Greenhouse Gas Fluxes and Soil Carbon and Nitrogen Cycling following Chisel Plow Application in Winter Wheat Cropping System

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Rationale: Disturbance in the form of tillage can increase soil carbon and nitrogen cycling. Tillage is commonly used to control weeds and prepare fields for planting. Repeating this practice can result in increased soil drying, sudden bursts of mineralized carbon and nitrogen from soil organic matter, and alterations in soil microbial communities.

When priming (a flush of carbon and nitrogen into the soil matrix) occurs, soil organic matter is mineralized and converted to plant- and microbe-usable forms of carbon and nitrogen. However, if the carbon or nitrogen is not immediately immobilized, it is further processed by microbes and released to the atmosphere as greenhouse gases (GHG) in the form of carbon dioxide or nitrous oxide in semi-arid regions.

The effects of tillage on winter wheat cropping systems of the Southern Plains is not well understood. The use of tillage tools can impact the nutrient cycling of soils and GHG flux. The impact of tillage equipment on disturbance of soil is well established, however, has not been studied in the Southern Plains' Winter Wheat production system.

Revision to classic field management strategies could lead to stored carbon and nitrogen, which in turn would enhance soil organic matter and ideally reduce greenhouse gas emissions. Knowledge of how different tillage practices alter soil priming and GHG emissions will help to establish sustainable management practices and improve ecosystem services, while reducing input cost.

Objective: Determine the impact of chisel plow tillage tool use on soil priming of carbon and nitrogen cycling and GHG flux in winter wheat production.

What we are doing: We established two half-acre wheat plots that represent chisel plowing (conventional tillage), and no-tillage (control) treatments. Within each treatment five replicates were established to monitor the effects of tillage treatments over 336 hours after tillage. Each plot was monitored for soil carbon, soil nitrogen, soil water content, soil microbial community, and GHG (carbon dioxide, nitrous oxide, and methane) assimilation at time zero, 3, 6, 9, 24, 48, 96, 168, and 336 hours after tillage. Study was conducted in July of 2015 and 2016.

Treatments include:
1) Winter Wheat Production-Post Harvest with Chisel Plow
2) Winter Wheat Production-Post Harvest No-Tillage (Control)

Soil Analyses at each time period:
Soil water content
Soil Inorganic Nitrogen- Ammonium and Nitrate Content
Total Nitrogen
Dissolved Organic Nitrogen
Microbial Biomass Nitrogen
Total Carbon
Dissolved Organic Carbon
Microbial Biomass Carbon
Microbial Fatty Acid Community Assessment

Greenhouse Gas Analyses at each time period:
Carbon Dioxide
Nitrous Oxide
Methane

Proposed Evaluations:

- Assess cumulative greenhouse gas flux given tillage type.
- Determine soil priming caused by tillage and respective types.
- Determine how tillage post application affects microbial community changes.

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