Cultivating Soil Health

Allen Philo

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Midwest Mechanical **Weed Control** FIELD DAY

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Cultivating Soil Health

Allen Philo

Cultivation vs. Soil Health

- Cultivation
  - Need to remove weeds without hindrance
  - Disturbs soil, destroys aggregation
  - Burns organic matter
- Soil Health Practices
  - Cover Crops create residue
  - No-Till (Roller Crimped Rye method) reduces yield or doesn’t work with all crops
  - Living mulches hard to establish/maintain

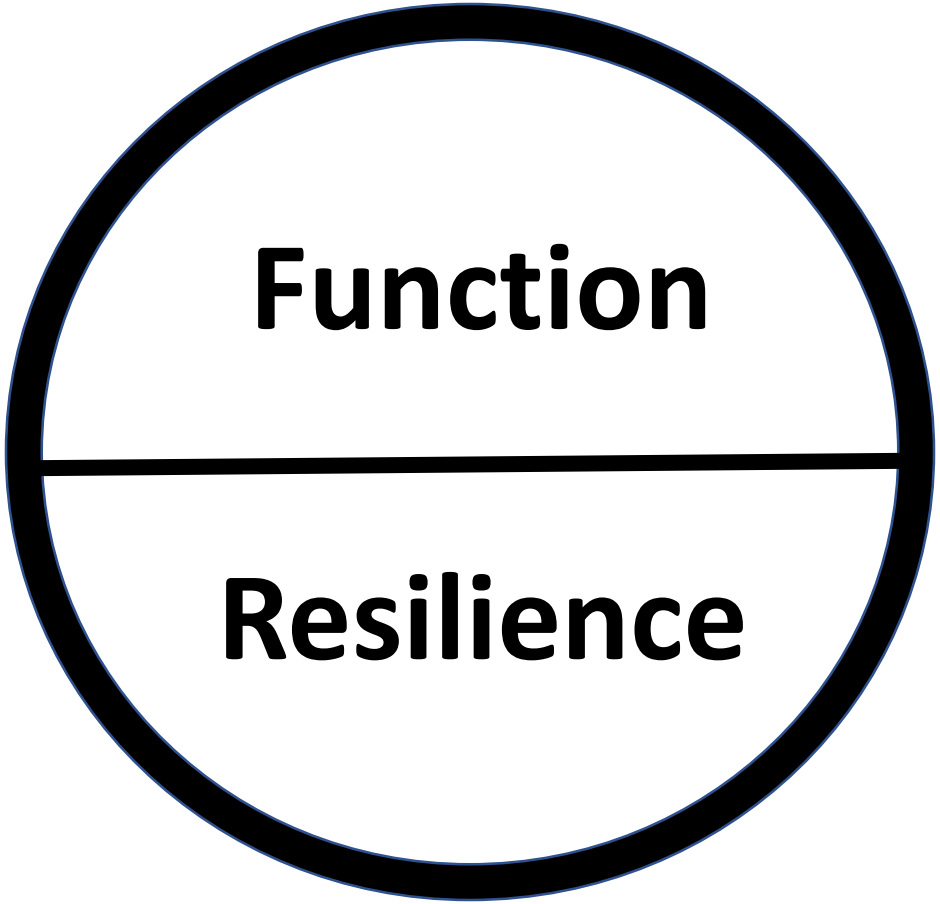
It is possible. . .

Cultivating Soil Health

- What is soil health?
  - Definition
  - Practices
- Cultivation
  - Goals
  - How damage occurs
  - Methods - Principles
- Ideas for best practices
  - Reducing damage
  - Repairing damage

Soil Health

What is it?

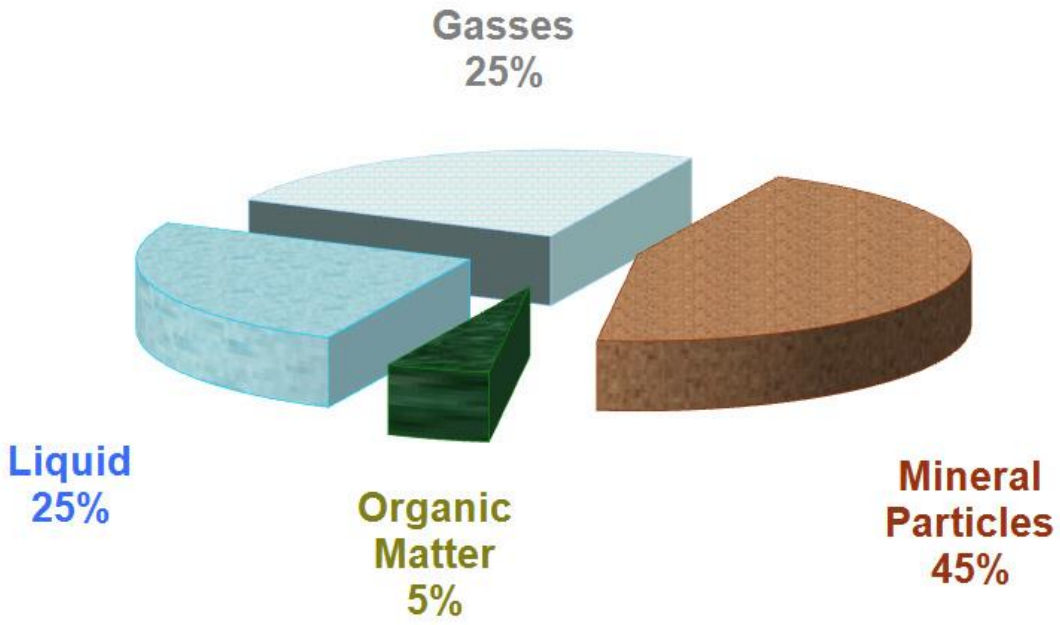


Soil Health - Functionality

- Function – The ability to operate
  - Water Infiltration and Holding Capacity
  - Gas Exchange
  - Nutrient Release

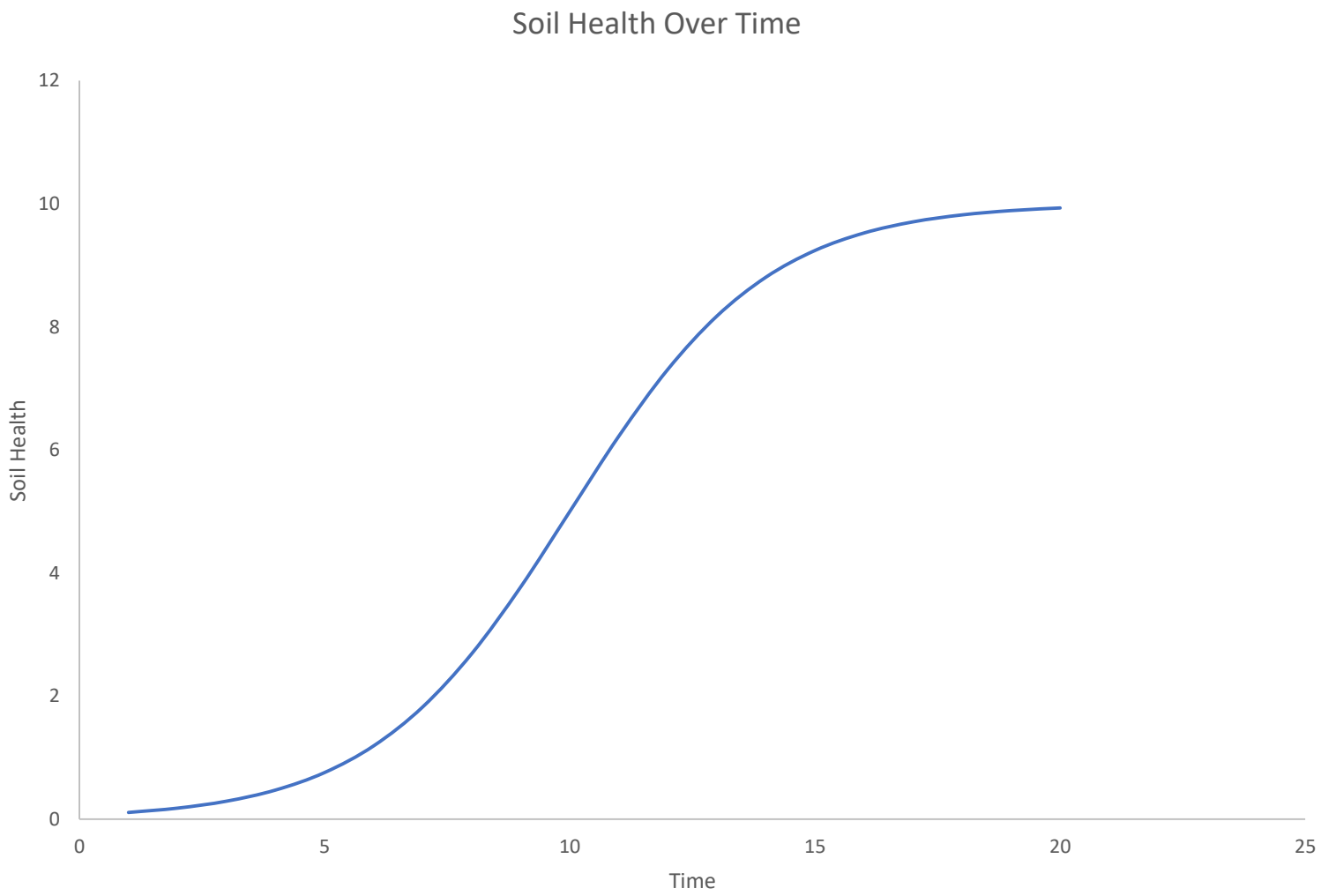
Soil Health-Functionality

- Soils are functional when. . .



Soil Composition by Volume

Soil Health-Functionality

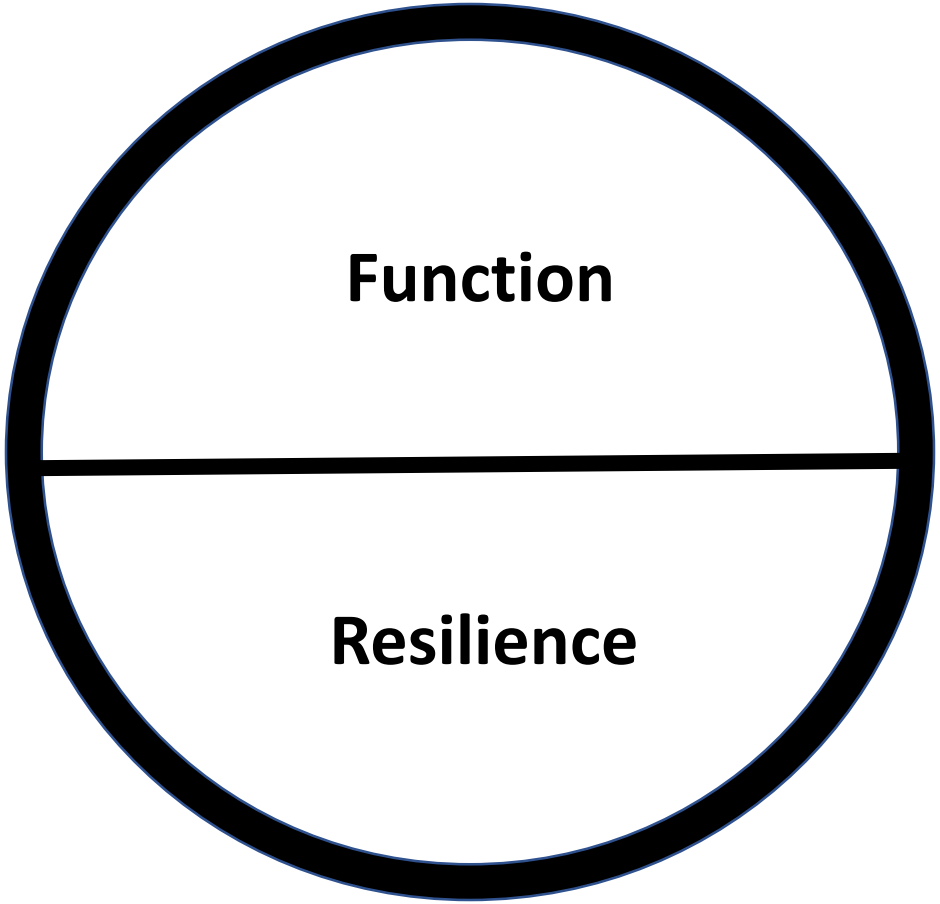


Soil Health-Functionality

- What creates that balance?
  - Balance is created and maintained by microbes.
- When soils are functional are they healthy?
  - What happens when you disturb a soil?

Soil Health

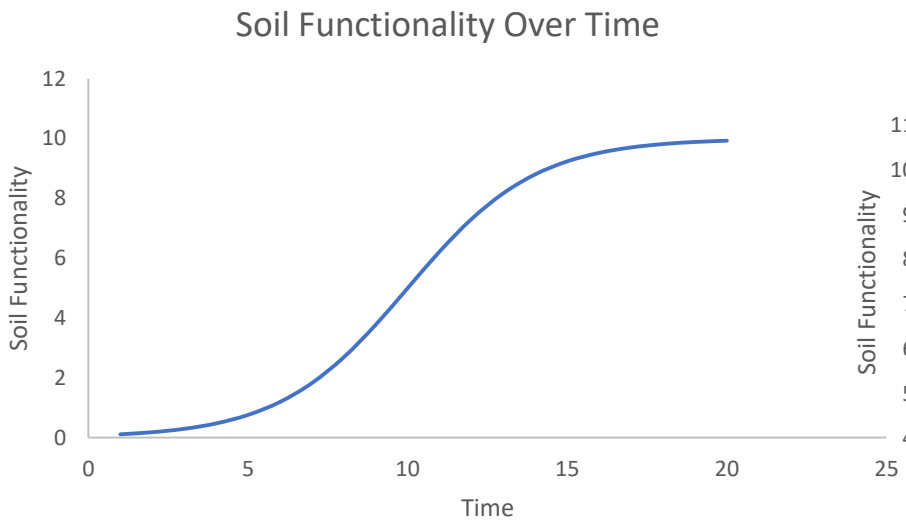
What is it?

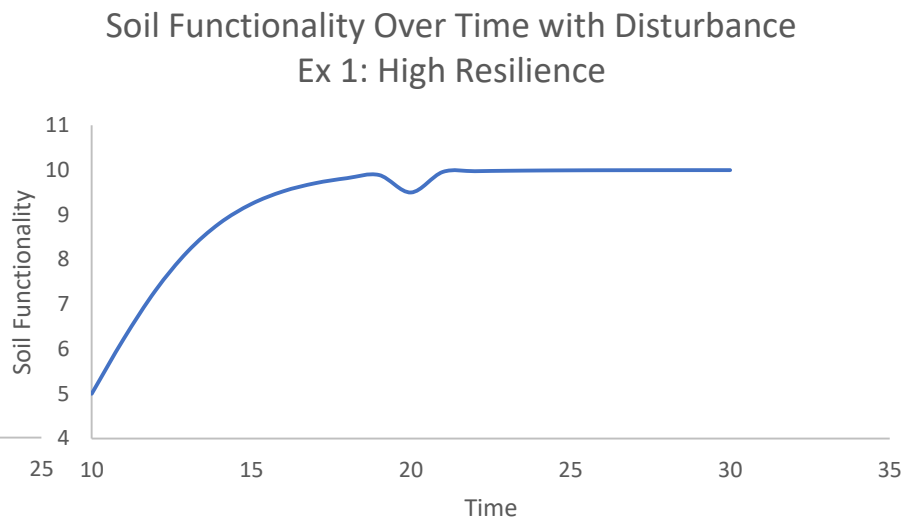


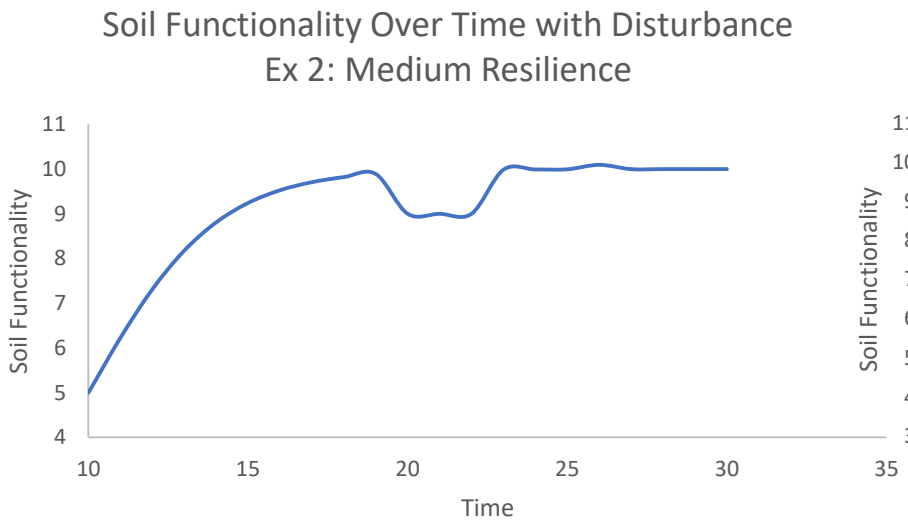
Soil Health- Resilience

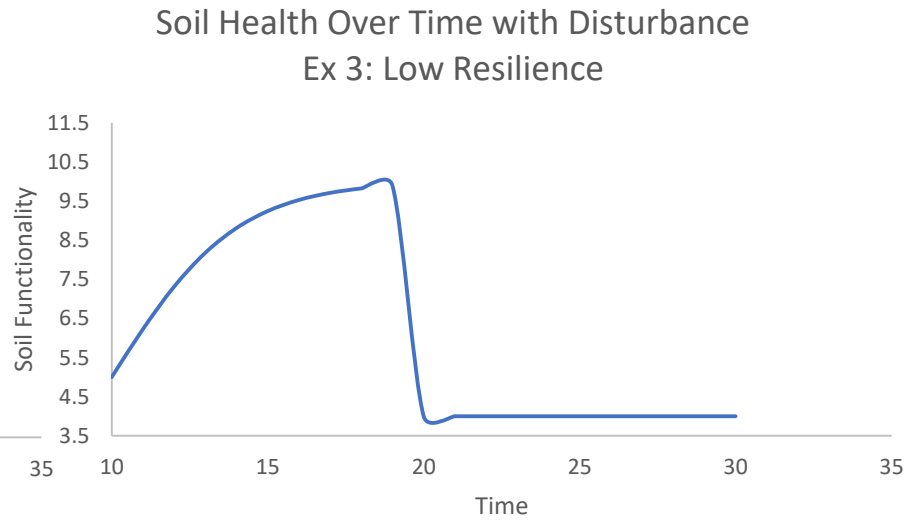
- Resilience – What is it?
  - The ability to recover functionality after a disturbance.

Soil Health- Resilience

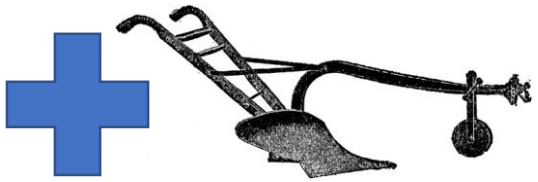




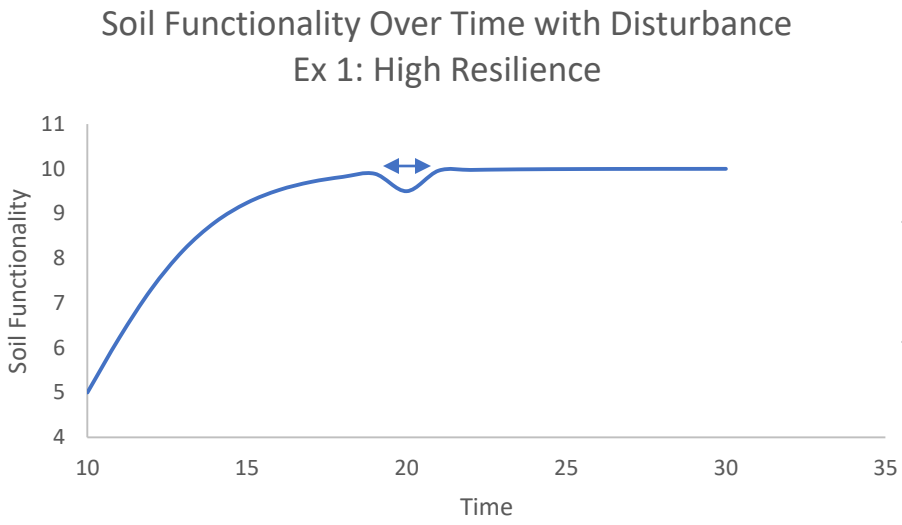


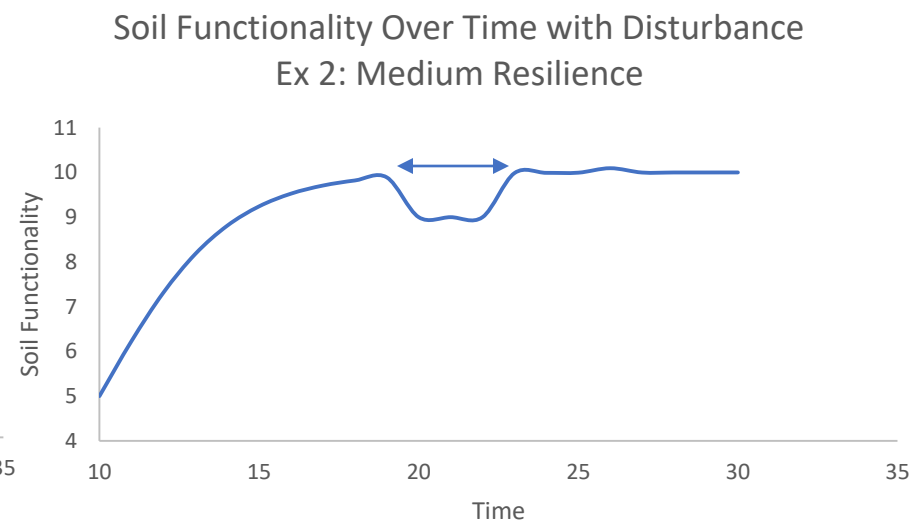


Soil Health- Resilience



Soil Health - Resilience



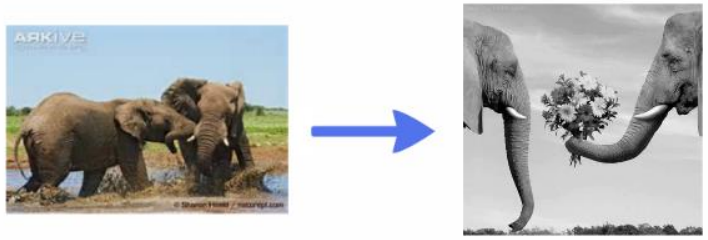


- Resilient soils have a shorter time interval between disturbance and full functionality.
- How do we shorten this time interval?

Farming System

Speed of Life

Elephants vs. E. Coli



Divide every 20 min.

24hrs x 60 minutes = 1,440 min

1,440min/20min = 72

2^72 = 4.72 x 10^21

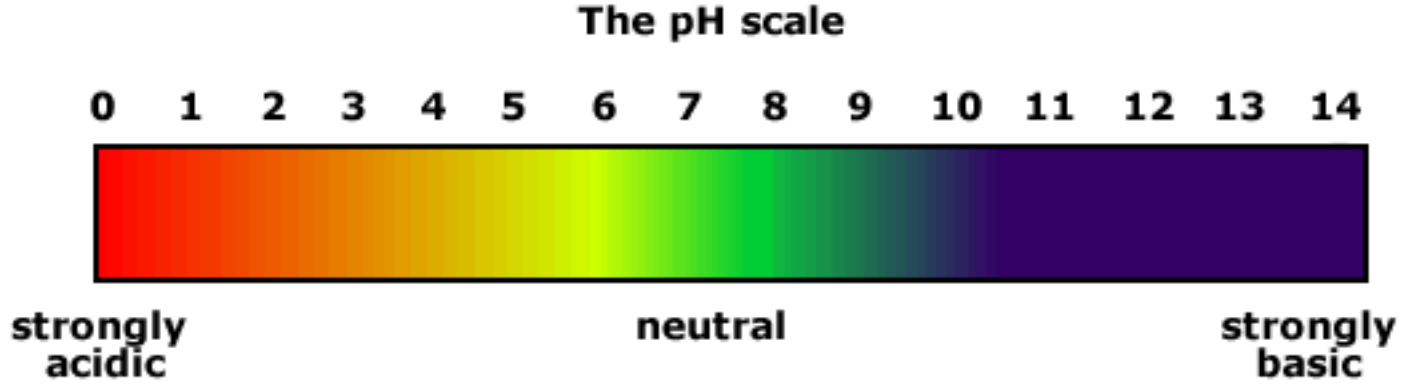
Maybe?

In 24 hours they can cover the earth on layer thick, or approximately the surface area of 1000 acres.

pH

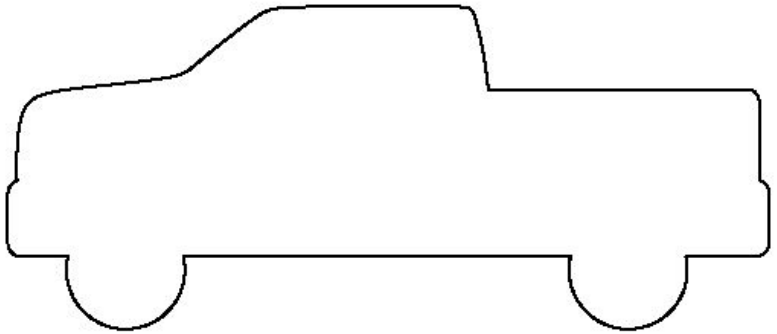
- Bacteria thrive in neutral pH
  - Population numbers double on a gradient between a pH of 4 and 8
  - pH is a determining factor in structuring Bacterial Communities

- Fungi thrive in almost any pH

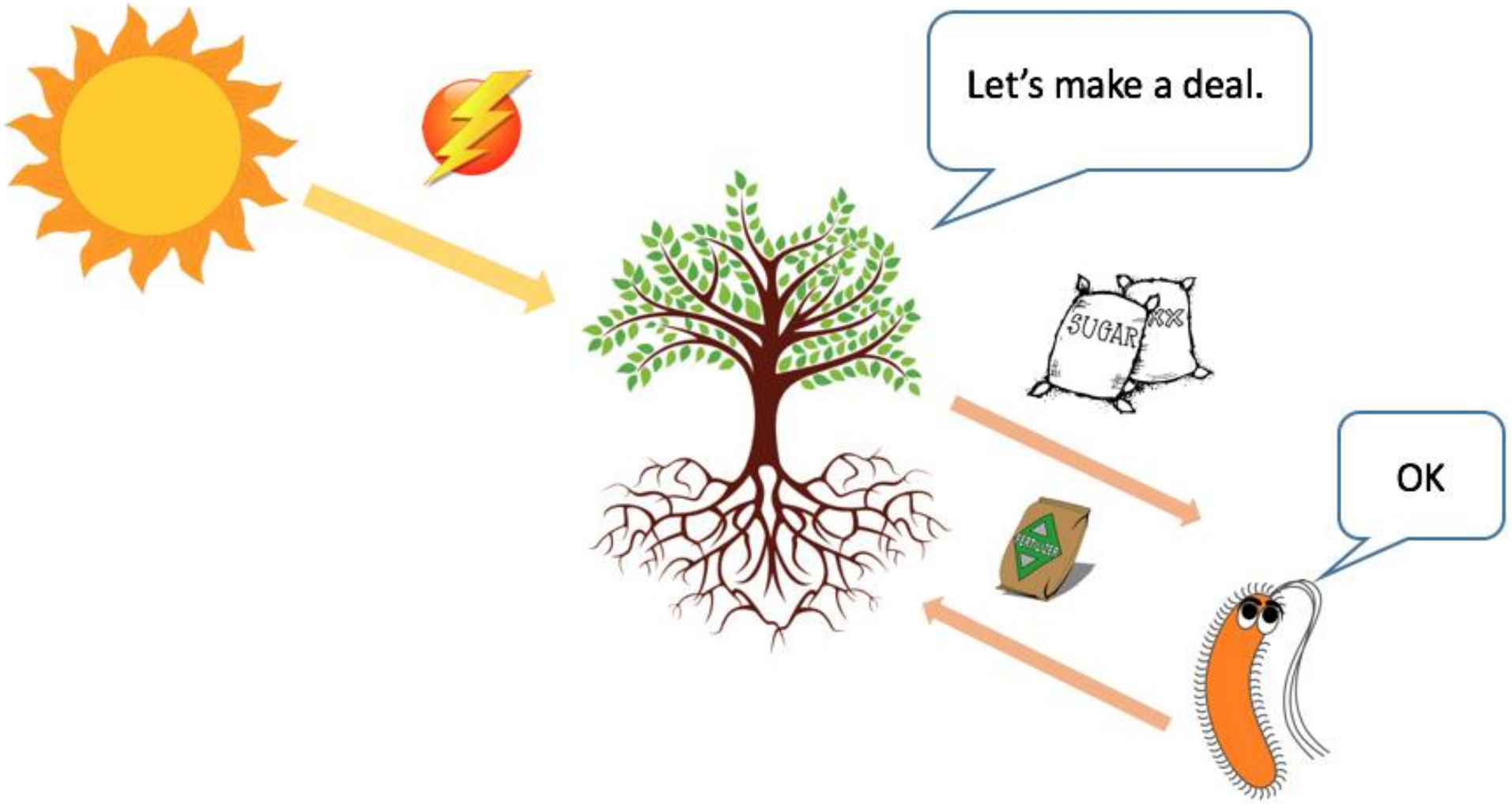


Rousk, Johannes, et al. "Soil bacterial and fungal communities across a pH gradient in an arable soil." *The ISME journal* 4.10 (2010): 1340-1351.

All Complex Systems Need Energy



Energy in the Soil



Energy in the Soil

Energy in the Soil

Switchgrass is a great example of how native grasses have huge root systems. For scale, the grass above ground is at least 4 feet tall, if not taller.

Energy for the Soil System

- Carbon/Food
  - Growing Roots
  - Cover Crops
  - Sugar
  - Compost

Food Sources

Sudan Grass

- Total dry matter above and below ground → 18 T/A
- $24/50lbs $16.20
- Management $30
- Total Cost/A $46.20
- $T/OM $2.56

Compost

- Up to 60 Tons of Compost
  - Compost is 50% Moisture by weight and 50-70% OM
- AT $50/Ton Delivered $3000
- Management $100
- Total Cost/Acre $3100
- $/T OM $172.00

Takeaways

- Adjust pH
  - Creates the right environment for rapid repair of damage
  - Helps with residue breakdown
- Feed soil life
  - Cover crops most effective
  - Repair damage from cropping years

Cultivation

- Goals
- Methods
- How Damage Occurs

Goals

- Reduce weed pressure
- Avoid creating more weed pressure
- Correct damage/other
  - Break crust
  - Dust Mulch

Goals

- Reduce weed pressure
  - “The point of cultivation is to create the largest size differential possible between the weeds and the crop.”

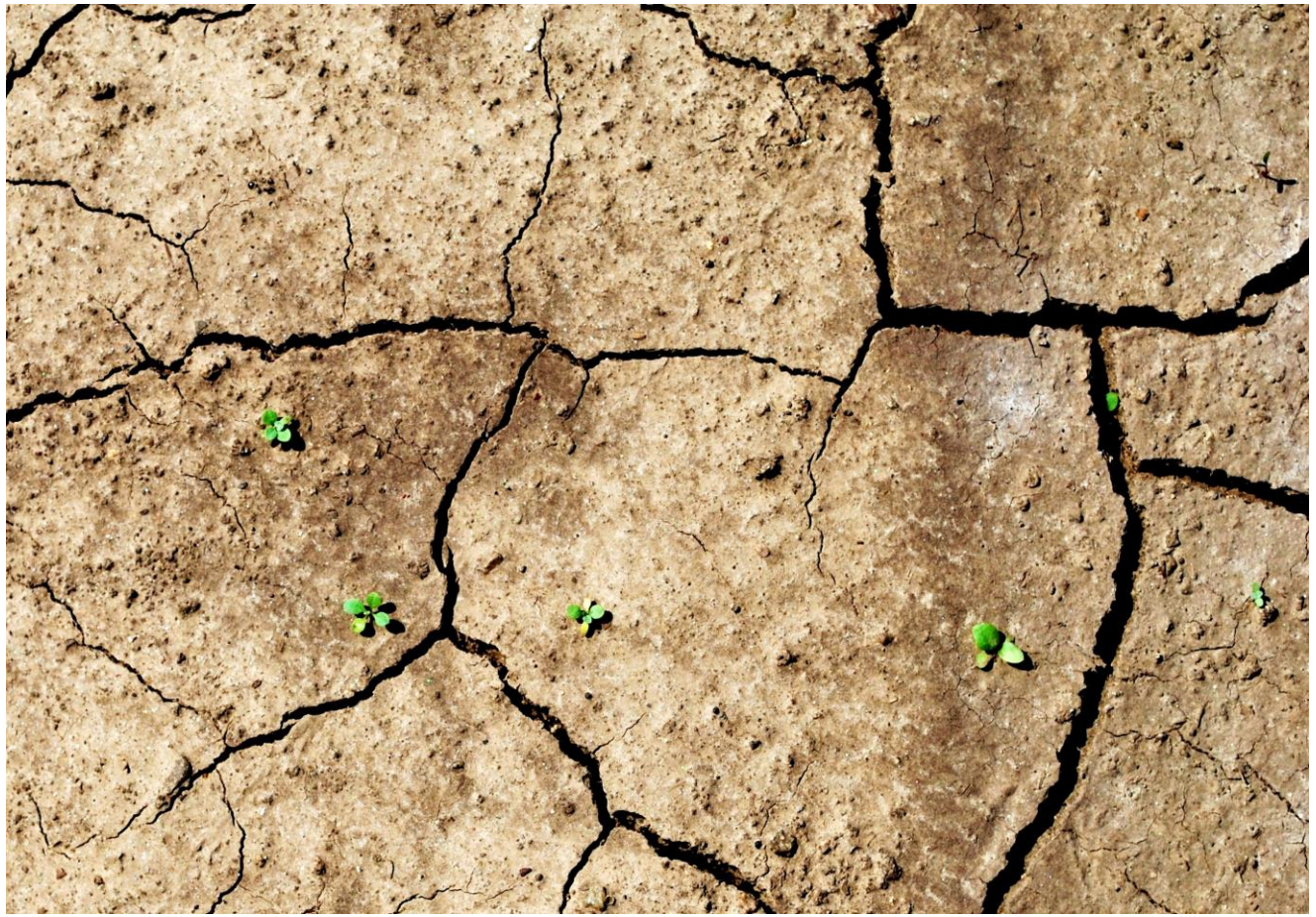
    Klass Marten

Goals

- Avoid creating more weed pressure
  - Cultivating to deeply
  - Cultivating to late

Goals

- Correct damage/other
  - Break crust
  - Dust Mulch



Methods-Principles

- Remove weeds at smallest stage possible
- Disturb as little as possible

Methods-Principles

- Remove weeds at smallest stage possible
  - Blind Cultivation
  - Tine Weeding/Rotary Hoeing
  - Weeds are to big when?

Methods-Principles

- Disturb a little as possible
- Most weed seeds germinate in top half inch to inch
- Setting tools below an inch can bring up new weeds seeds and lead more cultivation passes

How Damage Occurs

- Oxidation/Aggregate Breakdown
- Compaction
- Bricking/Slicking

Oxidation/Aggregate Breakdown

- Exposes more OM to oxygen
- Leads to OM breakdown by microbes
- Loss of aggregation

Compaction

- Heavy Equipment
- Cultivating Wet

Bricking/Slicking

- Cultivating Wet
- Setting equipment to deep

Ideas for Best Practices

- Reducing Damage
- Repairing Damage

Reducing Damage

- You are going to do damage
- Don’t Cultivate Wet
- Shallow cultivation
- Fewest passes possible
- Use the lightest tool for the job

Repairing Damage

- Cover Crops
- Cover Crops
- Cover Crops

- What about residue?

Cover Crops

- Rotation
- Termination
- Planning

Cover Crops-Rotation

- Cover crops are for in between cash crops on a short run basis
- Stop using Rye as a cover crop
- Soil Building is for taking a year off
  - Rye and Vetch going into winter
  - Sudan with Clover the following summer

Cover Crops - Rotation

- Spring Transplanted Crops, or large directed seeded crops.
  - Winter Killed Barley or Oats
- Small Direct Seeded Crops
  - Nothing
- Summer Crops
  - Hairy Vetch or Clover
- Fall Crops
  - Can have Rye in the Spring, use Buckwheat with Crimson Clover for short summer runs or gaps
- Underseed Crops where possible with clover at last cultivation.

Cover Crops - Termination

- Terminate when in the vegetative state
- Avoid lignified stands
- Shallow incorporate in the the top 4-6 inches for rapid decomposition
- It’s about energy, not building OM

Cover Crops - Planning

- Think multiple years ahead
- Always have a backup plan for planting and for termination.

Cover Crops

- Repair the damage from cultivation
- If properly managed the residue is not an issue
- Can be used to help reduce weeds as well

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Summary

- Adjust your pH
- Feed the soil with cover crops, don’t be afraid
- Cultivate intelligently
- Be thankful you are farming