

# Soil C Sequestration and Agronomic Yield of Diverse Crop Rotations Under No-Till Soil Management

## A Call to Action:

Develop sustainable practices that improve soil properties:

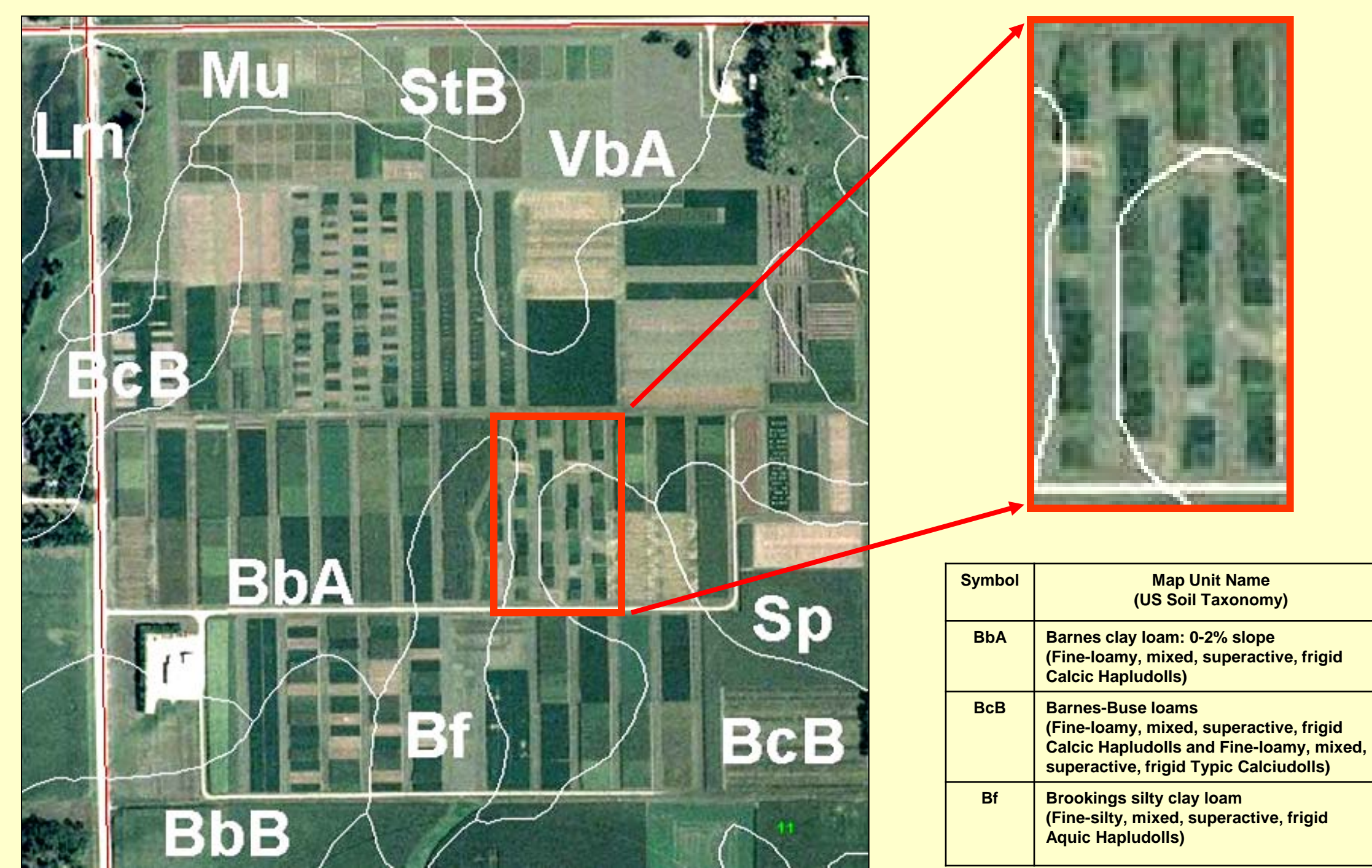


"Because soil organic matter enhances water and nutrient holding capacity and improves soil structure, managing for soil carbon can enhance productivity and environmental quality, and can reduce the severity and costs of drought, floods, and disease."

- Soil Quality Institute, USDA-NRCS, Auburn AL

**Eastern South Dakota Soil and Water Research Farm**  
Purpose of farm: to find solutions to national and regional concerns related to soil and water conservation and the efficiency and sustainability of agricultural production.

## Diverse Crop Rotation Experiment



- No-till experiment established in 1996
- Crops production practices used were common to this region.
- Corn (C) and soybeans (S) are important grain crops usually grown in 2-year rotation.
- Oat/pea hay (O/P) and alfalfa (A) are important forage crops for dairy cows.

## Rotation Treatments

C-S = corn-soybean  
C-S-O/P = corn-soybean-oat/pea hay  
C-S-O/P-A-A= corn-soybean-oat/pea hay-alfalfa-alfalfa

Research objective was to determine how diversified crop rotations, which reduce the risk associated with adoption of no-till soil management, influence long-term soil C sequestration.

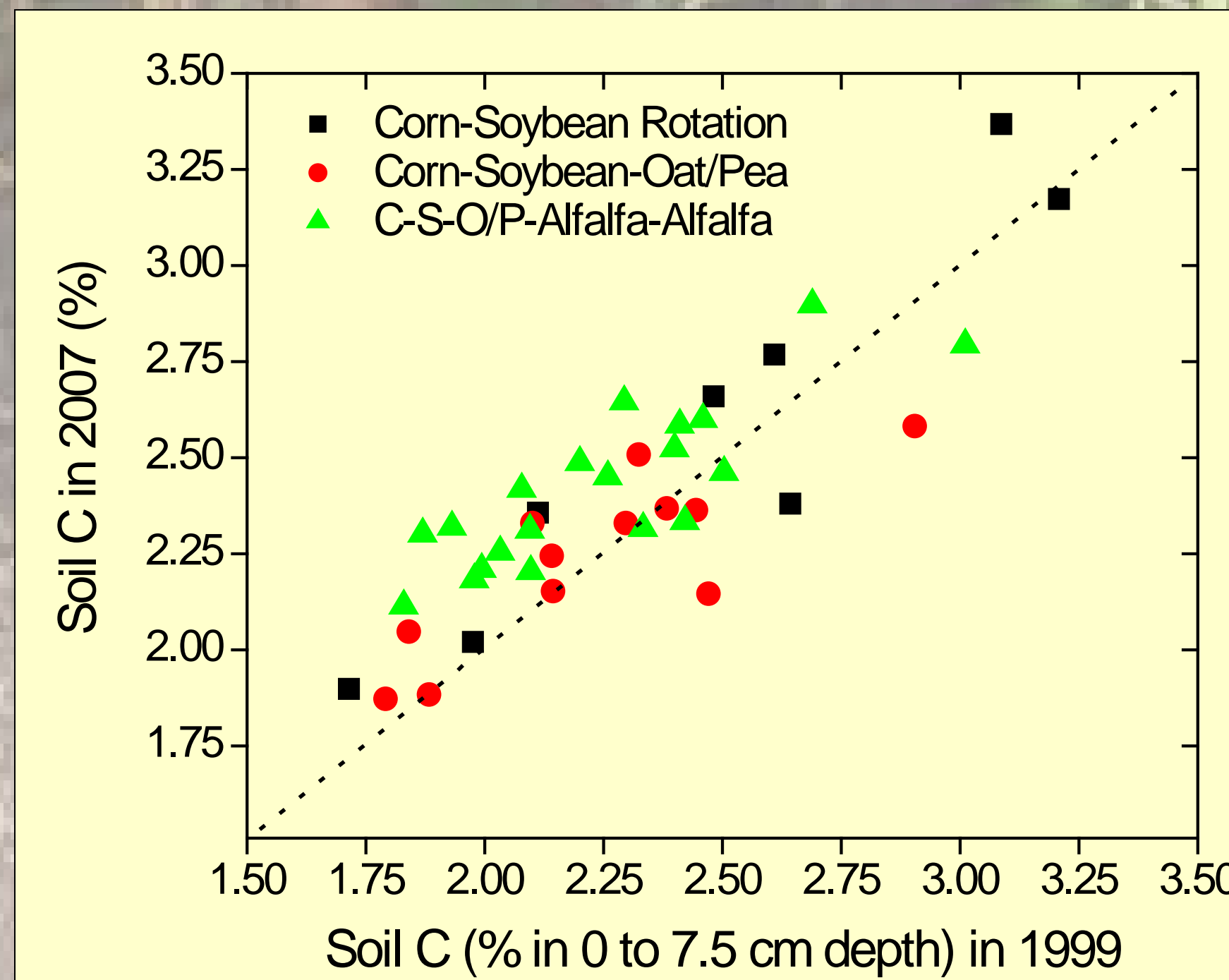
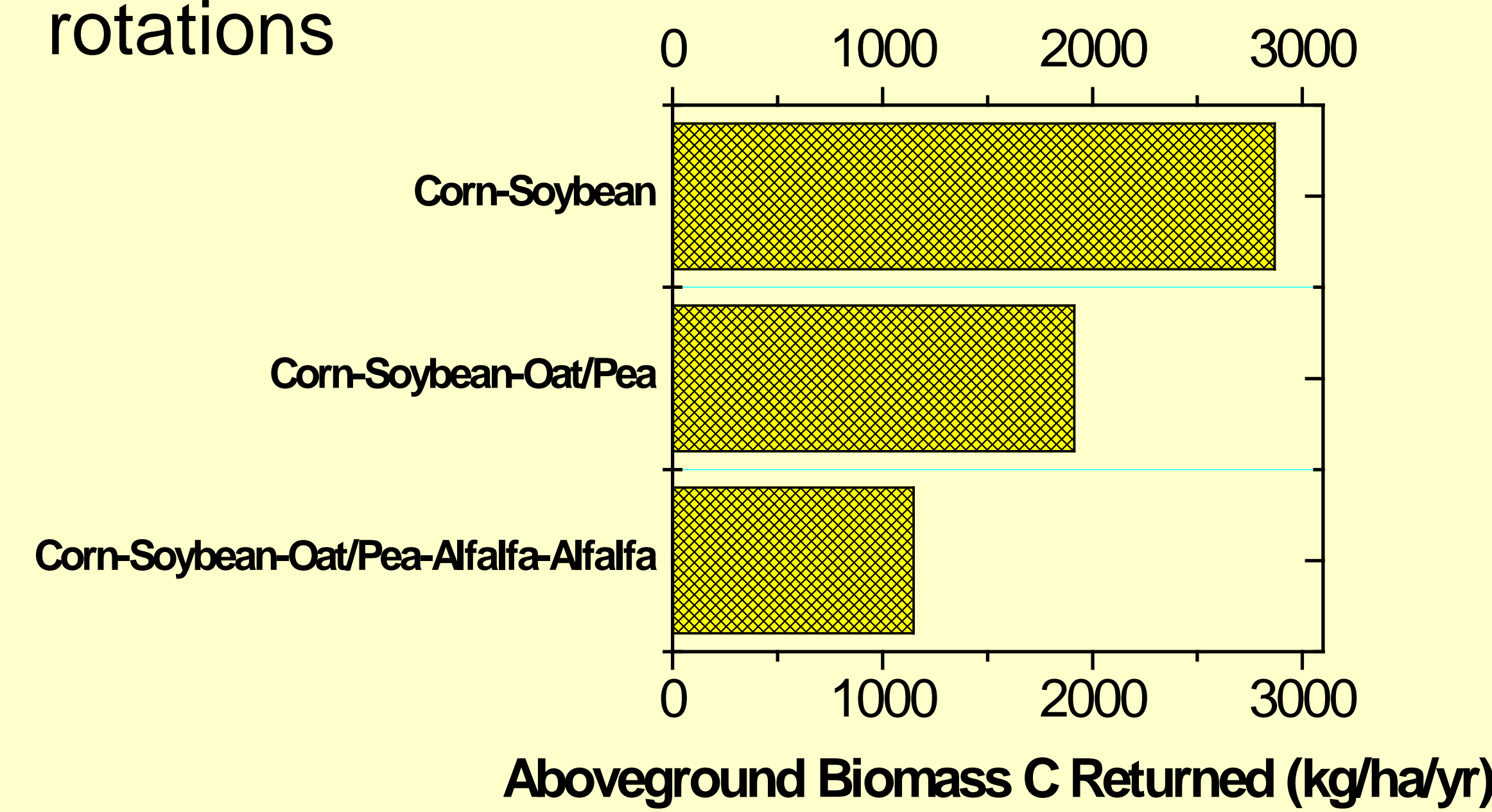
Corn stover (10.6 Mg/ha) remaining in the field after harvest was much greater than that of soybean (2.2 Mg/ha). Corn stover also had a much higher C/N ratio (69) than that of soybean (25)

Table 1. Characteristics of crops grown in rotation treatments. Values presented represent average (C.V.) for data combined across the 2008 and 2009 growing seasons.

Crop	Above-Ground Biomass			Grain yield	Biomass returned	Biomass removed	C returned	C removed
	Carbon	Nitrogen	C/N ratio					
Corn	45.3 (1.6)	0.7 (10)	69 (30)	9885 (15)	10569 (28)	-	4780 (28)	-
Soybean	43.5 (0.7)	1.5 (24)	30 (25)	1831 (49)	2205 (16)	-	959 (16)	-
Hay <sup>1</sup>	44.4 (0.7)	1.4 (13)	32 (11)	-	-	5349 (31)	-	2373 (32)
Alfalfa <sup>2</sup>	44.6 (1.0)	2.5 (25)	19 (35)	-	-	3906 (32)	-	1749 (32)
Alfalfa <sup>3</sup>	44.8 (0.6)	2.5 (16)	18 (17)	-	-	5658 (19)	-	2539 (20)

<sup>1</sup>Oat-pea hay  
<sup>2</sup>First year alfalfa  
<sup>3</sup>Second year alfalfa

Biomass C amounts returned to the soil per year, when averaged across the rotation treatments, were strongly influenced by the number of times corn was present in those rotations



Based upon changes in C in soil samples taken in 1999 and again in 2007, almost all of the C-S and the C-S-O/P-A-A plots had increased C levels while those in C-S-O/P remained relatively unchanged.

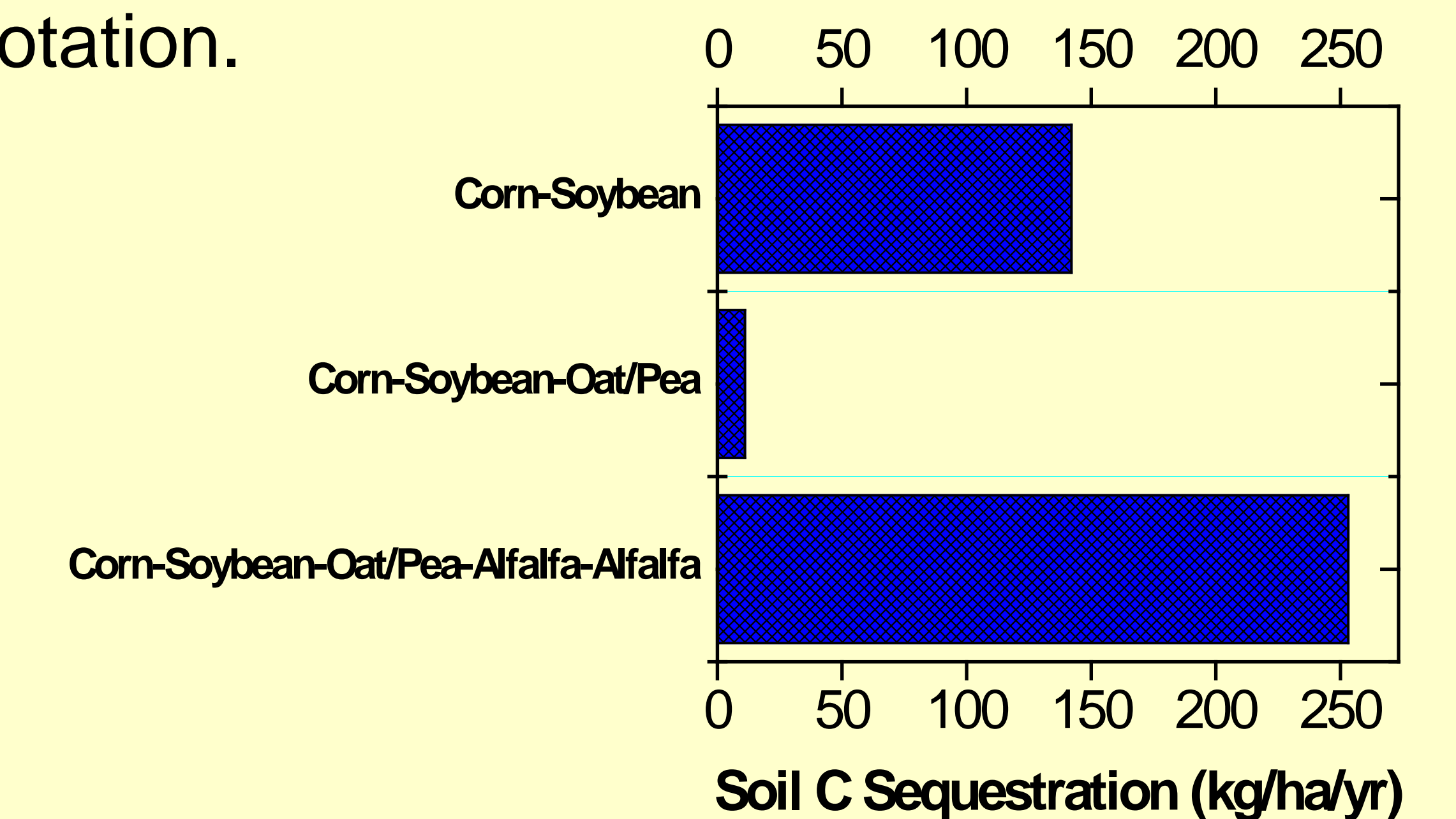
Cooperative investigations of the USDA Agricultural Research Service<sup>1</sup> and Plant Science Department at South Dakota State University<sup>2</sup> in Brookings SD.

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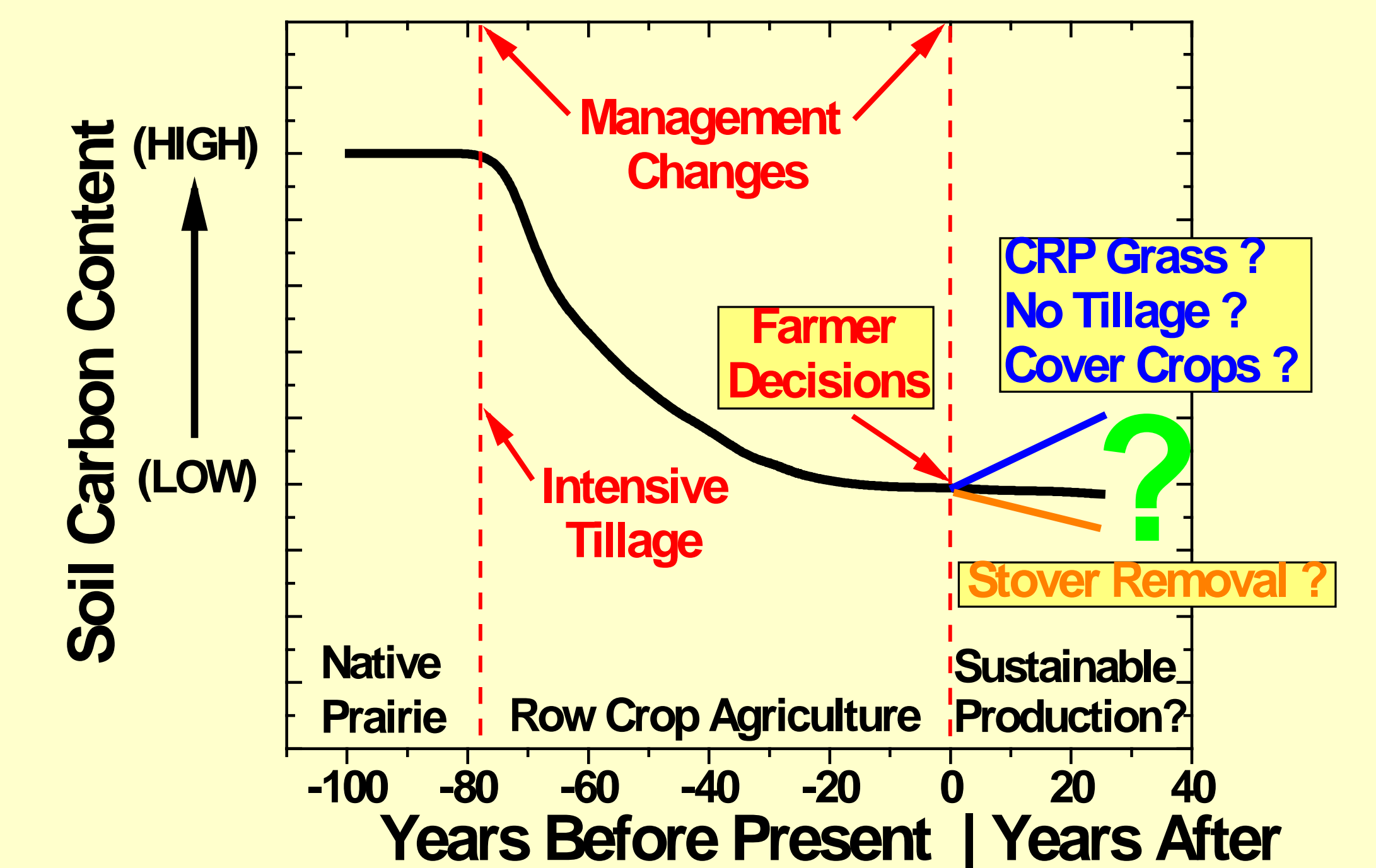
Authors thank A. Wagner, K. Dagle, and D. Harris for excellent technical assistance

Perennial forages included as rotational crops (C-S-O/P-A-A) strongly increased soil C sequestration rate.

Plots with oat/pea hay as a rotational crop (C-S-O/P) had lower soil C sequestration rates, suggesting that increased rotation diversity did not compensate for the reduction in the number of corn phases that were present in the corn-soybean (C-S) rotation.



## Management Effects on Soil Carbon (Hypothetical)



## Management Effects on Soil Carbon (Actual)

