



Soil Health Principles

Module 2

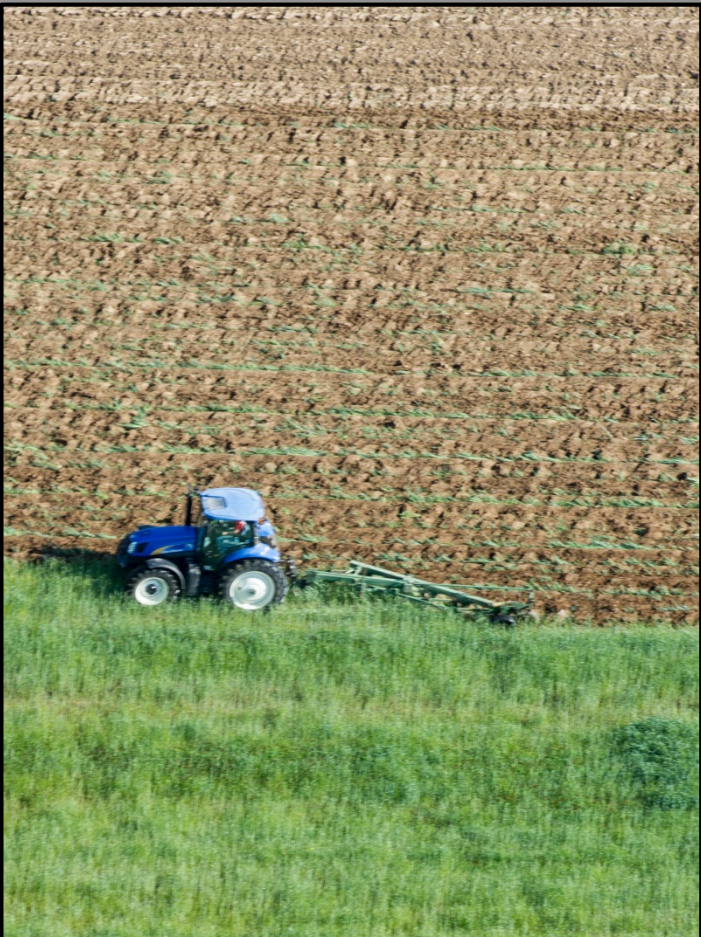
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Agronomist



Objectives

1. List and explain the soil health principles
2. Identify and explain how conservation practices address soil health principles
3. Identify *core* soil health practices in your region





What are General Characteristics of Cultivated Soils?

- ↓ H_2O Infiltration & Storage
- ↓ Biological Activity
- ↓ Biological Diversity
- ↓ Efficient Nutrient Cycling
- ↑ Summer Temps
- ↓ Contribution to Vigor
- ↑ Erosion Potential
- ↓ Aggregation



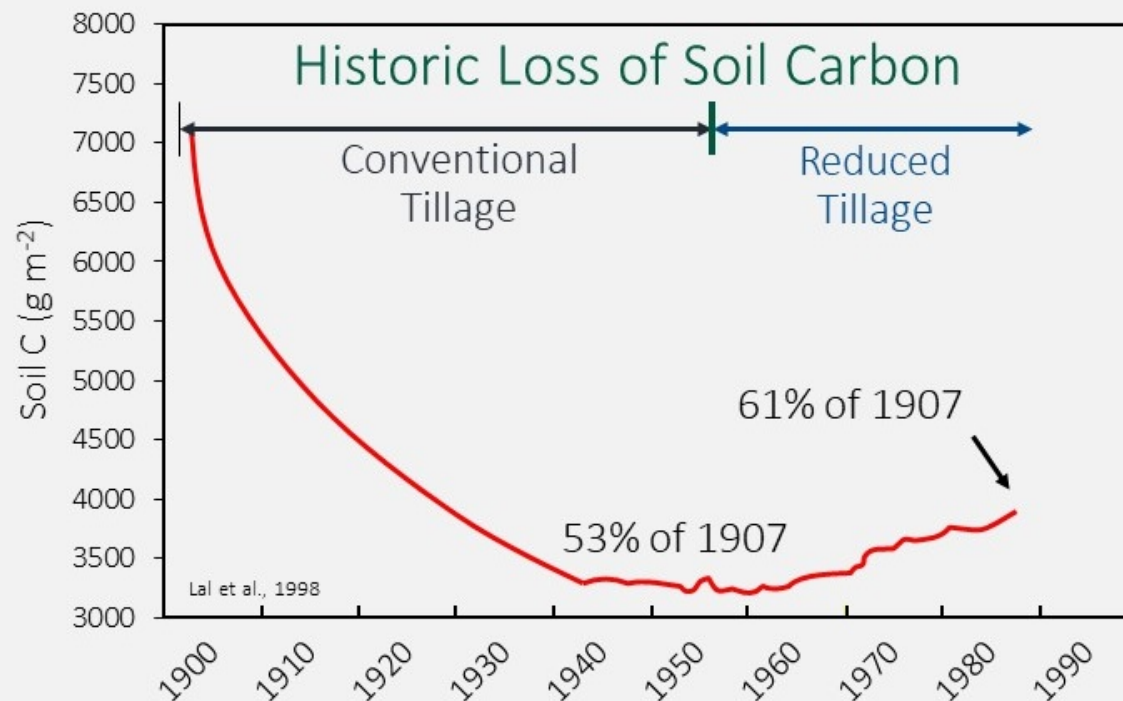
The productivity of conventional agricultural systems are maintained with increased technology, labor, fuel, nutrients, pesticides, water...

The Challenge

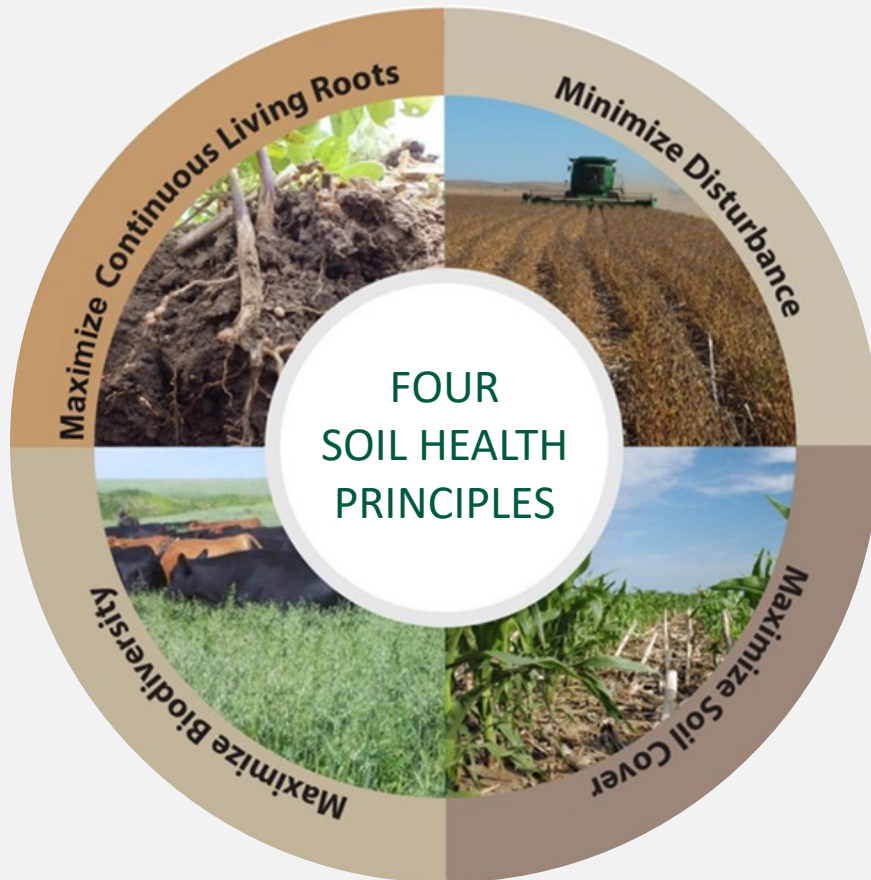
How can we regain soil function so that...

1. Resource concerns are addressed?
2. Inputs can be reduced?
3. Agricultural productivity is sustainably maintained?

Is it possible to achieve all 3?

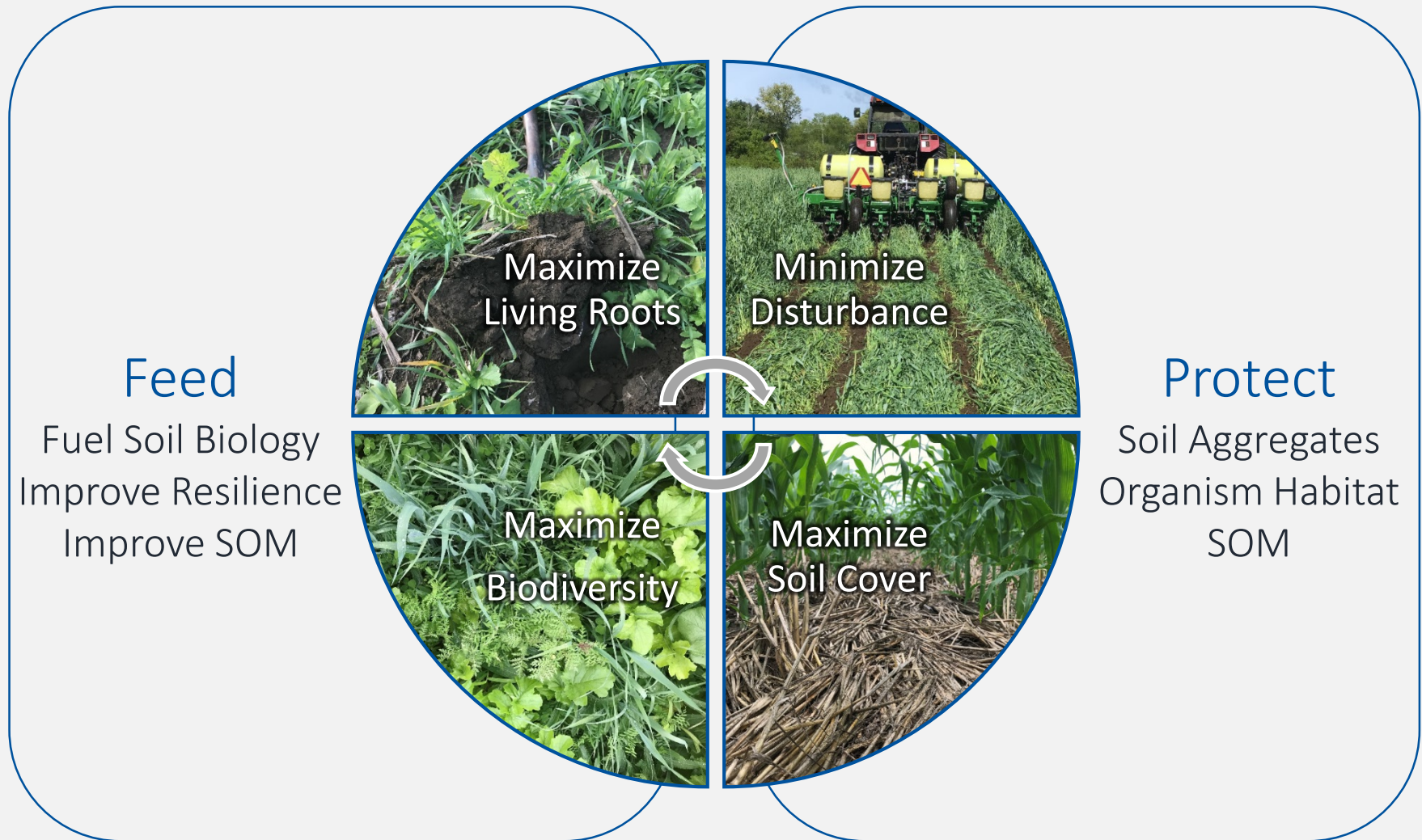


The 4 Principles that Conserve the Soil Ecosystem



1. Minimize Disturbance
2. Maximize Living Cover
3. Maximize Biodiversity
4. Maximize Continuous Living Roots

Soil Health Principles to Support High Functioning Soils



How Soil Health Principles Support Soil function – PROTECT



- Maintain stable aggregates
- Manage erosion
- Buffer temperature
- Reduce evaporation
- Maintain soil organic matter

Minimize Disturbance

Disturbance can:

- ↓Habitat for soil organisms
- Destroy soil structure

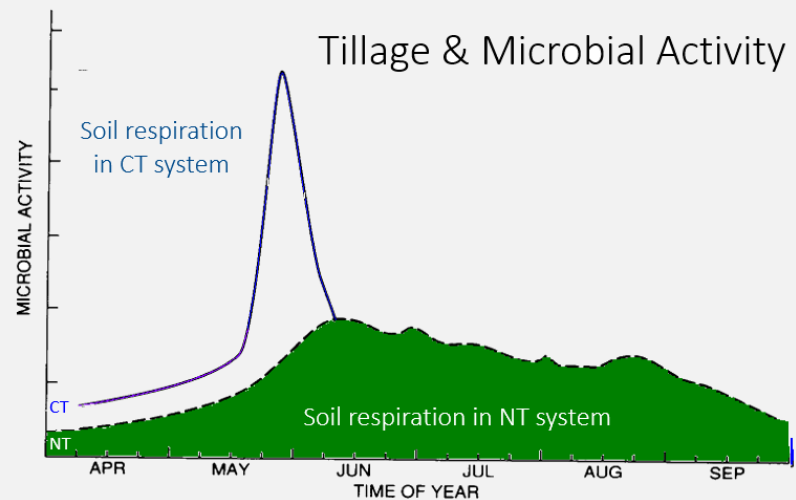
What Types of Disturbance are Common in Agriculture?

- Physical (excess tillage)
- Chemical (over use of fertilizer, pesticides)
- Biological (overgrazing, fallow systems)



What Practices Minimize Disturbance?

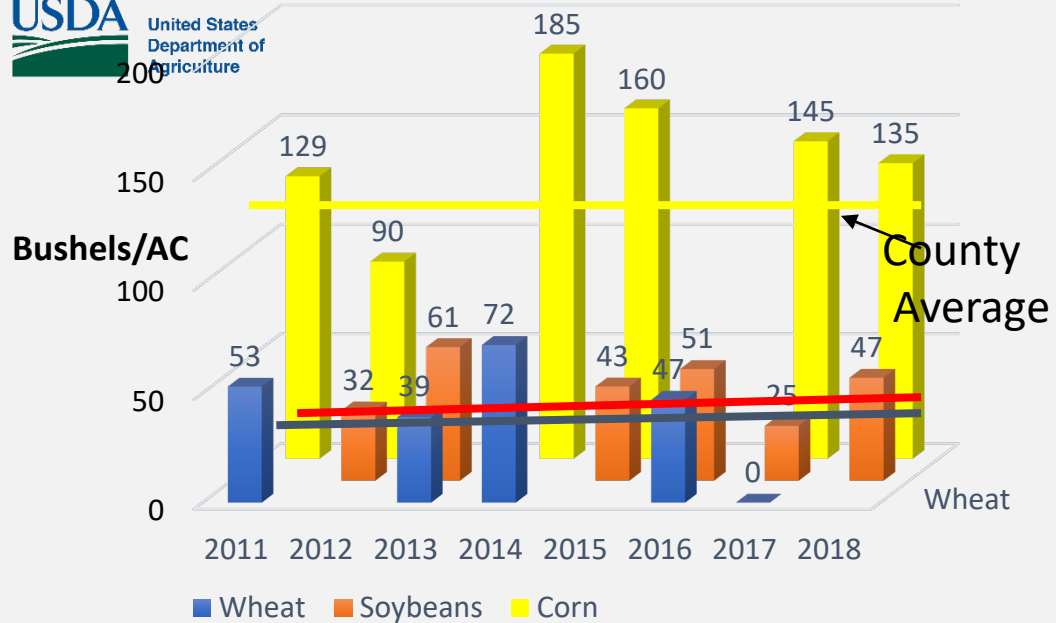
- Residue & Tillage Mgmt. (329/345)
- Conservation Cover (327)
- Nutrient Mgmt. (590)
- IPM (595)
- Prescribed Grazing (528)



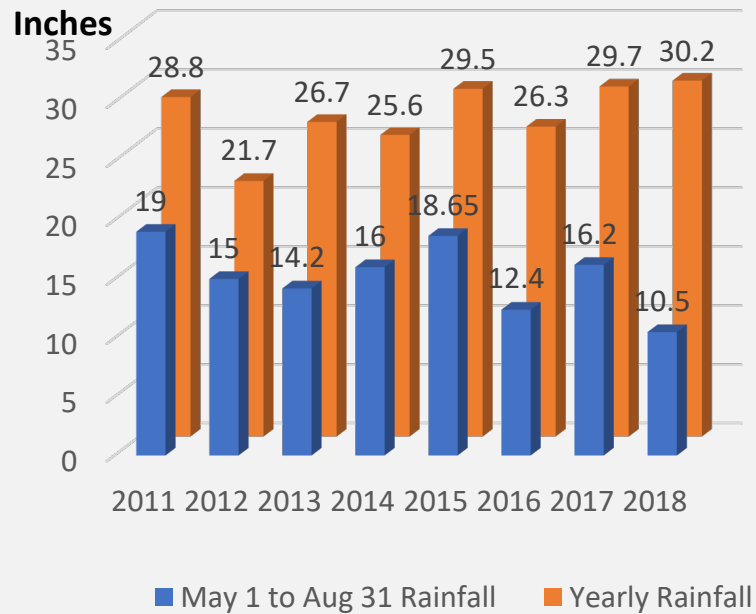
Why Maximize Soil Cover?

- ↓ Erosion
- ↑ Infiltration
- ↓ Evaporation
- ↔ Soil Temp
- Habitat for Soil Organisms ↑
- Food for Biota ↑
- ↔ Compaction from Machines & Livestock





Rainfall



What Practices Maximize Soil Cover?

- Cover Crop (340)
- Residue & Tillage Mgmt. (329/345)
- Conservation Cover (327)
- Mulching (484)
- Controlled Traffic (334)
- Forage & Biomass Planting (512)
- Prescribed Grazing (528)



How Soil Health Principles Support Soil Function – FEED



- Stimulate below-ground diversity
- Increase SOM
- Improve nutrient cycling
- Enhance plant growth
- Break pest cycles
- Increase predator & pollinator populations



How Do We Maximize Living Roots?

- Grow crops in the off-season
- Avoid fallow & ↓ re-cropping interval
- ↑ time in perennial crops
- Manage rotations & forage height

What Practices?

- Conservation Crop Rotation (328)
- Conservation Cover (327)
- Cover Crop (340)
- Forage & Biomass Planting (512)
- Prescribed Grazing (528)



How Do We Maximize Biodiversity?

- Grow diverse cover crops & legumes
- ↑ diversity of crop rotations
- Integrate livestock & graze cover crops
- ↑ time in diverse perennial crops

What Practices?

- Conservation Crop Rotation (328)
- Conservation Cover (327)
- Cover Crop (340)
- Forage & Biomass Planting (512)
- IPM (595)
- Prescribed Grazing (528)

Core Practice Review

Cons. Crop Rotation

Principles Addressed

- ☐ Disturbance
- ☐ Cover
- ☒ Diversity
- ☒ Roots

Practice Highlights

- Provides diverse root architecture & exudates
- ↑ Development of diverse soil microbial communities
- Breaks disease & pest cycles
- ↑ nutrient cycling

Conservation Cover

Principles Addressed

- ☒ Disturbance
- ☒ Cover
- ☒ Diversity
- ☒ Roots

Practice Highlights

- Eliminates mechanical soil disturbance
- Provides year-round roots
- Keeps the soil covered 365 days a year
- Offers a diverse plant community with above & below ground benefits

Cover Crop

Principles Addressed

- ☐ Disturbance
- ☒ Cover
- ☒ Diversity
- ☒ Roots

Practice Highlights

- Provides diverse root architecture & exudates
- Covers, protects, and adds C to soil during non-cash crop periods
- Erosion, compaction & weed mgmt. benefits
- Adds diversity & fix N

Core Practice Review

Residue/Tillage Mgmt.

Principles Addressed

- ☒ Disturbance
- ☒ Cover
- ☐ Diversity
- ☐ Roots

Practice Highlights

- ↓ Physical destruction of aggregates
- ↓ Erosion & evaporation
- ↓ Amount of SOC oxidized to CO₂
- Keeps residue on the surface to protect aggregates, moderate soil temps & moisture

Mulching

Principles Addressed

- ☐ Disturbance
- ☒ Cover
- ☐ Diversity
- ☐ Roots

Practice Highlights

- Armor dissipates raindrop energy
- Moderates soil temps & ↓ evaporation rates
- Protects soil organisms & aggregates
- ↓ erosion
- Suppresses weed growth

Nutrient Management

Principles Addressed

- ☒ Disturbance
- ☐ Cover
- ☐ Diversity
- ☐ Roots

Practice Highlights

- ↓ disruption of the soil ecosystem due to over- or mis-use of plant nutrients
- Supply only those nutrients not provided by the soil system

Core Practice Review

Prescribed Grazing

Principles Addressed

- ☒ Disturbance
- ☒ Cover
- ☒ Diversity
- ☒ Roots

Practice Highlights

- Manure improves activity & diversity of soil organisms
- Managed forage heights promote deeper rooting
- Maintains higher levels of residue on the soil surface
- Reduces chemical & mechanical disturbance

Forage/Biomass Planting

Principles Addressed

- ☐ Disturbance
- ☒ Cover
- ☒ Diversity
- ☒ Roots

Practice Highlights

- Provides year-round roots
- Keeps the soil covered 365 days a year
- Offers a diverse plant community with above & below ground benefits

IPM

Principles Addressed

- ☒ Disturbance
- ☐ Cover
- ☒ Diversity
- ☐ Roots

Practice Highlights

- Reduces chemical disturbance associated with over- or mis-use of pesticides
- Encourages greater diversity of soil organisms
- Manage weed resistance

Adapt, learn, and leave land better for the next generation!!!



https://www.climatehubs.oce.usda.gov/sites/default/files/adaptation_resources_workbook_ne_mw.pdf



Questions?

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