



## Legacy Effects of Cover Crops on Cash Crop Performance and Soil Health in a No-till Corn-Soybean Cropping System

Chuntao Yin, Nathan Lahr, Shannon Osborne, and Michael Lehman  
USDA-ARS North Central Agricultural Research Laboratory, Brookings, SD



### Key Findings:

- Cover crops significantly increased soybean yields and marginally increased corn yields.
- Cover crops affected the soybean root microbiomes, but not the corn root microbiomes.
- Cash crop growth stage and identity affected cash crop root microbiomes.
- Five years of cover crops had minimal effects on the soil health indicators we measured.



## Background

Introducing cover crops is a conservation practice that diversifies cropping systems and mitigates some negative environmental effects of simplified cropping systems. Cover cropping benefits soil health through increasing soil aggregation and organic matter, reducing soil erosion, decreasing disease and weed pressure, and changing soil microbial diversity and activity. The majority of studies on the effects of cover crops address bulk soil microbiomes, with surprisingly few reports of the root microbiomes of the following cash crops.

## Objective

Investigate the legacy effects of 5 years of cover crops on cash crop performance, their root-associated microbiomes, and soil health in a corn-soybean rotation

## Methods

Cover crops were interseeded in-season in both the corn and soybean phases of the corn-soybean rotation. Winter rye was interseeded into the corn plots, and an equal mixture of winter rye, forage turnip, and clover (berseem and crimson) was interseeded in the soybean plots. In the 2022 growth season, bulk soils were collected from each plot at the seedling stage. Six soil health indicators were measured: potentially mineralizable nitrogen (PMN), autoclaved-citrate extractable soil protein (ACE protein), permanganate oxidizable carbon (POXC), basal respiration, mineralizable C, and beta-glucosidase activity. Plant and root soils were harvested from both corn and soybean phases at the seedling and flowering stages. DNA was extracted from the collected soils and sequenced for microbial characterization.



Samples were collected from a long-term crop rotation field trial.

## Results

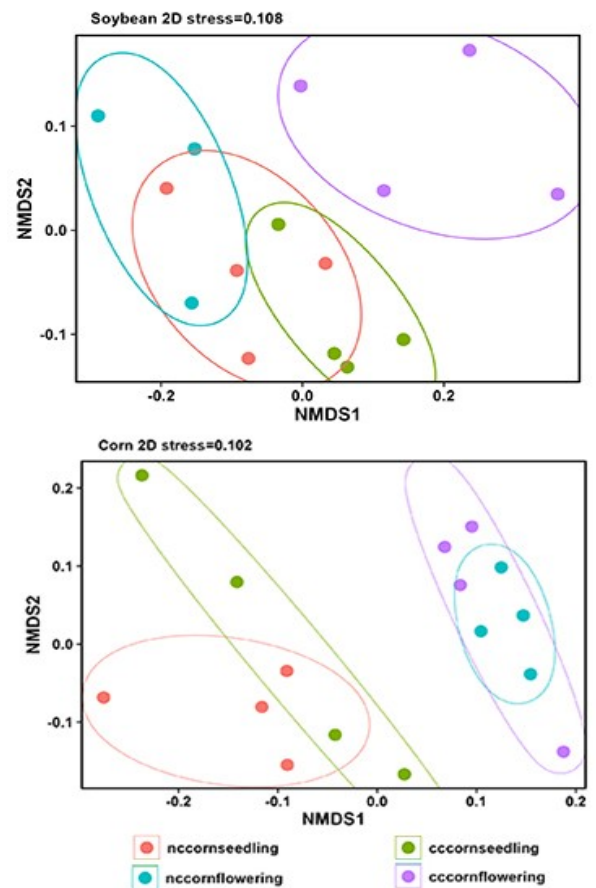
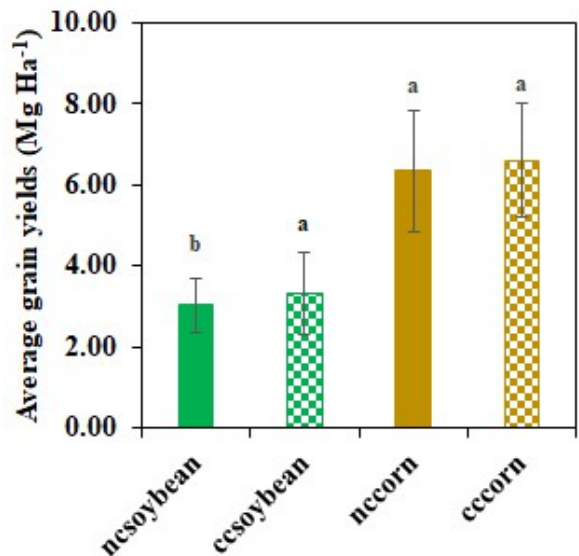
Five years of cover crop integration into a long-term corn-soybean rotation significantly increased average soybean yields (9.93%) and marginally increased average corn yields (4.13%) but not significantly, compared to no cover crop treatments between 2017 and 2021.

Cover crops significantly influenced bacterial and fungal communities in the soybean roots, but did not affect bacterial and fungal communities in the corn roots.

Cash crop growth stage had consistent, significant effects on the root microbiomes in both soybean and corn, with strong effects at the flowering stage for soybean and the seedling stage for corn.

The soybean rhizosphere was enriched with nitrogen (N)-fixing bacteria in the flowering stage, whereas the corn rhizosphere recruited a high abundance of plant growth promoting bacteria in the seedling stage.

Five years of cover crop introduction did not significantly improve six selected soil health indicators. But cover crop treatments had marginally increased all six soil health indicators in the corn plots, with mixed results in the soybean plots.



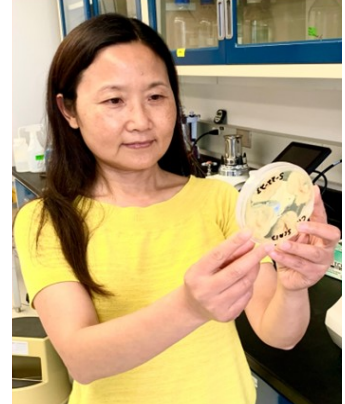
## Summary

Cover cropping has been reported to stimulate beneficial microbes in the bulk soil, but despite their importance in determining crop yield, few previous studies analyzed cash crop rhizobionomes. Our study provided evidence for recruitment of beneficial microbes from the bulk soil to the cash crop rhizosphere, where effects on plant performance can be realized. Our results suggest that cover crop introduction may increase cash crop yields and promote beneficial changes in cash crop root microbiomes, but effects differ by cash crop identity and growth stage.

## Next Steps

This Research Brief includes research findings from a long-term crop rotation field trial that includes the 2-year rotation (used for this study) and four 4-year rotations with and without cover crops. In follow-up studies, we will evaluate the benefits of 8 years of cover crops in both this 2-year and various 4-year crop rotation plots.

**Chuntao Yin**  
Research Microbiologist



**Questions or comments?**  
**Email:** [Chuntao.Yin@usda.gov](mailto:Chuntao.Yin@usda.gov)  
**Phone:** 605-693-5207

## About NCARL

The North Central Agricultural Research Laboratory (NCARL) is a USDA-Agricultural Research Service laboratory located in Brookings, SD. The goal of NCARL is to develop, document, and promote soil, crop, and pest management practices that are ecologically sustainable while maintaining producer profitability.

