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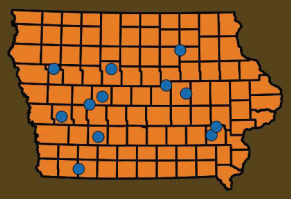
Field Crops Research



Winter Rye Cover Crop Effect on Cash Crop Yields: Year 5

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Cooperators:

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

Funding By:

Iowa Department of Ag and Land Stewardship; Walton Family Foundation; NCR-SARE in partnership with the Iowa Learning Farms

In a Nutshell

- Cover crops are an important addition to any farming system to **improve soil quality** and **decrease soil erosion or nutrient loss.**
- 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 or soybeans properly-managed cover crops can be added to crop farms with **little or no effect on yield.**
- Across 40 site-years, a winter cereal rye cover crop negatively affected cash crop yield five times and positively affected cash crop yield four times.

Project Timeline:
Fall 2008 - Fall 2013

Cooperator, Kelly Tobin, standing among strips with winter cereal rye cover crop and without cover on his farm near New Market, Iowa.

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 do 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 a winter cereal rye cover crop to either reduce corn yield (Johnson et al., 1998) or to 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 was 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.

Method

Six sites on cooperator farms across the state of Iowa were established in the fall of 2008; five more sites were established in the fall of 2009 with two 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, broadcasted rye seed, or drilled the rye following harvest of corn or soybean 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 or soybeans. Winter cereal rye varieties used included variety not stated (VNS), or the improved variety 'Wheeler,' from Michigan State University. Cooperator farm location, 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-ft2 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 soybean. Upon collection, replicate samples were combined and then dried and weighed.

In the fall, cooperators combined 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 $P \leq 0.05$ level with tendencies noted at the $0.05 < P \leq 0.10$ level.

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 [$0.05 < P \leq 10$]) (**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, Jefferson in 2009, herbicide failed to adequately terminate the rye in the strips with cover crop. The rye likely competed with the corn and contributed to the 38.5 bu/ac reduction in corn yield compared to the strips without cover crop. This instance underscores the importance of proper and timely management of a cover crop in a cash crop system.

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 2406.5 lb/ac at New Market in 2012. Corn yield was negatively correlated to cover crop biomass across strips with cover and without cover at Jefferson in 2009 ($r = -0.92$; $P = 0.0011$). Corn yield was not correlated whatsoever to spring cover crop biomass across the strips with cover and without cover at any of the remaining 16 site-years.

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**). 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

Winter cereal rye cover crop at Rick Juchems's farm near Plainfield, Iowa.

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 2013**
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	Aerial	90 lb/ac	Herbicide	Soybean
New Market (SW Iowa)	8 Sept. 2012	Drilled	60 lb/ac	Herbicide	Soybean

Figure 1

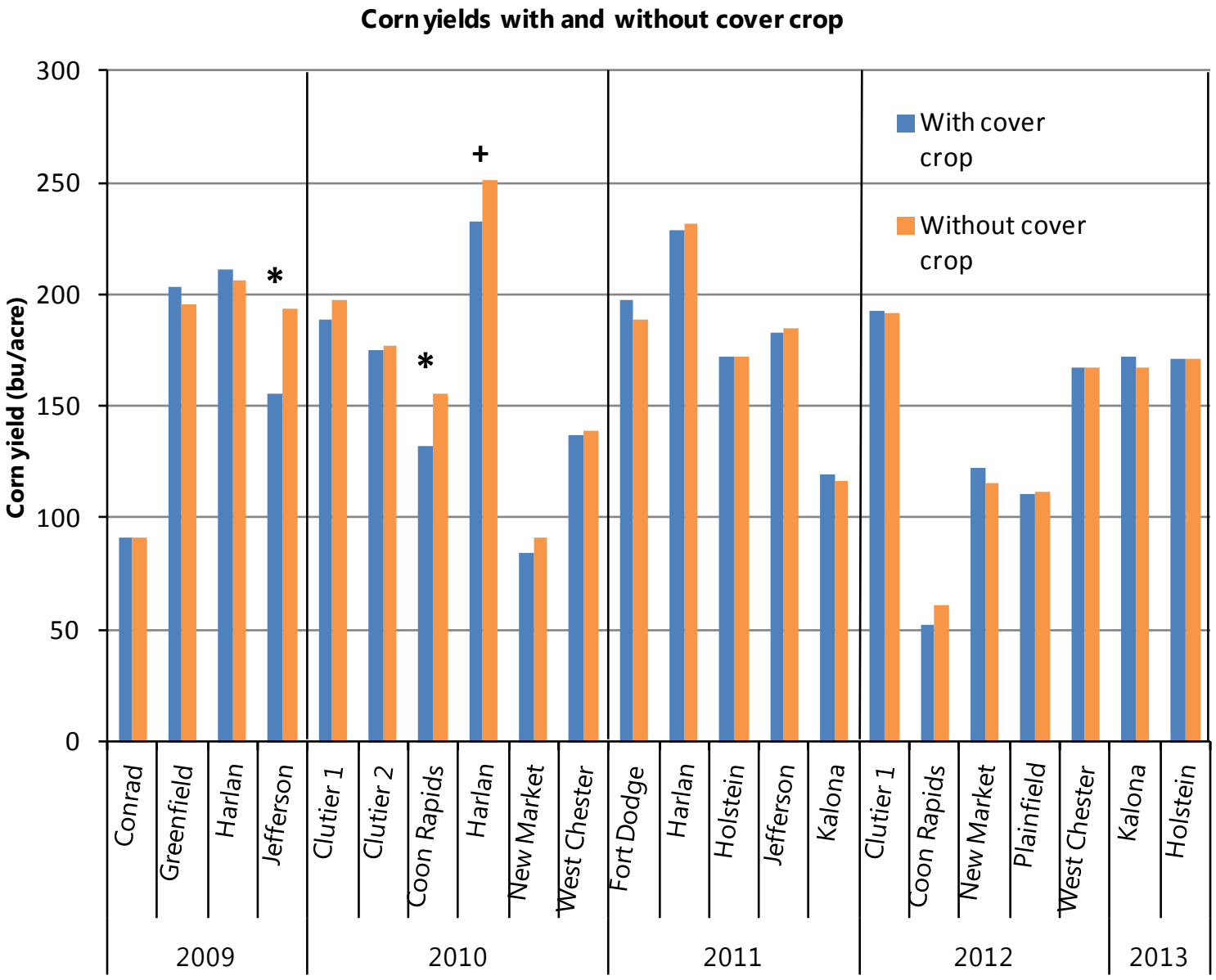

Figure 1. Corn yields with and without a winter cereal rye cover crop at cooperator farms from 2009-2013 (22 site-years). Columns over-written with '*' denote significance at P ≤ 0.05 and overwritten with '+' denote significance at 0.05 < *P* ≤ 0.10.

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 served as in-season weed management for the soybeans. The strips that did not follow a cover crop had increased weed pressure, which likely reduced soybean yield.

Spring cover crop growth was measured prior to termination and before soybean planting at 16 site-years. Biomass in the strips with cover crop ranged from 153.5 lb/ac at Clutier 1 in 2013 to 2475.4 lb/ac at New Market in 2013. Soybean yield was positively correlated to spring cover crop biomass across the strips with cover and without cover at Clutier 1 in 2011 (r = 0.85; *P* = 0.0074), New Market in 2011 (r = 0.94; *P* = 0.0053), and Clutier 1 in 2013 (r = 0.74; *P* = 0.0932). Soybean yield was negatively correlated to cover crop biomass across strips with cover and without cover at West Chester in 2011 (r = -0.83; *P* = 0.0786) and Coon Rapids in 2013 (r = -0.80; *P* = 0.0563).

Strips with winter cereal rye cover crop and without cover in spring at Jim Funcke's farm near Jefferson, Iowa.

Figure 2

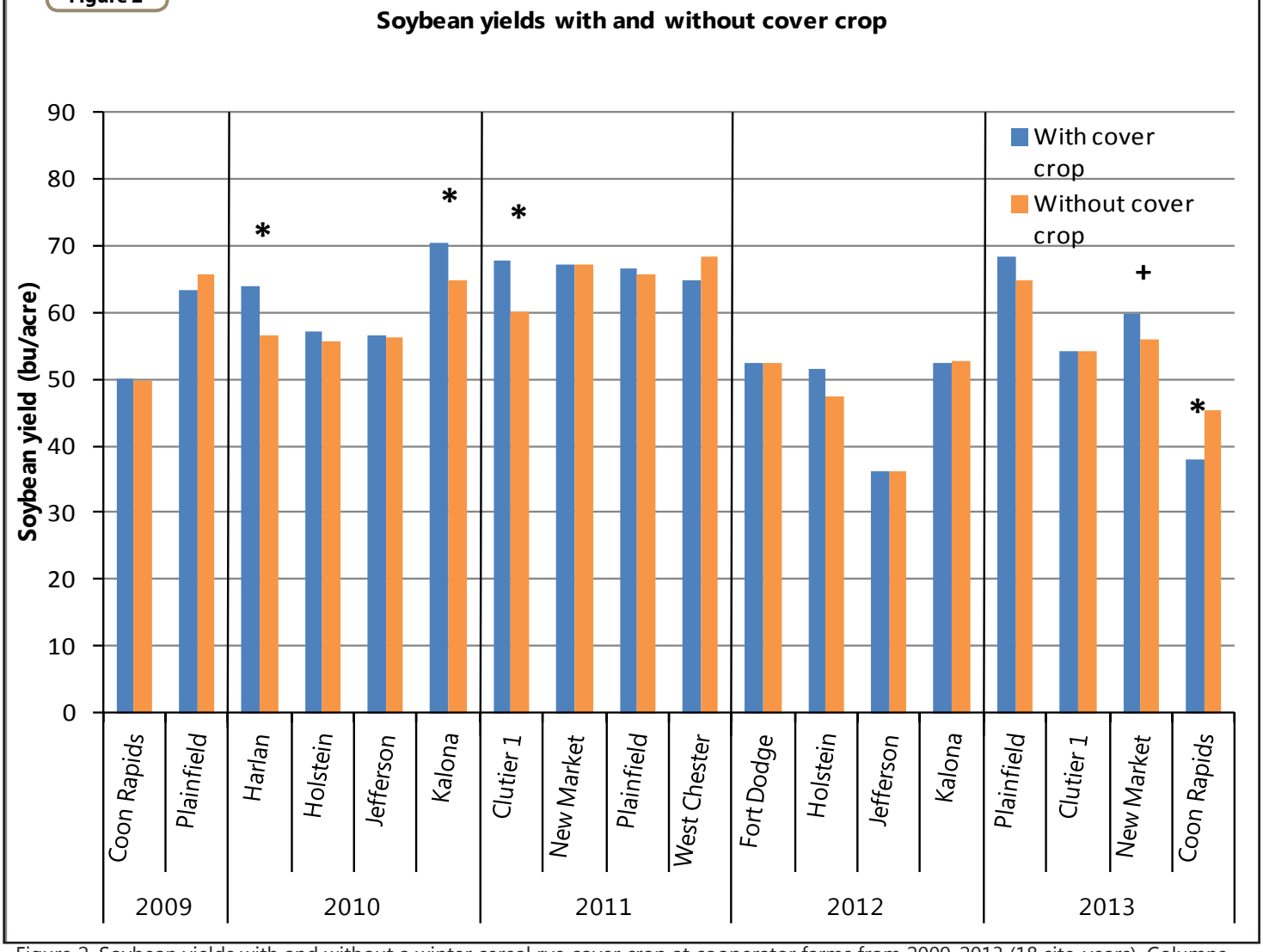

Figure 2. Soybean yields with and without a winter cereal rye cover crop at cooperator farms from 2009-2013 (18 site-years). Columns overwritten with '*' denote significance at $P \leq 0.05$ and overwritten with '+' denote significance at $0.05 < P \leq 0.10$.

Conclusions

This study shows that a winter cereal rye cover crop can 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, as was the case with corn at Jefferson in 2009, can result in such yield reductions. In the majority of site-years, however, corn or soybean yields were either not affected or 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. It is encouraging that corn yield was negatively correlated to spring cover crop growth at only one of 18 site-years where spring cover crop biomass was measured and that soybean yield was positively correlated to spring cover crop biomass at three of 16 site-years where spring cover crop biomass was measured. However, because spring rye biomass was sometimes collected from only one strip at some site-years and not collected from strips in all site-years, no firm relationship between cash crop yield and spring cover crop growth can be stated. 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.

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 Co-operators' Program began in 1987 with farmers looking to save money through more judicious use of inputs. If you are interested in conducting an on-farm trial contact Stefan Gailans @ 515-232-5661 or stefan@practicalfarmers.org.

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