

Giving your soil a breathalyzer!?

New ways to measure soil organic matter and microbial activity



Charlie White
Crop Management Extension Team



Penn State Extension



Outline

- **What is soil organic matter?**
- **Why do we care about soil organic matter?**
- **How can we measure soil organic matter?**
- **How to interpret the results**

Soil Health Indicators

Potentially Mineralizable Nitrogen

- Nitrogen from soil organic matter made 'plant available' by microbes
- Organic N → Ammonium + Nitrate
- N supplied from organic matter can reduce N fertilizer needs
- On average, 50% of N uptake by a corn crop is from soil organic matter



Soil Health Indicators

Aggregate Stability

- Ability of soil aggregates to resist erosion, slaking, crusting
- Important for water infiltration, aeration, rooting

Soil Crumbled and Dried



Soil Saturated then Dried

Measuring Total Soil Organic Matter

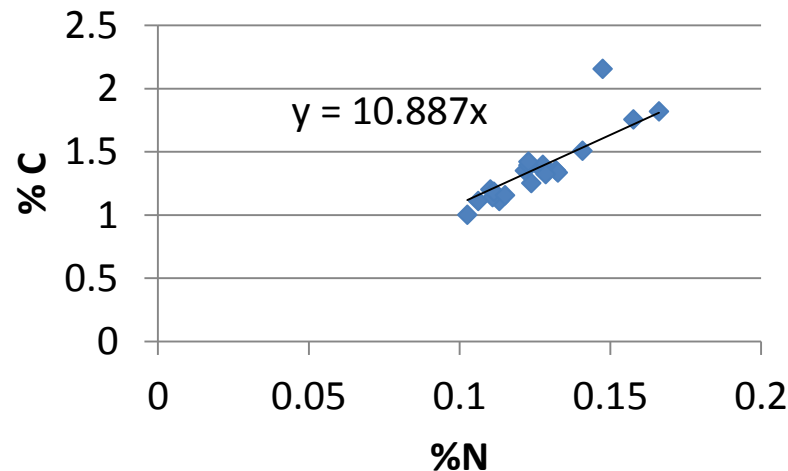
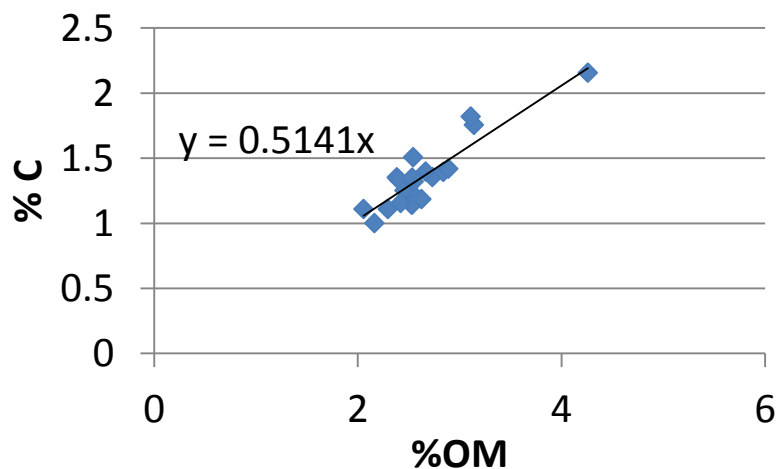
Loss on Ignition

- A crude but useful measurement of the total soil organic matter pool
- The most widely available method
- Soil sample is raised to a high temperature and organic matter burns off
- Measure the mass lost to calculate % OM
- 2% is average for Pennsylvania
- Many no-till farmers using cover crops and manure report values as high as 4%
- Consider sampling different depth segments in a few fields: 0-2", 2-6", 6-12"

Measuring Total Soil Organic Matter

Elemental Analysis

- A precise measurement of the elemental composition of soil (eg. %C, %N)
- Typically used by researchers; available from PSU Ag Analytical Lab
- Soil sample is combusted, measure gases released



Measuring Labile Soil Organic Matter

Permanganate Oxidizable Carbon (POXC)

- Carbon oxidized by weak solution of potassium permanganate
- Indicator of partially decomposed labile organic matter
- Available via Cornell Soil Health Test
- Reported as mg C/kg soil (ppm)
- Correlated to microbial biomass



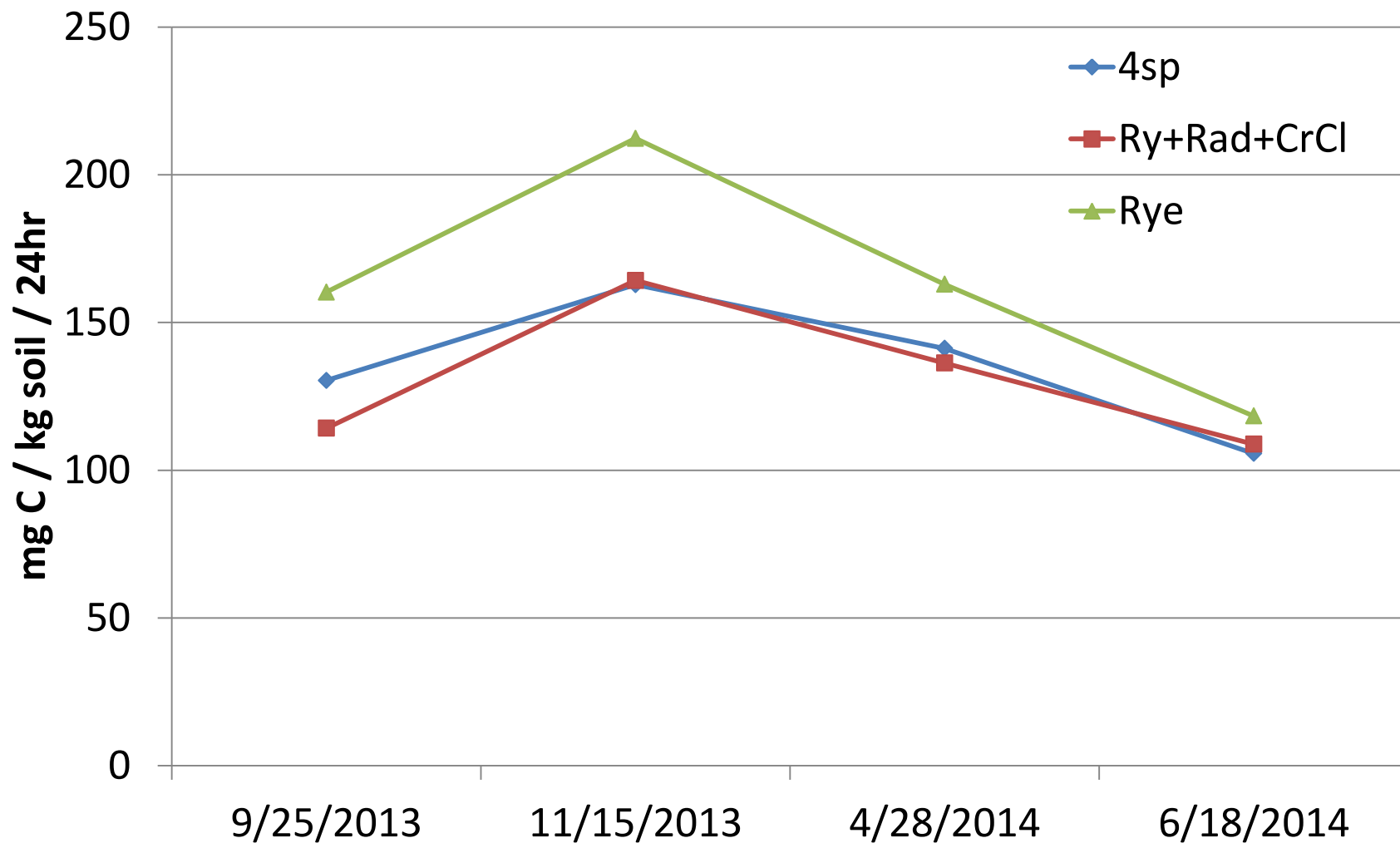
Measuring Labile Soil Organic Matter

Microbial Respiration

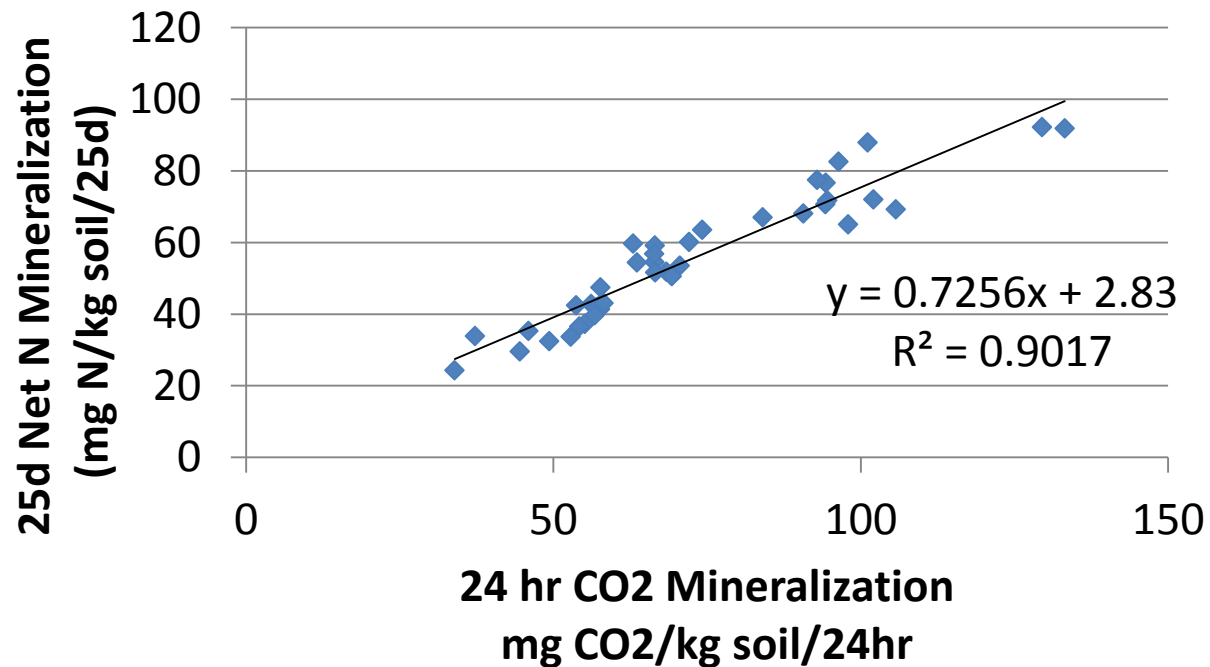
- Quantity of CO₂ respired by microbes in 24 or 96 hours
- Indicator of size of microbial population and availability of organic matter to decompose
- Available via Solvita Soil Health Tool, Cornell Soil Health Test, certain soil testing labs including Agri-Analysis and Dairy One (\$30 @ Agri-Analysis)
- Reported as mg C/kg soil (ppm) per 24 hrs or 96 hrs



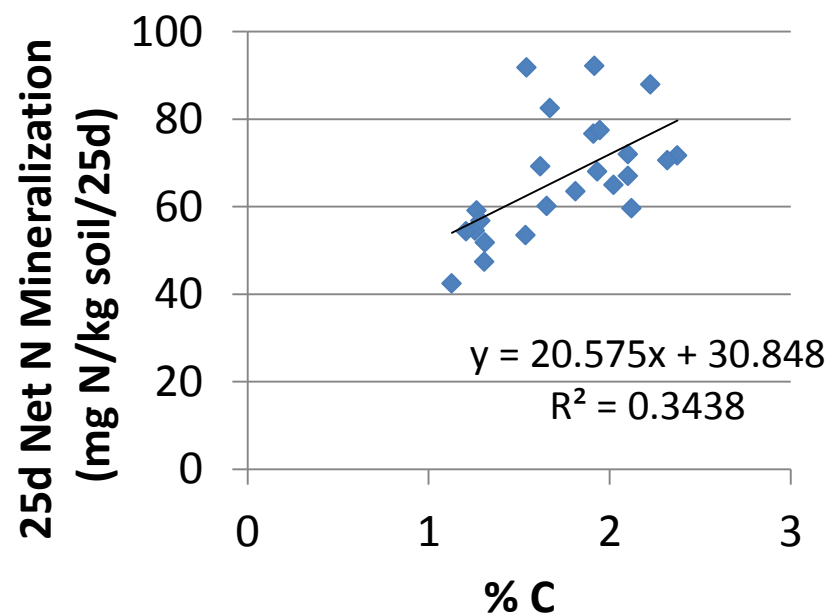
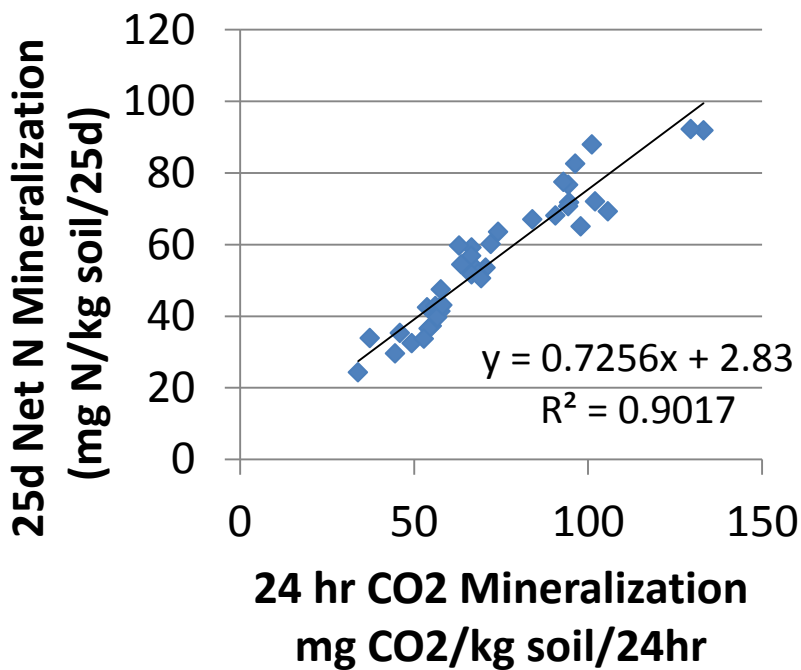
Cover crops breathe life into the soil



24hr CO₂ respiration is closely correlated to short-term N mineralization in laboratory settings

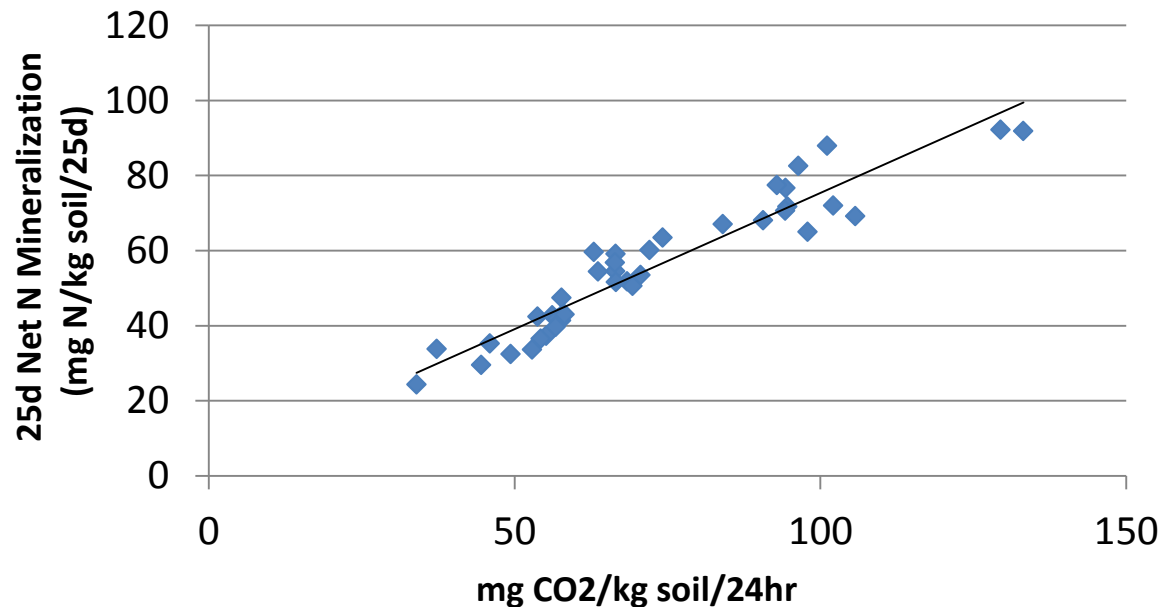


24hr CO₂ respiration is better predictor of N mineralization than %C



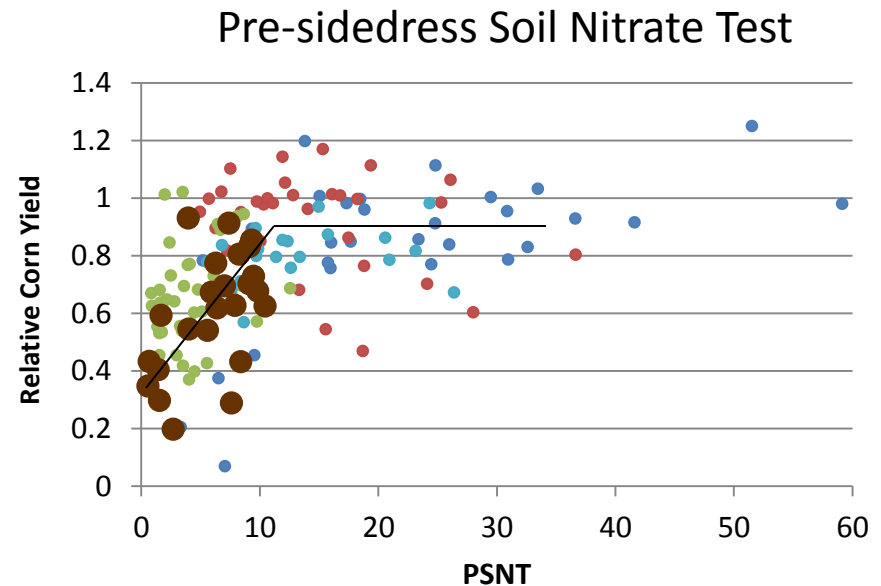
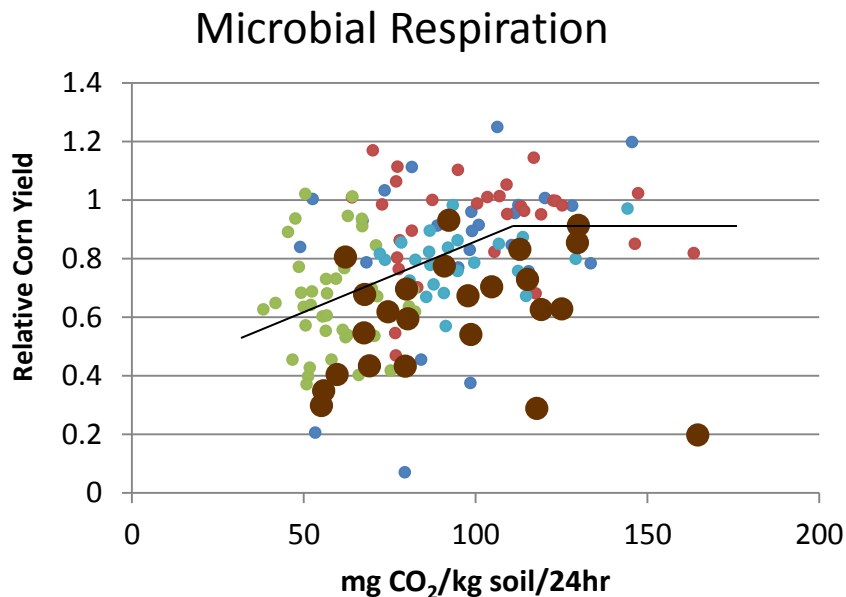
Conclusions about microbial respiration as a predictor of N supply to crops

- 24hr CO₂ respiration can show you what end of the spectrum you are on
- Soil samples can be taken any time of year to get a rough idea of the test levels



Conclusions about microbial respiration as a predictor of N supply to crops

- However, microbial respiration is not as good a predictor of N supply to corn as PSNT test
- Coupling between microbial respiration and N supply is affected by cover crop C:N ratio
- PSNT results integrate the N mineralization/immobilization processes



How to interpret soil organic matter test results

Total soil organic matter (%OM)

- For most Pennsylvania soils: 2% is average; 4% is high
- Compare within similar soil textures
- Consider stratification with depth
- Observe trends over time
- Watch for new equilibrium level

Labile organic matter

- Much smaller dataset to interpret range of values
- Useful for relative comparisons, trends over time
- POM and POXC will likely remain research tools
- Microbial respiration has some potential for applied use
 - Currently: guide your mindset towards N management but follow up in-season with additional monitoring tools (eg, PSNT, SPAD, NDVI sensors)



This presentation is a training initiative of the
Northeast SARE Pennsylvania State Program

What do you think?

Let's stay in touch!

- Follow-up survey in 1-2yrs
- Free microbial respiration analysis!

Feel free to contact me for more information:

Charlie White - cmw29@psu.edu - 814-863-9922