Net Returns to Cover Cropping

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International Soil Carbon Network, American Geophysical Union, and USDA Climate Hubs Webinar.
September 29, 2021

Cover Crops in Iowa

Photo courtesy: PFI

- **What is a cover crop?**
  - A plant that covers the soil between cash crops
- **Why use cover crops?**
  - Soil Health (↓ soil erosion)
  - Water Quality (Iowa Nutrient Reduction Strategy):
    % reduction in Nitrogen load 29%
    % reduction in Phosphorous load 28%
  - Pest management (?)
- **Adoption rate?**
  - From 1% in 2012 to 4% in 2017 (Census of Ag)

Photo courtesy: PFI

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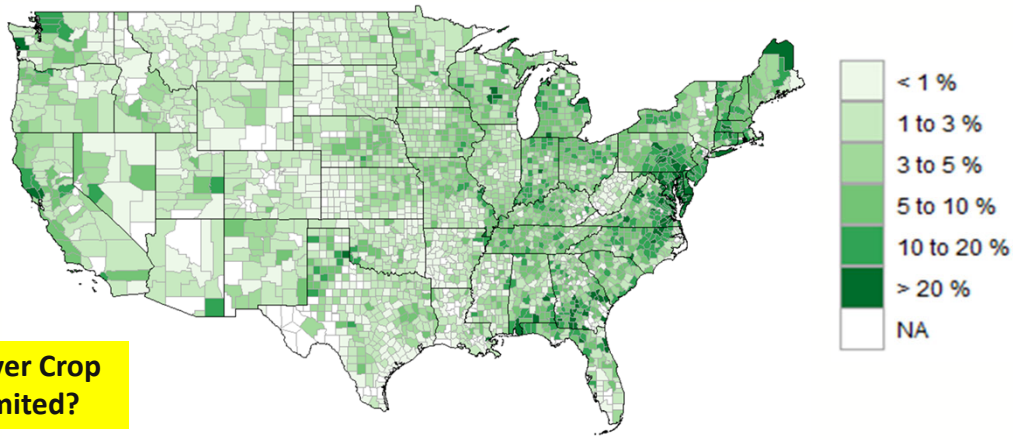
Cover Crops
Adoption Rate by County in 2017



Why is Cover Crop use so limited?

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Source: Sawadgo and Plastina, forthcoming in *Choices*, based on U.S. Census of Agriculture.

Summary of select State programs for cover crops

State (years active)	Program/ Implementing agency	Scope of program (acres)	Per-acre payment range (dollars)	Annual State spending (dollars)
Maryland (2009-present)	Agricultural Water Quality Cost-Share	639,710	30-75	22.5 million
Iowa (2013-present)	Department of Agriculture and Land Stewardship (IDALS)	250,000	15-25	5 million
Virginia (1998-present)	Virginia Department of Conservation and Recreation with funding from Water Quality Improvement Fund and real estate recordation fees	200,539 (2016)	15-33	5.1 million (2016)
Missouri (2015-present)	Department of Natural Resources	117,175	30-40	3.8 million
Delaware (at least 2011-present)	County conservation districts	85,438	30-50	
Ohio (2012-present)	Various, including Muskingum Watershed Conservancy Project, Ohio Department of Natural Resources, and Ohio Department of Agriculture	~50,000	12-40	~600,000
Indiana (2015-present)	Watersheds and county conservation districts with funding from Indiana State Department of Agriculture (ISDA) Clean Water Indiana Grants	18,278	Up to 20	307,385

Source: Wallander et al. 2021. *Cover Crop Trends, Programs, and Practices in the United States*. USDA/ERS, EIB 222.

Why is the adoption rate so low?

1. In crop-only Midwestern production systems, cover crops are not profitable for most farmers
2. Cost-share payments make net returns less negative among program participants, but not all experience positive profits
3. In mixed production systems with cows, cover crops can be profitable under the "right" conditions

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Motivations to Use Cover Crops Focus Groups IA, IL, MN (16 experienced CCroppers)

Fig. 2. Count of farmers in focus groups citing alternative motivations to use cover crops for the first time (by state).

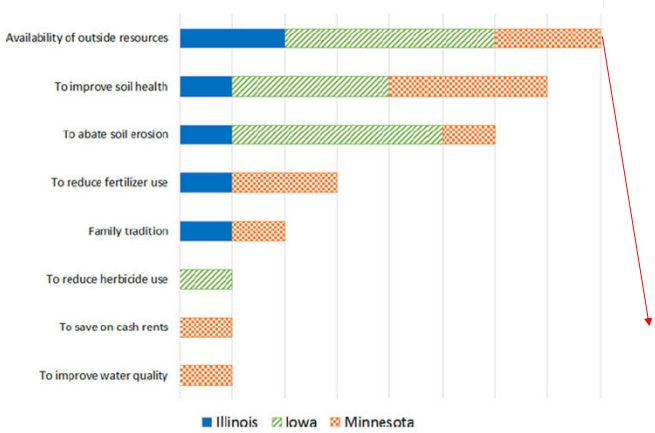
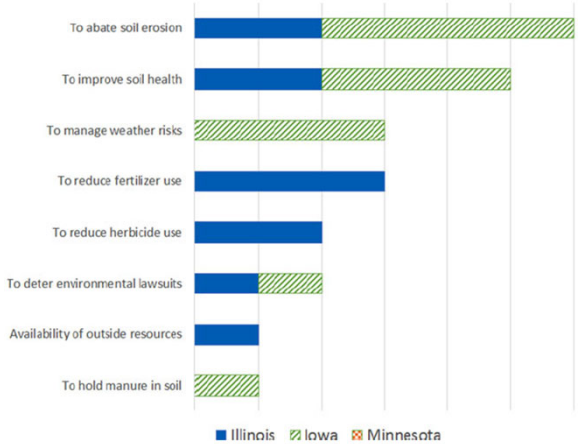
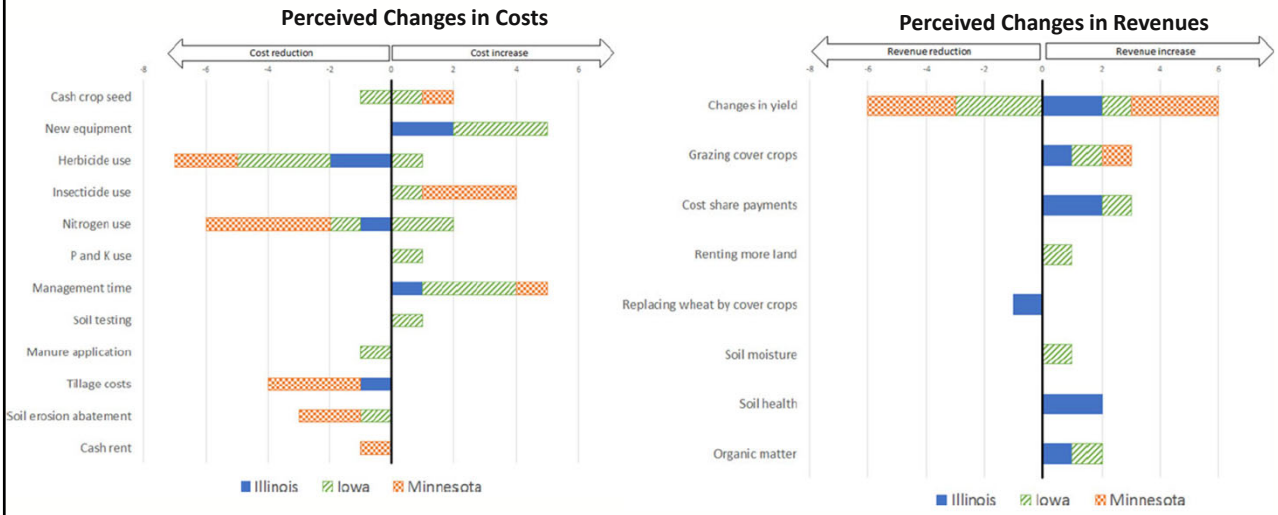


Fig. 3. Count of farmers in focus groups citing alternative motivations to continue using cover crops (by state).



Plastina et al. 2018. *Renewable Agriculture and Food Systems*

Perceived Changes in Cost & Revenue Focus Groups IA, IL, MN (16 experienced CCroppers)



Plastina et al. 2018. *Renewable Agriculture and Food Systems*

Net Returns to Cover Crops?

PARTIAL BUDGETS:

- For each farm operator, expenses and revenues in their production system <u>with cover crops</u> are compared against expenses and revenues in their production system <u>without cover crops</u>.

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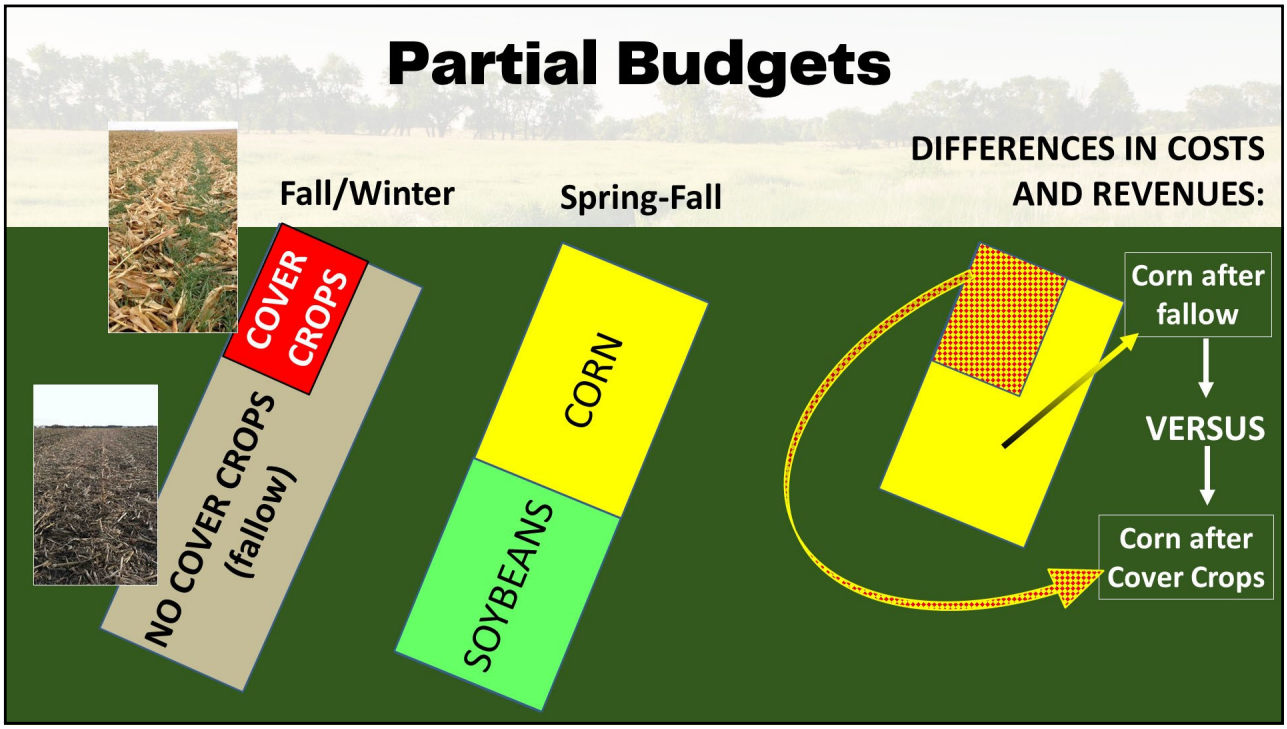
PRACTICAL FARMERS of Iowa

NORTH CENTRAL SARE Sustainable Agriculture Research & Education

NCR-SARE LNC15-375

Partial Budgets



Net Returns IA IL MN (n=15)

Source of Change in Costs	Value of Change in $/acre	
	Mean	Median
CC Seed cost	$20.4	$18.0
CC Planting	$20.3	$20.0
Extra herbicide cost for termination	$2.5	$0.0
+/- Other costs (NPK, manure, cash rent, soil erosion repair, etc.)	-$0.1	$0.0
Subtotal	*$43.1*	*$38.0*

Source of Change in Revenue	Median Value of Change in $/acre	
	Mean	Median
Cost-share	$11.7	$10.0
Yield change	$9.0	$0.0
Feed cost savings	$0.7	$0.0
Subtotal	*$21.4*	*$10.0*

Net Returns	Mean	Median
Total Change R-C	**-$21.7**	**-$28.0**
Excl. feed savings	**-$22.4**	**-$28.0**
Excl. Cost-share	**-$34.1**	**-$38.0**

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Total Change R-C: Range = [-67; +66]; 2/15 positive returns
Plastina et al. 2018. *Renewable Agriculture and Food Systems*

Regional Online Survey

MN IA IL ND IN NE OH MI MO SD WI (n=79) 2017

https://works.bepress.com/alejandro-plastina/23/

Sources of changes in net profits	Cover crops terminated with herbicides followed by corn for grain ($/acre)	Cover crops terminated with herbicides followed by soybeans ($/acre)
A. Changes in revenue:		
1. Cash Crop Yield	-9.18	31.74
2. Cost-share program	25.33	28.07
Subtotal	*16.16*	*59.81*
B. Changes in costs:		
1. Cover crop planting	31.84	31.14
2. Herbicide expenses	4.05	3.82
3. Other Costs	1.02	-0.27
Subtotal	*36.91*	*34.69*
Net change in profit (A-B):	*-20.76*	*25.13*
Net change in profit without Cost-Share	*-46.09*	*-2.95*

1. **Average Extra Costs: $35-$37 per acre**
2. **Average Payments from Cost-Share Program: $25–$28**
3. **Corn yield drag ~ 2 bushels/acre**
   Soy yield bump ~ 3 bushels/acre
   Average Net Returns to cover crops:
   –$21 preceding corn
   +$25 preceding soy
4. **Net Returns Excluding Cost-Share:**
   –$46/acre preceding corn
   –$3/acre preceding soy

Plastina et al. 2018. *Journal of the American Society of Farm Managers and Rural Appraisers*

Mail Survey administered by NASS

- Sample size: 1,250 Iowa 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.

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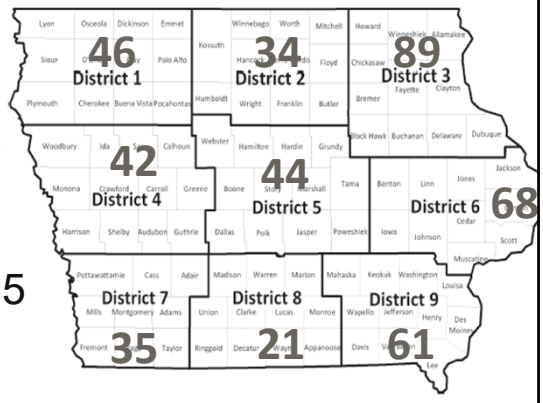
Respondents

- 674 responses
  (54% resp. rate)
- 440 planted Cover Crops in fall 2015
  (35% rate)
- Data on CC planted in fall 2015 → cash crop in 2016
  (average yields: C 196.4 bu/a; S 57.9 bu/a)



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Plastina et al. 2018. *Journal of Applied Farm Economics*
Survey instrument:
https://www.card.iastate.edu/conservation/economics-of-cover-crops/

CARD Center for Agricultural and Rural Development | NORTH CENTRAL SARE Sustainable Agriculture Research & Education | STATE | PRACTICAL FARMERS of Iowa

Statewide Mail Survey IA
(n=440; 35% Resp. rate) 2017

https://docs.lib.purdue.edu/jafe/vol2/iss2/2/

Source of Change in Profits	Median Value of Change in $/acre	
	CC followed by Corn	CC followed by Soybeans
CC Seed cost	$16	$15
CC Planting	$16	$17
Extra herbicide cost	$3	$2
+/- Other costs	$0	$0
A. Subtotal Extra Costs	***$35***	***$34***
Cost-share	$20	$15
Value of yield change	$0	$0
B. Subtotal Extra Revenue	***$20***	***$15***
C. Net Returns (B-A)	***-$15***	***-$19***
Feed cost savings	$22	$20
D. Net Returns w/ Livestock	***+$7***	***+1***

1. **Median Extra Costs: $34-$35 per acre**
2. **Median Payments from Cost-Share Program: $15–$20**
3. **Median Corn and Soy yields same as following fallow**
   Median Net Returns to cover crops (including cost-share payments):
   –$15/a preceding corn
   –$19/a preceding soy
4. **Net Returns in Mixed Crop-Livestock system (incl. feed cost savings):**
   +$7/a preceding corn
   +$1/a preceding soy

Major Findings from Statewide Survey

Substantial variability in net returns, driven by:

1. savings in animal feed (grazing/harvesting CC) (+)
2. cost-share program payments (+);
3. planting costs (-);
4. termination costs (-)
5. yield differences (+ or -).

Results are robust to:

- tillage, planting, years of experience with CC

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Plastina et al. 2018. *Journal of Applied Farm Economics*

Criticism of Survey Results

- "Inconvenient" results
- No "hard science," only "opinions"
- Missing "long-term effects" on soil health and land values

My response:

- **Survey other states**
- **Collect data from experimental plots**
- Impact of land tenure on CC adoption?
- Effect of cover crops on land values?

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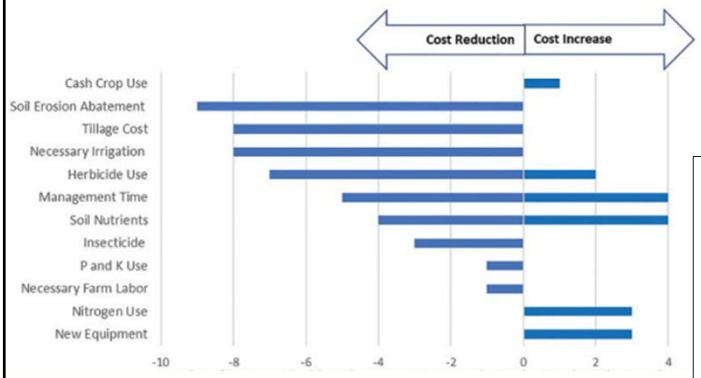
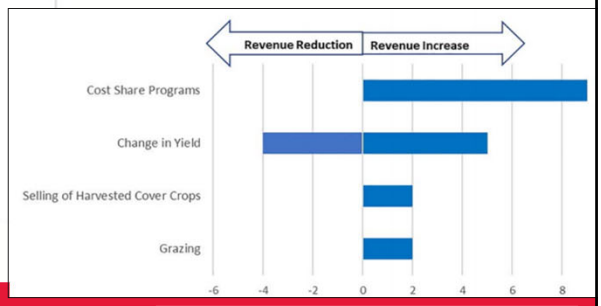
Focus groups in Georgia (n=14)
Irrigated cotton & peanuts, 4 locations





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Hancock et al. 2020. *Journal of the American Society of Farm Managers and Rural Appraisers*

Benefits associated with cover crops in South Carolina (n=308, 51% CC users)

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1 Does not matter to me; 2 Not important; 3 Indifferent/Neutral; 4 Somewhat important; 5 Very important

	Count–CC Users							Count–CC Non-Users							
	1	2	3	4	5	Mean	Rank	1	2	3	4	5	Mean	Rank	
Reduces soil erosion	4	5	5	28	83	4.45	2	8	4	16	29	54	4.05	2	*
Controls weeds	3	3	13	36	68	4.33	4	5	4	27	32	41	3.92	6	*
Provides nitrogen scavenging	5	6	25	31	54	4.02	10	6	6	33	31	33	3.72	10	*
Increases yields in following cash crop	7	6	27	21	63	4.02	9	6	6	41	23	32	3.64	13	*
Economic return	4	5	24	26	63	4.14	6	5	5	35	25	41	3.83	7	*
Deep tap roots	6	10	27	39	38	3.78	13	8	5	49	26	22	3.45	17	*
Attracts pollinators to my farm	5	12	38	25	39	3.68	14	8	6	37	30	28	3.59	14	*
Reduces nutrient/pesticide runoff	5	8	15	33	56	4.09	7	8	4	31	29	35	3.74	9	*
Winter kills easily	8	26	49	16	18	3.09	18	8	9	44	33	16	3.36	18	*
Winter hardiness/survival	7	12	34	27	37	3.64	15	9	4	45	28	23	3.48	16	
Controls insects	7	10	51	22	25	3.42	17	10	4	38	28	29	3.57	15	*
Reduces diseases	8	10	40	28	30	3.53	16	9	7	28	33	33	3.67	12	*
Increases soil organic matter and soil health	2	3	6	29	83	4.53	1	7	3	14	32	55	4.13	1	*
Reduces soil compaction	4	3	11	31	71	4.35	3	8	2	23	33	44	3.94	4	
Provides a nitrogen source	5	6	22	34	54	4.04	8	7	2	24	32	45	3.96	3	
Fibrous root system	7	6	29	35	40	3.81	12	8	2	32	31	36	3.78	8	*
Decreases the cost of producing the following cash crops	5	7	37	26	44	3.82	11	9	2	36	30	33	3.69	11	
Environmental Benefits to protect waterways	5	4	19	28	62	4.17	5	8	2	24	32	44	3.93	5	

* significantly different at $p < 0.05$ (Chi-Squared test).

Clay et al. 2020. *Agriculture*

Challenges associated with cover crops in South Carolina (n=308, 51% CC users)

1 Not a Problem I Considered; 2 Not a Challenge; 3 Neutral; 4 Somewhat of a Challenge; 5 A Difficult Challenge

	Count—Cover Crop (CC) Users							Count—CC Non-Users							
	1	2	3	4	5	Mean	Rank	1	2	3	4	5	Mean	Rank	
Cover crops sometimes use too much moisture	58	32	22	6	2	1.85	14	41	14	39	11	0	2.77	5	*
Not knowing most effective seeding rate	33	41	17	27	1	2.34	9	27	21	30	23	4	2.19	11	*
Selecting the right cover for my operation	27	36	22	30	5	2.58	5	21	18	31	28	8	3.25	2	
No measurable economic return	24	25	39	15	13	2.72	1	19	12	41	21	12	2.77	5	*
Cover crop becomes a weed the following year	40	50	18	9	1	2.34	9	30	17	32	16	10	2.19	11	*
Nitrogen conversion to organic forms	21	36	56	4	3	2.58	5	30	18	46	10	1	2.24	8	
Yield reduction in the following cash crop	30	43	34	6	5	2.72	1	29	13	47	8	7	2.77	5	
Increased insect potential	32	35	35	11	4	1.99	11	27	11	46	16	4	2.19	11	*
Time and labor required for planting and management	18	29	16	47	10	2.58	5	16	8	28	31	25	2.24	8	
Cover crop seed cost	16	13	31	48	14	2.72	1	15	6	37	27	20	3.10	3	*
Cover crop seed availability	19	30	32	29	6	1.99	11	19	9	46	24	8	2.19	11	
Increased disease potential	34	37	39	7	1	2.43	8	28	16	46	10	5	2.24	8	*
Increases overall crop production risk	31	41	38	8	2	2.72	1	22	13	51	12	5	3.10	3	*
Cost of planting and managing cover crops	19	15	30	49	8	1.99	11	13	7	30	32	25	3.46	1	

* significantly different at $p < 0.05$ (Chi-Squared test).

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Clay et al. 2020. *Agriculture*

Net Returns from Experimental Data IA

- INRC Grant to develop BMPs for CC (cereal rye), based on:
  - seeding rate,
  - seeding method,
  - and termination date.

PIs: Alison Robertson and Mark Licht.

CO-PIs: J. Arbuckle, M. Castellano, L. Dong, B. Hartzler, E. Hodgson, A. Lenssen, M. McDaniel, T. Moorman, A. Plastina

- One of multiple objectives: Calculate economic returns to CC.

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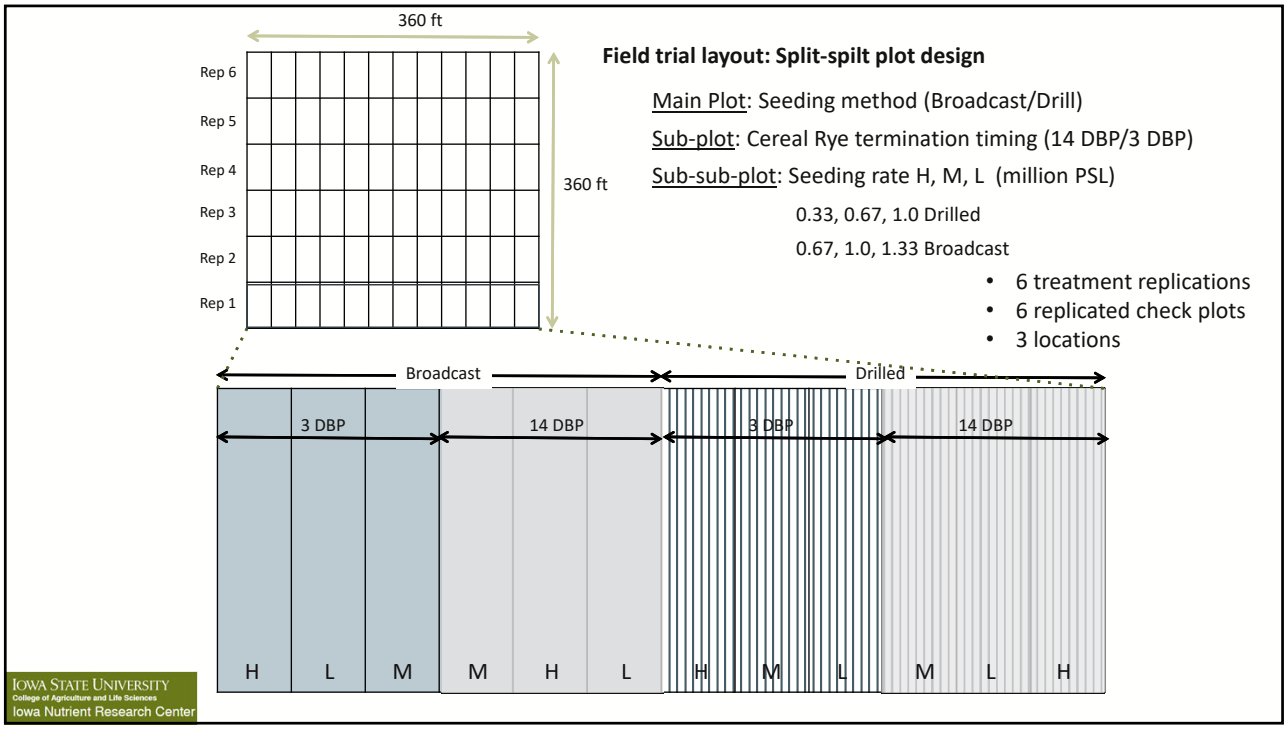
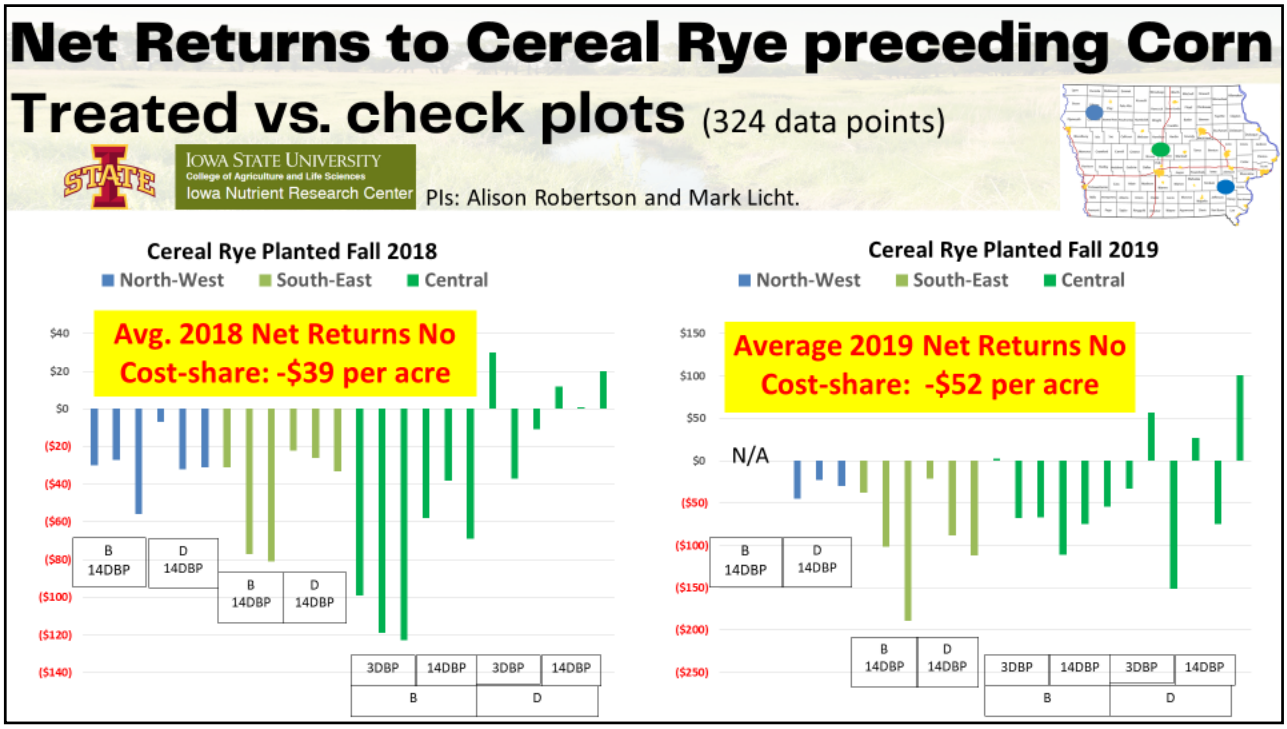
College of Agriculture and Life Sciences
Iowa Nutrient Research Center


360 ft
Rep 6
Rep 5
Rep 4
Rep 3
Rep 2
Rep 1
360 ft
Field trial layout: Split-spilt plot design
Main Plot: Seeding method (Broadcast/Drill)
Sub-plot: Cereal Rye termination timing (14 DBP/3 DBP)
Sub-sub-plot: Seeding rate H, M, L (million PSL)
0.33, 0.67, 1.0 Drilled
0.67, 1.0, 1.33 Broadcast
• 6 treatment replications
• 6 replicated check plots
• 3 locations
Broadcast
Drilled
3 DBP
14 DBP
3 DBP
14 DBP
H L M M H L H M L M L H
Iowa State University
College of Agriculture and Life Sciences
Iowa Nutrient Research Center


Net Returns to Cereal Rye preceding Corn
Treated vs. check plots (324 data points)
Iowa State University
College of Agriculture and Life Sciences
Iowa Nutrient Research Center
PIs: Alison Robertson and Mark Licht.
Cereal Rye Planted Fall 2018
North-West
South-East
Central
Avg. 2018 Net Returns No Cost-share: -$39 per acre
$40
$20
$0
($20)
($40)
($60)
($80)
($100)
($120)
($140)
B 14DBP
D 14DBP
B 14DBP
D 14DBP
3DBP
14DBP
3DBP
14DBP
B
D
Cereal Rye Planted Fall 2019
North-West
South-East
Central
Average 2019 Net Returns No Cost-share: -$52 per acre
N/A
$150
$100
$50
$0
($50)
($100)
($150)
($200)
($250)
B 14DBP
D 14DBP
B 14DBP
D 14DBP
3DBP
14DBP
3DBP
14DBP
B
D

Other findings from Experimental Plots

- No benefits of CC on weed management
- No benefits of CC on soil health
- No benefits of CC on insect management

→ High variability of CC biomass (Cereal Rye is still a CROP!)
→ High variability of potential private and social benefits

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Comparison of "Average" Returns $ per acre

Source	Focus groups IA IL MN (n=15) 2016	Regional Survey (n=79) Corn 2017	Regional Survey (n=79) Soy 2017	Statewide IA Survey (n=440) Corn 2017	Statewide IA Survey (n=440) Soy 2017	Experimental Plots in IA (n=324) Corn 2018-19
Value of Yield Change	9.0	-9.2	31.7	0.0	0.0	-17.6
Planting CC	-40.7	-31.8	-31.1	-32.0	-32.0	-27.5
Other Costs	-2.4	-5.1	-3.6	-3.0	-2.0	+1.0
Net Returns	**-34.1**	**-46.1**	**-3.0**	**-35.0**	**-34.0**	**-44.1**
NR + Cost Share	**-22.4**	**-20.8**	**+25.1**	**-15.0**	**-19.0**	**n/a**
NR + CS + Grazing Lvst.	**-21.7**	**n/a**	**n/a**	**+7.0**	**+1.0**	**n/a**

My opinion: 5%-15% of the farms with no cows can obtain positive net returns from cover crops with cost share.
15%-25% of the farms with cows can obtain positive net returns from cover crops with no cost share.
20%-30% of the farms with cows can obtain positive net returns from cover crops with cost share

Create your own partial budgets (1)

https://www.card.iastate.edu/conservation/economics-of-cover-crops/

Net Returns Calculator for Cover Crops Terminated with Herbicides

Begin here:

Agricultural District:
(●) State of Iowa ( ) Northwest ( ) North Central ( ) Northeast ( ) West Central ( ) Central ( ) East Central

Following Cash Crop:
( ) Corn (●) Soy

Tillage method:
( ) All observations (●) Rotational no-till or continuous no-till ( ) Conventional or vertical tillage

Cover crop mix:
( ) All observations (●) Cereal rye

Do you custom hire your cover crop planting? (●) No ( ) Yes

Do you apply a pre-plant burn down in all your acres (with and without cover crops)? ( ) No (●) Yes

Expected crop price ($/bushel): 10.36 autofill with: Nov-2021 Futures ($10.36)

Submit Reset

Sources of changes in net profits	Mean ($/acre)	Median ($/acre)	Your Scenario ($/acre)
A) Changes in Revenue			import Mean / import Median
1. Cost-share program	$18.71	$15.00	
2. Value of change in following cash crop yield	$0.39	$0.00	
3. Savings or extra revenue from grazing/harvesting cover crop for forage	$16.14	$17.00	
Subtotal A. Changes in Revenue	**$35.24**	**$32.00**	
B) Changes in Cost			
1. Cover crop planting			
a. Seeds	$16.38	$14.00	
b. Planting *(excluding seeds)*	$15.93	$16.99	
Subtotal B.1	**$32.31**	**$30.99**	

Create your own partial budgets (2)

https://www.extension.iastate.edu/agdm/crops/html/a1-91.html

Economics of Cover Crops

Iowa State University Extension and Outreach - Ag Decision Maker

See the Ag Decision Maker page, Economics of Cover Crops, for more information.

This decision tool contains three different worksheets:

Cover Crops Budget	For analyzing the projected economic costs and benefits of cover crops, without grazing or harvesting.
Grazing Cover Crops Budget	For analyzing the projected economic costs and benefits of cover crops, with grazing or harvesting.
Grazing Cover Crops Results	For analyzing the actual economic costs and benefits resulting from cover crops, including grazing or harvesting.

More information on the economics of cover crops can be found at:

Practical Farmers of Iowa: Grazing Cover Crops fact sheet, www.practicalfarmers.org/app/uploads/2013/11/Grazing-Cover-Crops-Fact-Sheet-2013.pdf
Practical Farmers of Iowa cover crop information, www.practicalfarmers.org/member-priorities/cover crops/
On-farm research quantifies value of grazing cattle on cover crops, www.practicalfarmers.org/news-events/newsroom/news-release-archive/28152/
CARD Cover Crop website-forthcoming, www.card.iastate.edu/

Version 1.4_70318

Authors: William Edwards, retired ISU economist,
Alejandro Plastina, ISU Extension Economist,
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Questions? Email agdm@iastate.edu

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Questions? Comments?

Thank you for your attention!

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References in:

https://www2.econ.iastate.edu/faculty/plastina/

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