Farm management systems in the coastal plain of NC and their impact on soil nitrous oxide emissions

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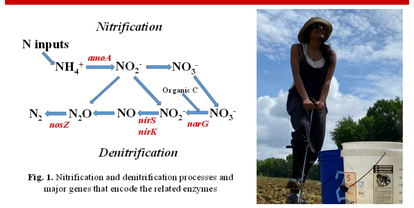


Fig. 1. Nitrification and denitrification processes and major genes that encode the related enzymes

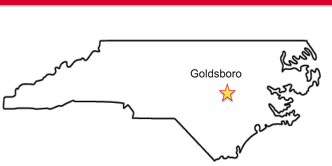
1. Introduction

In North Carolina, 7% of greenhouse gas emissions are attributed to agricultural production (NC DEQ 2019). Unlike carbon dioxide and methane, the vast majority (78%) of nitrous oxide (N_2O) emissions are from agriculture, with most of this N_2O produced by soil microbes (EPA). Hence, farm management techniques have been indicated as a potential way to reduce N_2O emissions.

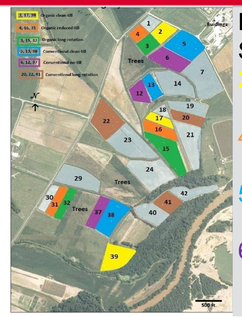
2. Key Questions

1. *How do different farm management (organic or conventional inputs / reduced tillage or conventional tillage) systems affect the level of nitrous oxide emitted from soil?*
2. *How do these same systems affect various soil health indicators like microbial biomass carbon and soil respiration?*
3. *What's the relationship between these microbial activity indicators and N_2O emissions?*

3. Methods



Samples were collected June 7, 2021 at the Cherry Research Farm Center for Environmental Farming Systems' Farming Systems experiment near Goldsboro, NC. Treatments have been in place since 1999.



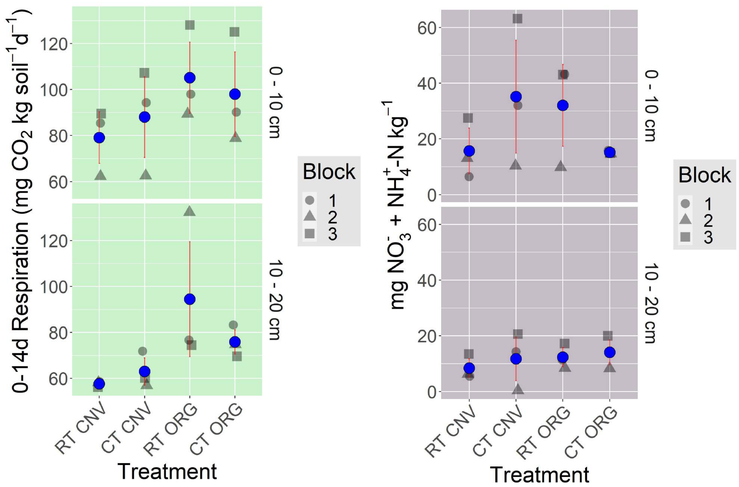
Plots Sampled:
2,17,39
4, 16, 31
5,13, 38
6, 12, 37

Experiment was randomized and blocked by soil type: 4 treatments with 3 replicates, totaling 12 plots. Treatments had varying tillage intensities and organic or conventional inputs:

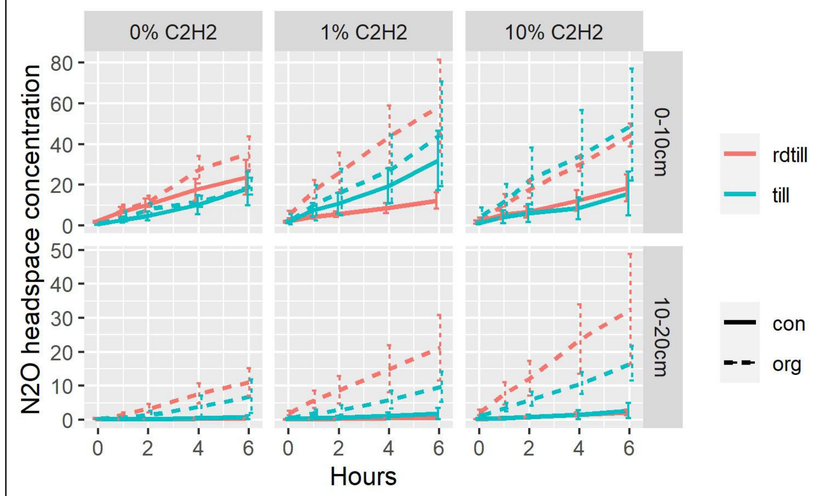
1. Organic clean till (Org High)
2. Organic reduced till (Org Medium)
3. Conventional clean-till
4. Conventional no till (Con No)

Variable	Protocol Utilized
MBC	Chloroform Fumigation (CFDE)
MBN	Fumigation and Oxidation (CFDE)
N_2O	Basal denitrification (Drury, et. al 2008), Shimadzu GC2014 Gas Chromatograph equipped with Electron Capture Detector
pH	pH in 0.01M Calcium Chloride (Thomas 1996)
C and N mineral-ization	Closed Jar Incubation and NaOH Trap Method, and Incubation-Extraction for Extractable N (Dr. Hu Lab, adapted from K. Alef and P. Nannipieri, 1995).

4. Results



A subset of the soil health indicators measured



- Soil from two depths and four long-term farming systems was rewetted to 100% of Water Holding Capacity (WHC).
- C_2H_2 (Acetylene) was added to limit nitrification (1%) and denitrification of N_2O to N_2 (10%).

Mean soil carbon and nitrogen content by farming system

System	Mean (% Carbon)	SE (% C)	Mean (% Nitrogen)	SE (% N)
Conventional	0.981	0.064	0.072	0.005
Organic	1.196	0.063	0.084	0.006
Tillage	1.072	0.047	0.075	0.002
Reduced Tillage	1.085	0.094	0.077	0.008

5. Preliminary Findings

- Organic management systems demonstrate a higher level of N_2O emissions (mainly from denitrifiers)
- Organic management systems may have a higher level of microbial biomass C and N and respiration
- Higher N_2O emissions in CT-ORG under 10% C_2H_2 suggest N_2 denitrification limits N_2O emitted.
- No clear system differences in pH or NO_3^-+ NH_4^+
- Most properties clearly differ by depth

6. References

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7. Acknowledgements

This work made possible by funding by USDA's National Institute of Food and Agriculture [Grant 2018-51106-28773] for the NCSU Agroecology Scholars Program in Research and Extension (ASPIRE).