Whole Farm Approach of Plant and Soil Health at Roxbury Farm
1. Farm Overview
2. Soil Health
3. Other Cultural Practices
4. Farm Diversity
5. Quality Of Life
1. Farm Overview
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3. Other Cultural Practices
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5. Quality Of Life
Roxbury Farm North Farm from the West
100 acres of hay and pasture (50 ewes and offspring)
20 acres of vegetable land, 
15 acres of fenced in forest (roamed by pigs)
Remainder in forest floodplain
Roxbury Farm “South Farm” from the North
115 acres of vegetable land
70 acres of hay and pasture (for steers)
Remainder in forest floodplain
1. Farm Overview
2. Soil Health
3. Other Cultural Practices
4. Farm Diversity
5. Quality Of Life
Strategies at Roxbury Farm to support good soil and plant health:

I. Soil Selection
II. Mineral Balancing
III. Reduced Tillage
IV. Increase Biological Activity
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It is always cheaper to purchase land with good physical qualities than to improve land with poor physical qualities.
Good vegetable land has:

- A high carrying capacity (carry the weight of equipment without creating irreversible compaction)
- Good natural or artificial drainage
- Good access to irrigation water
- A deep A horizon (topsoil) that is free from stones
- Is almost flat with slopes that do not exceed 2%.
- Is located in a long season micro climate
- Good exposure to sunlight
- Good air drainage to avoid late spring frosts.
- Good access to farm roads
- High CEC value (Cation Exchange Capacity)
Some of the best land is often located in floodplains.
But flooding can occur every 100 years..... or every year possibly creating crop losses during the growing season. These are our steers in the summer of 2009.
Strategies at Roxbury Farm to support good soil and plant health:

I. Soil Selection
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Roxbury Farm was farmed by three different farmers prior to 1999

- Farm #1 a former potato farm with elevated K and P level, low pH, Ca and OM.
- Farm #2 continuous corn ground with very low K, Ca and pH levels
- Farm #3 corn alfalfa rotation whereby the pH was correct and most nutrients were correctly balanced.
After the pH was corrected additional gypsum was applied to correct the Calcium levels on the potato land. SulPoMag was utilized on the petered out corn ground. A seeding of orchard grass with red clover was used during the transitional years to increase Organic Matter and mineralizable N levels.
Applications of Organic Fertilizer or Minerals can:

- Reduce the incidence of deficiencies
- Provide conditions for optimum plant development and increase plant health
- Improve structural and biological fertility
- Enhance the nutritional value of crops
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III. Reduced Tillage

- Short intervals between Green Manure and Cash Crop
- Use of Less aggressive Tillage Tools
- Use of Plasti-Culture in combination with Mulch
Yeoman Plow is used if a plow pan has developed. The Yeoman or Keyline plow is set a depth of two inches below the plow pan.
Avoid future compaction by:

• Avoid working the soil too wet
• Use wide radial tires for field prep
• Lower tire pressure during spring field work (6-15psi)
• Ballast tractor to 10-15% wheel slippage
Spading in sweet clover using the Imants Spading Plow to incorporate a green manure shortly before planting a cash crop.
Recently a Coulter Chisel Plow with S Tine attachment has partially replaced the Imants.
The use of dead mulch to reduce tillage.
Converting from synthetic plastic to corn based plastic mulch.
An early cutting of hay or rye straw is baled up for dead mulch.
Spreading dead mulch with bale shredder
Dead mulch reduces weed pressure and increases soil fertility
Keeping crops clean, creating a mud-free pathway for harvest crew
Tunnels protect crops against late frosts and allow for early harvest of cucumbers, zucchinis, peppers, melons, eggplants, and tomatoes.
Strategies at Roxbury Farm to support good soil and plant health:

I. Soil Selection
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IV. Increase Biological Activity
IV. Increase biological activity through the use of:

- Compost
- Soil Building Crops
- Crop Rotation.
- Use of Biodynamic Preparations
IV. Increase biological activity through the use of:

- Compost
- Soil Building Crops
- Crop Rotation
- Biodynamic Preparations
Compost can be too much of a good thing. Vegetable growers need to practice nutrient budgeting as phosphorus can build up by using more than 6 tons of (ruminant based) manure per acre a season.
IV. Increase biological activity through the use of:

- Compost
- Soil Building Crops
- Crop Rotation
- Biodynamic Preparations
Rye and Hairy vetch to fix nitrogen and to use as dead mulch
Bell Beans and Oats to fix nitrogen
Oats, Peas and Bell Beans to fix nitrogen and add organic matter
Buckwheat as weed suppressant and as a source to provide nectar for bees
Sweet Clover to increase rooting depth and as a source of nectar for bees
Sorghum Sudan Grass to increase O.M. and to reduce Soil Borne Diseases
Tillage Radish to:

- Break up Plow pan and aerate soil
- Add organic matter
- Preserve Nitrogen and other nutrients
- Facilitate early field work in spring
Mustard to increase O.M.
And reduce Soil Borne Diseases
IV. Increase biological activity through the use of:

- Compost
- Soil Building Crops
- Crop Rotation.
- Biodynamic Preparations
Crop Rotations

- Increases general species diversity on the farm
- Can reduce weed pressure
- Can reduce insect pressure
- Can reduce disease pressure
General Rule of Rotation:

Equal distribution between:

Vegetables crop production and
Legumes with cereals/grasses
Farmer Jesse Buel (1778-1839) in his address to the Berkshire Agricultural Society:

“Cattle and Sheep make manure,—manure makes grain, grass and roots—these, in return, feed the family, and make meat, milk and wool;--and meat, milk and wool are virtually money, the great object of the farmer’s ambition, and the reward of his labors. This is the farmer’s magic chain, which kept bright by use, is ever strong and sure; but if broken, or suffered to corrode by neglect, its power and efficacy are lost”.

Out of “Larding the Lean Earth” by Steven Stoll
A farm is true to its essential nature, in the best sense of the word, if it is conceived as a kind of individual entity in itself — a self-contained individuality. Every farm should approximate to this condition. This ideal cannot be absolutely attained, but it should be observed as far as possible. Whatever you need for agricultural production, you should try to possess it within the farm itself (including in the “farm,” needless to say, the due amount of cattle). Properly speaking, any manures or the like which you bring into the farm from outside should be regarded rather as a remedy for a sick farm. That is the ideal. A thoroughly healthy farm should be able to produce within itself all that it needs.
45 acres in Green Manure crops

45 acres in Vegetables

200 acres in Hay and Pasture
Rotations can help reduce insect damage, reduce weed pressure and plant diseases, but we need to carefully review what insect weed or disease can be controlled by crop rotation.
<table>
<thead>
<tr>
<th>Insect</th>
<th>Rotation</th>
<th>Length</th>
<th>Affected Crop</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aphids</td>
<td>limited</td>
<td>1 year</td>
<td>many crops, different species</td>
<td>limit on nitrogen fertilizer</td>
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<tr>
<td>Armyworm, common</td>
<td>no</td>
<td></td>
<td>cole crops</td>
<td>migrates from south</td>
</tr>
<tr>
<td>Cabbage looper</td>
<td>no</td>
<td>1 year</td>
<td>cole crops</td>
<td>migrates from south</td>
</tr>
<tr>
<td>Carrot rust fly</td>
<td>yes</td>
<td>1 year</td>
<td>carrots</td>
<td>plant upwind</td>
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<tr>
<td>Colorado potato beetle</td>
<td>yes</td>
<td>1 year</td>
<td>potato, eggplant</td>
<td>plant succession far away</td>
</tr>
<tr>
<td>Corn ear worm</td>
<td>no</td>
<td>1 year</td>
<td>sweet corn</td>
<td>migrates from south</td>
</tr>
<tr>
<td>Cucumber beetle striped</td>
<td>yes</td>
<td>1 year</td>
<td>cucurbits</td>
<td>use trap crops</td>
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<tr>
<td>Cutworm black</td>
<td>no</td>
<td></td>
<td>many plants</td>
<td>fall plowing, weed control</td>
</tr>
<tr>
<td>Cutworm variegated</td>
<td>no</td>
<td></td>
<td>many plants</td>
<td>both cutworms are migratory</td>
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<tr>
<td>European corn borer</td>
<td>yes</td>
<td>1 year</td>
<td>sweet corn, peppers</td>
<td>shred stalks in fall, plow under</td>
</tr>
<tr>
<td>Fall armyworm</td>
<td>no</td>
<td>1 year</td>
<td>sweet corn</td>
<td>migrates from south</td>
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<tr>
<td>Flea beetles</td>
<td>yes</td>
<td>1 year</td>
<td>cole crops, eggplant</td>
<td>plant succession far away</td>
</tr>
<tr>
<td>Imported cabbage worm</td>
<td>limited</td>
<td>1 year</td>
<td>cole crops</td>
<td>can fly large distances</td>
</tr>
<tr>
<td>Japanese beetle</td>
<td>no</td>
<td>1 year</td>
<td>basil, corn,</td>
<td>can fly large distances</td>
</tr>
<tr>
<td>Leaf miners</td>
<td>yes</td>
<td>1 year</td>
<td>beets, chard, spinach</td>
<td>weed control</td>
</tr>
<tr>
<td>Leafhopper potato</td>
<td>no</td>
<td>1 year</td>
<td>potato, lettuce, snap beans</td>
<td>migrates from south</td>
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<tr>
<td>Squash bug</td>
<td>yes</td>
<td>1 year</td>
<td>summer squash, cucurbits</td>
<td>plant succession far away</td>
</tr>
<tr>
<td>Squash vine borer</td>
<td>yes</td>
<td>1 year</td>
<td>cucurbits</td>
<td></td>
</tr>
<tr>
<td>Stalk borer common</td>
<td>yes</td>
<td>1 year</td>
<td>tomato</td>
<td></td>
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<tr>
<td>Stink bug</td>
<td>limited</td>
<td>1 year</td>
<td>many plants</td>
<td>overwinters in sod and hedgerows</td>
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<tr>
<td>Tarnished plant bug</td>
<td>limited</td>
<td>1 year</td>
<td>strawberry, lettuce</td>
<td>many hosts, weed control</td>
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<tr>
<td>Thrips onion</td>
<td>limited</td>
<td>1 year</td>
<td>alliums, colecrops</td>
<td>manage hayfields</td>
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<tr>
<td>Tomato hornworm</td>
<td>limited</td>
<td>1 year</td>
<td>tomato</td>
<td>can fly large distances</td>
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<tr>
<td>Whitefly</td>
<td>yes</td>
<td>1 year</td>
<td>lettuce, tomatoes</td>
<td>hygiene</td>
</tr>
<tr>
<td>Wireworm</td>
<td>yes</td>
<td>1 year</td>
<td>many crops</td>
<td>when issue reduce OM input</td>
</tr>
<tr>
<td>Common disease problems</td>
<td>at Roxbury Farm</td>
<td>Common name</td>
<td>Rotation</td>
<td>Length</td>
</tr>
<tr>
<td>-------------------------</td>
<td>----------------</td>
<td>-------------</td>
<td>----------</td>
<td>--------</td>
</tr>
<tr>
<td>Alternaria brassicicola</td>
<td>early blight</td>
<td>yes</td>
<td>4 years</td>
<td>cole crops</td>
</tr>
<tr>
<td>Alternaria solani</td>
<td>early blight</td>
<td>yes</td>
<td>4 years</td>
<td>tomato, potato</td>
</tr>
<tr>
<td>Alternaria dauci</td>
<td>early blight</td>
<td>yes</td>
<td>4 years</td>
<td>carrots</td>
</tr>
<tr>
<td>Bremia lactuca</td>
<td>downy mildew</td>
<td>yes</td>
<td>2-4 years</td>
<td>lettuce</td>
</tr>
<tr>
<td>Cercospora beticola</td>
<td>leaf spot</td>
<td>yes</td>
<td>5 years</td>
<td>beets</td>
</tr>
<tr>
<td>Clavibacter michiganensis</td>
<td>bacterial canker</td>
<td>yes</td>
<td>6 years</td>
<td>tomatoes</td>
</tr>
<tr>
<td>Erwinia tracheiphila</td>
<td>bacterial wilt</td>
<td>yes/no</td>
<td>2-4 years</td>
<td>cucurbits</td>
</tr>
<tr>
<td>Erysiphe cichoracearum</td>
<td>powdery mildew</td>
<td>no</td>
<td>airborne</td>
<td>cucurbits</td>
</tr>
<tr>
<td>Erysiphe cruciferarum</td>
<td>powdery mildew</td>
<td>no</td>
<td>airborne</td>
<td>cole crops</td>
</tr>
<tr>
<td>Hyaloperonospora parasitica</td>
<td>downy mildew</td>
<td>yes</td>
<td>2-4 years</td>
<td>cole crops</td>
</tr>
<tr>
<td>Phytophtora capsici</td>
<td>phytophtora blight</td>
<td>yes</td>
<td>4 -5 years</td>
<td>peppers, cucurbits</td>
</tr>
<tr>
<td>Phytophtora Infestans</td>
<td>late blight</td>
<td>no</td>
<td>freeze/airborne</td>
<td>tomatoes, potatoes</td>
</tr>
<tr>
<td>Plectosorium tabacinum</td>
<td>downy mildew</td>
<td>yes/no</td>
<td>4 years/airborne</td>
<td>Cucurbits</td>
</tr>
<tr>
<td>Podosphaera xanthii</td>
<td>powdery Mildew</td>
<td>no</td>
<td>airborne</td>
<td>Cucurbits</td>
</tr>
<tr>
<td>Pseudonomas syringae</td>
<td>bacterial speck</td>
<td>yes</td>
<td>2-4 years</td>
<td>tomatoes</td>
</tr>
<tr>
<td>Pseudoperonospora cubensis</td>
<td>downey mildew</td>
<td>no</td>
<td>airborne</td>
<td>cucurbits</td>
</tr>
<tr>
<td>Rhizoctonia solani</td>
<td>root rot, belly rot, black rot</td>
<td>yes</td>
<td>10 years</td>
<td>cabbage, lettuce, potato, tomato</td>
</tr>
<tr>
<td>Septoria lycopersici</td>
<td>septoria Leaf spot</td>
<td>yes</td>
<td>4 years</td>
<td>tomato</td>
</tr>
<tr>
<td>Ustilago maydis</td>
<td>corn Smut</td>
<td>no</td>
<td>airborne</td>
<td></td>
</tr>
<tr>
<td>Verticillium albo-astrum</td>
<td>verticillium wilt</td>
<td>yes</td>
<td>13 years</td>
<td>eggplant, many hosts</td>
</tr>
<tr>
<td>Xanthomonas campestris pv. vesicatoria</td>
<td>bacterial leaf spot</td>
<td>yes</td>
<td>2-4 years</td>
<td>peppers, tomatoes</td>
</tr>
</tbody>
</table>
These families are grouped into three different groups in one rotation:

- **Sweet corn (25%)**
  - tomatoes, peppers, eggplant summer squash, cucumbers, melons, onions

- **Plasti-culture (25%)**
  - two row crops like early broccoli, bok-choi, Chinese cabbage, collards, early kale, leeks, fennel.
  - three row crops like summer cabbage, mei-ching-choi, sugarsnap peas, summer beets, chard and broccoli rabe for bunching, tatsoi for greens, basil, parsley, head lettuce, and baby turnips.
  - five or nine row crops like spinach, salad greens, braising mix, baby carrots, chard and broccoli rabe for leaves, tatsoi for salad, and herbs like cilantro and dill.

- **Mixed veggies (40%)**
  - two row crops like early broccoli, bok-choi, Chinese cabbage, collards, early kale, leeks, fennel.
  - three row crops like summer cabbage, mei-ching-choi, sugarsnap peas, summer beets, chard and broccoli rabe for bunching, tatsoi for greens, basil, parsley, head lettuce, and baby turnips.
  - five or nine row crops like spinach, salad greens, braising mix, baby carrots, chard and broccoli rabe for leaves, tatsoi for salad, and herbs like cilantro and dill.

- **Snap beans (10%)**
And in a different rotation for the Storage Crops:

potatoes (15%)

winter-squash (15%)

beets, carrots, parsnips, celeriac (20%)

Green, red cabbage, rutabaga, kale, collards, cauliflower, fall broccoli (40%)

Sweet potatoes (10%)
Crop rotation sample

• Year 1
Barley/peas/bell beans mix followed by broccoli, cauliflower, kale and late cabbage

• Year 2
Spring fallow followed by Sudan and forage soybeans followed by fallow followed by oats

• Year 3
Potatoes and winter squash followed by rye and hairy vetch

• Year 4
Rye and hairy vetch for straw followed by summer bare fallow followed by oats and peas

• Year 5
Spring fallow followed by sweet potatoes, carrots, beets, celeriac and parsnips

• Year 6
back to year 1
IV. Increase biological activity through the use of:

- Compost
- Soil Building Crops
- Crop Rotation
- Biodynamic Preparations
Horn Silica is applied on crops to increase photo synthesis.
Horn manure is applied on the soil to increase humus formation and rooting depth.
The compost pile is like another animal on the farm; it breathes, it has body temperature, it is alive! Measures need to be taken that manure never falls back to a pure anaerobic state as this facilitates breakdown of vital nutrients. A compost pile needs to be looked after like each other animal on the farm.
Compost Preparations provide this particular farm animal with organs (as in organization).

Each preparation facilitates a particular process.

- 502 Yarrow to regulate the process of trace minerals.
- 503 Chamomile to increase stability of N in compost and regulate the process of Ca and K uptake of plants.
- 504 Nettle regulate the process of Fe and N uptake and to increase the nutritional content of plants
- 505 Oakbark to regulate the process of Ca uptake and to decrease plant diseases
- 506 Dandelion to regulate the process of Si and to assist in the process of the farm becoming a living organism
- 507 Valerian to facilitate the process of spirit becoming substance
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• The use of Row Covers to increase soil temperature and keep insects off plants

• Extensive use of transplants to allow the plants a “jump” on weeds and insects

• Appropriate use of farm equipment sized at 200% of needed capacity allowing for timely field operations and weed control

• Good access to vegetables by creating harvest lanes (each section is 8 beds wide separated by a 12 foot grass strip facilitating for harvest, irrigation and spraying).

• The installation of drainage tile in seasonal wet fields.

• The use of irrigation

• Introduction of parasitic wasps and other beneficial insects

• Regular soil testing and nutrient budgeting to prevent build up of phosphorus and potassium.
Farm diversity consists of three elements:

• Genetic diversity
• Species diversity
• Ecosystem diversity
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- Genetic diversity
- Species diversity
- Ecosystem diversity
Even during the second part of the 20th century breeds were region specific. These days genetic diversity has narrowed to very few Holstein sires.
Heritage Breed Kathadin Sheep at Roxbury Farm, are not over bred for wool and have greater resistance to internal parasites and lamb easily. (Photo Brian Kimmel ©)
On the vegetable farm we have a preference for disease resistant hybridized varieties over heirlooms. More research money needs to be invested in plant breeding. We have selected triple (alternaria, phytophthora, and septoria) resistant tomato varieties, scab resistant potato varieties, and powdery mildew tolerant squash varieties that yield well, and taste great.
Farm diversity consists of three elements:

- Genetic diversity
- Species diversity
- Ecosystem diversity
We raise 60 different crops allowing for good rotations
The woods are utilized for the pigs
Interspecies pasturing to reduce internal parasites (Photo Brian Kimmel ©)
But ultimately the greatest diversity is cultivated in the soil itself.
Allowing certain fields to be mowed every third season or after July 1 facilitates a greater diversity of bird life on the farm.
Facilitating habitat for wild bees (courtesy Cooperative Extension Minnesota)
Farm diversity consists of three elements:

- Genetic diversity
- Species diversity
- Ecosystem diversity
“The correct balance of wood, orchards, bushes, and meadows – with their natural growth of fungi – is so essential to good farming that your farm will really be more successful even if this means a slight reduction in your tillable acreage. There is no true economy in using so much of your land that all the things I have mentioned disappear. The resulting loss in quality will far outweigh the advantage of the other things. Without this kind of insight into the interconnections and interactions of nature, it is really almost impossible to engage in an enterprise like farming which is so closely bound up with nature.”

Rudolf Steiner June 15, 1924
Roxbury Farm “South Farm”
1948  1959

Photo’s by NRCS National Resource Conservation Service
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Agriculture is as much an Art as it is a Science

Photo by Johannes Courtens
Biodynamics is a Radical Approach to Revitalize our Farms by Locking into the Intricate and Delicate Webs of Life that Hold this Earth Together
Our recent relationship to the land whereby farms have become factories providing for a global market has failed to nourish the communities that depend on the land.
A farm should be a place of beauty whereby all individuals involved are given the opportunity to find meaningful work, the integrity of all living things is valued, and the food produced is a source of true nourishment.
After all, it is the earth that sustains us all

Photo © Brian Kimmel
Therefore, it is our responsibility to sustain the earth
“We should perhaps think of Agriculture not as humanity’s dominion over Nature, but rather as Nature’s gift to humankind.

We forego that dominion not because we lack the muscle to demand it, but because we have the heart and foresight to avoid it”.

Conrad Vispo of the Farmscape Ecology Program