SOILS: Understanding and Improving Soil

FRESH FORK MARKET
LOCAL PROVISIONS FOR MODERN DOMESTIC LIVING

Outline: Possible Topics

Understanding Soils

Basic Overview of Soil Types

Ideal Soil Components and Characteristics (Drainage)

Soil Test and pH – How, Where, and Interpreting (what deficiencies may mean to plants)

Improving Soils

Building Available Nutrients – soil biology and compost

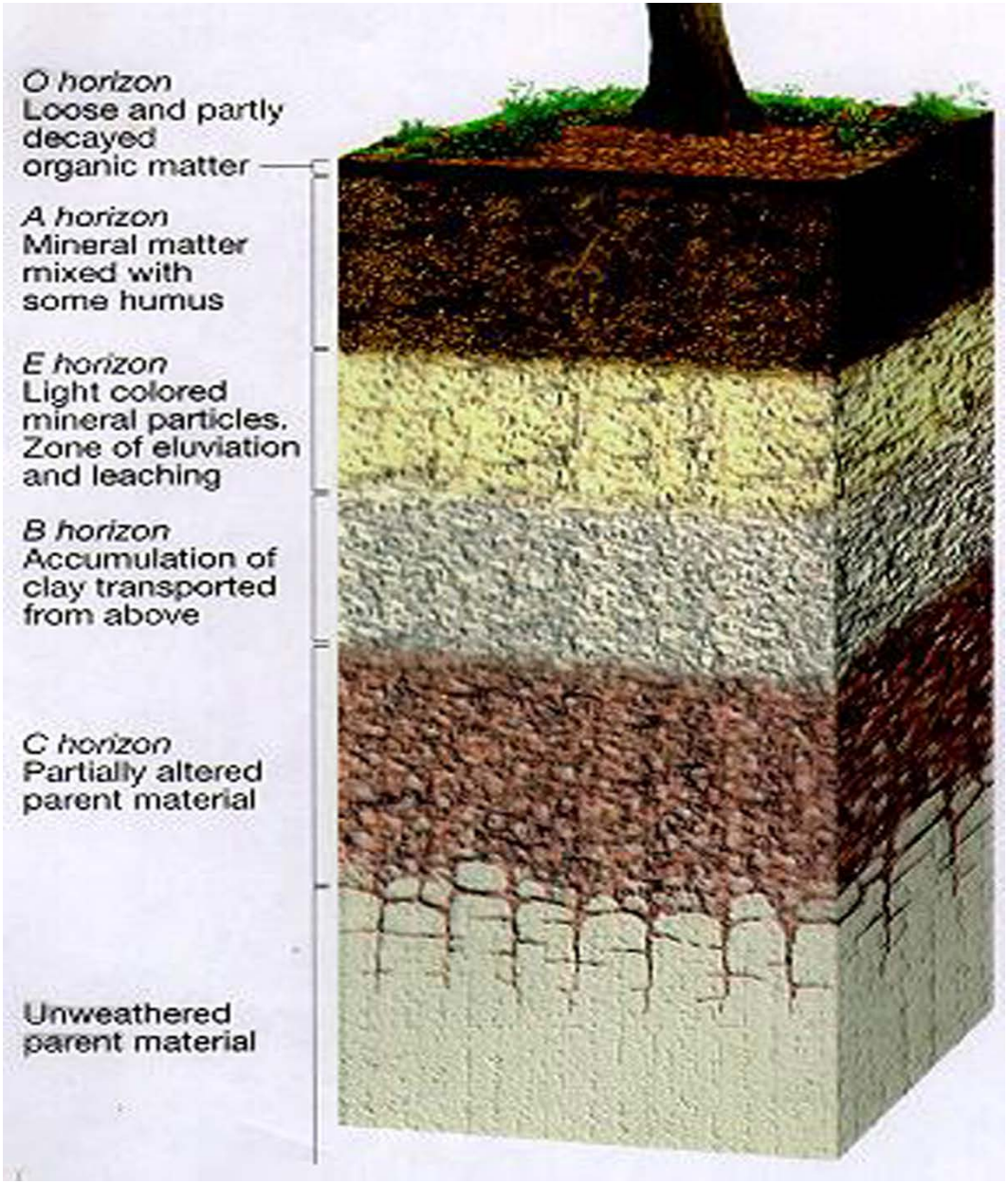
Drainage – Tilling Techniques and Raised Bed Gardens

Techniques for Your Garden

Raised Bed Gardens, Hugelkultur, Straw Bale Gardens

Additional Resources

Understanding Soil Composition



This is a cross-section of Earth. For our purposes, we are focusing on the top layer – topsoil.

In this layer we are concerned with:

-Drainage characteristics
- Organic material (humus)
- Biological activity
- Proportion of air, water, and carbon

There are 3 Basic Components

Three types of soil texture

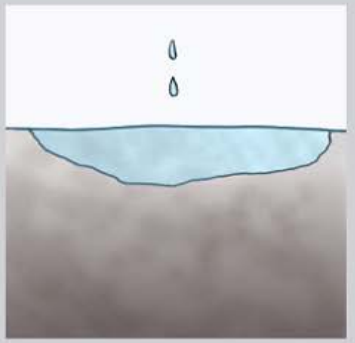
- Clay soil has very fine particles, holds moisture a long time, and may not admit air into the root zone.

  Remedy: add organic matter or gypsum to cause the clay particles to clump together.

- Loam soil is a mix of clay, silt and sand particles. These soils are generally considered ideal for plant growth.

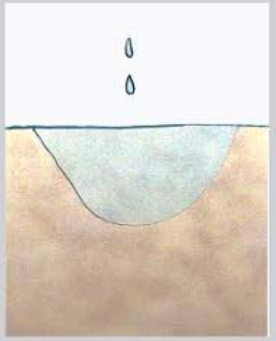
- Sandy soils have coarse particles, drain rapidly and dry quickly.

  Remedy: add organic matter. It will act as a sponge to keep the water in the root zone longer.



Clay

- Clay particles are very small, invisible to the naked eye.
- Water penetrates clay soils slowly – but it does spread
- Retains water well, but compacts easily.



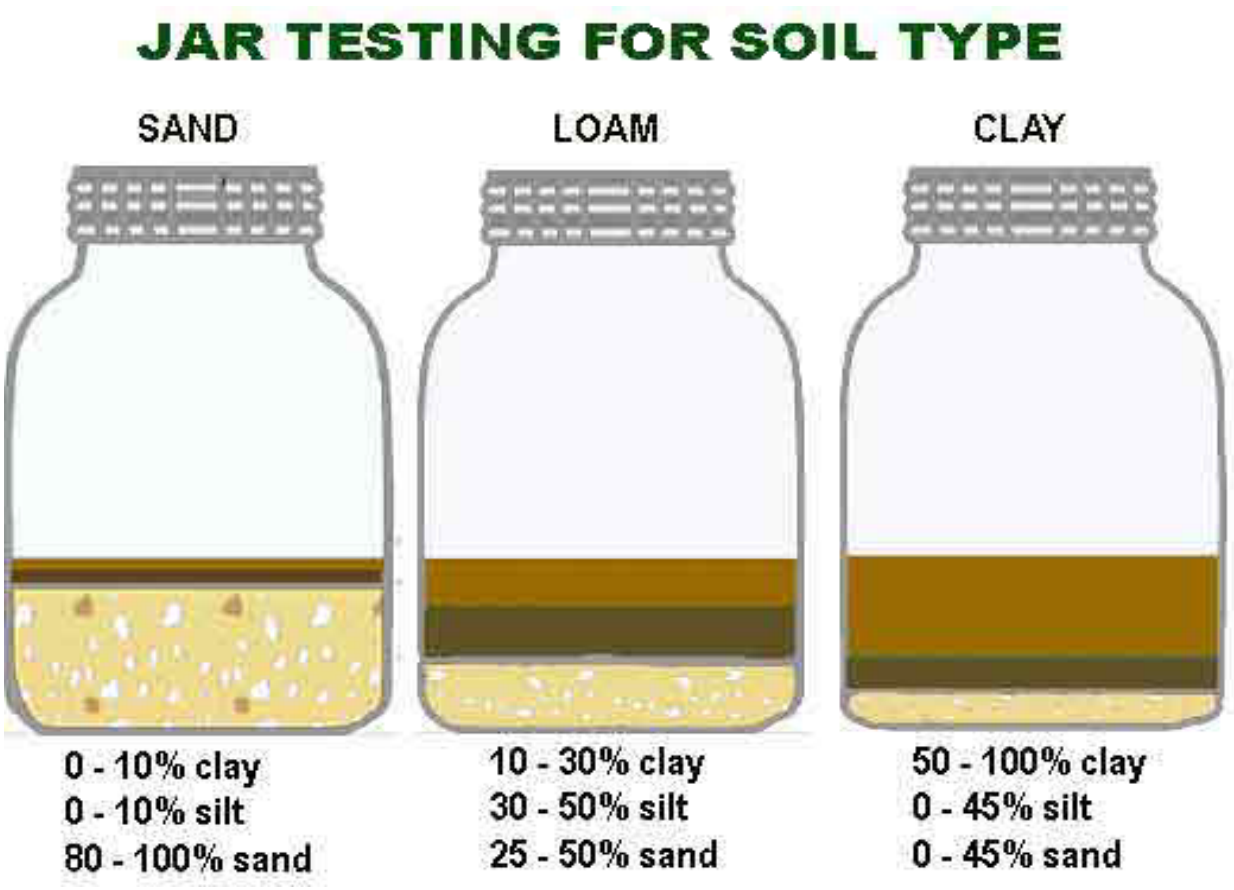
Silt

- Silt is intermediate between clay and sand.
- This is generally a good soil for plant growth.

Sand

- Sand particles are coarse, visible to the naked eye.
- Water penetrates quickly, and does not remain in the soil.

Here is How to Test Your Soil



Step 1: In a mason jar, put a few small shovels of soil from the middle of your garden. Dig down to the root-zone to get the representative sample.

Step 2: Add a few drops of dish soap and fill the jar with cold water.

Step 3: Shake vigorously. Allow several days for all components to settle.

Sand is the heaviest and will settle first. Second will be silt and third will be clay.

Also, consider a laboratory soil test

FRESH FORK MARKET
LOCAL PROVISIONS FOR MODERN DOMESTIC LIVING

SOIL TEST REPORT

Jane Doe
BA04NW01
Test Alias
131.3 ac
2009

MZB Mapping Center

Nutrients		Levels	Interpretation VL	L	M	H	VH
Nitrate-Nitrogen	N1	21 lbs/ac					
	N2	24 lbs/ac					
	N Total	45 lbs/ac					
Phosphorus	Olsen	5 ppm					
Potassium		367 ppm					
Sulfur	S1	18 lbs/ac					
	S2	42 lbs/ac					
Zinc		1.11 ppm					
Chloride		24 lbs/ac					
Iron							
Manganese							
Copper							
Magnesium							
Calcium							
Boron							
Sodium							
Organic Matter		3.6 %					
Soluble Salts	Salts1	0.3					

Soil pH	Buffer pH	Cation Exchange Capacity
6.5		

GoodNature™

Aveni, Virginia

Soil Test Results

Sample Location: WHOLE YARD -- LAWN Report Date: 4/24/2009 Area: 8.0

	Result	Desired Result	Deficit-Sufficiency	Deficit-Sufficiency lbs/1000 sq ft	Graphical Result
Exchange Capacity	12.17				
Water pH (1:1)	6.2	6.5	-0.3		Very Low Low Desired Excess
Organic Matter (%)	5.01	6.0	-0.99		Very Low Low Desired Excess
Soluble Sulfur (ppm)	13	37.5	-24.5	-1.13	Very Low Low Desired Excess
Easily Extractable P as P2O5 (lbs/ac)	73.0	200.0	-127	-2.92	Very Low Low Desired Excess
Bray II P as P2O5 (lbs/ac)	234	400.0	-166	-3.82	Very Low Low Desired Excess
Calcium (lbs/ac)	3064	3310.0	-246	-5.66	Very Low Low Desired Excess
Magnesium (lbs/ac)	478	380.0	+98	2.25	Very Low Low Desired Excess
Potassium (lbs/ac)	192.0	380.0	-188	-4.32	Very Low Low Desired Excess
Sodium (lbs/ac)	84	56.0	+28	+0.64	Good Ok Alert Problem

Base Saturation

Desired

Element	Desired Result
Calcium%	68.0
Magnesium%	13.0
Potassium%	4.0
Sodium%	<1.0
Hydrogen%	10.0
Other%	3.0

Actual

Element	Actual Result
Calcium%	62.9
Magnesium%	16.4
Potassium%	2.0
Sodium%	1.5
Hydrogen%	12.0
Other%	5.2

Minor Elements

Boron (ppm)	0.72	1.5	-0.78	-0.04	Very Low Low Desired Excess
Iron (ppm)	270	225.0	+45	2.07	Very Low Low Desired Excess
Manganese (ppm)	17	112.5	-95.5	-4.39	Very Low Low Desired Excess
Copper (ppm)	3.09	3.5	-0.41	-0.02	Very Low Low Desired Excess
Zinc (ppm)	2.40	8.0	-5.6	-0.26	Very Low Low Desired Excess
Aluminum (ppm)	685	600.0	+85	3.91	Very Low Low Desired Excess

Alec McClennan
5201 Grant Avenue -- Cleveland, OH 44125
O - (216) 641-9800 F - (216) 641-9805
C - (216) 570-5346 alec@whygoodnature.com

Analytical Services By:

SOIL TEST RESULTS

			RATING: Very low	Low	Medium	High	Very high	Excess
pHs	5.1		**********					
Phosphorus (P)	23	lbs/a	********					
Potassium (K)	199	lbs/a	**********					
Calcium (Ca)	2729	lbs/a	**********					
Magnesium (Mg)	626	lbs/a	**********					
Organic Matter:	2.3 %		Neutr. Acidity: 2.5 meq				CEC: 11.9 meq	

Fertilizer & Limestone Recommendations (lbs/1000 sq ft)

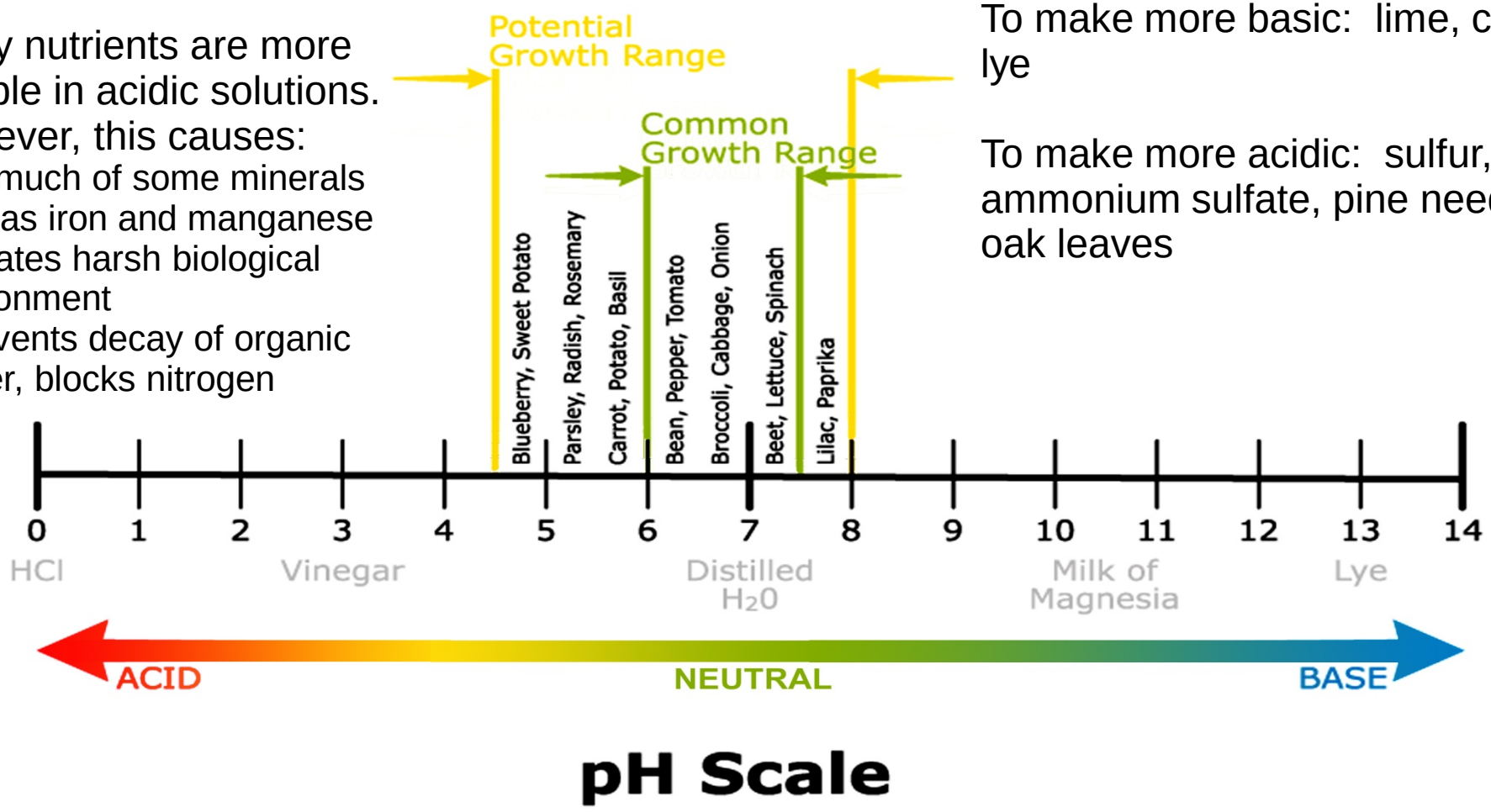
Crop	Nitrogen (N):	Phosphorus(P_2O_5)	Potash(K_2O)	Zinc(Zn)	Sulfur(S)	LIME
1 vegetables	0.5	2.5	0.5			50
4 fescue,blue,ryegrass(avg)	2.0	1.0	0.5			50
9 perennial bedding plants	0.5	2.5	1.0			50

Comments: ---Some herbicide labels list restrictions based on soil pH in water. Use the estimated pH in water of 5.6 as a guide to the label. If you wish to have soil pH in water analyzed, contact your dealer or local Extension specialist listed below.
---The soil should be tested every 2 to 3 years to determine the effects of your fertilization practices and to develop a new set of fertilizer and limestone guidelines.
***The soil needs additional organic matter for gardens and crops other than lawns. See MU Publication G6950, "Steps in Fertilizing Garden Soil" and G6956, "Making and Using Compost".
***For average maintenance of fescue, blue, ryegrass apply one pound of nitrogen per 1000 square feet in early September and again in early November or April-May. If available use a fertilizer containing about 1/2 of the nitrogen in slow release form. See MU Publication G6705, "Cool-Season Grasses, Lawn Maintenance Calendar".
***Do not apply sulfur to established lawns as sufficient amounts cannot be applied to lower pH without the possibility of leaf burn.

The lab test will identify pH

The pH level determines the availability of minerals in the soil. High acid (low number) pH makes more minerals available; however, most plants cannot tolerate an acidic soil.

Many nutrients are more soluble in acidic solutions. However, this causes:
-Too much of some minerals such as iron and manganese
- Creates harsh biological environment
- Prevents decay of organic matter, blocks nitrogen

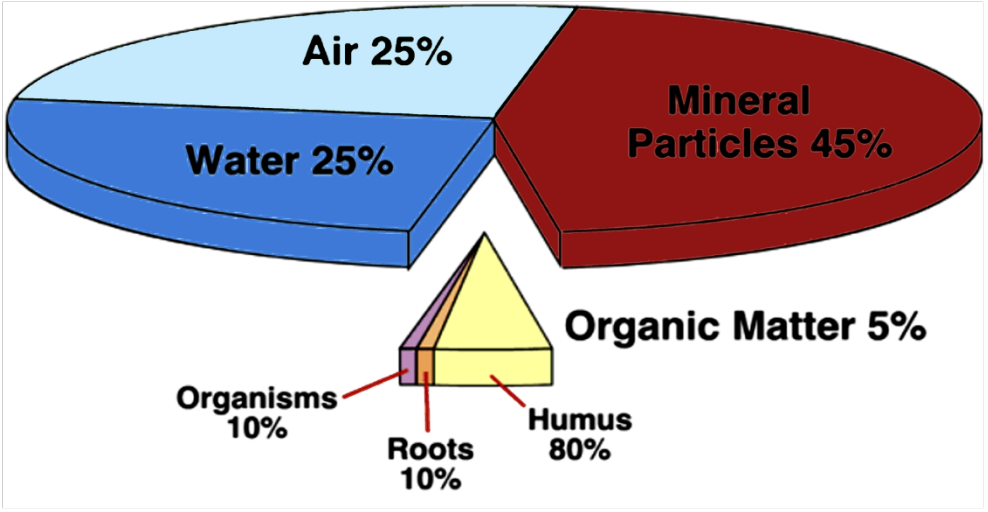


pH Scale

To make more basic: lime, calcium, lye

To make more acidic: sulfur, ammonium sulfate, pine needles, oak leaves

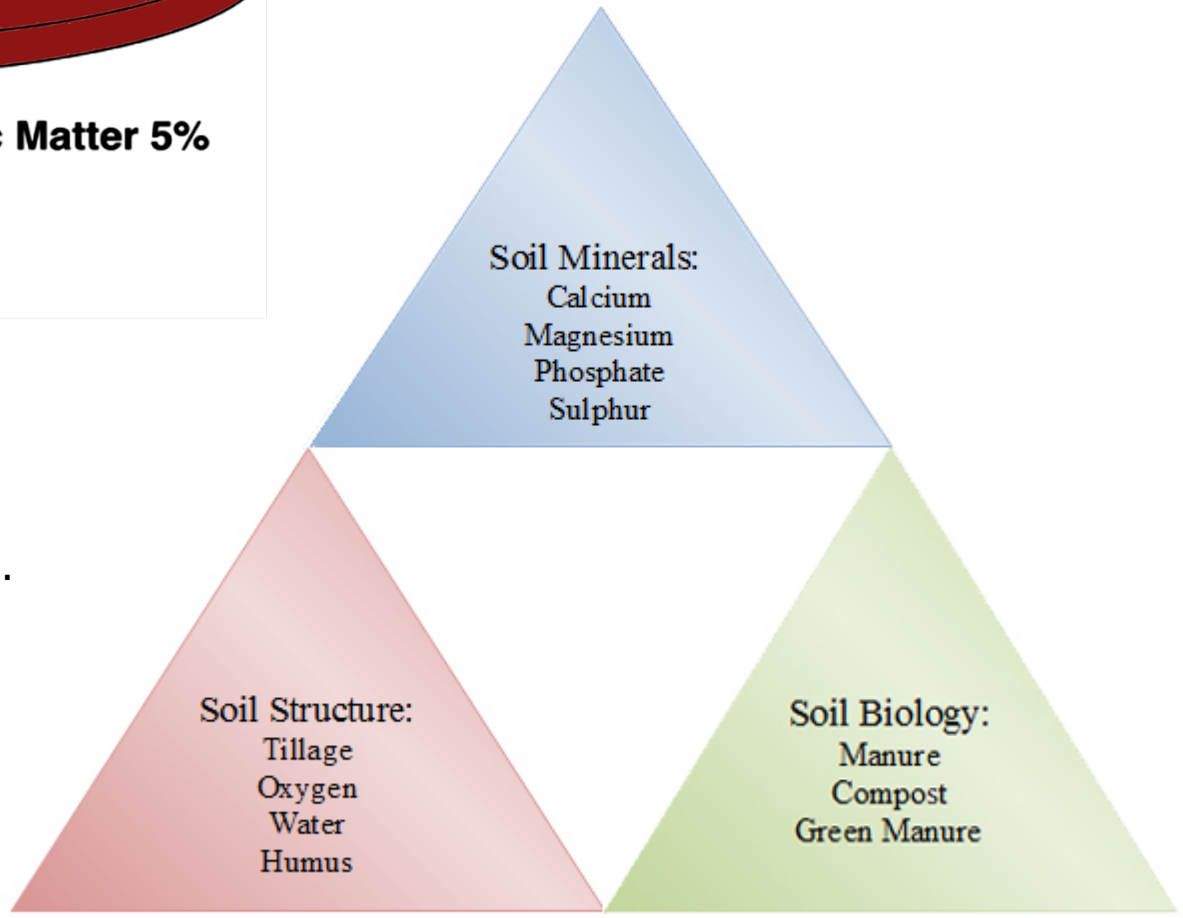
Here, we can look more closely for:



Above: An ideal soil is approximately these proportions.

Right: To optimize the soil, think about the elements in each triangle.

Discuss.



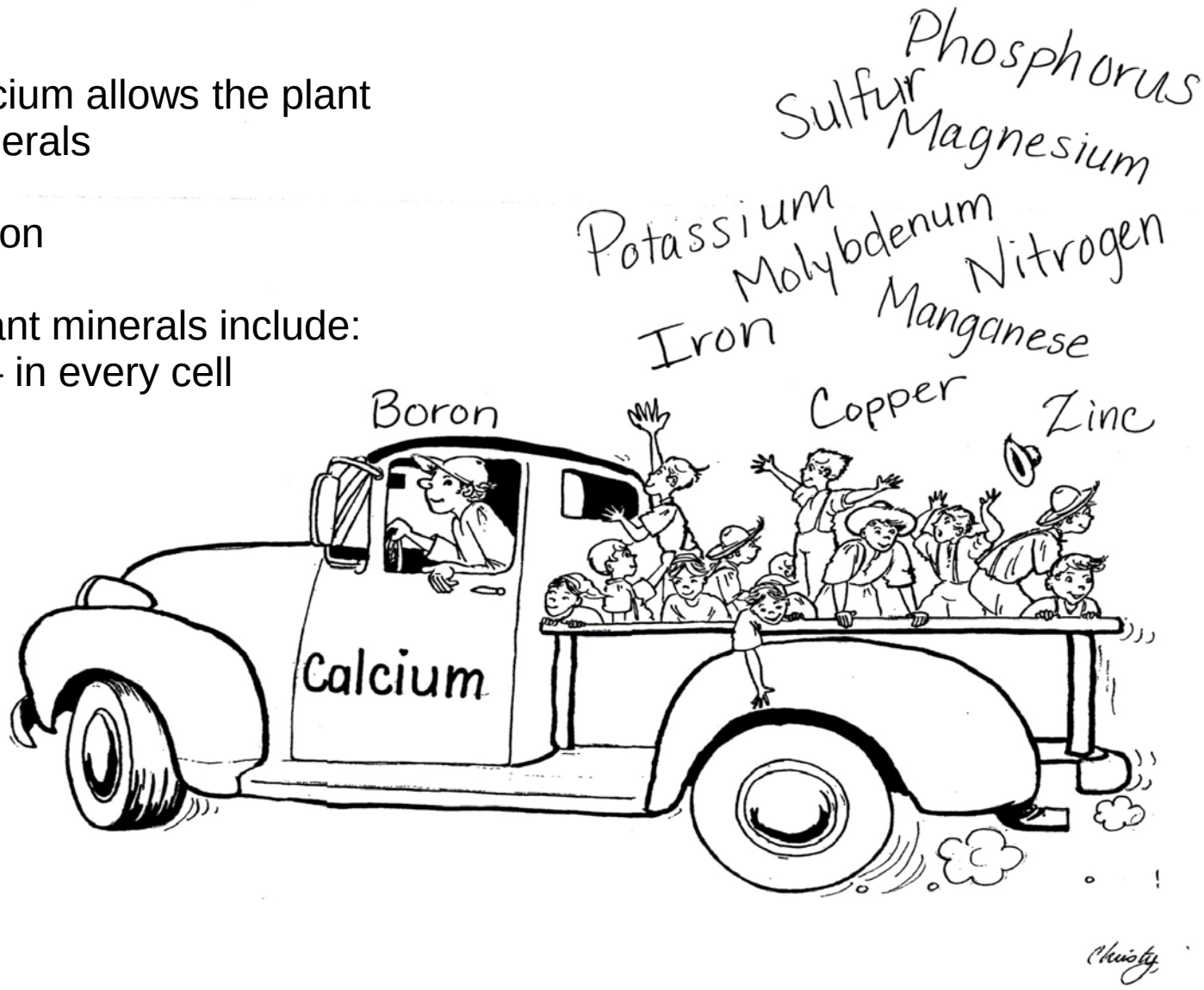
Here is a fun way to think of minerals

If the minerals want to go to town, they need:

A Truck: Calcium allows the plant to uptake minerals

A Driver: Boron

Other important minerals include:
Manganese – in every cell



Cation Exchange Capacity

Cation Exchange Capacity (CEC) is influenced by:

Soil pH: basic soils can increase CEC score

Humus: increases CEC score

Let's do an analysis on an actual soil test.

lb/A

BROOKSIDE LABORATORIES, INC.

70096-1

SOIL AUDIT AND INVENTORY REPORT

Name Jacob J. Yoder Account Green Field Farms

Address 76382 Peoli Road Port Washington, OH 43837 Date 04/17/2013

Sample Location	ORGANIC		1	2			
Sample Identification			PRODUCE	PRODUCE			
Lab Number			0646-1	0647-1			
Total Exchange Capacity (ME/100 g)			6.48	13.71			
pH	Buffer (SMP/Sikora)		a NA	7.3			
	H_2O (1:1)		7.5	6.9			
Organic Matter (humus) %			3.09	3.78			
Estimated Nitrogen Release		lb/A	81	88			
ANIONS	SOLUBLE SULFUR*	ppm	8	10			
PHOSPHORUS	MEHLICH III	lb/A P as P_2O_5	69	87			
		ppm of P	15	19			
	BRAY II	lb/A P as P_2O_5					
		ppm of P					
	OLSEN	lb/A P as P_2O_5					
		ppm of P					
EXCHANGEABLE CATIONS	CALCIUM*	lb/A	1758	3752			
		ppm	879	1876			
	MAGNESIUM*	lb/A	408	748			
		ppm	204	374			
	POTASSIUM*	lb/A	48	186			
		ppm	24	93			
	SODIUM*	lb/A	34	68			
		ppm	17	34			
BASE SATURATION PERCENT							
Calcium %			67.82	68.42			
Magnesium %			26.23	22.73			
Potassium %			0.95	1.74			
Sodium %			1.14	1.08			
Other Bases %			3.90	4.50			
Hydrogen %			0.00	1.50			
EXTRACTABLE MINORS							
Boron* (ppm)			0.36	0.64			
Iron* (ppm)			68	118			
Manganese* (ppm)			114	179			
Copper* (ppm)			0.97	5.74			
Zinc* (ppm)			1.51	4.23			
Aluminum* (ppm)			513	636			
OTHER TESTS	Soluble Salts (mmhos/cm)						
	Chlorides (ppm)						

a - alkaline soil

* Mehlich III Extractable

Courtesy of Greenfield Family Farms

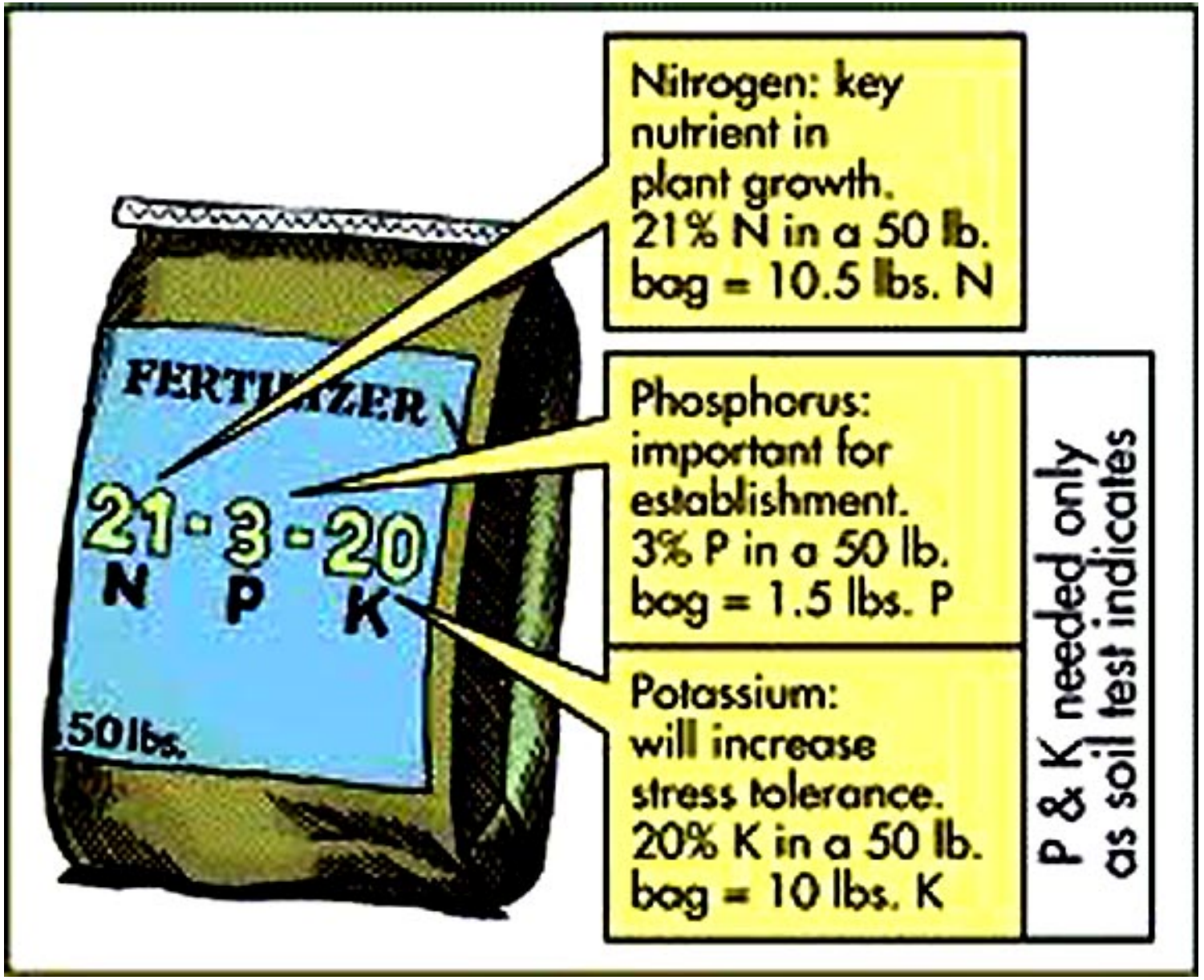
To test your soil, see their stand here today. Soil tests are available.

Items of note:
Organic Matter – how can we build humus?

Cations (minerals) – how can we adjust these?

(see next slide for discussion about commercial fertilizer options)

Here is how to read a commercial fertilizer



Important Notes:

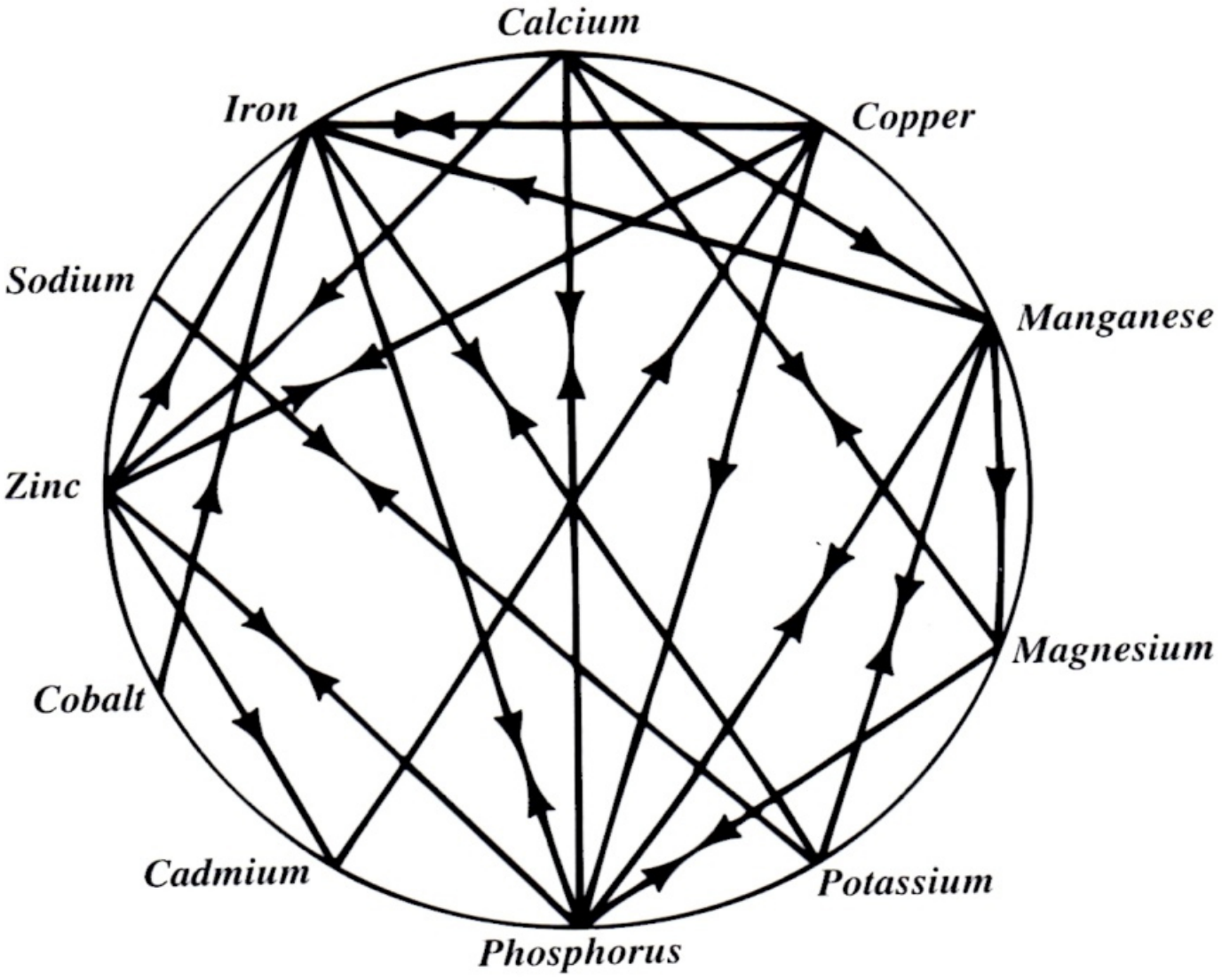
Salts: increase acidity, dehydrate plants

Lots of commercial fertilizers are salt based (sulfate, salt of sulfuric acid)

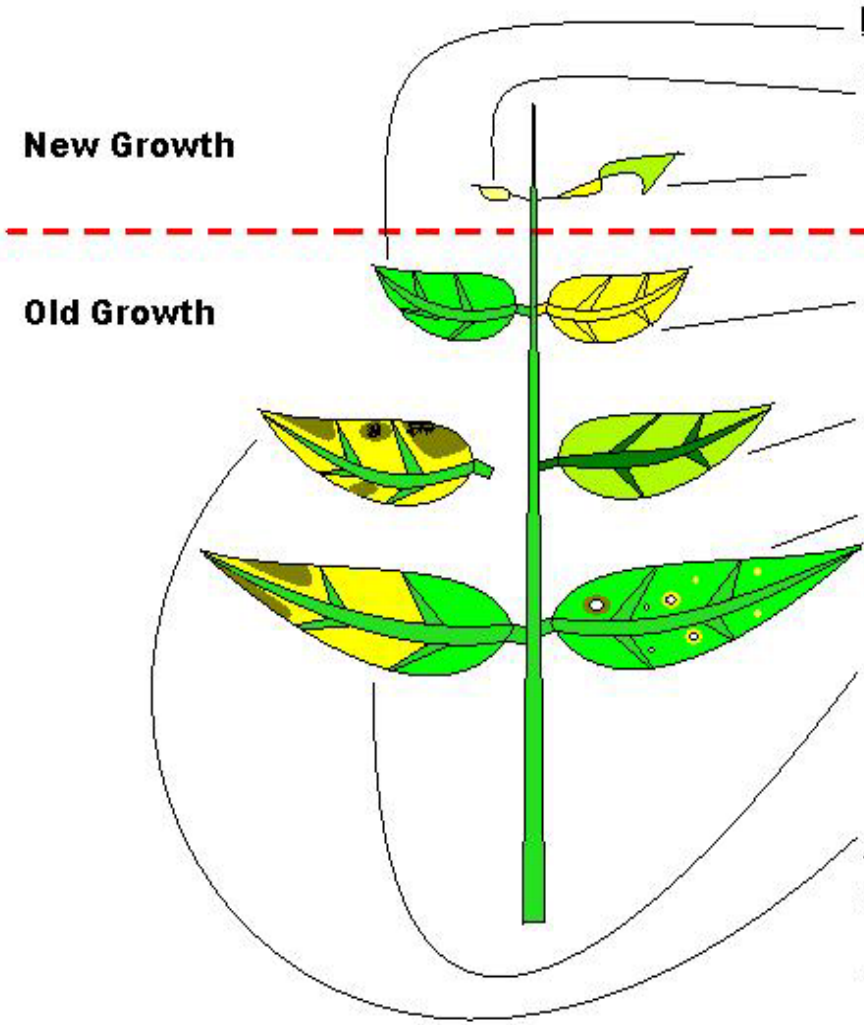
Potash – a salt containing potassium

Phosphorus – extracted from phosphate rock with either phosphoric acid or ammonium (ammonium phosphate)

This chart indicates interrelations of nutrients



Looking at your garden: Understanding nutrients



Normal leaf

Severe nitrogen deficiency (white/yellow tiny leaves)

Calcium deficiency (or might be K, Mg overdose) twisted pale new growth

Iron deficiency(yellowing of entire plant)

Magnesium deficiency (dark veins lighter leaf tissue)

Potassium deficiency (pin-holes form in leaf that enlarge with a yellowing edge, leaf is otherwise normal looking)

Early signs of **nitrogen deficiency** (old leaves yellow and are reabsorbed from tip to stem)

Phosphate deficiency (older leaves yellow, and parts of the leaf is reabsorbed leading to dead patches, the leaf falls off rather quickly, looks similar to early nitrogen deficiency)

A More In-Depth Chart of Nutrient Deficiency

Symptoms	Suspected Element										Over
	N	P	K	Mg	Fe	Cu	Zn	B	Mo	Mn	Fertilization
Yellowing of Younger leaves					■					■	
Yellowing of Middle leaves									■		
Yellowing of Older leaves	■		■	■			■				
Yellowing Between veins				■						■	
Old leaves drop	■										
Leaf Curl Over				■							
Leaf Curl Under			■			■					■
Leaf tips burn, Younger leaves								■			
Hollow Heart/Core								■			
Young leaves wrinkle and curl			■				■	■	■		
Dead areas in the leaves			■	■	■		■			■	
Leaf growth stunted	■	■									
Dark green/purplish leaves and stems		■									
Pale green leaf color	■								■		
Leaf Spotting							■				
Spindly	■										
Soft stems	■		■								
Hard/brittle stems		■	■								
Growing tips die			■					■			
Stunted root growth		■									
Wilting						■					

Elements

N – Nitrogen
P – Phosphorus
K – Potassium
Mg – Magnesium
Fe – Iron
Cu – Copper
Zn – Zinc
B – Boron
Mo – Molybdenum
Mn – Manganese

Part II: Improving Soils and Your Garden

Improving Soils

Building Available Nutrients –

Biological Stimulants/Enzymes

Compost – basic components, municipal/yard compost vs farm compost

Commercial Fertilizers (discussion about salts) and how to add nutrients organic

Drainage – Tilling Techniques and Raised Bed Gardens

Techniques for Your Garden

Raised Bed Gardens, Hugelculture, Straw Bale Gardens

Additional Resources

Compost: Biological Activity and Nutrients

Compost is aerobic process, it requires:

Carbon (browns) – dead leaves, wood, cardboard, etc

Nitrogen (greens) – fresh grass clippings, fresh manure

Air and Water – stimulates decomposition

Look for a ratio of about 75% browns and 25% greens.

40% moisture suggested. "Feeds" the microorganisms. Too much moisture creates "anaerobic" environment and blocks oxygen.

Temp should be between 90 and 140 F

Other Organics

FRESH FORK MARKET
LOCAL PROVISIONS FOR MODERN DOMESTIC LIVING

Organic Soil Amendments

Compost

Shredded tree bark

Sphagnum peat moss

Manure
(cow/sheep/horse rabbit/chicken)

Leafmold

Wood ash

Other Organics

Tilling: When and How Far

Tilling: act of loosening the soil mechanically with shovel, rake, or machine

Good: introduces air to soil, proper techniques promote good drainage

Bad: Can disturb microbial activity, create soil compaction (from plow)

Suggestions:
Minimal Till – as light as necessary, need to create a seed bed

Loosen the soil, don't turn it.

4 inches is a safe distance.

Use a shovel and rake.

Other Garden Techniques

Raised Bed Gardens.

1) Built above existing soil or surface.
2) Creates loose, well drained soil.
3) Allows you to create the perfect soil using purchased top soil and compost.

Straw Bale Gardening:

1) Use straw, not hay. Turn on side.
2) "Condition" bale. Sit out over winter, cover top with topsoil or compost.
3) Punch holes in straw with hand or tools. Add compost.
4) Plant in holes. Water regularly

The straw essentially creates an internal compost bin. It is great for root structure.

Question and Answer

FRESH FORK MARKET
LOCAL PROVISIONS FOR MODERN DOMESTIC LIVING

Today's Presentations and Additional Resources at
www.freshforkmarket.com