Lead Organization Name: North Dakota State University

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Duration of Project: Three years

Project Title:
Cover Crops and No-Tillage Enhance Soil Water Management in Frigid Northern Great Plains Soils

Project in a Sentence:
This project will compare soil management approaches currently used in the northern Great Plains to manage excessively wet soil conditions with the modified practices (reduced tillage and/or cover crops) used to conserve and save soil moisture, providing direct benefit to agricultural producers by maximizing their potential to enhance soil water management, ultimately stabilizing crop yields, improving soil health, and conserving natural resources during future climate conditions.

Project Elevator Pitch:
The northern Great Plains has experienced a wet climate cycle for the last 30 years. The most common practice for managing excess soil water in annual cropping systems is with frequent chisel plowing to facilitate soil warming and drying prior to spring planting. Many annual crop producers have only experienced farming during this period and are accustomed to managing cold, wet soils. However, future climate variability may cause producers to shift from managing excess water to conserving water during drought. No-tillage and the use of cover crops are currently alternatives to frequent tillage, and are increasing in popularity among regional farmers, especially to improve soil health. There is a scarcity of data-supported knowledge on how different tillage and cover crop practices influence water budgets, soil health, and farm economics across different soils, crop rotations, and climate scenarios. The objectives of this project are to 1) establish full-production scale demonstration sites to allow side-by-side comparisons of tillage and cover cropping practices available for managing soil water and improving soil health, 2) quantify water budgets under different tillage and cover cropping treatments as they relate to cash crop water use and yield, 3) assess soil health in response to these treatments, 4) develop economic models that incorporate the value of water availability to cash crop production along with expenses associated with different tillage and cover cropping practices, evaluating the profitability of a set of practices under variable precipitation and water use conditions, and 5) distribute information about feasible water management options under variable weather.
conditions to farmers, agronomists, educators, and scientists through field days at the demonstration sites, circular media, videos, and presentations.

**Deliverables:**

Based on field results, educational materials (print and electronic) suitable for producer workshops, classroom curricula, and on-line tutorials will be developed. These materials will discuss the importance of managing soil water in the face of climate variability and the impact of tillage and cover crops for sustaining soil health and maintaining long-term productivity. These materials will be distributed to regional producers, agronomists, and agency personnel during field days, workshops, and cafe talks. Results from the research objectives will be published in the North Dakota Research and Extension Station bulletins and newsletters, NRCS fact sheets, videos, podcasts, circulars, and project updates, made available on the NDSU Soil Health (www.ndsu.edu/soilhealth) and the SDSU iGrow (http://igrow.org/) webpages. Project results will also be presented at state and national soil and water quality conferences, extension programs, field days, and tours. The project will provide opportunities for graduate student training and contributions to the scientific and agronomic communities beyond the Dakotas.

Deliverables and products will also include:

1. Mechanistic knowledge on the controls and soil water intake, storage, use, surplus, and deficit under interacting effects of tillage and cover crop practices across a range of soil types and climates. This information will provide guidance on managing water for the short (within year) and long term (future forecasting).

2. Understanding of how soil's physical, chemical, and biological properties respond to implementation of tillage and cover cropping practices, and how these properties relate to water budgets, drought mitigation, and soil resilience to extreme events. This information will provide guidance on the value of soil health for water management and soil resilience to climate extremes, as well as a risk/benefit analysis of cover crop use in the region.

3. Economic decision-support tools for producers on the feasibility, costs, and benefits associated with water management technologies (tillage and cover crop practices).

**How We Are Innovating in Natural Resource Conservation:**

This project innovates natural resources conservation by aiming to better understand the risks and benefits associated with tillage and cover crop practices and, therefore, to quantify positive and negative impacts of these practices on soil and water quality. Specifically, potential impacts of conservation tillage, coupled with the use of cover crops, may include reducing wind erosion (improved air quality), increasing water use efficiency (improved plant health), and increasing plant nutrient use efficiency (improved water quality and plant health). It is anticipated that the different practices will highlight opportunities to minimize agronomic inputs while improving efficiencies.

Currently, no-tillage practices are popular among farmers located in central North Dakota and central South Dakota. A project goal is to increase no-tillage knowledge and adoption in eastern North Dakota and South Dakota. Because the region has experienced wet conditions for 30 years, young producers do not have experience with crop production during dry periods. Yet, they are an innovative group that would benefit from more knowledge of water management technologies across climate extremes. This will be facilitated by establishing full production-sized
demonstration sites to allow side-by-side comparisons of 1) soil management approaches currently used to manage excessively wet soil conditions and 2) modified practices (reduced tillage and/or cover crops) to conserve and save soil moisture. These demonstrations will directly benefit agricultural producers and maximize their potential to stabilize crop yields, soil health, and conserve natural resources during future climate conditions.