Soil Science Basics:

Foundations for getting the best for your gardening efforts

AdAgra 2017

Berea Gardens Agriculture Center

Bob and Lynnita Gregory

Fixing Depleted Soil

How to Balance Your Soil's Base Saturation pt.1
How to Balance Your Soil's Base Saturation pt. 2

How to Calculate and Amend Soil Nutrient Levels pt. 1
How to Calculate and Amend Soil Nutrient Levels pt. 2

Safe Soil Ammendments/Fertilizers

Garden site selection criteria

1. Full sun
2. Southern exposure/Slope
3. Drainage/Irrigation
4. Accessibility/Security
5. Soil type, Texture, Structure and Depth
6. Web Soil Survey

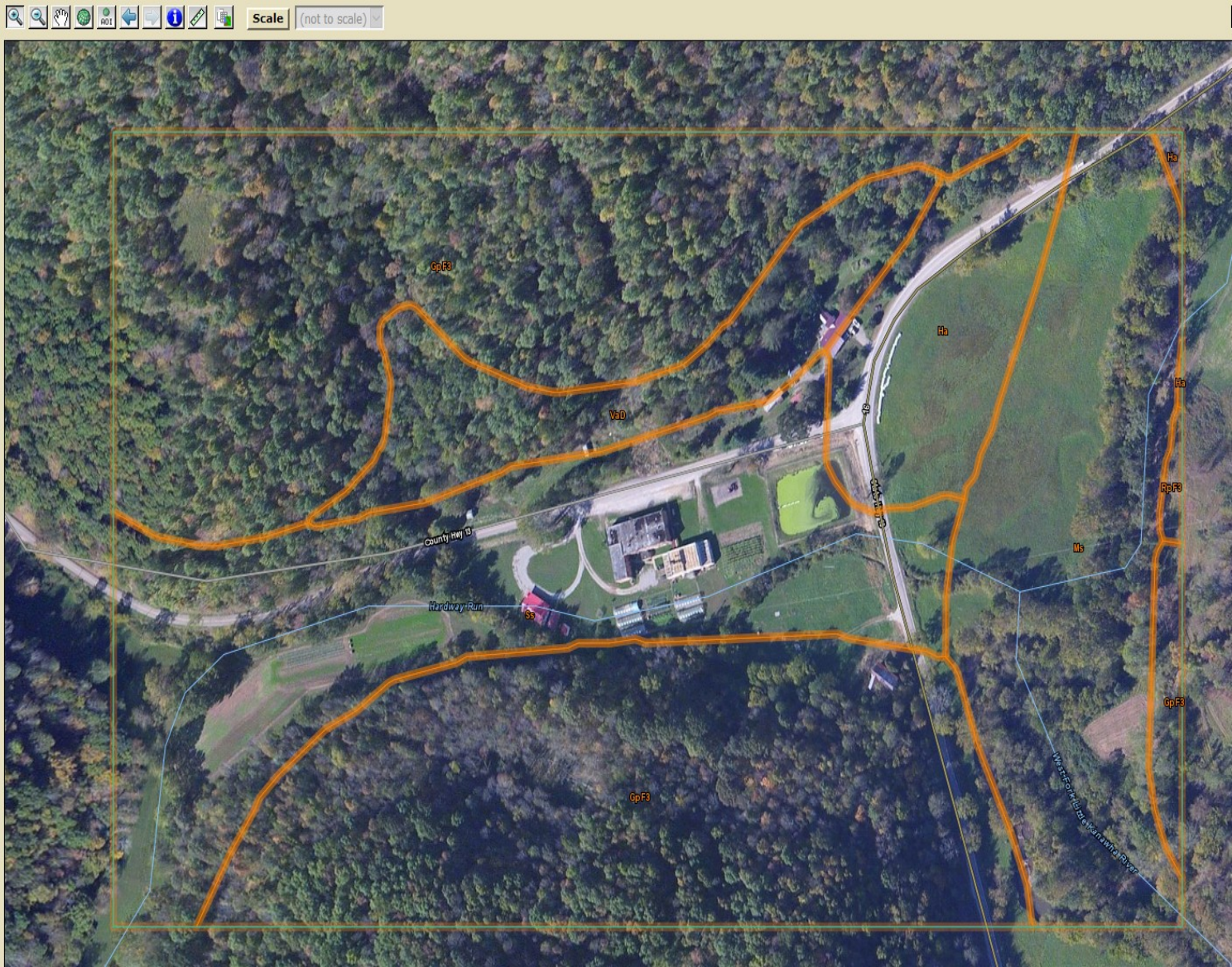
websoilsurvey.nrcs.usda.gov/app/

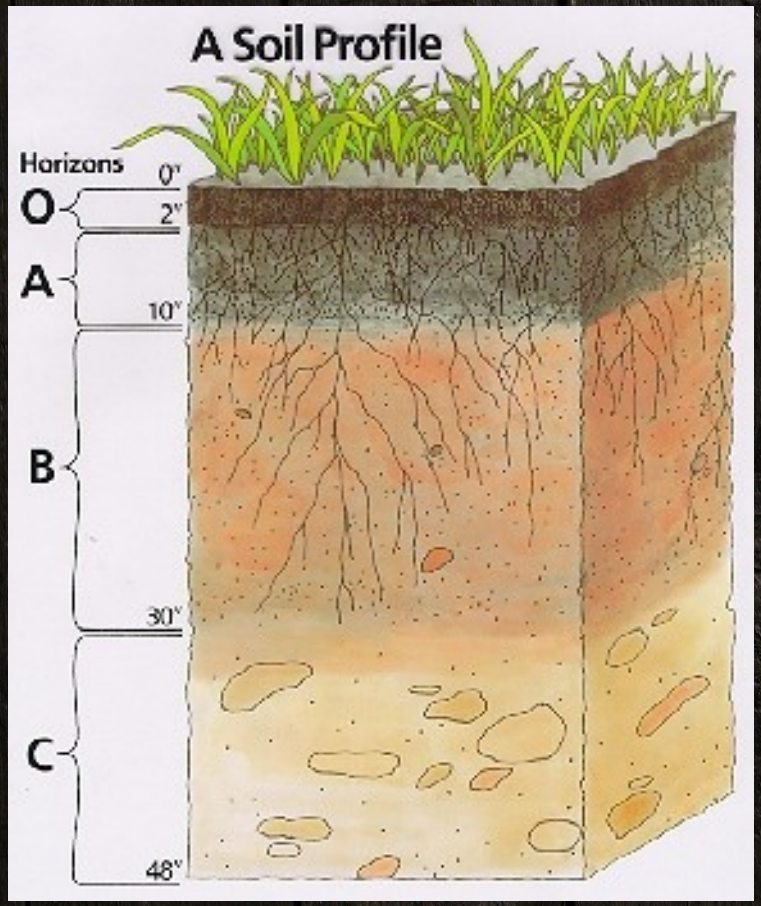
websoilsurvey.nrcs.usda.gov/app/

Map Unit Legend

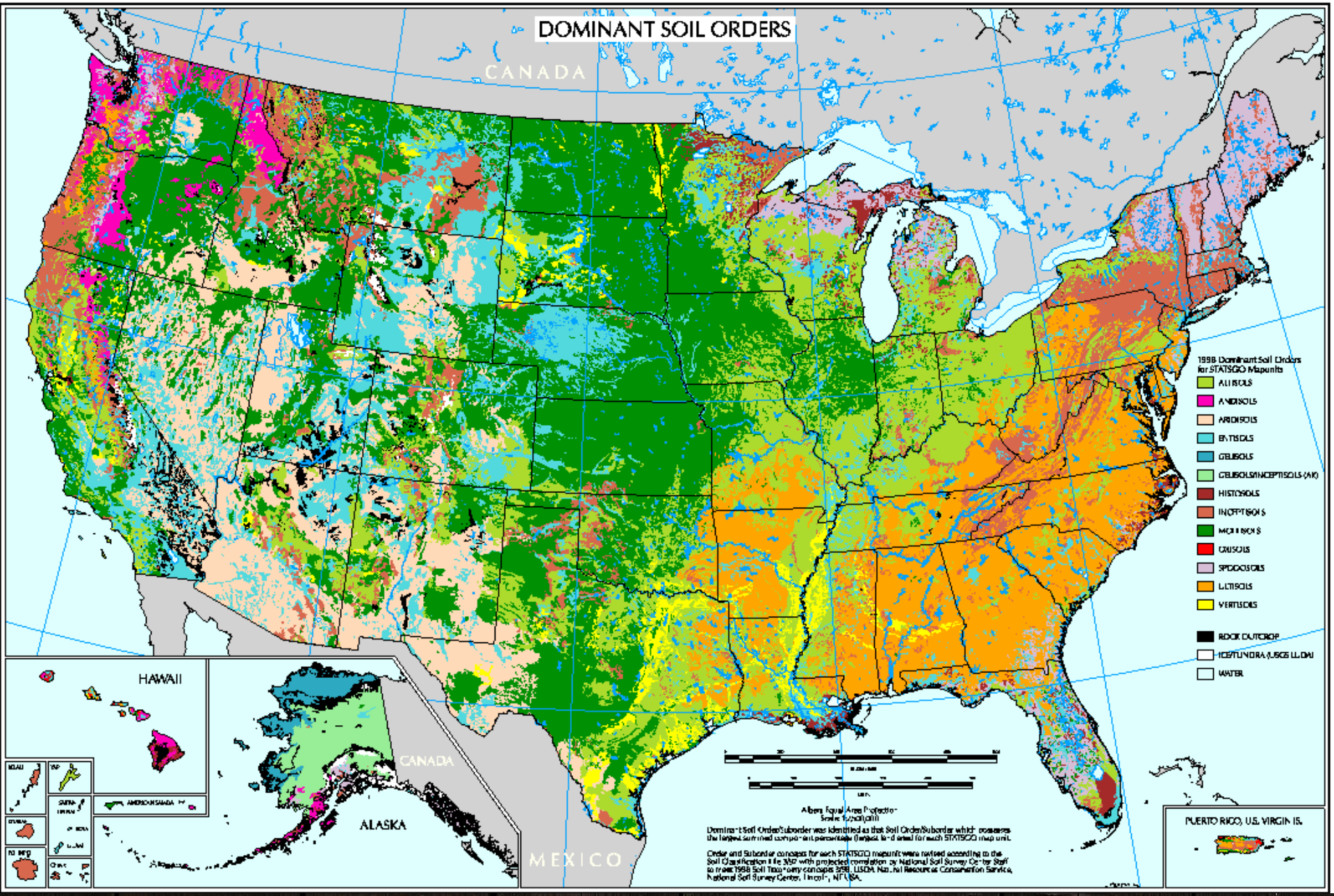
Calhoun and Roane Counties, West Virginia (WV624)

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
GpF3	Gilpin-Peabody complex, 35 to 70 percent slopes, severely eroded	34.9	48.5%
Ha	Hackers silt loam, 0 to 3 percent slopes, rarely flooded	4.8	6.6%
Ms	Moshannon silt loam, 0 to 3 percent slopes, occasionally flooded	11.2	15.5%
RpF3	Rock outcrop-Peabody-Gilpin complex, 35 to 70 percent slopes, severely eroded	0.2	0.3%
Ss	Sensabaugh silt loam, 0 to 3 percent slopes, occasionally flooded	15.9	22.1%
VaD	Vandalia silt loam, 15 to 25 percent slopes	5.0	7.0%
Totals for Area of Interest		**72.0**	**100.0%**



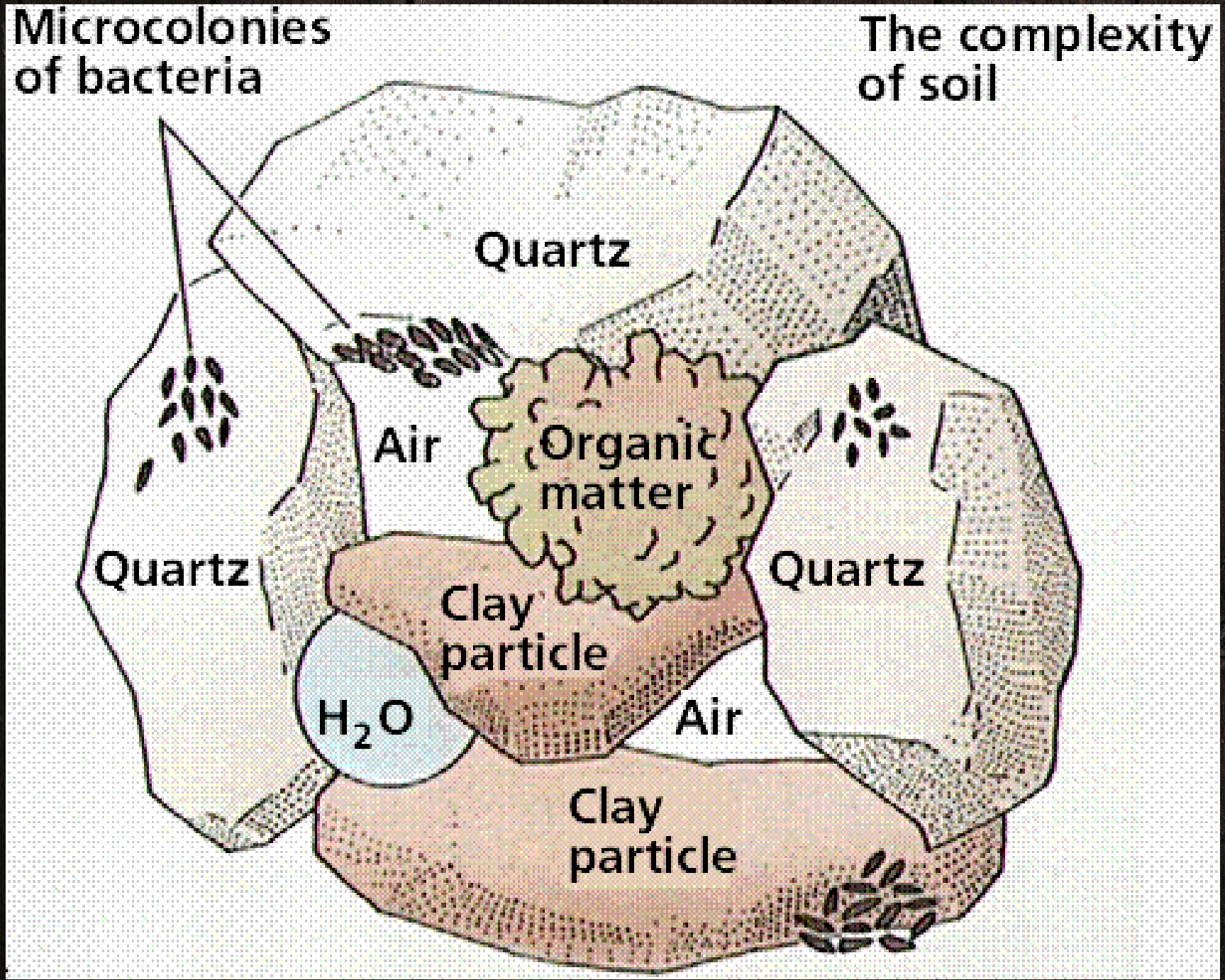


- Soil textural class
- Depth of “A” horizon
- Depth to a restrictive feature
- Depth to water saturation
- Soil productivity comparisons


DOMINANT SOIL ORDERS
CANADA
1998 Dominant Soil Orders for STATSGO Mapunits
ALFISOLS
ANDISOLS
ARIDISOLS
ENTISOLS
GELISOLS
GELISOLS/INCEPTISOLS (AK)
HISTOSOLS
INCEPTISOLS
MOLLISOLS
OXISOLS
SPODOSOLS
ULTISOLS
VERTISOLS
ROCK OUTCROP
TUNDRA (USGS LULC)
WATER
HAWAII
ALASKA
CANADA
MEXICO
PUERTO RICO, U.S. VIRGIN IS.
Albers Equal Area Projection
Dominant Soil Order/Suborder was identified as that Soil Order/Suborder which possesses the largest summed component percentage (largest land area) for each STATSGO map unit.
Order and Suborder concepts for each STATSGO mapunit were revised according to the Soil Classification of the USA with projected correlation by National Soil Survey Center Staff to meet 1998 Soil Taxonomy concepts. 1998, USDA, Natural Resources Conservation Service, National Soil Survey Center, Lincoln, NE USA.

What is soil?

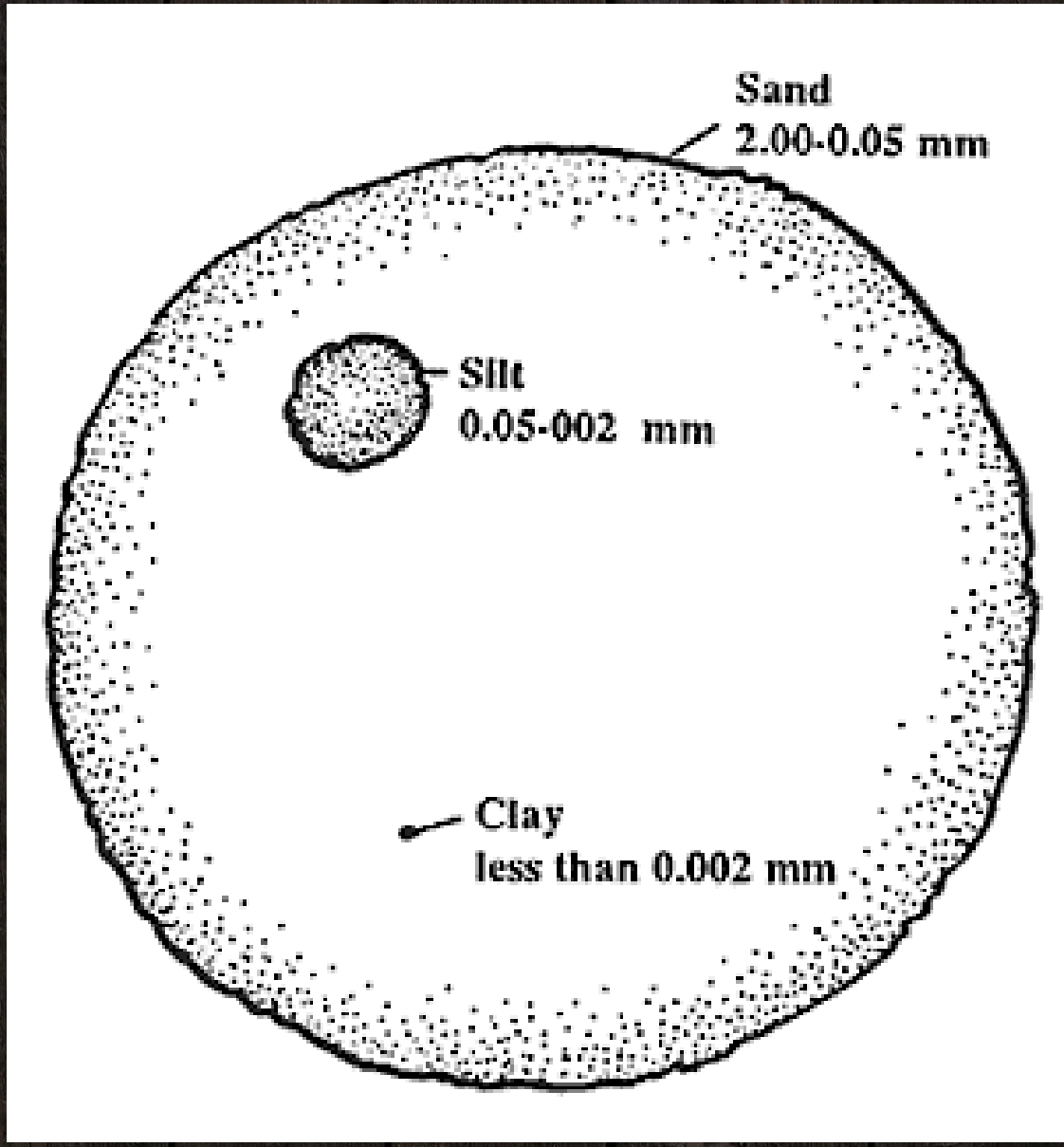
Minerals	50%
Air	23-25%
Water	23-25%
Organic Matter	3-5%

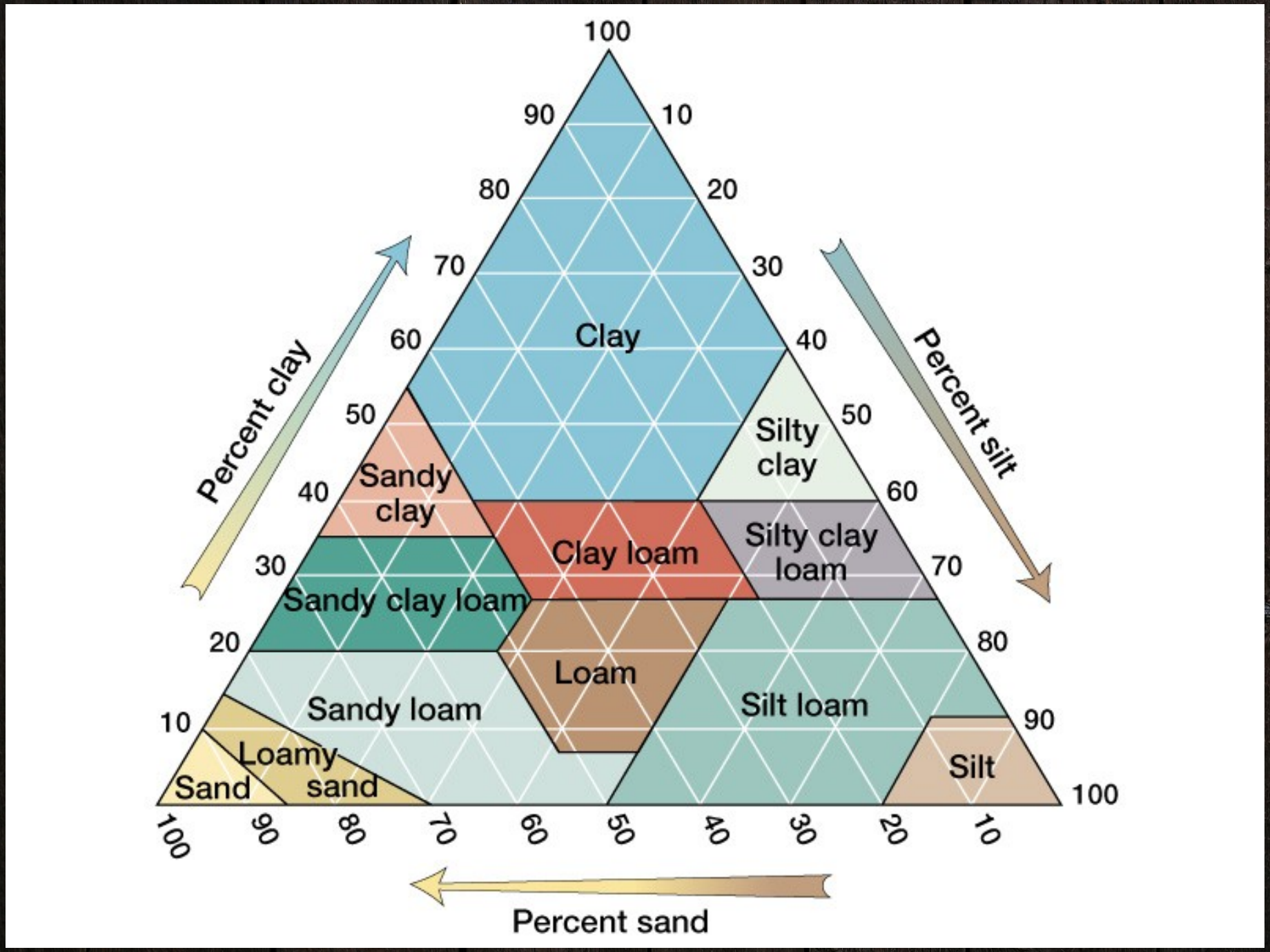

Microcolonies of bacteria
The complexity of soil
Quartz
Air
Organic matter
Quartz
Quartz
Clay particle
H_2O
Air
Clay particle

Soil Texture:

Size of soil particles

Sand
Silt
Clay




100
90
10
80
20
70
30
60
40
50
50
40
60
30
70
20
80
10
90
100
Percent clay
Percent silt
Percent sand
Clay
Silty clay
Sandy clay
Clay loam
Silty clay loam
Sandy clay loam
Loam
Sandy loam
Silt loam
Silt
Loamy sand
Sand

Soil Organic Matter:

Definition of “organic”

1. In chemistry:
   Chemical molecules containing the
   a carbon atom

2. In agriculture:
   Anything that is living or was living

Examples of soil organic matter:

- Plant roots
- Insects/Arthropods
- Bacteria
- Fungi
- Algae
- Detritus (compost, humus)*
- Animal wastes/byproducts

*sugars, starches, proteins, cellulose, lignins, fats, & waxes

Soil Organic Matter

- Improves soil structure
- Improves aeration and water retention
- Provides pH buffering capacity
- Increases Cation Exchange Capacity
- Provides nutrients for plants and microbes

Periodic Table of the Elements

	IA	IIA	IIIB	IVB	VB	VIB	VIIB	VII	IB	IIB	IIIA	IVA	VA	VIA	VIIA	O
1	1 H															2 He
2	3 Li	4 Be									5 B	6 C	7 N	8 O	9 F	10 Ne
3	11 Na	12 Mg									13 Al	14 Si	15 P	16 S	17 Cl	18 Ar
4	19 K	20 Ca	21 Sc	22 Ti	23 V	24 Cr	25 Mn	26 Fe	27 Co	28 Ni	29 Cu	30 Zn	31 Ga	32 Ge	33 As	34 Se	35 Br	36 Kr
5	37 Rb	38 Sr	39 Y	40 Zr	41 Nb	42 Mo	43 Tc	44 Ru	45 Rh	46 Pd	47 Ag	48 Cd	49 In	50 Sn	51 Sb	52 Te	53 I	54 Xe
6	55 Cs	56 Ba	57 *La	72 Hf	73 Ta	74 W	75 Re	76 Os	77 Ir	78 Pt	79 Au	80 Hg	81 Tl	82 Pb	83 Bi	84 Po	85 At	86 Rn
7	87 Fr	88 Ra	89 +Ac	104 Rf	105 Ha	106 Sg	107 Ns	108 Hs	109 Mt	110 110	111 111	112 112	113 113					

* Lanthanide Series	58 Ce	59 Pr	60 Nd	61 Pm	62 Sm	63 Eu	64 Gd	65 Tb	66 Dy	67 Ho	68 Er	69 Tm	70 Yb	71 Lu
+ Actinide Series	90 Th	91 Pa	92 U	93 Np	94 Pu	95 Am	96 Cm	97 Bk	98 Cf	99 Es	100 Fm	101 Md	102 No	103 Lr

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

(Trace Nutrients)

"Assistive" Elements

Cobalt

Selenium

Vanadium

Silicon

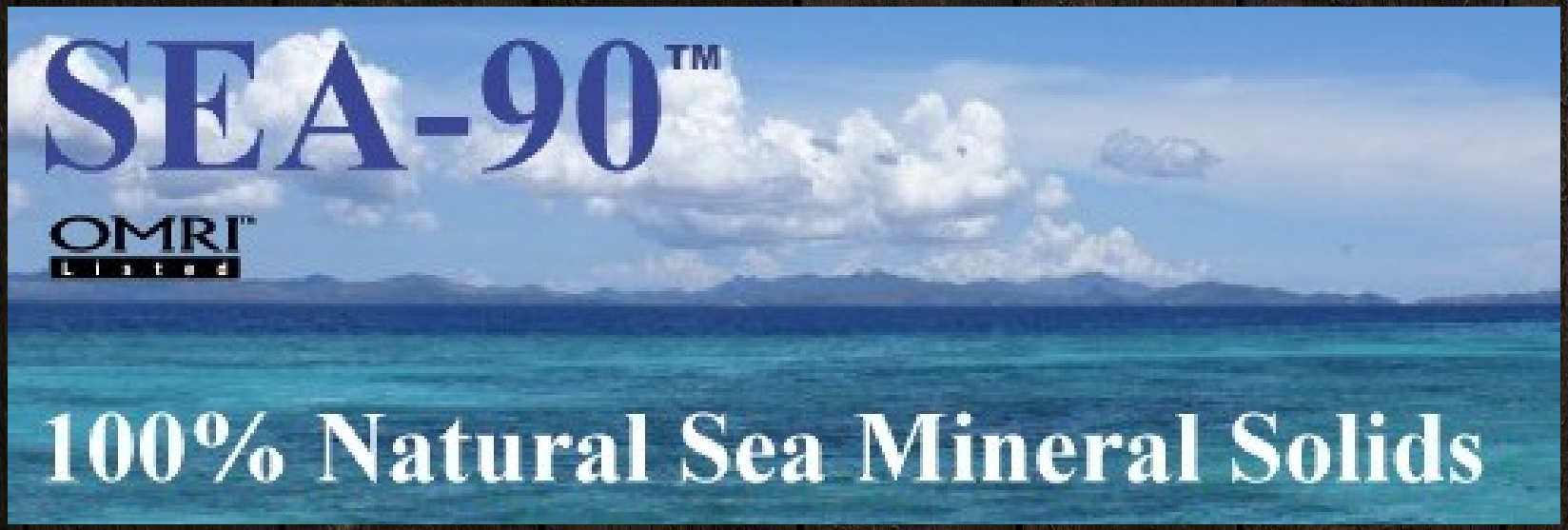
*16 Additional Elements Required for Human Health

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 are trace elements added through foliar applications and soil deficiencies are not corrected
- The other 16 elements required for human nutrition are *not* considered as necessary in agriculture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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
GH4	05347	3.1	M	92	43	M			282	VH	333	H	1502	M			5.7	6.64	2.9	13.9

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					
GH4	5.2	20.0	54.0		21.1			12	L	2.6	M	44	H	117	VH	2.4	H	0.5	L					

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.

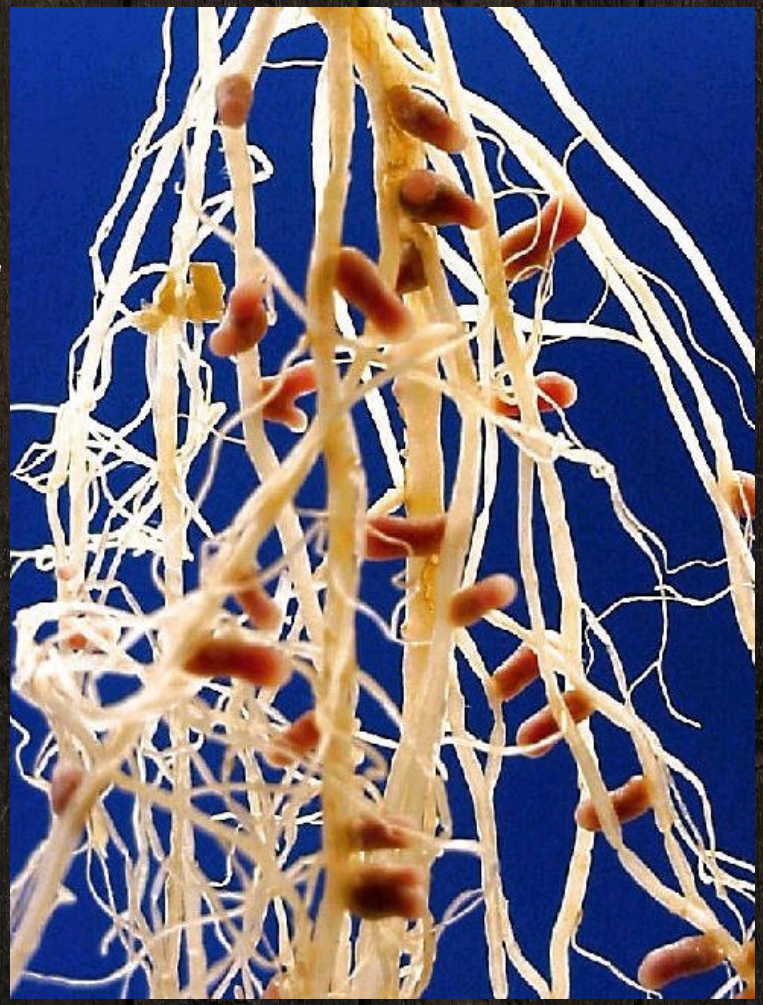
by: Pamie McGeary

Organic plant nutrient sources:

- Animal wastes
- Animal byproducts
- Crop residues
- Cover crops
- Composts
- Seaweeds
- Mined minerals

Nitrogen Fixation by legumes in symbiosis with Rhizobia bacteria

- Alfalfa
- Clover
- Vetch
- Peas
- Beans
- Sunn Hemp



Synthetic plant nutrient sources:

- Nitrogen – atmosphere
- Phosphorous – mined mineral
- Potassium – mined mineral
- Sulfur – mined mineral/refining byproduct
- Calcium – mined mineral
- Magnesium – mined mineral
- Micronutrients – mined minerals/byproducts
- Additives – clay, heavy metal byproducts, industrial, municipal wastes

To quote J. I. Rodale, from Organic Gardening magazine,

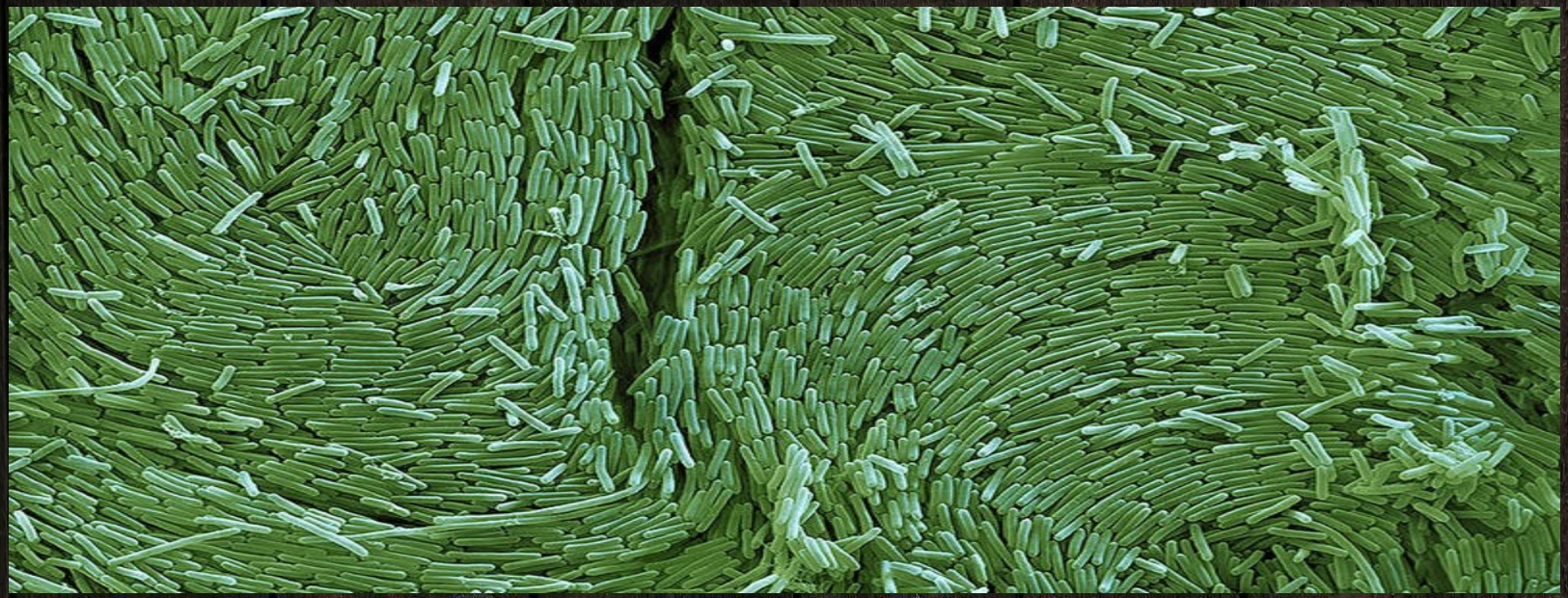
"we organic gardeners have let our enthusiasm run away with us. We have said that the nitrogen which is in organic matter is different (and thus somehow better) from nitrogen in a commercial fertilizer. But this is not so." And "actually there is no difference between the nitrogen in a chemical fertilizer and the nitrogen in a leaf."

Blended fertilizers may contain hazardous ingredients!

Fertilizer Plant

Feedlot

The Ubiquity of Biology



Bacillus sphaericus

Rhizobia

Nitrosomonas

Actinomycetes

Streptomycetes

Fungi

Mycorrhizae

Ectomycorrhizae