

unlock the
SECRETS
IN THE
SOIL

The road to Soil Health: Farming in the 21st Century



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United States Department of Agriculture
Natural Resources Conservation Service

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Agricultural soils do not have a water erosion/runoff problem, they have a water infiltration problem.

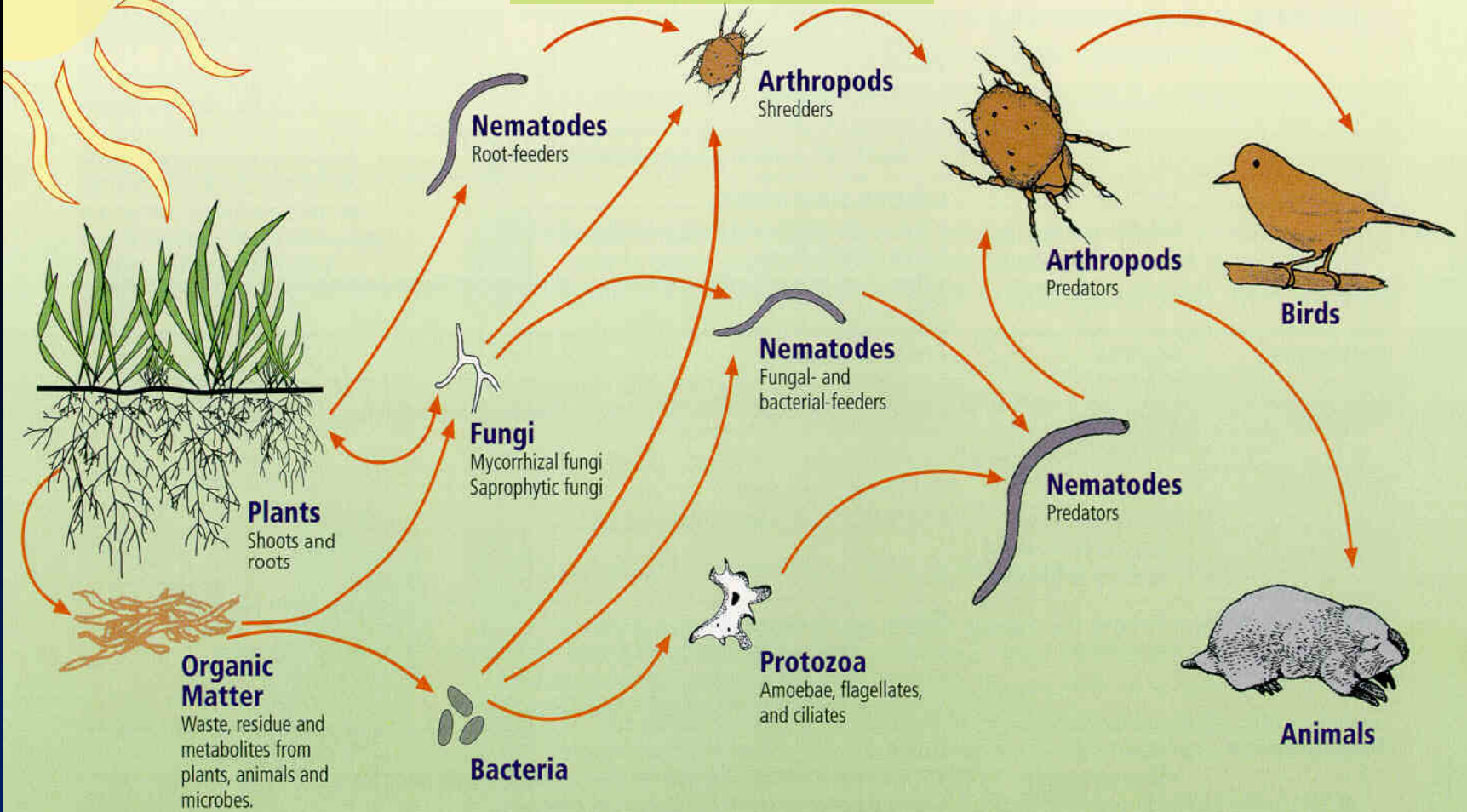


SOIL QUALITY/HEALTH is

The continued capacity of the soil to function as a vital living ecosystem that sustains plants, animals, and humans.

The Soil Food Web

Is complex



Dr. Nardi

First trophic level:

Photosynthesizers

Second trophic level:

Decomposers
Mutualists
Pathogens, parasites
Root-feeders

Third trophic level:

Shredders
Predators
Grazers

Fourth trophic level:

Higher level predators

Fifth and higher trophic levels:

Higher level predators

Soil is a Living Factory



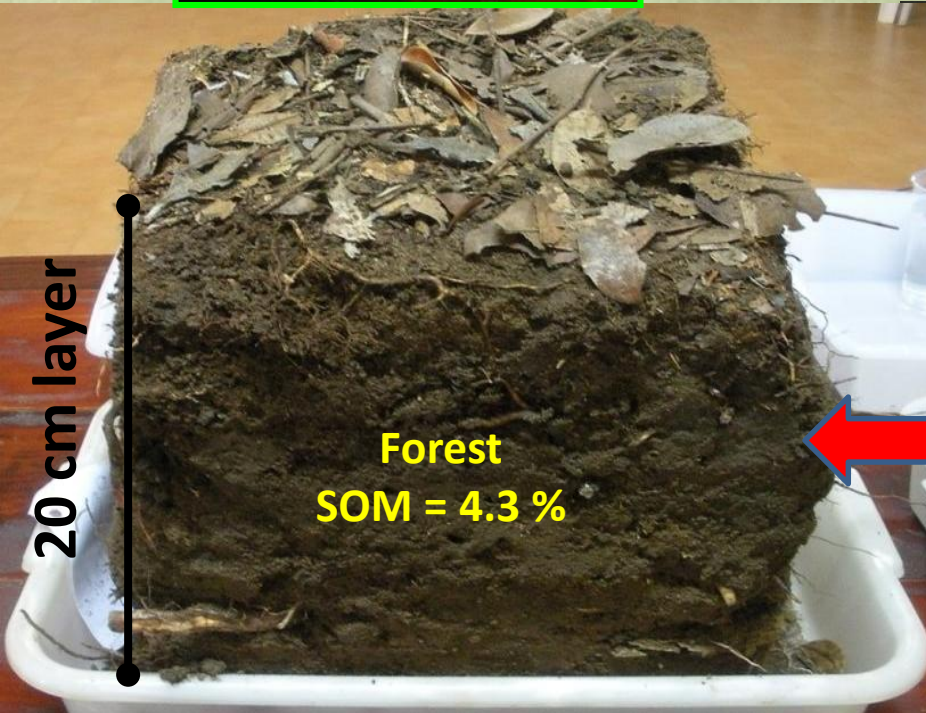
- **Macroscopic and microscopic organisms**
 - Food
 - Water
 - Habitat
 - Powered by sunlight

- **Management can improve or degrade soil health**
 - Tillage
 - Fertilizer
 - Livestock
 - Pesticides

Management Changes Soil Properties & Capacity of Soil to Function



62.8% loss
of SOM after
17 yr
intensive
tillage



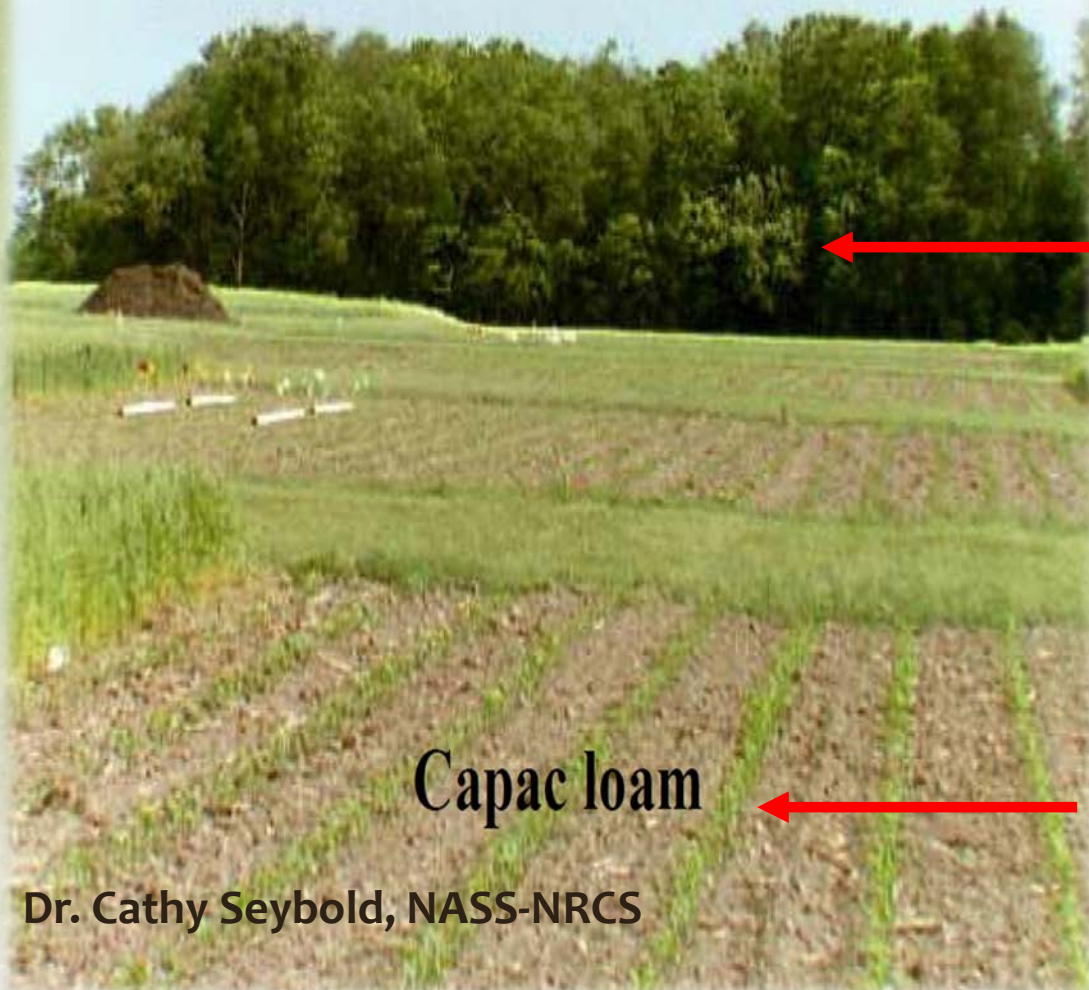
Study: Use-dependent Soil Properties



Land uses:

Woodland

Cropland: Conventional tillage, corn-soybean rotation



Wooded Soil: Bulk Density- 1.01 g/cm³

Infiltration rate	Soil Nitrate loss
50 in./hr	1.8 lbs. N/ac.

Conventional Tillage- Corn-Soybean: Bulk Density- 1.40 g/cm³

Infiltration rate	Soil Nitrate loss
.50 in./hr	15 lbs. N/ac.

Capac loam

Dr. Cathy Seybold, NASS-NRCS

Soil Organic Matter & Available Water Capacity

Percent SOM	Sand	Silt Loam	Silty Clay Loam
1	1.0	1.9	1.4
2	1.4	2.4	1.8
3	1.7	2.9	2.2
4	2.1	3.5	2.6
5	2.5	4.0	3.0

Inches of Water/One Foot of Soil

1 acre inch = 27,150 gallons of water

Berman Hudson

Journal Soil and Water Conservation 49(2) 189 194

189-

March April 1994 –

Summarized by:

Dr. Mark Liebig, ARS, Mandan, ND

Hal Weiser, Soil Scientist, NRCS, Bismarck, ND





Reduce
Chemical,
Biological, and
Physical
Stress

Synergize with
Diversity: Crop
Rotations and
Cover Crops

Understanding
how soil
functions

Cover The
Soil at all
times

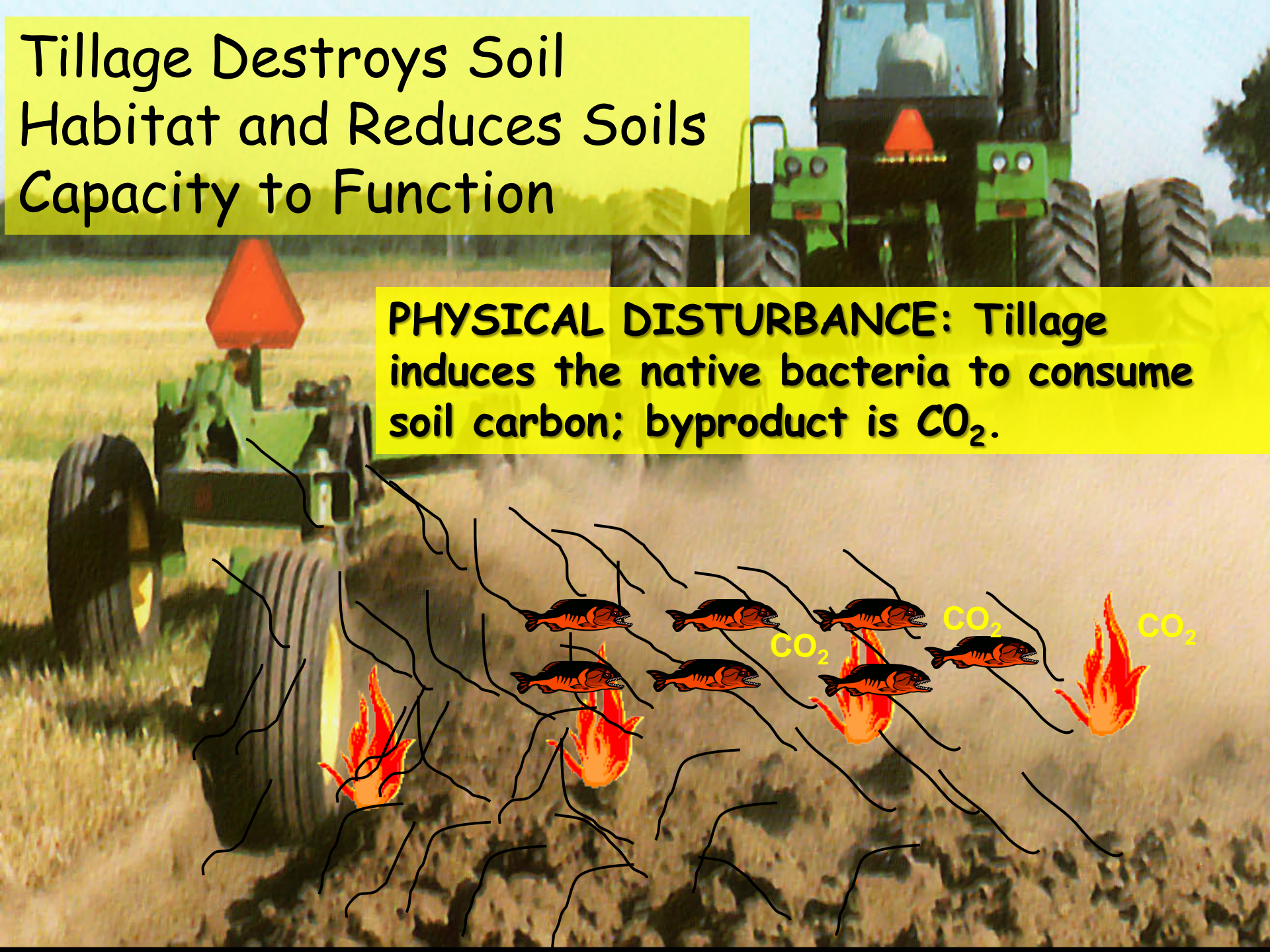
Grow a Living
Root 24/7

Protect the Habitat

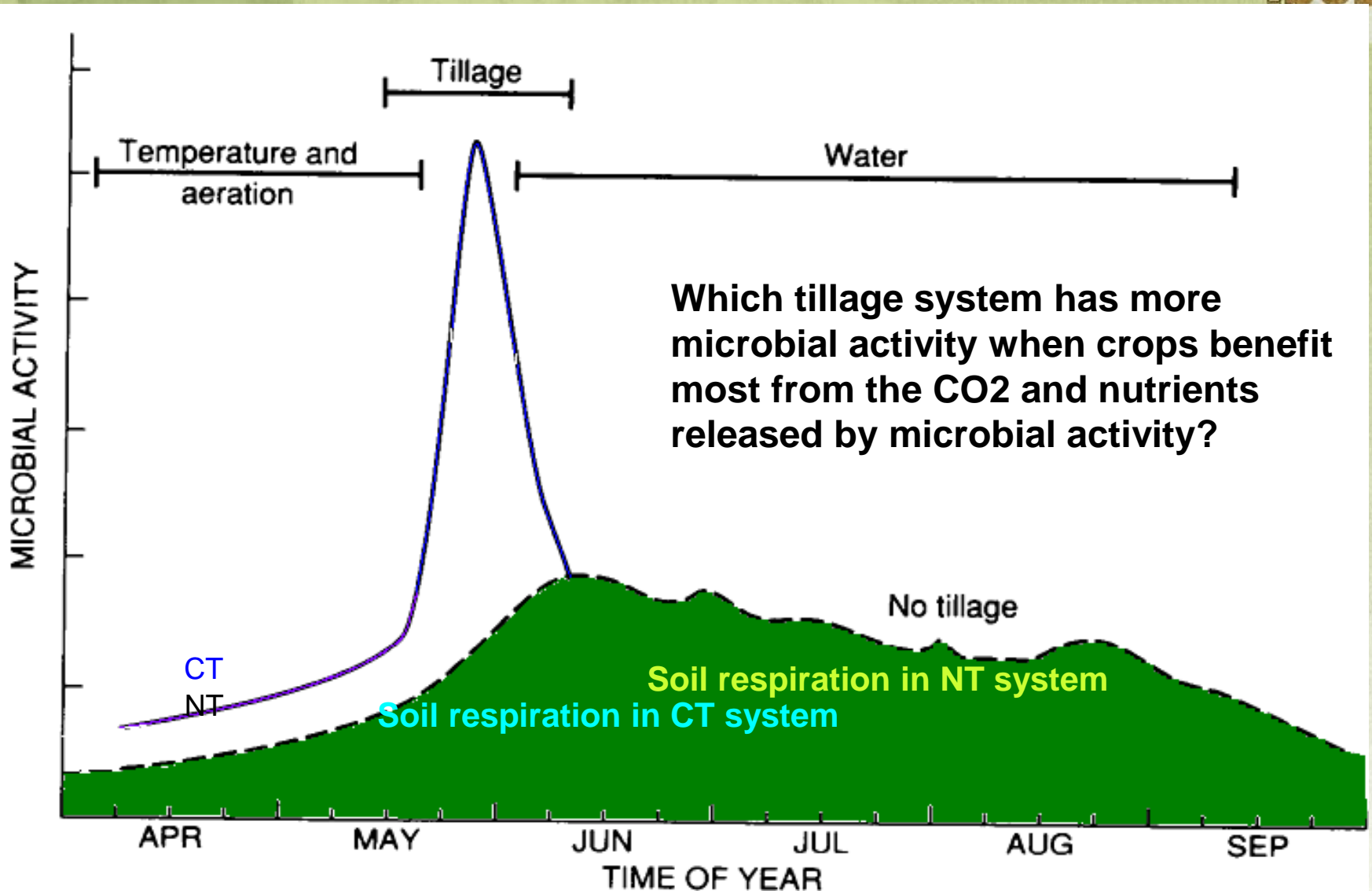
Reduce Chemical,
Biological, and
Physical Stress

Tillage Destroys Soil Habitat and Reduces Soils Capacity to Function

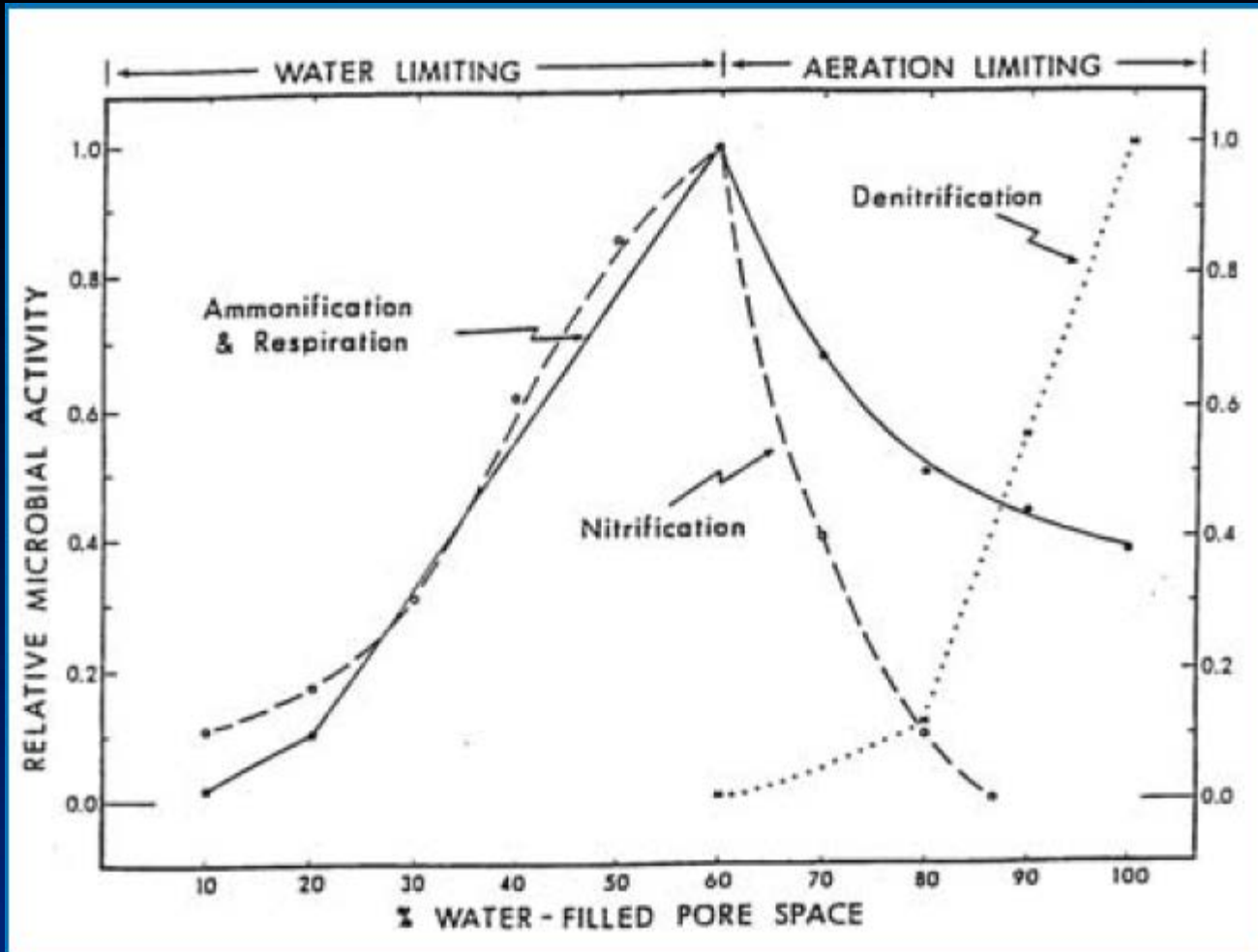
PHYSICAL DISTURBANCE: Tillage induces the native bacteria to consume soil carbon; byproduct is CO_2 .



Effect of tillage on microbial activity



Factor Affecting Respiration



- Respiration peaks at field capacity
- 60% of pore spaces field
- >80% pore space water filled
- Anaerobic organisms use Nitrate instead of Oxygen



Chemical disturbances: over-application of pesticides, fertilizers and manures



Feed the soil diverse food
(carbon)

Synergize with
Diversity: Crop
Rotations and
Cover Crops

Diversify with Crop Diversity

- Plants interact with particular microbes
 - Trade sugar from roots for nutrients
- Microbes convert plant material to OM
- Requires a diversity of plant carbohydrates to support the variety of microbes
- Lack of plant diversity will drive system to favor some microbes more than others

Ecological Architecture:



Source: Conservation Research Institute

Broadcast while defoliating cotton

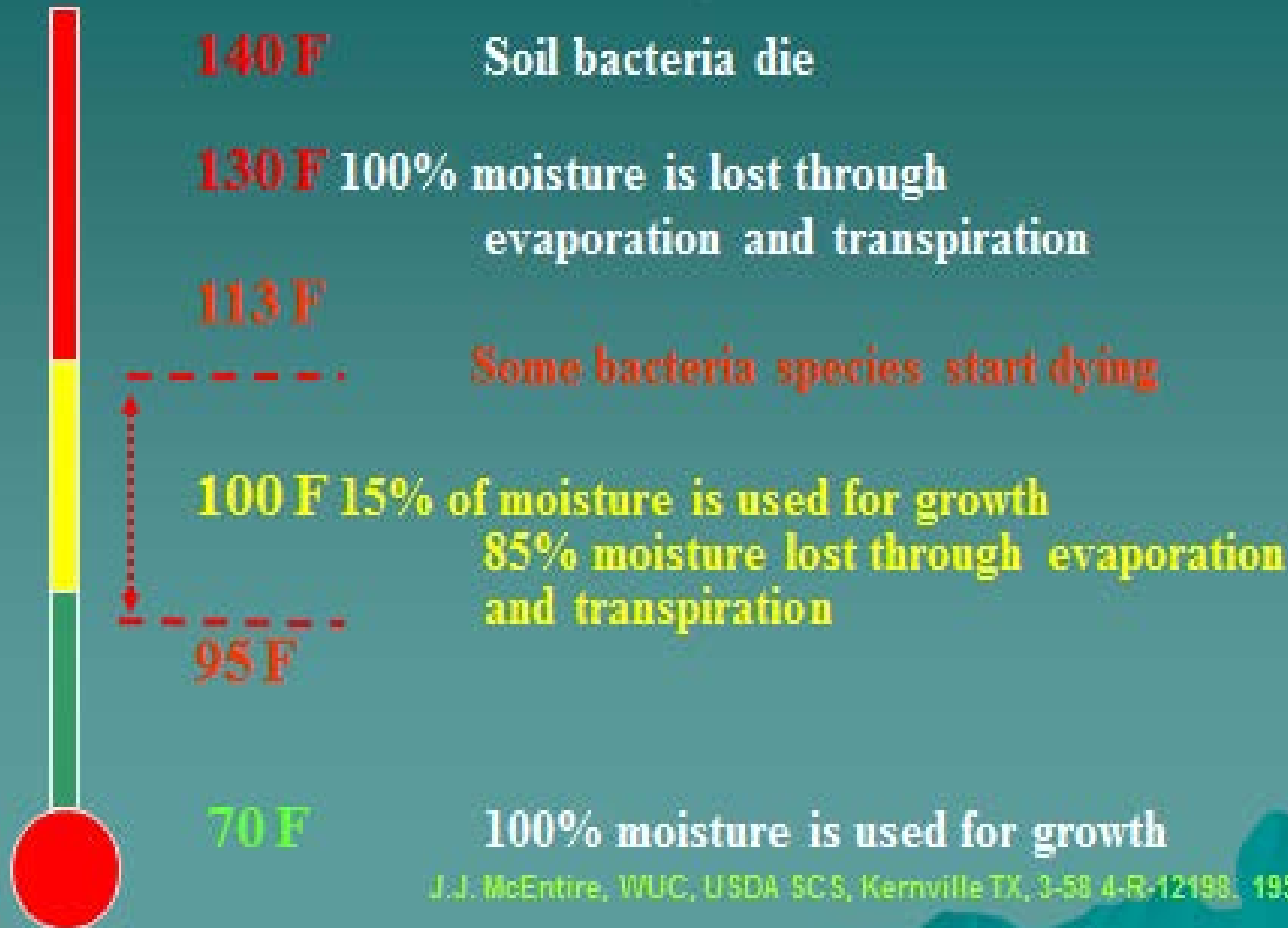


Seeded a multi-species
cover crop mix

- Cereal rye
- Crimson clover
- Hairy Vetch



When soil temperature reaches...



J.J. McEntire, WVUC, USDA SCS, Kernville TX, 3-58 4-R-12198, 1956

Soil Temperature



**3 Bales Per
Acre**



