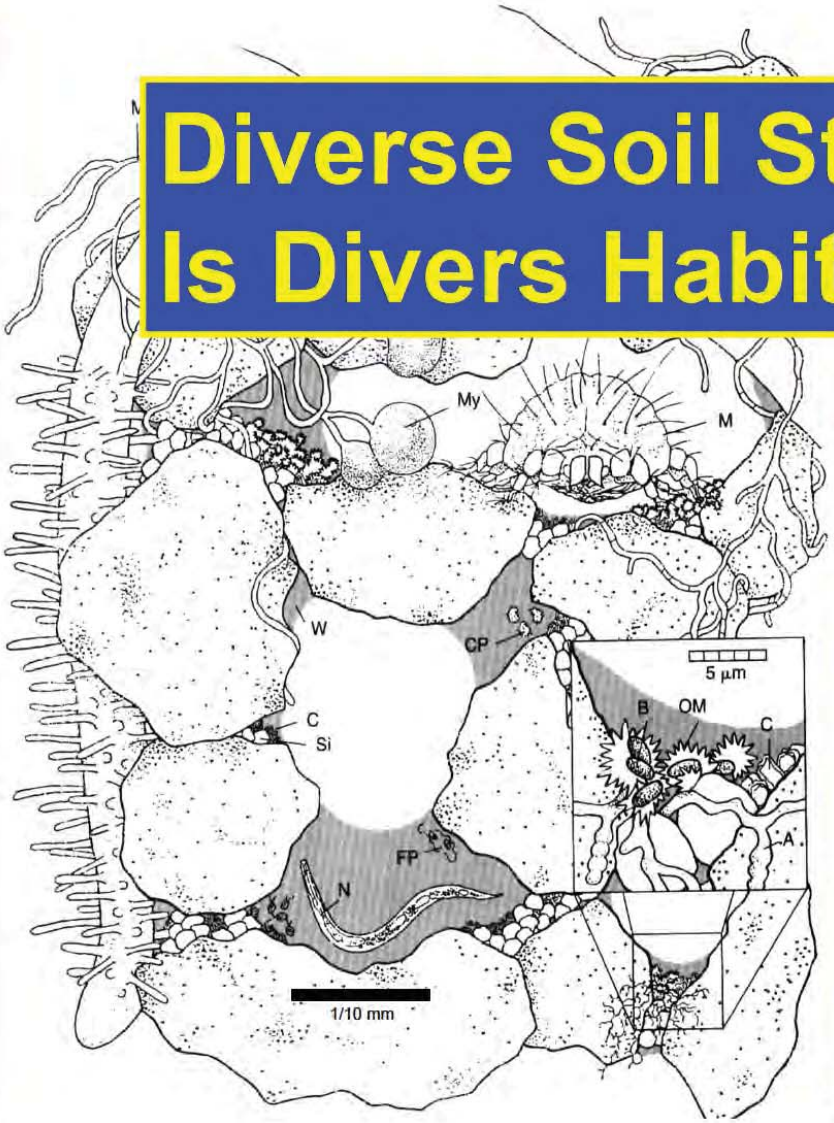
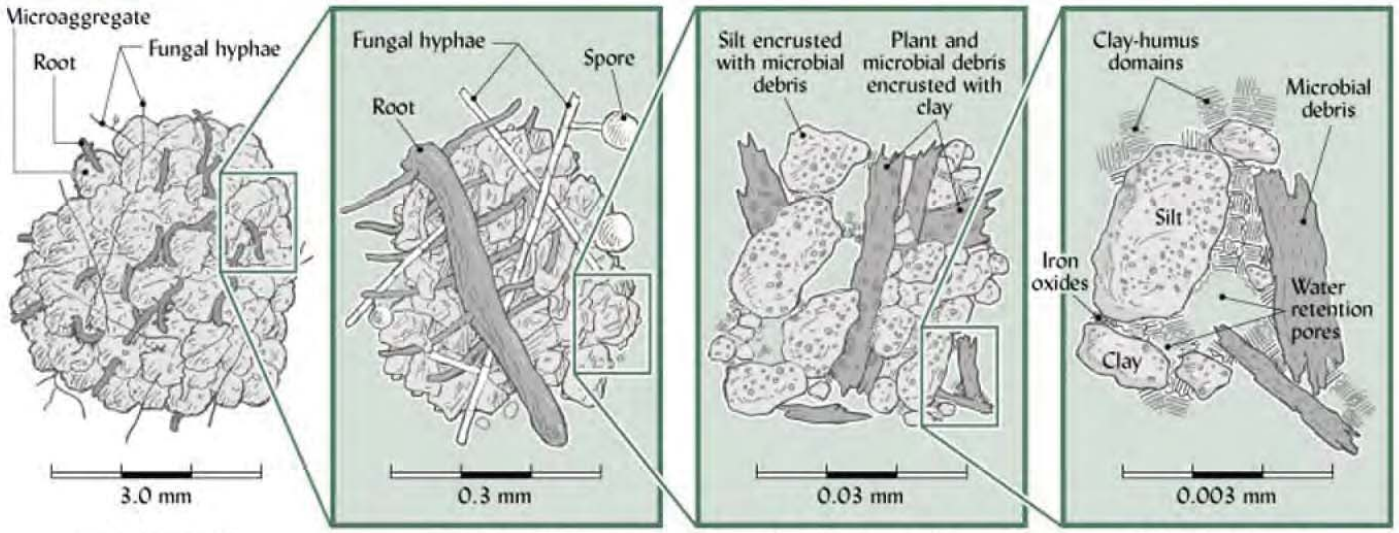
Diverse Soil Structure Is Divers Habitat!



B – Bacteria
A – Actinomycetes
My – Mycorrhizae
H – Saprophitic fungus
N – Nematode
CP – Ciliate protozoa
FP – Flagellate protozoa
M – Mite

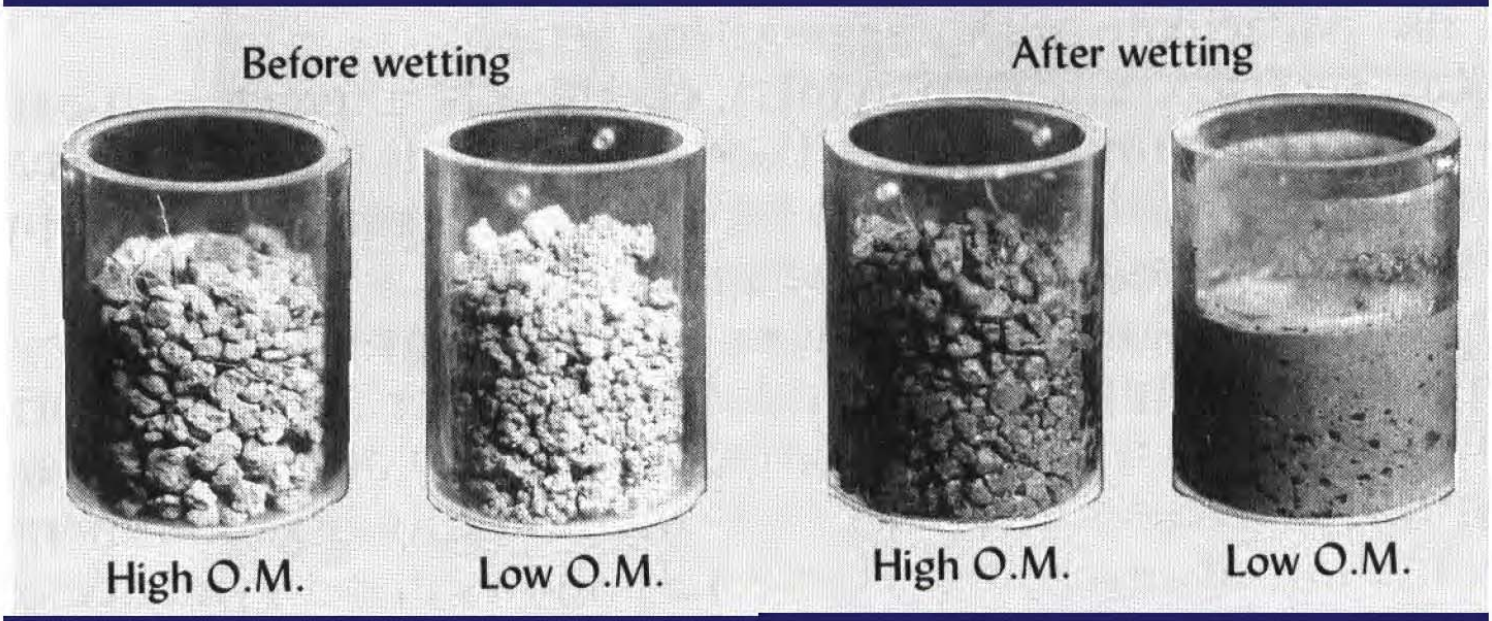
< 1mm

Soil Structural Stability
- particles held & "glued" together



Disturb soil as little as possible!

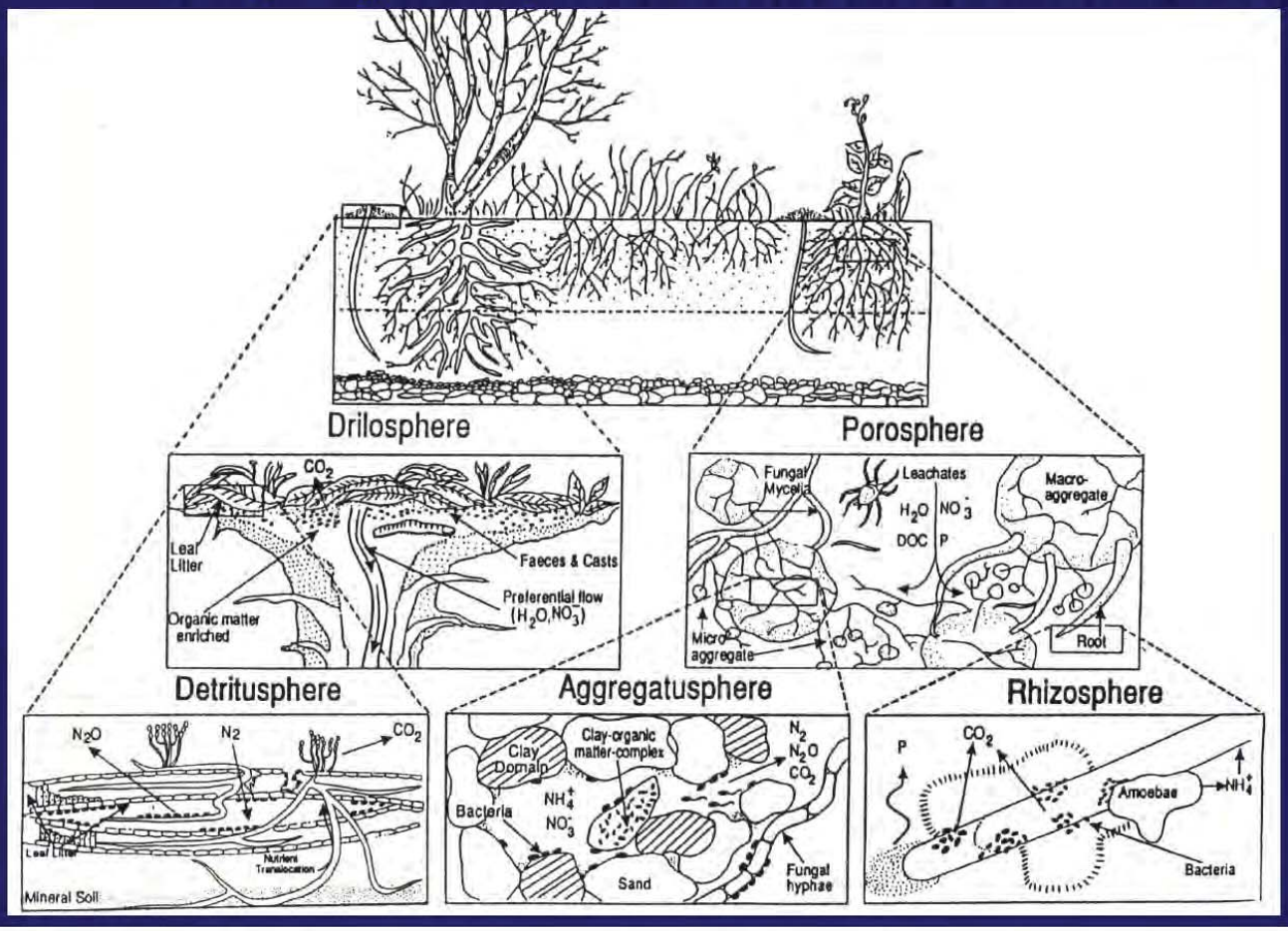
Effect of OM on structure stability




Soil is habitat!

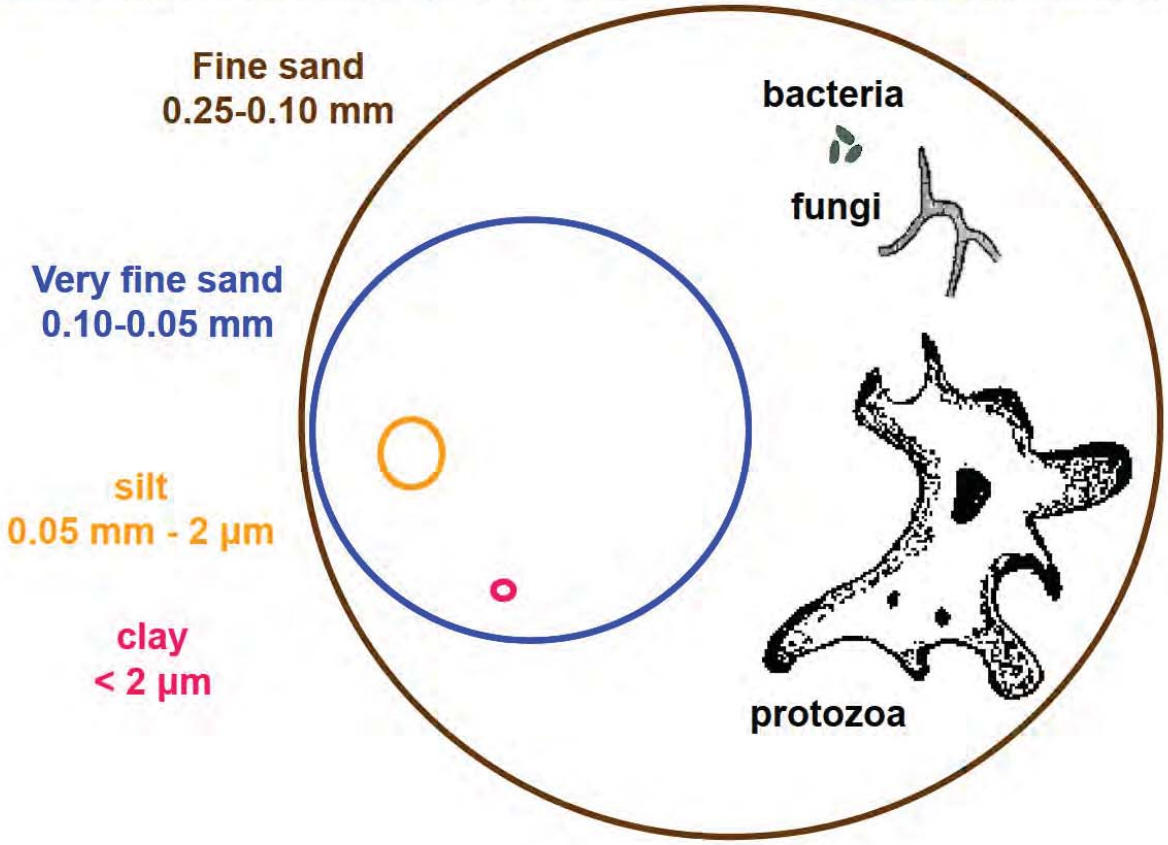
Soil Microhabitats

Everything is everywhere and the milieu selects—Martinus Beijerinck



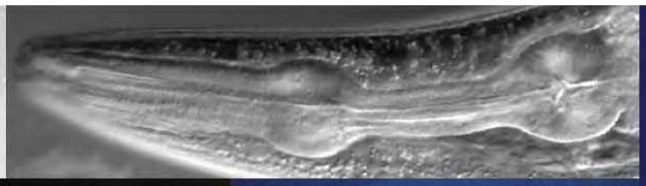
How biota diameter relates to particle size and pore size?

- Microflora and microfauna are similar in size to fine sand and clay.



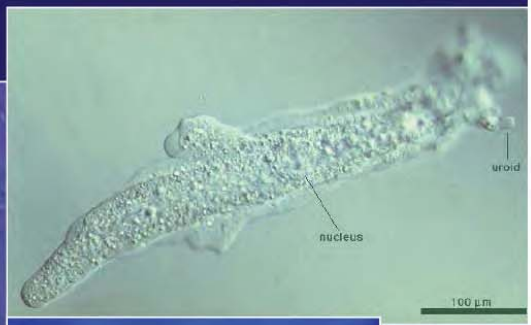

!It's their world!
Live in the tiniest pores in soil
!We just die in it!

Nematodes

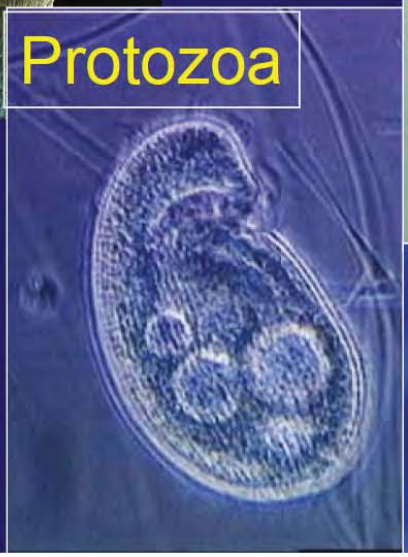


Live in small pores in soil

Microfauna



Protozoa

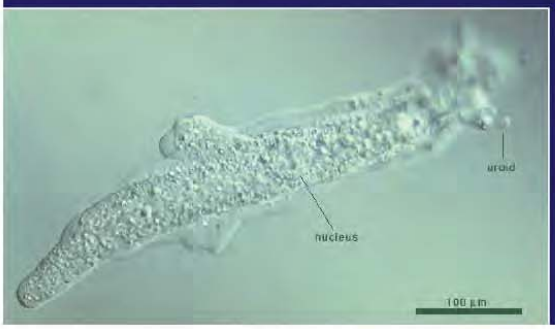


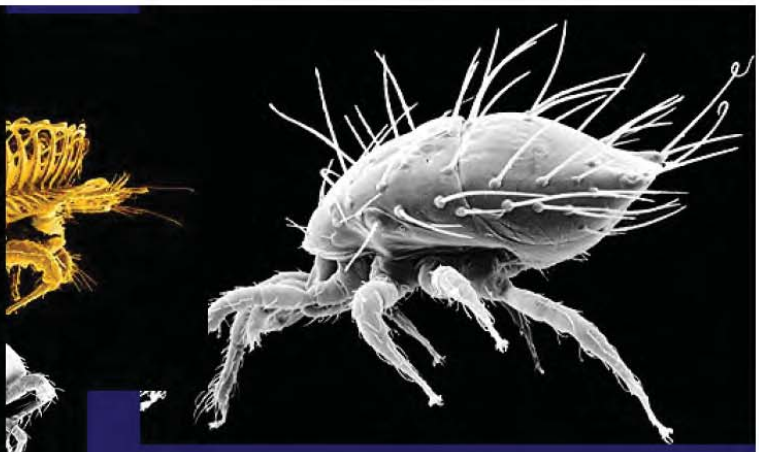
20-200 kg/ha!

Microfauna

Protozoa

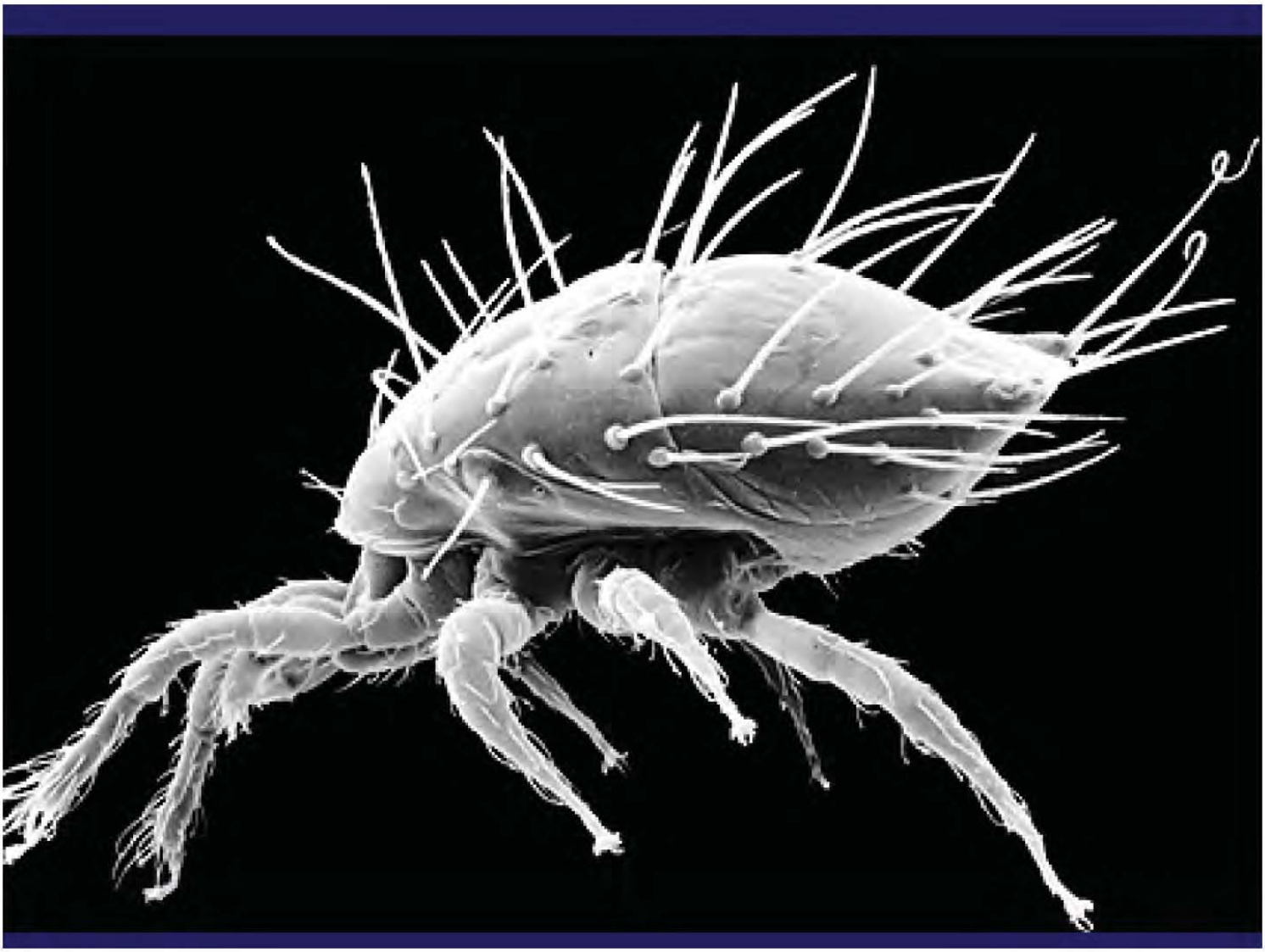
- Most abundant of all soil fauna
- One-celled
- Feed on bacteria (live and move in water films)
- Up to 30% of all mineralized N from protozoa

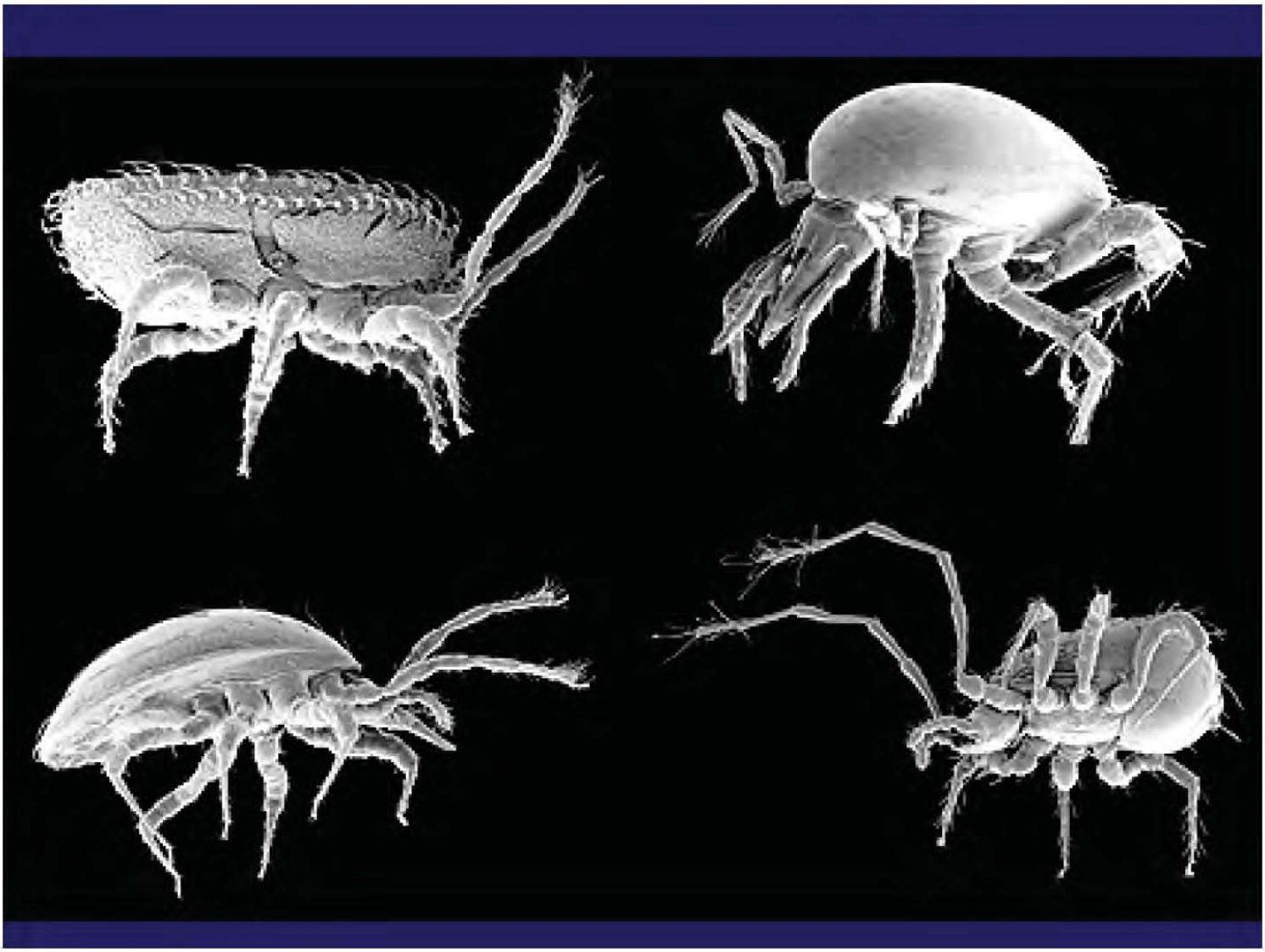




Mesofauna

Live in medium size pores in soil





Mesofauna

- Heterotrophs (detritivores, predators)
- Feed on fungi, protozoa, nematodes, mites
- Important in regulating populations of everything smaller

Collembola (springtails)

Fungus feeding mite

Nematode feeding mite


pseudoscorpion
Mesofauna

Worms

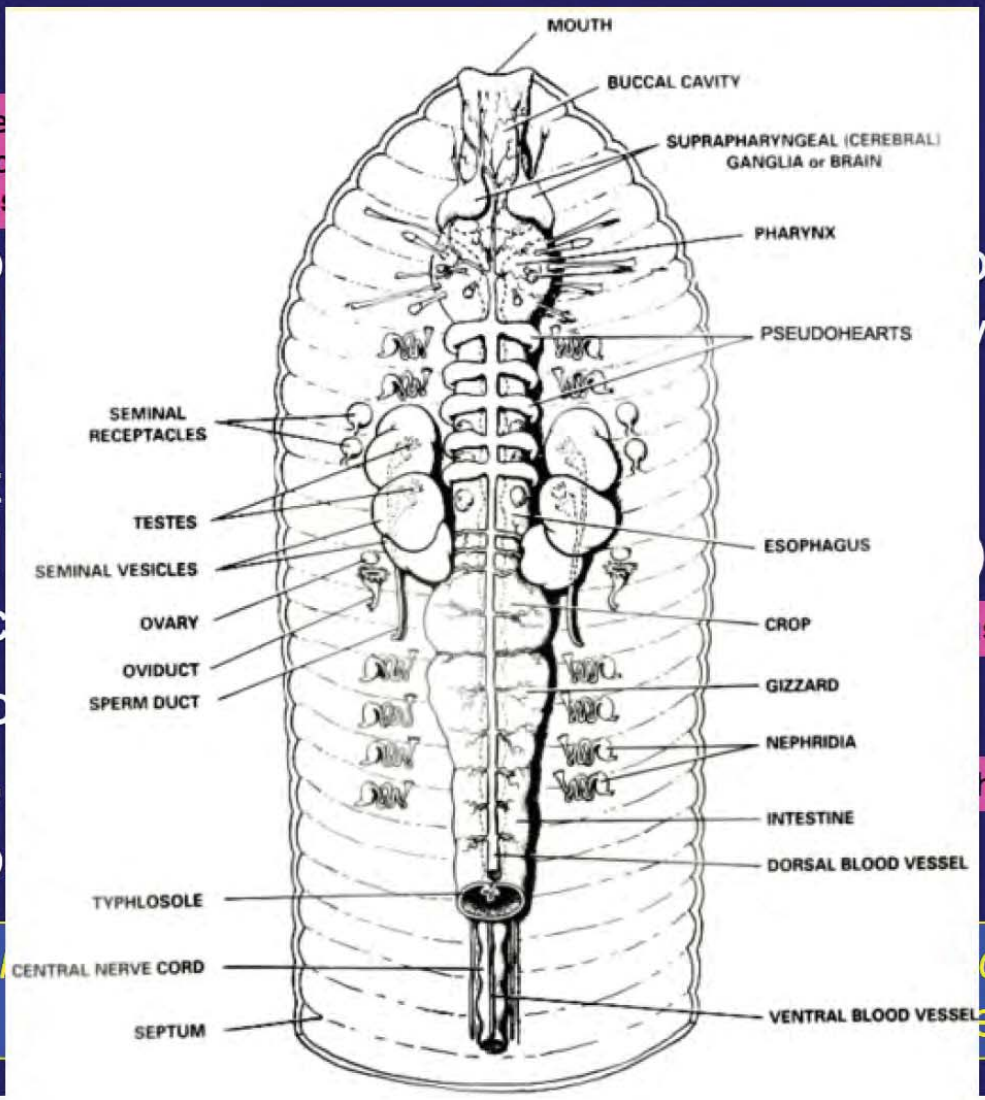
Voles!

Live in large pores in soil

Macrofauna

Biopore
conditic
tons ca

- Pro
soil
soil
- Eat
soil
eac
- Exc
pH,
- Pro



of
y

stry!

human population

The Fo *on of Worms*
with es Darwin

"It may be doubted whether there are many other animals which have played so important a part in the history of the world, as have these lowly organized creatures." Charles Darwin 1881

Earthworm casts vs. soil

Characteristic	Earthworm casts	Soil
% silt & clay **(gizzard action)**	38.8	22.2
Bulk density	1.11 g/cm^3	1.28 g/cm^3
Structural stability	849 (raindrops)	65 (raindrops)
CEC ($cmol_c/kg$)	13.8	3.5

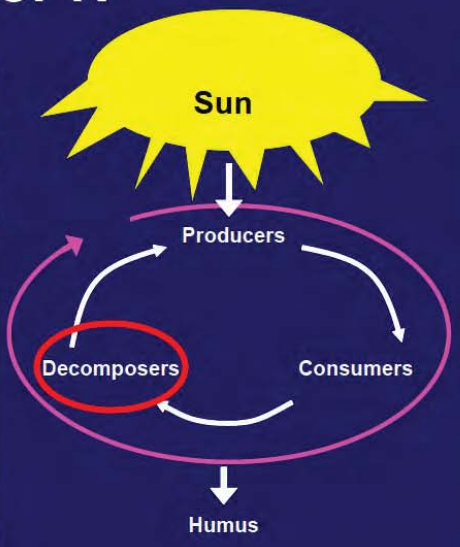
From Table 10.4 of text

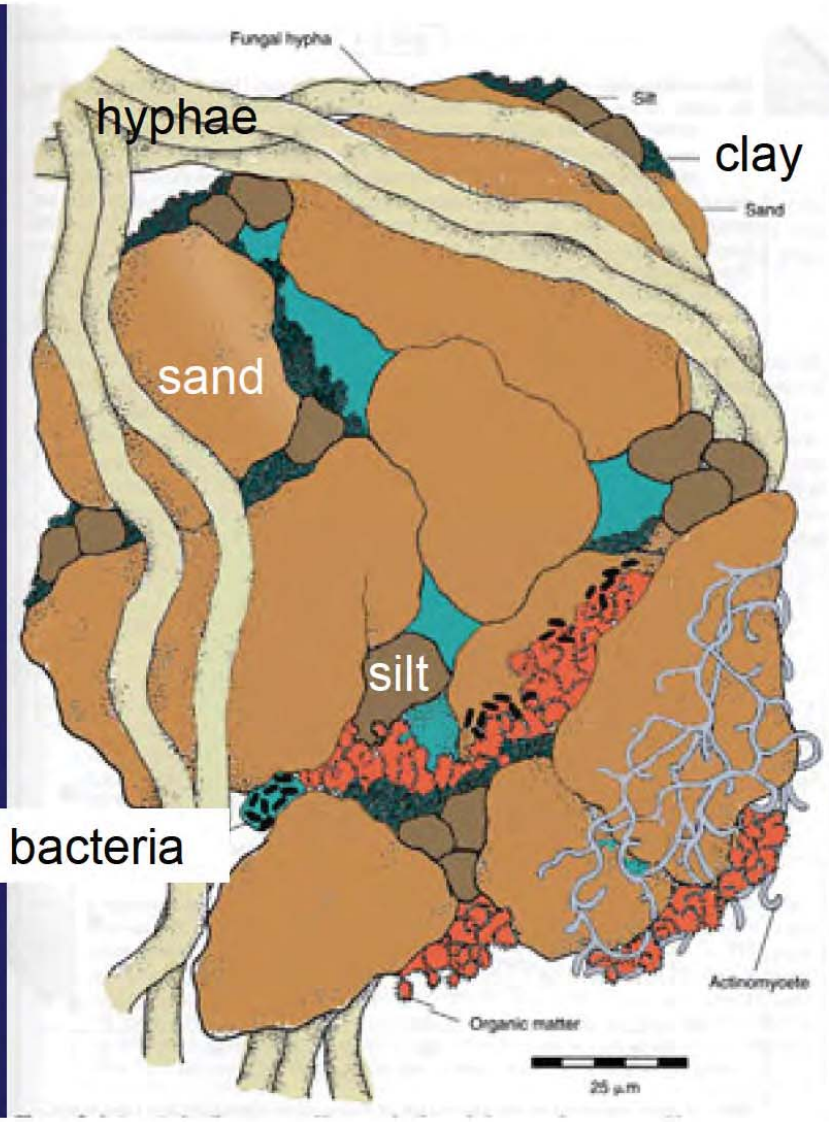
Worms increase availability of mineral nutrients to plants by:

1. Physical/chemical breakdown organic materials
2. Bioaccumulation: **Collect, concentrate, & assimilate nutrients into their body tissue**

Fungi – tens of thousands of spp.

- The major agent of decay in acid environs
- Network of hyphae: improves soil structure
- Decomposition of cellulose!!!
- Can compete with higher plants for N





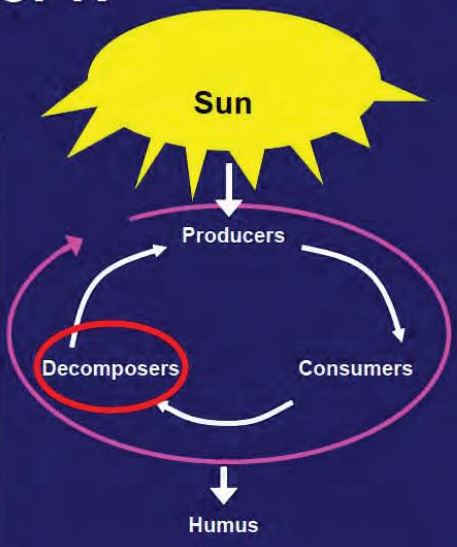
Aggregates held together by:

1. Fungal hyphae
2. Bacterial "glues"
3. Organic matter

Fungi – tens of thousands of spp.

- The major agent of decay in acid environs
- Network of hyphae: improves soil structure
- Decomposition of cellulose!!!
- Can compete with higher plants for N

- Chemo Heterotrophs – energy and carbon from dead or living biomolecules (trap nematodes!)

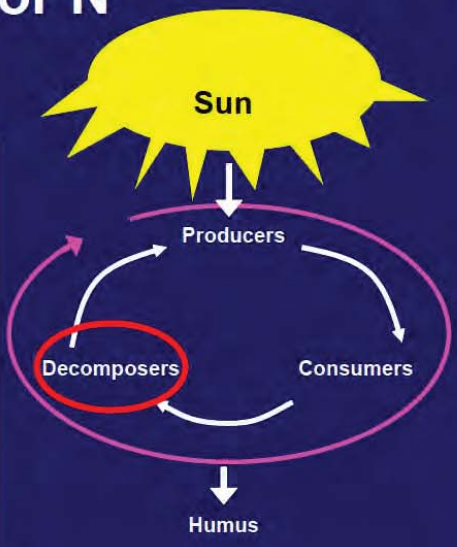


Fungi – tens of thousands of spp.

Got beer?

- The major agent of decay in acid environs
- Network of hyphae: improves soil structure
- Decomposition of cellulose!!!
- Can compete with higher plants for N

- Chemo Heterotrophs – energy and carbon from living (trap nematodes!) or dead biomolecules
- 3 groups, yeast, mold, mushrooms
- Mycorrhizae - symbiotic relationships with most plants
- Produce chemicals that are toxic (or otherwise…)



ONIONS

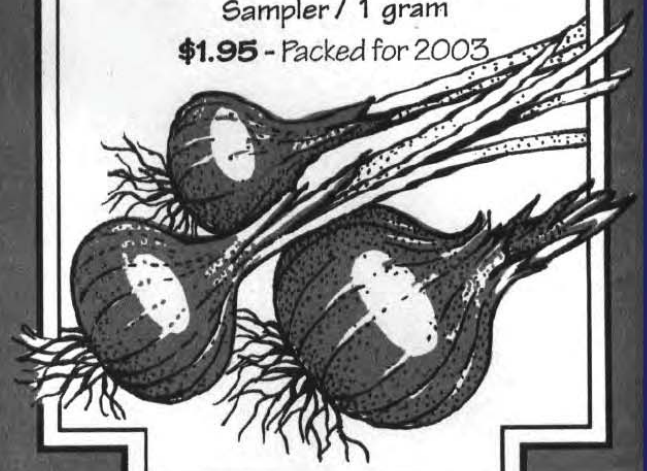
ON547 Copra Hybrid

STORAGE ONION

104 days. A great storage onion! A medium sized, round, dark yellow type with ivory flesh. Stays flavorful stored up to 7 months.

Sampler / 1 gram

$1.95 - Packed for 2003



Territorial Seed Company
P.O. Box 158, Cottage Grove, Oregon 97424

ON547/S

Seed Depth	Soil Temp. For Germ.	Days To Germination	Light Requirements	Thin Plants to
1/8-1/2"	55-75°	6-12	full sun	2-5"

ONIONS *Allium cepa*

SCALLIONS *Allium fistulosum*

Sowing Indoors-Start up to 100 seeds in a 4-6 inch pot. Place in a warm location and keep moist. If you cannot transplant outside before the tops reach 5 inches, then cut back the tops to 3 inches.

Sowing Outdoors-Direct-sown crops will be more uniform. Sow when soil temperatures are at least 55°F.

Growing Tips-Thin bulbing onions 5-7 inches between plants and bunching onions 2 inches between plants.

Fertilization Tips-Before transplanting or seeding, apply 1/4-1/2 cup of our blended organic fertilizer per 5 row feet. Mycorrhizae inoculant (see our catalog) may help produce larger bulbs.

Insect Prevention Tips-Because onions have a pungent odor, they repel many pests that may visit your garden. Many gardeners integrate onions throughout their garden for this reason.

Seed Specs-Min. germ. standard: 75%. Usual seed life: 1 year.

Some varieties are suitable for winter gardening. See winter catalog.

PLEASE READ OUR SEED WARRANTY BEFORE OPENING THIS ENVELOPE

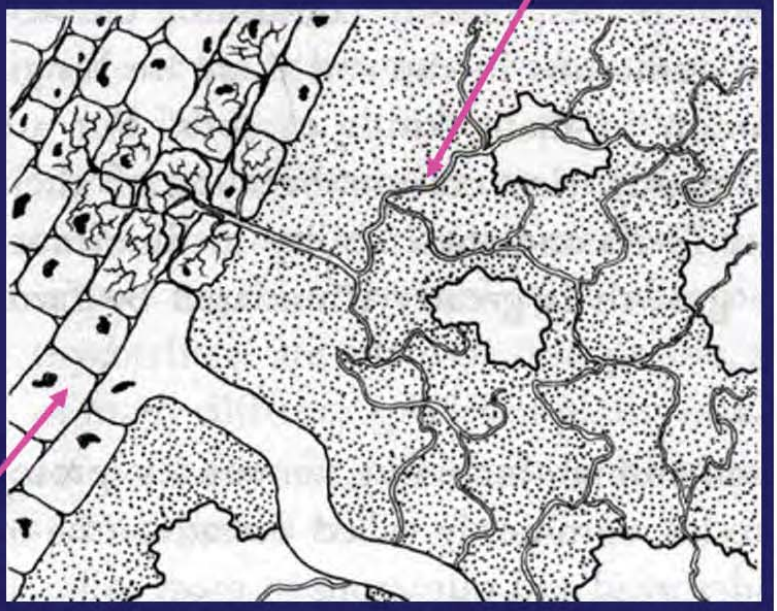
Phone orders and catalog requests: 541-942-9547
Fax orders: 888-657-3131
Web site: http://www.territorial-seed.com

N capture (mycorrhizal fungi)

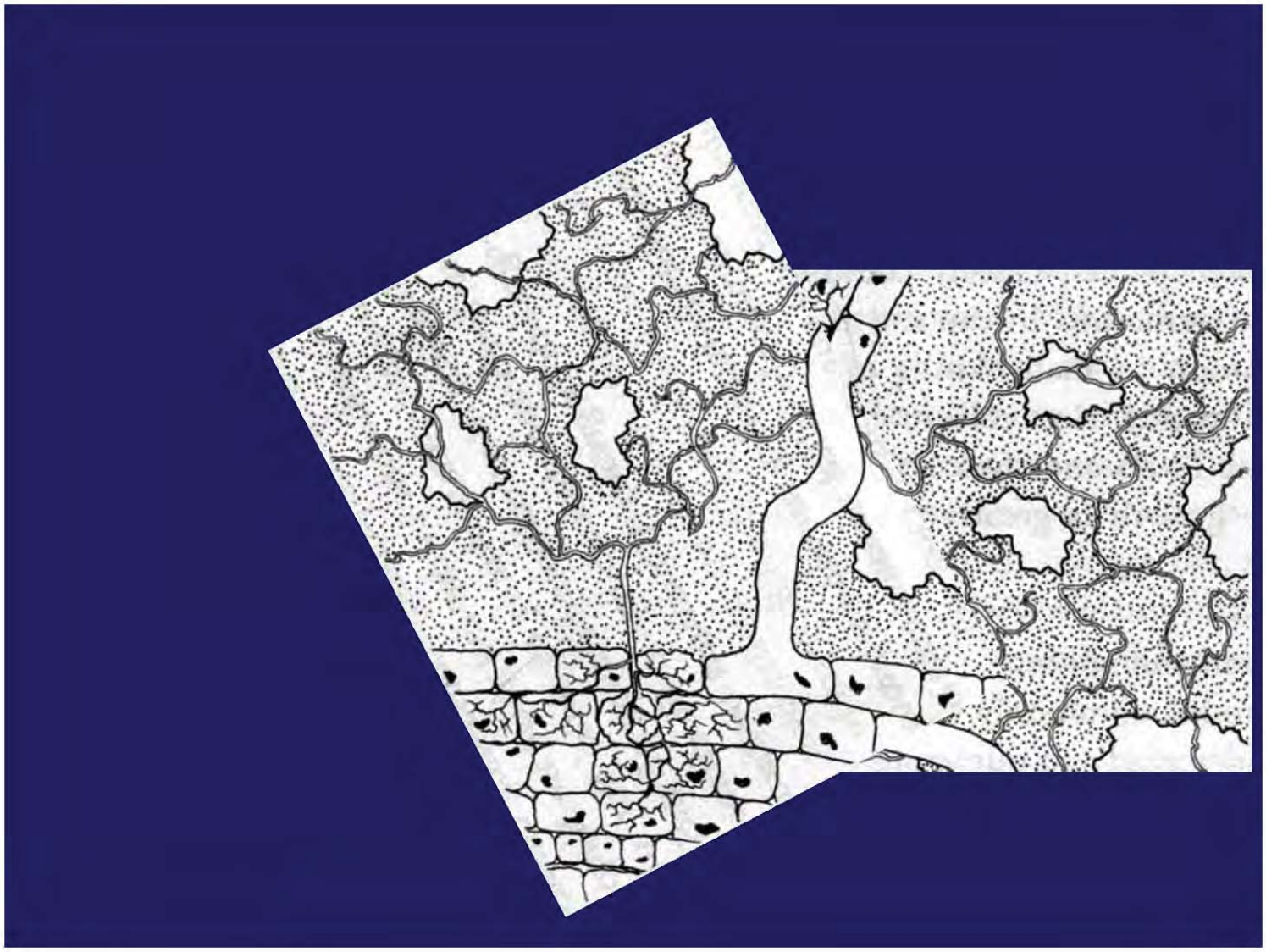
(Fungus Root)

- Soil fungi that form symbiotic relationship with plant roots
- Extend root surface area for uptake of nutrients
  - Fungus transfers nutrients (N,P,K) to plant
  - Especially important for phosphorous uptake because it is immobile in the soil
- Plant provides fungus with carbon (root exudates)

Ecto & endo types



Mycorrhizae "infecting" a plant root and extracting nutrients from rock particles.

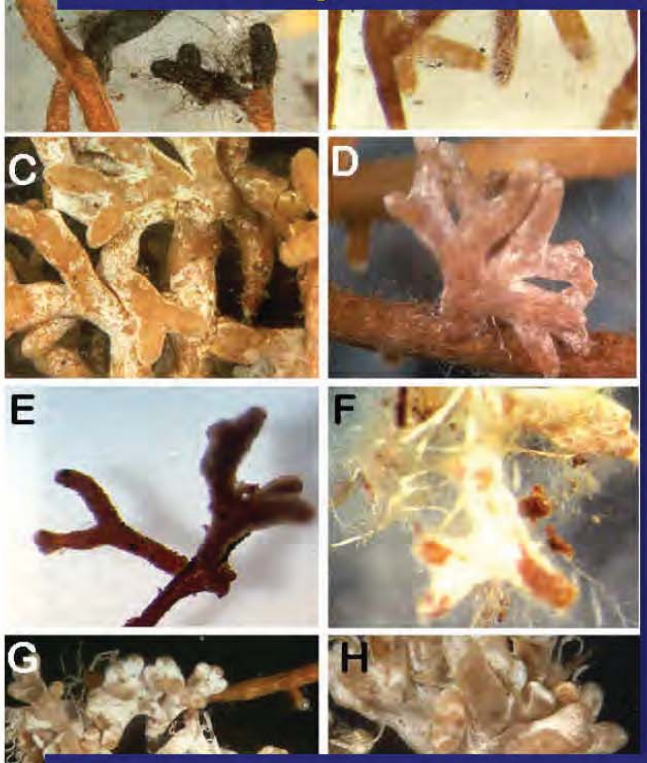


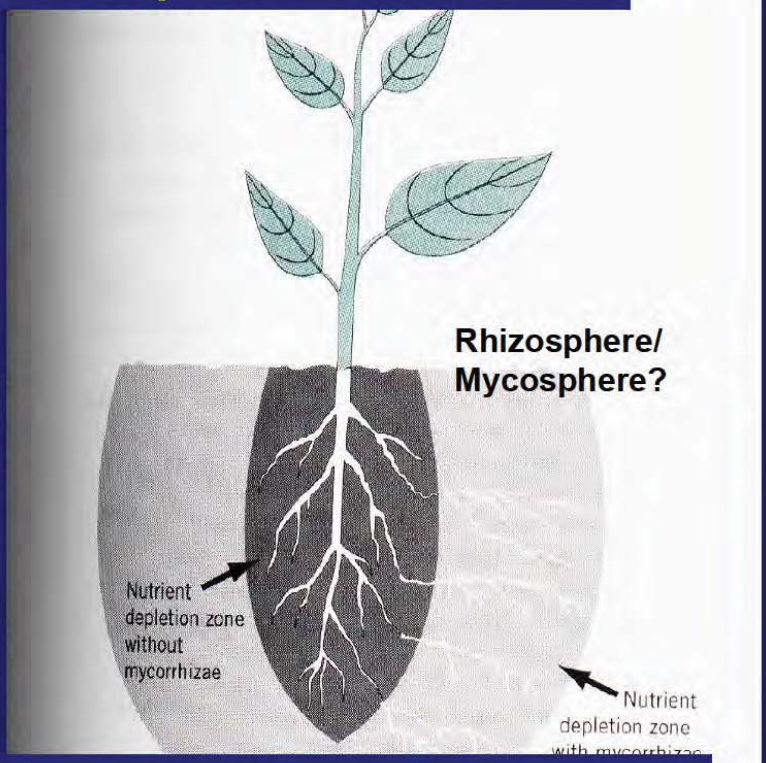
Crops with mycorrhizal associations

- onions
- corn
- cotton
- wheat
- soybeans
- potatoes
- alfalfa
- sugarcane
- cassava
- rice
- most vegetables
- beets
- apples
- grapes
- citrus fruit
- trees (lumber and fiber)
- cacao
- coffee
- rubber

Oregon industries:
Wine!
Christmas trees!

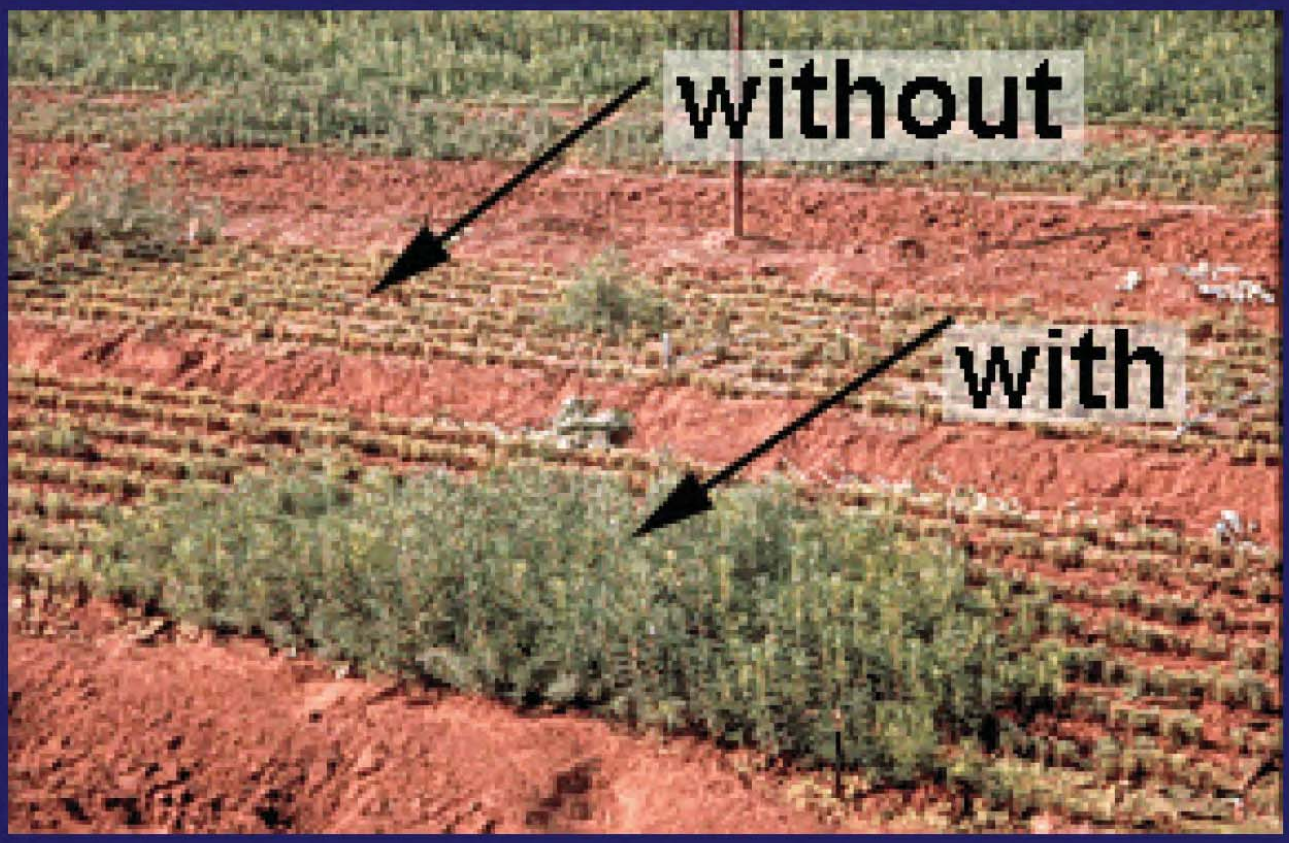
Cost to plant – 5-10% of photosynthate production
Benefit to plant - 10X the absorptive surface



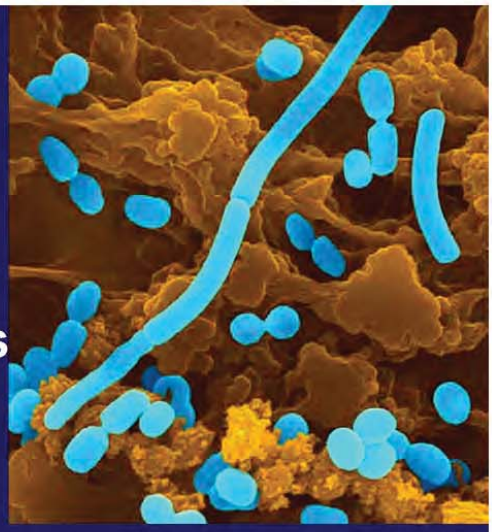


Cost to Mycorrhizae – nutrient shuttle to plant
Benefit to Mycorrhizae – get sugars directly from plant

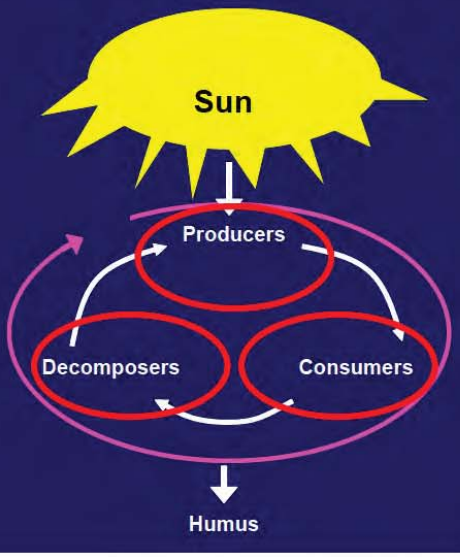
Douglas Fir Trees with and without mycorrhizae inoculation



Bacteria – 1 billion -1 trillion/g soil (up to 20,000 spp.)

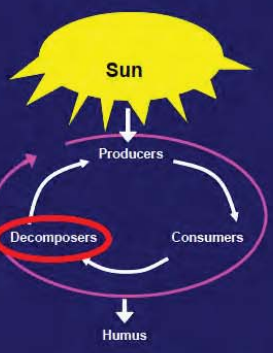


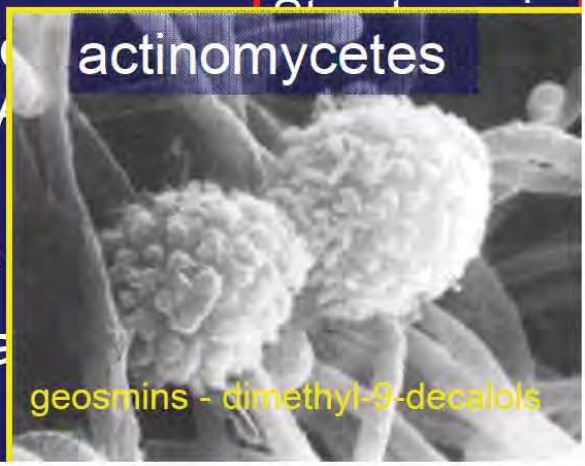
- Exist in both forest and grassland soils
- Aerobic, anaerobic, and facultative forms
- Autotrophic and heterotrophic forms
- Most do best under high Ca^{2+}, high pH
- Do best when soil temp 20-40C (68-100F) but seldom killed by temp extremes



Actinomycetes - fungus-like, filamentous bacteria, huge numbers in soil; second only to "regular" bacteria

- Historically classified as fungi - misnomer
- Specialized group of soil bacteria - (unicellular, no nuclear membrane)
- Aerobic heterotrophs – decompose OM – humus-forming, also parasitic/symbiotic relationships with some plants
- Produce antibiotic compounds t competition etc. (side benefit – A drugs e.g. streptomycin)
- Super resistant to hostile enviro
- Sporulate – smell "good" after ra





Streptomyces - 199901-008

Filamentous bacteria which produces the antibiotic, Streptomycin.

Thanks bacteria!!!

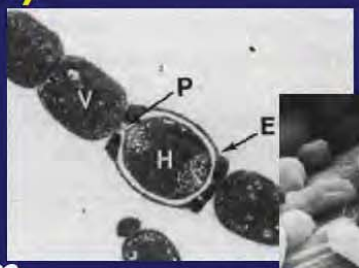
From - http://www.scharfphoto.com/fine_art_prints/archives/000611.php

Bacteria and N fixation

Types of Biological Nitrogen Fixation (N^2 from atmosphere)

Free-living (asymbiotic)

- Cyanobacteria
- *Azotobacter*

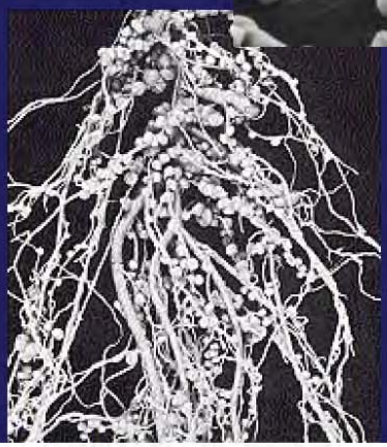


Associative

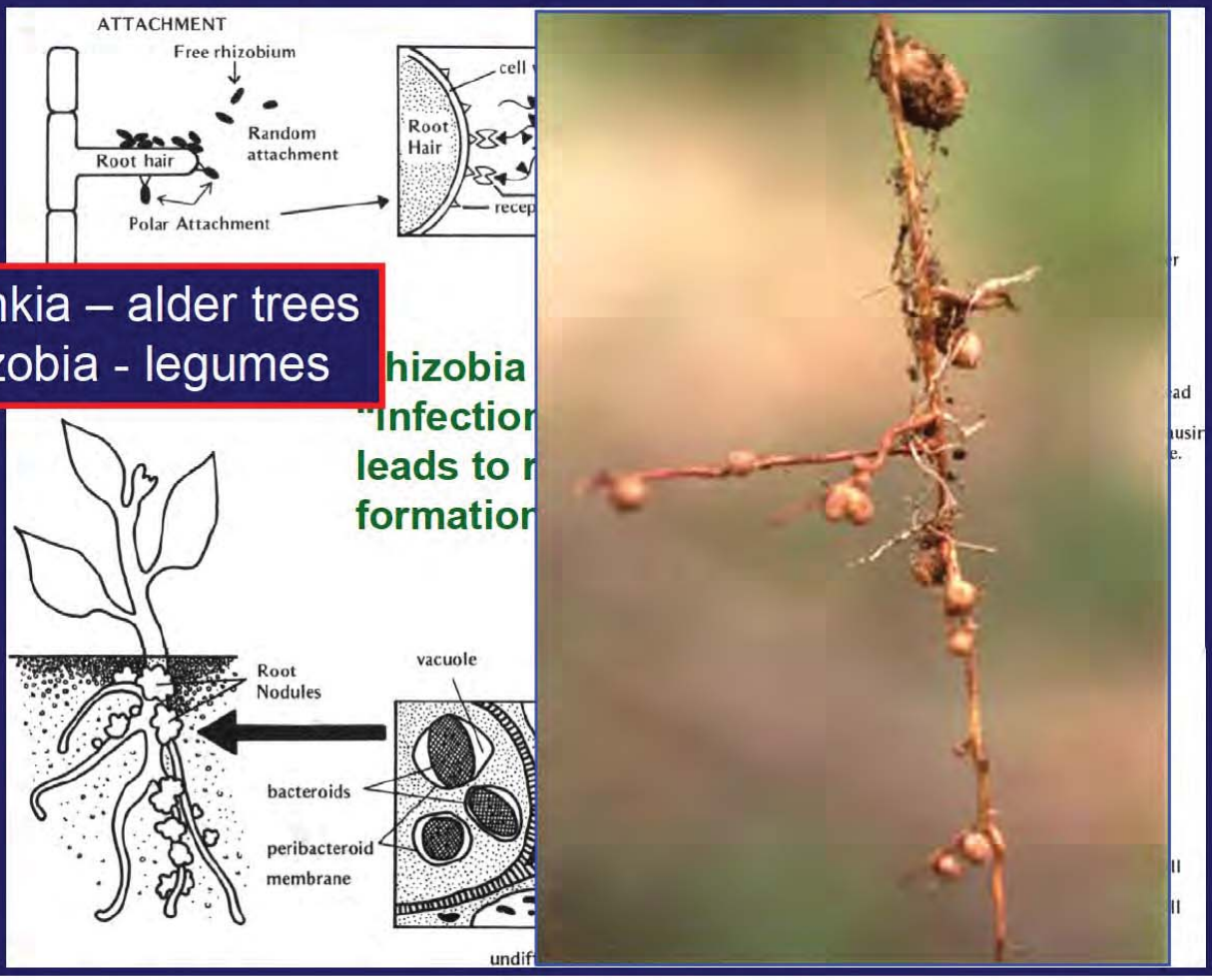
- Rhizosphere–*Azospirillum*
- Lichens–cyanobacteria (with fungi)
- Leaf nodules

Symbiotic – nodule forming

- Legume-rhizobia
- Actinorhizal-*Frankia*

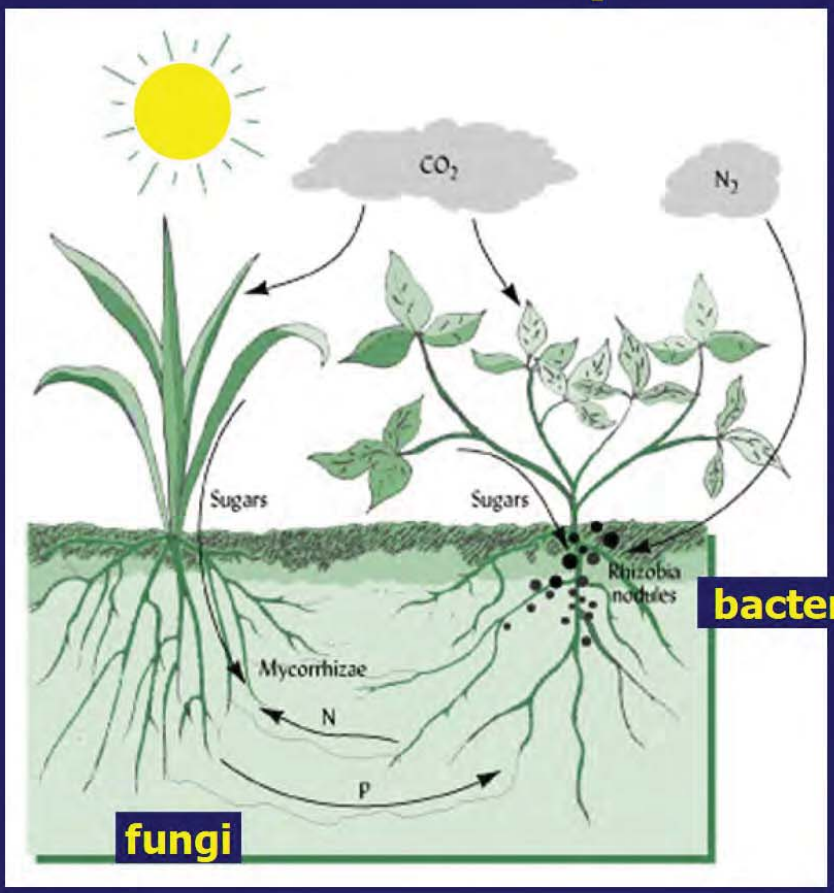


Nodulation in Legumes



Frankia – alder trees
Rhizobia - legumes

Complex, mutually beneficial relationships

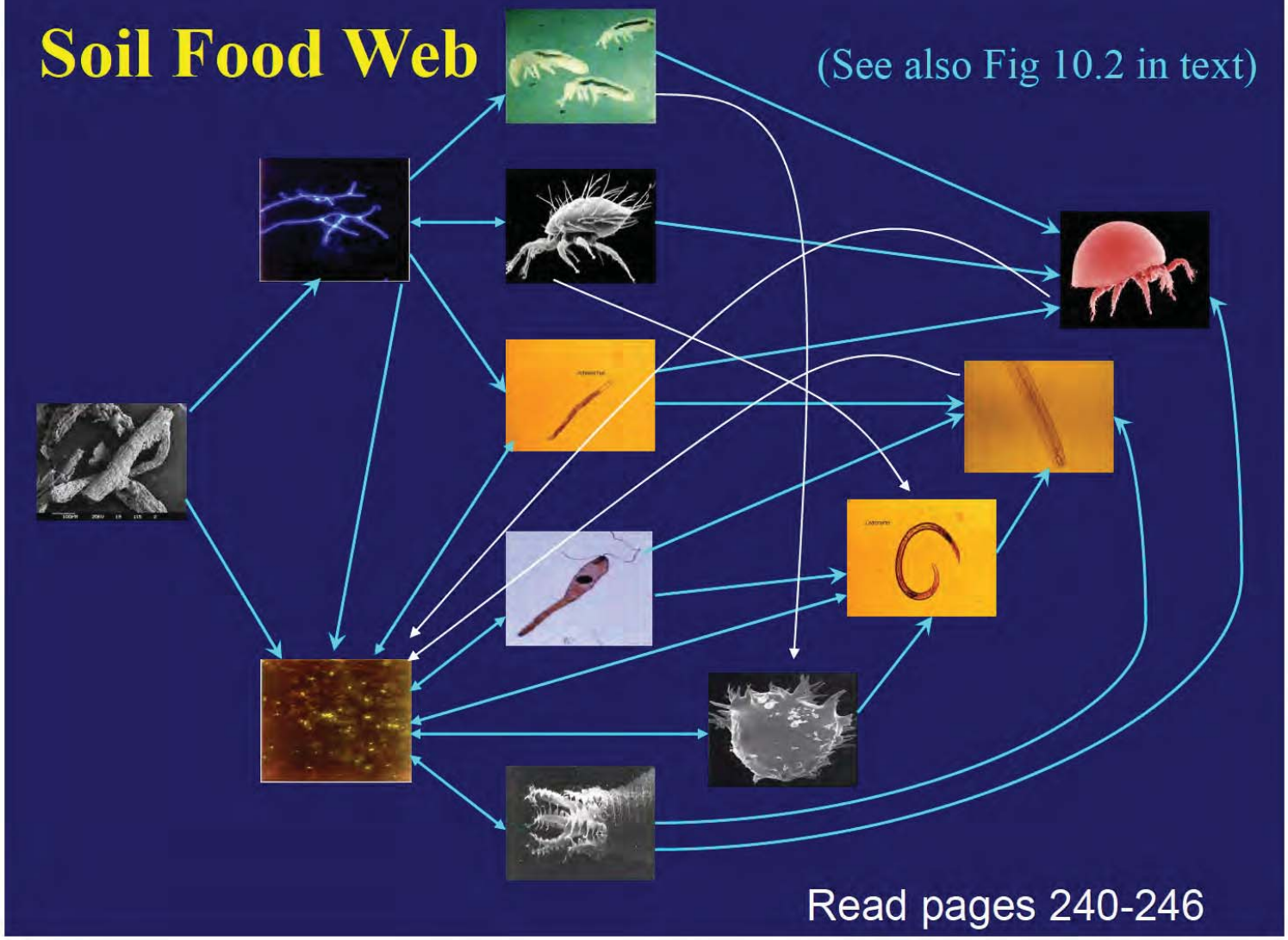


bacteria

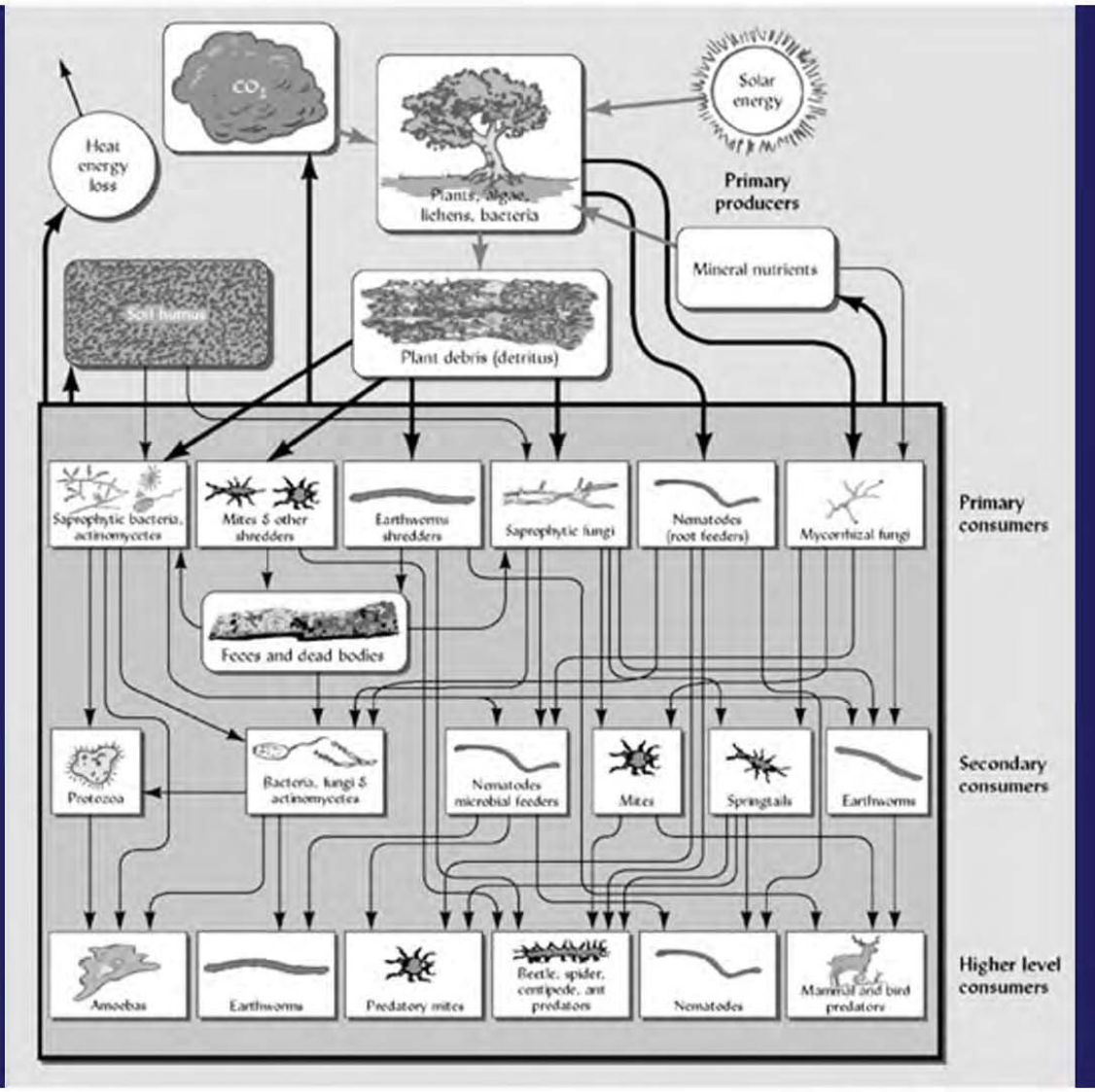
fungi

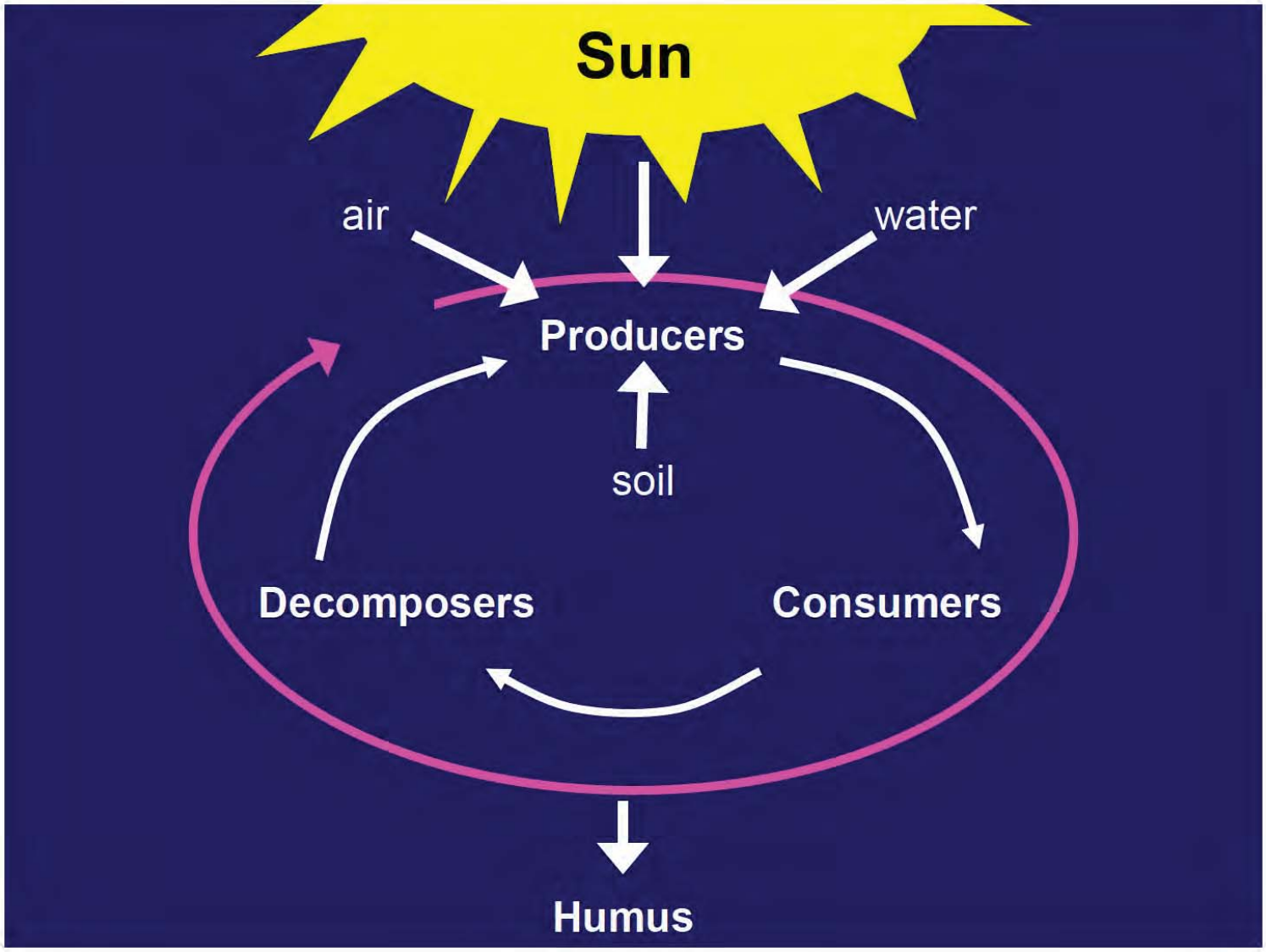
Soil Food Web

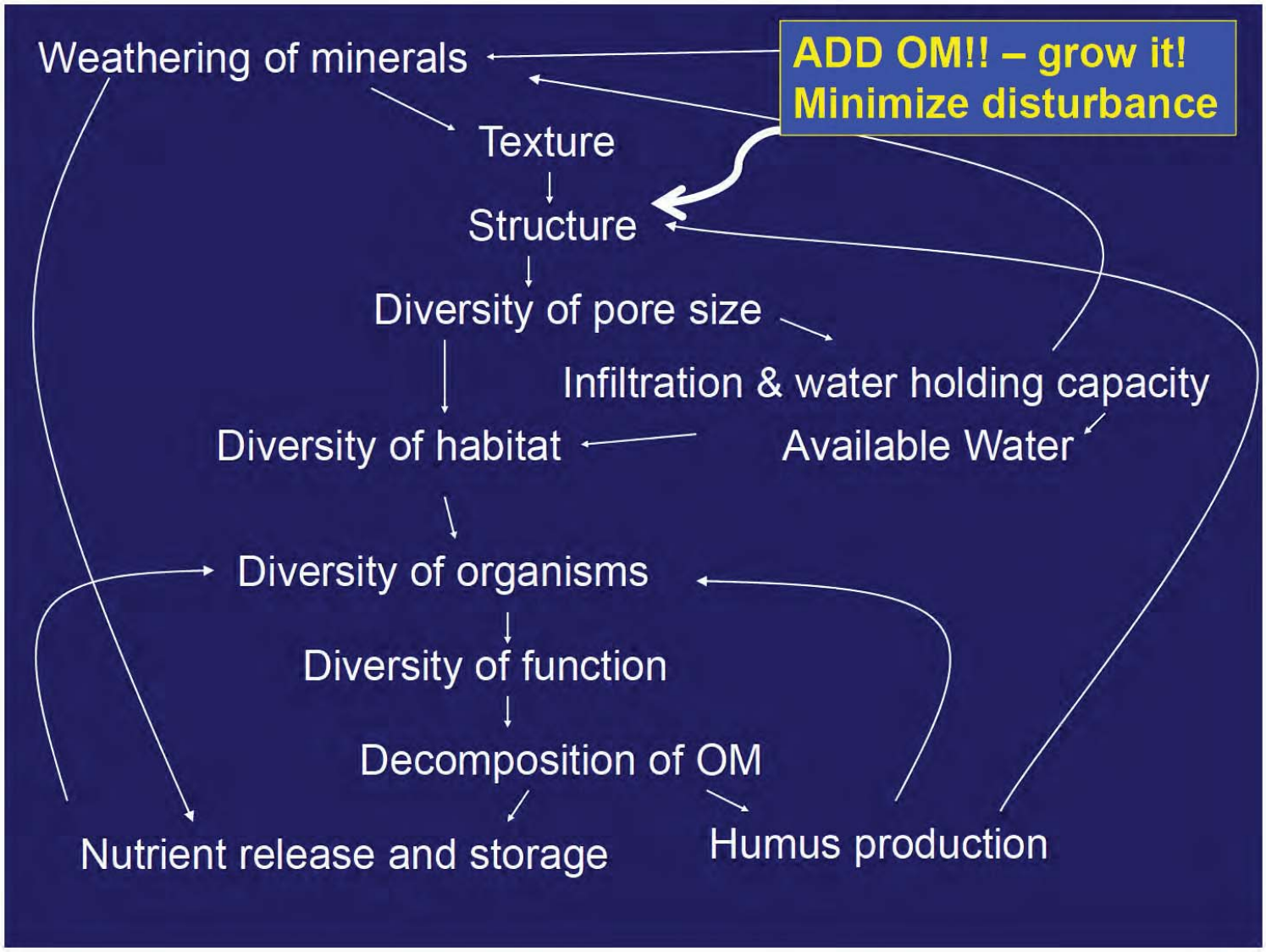
(See also Fig 10.2 in text)



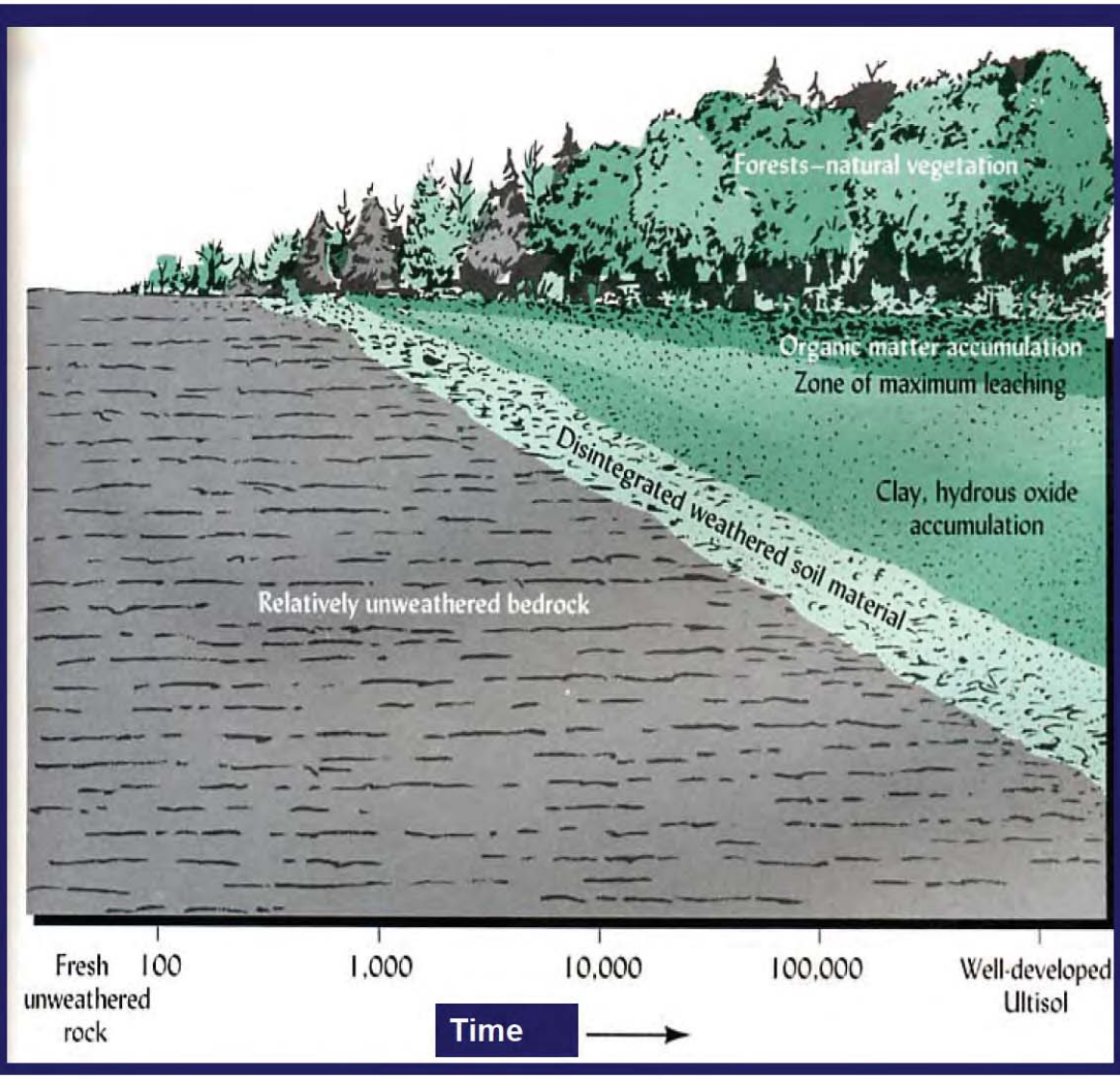
Read pages 240-246

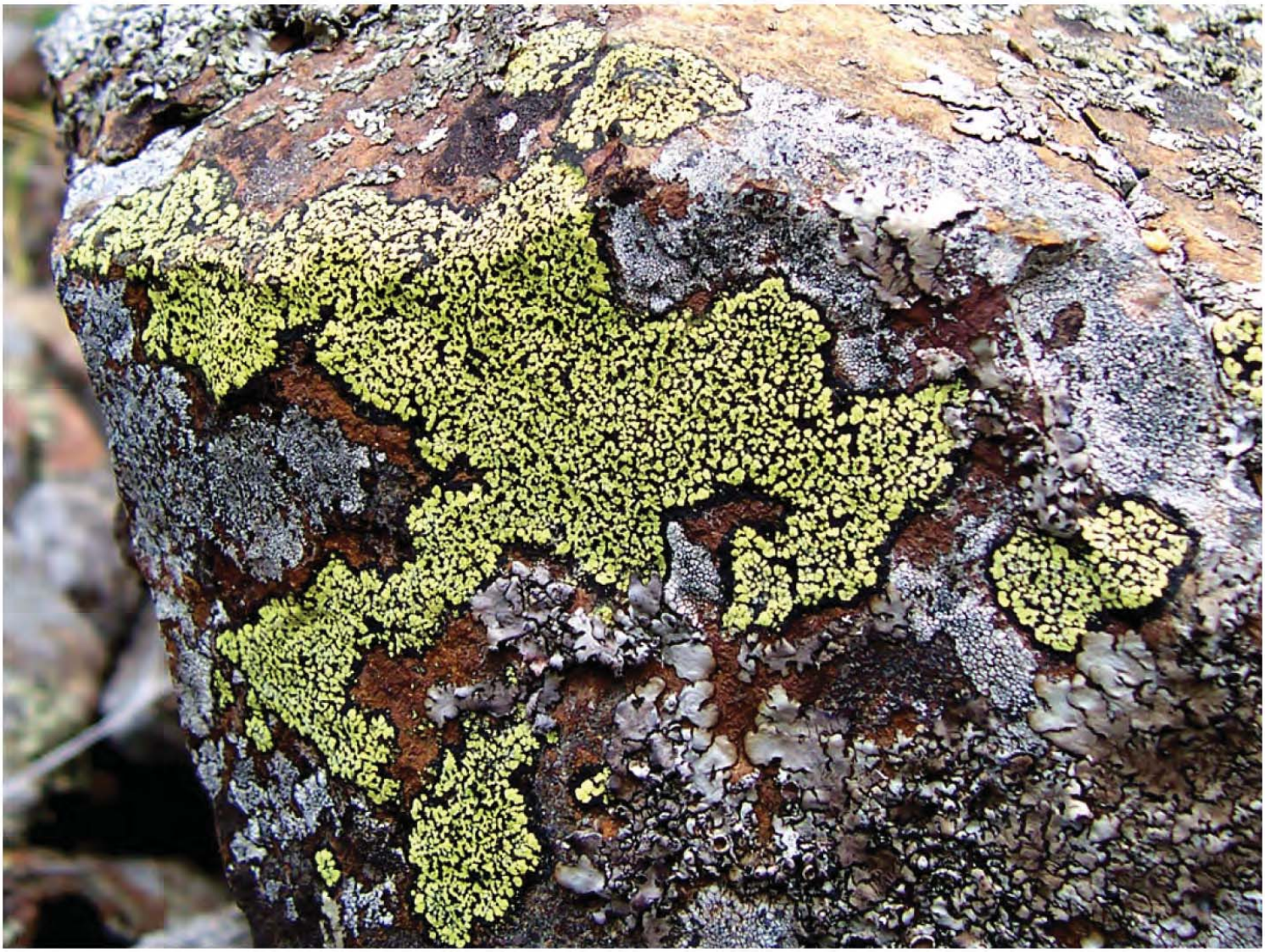

CO_2
Heat energy loss
Solar energy
Plants, algae, lichens, bacteria
Primary producers
Mineral nutrients
Soil humus
Plant debris (detritus)
Saprophytic bacteria, actinomycetes
Mites & other shredders
Earthworms shredders
Saprophytic fungi
Nematodes (root feeders)
Mycorrhizal fungi
Primary consumers
Feces and dead bodies
Protozoa
Bacteria, fungi & actinomycetes
Nematodes microbial feeders
Mites
Springtails
Earthworms
Secondary consumers
Amoebas
Earthworms
Predatory mites
Beetle, spider, centipede, ant predators
Nematodes
Mammal and bird predators
Higher level consumers


Sun
air
water
Producers
soil
Decomposers
Consumers
Humus


Weathering of minerals
ADD OM!! – grow it!
Minimize disturbance
Texture
Structure
Diversity of pore size
Infiltration & water holding capacity
Diversity of habitat
Available Water
Diversity of organisms
Diversity of function
Decomposition of OM
Nutrient release and storage
Humus production


Soil is habitat!


Forests–natural vegetation
Organic matter accumulation
Zone of maximum leaching
Clay, hydrous oxide accumulation
Disintegrated weathered soil material
Relatively unweathered bedrock
Fresh unweathered rock
100
1,000
10,000
100,000
Well-developed Ultisol
Time




Soil!