

Winter Cereal Rye Cover Crop Effect on Cash Crop Yield

Year 10

Iowa Learning Farms and Practical Farmers of Iowa



Summary

Farmers reported that in 61 of 68 site-years, properly managed cover crops had little to no negative effect on corn and soybean yield (and actually increased soybean yield in 8 site-years and corn yield in 3 site-years).

Cooperators

Bill Buman, Harlan
Randy Caviness, Greenfield
Jim Funcke, Jefferson
Devan Green, Conrad
Rick Juchems, Plainfield
Rob Davis & 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

Project Timeline

2008-2018 (10th year report)

This project was funded by the State Soil Conservation Committee, the Iowa Department of Agriculture and Land Stewardship and the Leopold Center for Sustainable Agriculture. Additional outreach and education funding came from a NCR-SARE grant, Walton Family Foundation, Iowa Learning Farms, Iowa State University Extension and Outreach and Practical Farmers of Iowa.

Methods

- 12 sites over the course of this study with five participating in 2018. Three sites completed their 10 year, with the remaining two completing year ten next year. All sites are in corn-soybean rotations.
- Cooperators establish and maintain replicated strips the length of their field for duration of the study. Each replication has one strip with cover crops and one without cover crops.
- Cooperators seed cereal rye cover crop in the fall of 2017 aerially or with a drill at seeding rates ranging between 56-60 lb/ac.
- Cover crop termination was accomplished with herbicide applied prior to cash crop planting the following spring.

Table 1. Farm location, cover crop management, and cash crop for the 2018 growing season.

Location	Cover Crop planting date	Cover crop planting method	Cover crop seeding rate	Cover crop termination method	Cash crop	Planting date
Plainfield (NE Iowa)	9/6/17	Aerial	56 lb/ac	Herbicide	Corn	5/8/18
Coon Rapids (West central Iowa)	10/18/17	Drilled	56 lb/ac	Herbicide	Corn	5/6/18
West Chester (SE Iowa)	10/23/17	Drilled	56 lb/ac	Herbicide	Corn	4/30/18
New Market (SW Iowa)	10/23/17	Drilled	56 lb/ac	Herbicide	Corn	5/2/18
Jefferson (West Central Iowa)	1/15/17	Drilled	60 lb/ac	Herbicide	Soy	4/29/18

Results

Cover crop biomass

Above ground cover crop biomass was determined at most locations at the time of cover crop termination (Table 2). Over the years, aboveground cover crop biomass at locations ranged from trace amounts to 2,407 lb/ac prior to corn and from 55- 6,513 lb/ac prior to soybeans. Cover crop was typically terminated 7-10 days prior to planting.

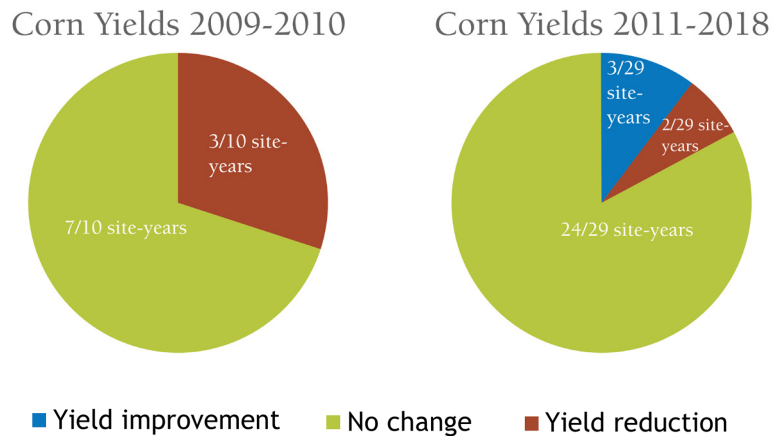
Location	Cover crop biomass (lb/ac)	Sampling date
Plainfield	1,070	5/16/18
Coon Rapids	667	4/25/18
West Chester	172	4/24/18
New Market	291	4/27/18
Jefferson	82	4/29/18

Table 2. Mean cover crop aboveground biomass samples prior to termination in 2018.

Corn yields 2018

In general, corn yields were equivalent regardless of cover crop treatment as determined by statistical analysis (t-test) $P = 0.10$. Only at Jefferson (2009), Coon Rapids (2010, 2014, 2018), and Harlan (2010) were corn yields reduced in the cover crop strips. It should be noted that the majority of these instances occurred the first two growing seasons of the trial. Cooperators identified insufficient cover crop termination or improper planter settings as reasons for the average yield decrease of 19 bu/ac. In the remaining cases, corn yields were mostly not affected by the cover crop (Figure 1). In 2016, corn yields were statistically improved by 3 and 19 bu/ac at West Chester and New Market, respectively and in 2018 at New Market by 15 bu/ac.

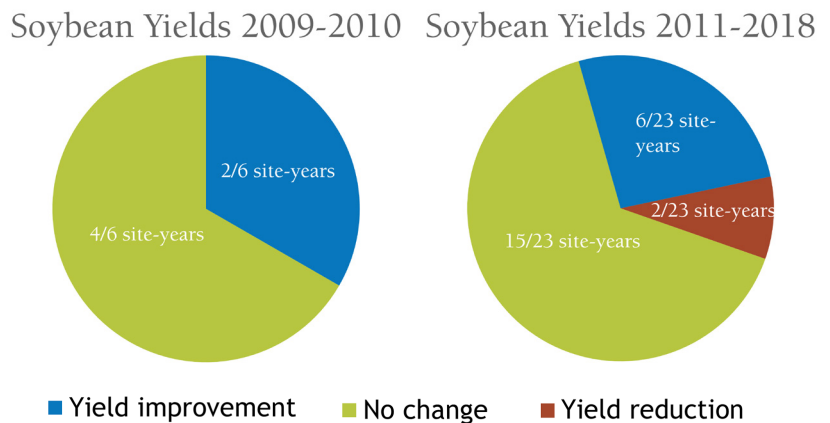
Figure 1. Trends with respect to cover crop effect on corn yields at 10 site-years from 2009 to 2010 and 29 site-years from 2011 to 2018.



Soybean yields 2018

Soybean yields were typically equivalent regardless of cover crop treatment as determined by statistical analysis (t-test) $P = 0.10$. In eight cases, however, soybean yields were improved by the cover crop. Increase in soybean yield ranged from 3 to 11 bu/ac with an average increase of 8 bu/ac in these cases. As with corn, soybean yield was also mostly not affected by the cover crop (Figure 2). Only at West Chester (2011) and Coon Rapids (2013) were soybean yields reduced in the cover crop strips. The cooperators identified planter setting as a reason for the yield difference.

Figure 2. Trends with respect to cover crop effect on soybean yields at 6 site-years from 2009 to 2010 and 23 site-years from 2011 to 2018.



Cover crop effect on cash crop yield trends

Since 2008, there have been 39 site-years dedicated to determining the effect on corn yields and 29 site-years to determine the effect on soybean yields. After their first year of introducing cereal rye into their operations, the farmer partners made adjustments to their planter settings to handle more residue and planned to terminate the cover crop 10-14 days before planting to minimize negative impacts on yield. After ten years in the study, the farmer partners have reported mostly no effect of the cereal rye cover crop on corn and soybean yield.

For more detailed information on the project, see "Winter Cereal Rye Cover Crop Effect on Cash Crop Yield" on these websites:

ILF: <https://www.iowalearningfarms.org/content/cover-crop-research>

PFI: <https://practicalfarmers.org/research/winter-cereal-rye-cover-crop-effect-of-cash-crop-yield/>



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Winter Cereal Rye Cover Crop Effect on Cash Crop Yield

Year 9

Iowa Learning Farms and Practical Farmers of Iowa



Summary

Farmers reported that in 59 of 63 site-years, properly managed cover crops had little to no negative effect on corn and soybean yield (and actually increased soybean yield in 8 site-years and corn yield in 2 site-years).

Cooperators

Bill Buman, Harlan
Randy Caviness, Greenfield
Jim Funcke, Jefferson
Devan Green, Conrad
Rick Juchems, Plainfield
Rob Davis & 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

Project Timeline

2008-2017 (9th year report)

This project was funded by the State Soil Conservation Committee, the Iowa Department of Agriculture and Land Stewardship and the Leopold Center for Sustainable Agriculture. Additional outreach and education funding came from a NCR-SARE grant, Walton Family Foundation, Iowa Learning Farms, Iowa State University Extension and Outreach and Practical Farmers of Iowa.

Methods

- 12 sites over the course of this study with five participating in 2017. All sites are in corn-soybean rotations.
- Cooperators establish and maintain replicated strips the length of their field for duration of the study. Each replication has one strip with cover crops and one without cover crops.
- Cooperators seed cereal rye cover crop in the fall of 2017 aerially or with a drill at seeding rates ranging between 56-60 lb/ac.
- Cover crop termination was accomplished with herbicide applied prior to cash crop planting the following spring.

Table 1. Farm location, cover crop management, and cash crop for the 2017 growing season.

Location	Cover Crop planting date	Cover crop planting method	Cover crop seeding rate	Cover crop termination method	Cash crop	Planting date
Plainfield (NE Iowa)	11/7/16	Drilled	56 lb/ac	Herbicide	Soy	5/15/17
Coon Rapids (West central Iowa)	10/26/16	Drilled	60 lb/ac	Herbicide	Soy	5/15/17
West Chester (SE Iowa)	10/18/16	Aerial	60 lb/ac	Herbicide	Soy	5/15/17
New Market (SW Iowa)	10/9/16	Drilled	56 lb/ac	Herbicide	Soy	5/6/17
Jefferson (West Central Iowa)	10/30/16	Drilled	56 lb/ac	Herbicide	Corn	4/24/17

Results

Cover crop biomass

Above-ground cover crop biomass was determined at most locations at the time of cover crop termination (Table 2). Over the years, aboveground cover crop biomass at locations ranged from trace amounts to 2,407 lb/ac prior to corn and from 55- 6,513 lb/ac prior to soybeans. Cover crop was typically terminated 7-10 days prior to planting.

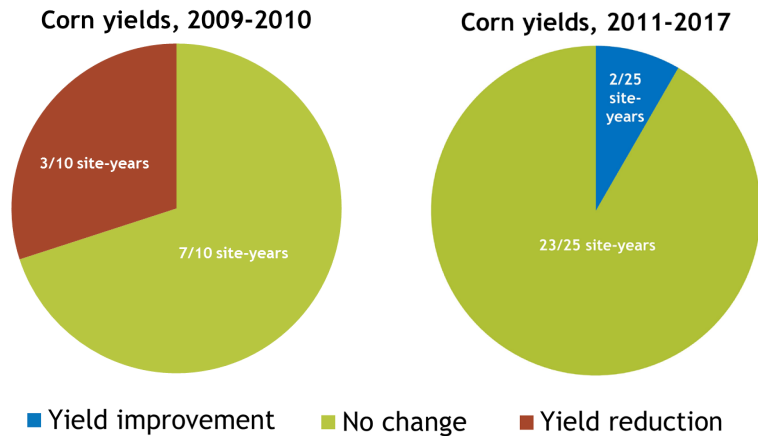
Location	Cover crop biomass (lb/ac)	Sampling date
Plainfield	220	5/4/17
Coon Rapids	183	4/11/17
West Chester	6,513	5/9/17
New Market	1,014	4/20/17
Jefferson	600	5/5/17

Table 2. Mean cover crop aboveground biomass samples prior to termination in 2017.

Corn yields 2017

In general, corn yields were equivalent regardless of cover crop treatment as determined by statistical analysis (t-test). Only at Jefferson (2009), Coon Rapids (2010) and Harlan (2010) were corn yields reduced in the cover crop strips. It should be noted that these instances occurred only in the first two growing seasons of the trial. Cooperators identified insufficient cover crop termination (Jefferson '09) or improper planter settings (Coon Rapids, Harlan '10) as reasons for the average yield decrease of 27 bu/ac. In the remaining cases, corn yields were mostly not affected by the cover crop (Figure 1). In 2016, corn yields were statistically improved by 3 and 19 bu/ac at West Chester and New Market, respectively.

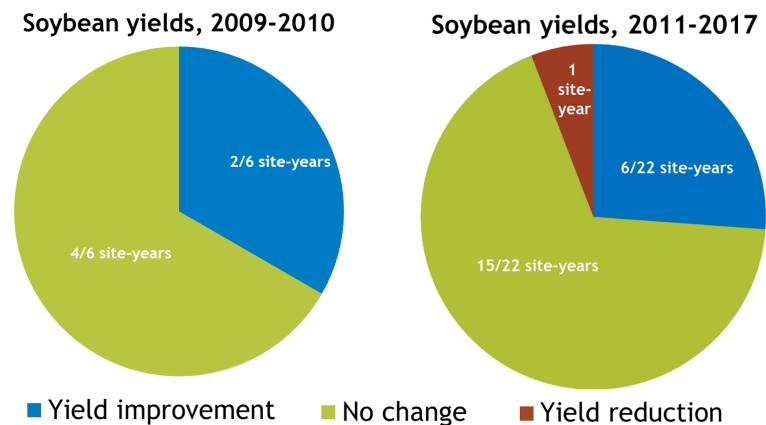
Figure 1. Trends with respect to cover crop effect on corn yields at 10 site-years from 2009 to 2010 and 25 site-years from 2011 to 2017.



Soybean yields 2017

Soybean yields were typically equivalent regardless of cover crop treatment as determined by statistical analysis (t-test). In eight cases, however, soybean yields were improved by the cover crop. Increase in soybean yield ranged from 3 to 11 bu/ac with an average increase of 8 bu/ac in these cases. As with corn, soybean yield was also mostly not affected by the cover crop (Figure 2). Only at Coon Rapids (2013) were soybean yields reduced in the cover crop strips. The cooperator identified planter setting as a reason for the yield difference.

Figure 2. Trends with respect to cover crop effect on soybean yields at 6 site-years from 2009 to 2010 and 22 site-years from 2011 to 2017.



Cover crop effect on cash crop yield trends

Since 2008, there have been 35 site-years dedicated to determining the effect on corn yields and 28 site-years to determine the effect on soybean yields. After their first year of introducing cereal rye into their operations, the farmer partners made adjustments to their planter settings to handle more residue and planned to terminate the cover crop 10-14 days before planting to minimize negative impacts on yield. After nine years in the study, the farmer partners have reported mostly no effect of the cereal rye cover crop on corn and soybean yield.

For more detailed information on the project and Year 5 report, see "Winter Cereal Rye Cover Crop Effect on Cash Crop Yield – Year 5" on these websites:

ILF: <https://www.iowalearningfarms.org/content/cover-crop-research>

PFI: <http://practicalfarmers.org/farmer-knowledge/research-reports/2014/winter-cereal-rye-cover-crop-effect-cash-crop-yield/>



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Winter Cereal Rye Cover Crop Effect on Cash Crop Yield

Year 8

Iowa Learning Farms and Practical Farmers of Iowa



Summary

Farmers reported that in 55 of 59 site-years, properly managed cover crops had little to no negative effect on corn and soybean yield (and actually increased soybean yield in 7 site-years and corn yield in 2 site-years).

Cooperators

Bill Buman, Harlan
Randy Caviness, Greenfield
Jim Funcke, Jefferson
Devan Green, Conrad
Rick Juchems, Plainfield
Rob Davis & 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

Project Timeline

2008-2016 (8th year report)

This project was funded by the State Soil Conservation Committee, the Iowa Department of Agriculture and Land Stewardship and the Leopold Center for Sustainable Agriculture. Additional outreach and education funding came from a NCR-SARE grant, Walton Family Foundation and the Iowa Learning Farms.

Methods

- 12 sites over the course of this study with six participating in 2016. All sites are in corn-soybean rotations.
- Cooperators establish and maintain replicated strips the length of their field for duration of the study. Each replication has one strip with cover crops and one without cover crops.
- Cooperators seed cereal rye cover crop in the fall of 2015 aerially or with a drill at seeding rates ranging between 56-60 lb/ac.
- Cover crop termination was accomplished with herbicide applied prior to cash crop planting the following spring.

Table 1. Farm location, cover crop management, and cash crop for the 2016 growing season.

Location	Cover Crop planting date	Cover crop planting method	Cover crop seeding rate	Cover crop termination method	Cash crop	Planting date
Plainfield (NE Iowa)	10/8/15	Drilled	56 lb/ac	Herbicide	Corn	5/8/16
Coon Rapids (West central Iowa)	10/20/15	Drilled	60 lb/ac	Herbicide	Corn	4/25/16
Holstein (NW Iowa)	9/9/15	Aerial	60 lb/ac	Herbicide	Soy	5/18/16
West Chester (SE Iowa)	11/4/15	Drilled	56 lb/ac	Herbicide	Corn	4/25/16
New Market (SW Iowa)	10/14/15	Drilled	56 lb/ac	Herbicide	Corn	4/22/16
Jefferson (West Central Iowa)	11/1/15	Drilled	60 lb/ac	Herbicide	Soy	5/15/16

Results

Cover crop biomass

Above-ground cover crop biomass was determined at most locations at the time of cover crop termination (Table 2). Over the years, aboveground cover crop biomass at locations ranged from trace amounts to 2,407 lb/ac prior to corn and from 55- 2,475 lb/ac prior to soybeans. Cover crop was typically terminated 7-10 days prior to planting.

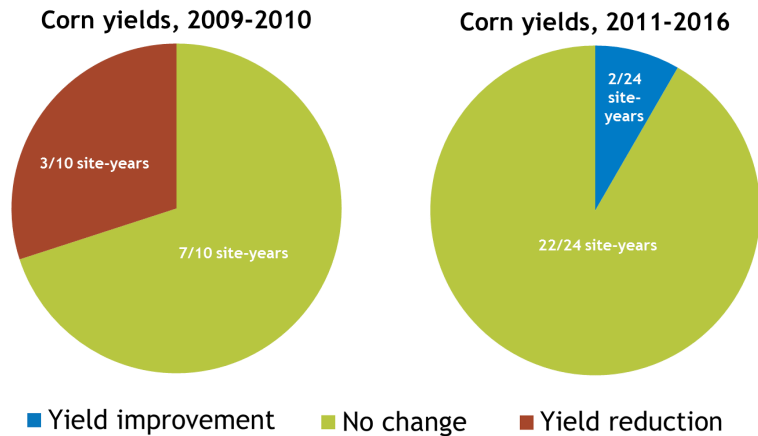
Location	Cover crop biomass (lb/ac)	Sampling date
Plainfield	680.12	4/29/16
Coon Rapids	515.42	4/19/16
Holstein	834.71	5/12/16
West Chester	454.24	4/14/16
New Market	231.14	4/19/16
Jefferson	398.90	4/27/16

Table 2. Mean cover crop aboveground biomass samples prior to termination in 2016.

Corn yields 2016

In general, corn yields were equivalent regardless of cover crop treatment as determined by statistical analysis (t-test). Only at Jefferson (2009), Coon Rapids (2010) and Harlan (2010) were corn yields reduced in the cover crop strips. It should be noted that these instances occurred only in the first two growing seasons of the trial. Cooperators identified insufficient cover crop termination (Jefferson '09) or improper planter settings (Coon Rapids, Harlan '10) as reasons for the average yield decrease of 27 bu/ac. In the remaining cases, corn yields were mostly not affected by the cover crop (Figure 1). In 2016, corn yields were statistically improved by 3 and 19 bu/ac at West Chester and New Market, respectively.

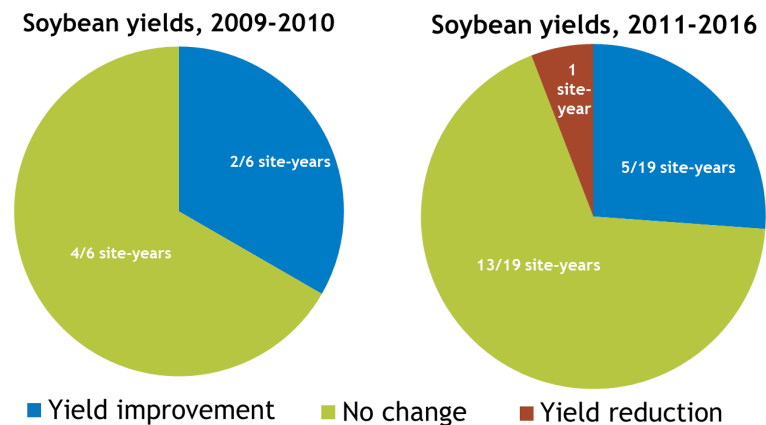
Figure 1. Trends with respect to cover crop effect on corn yields at 10 site-years from 2009 to 2010 and 24 site-years from 2011 to 2016.



Soybean yields 2016

Soybean yields were typically equivalent regardless of cover crop treatment as determined by statistical analysis (t-test). In seven cases, however, soybean yields were improved by the cover crop. Increase in soybean yield ranged from 3 to 8 bu/ac with an average increase of 5 bu/ac in these cases. As with corn, soybean yield was also mostly not affected by the cover crop (Figure 2). Only at Coon Rapids (2013) were soybean yields reduced in the cover crop strips. The cooperator identified planter setting as a reason for the yield difference. Soybean yields in 2016 ranged between 63 and 64 bu/ac at two locations.

Figure 2. Trends with respect to cover crop effect on soybean yields at 6 site-years from 2009 to 2010 and 19 site-years from 2011 to 2016.



Cover crop effect on cash crop yield trends

Since 2008, there have been 34 site-years dedicated to determining the effect on corn yields and 25 site-years to determine the effect on soybean yields. After their first year of introducing cereal rye into their operations, the farmer partners made adjustments to their planter settings to handle more residue and planned to terminate the cover crop 10-14 days before planting to minimize negative impacts on yield. After eight years in the study, the farmer partners have reported mostly no effect of the cereal rye cover crop on corn and soybean yield.

For more detailed information on the project and Year 5 report, see "Winter Cereal Rye Cover Crop Effect on Cash Crop Yield – Year 5" on these websites:

ILF: <https://www.iowalearningfarms.org/content/cover-crop-research>

PFI: <http://practicalfarmers.org/farmer-knowledge/research-reports/2014/winter-cereal-rye-cover-crop-effect-cash-crop-yield/>



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Winter Cereal Rye Cover Crop Effect on Cash Crop Yield

Year 7

Iowa Learning Farms and Practical Farmers of Iowa



Summary

Farmers reported that in 49 of 53 site-years, properly managed cover crops had little to no negative effect on corn and soybean yield (and actually increased soybean yield in 7 site-years).

Cooperators

Bill Buman, Harlan
Randy Caviness, Greenfield
Jim Funcke, Jefferson
Devan Green, Conrad
Rick Juchems, Plainfield
Rob Davis & 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

Project Timeline

2008-2015 (7th year report)

This project was funded by the State Soil Conservation Committee, the Iowa Department of Agriculture and Land Stewardship and the Leopold Center for Sustainable Agriculture. Additional outreach and education funding came from a NCR-SARE grant, Walton Family Foundation and the Iowa Learning Farms.

Methods

- 12 sites over the course of this study with seven participating in 2015. All sites are in corn-soybean rotations.
- Cooperators establish and maintain replicated strips the length of their field for duration of the study. Each replication has one strip with cover crops and one without cover crops.
- Cooperators seed cereal rye cover crop in the fall of 2014 aerially or with a drill at seeding rates ranging between 56-84 lb/ac.
- Cover crop termination was primarily accomplished with herbicide applied prior to cash crop planting the following spring.

Table 1. Farm location, cover crop management, and cash crop for the 2014 growing season.

Location	Cover Crop planting date	Cover crop planting method	Cover crop seeding rate	Cover crop termination method	Cash crop	Planting date
Plainfield (NE Iowa)	10/29/14	Drilled	56 lb/ac	Herbicide	Soy	5/13/15
Coon Rapids (West central Iowa)	11/6/14	Drilled	60 lb/ac	Herbicide	Soy	5/22/15
Holstein (NW Iowa)	9/12/14	Aerial	60 lb/ac	Cultivated & Herbicide	Corn	4/28/15
Kalona (SE Iowa)	8/29/14	Aerial	84 lb/ac	Herbicide	Soy	5/29/15
West Chester (SE Iowa)	11/1/14	Drilled	56 lb/ac	Herbicide	Soy	6/1/15
New Market (SW Iowa)	10/9/14	Drilled	56 lb/ac	Herbicide	Soy	5/14/15
Jefferson (West Central Iowa)	10/22/14	Drilled	60 lb/ac	Herbicide	Corn	5/4/15

Results

Cover crop biomass

Above-ground cover crop biomass was determined at most locations at the time of cover crop termination (Table 2). Over the years, aboveground cover crop biomass at locations ranged from trace amounts to 2,407 lb/ac prior to corn and from 55- 2,475 lb/ac prior to soybeans. Cover crop was typically terminated 7-10 days prior to planting.

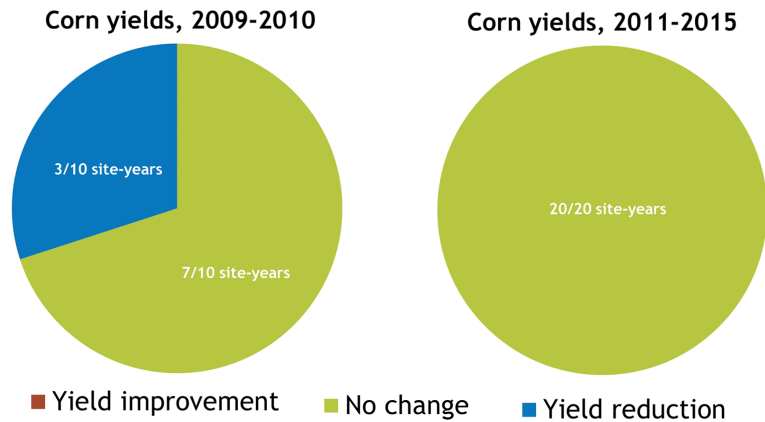
Location	Cover crop biomass (lb/ac)	Sampling date
Plainfield	695.30	5/13/15
Coon Rapids	55.24	4/22/15
Holstein	NA	Failed to Establish
Kalona	678.01	4/28/15
West Chester	317.97	5/1/15
New Market	453.47	4/21/15
Jefferson	34.80	4/28/15

Table 2. Mean cover crop aboveground biomass samples prior to termination in 2015.

Corn yields 2015

In general, corn yields were equivalent regardless of cover crop treatment as determined by statistical analysis (t-test). Only at Jefferson (2009), Coon Rapids (2010) and Harlan (2010) were corn yields reduced in the cover crop strips. It should be noted that these instances occurred only in the first two growing seasons of the trial. Cooperators identified insufficient cover crop termination (Jefferson '09) or improper planter settings (Coon Rapids, Harlan '10) as reasons for the average yield decrease of 27 bu/ac. In the remaining cases, corn yield was not affected by the cover crop (Figure 1). At all but one location which suffered a hail storm in June, corn yields were near or above 200 bu/ac in 2014 and 2015.

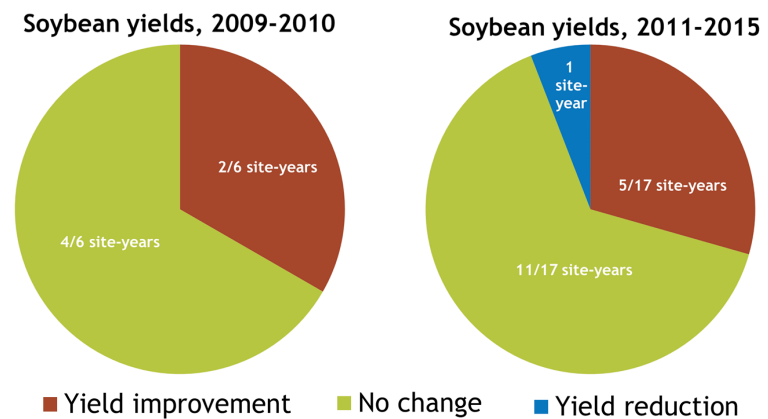
Figure 1. Trends with respect to cover crop effect on corn yields at 10 site-years from 2009 to 2010 and 20 site-years from 2011 to 2015.



Soybean yields 2015

Soybean yields were typically equivalent regardless of cover crop treatment as determined by statistical analysis (t-test). In seven cases, however, soybean yields were improved by the cover crop. Increase in soybean yield ranged from 3 to 8 bu/ac with an average increase of 5 bu/ac in these cases. As with corn, soybean yield was also mostly not affected by the cover crop (Figure 2). Soybean yields in 2015 ranged between 41 and 63 bu/ac.

Figure 2. Trends with respect to cover crop effect on soybean yields at 6 site-years from 2009 to 2010 and 17 site-years from 2011 to 2015.



Cover crop effect on cash crop yield trends

Since 2008, there have been 30 site-years dedicated to determining the effect on corn yields and 23 site-years to determine the effect on soybean yields. After their first year of introducing cereal rye into their operations, the farmer partners made adjustments to their planter settings to handle more residue and planned to terminate the cover crop 7-10 days before planting to minimize negative impacts on yield. After seven years in the study, the farmer partners have reported mostly no effect of the cereal rye cover crop on corn and soybean yield.

For more detailed information on the project and Year 5 report, see "Winter Cereal Rye Cover Crop Effect on Cash Crop Yield – Year 5" on these websites:

ILF: <http://www.extension.iastate.edu/ilf/content/cover-crop-research>

PFI: <http://practicalfarmers.org/farmer-knowledge/research-reports/2014/winter-cereal-rye-cover-crop-effect-cash-crop-yield/>



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Winter Cereal Rye Cover Crop Effect on Cash Crop Yield

Year 6

Iowa Learning Farms and Practical Farmers of Iowa



Summary

Farmers reported that in 42 of 46 trials, properly managed cover crops had little or no negative effect on corn and soybean yield (and actually increased soybean yield in 4 trials).

Cooperators

Bill Buman, Harlan
Randy Caviness, Greenfield
Jim Funcke, Jefferson
Devan Green, Conrad
Rick Juchems, Plainfield
Rob Davis & 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

Project Timeline

2008-2014 (6th year report)

This project was funded by the State Soil Conservation Committee, the Iowa Department of Agriculture and Land Stewardship and the Leopold Center for Sustainable Agriculture. Additional outreach and education funding came from a NCR-SARE grant, Walton Family Foundation and the Iowa Learning Farms.

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 previous sites dropping out of the study; 10 sites were then maintained from 2009-2012. In 2013, seven sites participated, and in 2014, six sites participated in the study resulting in a total of 46 site-years over the course of the study (2009-2014). 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. Cooperator farm location, cover crop management, and cash crop grown for the 2014 growing season is provided in Table 1.

Table 1. Farm location, cover crop management, and cash crop for the 2014 growing season.

Location	Cover Crop planting date	Cover crop planting method	Cover crop seeding rate	Cover crop termination method	Cash crop	Planting date
Plainfield (NE Iowa)	10/22/13	Drilled	50 lb/ac	Cultivated & herbicide	Corn	5/8/14
Coon Rapids (West central Iowa)	10/21/13	Drilled	60 lb/ac	Herbicide	Corn	5/6/14
Clutier (East central Iowa)	10/14/13	Drilled	112 lb/ac	Cultivated	Corn	5/2/14
Kalona (SE Iowa)	11/1/13	Drilled	84 lb/ac	Cultivated & herbicide	Corn	5/10/14
West Chester (SE Iowa)	9/26/13	Aerial	90 lb/ac	Herbicide	Corn	5/9/14
New Market (SW Iowa)	10/10/13	Drilled	56 lb/ac	Herbicide	Corn	5/15/14

Results

Cover crop biomass

Above-ground cover crop biomass was determined at most locations at the time of cover crop termination in 2014 (Table 2). In previous years, above-ground cover crop biomass at locations ranged from 110.0 lb/ac to 2,406.5 lb/ac prior to planting corn and from 153.5 lb/ac to 2,475.4 lb/ac prior to planting soybeans. Low amounts of cover crop biomass in 2014 were likely due to cool spring temperatures.

Table 2. Mean cover crop aboveground biomass at four locations samples prior to termination in 2014.

Location	Cover crop biomass (lb/ac)	Sampling date
Plainfield (NE Iowa)	97.2	5/7/14
Coon Rapids (West central Iowa)	93.2	4/23/14
Clutier (East central Iowa)	72.7	4/23/14
New Market (SW Iowa)	169.3	4/11/14

Corn yields 2014

Mean yields at participating locations in 2014 are provided in Figure 1. At each location, corn yields were equivalent regardless of cover crop treatment as determined by statistical analysis (t-test). At five of the six locations, corn yields were near or above 200 bu/ac.

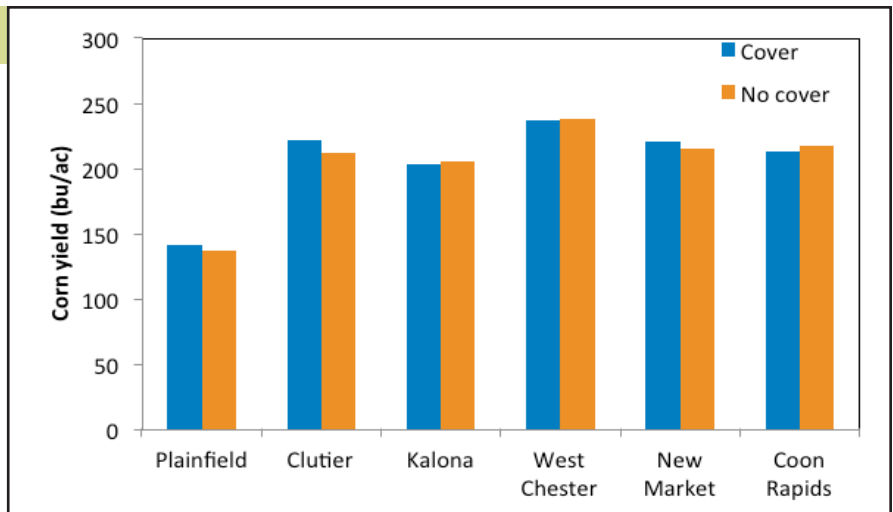


Figure 1. Mean corn yields at participating locations in 2014.

Cover crop effect on cash crop yield trends

Over the course of this project, 28 site-years have been dedicated to determining the effect of the cover crop on corn yields and 18 site-years have been dedicated to determining the effect of the cover crop on soybean yields. In the majority of cases, corn yield was not affected by the cover crop (Figure 2).

It should be noted that the instances in which corn yield was reduced by the cover crop occurred only in the first two growing seasons of the trial (2009 and 2010). Farmer inexperience with terminating cover crops or adjusting the planter to plant into the cover crop residues could have contributed to the yield losses in these instances.

As with corn, soybean yield was also mostly not affected by the cover crop (Figure 3). In four cases, soybean yields were actually improved by the cover crop. After six years of this study, farmers have reported no effect of the cover crop on corn and soybean yield in the majority of cases.

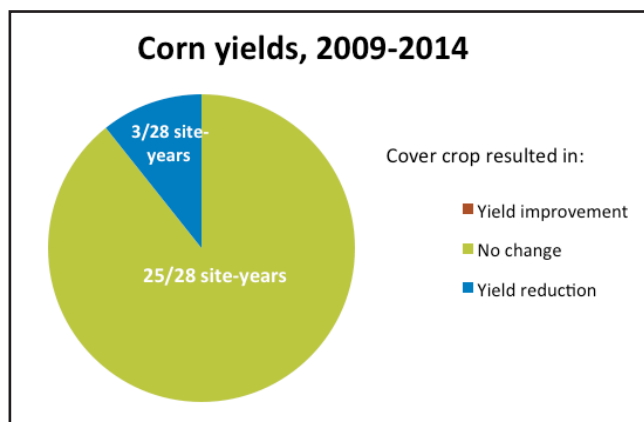


Figure 2. Trends with respect to cover crop effect on corn yields at 28 site-years from 2009 to 2014.

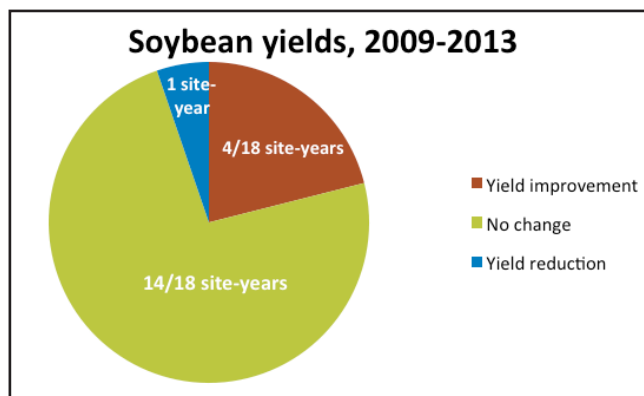


Figure 3. Trends with respect to cover crop effect on soybean yields at 18 site-years from 2009 to 2013.

For more detailed information on the project and Year 5 report, see “Winter Cereal Rye Cover Crop Effect on Cash Crop Yield – Year 5” on these websites:

ILF: <http://www.extension.iastate.edu/ilf/content/cover-crop-research>

PFI: <http://practicalfarmers.org/farmer-knowledge/research-reports/2014/winter-cereal-rye-cover-crop-effect-cash-crop-yield/>



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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.

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.

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).

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.

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



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-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 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 $P \leq 0.05$ level with tendencies noted at the $0.05 < P \leq 0.10$ level.

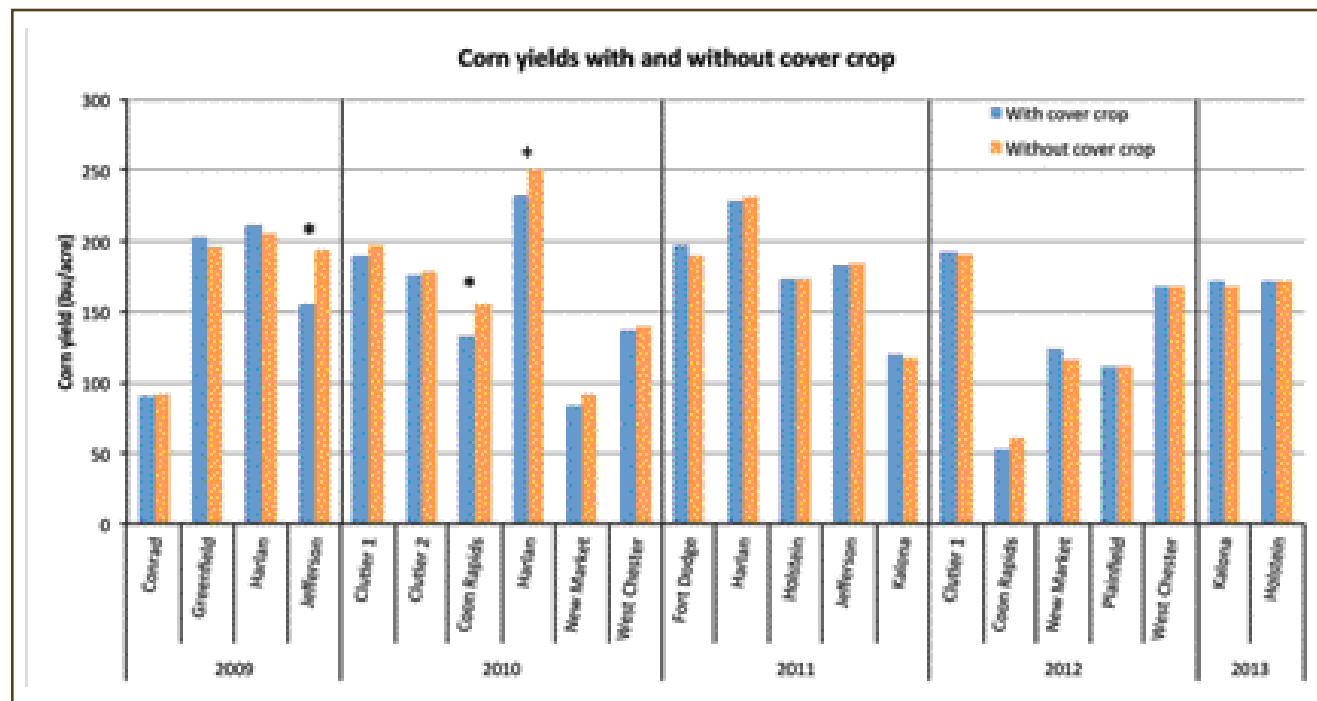


Figure 1. Corn yields with and without a winter cereal rye cover crop from 2009-2013 (22 site-years). Columns overwritten with * denote significance at $P \leq 0.05$ and overwritten with + denote significance at $0.05 < P \leq 0.10$.

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).

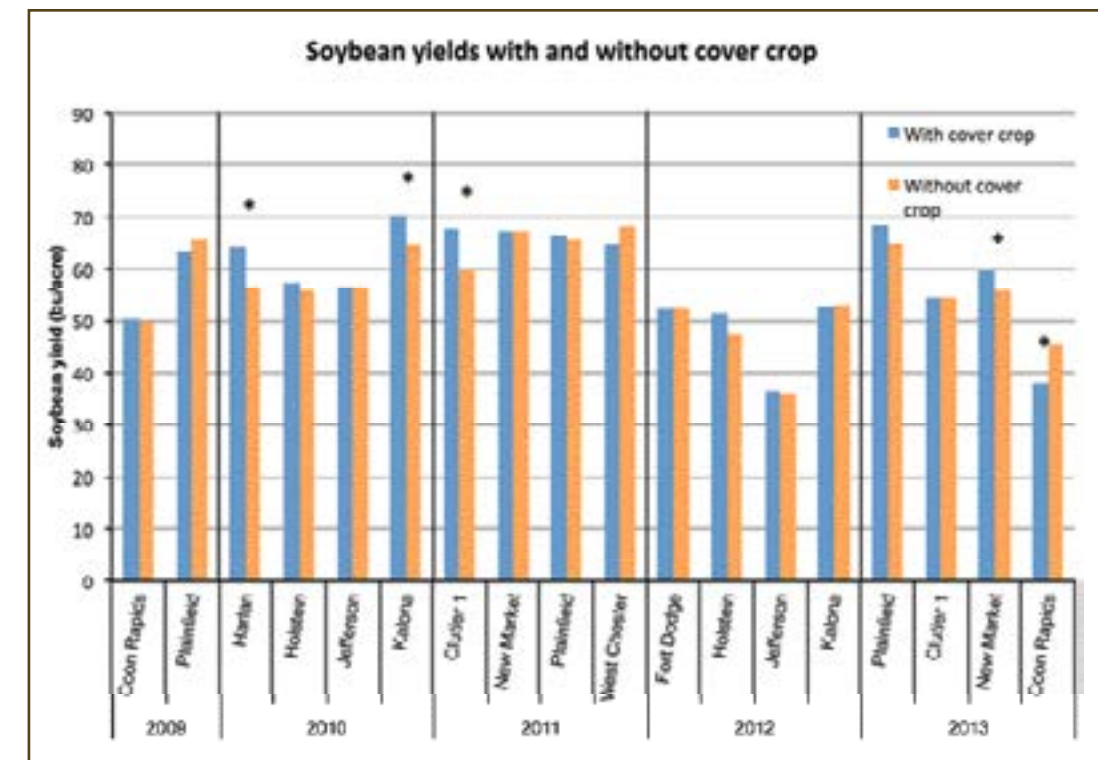


Figure 2. Soybean yields with and without a winter cereal rye cover crop from 2009-2013 (18 site-years). Columns overwritten with * denote significance at $P \leq 0.05$ and overwritten with + denote significance at $0.05 < P \leq 0.10$.



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

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.

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 Rob Stout, West Chester
 Gary & Dave Nelson, Fort Dodge
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Project Timeline

2008-2014 (5th year report)

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