off the outside of the cellar before I even put food in it," Emily explained. "This was pressed-wood-fiber-type paneling, got cheap at the re-use center. It was pretty, but even though I took great pains to keep it from touching the floor or walls, it started absorbing moisture and got very moldy very fast. I pulled it off and didn't replace it with anything, so the outside wall of the cellar is bare studs and you can see through to the rigid-foam insulation. While my aesthetic side is sad, it doesn't change the functionality at all, and I really want to avoid starting a mold farm in the basement."

As you can see in the previous photo, water sometimes trickles across the cellar floor during heavy spring rains, which isn't a problem since root cellars are meant to be damp environments. In a continued effort to prevent mold from forming, Emily painted the walls with Killz paint and made sure that no insulation or paneling touched the outside walls or floor.

The original ventilation system involved making an insulated door to replace the glass window…

...and installing pipes for air to move through.

Emily's original goal was to ventilate the root-cellar area with two drainage-tile pipes going through the hole where the window used to be. First, she blocked off the majority of the window with a homemade door made out of foam insulation sandwiched between two pieces of plywood, glued together with Liquid Nails, then sealed with exterior paint. Next, she added two pipes —a short pipe stopping at ceiling height to let out warm air and a long pipe extending down to the ground at the opposite side of the room to let in cold air. The pipes were screened to prevent mice incursions, and Emily built caps to close the pipes as needed.

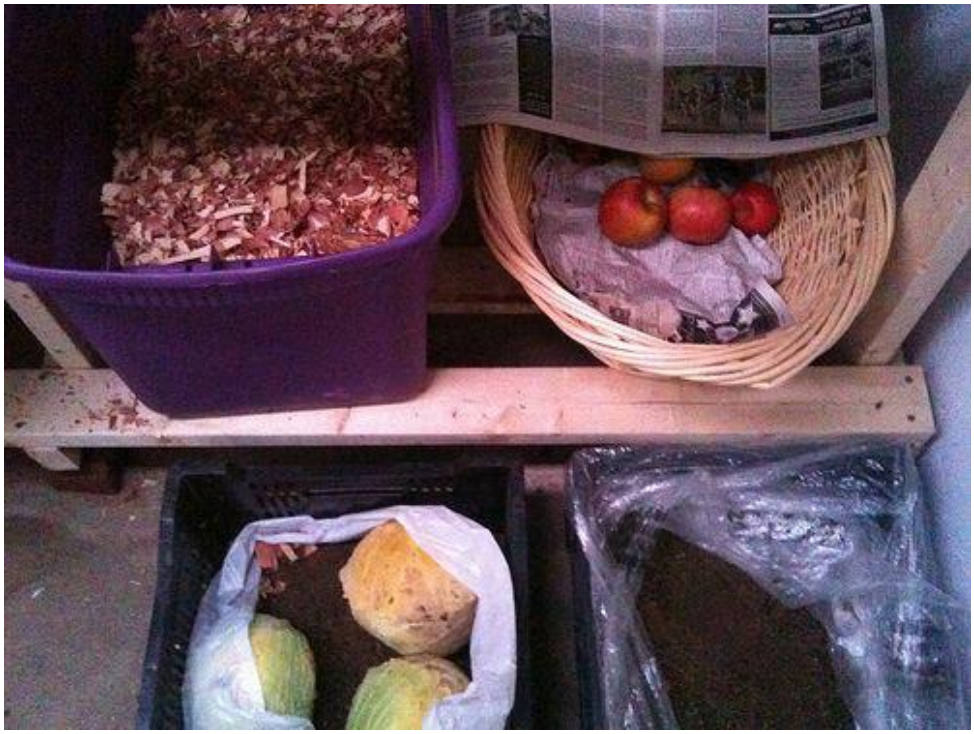
However, she soon found that the pipes weren't allowing cold air to flow in fast enough to keep the root cellar chilled. Emily's solution was to remove the pipes and simply open and close the

whole window as needed. A thermometer in the root cellar with a remote readout in the kitchen made it easy to learn the way the root cellar responded to weather.

"Temp has been fluctuating between 45 and 55," she wrote in November 2011. "I've just been opening the window at night and closing it during the day if it's going to get over 50. If I close the window, the temp tends to go back up to 55—makes sense, as the earth surrounding 3.5 of the planes of the room is 55 degrees."

Later in the winter, she reported some changes: "[Opening and closing the window as needed] worked really well until about mid-December. Then I got to a point where having the window open was too cold, but leaving it closed was too warm. (The cellar holds around 40 with no ventilation.) So I took the window out completely and put the board back into the window. (There's a screen to keep critters out.) This board is about 4 inches narrower than the window frame (it had held the vent pipes in place) so it effectively closes off 85% of the window but leaves it open a bit for some air to get in and out. I can leave it like that night and day unless we have a series of lows near zero and highs below 15 degrees Fahrenheit—then I need to put the window back in or it gets too cold in the cellar. It's a 5-minute chore to open the window, or to swap the window and the ventilated board, so no big deal there."

Homemade shelves built from 2X4s allowed for plenty of ventilation. Emily propped them up on bricks to keep their feet out of the water that sometimes flows over the floor.



Successful storers included potatoes, apples, and rutabagas. Emily had moderate success with beets and cabbages.

Emily's biggest trial with her in-basement root cellar was humidity. "I can't seem to get the humidity in the room to stay above 50% now that winter has set in, even with bins of damp sand on the floor, so instead I'm trying to keep the local humidity around the produce high," she wrote. She experimented with storing produce between layers of newspapers, straw, damp cedar shavings, damp peat moss, and damp sand.

The flower pots full of carrots and parsnips layered with straw didn't last long. "This will be compost soon; my parsnips had all split and are starting to get moldy already," she explained early in the winter. Beets lasted longer, but were sensitive to the lack of moisture and did best when layered in damp cedar shavings.

On the other hand, Kennebec, Russet, and Pontiac Red potatoes lasted a long time in all storage situations, seeming to prefer being stored between layers of newspaper in a basket. Cameo apples kept well under the same conditions as potatoes, with only a few on the edges going mealy by February. Rutabagas were more like beets (although a bit hardier), preferring the damp cedar shavings.

Emily discovered that the biggest factor determining how long her cabbage lasted wasn't storage method but variety. "I have three different varieties of cabbage, and it's clear one is a better keeper than the others. The problem is, it's hard to tell varieties at the market and the sellers often don't know the variety. So by buying from a couple different places, and looking for the hardest, most dense heads, I even the odds that something will be a long keeper."

In February 2011, Emily concluded "Overall, I am very pleased with the root cellar I built last spring. It's keeping temperature well, not showing signs of mold or infestation, and most of the produce is in very good shape." She added that the root cellar was really far too big for a family of two (a 3-by-8-foot structure would have been sufficient), but that "it was actually easier to do it this way than to make it smaller."

Since that report, Emily and her husband have moved away from their homemade root cellar. She wrote: "I love our new house (lots of passive solar features!) but I'm having a hard time living without a root cellar now! Anything stored in the unfinished-basement utility room is sprouting or going bad (too warm). I'm having better luck with stuff hanging out in

cardboard boxes in the workroom (unheated detached garage), but I'm afraid if we get a cold snap it'll all freeze. So I may have to rebuild this root cellar at the new place. It'll be a little more difficult because I'll need to make a hole to the outside somehow, and that makes me nervous. But a cold room is so awesome to have, I may just have to figure that out!"

To read more about Emily's adventures, visit her blog at http://eatclosetohome.wordpress.org/.

Under-floor root cellar

This simple root storage pit is under the dining-room floor.

Flickr-user lieber_matthew photographed this under-floor root cellar in the Gokyo Valley in Nepal. He explained: "This root cellar mainly stored potatoes, and it was underneath the floor of a dining room of a small Inn (or 'Tea House,' as they're known in Nepal). When the chef needed more potatoes, he would go to the dining room, ask some of the diners to move their chairs, and open the root cellar to retrieve the potatoes."

While no information was available on how or when the pit root cellar was built, my guess is that a hole was cut in the floor,

the pit hollowed out, and a door added on top. Obviously, adding this type of root cellar would only be possible if your house was built without a concrete foundation, but potatoes in the dining room definitely do sound handy.

Integrating roots into your homestead

Growing enough roots

So how do you grow all of the roots to fill up your new root cellar? When learning new skills, I believe in starting small rather than trying to do it all at once. If you've never had a vegetable garden, I highly recommend planting a small plot and expanding each year at a pace you're comfortable with. On the other hand, if you're already a gardener and are ready for the challenge of growing all your own roots, this section will help you plan your campaign.

Nutritional information of common root-cellar vegetables. (Please rotate to landscape mode to more easily view this table.)

	Significant vitamins and minerals	**Percent of calories from protein**	**Calories per pound (raw)**	**Calories per square foot**	**Potential yield (pounds per square foot)***
Beets	vitamin C, iron, magnesium, dietary fiber, folate, potassium, manganese	4	192	209	1.09
Cabbage	thiamine, calcium, iron, magnesium, phosphorus, potassium, dietary fiber,	2	112	62	0.55

	vitamin C, vitamin K, vitamin B6, folate, manganese				
Carrots	thiamine, niacin, vitamin B6, folate, manganese, dietary fiber, vitamin A, vitamin C, vitamin K, potassium	2	186	143	0.77
Parsnips	potassium, dietary fiber, vitamin C, vitamin K, folate, manganese	3	336	?	?
Potatoes (white)	dietary fiber, vitamin B6, potassium, vitamin C	10	352	194	0.55
Turnips	vitamin B6, folate, calcium, potassium, copper, dietary fiber, vitamin C, manganese	2	128	29	0.23

* Yield will depend on your growing techniques and on the variety you plant. I've used "good" yields from the North Dakota Extension Service document *Vegetable Maturity Dates, Yields and Storage* for cabbage, carrots, potatoes, and turnips, the U.S. average from USDA's *Crop Production 2011 Summary* for beets, and have left parsnips blank since

little data on this crop seems to be available. Growers using intensive backyard methods may see yields as much as twice as high as the ones in the chart. I average about 1 pound per square foot for carrots, for example.

The table above provides some nutritional and yield information for common storage vegetables. Based on the information above and assuming a 2,000 calorie diet, you could follow the techniques of poor Irish farmers from a couple of hundred years ago and subsist on cabbages and potatoes, depending on a bit less than a tenth of an acre of the latter to provide the majority of your calories. However, you'll notice that most roots are very low in protein (and that the protein they contain isn't as balanced as the protein you get from meat and dairy), so I recommend considering your root crops a supplement to foods that provide more protein.

A good way to determine the quantity of each type of vegetable to plant is to keep track of how much your family actually eats in a year. For our two-person family on a high-protein diet, we plant about 30 square feet of cabbage and 90 square feet of fall carrots for fresh winter vegetables, along with 90 square feet of potatoes for year-round carbs. We're definitely below-average potato-eaters since Americans consume about 140 pounds of potatoes per person per year, but we eat about five times as many carrots as the average American, who only chomps through 9.6 pounds. I've resisted including the average consumption of each type of root vegetable in the chart above because you're likely to be abnormal in your own particular way as well.

How to grow storage vegetables

Once you figure out how large of an area you want to allot to root crops, the next step is to carve out a spot for them in your garden. The chart below sums up basic growing information for the seven main vegetables likely to be stored over the winter in a root cellar.

How to grow root-cellar crops

Beets *Spacing:* 3-4 inch spacing in rows 12-18 inches apart *Planting date:* 55 to 110 days before the first fall frost *Harvest information:* Greens are best harvested when small and roots are tastiest when 1.5 to 2 inches in diameter. Leave one inch of leaves on the roots when storing. Harvest before or soon after your first frost. *Notes:* Soak seeds the night before planting to improve germination rates. Multiple seeds sprout from each seed cluster, so you must thin. Be sure to eat the greens as well as storing the roots.
Cabbage *Spacing:* 12-24 inches apart in rows 36-44 inches apart *Planting date:* 100 to 140 days before the first fall frost. (Transplants can be set out as much as a month later.) *Harvest information:* Harvest when heads are firm. Leaves on top of the head might begin to dry up. Cabbages should be harvested before or soon after your first frost since they can't stand hard freezes. *Notes:* Cabbage sets (small plants) are often available at farm-supply stores in late summer, or you can start your own inside. If growing cabbage from seed, choose varieties suited for storage since these will produce denser heads.

Carrots

Spacing: 2-3 inch spacing in rows 12-18 inches apart

Planting date: 90 to 120 days before the first fall frost

Harvest information: Wait until after at least one frost to harvest since cold weather sweetens carrots. However, if you wait too long and experience a warm autumn, carrots will split and may rot if left past their prime.

Notes: Seeds can be scattered on the soil surface, but care must be taken to keep late-summer plantings moist so seeds will sprout. Seedlings grow slowly, so weed carefully for at least the first month. Varieties designated for winter storage will be larger and will last longer, but aren't as sweet as other carrots; we've found the smaller, sweeter varieties still last for months and are more to our taste.

Parsnips

Spacing: 2-4 inch spacing in rows 18-24 inches apart

Planting date: 90 to 120 days before the first fall frost

Harvest information: Dig roots when they are 1.5 to 2 inches in diameter and 8 to 12 inches long. Wait to dig until after at least one frost.

Notes: Germination is often mediocre, so you may need to seed thickly and then thin. Otherwise, growing parsnips is much like growing carrots.

Potatoes (white)

Spacing: 9-12 inch spacing in rows 28-34 inches apart

Planting date: Potatoes prefer cold weather, but the tops (which emerge about two weeks after planting) can't handle freezes below 28 degrees. Unless your summers are cool, you'll want to start your potatoes 20 to 50 days before your spring frost-free date. (Note that this is the only root crop I don't recommend planting in the summer, at least in our area.)

Harvest information: Wait until two weeks after the tops have died back before harvesting. You can also grub out new potatoes much sooner, but these won't last long and should be eaten right away.

Notes: Potatoes are grown from pieces of other potatoes, cut into chunks containing at least one eye and weighing at least 1.5 ounces. These seed potatoes can be given a jump on the season by spreading them out in a warm place inside a week before planting. After planting, hill up dirt around the stems of young plants once they're 6 to 8 inches tall, repeating throughout the season to prompt the plants to produce more tubers. Don't let tubers sit on the surface uncovered or they'll become green, producing a mildly poisonous substance.

Turnips

Spacing: 2-6 inch spacing in rows 12-30 inches apart

Planting date: 60 to 90 days before the first fall frost

Harvest information: Harvest at 2-3 inches in diameter, before or soon after the first frost and before the turnips become woody. Leave half an inch of stem on the turnip when storing.

Notes: Turnip tops are a tasty green, but choose storage varieties with less-tasty tops if you want to eat the roots all winter. The related rutabaga requires an extra month's growth, gets larger, and can handle colder weather before harvest.

Notes:

Spacing information on this chart is for traditional, row cultivation. In a high-density planting with permanent beds, you can use the between-plant spacing in all directions and ignore the between-row spacing.

Not every day within the planting date range will be appropriate for each variety. For a more accurate planting time for all crops except potatoes, decide on your appropriate harvest time, count back the number of days listed on your seed packet for the specific variety you're planting, then subtract ten to twenty

more days for safety. For example, this year we are growing Nectar carrots, listed at 72 days to maturity. Our average first-frost date is October 10, so we want to harvest our fall carrots around the middle or end of October. Using a harvest date of October 20, I count back 72 days to August 9, then another ten to twenty days to provide my planting window of July 20 to 30.

In addition to the specific information above, it's worth mentioning a few ways in which root crops differ from other vegetables. When I plan my garden rotation, I always save our deepest, lightest, least-waterlogged soil for root crops. If your plot is a well-drained loam or sandy soil, you won't have to worry about this, but those of you gardening in clay will want to follow suit. If you don't have any light soil on hand, raised beds are one good method of keeping root crops out of wet, compacted ground.

Over-mature carrots will split down the middle, especially after heavy rains. You may also opt to harvest early if small mammals begin eating your roots while they're still in the ground.

Another factor to consider with root crops is planning ahead for storage. Most root crops keep best over the winter if you plant

them as late as possible (while still allowing enough time for the crops to mature before excessive cold weather slows growth). While we can direct-seed carrots starting in March in my zone 6 climate, I don't plan to grow enough spring carrots to last through the year, but instead make a second (larger) planting in July for winter storage. A neighbor uses a similar technique to plant his white potatoes as late as May (rather than the usual mid-March planting) for winter storage, although I've found that summer heat produces low yields for late-planted potatoes in my own garden. Some trial and error on your part will help you determine the perfect time to plant each root crop so that it matures late enough to keep well through the winter.

The final factor to consider with root crops is soil nutrients. High nitrogen levels in the soil can make potatoes watery and more prone to rotting in storage. Similarly, lack of potassium in the soil can cause spoiling problems. On a homestead scale, it probably isn't worth treating soil for your root crops differently from the rest of your garden, but you might consider using less compost for potatoes or otherwise tweaking your planting method if crops don't store as well as you'd hoped.

Flea beetles (above) and a cabbage worm (below).

Two common pests found in crops grown for the root cellar—tiny flea beetles on potato leaves and a plump cabbage worm on a cabbage leaf.

In my experience, if you get the soil right, most root crops are relatively trouble-free. The toughest part for us is usually making sure summer-planted seeds germinate. (Check out *Weekend Homesteader: July* for tips on fall planting.) Flea beetles nibble on potato leaves, but seem to be merely a cosmetic problem in our area, while blight can occasionally wipe out whole potato plantings. Cabbage worms often eat the leaves of our cabbages, but are easy to hand-pick and are much less prevalent on fall than on spring crops. The rest of the root-cellaring crops seem unaffected by pests and disease.

You'll need to pay particular attention to roots again once it's

time to harvest. White potatoes are ready to harvest when the tops die back and cabbages are ready when the heads are dense and full; for the rest of the vegetables covered in this book, just wait until the crops have reached a mature size. Dig roots carefully and sort out any injured tubers since accidentally-sliced carrots and potatoes won't last long in storage. And don't forget to handle root crops carefully during harvest—although potatoes look as hard as rocks, tossing them around will form bruises that will drastically reduce the longevity of your stored crop.

Filling the root cellar

It's also worth putting a bit of extra effort into storage technique within your root cellar if you want your food to last as long as possible. First, flip back to the chart at the beginning of this book and make sure you're storing cool, moist storers, not warm, dry storers. Sweet potatoes, onions, garlic, and other vegetables that like it dry are going to rot quickly in a root cellar, so stick to carrots, turnips, and other cool, moist storers.

Lightly hosing off roots before storage removes the largest chunks of dirt without damaging the skin.

Most root crops will store best unwashed, or at most lightly hosed off rather than scrubbed. Cut off leaves but allow half an inch or so of stem to stay behind on crops like carrots so that you don't injure the root. For cabbages, just peel off the biggest outer leaves and cut off the roots.

Unlike warm, dry storers (which often last longest if properly cured), most cool, moist storers will do best if taken straight from the ground to the cellar. The exception is white

potatoes, which some sources recommend keeping at 50 to 60 degrees Fahrenheit and 95% humidity for two weeks before moving to the colder temperatures of the root cellar. If you're harvesting white potatoes in early fall, your root cellar temperatures will probably be slightly elevated, so you can just toss your white potatoes in and let them cure inside.

Next, focus on air flow. Wire or plastic baskets (like the ones that often come out of junked freezers), mesh bags (like the kind you'll buy oranges or onions in), and even wooden crates with plenty of room between the slats are a good choice because they allow their contents to breathe and let air move upward through the storage container.

Stacking vegetables more than a few high is a recipe for bruising, which leads to rotting. To prevent this problem in a fridge root cellar, put the wire shelves that came with your fridge back in, or fill bins only partway full so the next bin up doesn't rest on your fruits or vegetables. In a larger root cellar, you may want to build shelves for your crops.

Some root-cellar keepers like to pack their crops in sand, sawdust, or newspapers to prevent bruising and to keep the moisture levels high against crops' skins. This technique seems to have originated when root-storage pits were located under the floor of the kitchen, in which case foul odors often wafted up into the living space. I've tried storing carrots both with sawdust and without and had similar results inside my high-humidity fridge root cellar, but your mileage may vary. Flip back to the "Basement cut-off" section for a comparison of storage in newspapers, straw, damp cedar shavings, damp peat moss, and damp sand in a less-humid, basement situation.

My final piece of advice is to try to check on the contents of your root cellar at least twice a month. If you catch vegetables as they first begin to go bad, you can pull out the few ruined roots and quickly cook up the rest. It's also a good idea to keep track of how much of each type of crop you put in the cellar in the fall and when you ran out in the spring so you'll know whether to grow more or less next year.

Eating roots

Now for the fun part—eating those delicious roots! The first option for eating up winter roots is to take advantage of their freshness and consume them raw. In our household, sliced carrots or cabbage served with hummus makes a great side dish, but you might prefer grating the vegetables, adding a dressing, and turning them into coleslaw.

Green Bean and Potato Salad

2 c. potatoes (new potatoes or Yukon Gold work best)
2 c. green beans
1/4 c. fresh basil
1/4 c. green onions
salt
pepper
2 tbsp. balsamic vinegar
2 tbsp. olive oil
2 tbsp. lemon juice
1 tbsp. sugar
1/4 tsp. dried mustard
1 clove garlic, minced

Cut potatoes into bite-sized pieces. Boil in a small amount of water for a few minutes while breaking the ends off the beans, stringing them if necessary, and snapping them into pieces. Add the beans to the potatoes and water (or place them in a steamer over top) and keep boiling for a few more minutes until potatoes and beans are tender but not mushy. Drain off the water and put the vegetables in the fridge to cool.

Chop the basil and onions and mince the garlic. Mix the herbs with salt, pepper, vinegar, oil, lemon juice, sugar, and mustard. Pour the dressing over the bean and potato mixture. You may choose to increase or decrease the amount of dressing to taste—we recommend using only enough to lightly coat the vegetables.

Serves 2-3.

Speaking of salads, potato salad is a classic that's easy to tweak to suit the more advanced palate. Rather than mixing your boiled potatoes with mayonnaise, why not try out the recipe above, which dresses up your roots using balsamic vinegar and herbs?

Roast Roots

2 medium onions, diced
4 carrots, sliced into half-inch sections
4 potatoes, sliced into bite-sized cubes
4 cloves of garlic, minced
1/4 c. fresh parsley and/or 4 sprigs of fresh thyme
oil, salt, and pepper

Preheat the oven to 350 degrees Fahrenheit. Chop the vegetables, toss with oil, salt, and pepper, and place in a roasting pan. Bake, stirring occasionally, until roots are soft, about 40 minutes. For an even tastier dish, bake the root mixture underneath a roasting chicken. Other roots, like beets, turnips, and sweet potatoes, can be used in place of some or all of the carrots and potatoes.

Serves 4.

Another very easy way to prepare roots of any kind is the Roast Roots recipe above. Or, if you want to keep things simple, you can cut sweet and white potatoes into long strips, coat them with oil, salt, pepper, and paprika, scatter them a small distance apart on a cookie sheet, then bake at 400 degrees Fahrenheit to make homemade, baked fries that are crispy on the outside and soft on the inside.

Harvest-Bounty Soup

1 quart homemade chicken stock
1 quart water
2 onions, diced
6 cloves of garlic, minced
1/2 head of cabbage, chopped
2 quarts of fresh tomatoes, chopped
1 large handful of fresh parsley, chopped
4 carrots, chopped
4 potatoes, chopped
1 quart of fresh green beans, broken into pieces
4 ears of sweet corn, cut off the cob
salt and pepper

Prepare the soup base by simmering the stock, water, onions, garlic, cabbage, tomatoes, and parsley for at least one hour, until the tomatoes have lost their shape and the soup is slightly thick. Add more water, if necessary, then put in the carrots and potatoes. Cook for half an hour, then add the green beans and cook for ten minutes. Turn off the heat and add the corn, stirring well. Salt and pepper to taste.

To turn this soup into a protein-rich meal, include precooked beans (great northern are best) with the sweet corn, or add raw beef chunks at the same time as carrots and potatoes.

Serves 4-6.

Since you'll be eating up many of your roots over the winter, they make a perfect addition to soups and stews. Both chicken soups and tomato-based soups become heartier when you add cubed potatoes, carrots, parsnips, and turnips about forty minutes before serving.

Potatoes, especially, are so utilitarian that whole cookbooks have been written about their preparation, so I've just hit the highlights above. Feel free to email anna@kitenet.net with your favorite root recipes, and I'll consider including them in later editions of this book.

Feeding roots to livestock

Mangels are a root vegetable often raised for livestock but seldom eaten by humans. Photo credit: Nita.

Winter was once a harsh time on European farms. Without enough grass to keep their livestock fed, farmers dried off dairy animals and slaughtered all but the breeding stock among meat breeds as soon as cold weather hit.

In *The Self-Sufficient Life and How to Live It*, John Seymour reports that the popularization of turnips spurred a culinary revolution during the Middle Ages because the roots provided enough supplemental feed to carry cows, pigs, and other animals through the cold months. Soon farmers were adding fodder beets, rutabagas, mangels, carrots, parsnips, and potatoes to their livestock gardens, and meat and dairy became a larger part of the year-round diet.

Dairy cows require more nutrition than they can consume on winter grass, so roots make a good addition to their daily ration. Photo credit: Nita.

More recently, roots as livestock food have fallen out of favor. Until the twentieth century, grains were a staple earmarked for humans because of laborious processing, but heavy machinery and chemical fertilizers now make it easy to grow enough wheat, corn, and other grains to feed to livestock. Roots provide fewer calories pound-per-pound than grain, so it's cost-prohibitive for agribusinesses to transport carrots and beets across the country to confinement animal operations. Despite human health problems that stem from eating grain-fed meat, economics maintain the current status quo.

On the homestead scale, though, roots make just as much sense for livestock food as they do for people food. Most backyard growers lack equipment to thresh and winnow their wheat, but a shovel is all you need to dig potatoes and carrots. For many of us, keeping our livestock healthy and our farm ecosystem cyclical is a top priority, so we're willing to put a little extra effort into growing parsnips and mangels.

Nita uses roots to replace most of the grains in her dairy cow's winter diet. Photo credit: Nita.

Nita is a modern expert on overwintering dairy cows on roots. She and her family grow most of their own food on 180 acres in the Pacific Northwest, depending on rotational grazing to feed their beef cows over the winter. However, as Nita notes, "A dairy cow is a horse of a different color nutrition- and production-wise." Dairy cows need supplemental nutrition during the winter, and that supplement usually comes in the form of grain.

Nita's beef cows subsist almost entirely on grass year-round. Photo credit: Nita.

"I only had to look back in history a little ways to get away from grain," Nita explained. "Roots. Root crops for fodder is a practice brought to the United States with Northern European immigrants. Cool climates not conducive to growing grain are perfect for various root crops for fodder. I live in a climate like that. Getting corn to ripen here is not the easiest thing to do. Root crops? No problem. Storing grain or green chop? Ugghhh. Storing roots? Easy.

A variety of roots (plus blemished apples) makes its way to the dairy cow's trough. Photo credit: Nita.

"We were looking for roots that would suit multiple species, namely us, the family cow, and the laying hens. All of the root crops we chose would work well for sheep, goats, and rabbits too. The roots that we settled on were carrots, beets, parsnips, and rutabagas. We had grown mangels (fodder beets) before, but found that they were large and because a large portion of the root grows above ground, they did not meet our criteria for easy storage. The only references I have seen concerning problems is for feeding beets and mangels to rams and wethers. Some believe mangels and sugar beets can cause calculi in the kidneys and bladder."

Mangels require curing out of the ground for a few weeks before feeding since they are mildly poisonous when first harvested. Photo credit: Nita.

Every farmer tends to develop favorite root crops to match their specific growing conditions and their livestock's needs. In *Feeding Poultry*, Gustave Heuser recommends giving 0.04 to 0.05 pounds of mangels, carrots, turnips, rutabagas, or potatoes to each chicken per day as a supplement to their regular diet. John Seymour prefers feeding rutabagas and fodder beets to his livestock, while Nita usually provides her milk cow a mixture of carrots, parsnips, and beets. She grows Red-cored Chantenay carrots, Harris Model or Andover parsnips, Lutz/Winterkeeper beets, Laurentian or Joan rutabagas, and Golden Eckendorf or Colossal Long Red mangels for animals and humans, along with Jerusalem artichokes, celeriac, and daikon or salad turnips for the table. "Brassicas are a no-no during lactation unless you want cole-flavored milk," she warns.

Nita hoses her roots down on top of a raised screen before sorting them into livestock or human food. Photo credit: Nita.

"In our zone 7 garden, we are able to hill soil over our root crops and leave them in situ," Nita said. "We harvest weekly as needed from fall to spring. After washing, we sort, and any damaged or small roots go to the barn, and the rest are stored in plastic buckets on our north-facing porch, where they stay cool." Her whole family enjoys the unblemished roots, which are also used as dog treats.

Mixed roots as they come out of the automatic chopper. Photo credit: Nita.

Nita uses a mechanical chopper to cut up the five pounds of mixed roots she provides for her dairy cow each winter day. She notes that the chopper processes the day's roots in one minute, versus five minutes with a knife. Alternative methods for processing roots for livestock include cooking (essential when feeding potatoes to non-ruminants like pigs and chickens), grating, or feeding whole and raw.

Nita has to be careful or her dogs will swipe carrots and other roots. However, their help in the garden is worth the trouble since the dogs catch voles that enjoy eating her overwintering roots. Photo credit: Nita.

"While the roots won't replace all the grain for your stock, they can play a bigger part of their winter diet, giving variety and giving you more control in what you are feeding your animals," Nita concluded. "Growing and harvesting roots has made us feel closer to our goal of self-reliance. And we find as we eat more of these types of in-season vegetables ourselves, we rely less on labor- and energy-intensive food-preservation methods. While I'm not giving up my canning and freezing, I find that I'm storing less food that way, and actually providing more variety in our meals."

For more information, visit Nita's photo-rich blog at www.matronofhusbandry.wordpress.com.

Beyond the potato

As you've probably realized by flipping through this book, root cellars—and the roots we store inside them—are a simple but effective way to increase a homestead's self-sufficiency. But even though I've focused on vegetables that can be stored in root cellars, the structures come in handy for a variety of other purposes too.

Fruit-tree producers store scionwood in their root cellars between their midwinter cutting and the early-spring grafting window. After bench grafting, they also put the small trees back into the root cellar for a few weeks to allow their wounds to callous before planting each tree directly into the ground outside.

Fruits, of course, can be stored in the root cellar right alongside vegetables. Apples and pears are the most common root-cellared fruits, but you can also extend the life of oranges, other citrus fruits, and clusters of grapes by keeping them in your cellar. Be aware that many fruits produce ethylene, a gas that promotes ripening of other fruits and may prompt nearby roots to sprout or spoil prematurely.

To some extent, a root cellar can even take the place of a summer refrigerator, although interior temperatures may be cool rather than cold during the warm months. And if you build a room-sized root cellar, it can serve as a storm shelter.

But don't get bogged down too much in planning an extensive structure that could take years to come to fruition. If you get started on something simple today, you can always expand as your garden bounty grows!

About the author

Anna Hess lives with her husband Mark Hamilton (plus two spoiled cats, a hard-working dog, and a varying number of chickens) on 58 acres of swamp and wooded hillsides in the mountains of southwest Virginia. The duo spends most of their time homesteading—Anna likes to putter around the garden while Mark uses his inventive streak to build chicken coops and deer deterrents out of a handful of screws and whatever is lying around in the barn. They make a living selling POOP-free chicken waterers (www.AvianAquaMiser.com) and blogging about their adventures (www.WaldenEffect.org).

The Modern Simplicity series, of which this book is the third volume, suggests ways to incorporate appropriate technology into your life so you have time to pursue your passions. The first book in the series—*Microbusiness Independence*—is a joint venture by Anna and Mark explaining how to make a living in just a few hours per week, while the second book—*Trailersteading: Voluntary Simplicity in a Mobile Home*—profiles nine families who use cheap housing to achieve their

dreams.

Anna's popular *Weekend Homesteader* series provides one fun and easy project for each week of the year to guide beginners onto the path of self-sufficiency. A full-color paperback version of *The Weekend Homesteader* was published by Skyhorse Publishing in fall 2012, and each month can also be bought separately as a 99 cent ebook.

Homegrown Humus provides tips on incorporating cover crops into a no-till garden, and the *Permaculture Chicken* series is devoted to making backyard chicken-keeping cheap, sustainable, less smelly, and more fun. All are available as ebooks at www.Amazon.com. Visit www.Wetknee.com to learn about future books.

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