Soil quality as affected by rye under no-till corn-soybean rotation

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Introduction

It is not feasible to measure *every* aspect of a soil to determine its quality. Therefore, subsets of parameters must be selected to address the impacts of management.

These "indicators" of soil quality lend insight into which management practices should be recommended on specific soils, in specific regions, and for specific management goals.

Objectives

- Examine the affect of rye cover crop on several soil quality indicators in a no-till corn-soybean rotation
- Integrate several of these soil surface parameters into a unit less soil quality index (SQI)

Hypothesis

- Cover crops would be associated with enhanced soil quality indicators, thus overall soil quality

To test these hypotheses two case studies comparing rye cover crop with a no cover control were investigated. A clay loam Mollisol in northwestern Iowa (Nicollet series) and a sandy loam Alfisol in central Michigan (Capac series) were sampled in 2011.

Soil quality index (SQI) values were calculated for the surface 0-10 cm layer using the Soil Management Assessment Framework (SMAF) (Andrews *et al*. 2004).

Indicators included in SQI:

- Soil bulk density
- Plant available water content
- Soil organic carbon
- pH

Results and Discussion

Bulk density (BD)

Significant differences were not detected between treatments at any individual depth at either the Gilmore or Mason sites.

The BD at the Gilmore site (under both treatments) increased with each depth increment. However, the same trend was not observed at the Mason site (Figure 1.) where the mean BD in both the 20-40 and 40-60 cm depths was slightly lower than in the 10-20 cm interval.

This seems to indicate the presence of an historic plow pan. Longer inclusion of cover crop in the rotation may lead to an eventual amelioration of this plow pan.

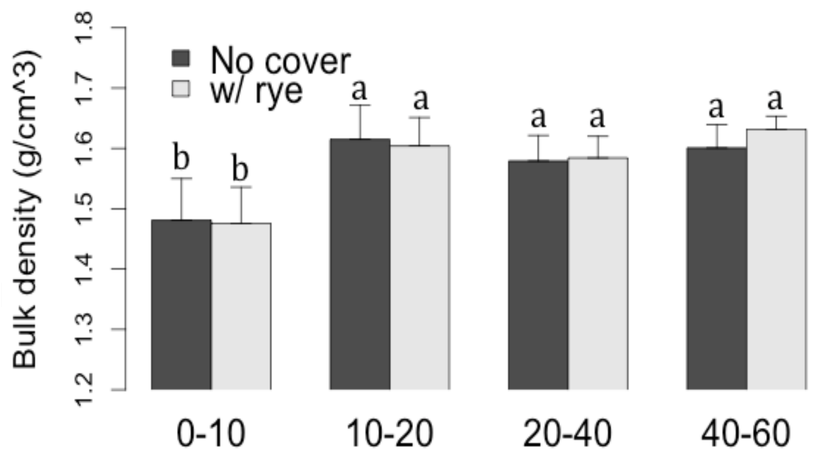

Figure 1. Bulk density by depth for control and rye treatments at Mason site.

Soil organic carbon (SOC)

Though significant differences were not detected in SOC within any depth at the Gilmore site, it is of note that the mean SOC within all depths of the rye treatment were slightly higher than control. At Mason the SOC significantly ($p<0.05$) increased in the 10-20 and 20-40 cm depths by 56% and 43%, respectively.

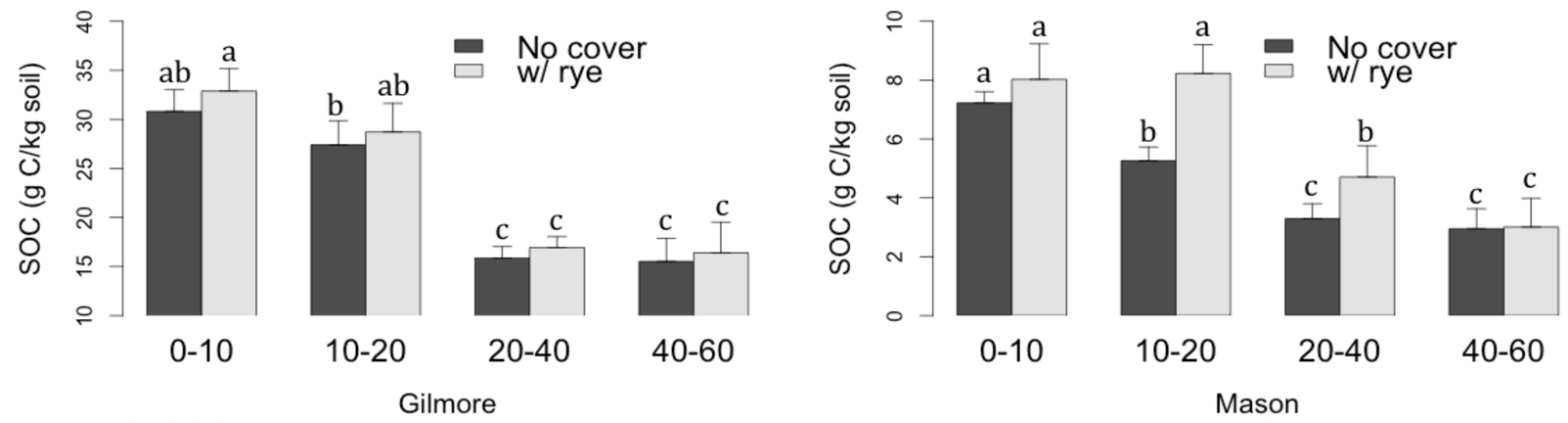

Figure 2. SOC concentrations by depth for control and rye treatments at Mason and Gilmore sites.

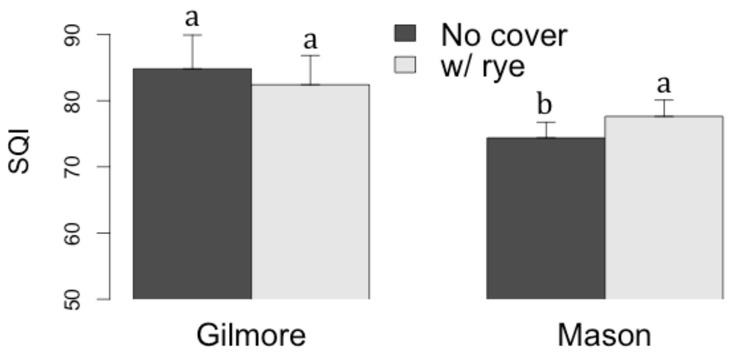

Figure 3. SQI scores for control and rye treatments (SQI calculated for surface 0-10 cm)

Soil quality index (SQI)

Statistical differences in SQI were not detected between treatments at the Gilmore site. This suggests that these soils are of inherently high quality and that the addition of rye has not led to a detectable change.

There was a significant increase ($p = 0.07$) in SQI on the sandy loam soils at the Mason site. This increase in SQI is mostly due to the increased soil organic matter as the SOC was the only individual indicator that significantly contributed to this increase.

Conclusions

- Rye may accumulate carbon in the subsurface on no-till systems through the additional input of root biomass
- SQI scores for the inherently high quality Mollisols in Iowa were unaffected by the addition of rye to the system. However, the sandier Alfisol in Michigan showed a positive response to the inclusion of rye

Recommendation

- Rye should be included in corn-soybean rotations on sandy loam soils under no-till to enhance SOC as well as increase overall soil quality

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