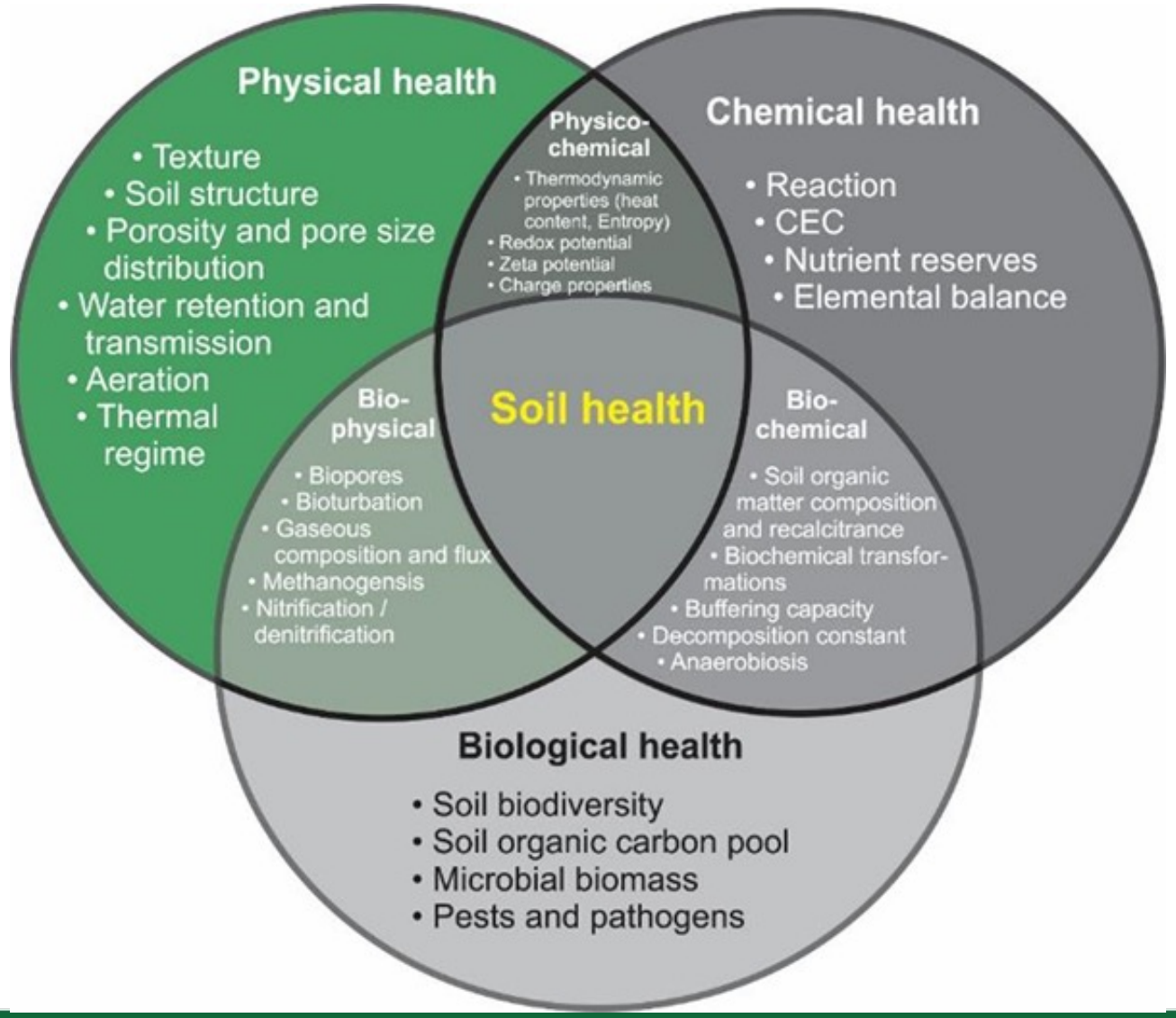
Tracking On-Farm Progress Through Soil Testing

Lance Gunderson



Establish Your Purpose

- What is your goal?
  - Reduce input costs
  - Increase water infiltration and retention
  - Monitor microbial community health
  - Diversify your income
  - Try something new
  - Balance work and life

Identify the Resource Concerns

- What is the problem?
  - Weeds and pests
  - Drought
  - Crop disease
  - Erosion

- Build a testing program
- Be consistent in sampling
- Be adaptable as your goals and/or concerns change

When and How - SH Tests

GENERAL Sampling How To's

- Typical depth is 0 to 6-8" – Can use other depths, but must include depth with sample
- 10-15 cores composited into one sample
- Keep cool or near field soil temp – Can be frozen for longer storage
- Send to the lab in plastic freezer bags or plastic lined paper soil bags
- Sample to represent up to 40 Acres

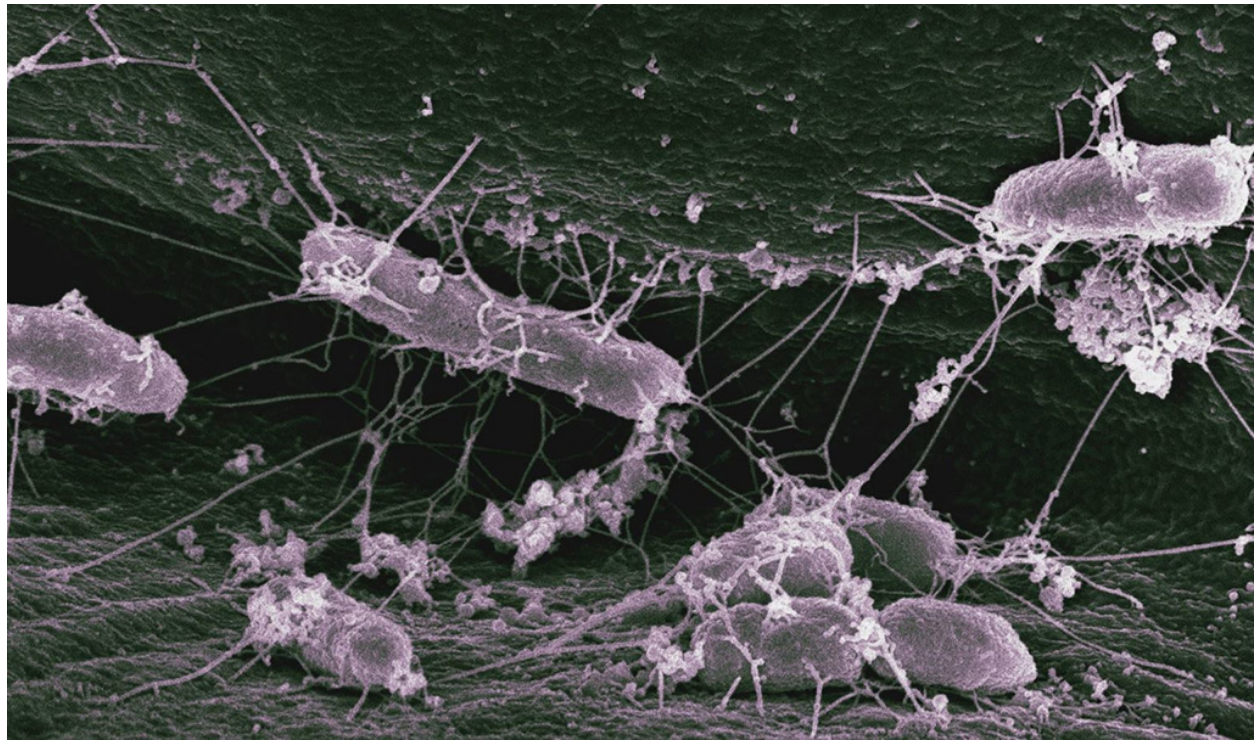
- Year 1 establishes a baseline
- Sample frequency determined by management intensity
- Note soil temps and moisture – sample consistency is key!

- ***https://regenaglab.com/sampling-instructions/***

Power of Observation

Measuring Soil Microbes

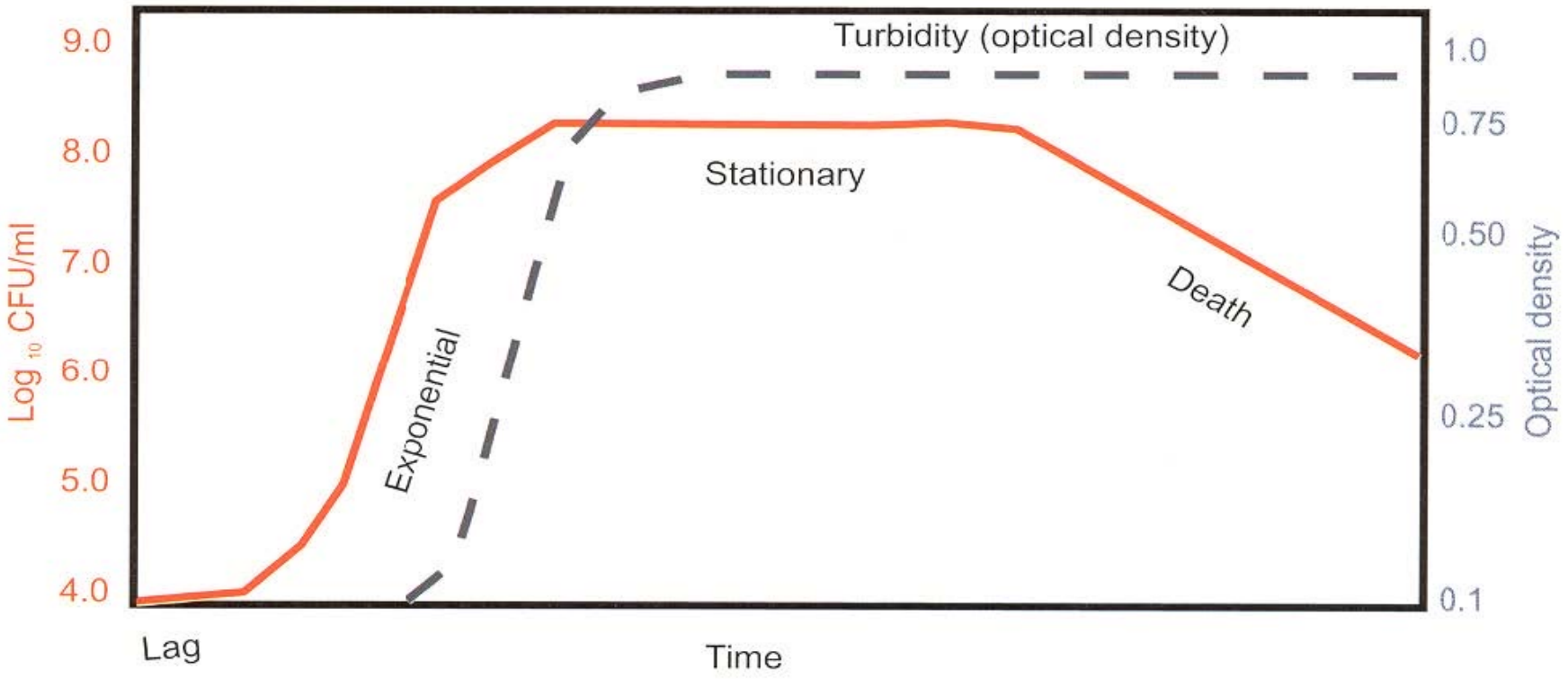
- **Three main techniques**
  - **Microscopy and culture plating**
    - **Advantages – Specific, Qualitative or Quantitative**
    - **Disadvantages – Non-inclusive, time consuming, expensive**
  - **Molecular: e.g PLFA**
    - **Advantages – Inclusive, relatively cheap, fast, quantitative**
    - **Disadvantages – Not specific, technical, controversy with biomarkers**
  - **Genomics**
    - **Advantages – Inclusive, greater detail, specific, quantitative**
    - **Disadvantages – Expensive, slow, very technical**



Microbial Growth in Soil

- Microbial growth in soil is driven by the search for energy under *restrictions* imposed by abiotic and biotic factors
  - Although soils are "open" systems, microbial growth often mimics "closed" systems because of diffusional and space limitations
  - Thus, soils exhibit all phases of the "batch culture" growth curve
  - More extended exponential growth would only occur in carbon-rich environments, such as on decomposing residues & in the rhizosphere. However, predation would keep microbial biomass in check.

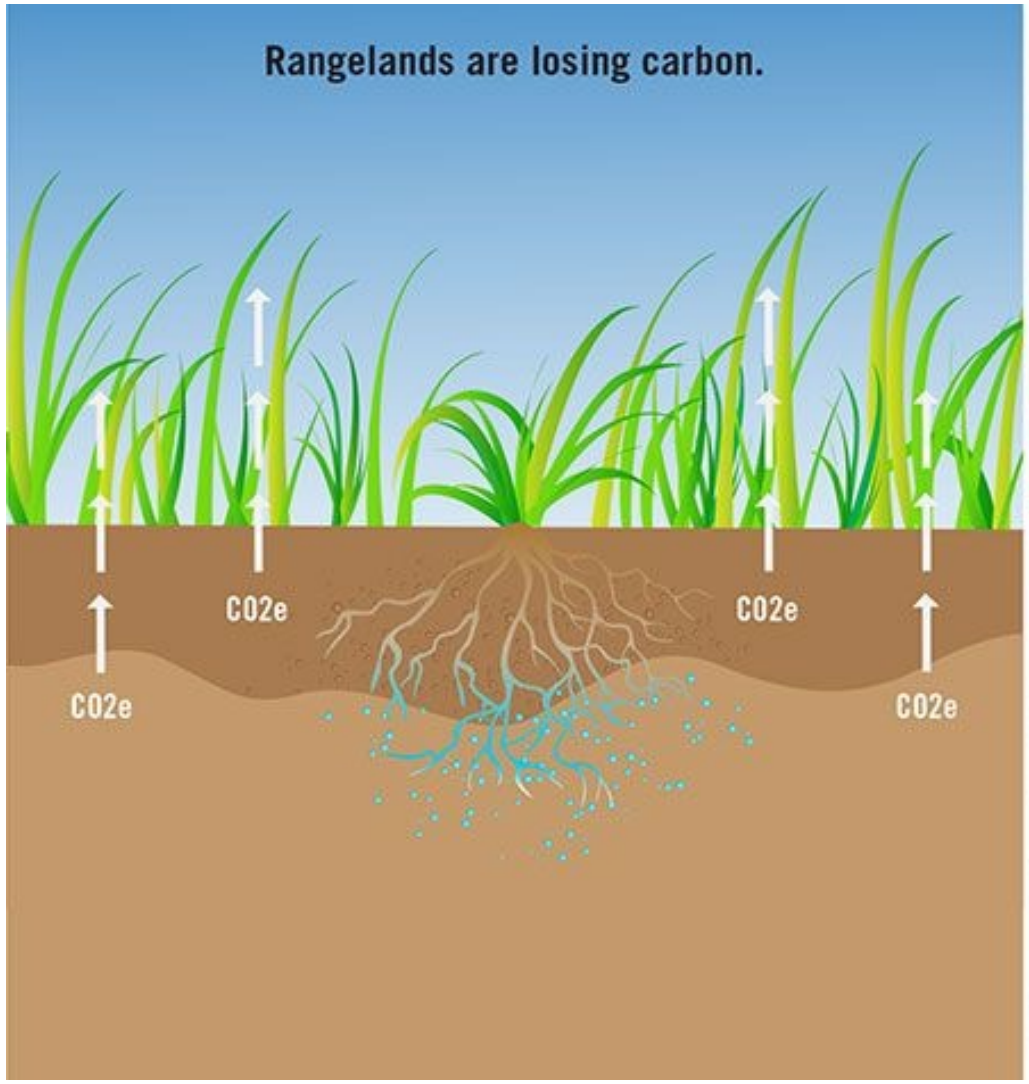
Gives rise to 4 phases:

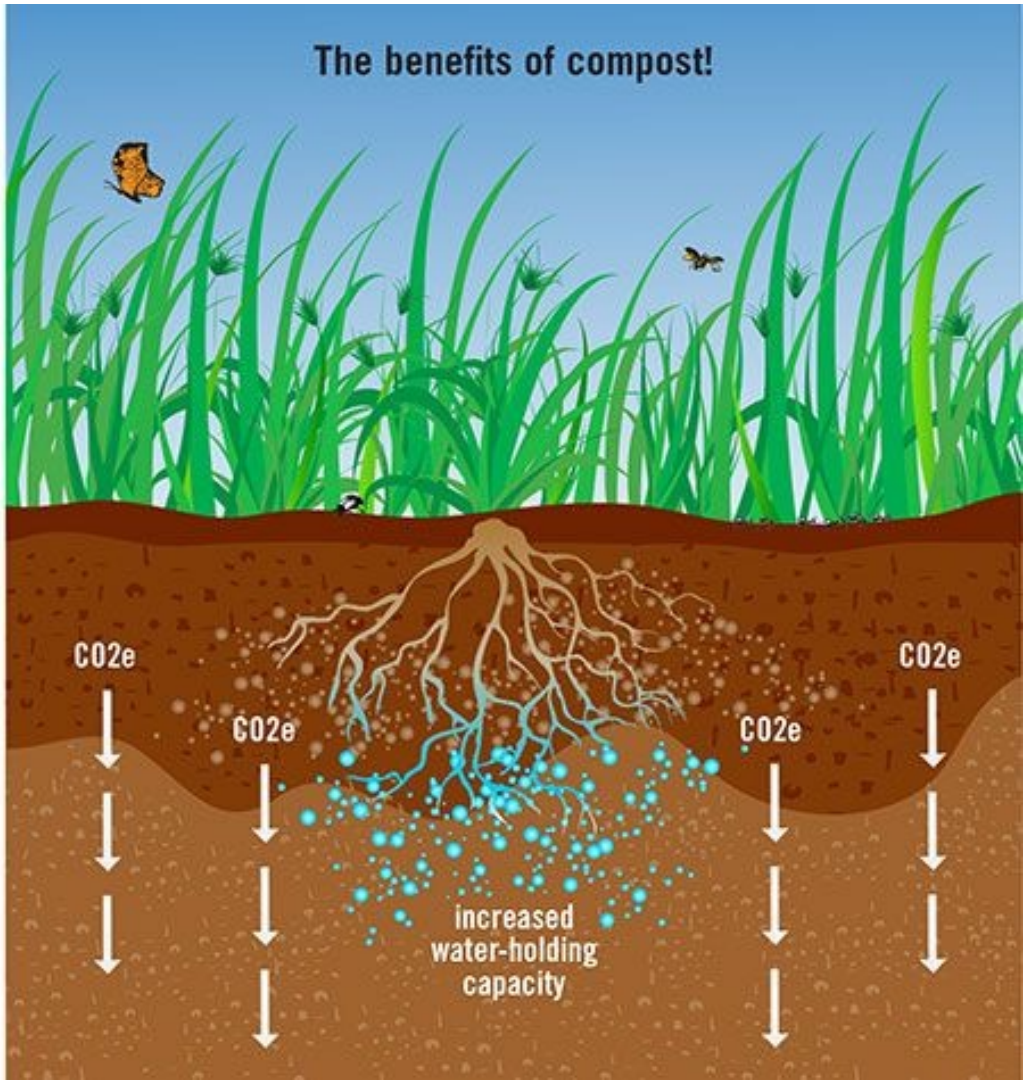


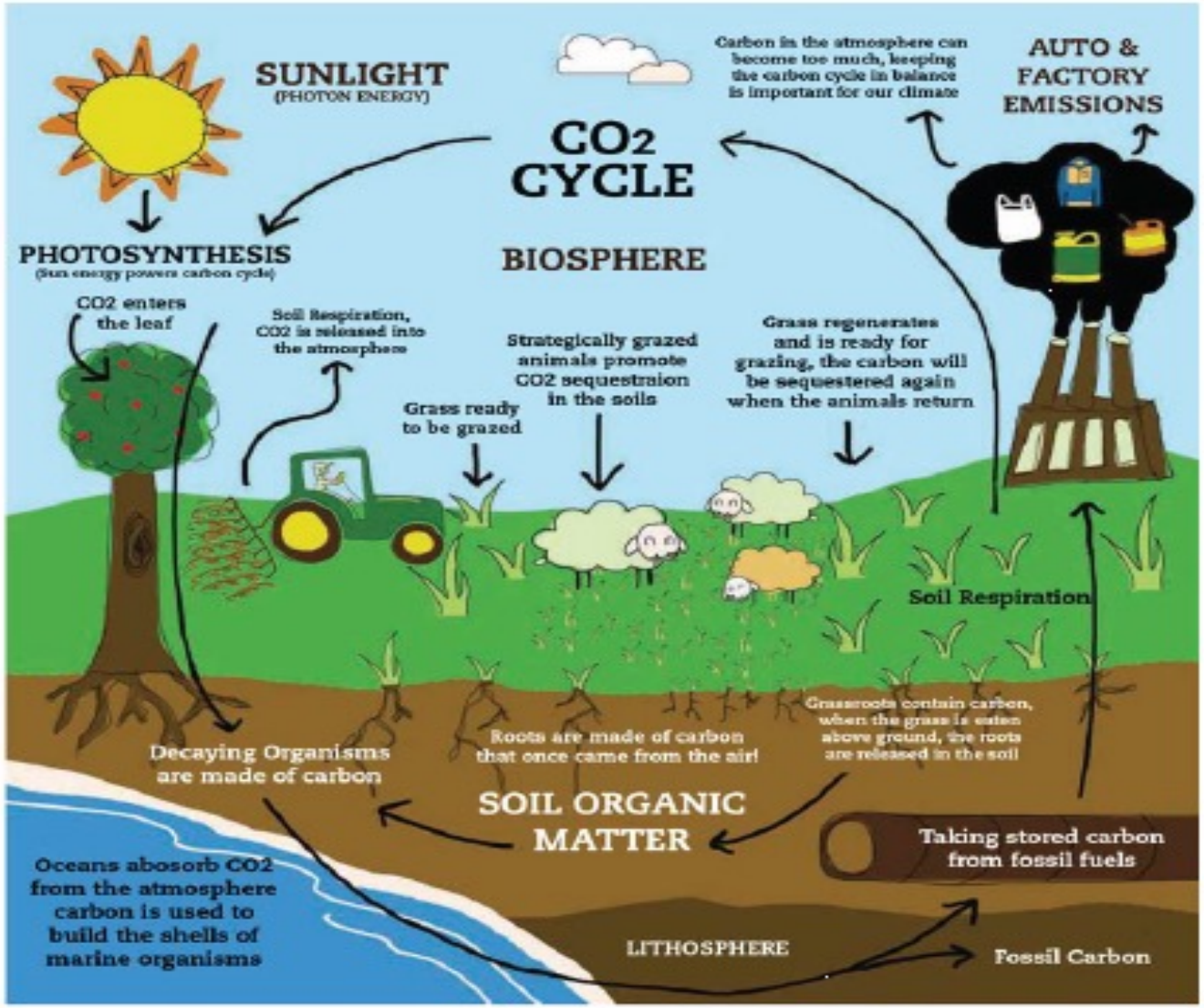
Determinants of Growth

- Abiotic determinants:
  - Temperature, pH, electrical conductivity (EC; salinity), redox potential, light & WATER
  - Bioavailable carbon, energy & reducing power
  - Macronutrients
    - N,S,P, etc.
  - Micronutrients
    - Cofactors, vitamins

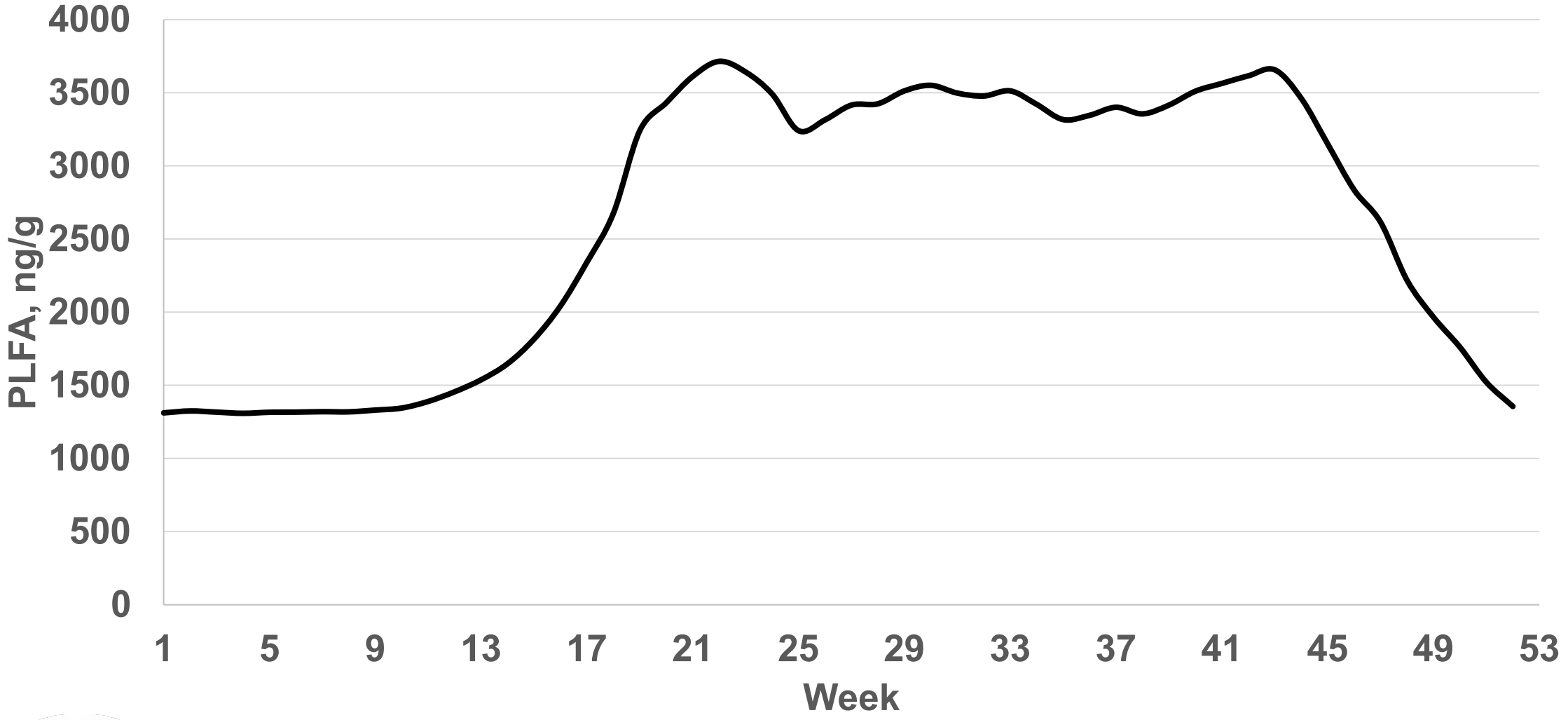
Hot Spring in Yellowstone!



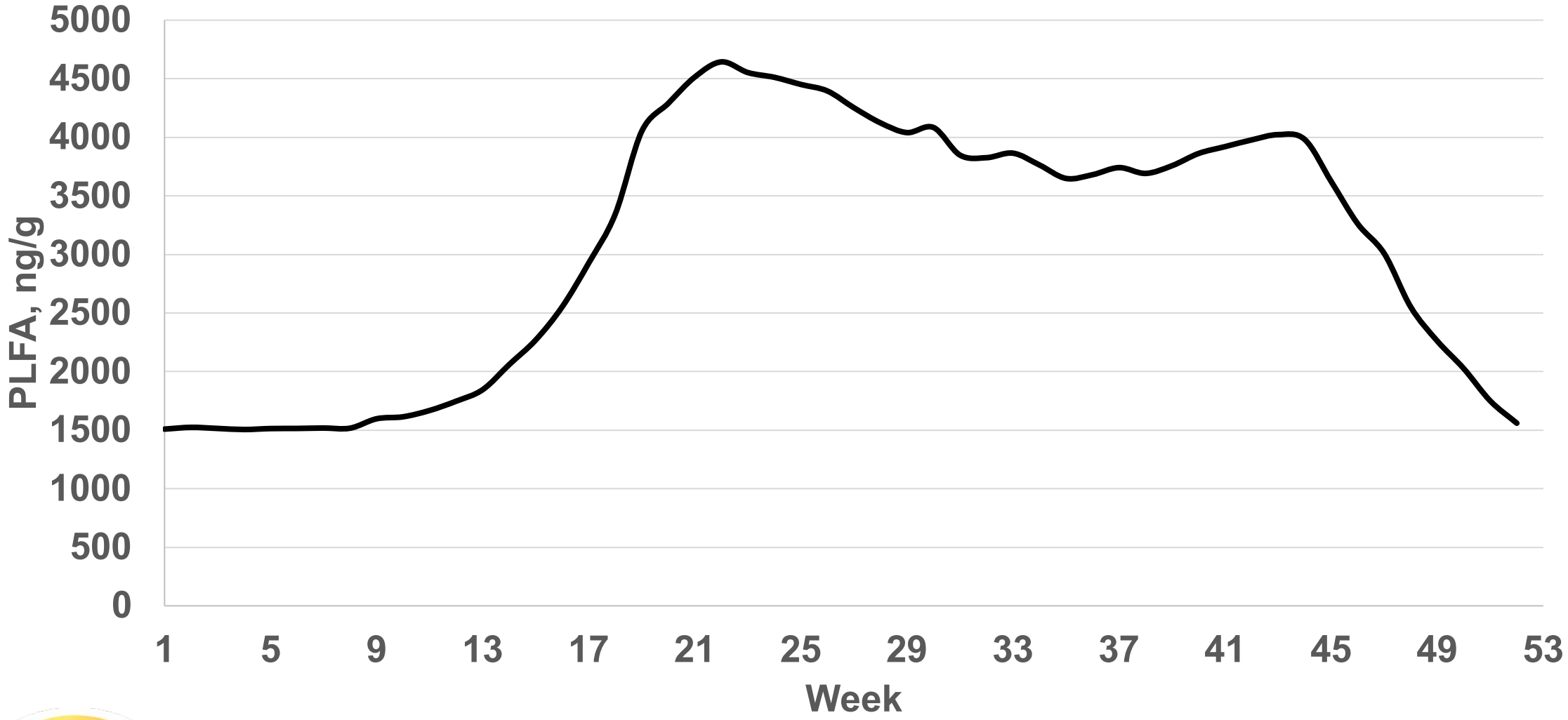




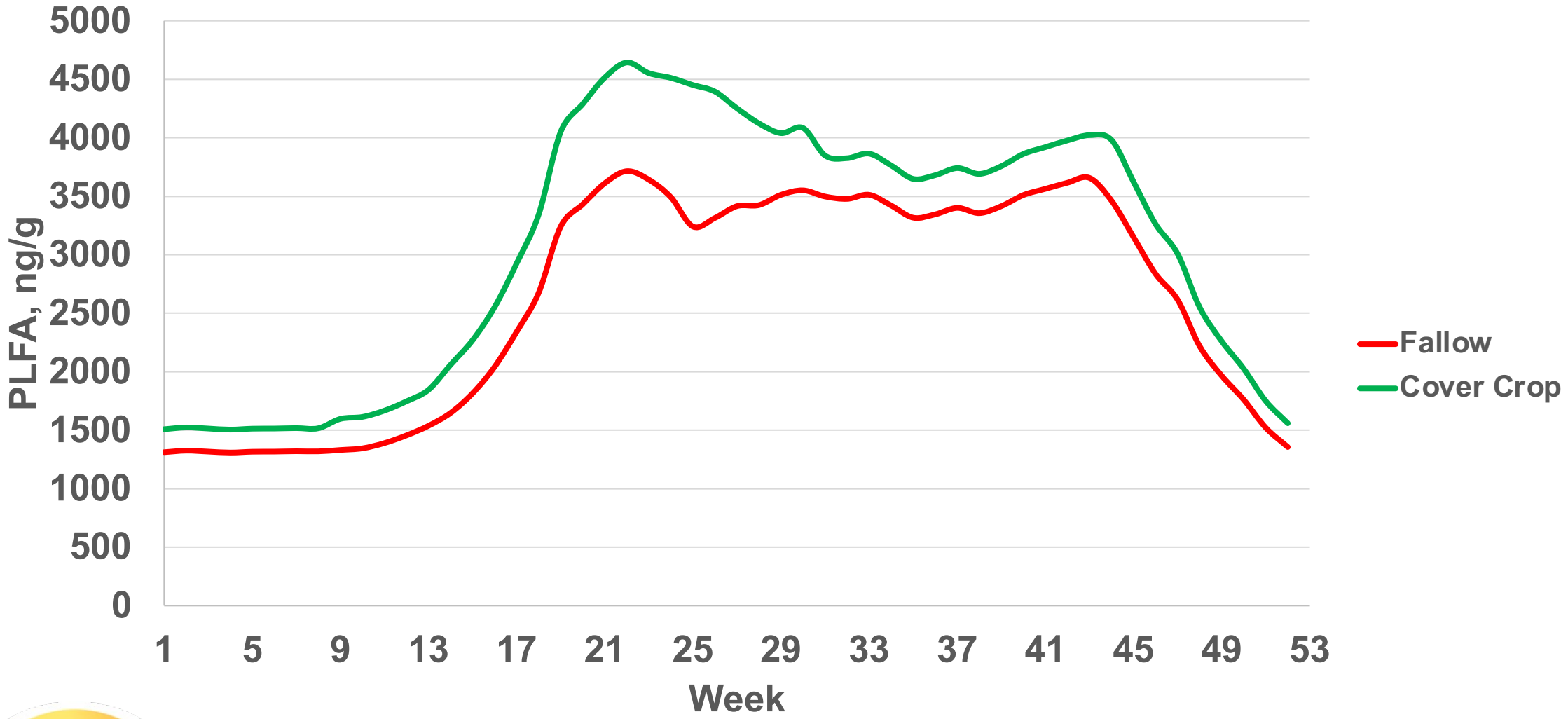
Microbial Biomass Fallow w/ Summer Annual



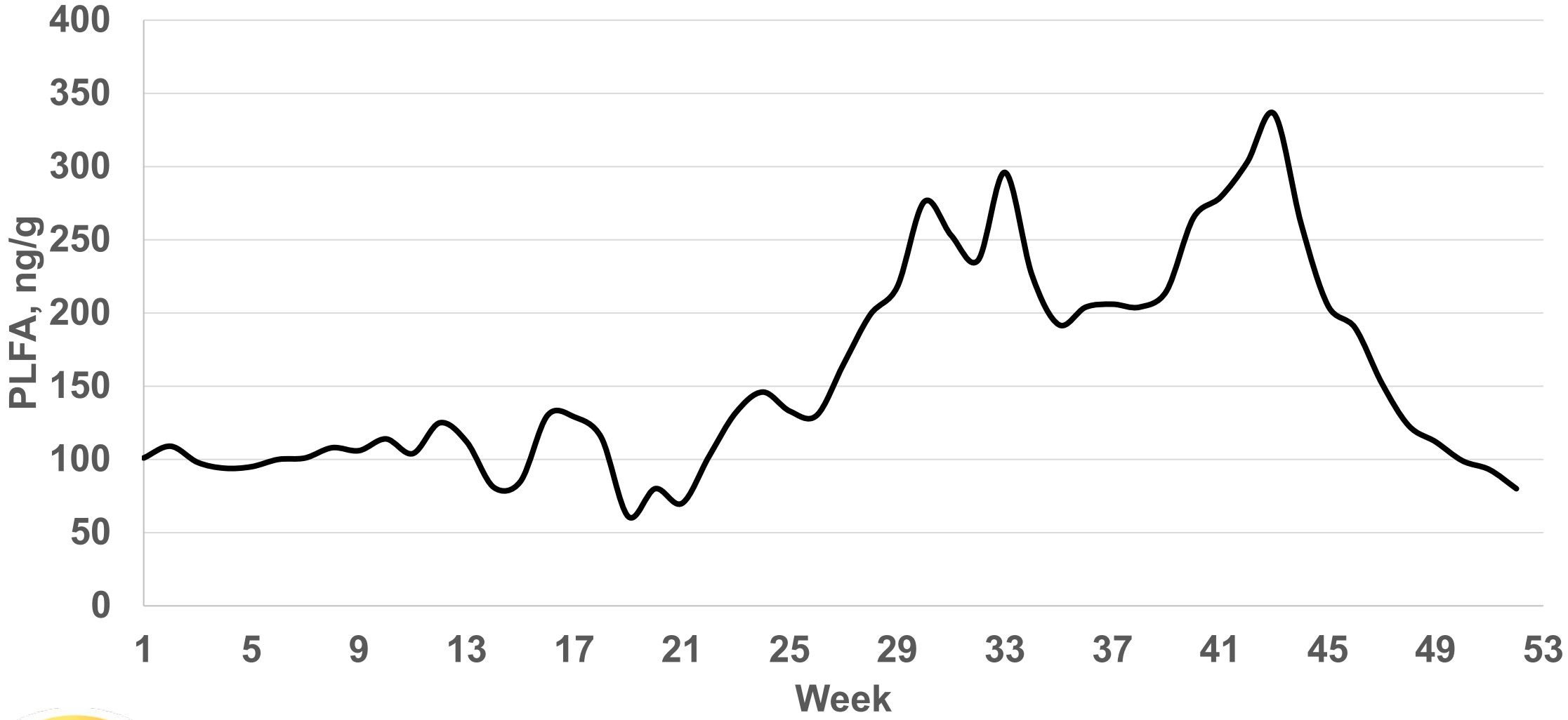
Microbial Biomass Cover w/ Summer Annual



Microbial Biomass Fallow vs Cover



Fungal Biomass Fallow w/ Summer Annual



What are the different parts of the Report?

BiomeMakers

BeCrop Test

QUANTIFICATION OF SPECIES

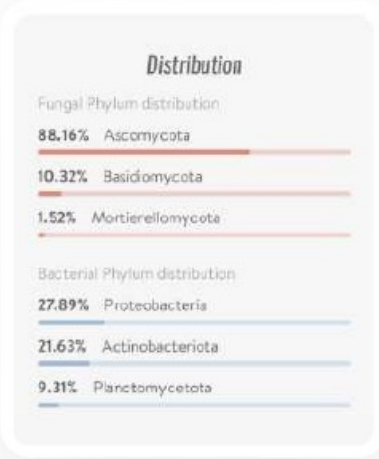
In this section, you can see the **total amount of fungus and bacteria found** in your sample(s), based on the number of fungi or bacteria molecules detected.

SUMMARY

A glance at the general status of your crop.

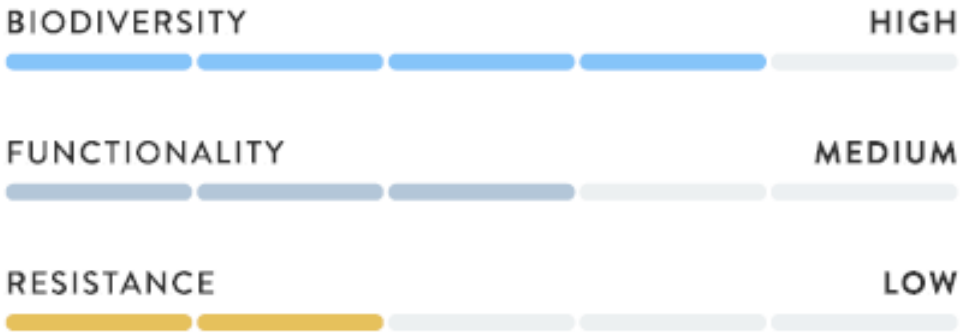
Distribution

Here you can see a summary distribution of Bacteria and Fungi in your sample.



SOIL QUALITY

Diversity, functionality, and resistance of microbial species and metabolic functions present in the soil, and the vulnerability of the system based on estimation of the microbiome resistance. Here you can see Biodiversity, Functionality, and Resistance.



HEALTH

The role of microorganisms in plant health and yield is defined by the balance between **Biocontrol, Hormone Production, and stress adaptation**

HEALTH
VERY LOW
4 *Disease Risks found*

HORMONE PRODUCTION
LOW
3 *Disease Risks found*

STRESS ADAPTATION
MEDIUM
7 *Disease Risks found*

NUTRITION

The potential of soil microorganisms to cycle nutrients and to increase the bioavailability of nutrients for plants. This part shows you the **macro and micronutrients** found in it.

C	N	P	K
Carbon	Nitrogen	Phosphorus	Potassium
MEDIUM	MEDIUM	MEDIUM	MEDIUM

Major Compounds

C — Carbon — HIGH

PATHWAYS

GAIN		LOSS		INDIRECT BENEFITS	
CARBON FIXATION	VERY LOW	AEROBIC RESPIRATION	MEDIUM	ORGANIC MATTER RELEASE	MEDIUM
		FERMENTATION	VERY LOW		
		METHANOGENESIS	VERY LOW		

N — Nitrogen — VERY LOW

PATHWAYS

NUTRIENT SUPPLY		NUTRIENT COMPETITION		INDIRECT BENEFITS	
INORGANIC NITROGEN RELEASE	VERY LOW	INORGANIC NITROGEN CONSUMPTION	VERY LOW	NITROGEN CYCLE	MEDIUM

P — Phosphorus — LOW

PATHWAYS

NUTRIENT SUPPLY		NUTRIENT COMPETITION		INDIRECT BENEFITS	
INORGANIC P SOLUBILIZATION	LOW	INORGANIC P CONSUMPTION	LOW	ORGANIC P ASSIMILATION	MEDIUM

K — Potassium — LOW

PATHWAYS

NUTRIENT SUPPLY		NUTRIENT COMPETITION	
POTASSIUM SOLUBILIZATION	LOW	POTASSIUM CONSUMPTION	LOW

Minor Compounds

Fe — Iron

HIGH

Iron assimilation

Zn — Zinc

VERY LOW

Zinc transport equilibrium

Mn — Manganese

LOW

Manganese transport equilibrium

S — Sulfur

MEDIUM

Sulfur cycle equilibrium

Ca — Calcium

VERY LOW

Calcium transport

Cu — Copper

MEDIUM

Copper export

Mg — Magnesium

HIGH

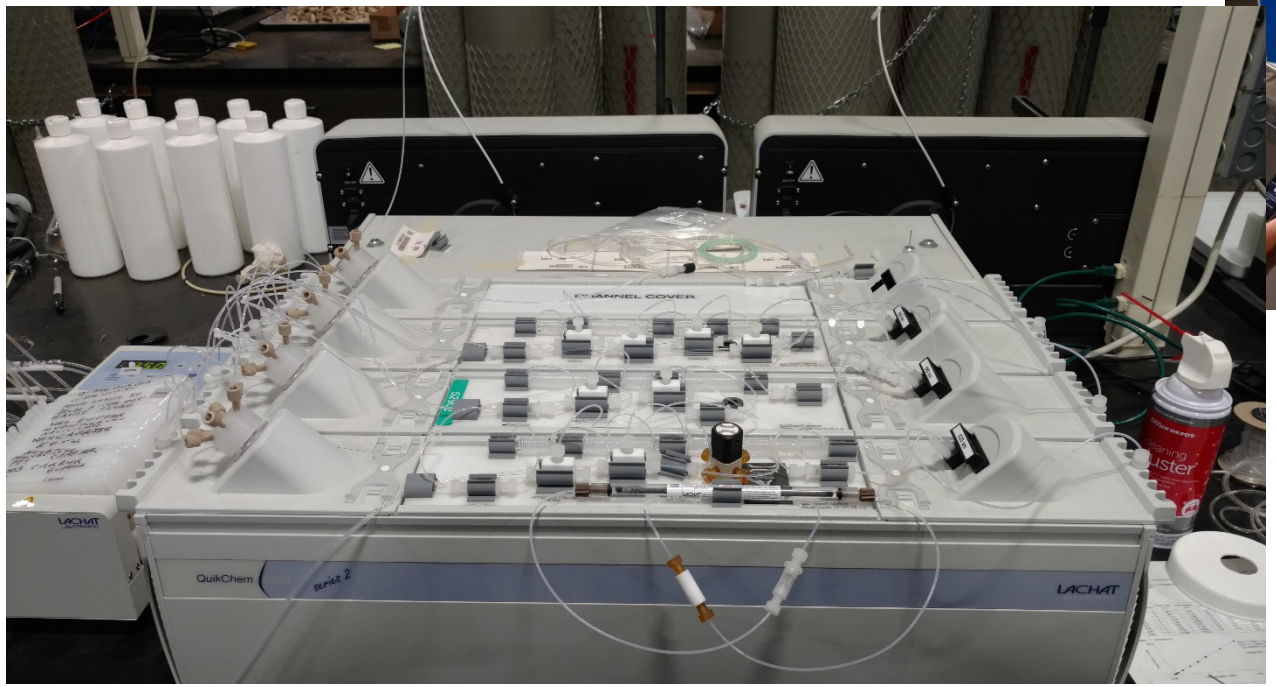
Magnesium transport

Cl — Chlorine

LOW

Chlorine transport

Haney Test



Fertility tied to Biology

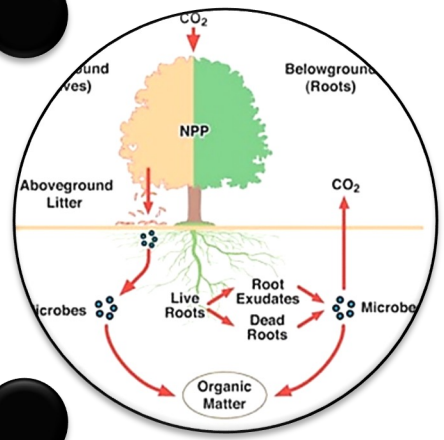
Soil N, P, K

Soil Organic N and P

Microbial Biomass

Water Extractable C

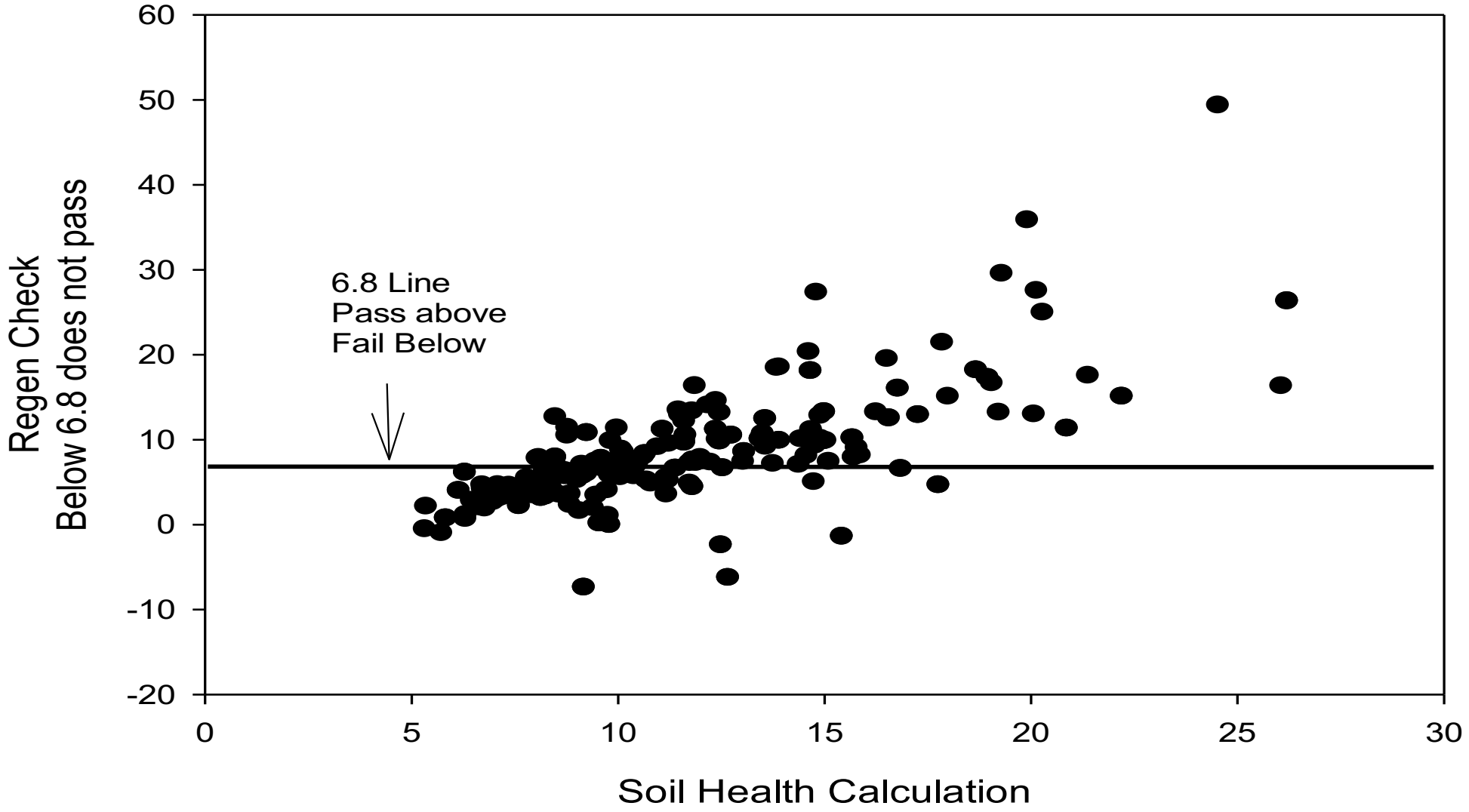
C:N balance



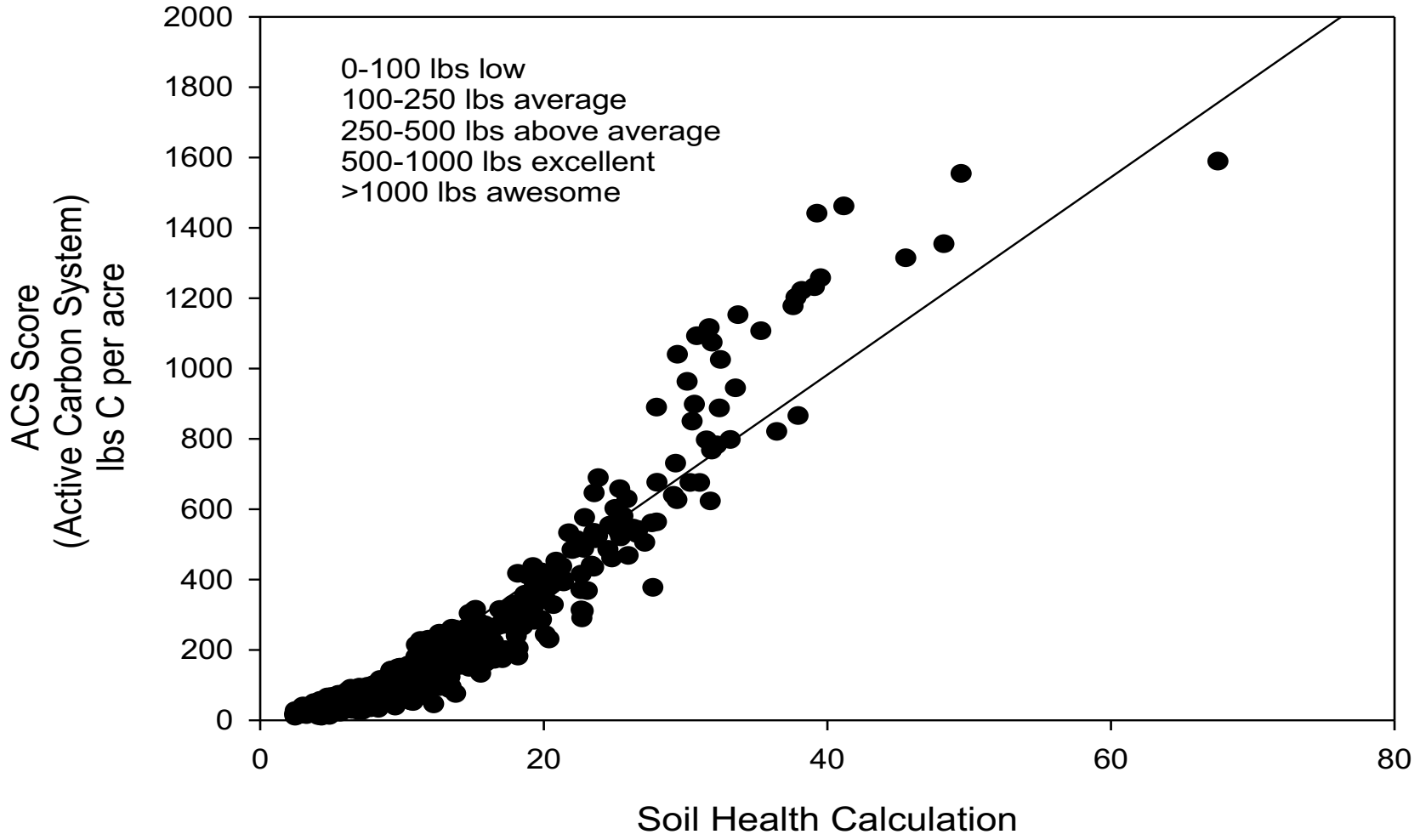
The BIG Indicators

• Soil Respiration – CO2	• >80ppm for most soils
• % MAC – Microbially Active Carbon	• Between 50-80%
• C:N Ratio	• Between 8:1 & 15:1 Ok, 10:1 to 12:1 Ideal
• Org. N:Inorganic N Ratio	• >1:1 but depends on time of year
• Water Extractable Organic Carbon	• >200ppm but not at expense of C:N ratio
• Water Extractable Organic Nitrogen	• >20ppm but not at expense of C:N ratio
• SHC – Soil Health Calculation	• >7 on the right track, but >10 is ideal

Regenerative Farming Check



Soil Solid-Liquid-Gas phase Carbon



Questions?

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