Short-term Effect of Soil Management Practices on Corn Yields (Tillage, Cover Cropping and Crop Rotation)

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Introduction

- Corn (*Zea mays* L), one of the top cereal crop, constitute ~40% of global corn production, produced only in Midwest USA, which is also known as corn belt (USEPA, 2009).
- Among various factors affecting corn yield, tillage, cover cropping, and crop rotations are widely practiced around the world (Christensen, 2002).
- For many decades, these cropping systems have shown improved soil quality and crop yields. However, recent studies suggest that long-term tillage practices have adverse impact on soil quality, thus reducing the crop yield and ultimately leads to soil erosion.
- The data suggest that effects on crop yield using different tillage, cover cropping, and rotation practice are site-specific with some variations (DeFelice et al., 2006). However, there are not enough experiments that have investigated such impacts in the Midwest region.
- Therefore, to fill the gap on crop yield in this region, we analyzed and evaluated the corn yield data by assessing the effects of Tillage, Cover cropping and Crop Rotation.

Research Questions

- How do tillage management systems affect corn yield?
- Can crop rotations improve corn yield?
- Do cover crops influence corn yield?
- Is there an additive effect of tillage, cover cropping and crop-rotation on corn yield?

Materials and Method

Site description

- Freeman farm of Lincoln University, MO
- Experimental area: 10 acre with Waldron silt-loam.
- Historically, the area was under conventional tillage.

Experimental design

- Randomized Complete Block Design (RCBD): 3 factor factorial with 3 replications (i.e., tillage at two levels (tillage vs. no tillage), cover crop at two levels (cover vs. no cover), and rotation at four levels (CM, CS, MS, and SM).
- Three blocks with 16 plots each. Each plot measures 12.2 m x 21.3 m.
- Of 48 plots, corn = 24 and soybean = 24.
- The cover crop is Rye.
- The corn and soybean are rotated every year.
- Each plot receives equal amount of fertilizer without irrigation.

Yield Estimation

- Estimated corn yield from randomly selected six corn stalks from each sampling plots.
- Measured dry weight of corn grain at 15% moisture content and reported in Bushel/acre.
- Mean crop yields were analyzed using two-way ANOVA; statistical package SAS.

Tillage Treatments

	Plot I		Plot II		Plot III
15 ft	Non BT Corn Buffer (25ft wide)				
buffer	NT		CT		NT
	NT	30 ft	CT	30 ft	NT
	CT		NT		CT
	CT		NT		CT

Cover Treatments

15 ft	Non BT Corn Buffer (25ft wide)			
buffer	NC		CC	CC
	CC	30 ft	NC	30 ft NC
	NC		NC	NC
	CC		CC	CC

Crop Treatments

1	2	3	4	5	6	7	8	9	10	11	12
CM	MS	CS	SM	CS	SM	MS	CM	SM	MS	CS	CM
24	23	22	21	20	19	18	17	16	15	14	13
SM	CS	MS	CM	CS	CM	MS	SM	SM	CS	CM	MS
25	26	27	28	29	30	31	32	33	34	35	36
CS	CM	MS	SM	CM	CS	SM	MS	CS	SM	CM	MS
48	47	46	45	44	43	42	41	40	39	38	37
MS	SM	CM	CS	MS	CS	CM	SM	CM	MS	SM	CS

NT= No Till; CT= Conventional Tilage; NC= No Cover Crop
CM= Continuous Maize; CS= Continuous Soybean; CC= Cover Crop
MS= Maize/Soybean Rotation (Maize=1st year, Soybean =2nd year)
SM= Soyabean/Maize Rotation (Soybean= 1st year, Maize = 2nd year)

Results

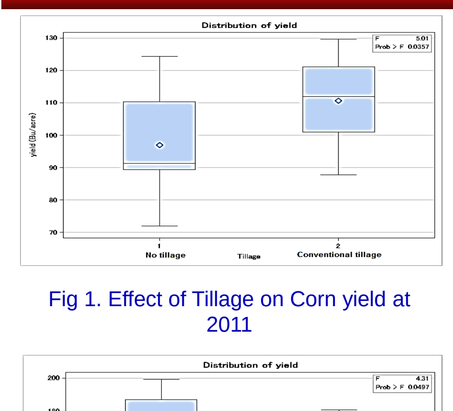

Fig 1. Effect of Tillage on Corn yield at 2011

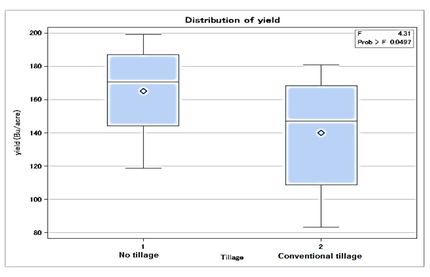

Fig 3. Effect of Tillage on Corn yield at 2014

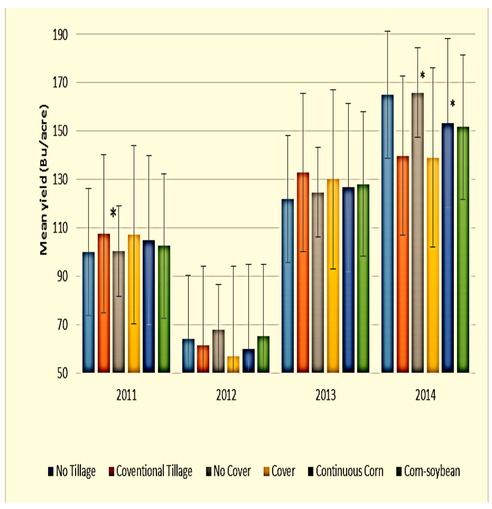

Fig 4. Effect of treatments over four years experiment

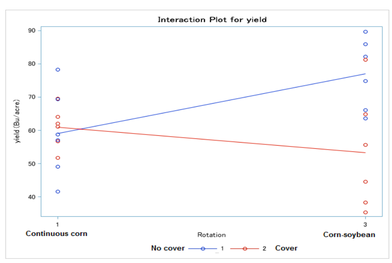

Fig 2. Effect of rotation*cover on Corn yield at 2012

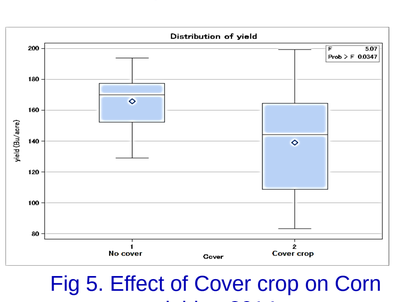

Fig 5. Effect of Cover crop on Corn yield at 2014

- Overall, the crop yield has been increased over time with exception of 2012 (Fig 4).
- In 2012, lower yield attributed to drought in mid-west. Noticeably continuous corn has significant interaction effects with no cover yield (Fig 2).
- Significant increased of crop yield under conventional tillage in 2011 (Fig 1).
- By 2014, no tillage and no cover practices significantly increased the corn yield (Fig. 3 & 5).

Conclusion & Recommendation

- Crop/soil management practices increase the crop yield over the time.
- The increased yield attributed to the continuous corn planting and no cover practices, might be due to less competition within crop for nutrient and soil moisture or due to varying environmental condition such as drought, uneven rainfall.
- Extended research should be done to identify the best crop type as a cover crop.
- Short-term data showed improved practices have increased the crop yield, however, long-term studies will be needed for the robust explanations on different practice under variable environmental conditions.

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