Soil conservation as affected by cover cropping practices in corn-soybean rotation

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INTRODUCTION

Increased vegetation across agricultural landscapes is effective for minimizing soil erosion. Cover crops can be a a solution in corn and soybean rotations, however measuring soil savings is intensive.

Fig 1. Soil erosion in conventional agriculture (pc: wwf.org)

Fig 2. Clover ground cover in corn (Waseca, MN)

Fig 3. Soil cover with pennycress in soybean (Morris, MN)

The Revised Universal Soil Loss Equation 2 (RUSLE2) is a tool for modeling soil erosion and sediment delivery in response to environmental factors and cropping practices. RUSLE2 can be used to broadly quantify the soil impact of cover across multiple cover crop species and planting methods.

Modeling the loss and gain of soil through erosion variables (Fig 4), as affected by agronomic management, provides information to assess the sustainability of varying cropping practices and cover crop species.

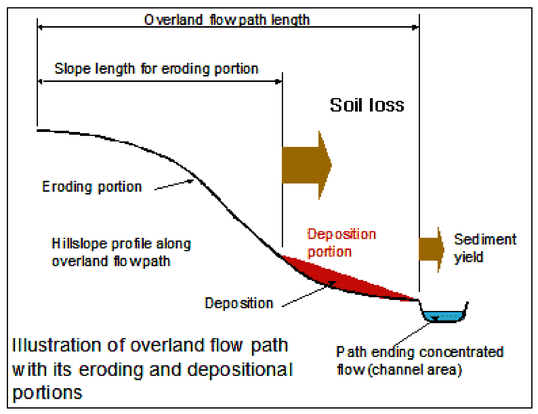

Figure 4. RUSLE2 Erosion variables (ars.usda.gov)

To estimate the impact of soil savings associated with cover crop species and planting method in the upper Midwest, this experiment combined data over cropping systems. This data was applied to the RUSLE2 equation and database as a resource to quantify soil savings across system managements in the upper Midwest.

OBJECTIVES

1) Utilize RUSLE2 to predict amount of soil loss affected by cover crop species and planting method
2) Apply data to varying cropping systems and practices within the upper Midwest
3) Contrast empirical soil loss data from Merten et al. (2015) to RUSLE2 theoretical values

MATERIALS & METHODS

Experiment

Design

- RCBD (Four site-years)
- Two planting methods
  - Broadcast incorporated (Fig 5)
  - Drilled (Fig 6)
- Four replications
- Waseca, MN

Management

- Interseeded at corn leaf stage V7 (Fig. 6)
- Terminated in spring (glyphosate) May 18th

Cover crop species

- Winter Rye
- Red Clover
- Radish + Pea + Oat Mix
- Pennycress
- Hairy vetch

Figure 5. Avenger interseeder in R6 corn (Rosemount, MN)

Figure 6. Interseeder in V7 corn (Rosemount, MN)

1) Application to RUSLE2

Parameters Measured		Templates	
• CC Biomass	• Management	• Location	• Climate

Management Operations

Date, m/d/y	Operation	Vegetation	Yield (harv. units), #/ac	Type of cover material	Cover matl add/remove, lb/ac	Cover from addition, %
4/25/1	Cropland\chisels\chisel, st. pt.					
4/25/1	Disk, tandem secondary op.					
4/25/1	Cropland\planters\planter, double disk opnr	cce_corn_grain	180			
4/25/1	Fert applic, surface broadcast					
4/25/1	Sprayer, pre-emergence					
7/25/1	Aerial interseeding					
10/20/1	...0pct standing stubble, release cover crop	pc_intseed	400		7800	99
4/15/2	Sprayer, kill crop				23	1.3
5/7/2	Planter, double disk opnr w/fluted coulter	cce_soybean	60			
6/10/2	Sprayer, insecticide post emergence					
10/10/2	Cropland\harvest\harvest killing crop				1900	68

Figure 7. RUSLE2 interface with template design (Experiment 1: pennycress)

2) Manipulating treatments

Parameters Applied		Parameter Manipulated
• CC Biomass	• Management	• Tillage practices

3) Empirical vs. Theoretical Results

- Contrast soil loss findings in Merten et al. (2015) with the application of the parameters from the study to RUSLE2 interface

RESULTS

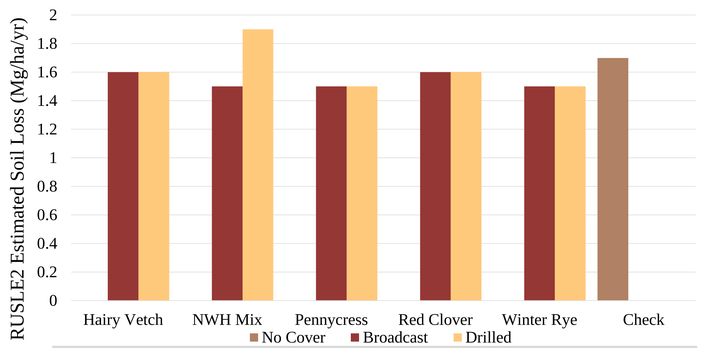

Figure 8. Soil loss as effected by cover crop species and planting methods showing no difference between cover crop species and conventional check on soil loss.

RESULTS

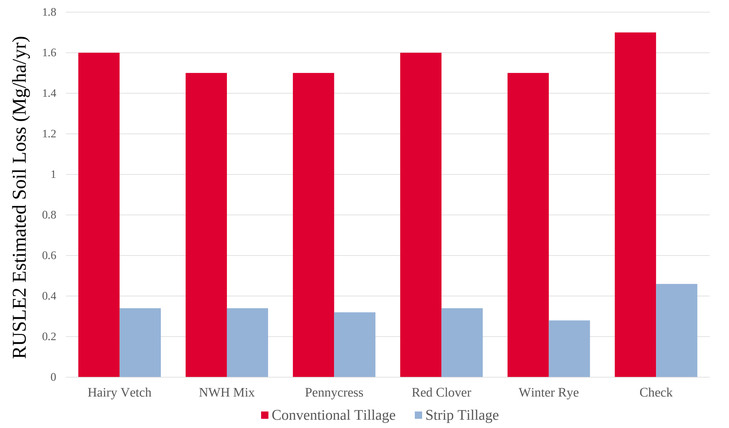

Figure 9. RUSLE2 results of estimated soil loss from conventionally tilled full-width vs. conservation strip-tilled corn-cover-soybean rotation. Conservation strip-tillage shows decreased soil loss as compared to conventional tillage.

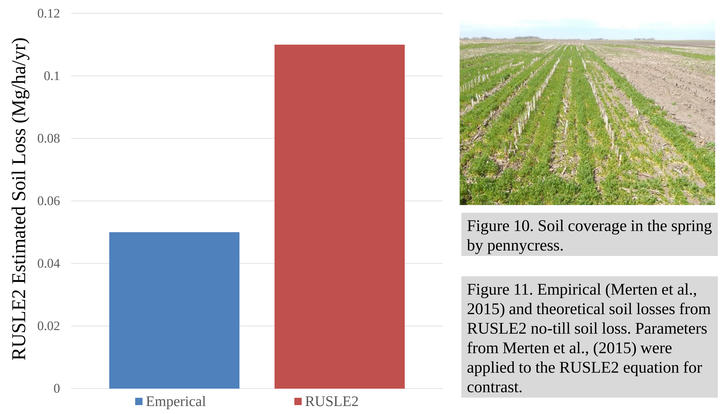

Figure 10. Soil coverage in the spring by pennycress.

Figure 11. Empirical (Merten et al., 2015) and theoretical soil losses from RUSLE2 no-till soil loss. Parameters from Merten et al., (2015) were applied to the RUSLE2 equation for contrast.

FINDINGS

1) In order to create differences in the predicted soil loss, the RUSLE2 calculation requires major biomass production to overcome spring tillage
2) According to RUSLE2, conservation tillage has an effect on the soil loss as compared to conventional tillage, though still results in a net loss
3) There is variability in empirical vs theoretical soil loss in RUSLE2 as applied in continuous cropping systems

Limitations:

- Operation effects (OE) in RUSLE2 create greater variability; our experiment heavily relied on OE
- Need representative templates both for specific rotations and for cover crop species
- RUSLE2 may over penalize spring tillage practices in upper Midwest when applying cover crops in rotation and may need to be amended

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Literature Cited

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