Using Archived Soil Samples to Examine Carbon Sequestration after 20 Years of Conservation Tillage in Alberta, Canada

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Soil Science 101

Why is soil organic matter important?

1. Retains more water
2. Reduces bulk density
3. Increases biodiversity
4. Increases Soil fertility
5. Increases Microbial activity

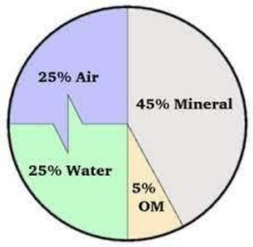

Figure 1. Composition of soil (3)

Soil composition

- Inorganic matter (minerals) in soil function as skeleton [1]
- Organic matter is carbon-based compounds that come from the decomposition of plants and animals (Figure 1)

Two parts of organic matter

1. Particulate Organic Matter (**POM**)- larger more decompostable pieces
2. Mineral Associated Organic Matter (**MAOM**)- stable, smaller pieces of matter

Why soil health is important:

- Carbon sequestration, food security, climate mitigation
- Using sustainable soil practices helps soil health
- Improves nutrient recycling
- Improve resiliency of land

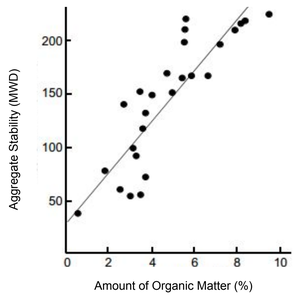

Figure 2. Relationship between aggregate stability and OM

Research Question

- **Does conservation tillage allow long term carbon sequestration in soils?**

- Samples collected from 1998-2019

- Carbon sequestration mitigates climate change by capturing atmospheric CO2 and stores it into the soil [6].

- Tilling is when you mechanically disturb the soil to prepare for planting, this influences [5].
  1. Reaction of microorganisms
  2. Carbon loss
  3. Soil disturbance

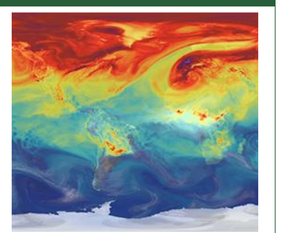

Figure 4. Atmospheric carbon dioxide during months when tilling is used. (4)

Figure 3. Unsustainable tillage. (5)

Methods

Fractionation objective is to separate the soil into MAOM and POM components:

1. Weighing and sonication
   - disturbs physical structure and releases organic matter from other particles [8]
2. Wet sieving
   - <53 µm (**MAOM**) pass through the wet sieve
   - >53 µm (**POM**) stay on the wet sieve

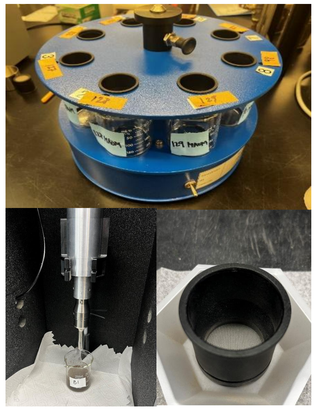

Figure 5. fractionation methods

Oxidation removes organic matter from the soil, enabling further analysis of the soil sample

1. pH adjustment and lab preparations
   - Adjusting pH with HCl ensures oxidation of OM without altering the mineral matrix of the soil.
2. Oxidation and shaking
   - Adding NaOCl to soil samples
3. Centrifugation and washing
   - Ensures clean samples and removes any excess residues
4. Oven drying the samples

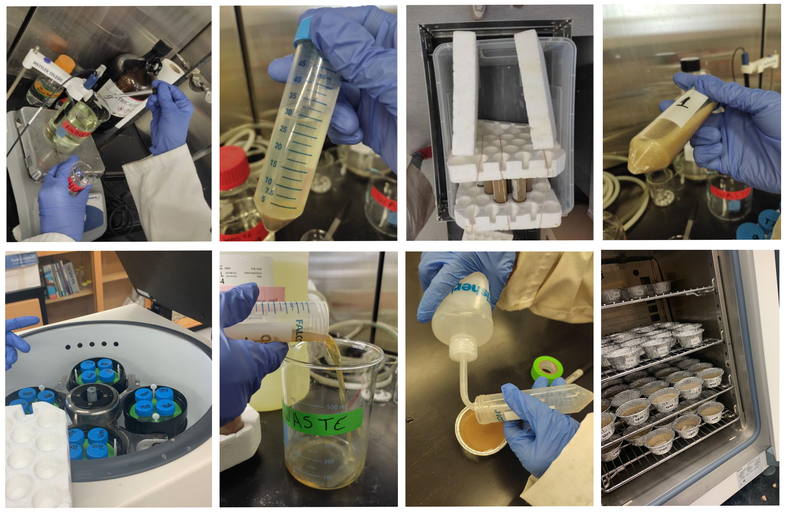

Figure 6. Different laboratory techniques for oxidation in chronological order

Expected Outcome

Expected results from fractionation:

- Increased MAOM in conservation tillage rather than conventional practices [7]
- Reduced POM (more labile and decomposes faster)

Expected DRIFT (Diffuse Reflectance Infrared Fourier Transform) results:

- Larger peaks
- Decreases in some labile organic compounds
- Different peak intensities (differences in organic matter)

Why isolate the organic matter?

- Isolation of the **MOAM** and the **POM** may show how tillage may affect the stability and distribution of carbon in the soil.

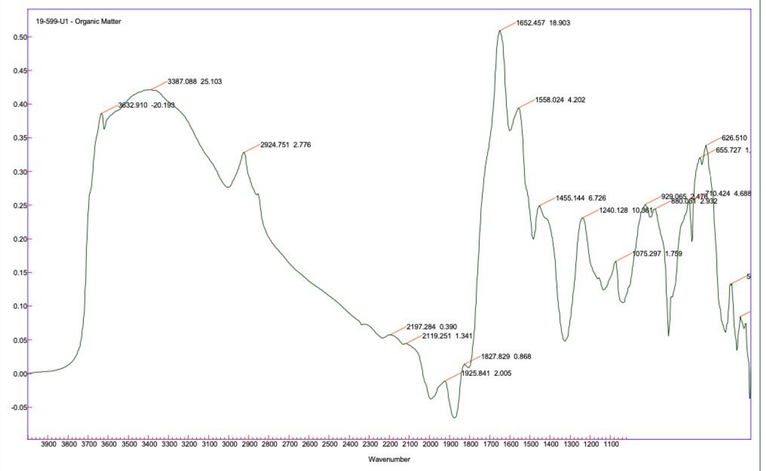

Figure 7. DRIFT spectra results for the OM in Bulk soil.

Acknowledgements

S-PRL SOIL-PLANT RELATIONS LAB

References

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