Evaluating Carbon Sequestration in CRP and Restored Grasslands in the North Central U.S.

Jason Riopel and Larry Cihacek, North Dakota State Univ.

Abstract

Terrestrial sequestration of CO_2 as soil organic matter in cropland and restored grasslands has been proposed and promoted as a means to offset CO_2 emissions in the United States. A study was conducted to discover the relationship between age classes of Conservation Reserve Program (CRP) soils and the amount of organic carbon that is stored in the soil. Samples have been collected from five northern Great Plains states in an effort to set benchmark values for carbon sequestration rates for different year classes of CRP and the major soils associated with them. Study sites were selected and placed into a sampling matrix that classified different CRP year classes along with native prairie and cropland as two controls. One sample point was taken for every four hectares within a field and sample locations were distributed between the soil series and landscapes present within the field. At each sample point, five cores were collected and the 0-15 cm and 15-30 cm portions of the cores were separately composited and analyzed for organic carbon content. From data evaluated thus far, there appears to be a relationship with the age of grassland and the amount of organic carbon that is stored within the soil. The potential threshold point for the system to store organic carbon has been obtained from the native prairie systems.

Objective

To understand the relationship between grassland age and amount of carbon sequestered into the soils of the Great Plains.

Soil Tests

Samples were analyzed for volumetric moisture % and bulk density was determined. Organic carbon was determined using a high temperature combustion method by the NDSU Soil and Water Environmental Laboratory.

Methods

At sampling locations, five soil samples were taken with a hand probe. The top 0-15 cm and bottom 15-30 cm portions of the sample were composited in separate bags. Results will indicate a composite of the samples and be reported as 0-30 cm. After the samples were collected notes were taken to record vegetation, landscape position, GPS coordinates, and other unique characteristics about the sampling location (Figure 2).

Figure 2. Example of a study site.

Table 1. Summary of Grassland Carbon Sequestration Rates

Area	All Data (g/ha)
Montana	0.45 ± 2.10
Minnesota	-0.05 ± 2.00
North Dakota	0.23 ± 2.14†
North Dakota – Sheridan County	0.43 ± 1.96
South Dakota - Central	0.41 ± 1.52
South Dakota – North Central	0.35 ± 1.69
North Central Iowa and Southern Minnesota	0.31 ± 2.10

† Preliminary 2008 data

Figure 1. Study site locations.

Results

Throughout the Prairie Pot Hole Region, there appears to be a relationship between age of grassland and the amount of organic carbon stored within the soil (Table 1). It also appears that there is a relationship between organic carbon sequestered into the soil and spatial differences in temperature, rainfall, and previous crop management practices (Figure 10). The different regions throughout the Prairie Pot Hole region appear to have different rates of sequestering organic carbon into the soil (Figures 3-10).

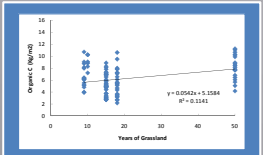

Figure 3. North Dakota Organic Carbon Sequestration Summary
† Preliminary 2008 data

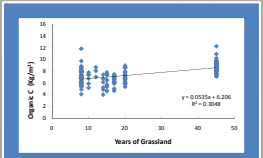

Figure 4. Central South Dakota Organic Carbon Sequestration Summary

Summary

The climate, temperature, and rainfall gradient that is present in the study region appears to impact rates of carbon sequestration within the soil.

Agricultural farming practices appear to have affect organic carbon in the soil. Preliminary data indicates differences in organic carbon levels as related to previous crop-fallow, continuous cropping, and no till management practices.

Due to the apparent relationships between age of grassland and soil carbon, grasslands can be used in conjunction with carbon markets and the regulation or mitigation of anthropogenic releases of CO_2.

Sampling Locations

Sampling regions are in north eastern Montana, central North Dakota, east central North Dakota, north central South Dakota, central South Dakota, western Minnesota, south central Minnesota, and north central Iowa (Table 1). These areas were selected in conjunction with previous long-term wetland studies conducted by the U.S. Geological Survey. The sites give a good representation of the Prairie Pothole Region of the United States.

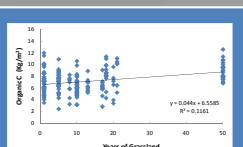

Figure 5. Eastern North Dakota-Sheridan County Organic Carbon Sequestration Summary

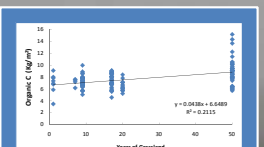

Figure 6. North Central South Dakota Organic Carbon Sequestration Summary

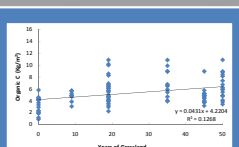

Figure 7. Montana Organic Carbon Sequestration Summary

Acknowledgments

This work was sponsored in part by US-DOE Plains CO_2 Reduction Partnership (PCOR) and Ducks Unlimited Inc.

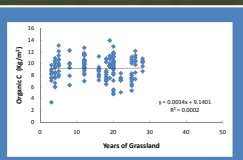

Figure 8. Western Minnesota Organic Carbon Sequestration Summary

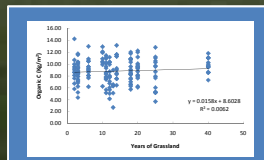

Figure 10. North Central Iowa and Southern Minnesota Organic Carbon Sequestration Summary

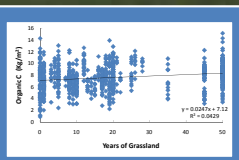

Figure 9. Six Study Regions Organic Carbon Sequestration Summary

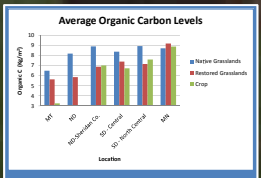

Figure 10. Average Organic Carbon Levels Across Six Sampling Areas.