Developing a Soil Health Assessment Protocol for Saskatchewan Producers

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Introduction

Healthy soil is fundamental to a productive farming system. Soil health is defined as the capacity of soil to function and to sustain biological productivity, environmental quality, and plant health (Doran and Zeiss, 2000). Maintaining and building soil health is an essential component of any modern-day crop production plan.

Farmers need appropriate tools or methods for assessing and interpreting the soil health status of their soils; however, there is no standardized prairie-based soil health test available. Yet, soil health tests developed for other regions exist, such as the Cornell Soil Health Assessment. Developing a regional soil health test for Saskatchewan is needed for a more meaningful interpretation of prairie soil health.

The goal of this research is to develop the 'Saskatchewan Soil Health Assessment Protocol (SSHAP)', tailored to our prairie climate, representative agricultural systems, and major soil zones.

Materials

From Sept to Oct 2018, we initiated a soil sampling campaign across Saskatchewan. The selected sites include various Agri-Arm sites, producer fields, and AAFC long-term sites (Figure 1). The selected sites are representative of Saskatchewan agriculture as most sites were previously cropped with wheat or canola; other sites had barley, chickpea, lentil, field pea, soybean, potato, and green manure (Figure 2). Some native prairie samples were also collected. The samples cover most soil zones in prairie (Figure 3).

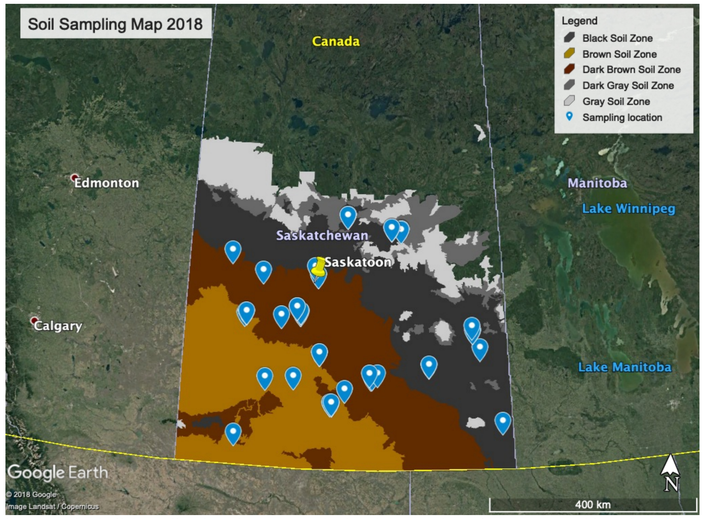

Figure 1. The Soil Sampling locations across Saskatchewan. The points are created based on the GPS coordinated. The soil sampling map overlay with Saskatchewan soil zones, the map resource retrieved from https://open.canada.ca/data/en/dataset/ac6a1e51-9c70-43ab-889f-106838410473.

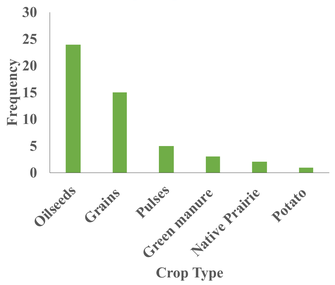

Figure 2. The frequency count for various crop types that were grown in 2018, prior to soil sampling.

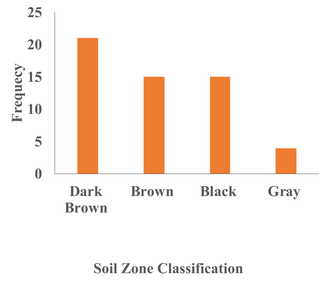

Figure 3. The frequency count for different soil zone classes that were sampled.

Methods

The development of SSHAP will be incremental, which each step building on the last (Figure 4).

- **Inventory of soil attributes:** We will quantify numerous soil attributes, such as: soil texture, available water capacity, surface hardness, subsurface hardness, aggregate stability, organic matter, soil respiration, active carbon, nutrient levels (including N, P, K, S, Ca, Mn, and micronutrients), soil protein, potentially mineralizable N, root pathogen pressure rating , soil pH and salinity. Figure 5 shows lab-work pictures of some soil attribute measurements.

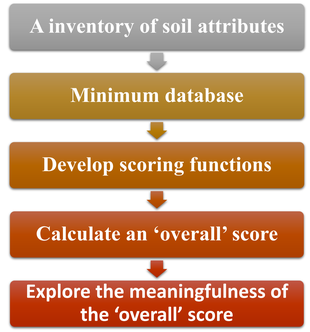

Figure 4. The framework for building the Soil Health Assessment Protocol.

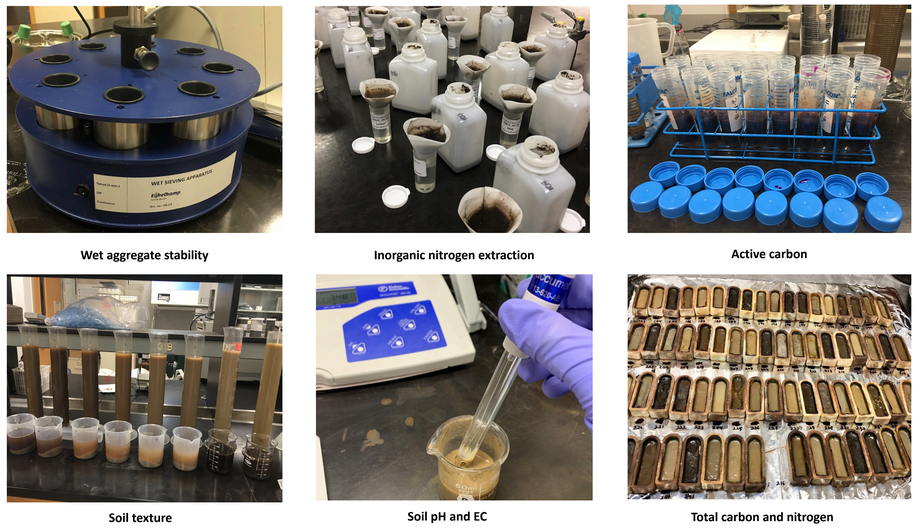

Figure 5. Photo examples for lab-work currently underway for some (but not all) soil attribute characterization. The photo credit for total carbon and nitrogen is Wenjie Chi.

- **Minimum database:** The soil attribute database will be analyzed by descriptive statistics and multivariate analyses. We are interesting in identifying the most representative attributes to describe soil health status in the semi-arid prairies. A 'minimum dataset' method for soil health interpretation will be considered. Expert opinion will also be used to facilitate the selection of soil attributes in the minimum database.
- **Developing soil scoring functions:** The dataset will enable descriptive statistics (and distribution curves) for each soil health attribute – from which scoring functions will be explored. Each soil attribute will be assigned a specific form of scoring (i.e., more is better, less is better, middle is best – see Figure 6).
- **The overall score calculation:** Since soil is a complex ecosystem, an equal contribution to each soil attribute may not accurately reflect the overall health status. To improve the meaningfulness of an overall score, we will develop a 'weighting' system to better calculate the overall soil health scores (Congreves et al., 2015). We will explore multivariate (i.e., PCA or least squares) approaches to do this. Other methods, such as ecosystem functioning indices will be explored.

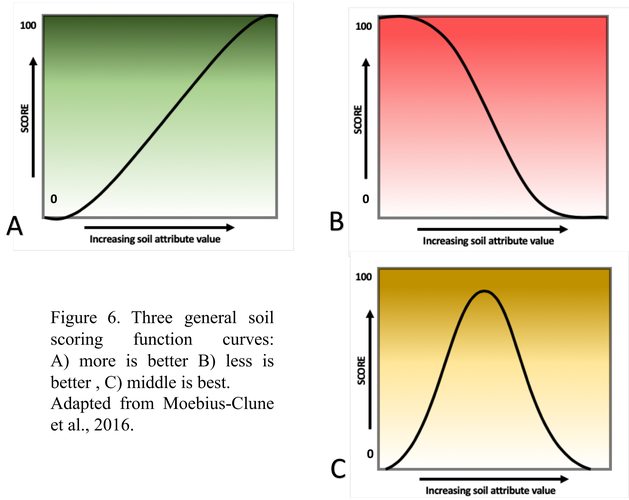

Figure 6. Three general soil scoring function curves: A) more is better B) less is better , C) middle is best. Adapted from Moebius-Clune et al., 2016.

Anticipated Outcomes

This project will develop a new producer-oriented manual describing the SSHAP. This manual will be produced, published, and distributed to Saskatchewan growers.

The SSHAP scores across the sampling locations will give clues about which management practices may help maintain or improve soil health. Maintaining soil health is an essential constituent of sustainable agriculture, and having an appropriate and standardized method for quantifying and interpreting soil health status is a logical first step.

Acknowledgements

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