It's Alive !!

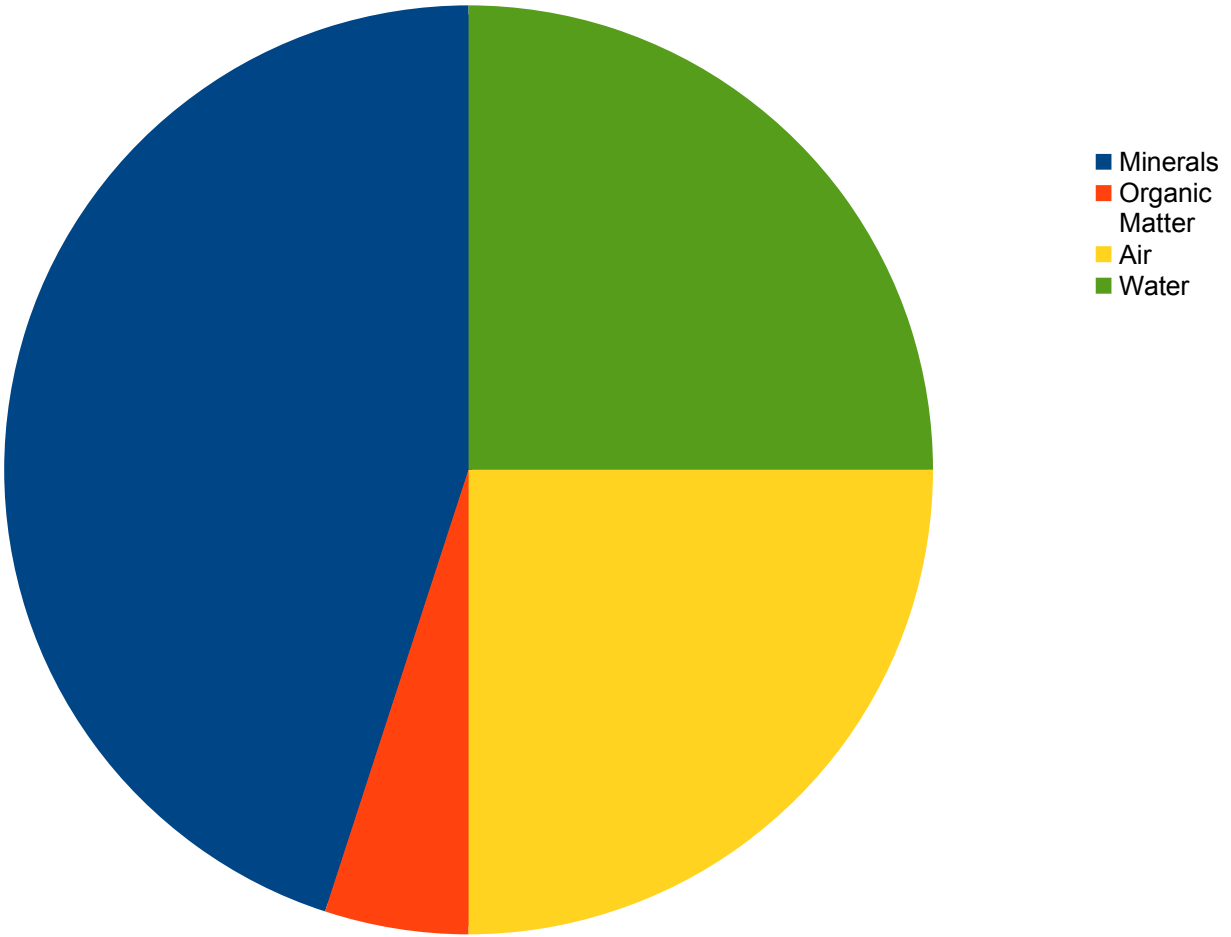
- Soil is our greatest resource
- It's alive, as opposed to “dirt”
- It's part of the food web as part of the three-way relationship with soil organisms and plants
- It's considered the most complex of all habitats

Soil

Soil is a mantle of weathered rock, which, when combined with organic matter, contains minerals and nutrients capable of supporting plant growth.

Soil forms as the rock minerals and organic matter interact with climate, living organisms and topography over time.

Soil Composition



Minerals

- Gravel, pebbles, rocks
- Sand
- Silt
- Clay

Soil Texture

- Relative amounts of clay,silt, sand determine your soil texture.
- Ideally – 40% sand, 40% silt, 20% clay make up the 45% mineral portion of soil
- This is the gardener's holy grail called LOAM.

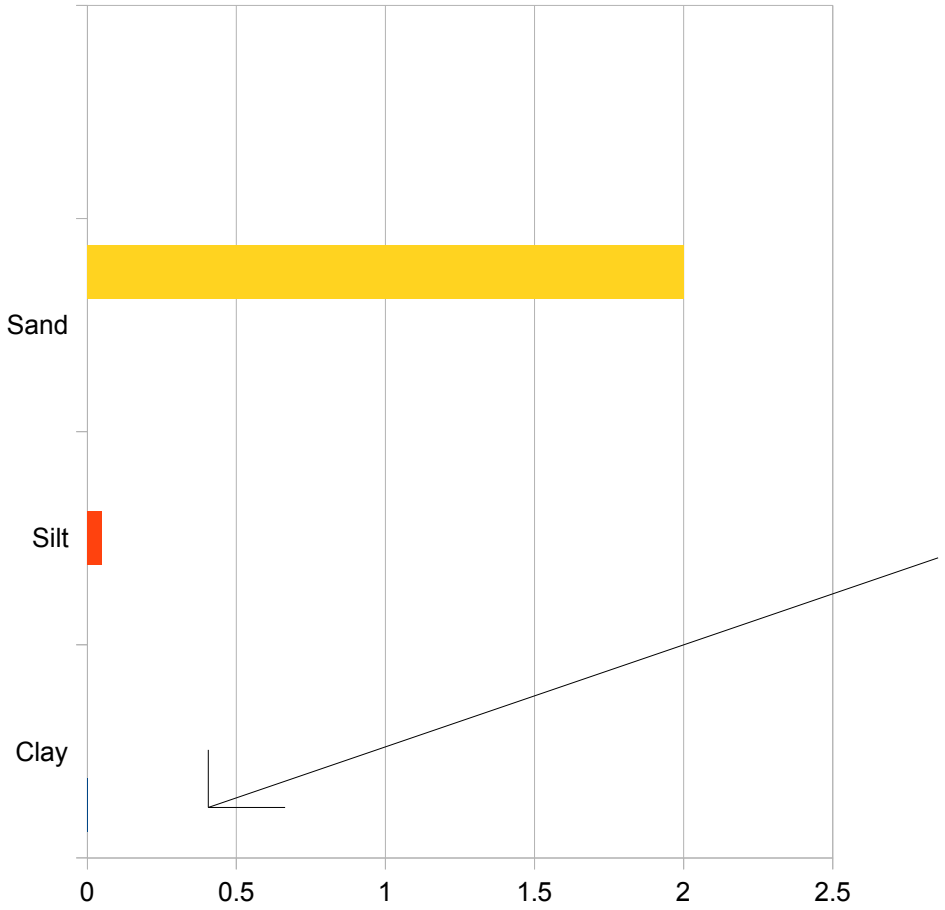
Size Matters

- Sand is HUGE but contains few nutrients, water drains quickly from the large pore spaces between particles, nutrients leach out rapidly.

- Silt is smaller than sand, has moderate fertility with medium-size pore spaces to hold water and air. Powdery and dusty when dry, it is easily carried off by rainwater or blown by wind.

- Clay is tiny, but has more total pore spaces which are very small. It easily packs tightly, leaving little room for air and water to flow, drains poorly, stays wet longer, contains little oxygen and dries hard as concrete.

Relative Mineral Sizes



Surface Area

(cm per gram)

Sand – 45

Silt – 454

Clay – 8,000,000

(Yes, clay is shown)

How does this affect the availability of Nutrients?

- The absorbtion of water, nutrients and gases are all surface phenomena
- The greater the surface area of the soil particles, the greater the absorbtion

- Clay has many, many times the surface area per unit of volume to absorb and hold water, nutrients and gases than silt or sand! Yea, clay!

That 5% Organic Matter

- Decayed plants and animals, animal matter

- Provides a major food source for all the microorganisms living in the soil

Marvelous Organisms

- Soil is THE most abundant ecosystem on Earth
- Estimate between 500,000 to over a billion organisms per teaspoon of good soil!
- Macrofauna from badgers down to ants, including rabbits, gophers, slugs, moles, earthworms and millipedes affect soil structure by burrowing
- Mesofauna – arthropods, collembolla and enchytraeids – tiny organisms scavenge dead organic matter, eat bacteria, fungi and algae

- Microfauna and microflora – really, really tiny creatures that play the final role of converting plant debris back into plant nutrients and in making the nutrients and water available to plants.
- Microfauna include nematodes and protozoa
- Microflora include bacteria, fungi and viruses, all of which take part in weathering of rocks and minerals, breakdown of organic matter and many aspects of the nutrient cycle.

- All this activity effects the rate of chemical exchanges which draw nutrients and water from the soil into the plant roots
- Worms and 97% of insects are gardeners' friends.
  - Feed on organic matter and then disperse it though the soil
  - Speed up composting process

Bringing it Home to our Garden Soil

- Garden soil is ever evolving and never perfect!

- As crops and flowers are harvested, the soil gradually becomes depleted of essential nutrients.

- Soils can be improved in a number of ways, depending on the soil type in the garden.

Soil Testing

- To determine the soil's nutrient content

  Too much of this nutrient or too little of that, and we have problems!

- To determine the soil's pH level

  The right pH enables plants to use nutrients from the soil most efficiently.

Nutrients Essential to Plants

- Essential for growth and development
- Each element is essential because no other element can substitute for it in all it's functions
- Plants cannot complete their life cycle without these nutrients.

- Non-soil nutrients come from the atmosphere: Hydrogen, Carbon and Oxygen

Essential Soil Nutrients

- Major
  - Nitrogen (for growth of stems and leaves)
  - Phosphorus (germination, flowering and fruiting)
  - Potassium (roots, disease-resistance growth)
- Secondary
  - Magnesium (chlorophyll, sugars and starches)
  - Sulfur (chlorophyll production, oil content)
  - Calcium (development of terminal buds and roots)

Minor and Trace Soil Nutrients

- Chlorine (roots, water retention)
- Iron (chlorophyll)
- Manganese (chlorophyll)
- Boron (solid, well-formed fruit)
- Zinc (more fruit)
- Copper (leaf unfolding)
- Molybdenum (roots)
- Sodium
- Cobalt
- Silicon
- Selenium
- Nickel

Soil tests will measure all the nutrients present in the sample and make recommendations for fertilizing to cure deficiencies.

Soil tests will also tell us the pH value of the sample.

The pH Scale

- Symbolizes the hydrogen ion concentration in a solution

- Ranges from 1 to 14
- 7 is “neutral”, like water
- Less than 7 = acidic
- Greater than 7 = base

- Each pH unit represents a 10x increase in hydrogen ion concentration! This affects how much of a nutrients must be added to raise or lower pH.

pH levels

- "low pH"

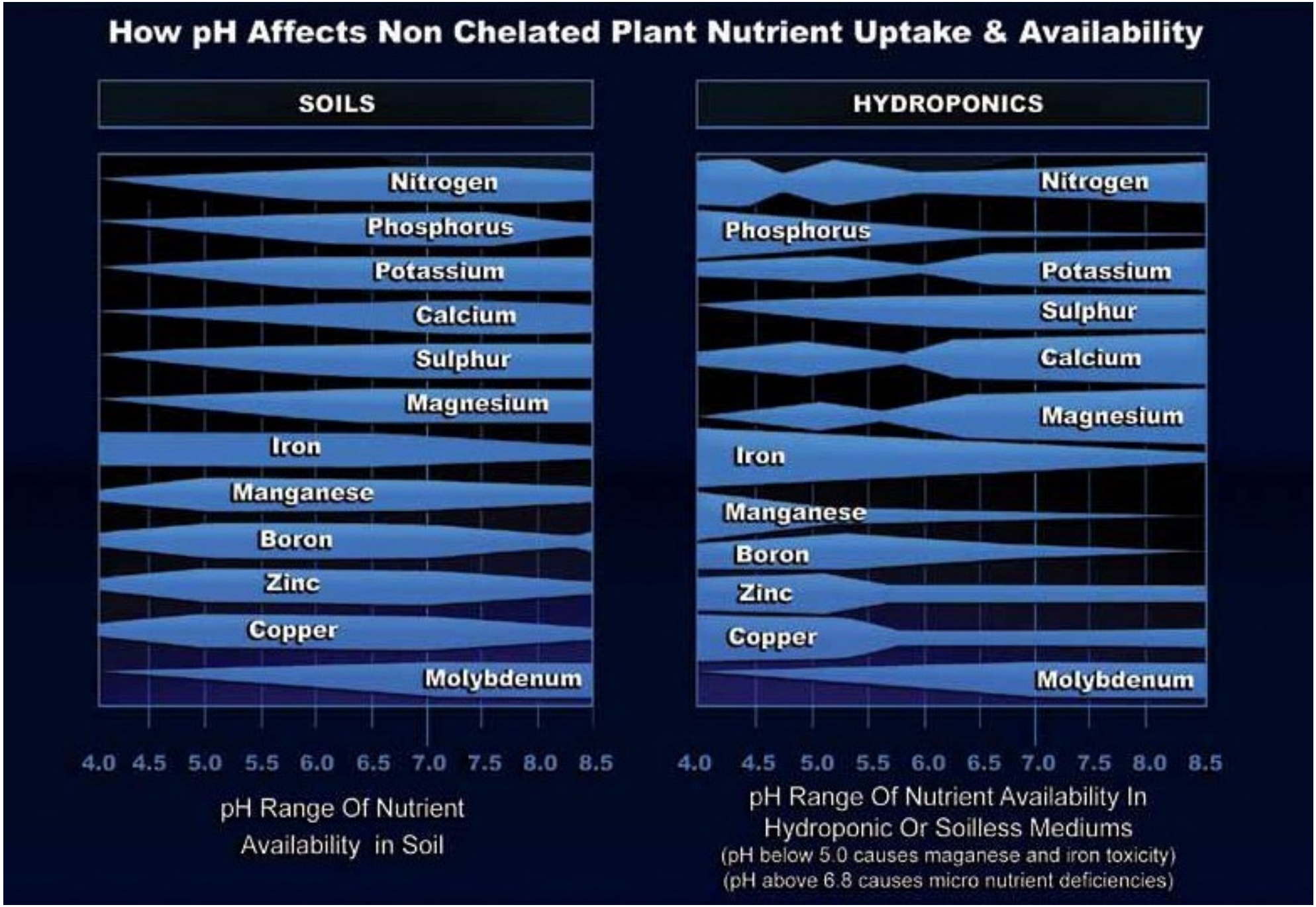
0	Hydrocloric Acid
1	Stomach Acid
2	Lemon juice
3	Cola, beer, vinegar
4	Tomatoes
4.5	Fish die in water this acidic
5	Coffee
6	Urine
6.5	Saliva

- "higher pH"

7	(neutral) water
7.5	Human blood
8	Seawater
9	Baking soda, antacids
10	Great Salt Lake
11	Ammonia
12	Bicarbonate of soda
13	Oven cleaner
14	Sodium hydroxide (lye)

Why is pH Important?

- It greatly affects the availability of each nutrient to the plants' roots.
- Too low pH suppresses: nitrogen,phosphorus, potassium,sulfur,calcium,magnesium and molybdenum
- Too high pH suppresses: nitrogen, phosphorus, magnesium, iron, manganese, copper, zinc and boron
- Maximum nutrient availability between 6.0 -7.5


How pH Affects Non Chelated Plant Nutrient Uptake & Availability
SOILS
Nitrogen
Phosphorus
Potassium
Calcium
Sulphur
Magnesium
Iron
Manganese
Boron
Zinc
Copper
Molybdenum
4.0 4.5 5.0 5.5 6.0 6.5 7.0 7.5 8.0 8.5
pH Range Of Nutrient Availability in Soil
HYDROPONICS
Nitrogen
Phosphorus
Potassium
Sulphur
Calcium
Magnesium
Iron
Manganese
Boron
Zinc
Copper
Molybdenum
4.0 4.5 5.0 5.5 6.0 6.5 7.0 7.5 8.0 8.5
pH Range Of Nutrient Availability In Hydroponic Or Soilless Mediums
(pH below 5.0 causes maganese and iron toxicity)
(pH above 6.8 causes micro nutrient deficiencies)

Different pH's for Different Crops

- Vegetables – 6.0-6.5
- Perennial Flowers – 5.5-6.0
- Blueberries – 4.2-5.2
- Pear trees – 6.0-6.5
- Kiwi – 6.0-6.5

Some Real Examples

- Original Garden Soil – unamended
  - 41 % Sand
  - 21 % Silt
  - 31 % Clay
  - 7 % Insoluable Organic Matter

“Original Soil”

Soil Test Results

Extremely low Phosphorus (fruits and flowers)
Low Potassium (roots, disease resistance)
Very high Calcium
Good Magnesium and Zinc

PH 6.8

More.....

- Improved soil from the apple orchard
  - 55% Sand
  - 27% Silt
  - 9% Clay
  - 9% Insoluable Organic Matter

Improved Apple Orchard Soil

- Soil Test Results

- Very high Phosphorus
- Borderline Potassium
- Very High Calcium
- Good Magnesium and Zinc

- PH 6.8, SHOULD BE 6.0-6.5

More.....

- Soil from my garden plot :(
  - 43% Sand
  - 52% Silt
  - 1% Clay
  - 4% Insoluable Organic Matter

Ann's DCGO Plot #7

- Soil Test Results

- Good Phosphorus
- OK Potassium
- Very High Calcium
- Good Magnesium and Zinc
- Extremely low Nitrogen!!!!! (leaves and stems)
- PH 6.6, SHOULD BE 6.0-6.5 FOR VEGGIES

And more.....

- The compost pile
  - 57% Sand!!
  - 38% Silt
  - 0% Clay
  - 5% Insoluable Organic Matter

Compost Pile

- Soil Test Results

- Low on Phosphorus (flowers and fruit)
- Good Potassium
- Very high Calcium
- Good Magnesium and Zinc
- PH 6.4 EXCELLENT FOR VEGGIES
- Should be 5.5-6 for flowers

And finally.....

- The potting mix in the greenhouse
  - 36% Sand
  - 14% Silt
  - 0% Clay
  - 36% Insoluable Organic Matter

Secret Potting Soil Mix

- Soil Test Results

- Very high Phosphorus, Potassium and Calcium
- Good Magnesium and Zinc
- PH 5.7, Excellent for Perennial Flowers, SHOULD BE 6-6.5 FOR VEGGIES (add lime)

Top Priority for Gardeners

- Boosting topsoil with good quality organic matter
  - Compost – completely decomposed, please!
  - Well-rotted farmyard manure
- Spread on the surface and worked into top 12” of soil while still including some clay
- Allows easier root growth, better drainage, more nutrient production by microorganisms
- Facilitates root contact with nutrients

Be Aware of Nitrogen Thieves

- Flowers and veggies use Nitrogen for the growth of stems and leaves. Constant harvesting depletes soil of Nitrogen.
- Incompletely decomposed materials added to the soil – the decomposition process continues and utilizes Nitrogen.
- Planting in a newly amended, nitrogen depleted soils will yield yellow and declining plants!

Compost vs Mulch

- Compost is a mixture of decaying organic matter which improves soil structure and provides LOW levels of nutrients. ***It is not a substitute for the recommended rates of fertilizer required for good plant growth.***

- Mulch is a protective covering left on the surface to reduce evaporation, maintain even soil temps, limit erosion and control weeds. Mulch decomposes to enrich soil (but uses Nitrogen to decompose).

Next Month....

Fertilizers !!!