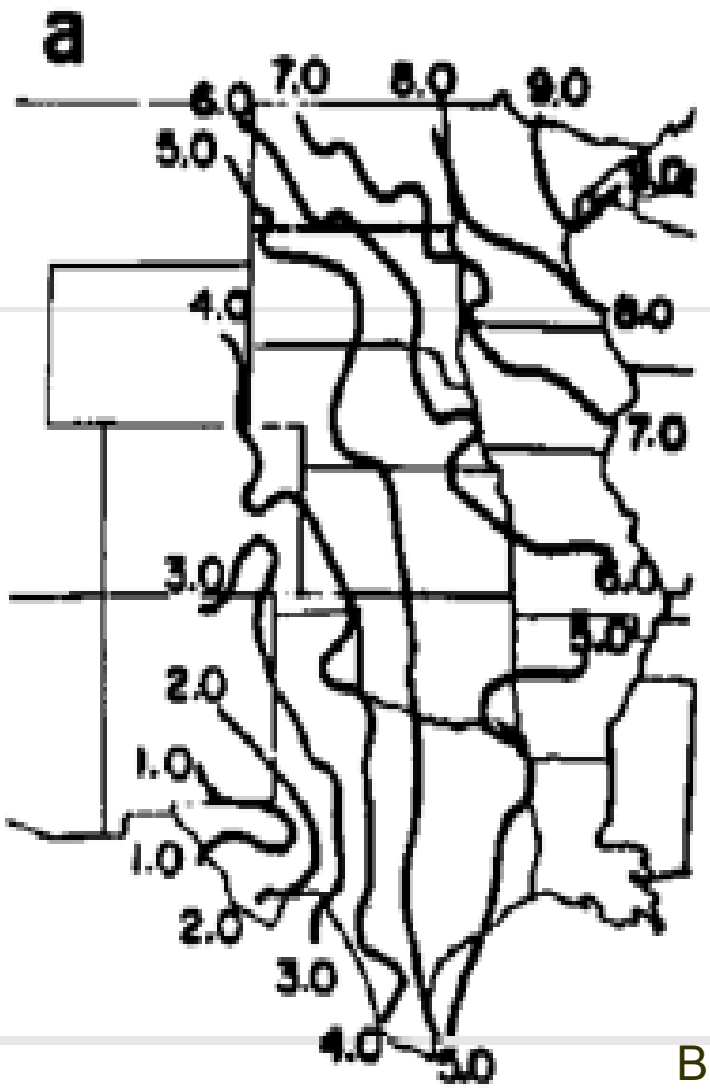
Pasture Soil Health

Doug Peterson
Missouri NRCS

Historical Soil Information

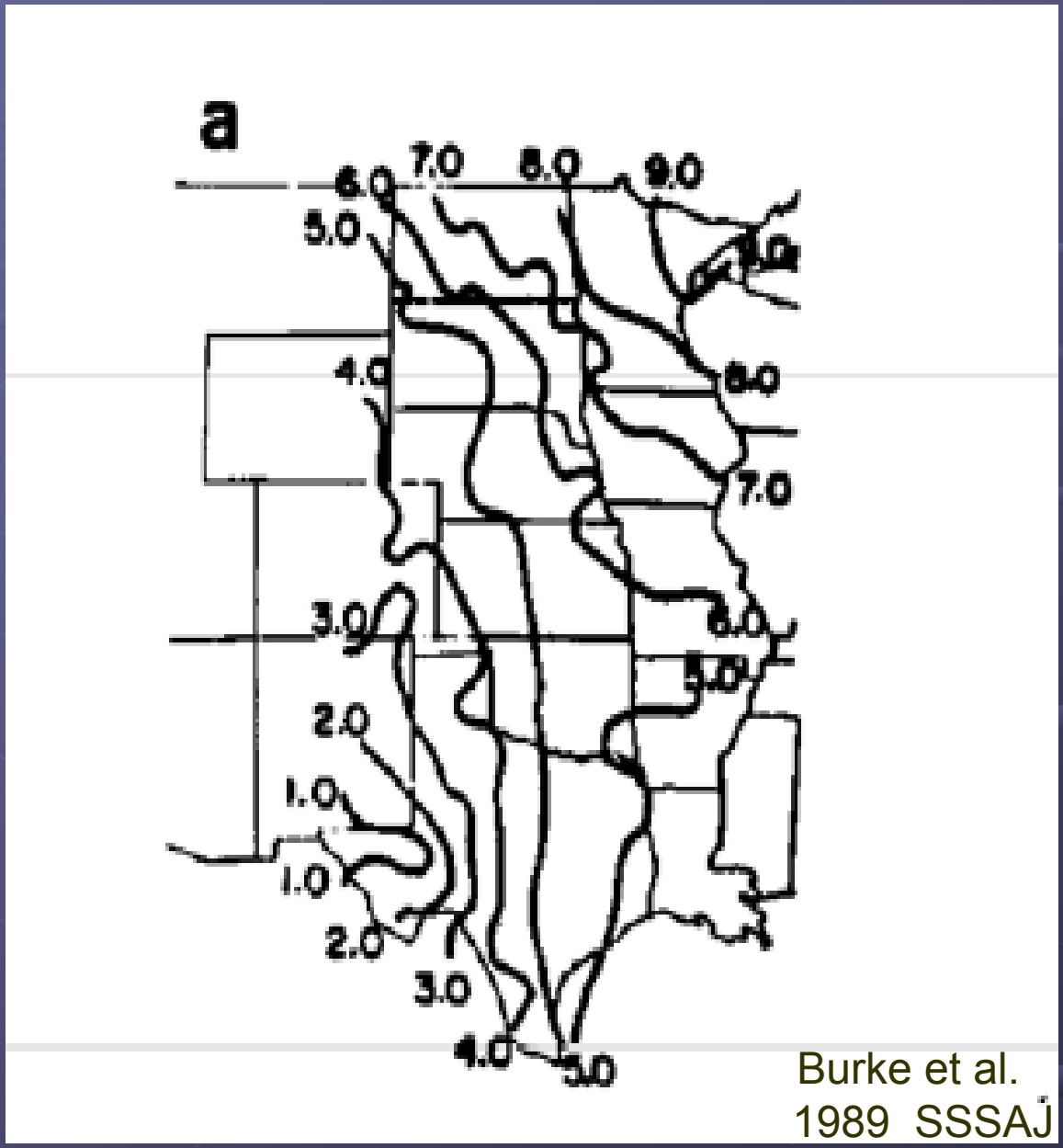
- **Western Coastal Plain**
- **Southern Mississippi Valley Alluvium**
- **Ozark Highland**
- What are the differences in organic matter in a forest soil and a grassland soil?
- What really determines our potential SOM?
- What do most of your soil tests show today?

Soil Organic Carbon



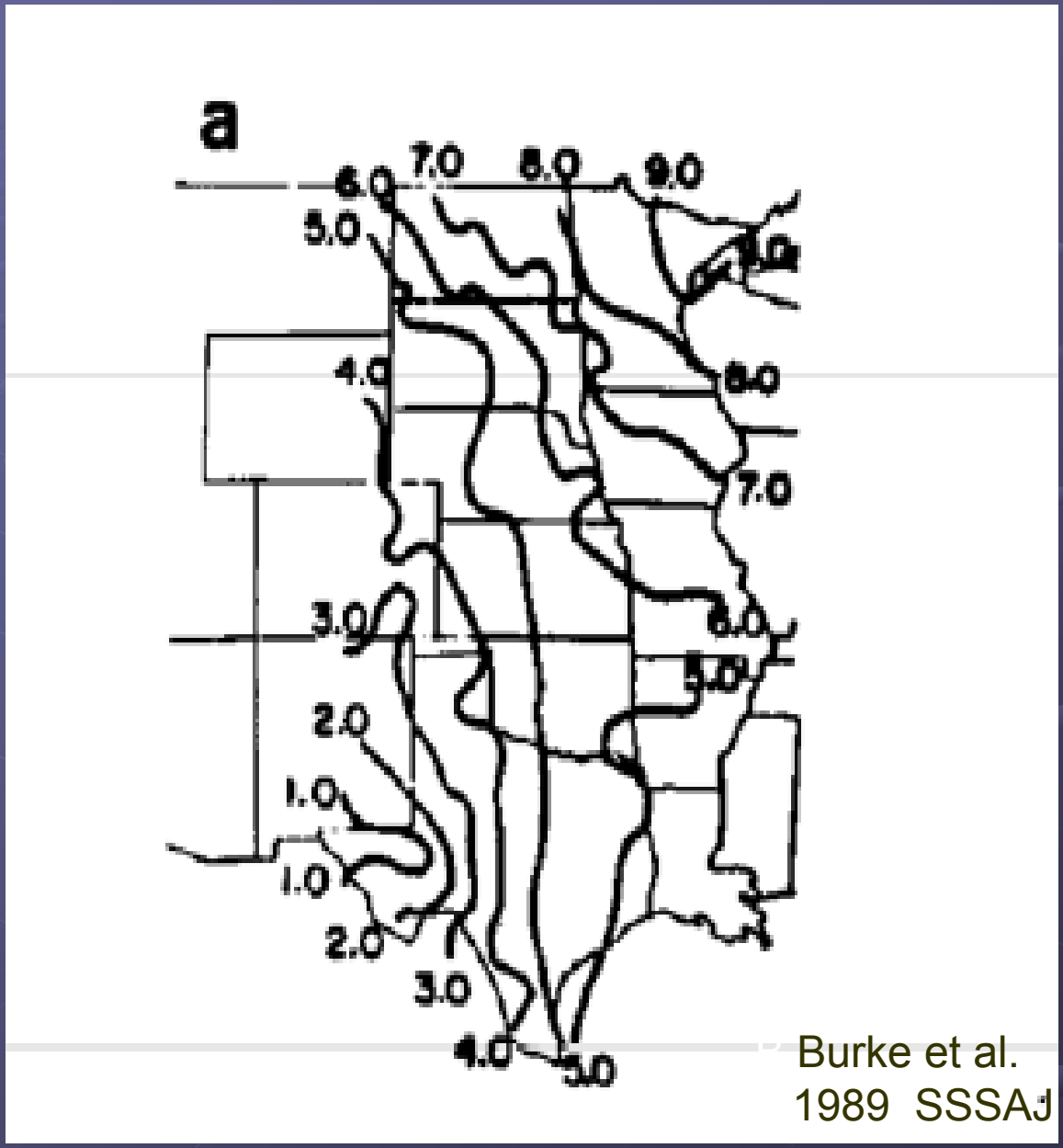
Burke et al. 1989 SSSAJ

Soil Organic Matter is 58% SOC



Burke et al.
1989 SSSAJ

5% SOC divided by 58% = 8.6% OM



Burke et al.
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“The southeastern United States is a region of high potential productivity based on favorable climatic conditions, eg., mild winters, hot summers, and plentiful precipitation. Soil acidity, low water holding capacity, and low nutrient-supplying capacity are conditions that limit productivity but that can be over come with management to increase soil organic matter.”

Alan Franzluebbers
USDA-ARS
Watkinsvile GA

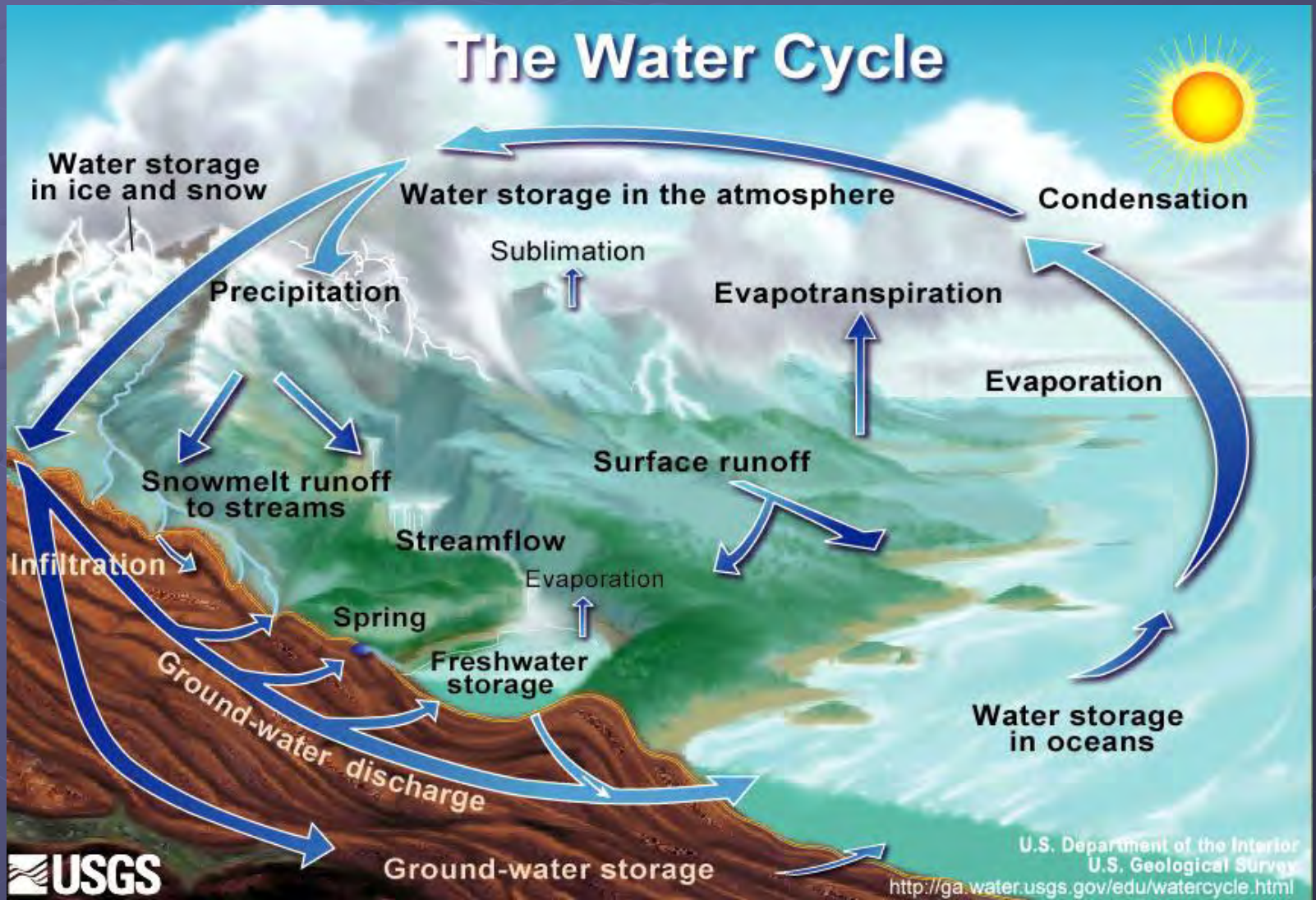
What is the most limiting natural resource in your forage production system?

Sunshine?

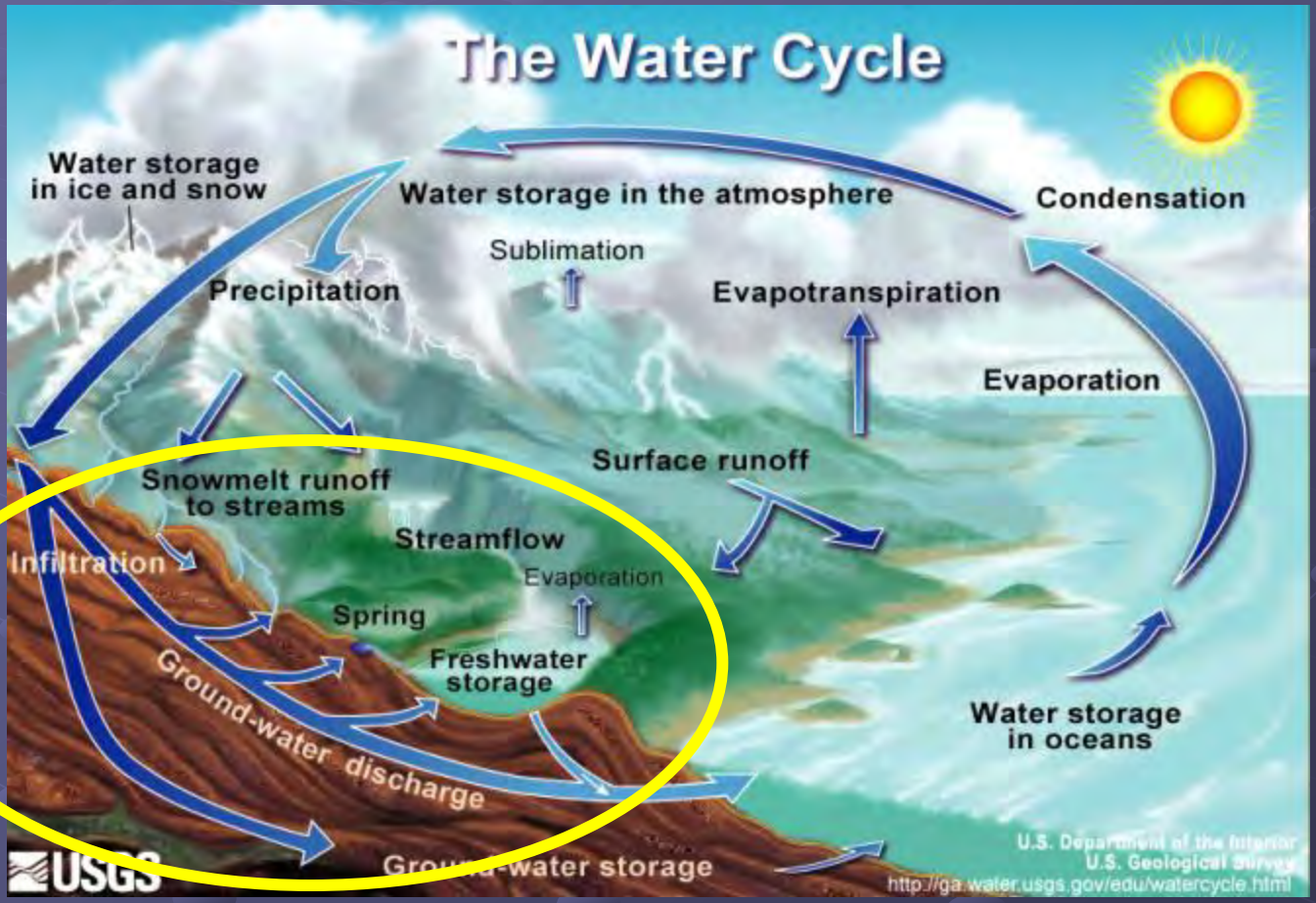
Minerals?

Water?

What is the most important item in the water cycle???

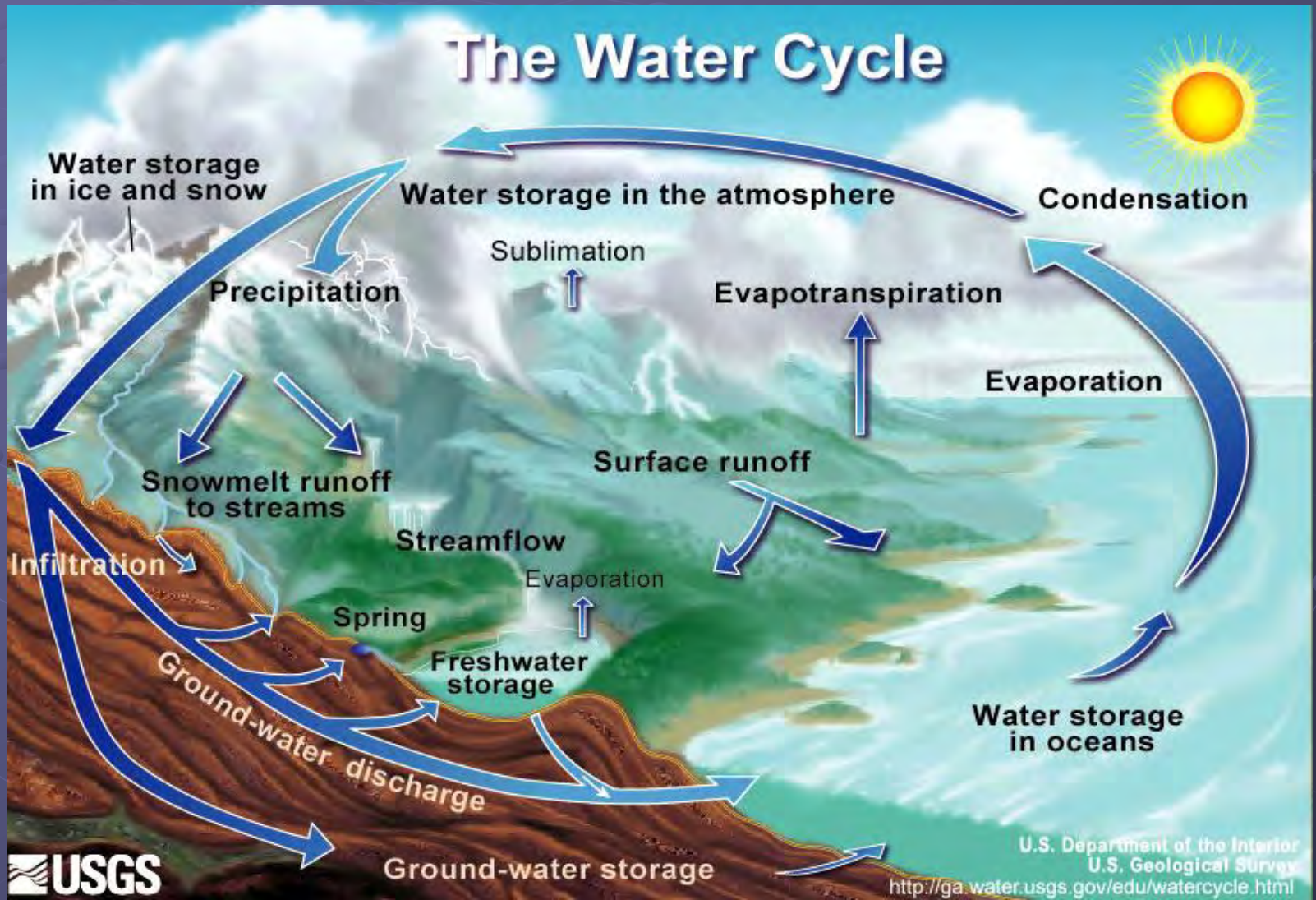


Let's consider the most important soil function—The role of soil in the global water cycle.



Infiltration, percolation, and groundwater recharge are the key components.

The Water Cycle
-Is it broken?



Ranching/Farming in the 21st Century
-a practical approach to soil health

- Manage more by disturbing less
- Diversity is Critical
- Feed your soil livestock with living roots all year long
- Keep the soil covered

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Manage more by disturbing less

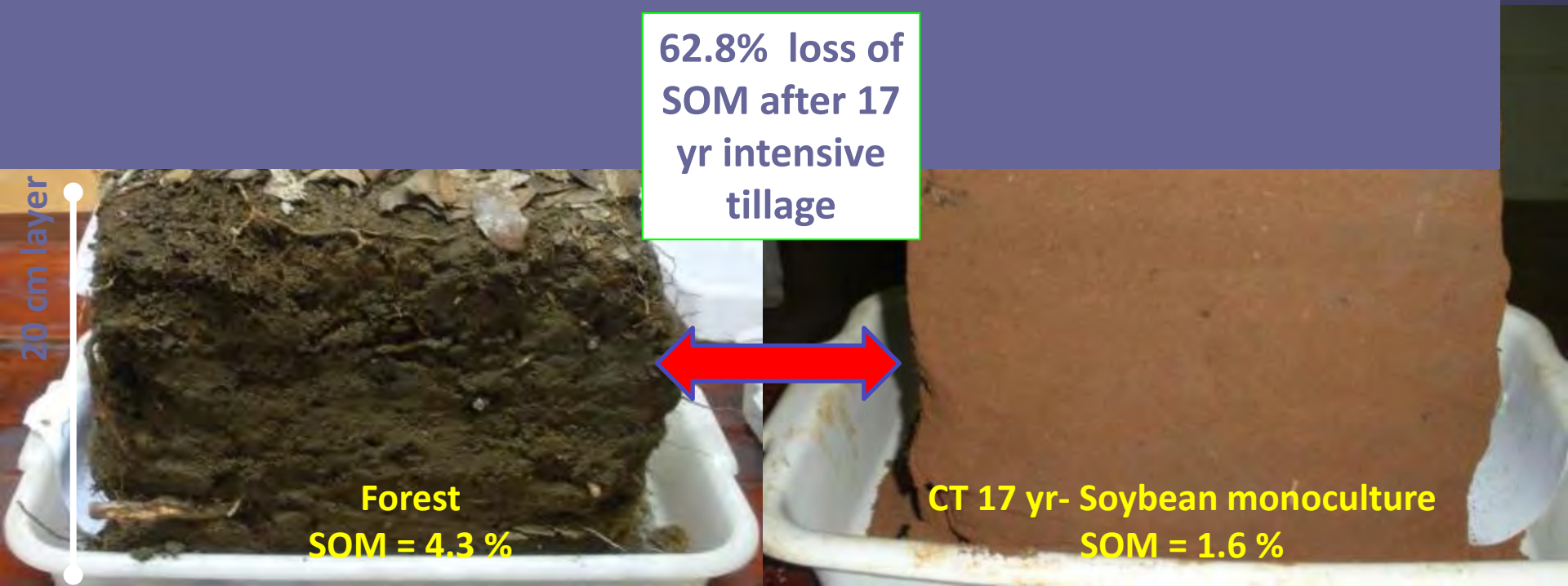
- Physical Disturbance
- Chemical Disturbance

This is the same soil- What happened?

Dynamic properties depend both on land management and inherent properties of the soil:

- organic matter,
- soil structure,
- infiltration rate,
- bulk density,
- and water and nutrient holding capacity.

62.8% loss of SOM after 17 yr intensive tillage



Chemical disturbances: excessive or repeated applications of pesticides, fertilizers and manures

Soil Health

- If we want our natural mineral cycle to be healthy and functioning we have to understand how everything effects it including the use of chemical fertilizers
- Chemical fertilizers can nourish plants but certain fertilizers have a detrimental effect on certain soil microorganisms.
- Some chemical fertilizers are actually acidifying the soil.

Soil Health

"Every chemical-based pesticide, fumigant, herbicide and fertilizer tested, harms or outright kills some part of the beneficial life that exists in the soil, (or on the leaf surfaces) even when applied at rates recommended by their manufacturers... Less than half of the existing active ingredients used as pesticides have been tested for their effects on soil organisms."

Dr. E. Ingham, 2002, Soil Food Web, Oregon State University

But….

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What does diversity really mean?

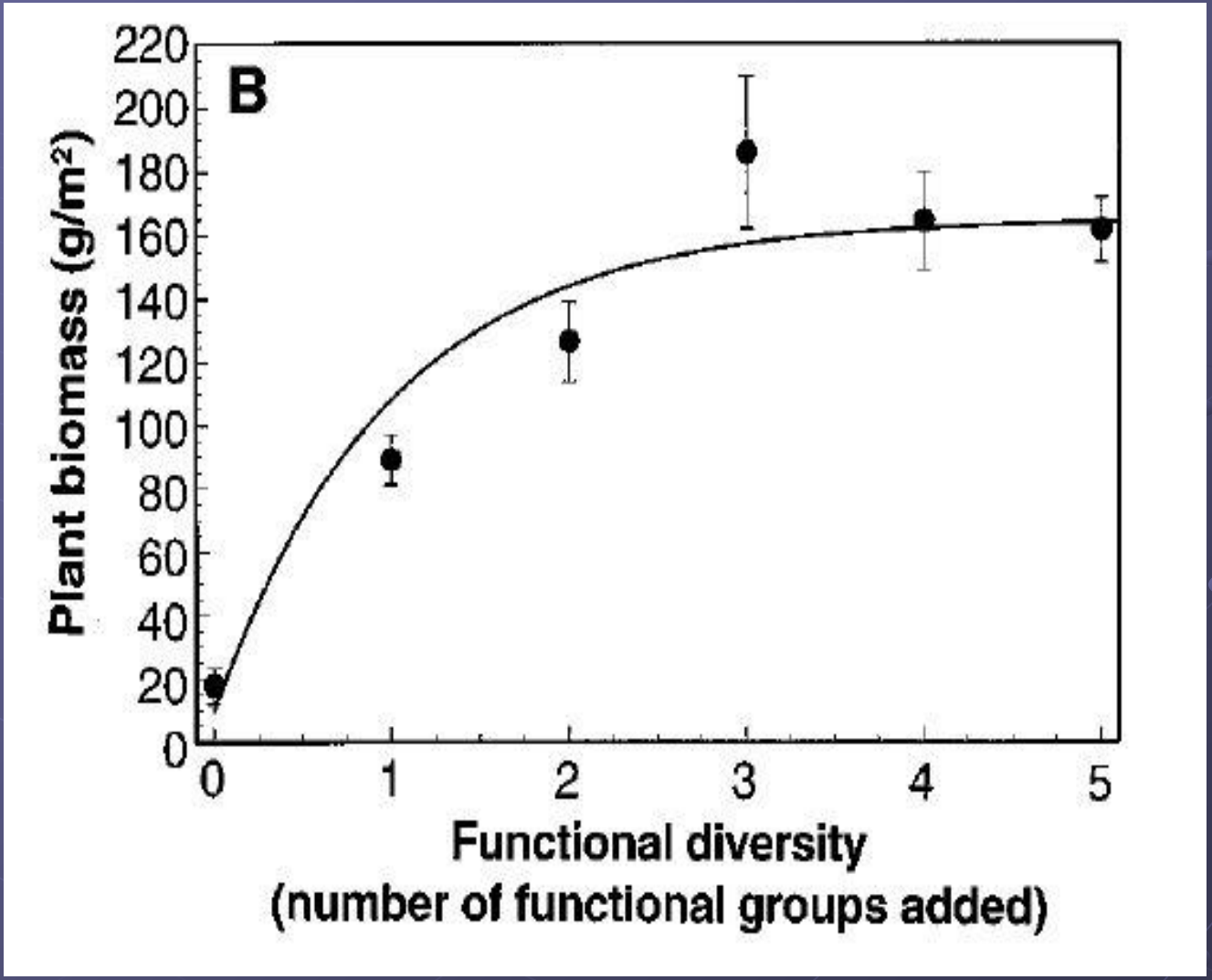
Cool Season Grass

Warm Season Grass

Cool Season Broadleaf

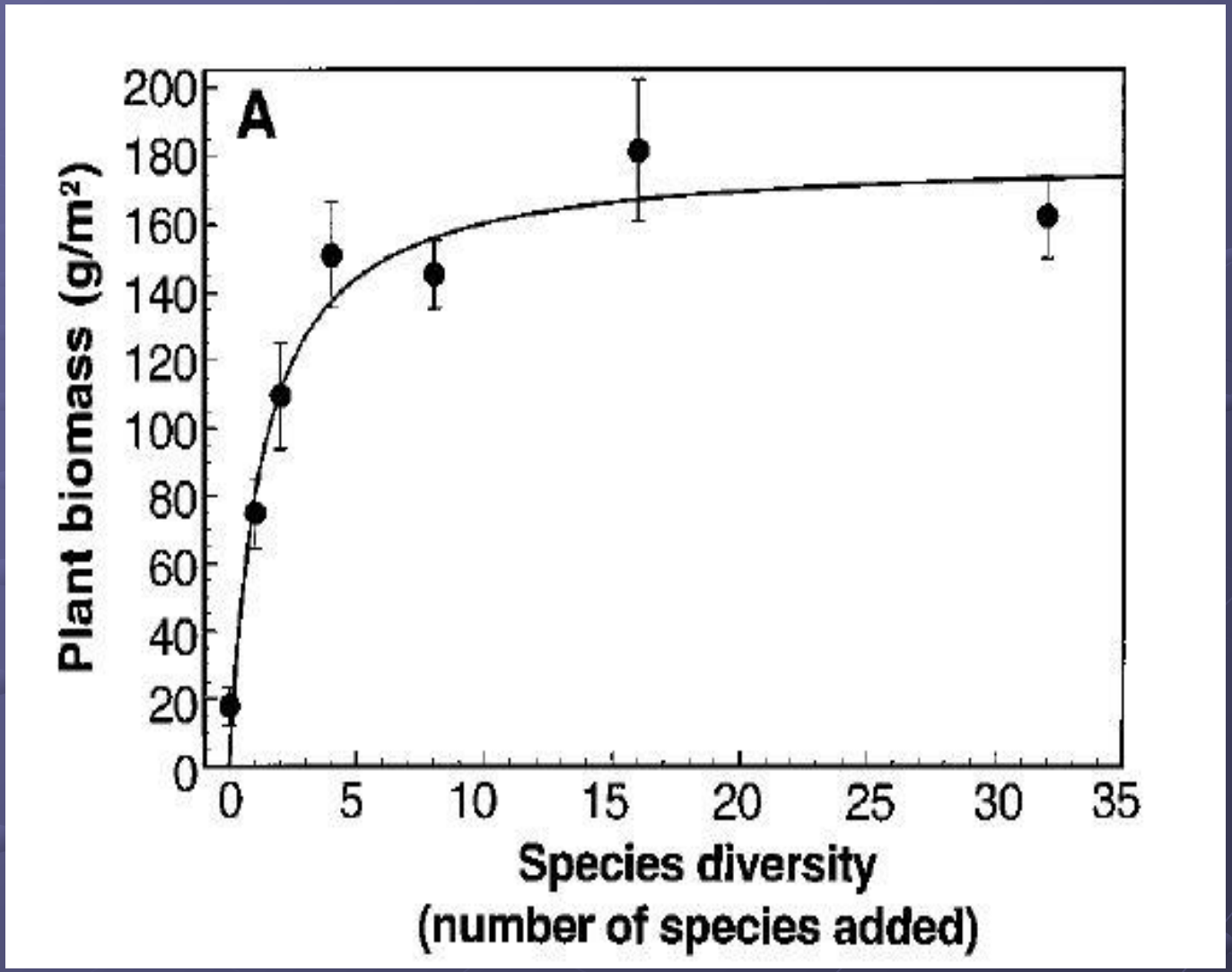
Warm Season Broadleaf

The Influence of Functional Diversity and Composition on Ecosystem Processes



David Tilman,* Johannes Knops, David Wedin, Peter Reich, Mark Ritchie, Evan Siemann

The Influence of Functional Diversity and Composition on Ecosystem Processes



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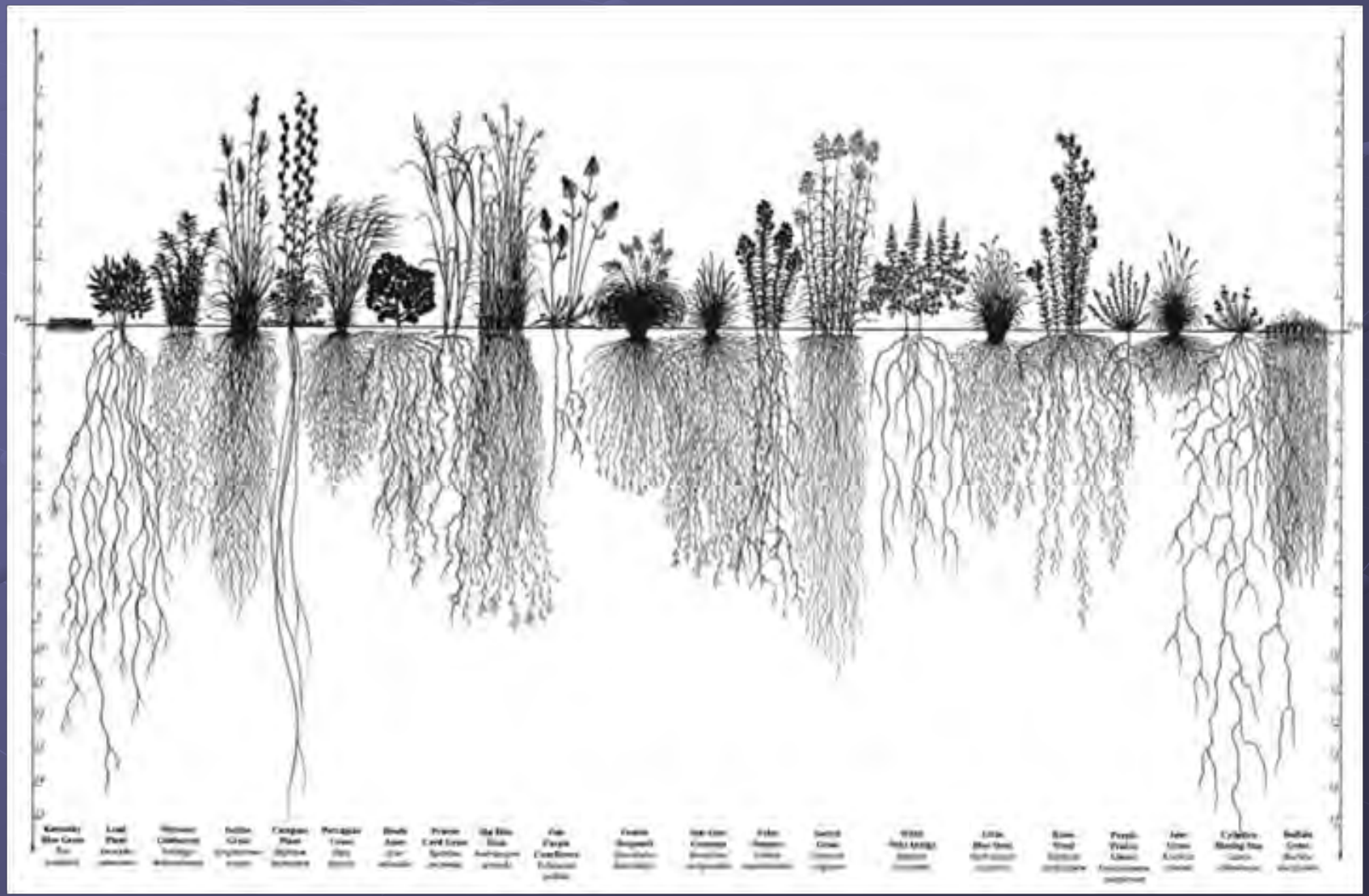
Diversity

- C3 plants flourish in cool, wet, and cloudy climates, where light levels may be low, because the metabolic pathway is more energy efficient if water is plentiful.

Diversity

- C4 plants, which inhabit hot, dry environments, have very high water-use efficiency, so that there can be up to twice as much photosynthesis per gram of water as in C3 plants, but C4 metabolism is inefficient in shady or cool environments.

Root Diversity



The answer is to imitate the Native Prairie

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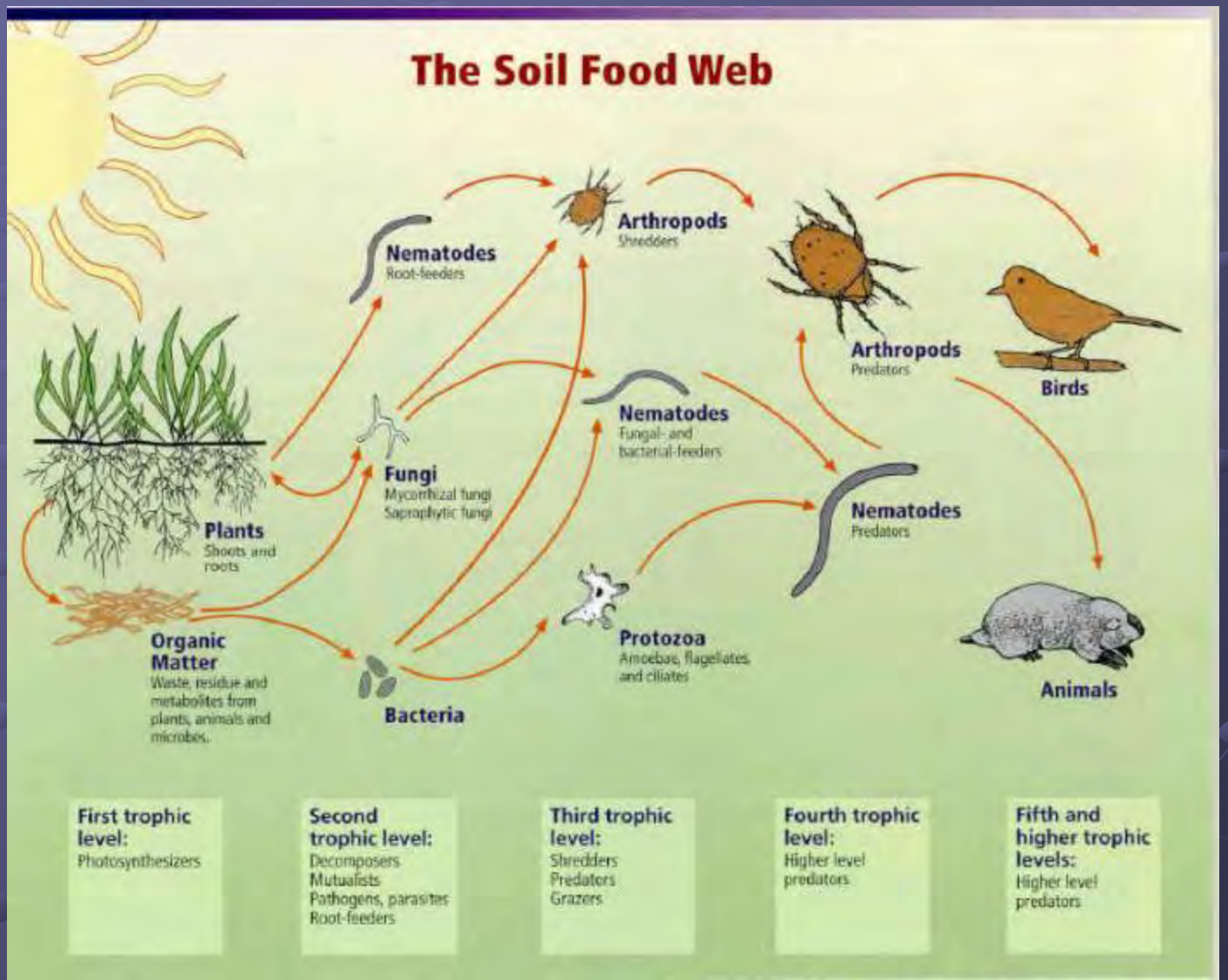
The Soil is alive!



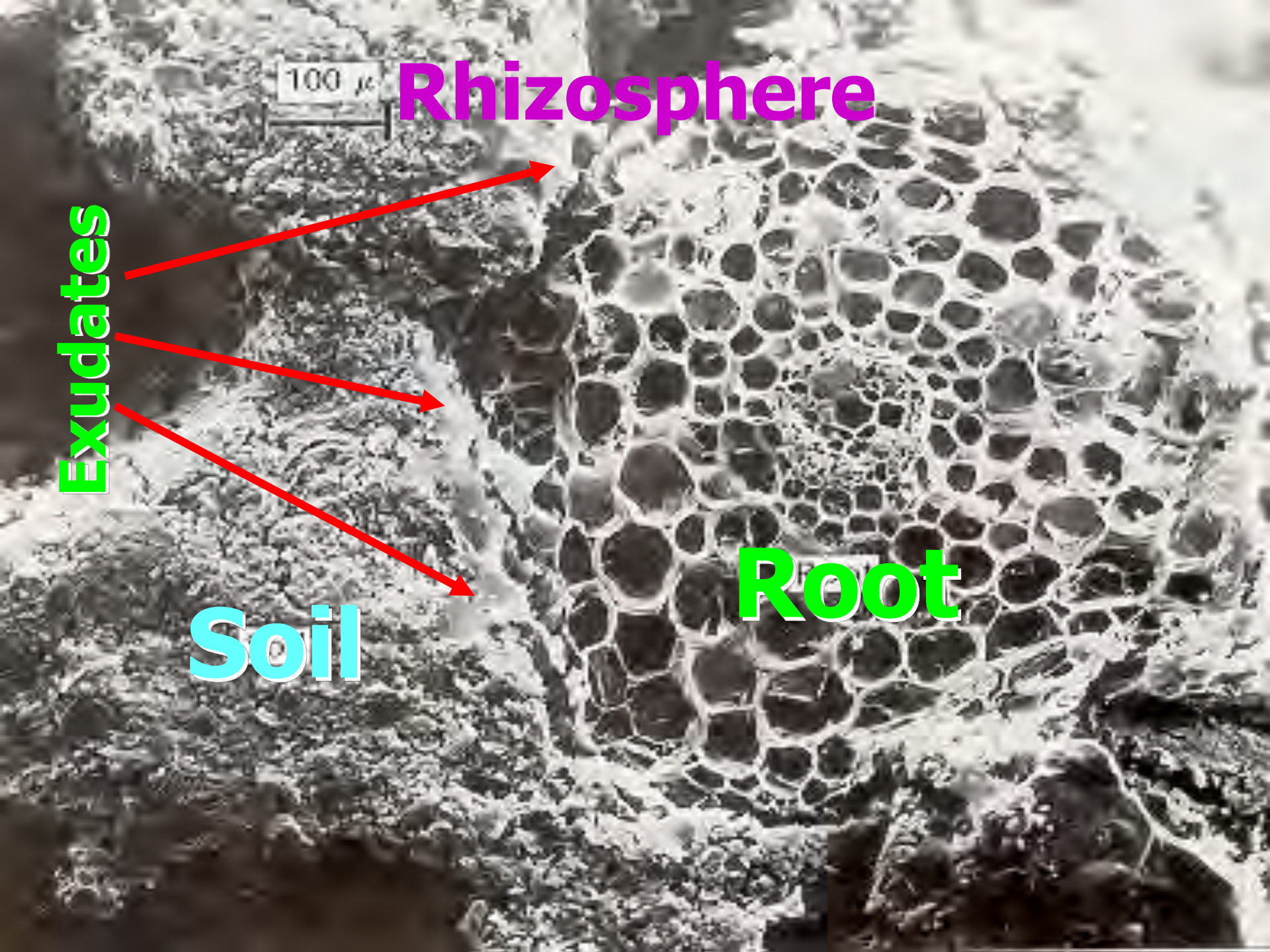
Soil Health

Type of Organism	number/acre	pounds/acre
Bacteria	800,000,000,000,000,000,000	2,600
Actinobacteria	20,000,000,000,000,000	1,300
Fungi	200,000,000,000,000	2,600
Algae	4,000,000,000	90
Protozoa	2,000,000,000,000	90
Nematodes	80,000,000	45
Earthworms	40,000	445
Insects /arthropods	8,160,000	830

Soil Food Web

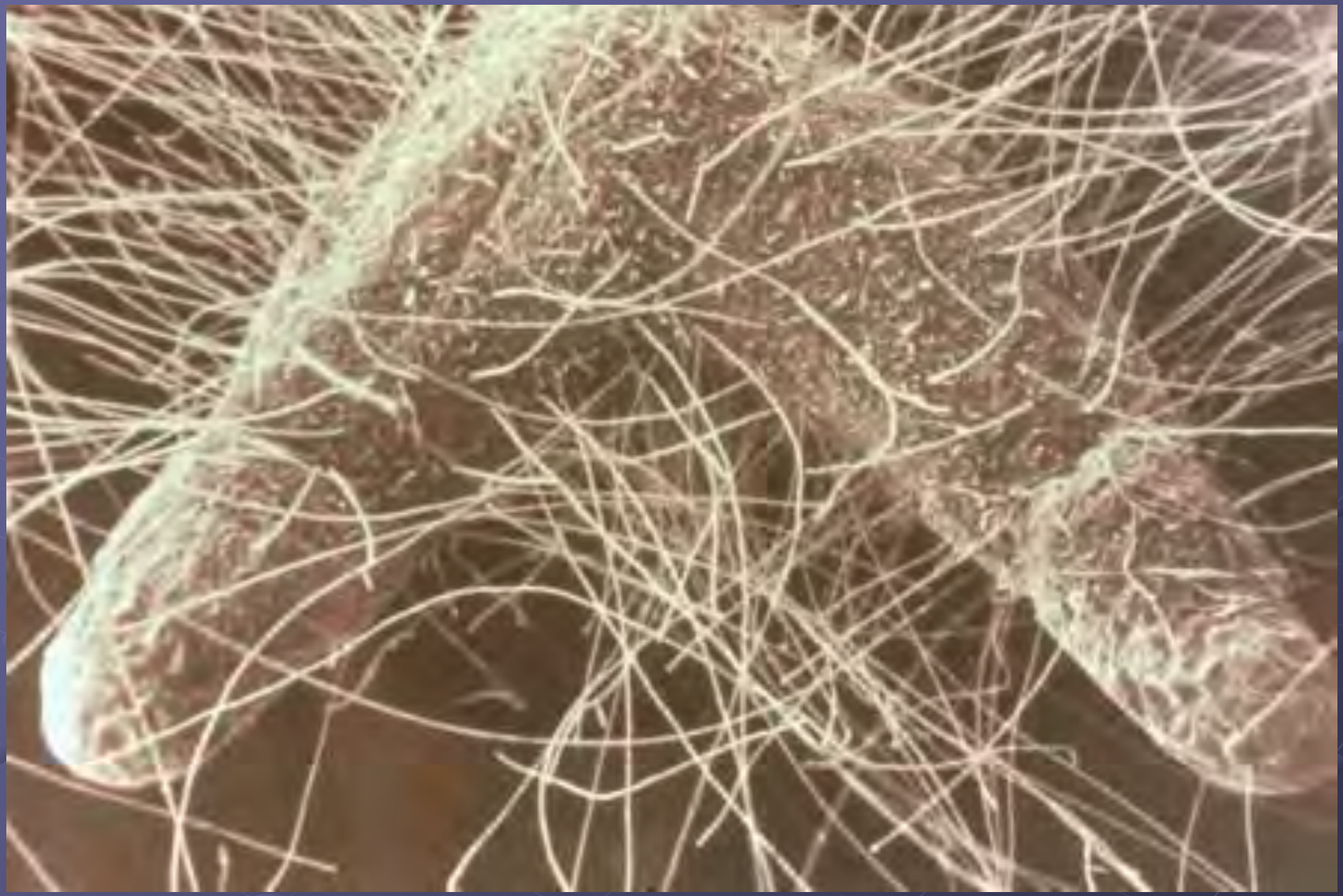
Rhizosphere

Living roots release many types of organic materials into the rhizosphere around the surface of the root

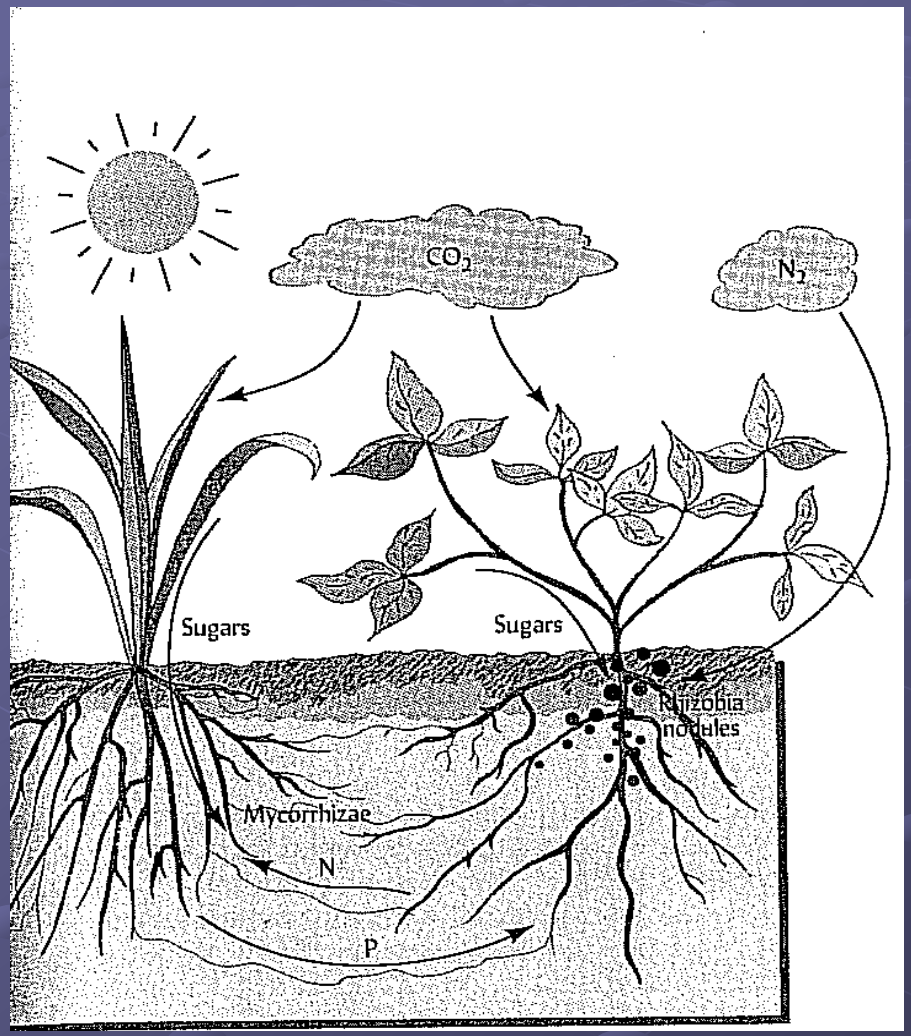

100 µ
Rhizosphere
Exudates
Root
Soil

Rhizosphere

The number of organisms in the rhizosphere is up to 2000 times higher than in the rest of the soil.



Plants Interacting with Mycorrhizal Fungi



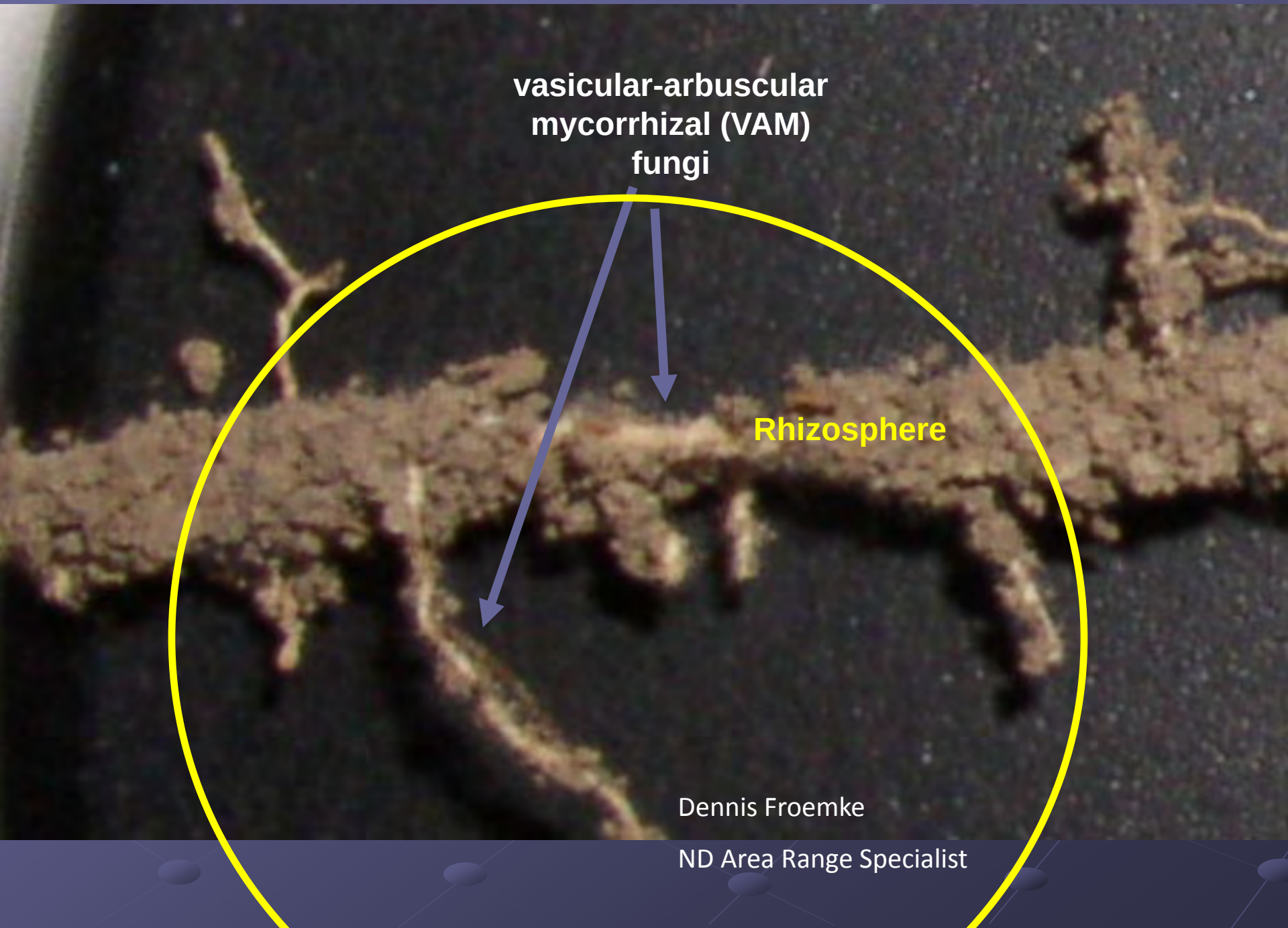
- Assists with P uptake from the soil
- Moves P from the non-legume plant to the legume plant
- Moves N from the legume plant to the non-legume plant

The Nature and Property of Soils, Brady and Weil

Fantastic Voyage into the Soil Ecosystem

Dennis Froemke

ND Area Range Specialist



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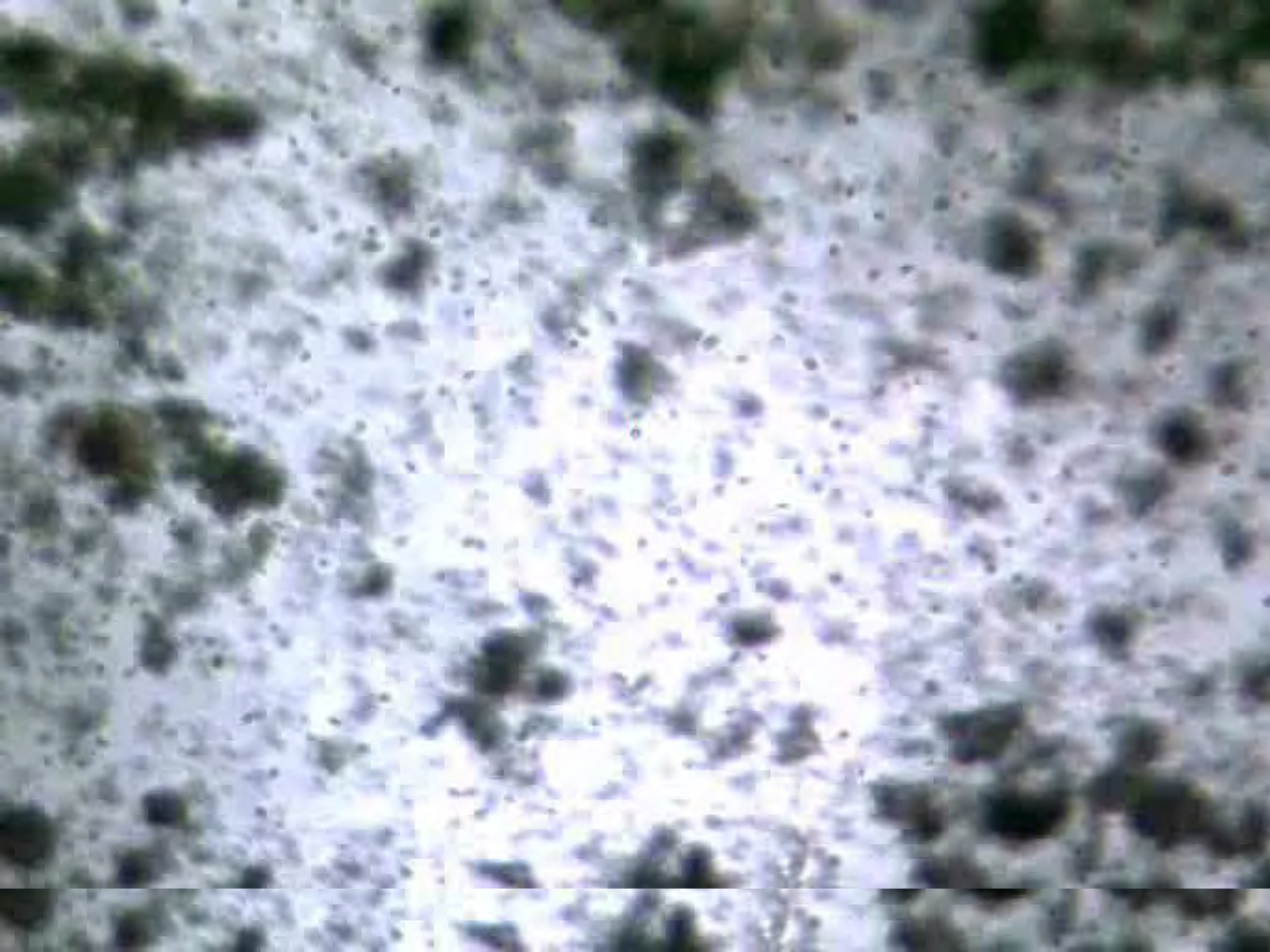

“There are more living creatures in a shovel full of rich soil than human beings on the planet. Yet more is known about the dark side of the Moon than about soil”.

(Source: The Secrets of Soil. Smithsonian’s Soil Exhibition, Museum of Natural History, Washington D.C.).

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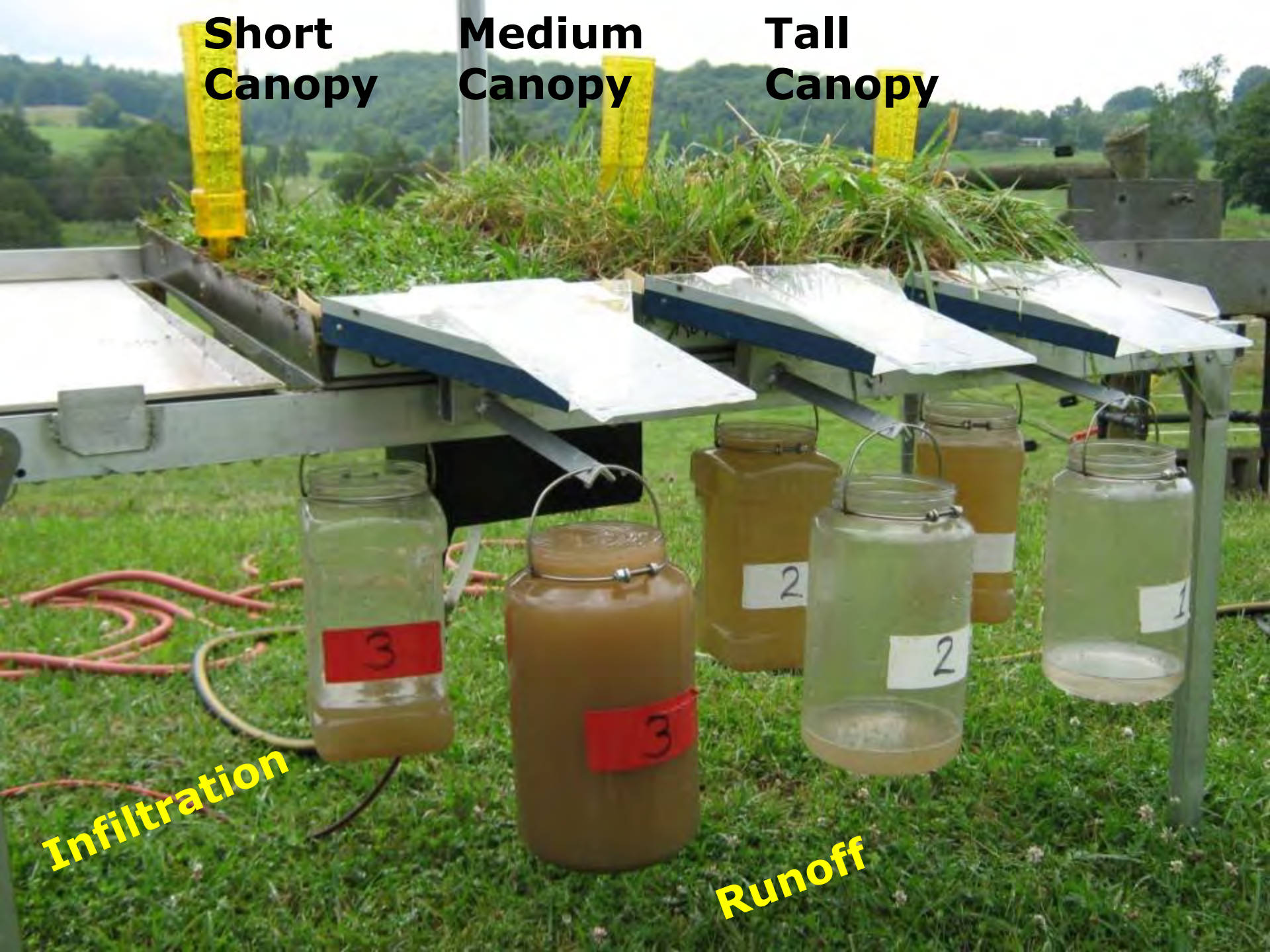
Short Canopy
Medium Canopy
Tall Canopy
3
3
2
2
1
Infiltration
Runoff


912F
06/28/2010


GENERAL
770F
06/28/2010

When soil temp reaches. . .

140° F	Soil bacteria die
130° F	100% moisture lost through evaporation & transpiration
100° F	15% moisture is used for growth 85% moisture lost through evaporation & transpiration
70° F	100% moisture is used for growth

J.J. Mc Entre, USDA SCS, Kerrville, TX, 1956

The quality of our lives depends on
the food we eat
the water we drink
and the air we breath.

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the food we eat
the water we drink
and the air we breath.

All of those things depend on
the quality of the **SOIL**.

Charles Kome

Where to find Soil Health information

- http://soils.usda.gov/sqi/concepts/soil_biology/soil_food_web.html
- http://www.soilhealth.com/
- http://www.pasturemanagement.com/index.htm
- http://www.holisticmanagement.org/index.html
- http://www.carbonfarmersofamerica.com/
- http://managingwholes.com/new-topsoil.htm
- www.bcscd.com
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