Economic Drivers of Cover Crop Adoption

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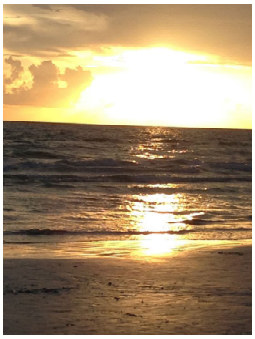
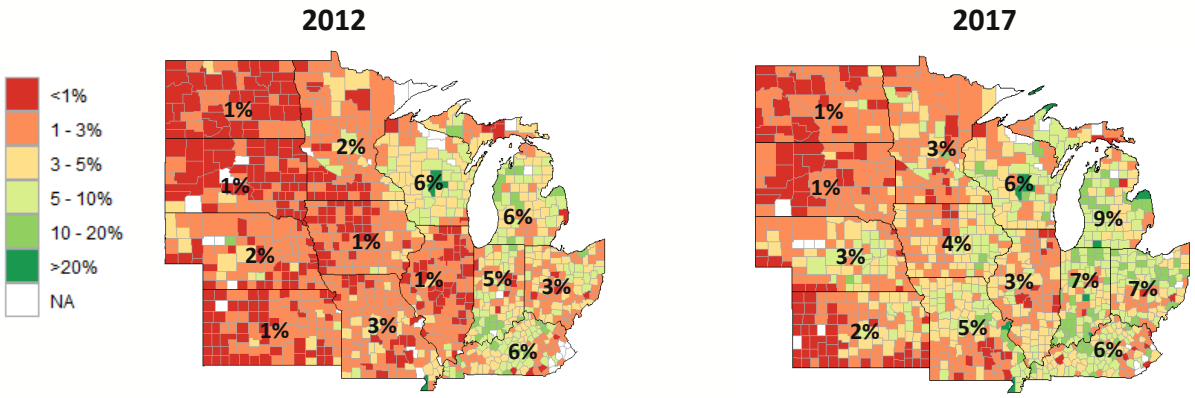
Soil Management Summit 2020
University of Minnesota Extension
December 16, 2020

What makes you feel good?



Photos: www.weforum.org; www.fishingbooker.com

Percent of Cropland in Cover Crop (2012-2017)



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Data Source: USDA-NASS

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).

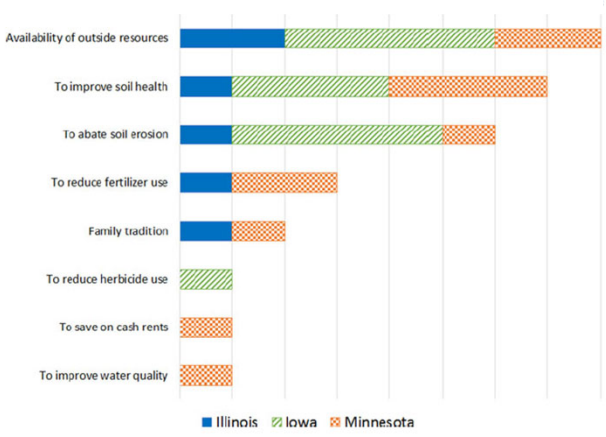
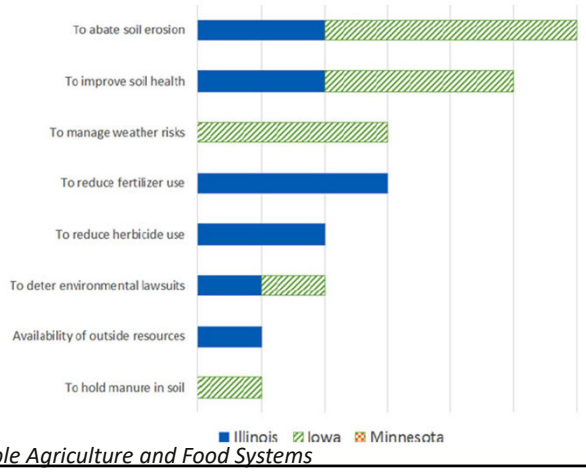
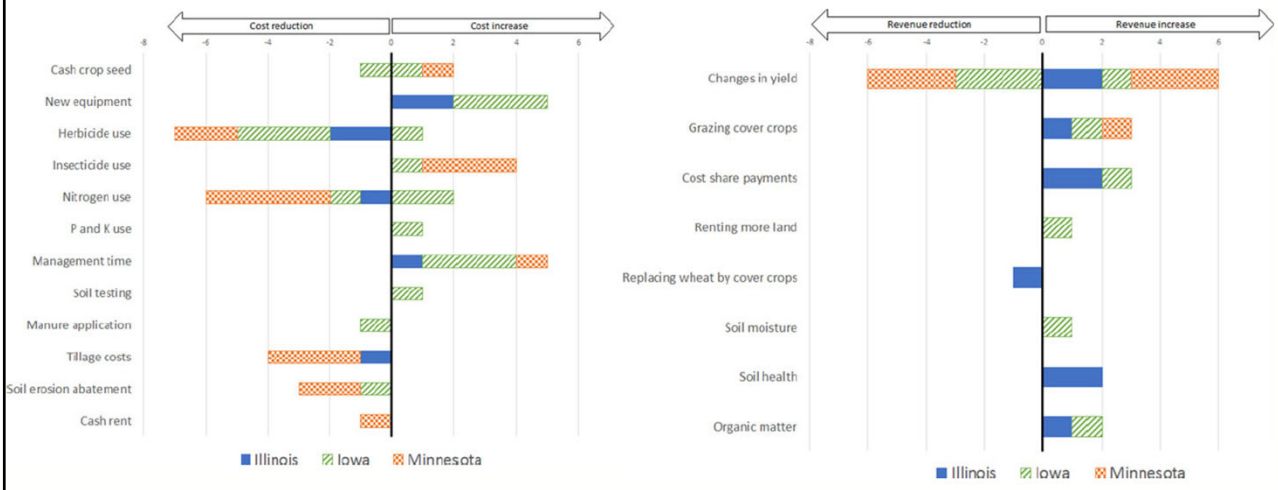


Fig. 3. Count of farmers in focus groups citing alternative motivations to continue using cover crops (by state).



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 with cover crops are compared against expenses and revenues in their production system without cover crops.

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PRACTICAL FARMERS of Iowa

NORTH CENTRAL SARE Sustainable Agriculture Research & Education

NCR-SARE LNC15-375

Changes in 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**
No feed cost savings	**-$22.4**	**-$28.0**
No 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 (n=79)
MN IA IL ND IN NE OH MI MO SD WI

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PRACTICAL FARMERS of Iowa

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*

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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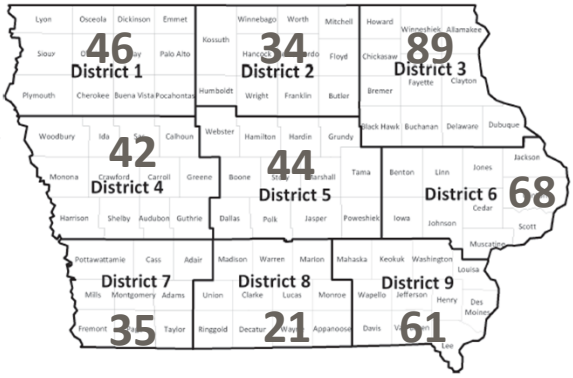
CARD Center for Agricultural and Rural Development

NORTH CENTRAL SARE Sustainable Agriculture Research & Education

PRACTICAL FARMERS of Iowa

Respondents

- 674 responses
  (54% resp. rate)
- 440 planted Cover Crops
  (35% rate)
- Data on CC planted in fall 2015
  → cash crop in 2016



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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/

Changes in Revenue and Costs

Source of Change in Costs	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 for termination	$3	$2
+/- Other costs (NPK, manure, cash rent, soil erosion repair, etc.)	$0	$0
Subtotal	*$35*	*$34*

Source of Change in Revenue	Median Value of Change in $/acre	
	CC followed by Corn	CC followed by Soybeans
Cost-share	$20	$15
Yield change	$0	$0
Feed cost savings	$22	$20
Subtotal	*$42*	*$35*

Net Returns	CC followed by Corn	CC followed by Soybeans
Total Change R-C	$7	$1
No feed cost savings	**-$15**	**-$19**
No Cost-share	**-$35**	**-$34**

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2016 Average Yields following CC: Corn 196.4 bu/a; Soybean 57.9 bu/a

Major Findings from Statewide Survey

Substantial variability in net returns, driven by:

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


Photo: Fernando Miguez

Results are robust to:

- tillage, planting, years of experience with CC

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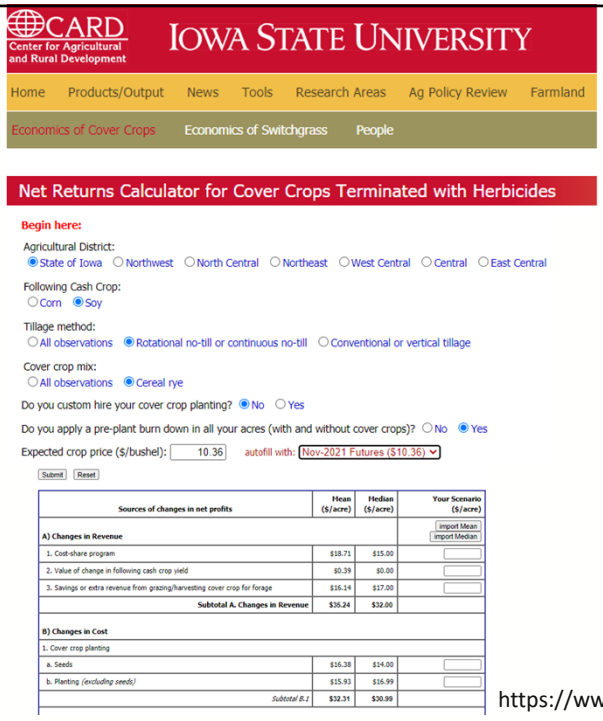
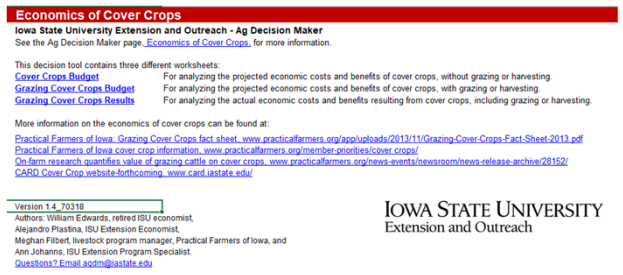
Plastina et al. 2018. *Journal of Applied Farm Economics*

Partial budgets tools:



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



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

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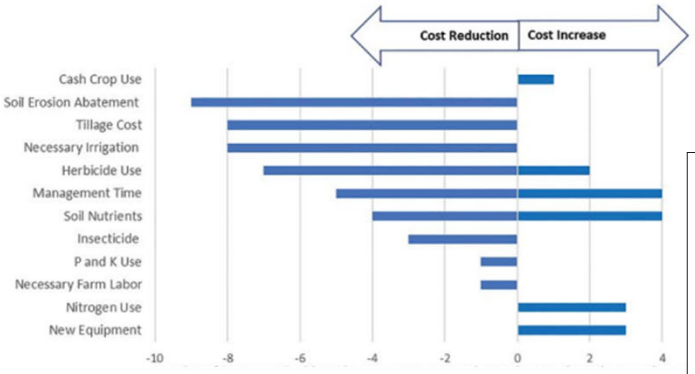
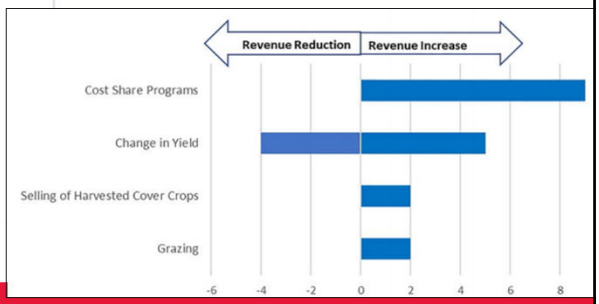
Focus groups in Georgia (n=14)
Irrigated cotton & peanuts, 4 locations





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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	

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

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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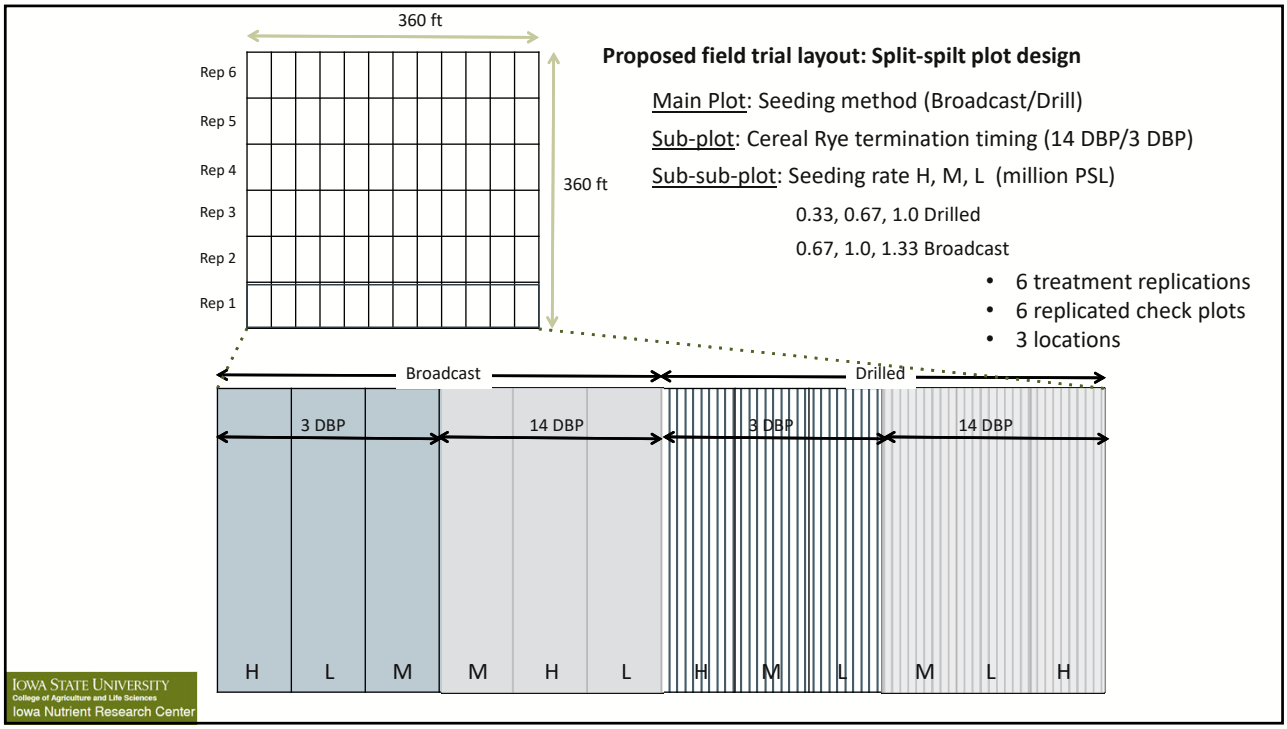
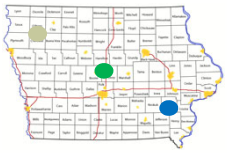
Iowa Nutrient Research Center



Net Returns (Experiments):

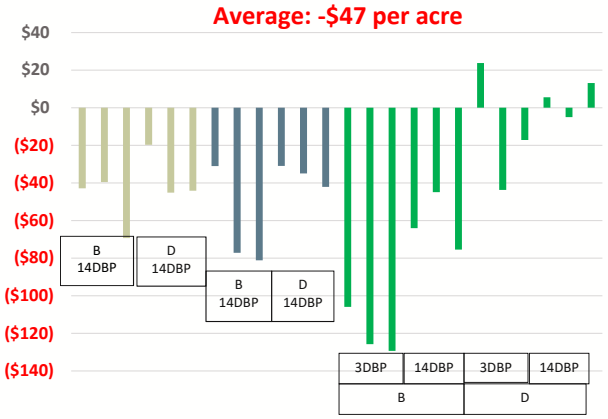
Planting Costs
Termination Costs
Corn Yield Change



CC Planted Fall 2018

North-West South-East Central

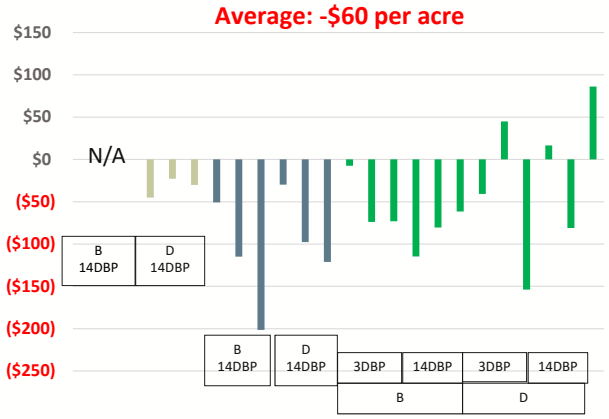
Average: -$47 per acre



CC Planted Fall 2019

North-West South-East Central

Average: -$60 per acre



Net Returns (Experiments):

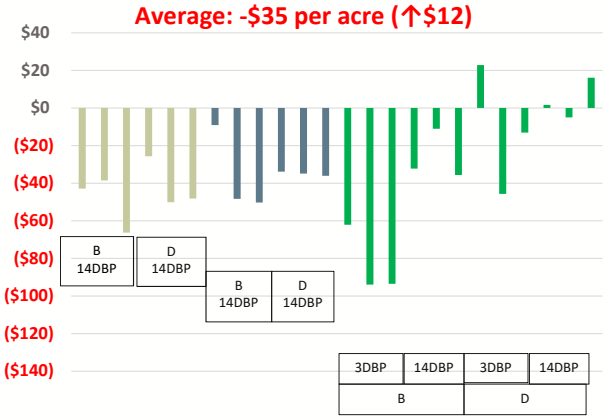
Planting Costs
Termination Costs
Corn Yield Change
Grazing Livestock on CC

48 cows w/calves, March 1st - Termination
Temporary Electric Fence 160 acres of CC
w/2 internal divisions

CC Planted Fall 2018

North-West South-East Central

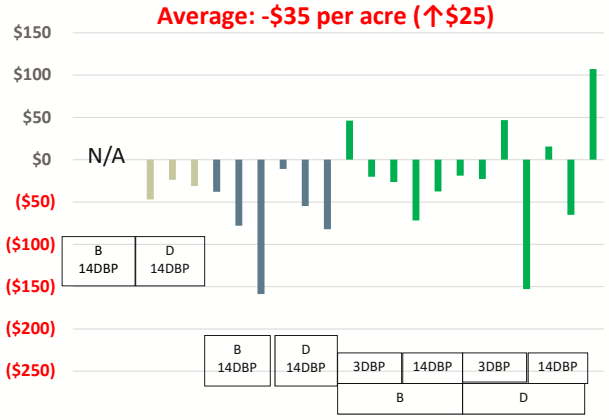
Average: -$35 per acre (↑$12)



CC Planted Fall 2019

North-West South-East Central

Average: -$35 per acre (↑$25)



Comparison of "Average" Returns

Source	Focus groups IA IL MN (n=14) 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=24 treatments x 6 replications) Corn 2018-19
Value of Yield Change	9	-9	32	0	0	-16
Planting CC	-41	-32	-31	-32	-32	-28
Extra Termination Cost	-2	-5	-4	-3	-2	-9
Net Returns	**-34**	**-46**	**-3**	**-35**	**-34**	**-53**
NR + Cost Share	**-23**	**-21**	**+25**	**-15**	**-19**	**n/a**
NR+ Grazing Livestock	**-34**	**n/a**	**n/a**	**-13**	**-14**	**-35**
NR + CS + Grazing L.	**-22**	**n/a**	**n/a**	**+7**	**+1**	**n/a**

Other findings from Experimental Plots

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

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

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Why is extension focusing on CC?

Source: http://www.umces.edu/people/boesch-gulf-mexico-hypoxia

- Social Benefits!
- To reduce eutrophication*
- …and improve Water Quality

- Actual benefits depend on CC biomass, which depends on variables outside the control of producers:
- Weather, temperature, soil moisture,…

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*The process by which a body of water becomes enriched in dissolved nutrients (such as NO_3^-) that stimulate the growth of aquatic plant life usually resulting in the depletion of dissolved oxygen.

What if conditions are not "right"?

- No benefit from CC to producers
- No benefit from CC to society
- Most likely beneficiaries are seed companies

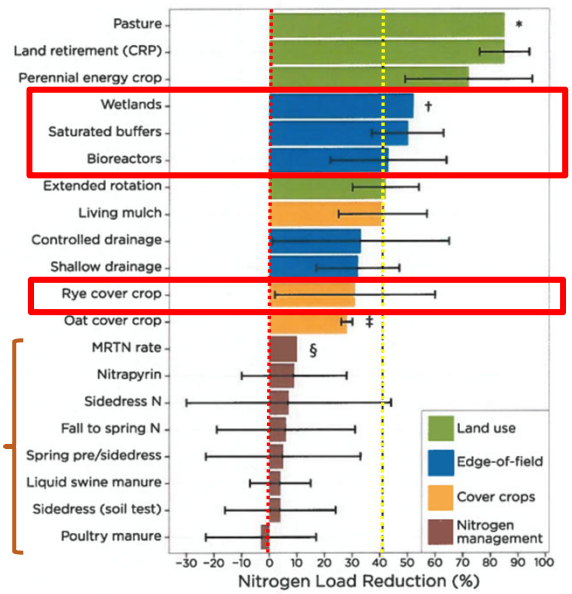
→ **What makes you feel good?**

Would you feel **better** using your resources to generate **higher** and **more stable N reduction with other practices**?

Iowa Nutrient Reduction Strategy: Nitrogen reduction practices

Average nitrate-nitrogen concentration or load reduction as a percentage. Error bars represent one standard deviation above and below the mean.

* Based on the land retirement (CRP) value. There were no observations to develop a standard deviation.
† Based on one report looking at multiple wetlands in Iowa (Helmers et al., 2008).
‡ Based on one study with three years of corn and two years of soybeans.
§ Reduction calculated based on initial estimated application rate for each Major Land Resource Area in Iowa.



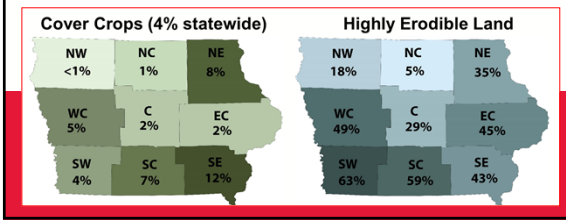
4 R's

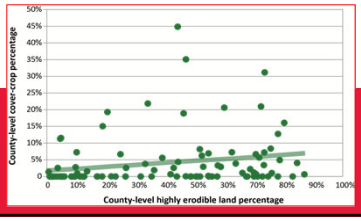
Data from the Iowa Nutrient Reduction Strategy (IDALS, IDNR, and ISU CALS, 2014).

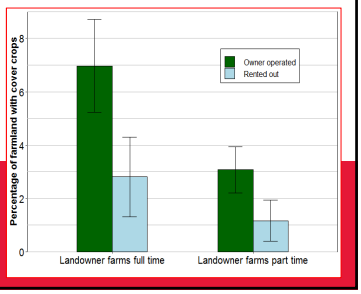
Findings from Representative IA Survey

- Land tenure may be a barrier to adoption of CC
- Conservation use is lower on farmland owned by non-operator landowners
- Also lower among absentee landowners
- Landowners seem open to increasing CC acreage in the future
- Willing to help tenants pay for portion of planting cost

Sawadgo *et al*. 2021. Forthcoming in *Journal of Soil and Water Conservation*







Monetizing Soil Health (INRC Grant)

- Appraisal of 3 farms with different long-term conservation practices by 9 appraisers (9 x 3 = 27 reports)
- Repeated in 2019 and 2020 (54 reports)
- Appraisers provided with detailed Soil Test results, but Not Informed about practices

➢ Preliminary finding: Rural Appraisers follow strict rules, **no room for adjusting land value based on soil health** (beyond CSR2)

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Questions? Comments?

Thank you for your attention!

plastina@iastate.edu

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