Cold Cellars for Year-Round Local Food and Farming

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Michigan is ready for good ideas, both high and low tech.

Stone and cement construction - described in later years by the Nearings.

Mott Estate, Flint, MI
Former farm of GM founder C.S. Mott

Michigan Root Cellar ~1921 in Leelanau County. Built with stone from the shore of West Grand Traverse Bay and primarily used to store apples. Interior dimensions 15' x 20' and 7' tall with a double door - 3' air lock.

01/01/2003
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January 2009

Side by Side

Two-Story

Desired Learning Outcomes

- Individual and family goals.
- Farm and local food system goals.
- Available educational resources.
- Suitable crops and conditions necessary.
- Methods and costs of construction.
- Sources of funding for cold cellars.
- Needs to be either searched out or discovered through research.

Presentation Outline

See Handout – Seven C’s

1. Concepts
2. Crops
3. Conditions
4. Construction
5. Considerations
6. Containers
7. Combinations

Why Season Extension and Year-round Farming?
localharvest.com – growing number of small farms and CSA’s in MI

Food Processing & Preservation
- Refrigeration and Cooling
- Freezing (energy, flavor, nutrition)
- Canning (Salsa, Tomato based products, etc)
- Dehydration (herbs, cherries, cranberries, blueberries, etc)
- Freeze-drying (more commercial or larger scale?)
- Salting (osmotic conditions limit microorganisms)
- Pickling (vinegar, acidic pH)
- Jams and Jellies (sugar)
- Pasteurizing (heat, impact on nutrition?)
- Fermentation (renewed interest?, improves nutrition?)

- Planning for local food in our cities

Energy & Global Warming
- MSU Forestry class prepared a carbon budget of the Student Organic Farm.
- Carbon from uses including electric, gasoline for tractors, tillers, mowers, trucks for transportation and employee and member miles was 2.4 tons/year.
- Carbon for refrigeration was 200 tons/yr or 98% of the carbon.
- An acre of trees for an offset
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Root Cellaring Topics

- Growing the right crops for storage.
- Variety selection.
- Scheduling for late harvest.
- Harvesting high quality produce and preparing it for storage.
- Recommended stage of development and harvest methods.
- Pretreatment to insure maturity of squash, onions, potatoes, garlic.
- Specific crop storage recommendations or uses.
- Vegetables
  - Fruits (ethylene considerations)
  - Other, eggs, pickled or fermented foods, mushroom production, root media for transplants,
- Construction
  - Small buried containers
  - Basement root closets
  - Excavated cold cellars
  - Personal experiences
  - Recipes

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Crops and Conditions

- What Crops?
- How Long?
- What Conditions?
  - Temperature
  - Humidity
  - Ventilation - ethylene

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Multiple Environments

<table>
<thead>
<tr>
<th>Humidity</th>
<th>Dry</th>
<th>Moist</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature</td>
<td>(&lt;70% RH)</td>
<td>(80-90% RH)</td>
</tr>
<tr>
<td>Cold Temp (33-40F)</td>
<td>onions, garlic</td>
<td>potatoes, cabbage</td>
</tr>
<tr>
<td>Cool Temp (50-60F)</td>
<td>winter squash, sweet potato</td>
<td>cucumbers, cabbage</td>
</tr>
</tbody>
</table>

Figure 1. Average Storage Duration for Commonly Stored Produce

<table>
<thead>
<tr>
<th>4 of Months</th>
<th>Oct</th>
<th>Nov</th>
<th>Dec</th>
<th>Jan</th>
<th>Feb</th>
<th>Mar</th>
<th>Apr</th>
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</thead>
<tbody>
<tr>
<td>Tomatoes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Celery, Leeks</td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>Beets, Peas</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Apples, Pumpkins, Squash</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cucumbers, Potatoes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Onions</td>
<td></td>
<td></td>
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<td>garlic</td>
<td>potatoes, cabbage (first choice)</td>
</tr>
<tr>
<td>Cool Temp (50-60F)</td>
<td>winter squash</td>
<td>sweet potato (second choice)</td>
<td>cucumbers, tomato</td>
</tr>
</tbody>
</table>

Example Crop Categories

- Low temp (32F) low humid (<60%)
  - onions and garlic
- Low temp (32F) high humid (90%)
  - carrots, beets, turnips, rutabagas, leeks
- Cold Temp (35-45F) high humid (90%)
  - potato, cabbage,
- Cool temp (50-60F) low humid (<600%
  - winter squash, sweet potato
- Cool temp (50-60F) and high humidity(90%+)
  - Cucumber, summer squash, tomato, pepper, eggplant

Ventilation is important

- Produce is alive and “breathing” – using oxygen and producing carbon dioxide.
- Ventilation is important to bring in fresh air, for cooling and for humidity control.
- When moisture is too high, fresh dry air is brought into the cellar.
- Can be on a timer or managed with a thermostat.
- Outside air temperature must also be taken into consideration.

Construction Options

- Buried direct or in container
- Insulated room in basement or building
- Buried Room or Rooms
  - Would not recommend wood?
  - Stone or block cemented together
  - Formed and poured cement walls
  - Precast sections assembled
  - Precast vaults or culverts

Basement Cold Closet
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Root Cellar for Cold Storage
New York State, Stone Barns Center

Black Star Farms
Can drive in forklift

Root Cellar for Cold Storage

Root Cellar Started:
A big hole in the ground

Concrete Blocks

Root Cellar Constructed

Steps and Roof
Basic Costs about $3000 total
Hole excavation - $200
Cement for footer - $200
Block $1 each - $600
Block $2 each - $1200
Roof materials - $600
Vents and Elec materials - $100
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Considerations and Containers

- Temperature
  - Rate of cooling in fall
  - Addition of refrigeration?
- Humidity
  - Reduce by ventilation
  - Increase by wetting floor or walls
- Ventilation - Ethylene

MSU-SOF 40F Cooler

Beets in Wood Shavings

Cabbage that got too wet?

Celeriac or Celery Root
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1. Potatoes in Bulb Crates
2. Harvesting and Storage Containers
3. Bulk Bins – wood or plastic
4. Second Cooler – Warmer and Dryer
5. Butternut Squash
6. Dehumidifier
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How does it work?

Refrigeration Unit

Refrigeration – How does it work?

Heat Exchanger Outside

Compressors

Heat Exchanger in Cooler

New Frontier: Winter Markets

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November
Don't fit inside!

THANKSGIVING
HIGHEST SALES!

NOVEMBER 22ND
37 DIFFERENT ITEMS FOR SALE!

NOVEMBER
Another winter market
7 within one hour

Plan for the Future
• Free Barns
• Central Placement
• Slate Roofs
• Root Cellar

Potting Shed Insulated
Attached Greenhouse
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Think Efficiency

ROOT CELLAR 20 FEET BY 30 FEET UNDER BARN
$10,000 refrigeration system—Value paid in one year.
Stores $85,000 in produce Sept to August

ROOT CELLAR
24 tons
Carrots
Potatoes
Beets
Cabbage
Turnips
Radishes
Leeks
Rutabagas
Brussels Sprouts
Celeriac

Combinations
- Foundation for a building above
- Mushrooms
- Fermentation
- Geothermal heat for hoop houses
- Seed germination medium

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Integral Agriculture
Friends and Families
Using Facts and Feelings to Faithfully, Physically and Fearlessly Farm
Front-yards, Forests, and Fields For Food, Feed, Fodder, Fiber, Fuel, Flowers, Fertility, Fun, Freedom, Fairness and the Future

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