Interpreting the CARA Soil Health Lab Report

Dorthea Gregoire, PhD, AIT

Why Do We Talk About Soil Health?

By definition, to have health, one must be alive!

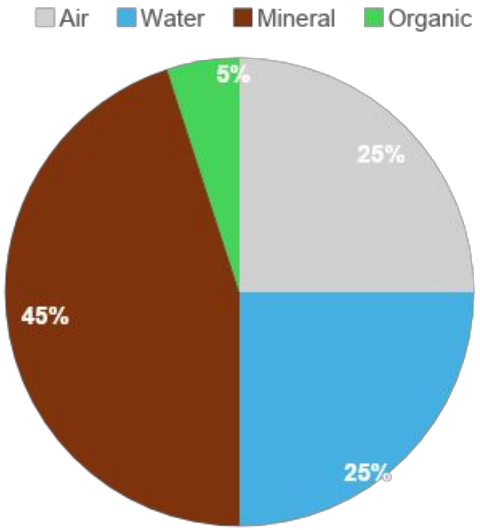
- Soil as a living entity – an ecosystem
- 1 billion microbes in a tsp of soil
- 10,000 - 50,000 species within that same tsp

Soil is first and foremost BIOLOGICAL

- Soil is alive, filled with biology that is the catalysts for all ecosystem processes that power our landscapes

In the rhizosphere, plants, microbes and other organisms build communities and these communities build soils

- ~55% of soil is made up of living organisms, their byproducts and the space they make for themselves



Cover Page

- There is no year/date - ADD it now!
- Double check that the legal land descriptions are correct
- Add your own “nickname” for the fields

- B = Best field
- W = Worst field
- U = Unmanaged site

- Assessment refers to the CARA lab test package that was used to analyze your sample



SOIL HEALTH LAB REPORT

Canadian Organic Growers
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Lab Submission # 1-003765

LAB #	SAMPLE NAME	DEPTH (inches)	LAND LOCATION	ASSESSMENT	OBSERVATIONS
5216	SE32_U	0-6	SE 32-46-2-W5	Benchmark	
5217	NE29_W	0-6	NE 29-46-2-W5		
5218	NE35_B	0-6	NE 35-46-2-W5		

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Fax: (403) 664 3000

Soil Health Analysis

- Soil type
- Physical soil metrics
- Biological soil metrics
- Chemical soil metrics

Submission N / Land Location	Farmer Id No.	Sample No.	Depth (cm)
1-003765 SE 32-46-2-W5	SE32_U	5216	0-15

% Sand	% Silt	% Clay	Textural Class:	
56	34	10	Coarse	Sandy Loam

Soil Health Analysis: Biophysical & Others

	Indicator	Results	Score	Constraint(s)
		5216	5216	
Physical	Wet Aggregate Stability (%)	80	96	
Physical	Water Infiltration (min)	0.86	100	
Physical	Bulk Density (g/cm3)	0.83	100	
Physical	Compaction Depth/cm (200psi)	10	91	
Physical	Compaction Depth/cm (300psi)	18	2	Deep rooting, drought resistance, water availability, nutrient uptake, plant growth and yield, subsurface pan/deep compaction/restrictive layer
	Mean Physical Health:		78	78
Biological	Organic Matter (%)	9.6	100	
Biological	Active Carbon (ppm)	468	54	
Biological	C:N Ratio	12	98	
Biological	Microbial Respiration (mg CO_2/g)	0.87	81	
	Mean Biological Health:		83	83
Chemical	pH	6.9	100	
Chemical	Extractable P (ppm)	44	79	
Chemical	Extractable K (ppm)	566	0	K High
Chemical	Magnesium (ppm)	249	0	Mg High
	Mean Chemical Health:		45	45
	Overall Soil Health Score:		69	Medium

Add-On Tests

Physical and Biological Indicator Scores are calculated using the cumulative normal distribution function for Coarse, Medium, and Fine textural classes. Depending on the measured soil texture distribution, this worksheet identifies the appropriate soil textural class and uses the corresponding Scoring Functions. Each Indicator Score represents the percentage of all samples scoring at or below the measured value when compared across the complete sample database. Chemical Indicator Scores are not based upon the normal distribution. Soil pH, Extractable P, and Extractable K are scored as follows: a) pH Score of 100 for pH 6.25-7.25, Score of 0 for pH >= 7.7 and <=5.4, b) P Scores were less on 25 = 5 ppm optimum P levels. c) K Score of 100 for >=74.5 ppm, Score of 0 for <= 20 or 200 ppm. Other Nutrients Rating are determined on a scale of 0-4, representing the sum of Scores for Mg, a) Mg Score of 1 for > 53 ppm, 0 for <= 53 ppm, and 0 for > 200ppm. Indicator Scores are assigned a color grade using the follows system: Very High, Score of 81-310 (Blue); High, Score of 60-80 (Green); Medium, Score of 40-60 (Yellow); Low, Score of 20-40 (Orange); Very Low, Score of 0-20 (Red). For Other Nutrients Ratings (no data available for Micronutrients. The Other Nutrients Rating is then converted to a 1-100 scale as follows: (4, 100), (3, 56), (2, 11), (1, 4), and (0, 0). The Mean Physical, Biological, and Chemical Health Scores are calculated as the average of the Indicator Scores within each category. The average of the Mean Physical, Biological, and Chemical Health Scores is the Overall Soil Health Score. The Overall Soil Health Score is categorized using the following scale: Very High, >= 85; High, >= 70; Medium, >= 55; Low, >=40; Very Low, < 40. DATABASE was adjusted for missing micronutrients (Fe, Zn and Mn)

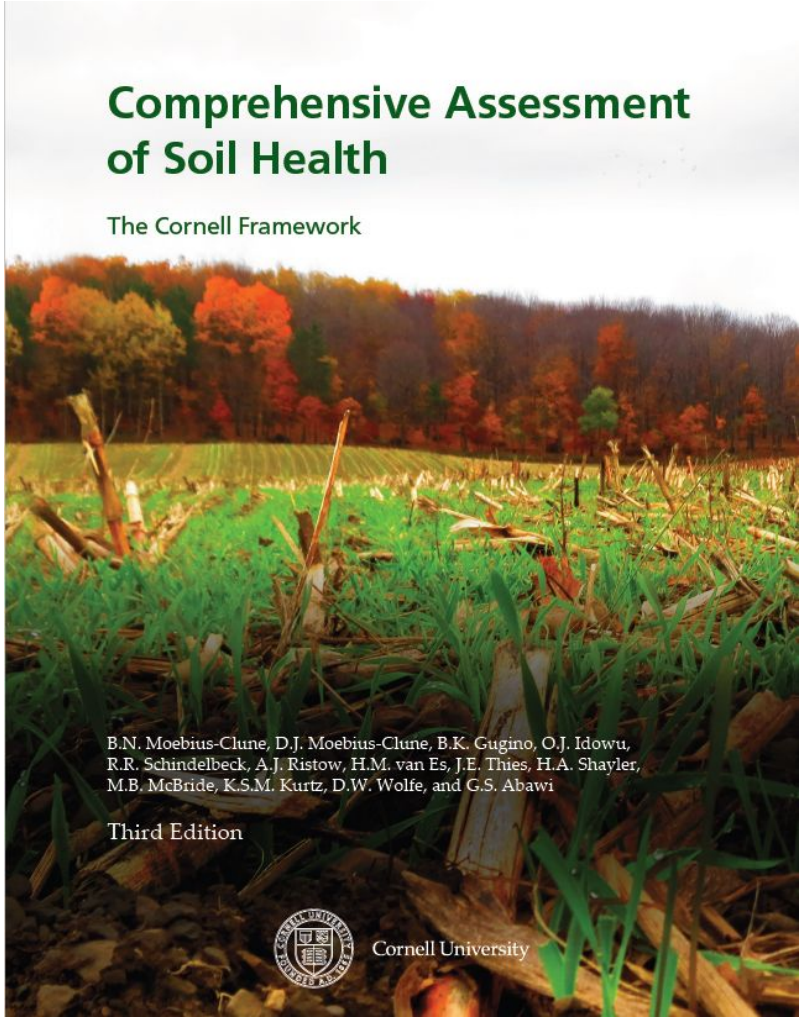
The Cornell Framework

Full Framework

Part 1 - Soil Health Concepts

Part 2 - Soil Health Assessment

Part 3 - Soil Health Management



Soil Type

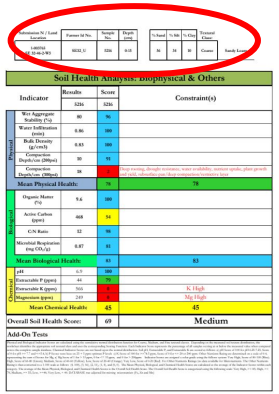
- % sand +
- % silt +
- % clay
- = 100 %

- Texture class
- Soil Type

- Depth at which sample was taken (in cm)
- 0-15 cm = 0-6 inches

Submission N / Land Location	Farmer Id No.	Sample No.	Depth (cm)
1-003765 SE 32-46-2-W5	SE32_U	5216	0-15

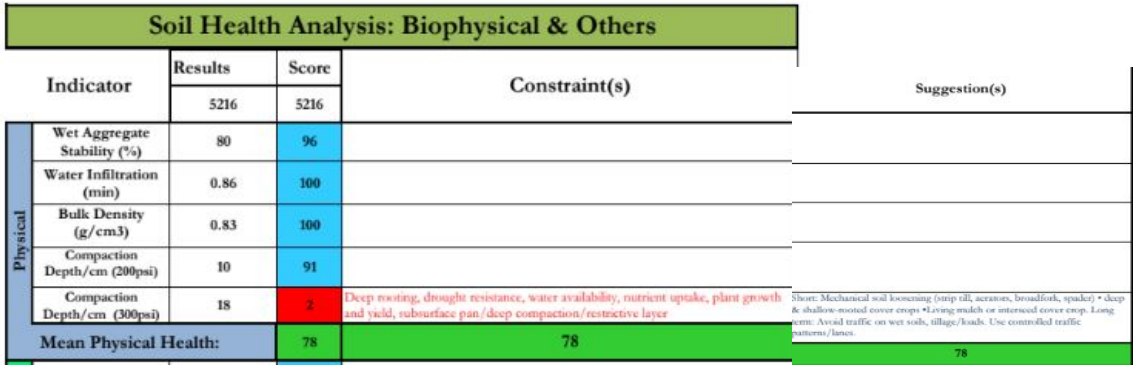
% Sand	% Silt	% Clay	Textural Class:	
56	34	10	Coarse	Sandy Loam



Soil Health Analysis

Tells you 4 things:

- Results - the metric measured for your sample
- Score - a relative rating based on your metric and color coded
  - Blue = very high
  - Green = high
  - Yellow = medium
  - Orange = low
  - Red = very low
  - (adjusted for soil texture)
- Constraints (pg 2 of report)
- Suggestions (pg 3 of report)



Soil Health Analysis: Biophysical & Others

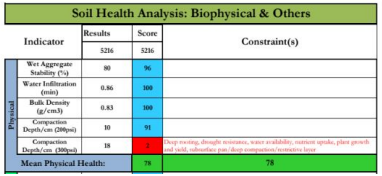
	Indicator	Results	Score	Constraint(s)	Suggestion(s)
		5216	5216		
Physical	Wet Aggregate Stability (%)	80	96		
Physical	Water Infiltration (min)	0.86	100		
Physical	Bulk Density (g/cm3)	0.83	100		
Physical	Compaction Depth/cm (200psi)	10	91		
Physical	Compaction Depth/cm (300psi)	18	2	Deep rooting, drought resistance, water availability, nutrient uptake, plant growth and yield, subsurface pan/deep compaction/restrictive layer	Short: Mechanical soil loosening (strip till, aerators, broadfork, spader) • deep & shallow-rooted cover crops •Living mulch or intersed cover crop. Long term: Avoid traffic on wet soils, tillage/loads. Use controlled traffic patterns/lanes.
	Mean Physical Health:		78	78	78

Physical and Biological Indicator Scores are calculated using the cumulative normal distribution function for Coarse, Medium, and Fine textural classes. Depending on the measured soil texture distribution, this worksheet identifies the appropriate soil textural class and uses the corresponding Scoring Function. Each Indicator Score represents the percentage of all samples scoring at or below the measured value when compared across the complete sample database. Chemical Indicator Scores are not based upon the normal distribution. Soil pH, Extractable P, and Extractable K are scored as follows: a) pH Score of 100 for pH 6.25-7.25, Score of 0 for pH >= 7.7 and <=5.4, b) P Scores were base on 25 + 5 ppm optimun P levels c) K Score of 100 for >=74.5 ppm, Score of 0 for <= 20 or 200 ppm. Other Nutrients Rating are determined on a scale of 0-4, representing the sum of Scores for Mg, a) Mg Score of 1 for > 33 ppm, 0 for <= 33 ppm, and 0 for > 200ppm. Indicator Scores are assigned a color grade using the follows system: Very High, Score of 80-100 (Blue); High, Score of 60-80 (Green); Medium, Score of 40-60 (Yellow); Low, Score of 20-40 (Orange); Very Low, Score of 0-20 (Red). For Other Nutrients Ratings (no data available for Micronutrients. The Other Nutrients Rating is then converted to a 1-100 scale as follows (4, 100), (3, 56), (2, 11), (1, 4), and (0, 0). The Mean Physical, Biological, and Chemical Health Scores are calculated as the average of the Indicator Scores within each category. The average of the Mean Physical, Biological, and Chemical Health Scores is the Overall Soil Health Score. The Overall Soil Health Score is categorized using the following scale: Very High, >= 85; High, >= 70; Medium, >= 55; Low, >=40; Very Low, < 40. DATABASE was adjusted for missing micronutriets (Fe, Zn and Mn)

Physical Indicators of Soil Health

Five (5) physical metrics to assess health of your soil

- Wet Aggregate Stability (%)
- Water Infiltration (min to infiltrate 1” equivalent)
- Bulk Density (g/cm3)
- Compaction (depth to 200 psi)
- Compaction (depth to 300 psi)



	Indicator	Results	Score
		5216	5216
Physical	Wet Aggregate Stability (%)	80	96
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Mean Physical Health:			78

Wet Aggregate Stability

- The percentage of a soil aggregate that will remain intact when submerged in water

Why this matters to you:

- Aggregates that aren't stable when wet can't hold themselves together and will disintegrate when it rains or you irrigate and they get wet
- When they fall apart, not only do they lose their structure but their tiny particles fill in the pore space of other aggregates leaving no room for air, water and life
- It's like shaking a bin of beans or flour to make a bit more room

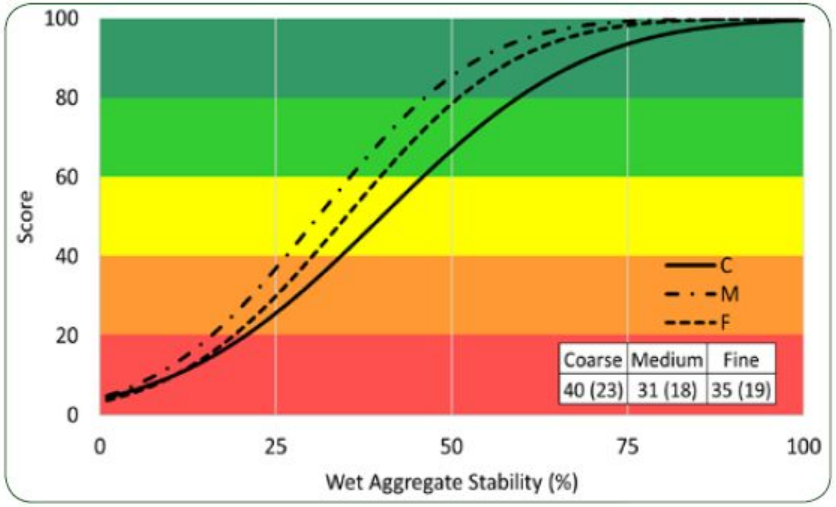


FIGURE 2.27. Wet Aggregate Stability scoring functions and upper value limits for Coarse (C), Medium (M) and Fine (F) textural classes. Mean and standard deviation (in parenthesis) for each class are provided. In this case more is better. Higher scores indicate a greater ability of the soil aggregates to resist falling apart when exposed to rainfall.

You want your wet aggregate stability values to be as close to 100% as possible

Water Infiltration

- How long it takes the soil to infiltrate the equivalent of a 1” rainfall

Why this matters to you:

- The absolute amount of precipitation you receive is meaningless if it can’t reach your plants/crops
- Water that doesn’t infiltrate ponds (flat areas and depressions) or runs off (sloped areas)
- The smallest members of the SFW live in the film of water in and on soil aggregates - without them no nutrient cycling occurs



You want your water infiltration to be as fast as possible (seconds to minutes)

Bulk Density

- The mass of soil of a known volume
- This quantifies the physical component of soil (primarily the 45% mineral component plus organic matter - which is lighter)
- If there's more mineral (in a given space) there's less room for air and water/pore space

Why this matters to you:

- High BD indicates less room for air, water, roots and SFW microbes making it harder for them to grow, move and thrive



You want spongy soil with lots of pore space that has a low bulk density

Bulk Density and Plant Growth

- Note: soil texture is influential in determining the impact of bulk density on the growth of your plants

Soil Texture	Ideal Bulk Density for Plant Growth	Bulk Density that Affects Plant Growth	Bulk Density That Restricts Plant Growth
Sand, Loamy Sand	<1.60g/cm³	1.63g/cm³	>1.80g/cm³
Sandy Loam, Loam	<1.40g/cm³	1.63g/cm³	>1.80g/cm³
Sandy Clay Loam, Clay Loam	<1.40g/cm³	1.60g/cm³	>1.75g/cm³
Silt, Silt Loam	<1.40g/cm³	1.60g/cm³	>1.75g/cm³
Silt Loam, Silty Clay Loam	<1.40g/cm³	1.55g/cm³	>1.65g/cm³
Sandy Clay, Silty Clay, Clay Loam	<1.10g/cm³	1.49g/cm³	>1.58g/cm³
Clay (<45% clay)	<1.10g/cm³	1.39g/cm³	>1.47g/cm³
Source: USDA			

Compaction Depth 200 psi

- How deep you can push into the soil before needing to exert 200 pounds of pressure per square inch
- Compaction occurs when large soil pores are filled in/aggregates packed closely together
- Not affected by soil texture

Why this matters to you:

- Roots can penetrate deeply into soils with greater depth to compaction
- Plants grow best when they have to exert less than 200 psi to push their roots through the soil



You want soil with greater depths to compaction. If you can sink your penetrometer to the handle, that’s ideal

Compaction Depth 300 psi

- How deep you can push into the soil before needing to exert 200 pounds of pressure per square inch

Why this matters to you:

- Most crop roots cannot exert a high enough pressure (eg >300 psi) needed to penetrate soil this compacted
- This prevents downward growth cutting off access to lower levels of soil, nutrients and water



You want soil with greater depths to compaction. If you can sink your penetrometer to the handle, that’s ideal

Mean Physical Health

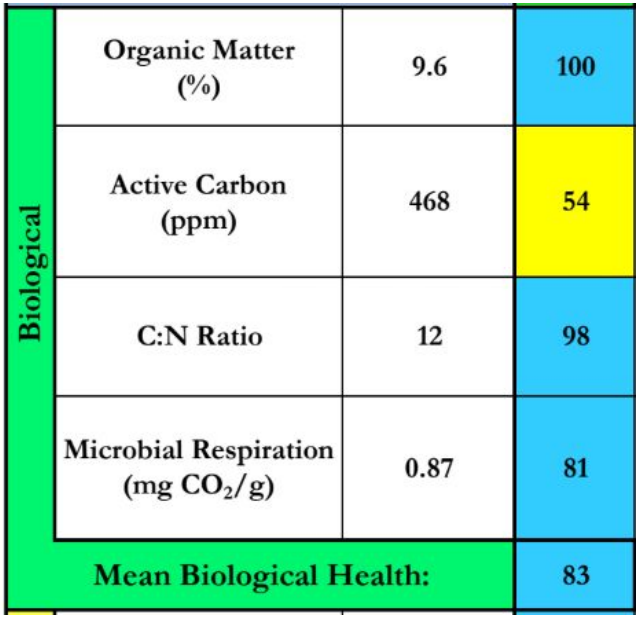
- Mean = average
- To obtain this number, add your five (5) scores up and divide by 5
- For example: 96+100+100+91+2 = 389
- 389/5 = 77.8 round up to 78
- A perfect score would be 100

	Indicator	Results	Score
		5216	5216
Physical	Wet Aggregate Stability (%)	80	96
	Water Infiltration (min)	0.86	100
	Bulk Density (g/cm3)	0.83	100
	Compaction Depth/cm (200psi)	10	91
	Compaction Depth/cm (300psi)	18	2
Mean Physical Health:			78

Biological Indicators of Soil Health

Four (4) biological metrics to assess health of your soil

- Organic Matter (%)
- Active Carbon (ppm)
- C:N Ratio
- Microbial Respiration (mg CO2/g)



Biological	Organic Matter (%)	9.6	100
	Active Carbon (ppm)	468	54
	C:N Ratio	12	98
	Microbial Respiration (mg CO_2/g)	0.87	81
	Mean Biological Health:		83

Organic Matter

- Living or once living organisms and their by-products
- Carbon rich (58% carbon) material

Why it matters to you:

- OM is the soil sponge
- Improves water infiltration and absorption
- Nutrients attach to OM (similar to how they attach to clay) preventing them from washing away
- SFW feed on and live in OM

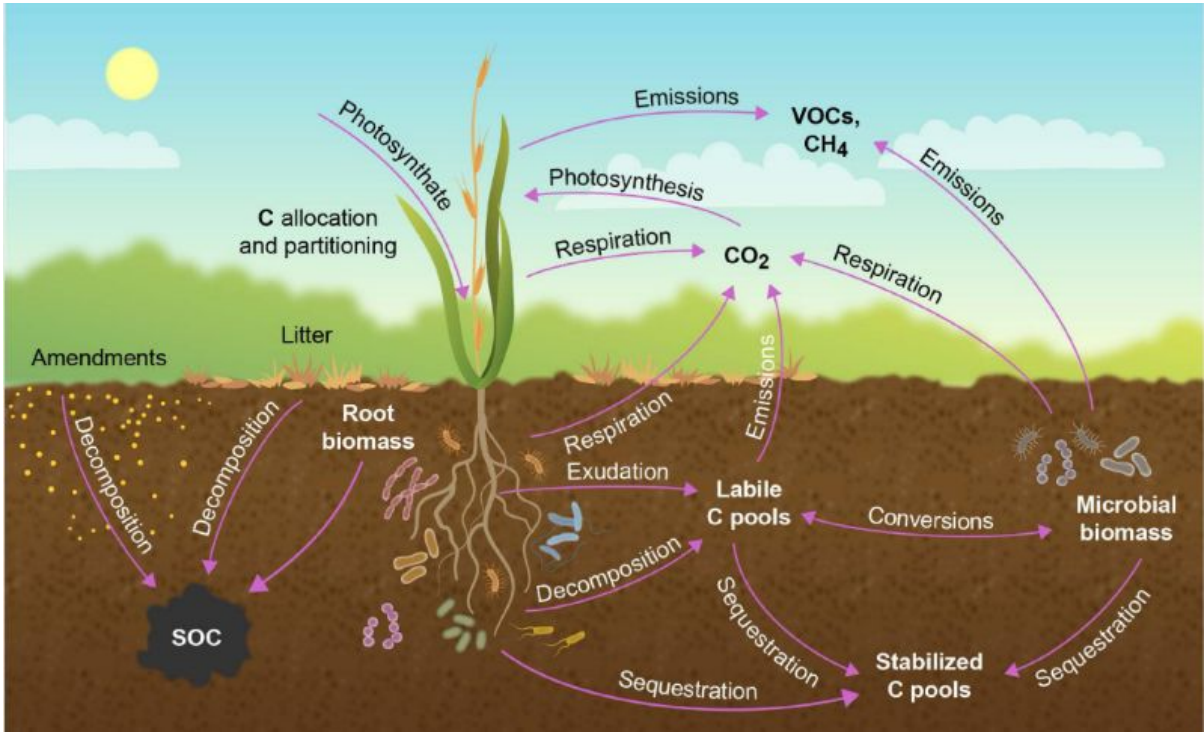


Active Carbon

- POXC
- The carbon in the soil that is readily available to the SFW as food
- It builds up quickly when there is a lot of biological activity in the soil

Why it matters to you:

- It is a “leading” indicator meaning it responds to change (ie your management) more rapidly than OM does



C:N Ratio

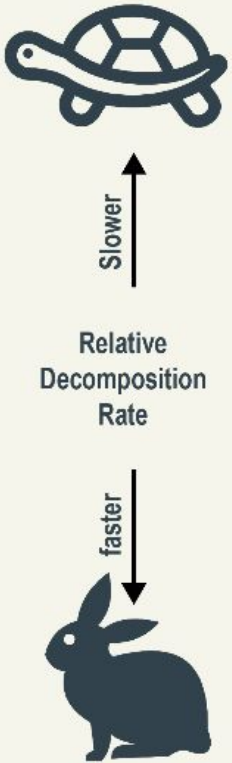
- Narrow C:N ratios (similar amounts of carbon and nitrogen)
- Wide C:N ratios (lots more carbon than nitrogen)

Why it matters to you:

- C:N impacts decomposition rates by influencing how fast microbes can break down materials and whether microbes will immobilize or mineralize N in the soil (more on that later)

Table1. Carborn to nitrogen ratios of crop residues and other organic materials

Material	C:N Ratio
rye straw	82:1
wheat straw	80:1
oat straw	70:1
corn stover	57:1
rye cover crop (anthesis)	37:1
pea straw	29:1
rye cover crop (vegetative)	26:1
mature alfalfa hay	25:1
Ideal Microbial Diet	24:1
rotted barnyard manure	20:1
legume hay	17:1
beef manure	17:1
young alfalfa hay	13:1
hairy vetch cover crop	11:1
soil microbes (average)	8:1



Source: USDA. National Resources Conservation Services

C:N and residue decomposition

Low/narrow C:N

- Microbes quickly consume crop residues
- Soil is left exposed/bare longer
- Exposure can lead to erosion (wind and water) and temperature increases that can kill SFW microbes

High/wide C:N

- Microbes need to use N from soil to break down the residues tying up/immobilizing N
- Can result in N deficiency for subsequent crop

LOW C:N RATIO

A C:N ratio **lower than 24:1**, will break down (decompose) rapidly.



Low C:N Ratio. (Approximately 15:1)

HIGH C:N RATIO

A C:N ratio **higher than 24:1**, will break down (decompose) slowly.



High C:N Ratio (Approximately 70:1)

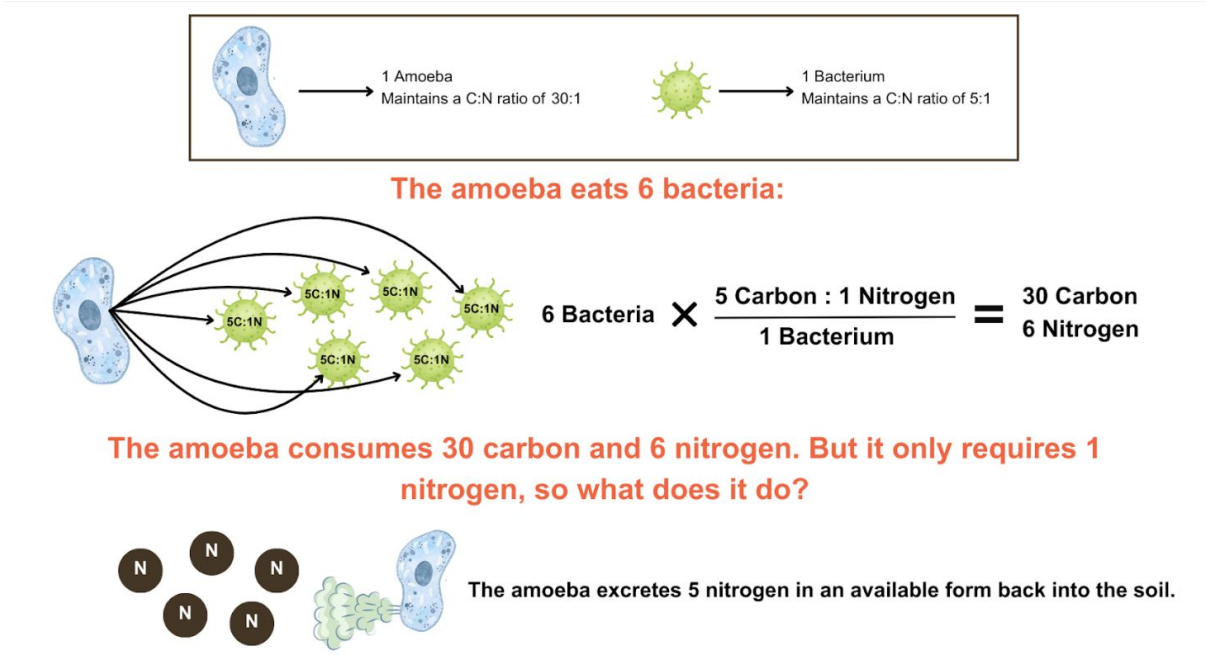
C:N Ratio in the SFW

- An organism with a narrow C:N (eg bacteria 5:1) have a few C for every N
- An organism with a wider C:N (eg protozoa 30:1) need more C for every N
- Let's look at an example

Group	C:N
Bacteria	5:1
Fungi	20:1
People	30:1
Green Leaves	30:1
Protozoa	30:1
Nematodes	100:1
Brown plant material	150 – 200:1
Deciduous Wood	300:1
Conifer wood	500:1

When a protist eats bacteria…

- If a protozoa eats bacteria, it needs to take in many bacteria to get enough C and ends up pooping out the excess N
- Ex. eats 6 bacteria (5:1) taking in a total of 30 C and 6 N. Only needs 1 N for every 30 C and poops out the other 5
- The poop is now available to plants for uptake



C:N ratio and Carbon Sequestration

Bacteria

- C:N 5:1
- Eat OM with C:N of ~30:1
- Release excess carbon (waste product) as CO_2
- If there are plants, leaves will absorb much of this CO_2 (stoma down for a reason!)
- If there are no plants, all that CO_2 goes back into the atmosphere

Fungi

- C:N average 20:1
  - Growing tip 5:1
  - Mid hypha 100:1
  - Old hypha 300:1
- Eat OM with C:N of ~30:1
- Store excess carbon (waste product) **within** their hyphae!!!
- Can be stored for centuries - if undisturbed/doesn't reenter the food chain

A closer look at N and C

- This table was created by CARA for ROO participants
- We've seen a lot of this already

LAB #	SAMPLE NAME
5216	SE32_U
5217	NE29_W
5218	NE35_B

Land Location Submission No	Farmer Id No.	Sample No.	Depth (cm)	% Sand	% Silt	% Clay	Textural Class:	
1-003765 SE 32-46-2-W5	SE32_U	5216	0-15	56	34	10	Coarse	Sandy Loam
1-003765 NE 29-46-2-W5	NE29_W	5217	0-15	45	43	11	Medium	Loam
1-003765 NE 35-46-2-W5	NE35_B	5218	0-15	43	37	20	Medium	Loam

Soil Health Analysis: Total Organic Carbon, Total Carbon, Total Nitrogen and C:N ratios, Bulk Density, Organic Carbon (OC T/ha for monitoring Carbon Sequestration)

TOTALS: TOC_TC_TN TOC T/ha

Sample ID	TN (%) (Total Nitrogen)	TC (%) (Total Carbon)	TOC (%) (Total Organic Carbon)	C:N Ratio	Soil Bulk Density (g/cm3)	OC (T/ha)
Date Sampled	2025-08-15					
5216	0.29	3.44	3.26	12	0.83	20
5217	0.20	2.03	1.93	10	0.91	13
5218	0.32	3.11	2.77	10	0.83	17

Sample ID	TN (%) (Total Nitrogen)	TC (%) (Total Carbon)	TOC (%) (Total Organic Carbon)
ate Sampled	2025-08-15		
5216	0.29	3.44	3.26
5217	0.20	2.03	1.93
5218	0.32	3.11	2.77

Total N (%)

- Sum of both organic and inorganic (mineral) forms of nitrogen including ammonium and nitrate

Why it matters to you:

- Remember the C:N ratio of SFW microbes
- If there isn't enough N in OM they are decomposing, they will tie up the N in the soil preventing it from reaching the plants; this is called *immobilization*
- If there's sufficient N in the OM, excess inorganic N is *mineralized* and released to the crop

Sample ID	TN (%) (Total Nitrogen)	TC (%) (Total Carbon)	TOC (%) (Total Organic Carbon)
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5216	0.29	3.44	3.26
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LAB #	SAMPLE NAME
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Total C (%)

- Sum of both organic carbon (carbon bound to OM) and inorganic carbon (carbon bound to minerals eg lime) in soil
- TOC < TC
- In soils with pH <6.5 TOC=TC
- In soils with ph>7.2 much of the TC is likely to be inorganic

Why it matters to you:

- The lab methods used to measure TC are subject to less error than the procedure used to measure OM

Sample ID	TN (%) (Total Nitrogen)	TC (%) (Total Carbon)	TOC (%) (Total Organic Carbon)
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LAB #	SAMPLE NAME
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Total Organic C (%)

- AKA Soil Organic Carbon (SOC)
- Includes fresh plant residues and more stable organic carbons

Why it matters to you:

- Like TC, it's a better measure of OM (a carbon sink with slow nutrient release - reserve)
- Soils with higher TOC require fewer inputs and are more resilient to drought and extreme rainfall

Sample ID	TN (%) (Total Nitrogen)	TC (%) (Total Carbon)	TOC (%) (Total Organic Carbon)
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Calculating C:N

- You can calculate C:N yourself:
- TC / TN = C:N
- For Example:
- 3.44/0.29 = 11.86
  round up to 12
- =12:1 ratio

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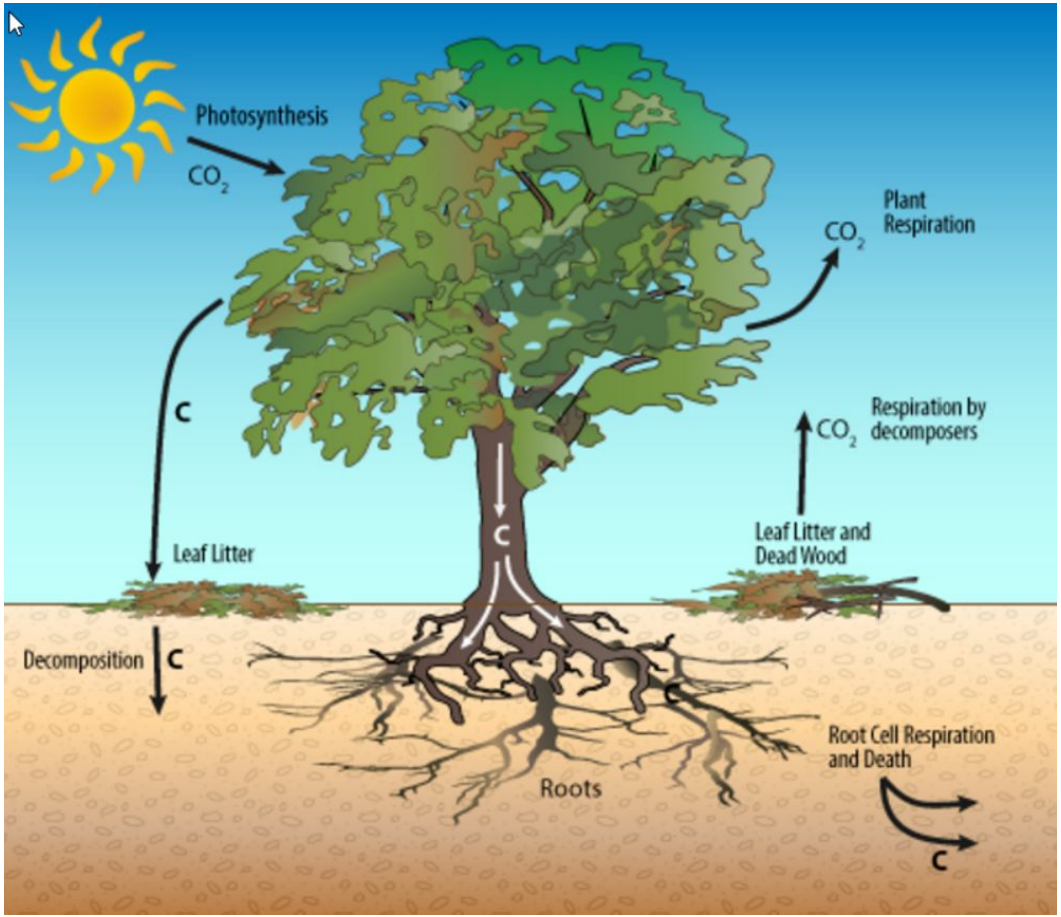
Biological	Organic Matter (%)	9.6	100
	Active Carbon (ppm)	468	54
	C:N Ratio	12	98
	Microbial Respiration (mg CO_2/g)	0.87	81
	Mean Biological Health:		83

Microbial Respiration

- Is measured by capturing the CO2 being “exhaled” by the soil
- A more active SFW “breathes” more and hence exhales more CO2 (just like us!)

Why it matters to you:

- Is indicative of biological activity in the soil
- A word of caution - fungi lay down a lot of C in their older hyphae therefore releasing less CO2 compared to bacteria - thus this metric favours bacterial activity



Mean Biological Health

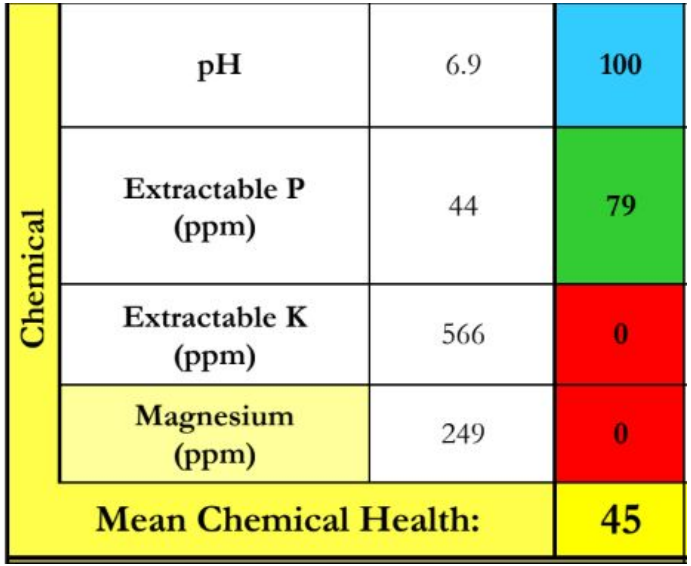
- Mean = average
- To obtain this number, add your four (4) scores up and divide by 4
- For example:
  100 + 54 + 98 + 81 = 333
- 333/4 = 83.25 round down to 83

Biological			
	Organic Matter (%)	9.6	100
	Active Carbon (ppm)	468	54
	C:N Ratio	12	98
	Microbial Respiration (mg CO_2/g)	0.87	81
	Mean Biological Health:		83

Chemical Indicators of Soil Health

Four (4) chemical metrics to assess health of your soil

- pH
- Extractable P (ppm)
- Extractable K (ppm)
- Magnesium (ppm)



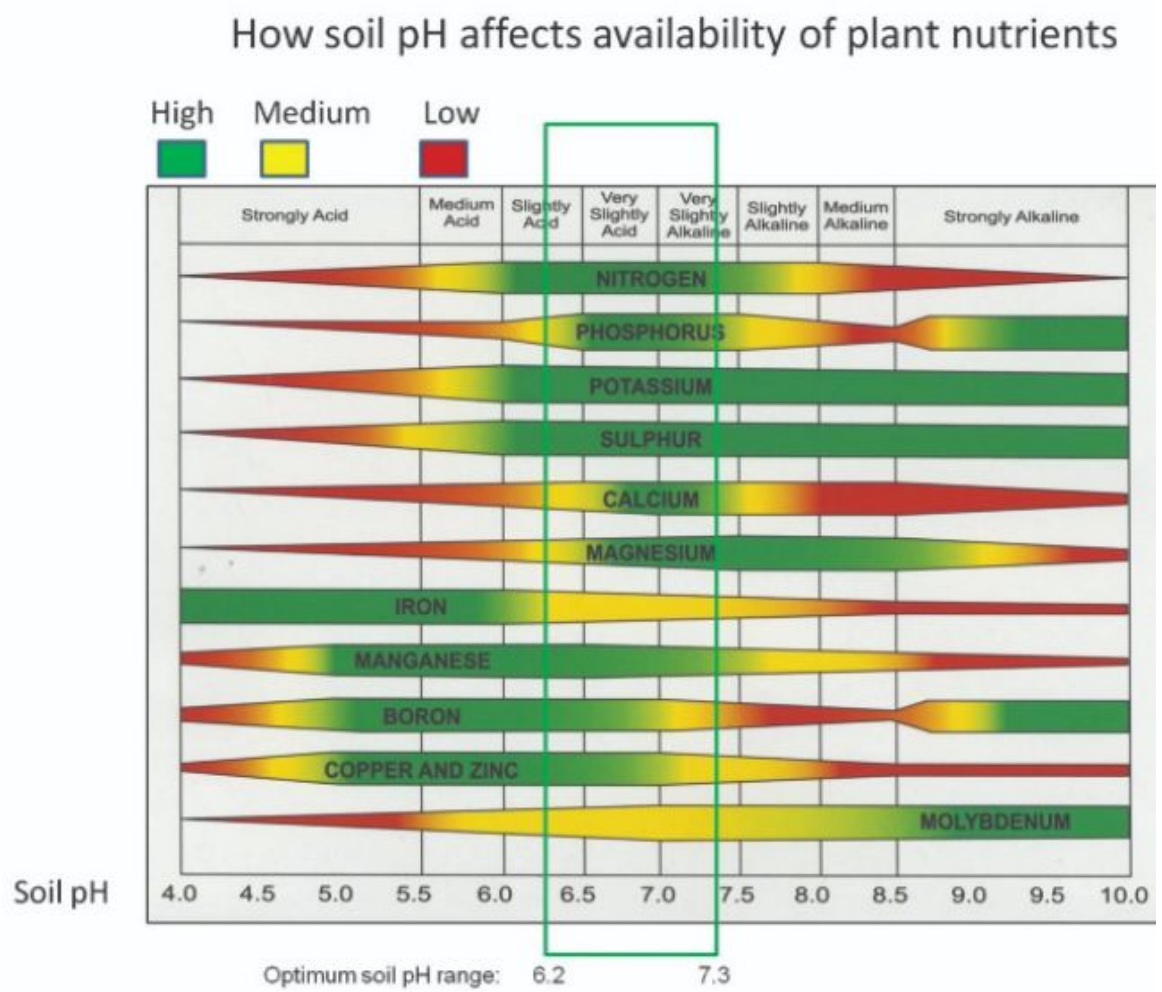
Chemical			
	pH	6.9	100
	Extractable P (ppm)	44	79
	Extractable K (ppm)	566	0
	Magnesium (ppm)	249	0
	Mean Chemical Health:		45

pH

- The negative log of the H+ concentration
    - Log scale means an increase of 1 pH is 10 times stronger base
- 0 (strong acid) more H (hydrogen)
- 14 (strong base/ alkaline) more OH (hydroxide)
- At pH 7 (neutral) OH- = H+

Why it matters to you:

- pH affects soil biology
- pH impacts nutrient availability
- pH is affected by exudates and SFW

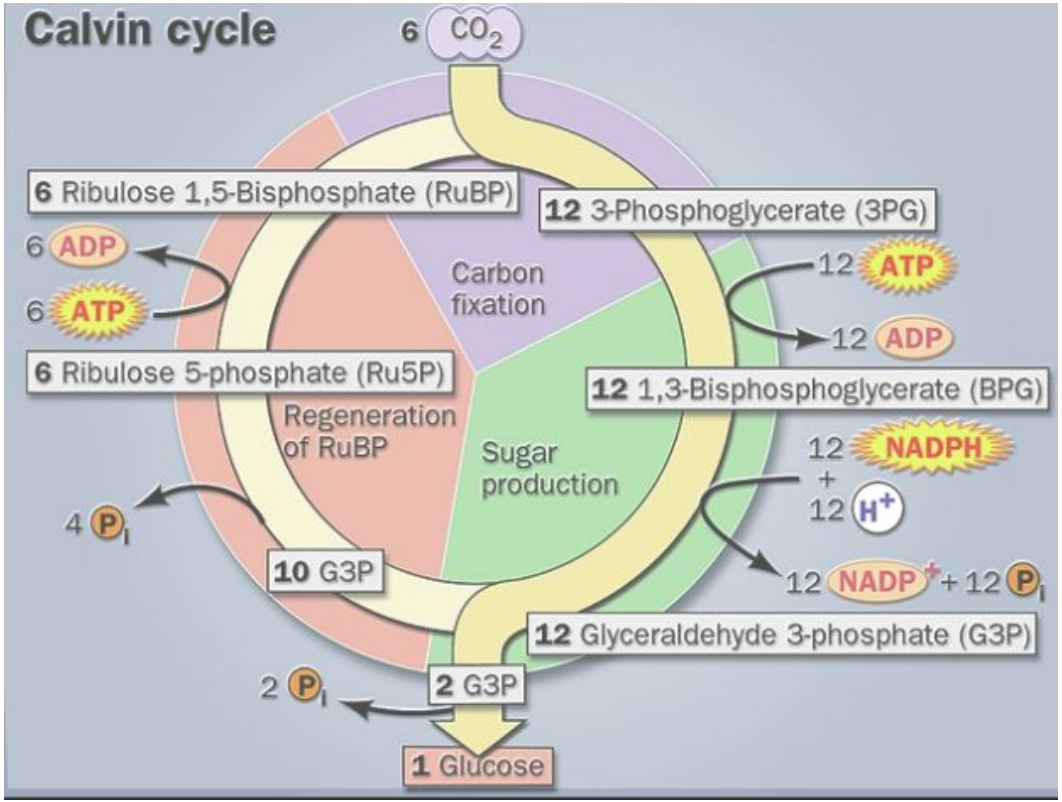


Extractable P

- A measure of P (phosphorous) available to a crop
- Availability changes with pH and soil type

Why it matters to you:

- P plays important roles in photosynthesis, respiration, energy storage and transfer, cell division, cell enlargement
- P is the element that is added and ripped off of various compounds to release energy

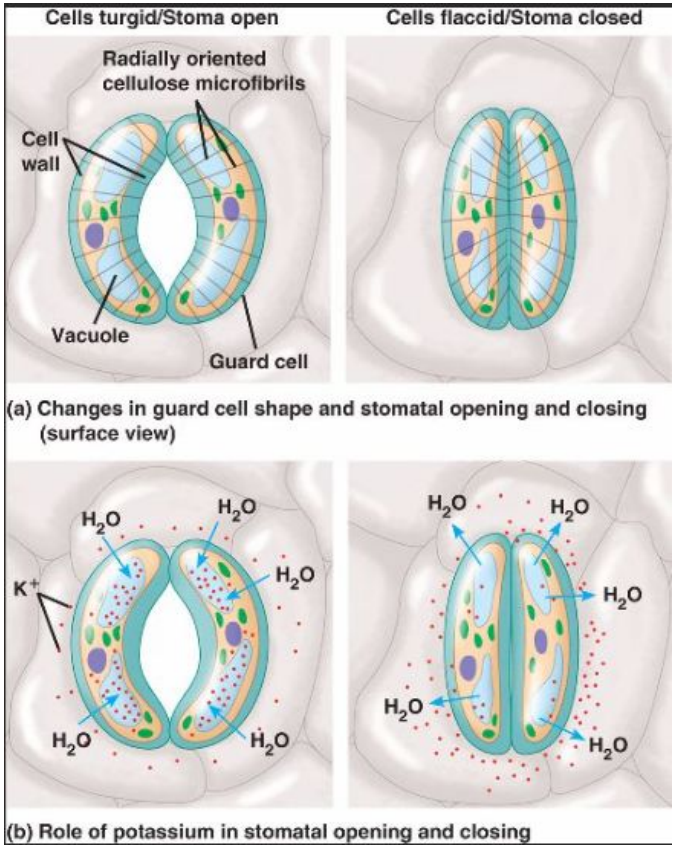


Extractable K

- A measure of potassium (K) availability to a crop
- K is easily leached from soils (especially sand)

Why it matters to you:

- Photosynthesis, respiration, energy storage and transfer, water uptake and loss, protein synthesis, activation of growth enzymes
- Regulates stomatal opening/closing

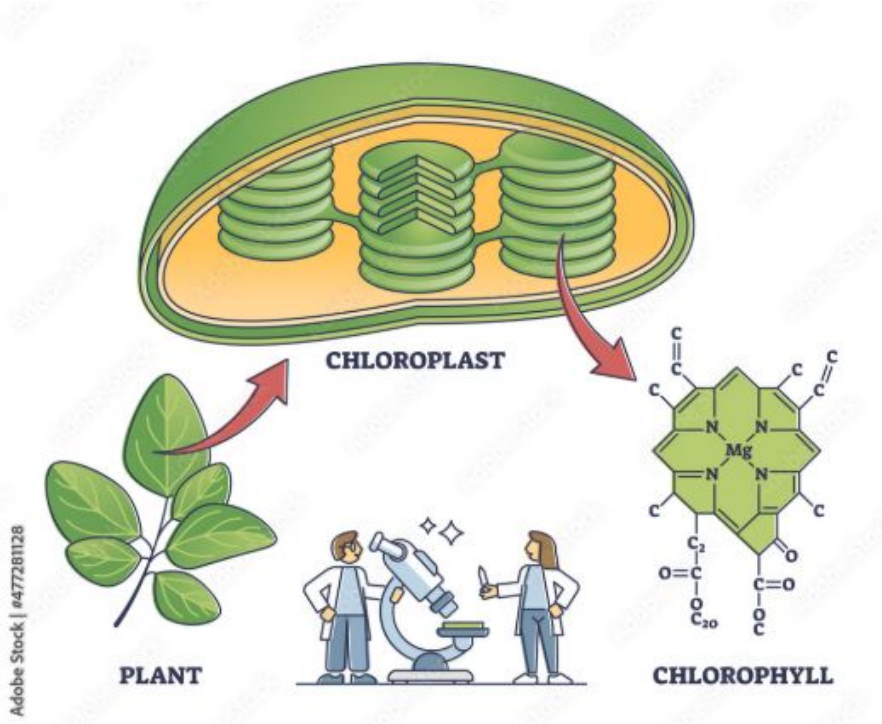


Magnesium

- Measure of magnesium in soil

Why it matters to you:

- Photosynthesis, enzyme activation and general plant health
- Mg is a central component of chlorophyll - the driver of photosynthesis
- Deficiency can lead to yellow leaves, stunted growth and disease susceptibility



Mean Chemical Health:

- Mean = average
- To obtain this number, add your four (4) scores up and divide by 4
- For example:
  100 + 79 + 0 + 0= 179
- 179/4 = 44.75 round up to 45
- A perfect score would be 100

Chemical			
	pH	6.9	100
	Extractable P (ppm)	44	79
	Extractable K (ppm)	566	0
	Magnesium (ppm)	249	0
	Mean Chemical Health:		45

Overall Soil Health Score:

- 96 + 100 + 100 + 91 + 2 (physical health)
- 100 + 54 + 98 + 81 (biological health)
- 100 + 79 + 0 + 0 (chemical health)
- = 901

- 5 physical health metrics +
- 4 biological health metrics +
- 4 chemical health metrics
- = 13 metrics

- 901/13 = 69.3 round down to 69 Medium

Overall Soil Health Score:	69	Medium

- Very High >= 85
- High >= 70
- Medium >= 55
- Low >= 40
- Very Low < 40

Physical and Biological Indicator Scores are calculated using the cumulative normal distribution function for Coarse, Medium, and Fine textural classes. Depending on the measured soil texture distribution, this worksheet identifies the appropriate soil textural class and uses the corresponding Scoring Function. Each Indicator Score represents the percentage of all samples scoring at or below the measured value when compared across the complete sample database. Chemical Indicator Scores are not based upon the normal distribution. Soil pH, Extractable P, and Extractable K are scored as follows: a) pH Score of 100 for pH 6.25-7.25, Score of 0 for pH >= 7.7 and <=5.4, b) P Scores were base on 25 + 5 ppm optimun P levels c) K Score of 100 for >=74.5 ppm, Score of 0 for <= 20 or 200 ppm. Other Nutrients Rating are determined on a scale of 0-4, representing the sum of Scores for Mg, a) Mg Score of 1 for > 33 ppm, 0 for <= 33 ppm, and 0 for > 200ppm. Indicator Scores are assigned a color grade using the follows system: Very High, Score of 80-100 (Blue); High, Score of 60-80 (Green); Medium, Score of 40-60 (Yellow); Low, Score of 20-40 (Orange); Very Low, Score of 0-20 (Red). For Other Nutrients Ratings (no data available for Micronutrients. The Other Nutrients Rating is then converted to a 1-100 scale as follows (4, 100), (3, 56), (2, 11), (1, 4), and (0, 0). The Mean Physical, Biological, and Chemical Health Scores are calculated as the average of the Indicator Scores within each category. The average of the Mean Physical, Biological, and Chemical Health Scores is the Overall Soil Health Score. The Overall Soil Health Score is categorized using the following scale: Very High, >= 85; High, >= 70; Medium, >= 55; Low, >=40; Very Low, < 40. DATABASE was adjusted for missing micronutrients (Fe, Zn and Mn)

Additional Micronutrients

- Fe (Iron)
- Zn (Zinc)
- Mn (Manganese)

- Not regularly measured in our ROO soil chemistry package but included in the CARA report if available

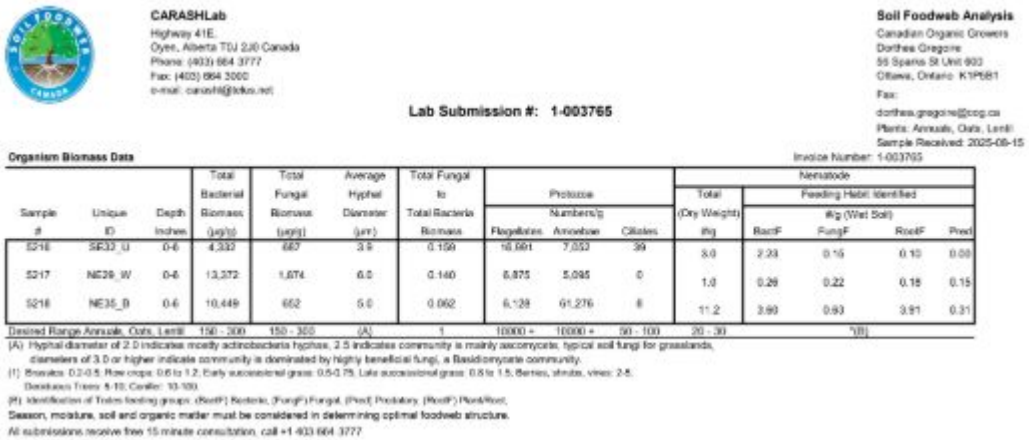


SFW Analysis

- This is where we look at the biology directly
- Bacteria, fungi, protozoa and nematodes

Why it matters to you:

- It is through the SFW that nutrients and carbon cycle/become available to our crops
- It's not so much about the "good guys" and the "bad guys" as it is about the "guys" who are best suited to the niche **YOU** created/are managing for



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Canadian Organic Growers
Dorthea Gregoire
55 Sparks St Unit 900
Ottawa, Ontario K1P5B1
Fax:
dorthea.gregoire@cog.ca
Plants: Annuals, Oats, Lentil
Sample Received: 2025-08-15

Lab Submission #: 1-003765

Invoice Number: 1-003765

Organism Biomass Data

Sample #	Unique ID	Depth Inches	Total Bacterial Biomass (µg/g)	Total Fungal Biomass (µg/g)	Average Hyphal Diameter (µm)	Total Fungal to Total Bacteria Biomass	Protozoa Numbers/g Flagellates	Amoebae	Ciliates	Nematode Total (Dry Weight) #/g	Feeding Habit Identified #/g (Wet Soil) BactF	FungF	RootF	Pred
5216	SE32_U	0-6	4,332	667	3.9	0.159	16,991	7,052	39	8.0	2.33	0.15	0.10	0.00
5217	NE29_W	0-6	13,272	1,874	6.0	0.140	6,975	5,095	0	1.0	0.26	0.22	0.18	0.15
5218	NE35_B	0-6	10,449	652	5.0	0.062	6,128	61,276	8	11.2	3.60	0.93	3.91	0.31
Desired Range Annuals, Oats, Lentil			150 - 300	150 - 300	(A)	1	10000 +	10000 +	50 - 100	20 - 30		%(B)		

(A) Hyphal diameter of 2.0 indicates mostly actinobacteria hyphae, 2.5 indicates community is mainly ascomycete, typical soil fungi for grasslands, diameters of 3.0 or higher indicate community is dominated by highly beneficial fungi, a Basidiomycete community.
(I) Brassicas: 0.2-0.5, Row crops: 0.6 to 1.2, Early successional grass: 0.5-0.75, Late successional grass: 0.8 to 1.5, Berries, shrubs, vines: 2-5, Deciduous Trees: 5-10, Conifer: 10-100
(B) Identification of Trophic feeding groups. (BactF) Bacteria, (FungF) Fungal, (Pred) Predatory, (RootF) Plant/Root,
Season, moisture, soil and organic matter must be considered in determining optimal foodweb structure.
All submissions receive free 15 minute consultation, call +1 403 664 3777

F:B Ratio

- The ratio of fungi to bacteria (measured using biomass)
- A higher ratio (> 1) indicates more fungi than bacteria
- A lower ratio (< 1) indicates more bacteria

Why it matters to you:

- F:B is positively correlated with plant growth
- A ratio of 1:1 is preferred by oats and field crops
- Weeds prefer a ratio closer to 0.1

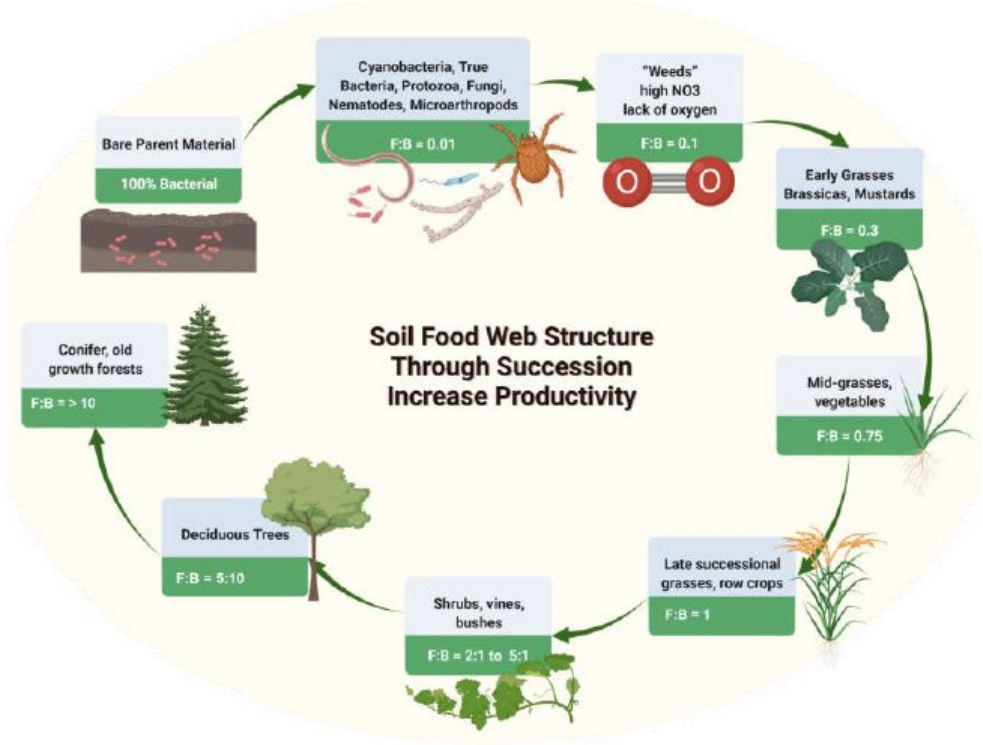


Figure 9. Soil food Web Structure Through Succession Increase Productivity
Note: Created with BioRender.com

Fungal Biomass (ug/g)

- Fungi are constantly taking in nutrients - they hold them in their hyphae preventing them from washing away
- Fungi excel at breaking down complex compounds like woods and lignins
- Produce ammonium (NH4)

Why it matters to you:

- Without active fungi you can’t break down crop residues especially the tough ones like corn stover or hemp trash

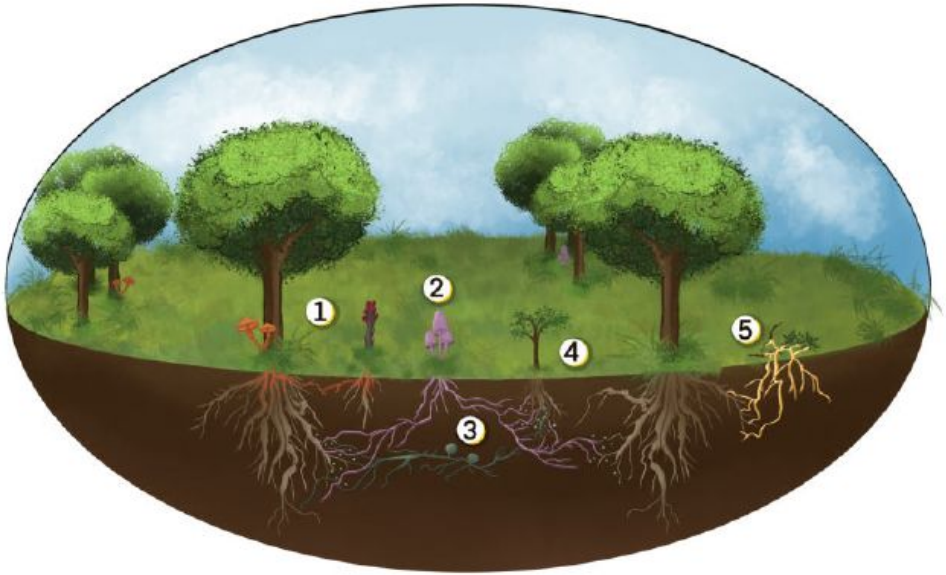


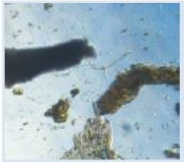
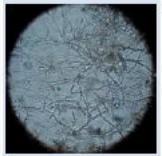
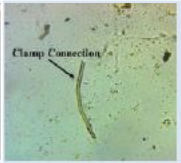
Figure 17. Mycorrhizal ecological connections.

Avg Hyphal Diameter

- A hypha is a strand of fungi - a “rootlet”
- Beneficial fungi have hyphae with wider diameters (>3um)
- “Bad guy” fungi have hyphae with narrower diamers (1.5-2.5um)

Why it matters to you:

- Looking at the average diameter of fungal hyphae in your sample lets you know if you have mostly beneficial/mycorrhizal fungi or disease causing fungi

Filamentous microorganisms	Actinobacteria	Bad Fungi	Ok Fungi	Good Fungi	Great Fungi
Family	Bacteria	Oomycetes (mildews, Blight & wilts)	Deuteromycetes	Ascomycetes	Basidiomycetes
Diameter	1 - 1.5 µm	1.5 - 2.5 µm	2.0 - 3.5 µm	2.0 - 3.5 µm +	3.0 - 5.0 µm +
Pictures					

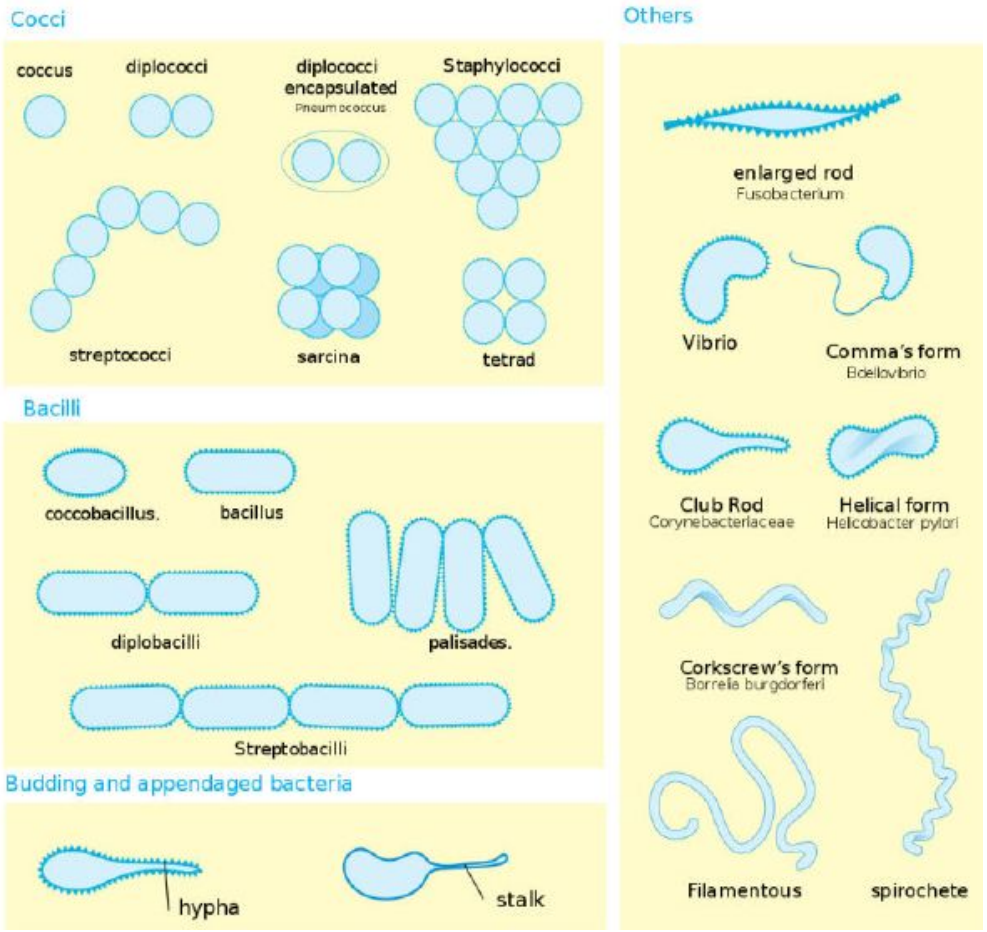
Bacterial Biomass (ug/g)

- Bacteria are constantly eating - they take in nutrients and hold them in their bodies preventing them from washing away
- Bacteria excell at breaking down simple compounds like sugars
- Produce Nitrate (NO3)

Why it matters to you:

- Bacteria can provide “fast fuel” to the system with incredible population growth (TIME) helping to cycle nutrients rapidly

17.1.5 Shapes of different bacterial species e.g. cocci, bacillus, and actinobacteria, etc.

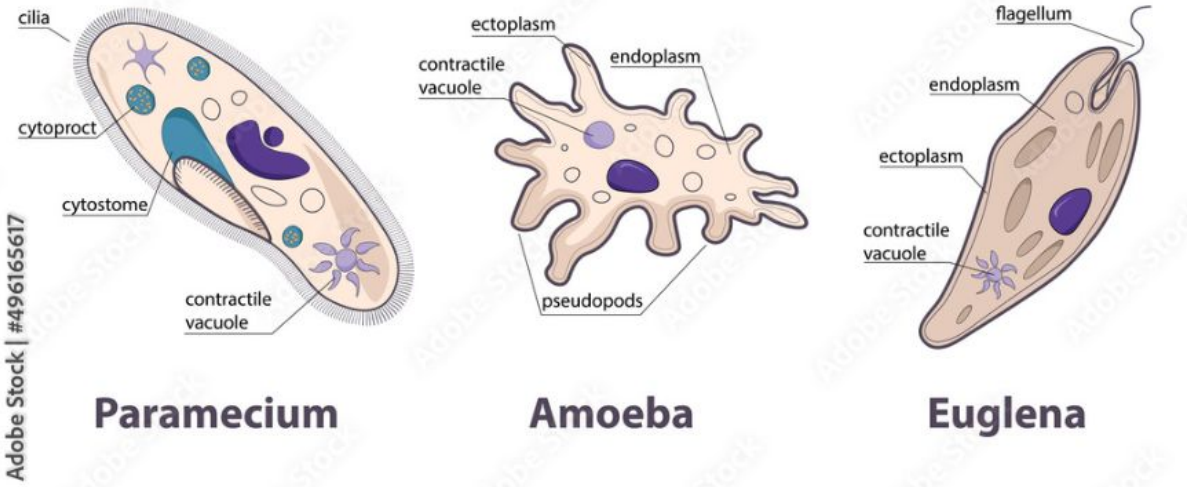


Protozoans

- Bacteria feeding predators
- Flagellates have tails (flagella), amoebae are primarily shapeless/amorphous - both are aerobic and eat bacteria
- Ciliates are covered in hairs but indicate anaerobic conditions - they also eat bacteria
    - They may be indicative of compaction or recent flooding

Why it matters to you:

- They cycle the nutrients otherwise trapped in the bodies of bacteria, pooping them out and making them available to plants



Nematodes

- Roundworms - different groups feed on different things including roots, bacteria, fungi and other nematodes

Why it matters to you:

- Nematodes cycle nutrients that are otherwise trapped in the bodies of fungi and bacteria, pooping out the nutrients where they can be taken up by plants





Reach out to me with your questions

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Or post in our What'sApp Group