Winter Cereal Rye Cover Crop Effect on Cash Crop Yield

Year 5

Iowa Learning Farms and Practical Farmers of Iowa

Rye grows between corn rows prior to harvest on the Nelson Family Farm, Fort Dodge.

Summary

- Cover crops are an important addition to any farming system to improve soil quality and decrease soil erosion and nutrient loss.
- When this project began, farmers were concerned that a winter rye cover crop could negatively impact their cash crop yields.
- Farmers reported that in 36 of 40 trials, properly managed cover crops had little or no negative effect on corn and soybean yield (and actually increased soybean yield in 4 trials).

Background

Cover crops are plants seeded without the intention of a direct harvest and are generally planted for the multiple benefits they provide to the farming system and the environment. In Iowa, cover crops are usually planted into standing corn or soybean crops or are planted immediately following grain harvest. While time constraints at this time of year may make it difficult to establish cover crops in the field, cover crops offer a wealth of potential benefits. These benefits include protection from soil erosion (Lal et al., 1991; Karlen and Cambardella, 1996), increased soil microbial activity and nutrient cycling (Karlen and Cambardella, 1996), decreases in excess nitrogen that would be vulnerable to leaching (Kaspar et al., 2007), and adding to soil carbon (Lal et al., 2004). Maintaining year-round soil cover, converting more sunlight to plant biomass that builds soil, and scavenging excess nutrients are features of cover crop systems and are proven methods to prevent soil and nutrient loss.

Determining whether or not a cover crop significantly impairs cash crop yield is necessary for widespread adoption of this practice. Some previous research has shown that a winter cereal rye cover crop may either reduce corn yield (Johnson et al., 1998) or have no effect on corn yield (Miguez and Bollero, 2005). These past studies were conducted over relatively short periods of time and at university research stations. The objective of the present project is to document any effects of a winter cereal rye cover crop on cash crop (corn or soybean) yield over multiple years and across multiple farm sites.

Methods

Six sites on cooperator farms across Iowa were established in the fall of 2008; five more sites were established in the fall of 2009 with two of the previous sites dropping out of the study; 10 sites were then maintained from 2009-2012. In 2013, seven sites participated in the study resulting in a total of 40 site-years over the course of the study (2009-2013). All cooperators were employing corn-soybean rotations. Cooperators established replicated strips the length of their field and maintained those strips across the duration of the trial. Each replication had one strip with cover crops and one without cover crops, and each site-year contained at least two replications. Cooperators either aerially seeded winter cereal rye into a standing corn or soybean crop, or drilled or broadcasted the rye following harvest of corn or soybeans in the fall. Rye seeding rates varied between 50 and 120 lb/ac among cooperators. The rye cover crop was then terminated the following spring by herbicide or tillage prior to planting corn

The strips with winter cereal rye cover crop are growing quickly in the spring at Jim Funcke's farm near Jefferson, Iowa. The cover crop was planted after soybeans in 2012.

Table 1. Farm location cover crop management, and cash crop for the 2013 growing season.

Location	Cover crop planting date	Cover crop planting method	Cover crop seeding rate	Cover crop termination method	Cash crop
Plainfield (NE Iowa)	29 Oct. 2012	Drilled	60 lb/ac	Herbicide	Soybean
Coon Rapids (West central Iowa)	18 Sept. 2012	Drilled	60 lb/ac	Herbicide	Soybean
Clutier (East central Iowa)	15 Oct. 2012	Drilled	90 lb/ac	Herbicide	Soybean
Kalona (SE Iowa)	8 Sept. 2012	Aerial	60 lb/ac	Herbicide	Corn
Holstein (NW Iowa)	28 Aug. & 2 Oct. 2012	Drilled	50 lb/ac	Herbicide	Corn
West Chester (SE Iowa)	23 Aug. 2012	Drilled	90 lb/ac	Herbicide	Soybean
New Market (SW Iowa)	8 Sept. 2012	Drilled	60 lb/ac	Herbicide	Soybean

or soybeans. Winter cereal rye varieties used include "variety not stated (VNS)," or the improved variety "Wheeler" from Michigan State University. Cooperator farm locations, cover crop management, and cash crop grown for the 2013 growing season, is provided in Table 1.

In the spring prior to cover crop termination, above-ground winter cereal rye biomass was collected from four 1-ft^2 quadrats in at least one cover crop strip from 34 site-years. Eighteen of these site-years were going into corn and 16 of these site-years were going into soybeans. Upon collection, samples were dried and weighed.

In the fall, cooperators harvested and weighed grain from individual "with cover crop" and "without cover crop" strips using a weigh wagon or a yield monitor. Corn yields were corrected for 15.5% moisture and soybean yields were corrected for 13% moisture.

Data were analyzed using JMP Pro 10 statistical software (SAS Institute Inc., Cary, NC) and yield comparisons employ least squares means for accuracy. Statistical significance is reported at the $P \le 0.05$ level with tendencies noted at the $0.05 < P \le 0.10$ level.

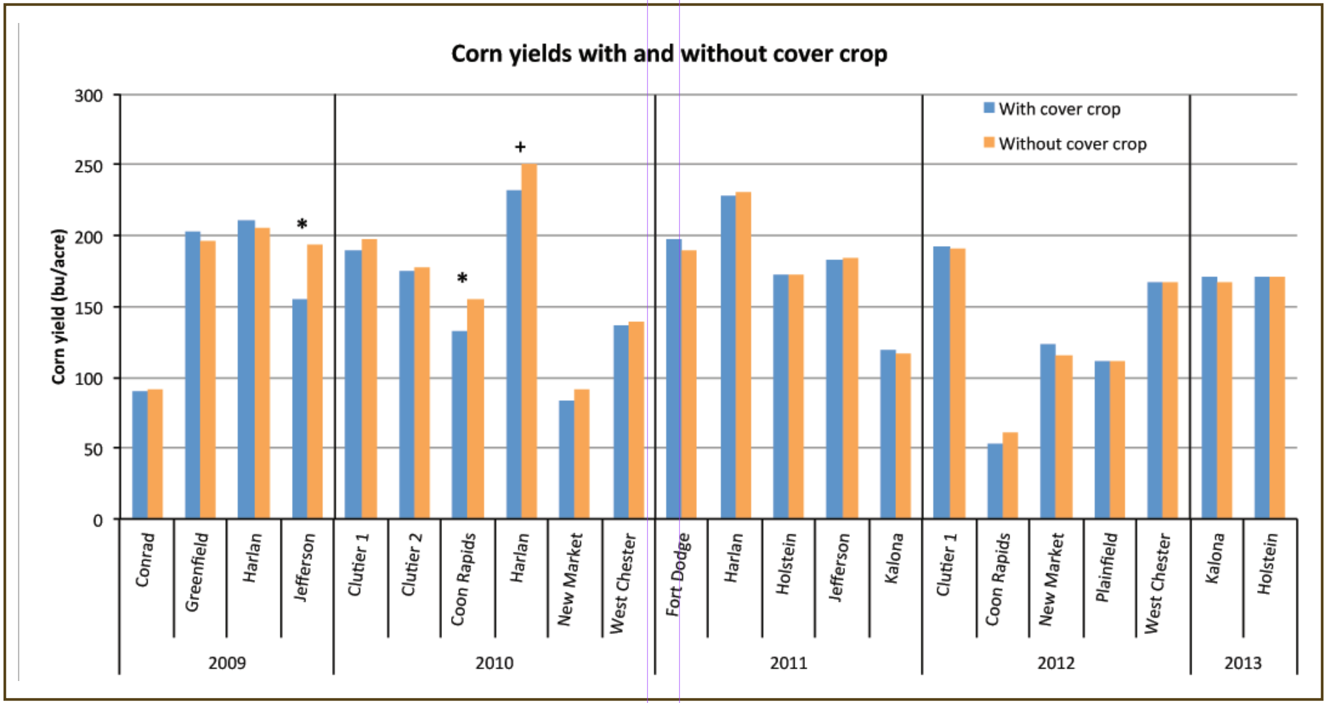

Figure 1. Corn yields with and without a winter cereal rye cover crop from 2009-2013 (22 site-years). Columns overwritten with * denote significance at $P \le 0.05$ and overwritten with + denote significance at $0.05 < P \le 0.10$.

Results and Discussion

Corn Yield

Corn yield ranged from 52.5 bu/ac with cover crop at Coon Rapids in 2012 to 250.6 bu/ac without cover crop at Harlan in 2010 (Figure 1). At three site-years, corn yield was less in strips following the cover crop than in strips without the cover crop (Jefferson in 2009 and Coon Rapids in 2010 [$P \leq 0.05$] and Harlan in 2010 [$0.05 < P \leq 0.10$]) (Figure 1). At the remaining 19 site-years, there was no difference in corn yield detected between strips with cover crop and without cover crop.

At one site-year where cover crop reduced corn yield (Jefferson in 2009), herbicide failed to adequately terminate the rye in the strips with cover crop. The rye likely competed with the corn early in the growing season and contributed to the 38.5 bu/ac reduction in corn yield compared to the strips without cover crop. These instances underscore the importance of proper and timely management of a cover crop in a cash crop system. At the two other site-years where cover crop reduced corn yield (Coon Rapids and Harlan in 2010), farmer-cooperators reported sufficient termination of rye prior to corn planting. It is unclear what caused the 23.6 and 17.5 bu/ac reductions, respectively, in corn yields in these instances.

Spring cover crop growth was measured prior to termination and before corn planting at 18 site-years. Biomass in the strips with cover crop ranged from 110.0 lb/ac at Greenfield in 2009, to 2,406.5 lb/ac at New Market in 2012.

Cooperator Kelly Tobin pauses from monitoring the height of the cover crop growth on his farm near New Market, Iowa. The winter cereal rye was planted in September 2012.

Soybean Yield

Soybean yield ranged from 36.1 bu/ac in strips without cover crop at Jefferson in 2012 to 70.6 bu/ac in strips with cover crop at Kalona in 2010 (Figure 2). At four site-years, soybean yield was greater with cover crop than without cover crop (Harlan in 2010, Kalona in 2010, and Clutier 1 in 2011 [$P \leq 0.05$] and New Market in 2013 [$0.05 < P \leq 0.10$]) (Figure 2). Soybean yield was greater with cover crop by an average 6.2 bu/ac at these four site-years. At one site-year (Coon Rapids in 2013), soybean yield was less with cover crop than without cover crop by 7.2 bu/ac (Figure 2).

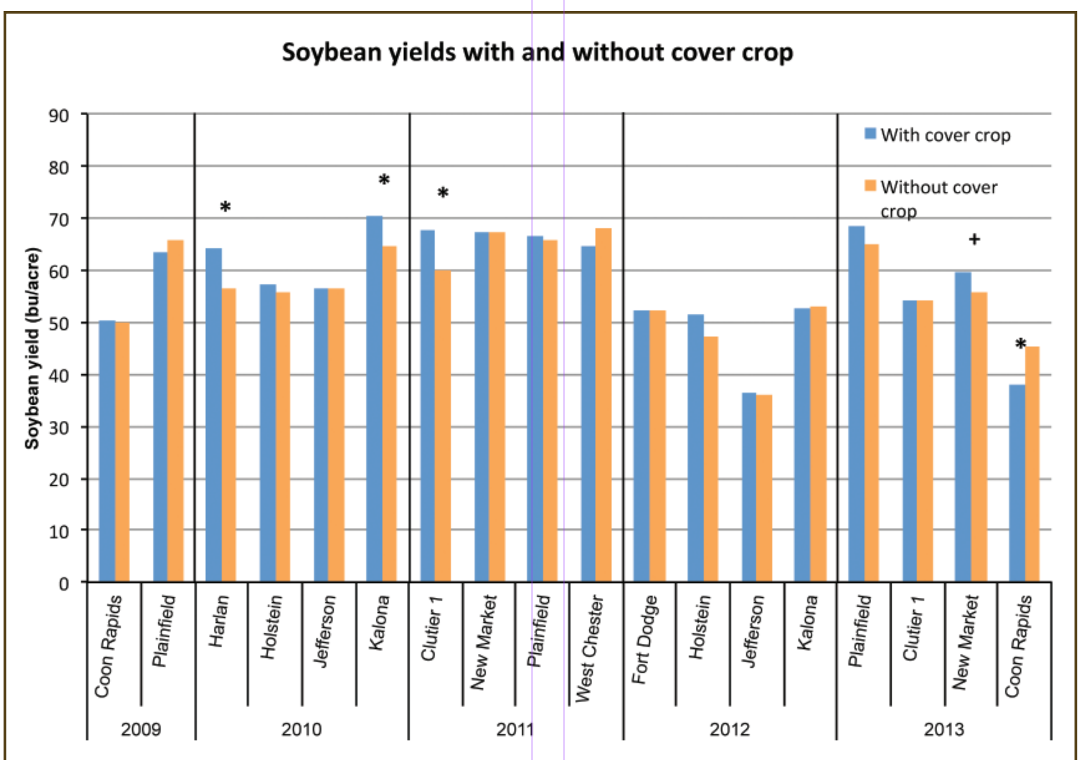

Figure 2. Soybean yields with and without a winter cereal rye cover crop from 2009-2013 (18 site-years). Columns overwritten with '*' denote significance at $P \leq 0.05$ and overwritten with '+' denote significance at $0.05 < P \leq 0.10$.

The winter cereal rye cover crop is growing again in the warm spring weather at Rick Juchems' farm near Plainfield, Iowa.

References

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At the remaining 13 site-years, no difference in soybean yield was detected between strips with cover crop and without cover crop.

At one site-year (Clutier 1 in 2011), non-GMO soybeans following a cover crop yielded 7.8 bu/ac greater than those that did not follow a cover crop (Figure 2). The mulch provided by the terminated cover crop likely served as in-season weed management for the soybeans. The farmer-cooperator observed that strips that did not follow a cover crop had increased weed pressure, which likely reduced soybean yield.

Conclusions

This study shows that a winter cereal rye cover crop can usually be added to a corn-soybean cropping system without significantly affecting yield, however proper management of the cover crop is important. Corn yield was reduced in three out of 22 site-years and soybean yield was reduced in one out of 18 site-years in the strips with cover crop compared to the strips without cover crop. Insufficiently terminating a cover crop in the spring is considered an explanation for yield reductions at Jefferson in 2009. In the majority of site-years, however, corn or soybean yields were either not affected or were increased in the cover crop strips. Corn yield was not affected by the rye cover crop in 19 out of 22 site-years. Soybean yield in the strips with cover crop was greater than soybeans in strips without cover crop in four out of 18 site-years. No firm relationship between cash crop yield and spring cover crop growth was detected. This study will continue to evaluate any effect of a winter cereal rye cover crop on corn and soybean yields in 2014 with eight cooperator sites participating.

Cooperators

Bill Buman, Harlan
Randy Caviness, Greenfield
Jim Funcke, Jefferson
Devan Green, Conrad
Rick Juchems, Plainfield
Larry Ness & Darwin Pierce,
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Mark Pokorny, Clutier
George Schaefer, Kalona
Jerry Sindt, Holstein
Rob Stout, West Chester
Gary & Dave Nelson, Fort Dodge
Kelly Tobin, New Market

Project Timeline

2008-2014 (5th year report)

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