WHAT CAN SOIL HEALTH TESTS TELL YOU?

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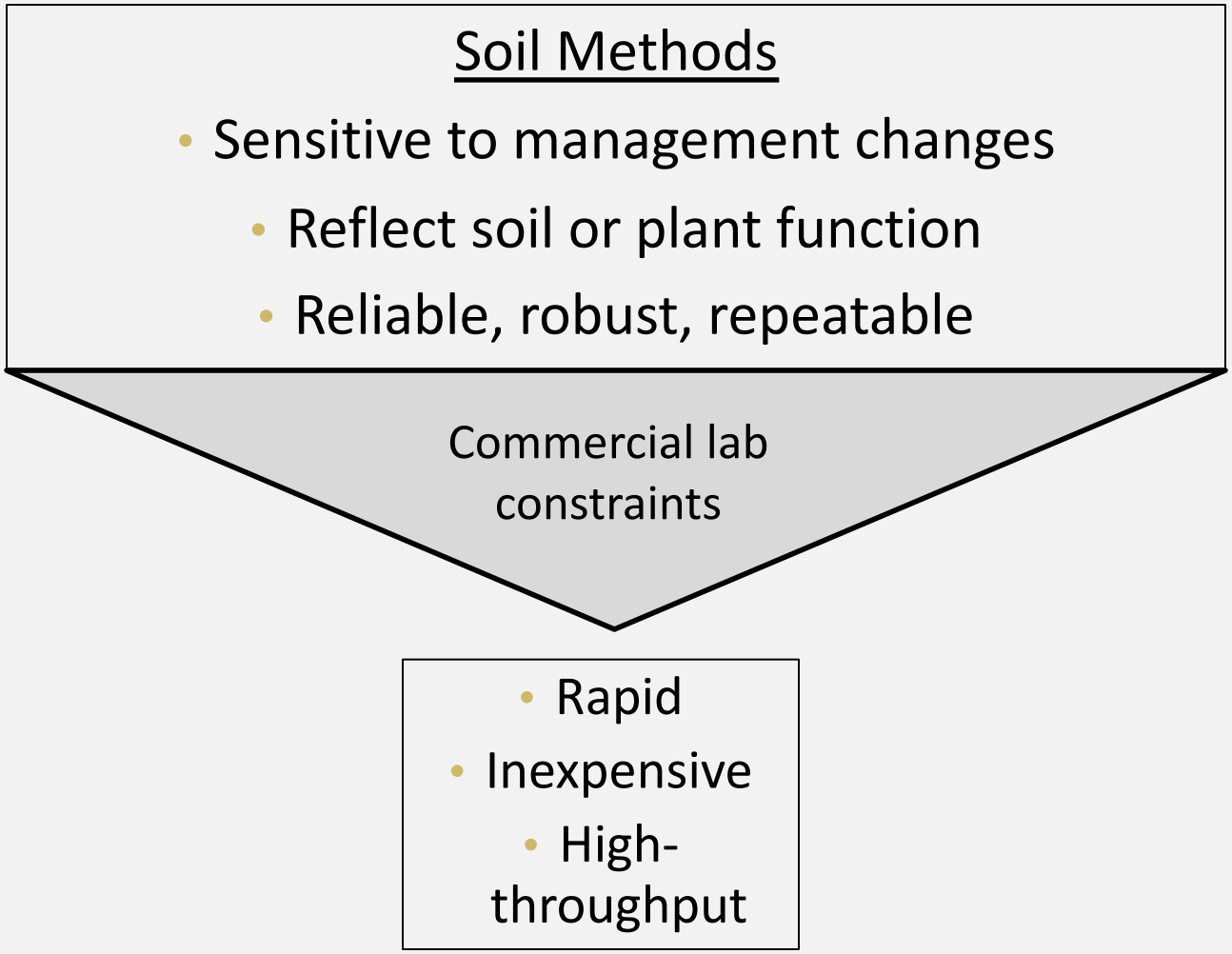
Soil Function ➔ Soil Indicator

If we want to manage it, we must be able to measure it!

There are many potential soil indicators

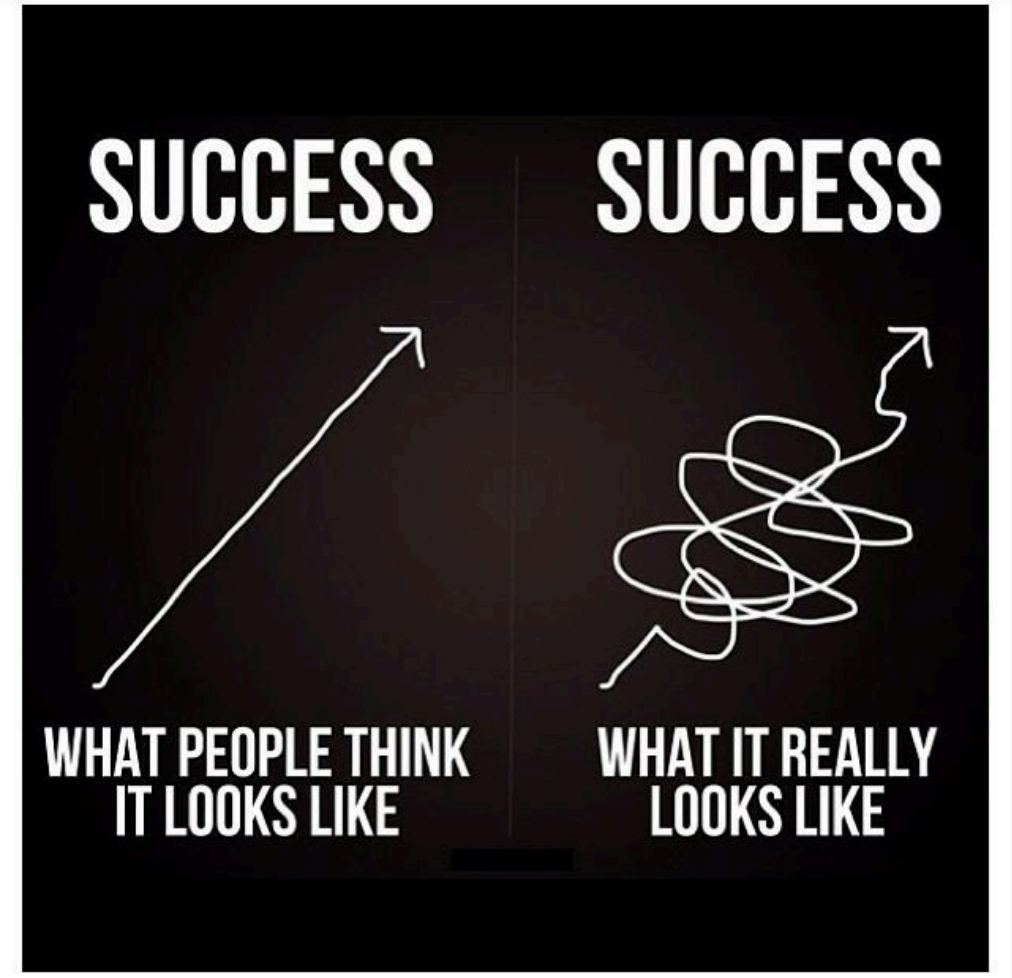
Chemical Indicators	Physical Indicators	Biological Indicators
Organic matter	Texture	Microbial biomass
Total C & N	Bulk density	Earthworms
pH	Penetration resistance	Nematodes
CEC	Aggregate stability	Arthropods
Nutrients	Water holding capacity	Mycorrhizal fungi
Electrical conductivity	Infiltration rate	Respiration rate
Heavy metals	Depth to hardpan	Soil enzyme activities
Other toxins	Depth to water table	Pollutant detoxification
	Erosive potential	Decomposition rates
	Aeration	Microbial community fingerprinting

Minimum Set of Indicators



Soil Health Is…

- A young and emerging field, needing refinement



Organic matter is… kinda a big deal

- The importance of soil organic matter in soil quality and functioning cannot be overstated
- Critical component that influences
  - Aggregation
  - Resistance to water and wind erosion
  - Bulk density
  - Root proliferation
  - Biological activity
  - Nutrient cycling and uptake
  - And more….
- Small fraction of soil's mass

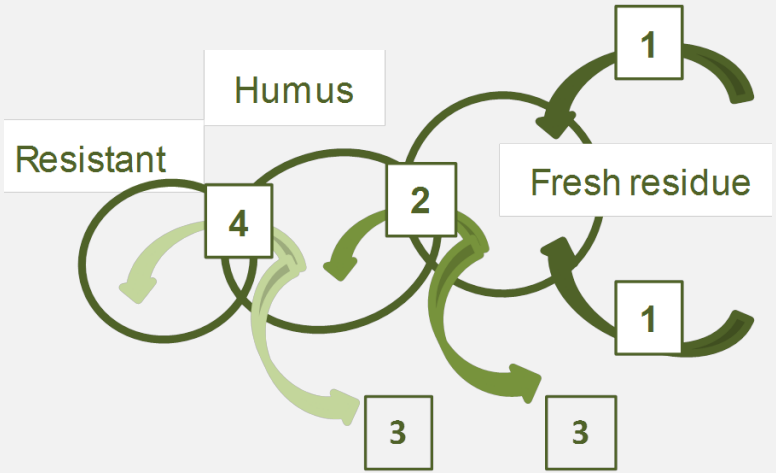
Dynamic Nature of Soil Organic Matter

It is the decay of organic matter, and not the mere presence of it, that gives 'life' to the soil.

Cyril Hopkins, 1910

Attempting to hoard as much organic matter as possible in the soil, like a miser hoarding gold, is not the correct answer. Organic matter functions mainly as it is decayed and destroyed. Its value lies in its dynamic nature.

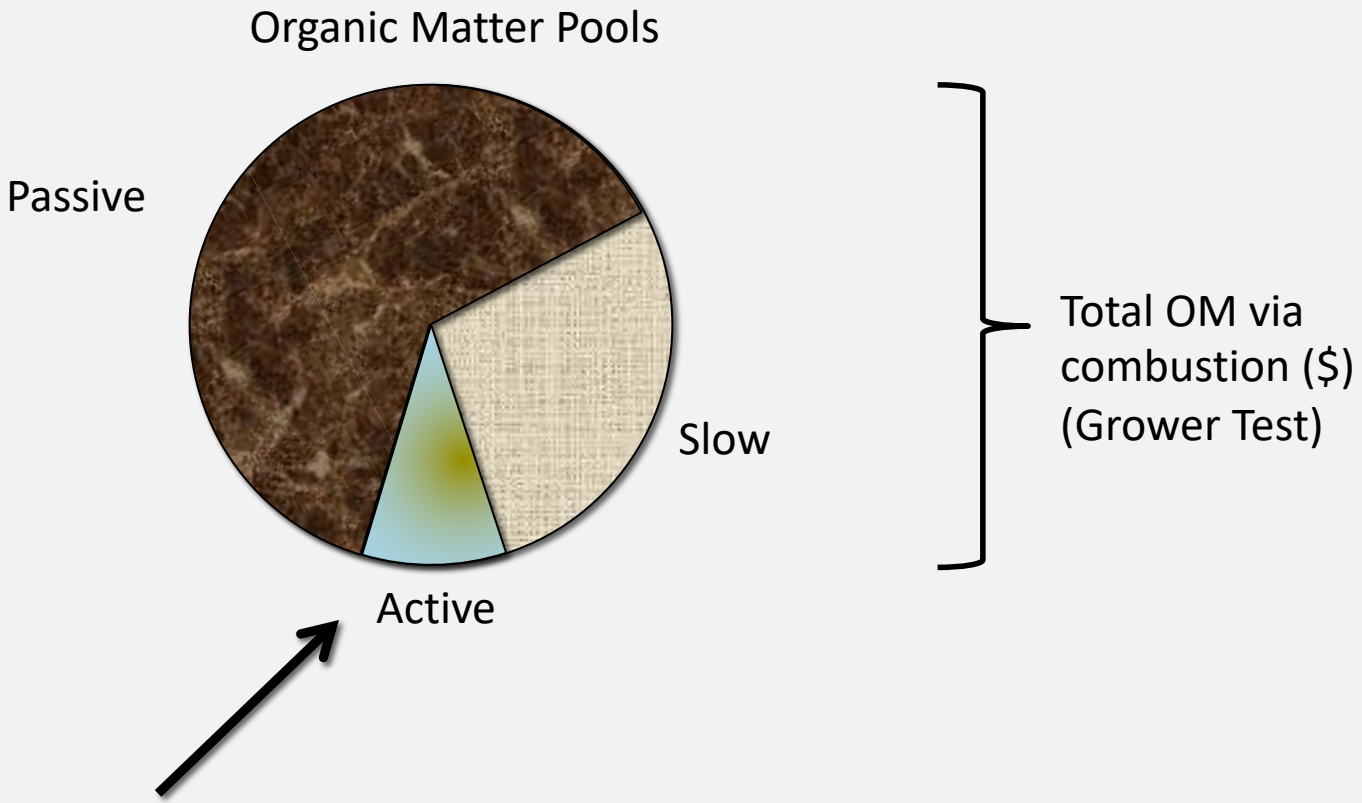
William Albrecht, 1938



How do we measure soil organic matter?

- Total Organic Matter
  - Direct combustion – gold standard but $$$
  - Loss on Ignition – Fast, simple, cheap
- Some fraction of the total
  - Many possible methods

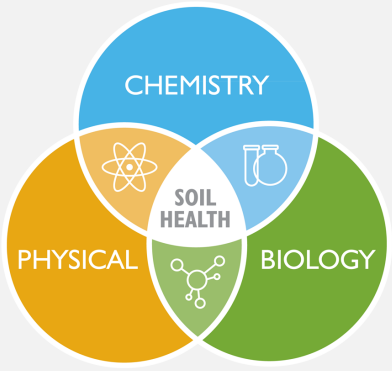
Measuring Soil Organic Matter (OM)



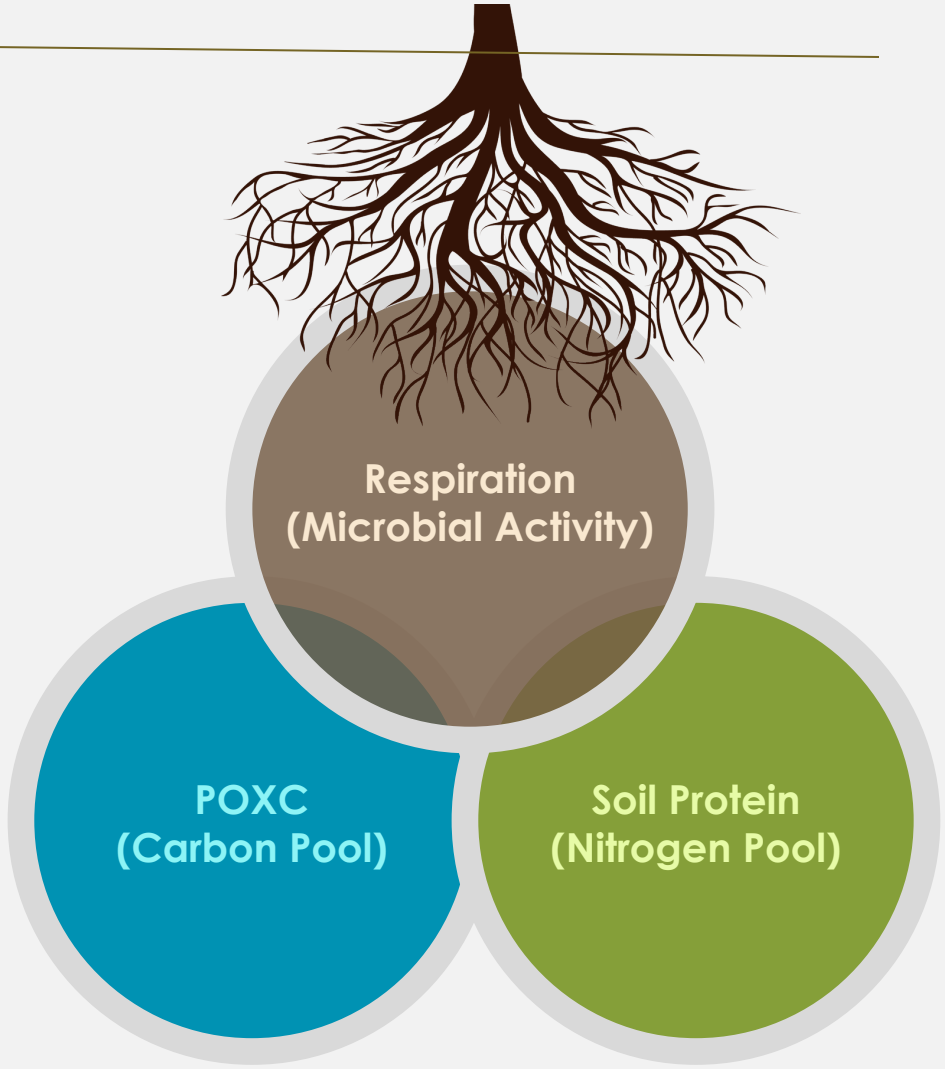
Active Organic Matter

- Small fraction of total organic matter (OM)- 5-10%
- Rapidly cycled nutrients, very important for soil fertility

Active Organic Matter Pools



Process-based measurements of soil biology and chemistry



Respiration

10-20 g soil + water → Seal in jar → Incubate for 24 hours → Measure concentration of CO_2 in jar

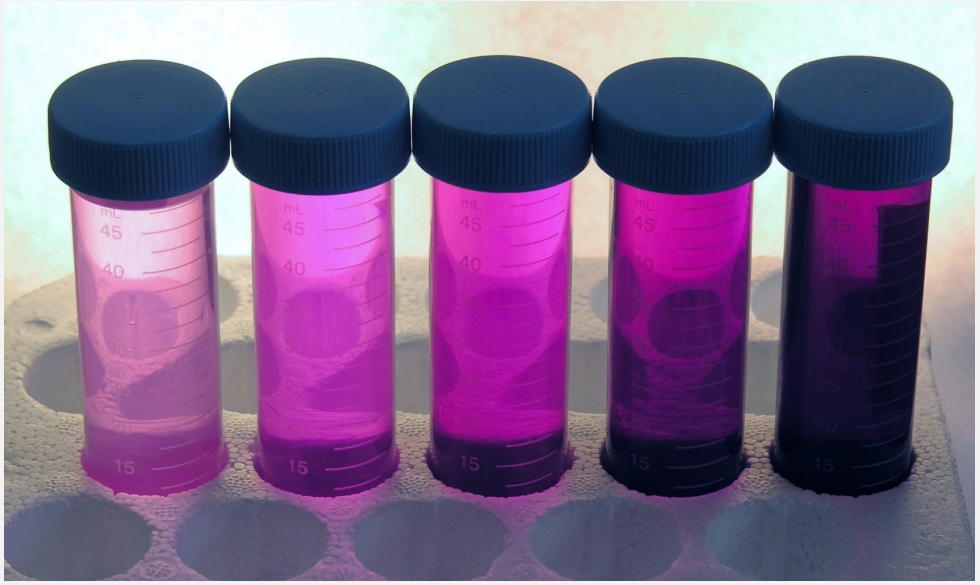
- Measures activity of soil microbes – CO_2 released from soil
- Solvita commercial example

- Can be measured on field-moist or dried soils
- Can measure CO_2
  - Directly with gas analyzer
  - Trap CO_2 with NaOH base trap

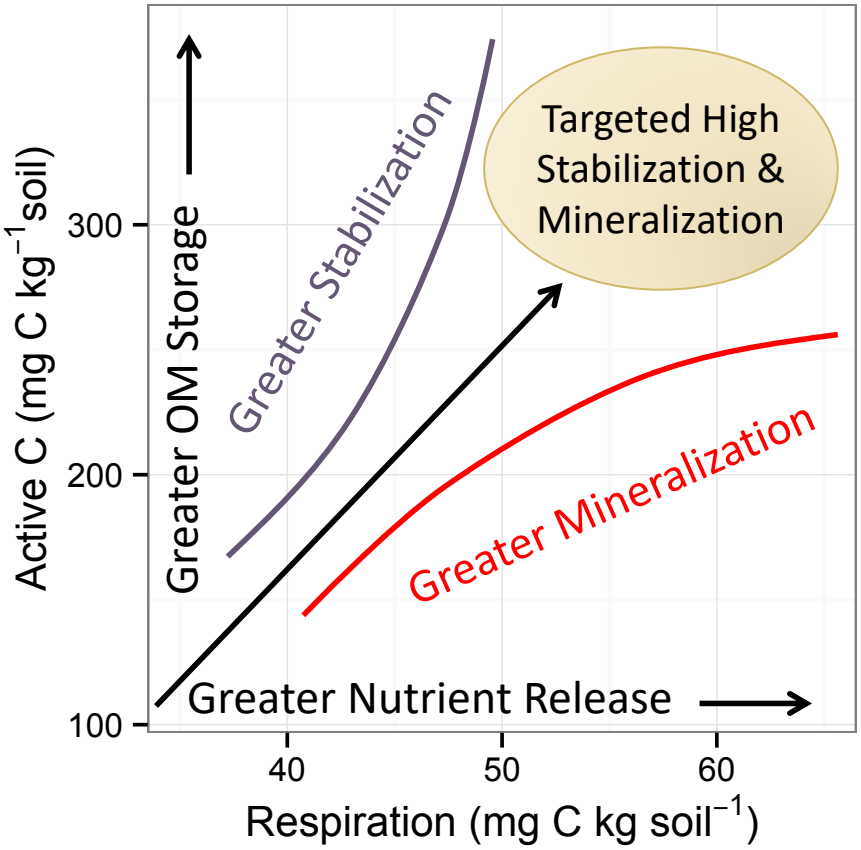
POXC (Permanganate Oxidizable Carbon or Active C)

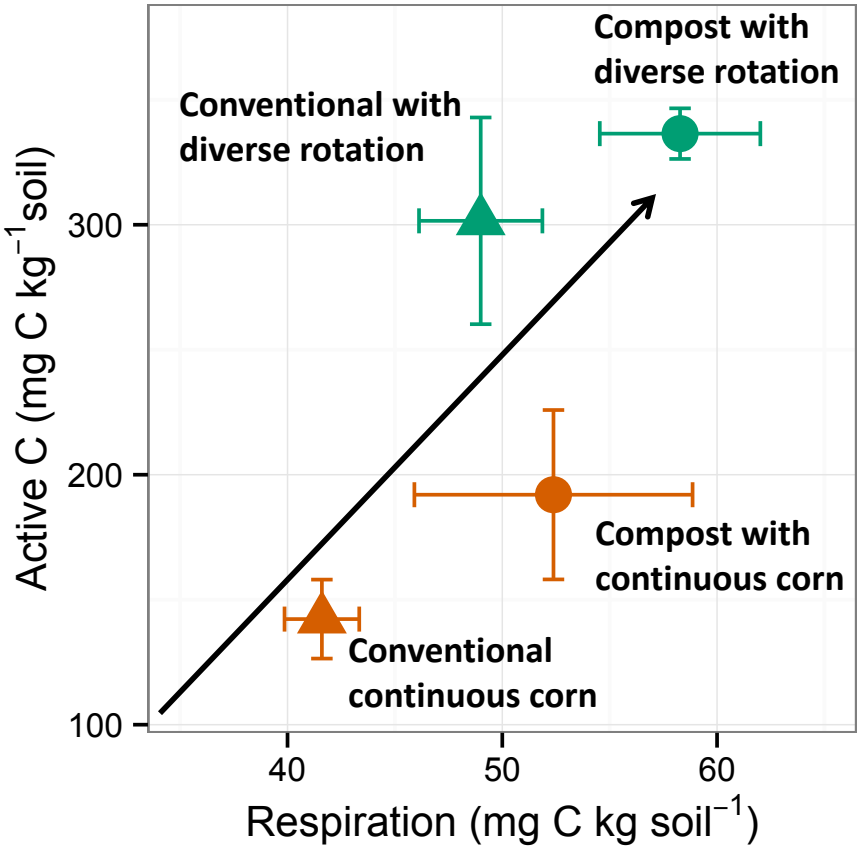
2.5 g soil + 20 ml 0.02 *M* $KMnO_4$ → Shake for 2 minutes → Settle for 10 minutes → 0.5 ml of supernatant + 49.5 ml H_2O → Read on spectrophotometer

- POXC reflects a processed but available pool of organic matter
- 1—4% of total organic C in soil
- Biologically active soil C fraction
- Sensitive to management



Active C vs. Respiration

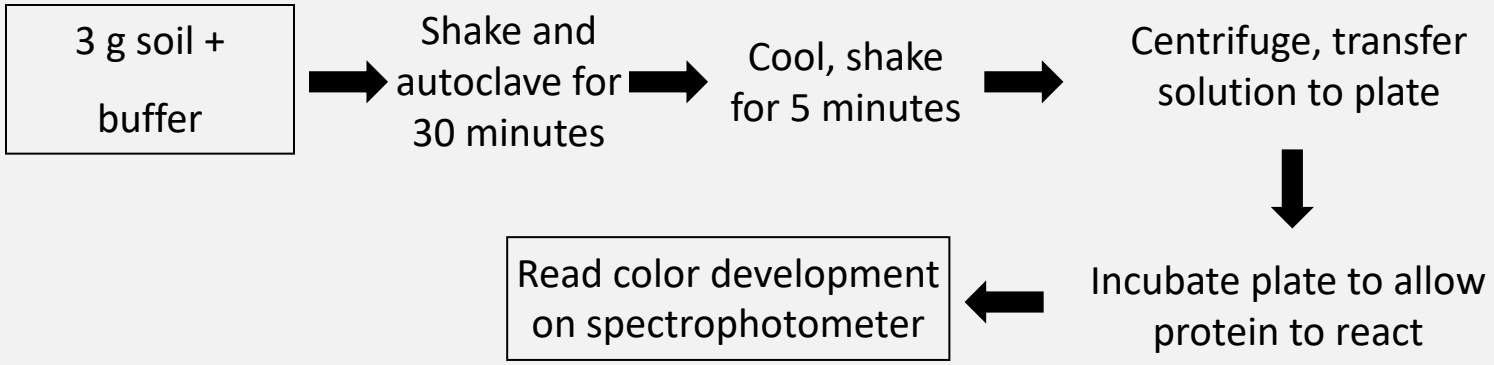




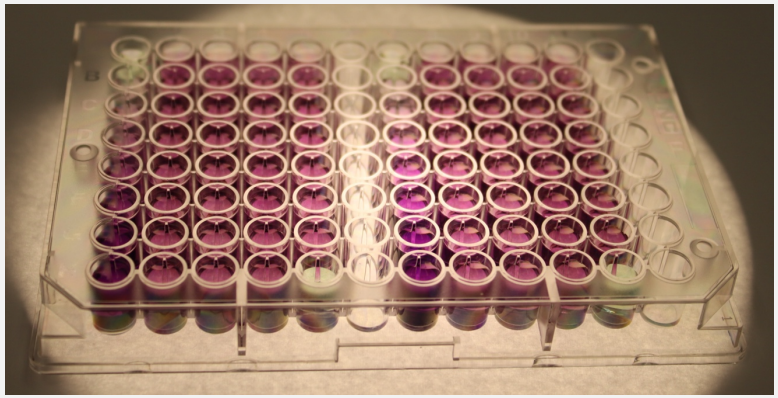
- Active C reflects management practices that promote OM stabilization
- Respiration reflects practices that promote OM mineralization

Hurisso, Culman, et al., 2016, SSSAJ

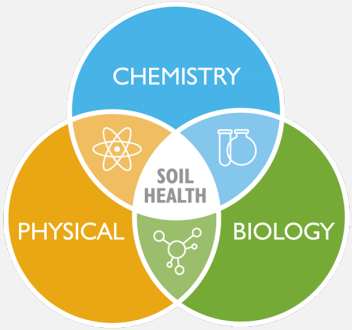
Soil Protein



- Abundant in plant and microbial biomass
- Contain a large proportion of organically-bound N
- Enzymatically-degradable by a wide array of microbes
- Supply of amino acids most often is the rate-limiting step in soil N cycling



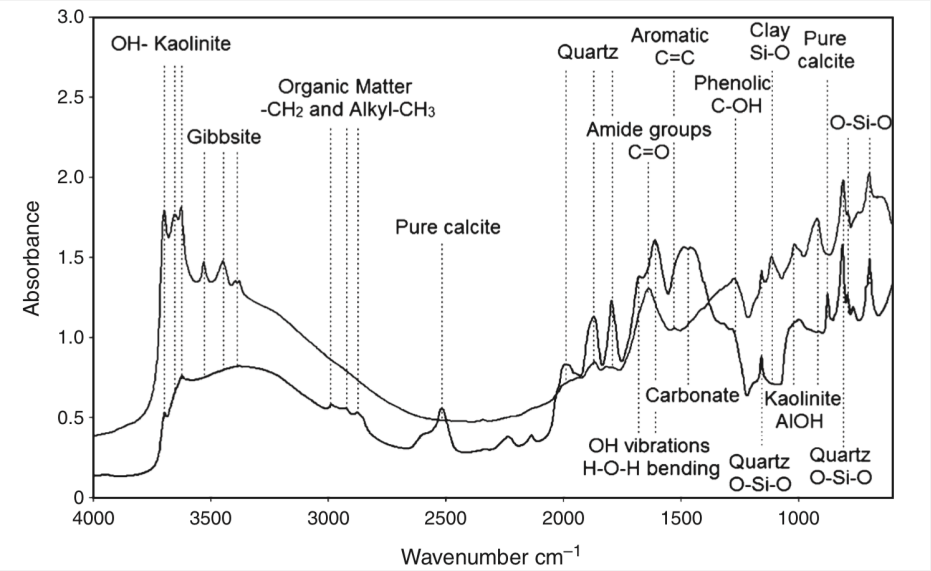
Field Measurements of Physical Structure



- Penetration Resistance
- Infiltration
- Aggregate stability
- Bulk Density

Infrared Spectroscopy (DRIFTS)

- Non-destructive, very rapid
- Measures reflectance of energy
- Can predict a wide number of soil properties



Where can I find commercially available soil health testing?

Self-assessments in Field

NRCS Soil Quality Test Kit

www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/

Commercial labs

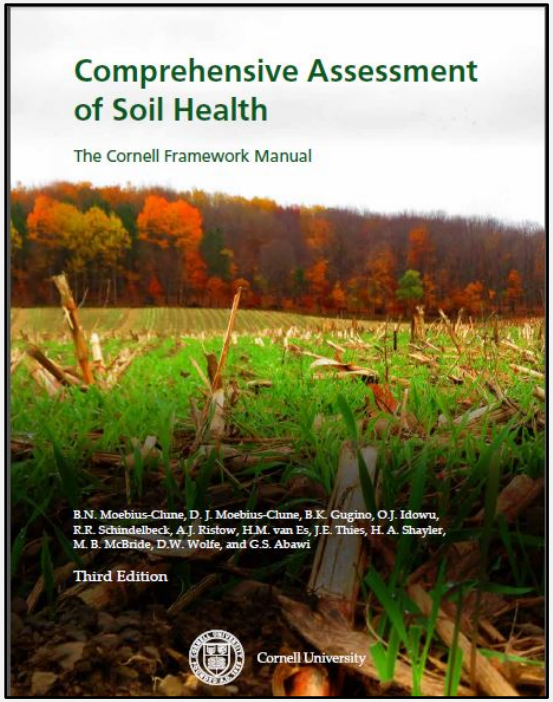
Brookside Labs	www.blinc.com/
Ward Labs	www.wardlab.com/
Woods End	woodsend.org/

University labs

Cornell University	soilhealth.cals.cornell.edu/
University of Missouri	cafnr.missouri.edu/soil-health/

Resources

https://soilhealth.osu.edu



Great, free online manual

http://soilhealth.cals.cornell.edu