

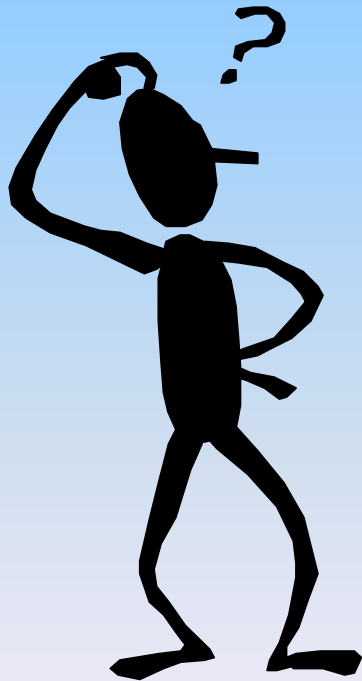
Organic Matter

The key to healthy soils

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Are these
problems or
symptoms?

compact soil



low nutrient levels

droughty

many pest problems

erosion and runoff

Symptoms

compact soil

low nutrient levels

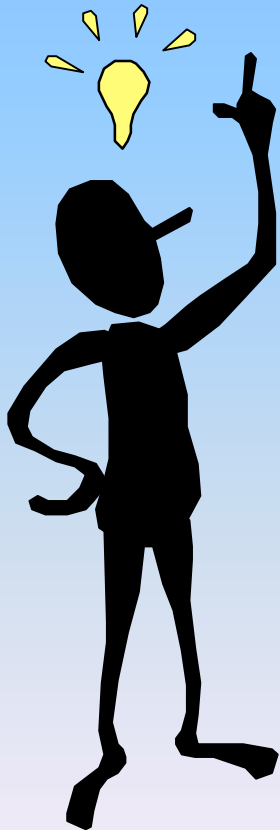
droughty

many pest problems

erosion and runoff

Problem

Degraded and
unhealthy soil



*Why are soils which in our
father's hands were
productive now relatively
impoverished?*

*The depletion of the soil
humus supply is apt to be
a fundamental cause of
lowered crop yields.*

—J.H. Hills, C.H. Jones, and C.
Cutler, 1908

Soil organic matter and
its management are at
the heart of soil health

Characteristics of Healthy Soils

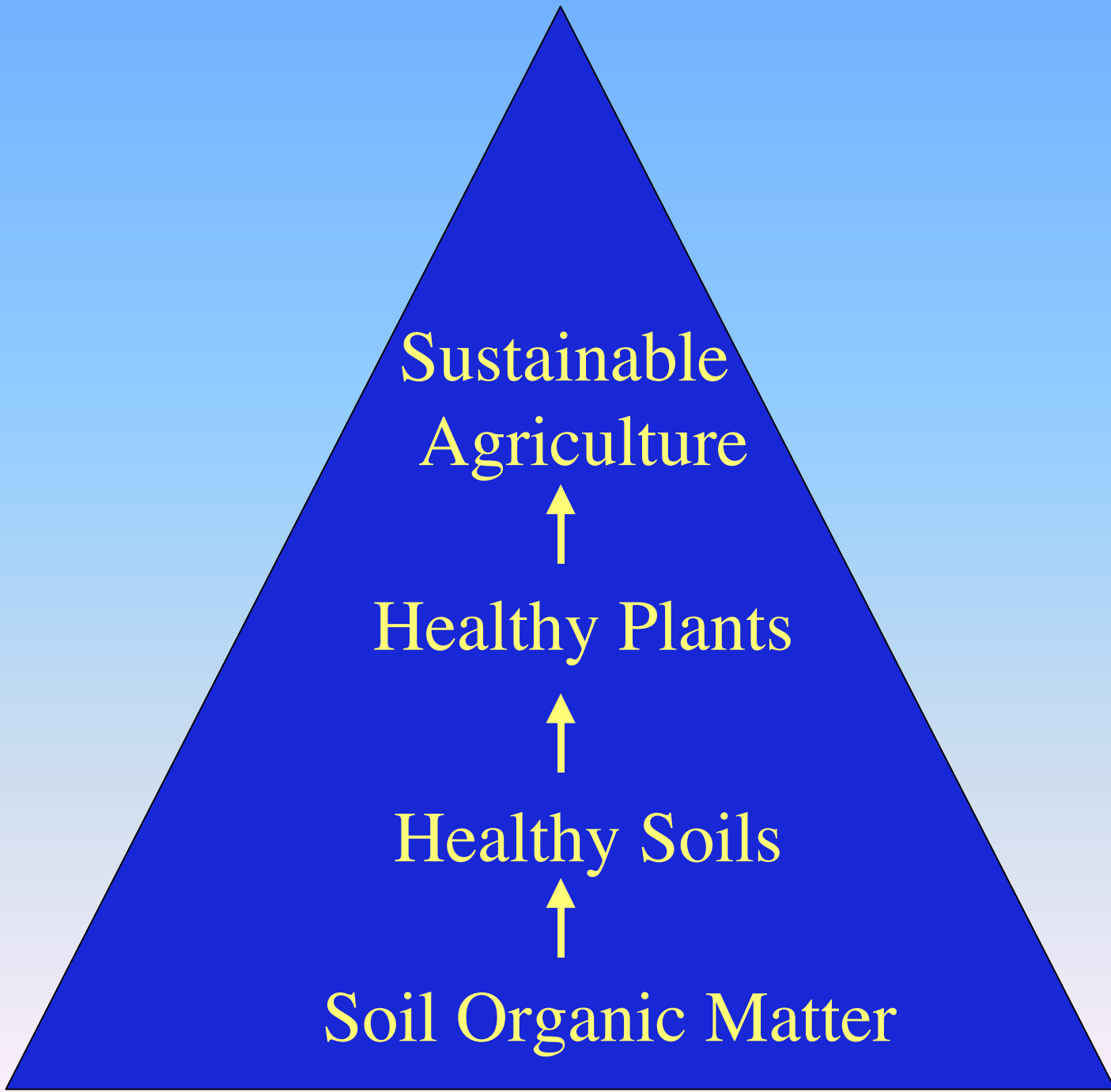
- Sufficient (but not excess) nutrients
- Good tilth
- Sufficient depth
- Good water storage and drainage
- Free of chemicals that might harm plants



Characteristics of Healthy Soils

- Low populations of plant disease and parasitic organisms
- High populations of organisms that help plant growth
- Low weed pressure
- Resistance to being degraded
- Resilience





Sustainable
Agriculture



Healthy Plants



Healthy Soils



Soil Organic Matter

There are three general
"types" of organic matter in soils

- ✓ Living
- ✓ Dead
- ✓ Very Dead

plant roots

bacteria

nematodes

—Living—

fungi

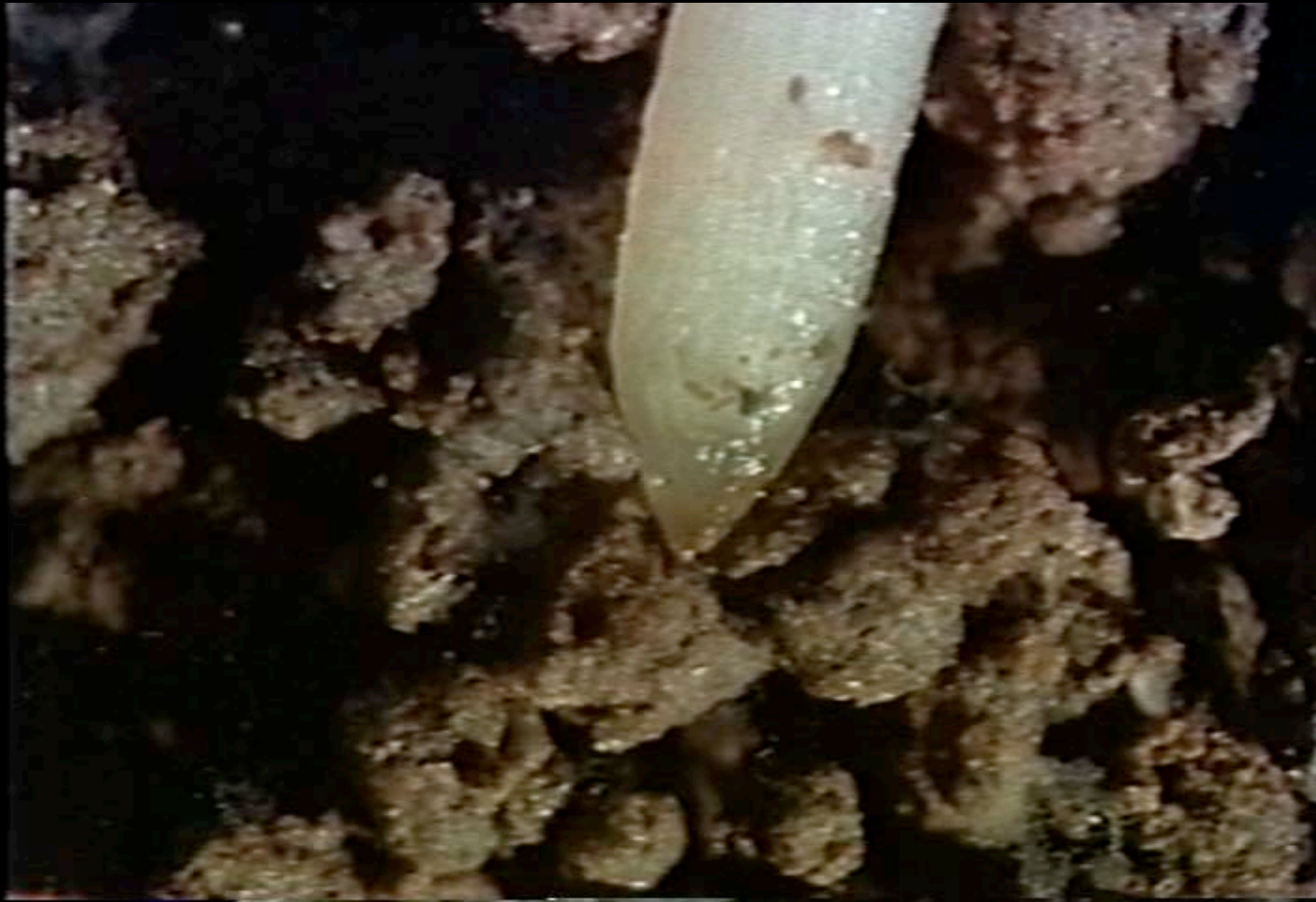
earthworms

mites

springtails

moles





[Watch Organic Matter Movies on youtube](#)

Soil ecology in balance
Tighter system
More fluid / greater biological diversity

- Low disturbance
- Direct seeding
- Permanent planting
- Cover cropping

- Crop rotation
- Build organic matter

- Soil fertility / slow nutrient release
- Manure / biosolids
- Neutral pH

- Infiltration
- Drainage
- Irrigation management

- Moisture conservation
- Residue cover

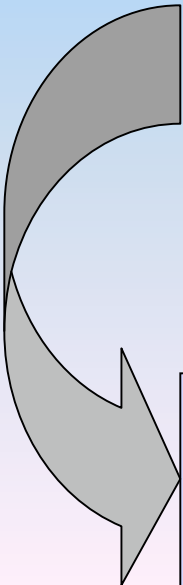
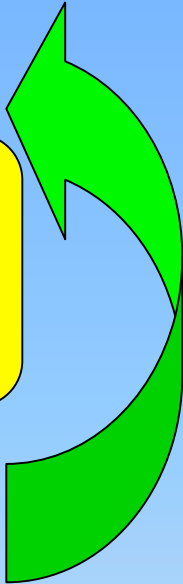
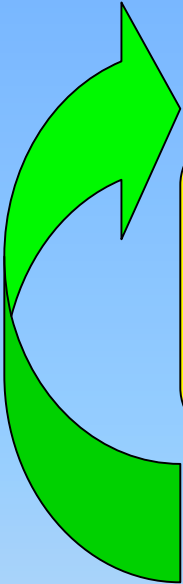
MANAGEMENT PRACTICES INFLUENCE ECOLOGY

- High disturbance
- Tillage
- Burning
- Steam sterilization

- Monoculture
- Overgrazing

- Fumigants
- Herbicides
- Fungicides
- Insecticides

Changing ecology of system
Imbalance in species
Some groups increasing in number; some groups eliminated



—Dead —

Recently dead soil organisms and crop residues provide the food (energy and nutrients) for soil organisms to live and function. Also called "active" or "particulate" organic matter.





Soil B
Control

Day 80 Soil A
Control

Day 80 Soil B
Control

Day 160 Soil A
Control

Day 160 Soil B
Control

Day 80 Soil A
Compost

Day 80 Soil B
Compost

Day 160 Soil A
Compost

Day 160 Soil B
Compost

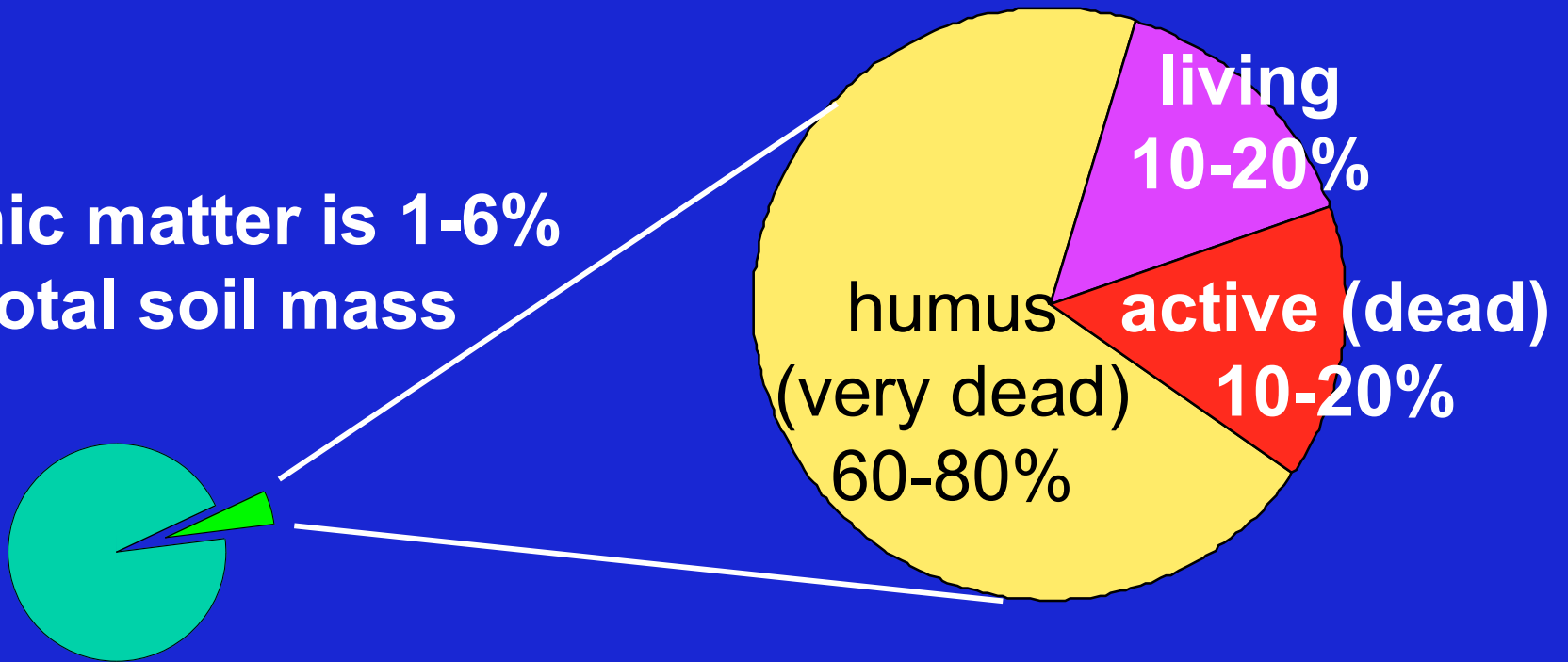
—Very Dead —

Well decomposed organic materials, also called humus. Humus contains very high amounts of negative charge.

All three "types" of soil organic matter play important roles in helping produce high yields of healthy crops.

Soil organic matter

Organic matter is 1-6%
of total soil mass



Organic Matter Influences a Vast Number of Important Soil Properties

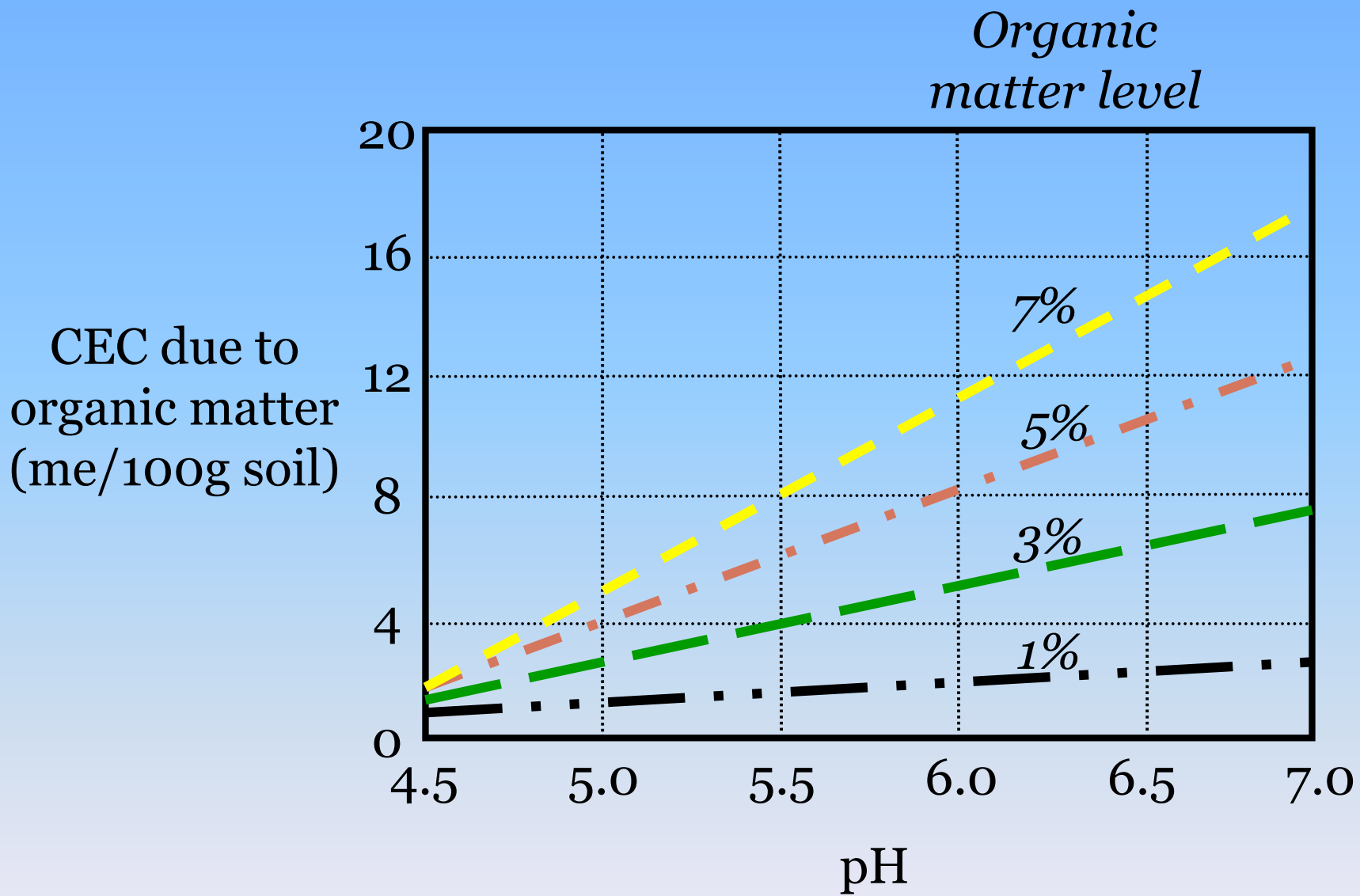
For Example:

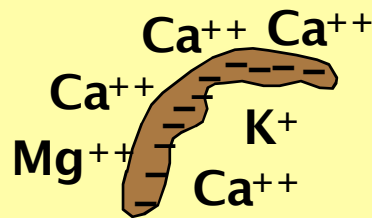
- Nutrient availability
- Aggregation (and infiltration and drainage)
- Water storage
- Diversity and activity of soil organisms
- Soil color
- Presence of growth stimulating compounds
- Important global cycles — carbon, nitrogen, and water — are strongly influenced by soil organic matter

Nutrient Availability

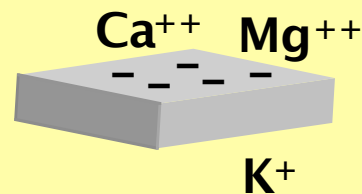
As organic matter is decomposed nutrients are transformed into forms that are available to plants.

From 50% to close to 100% of the CEC
is due to soil organic matter

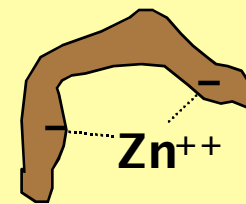




a) cations held on humus



b) cations held on clay particle



c) cations held by organic chelate

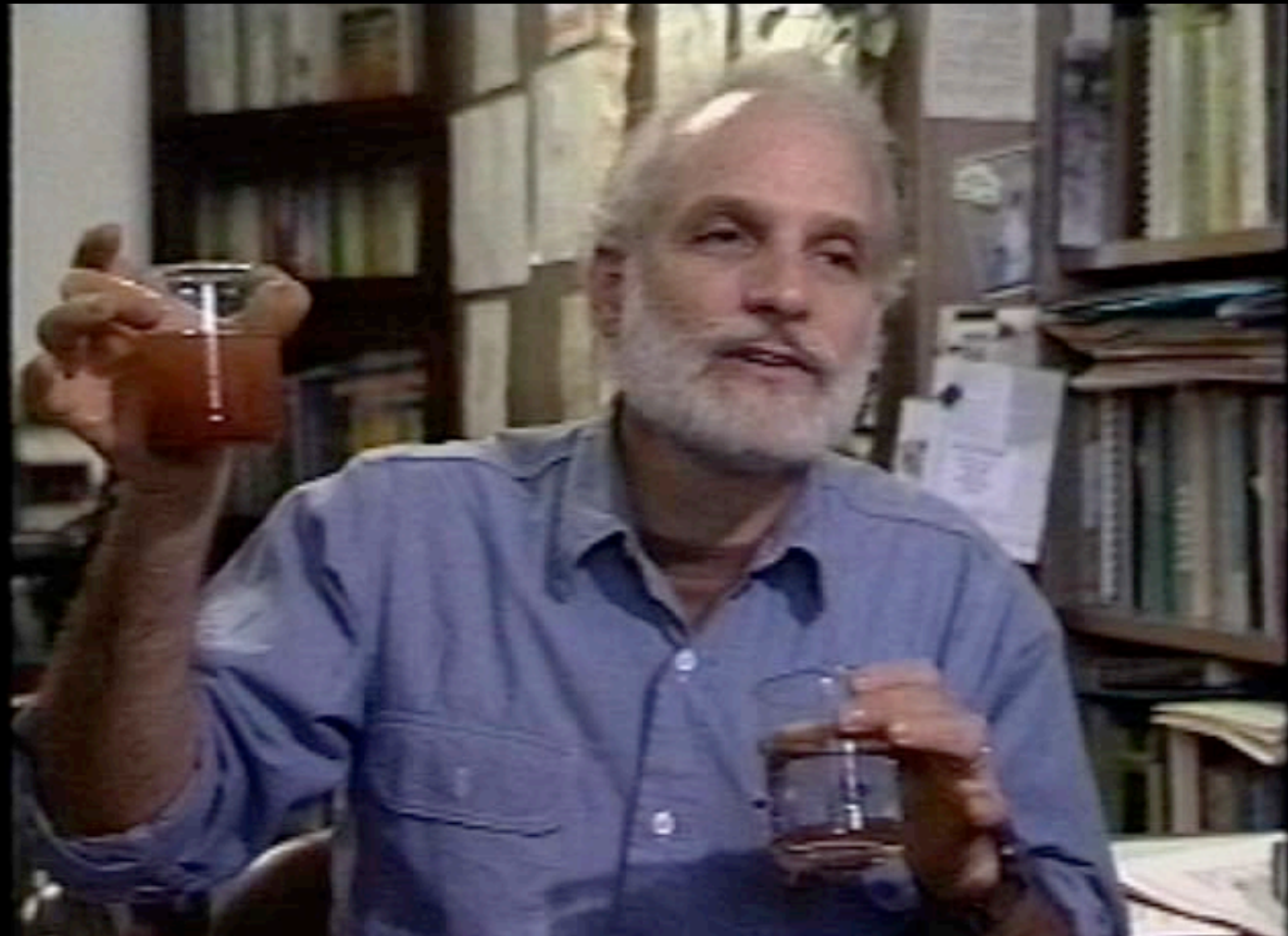
Cation Exchange Capacity and chelation



Corn grown in nutrient solution with (right) and without (left) humic acids.

Photo by R. Bartlett.

Soil Tilth

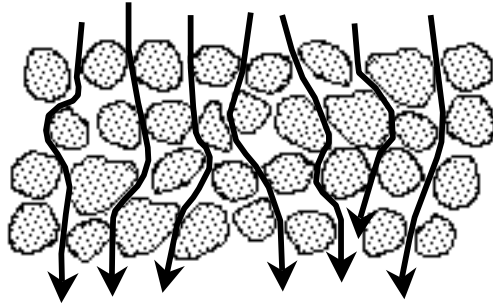




**LOW
O.M.**

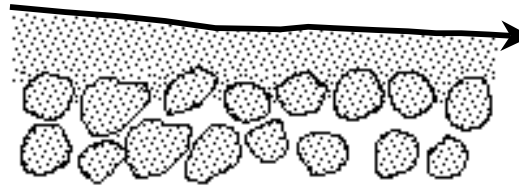
**HIGH
O.M.**

infiltration



a) aggregated soil

runoff



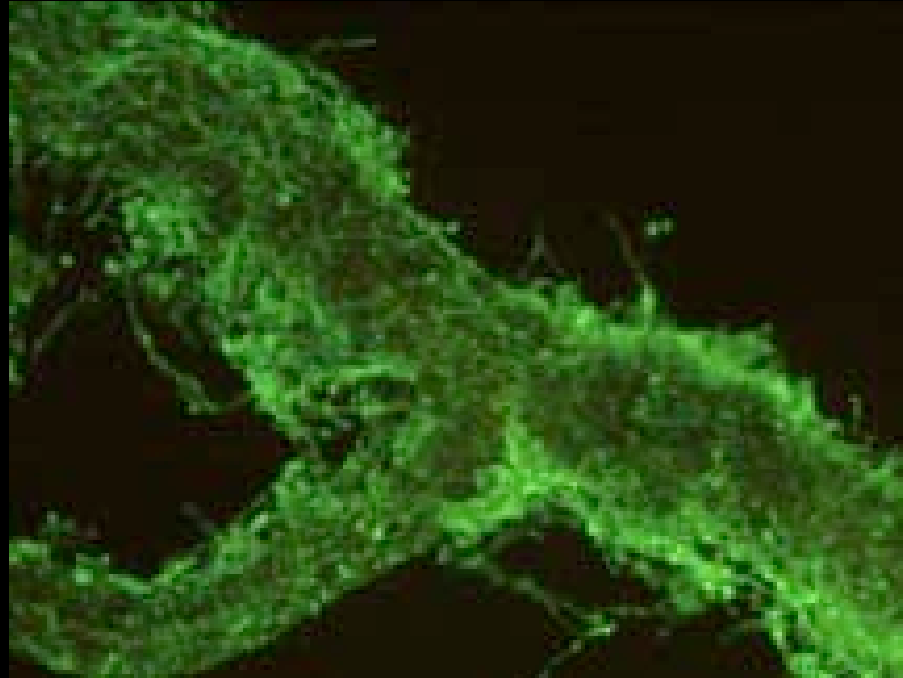
b) soil crusts after
aggregates break down





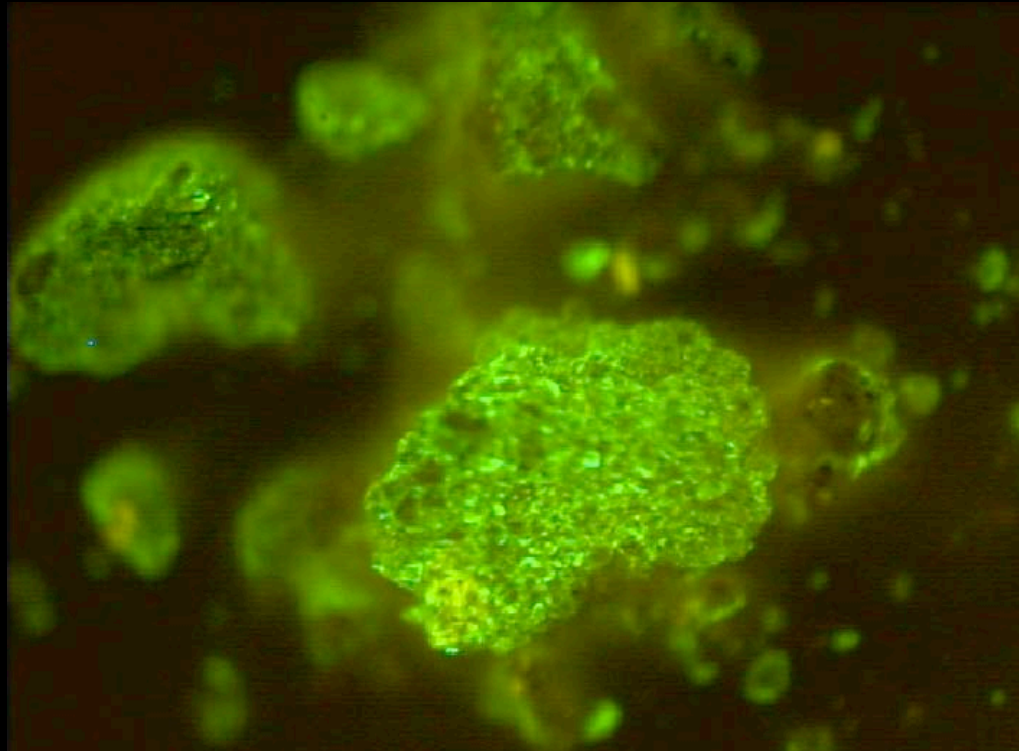


Root heavily infected with mycorrhizal fungi
(note round spores at the end of some hyphae).
Photo by Sara Wright.



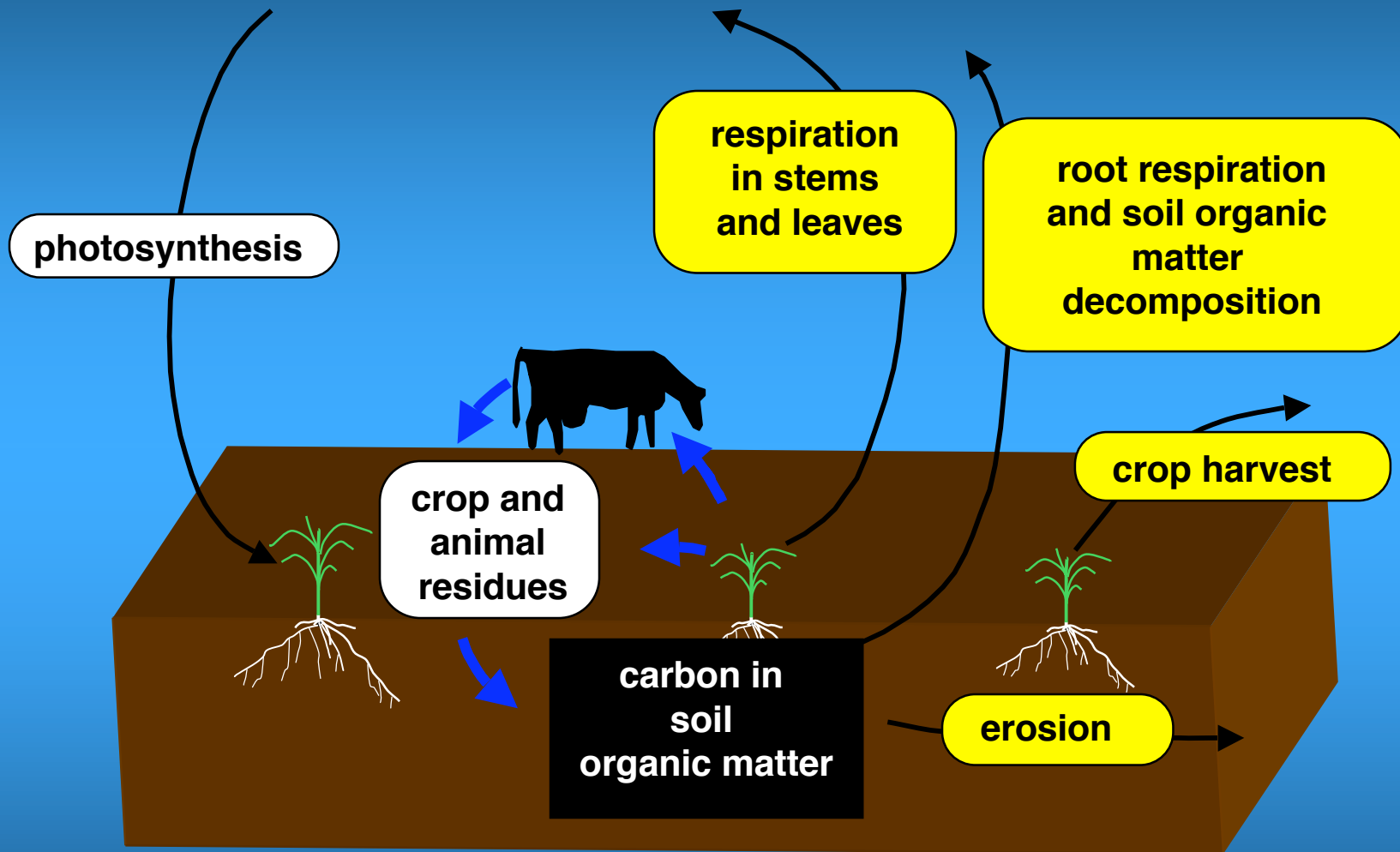
Sticky substance, glomalin, surrounding root heavily infected with mycorrhizal fungi.

Photo by Sara Wright.



Sticky substance, glomalin, surrounding soil aggregates. *Photo by Sara Wright.*

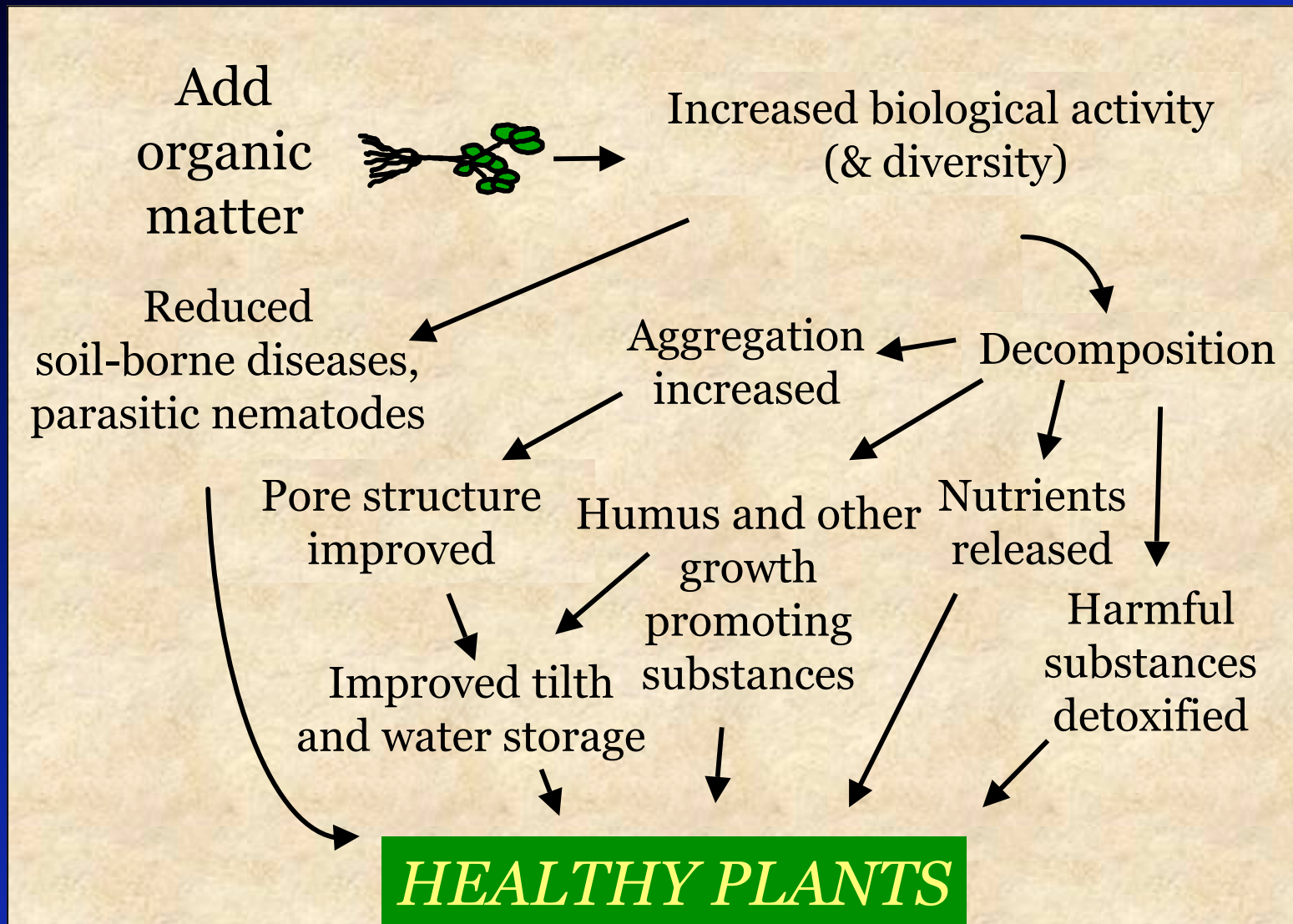
carbon dioxide (CO₂)
(0.04% in the atmosphere)

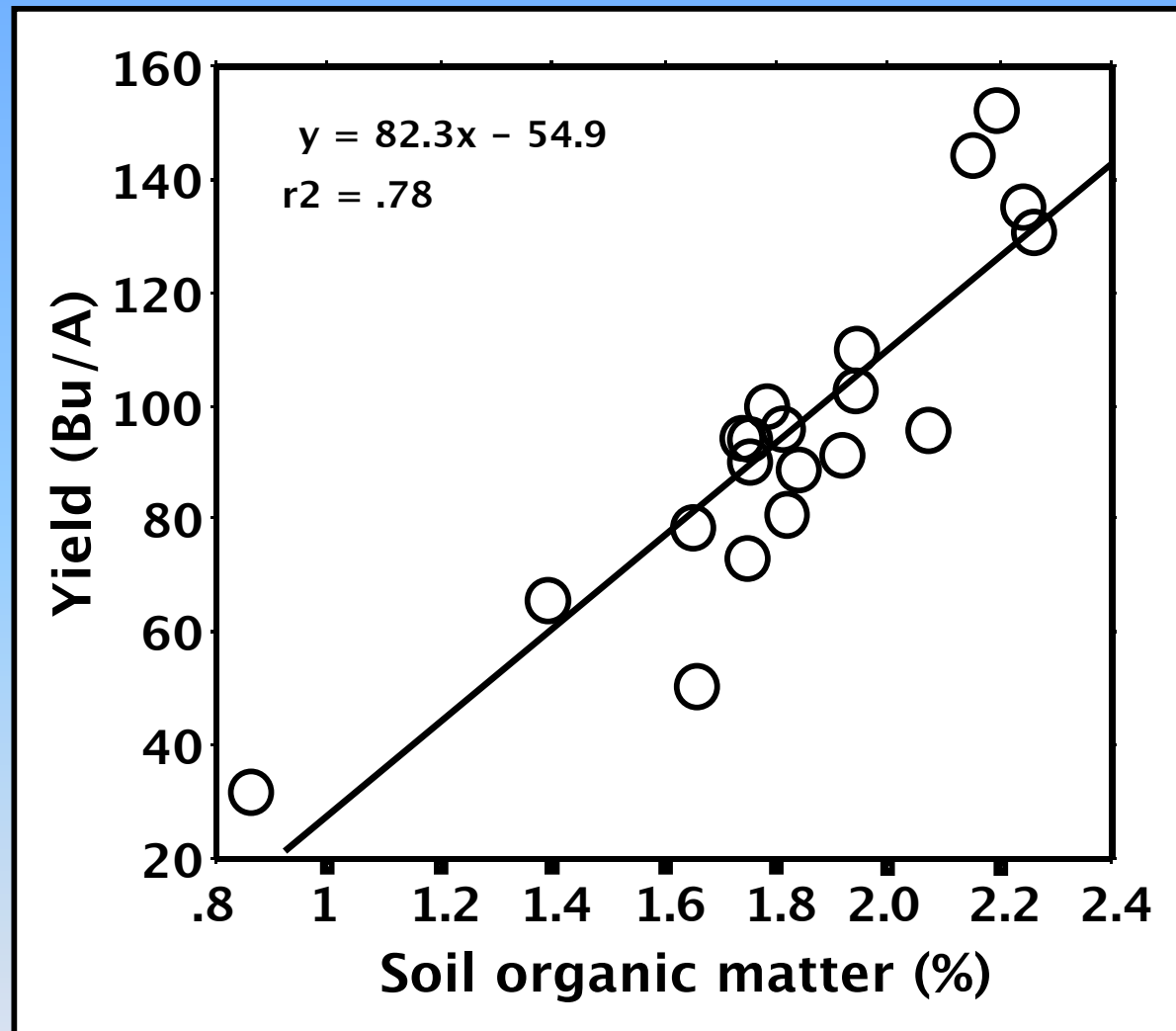


The role of soil organic matter in the carbon cycle.
Losses of carbon from the field are indicated by yellow color around the words describing the process.



Karen Hills, 2007

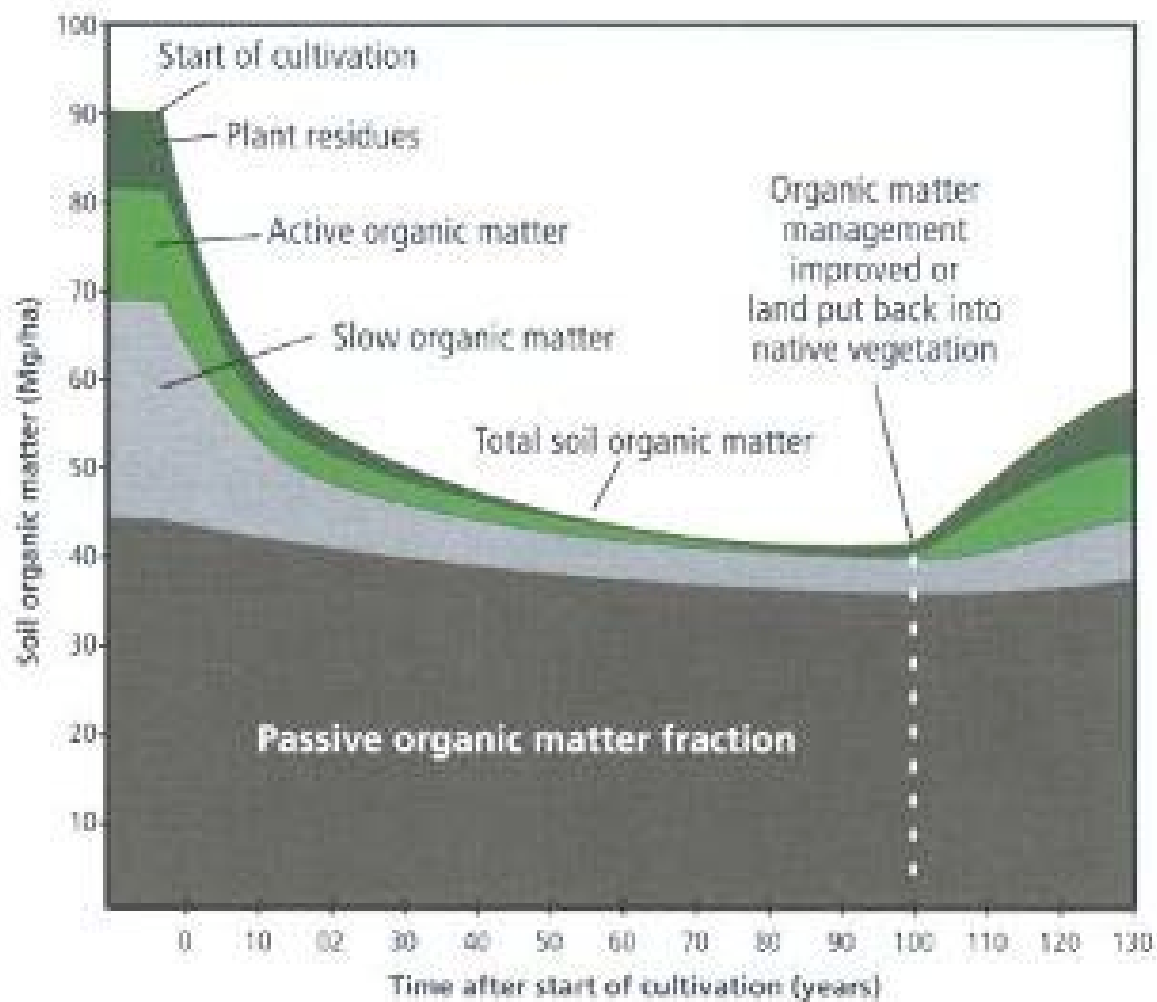




Relationship of corn yield and soil organic matter at the end of a long term cropping experiment

Two conditions are necessary to maintain an adequate amount of organic matter in the soil. These are, first, an adequate supply, and second, avoidance of a too-rapid loss...

– Lyon and Fippin. 1909.



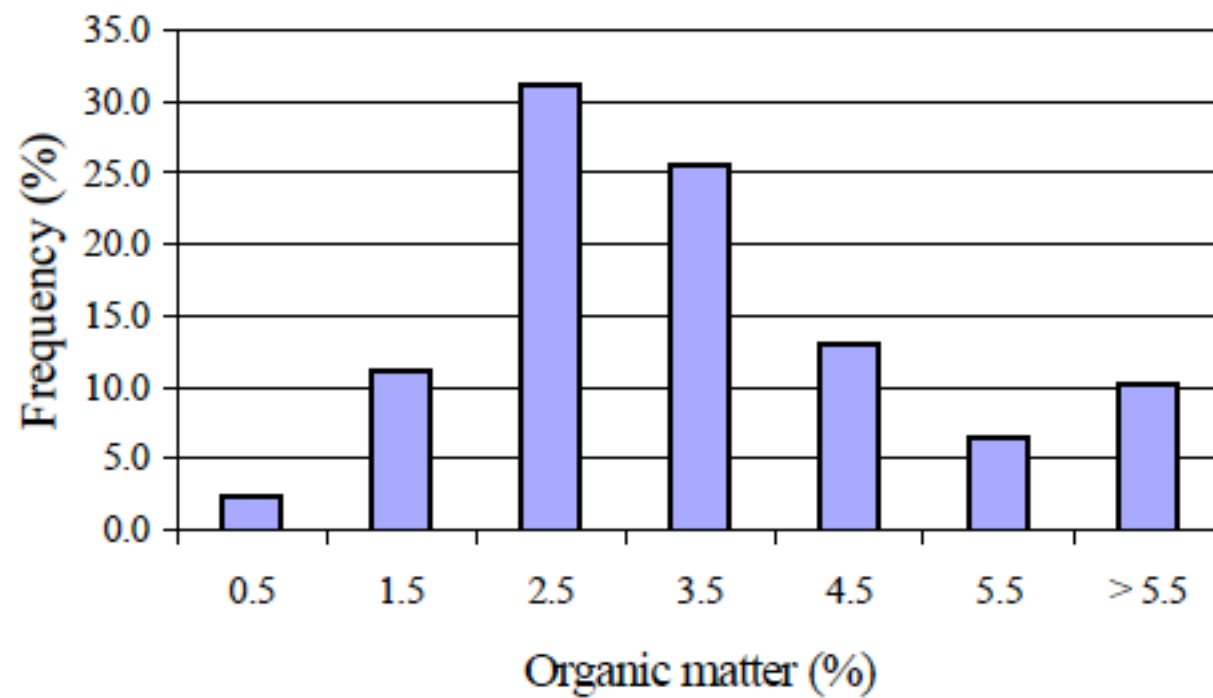


Fig. 3. Distribution of Organic Matter Levels in Soils of New Brunswick

