Wisconsin Dairy vs. Grain Rotation: How big are the differences in soil health?
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Abstract
Labile soil carbon (C) and nitrogen (N) dynamics are key variables in soil health assessments. Understanding these dynamics will provide a better understanding of how seasonality and various cropping systems influence soil C and N. Forage-based systems commonly used on dairy farms have greater perenniality in their rotation which resulted in greater PMN and POxC values, with PMN generally increasing during the production season until September. Though the difference in soil health between the grain and forage system were not extreme in this study, they suggest that grain system changes such as tillage reduction and intensive cover cropping are required to increase labile soil C and N.

Materials and Methods

Objectives
• To determine how common mid-western cash grain and forage cropping systems affect labile soil C and N.
• To determine how these labile C and N pools change with depth and time.

Materials and Methods

Location:
• Wisconsin Integrated Cropping Systems Trial (25 ha) at the South-Central Wisconsin Arlington Research Station in Arlington, WI (43°18′N;89°21′W).

Soil Type:
• Deep, well-drained Typtic argiudall (Mollisol).

Cropping Systems (CS) Analyzed:
• Continuous corn (CC), strip till corn/soybean rotation (CS-ST), organic corn/soybean/winter wheat/berseem clover and oats (CSWB), corn/alfalfa/alfalfa/alfalfa (CAAA), organic corn/oats-alfalfa/alfalfa (COA), and pasture (PAS).

Planting and Harvest Dates:
• Harvest date: 10/20/2016.

Management:
• Manure applied to CSWB (4/20/2016 at 1.8 ton/ac), CAAA (11/20/2015 at 14,000 gal/a), and COA (11/20/2015 at 14,000 gal/a).
• Pasture rotationally grazed by dairy heifers.
• Organic cropping systems were cultivated every week in June.

Experimental Design
Randomized complete block design
• Sampling Depths:
  • 0-15 cm
  • 15-30 cm

Sampling Dates
• Mid-month in May, June, July, August, September

Measured PMN of samples
• Samples were incubated at 40°C under anaerobic conditions and extracted using 2M KCl (Drinkwater, 1996).

Measured POxC of samples
• Carbon was oxidized with permanganate solution in 18 mL H2O (Calman et al., 2013).

Statistical Analysis
• Analyzed using Proc Mixed in SAS.

Conclusions
• There was a significant difference in POxC values among treatments for two out of the five sampling dates.
• The cash grain systems had generally lower POxC values in the beginning of the growing season.
• General in-season trends for PMN and POxC are different among treatments.
• There was a significant difference in PMN values among treatments for four out of the five sampling dates.
• Certain treatment’s mineralizable N pools are being replenished mid-season, while others are continuously replenished throughout the growing season until September.

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• USDA NIFA AFRI CAP Grant (Dairy CAP).

In-season Variation of POxC & PMN

Soil Depth Effects on POxC & PMN

Relationship between POxC & PMN

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