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## NCLE Long Term Field Laboratory Phase III – Soil Health Benefits

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Inclusion of perennial forages in crop rotations has demonstrated benefits to carbon (C) sequestration, reduction in nitrogen (N) losses to the environment, soil P draw-down, and general improvement of soil health for annual grain production in the Canadian Prairies. Unfortunately, we have observed in studies that the benefits to annual grain crops in the Red River of Manitoba of previous perennial forage cropping are short lived. However, recent developments in improved cropping methods such as cover cropping, strip tillage and prediction of N supply capacity of soil provides an opportunity to test if the benefits of previous perennial forage cropping can be preserved.

This project is possible by utilizing the NCLE (National Centre for Livestock and the Environment) Long-Term Field Laboratory at the Glenlea Research Station, University of Manitoba.

**Phases 1 & 2:** This field lab was established by Dr. Don Flaten in fall 2007. For the first eight years (Phase 1, from 2007 to 2015), treatments and measurements focused on the availability and uptake of N and phosphorus (P) from annual applications of commercial fertilizer, compared to annual and intermittent applications of liquid pig manure, solid pig manure and solid dairy cattle manure in two long term crop rotations (annual crops and perennial grass forage). Phase 2 (2015-2019) shifted management and focused on the effects of the previous applications of manure N on release of N from soil to crops, the effect of suspending manure application for several years on the draw-down of soil test P, and the availability of N and P from liquid and solid manures applied during Phase 1 to annual and perennial crop yields.

**Phase 3:** New direction - to build soil health and preserve the benefits of perennial forage cropping for grain production phases of crop rotations on the Prairies. Specifically, the objective is to test if a suite of soil improvement practices, referred to as the Soil Building treatment, maintains better soil health conditions, improved N release for crop uptake, soil C retention, and P draw-down, and reduced N losses to the environment than a Conventional Treatment. In Phase 3, the perennial managed plots of the field laboratory will be converted to annual grain cropping and contrasted to continuously annual cropped plots. Converted and continuous annual grain plots will be split to Soil Building and Conventional treatments. The Soil building treatment will include use of over-wintering cover crops, tillage reduction, manure addition, and accounting for N mineralization for setting manure and N fertilizer rates compared to the Conventional Treatment. The trial begins in 2019 with cropping years in 2020-2022.

**Importance of soil health:** The importance of soil health to improving the sustainable and environmental benefit of agricultural soils is increasingly being recognized. Soil health is an assessment of the biological, chemical and physical characteristics of soil to meet a range of ecosystem functions such as crop productivity and soil C retention. The Cornell Soil Health Test is widely being adopted in North America to gauge benefit of practices to soil health. The test is a framework based on; 1) measurement of indicators that represent critical soil processes, 2) scoring of measured values that allows for interpretation, and 3) linkage of identified constraints with management practices. The goal is to identify physical, biological and chemical constraints to crop productivity and production sustainability. The test has not been evaluated in Manitoba.

Questions to be addressed:

- Will soil building practices improve productivity, efficiency and soil health of continuously annual cropped clay soil?
- Will soil building practices preserve the improved soil health developed from perennial-grass forage cropping when transitioned to annual cropping?
- Will soil building practices interact with historical manure applications to more quickly increase soil health?

Soil health evaluation will be done based on; a) premise that reduction in nitrous oxide (N<sub>2</sub>O) emissions, increased carbon addition to soils, improved soil conditions, and reduced weed and crop competition, and b) Cornell Soil Test point to moving a production system in the right direction.

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