How do cover crops affect whole farm profitability?

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Practical Farmers of Iowa Annual Conference
Ames, IA
January 18, 2018

IOWA STATE UNIVERSITY
Extension and Outreach
Healthy People. Environments. Economies.

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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 Corn Belt

Special Thanks to Participating Cover Croppers!!

Overview

- What makes this study unique?
- Overview of regional survey - online
- Results from Iowa survey – USDA/NASS
- Long term considerations
- Policy implications

What makes this study unique?

1) Data collection:
   - Focus groups with experience cover croppers in IA, MN, IL
   - Pilot survey
   - Final questionnaire
2) Type of questions:
   - No “agree/disagree” type of questions (CTIC report)
   - Specific to each step in the production cycle
   - Eliciting changes in costs and revenues

What makes this study unique?

3) $ calculations: changes in annual budgets for corn and soybean production associated with the use of CC (not only $ to plant and terminate CC).

What makes this study unique?

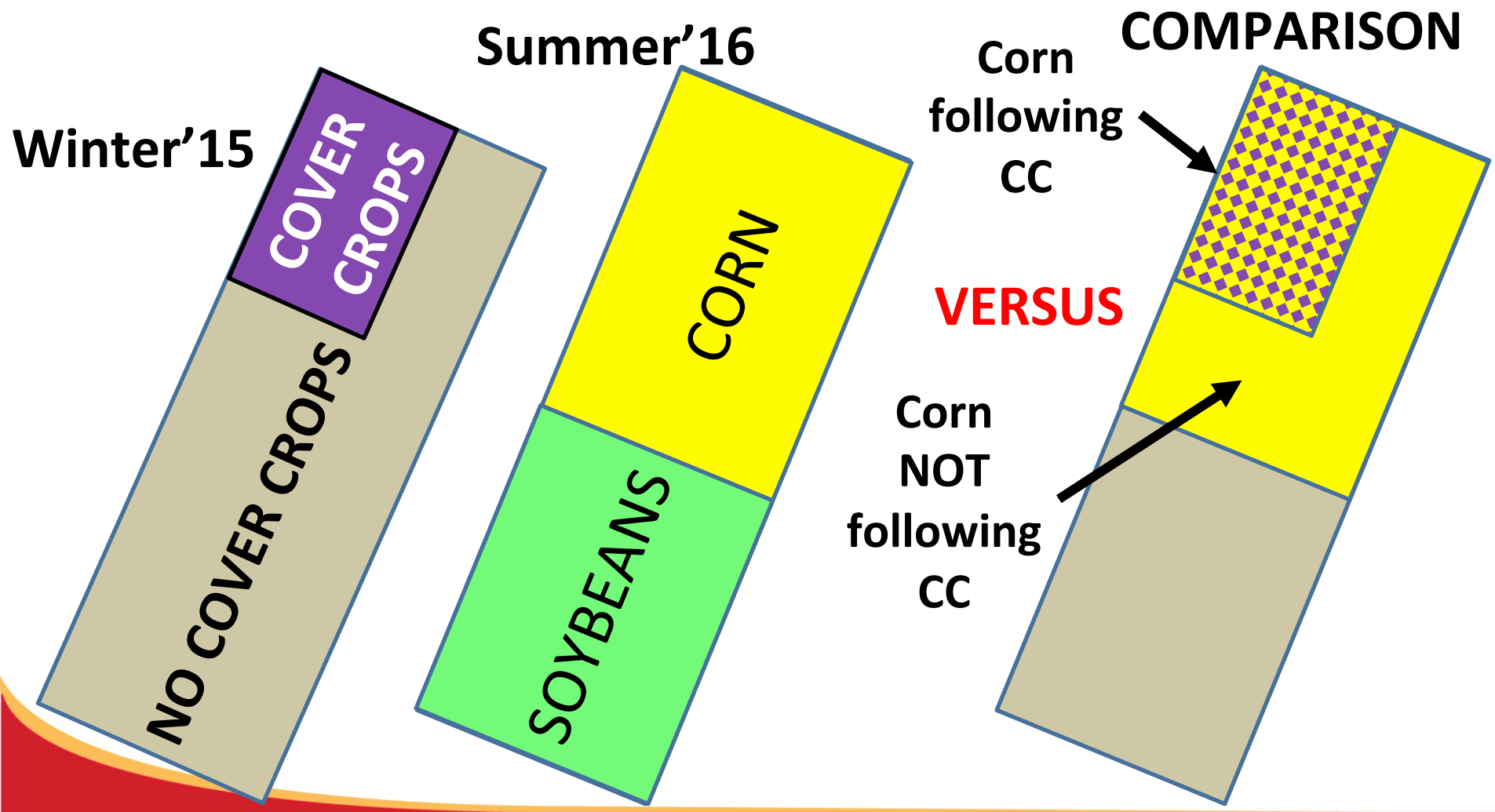
4) First study to calculate partial budgets using field data (instead of experimental plots) from farmers that manage row crop production on acres with cover crops and on acres with no cover crops.
5) Our partial budgets are the best available estimates of annual net returns to cover crop users, because the data were collected following a scientific method across the largest number of farms included in any cover crop study available to date.

$ Calculations

PARTIAL BUDGETS:

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

What are we comparing?



Data collection: Survey

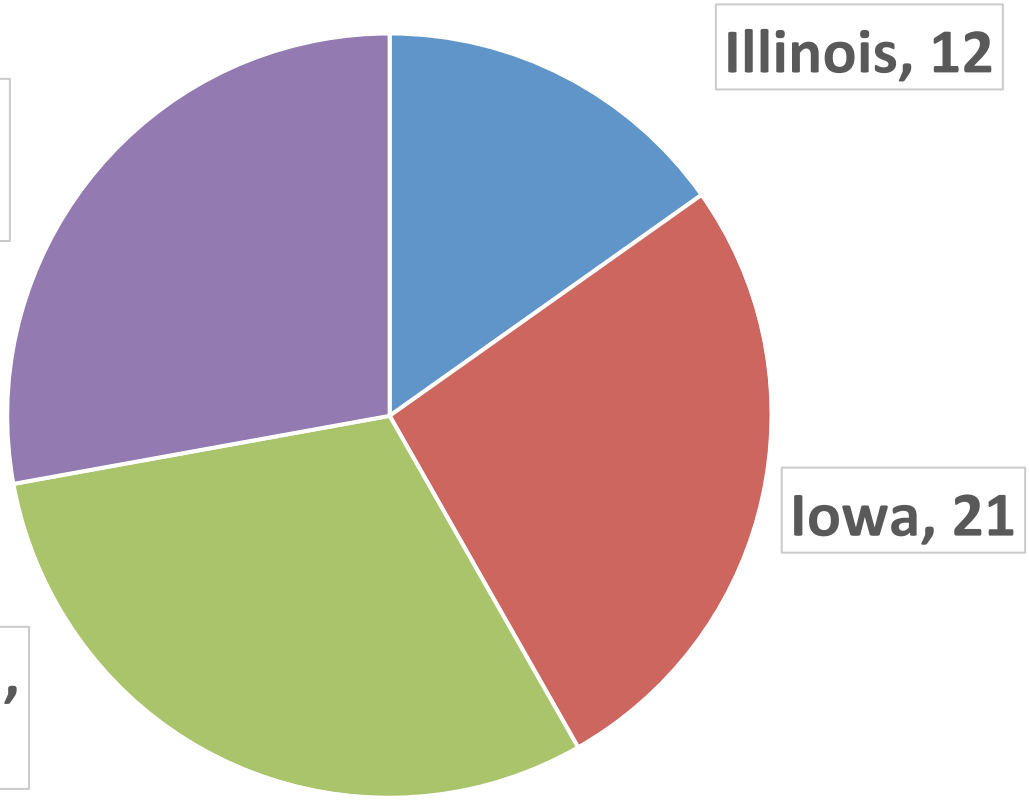
- Questionnaire design informed by extensive feedback from 16 experienced cover crop farmers in Iowa, Minnesota, and Illinois
- Online regional survey (11 states)
- Hard-copy survey in Iowa with phone follow-ups.
- Iowa survey implemented through USDA/ NASS in early 2017

Overview of Regional Survey - ONLINE

Source: Plastina *et al.*, 2018. *Journal of American Society of Farm Managers and Rural Appraisers* (forthcoming).

Respondents by State

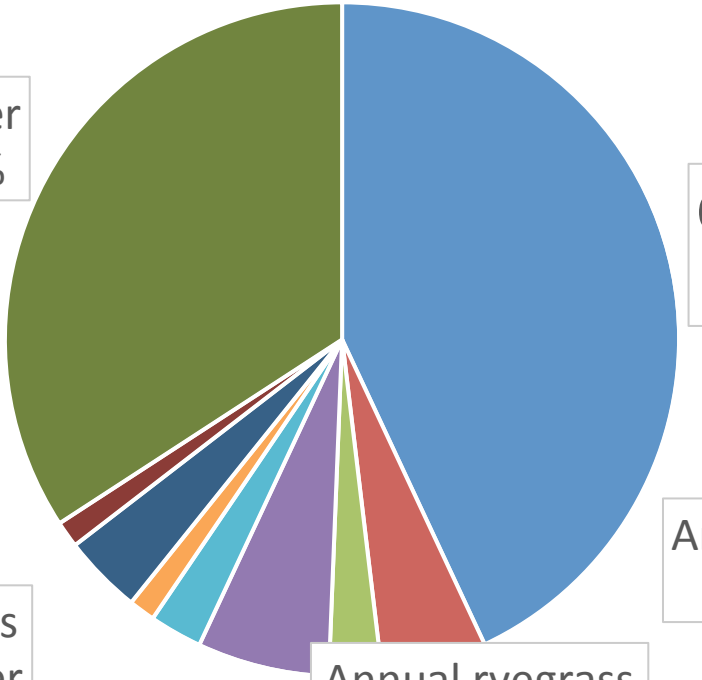
^Other States:
North Dakota: 11
Indiana: 3
Nebraska: 2
Ohio: 2
Michigan: 1
Missouri: 1
South Dakota: 1
Wisconsin: 1



Total: 79 Responses

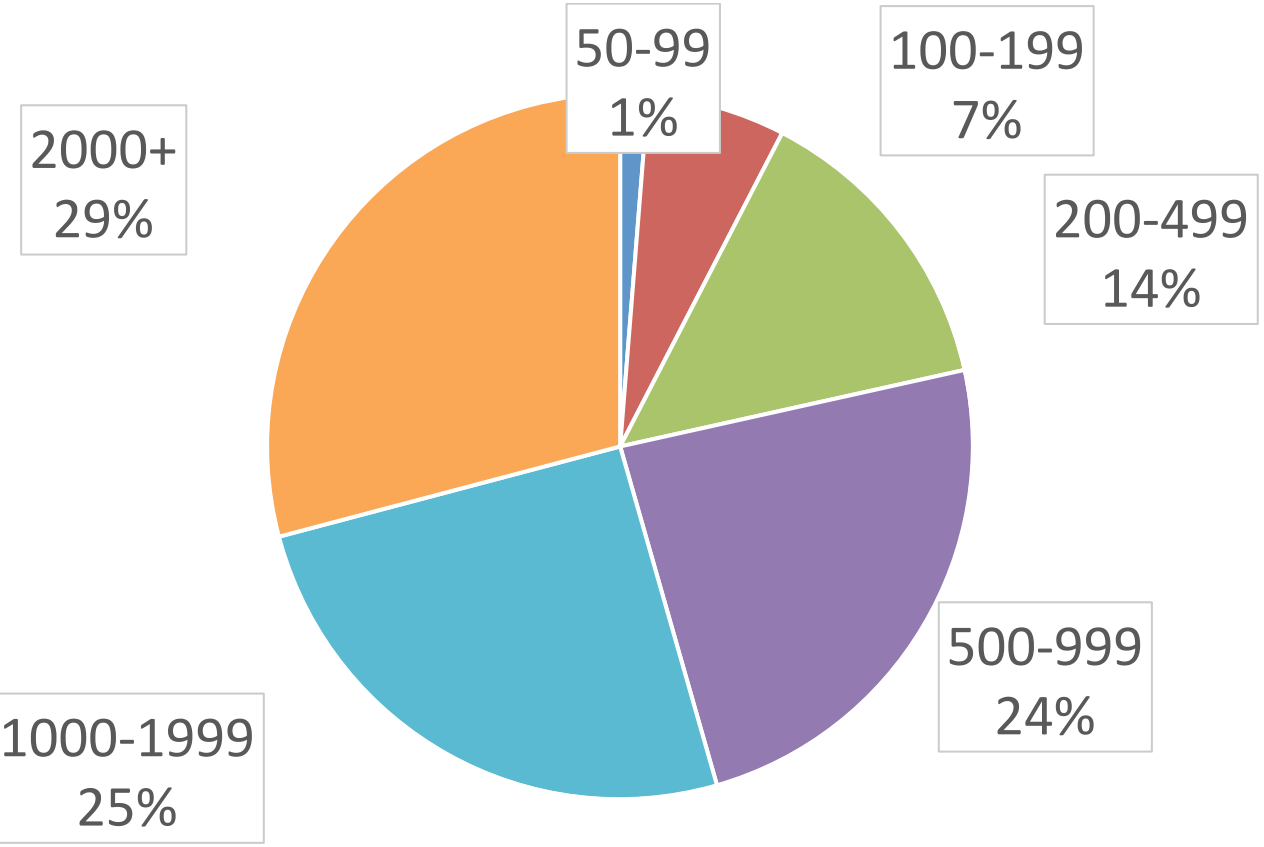
Source: Plastina, *et al.* 2018. Journal of ASFMRA

Respondents' characteristics: Cover Crop Mix



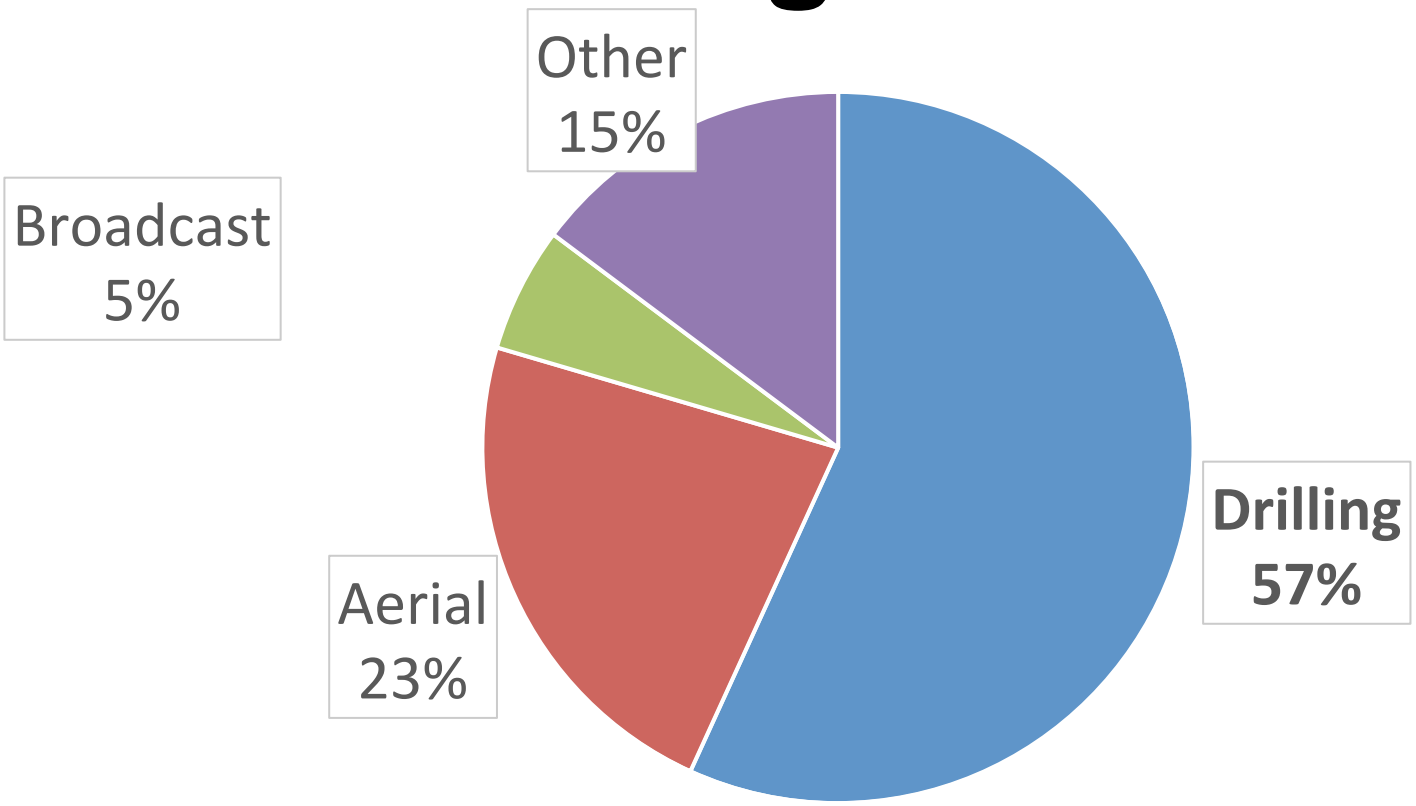
Source: Plastina, *et al.* 2018. Journal of ASFMRA

Respondents' characteristics: Farm Size (in acres)



Source: Plastina, *et al.* 2018. Journal of ASFMRA

Respondents' characteristics: Planting Methods



Source: Plastina, *et al.* 2018. Journal of ASFMRA

Respondents' Experience with Cover Crops

Variable	Mean	StDev	Median	Min	Max
Number of years planting cover crops	3.94	2.64	4	1	15
Cumulative cover crop acreage	1,483	3,783	540	5	30,000

Source: Plastina, *et al.* 2018. Journal of ASFMRA

Reported CC Seed Costs $ per Acre

Crop System	Mean	Median	Range	Number of Responses
CC before Corn	$16.33	$14.00	[$5, $35]	21
CC before Soybeans	$15.11	$13.50	[$3, $45]	34

Source: Plastina, *et al.* 2018. Journal of ASFMRA

Reported Planting Costs (excluding seeds) $ per Acre

Crop System	Mean	Median	Range	Number of Responses
CC before Corn	$15.51	$15.88	[$7.56, $23.00]	22
CC before Soybeans	$16.02	$16.27	[$4.48, $24.36]	38

Source: Plastina, *et al.* 2018. Journal of ASFMRA

Reported Cost-Share Payments for CC terminated with herbicides ($ per Acre)

Crop System	Mean	Median	Range	Number of Participants
CC before Corn	$25.33	$25.00	[$15.00, $45.00]	6 (29% all)
CC before Soybeans	$28.07	$25.00	[$10.00, $75.00]	14 (41% all)

Source: Plastina, *et al.* 2018. Journal of ASFMRA

Reported Yield Difference: with CC vs. without CC

Average Yields following CC: Corn 202 bu/a, Soybean 60 bu/a

Crop System	Mean Difference	Median Difference	Range of Reported Differences	Number of Responses
Corn following CC vs. Corn following NO CC	-2.74 bu/a	0.00 bu/a	[-54 bu, 20 bu]	21
Soybean following CC vs. Soybean following NO CC	3.32 bu/a	0.50 bu/a	[-5 bu, 20 bu]	34

Source: Plastina, *et al.* 2018. Journal of ASFMRA

AVERAGE ANNUAL CHANGES IN PROFIT DUE TO COVER CROP USE

Sources of changes in net profits	CC terminated with herbicides		CC winterkilled followed by corn or soybeans ($/acre)
	followed by corn ($/acre)	followed by soy ($/acre)	
A. Changes in revenue	***16.16***	***59.81***	***35.58***
1. Cash Crop Yield	-9.18	31.74	-8.25
2. Cost-share program	25.33	28.07	43.83
B. Changes in Costs	***36.91***	***34.69***	***29.16***
1. Cover crop planting	31.84	31.14	32.06
2. Herbicide expenses	4.05	3.82	-0.33
3. Other Costs	1.02	-0.27	-2.57
C. Change in profit (A-B)	***-20.76***	***25.13***	***6.43***
Change in profit without Cost-Share:	***-46.09***	***-2.95***	***-37.41***

Break-even yield without Cost Share (Change in Profits = $0)

	CC terminated with herbicides		CC winterkilled followed by corn or soybeans
	followed by corn	followed by soy	
Change in profit without Cost-Share:	***-$46.09***	***-$2.95***	***-$37.41***
BREAK-EVEN YIELD BUSHELS PER ACRE	**+14 bu/a corn +7%**	**+0.4 bu/a Soy +1%**	**+11.3 bu/a corn or +4 bu/a soy +6%**

Source: Plastina, *et al.* 2018. Journal of ASFMRA

Summary of Findings from Regional Survey - Online

- The average net return to cover crops terminated with herbicides followed by corn was **negative**,
- but the average net return to cover crops terminated with herbicides followed by soybeans was **positive**.

Summary of findings from Regional Survey (cont.)

- Substantial variability in net returns, driven by:
  - the difference in yields obtained in fields with and without cover crops,
  - planting costs, and
  - cost-share program payments.

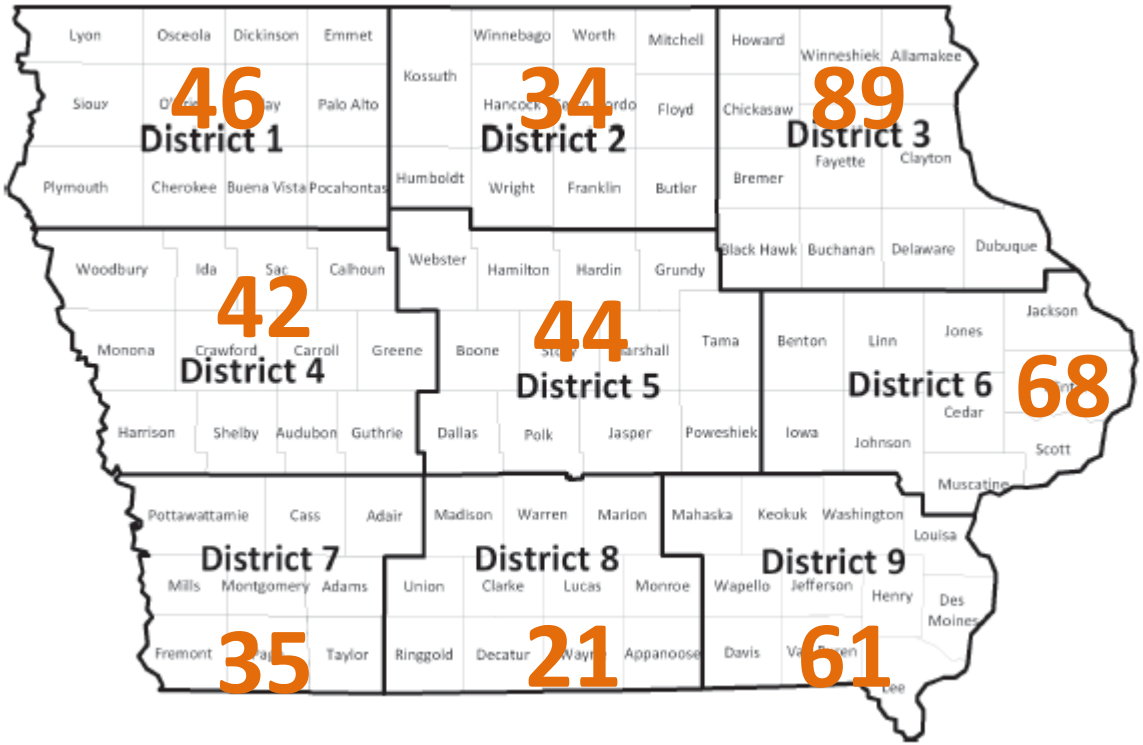
Summary of findings from Regional Survey (cont.)

- For most farmers, cost-share payments are insufficient to cover all private costs associated with cover crop use,
- but are a critical incentive to support this practice.

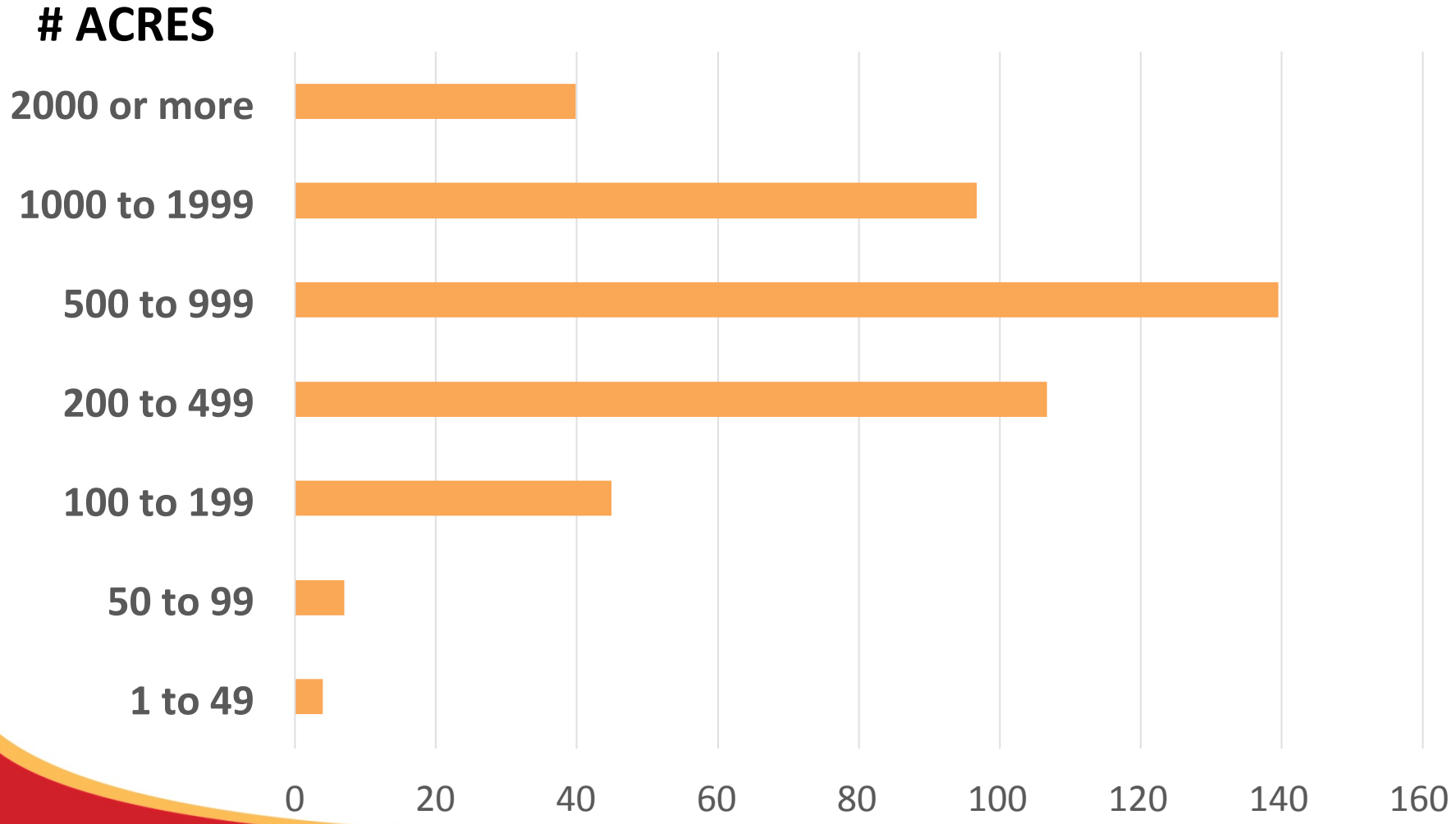
Results from Iowa survey

Respondents in Iowa

- 674 responses (27% resp. rate)
- **440 planted Cover Crops (22% rate):**



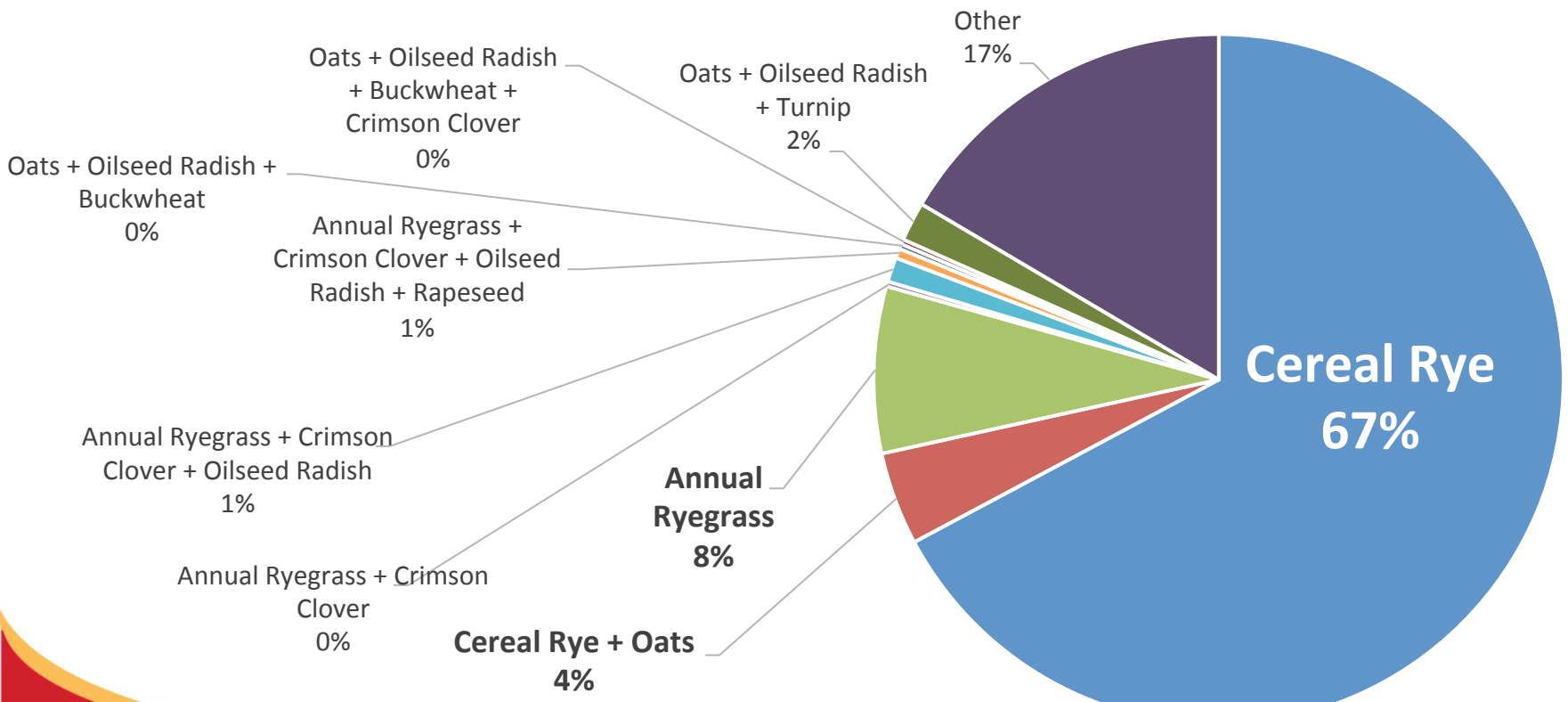
Responses by Farm Size



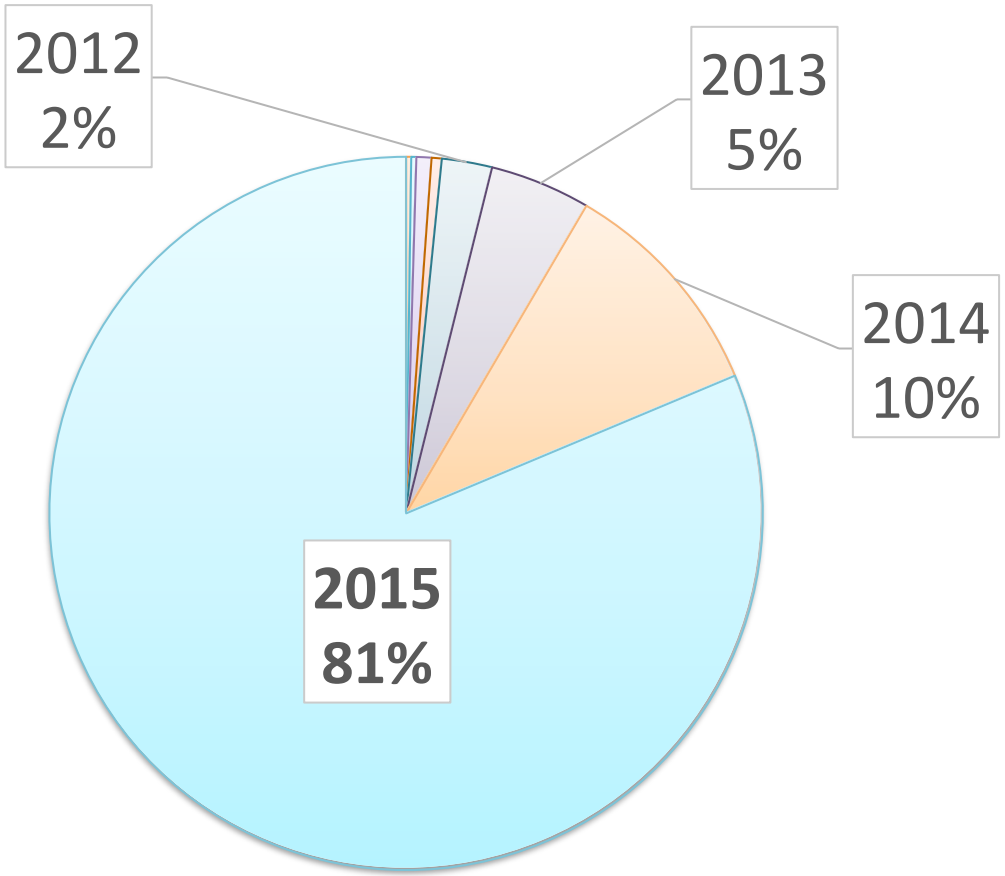
Experience with CC

Indicator	Mean	Std. Dev.	Median
Number of Years Planted CC (all CCs)	7	7	5
Cumulative Number of CC Acres (all years, all CCs)	907	1,485	20

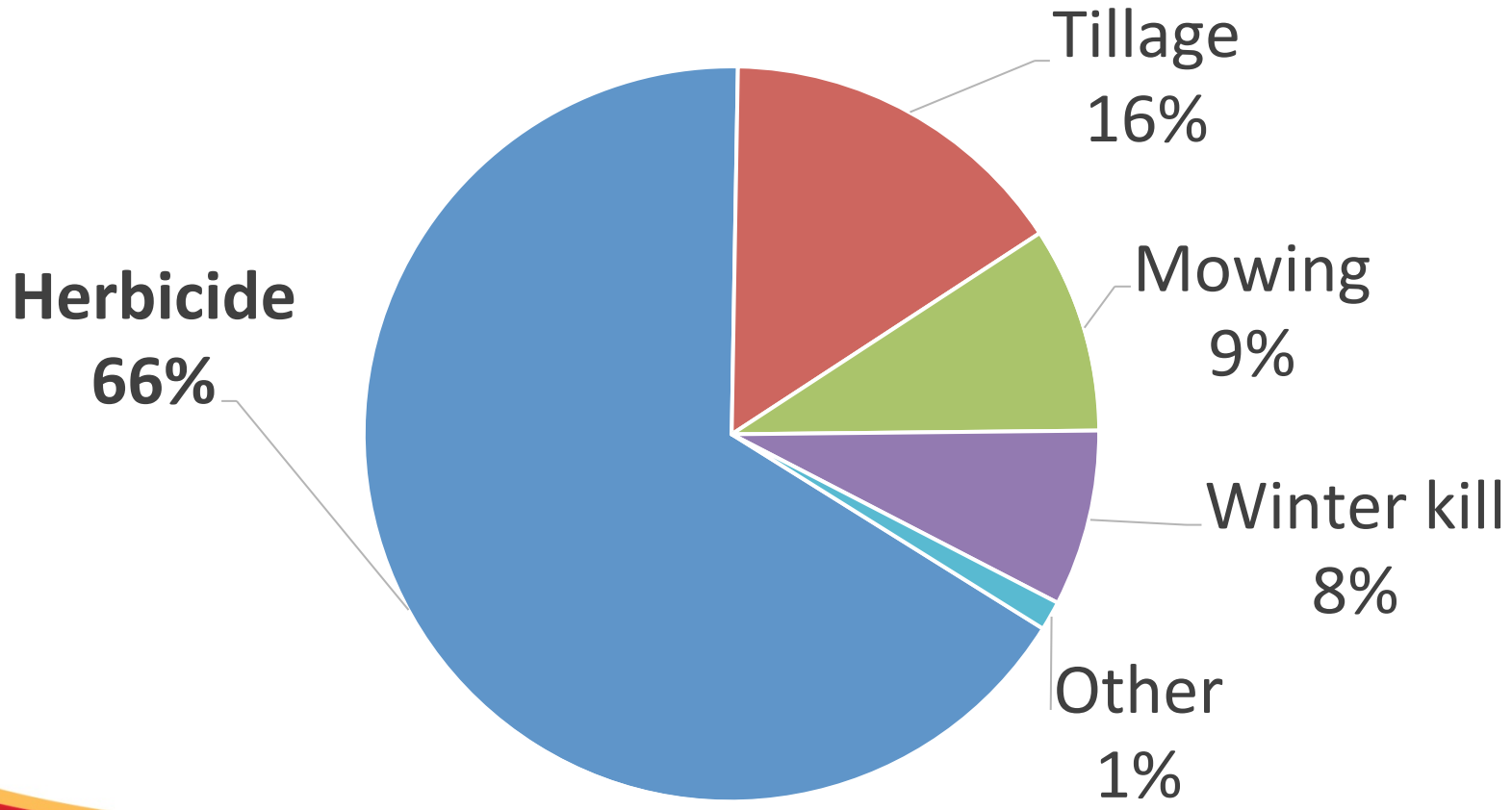
Most Extensively Used Cover Crop Mix



Most recent year respondent planted CC



Termination Method for CC planted in 2015



Partial Budgets

- Based on data availability:
  - Cereal Rye
  - Planted in fall 2015 (all planting methods)
  - Terminated with Herbicides
  - Followed by Corn: 89 observations
  - Followed by Soybeans: 61 observations

Reported Cereal Rye Seed Costs ($ per Acre)

Crop System	Mean	Median	Range	Number of Responses
CR before Corn	$16.63	$15.00	[$8, $30]	59
CR before Soybeans	$16.95	$15.00	[$8, $50]	41

Planting Costs for Cereal Rye (excluding seeds) $ per Acre

Crop System	Mean	Median	Range	Number of Responses
CR before CORN CUSTOM work	$14.45	$15.00	[$5; $30]	31
CR before CORN OWN work	$14.90	$15.64	[$2.4; $25.3]	46
CR before SOY CUSTOM work	$17.13	$16.00	[$6; $32]	16
CR before SOY OWN work	$16.49	$17.47	[$3.6; $24.2]	34

Reported Cost-Share Payments for Cereal Rye terminated with herbicides ($ per Acre)

Crop System	Mean	Median	Range	Number of Participants
CR before Corn	$23.03	$20.00	[$7; $80]	29 (41% all)
CR before Soybeans	$19.00	$15.00	[$8; $46]	16 (33% all)

Reported Yield Difference: with CC vs. without CC

Average Yields following CC: Corn 198 bu/a, Soybean 58 bu/a

Crop System	Mean Difference	Median Difference	Range of Reported Differences	Number of Responses
Corn following CR vs. Corn following NO CR	-2.28 bu	0.00 bu	[-27 bu; 20 bu]	58
Soybean following CR vs. Soybean following NO CR	0.18 bu	0.00 bu	[-7 bu; 5 bu]	38

Reported Savings in Animal Feed: grazing/harvesting CR for forage ($ per Acre)

Crop System	Mean	Median	Range	Number of Responses
CR before Corn	$39.00	$26.00	[$10; $100]	8 (11% of all)
CR before Soybeans	$35.08	$20.00	[$5; $150]	12 (25% of all)

Partial budget for CEREAL RYE terminated with herbicides followed by CORN for grain (All years of experience, all planting methods, and all tillage methods)

Part A. Changes in Revenues

A. Changes in Revenues:	**Mean ($/acre)**	**Median ($/acre)**	**Range ($/acre)**	**N**
1. Cost-share program	23.03	20.00	[7; 80]	29
2. Value of change in following cash crop yield ($4.00 / bushel)	-9.10	0.00	[-108; 80]	58
3. Savings or extra revenue from grazing or harvesting cover crop for forage	39.00	26.00	[10; 100]	8
Subtotal A. Changes in Revenue	***52.93***	***46.00***		

Part B. Changes in Costs

B. Changes in Costs:	**Mean ($/acre)**	**Median ($/acre)**	**Range ($/acre)**	**N**
B.1. Cover Crop Planting				
a. Seeds	16.63	15.00	[8; 30]	59
b. Planting (excluding seeds). Weighted average of custom and non-custom work.	14.72	15.38		
i. Custom work	14.45	15.00	[5; 30]	31
ii. Non-Custom	14.90	15.64	[2.42; 25.33]	46
Subtotal B.1	***31.35***	***30.38***		

Part B. Changes in Costs

B. Changes in Costs:	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	4.79	0.00		52
i. Extra herbicide cost on top of regular weed control program	0.63	0.00	[0; 17]	52
ii. Extra labor costs to apply herbicides on top of regular weed control program ($13/hr)	2.75	0.00	[0; 65]	52
iii. Other termination expenses	1.40	0.00	[0; 20]	52

Part B. Changes in Costs

B. Changes in Costs:	**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	16.21	14.92		14
i. Herbicide cost to terminate cover crops	8.71	8.00	[4; 24]	14
ii. Herbicide application cost. Weighted average of custom and non-custom work.	7.50	6.92		
1. Custom Work	16.25	14.00	[7; 30]	4
2. Non-Custom	5.00	4.90	[2.1; 10.5]	14
Subtotal B.2. Weighted average of B.2.a and B.2.b	***7.21***	***3.17***		

Part B. Changes in Costs

B. Changes in Costs:	Mean ($/acre)	Median ($/acre)	Range ($/acre)	N
B.3. Changes in other costs				
a. Cash crop seed costs	0.00	0.00	[0; 0]	71
b. Cash crop planting costs (excluding seeds)	0.00	0.00	[0; 0]	71
c. Nitrogen Costs	0.07	0.00	[0; 5]	71
d. P & K Costs	0.00	0.00	[0; 0]	71
e. Manure Costs	0.00	0.00	[0; 0]	71
f. Insecticide Costs	0.00	0.00	[0; 0]	71
g. Fungicide Costs	0.00	0.00	[0; 0]	71
h. Soil Testing Costs	0.00	0.00	[0; 0]	71

Part B. Changes in Costs

B. Changes in Costs:	**Mean ($/acre)**	**Median ($/acre)**	**Range ($/acre)**	**N**
B.3. Changes in other costs				
i. Costs to Repair Soil Erosion	0.00	0.00	[0; 0]	71
j. Opportunity cost of management time ($15/hr)	0.00	0.00	[0; 0]	71
k. Change in cash rent	-0.88	0.00	[-20; 0]	34
Subtotal B.3	***-0.81***	***0.00***		
Subtotal B. Changes in Costs B1+B2+B3	***37.75***	***33.55***		

Net Change in Profits ($/acre) Cereal Rye before Corn

Subtotal	Mean ($/ acre)	Median ($/ acre)
A. Changes in Revenues	52.93	46.00
B. Changes in Costs	37.75	33.55
C. Net change in profits (A-B)	***15.18***	***12.45***
C.1. Net Change in Profits excluding feed cost savings (C.1 = C - A.3)	***-23.82***	***-13.55***
C.2. Net Change in Profit excluding feed cost savings and cost-share payment (C. 2 = C - A.3 - A.1)	***-46.85***	***-33.55***

Mean Net Change in Profits All Cover Crops before Corn

Subtotal	Up to 3 years planting CC	4-9 years planting CC	10+ years planting CC
C. Net change in profits	*42.88*	*16.41*	*13.53*
C.1. Net Change in Profits excluding feed cost savings	*-37.12*	*-18.59*	*-14.97*
C.2. Net Change in Profit excluding feed cost savings and cost-share payment	*-57.95*	*-43.19*	*-31.97*
Reported Yield Change	*-5.0 [15,0]*	*-0.1 [-8, 7]*	*0.5 [0, 4]*

Net Change in Profits ($/acre) CR before Corn: 50+acres CC

Subtotal	Mean ($/ acre)	Median ($/ acre)
A. Changes in Revenues	73.00	51.00
B. Changes in Costs	43.64	41.17
C. Net change in profits (A-B)	*29.36*	*9.83*
C.1. Net Change in Profits excluding feed cost savings (C.1 = C - A.3)	*-9.64*	*-16.17*
C.2. Net Change in Profit excluding feed cost savings and cost-share payment (C. 2 = C - A.3 - A.1)	*-39.64*	*-41.17*

Net Change in Profits ($/acre) All CC, Corn: NO-TILL*

Subtotal	Mean ($/ acre)	Median ($/ acre)
A. Changes in Revenues	41.81	35.00
B. Changes in Costs	45.20	35.06
C. Net change in profits (A-B)	*-3.39*	*-0.06*
C.1. Net Change in Profits excluding feed cost savings (C.1 = C - A.3)	*-18.89*	*-15.06*
C.2. Net Change in Profit excluding feed cost savings and cost-share payment (C. 2 = C - A.3 - A.1)	*-42.89*	*-35.06*

*Includes rotational no-till & continuous no-till

WINTERKILL All CC - Corn
Part A. Changes in Revenues

A. Changes in Revenues:	**Mean ($/acre)**	**Median ($/acre)**	**Range ($/acre)**	**N**
1. Cost-share program	25.00	25.00	[25; 25]	3
2. Value of change in following cash crop yield ($4.00 / bushel)	0.00	0.00	[-20; 20]	12
3. Savings or extra revenue from grazing or harvesting cover crop for forage	20.00	20.00	[20; 20]	1
Subtotal A. Changes in Revenue	***45.00***	***45.00***		

WINTERKILL All CC –Corn
Part B. Changes in Costs

B. Changes in Costs:	**Mean ($/acre)**	**Median ($/acre)**	**Range ($/acre)**	**N**
B.1. Cover Crop Planting				
a. Seeds	13.09	10.00	[6; 30]	11
b. Planting (excluding seeds). Weighted average of custom and non-custom work.	10.20	9.34		
i. Custom work	11.33	9.00	[4; 25]	6
ii. Non-Custom	9.53	9.55	[2.2; 18.2]	10
Subtotal B.1	***23.29***	***19.34***		

Net Change in Profits ($/acre) WINTERKILL – All CC - Corn

Subtotal	Mean ($/ acre)	Median ($/ acre)
A. Changes in Revenues	*45.00*	*45.00*
B. Changes in Costs	*23.29*	*19.34*
C. Net change in profits (A-B)	*21.71*	*25.66*
C.1. Net Change in Profits excluding feed cost savings (C.1 = C - A.3)	*1.71*	*5.66*
C.2. Net Change in Profit excluding feed cost savings and cost-share payment (C. 2 = C - A.3 - A.1)	*-23.29*	*-19.34*

Partial budget for CEREAL RYE terminated with herbicides followed by SOYBEANS (All years of experience, all planting methods, and all tillage methods)

Part A. Changes in Revenues

A. Changes in Revenues:	**Mean ($/acre)**	**Median ($/acre)**	**Range ($/acre)**	**N**
1. Cost-share program	19.00	15.00	[8; 46]	16
2. Value of change in following cash crop yield ($4.00 / bushel)	1.84	0.00	[-70; 50]	38
3. Savings or extra revenue from grazing or harvesting cover crop for forage	35.08	20.00	[5; 150]	12
Subtotal A. Changes in Revenue	***55.93***	***35.00***		

Part B. Changes in Costs

B. Changes in Costs:	**Mean ($/acre)**	**Median ($/acre)**	**Range ($/acre)**	**N**
B.1. Cover Crop Planting				
a. Seeds	16.95	15.00	[8; 50]	41
b. Planting (excluding seeds). Weighted average of custom and non-custom work.	16.70	17.00		
i. Custom work	17.13	16.00	[6; 32]	16
ii. Non-Custom	16.49	17.47	[3.6; 24.2]	34
Subtotal B.1	***33.65***	***32.00***		

Part B. Changes in Costs

B. Changes in Costs:	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	2.05	0.00		39
i. Extra herbicide cost on top of regular weed control program	0.31	0.00	[-11; 12]	39
ii. Extra labor costs to apply herbicides on top of regular weed control program ($13/hr)	0.67	0.00	[0; 13]	39
iii. Other termination expenses	1.08	0.00	[0; 20]	39

Part B. Changes in Costs

B. Changes in Costs:	**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	17.75	14.31		7
i. Herbicide cost to terminate cover crops	12.29	10.00	[2; 30]	7
ii. Herbicide application cost. Weighted average of custom and non-custom work.	5.46	4.31	[3.9; 9.0]	
1. Custom Work	8.00	8.00	[8; 8]	2
2. Non-Custom	4.73	3.25	[2.7; 9.2]	7
Subtotal B.2. Weighted average of B.2.a and B.2.b	***4.44***	***2.18***		

Part B. Changes in Costs

B. Changes in Costs:	**Mean ($/acre)**	**Median ($/acre)**	**Range ($/acre)**	**N**
B.3. Changes in other costs				
a. Cash crop seed costs	-0.23	0.00	[-11; 0]	48
b. Cash crop planting costs (excluding seeds)	0.00	0.00	[0; 0]	48
c. Nitrogen Costs	0.00	0.00	[0; 0]	48
d. P & K Costs	0.00	0.00	[0; 0]	48
e. Manure Costs	0.00	0.00	[0; 0]	48
f. Insecticide Costs	0.00	0.00	[0; 0]	48
g. Fungicide Costs	0.00	0.00	[0; 0]	48
h. Soil Testing Costs	0.00	0.00	[0; 0]	48

Part B. Changes in Costs

B. Changes in Costs:	**Mean ($/acre)**	**Median ($/acre)**	**Range ($/acre)**	**N**
B.3. Changes in other costs				
i. Costs to Repair Soil Erosion	0.00	0.00	[0; 0]	48
j. Opportunity cost of management time ($15/hr)	0.00	0.00	[0; 0]	48
k. Change in cash rent	-0.50	0.00	[-10; 0]	20
Subtotal B.3	***-0.73***	***0.00***		
Subtotal B. Changes in Costs B1+B2+B3	***37.36***	***34.18***		

Net Change in Profits ($/acre) Cereal Rye before Soybeans

Subtotal	Mean ($/ acre)	Median ($/ acre)
A. Changes in Revenues	*55.93*	*35.00*
B. Changes in Costs	*37.36*	*34.18*
C. Net change in profits (A-B)	*18.56*	*0.82*
C.1. Net Change in Profits excluding feed cost savings (C.1 = C - A.3)	*-16.52*	*-19.18*
C.2. Net Change in Profit excluding feed cost savings and cost-share payment (C. 2 = C - A.3 - A.1)	*-35.52*	*-34.18*

Mean Net Change in Profits All Cover Crops before Soy

Subtotal	Up to 3 years planting CC	4-9 years planting CC	10+ years planting CC
C. Net change in profits	*6.64*	*19.01*	*22.71*
C.1. Net Change in Profits excluding feed cost savings	*-24.36*	*-11.70*	*-21.04*
C.2. Net Change in Profit excluding feed cost savings and cost-share payment	*-39.36*	*-34.33*	*-36.79*
Reported Yield Change	*-0.43 [-4, 5]*	*0.25 [-7, 4]*	*-0.09 [-5, 4]*

Net Change in Profits ($/acre) CR before Soy: 50+acres CC

Subtotal	Mean ($/ acre)	Median ($/ acre)
A. Changes in Revenues	54.62	40.00
B. Changes in Costs	35.94	33.55
C. Net change in profits (A-B)	*18.68*	*6.45*
C.1. Net Change in Profits excluding feed cost savings (C.1 = C - A.3)	*-1.61*	*-13.55*
C.2. Net Change in Profit excluding feed cost savings and cost-share payment (C. 2 = C - A.3 - A.1)	*-22.94*	*-33.55*

So…???

- Either lots of people plotted against us, or simply costs of cover crops cannot be fully recovered by Iowa farmers on an annual basis

Concluding remarks

- Substantial variability in net returns, driven by:
  - ➢planting costs (-);
  - ➢cost-share program payments (+);
  - ➢savings in feed (grazing/harvesting CC) (+)
  - ➢ and the difference in yields obtained in fields with and without cover crops (+ or -).

Policy Implications

- For most farmers, cost-share payments are insufficient to cover all private costs associated with cover crop use,
- but are a critical incentive to support this practice.
- Grazing or harvesting the biomass for feed has the potential to help cover crops to break even as a complement to cost-share programs.

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)

Thank you for your attention!

Questions?

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