Solid Manure Diversifies the Soil Dissolved Organic Matter Continuum:
Linking Manure Management to Organic Matter Stabilization in Aggregates

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1. Background

- **Soil dissolved organic matter (DOM)** fuels microbes, drives nutrient cycling, and contributes to long-term soil organic matter.
- Inside **macro- and microaggregates**, DOM is partially protected and spans a **continuum** from fresh plant inputs to microbially transformed, more stable compounds.
- Because DOM chemistry influences whether carbon is decomposed or stabilized on minerals, its composition is key to understanding soil carbon retention.
- How agronomic practices shape this aggregate-scale DOM continuum is still largely unknown.

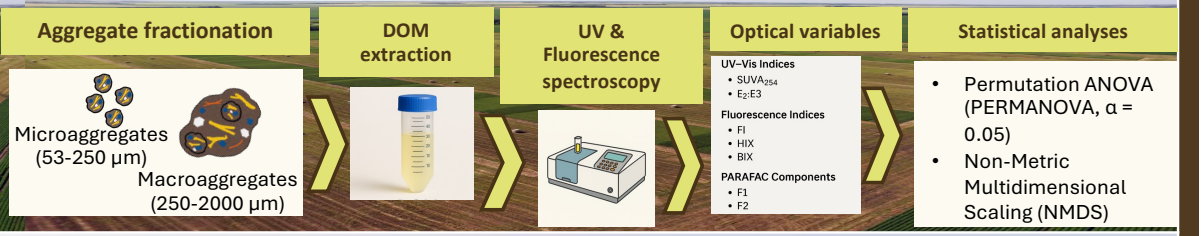
2. Objective

- To determine how **manure type, cropping system**, and **soil management** shape the DOM continuum within macro- and microaggregates.

3. Methods Overview

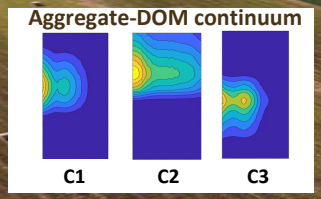
NCLE Long-term Field Trial (2007-2024) Treatments:

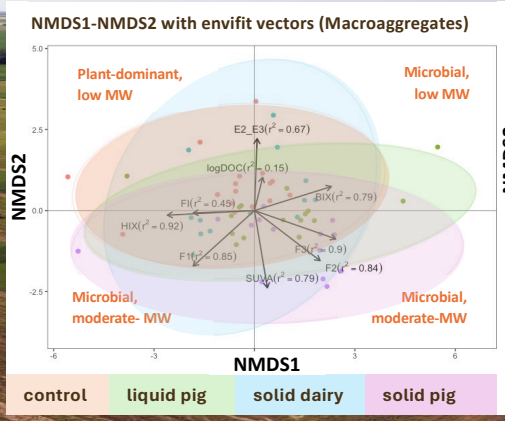
- **Cropping systems:** Annual and annual-perennial rotation
- **Manure treatments:** Liquid Pig, Solid Pig, Solid Dairy, No Manure
- **Soil management:** Regenerative: no-till + cover crops (since 2020), and Conventional: tillage
- **Treatment structure:** RCBD split-split plot

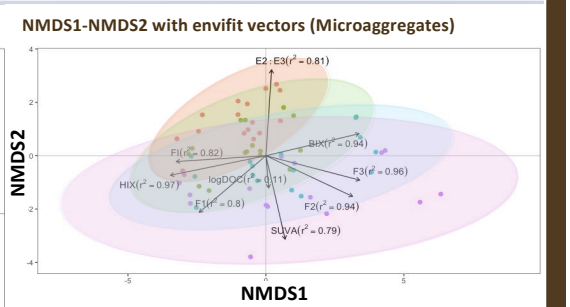


4. Key Findings

- **Fluorescence spectroscopy (EEM–PARAFAC)** identified **three components** of the **DOM continuum** in both macro- and microaggregates:
  - **C1:** plant-derived, less-processed humic-like DOM
  - **C2:** more oxidized, microbially reworked humic-like DOM
  - **C3:** low-molecular-weight, protein-/metabolite-like DOM







NMDS1 = shift from plant-derived → microbially processed DOM

NMDS2 = variation in aromaticity and molecular size

- **Multivariate PERMANOVA results for** optical variables showed that **manure type significantly altered composition of the DOM continuum** ($p < 0.05$), whereas **crop rotation, soil management, and all interaction terms had no detectable effects.**
- This means that **manure type** is the **primary driver of how carbon is transformed and stored within soil aggregates.**
- **Group ellipses** showed that **solid manures (solid pig, solid dairy)** produced **the most dispersed and chemically diverse DOM**, while **control and liquid pig manure clustered tightly**, indicating **less chemical diversity**.

7. Conclusions

- **Solid manures, especially solid pig and dairy, provides superior long-lasting soil-building benefits compared to liquid manure**, and non-manured making it a high-value option for producers seeking to improve soil carbon and overall soil health. **Producers can meaningfully shift soil carbon quality and stabilization pathways through manure choice**, even when other agronomic practices remain unchanged.

8. Acknowledgements

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