Eastern South Dakota Soil and Water Research Farm

Purpose: to find solutions to national and regional concerns related to soil and water conservation and the efficiency and sustainability of agricultural production.

Goal: to conduct research and provide technology transfer in areas that are directly or indirectly related to clean water, clean air, soil stewardship, and sustainable agriculture.

Research and technology transfer activities on the farm are conducted by a partnership including: USDA-Agricultural Research Service, USDA-Natural Resources Conservation Service, South Dakota State University, South Dakota Agricultural Experiment Station, and Brookings County Conservation District.

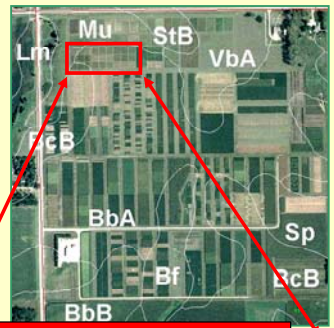
Farm Board of Directors

The 150 acre farm is located approximately two miles north of the campus of South Dakota State University.

Research Farm Soil Taxonomy and Map Unit Names

These soils are characteristic of those found in northeastern South Dakota and west central Minnesota and are similar to soils common to the northern corn belt.

Symbol	Map Unit Name (US Soil Taxonomy)
Bf	Brookings silty clay loam (Fine-silty, mixed, superactive, frigid Aquic Hapludolls)
VbA	Vienna-Brookings complex: Vienna silt loam and Brookings silty clay loam (Fine-silty, mixed, superactive, frigid Aquic Hapludolls and Fine-loamy, mixed, superactive, frigid Calcic Hapludolls)
StB	Strayhoss-Maddock complex (Strayhoss loam and Maddock sandy loam) (Fine-loamy over sandy, mixed, superactive, frigid Calcic Hapludolls and Sandy, mixed, frigid Entic Hapludolls)
Sp	Spottswood clay loam (Fine-loamy over sandy or sandy-skeletal, mixed, superactive, frigid Aquic Hapludolls)
BbA BbB	Barnes clay loam: 0-2% and 2-6% slopes (Fine-loamy, mixed, superactive, frigid Calcic Hapludolls)
Mu	McIntosh-Lamoure 0-2% slopes (Fine-loamy, mixed, superactive, frigid Calcic Hapludolls)
BcB	Barnes-Buse loams (Fine-loamy, mixed, superactive, frigid Calcic Hapludolls and Fine-loamy, mixed, superactive, frigid Typic Calciudolls)



Experimental Treatments and Seeding Rates

Grass Management Treatments
B = Spring Burn
M = Summer Mow + Remove
L = Leave (No Management)

Grass Species Treatments
C = Cool Season Mix
W = Warm Season Mix
WC = Cool+Warm Mix

Grass plots established in 2000 using the following grass species and rates

	Grass Species Mix Treatment		
	C	W	WC
Native Cool Season		(pounds live seed per acre)	
Western Wheatgrass (*Pascopyrum smithii*)	3.8	-	1.2
Green Needlegrass (*Stipa viridula*)	2.5	-	1.3
Canada Wildrye (*Elymus canadensis*)	3.6	-	1.3
Native Warm Season			
Big Bluestem (*Andropogon gerardii*)	-	1.5	1.0
Little Bluestem (*Schizachyrium scoparium*)	-	1.0	0.8
Indiangrass (*Sorghastrum nutans*)	-	1.4	1.0
Switchgrass (*Panicum virgatum*)	-	0.6	0.4
Sideoats Grama (*Bouteloua curtipendula*)	-	1.3	1.1

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Research Results from the Eastern South Dakota Soil and Water Research Farm:

Long-Term C and N Changes in Soil and Mixed Native Grass Canopies Under Different Grassland Management Strategies

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Purpose **There are 2.9 million conservation reserve program (CRP) acres in South Dakota and Minnesota. This region is also slated to provide cellulosic feedstocks for biofuels. Thus, scientific inquiry on CRP/grass management and its effect on soil condition as well as the transfer of this knowledge to producers in this region are important priorities.**

Objectives **This study was conducted to determine whether soil and grass C and N could be manipulated through canopy management and different grass mixtures.**

Design **The experiment was established using a criss-cross design (R. Mead. 1990. The design of experiments. Cambridge University Press.) with three replications. Grass plots were initially planted in 2000.**

Native Grass Species Mixtures **cool season mix (C); warm season mix (W); cool + warm season mix (WC).**

Grass Canopy Management **burn (early spring prescribed burning); mow (shredding and removing all residue after grass anthesis); and leave (no canopy management).**

Agronomy **Soil previously under row-crop cultivation since 1940s. Initial soil preparation (chisel plow, disk/harrow, packed with grass drill). Grasses planted with Truax no-till drill (double disc openers + specialized native seed boxes) .**

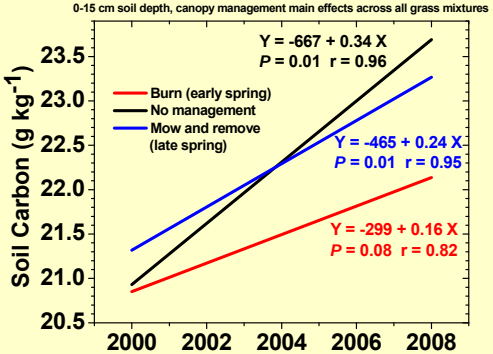
Methods **Soil: 0-15 cm soil core samples taken early spring; initial samples taken in 2000.**
Plant canopies: Biomass samples after anthesis but before mowing. Tissues dried, weighed, ground, and analyzed. C and N dry combustion in LECO.
Statistics: Linear regression and slope comparison (J. Zar. 1999. Biostatistical analysis. Prentice Hall). Main effects and interactions with Proc Mixed, Adjust=Tukey in SAS ($\alpha = 0.05$).

Grass Canopies in Spring

Long-Term Soil Carbon Response to Grass Canopy Management

Rate of soil C accumulation

0-15 cm soil depth, canopy management main effects across all grass mixtures



Bucket and Shovel Estimates

Mass of soil C accumulated

Treatment	Soil C accumulation	
	kg ha^{-1}yr^{-1}	*lbs ac^{-1}yr^{-1}*
Leave	714 a	638 a
Mow	504 ab	450 ab
Burn	333 b	297 b

Discussion

Across all grass treatments, soil C accumulation at 0-15 cm soil depth was significantly greater under no management than burn treatment while that under mow was intermediate.

Grass Canopy Responses to Treatments

Biomass, nitrogen, and C/N ratios from grass plants taken when warm season plants reached anthesis (17 July 2007 and 5 August 2008).

Grass mixture	Biomass	Nitrogen	C/N ratio
	kg ha^{-1}	*g kg^{-1}*	
Cool	2814 ± 226	11.74 ± 0.41	37.1 ± 1.0
Warm	3989 ± 419	8.51 ± 0.35	51.9 ± 1.9
Cool + Warm	4004 ± 246	7.88 ± 0.16	55.1 ± 1.5

Values represent mean ± standard error for grass samples from grass mixture plots across all management treatments.

Management	Biomass	Nitrogen	C/N ratio
	kg ha^{-1}	*g kg^{-1}*	
Burn	2730 ± 193	9.47 ± 0.63	48.9 ± 2.6
Leave	4656 ± 368	8.79 ± 0.46	51.4 ± 2.6
Mow	3421 ± 240	9.87 ± 0.41	43.8 ± 1.6

Values represent mean ± standard error for grass samples from management treatments across all grass mixtures.

Discussion

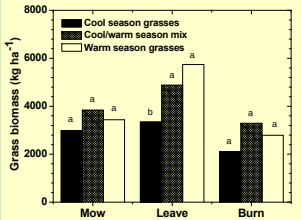
Cool season grasses produced less biomass than the other grass mixtures (P=0.0001).

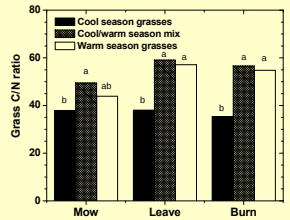
Cool season grasses had the lowest C/N ratio (P=0.0001).

The burn treatment significantly (P=0.0001) reduced grass biomass.

Grass C/N ratio was less under the mow treatment (P=0.0001).

Grass Biomass and C/N Ratio Interactions





Discussion

Significant management by grass mixture (2-way) interactions for biomass (P=0.02) and C/N ratio (P=0.003) were the result of lower values in the cool season grasses that received the no management treatment.

Conclusions

1. **Annual spring burn treatment was detrimental to soil C accumulation as well as to the growth of cool season grasses.**
2. **Mow and remove management, which would be compatible with cellulosic biomass production, showed values of soil C accumulation comparable with those seen under the no management treatments.**
3. **However, mow and removed also reduced grass biomass as well as grass tissue C/N ratio.**
4. **Additional time-course data is being collect to determine if mow and remove would be sustainable in terms of long-term soil resource quality.**

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