Trends in Soil Ecosystem Function Along a Gradient of Plant Diversity in Agricultural

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Introduction

Modern row crop agriculture is under pressure to increase food, fiber and fuel production, while reducing environmental impacts. A proposed method to achieve these goals is to offset external agronomic inputs by stimulating ecosystem processes via increasing plant diversity in cropping systems. This study examines a gradient of rotational and cropping system complexity for trends in nutrient stocks and turnover , and some of the microbially mediated processes in nutrient cycling. In particular we examined patterns emissions of carbon dioxide and nitrous oxide and speculate on the potential source of these across the gradient.

Methods

Experimental set-up: Treatments were established in 2000 in four randomized blocks (each plot 9m x 27m). No fertilizer is applied and weeds are controlled mechanically

Treatment ID	Rotation	Plants/ year	Plants/ Rotation
C	corn	1	1
S	soy	1	1
CS	corn+soy	1	2
WCS	wheat+corn+soy	1	3
Fspring	Fallow (spring till)	5-7	~15
WCS1cov	wheat+corn+soy + clover	2	4
WCS2cov	wheat+corn+soy +clover+ rye	3	6

- Soil sampling occurred for 2010 and 2011 growing season at six time points.
- Enzynme activities were measured on fresh soils normally within 24 hours after field sampling.
- Trace gas sampling occurred at 10 time points during 2010 and 2011 from static chambers installed in each plot.
- Soil DNA was extracted, amplified with *nirK* (nitrite reductase) primers using PCR and sequenced using 454 pyrosequencing.

Results

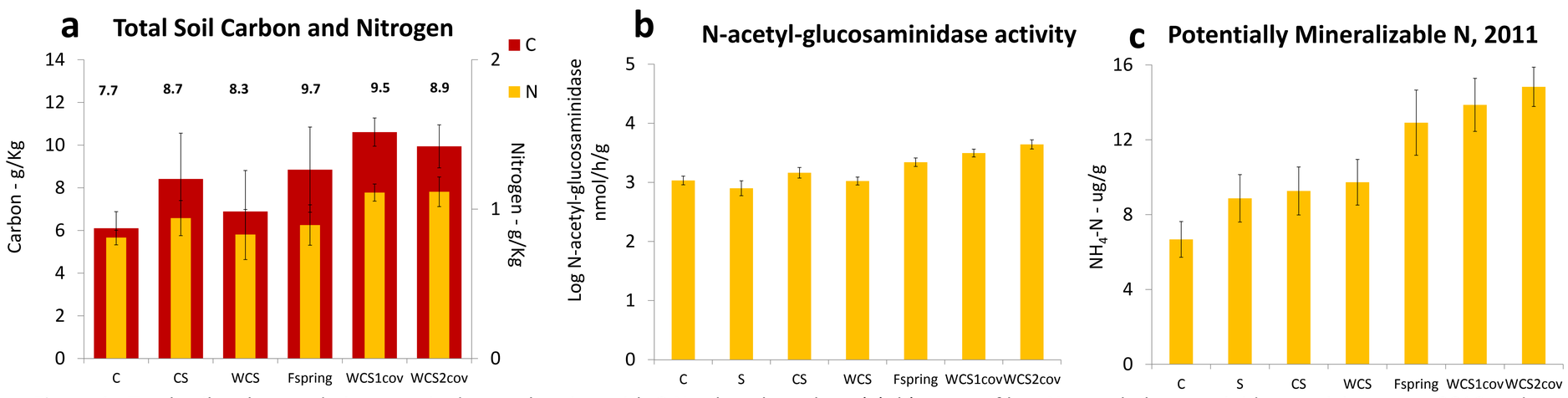

Figure 1. Total soil carbon and nitrogen via dry combustion with C:N value above bars (a), b) mean of log N-acetyl-glucosaminidase activity across 2010 and 2011, at 6 time points each year.(b), and potentially mineralizable nitrogen (PMN) measured as the change in ammonium concentration after seven day anaerobic incubation (c). All error bars are standard errors

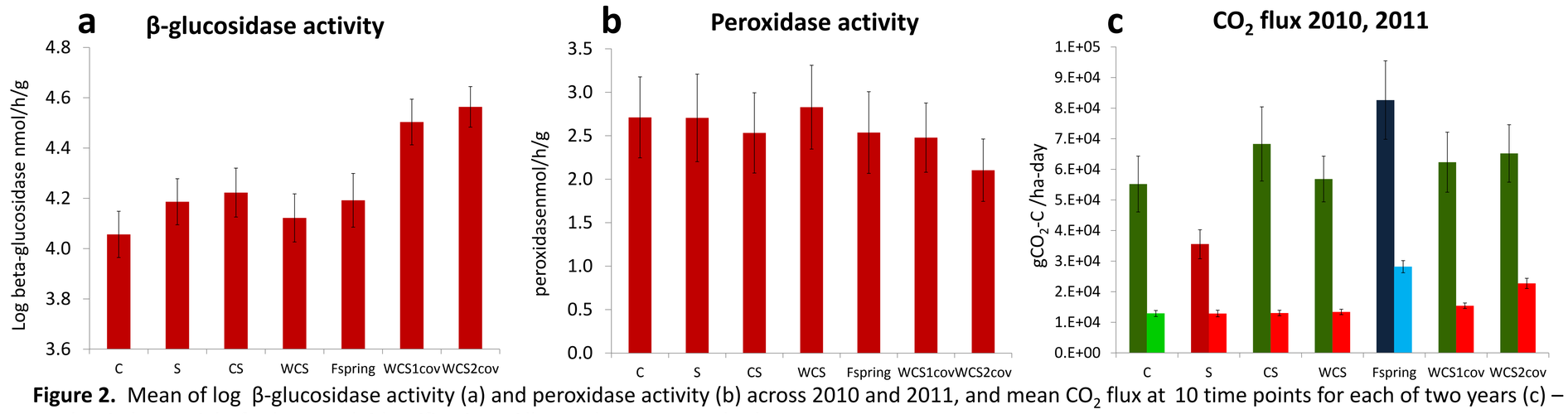

Figure 2. Mean of log β-glucosidase activity (a) and peroxidase activity (b) across 2010 and 2011, and mean CO_2 flux at 10 time points for each of two years (c) – see key in lower right for bar graph identification. All error bars are standard errors.

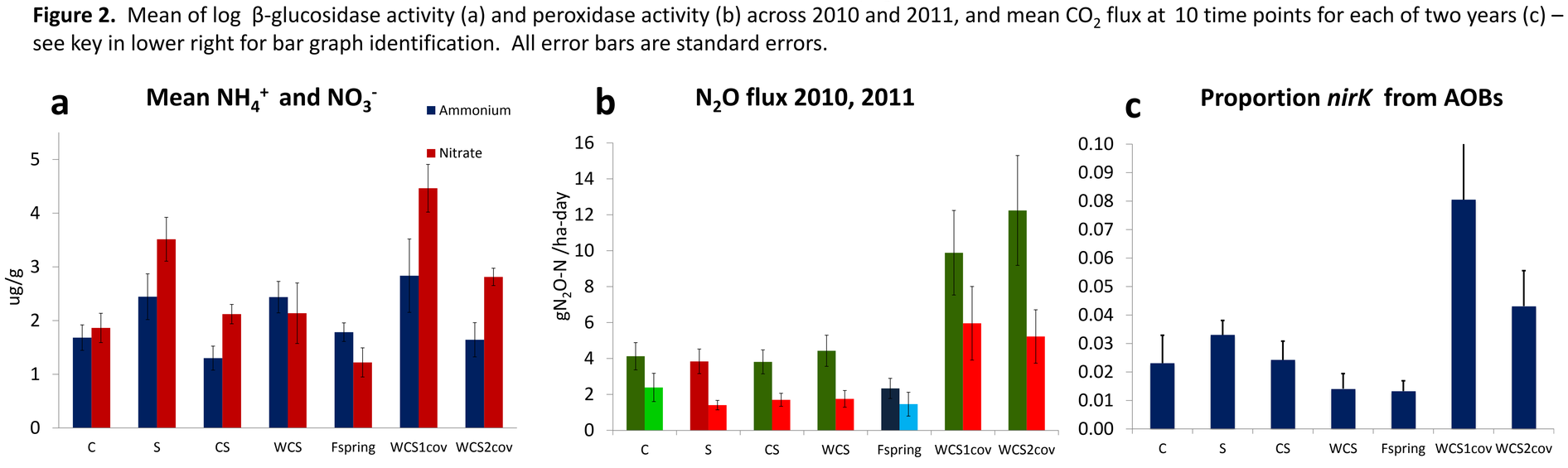

Figure 3. Mean of soil nitrate and ammonium concentration across 2010 and 2011, at 6 time points each year(a), mean N_2O flux at 10 time points for each of two years (b) and proportion of nitrite reductase gene (nirK) from ammonia oxidizing bacteria out of all nirK pyrotag sequences (c).

Conclusions

- Cover crops increased total soil carbon and nitrogen (fig. 1a) , and possibly the rate at which N is mineralized (fig. 1 a and b).
- Rate of carbon mineralization of carbohydrate C was higher in cover cropped systems compared to monoculture systems regardless of rotational complexity (fig. 2a). Enzymes associated with more recalcitrant carbon were more active in soils with reduced agricultural diversity (fig. 2b), but *in situ* carbon dioxide flux did not vary as much across the gradient (fig 2c).
- Nitrous oxide flux was higher in cover cropped systems (fig. 3a), and there is some indication that cover crop systems enriched for nitrite reductases (precursors of nitrous oxide production) asspocaited with ammonia oxidizing bacteria.

Trace Gas Key

Year	2010	2011
Corn		
Soy		
Fallow		

Acknowledgments

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