

**Washington Grain Commission**  
**2023 Wheat and Barley Research Annual Progress Reports and Final Reports**

**Project #:** 144786

**Progress Report Year:**   1   of   3   (*maximum of 3 year funding cycle*)

**Title:** Rapid and inexpensive measurements of soil carbon and sequestration potential in grain systems

**Cooperators:** Haly Neely, Kirti Rajagopalan, Steve Culman, and Dani Gelardi

**Executive summary:** So far in Year 1, we had our initial team meeting (June 13, 2023) to discuss soil sampling timing and strategies. Based on prior team experience, we will begin collecting samples in March 2024. Sampling in the spring is preferred to fall sampling due to soil moisture conditions. PI Neely has hired a Visting Scholar who will assist in sample collection and processing. Samples will be sent to SoilTest Farm Consultants, Inc., after collection. We also plan to leverage the State of the Soils project co-led by Washington State Department of Agriculture (WSDA) and WSU. Collaborator Gelardi has access to hundreds of archived samples with associated laboratory data. These samples will be scanned in both Neely's and Culman's labs for additional data to build prediction models. We plan to begin scanning these samples in February.

**Introduction:** Carbon incentive programs are gaining traction in both the policy arena and the farming community. In addition to being a potential source of revenue, increasing soil organic carbon (i.e., soil organic matter) also provides important benefits including increasing soil moisture storage, nutrient storage and cycling, and overall soil health. Whether we want to increase soil organic carbon to sell carbon credits or to gain the potential soil health benefits, we need to know 1) what is the best sampling method to monitor carbon storage over time at the field-scale, 2) what are the best management practices to sequester carbon in each growing region, and 3) what is the maximum amount of carbon that a given soil can store? This project combines an experienced team, innovative sampling methodology, and cutting-edge technology to address these questions for Eastern Washington grain systems.

**Approach:** Over the course of the proposed 3-year project, we will collect soil samples from at least 25 fields across all grain production regions in Washington state. Within each field, we will use multiple datasets to help select 6-10 sampling locations that are representative of the field. We will run a suite of physical, chemical, and biological properties on samples including a focus on physical soil carbon fractions (particulate organic matter, POM; and mineral-associated organic matter, MAOM). In addition to lab-measured properties, soil samples will also be analyzed using mid-infrared (MIR) spectroscopy and we will identify specific spectral peaks that we can use as indicators of early soil carbon accrual and permanence. We will use the lab data and MIR spectra to build calibrated prediction models that translate MIR spectra to the fraction predictions we are interested in, allowing future efforts to rely on just spectral measurements instead of intensive soil sampling.

**Results:** No results to report.

**Impact:** Our *long-term* goal is to fill critical gaps in the measurement, monitoring, and verification of soil organic C levels, as well as the sequestration benefits from changing management practices. The global voluntary carbon credit market has been estimated to be worth over \$50 billion by 2030 according to a report from McKinsey & Company (Blaufelder et al., 2021) and interest continues to grow as more and more companies pledge to achieve carbon neutral status. The Pacific Northwest represents a significant potential opportunity for long-term, stable carbon storage (Brown and Huggins, 2012) but presents unique challenges including highly complex landscapes and fewer options to build soil organic carbon through practices such as cover cropping. There are no private companies working in this area in the Pacific Northwest to provide field-scale carbon measurements, and any tools and/or recommendations developed in other regions are not likely to be applicable due to our unique soils and growing conditions. Without reliable assessments of soil carbon and sequestration potential, we can't make recommendations to farmers for which carbon credit program is the most profitable or work towards developing programs that reward farmers for the carbon they've already stored.

Our *short-term* goal is to develop predictions models for MIR spectroscopy so we can make more measurements in more locations. We will also identify primary drivers of soil organic carbon storage. Additionally, PI Neely has had conversations with SoilTest Farm Consultants, Inc. (Moses Lake, WA) about the potential to commercialize these methods. CEO Kyle Bair is very interested in this project, and we will continue to work with SoilTest and other commercial soil testing laboratories on making these methods available to farmers as quickly as possible.

Blaufelder, C., C. Levy, P. Mannion, and D. Pinner. 2021. A blueprint for scaling voluntary carbon markets to meet the climate challenge.

<https://www.mckinsey.com/capabilities/sustainability/our-insights/a-blueprint-for-scaling-voluntary-carbon-markets-to-meet-the-climate-challenge#/> Accessed on Jan. 5, 2024.

Brown, T.T., and D.R. Huggins. 2012. Soil carbon sequestration in the dryland cropping region of the Pacific Northwest. *J. Soil Water Conserv.* 67:406-415; DOI:10.2489/jswc.67.5.406

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**WGC project title:** Rapid and inexpensive measurements of soil carbon and sequestration potential in grain systems  
**Project PI(s):** Haly Neely, Kirti Rajagopalan, Steve Culman, and Dani Gelardi  
**Project initiation date:** July 1, 2023  
**Project year (X of 3-yr cycle):** Year 1 of 3

Objective	Deliverable	Progress	Timeline	Communication
1. Develop MIR-spectroscopy calibrations for soil organic C fractions (POM, MAOM, POXC, etc.) including applying various predictive models to validate which models perform best for Washington state's grain production regions.	A soil library of hundreds of samples with laboratory data (including soil C fractions) and MIR spectra.	Additional projects to leverage have been identified and a plan for collecting MIR spectra has been established.	We expect to be able to complete this initial soil library in Years 1 and 2.	We take farmer privacy very seriously. The soils library will not be publicly available but data collected on fields will be provided to our collaborators.
	A preliminary model to predict soil C fractions from MIR spectra.		We expect to begin building this predictive model in Year 2 and have a validated model in Year 3.	Academic and extension publications, field day abstracts, and podcasts.
2. Validate sampling strategies for field-scale soil C assessment including quantifying uncertainty those C assessments across complex landscapes.	Detailed protocols for sampling complex landscapes for soil C and C fractions.	Soil sampling plan has been established and additional team member hired.	We expect to begin building these initial protocols in Year 2 and finalize them in Year 3.	Academic and extension publications, field day abstracts, and podcasts.

<p>3. Begin to identify the major factors driving soil organic C sequestration at the field-scale (management practices, climate, landscape position, soil type, management history, etc.) in grain production systems including reference states for C sequestration potential.</p>	<p>Ranked lists of environmental and management factors driving soil C sequestration that are region-specific.</p>		<p>We expect to finalize this deliverable in Year 3</p>	<p>Academic and extension publications, field day abstracts, and podcasts.</p>
	<p>Identify preliminary reference states for each major rainfall zone</p>		<p>We expect to finalize this deliverable in Year 3</p>	<p>Academic and extension publications, field day abstracts, and podcasts.</p>

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