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Monitoring of Seasonal Soil Nutrient Cycling and Greenhouse Gas Flux in the Southern Plains

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Rationale: Climate variability in the Southern Plains region of the US is an abiotic factor that could greatly alter management plans for regional land stewards. As land managers, we often plan for ideal weather and in-turn experience 100-year rains or prolonged drought that affect not only our crops, but the nutrient cycling that occurs in the soil.

Severe drought in the region is not uncommon, but reduces biomass production, perennial forage quality, and livestock production. Much of the Southern Plains region relies on summer forage production in perennial grasslands to reduce the need for supplemental forage to livestock and the potential trucking of feed from outside the region. During the winter, annual production systems such as winter wheat supplement forage.

In the region, natural disturbances, like prolonged drought followed by intense rainfall, are speculated to occur, but anthropogenic disturbances like tillage, burning, and input addition also can affect soil nutrient cycling. Management practices can cause excessive soil organic matter mineralization. When the soil system does not have an established growing crop or microbial population, the usable carbon and nitrogen from the soil organic matter can be lost in the form of greenhouse gas emissions.

Knowledge of how common management practices of the Southern Plains' perennial and annual cropping systems alter soil nutrient cycling and greenhouse gas emissions will help to determine drivers in greenhouse gas emissions and establish sustainable management practices in the future to ensure agricultural resources.

Objective: The overall objective of this study was to monitor the seasonal effects of soil C and N cycling in perennial grasslands of the Southern Plains.

What we are doing: We have evaluated native, non-native, and annual crops since 2015 for changes in soil carbon and nitrogen cycling. We have monitored treatments throughout the whole year, paying close consideration to natural and anthropogenic disturbances.

Treatments include:

1) Native Cool-Season Pasture (Control) - GRL, Samuel R. Noble Foundation and Marena Prairie
2) Non-native Warm-Season Pasture (Control) - GRL
3) Winter Wheat Conventional and No-Tillage - GRL
4) Winter Canola Conventional and No-Tillage - GRL

Soil Analysis 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 Analysis at each time period:

Carbon Dioxide
Nitrous Oxide
Methane

Proposed Outcomes:

- Assess cumulative greenhouse gas flux given wetting.
- Determine soil priming caused by wetting.
- Determine how soil wetting affects microbial community changes post application.

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