

Homework III: The State Soil of Florida

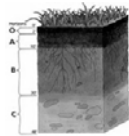
Posted on website

5 bonus points

Type all answers

Soil Organisms, Biology, and Nutrients

Mineral and Organic Components



Functions of soils: recycler of raw materials
Nutrient availability, replenishment

Organic Matter and Soil Biology

Soil Organic Matter

Accumulation of partially disintegrated and decomposed plant and animal residues plus biomass.
1 – 5% (by weight) in a typical, well-drained mineral soil

Transitory soil constituent (hours to 100s of years)

Requires continual addition to maintain O.M. levels.

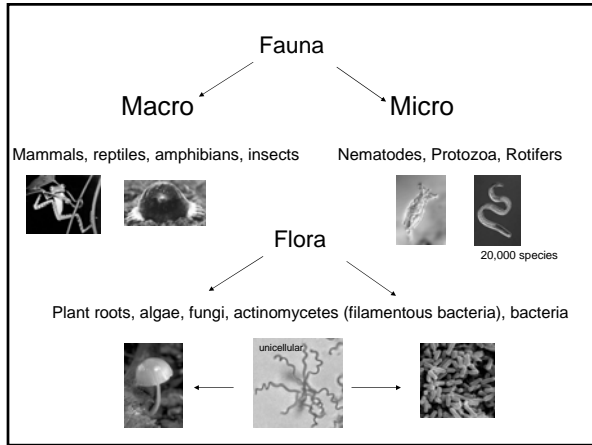
Constantly being broken down by soil microorganisms

Release/recycling of important plant nutrients

Soil Organisms

What creatures live in soil?





Basic Classification of Organisms

Food
Oxygen Demand
Energy Source

Based on food: live or dead

Herbivores

- Eat live plants
- Insects, mammals, reptiles



Detritivores

- Eat dead tissues:
- Fungi, bacteria & actinomycetes



Predators

- Eat other animals
- Insects, mammals, reptiles



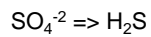
Based on O₂ demand

■ **Aerobic**

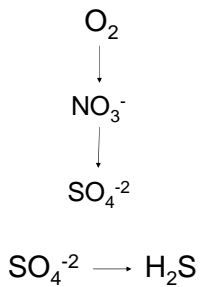
- Active in O₂ rich environment
- Use free oxygen for metabolism

■ **Anaerobic**

- Active in O₂ poor environment
- Use combined oxygen (NO₃⁻, SO₄⁻²)



Still Ponds



Based on energy & C source

Autotrophic (CO₂)

- Solar energy (photoautotrophs)
- Chemical reaction w/inorganic elements
N, S, & Fe (chemoautotrophs)

Heterotrophic

- From breakdown of organic matter (Carbon)
- Most Numerous

Quantification of Soil Organisms

Quantification of Soil Organisms

Three Criteria

- **Numbers of organisms**
 - Extremely numerous
 - 1,000,000-1,000,000,000 /g soil
 - 10,000 species /g soil
- **Biomass**
 - 1-8% of total soil organic matter
- **Metabolic activity**
 - Respiration: CO₂
 - Proportional to # & biomass

Soil Organisms in Surface Soils

Organisms	#/g soil	Biomass (g/m ²)
Microflora		
Bacteria	10⁸ -10⁹	40-500
Actinomycetes	10 ⁷ -10 ⁸	40-500
Fungi	10 ⁵ -10 ⁶	100-1,500
Algae	10 ⁴ -10 ⁵	1-50
Fauna		
Protozoa	10⁴ -10⁵	2-20
Nematodes	10 -10 ²	1-15
Mites	1 -10	1-2
Earthworms	1 -10	10-150

Note those in White

Earthworms



1,000,000 per acre
 five pairs of hearts
 Mostly intestine
 22 ft. long (Afr. and Aus.)



- Earthworm cast
- Casts: earthworm's wastes
- Eat soil organics: 2-30 times of their own wt.

Earthworms

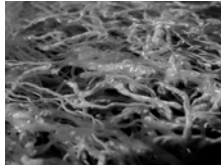
- Abundance of earthworms
 - 10-1,000/m³
 - 3,000 species



- Benefits of earthworms
 - soil fertility by producing cast (concentration of nutrients)
 - aeration & drainage
 - size & stability of soil aggregates

Soil Algae

- Autotrophs
- Capable of photosynthesis (chlorophyll)
- 1-10 billion/ m² (can be "mat" of algae on surface)
- Prefer moist environments
- Rich in wetland and paddy soils
- Fixing atmospheric N₂ (B-G algae)
- Some soil algae "swim" by flagella



Soil Fungi

Yeasts, molds, mushrooms

10 - 100 billion/m²

Cell with a nuclear membrane and cell wall
Most versatile & most active in acid forest soils
Tolerate extremes in pH (bacteria do not)

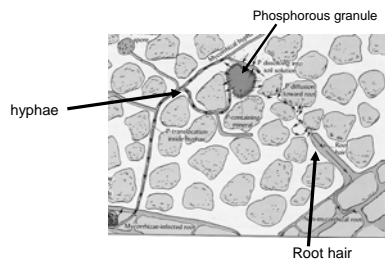
Mycorrhizae symbiosis

Association between fungi & plant root
Increased SA (up to 10 times)
Increased nutrient uptake, especially P



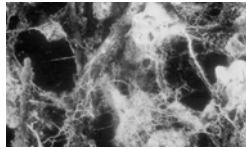
Mycorrhizae Fungi

1. Ions in solution
2. Movement from solution to root (diffusion)



Symbiosis

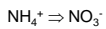
- Fungi provide nutrients
- Plant root provides carbon
- Ectomycorrhiza
Root surfaces and cortex in forest trees
- Endomycorrhiza
Penetrate root cell walls
agronomic crops-
 - corn, cotton, wheat, & rice



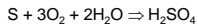
10-100 trillion/m²

- Single-celled organism
- Rapid reproduction
- Small (4-5 μm)
- Mostly heterotrophic

N oxidation: nitrification



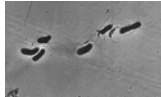
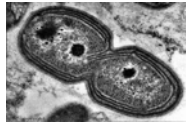
S oxidation



N fixation



Soil Bacteria



Oxygen, moisture, temperature, O.M., pH

Benefits of Soil Organisms

OM decomposition
The most significant contribution
N, S, & P nutrients

Elemental transformations

- N ($\text{NH}_4^+ \Rightarrow \text{NO}_3^-$)
- S ($\text{S} \Rightarrow \text{SO}_4$),
- Fe ($\text{Fe}^{2+} \Leftrightarrow \text{Fe}^{3+}$)
- Mn ($\text{Mn}^{2+} \Leftrightarrow \text{Mn}^{4+}$)

Nitrogen fixation
($\text{N}_2 \Rightarrow \text{NH}_4^+$)

Algae: wetland
Bacteria: legumes

Breakdown toxic organics
(bioremediation)

Pesticide degradation: DDT
Oil & gasoline degradation

Effect of Organisms on Nutrient Availability



Soil Organic Matter

- Carbon
- Hydrogen
- Oxygen
- Phosphorus
- Nitrogen
- Sulfur



