
The Top 6 Inches
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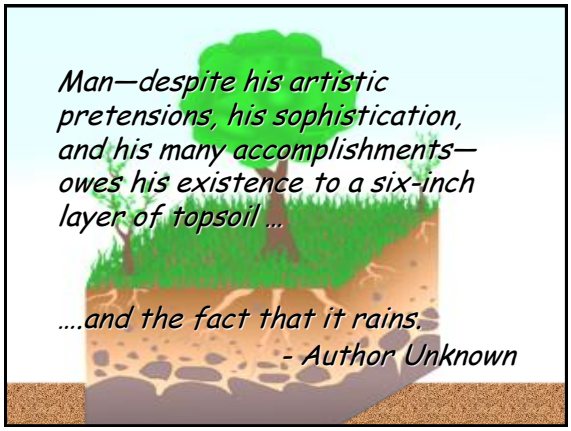
From
"dirt"….

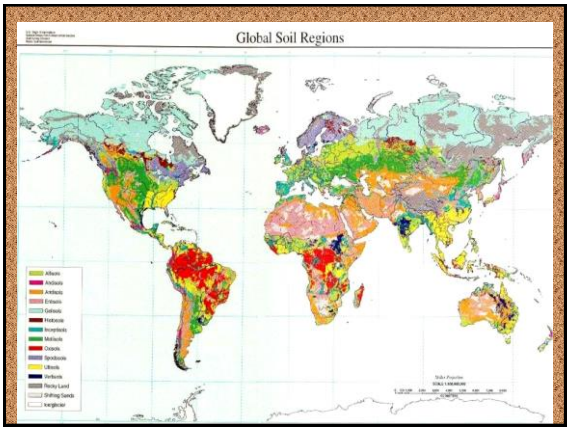

….to "soil".


Man—despite his artistic pretensions, his sophistication, and his many accomplishments—owes his existence to a six-inch layer of topsoil …
….and the fact that it rains.
- Author Unknown


And a little sun….


And just a couple 'o plants!

And what *YOU* do with them!



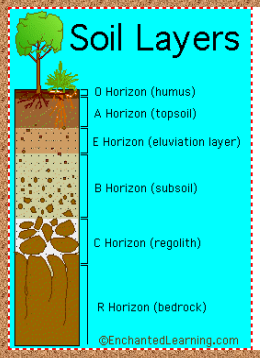
- There are 700 different soils in Wisconsin

What is soil?

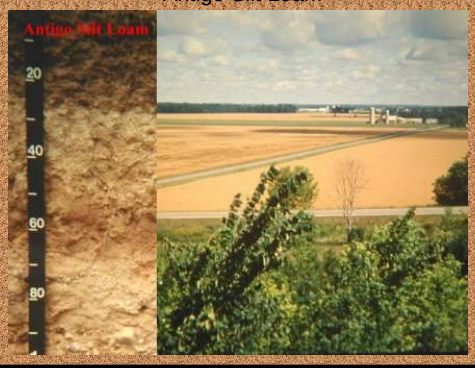
Soil is

- Parent material + bedrock
- Decaying vegetation

Influenced by:
climate
relief
time
organisms

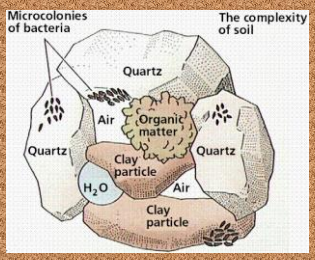


Wisconsin's State Soil:
Antigo Silt Loam

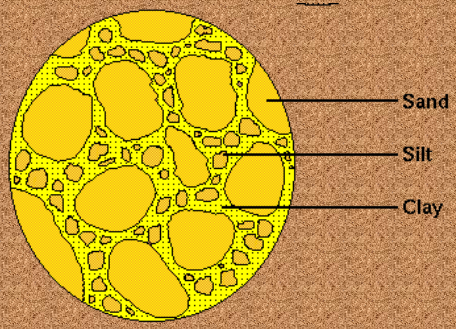


Soil Physical Features

- Texture
- Structure
- Air
- Water
- Organic matter



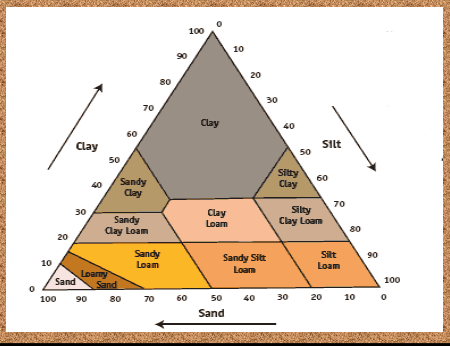
Soil Texture

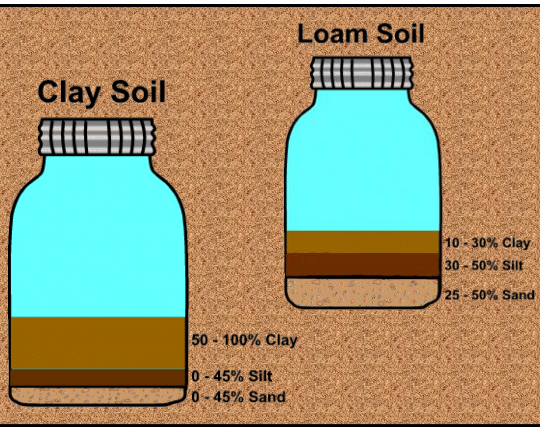


Soil Texture

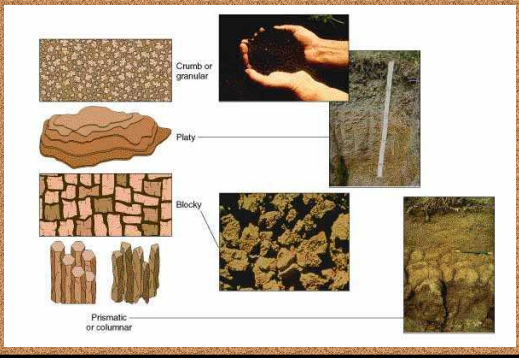
- classes - sand, silt, clay
  - names based on proportions
    - –loam,
    - –silty clay
    - –loamy sand

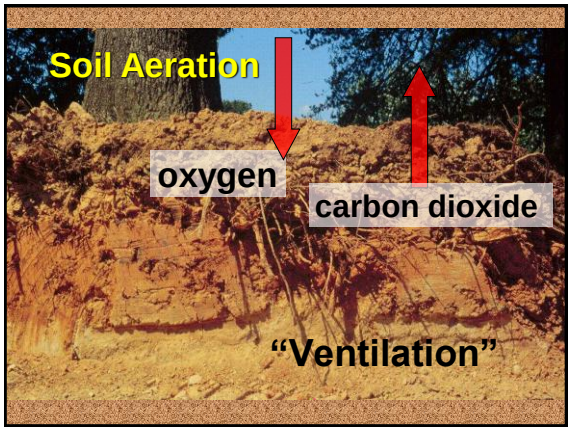
Soil Texture



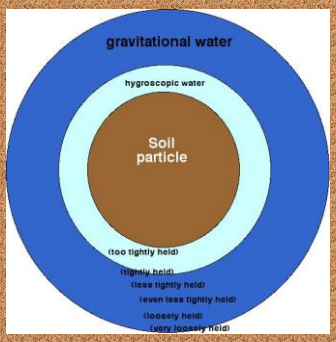


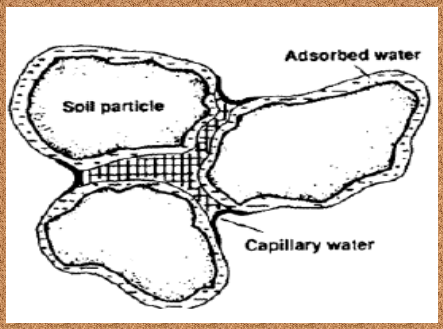
Soil Structure

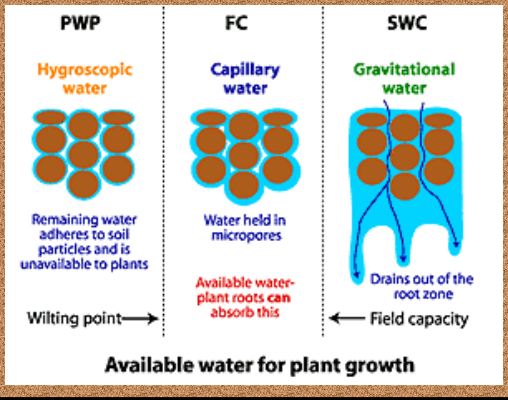




Soil Water







Organisms

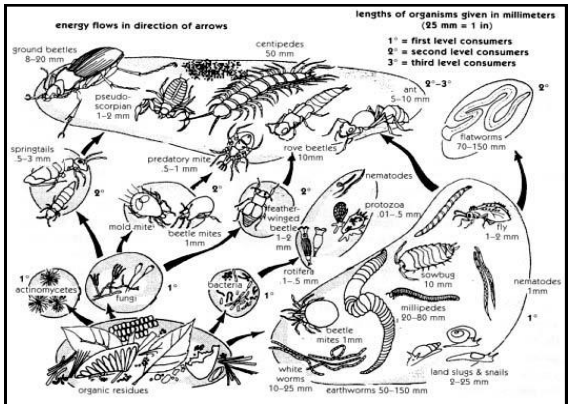
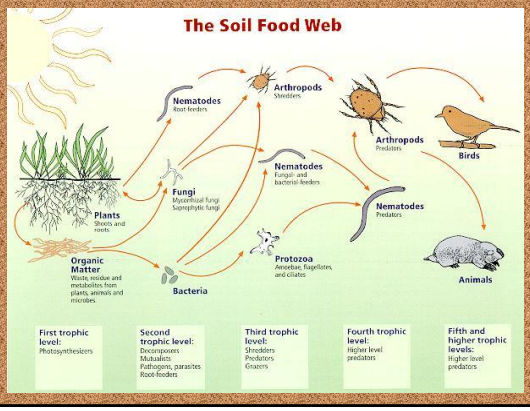
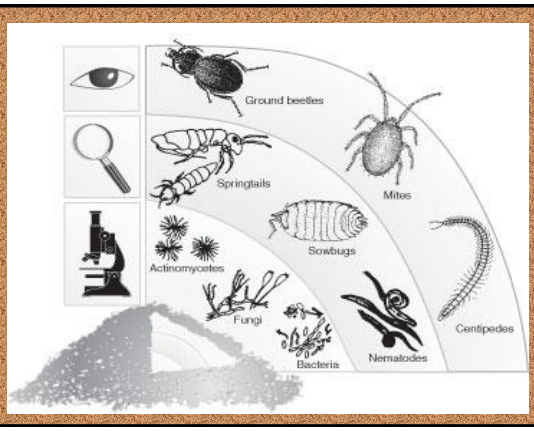
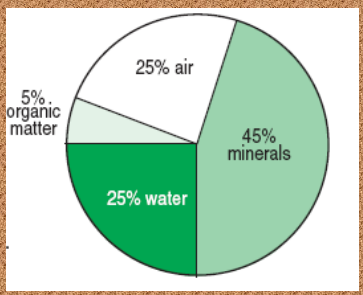


Figure 3.1 Soil organisms and their role in decomposing residues. Modified from D.L.Dindal, 1978.





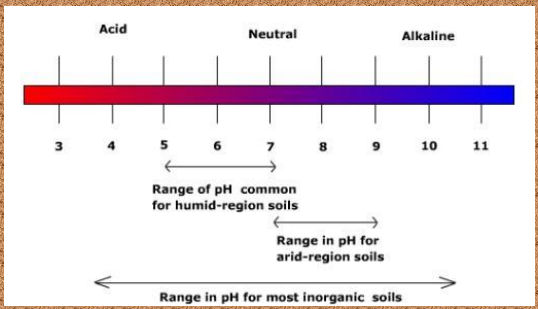
The Ideal Soil

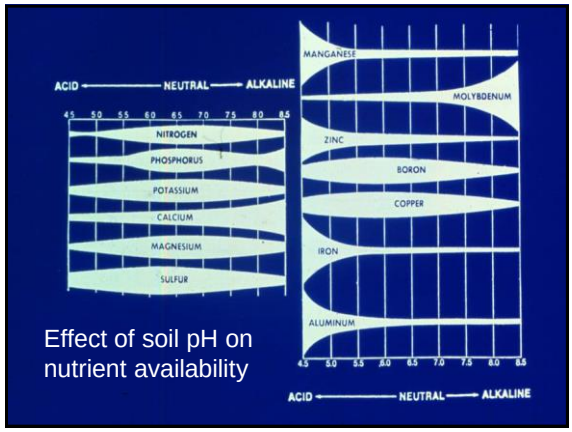


Soil Chemical Features

- -pH
- Cation Exchange Capacity
- nutrients

Soil pH





Effect of soil pH on nutrient availability

Lime Lifts pH

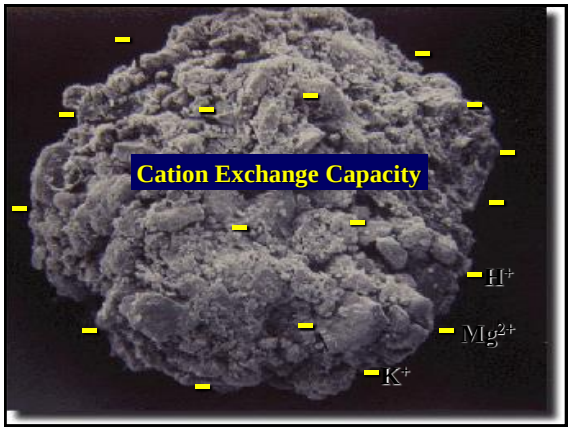
(less acidic)

Sulfur Suppresses pH

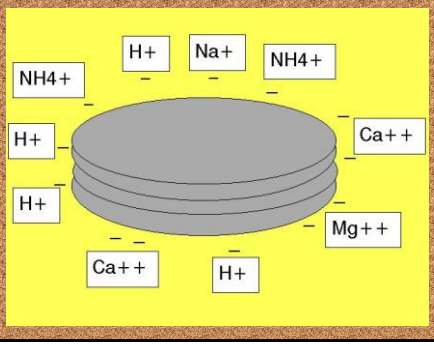
(more acidic)

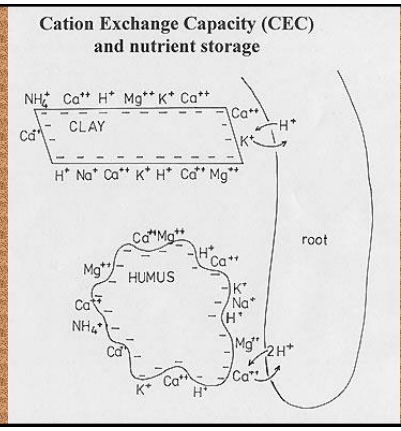
Cation Exchange Capacity

Quantifies the ability of a soil to provide a nutrient reserve for plant uptake



Cation Exchange Capacity





Soil Management

- **Improve Texture**
  - **Amendments**
- **Preserve Structure**
  - **Cultural practices**
- **Balance Air & Water**
  - **Aeration**
  - **Water-holding capacity**

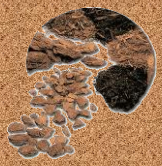
Amendments

- **Organic matter**
  - **Formerly living materials**
  - **Improve texture & structure**
  - **Add pore space**
  - **Improves water-holding and nutrient-holding**

- **Examples**
  - **Peat**
  - **Leaf mold**
  - **Mulches**
  - **Compost**

Peat

Compost



Wood mulches

Leaf mold

NEVER ADD SAND!

Compost

What is Compost ?

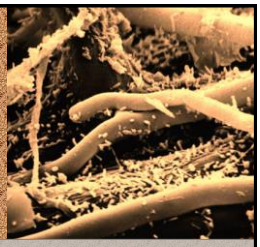
- Material left after the aerobic decomposition of organic material(s)

Organic Material + "bugs" + O_2 → Compost + CO_2 + H_2O

Why Compost?

- Save Money
- Improve soil structure
- Improve plant growth
- Benefit the environment

How to make compost



- **Bacteria do most of the work!**
  - **Bacteria break down fresh organic residues into compost using oxygen**
  - **Process generates a lot of heat**
    - **Up to 140 degrees F!**
    - **Heat kills weed seeds and diseases**

- You need to:
  1. Add the right balance of Carbon and Nitrogen (Browns and Greens)
  2. Turn the pile to improve oxygen flow
  3. Maintain a good moisture content (not too wet, not too dry)

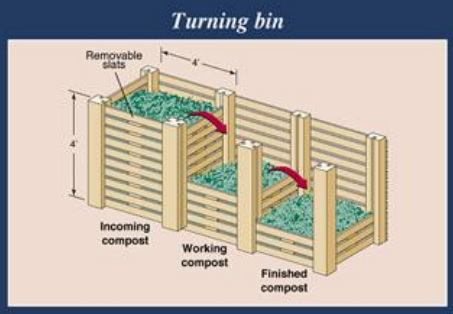
"Equal Weights of Green & Brown…"

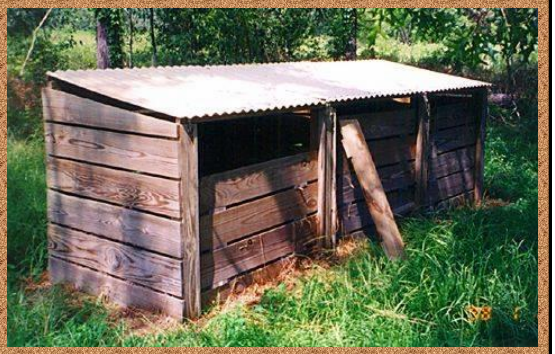
(Or 1-2 Parts Brown to 1 Part Green)

Browns (Carbon)	Greens (Nitrogen)
Dried leafs	Fresh Grass Clippings
Paper	Fruit and Veggie Scraps
Cardboard	Manure (no pet waste)
Sawdust	Fur, hair, fibers, feathers
Wood ash	
twigs	

Turning the pile

- Turn don't stir
- Improves oxygen, keeps the process moving





Do Not Compost

- Meat, bones, fat
- Cat, dog, human waste
- Dairy products
- Charcoal ash
- Oils
- Thorny twigs
- Logs or large branches
- Sawdust from treated lumber
- Poison Ivy

Troubleshooting

Problem	Observation	Solution
Too dry	Dry or crackles to the touch	Add water, keep pile as damp as a wrung out sponge
Too wet	Soggy, may smell	Turn pile, stop watering
All green	Pile matted, Smells bad	Turn pile, add brown
Greasy	Pile matted, smells bad, attracting varmints	Remove meat, fat and oils
Too slow	Doesn't heat up	Add more greens

When is the compost done?

- Original material is difficult to identify
- Few fibers left
- Smells like soil, or earth
- The pile is cool for at least 1 month
- Crumbly not slimy

How long does it take?

- Depends on material, moisture content, and how often you turn
  - Anywhere from 6 weeks to 1 year
- "Cold" Composting
  - No turning, just pile it up and scoop out finished compost from the bottom of the pile - 1 – 2 years

Using Compost

- Amend over a site, never amend a hole
- incorporate at least 25- 50 % by volume of a well composted organic matter source
- work in to a depth of at least 12-18 inches
- be sure that excess water in soil can drain
  - sufficient topography to drain water
  - use French drains where appropriate
  - install sub-surface drainage just above unamended soil

Apply an even layer of o.m. and work it into "the top 4 - 6 inches"

Preserve Structure

- Never work wet soil

Avoid overtilling

Avoid compacting soil

Avoid Excess De-icing Salt

Nutrients

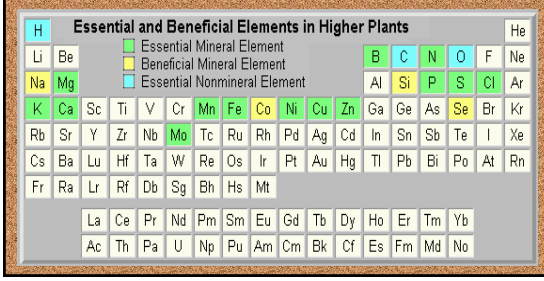
- Fertilizer provides nutrients so plants can make their own food

Nutrients

- Come from the soil
  - Dissolved in water
  - Taken up by plant roots
    - Very little by leaves

17 Plant Essential Elements

Hydrogen, Oxygen, Carbon	Nitrogen, Phosphorus Potassium (K)	Magnesium, Calcium, Iron, Sulfur, Boron, Zinc, Manganese, Molybdenum, Copper, Chloride, Nickel



How to remember the 17 essential elements

C HOPKINS CaFe is Mighty Nice, But Many More Prefer Clara's Zany Cup

- Required for the plant to complete life cycle
- Directly involved in metabolism
- Can not be substituted by another nutrient
- Essential for a wide range of plants

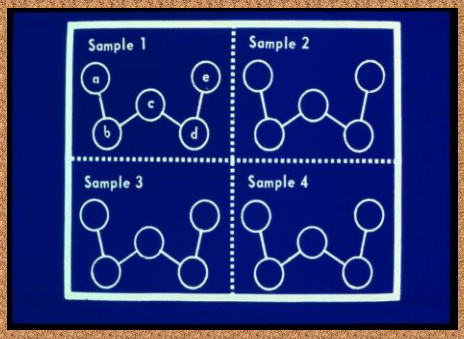
Inadequate nutrient supply leads to deficiency symptoms (plant illness)

Each nutrient deficiency is expressed differently

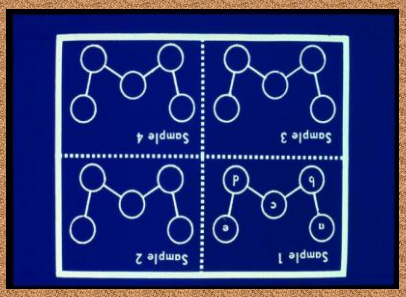
If significant a deficiency can lead to plant death

A shovel is OK too, mix a small amount in a clean bucket

Walk a "W"



In Minnesota, Maine, Missouri….



Sampling soils

- when
  - annual gardens, new turf
    - fall, spring before tillage
  - perennials, problems, established turf
    - anytime
  - suspected salt damage
    - very early spring
- sample each area separately
  - repeat every 2-3 yrs

Useful laboratory tests

- **routine**
  - **soil pH, 'buffer' pH**
  - **organic matter %**
  - **available P and K**
- **other**
  - **Ca, Mg, S, Zn, B, Mn**
- **no good test/need**
  - **N, Fe, Cu, Cl, Mo, Ni**
- **'problem solving'**
  - **texture, soluble salts**
  - **Cl, Pb, As,...**

UW Soil and Plant Analysis Lab
8452 Mineral Point Rd, Verona 53593
(West Madison Ag. Research Station)

Soil test results - P

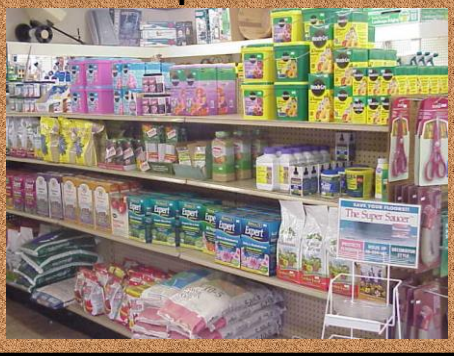
- stimulates root growth and flowering
  - shallow rooted greater need
- optimum soil test P for turf and gardens
  - established turf 11 - 15 ppm
  - sweet corn 16 - 25 ppm
  - green bean 16 - 25 ppm
  - tomato 31 - 45 ppm
  - potato 161- 200 ppm

Soil test results - K

- promotes disease resistance, winter hardiness
  - root crops require most
- optimum soil test K for turf and gardens

- established turf	41 - 60 ppm
- sweet corn	101 - 120 ppm
- green bean	101 - 120 ppm
- tomato	121 - 180 ppm
- potato	121- 160 ppm

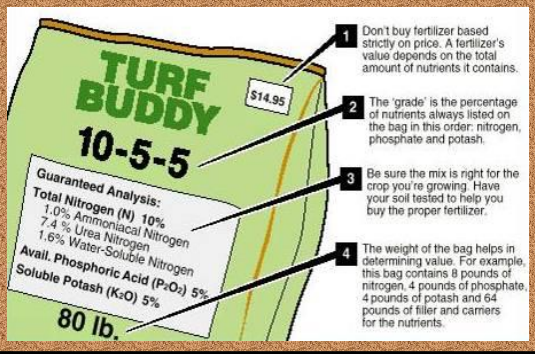
Fertilizers provide nutrients



Fertilizer Features

- **Analysis**
- **Grade**
- **Formulation**
- **Source**
  - **Organic**
  - **Inorganic**

Analysis is the percentage of nutrients contained per pound of product



Grade

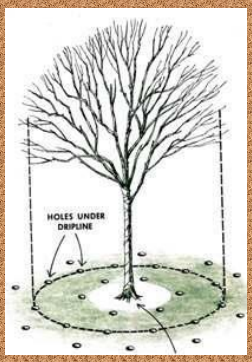
- **Mixed grade**
  - **Contains all 3 major nutrients**
- **Single or low grade**
  - **Contains only one or two**
    - **Potash**
    - **Superphosphate**

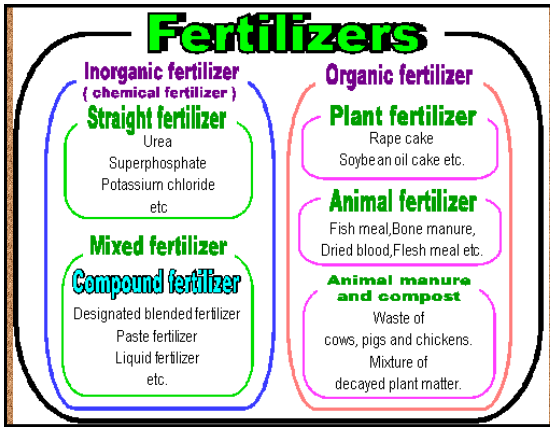
Milorganite
6-2-0

Fertilizer Formulations

- Liquid
  - drench
- Soluble
  - drench
- Granular
  - Broadcast, side-dress, banded
- Slow-release
  - incorporate
- Solid – spikes
  - insert

Applying Fertilizers





Organic fertilizer

- Nutrients in complex molecules
  - Need to decompose to release
  - Slow release
  - Low "burn" potential
- Very low analysis
- Adds organic matter
  - Primary benefit
- Often more expensive per pound of nutrient - unless its free!

Organic fertilizer

Type	Nutrient N	P_2O_5	K_2O
	----------%	----------	
Cow manure	2.1	3.2	3.0
Horse	0.6	0.3	0.5
Chicken	1.6	1.8	2.0
Coffee grounds	2.1	0.3	0.3
Lawn clippings	1.2	0.3	2.0
Compost	0.3	0.2	0.4
Green manure, rye	2.0	0.2	1.0

Organic fertilizer

Type	Nutrient N	P_2O_5	K_2O
	----------%	----------	
blood meal	13.0	1.5	0.6
bone meal	2.2	27.0	0
seaweed	1.5	1.0	4.9
tree leaves	0.7	0.1	0.8
greensand	0	1.4	6.3
activated biosolid	6.0	3.0	0.2

Inorganic fertilizer

- sold on a percent by weight basis
  - $N + P_2O_5 + K_2O$
- chemically simple
  - N in air plus natural gas
  - rock phosphate, potash mined, sized and cleaned
    - very soluble salts
    - easily blended
    - must be careful with rates

Inorganic fertilizer

Type	Nutrient N	P_2O_5	K_2O
	----------%	----------	
urea	46	0	0
ammonium nitrate	33	0	0
triple super P	0	46	0
ordinary super P	0	20	0
muriate of potash	0	0	60
potassium sulfate	0	0	50
Miracle Gro	15	30	15
Standard	10	10	10

Recommended Fertilization

- Depends on what you are fertilizing
- Why you are fertilizing it
- Soil test report

Soil Pests

- Insects
- Diseases
- Vertebrates

Soil Insects

- Grubs – larvae of Beetles

- Maggots – larvae of Flies

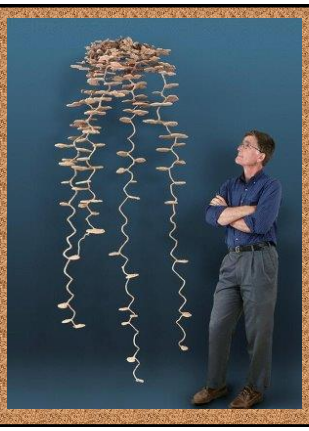
- Cutworms – larvae of butterflies and moths

Soil Insects

- Centipedes, millipedes, sowbugs (pillbugs)

- Ground-dwelling bees

- Ants



Control

Seriously…

- Crop Rotation
- Cultural practices
  - Cutworm collars
  - Modify moisture
- Pesticides

Soil Diseases

- **Biotic Pathogens**
  - **Fungi**
    - ***Verticillium* wilt**
    - ***Fusarium* wilt**
    - **Root rot organisms – *Pythium, Rhizoctonia, Phytophthora,***
    - ***Schlerotinia***

Soil Diseases

- **Biotic Pathogens**
  - **Bacteria- few soil-borne**
  - **Nematodes**
    - **Root knot nematodes**

Soil Diseases

- **Abiotic Pathogens**
  - **Black Walnut (Juglans) toxicity**

Understanding, respecting and nurturing the soil your plants grow in is the best control strategy for plant pests and problems.

Soil management is the basis of organic gardening.

A nation that destroys its soils, destroys itself.
– President Franklin D. Roosevelt, Feb. 26, 1937.

National Archives: 114 SC 5089

Good gardening starts at ground level….

…and depends entirely on a six inch layer of soil and the fact that it rains!

(and a little sunshine, of course!)