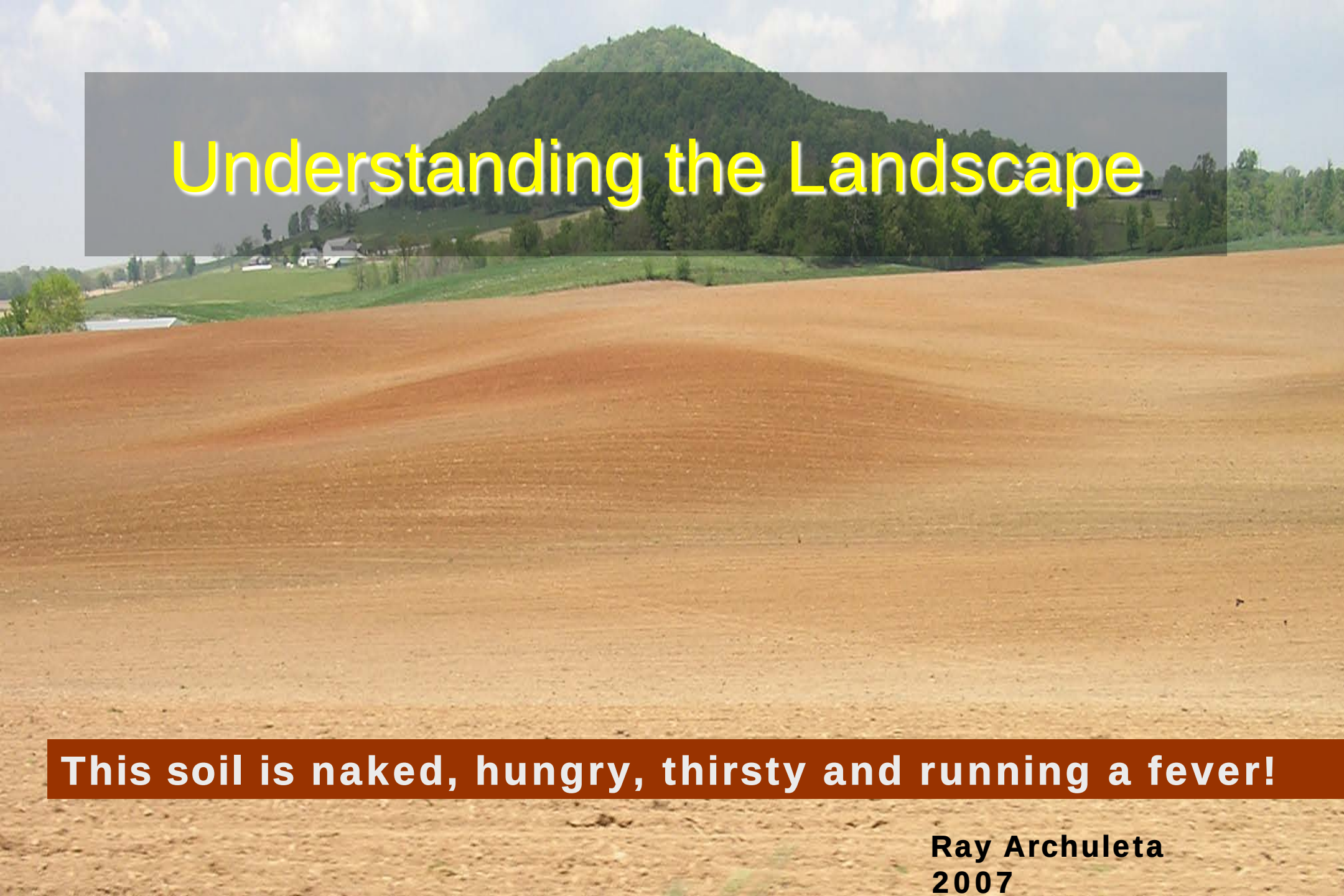
Building Sustainable Communities

- **Promote user friendly integrated cropland management and technology exchange**
- **Share resources, including Integrated Water Management Handbook on NRCS website:** http://www.nm.nrcs.usda.gov, **click on Irrigation**

Sustainable Agriculture Workshops Purpose

- Show how to evaluate site-specific conditions
- Learn how to build soil quality and improve overall farming system
- Promote development of sustainable communities

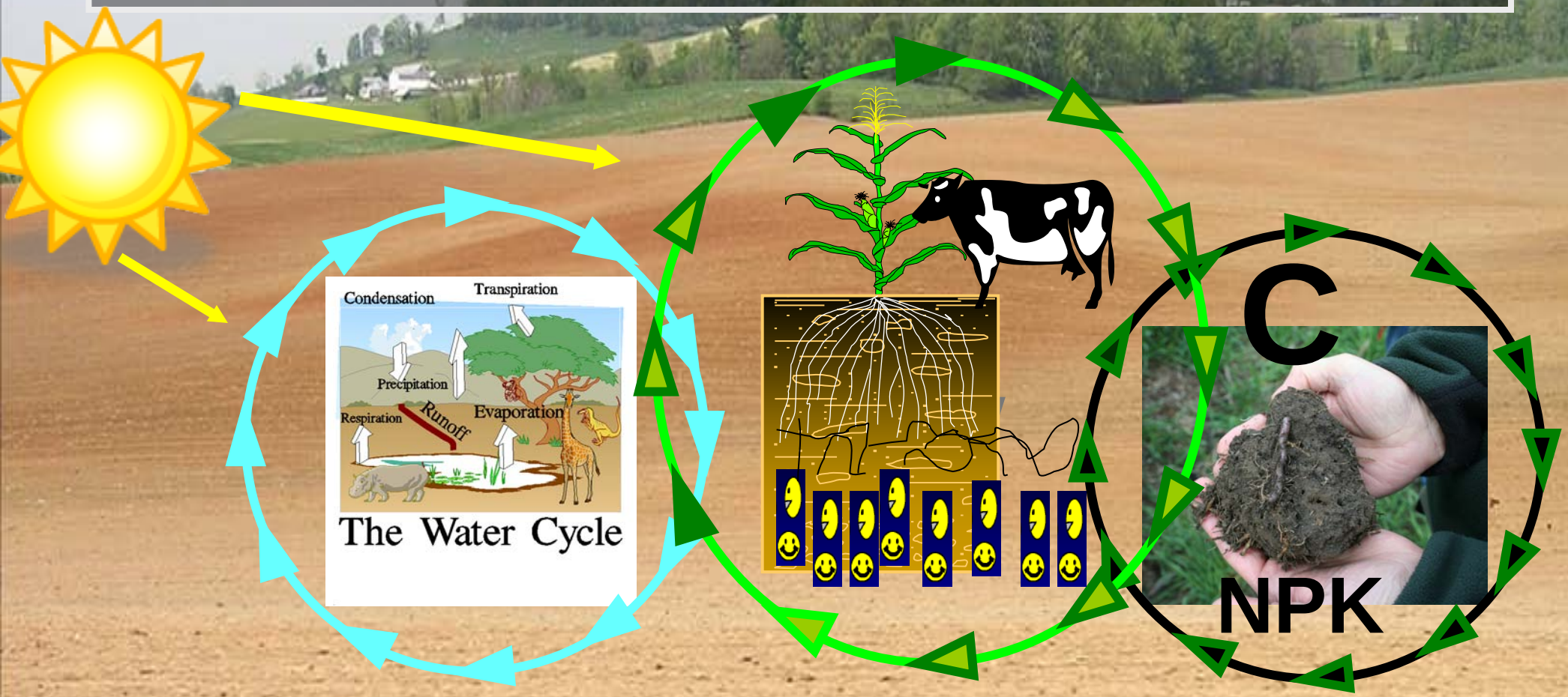


Understanding the Landscape

This soil is naked, hungry, thirsty and running a fever!

Ray Archuleta
2007

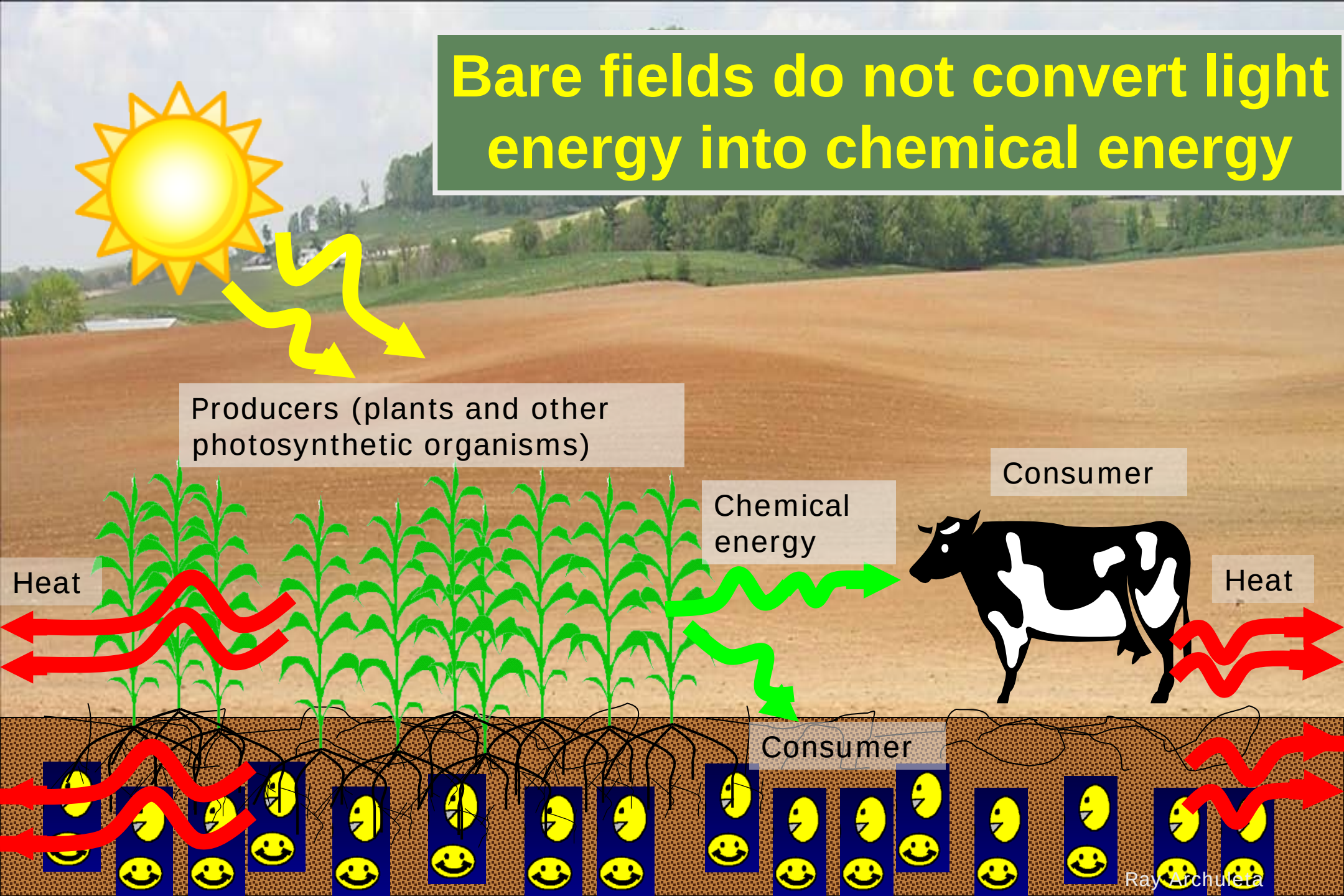
At the field level: Tillage disrupts Ecosystem Processes!



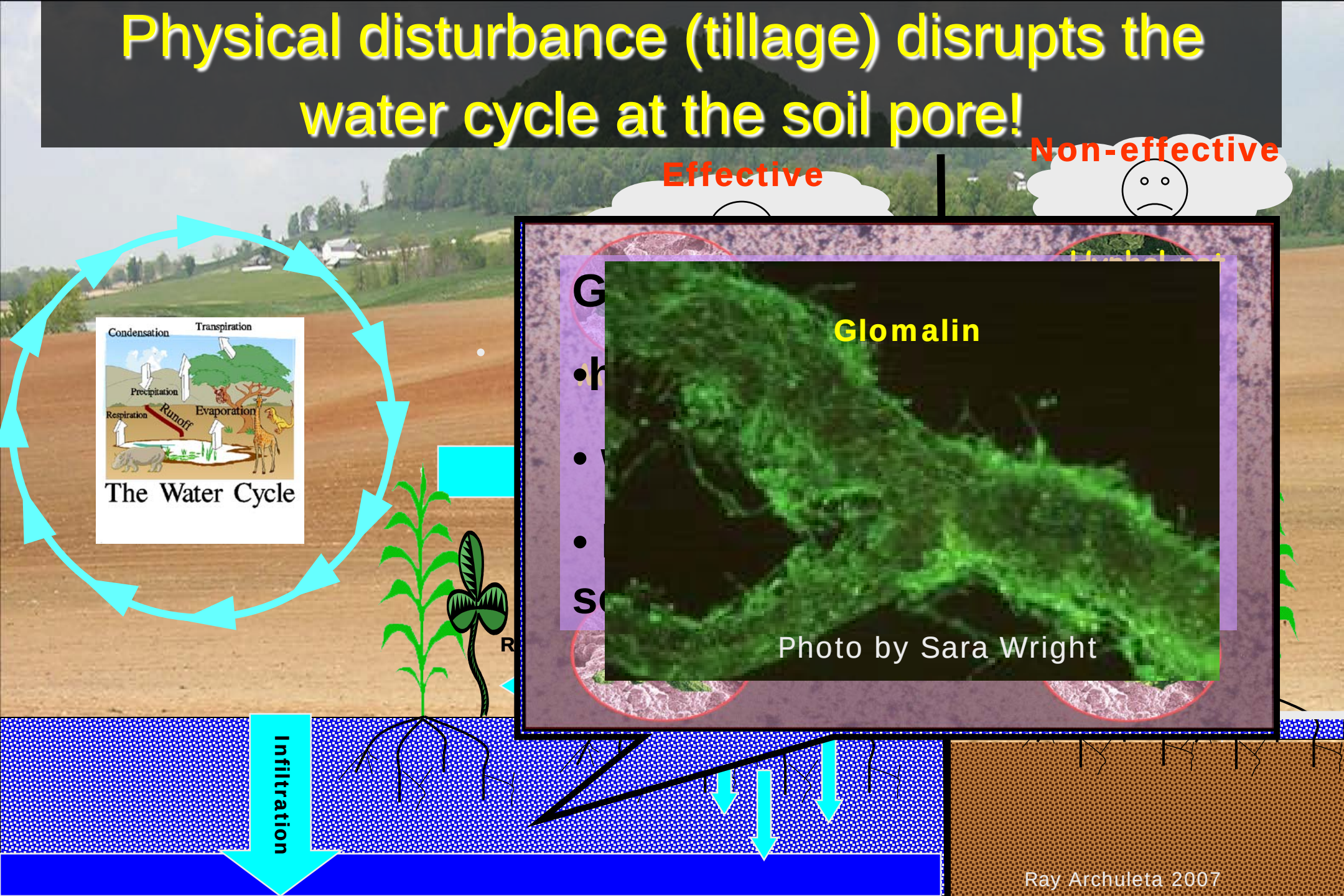
Energy flow, Water cycle, Bio-Community Dynamics and the Nutrient cycle

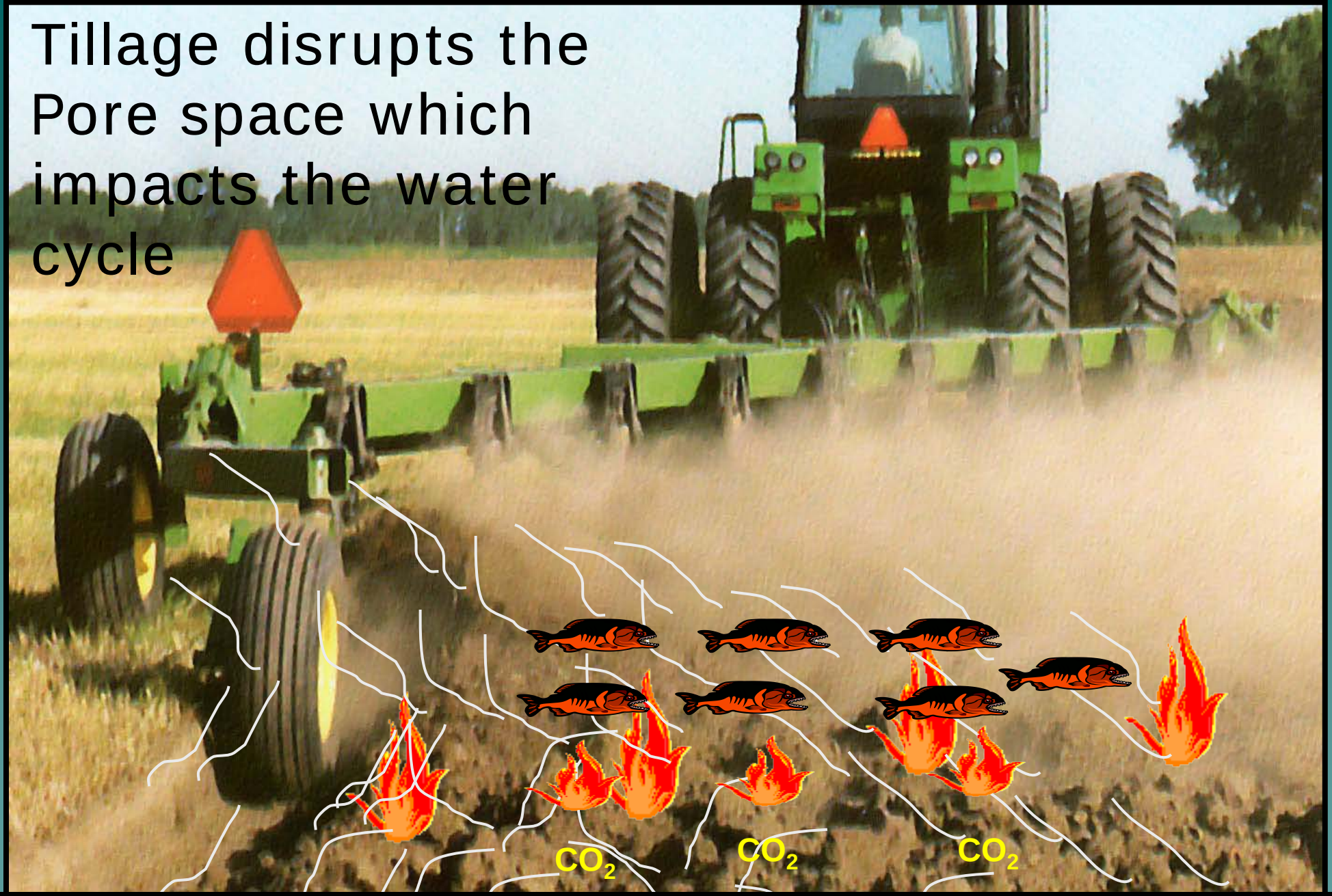
Ray Archuleta

Bare fields do not convert light energy into chemical energy

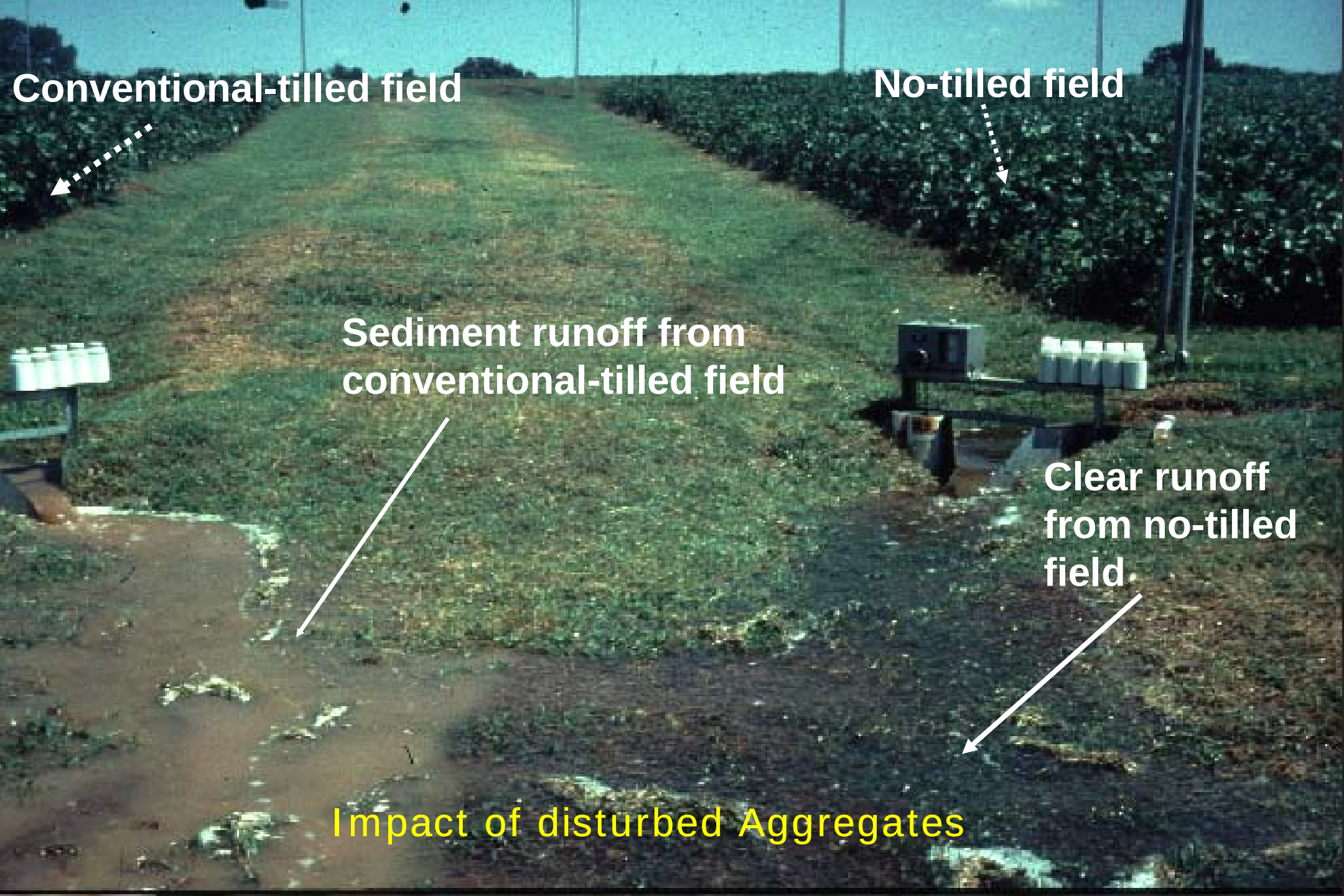


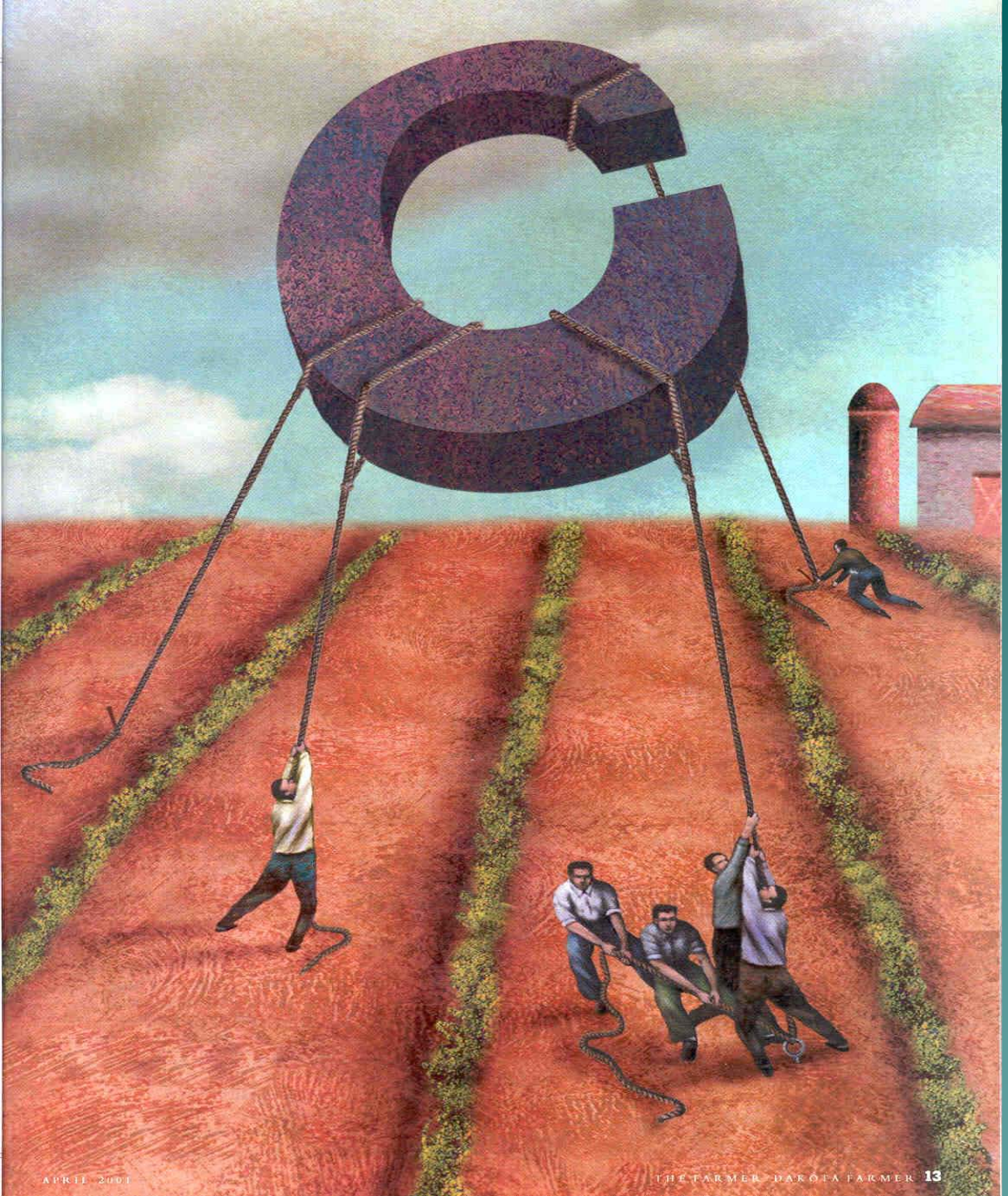
Physical disturbance (tillage) disrupts the water cycle at the soil pore!





PHYSICAL DISTURBANCE: Tillage induces the native bacteria to consume soil carbon; byproduct is $C0_2$.


Conventional-tilled field
No-tilled field
Sediment runoff from conventional-tilled field
Clear runoff from no-tilled field
Impact of disturbed Aggregates



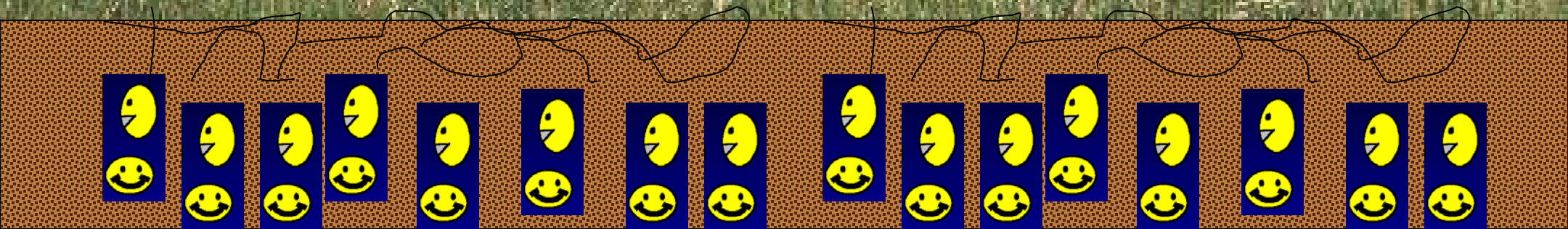
Holding SOM (C) by no-till and crop rotation

All the atmospheric CO_2 ~ only 40% of the soil's C holding capacity (Wallace 1984)

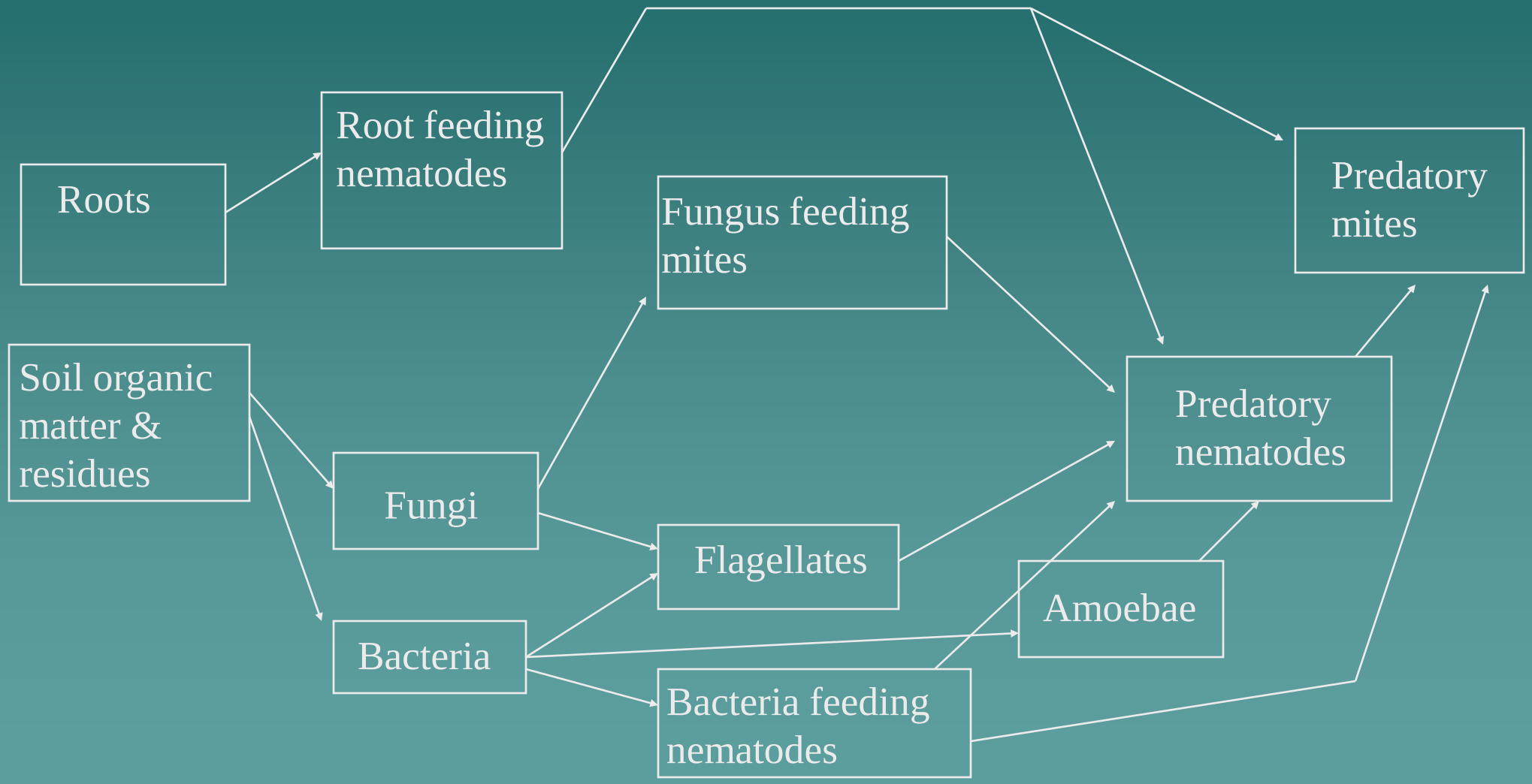
Physical disturbance (tillage) disrupts Bio-Community Dynamics

Most Biological Activity Occurs Underground

Soils contain about 7.75 to 15 tons of bacteria, fungi, earthworms, mites, nematodes, or protozoa per acre



What happens when an organism is missing?



Stability tends to Increase with Increasing Complexity

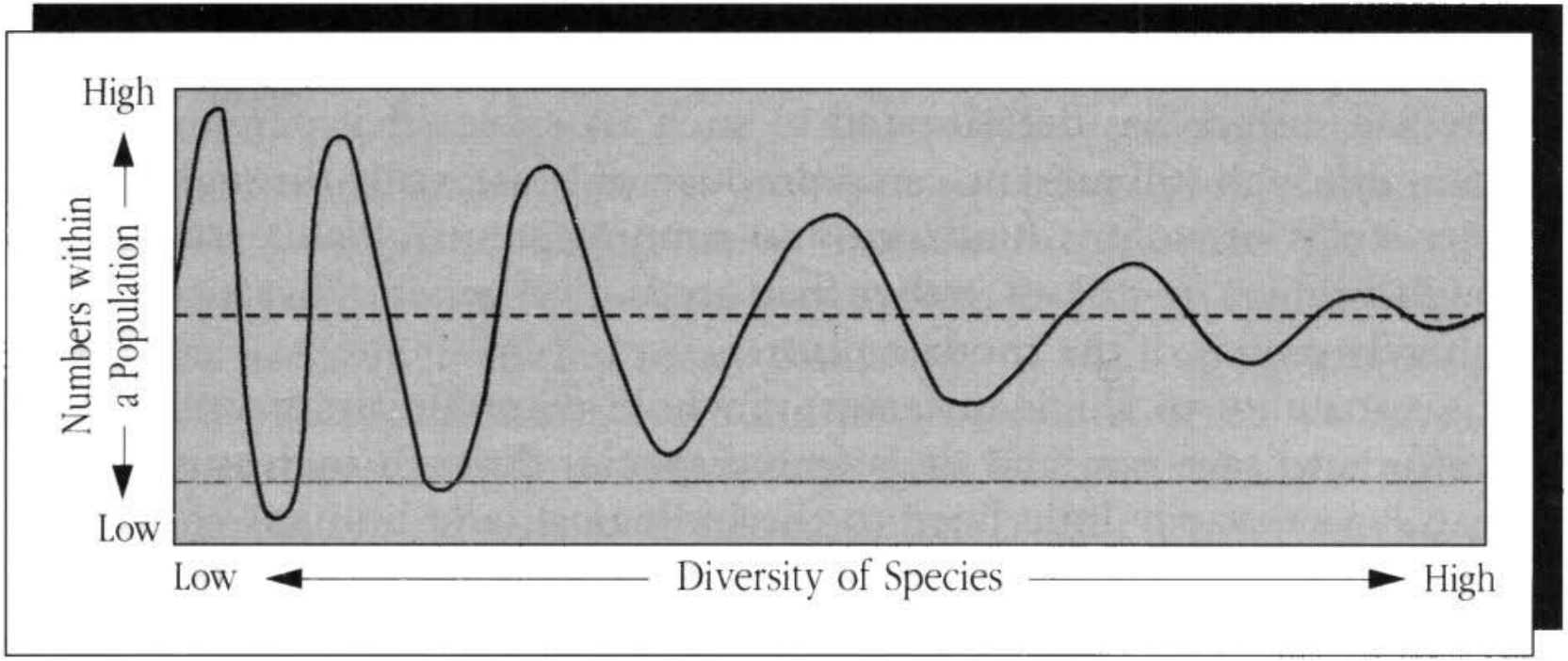


Figure 13-1 *The more complex and diverse communities become, the more stable populations within them tend to be.*

Allen Savory: Holistic Mgmt

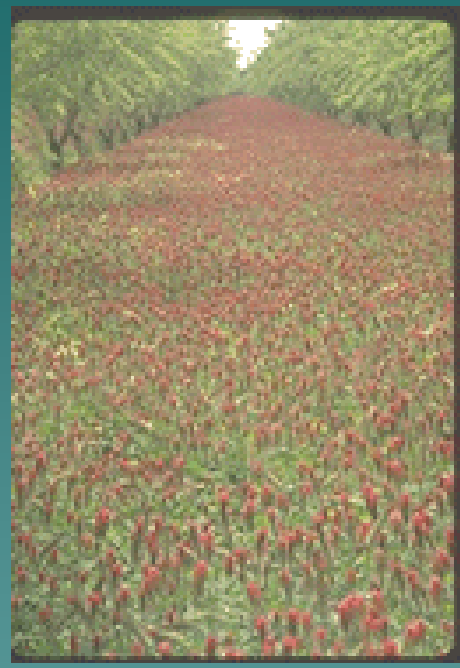
In the Ecosystem-Collaboration is more apparent than Competition:

ND case study: 2006 Production On Burleigh District Plot with 1.8 in. of rain

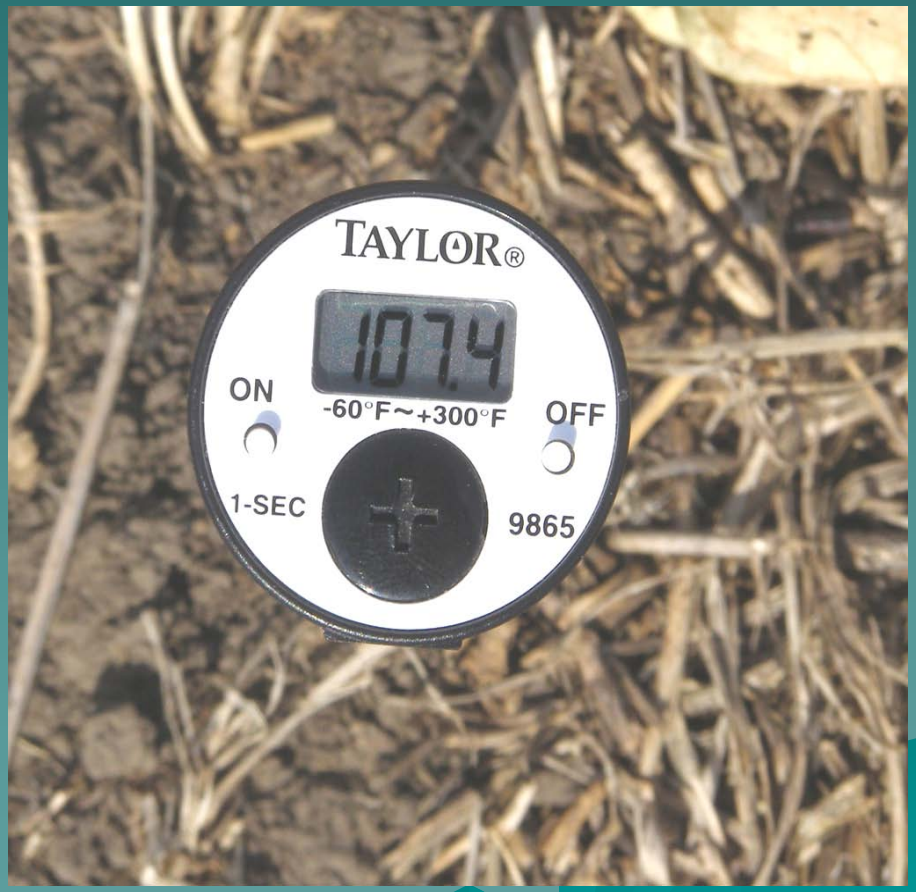
- Oilseed Radish 1260 Lbs.
- Purple Top Turnip 1513 Lbs.
- Pasja Turnip 2070 Lbs.
- Soybean 1496 Lbs.
- Cowpea 1914 Lbs.
- Lupin 1232 Lbs.
- Cocktail Mix (1/2 Rate) 4785 Lbs.
- Cocktail Mix (Full Rate) 4350 Lbs.

Cowpea (10 lbs.) Soybean (15 lbs.) Millet (7 lbs.) Radish (1 lb.) Turnip (½ lb.) Sunflower (1 lb.)

Collaboration at work: Cover Crops Keep soil cover and provide nutrients.



Soil Temperatures



When soil temperature reaches...

140 F — Soil bacteria die

130 F — 100% moisture is lost through evaporation and transpiration

113 F — Some bacteria species start dying

100 F — 15% of moisture is used for growth
85% moisture lost through evaporation and transpiration

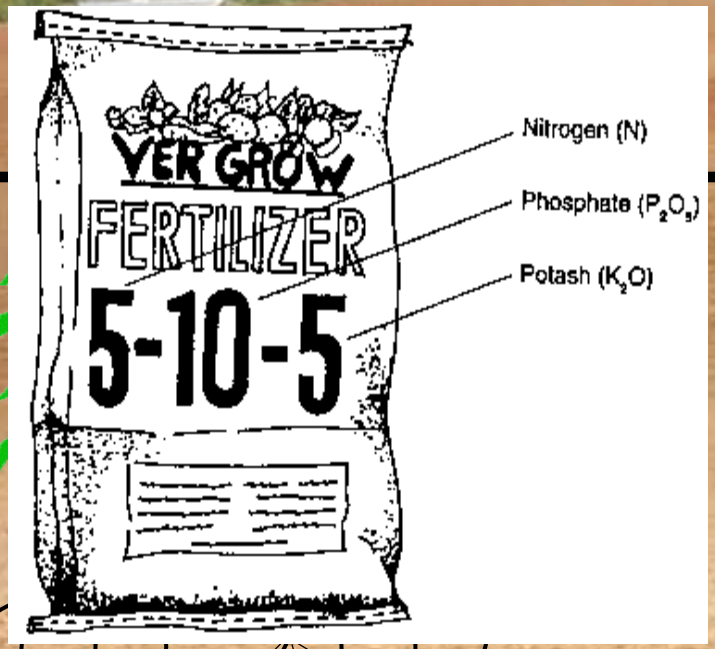
95 F

70 F — 100% moisture is used for growth

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

Physical disturbance (tillage) disrupts the Nutrient Cycle

- Allow plants to feed microbes and microbes feed plants

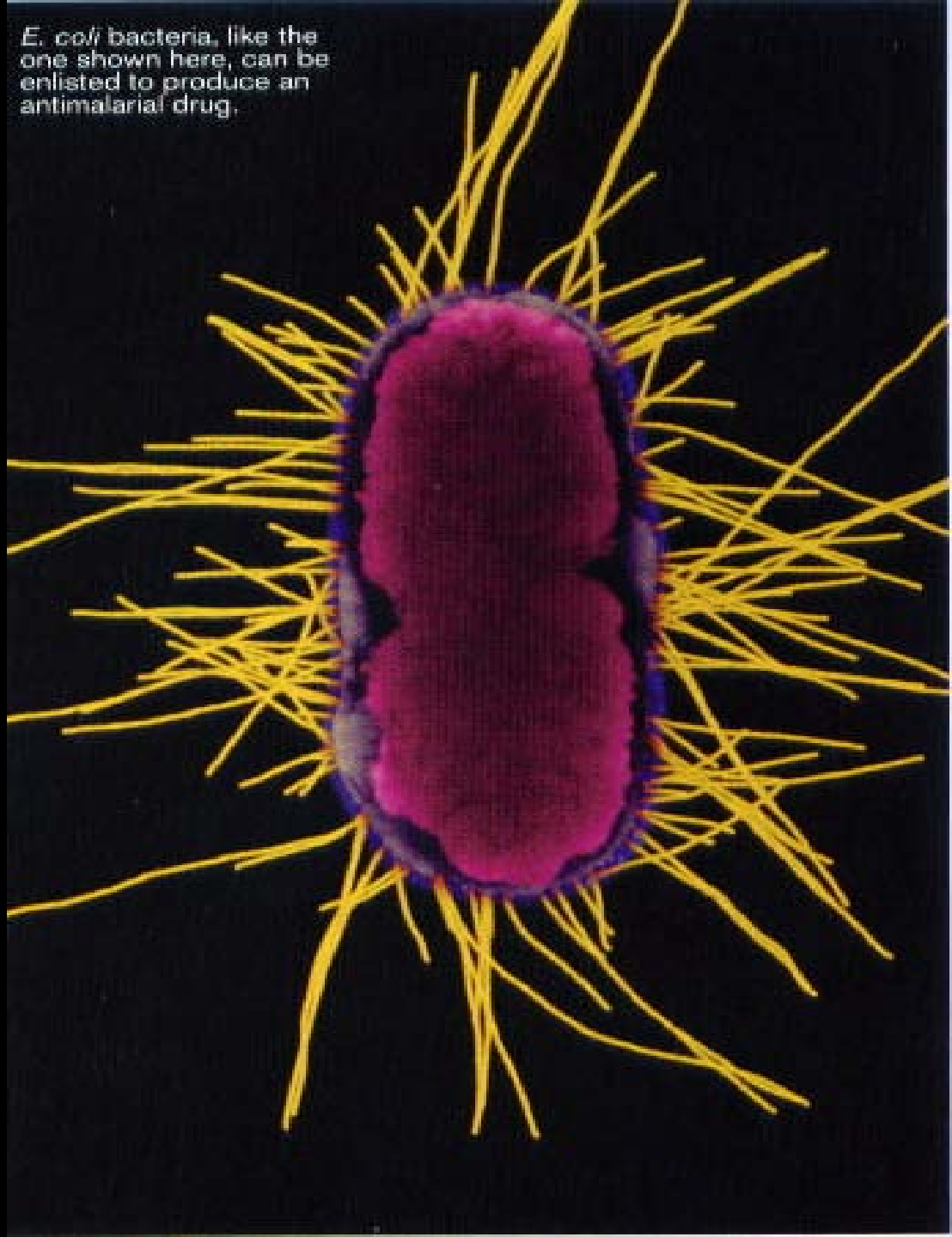


Nutrients from below

In Conventional Tillage systems

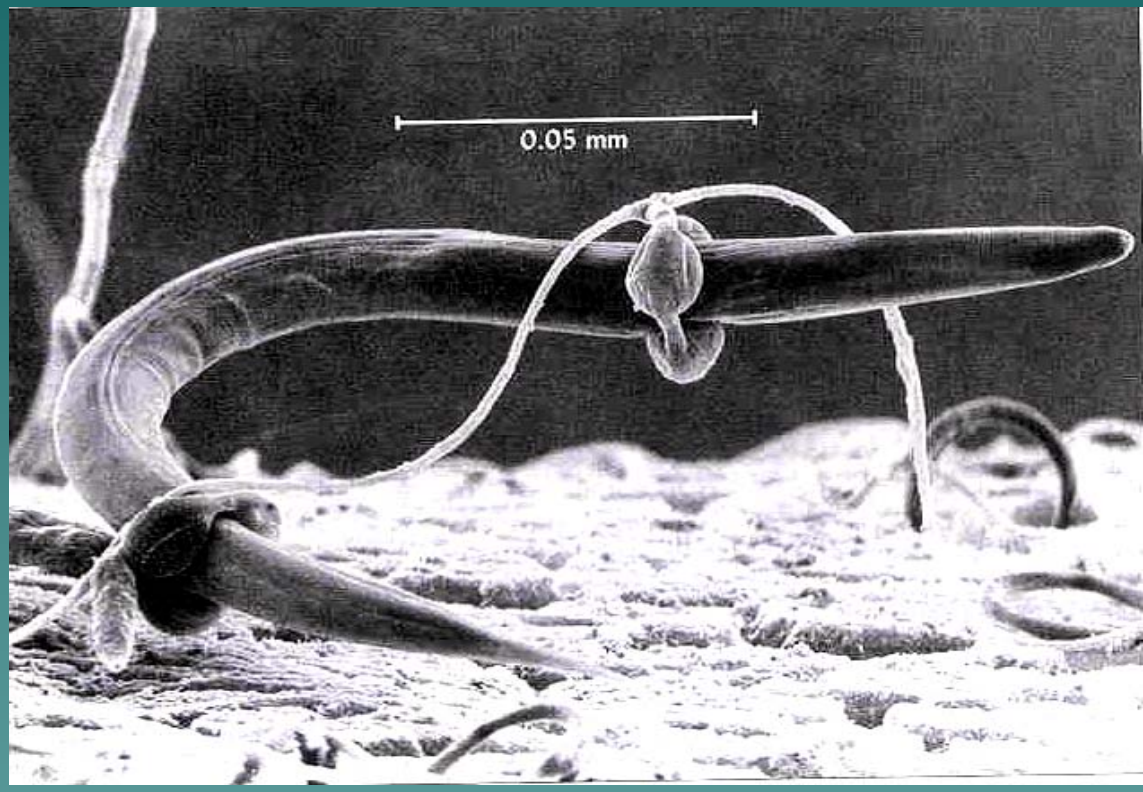
Bacteria-dominated food web

(Bacteria have 20-30% C-use efficiency)

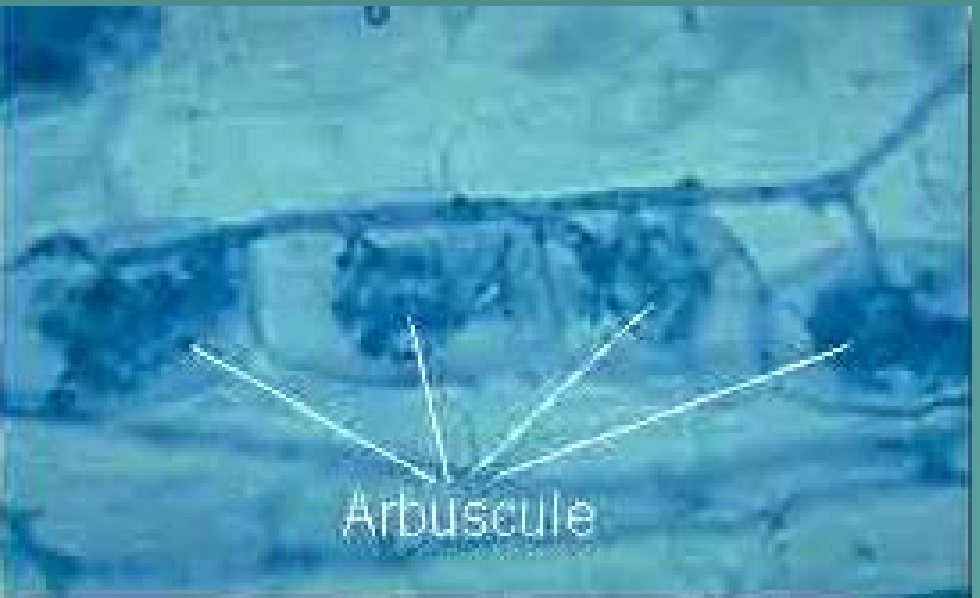


E. coli bacteria, like the one shown here, can be enlisted to produce an antimalarial drug.

In No-Till systems



Fungi-dominated food web

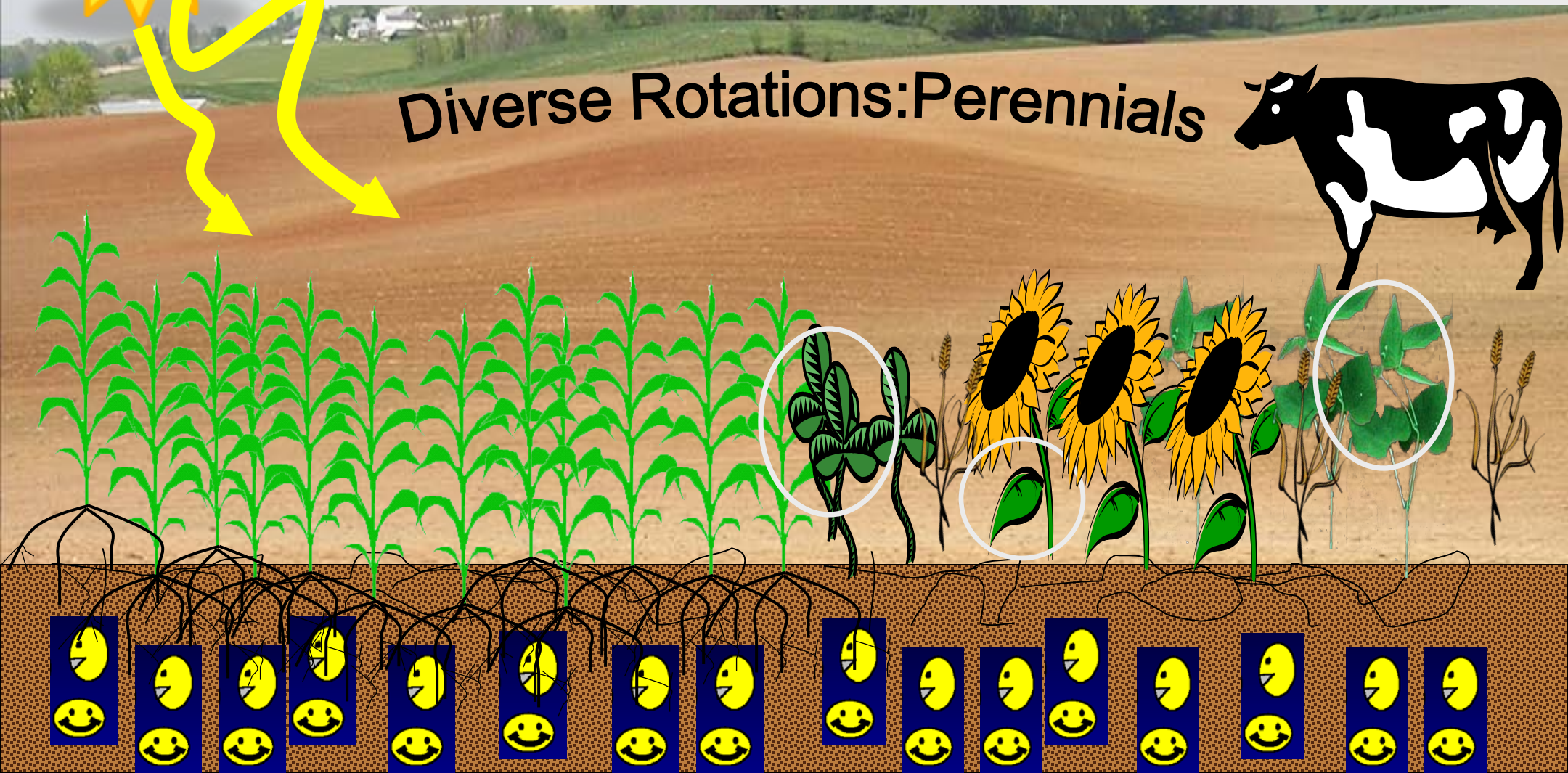


Nematode and fungal relationship (Fungi has 40-55% C-use efficiency)

First: Capture the sun

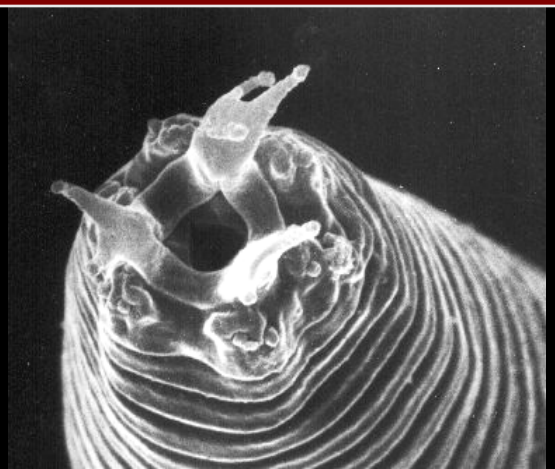
1) Time- duration and rate of plant growth
2) Density of plants
3) Surface area of leaf

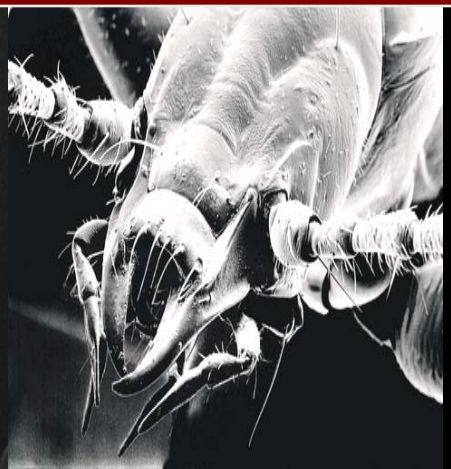
Ray Archuleta



Second: Soil is not a machine, it is an Ecosystem. A functioning ecosystem needs protection and energy.

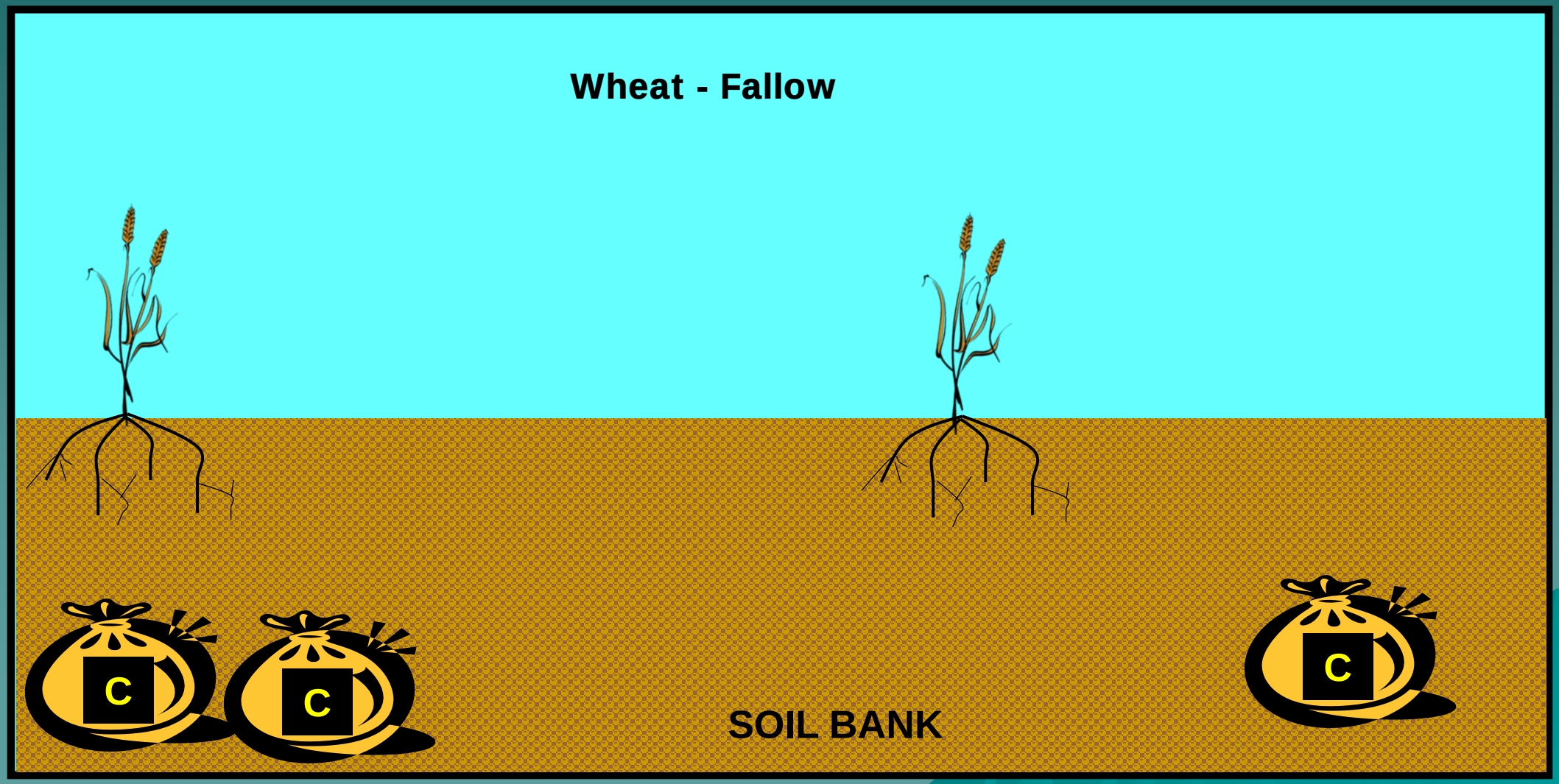
Soil Surface



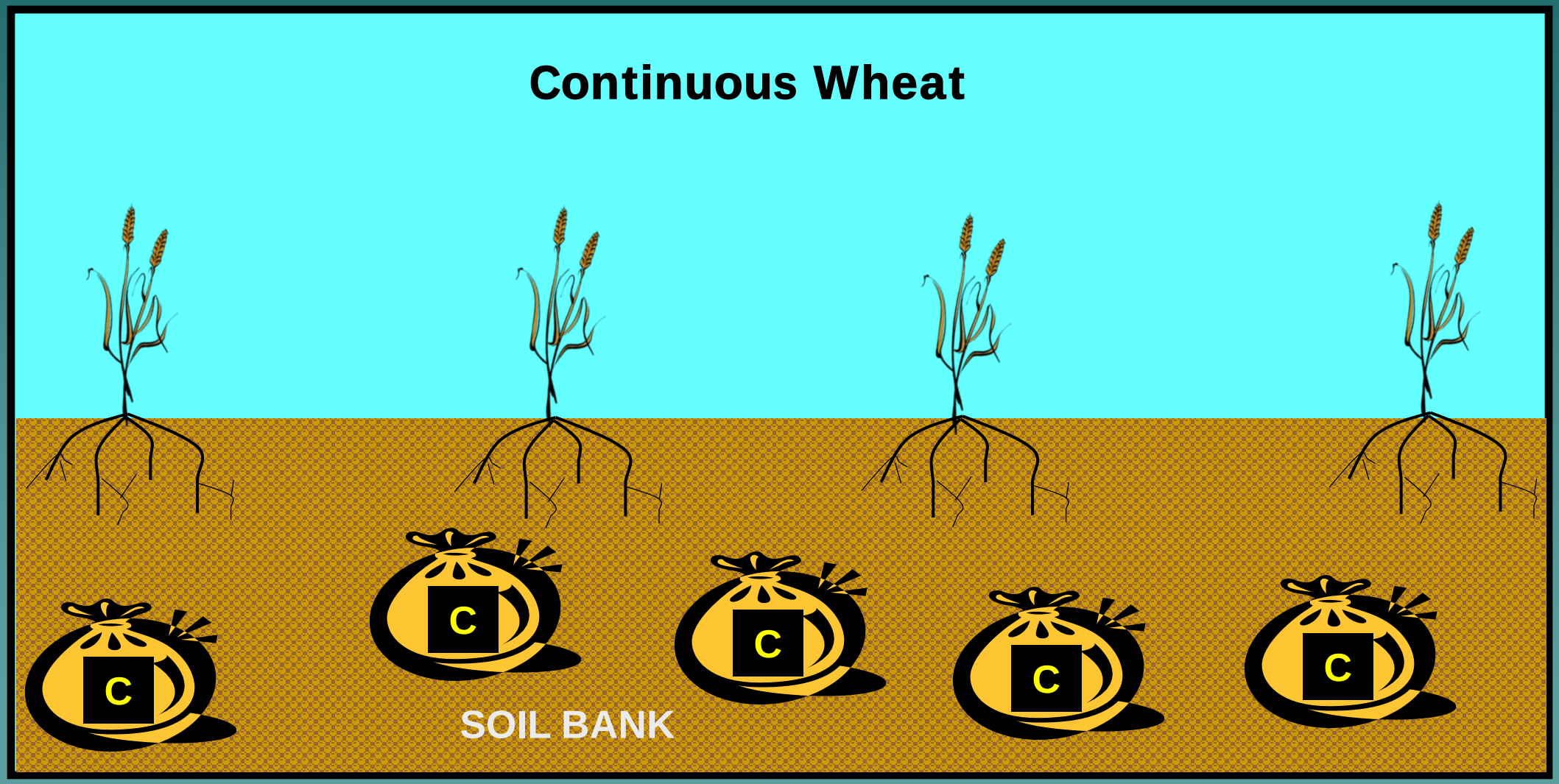


Third: Mimic Nature. Nature rewards diversity.

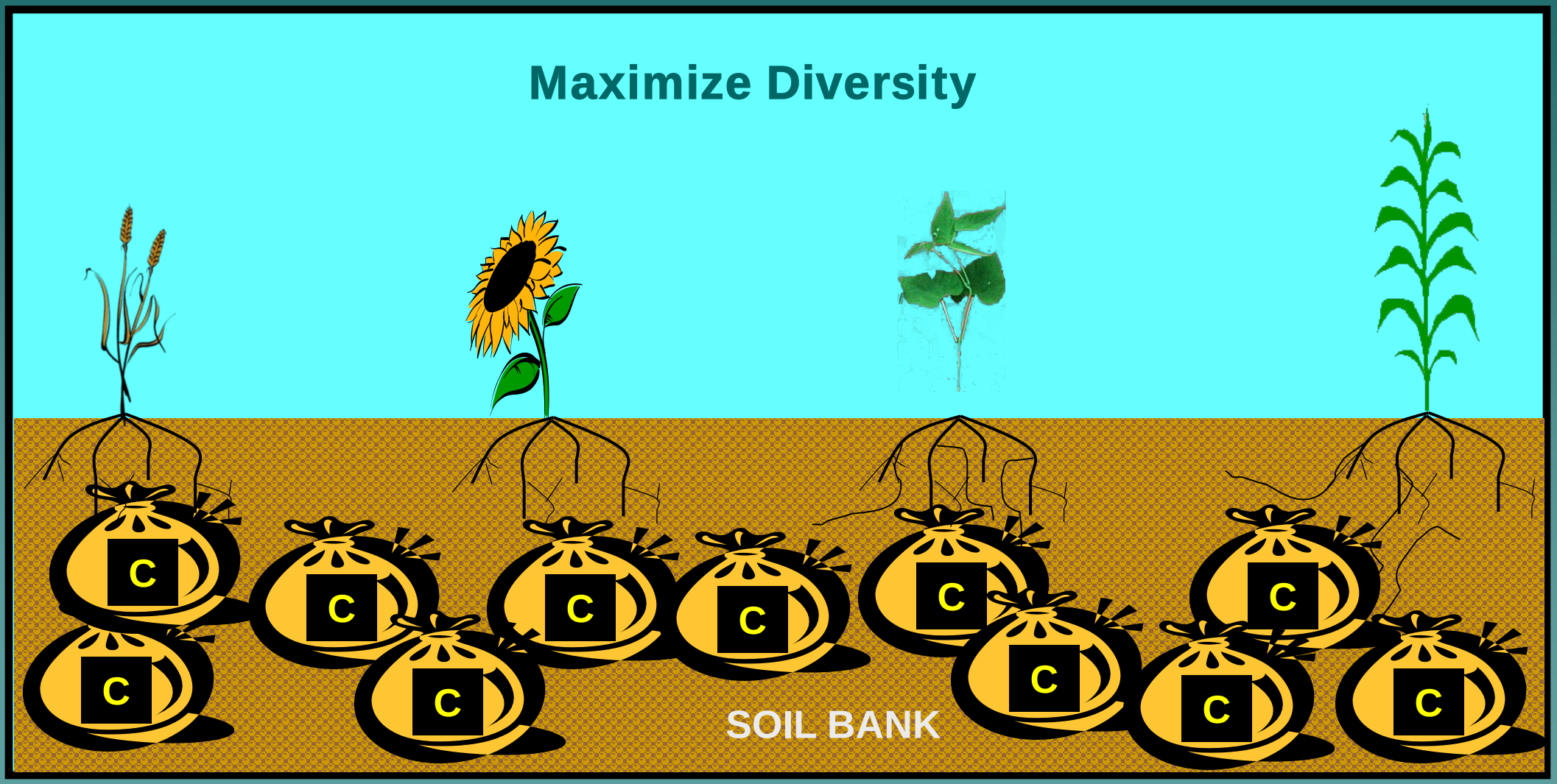
Microbes in the living **soil need diversity**



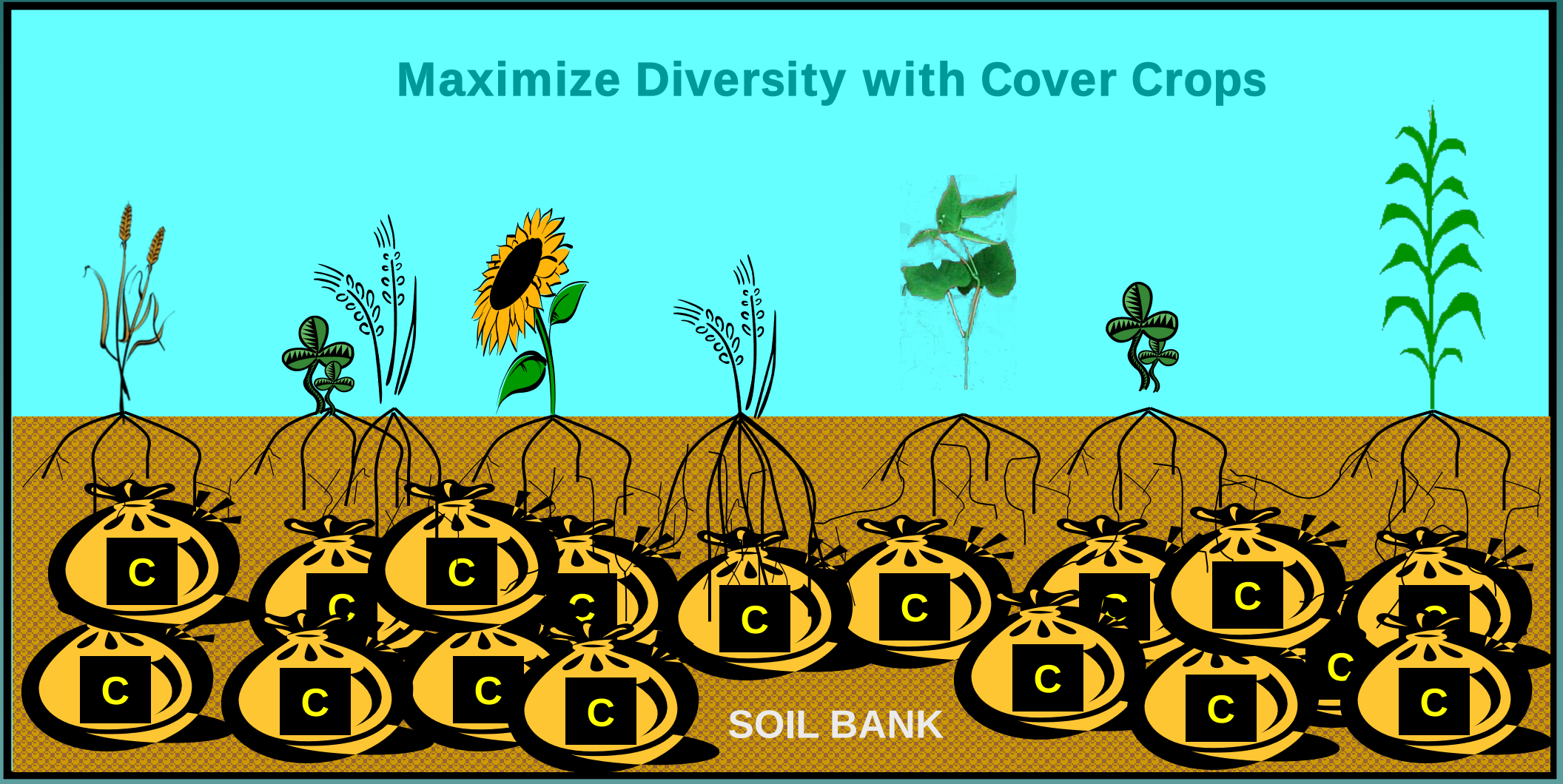
Continuous Cover and Crop Diversity



Continuous Cover and Crop Diversity



Continuous Cover and Crop Diversity



Four: Manage Disturbance (Physical and Chemical)

Before Primary Tillage

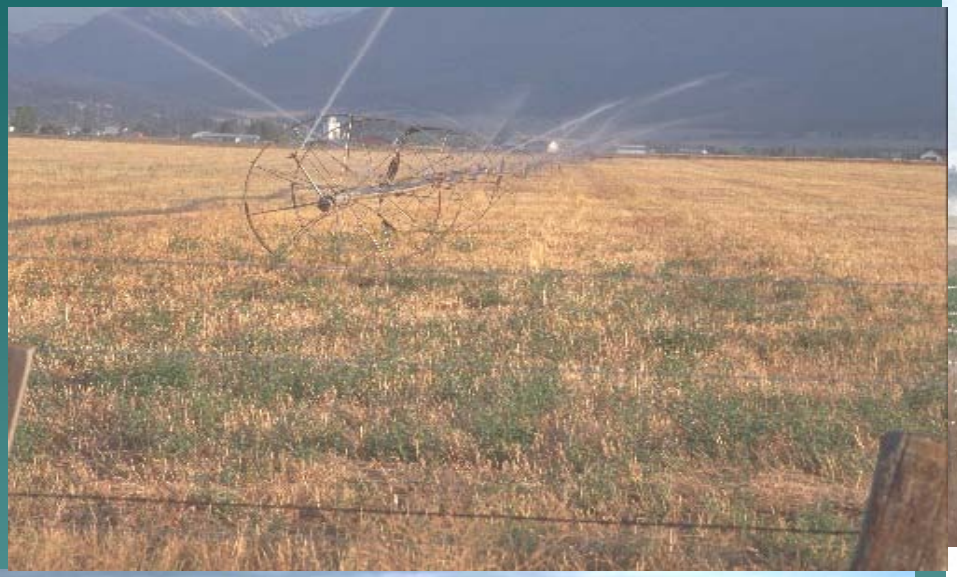
After Primary Tillage

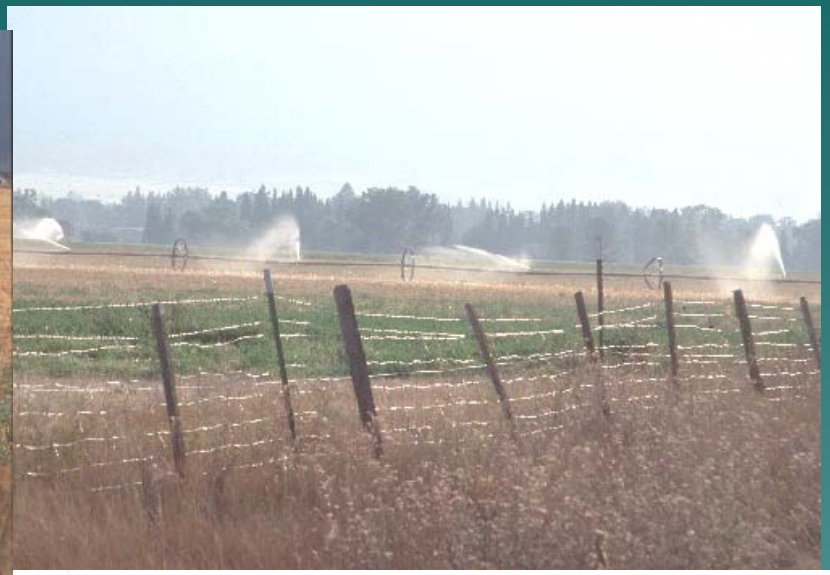
After Secondary Tillage

Dr. D.C. Reicosky, ARS, Morris, MN.

ANOTHER PHYSICAL DISTURBANCE : REPEATED OVERGRAZING

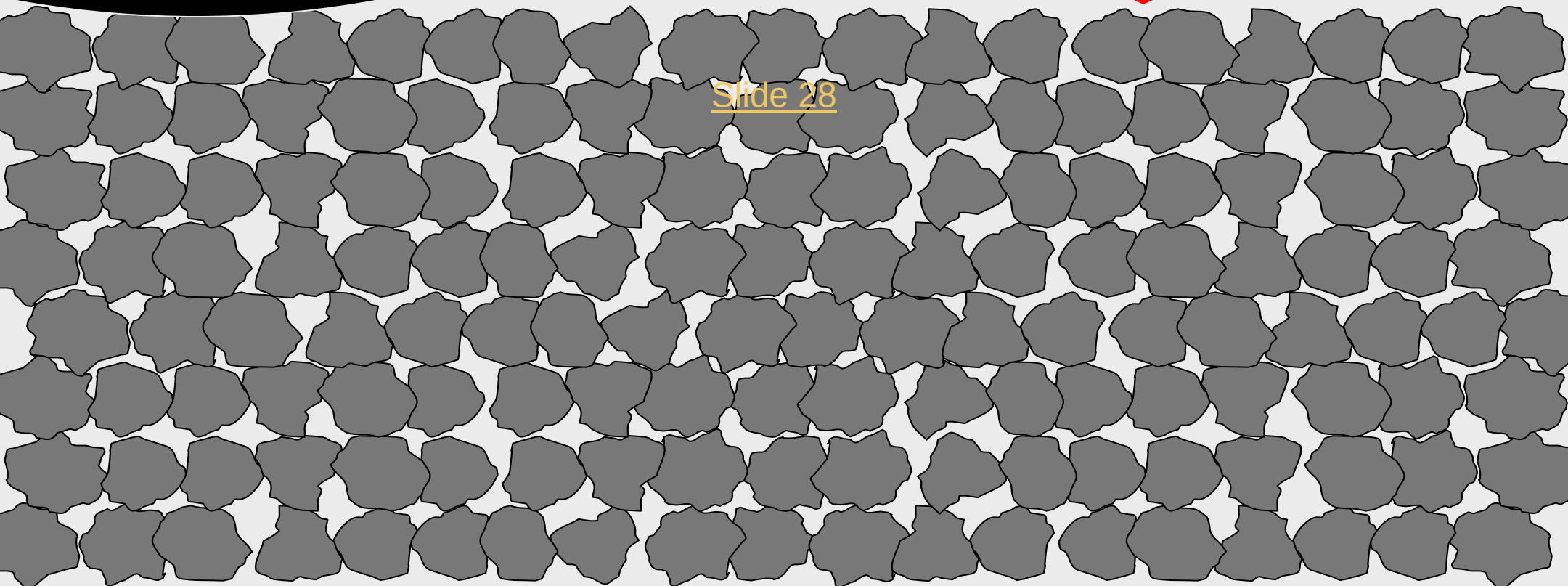
Physical disturbance: Over-irrigation





Disturbance

Compaction

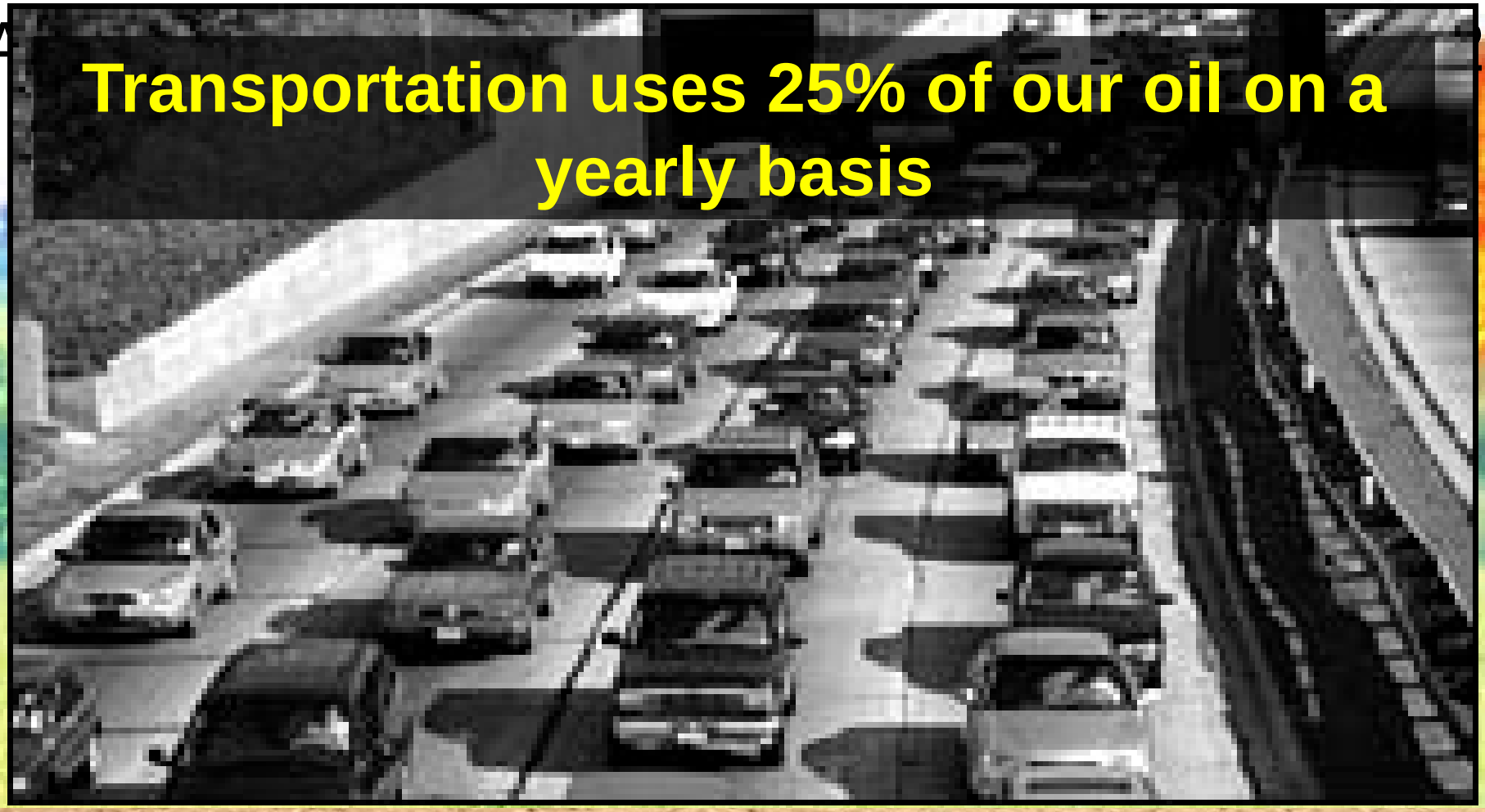


Slide 28

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

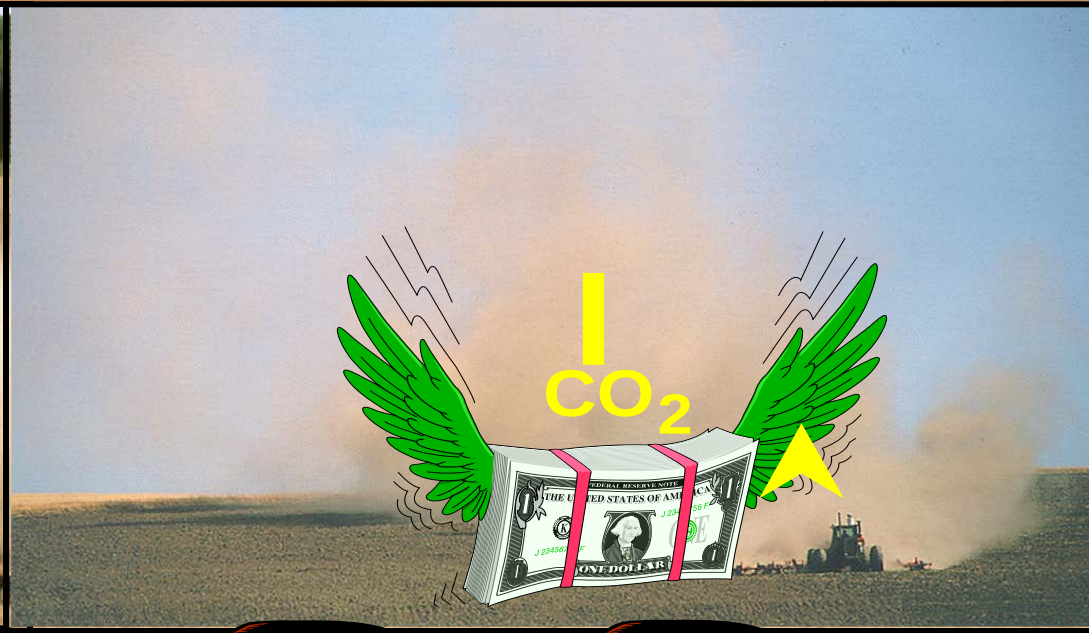
The foundation of our modern agriculture

A %

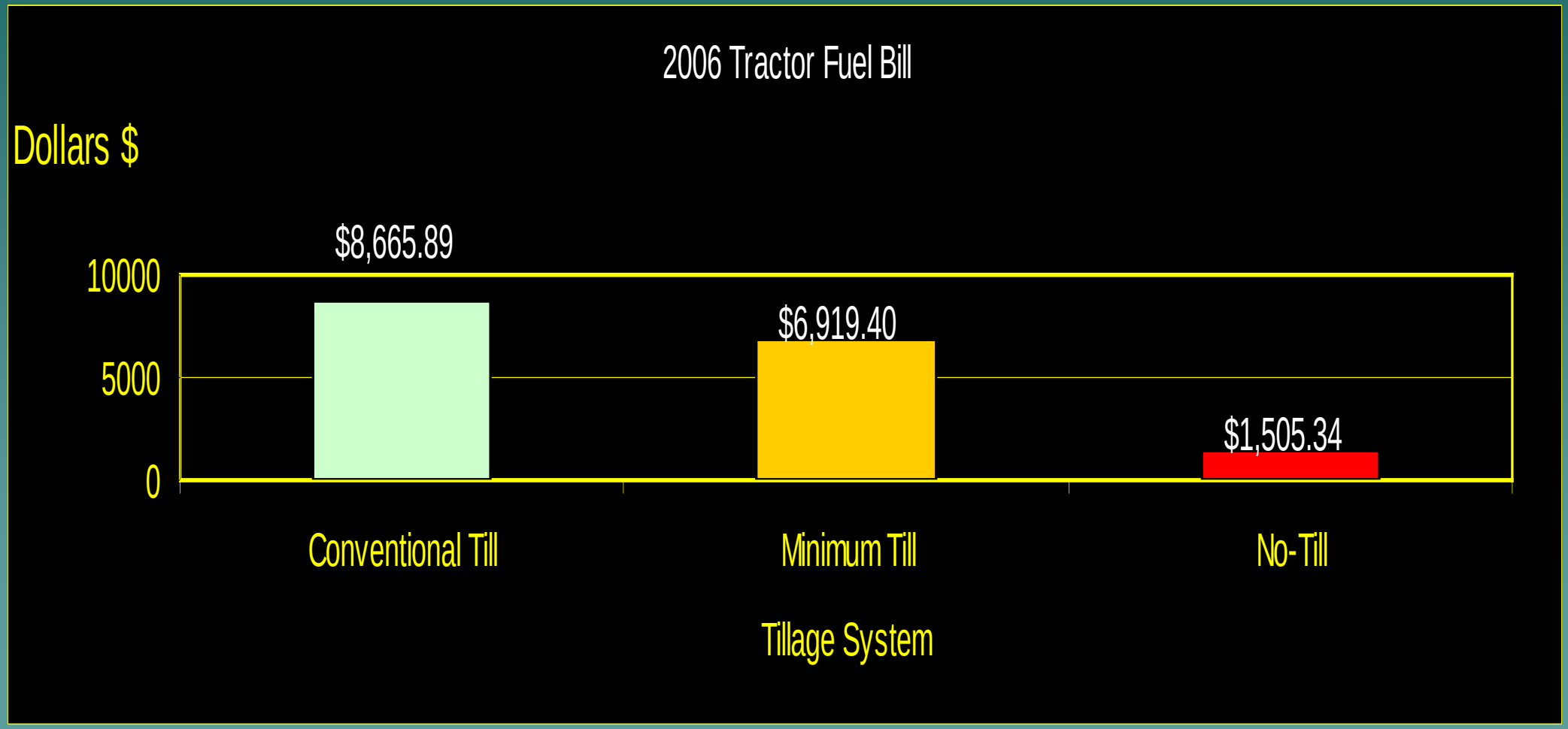


Economics:

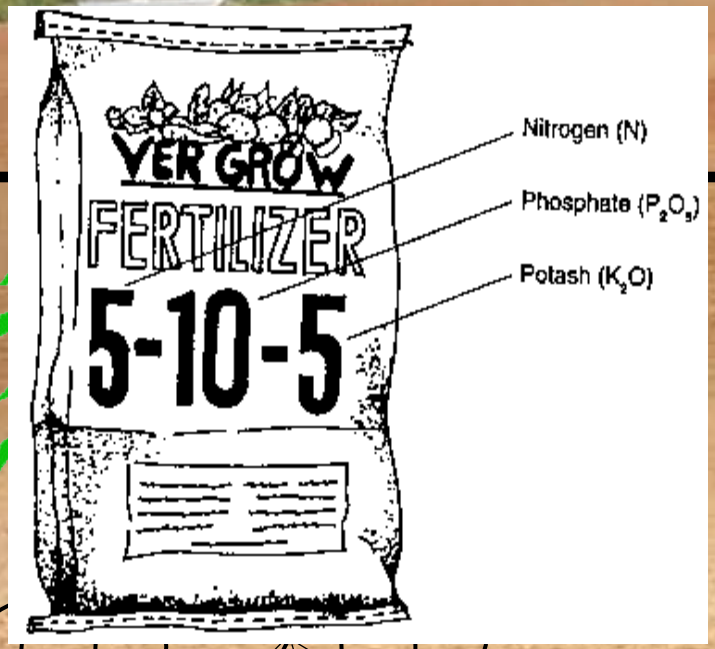
Disturbance Costs You Money



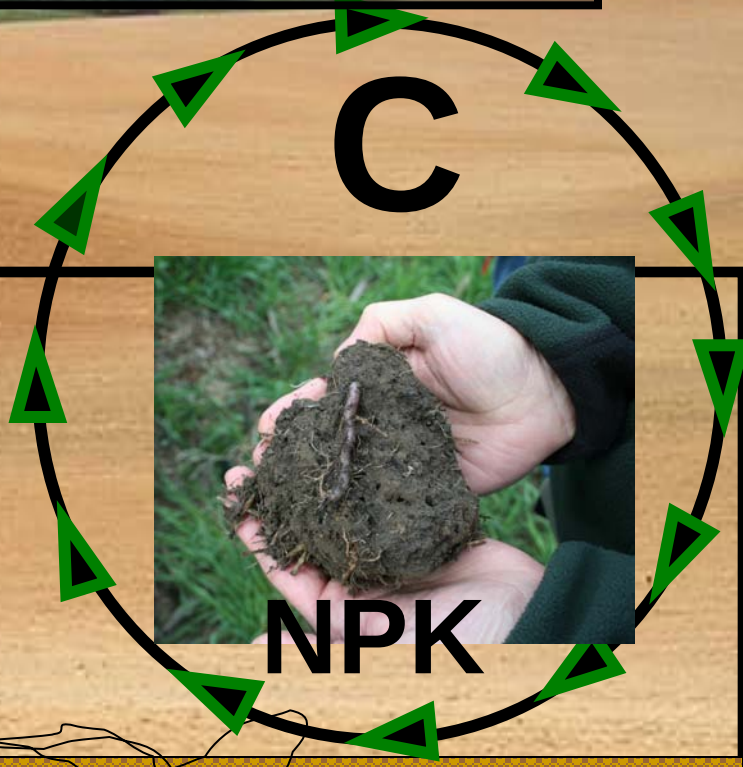
TAKE HOME: MORE SOIL DISTURBANCE EQUALS MORE FUEL USAGE



Understand the Ecosystem processes and the ecological principles you will create Synergy



Nutrients from below

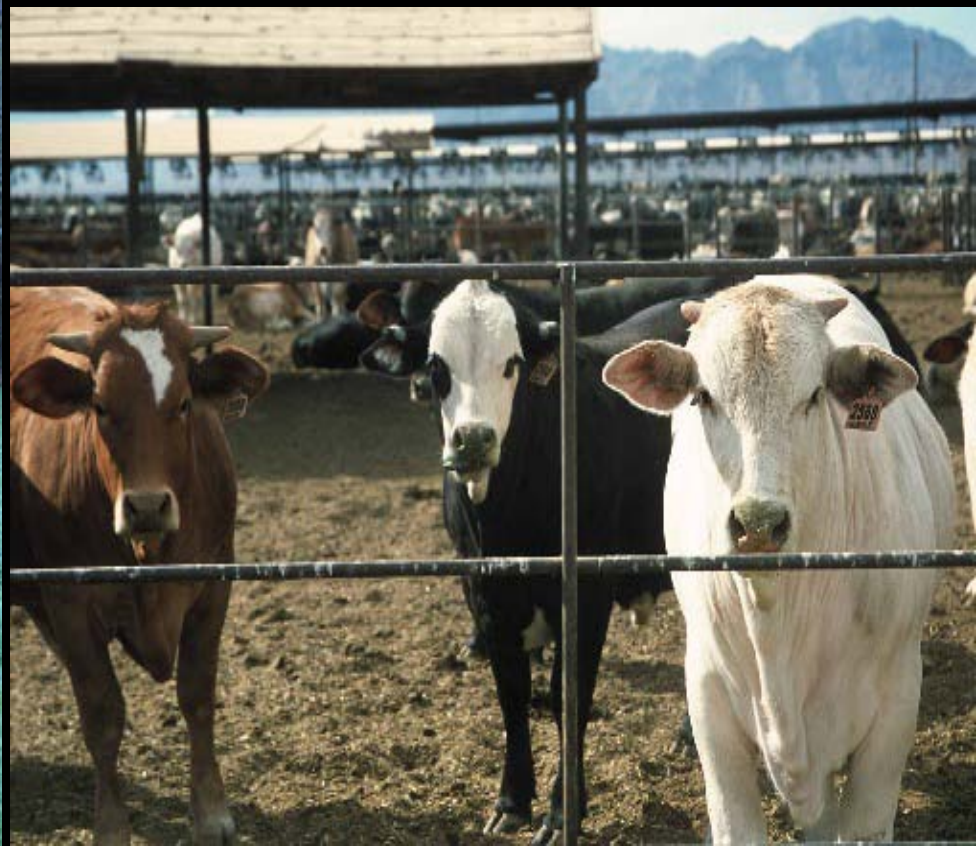


Sustainable

Low energy

Not Sustainable

High energy



Economics on a No-till system

No-till with Cover Crops	
Rye (1 bu./ac.)	**$15.00**
Vetch (20 lb./ac)	**$17.00**
Radish (4 lb./ac)	**$10.00**
Round up	**$ 7.00**
Cr. Clover (5 lb./ac.)	**$8.00**
Planting/Rolling per AC. Cover Crop	**$ 25.00**
Total	**$82.00 per/ac.**

No-till without Cover Crops	
18-46-0 *(18 units of N)	**$52.00**
*(162 units of N) **(30% N)** Mar. 2 2008 price-	**$160.00**
Round up	**$ 7.00**
2 lb Atrazine and Simazine	**$ 12.00**
Total	**$231.00 per/ac.**

Costs as of 3/1/2008

***Units of N recommended by NC State University**

$149.00 per ac. savings

HIGH SOIL QUALITY LEADS TO HIGH SILAGE QUALITY.

Ray’s silage provides enough energy- no extra corn needs to be added to the feed ration!

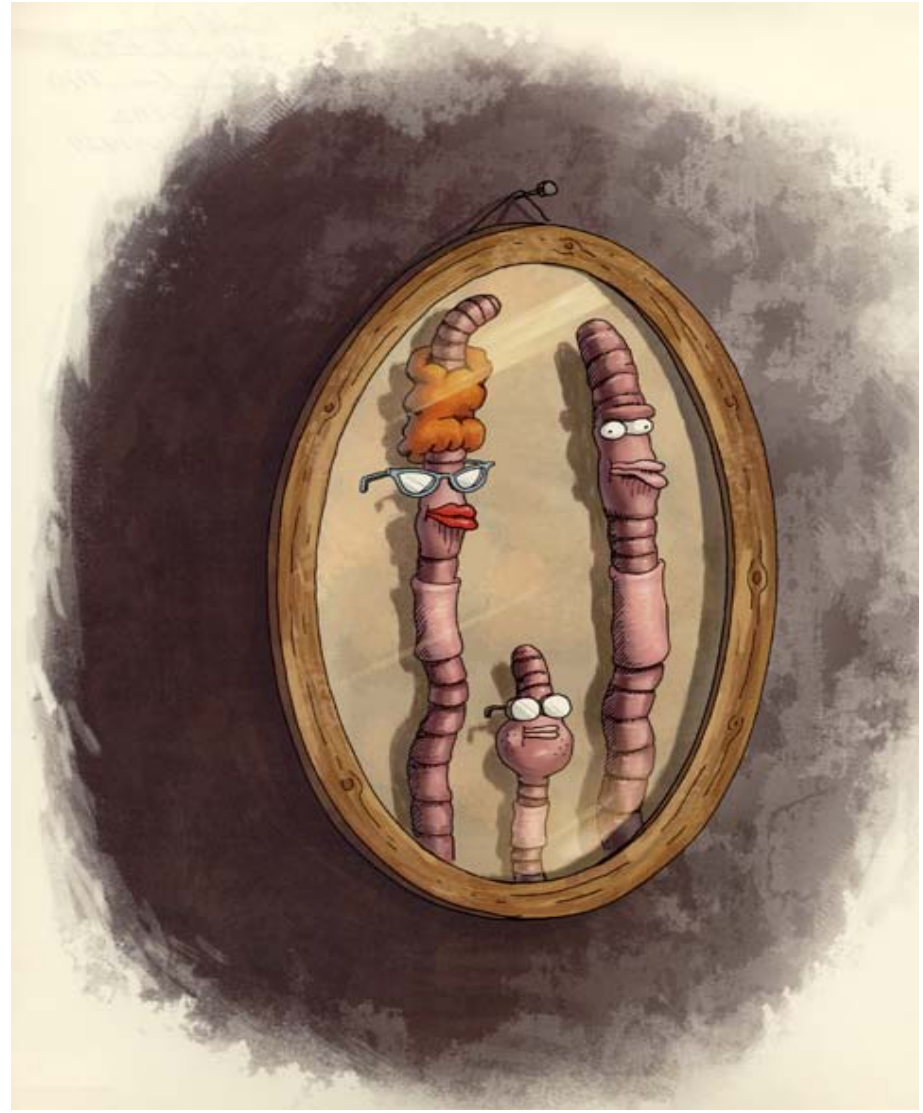
Which saves $ 1,638.00 for every 65 head of stocker steers!

Understanding Soil Health: The Only Sustainable Green Revolution!

4 "C"

- **Capture sunlight-make carbon (energy)**
- **Copy Nature (mimic diversity) with cover crops, intercropping and cover the soil at all times.**
- **Control physical and chemical disturbance**
- **Converge cropping and grazing systems together**

Super Heros

Among others in a

healthy soil system!