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Field Crops Research

Winter Rye Cover Crop Effect on Cash Crop Yields: Year 4

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In a Nutshell

- Cover crops are an important addition to any farming system to **improve soil quality** and **decrease soil erosion or nutrient loss.**
- Cover crops on average can reduce nitrogen loading by 28% and phosphorus loading by 50%.
- When this project began farmers were concerned that a winter rye cover crop could negatively impact their cash crop yields.
- Farmers report that whether you grow corn, soybeans or corn silage, properly-managed cover crops can be added to crop farms with **little or no effect on yield.**

Project Timeline:
Fall 2008 - Fall 2012

Boots on the ground in hearty rye cover crop.

Background

Cover crops are normally planted without the intention of a direct harvest. Rather, they are planted for the multiple benefits they provide to the farmer and the environment. In Iowa, cover crops are usually planted into standing corn or soybean crops or are planted directly following grain harvest. However, difficulty may exist in planting cover crops during this time, a busy one for farmers.

A few of the benefits of cover crops include soil quality improvements by protecting soil from erosion (Lal et al., 1991; Karlen and Cambardella, 1996), increasing soil microbial activity and cycling nutrients (Karlen and Cambardella, 1996), decreasing excess nitrogen (Kaspar et al., 2007), or adding to soil carbon (Lal et al., 2004).

Iowa's land has lost significant amounts of soil since annual crop farming began. Iowa's average erosion across the state is 5.2 tons/acre/year (Cox et al., 2011) with some areas losing significantly more. In addition, Iowa's pollution contributes to the increase in the size of the Gulf Hypoxic Zone (IDALS et al., 2012). Keeping year-round cover, capturing more sunlight to grow plants that build soil, and capturing any excess nitrogen are features of cover crops and are proven methods to stop soil and nutrient loss.

Direct, immediate economic return from adding a cover crop to a farming system has not been measured in Iowa. Thus, documentation of cover crop effect on cash crop yield is needed. Determining that a cover crop does not significantly impair the cash crop is necessary for widespread adoption.

Method

To study this question, six sites were established in the fall of 2008 and six more in 2009, and 10 were maintained through 2012. The 2011-2012 sites were located at Harlan (SW), Coon Rapids (West Central), Jefferson (West Central), Plainfield (NE), Clutier (East Central), Fort Dodge (Central),

Kalona (SE), West Chester (SE), Holstein (NW), and New Market (SW). **Table 1** describes each location's cash crop and cover crop management.

All sites planted a winter hardy rye cover crop in the fall of 2008 and/or 2009 (depending on when they initiated the study) and again in all continuing years of the study. Winter rye varieties used included 'VNS,' variety not stated, or the improved variety 'Wheeler,' from Michigan State University. Cover crop seed was planted from the previous year's seed or purchased from local seed retailers. Farmers planted replicated strips—cover and no cover—the length of their field in the fall in the same location each year. Two locations used a pseudo-replicated design since plots were aerial seeded. Farmers either aerial seeded into standing cash crops, drilled the cover crop following cash grain or corn silage harvest, or broadcast the cover crop seed with dry fertilizer. In the spring, above-ground cover crop biomass was sampled from four 1-ft^2 quadrates per plot. Samples were dried and weighed. To terminate the cover crop, all farmers used an herbicide as a "burn-down" before or on the cash crop planting date.

Carbon and nitrogen concentrations of the cover crop aboveground biomass samples were measured in the spring of 2009 and 2011. In the fall, farmers combined and weighed grain from individual plots using a weigh wagon or a yield monitor. Yields are reported as: corn in bu/A at 15.5% moisture content; soybean in bu/A at 13% moisture content; and corn silage in tons/A at 35% moisture content.

Statistics were analyzed using JMP Pro 10 (SAS Institute Inc., Cary, NC) and yield comparisons employ least squares means for accuracy. Statistical significance is determined at a α=.05 level and means separations reported using Tukey Least Significant Difference.

Results and Discussion

Corn Yield

In 2009, three out of four locations yielded the same following either crop treatment. At one location, Jefferson, herbicide failure to "burn down" the cover crop reduced corn yield by 38.5 bu/A. In 2010, corn yield following a cover crop was negatively impacted at all locations, resulting in an average decrease in corn yield of 12 bu/A. In 2011, corn yield was not statistically different when grown following a cover crop or no cover crop treatment. Finally in 2012 at four out of five locations corn yielded the same following a cover crop versus the no cover crop treatment. At one location, Coon Rapids, an 8.4 bu/A decrease in corn yield was measured when following a cover crop. Observations taken by the farmer cooperator at that location suggest that field management in one cover crop strip might have caused reduced yield in that treatment. **Figure 1** shows corn yields for all four years of the study.

Soybean Yield

Soybean yield ranged from 36.6 bu/A in 2012 at Jefferson to 70.4 bu/A in 2010 at Kalona. In 2009, soybean yields were not statistically different between the two treatments. In 2010, soybean yield at all locations in the cover crop treatment was statistically higher than in the no cover crop treatment. This resulted in a yield "bump" of 4 bu/A in the soybean plots where cover crops had been planted the previous fall of 2009. In 2011, no difference in soybean yield was measured at three of the four locations. At one location, Clutier 2, non-GMO soybeans yielded 8 bu/A higher following a cover crop than in the no cover crop strips. The cover crop mulch served as in-season weed management where non-GMO soybeans followed cover crop strips. The non-GMO soybeans that did not follow a cover crop had increased weed pressure which reduced yield. In 2012 no statistical difference was measured in soybean yield following cover or no cover crop strips. A 4 bu/A difference did occur at Holstein but was not statistically significant. Yield data from Coon Rapids in 2011 or Harlan in 2012 was not available due to a technical issue. **Figure 2** shows soybean yields for all four years of the study.

Corn Silage

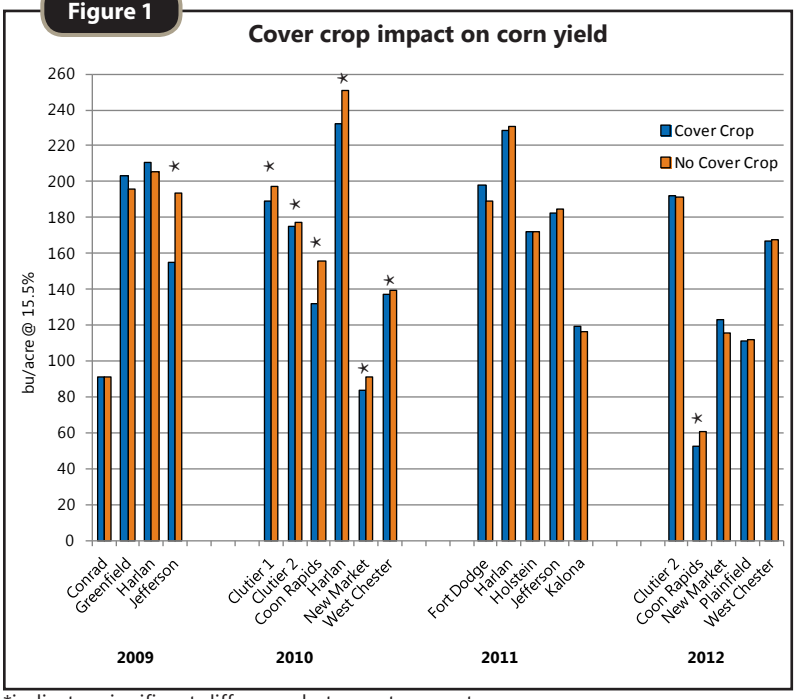
Corn silage yields were not different when grown following a cover crop or no cover crop treatment in 2010 at Plainfield. Only one cooperator's rotation included corn silage in the cropping system. **Figure 3** shows corn silage yields for all four years of the study.

Table 1

Location	Farm location and cover crop management					
	Cash Crop				Cover crop Planting	Cover crop Termination
	2009	2010	2011	2012	2011-2012	2012
Harlan	C	C&S	C&S	C&S	Aerial	Herbicide
Jefferson	C	S	C	S	Drilled	Herbicide
Plainfield	S	C_Sil	S	C	Drilled	Herbicide
Coon Rapids	S	C	S	C	Drilled	Herbicide
Clutier 1 & 2	-	C	S	C	Drilled	Herbicide
Kalona	-	S	C	S	Aerial	Herbicide
Holstein	-	S	C	S	Aerial	Herbicide
Fort Dodge	-	S	C	S	Aerial	Herbicide
West Chester	-	C	S	C	Aerial	Herbicide
New Market	-	C	S	C	Drilled	Herbicide

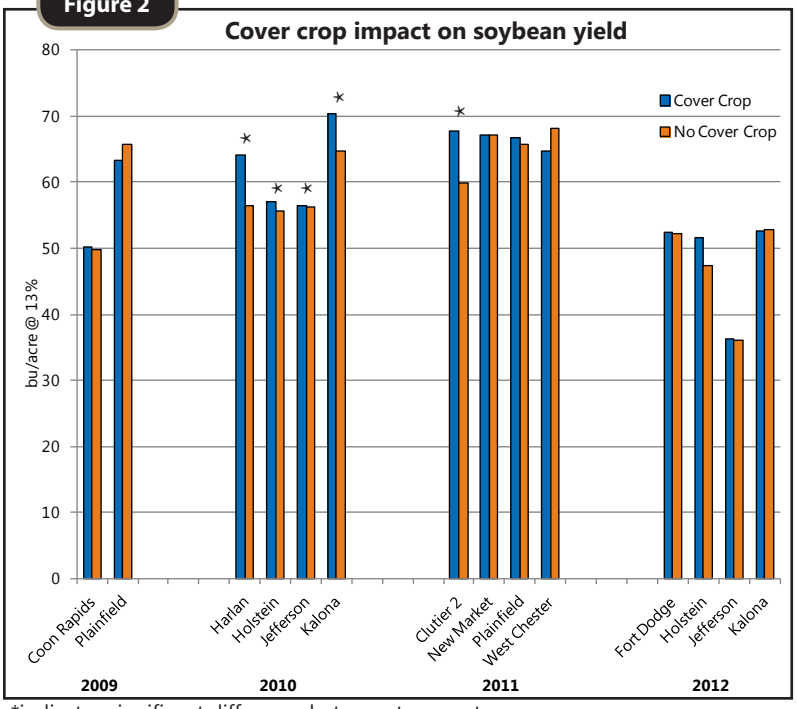
Cooperator, Kelly Tobin, standing in a cover crop plot.

Figure 1



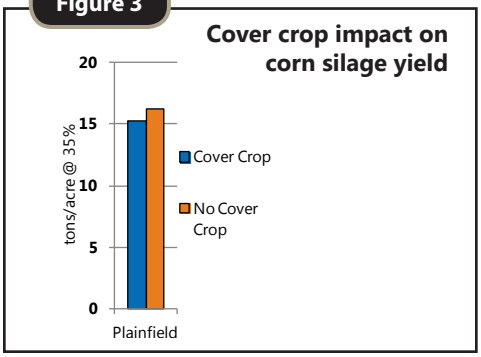
*indicates significant difference between treaments

Figure 2



*indicates significant difference between treaments

Figure 3



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Conclusions

Whether growing corn, soybeans or corn silage, findings from this study show that winter rye cover crops can be added to a farming system, but management is important. No significant difference in corn silage yield was measured at one location. Following a cover crop, soybean yield showed increased yields in five out of 14 site-years. In nine out of 14 site-years no statistical difference was measured. Winter rye cover crop can negatively affect corn yield; however, in our on-farm study only in eight of 20 site-years was corn yield negatively affected. In 12 of 20 site-years no effect was measured. Corn yield was lower when following cover crops across all locations in 2010, the wettest year of the four in which this research was conducted. In contrast, 2009, 2011 and 2012 were generally dryer and resulted in little negative effect of winter cover crops on corn yield. Surprisingly, 2012 was an extremely dry year and an early spring produced large cover crop growth, but no negative effect was measured on corn yield.

PFI Cooperators' Program

PFI's Cooperators' Program gives farmers practical answers to questions they have about on-farm challenges through research, record-keeping, and demonstration projects. The Cooperators' Program began in 1987 with farmers looking to save money through more judicious use of inputs.