Plant Community and Soil Functional Characteristics of Prairie Conservation Strips

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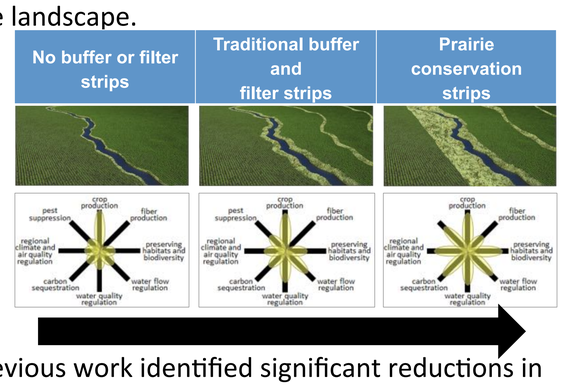
Introduction

Intensive row-crop agriculture in the US Corn Belt produces high yields of grain that provide food, feed, and fuel to our economy. The landscape alteration and simplification supporting this productivity have significantly reduced many of the ecosystem services the land would otherwise provide in exchange for crop production, including loss of wildlife habitat, increased soil erosion, and nutrient loss from fields into our waterways. The STRIPS research project (Science-based Trials of Row-crops Integrated with Prairie Strips) addresses the question of whether we can achieve conservation goals on production acres by strategically placing native prairie vegetation strips in the landscape.



Previous work identified significant reductions in water, soil, and nutrient loss from watersheds; increased native species abundance and diversity; and improved footslope soil function. The work described here was designed to determine whether middle backslope prairie strips contribute ecosystem services beyond habitat, biodiversity, and surface water flow regulation 7 years after establishment.

Objectives

- Identify and compare species diversity and cover of prairie plants between the upper edges, center, and lower edges of mid-slope prairie strips
- Identify and compare soil functional characteristics between crop areas, crop edges immediately adjacent mid-slope prairie conservation strips, upslope and downslope prairie edges, and center of prairie strips.

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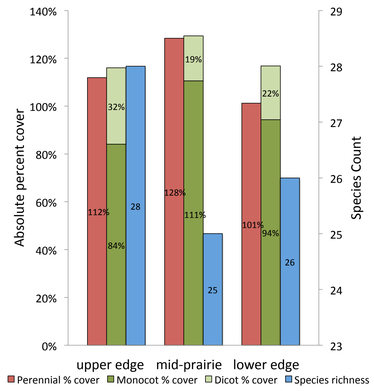
STRIPS research team

% Cover of Perennials, Monocots and Dicots, & Species Richness




View across prairie strip


Plant surveys


Hand probe soil collection

Species with Greater Than 10% Cover

Up-slope edge

Species	% cover	Native/Non-native status
*Poa compressa/pratensis**	39.2%	Non-native
*Bromus inermis**	23.2%	Non-native
Solidago canadensis	14.4%	Native

Mid-prairie

Species	% cover	Native/Non-native status
*Poa compressa/pratensis**	37.8%	Non-native
*Bromus inermis**	25.8%	Non-native
Schizachyrium scoparium	12.2%	Native
Sorghastrum nutans	12.0%	Native
Bouteloua curtipendula	12.0%	Native

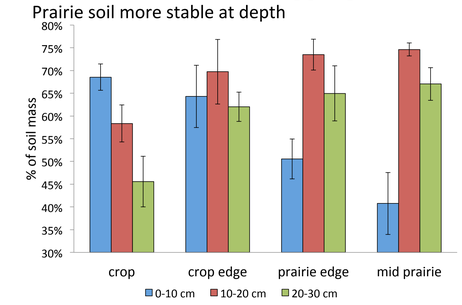
Down-slope edge

Species	% cover	Native/Non-native status
*Bromus inermis**	42.2%	Non-native
*Poa compressa/pratensis**	28.4%	Non-native

* dominant species

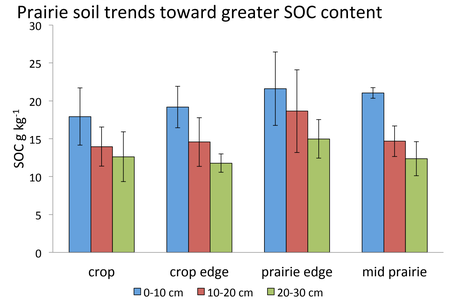
Water Stable Macroaggregates

Prairie soil more stable at depth



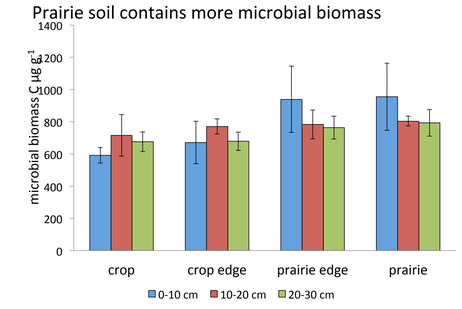
Soil Organic Carbon (SOC)

Prairie soil trends toward greater SOC content



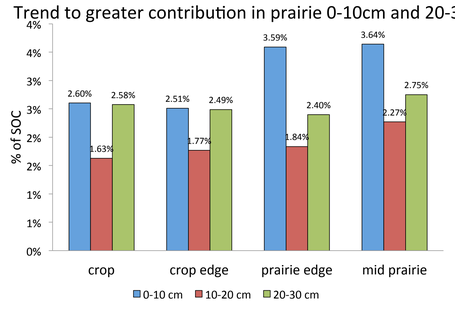
Microbial Biomass C

Prairie soil contains more microbial biomass



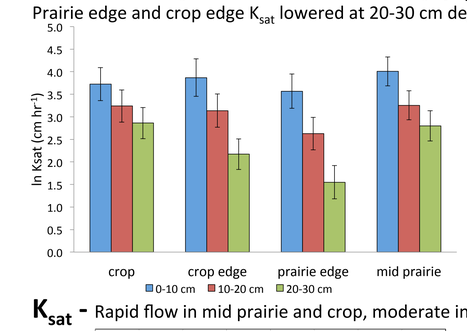
Microbial Biomass C as % of SOC

Trend to greater contribution in prairie 0-10cm and 20-30cm



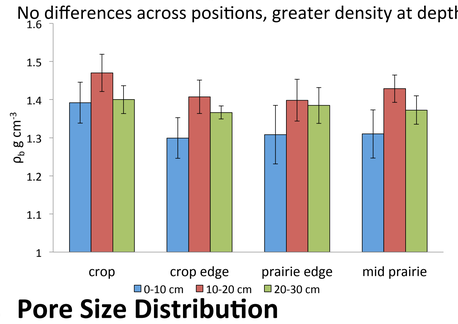
Saturated Hydraulic Conductivity (K_{sat})

Prairie edge and crop edge K_{sat} lowered at 20-30 cm depth

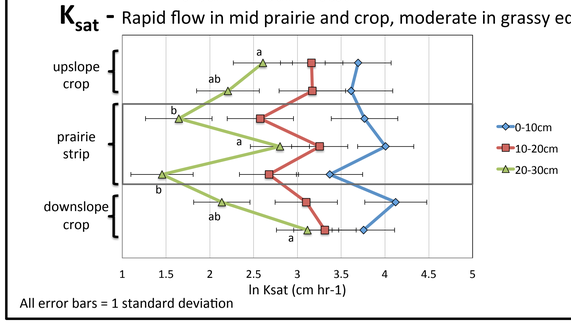


Soil Bulk Density

No differences across positions, greater density at depth

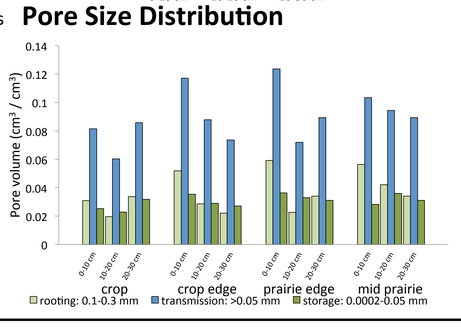


K_{sat} - Rapid flow in mid prairie and crop, moderate in grassy edges



All error bars = 1 standard deviation

Pore Size Distribution

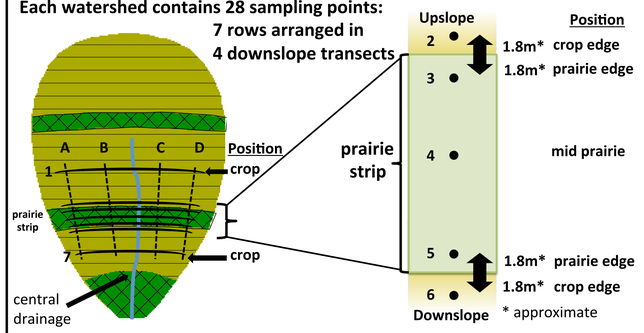


Methods

- 3 fields with prairie strips across the middle backslope

Experimental watersheds showing sampling positions:

Each watershed contains 28 sampling points:
7 rows arranged in
4 downslope transects



- Slope ranges from 6.4% to 7.7%
- Silt loam and silty clay loam soils with shrink-swell clay
- Points placed relative to prairie strip edges
- Plant surveys conducted at peak vegetation with 0.5 m^2 quadrats; vegetation identified to species
- 2.5 cm diameter hand probe samples to 30 cm depth
- 7.3 cm diameter intact cores collected to 30 cm depth with a Giddings rig

Results

Plant Community

- Prairie conservation strips were more evenly diverse in their interiors than at either edge.
- Perennial monocots comprised a greater proportion of cover in strip centers than in edge positions.
- Non-native perennial monocots dominated all areas after 7 years without controlled burning.

Ecosystem services: Soil erosion control - Enhanced belowground plant biomass and MBC in diverse prairie improves soil structure[1]; Habitat - diverse plant structure and composition in prairie center

Soil Functional Characteristics

- Prairie conservation strip soil was more stable (resistant to slaking) below 10 cm than soil under no-till annual row crops.
- Microbial biomass in prairie soil was greater than in both immediately adjacent and distant crop soil.
- Soil at 20-30 cm under prairie edges had significantly lower K_{sat} than in the crop or center of prairie strips, while K_{sat} in crop, mid prairie, and shallower depths was similar and rapid.
- Crop soil trends to greater density than prairie soil.

Ecosystem services: Water flow and soil erosion control via soil structure regulation - Aggregate stability, MBC

1: Balvanera, P., Pfisterer, A. B., Buchmann, N., He, J. S., Nakashizuka, T., Raffaelli, D. & Schmid, B. 2006. Quantifying the evidence for biodiversity effects on ecosystem functioning and services (vol. 9) Oxford, UK, 1146-1156.