



Soil Health & Restoring Soil Function

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Growing ag Media Interest

MISSOURI RURALIST

April 2013

Grillers find new food sources **see Page 5** | Thinkings make farmers to state **see Page 18** | Get the most from your sprayer **see Page 28**

What lies beneath

By BRUCE HARRIS

Key Points

- Healthy soils are full of life and high in organic matter.
- Reducing tillage is the first step in building soil health.
- Soil health also can mean that fewer crop inputs will be needed.

They say to be healthy your soils should be full of life, high in organic matter, well-structured and covered all the time. "Any farmer can tell you his or her practices farm the best soil on the farm," says Jim Hoopes, an assistant professor and Ohio State University Extension educator. "The organic matter there, where the soil was built naturally, may be 3% to 4% or higher,

Put the soil first

MAKE GOOD SOIL: Loam, crumbly soils with strong structure and high organic content (insert) at built steadily using no-till and continual living cover. Soil health practitioners often start with one or two cover crop species, but gravitate to mixes that give more benefits.

Soil health summary profiles of experienced practitioners

| Soil Type |
|--|--|--|--|--|
| Dark Brown, North Dakota |
| Area farmed: 1,100 |
| Years in soil health system: 10 |
| Primary crops: Corn, wheat, soybeans |
| Primary cover crops: All cover, some night and day cover, annual and perennial, cover crop mix | Primary cover crops: All cover, some night and day cover, annual and perennial, cover crop mix | Primary cover crops: All cover, some night and day cover, annual and perennial, cover crop mix | Primary cover crops: All cover, some night and day cover, annual and perennial, cover crop mix | Primary cover crops: All cover, some night and day cover, annual and perennial, cover crop mix |
| Tillage: 0% no-till, 10% reduced tillage |

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Conservation

Steps to build healthy soils

BY LYNN BETTS

Key Points

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VALUE IN THE MIX: One of the keys to healthier soils, Jim Hoopes says, is the use of cover crops.

SPECIAL ISSUE: BUILDING BETTER SOILS

THE FURROW

January 2013

SOIL TEST QUEST

COVER CROP MAGIC / BIO-BOOSTERS

www.FarmProgress.com • JANUARY 2013 29

Crops

Mixes maximize cover crop benefits

BY LYNN BETTS

Key Points

- Diversity of cover crop species creates a more resilient habitat.
- Farmers can get more benefits from cover crop mixes.
- No-till can combine both types of plants.

There's a reason — no, several reasons — most farmers who start with single species cover crops eventually move to mixes.

"No one species can deliver all the advantages multiple cover crops deliver in combination," says David Lamm, USDA

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NATURAL RESOURCE MANAGEMENT

Emulate nature to build organic matter

BY LYNN BETTS

Key Points

- Use diverse cover crop species to build organic matter.
- Planting cover crops in the fall can help build organic matter.
- Use cover crop mixes to build organic matter.

Emulating nature's way of building organic matter in the soil can help farmers build more organic matter in their soil, says a new study from the University of Minnesota. The study found that cover crop mixes, which include a variety of species, can build more organic matter in the soil than single species cover crops.

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Crop Production

Cover crop mix offers best bet

BY LYNN BETTS

Key Points

- Diversity of plants aboveground creates underground habitat.
- You get more benefits from using several cover crops together.
- Use four types of plants: grass, broadleaf, soil erosion and warm season.

Natural Resources Conservation Service: "Soil is the foundation of our food system, and cover crops are a key to building soil health. Cover crops help improve soil structure, increase soil organic matter, and reduce soil erosion. They also help fix nitrogen in the soil, which can be used by the next crop. Cover crops also help reduce the need for synthetic fertilizers and pesticides. They are a key to building a more sustainable and profitable farming system."

Lamm, the leader for the NRCS National Soil Health and Sustainability Team in Michigan, says cover crop mixes are the best way to build soil health. "Cover crop mixes provide a diverse habitat for soil organisms, which helps build soil structure and organic matter. They also help fix nitrogen in the soil, which can be used by the next crop. Cover crops also help reduce the need for synthetic fertilizers and pesticides. They are a key to building a more sustainable and profitable farming system."

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Manage Soil Microorganisms for Healthier Soil

APRIL 27, 2013
By: Darrell Smith, Farm Journal Conservation and Machinery Editor

SOIL HEALTH

Manage soil microorganisms to pave the way to healthier soil and higher yields

You till (or don't till), manage drainage and apply lime or fertilizer to grow higher yielding crops. But that's the result, not the motivation. The reason you take those steps is to make your soil healthier by improving the habitat for microorganisms. You want those soil-dwelling creatures to be plentiful and active, decomposing residue and recycling its nutrients into forms your crops can use.

RELATED STORIES

- Soil Air and Water Units

NRCS Soil Health Campaign

Soil Health Awareness

Unlock the Secrets in the Soil

Sign up for e-mail updates on Soil Health Awareness

Soil is a living and life-giving natural resource.

As world population and food production demands rise, keeping our soil healthy and productive is of paramount importance. So much so that we believe improving the health of our Nation's soil is one of the most important conservation endeavors of our time.

The resources on this soil health section of our site are designed to help visitors understand the basics and benefits of soil health—and to learn about Soil Health Management Systems from farmers who are using these systems.

soil health THEATER

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Explore the Science of Soil Health

Profiles in Soil Health

Under Cover Farmers of Stanly County, NC

Researcher's Under Cover journeys of to adapt soil health. Recently, the video work and Soil Health partnership can be seen in NRCS' Soil Health Theater.

OKLAHOMA

PROFILES IN soil health

Jimmy Emmons
Dewey County, Oklahoma
2,000 acres
Crops: Wheat, alfalfa, canola, cow/calf operation
Covers: Multi-species

unlock the SECRETS OF THE SOIL

unlock

THE SCIENCE OF SOIL HEALTH

MONTANA

PROFILES IN soil health

Julie Taylor
Fairfield, MT
510 acres (cropland, pastureland & rangeland)
Crops: barley and hay
Covers: Austrian winter peas, berseem clover, soybeans, field peas, red clover & hairy vetch

Farming Changes Focus on Soil Health

Julie Taylor, who farms on the Fairfield Bench, has changed her farming practices to include no-till farming methods, planting cover crops, composting to augment soil fertility, and intensively grazing both hay land and rangeland.

unlock the SECRETS OF THE SOIL

- ✓ Raised awareness
- ✓ Expanded demand for system adapted information
- ✓ Raising many good questions

Why in 2016?

World population is estimated to be at 9.1 billion by 2050

To sustain this level of growth, food production will need to rise by 70 percent

Between 1982-2007, 14 million acres of prime farmland in the U.S. was lost to development

Energy demands

- Increase use of biofuels (40% of corn used for ethanol)
- Increase use of fertilizer (use of Anhydrous up 48%, Urea up 93%)
- Phosphorous is a finite resource

Soil Health What is It?

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

- Nutrient cycling
- Water (infiltration & availability)
- Filtering and Buffering
- Physical Stability and Support
- Habitat for Biodiversity (90% is mediated by soil microbes)

Soil is a Living Factory

Macroscopic and microscopic organisms

- Food
- Water
- Shelter
- Habitat
- **Powered by sunlight**

Management activities improve or degrade soil health

- Tillage
- Fertilizer
- Pesticides
- Grazing
- Plant Diversity



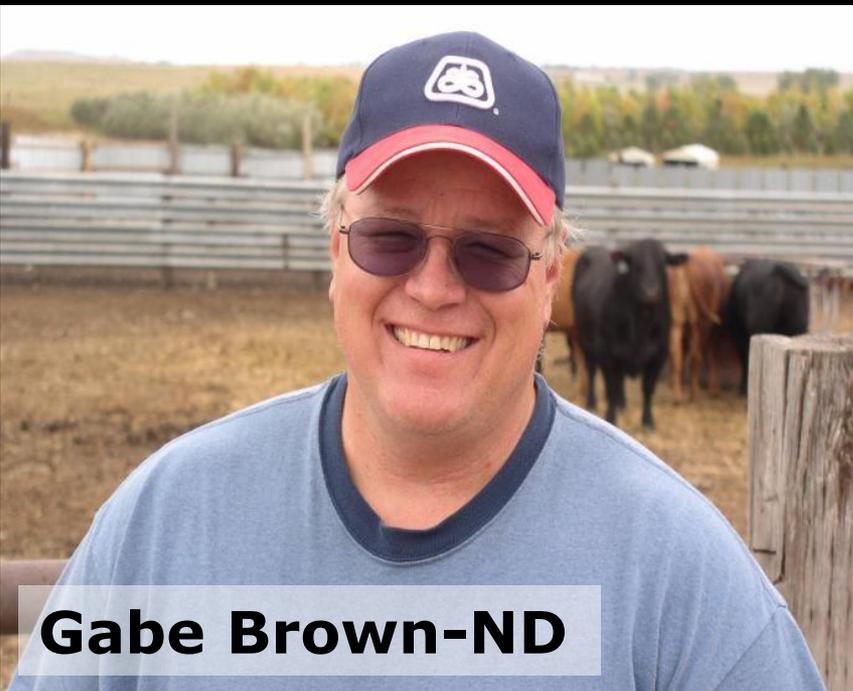
Ray Styer-NC



Dave Brandt-OH



Brandon Rockey-CO



Gabe Brown-ND



Ray McCormick-IN



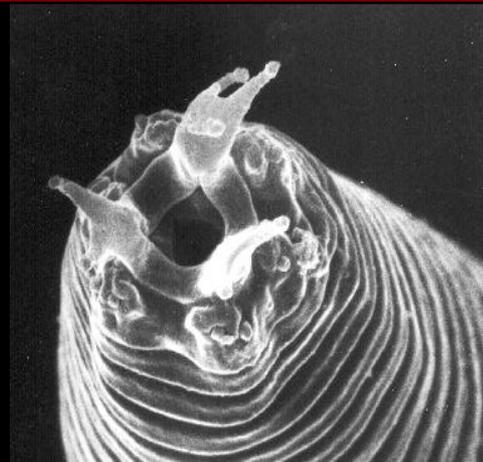


Ecology:

The study of relationships between people, animals, and plants, and their environment.

Interconnectedness

Soil Surface

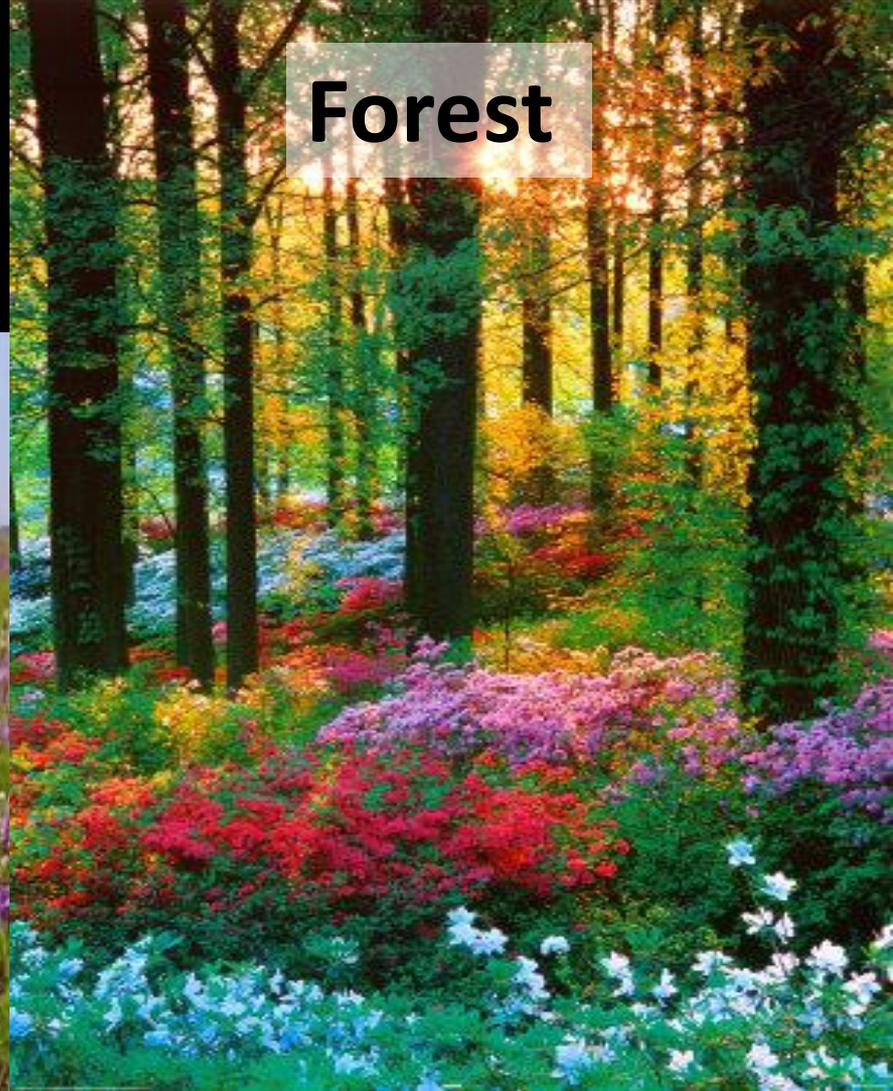


How do these Ecosystem Flourish Without Human Inputs?

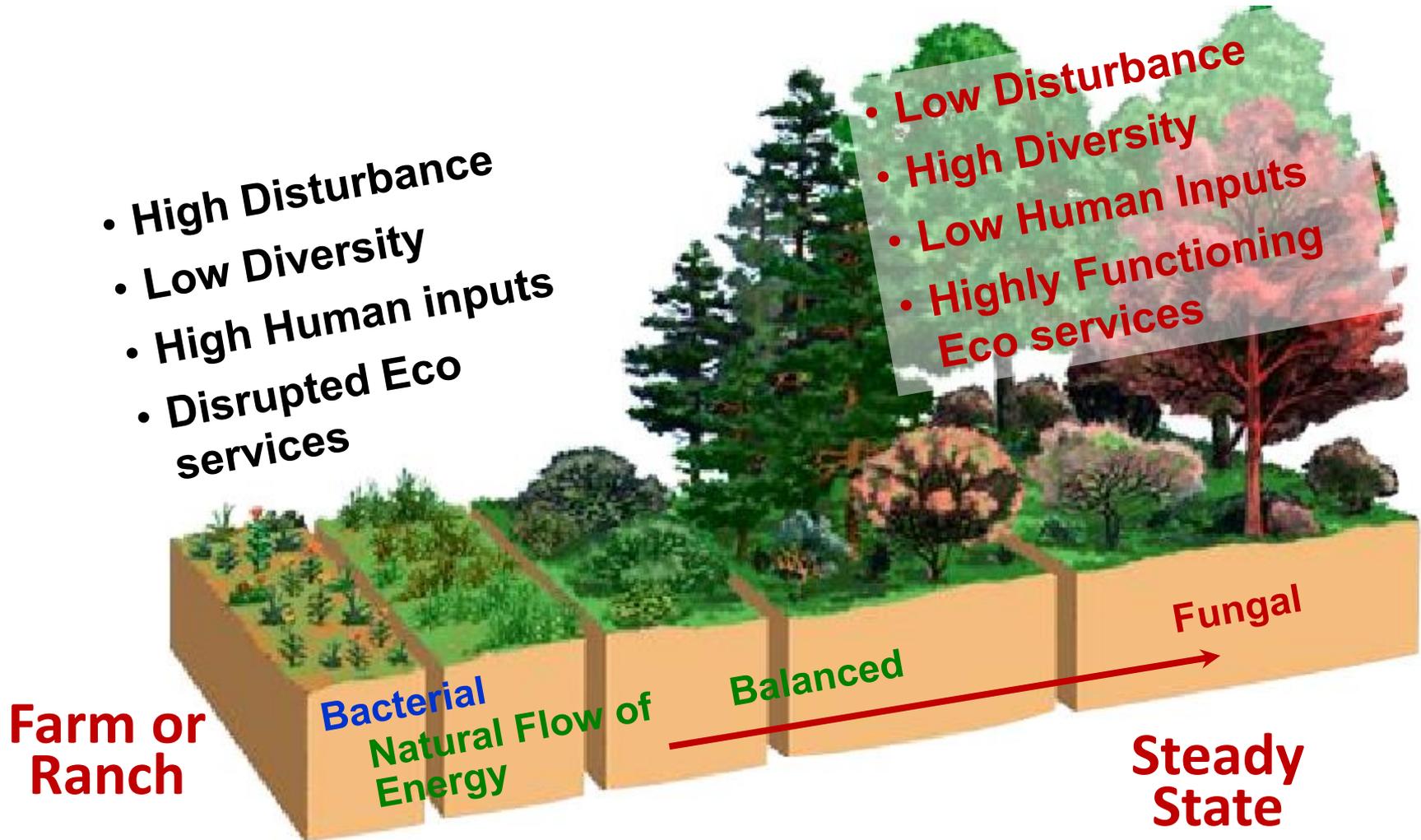
Prairie



Forest



Characteristics of a Stable Ecosystem





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

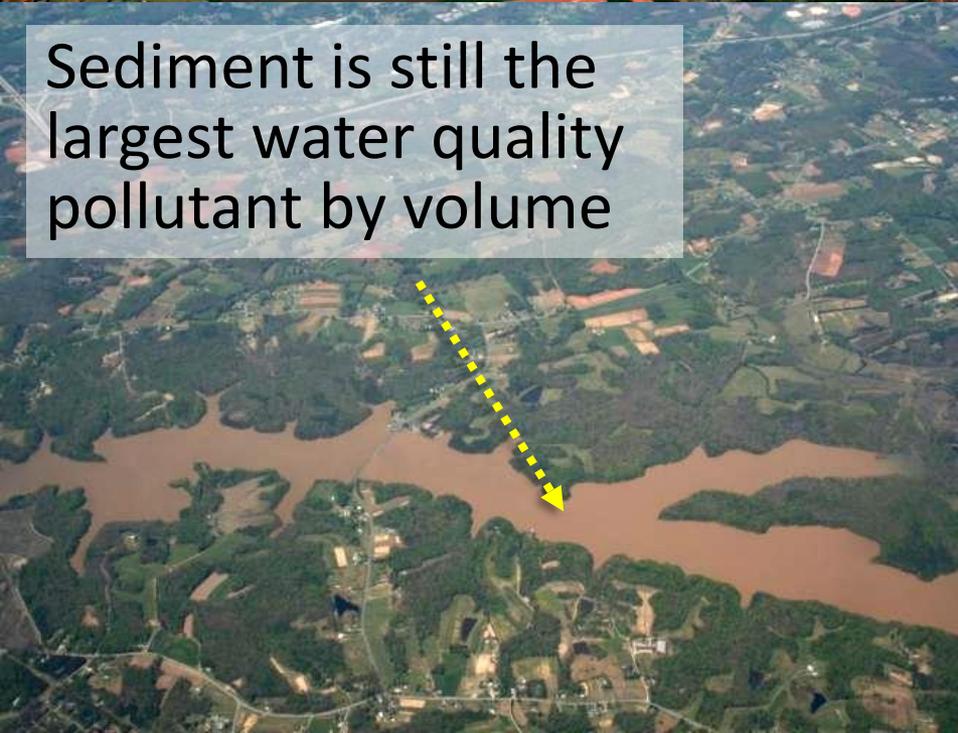
Erosion from bare fields into river



Oklahoma, October 2012, I-35



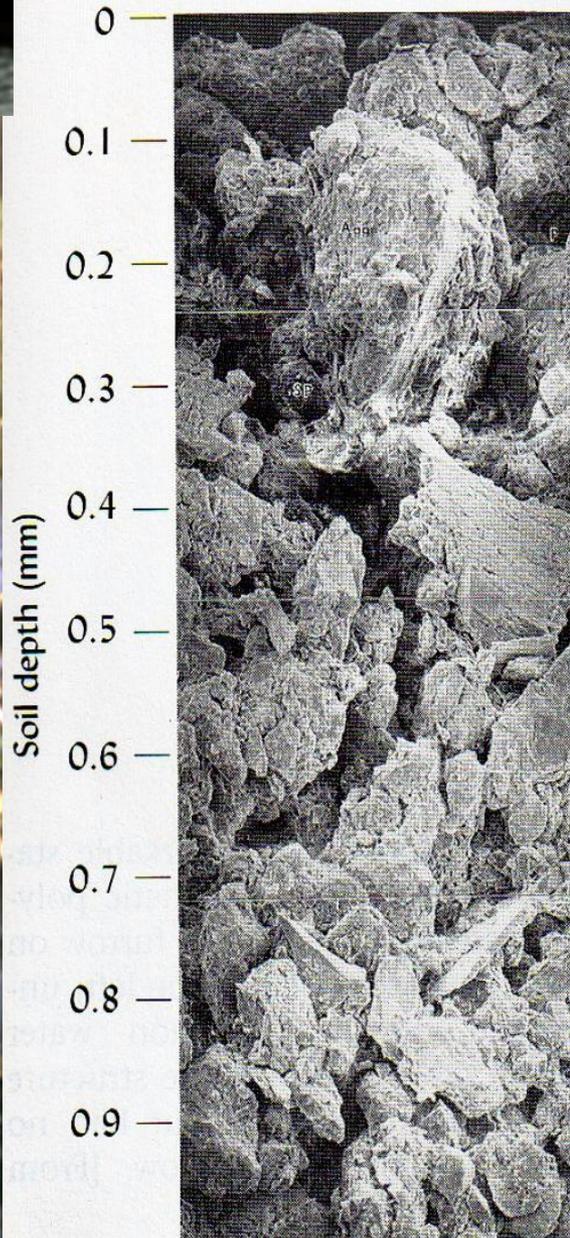
Sediment is still the largest water quality pollutant by volume



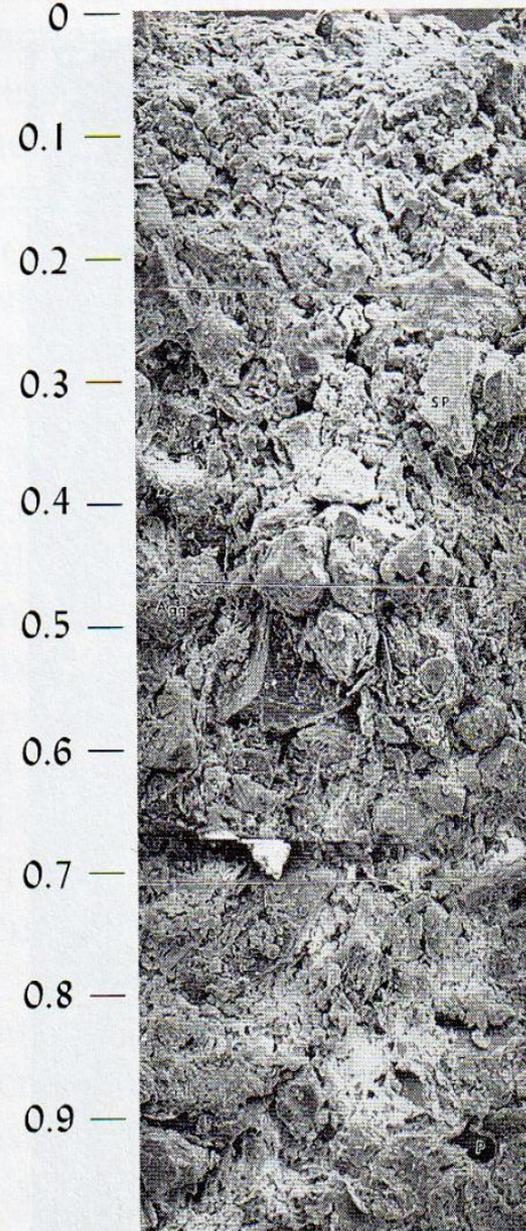
Lubbock, Texas Oct. 17, 2011



The Battle is Won or Lost Here



(a)



(b)





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

Understands Soil Function !



Does Not Understand Soil Function!



Soil Disturbances that Impact Soil Health

Physical

- Tillage
- Compaction

Biological

- Lack of Plant Diversity
- Over grazing

Chemical

- Misuse of fertilizer, pesticides, manures and soil amendments

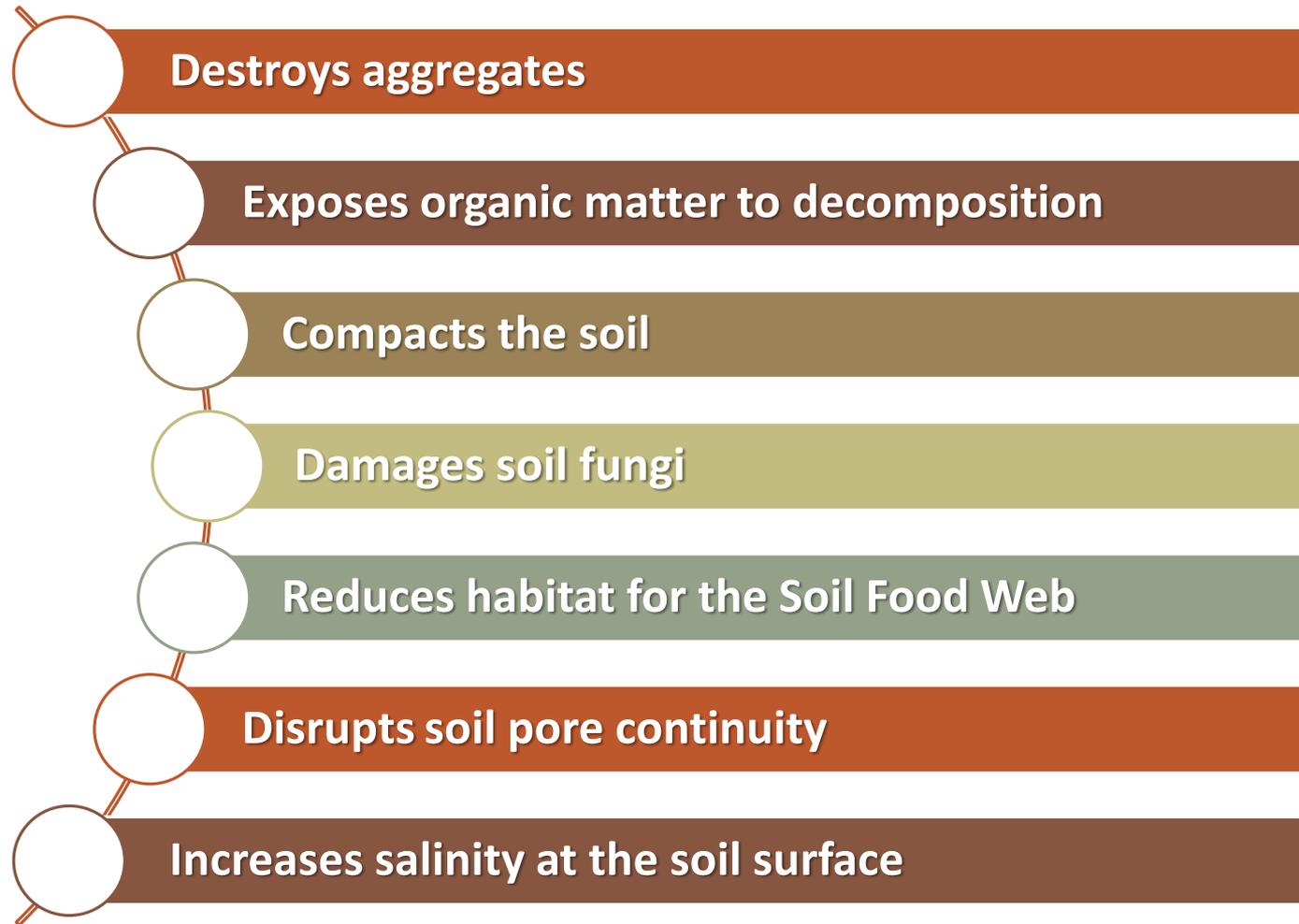


What is Tillage?

The physical manipulation of the soil for the purpose of:

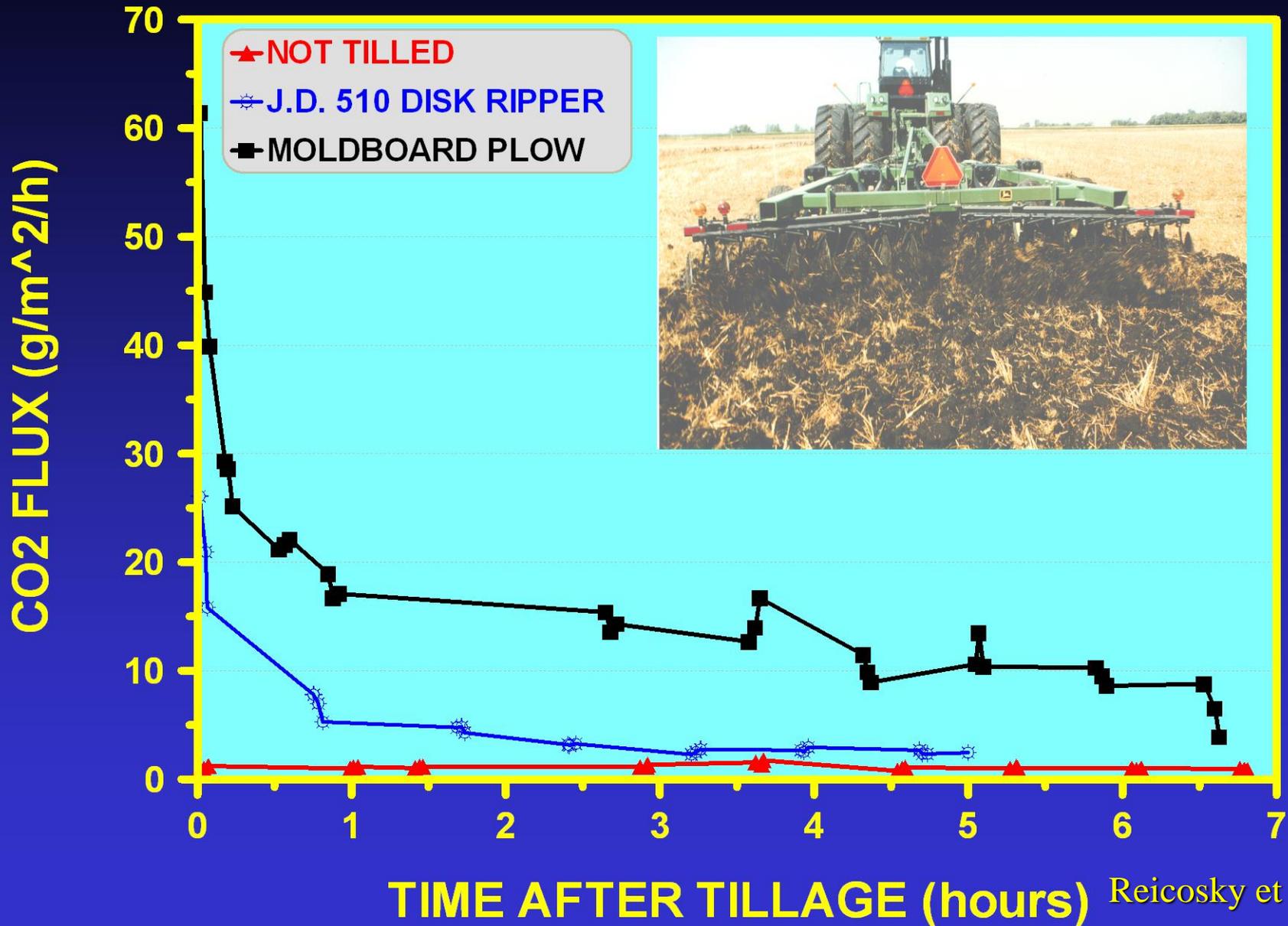
- Management of previous crop residue
- Control of competing vegetation (weeds)
- Incorporation of amendments (fertilizer/manure)
- Preparation of a soil for planting equipment
- Recreation for folks who don't fish or golf.

What Tillage does to the Soil



JOHN DEERE 510 DISK RIPPER CO2 FLUX DATA

SWAN LAKE TILLAGE DEMONSTRATION AUGUST 24, 1994

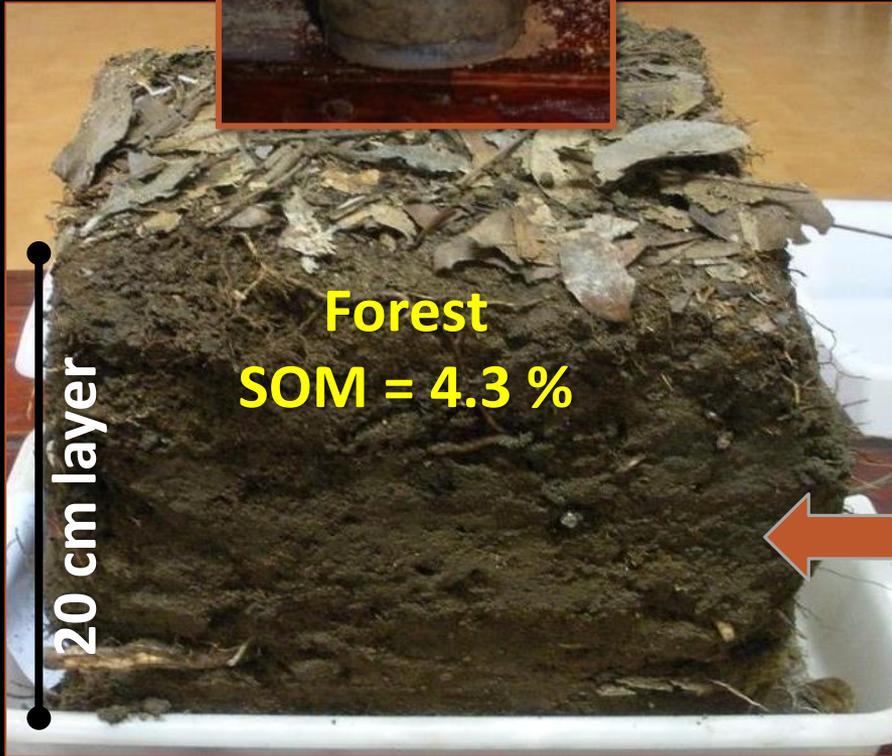


Reicosky et al., 1995

Management Changes Soil Properties & Capacity of Soil to Function



62.8% loss of
SOM after 17 yr
intensive tillage



Forest
SOM = 4.3 %



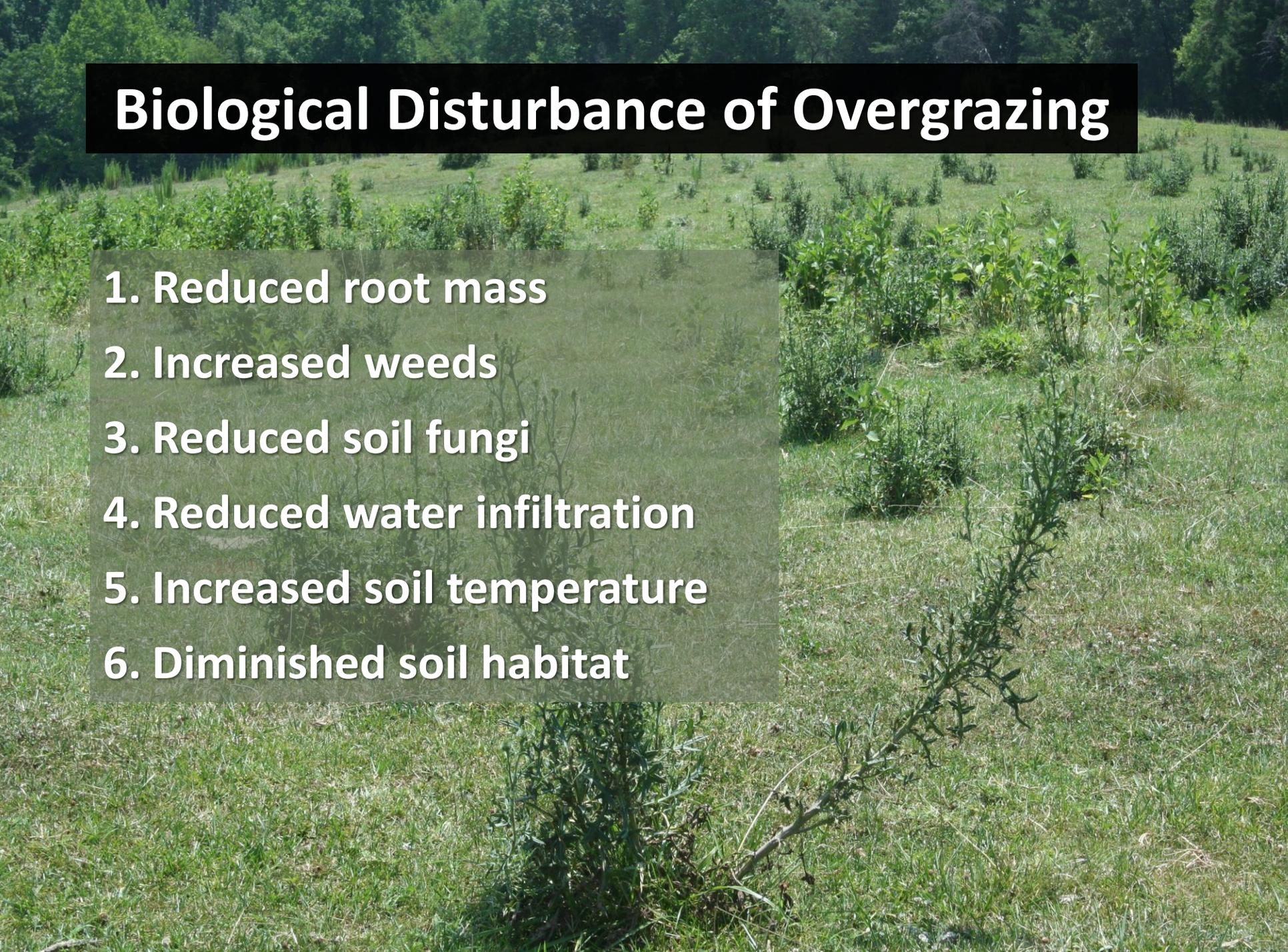
CT 17 yr- Soybean
Monoculture SOM = 1.6 %

Biological Disturbance

- **No diversity in the crop rotation**
 - Growing single species or few crops in rotation
 - Lack of diversity limits diversity of plant root exudates
 - Hampers the development of a diverse soil biota
- **Overgrazing**
 - Plants are exposed to intensive grazing for extended periods of time, without sufficient recovery periods
 - Many pasture have single species grasses



Biological Disturbance of Overgrazing



1. Reduced root mass
2. Increased weeds
3. Reduced soil fungi
4. Reduced water infiltration
5. Increased soil temperature
6. Diminished soil habitat

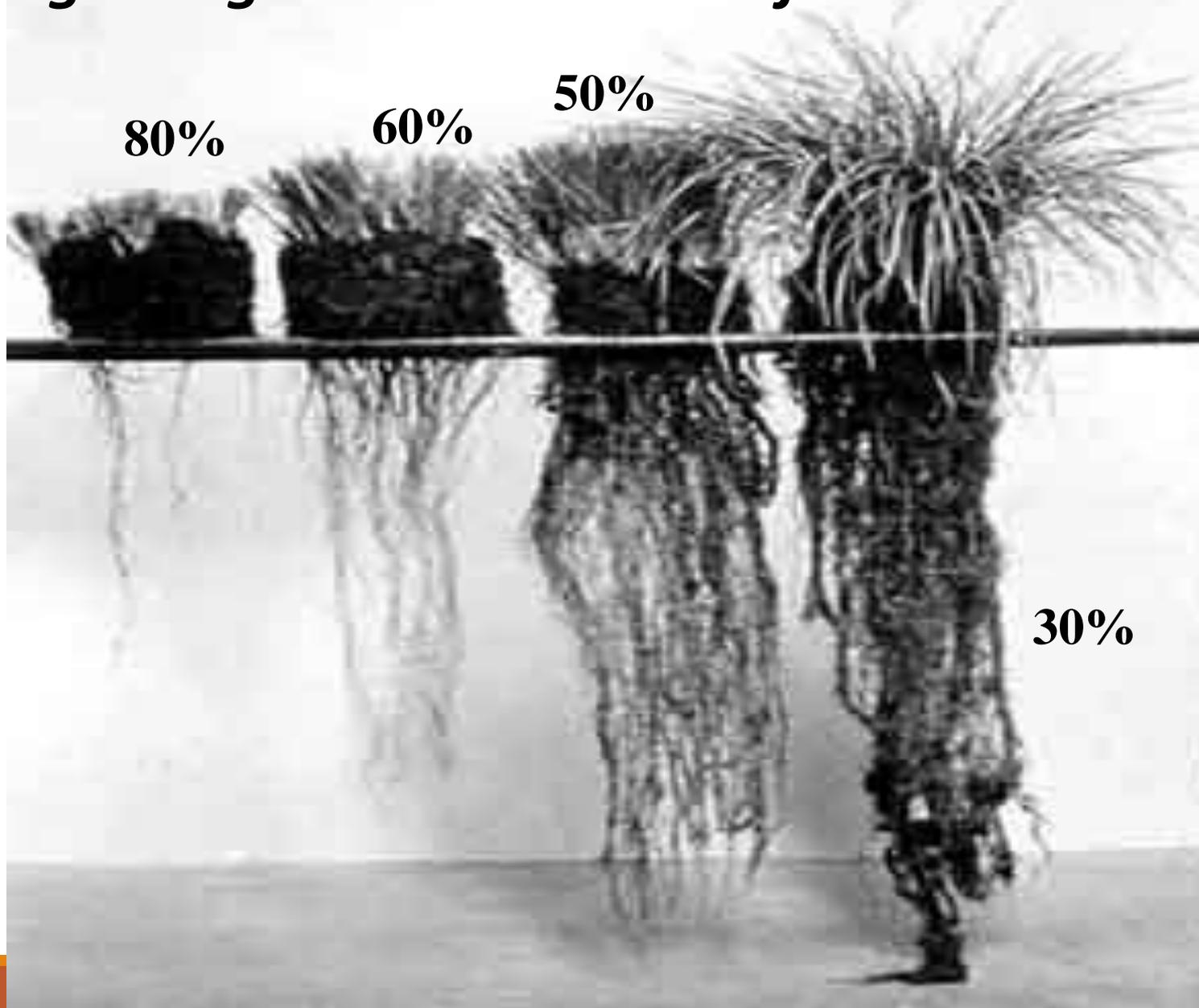


Alternative water sources & controlled access to stream but no control of grazing time on watershed

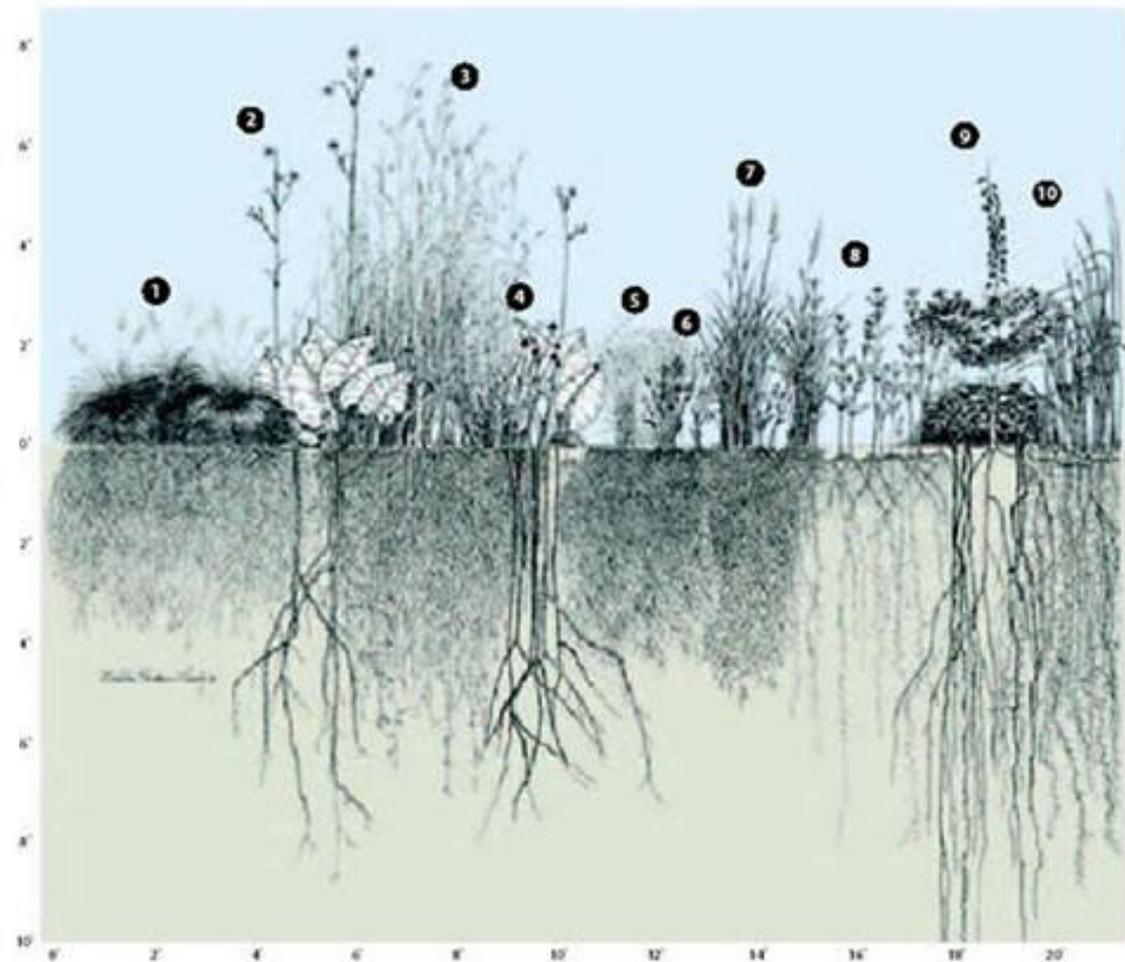
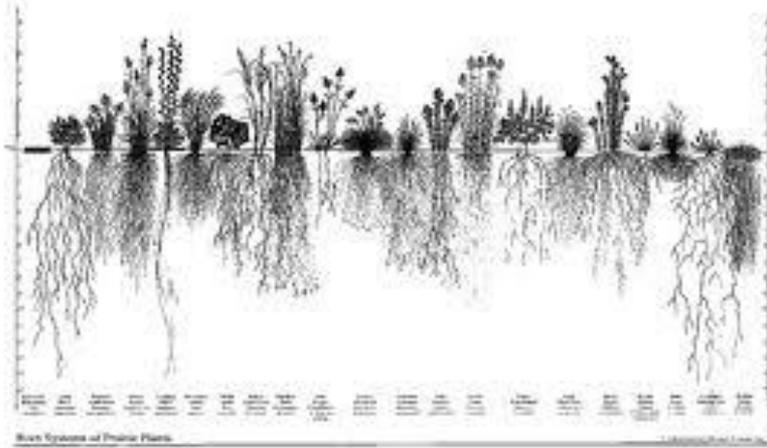
Soil Health in pasture systems



Overgrazing: another source of disturbance



Diversity of roots in nature



1. Prairie Dropseed

2. Prairie Dock

3. Big Bluestem

4. Pale Purple Coneflower

5. Little Bluestem

6. Black Eyed Susan

7. Indiangrass

8. Showy Sunflower

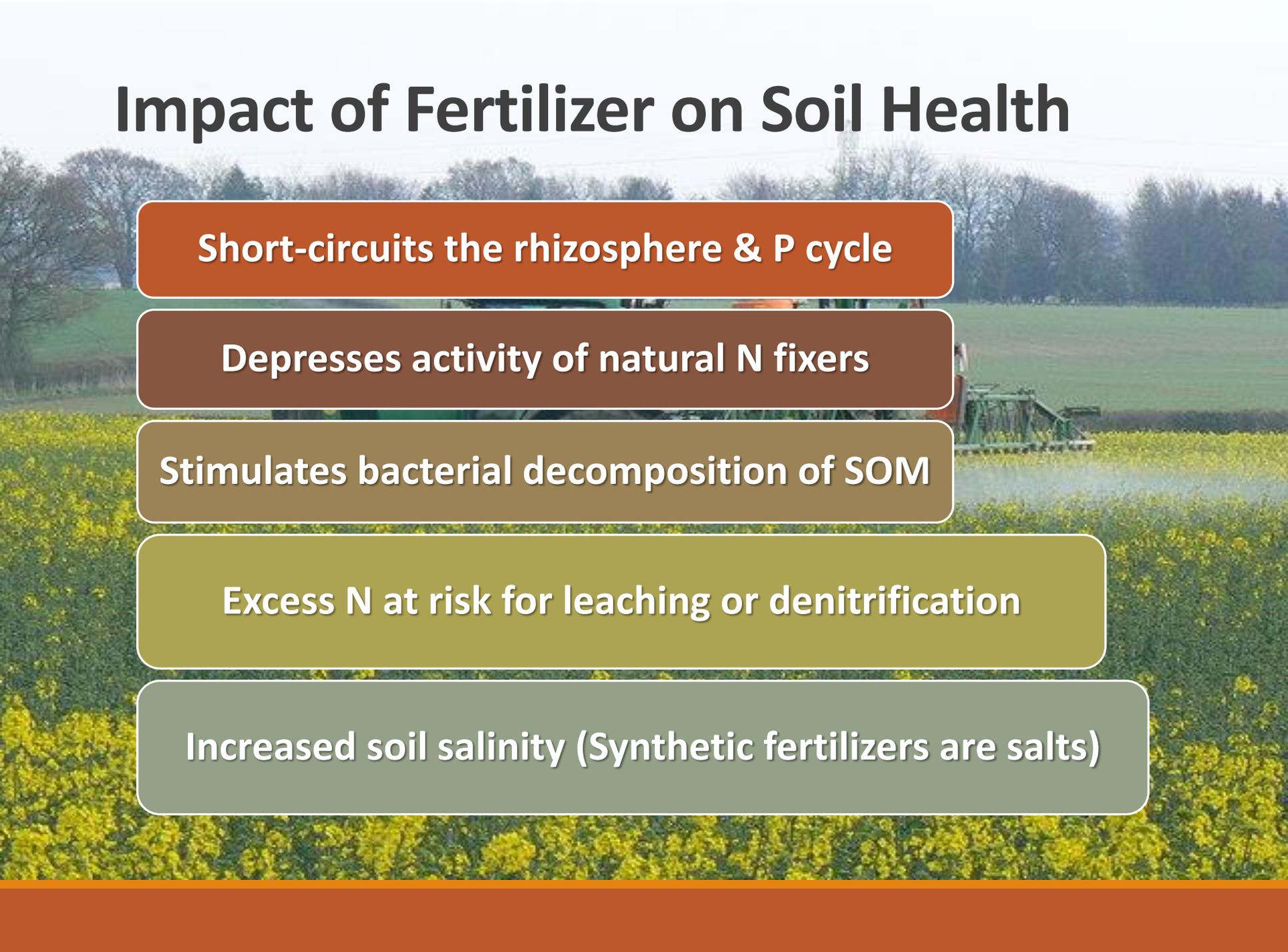
9. White False Indigo

10. Prairie Cordgrass

**Chemical disturbances:
Over-application of
pesticides, fertilizers,
amendments & manures**



Impact of Fertilizer on Soil Health



Short-circuits the rhizosphere & P cycle

Depresses activity of natural N fixers

Stimulates bacterial decomposition of SOM

Excess N at risk for leaching or denitrification

Increased soil salinity (Synthetic fertilizers are salts)

Paradigm Shifts

Paradigm shift #1 Stop treating the symptoms of dysfunctional soil; solve the problem of dysfunctional soil.

Paradigm shift #2 Restoring soil function can be accomplished without going broke.

- Apply basic principles of ecology to create quality habitat.

Paradigm shift #3 Conservation practices do not restore soil health, understanding soil function restores soil health.

Managing for Soil Health

Keep the soil armored with plants and plant residues

Minimize disturbance of the soil

Maximize diversity of plants

Keep living roots in the soil as much as possible

Incorporate livestock into the cropping system

Create the most favorable habitat possible for the soil food web

Soil Health Is Understanding How the Soil is Designed to Function and Managing it Accordingly

