UMassAmherst | College of Natural Sciences, Center for Agriculture, Food, and the Environment

United States Department of Agriculture, National Institute of Food and Agriculture

The effect of cover crop termination on the fate of cover crop root nitrogen

Ruichen Wang, Alexander Wu, Corey Palmer, Dr. Ashley Keiser

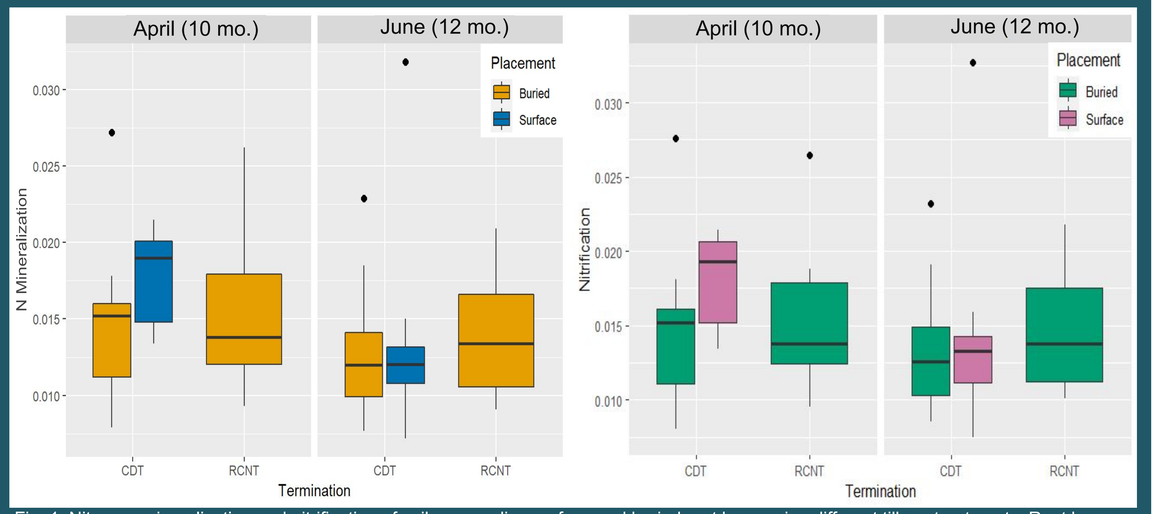


Fig. 1. Nitrogen mineralization and nitrification of soil surrounding surface and buried root bags using different tillage treatments. Root bags were collected on April 22 and June 15, after 10 and 12 months of decomposition, respectively. CDT – disk tillage with cultivation, RCNT – no-till with roller crimper.

Central finding: The method of cover crop termination impacts the decomposition of cover crop roots and the release (mineralization) of nitrogen.
Roller crimping, which keeps roots undisturbed, induces greater nitrogen mineralization and nitrification during the early growing season when crop demand for inorganic nitrogen is high (Fig. 1).

This work is in partnership with CAFE Extension. This research helps build our understanding of how roots contribute to soil organic matter (SOM) development and turnover. See existing extension fact sheets and look forward to our soil organic matter fact sheet here:

Introduction

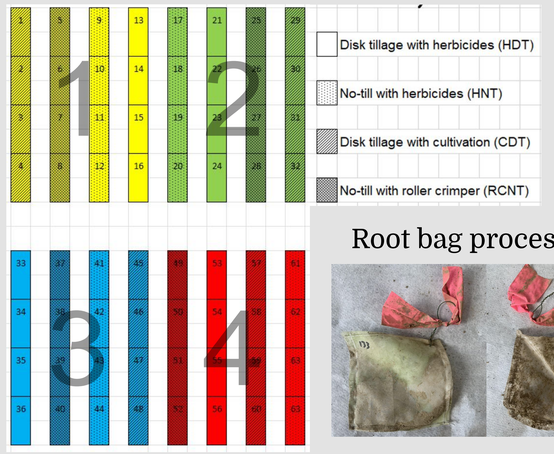
1. Cover crops take up nitrogen (N) and thus prevent N losses from fields during the non-growing season.[1,2,4]
2. Once cover crops are terminated, soil microorganisms decompose the dead plant tissues and release nitrogen into soil pools. Nitrogen mineralization is the chemical transformation of organic N into inorganic ammonium and nitrate. We do not have a clear understanding of how cover crop termination impacts root decomposition and N mineralization.[2,3]

How do termination methods affect the N mineralization and nitrification rate of cover crop root tissue?
Hypotheses:

- **A.** Using disk tillage, N mineralization will be faster because the mixing of the soil distributes roots throughout the soil and surface, exposing roots to warmer temperatures with increased aeration, allowing for increased microbial activity.
- **B.** Using roller crimping, N mineralization will be faster because microbes already have a close relationship with the plant roots providing fast and early access to root biomass.

Methods

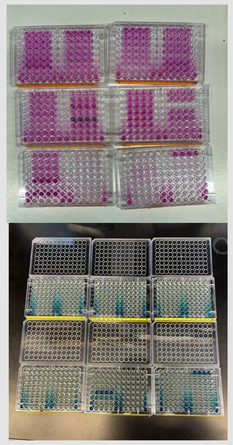
Experimental design



Root bag processing

Disk tiller & roller crimper

N extraction of soil



Additional Results

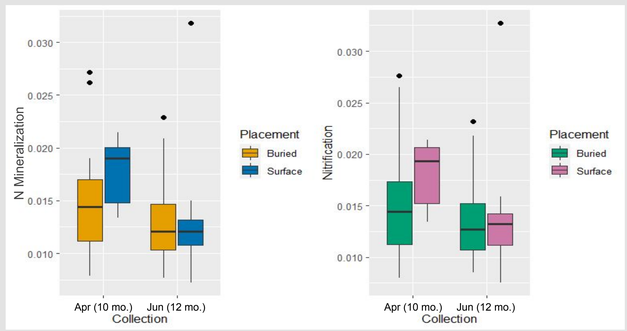


Fig 2: N mineralization and nitrification influenced by placement and collection time

- The differences of N mineralization and nitrification between surface and sub-surface soil are larger in the spring.
- Temperature appears to interact with termination method to influence N mineralization and nitrification, and thus, inorganic N availability.

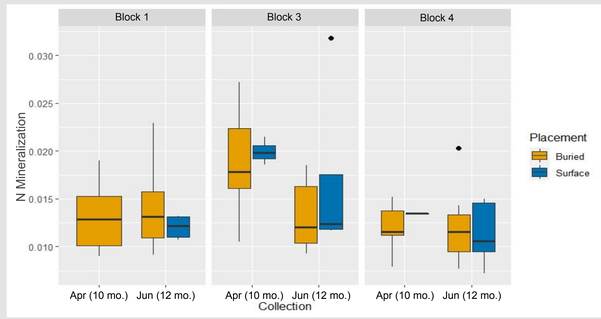


Fig 3: N mineralization influenced by block and collection date

Three experimental blocks showed different N mineralization rates, showing the influence of in-field soil heterogeneity.

Next Steps:
1. Investigate the reason for spatial heterogeneity, i.e., moisture.
2. Add the mass loss of cover crop root into the model

References

1. Liebman, A. M., Grossman, J., Brown, M., Wells, M. S., Reberg-Horton, S. C., & Shi, W. (2018). Legume Cover Crops and Tillage Impact Nitrogen Dynamics in Organic Corn Production. *Agronomy Journal*, *110*(3), 1046–1057. https://doi.org/10.2134/agronj2017.08.0474
2. Sievers, T., & Cook, R. L. (2018). Aboveground and Root Decomposition of Cereal Rye and Hairy Vetch Cover Crops. *Soil Science Society of America Journal*, *82*(1), 147–155. https://doi.org/10.2136/sssaj2017.05.0139
3. St. Luce, M., Whalen, J. K., Ziadi, N., Zebarth, B. J., & Chantigny, M. H. (2014). Labile organic nitrogen transformations in clay and sandy-loam soils amended with 15N-labelled faba bean and wheat residues. *Soil Biology and Biochemistry*, *68*, 208–218. https://doi.org/10.1016/j.soilbio.2013.09.033
4. Wayman, S., Cogger, C., Benedict, C., Burke, I., Collins, D., & Bary, A. (2015). The influence of cover crop variety, termination timing and termination method on mulch, weed cover and soil nitrate in reduced-tillage organic systems. *Renewable Agriculture and Food Systems*, *30*(5), 450–460. https://doi.org/10.1017/S1742170514000246