SOIL SCIENCE

Learning Objectives

The learner will:

- Understand how soils form
- Understand soil characteristics and how they effect crop growth
- Learn why and how to take soil samples, what to test for and what to do with the results
- Learn how to manage for healthy soil ecosystems, increased fertility, and sustainable crop production

How Soils Form

- ClORPT Concept: Climate, Organisms, Relief, Parent Material, Time
- Soil Toposequence: Moving from the ridge top to valley bottom, soil characteristics vary greatly…

Soil Characteristics

- Soil Components: Minerals (45%), Air and Water (25% each), and Organic Matter (usually 2 – 5%)
- Soil Texture: Sand, silt, & clay, the soil triangle, and associated properties:
  - Sandy soils – low water and nutrient holding capacity, droughty
  - Clay soils – high water and nutrient holding capacity, but low permeability, poor tilth
- Soil Nutrient Profile: major and minor nutrients, trace elements
- Cation Exchange Capacity: capacity of negatively charged humus and clay particles (colloids) to hold cations (Calcium, Magnesium, Potassium – also sodium & ammonia) – importance
  - Albrecht system
- PH (and its relation to CEC – if your bases are balanced, pH will take care of itself)

Soil Biotic Community

- We know that an acre of soil can support or "produce" 2000 lbs of beef (cow / calf pair), 5 sheep, and lots of chickens, for example, but we rarely consider the extent of the soil fauna living underground: 1 acre of topsoil contains approximately 900 pounds of earthworms, 2,400 pounds of fungi, 1,500 pounds of bacteria, 133 pounds of
  Protozoa, 890 pounds of arthropods and algae, and small mammals

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- Earthworms – air & water penetration, high-nutrient castings, secretion of plant growth stimulant, natural soil tiller
- Arthropods – sow bugs, centipedes, slugs, snails, springtails: primary decomposers
- Bacteria – make plant growth hormones, make nutrients and minerals available to plants, fix atmospheric nitrogen, fight root diseases, detoxify soils
- Fungi – break down OM and release nutrients available to plants, produce plant hormones and antibiotics; mycorrhizal associations
- Actinomycetes – threadlike bacteria that look like fungi: decompose OM, produce root disease-fighting antibiotics, produce sweet, "earthy" smell
- Algae – upper ½ inch, fix nitrogen and enhance soil structure by producing biologic glues
- Protozoa – free-living organisms that swim in soil water, eating bacteria and speeding up the nutrient cycle
- Nematodes – eat decaying plant litter, bacteria, algae, protozoa, and other nematodes – only a few species harmful to plants.

Key to managing for a healthy soil community: build soil organic matter

Soil Organic Matter

- Carbon Cycle: role of C (CO_2) and how to manage it.
- Humus, Humic Acid (organic compounds containing displaceable hydrogen), Humate (the salt of a humic acid, where hydrogen has been displaced by cations such as potassium, calcium, and magnesium)
- Managing SOM: cover crops, field rotations, compost and compost tea applications, etc.
- Tillage systems
- Nitrogen Cycle: role of N, and how to manage it.

Soil Testing and Assessment

- What to test, how to test, when to test: texture, major nutrients, minors and trace, pH, CEC, soil biotic community,
  - Conventional
  - Emphasis on Mineral Analysis: Albrecht System
  - Soil Biotic Communities
  - USDA Soil Quality Test
- Soil Testing Laboratories

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Assessment/Review

- How is soil formed?
- What are some important soil characteristics?
- Explain cation exchange capacity and how to improve it.
- Describe a cropping system that improves soil organic matter and enhances the soil biotic community.