

Economics of Cover Crops

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Disclosure

- Research funded by NCR-SARE and the ISU Center for Agricultural and Rural Development (CARD)
- Collaborators:
 - Dept. of Economics, ISU
 - Dept. of Agronomy, ISU
 - Practical Farmers of Iowa
 - Hundreds of Cover Croppers in Iowa



Highlights

- Iowa farmers tend to obtain negative annual returns on cover crops, unless feed cost savings from grazing or forage usage can be realized.
- Consistent results across CC species, years of experience, locations, management practices, scale, corn/soybeans.
- How to make cover crops pay?

Overview

- What makes this study unique?
- Results from Iowa survey
- Long term considerations
- Strategies to make cover crops pay

What makes this study unique?

- Questionnaire based on Focus Groups (IA, MN, IL)
- Survey collected information on farmers' changes in costs and revenues at each step of production with cover crops compared to fields without cover crops
- Regional Online Survey & Mailed Iowa Survey
- Our partial budgets are the best available estimates of annual net returns to cover crop users: data collected using scientific method & largest sample size available to date.

\$ Calculations

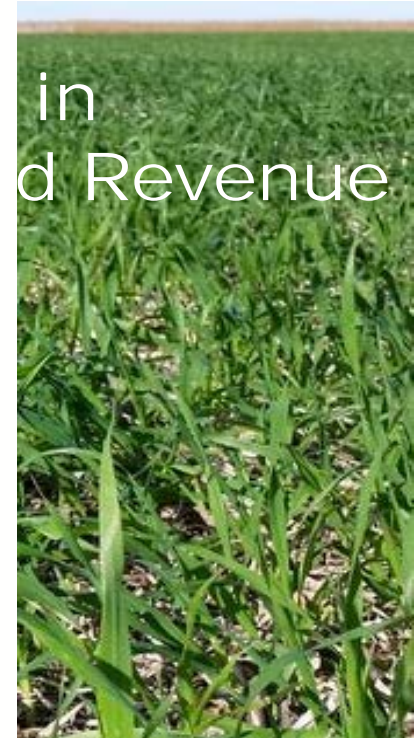
PARTIAL BUDGETS:

- For each farm operator, expenses and revenues in his/her production system with cover crops are compared against expenses and revenues in his/her production system without cover crops.

What are we comparing?

**Winter '15 Corn ground →
'16 Soybeans w/ and w/out cover crops**

**Winter '15 Soybean ground →
'16 Corn w/ and w/out cover crops**

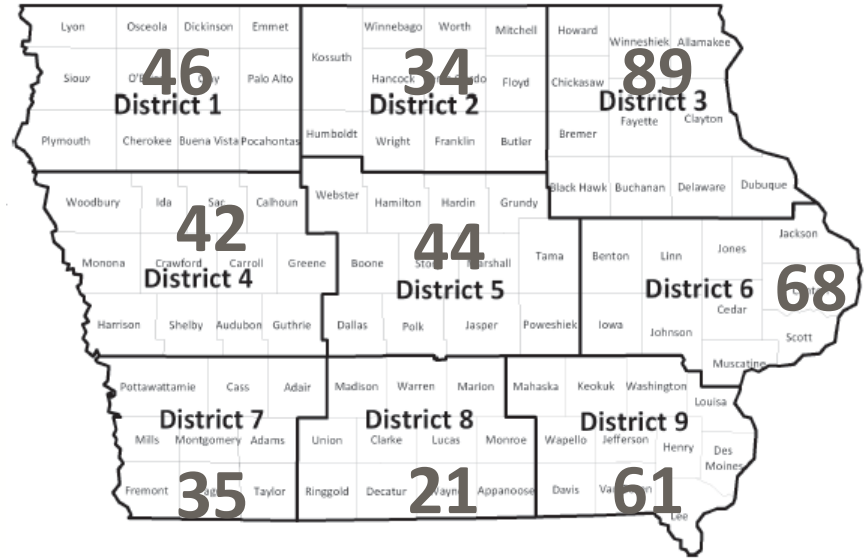


IOWA Survey Sample

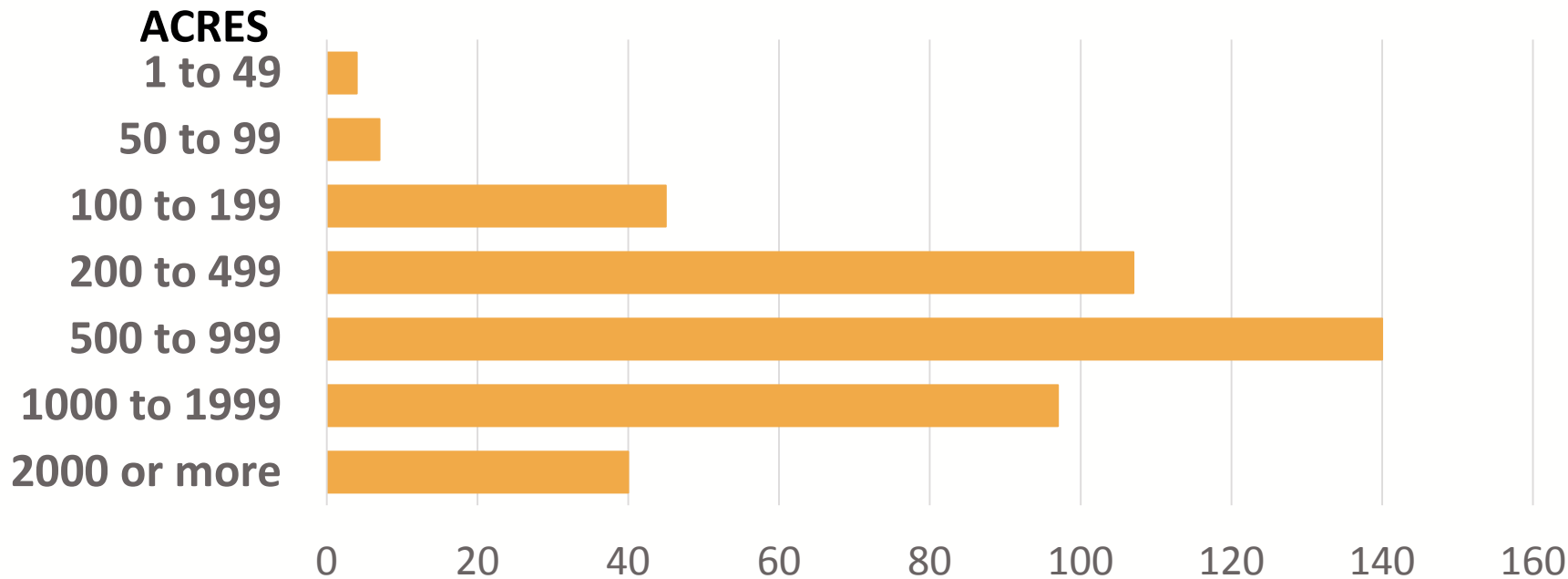
- Sample size 1,250 farmers
- Stratified random sample of operators from 2012 Census of Agriculture:
 - that reported planting 10+ acres of cover crops;
 - in rotation with row crops;
 - in farms of 50+ cropland acres in size;
 - NASS sampling strategy accounted for farm sizes, and geographical coverage.

Respondents in Iowa

- 674 responses
(54% resp. rate)
- 440 planted Cover Crops
(35% rate)



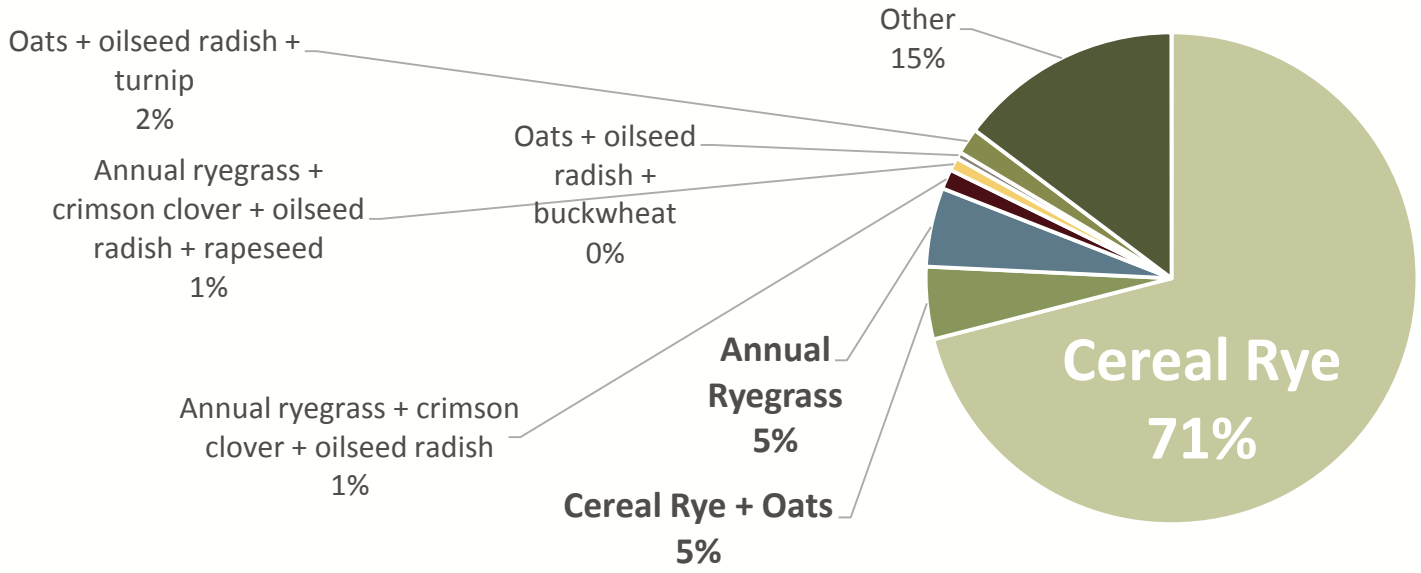
Responses by Farm Size



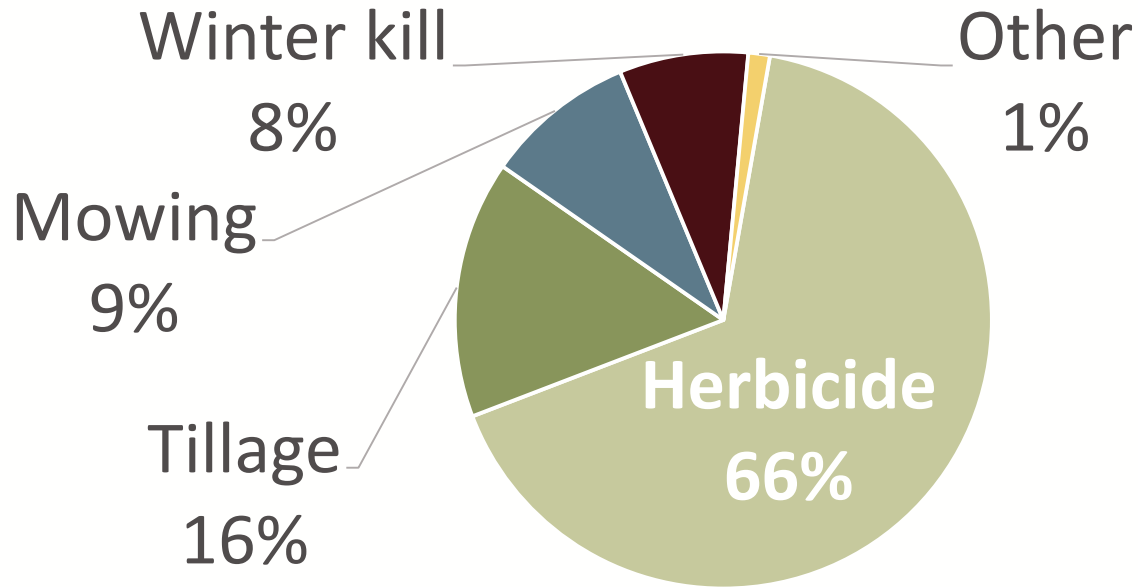
Experience with Cover Crops (CC)

Variable	Mean	Median	Range	N
Acres of CC planted in fall 2015	268	80	[5; 7,500]	227
Total number of acres planted to CC since starting using CC	870	360	[4; 10,000]	230
Years of experience with CC	7.9	6	[1; 45]	233

Cover Crop Species in 2015



Termination Method for CC Planted in 2015



Selected Partial Budgets

- 1) All CC species followed by corn, all planting methods, terminated with herbicides
- 2) Same as 1), by CC Experience level:
 - CC Experience \leq 3 years
 - CC Experience 4-9 years
 - CC Experience \geq 10 years
- 3) Similar to 1) for Cereal Rye, No-Till only.
- 4) All CC species followed by soybeans, all planting methods, terminated with Herbicides
- 5) Same as 4), by CC Experience level.

Reported CC Seed Costs (2015) All Species, in \$ per Acre

Crop System	Mean	Median	Range	N
CC before Corn	17.70	16.00	[5; 47]	76
CC before Soybeans	16.34	15.00	[2; 50]	50

CC Planting Costs (2015)

Excluding Seeds, in \$ per Acre

Crop System	Mean	Median	Range	N
CC before CORN , CUSTOM work (reported)	14.39	15.00	[4; 30]	41
CC before CORN , OWN work (calculated)	15.14	16.99	[2.4; 25.3]	56
CC before SOY , CUSTOM work (reported)	16.52	16.00	[6; 32]	21
CC before SOY , OWN work (calculated)	16.45	17.47	[3.6; 24.2]	38

Reported Cost-Share Payments (2015), in \$ per Acre

Crop System	Mean	Median	Range	N
CC before Corn	22.41	20.00	[5; 80]	39 (47% all)
CC before Soybeans	20.13	15.00	[7; 46]	23 (38% all)

Reported Yield Differences (2016): with CC vs. without CC

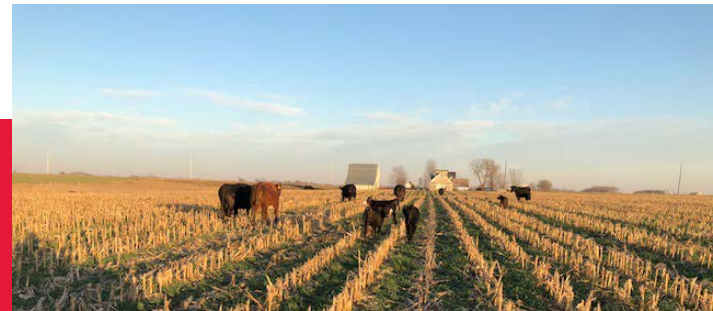
Average Yields following CC: Corn 196.4 bu/a, Soybean 57.9 bu/a

Crop System	Mean Difference	Median Difference	Range of Reported Differences	N
Corn: CC acres vs. NO CC acres	-2.01 bu/a	0.00 bu/a	[-27bu; 20bu]	69
Soybeans: CC acres vs. NO CC acres	-0.11 bu/a	0.00 bu/a	[-10bu ; 5bu]	56



Reported Savings in Feed (2016): Grazing/harvesting CC for forage, in \$ per Acre

Crop System	Mean	Median	Range	N
CC before Corn	35.00	22.00	[3; 100]	9 (11% of all)
CC before Soybeans	32.54	20.00	[2; 150]	13 (21% of all)



1) Partial budget for **All Cover Crops Species** terminated with herbicides followed by **CORN**
(All years of experience,
all planting methods,
and all tillage methods)

Part A. Changes in Revenues

<u>A. Changes in Revenues:</u>	Mean (\$/acre)	Median (\$/acre)	Range (\$/acre)	N
1. Cost-share program	22.41	20.00	[5; 80]	39
2. Value of change in following corn yield (\$4.00/bu)	-8.06	0.00	[-108; 80]	69
3. Savings or extra revenue from grazing or harvesting CC for forage	35.00	22.00	[3; 100]	9
<i>Subtotal A. Changes in Revenue</i>	<i>49.35</i>	<i>42.00</i>		

Part B. Changes in Costs

<u>B. Changes in Costs:</u>	Mean (\$/acre)	Median (\$/acre)	Range (\$/acre)	N
B.1. Cover Crop Planting				
a. Seeds	17.70	16.00	[5; 47]	76
b. Planting (excluding seeds). Weighted average of custom and non-custom work.	14.82	16.15		
i. Custom work	14.39	15.00	[4; 30]	41
ii. Non-Custom	15.14	16.99	[2.4; 25.3]	56
<i>Subtotal B.1</i>	<i>32.52</i>	<i>32.15</i>		

Part B. Changes in Costs

<u>B. Changes in Costs:</u>	Mean (\$/acre)	Median (\$/acre)	Range (\$/acre)	N
B.2. Cover Crop Termination				
B.2.a. Extra expenses for farmers that applied herbicides to all acres (with and without cover crops): i+ii+iii	8.07	0.00		68
i. Extra herbicide cost on top of regular weed control program	0.56	0.00	[0; 17]	68
ii. Extra labor costs to apply herbicides on top of regular weed control program (\$13/hr)	5.54	0.00	[0; 130]	68
iii. Other termination expenses	1.97	0.00	[0; 40]	68

Part B. Changes in Costs

<u>B. Changes in Costs:</u>	Mean (\$/acre)	Median (\$/acre)	Range (\$/acre)	N
B.2.b. Expenses for farmers that did not apply herbicides before planting cash crop in acres without cover crops: i+ii	16.82	15.54		16
i. Herbicide cost to terminate cover crops	9.50	8.00	[4; 24]	16
ii. Herbicide application cost. Weighted average of custom and non-custom work.	7.32	7.54	[3.06; 15.4]	
1. Custom Work	14.20	14.00	[6; 30]	5
2. Non-Custom	5.02	5.38	[2.08; 10.53]	15
<i>Subtotal B.2. Weighted avg. B.2.a & B.2.b</i>	<i>9.74</i>	<i>2.96</i>		

Part B. Changes in Costs

<u>B. Changes in Costs:</u>	Mean (\$/acre)	Median (\$/acre)	Range (\$/acre)	N
B.3. Changes in other costs				
a. Cash crop seed costs	0.00	0.00	[0; 0]	83
b. Cash crop planting costs (excluding seeds)	0.00	0.00	[0; 0]	83
c. Nitrogen Costs	-0.18	0.00	[-20; 5]	83
d. P & K Costs	0.00	0.00	[0; 0]	83
e. Manure Costs	-0.09	0.00	[-10; 2.5]	83
f. Insecticide Costs	-0.11	0.00	[-12; 3]	83
g. Fungicide Costs	-0.13	0.00	[-14; 3.5]	83
h. Soil Testing Costs	-0.14	0.00	[-16; 4]	83

Part B. Changes in Costs

<u>B. Changes in Costs:</u>	Mean (\$/acre)	Median (\$/acre)	Range (\$/acre)	N
B.3. Changes in other costs				
i. Costs to Repair Soil Erosion	-0.16	0.00	[-18; 4.5]	83
j. Opportunity cost of management time (\$15/hr)	0.00	0.00	[0; 0]	83
k. Change in cash rent	-0.68	0.00	[-20; 0]	44
<i>Subtotal B.3</i>	<i>-1.50</i>	<i>0.00</i>		
<i>Subtotal B. Changes in Costs B1+B2+B3</i>	<i>40.76</i>	<i>35.11</i>		

1) Net Change in Profits (\$/acre)

All CC before Corn

Subtotal	Mean (\$/acre)	Median (\$/acre)
A. Changes in Revenues	49.35	42.00
B. Changes in Costs	40.76	35.11
C. Net change in profits (A-B)	8.59	6.89
C.1. Net Change in Profits excluding feed cost savings (C.1 = C - A.3)	-26.41	-15.11
C.2. Net Change in Profit excluding feed cost savings and cost-share payment (C.2 = C - A.3 - A.1)	-48.82	-35.11

2) Mean Net Change in Profits by Years of CC Experience: All CC before Corn

Subtotal	Exp. ≤ 3 years	Exp. 4-9 years	Exp. ≥10 years
<i>Reported Yield Change (bu/a)</i>	<i>-5.0 [-15; 0]</i>	<i>-0.1 [-8; 7]</i>	<i>0.5 [0; 4]</i>
<i>C. Net change in profits</i>	<i>42.88</i>	<i>16.41</i>	<i>13.53</i>
<i>C.1. Net Change in Profits excluding feed cost savings</i>	<i>-37.12</i>	<i>-18.59</i>	<i>-14.97</i>
<i>C.2. Net Change in Profit excluding feed cost savings and cost-share payment</i>	<i>-57.95</i>	<i>-43.19</i>	<i>-31.97</i>

3) Net Change in Profits (\$/acre)

C.Rye before Corn: **NO-TILL*** *Rotational & continuous no-till

Subtotal	Mean (\$/acre)	Median (\$/acre)
A. Changes in Revenues	27.85	40.00
B. Changes in Costs	39.24	34.83
C. Net change in profits (A-B)	-11.38	5.17
C.1. Net Change in Profits excluding feed cost savings (C.1 = C - A.3)	-28.72	-14.83
C.2. Net Change in Profit excluding feed cost savings and cost-share payment (C.2 = C - A.3 - A.1)	-53.41	-34.83

4) Partial budget for **All Cover Crops Species** terminated with herbicides followed by **SOYBEANS**

(All years of experience,
all planting methods,
and all tillage methods)

Part A. Changes in Revenues

<u>A. Changes in Revenues:</u>	Mean (\$/acre)	Median (\$/acre)	Range (\$/acre)	N
1. Cost-share program	20.13	15.00	[7; 46]	23
2. Value of change in following soybean yield (\$10.00 /bu)	-1.07	0.00	[-100; 50]	56
3. Savings or extra revenue from grazing or harvesting cover crop for forage	32.54	20.00	[2; 150]	13
<i>Subtotal A. Changes in Revenue</i>	<i>51.60</i>	<i>35.00</i>		

Part B. Changes in Costs

<u>B. Changes in Costs:</u>	Mean (\$/acre)	Median (\$/acre)	Range (\$/acre)	N
B.1. Cover Crop Planting				
a. Seeds	16.34	15.00	[2; 50]	50
b. Planting (excluding seeds). Weighted avg. of custom and non-custom work.	16.47	16.95		
i. Custom work	16.52	16.00	[6; 32]	21
ii. Non-Custom	16.45	17.47	[3.6; 24.2]	38
<i>Subtotal B.1</i>	<i>32.81</i>	<i>31.95</i>		

Part B. Changes in Costs

<u>B. Changes in Costs:</u>	Mean (\$/acre)	Median (\$/acre)	Range (\$/acre)	N
B.2. Cover Crop Termination				
B.2.a. Extra expenses for farmers that applied herbicides to all acres (with and without cover crops): i+ii+iii	2.63	0.00		49
i. Extra herbicide cost on top of regular weed control program	0.29	0.00	[-11; 12]	49
ii. Extra labor costs to apply herbicides on top of regular weed control program (\$13/hr)	1.33	0.00	[0; 39]	49
iii. Other termination expenses	1.02	0.00	[0; 20]	49

Part B. Changes in Costs

<u>B. Changes in Costs:</u>	Mean (\$/acre)	Median (\$/acre)	Range (\$/acre)	N
B.2.b. Expenses for farmers that did not apply herbicides before planting cash crop in acres without cover crops: i+ii	18.54	14.55		9
i. Herbicide cost to terminate cover crops	11.56	10.00	[2; 30]	9
ii. Herbicide application cost. W.avg 1&2	6.99	4.55	[4.2; 13.5]	
1. Custom Work	13.67	8.00	[8; 25]	3
2. Non-Custom	4.48	3.25	[2.7; 9.2]	8
<i>Subtotal B.2. Weighted avg. B.2.a & B.2.b</i>	5.10	2.26		

Part B. Changes in Costs

<u>B. Changes in Costs:</u>	Mean (\$/acre)	Median (\$/acre)	Range (\$/acre)	N
B.3. Changes in other costs				
a. Cash crop seed costs	-0.18	0.00	[-11; 0]	61
b. Cash crop planting costs (excluding seeds)	0.00	0.00	[0; 0]	61
c. Nitrogen Costs	0.00	0.00	[0; 0]	61
d. P & K Costs	0.00	0.00	[0; 0]	61
e. Manure Costs	0.00	0.00	[0; 0]	61
f. Insecticide Costs	0.00	0.00	[0; 0]	61
g. Fungicide Costs	0.00	0.00	[0; 0]	61
h. Soil Testing Costs	0.00	0.00	[0; 0]	61

Part B. Changes in Costs

<u>B. Changes in Costs:</u>	Mean (\$/acre)	Median (\$/acre)	Range (\$/acre)	N
B.3. Changes in other costs				
i. Costs to Repair Soil Erosion	-0.02	0.00	[-1; 0]	61
j. Opportunity cost of management time (\$15/hr)	0.00	0.00	[0; 0]	61
k. Change in cash rent	-0.37	0.00	[-10; 0]	27
<i>Subtotal B.3</i>	<i>-0.57</i>	<i>0.00</i>		
<i>Subtotal B. Changes in Costs B1+B2+B3</i>	<i>37.34</i>	<i>34.21</i>		

4) Net Change in Profits (\$/acre)

All CC before Soybeans

Subtotal	Mean (\$/acre)	Median (\$/acre)
A. Changes in Revenues	51.60	35.00
B. Changes in Costs	37.34	34.21
C. Net change in profits (A-B)	14.25	0.79
C.1. Net Change in Profits excluding feed cost savings (C.1 = C - A.3)	-18.29	-19.21
C.2. Net Change in Profit excluding feed cost savings and cost-share payment (C.2 = C - A.3 - A.1)	-38.42	-34.21

5) Mean Net Change in Profits by Years of CC Experience: All CC before Beans

Subtotal	Exp. ≤ 3 years	Exp. 4-9 years	Exp. ≥10 years
<i>Reported Yield Change (bu/a)</i>	0.43 [-4; 5]	0.25 [-7; 4]	-0.09 [-5; 4]
<i>C. Net change in profits</i>	6.64	19.01	22.71
<i>C.1. Net Change in Profits excluding feed cost savings</i>	-24.36	-11.70	-21.04
<i>C.2. Net Change in Profit excluding feed cost savings and cost-share payment</i>	-39.36	-34.33	-36.79

Summary of Findings

Substantial variability in net returns, driven by:

- savings in feed (grazing/harvesting CC) (+)
- cost-share program payments (+);
- planting costs (-);
- termination costs (-)
- yield differences (+ or -).



Long term considerations:

- Soil health (private benefit) → higher yields, less soil erosion (both accounted for in survey)
- Cropland traded on CSR2 values, NOT soil health parameters: No market for soil health.
- Water quality (societal benefit, does NOT change profitability analysis for farmer)

An aerial photograph of a cornfield. A central strip of the field is covered with a lush green cover crop, while the surrounding areas are filled with mature, golden-brown corn stalks. The perspective is from a high angle, looking down on the rows of crops.

Make Cover Crops Pay on your Farm

Sarah Carlson

**Practical Farmers of Iowa
Strategic Initiatives Director**

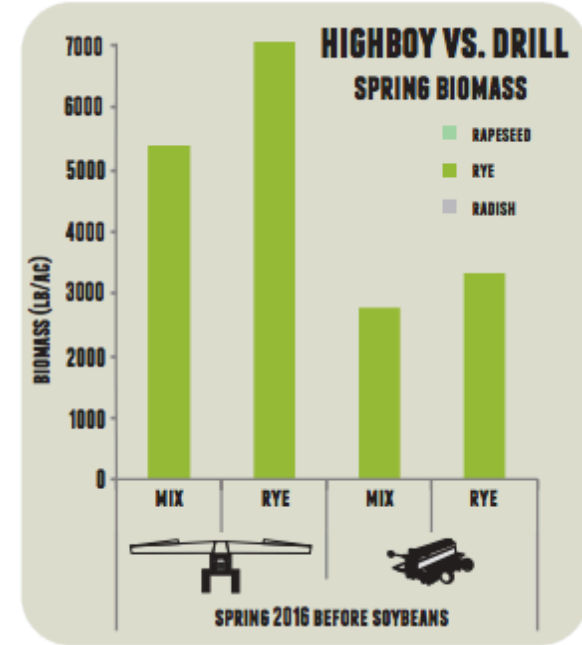
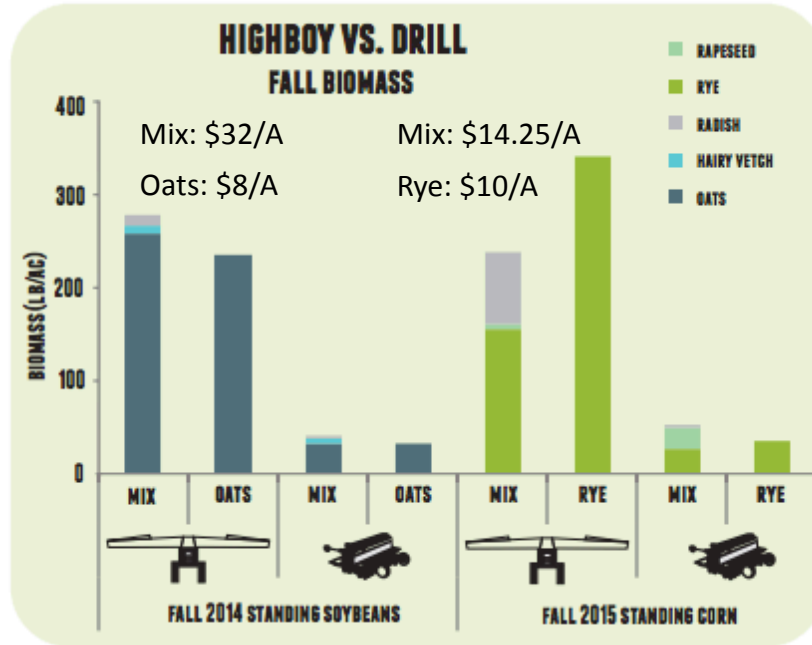
sarah@practicalfarmers.org 515-232-5661



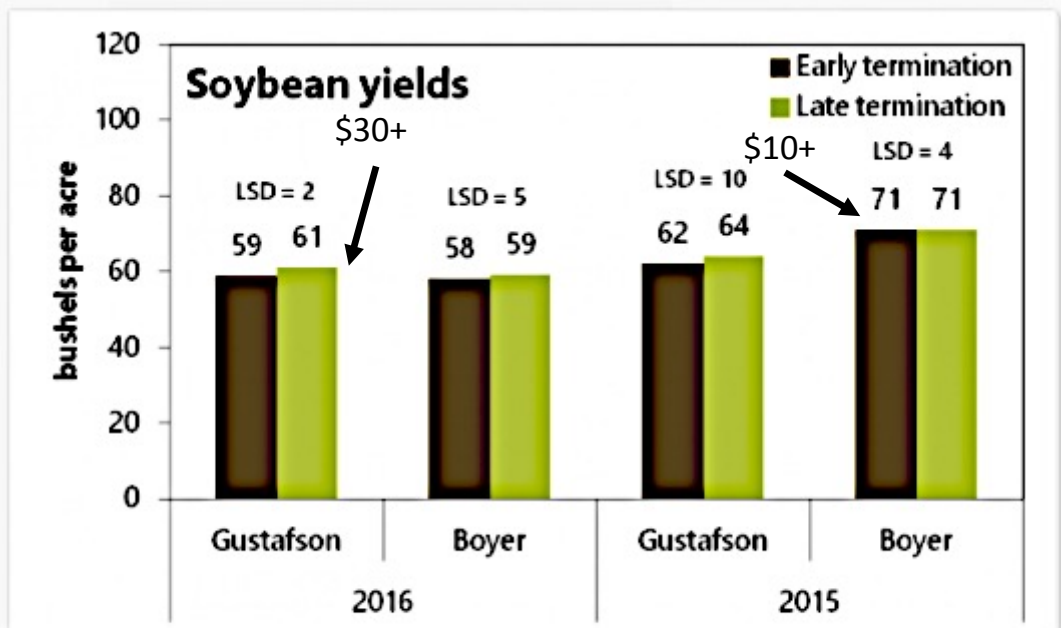
Barriers to reaching goals



1. Control Seed Costs



2. Control Herbicide Costs



Mid-season "mulch" at Jeremy Gustafson's on Aug. 6, 2016. Jeremy was able to eliminate two weed control passes in the late termination treatment.



Soybean yields for the early and late cover crop termination treatments at Jeremy Gustafson's and Jack Boyer's in 2016 and 2015. The least significant difference (LSD) at the $P \leq 0.05$ level is indicated above each pair of mean columns for both years. By year and farm, if the difference between the treatment means is equal to or greater than the LSD, the treatments are considered significantly different.

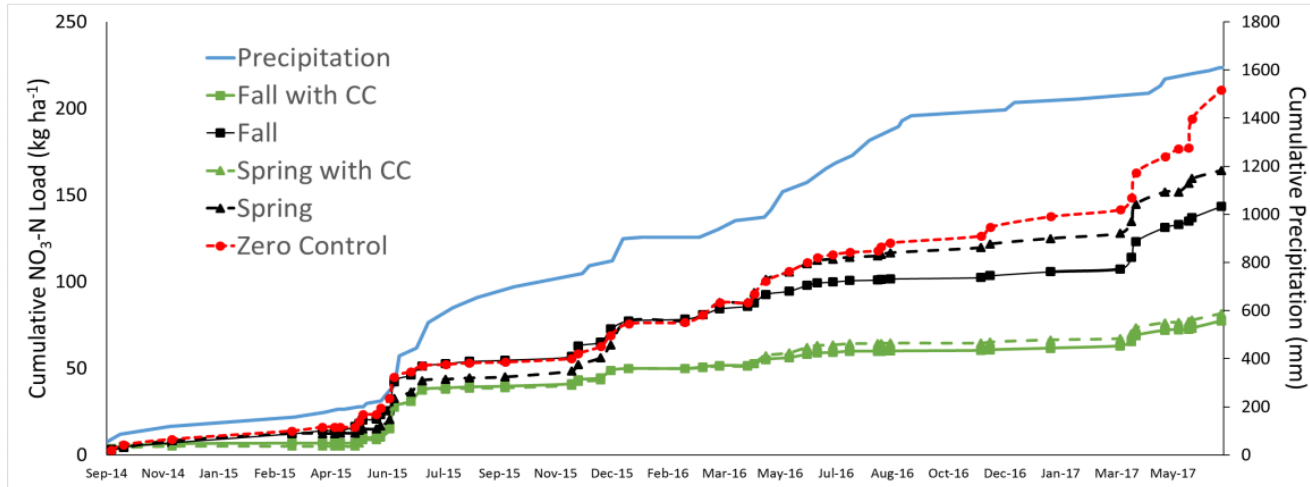
3. Avoid Cover Crop Failure

- Herbicide carryover into fall
- Cereal rye only affected by 2x Dual II Magnum
- Vetch, lentil, and radish affected by:
 - Balance Flexx, Corvus, & Hornet
- Atrazine, Callisto, & Laudis caused no injury



4. Avoid Redundant Expenses

Cover Crop Impact on Water Quality



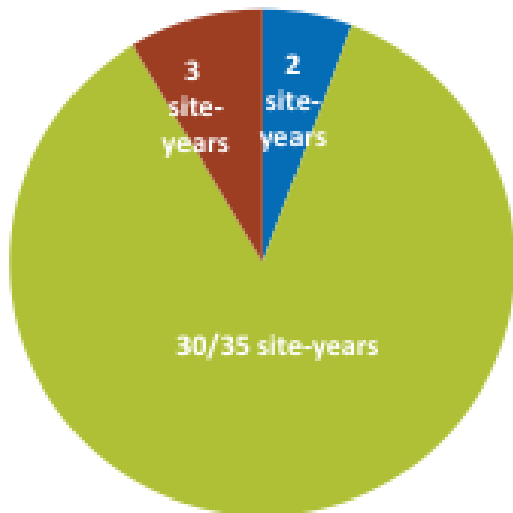
Precipitation
 Total = 63 inches
 Annual Average = 25

N Loading Treatment Comparison	
Fall N	52 kg ha ⁻¹ year ⁻¹
Fall N + CC	30 kg ha ⁻¹ year ⁻¹ (42% reduction)
Spring N	60 kg ha ⁻¹ year ⁻¹
Spring N + CC	30 kg ha ⁻¹ year ⁻¹ (50% reduction)

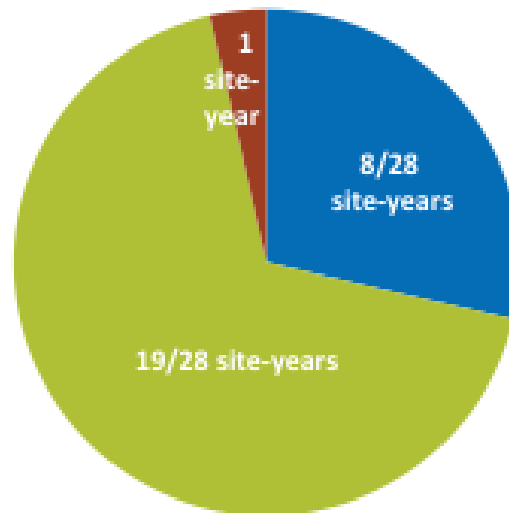
N Loading Trends	
Fall N vs. Spring N	= Equal
Fall N vs. Spring N + CC	= 42% ▼
Spring N vs. Fall N + CC	= 50% ▼
Spring N + CC vs. Fall N + CC	= Equal

5. Protect Crop Yield

Corn yields, 2009-2017



Soybean yields, 2009-2017



Cover crop resulted in:

- Yield improvement
- No change
- Yield reduction

6. Feed Cover Crops

FEEDLOT ECONOMICS

Cattle	Acres	Cover Crops Seeded	Avg. Weight In (lbs)	Avg. Weight Out (lbs)	Total Gain (lbs)	Value per head	Value per acre
2016							
180	11	Cereal Rye + Oats	850	1479	629	\$31.45	\$514.64
330	50	Cereal Rye + Oats	923	1459	536	\$26.80	\$176.88
240	79	Cereal Rye + Oats	898	1462	564	\$28.20	\$85.67
						\$28.82	\$259.06
2017							
180	11	Cereal Rye + Oats	756	1371	615	\$30.75	\$503.18
230	71	Cereal Rye + Oats	789	1311	522	\$26.10	\$83.38
225	79	Cereal Rye + Oats	938	1416	478	\$23.90	\$68.07
						\$26.92	\$218.21

Cattle grazed November to March
Cover crop valued at \$0.05 per pound of gain



Photo: Fernando Miguez

If we want to turn this....into this



Make Cover Crops Pay on your Farm

1. Control Seed Costs
2. Control Herbicide Costs
3. Avoid Cover Crop Establishment Failures
4. Avoid Redundant Expenses
5. Protect Crop Yield
6. Feed Cover Crops

Questions? Comments?

Economics of Cover Crops Website:

<https://www.card.iastate.edu/conservation/>

Final NCR-SARE Project Report:

<https://projects.sare.org/project-reports/Inc15-375/>

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