COMPARATIVE ANALYSIS OF CARBON AND NITROGEN MINERALIZATION IN DIVERSE FARMING SYSTEMS
How do different farming systems affect the health of the soil, as shown through the pools of labile carbon and nitrogen?
Palouse Conservation Field Station

- 12th year in five different farming systems
- ART: Agroecosystem Research Trials
  - NAT: Native Agroecosystem Trial
    - Idaho fescue and Bluebunch wheatgrass
  - OAT: Organic Agroecosystem Trial
    - Spring Pea as a green manure
  - PAT: Perennial Agroecosystem Trial
    - Alkar Tall Wheatgrass
- No Till a (with legume)
  - Winter Wheat, Garbonzo Beans, Spring Wheat
- No Till b (only cereals)
  - Winter Wheat, Spring Barley, Spring Wheat
Aerial View of ART at PCFS
Purpose

- 24-hour CO$_2$ burst
- Applicability to Farmers
  - Simply gauge the health of the soil
- Solvita Test (Haney et. al, 2008)
Hypothesis

Carbon mineralization rates would be highest with “healthiest” soils:

- Native Prairie Grasses
- OAT
- PAT
- NTa (with legume)
- NTb (only cereals)

NAT > OAT > PAT > NTa = NTb
Methodology

- Field work:
  - 10-cm depth samples
  - Approximately 50 soil cores per plot

- Lab work:
  - Carbon Mineralization
  - Nitrogen Mineralization
  - Total Carbon
  - Total Nitrogen
Carbon Mineralization Incubations

Measurement of the respiration rates (CO$_2$) of the microbes in the soil

- Carbon dioxide reacts with alkali traps (10.0 mL 1M NaOH) to form CO$_3^{2-}$

- 24 day Incubation:
  Samples taken at days 1, 3, 7, 15, and 24
Titrations

\[ \text{Na}^+ + \text{OH}^- + \text{CO}_2 \rightarrow \text{Na}^+ + \text{CO}_3^{2-} \]

\[ \text{Ba}^{2+} + \text{CO}_3^{2-} \rightarrow \text{BaCO}_3 \text{\ (solid)} \]

(Campbell et al., 1991; Franzluebbers et al., 2000; Haney et al., 2001)
Other Lab Work

- Nitrogen Mineralization measures the change nitrate ($\text{NO}_3^-$) and ammonium ($\text{NH}_4^+$) content of the soil (Liebig et al., 2004)
  - Analyzed at $T_0$ and days 1, 3, 7, 15 and 24

- Total Carbon (C) and Total Nitrogen (N) (Liebig et al., 2004)
  - Overall assessment of total soil C, N and their ratios among farming systems
  - Analyzed using dry combustion (TrueSpec)
Results: Carbon Mineralization Incubations
Next Steps

**CO₂ Burst Predicting Nmin**

Franzluebbers et al., 2007
Summary and Conclusions

My Hypothesis: NAT > OAT > PAT > NTa = NTb

Actual Results: NTb > OAT = Nta > PAT = NAT

- Is it applicable to farmers?
  - General indicator of soil health
  - Not precise enough to measure differences in a mere 24 hr

Future Research:
Determine general range of carbon mineralization rates for public use
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