# How Do We Nurture Soil Health?

Implementing the Six Principles of Soil Health

By John Hays

# Let’s Talk About Health

- Is our health important?
  - Yes, without health we have nothing
    - We may be living longer, but are we healthy?
  - Degenerative diseases continue to rise
  - “Healthcare” costs continue to rise
- Is our health related to soil health?
  - “We are what our food eats.”

# Let’s Talk About Health

- Are we addressing problems or just symptoms?
  - Human health?
  - Soil Health?
- Healthy soil promotes healthy plants which promotes healthy animals.
- As omnivores, we will be healthier when we eat both healthy plants and healthy animals
- *We have choices to make!*

# Can we build soil health?

- Yes!
- How?
- We can build Soil Health by applying Regenerative Agriculture Principles
  - It doesn't matter where we are or what we are growing, the principles remain the same.

# Introduction

- A Life-Long Learner, a student of life
- Actively farming for over 40 years and have always had an interest in building soil health.
- Tried many different ways over the years to farm in synchrony with nature.
  - Cover Crops w/row crops and vegetable production
  - Forage Production vs Row Crops
- Made the commitment in 2021 to follow regenerative farming principles to advance health of soils under our management.
- Very excited about the results we are seeing and that others are seeing!
- Passionate about sharing with others

# What is Regenerative Agriculture?

- Farming and ranching in synchrony with nature to repair, rebuild, revitalize and restore ecosystem function starting with all life in the soil and moving to all life above the soil. *Understanding Ag*

# We Don’t Know What We Don’t Know

- There is a major lacking of education and understanding about basic soil function and soil health in our society.

- Soil has become considered a medium to hold plants upright.
- The focus is typically put solely on soil chemistry and or technology, but:
- Biology is the key to soil health
  - What promotes soil biology?
    - Carbon
    - The 6 Principles of Soil Health

- Biology can correct the chemistry for us
  - We must create an environment for biology to flourish

# What Does Healthy Soil Look Like?

- Well aggregated, looks similar to chocolate cake
- Smells good

- What is a soil aggregate?
  - Particles of sand, silt and clay bound together by biological glues

- Why is aggregation important?
  - Key indicator to how well soil is functioning, how much life is in your soil.
  - Creates pathways for water and air to infiltrate the soil
  - Creates an environment for nutrients to cycle properly

- How long does an aggregate last?
  - Typically 3-4 weeks
  - They need to be rebuilt frequently

- When we have well aggregated soils, the 4 ecosystem processes are able to function properly.

What does well aggregated soil look like?

# Where Do We Start?

Building Soil Health

# The 4 Ecosystem Processes

- 1st let's understand the 4 ecosystem processes
  - Energy Flow
  - Water Cycle
  - Mineral Cycle
  - Diversity (Community Dynamics)

# Energy Flow

- What is it?
  - Taking light energy (sunlight) and converting it into photosynthetic material that leaks into the soil to feed an array of biota.
- Energy flow is all about solar energy or photosynthesis.
- Unlike the water cycle and mineral cycle, solar energy does not cycle.
- It flows from the sun to the earth.
- It is necessary for everything on the planet to survive.
- The importance of an adequate solar panel.
  - Plant leaves are that solar panel
  - We want as big of a solar panel as we can get
- Leaving enough plant material behind (solar panel) for this process to occur is crucial to all life.

# Energy Flow (cont.)

- How much sunlight are you capturing?

# Water Cycle

- It's not how much rain you get, but how much rain you keep.

- When rain or snow falls on our land, we are responsible for its fate from that point forward.
- Will it infiltrate and be retained?
- Will it pond and pool and evaporate or run off?
- Will it cause erosion and harmful runoff to others?
- Can we keep it or do we lose it?

- Every 1% increase in organic matter holds an additional 20,000 gal of water/acre. (nearly 1 acre-inch)

# Water Cycle (cont.)

- How much water are you capturing in a rain event?

# Mineral Cycle

- A complex exchange occurs with the soil microbiology, cycling nutrients from unavailable form to available form and back again in our soils

- The three phases of an effective mineral cycle are:
  - 1. Moving minerals from below to above the soil surface
  - 2. Placing those minerals on the soil surface
  - 3. Moving minerals from above the soil surface back into the soil
    - The air we breathe contains 78% nitrogen

- This is a crucial part of a larger carbon cycle and is enabled by a highly functioning water cycle.
- Grazing foraging and browsing animals are an important part of this process

# Mineral Cycle (cont.)

- Our soils aren't deficient in minerals.  The minerals may just not be in an available form for the plant.
  - With a properly functioning mineral cycle, lots of commercial inputs are not necessary.
  - Total Nutrient Digestion (TND) results from soil samples across the country and globe reveal our soils are not mineral deficient

- Is your mineral cycle functioning properly?
  - How many applied nutrients are you using?

# Diversity (Community Dynamics)

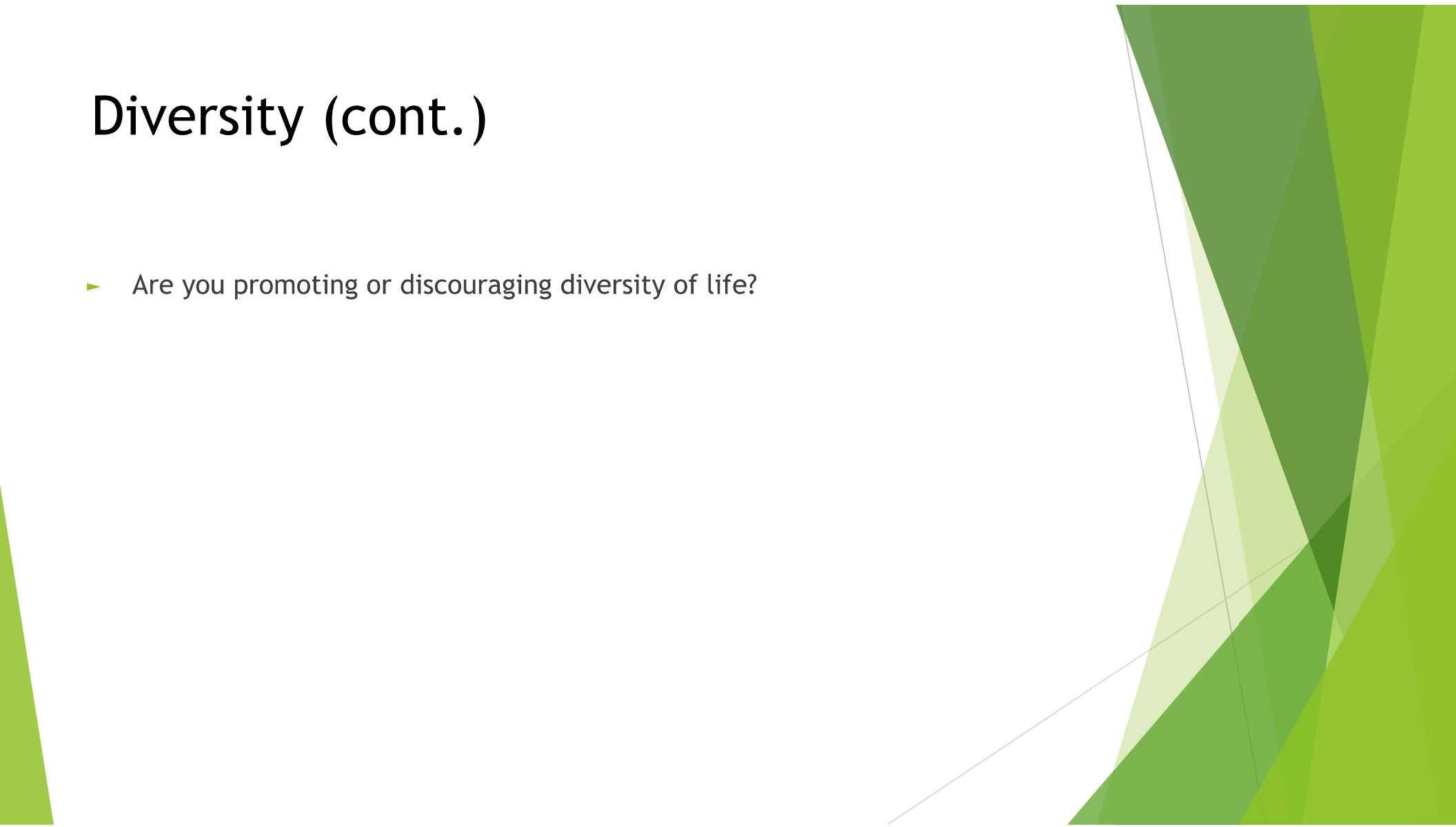
- *"All are related" Lakota*

- This is also sometimes called biological succession.
- It involves the changes in the development of all living things.

- A fundamental rule of succession:
  - "A species will move into an environment when the conditions are suitable for its establishment and will move out of that environment when conditions become unsuitable for its reproduction." *by Bruce Ward Legacy Trust*

# Diversity (cont.)

- Are you promoting or discouraging diversity of life?



# How Do We Support the 4 Ecosystem Processes?

# The Six Principles of Soil Heath

- 1. Know Your Context
- 2. Keep Soil Armored
- 3. Minimize Disturbance
- 4. Keep Living Root in the Soil
- 5. Diversity
- 6. Integrate Livestock

# 1st Principle: Know Your Context

- Our soil health practices are a reflection of ourselves and our stewardship of the land.

- What are you trying to accomplish?
  - What is the historical context?
  - Is it suitable for your environment?
  - Is it suitable for your management style or lifestyle?
  - Are you and your people on board?
  - What are your financial resources?
  - Is peer pressure a concern?

Is there anything wrong with this context?

# 2nd Principle: Keep Soil Surface Armored

- Nature does not like bare soil. It is always trying to cover and protect itself.
- Think of armor as the "skin" of the soil
- Proper armor reduces or prevents water evaporation.
- Proper armor keeps soil temperatures conducive to life in the soil.
  - Soil temperatures above 90F begin to inhibit biological activity. Temps above 140F begin to kill microbes.
- With proper armor, soil life (biology) will begin building aggregation from the surface down. The mineral cycle will begin to function properly.
- Carbon feeds this entire system.
  - The more biology in the soil, the more carbon is needed to feed that biology.

## WHEN SOIL TEMPEATURE REACHES:

**140 F** Soil bacteria dies.

**130 F** 100% moisture is lost through evaporation or transpiration.

**113 F** Some bacteria species start dying.

**100 F** 15% moisture used for growth, 85% moisture lost through evaporation and transpiration.

**90 F** Plant growth slows.

**70 F** 100% moisture is used for plant growth.

Ideal range for nitrification, plant growth and planting (65 to 86 F)

Garlic no-till planted into heavy soil armor.

# 3rd Principle: Minimize Disturbance

- In nature there is no mechanical or chemical disturbance.
- Mechanical disturbance (tillage) releases carbon from the soil into the atmosphere and leaves the surface unprotected.
  - Tillage destroys aggregation
    - The goal is well aggregated soil
- Chemical disturbance inhibits life in the soil.
  - We are trying to promote life, not kill it.
  - What is a “cide”?
    - Death
    - Herbicide, Insecticide, Fungicide, Pesticide
- Minimize disturbance to promote life in the soil

Fall Cabbage no-till transplanted into heavy soil armor

# 4th Principle: Keep a Living Root in the Soil

- Living roots not only hold soil in place, they help build soil aggregates.
- Living roots put off exudates which feed a whole host of soil microorganisms, which feed our plants.
- Living Roots pump Carbon into the soil.
  - Carbon drives soil health.  It's what the biology feeds on.
- Living roots are key to a properly functioning Mineral Cycle.
  - Diversity of living roots will cycle more nutrients in plant available form.
- Ideally, there should be a living root in the soil year around.

Lots of living roots in this fall brassica patch

# 5th Principle: Diversity

- Nature is designed to collaborate, not compete!
- Nature abhors a monoculture!

- Remember: “All Are Related” Lakota

- Every plant grows for a specific purpose.
  - Take advantage of that purpose

- Mix it up with a diversity of plants, microbes, insects, wildlife, and livestock.
  - Let these things all work in harmony to build soil health.
    - When in balance we don’t see as much pest pressure or “weed” pressure

# Diversity (cont.)

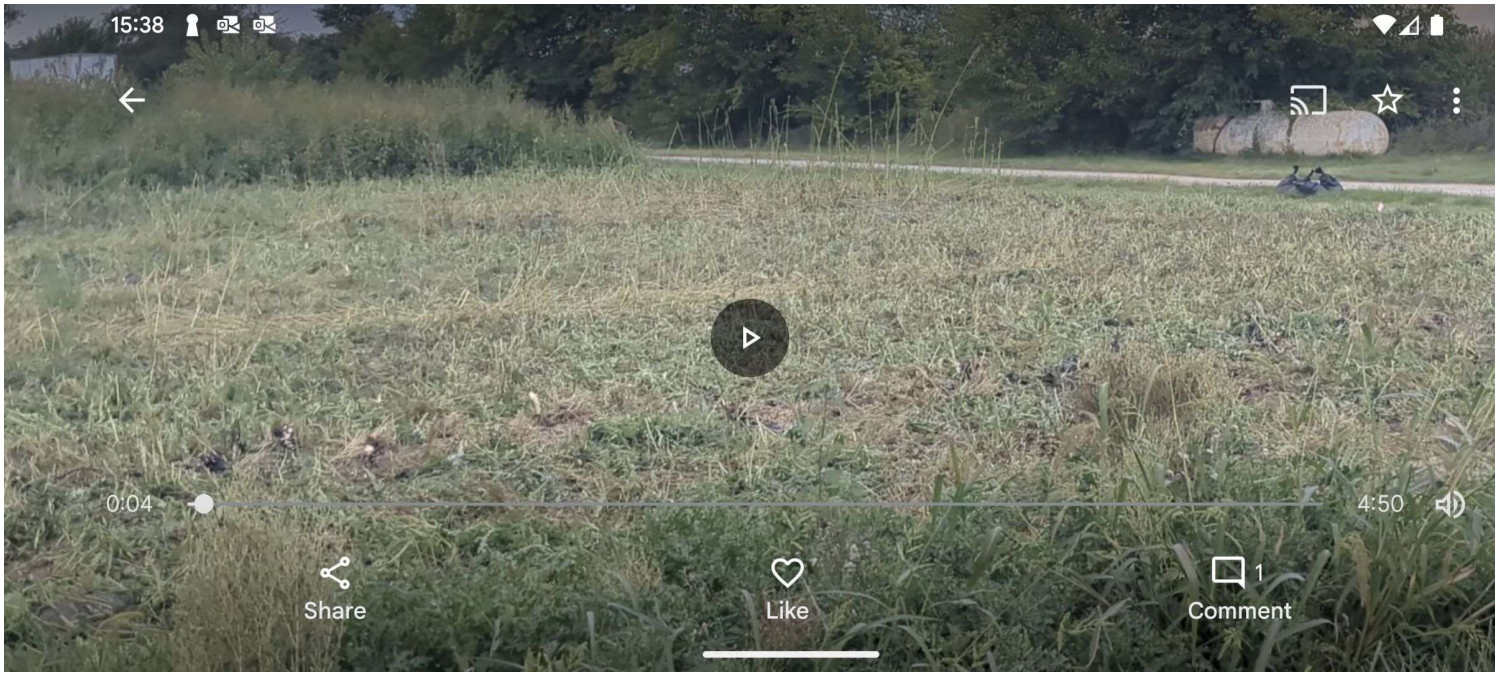
- What is a “weed”?
  - A plant whose virtues are not yet recognized
- Examples:
  - Diverse perennial pastures
  - Multi-species cover crops
  - Companion Planting
  - Interseeding
  - Stacked Enterprises
  - Multi-species grazing
- Promote diversity everywhere you can


Perennial pasture with diverse array of forages

# 6th Principle: Integrate Livestock

- The fasted way to build soil health is with proper livestock integration.
  - Cattle return 80-90% of the nutrients they consume back onto the soil in usable form as manure and urine.
  - Livestock shed biology
    - Saliva
    - Manure/Urine
- Use Adaptive Grazing to grow healthy animals and soil together.
- Grazing has been an essential component of all soils at one time or another.

Adaptive grazing Summer Annual Cover Crop in Garden, nearly 1 million pounds of cattle per acre stocking density.




# 1 Hour Later

With nearly 1 million pounds per acres stocking density

# The 6 Principles of Soil Health Are Universal

- Apply them and watch things grow!

# The 3 Rules of Adaptive Stewardship

*as defined by Understanding Ag*

- 1. Compounding
  - Everything we do has compounding and cascading effects that are either positive or negative, never neutral.
- 2. Disruption
  - Nature becomes stagnant if we settle into a routine with our management practices.
  - Introduce planned periodic disruptions to keep things moving forward
- 3. Diversity
  - Nature never supports or produces a monoculture.
  - Promote diversity in every way we can within our environment
  - “All Are Related” Lakota

# Implementation Tools:

- Manage for what you want, not what you don't want.
- Diverse Perennial pastures that are adaptively grazed, fasted way to progress
- No-till
- Multi-species cover crops
  - Diverse Cool Season crops
  - Diverse Warm Season crops
- Companion planting
  - Plant crops together that compliment each other
  - Cover Crops in walkways
- Mulch
- Adaptive Grazing of Livestock
  - Cattle
  - Sheep
  - Goats
  - Pigs
  - Poultry

# Adaptive Grazing for Building Soil Health

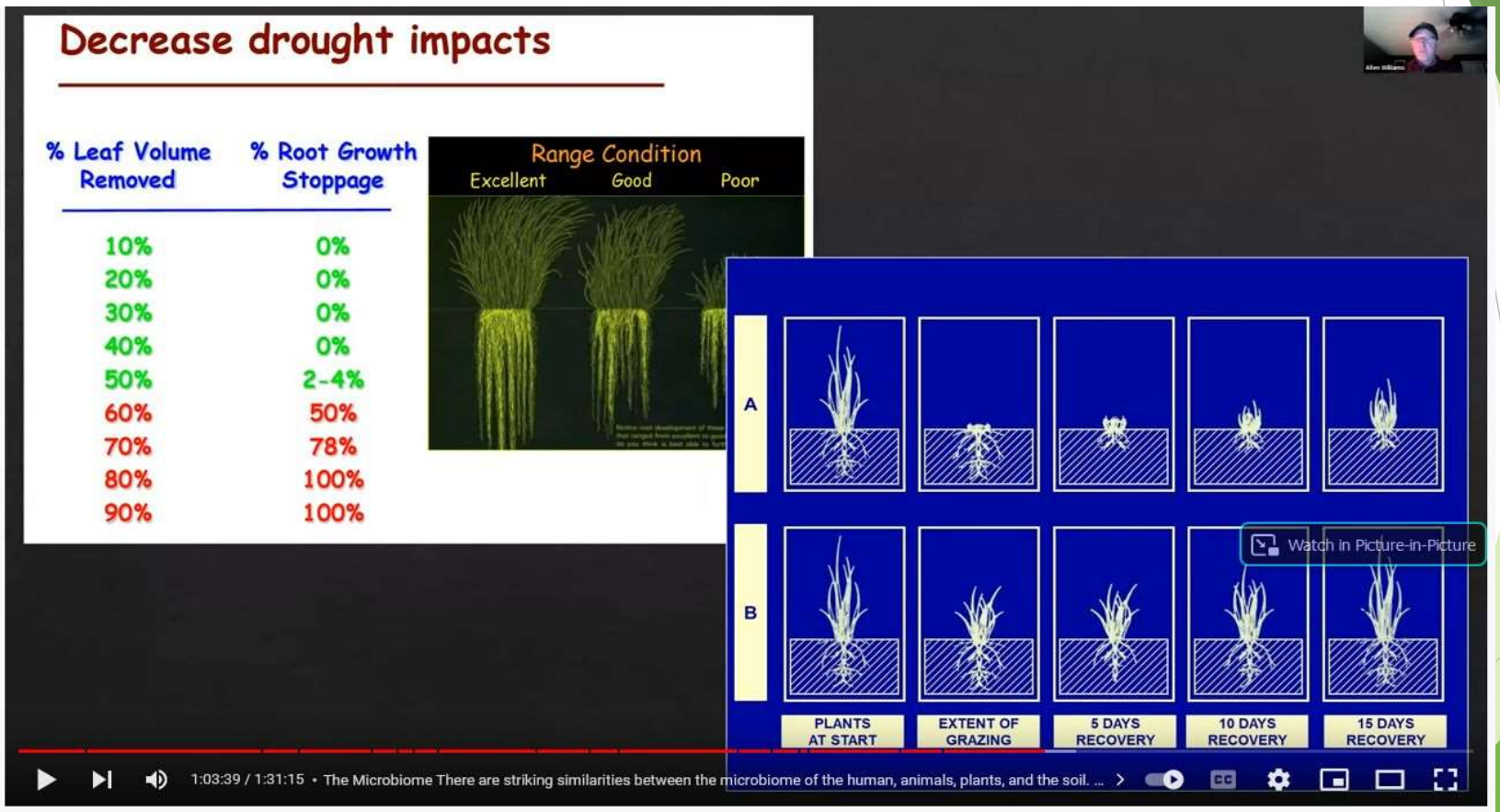
- Cycle Nutrients
- Armor Soil, trample effect
  - What happens at soil surface?
- Hoof action
- Short Graze periods, typically <24 hours
  - Prevents overgrazing of plants
- Long Rest and Recovery Periods, allows plants time to recover and express themselves.
  - 60+ day rest periods in our environment

# Adaptive Grazing (cont.)

- Accomplish specific goals
  - Move from low succession plants to higher succession plants
  - Rid pasture of “invasive species”
  - Bale grazing, importing nutrients
  - Planned Disruptions
    - Remember the rule of disruption
- Alter stocking density for specific goals (disruption)
- Alter paddock configurations (disruption)
- Move nutrients to where needed
- Promote diversity
- Access the latent seed bank
- Adaptive vs. Prescriptive

# How important is it to keep an effective solar panel?

% Leaf Volume Removed vs. % Root Growth Stoppage

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# Measuring Tools:

- Shovel
  - The shovel is the most powerful tool you have
- Thermometer
- Water Infiltration Ring
- Refractometer (Brix)
- Soil Tests
  - Haney Soils Test
  - PLFA Test
  - Wet Aggregate Test
  - Total Nutrient Digestion Test (TND)

# The Power of Observation

"If you know what's going on around you, you will know what to do"

# Let’s Use Our Senses!

- ..To see what nature is telling us

- Pay attention to what you:
  - See
  - Hear
  - Smell
  - Feel
  - Taste

*“If you want to make small changes, change the way you do things.*

*If you want to make big changes, change the way you see things.”*

Gabe Brown

# Results of Building Soil Health

- Improved nutrient density in our food.
- Improved human health!
- Improved Resiliency
  - In times of drought
  - In times of excess moisture
- Less pest pressure, more beneficial insects
- More wildlife
- Fewer purchased inputs needed
  - Fertlizers
  - Chemicals
- Increased Profit Margins
  - Focus on margin, not on yield.
- Remember: Healthy soils promote healthy plants which promote healthy animals.

# You Can Build Health!

- Healthy Soils
- Healthy Plants
- Healthy Animals
- Healthy Communities

- By applying the 6 Principles of Soil Health to your operation today.

- Let’s commit to building healthier soils and communities for future generations!

# Resources

- The Omnivore's Dilema, by Michael Pollan
- Holistic Management, by Savory & Butterfield
- Understanding Ag
  - www.UnderstandingAg.com
  - YouTube
  - Webinars
  - Blog Posts
- Soil Health Academy
  - www.SoilHealthAcademy.org
  - Online courses
  - Workshops
  - Case Studies
- No Work Garden Book, by Ruth Stout & Richard Clemence
- Dirt to Soil, by Gabe Brown
- A Bold Return to Giving a Damn, by Will Harris

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# Thank You!

- For your interest in soil health.
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# Questions?