The Importance of Aggregate Stability to Soil Health

An Introduction to the Tabletop Rainfall Simulator

Soil Matters 2026

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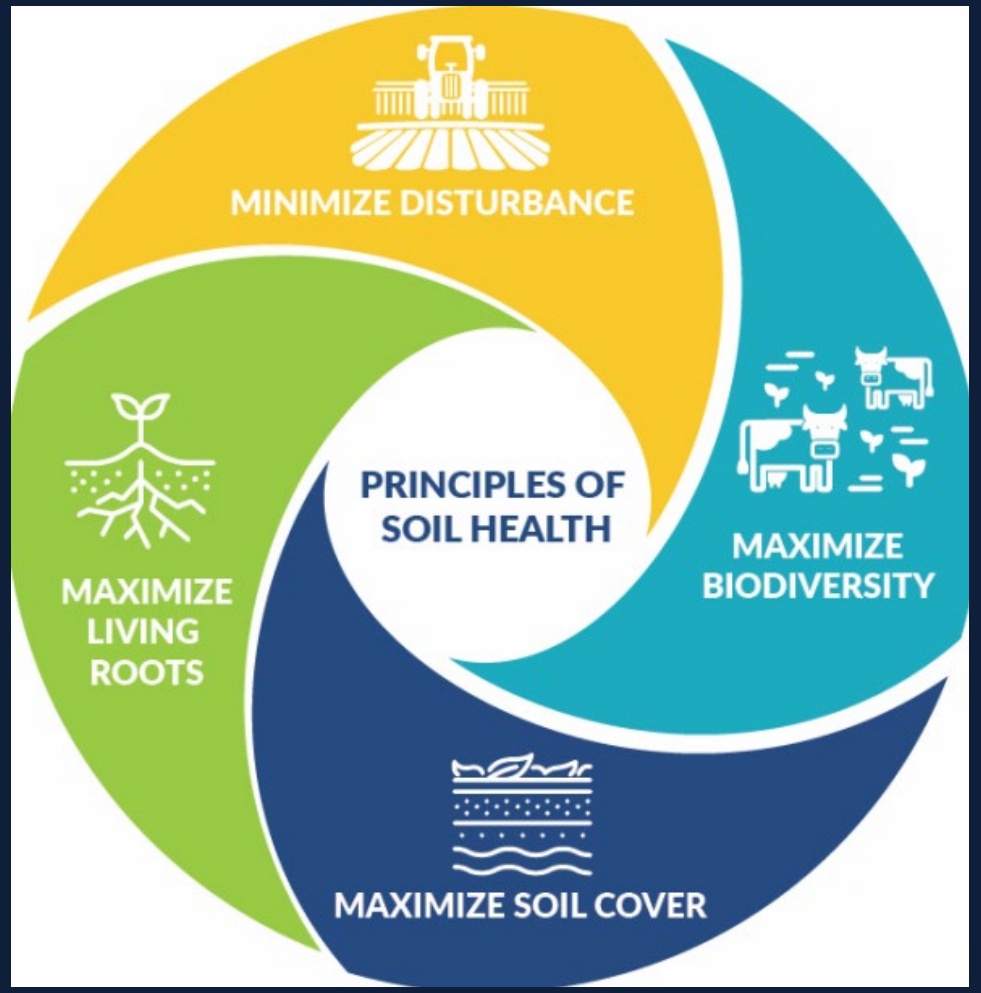
Soil Health

USDA Definition:

- "The continued capacity of soil to function as a vital living ecosystem that sustains plants, animals and humans . . . by performing five essential functions:
  - *Regulating water*
  - Sustaining plant and animal life
  - Filtering and buffering potential pollutants
  - Cycling nutrients
  - *Providing physical stability and support*"



Inherent vs. Dynamic Properties

Inherent: not easily changed

- Texture
- Parent materials
- Depth to restricting layer
- Landscape position
- Slope & slope length
- Climate

Dynamic: changed by management

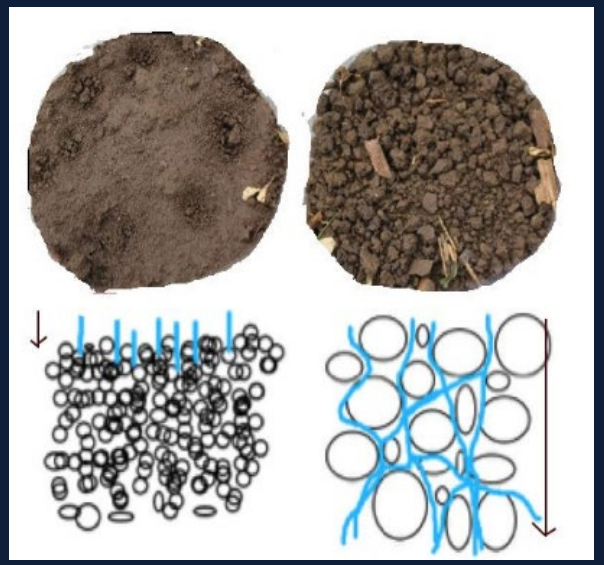
- *Organic matter content*
- *Biological activity*
- Soil food web
- *Structure*
- Water content
- *Mulches/surface cover*
- pH & nutrient content

Soil Physical Properties

- Color: appearance based on coloring agents in soil
- Texture: Proportion of sand, silt and clay (*inherent*)
- Structure: arrangement of soil particles (sand, silt and clay) and organic matter into shapes (*dynamic*)

Aggregate Stability

- Stable aggregates improve infiltration, aeration, root growth and erosion resistance
- Aggregate stability is the ability of soil aggregates to resist disintegration from disruptive forces (tillage, rainfall, wind, etc.)
- Soil structure is defined by soil aggregates and pore structure:
  - Aggregates are made up of soil particles (sand, silt and clay) and 'sticky' material (clay, organic matter, exudates, etc.)
  - Pores are within and between aggregates, allowing for water, air and biological movement



L: Unstable aggregates; R: Stable aggregates (Improving Aggregate Stability, Cornell)

Slake test demonstration

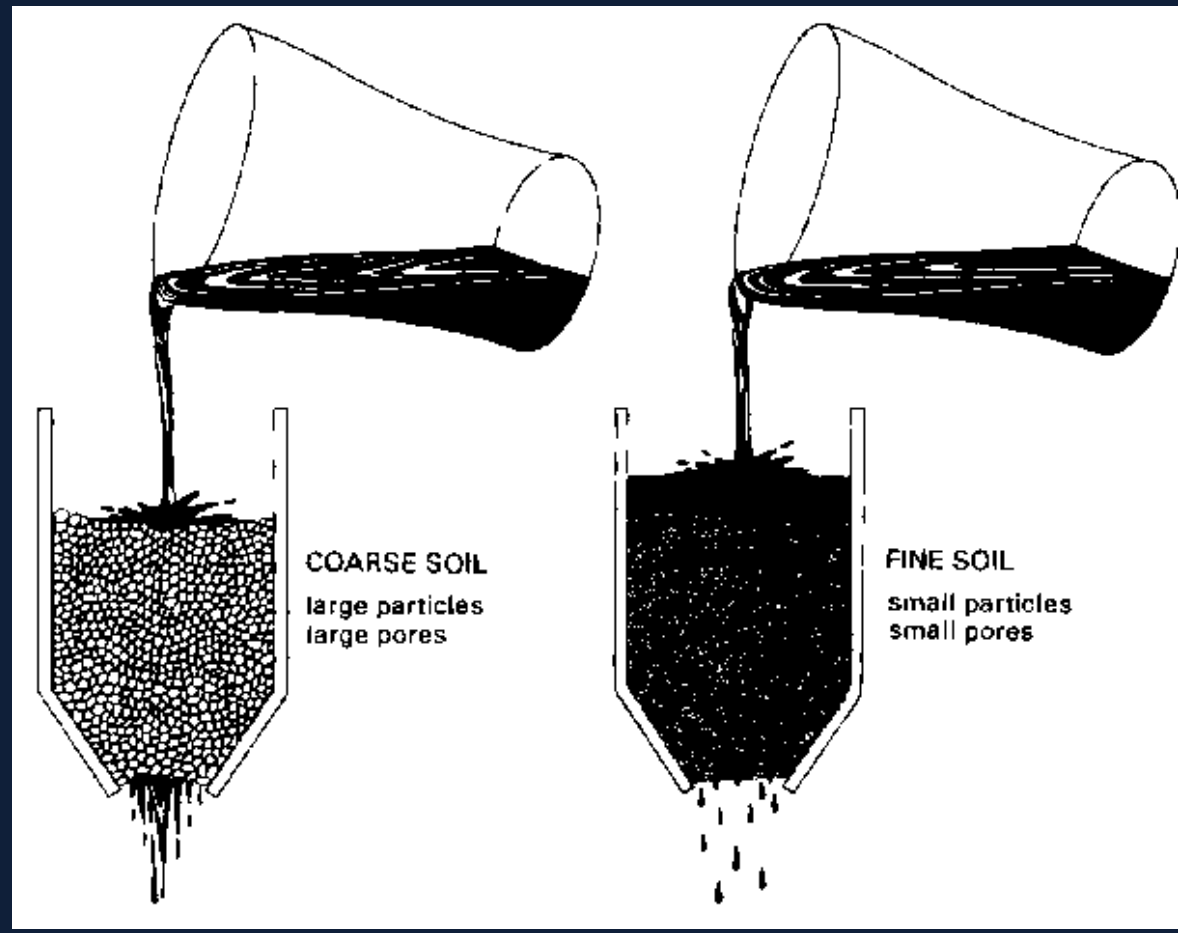
Soil Infiltration

Smaller pores hold water with more force

- Water moves more slowly in clay soils (very small pores)
- Larger pores (sandy soils) drain more quickly and retain less water

Infiltration is the process of water seeping into the soil

- Infiltration rate is dependent on soil texture and soil moisture content
    - Infiltration rate is higher for coarse soils than fine soils and when soil is dry compared to when it is wet



Infiltration rate and soil texture (Soil and Water, FAO)

Organic Matter

- Organic Matter essential to soil functioning:
  - Increases nutrient and *water holding-capacity*
  - *Improves structure and drainage*
  - Source of plant nutrients
  - Source of energy/food for soil organisms
  - Organic compounds stimulate plant growth
- Adding Organic Matter:
  - Directly as Compost, Mulch, Manure, Natural Fertilizer, etc.
  - Indirectly through Cover Crops, Green Manure

Compost and cover crop (buckwheat, peas, oats), photos by Amelia Magistrali

Indicators of poor Soil Health

- Hard, cloddy soil & poor seed beds
- Rutting and ponding
- Runoff & erosion
- Soil crusting
- Poor plant growth

SHI and CASH

The Soil Health Institute recommends three measurements as widely applicable across North America

- Organic carbon (organic matter)
- Carbon mineralization potential
- Aggregate Stability

The Cornell Soil Health Lab provides a Comprehensive Assessment of Soil Health (CASH)

- Includes active carbon, wet aggregate stability, soil respiration, soil organic carbon, and more
- CASH manual includes detailed background, soil test development, sampling and interpretation recommendations.

Test Report

Measured Soil Textural Class: sandy loam

Sand: 59% - Silt: 36% - Clay: 5%

Group	Indicator	Value	Rating	Constraints
physical	Available Water Capacity	0.09	28	
physical	Surface Hardness	255	14	Rooting, Water Transmission
physical	Subsurface Hardness	400	18	Subsurface Pan/Deep Compaction, Deep Rooting, Water and Nutrient Access
physical	Aggregate Stability	56.4	76	
biological	Organic Matter	2.1	54	
biological	ACE Soil Protein Index	6.9	44	
biological	Soil Respiration	0.6	55	
biological	Active Carbon	359	32	
chemical	Soil pH	5.9	54	
chemical	Extractable Phosphorus	2.3	66	
chemical	Extractable Potassium	175.3	100	
chemical	Minor Elements Mg: 134.0 / Fe: 3.4 / Mn: 2.7 / Zn: 1.3		100	

Overall Quality Score: **53** / Medium

Management to improve Soil Health

Limit tillage & heavy equipment use

Optimize/limit chemical inputs (fertilizers & pesticides)

Tarping/plastic

Integrate livestock

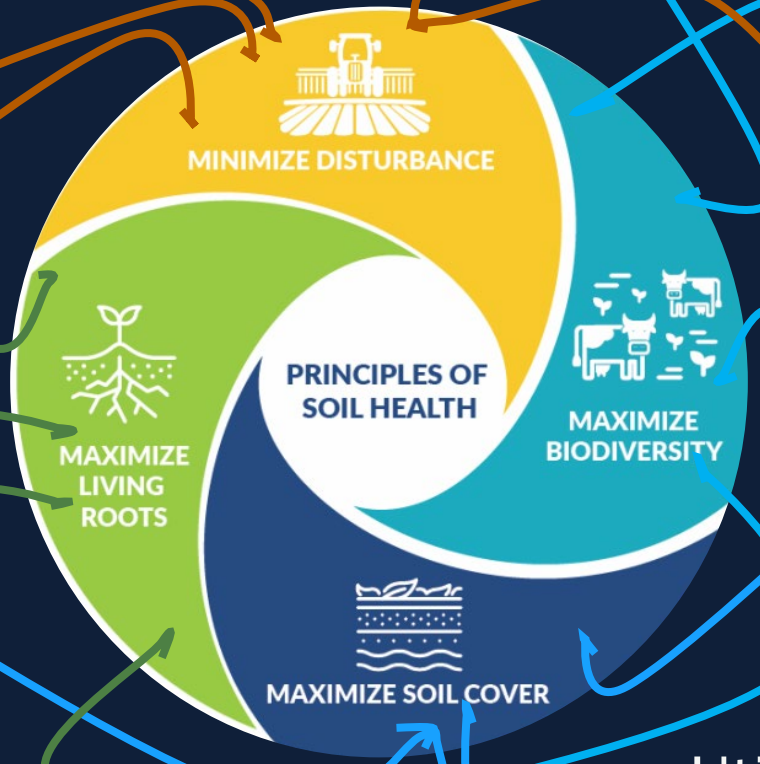
Rotate livestock; low stocking density

Utilize mulches and leave plant residue

Pasture-based grazing

Utilize diverse crop rotations

Plant diverse cover crops



Management affects Soil Health

Management	Improve	Degrade	Soil Health Approach
Tillage	Incorporate organic matter, weed control	Erosion, compaction, plow pan, harm soil biota	No-till, reduced (zone/strip etc.), cross slope till
Heavy Equipment	Reduced tillage options	Compaction, ponding, erosion	Direct/No-till Drill
Mulches	Organic matter, benefit soil biota, weed/disease control	Anaerobic conditions, excess heat, nutrient imbalance	Natural mulches, composting
Tarping/ Plastic	Reduced tillage options, weed control, moisture control	Microplastics, anaerobic conditions harm soil biota	Cover crop termination, biodegradable plastic mulch
Livestock Grazing	Fertility &organic matter, benefit soil biota	Compaction, erosion, pollution	Pasture-based rotational grazing (with cover crops)
Fertilizer	Healthy plants and roots	Leaching (pollution), pest/disease interaction	Nutrient-use-efficiency, organic fertilizer
Pesticide	Reduce pest/disease pressure	Pollution, residue build-up, harm soil biota	Integrated Pest Management

Rainfall Simulator Demonstration

Shows how different soils handle rain, depending on:

- Disturbance (tillage, traffic)
- Plant residue or cover on surface
- Living roots and soil organisms

Demonstrates:

- Soil Erosion
- Aggregate Stability
- Infiltration vs. Run-off
- Soil Health Principles

The Simulator will run at intervals throughout the day:

Mid-morning, Lunch-time and Mid-afternoon

Thank You!

Any Questions?

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