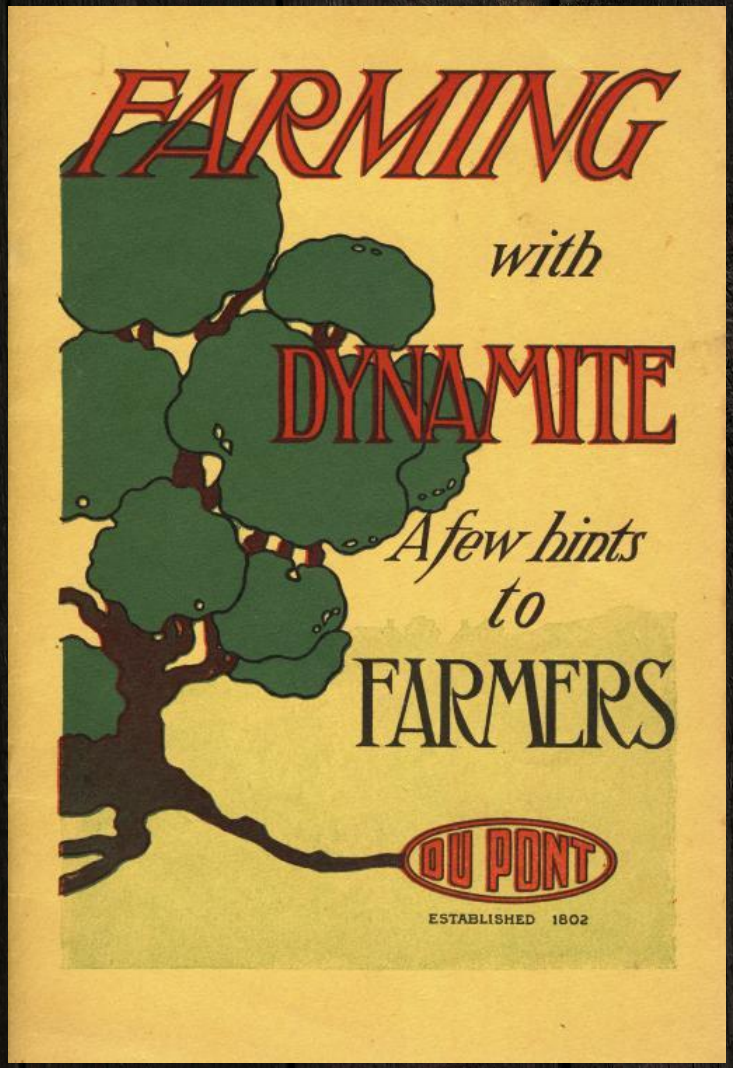
Soil Sampling for Accurate Results

on the web: www.bereagardens.org

Your instructor
Bob Gregory

“Agriculture should be advanced by scientific knowledge.”

5ST 8-13-96



Do I advocate:

- Hydroponics ? no
- Biodynamics ? no
- Aquaculture ? no
- Permaculture ? no
- “Back to Eden” ? no

Building a ”soil bank” of nutrition for you and your crops starts with establishing the right mineral environment for highly active microbiology. Fungi, bacteria, protozoa, algae and enzymes are the biological catalysts for the mineral nutrients that your plants (and you) need.

Building soil involves evaluating your soil analysis in two steps.

1. Correcting the “Base Saturation”
2. Supplying mineral nutrients

Major Soil Orders of the United States

websoilsurvey.nrcs.usda.gov/app/

Physical characteristics of soil
Depth of soil
Rate of water penetration
Potential agricultural productivity*

What is soil?

Minerals	50%
Air	23-25%
Water	23-25%
Organic Matter	3-5%

What we learn with soil analysis

Percentage of organic matter

Texture – sand, silt, clay (based on CEC)

pH – (acidity or alkalinity)

Cation Exchange Capacity – (CEC)

Elements adsorbed by soil particles - (Base Saturation %)

Elements in total volume of soil – parts per million (ppm)

<u>Exact targets for mineral applications</u>

pH scale (potential Hydrogen)

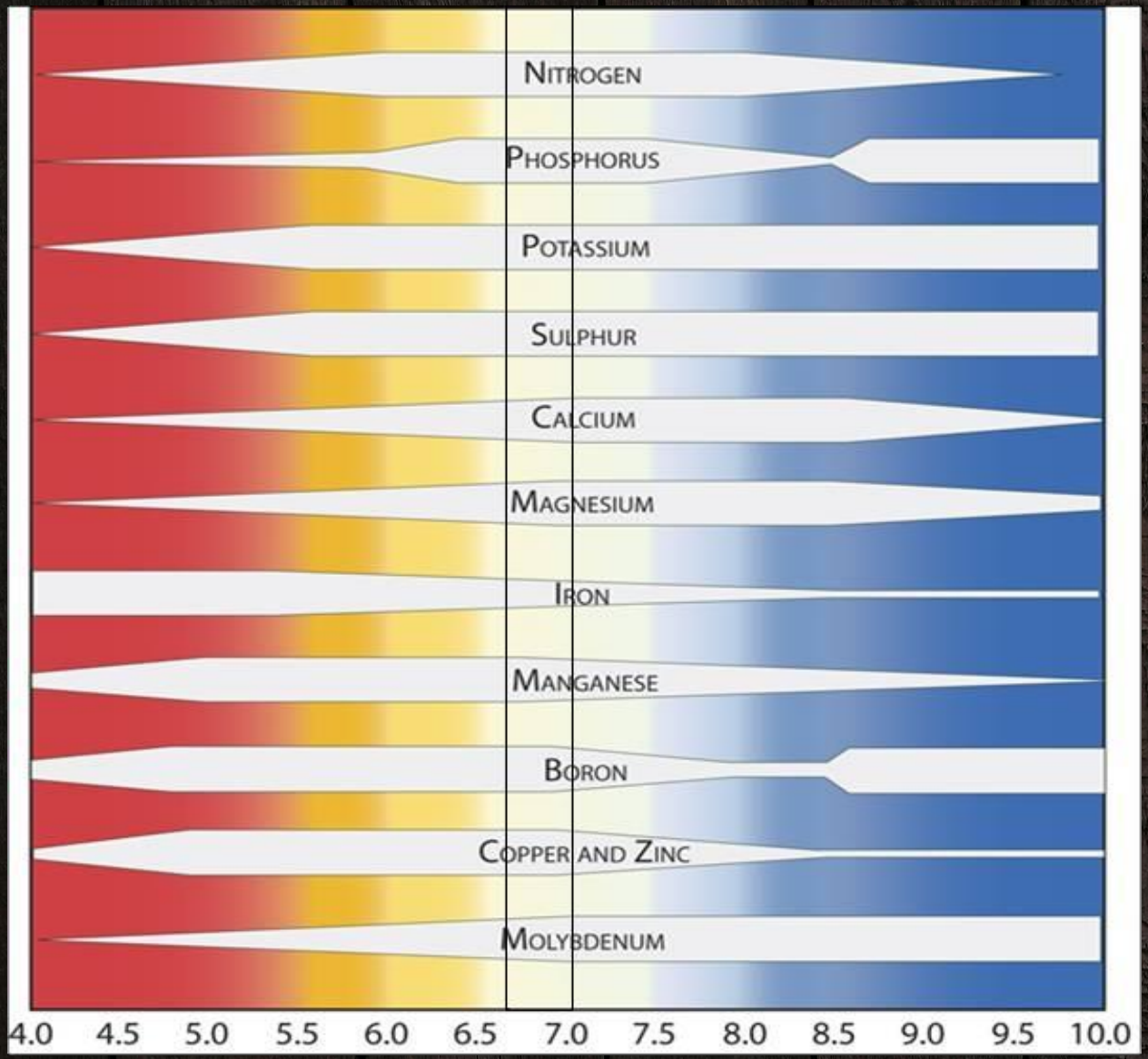
0	7	14
H^+	Neutral	OH^-
(Hydrogen ions)		(Hydroxyl ions)
H^+ in base Saturation		Na^+ in Base Saturation

Limestone raises pH ----> 6.5 to 7 optimum range <---- Sulfur lowers ph

Calcitic limestone
Hydrated limestone
Dolomite limestone

Elemental Sulfur

Nutrient availability changes according to pH



Three primary soil chemical classes:

Acid soils
- pH below 7
- free hydrogen H^+ in the “Base Saturation”
- 70% of world’s arable land

Calcareous soils
- alkaline pH - 7.1 to 8.3
- contain Calcium and Magnesium carbonates
- often contain phosphates
- can be very fertile

Sodic soils
- highly alkaline – pH above 8
- excessive free sodium Na^+ (above 15% in Base Saturation)
- very poorly drained, poor water penetration
- found in arid and semi-arid regions

First Step: A Soil Analysis

- Use a reputable, privately run soil laboratory
- Be certain that they include a “Base Saturation” component
- Extraction Methods:

Bray (for Calcareous soils with pH >7.3)

Ammonium Acetate or Morgan (low acid extraction)

Mehlich I

*Mehlich III (for acidic to pH <7.3 soils)

Olsen (for very high pH >8 and Sodic soils)

I like the “S3M” package from A&L Eastern Laboratories in Richmond, VA

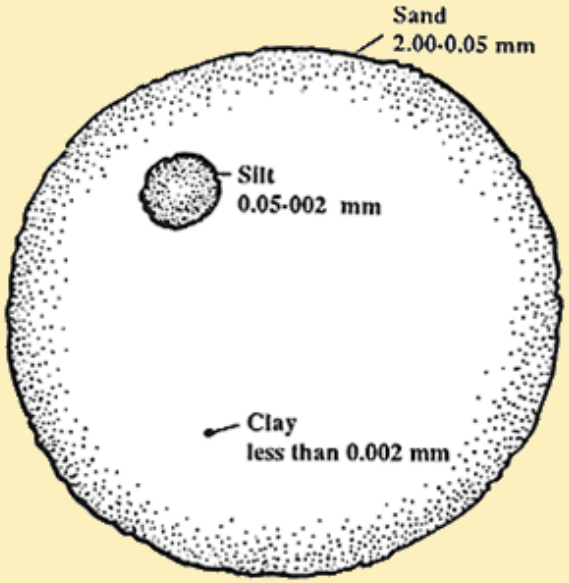
http://al-labs-eastern.com/agricultural.html

Other laboratories listed here:

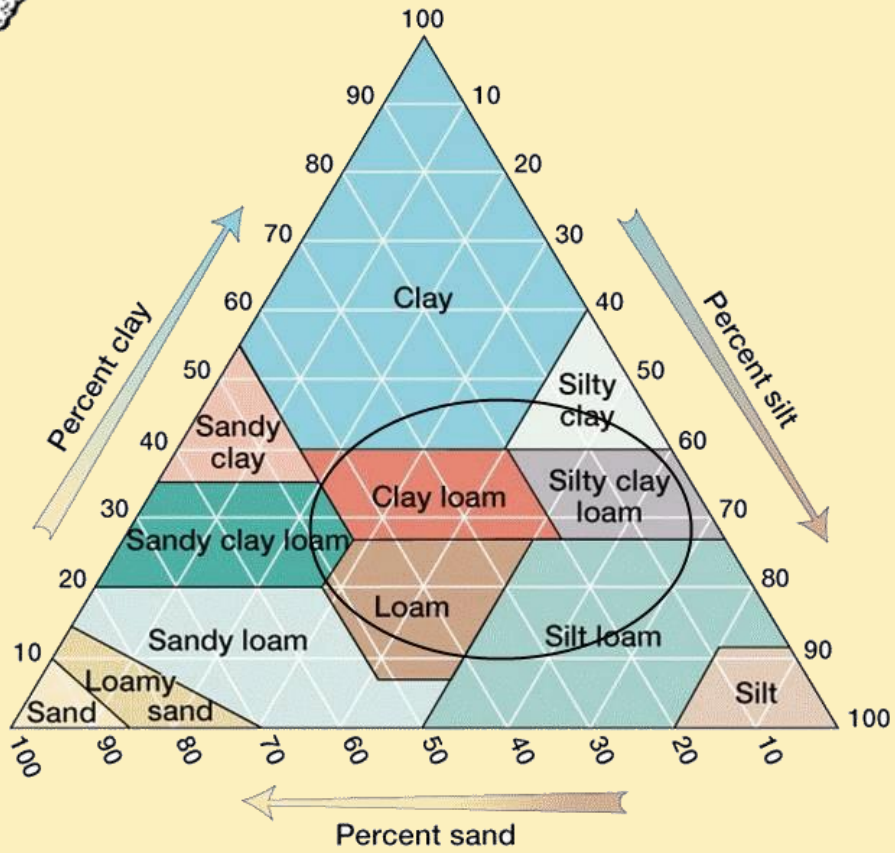
http://www.bereagardens.org/soil.html

Soil texture: a reference to the size of soil particles

- Sand
- Silt
- Clay



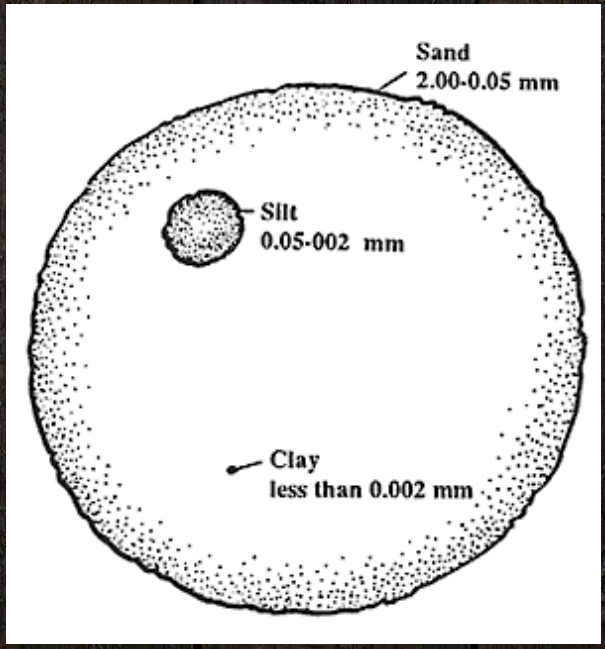
- Texture indicates potential capacity to hold water and nutrients
- Gives an indication of friability



Soil mineral particles have a slight negative electrical charge

Size of soil particles determines how much negative charge in a given quantity or volume of soil

Sand - very low
Silt - low
Clay - high



Dr. William A. Albrecht, University of Missouri

Correlated soil chemistry (health) with human health

Developed understanding of Base Saturation of the Cation Exchange Capacity in soils

Emphasized the role of calcium in ratios with magnesium and potassium to promote optimum health

"NPK formulas, (nitrogen, phosphorus, potassium) as legislated and enforced by State Departments of Agriculture, mean malnutrition, attack by insects, bacteria and fungi, weed takeover, crop loss in dry weather, and general loss of mental acuity in the population, leading to degenerative metabolic disease and early death."

William A. Albrecht

Cation Exchange Capacity (CEC)

Measurement of a soil's ability to hold cation (positively charged ion) nutrients in the soil

Cations are positively charged ions

Calcium	Ca^{++}
Magnesium	Mg^{++}
Potassium	K^{+}
Hydrogen	H^{+}
Sodium	Na^{+}

More resources on our website

http://www.bereagardens.org/OnlineMedia.html

Free Presentations

"Optimizing the Base Saturation of Soil" - This is a 78 minute PowerPoint on how to calculate for optimum soil pH and Base Saturation percentages using information from your soil analysis. This presentation explains how to provide an optimum environment for plant growth and human health. I will walk you through the steps of doing calculations for adjusting pH, maximizing the levels of Calcium, Magnesium and Potassium so that you can get the absolute best productivity from your soil and provide the ideal environment for biological activity from beneficial organisms. This effective "First Step" in dealing with your soil chemistry will enhance any fertilizers you make use of to grow your crops, whether organic or synthetic.

"The Other Side of the Fence" William Albrecht's classic explanation about the importance of soil mineralization

"Growing Food, Growing Crisis" - Free Webinar outlining the issues with our modern food system and what we can do about it

"From Garden to Garden" - Free video of a presentation at the McDonald Road Church in March 2013.
The Biblical and practical imperatives for growing your food. Why it is essential to have a garden.

Two types of mineral measurement:

Base Saturation by percentage
adsorbed by soil mineral particles

Parts Per Million (ppm)
total amount of element in a given volume of soil

SOIL ANALYSIS REPORT

Analytical Method(s): Mehlich 3

Date Received: 04/13/2010 Date Of Analysis: 04/14/2010 Date Of Report: 04/15/2010

Sample ID / Field ID	Lab Number	Organic Matter %	Organic Matter Rate	Organic Matter ENR lbs/A	Phosphorus Mehlich 3 ppm	Phosphorus Mehlich 3 Rate	Phosphorus Reserve ppm	Phosphorus Reserve Rate	Potassium K ppm	Potassium K Rate	Magnesium Mg ppm	Magnesium Mg Rate	Calcium Ca ppm	Calcium Ca Rate	Sodium Na ppm	Sodium Na Rate	pH Soil pH	Buffer Index	Acidity H meq/100g	C.E.C meq/100g
F1	05346	1.7	L	68	37	M			131	M	199	M	1097	L			5.2	6.54	3.9	11.4

Sample ID / Field ID	Percent Base Saturation K %	Mg %	Ca %	Na %	H %	Nitrate NO_3N ppm	Nitrate Rate	Sulfur S ppm	Sulfur Rate	Zinc Zn ppm	Zinc Rate	Manganese Mn ppm	Manganese Rate	Iron Fe ppm	Iron Rate	Copper Cu ppm	Copper Rate	Boron B ppm	Boron Rate	Soluble Salts SS ms/cm	Soluble Salts Rate	Chloride Cl ppm	Chloride Rate	Aluminum Al ppm
F1	2.9	14.5	48.1		34.0			19	M	1.7	L	29	H	121	VH	2.1	H	0.4	L					
	5	*20*	*>68*		*0*																			

Values on this report represent the plant available nutrients in the soil. Rating after each value: VL (Very Low), L (Low), M (Medium), H (High), VH (Very High). ENR - Estimated Nitrogen Release. C.E.C. - Cation Exchange Capacity.

Explanation of symbols: % (percent), ppm (parts per million), lbs/A (pounds per acre), ms/cm (milli-mhos per centimeter), meq/100g (milli-equivalent per 100 grams). Conversions: ppm x 2 = lbs/A, Soluble Salts ms/cm x 640 = ppm.

This report applies to sample(s) tested. Samples are retained a maximum of thirty days after testing.

Analysis prepared by: A&L Eastern Laboratories, Inc.

by: Pauric McGroary

Pauric McGroary

The “Base Saturation” refers to the quantity of cations adsorbed by the soil particles and held by the soil’s negative charge.

The “Percent Base Saturation” tells us how much of each cation element is presently attached in the soil complex.

Example of a soil analysis report

Page 1 of 1

Report Number: 10-103-0558
Account Number: 00879

www.allabs.com

A&L Eastern Laboratories, Inc.

7621 Whitepine Road Richmond, Virginia 23237 (804) 743-9401 Fax (804) 271-6446

Send To: ROBERT GREGORY
97 MILO RD
ORMA WV 25268

Grower: BEREA GARDENS

Submitted By: BOB GREGORY
Farm ID:

SOIL ANALYSIS REPORT

Analytical Method(s): Mehlich 3

Date Received: 04/13/2010 **Date Of Analysis:** 04/14/2010 **Date Of Report:** 04/15/2010

Sample ID / Field ID	Lab Number	Organic Matter			Phosphorus				Potassium		Magnesium		Calcium		Sodium		pH		Acidity	C.E.C
		%	Rate	ENR lbs/A	Mehlich 3 ppm	Mehlich 3 Rate	Reserve ppm	Reserve Rate	K ppm	K Rate	Mg ppm	Mg Rate	Ca ppm	Ca Rate	Na ppm	Na Rate	Soil pH	Buffer Index	H meq/100g	meq/100g
F1	05346	1.7	L	68	37	M			131	M	199	M	1097	L			5.2	6.54	3.9	11.4

Sample ID / Field ID	Percent Base Saturation					Nitrate		Sulfur		Zinc		Manganese		Iron		Copper		Boron		Soluble Salts		Chloride		Aluminum
	K %	Mg %	Ca %	Na %	H %	NO_3N ppm	NO_3N Rate	S ppm	S Rate	Zn ppm	Zn Rate	Mn ppm	Mn Rate	Fe ppm	Fe Rate	Cu ppm	Cu Rate	B ppm	B Rate	SS ms/cm	SS Rate	Cl ppm	Cl Rate	Al ppm
F1	2.9	14.5	48.1		34.0			19	M	1.7	L	29	H	121	VH	2.1	H	0.4	L					

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17 Essential Plant Nutrients:

Carbon, Hydrogen, Oxygen

(Environmental Nutrients)

Nitrogen, Phosphorous, Potassium

(Primary Nutrients)

Calcium, Magnesium, Sulfur

(Secondary Nutrients)

Boron, Copper, Iron, Zinc, Molybdenum, Manganese, Chlorine, Nickel, *Cobalt*

(Trace Nutrients)

*15 Additional Elements Required for Human Health

*Aluminum**
*Arsenic**
Boron
*Bromine**
*Cadmium**
Calcium
Carbon
Chlorine
*Chromium**
Cobalt
Copper
*Fluorine**
*Germanium**
Hydrogen
*Iodine**
Magnesium
Manganese
Molybdenum
Nickel
Nitrogen
Oxygen
Phosphorous
Potassium
*Rubidium**
*Selenium**
*Silicon**
*Sodium**
Sulfur
*Tin**
*Tungsten**
*Vanadium**
Zinc

Plants *mine* the soil for minerals

Only a few of these are replaced through fertilization of crops

- Typically only Nitrogen, Phosphorous, Potassium are applied
- Occasionally Sulfur or Calcium are added
- Rarely some trace elements added through foliar applications
- Soil deficiencies are very rarely corrected
- The other 15 elements required for human nutrition are ignored as considerations in agriculture

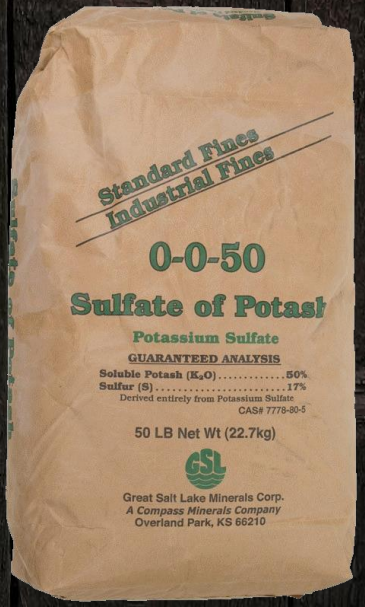
Potassium Sources

Potassium Sulfate	0-0-50	(50% potash)
Greensand	0-0-3	(3% potash)
Manure	?	?

If I need to add 100 pounds of potash per acre;

100/.50 = 200 pounds of Potassium Sulfate per acre

100/.03 = 3,333 pounds of Greensand per acre



How to sample

Represent the root zone accurately

Represent the area accurately

Use clean instruments

Sample at moderate soil temperature

Sample at moderate soil moisture

Use a composite sample method


Berea Gardens