

Effect of manure and perennials on soil health indicators in the Red River Valley

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Highlights

- Soil health indicators were responsive to management practices on heavy clay soil in the Red River Valley.
- Solid dairy manure history improved active carbon, total organic carbon, soil protein, and potentially mineralizable nitrogen.
- Perennial crop history improved potentially mineralizable nitrogen, soil respiration, and aggregate stability.
- The perennial crop history soil health legacy improved wheat yield in a drought year.

Introduction

Improving soil health will make agriculture more sustainable on the prairies. The Comprehensive Assessment of Soil Health (CASH) is a soil health test developed by Cornell University. CASH uses 13 different tests known as soil health indicators to measure soil health. Little soil health research has occurred in Manitoba and there is a need to understand and measure soil health in Manitoba in order to improve agriculture's resilience to climate change. The objective to this research was to determine if soil health indicators were sensitive to manure history and perennial history in the Red River Valley.

Materials & Methods

Samples were taken in fall of 2020 from a selection of treatments at the NCLE Long Term Field Laboratory in Glenlea, MB using the bread slice technique to a depth of 6 inches. The NCLE long term field laboratory is a randomized complete block design with a split-split treatment structure. The main plot, crop history (2007-2019) contains annual and perennial history. The first split, fertility history (2007-2015), contains a control, synthetic fertilizer, liquid pig manure and solid dairy manure. Since 2019 fertilization has been the same across all fertility treatments. In 2021 a wheat test crop was grown. To analyze the data an ANOVA with an alpha of 0.05 was conducted using Proc Glimmix ran on SAS 9.4.

Table 1. Soil health indicators sensitive to fertility history

Treatment	Active carbon	Total organic carbon	Soil Protein	Potentially Mineralizable Nitrogen
	mg/kg	%	ug/g	mg/g/day
Control	738.6 b	2.7 b	3.1 b	2.3 b
Synthetic Fertilizer	759.8 b	2.9 b	3.6 b	2.8 ab
Liquid Pig Manure	810.7 ab	2.9 ab	4.0 ab	3.3 a
Solid Dairy Manure	887.5 a	3.5a	4.3 a	3.6 a

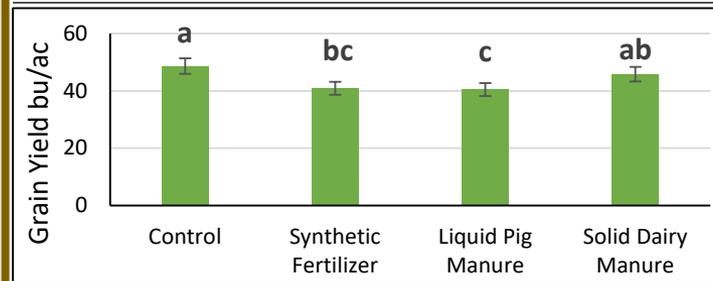


Figure 1. Wheat grain yield for fertility history in 2021.

Treatment	Potentially Mineralizable Nitrogen	Soil Respiration	Water Stable Aggregates
	mg/g/day	mg/g/day	%
Perennial	3.51 a	20.32 a	96 a
Annual	2.46 b	16.26 b	93 b

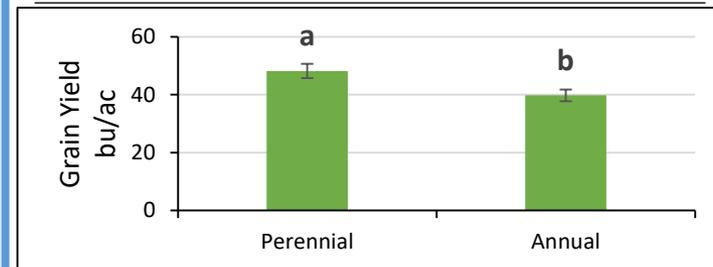


Figure 2. Wheat grain yield for crop history in 2021.



Figure 3. Areal image of NCLE Field Laboratory

Results

- History of Solid dairy manure was the most effective at increasing soil health indicators. It was higher than the control for active carbon (POXC), total organic carbon (TOC), soil protein, and potentially mineralizable nitrogen (PMN). History of Solid dairy manure was higher than the synthetic fertilizer for 3 indicators, POXC, TOC, and soil protein (Table 1).
- There was no difference between synthetic fertilizer and liquid pig manure for all four indicators while liquid pig manure was higher than the control for PMN.
- PMN, soil respiration and wet aggregate stability (WSA) were responsive to crop history. Perennial crop history improved all three indicators compared to annual crop history (Table 2).
- Soil with perennial crop history had higher grain yield than soil with an annual crop history in 2021 (Figure 2).
- Increased Soil health indicator values for fertility history did not translate into increased yield for 2021. "Haying-off" maybe occurring due to the drought conditions (Figure 1).

Acknowledgements

