Effect of Cover Crop and Crop Rotation on Soil Carbon, Nitrogen and Microbial Activity

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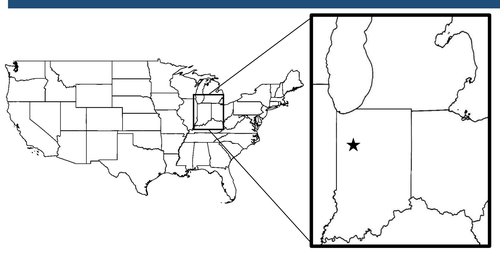
Objective

Cover crops and crop rotation are two conservation cropping systems practices that are thought to improve soil health. The goals of this study were to determine how cover crops affect soil biological activity (C, N, and enzyme activity) which are critical indicators in quantifying soil health.

Location

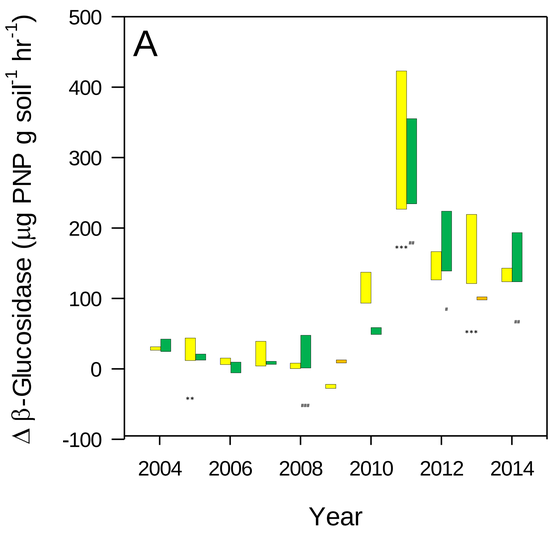


The experiment was conducted from 2003 to 2014 at the Purdue University Agronomy Center for Research and Education (ACRE) experimental farm located in West Lafayette, IN.

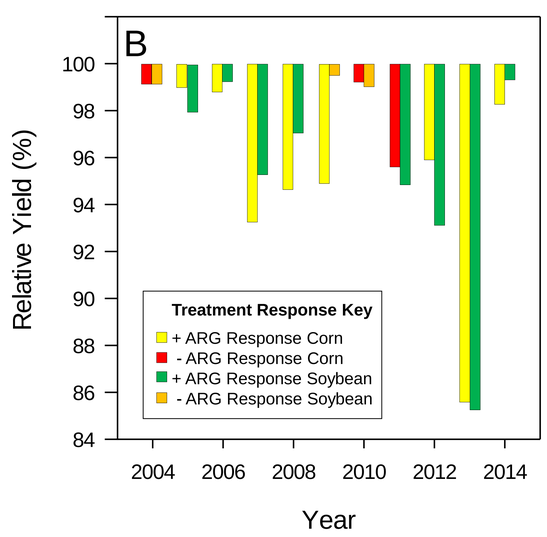
Methods

- Baseline soil samples (0-10 cm) were taken and analyzed in spring 2003 for total C and N, potentially mineralizable C and N, and β-glucosidase enzyme activity.
- Each year was sampled and analyzed post-harvest.
- Corn-soybean (C-S) was the sole rotation from 2003 to 2011.
- In 2012 corn-soybean-wheat (C-S-W) rotation was included and was carried out for three years.
- From 2003 to 2011 annual ryegrass (ARG) was the sole cover crop.
- In 2012 hairy vetch (HV) and oilseed radish (OSR) were included into treatments.

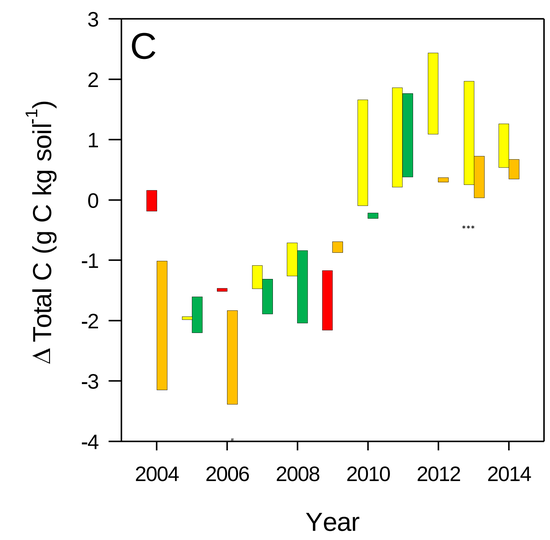
Change from Baseline Soil β-Glucosidase



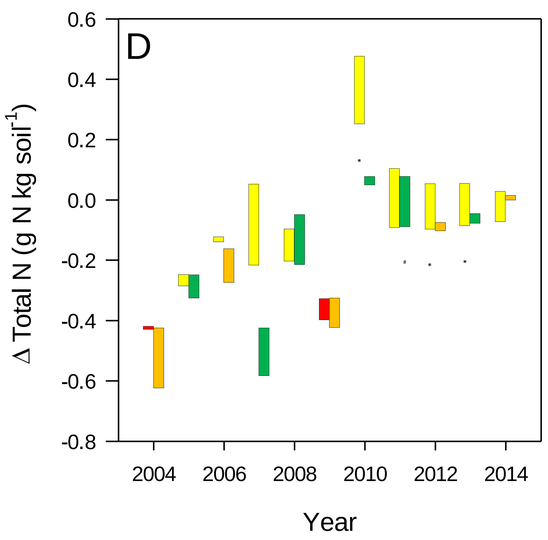
Corn and Soybean Relative Yield



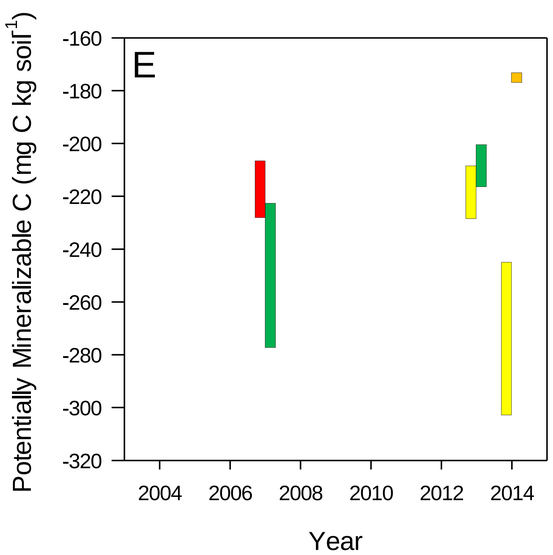
Change from Baseline Soil C



Change from Baseline Soil N



Change from Baseline Mineralizable C



Change from Baseline Mineralizable N

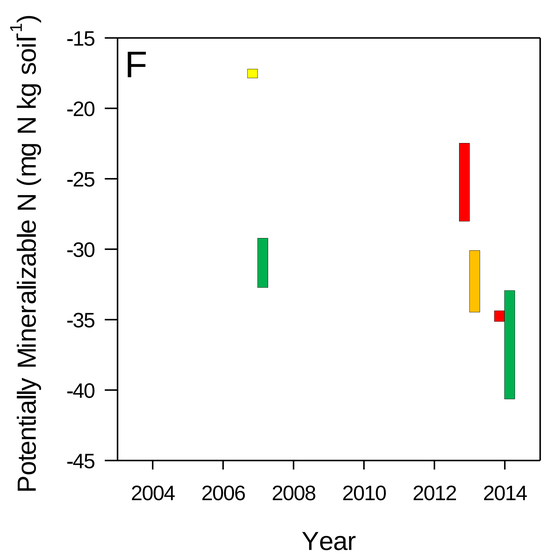


Figure 1: Changes in total soil C and N, potentially mineralizable C and N, β-Glucosidase, and relative yield from 2003 baseline levels owing to annual ryegrass cover crop.
*, **, and *** indicate significant differences between cover crop and control at the 0.1, 0.05, and 0.01 probability levels for corn.
#, ##, and ### indicate significant differences between cover crop and control at the 0.1, 0.05, and 0.01 probability levels for soybean.

Results

- Significant cover crop X year interaction for corn and soybean BG (Figure 1A).
- Significant cover crop X year interaction for corn and soybean yield (Figure 1B).
- No significant effect of cover crops for any one year for any crop yield (Figure 1B).
- Yield stability for corn and soybean was greater in cover crop treatments (lower standard deviation) (data not shown).
- ARG > no cover for corn and soybean
- Significant cover crop X year interaction for corn and soybean total C (Figure 1C).
- Significant cover crop X year interaction for corn and soybean total N (Figure 1D).
- C_{min} and N_{min} were significantly greater in C-S rotation (Table 1).
- BG was greater in C-S-W rotation (Table 1).
- Corn yield was greater in C-S rotation (Table 1).
- Soybean yield was greater in C-S-W rotation (Table 1).
- Yield stability was greater for corn in C-S and greater for soybean in C-S-W (Table 1).

Rotation	Total C (g C kg soil^{-1})	Total N (g N kg soil^{-1})	C_{min}† (mg C kg soil^{-1})	N_{min}‡ (mg N kg soil^{-1})	BG§ (μg PNP g soil^{-1} hr^{-1})
C-S*	18.7	1.65	469	38.6	165
C-S-W#	18.9	1.67	368	23.9	217
***P*-value**	*NS*	*NS*	*0.0003*	*<0.0001*	*0.0003*

Rotation	Corn Yield (kg ha^{-1})	Corn SD††	Soybean Yield (kg ha^{-1})	Soybean SD
C-S	11253	757	3299	354
C-S-W	10153	1411	3351	274
***P*-value**	*0.0482*		*NS*	

Table 1: Total soil C and N, potentially mineralizable C and N, β-Glucosidase, and relative yield owing crop rotation. Significant differences between crop rotations are indicated by *P*-value.
†C_{min}, Potentially Mineralizable C
‡N_{min}, Potentially Mineralizable N
§BG, β-Glucosidase
*C-S, Corn-Soybean Rotation
#C-S-W, Corn-Soybean-Wheat Rotation
††SD, Standard Deviation

Acknowledgements

We thank Rhonda Graef and Art Martin for their excellent technical assistance. Photo credit: Stan Livingston. This work was supported by the USDA-ARS. The USDA is an equal opportunity provider and employer.