

A photograph of a cornfield at sunset or sunrise. The corn stalks are golden-brown and mostly harvested, with some still standing. A strip of green cover crop is visible in the foreground, running diagonally across the field. The sky is a soft orange and yellow.

Maximizing Cover Crops: What We've Learned from 10 Years of Cover Crop Research

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Strategic Initiatives Director

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Cover Crop Time Lapse Video

November 14 – July 30





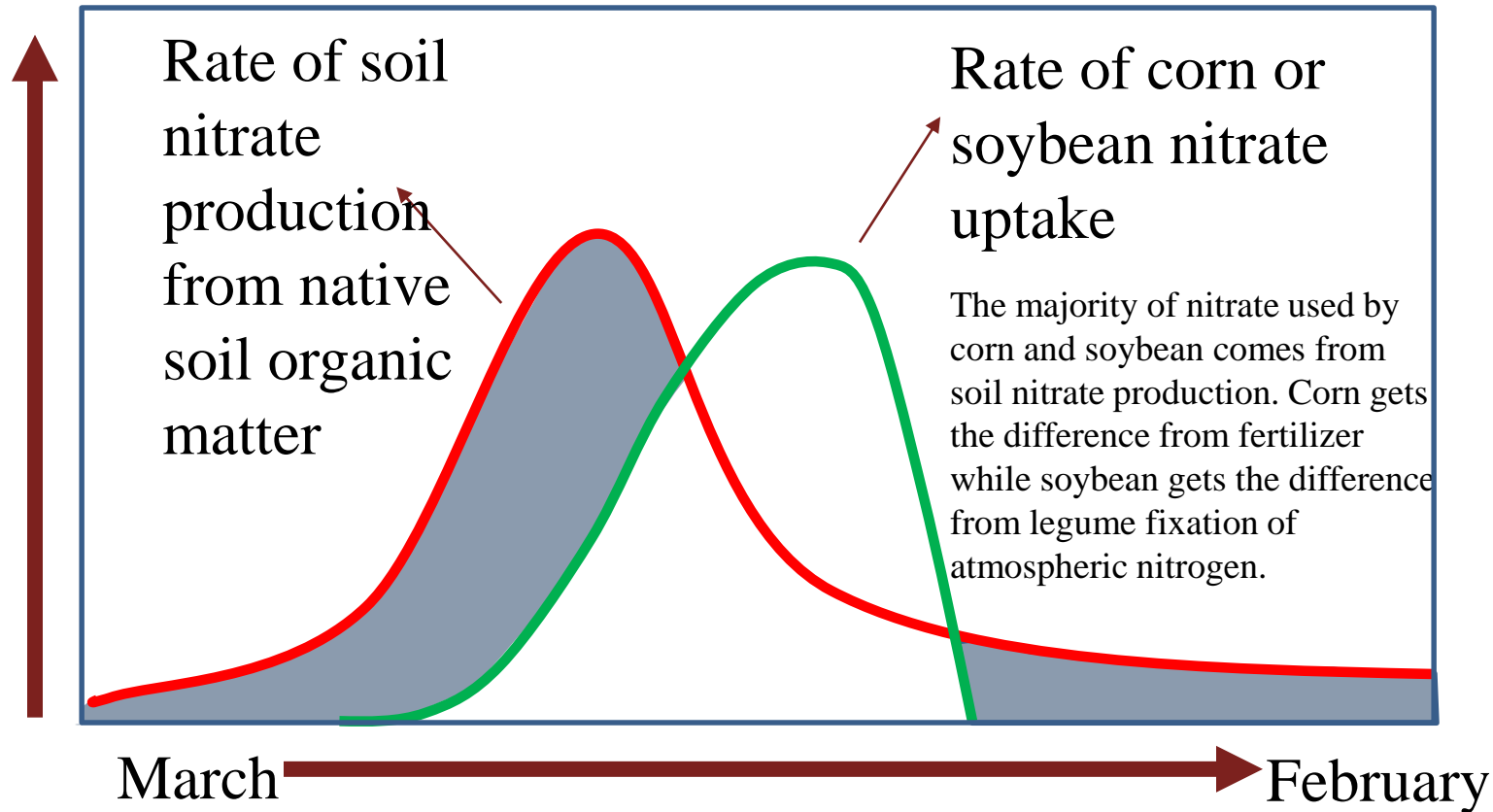
Equipping farmers to build resilient farms and communities.

Member-led, non-profit organization 3,400 members





Soil Nitrate Production vs. Crop Nitrate Uptake



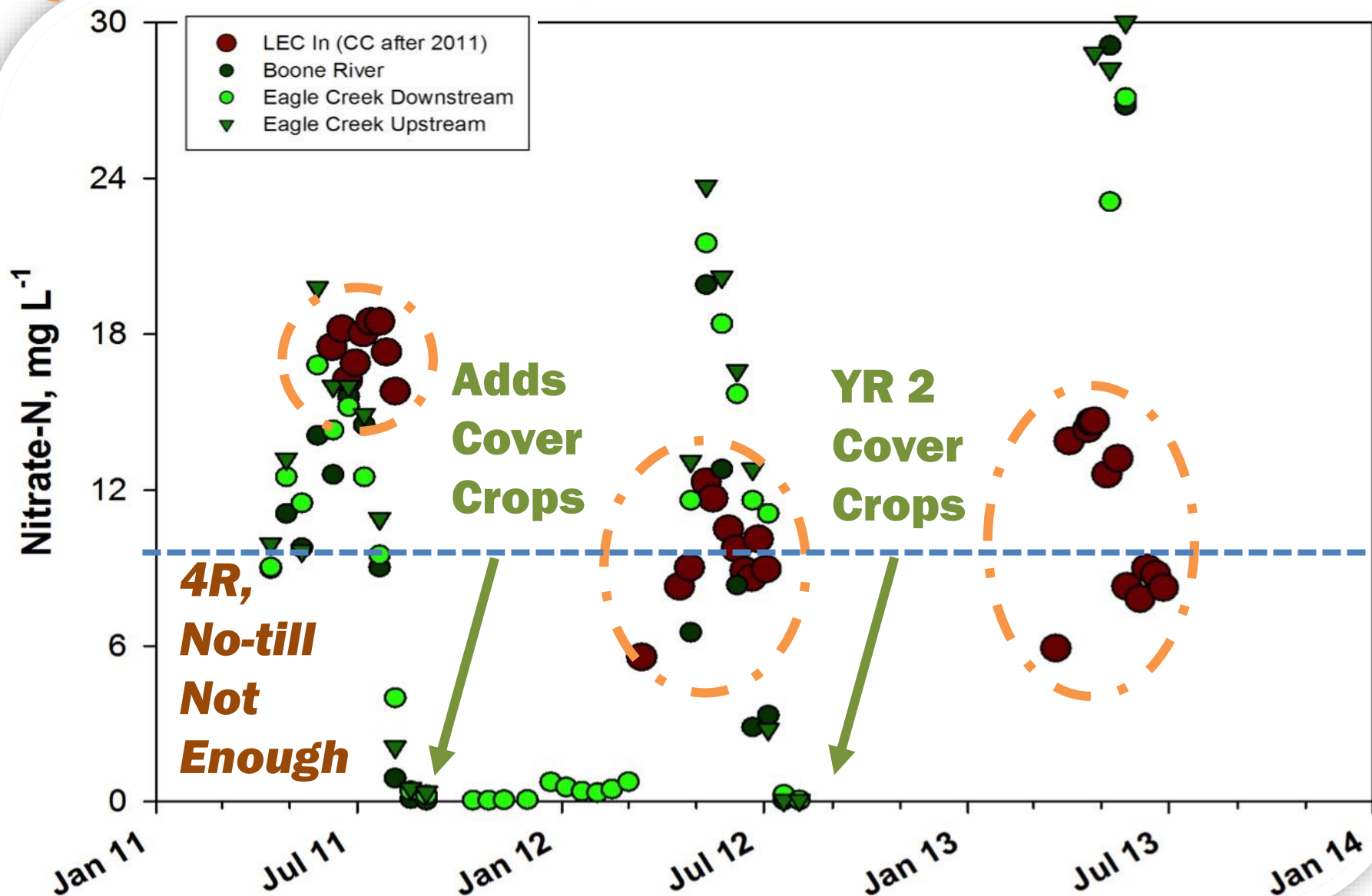
*In the shaded areas, the soil produces nitrate, but there is no crop to use it.
As a result, some nitrate is lost to waterways.*

IOWA STATE
UNIVERSITY

2011

2012

2013



Iowa Nutrient Reduction Strategy: Nitrogen reduction practices

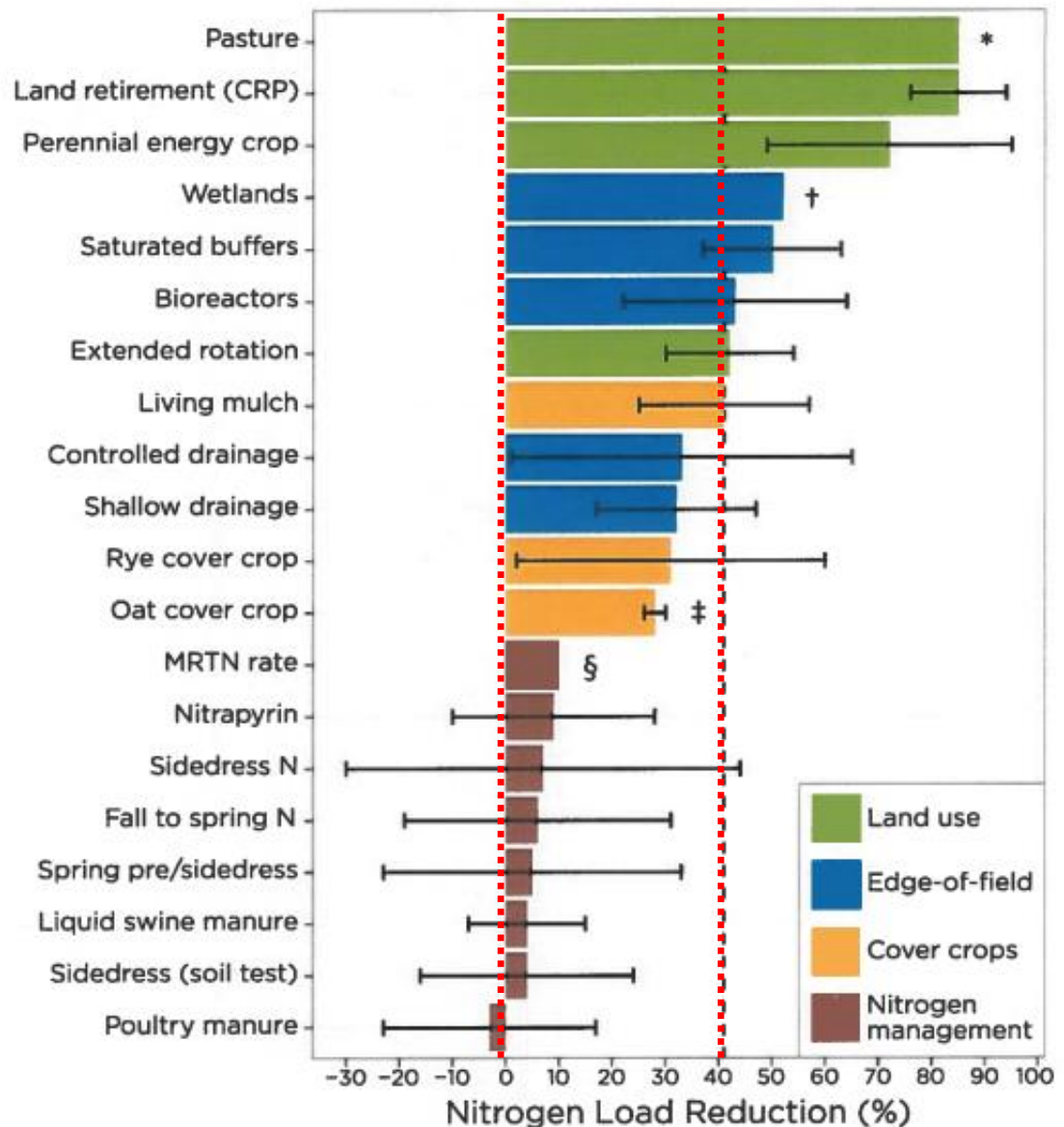
Average nitrate-nitrogen concentration or load reduction as a percentage. Error bars represent one standard deviation above and below the mean.

* 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.



ALL TOO COMMON



DON'T FARM NAKED



PLANT COVER CROPS



PRACTICAL *farmers*
of Iowa



WIN – PFI Corn/Soybean Farmer Members

(~1400/3300)

73% Use/Added Cover Crops

50% Use/Added Small Grains



WIN – Private Cover Crop Cost Share

Sustainable Soy



PEPSICO



GOALS

26,000 A of cover crop scaling to
188,000 A by 2023



WIN – Crop Insurance Premium Discount



www.iowaagriculture.gov



United States Department of Agriculture
Risk Management Agency

- Three Year Pilot
- **\$5/A** of cover crop discounted from crop insurance premium
- Year 1 **165,000A** signed up

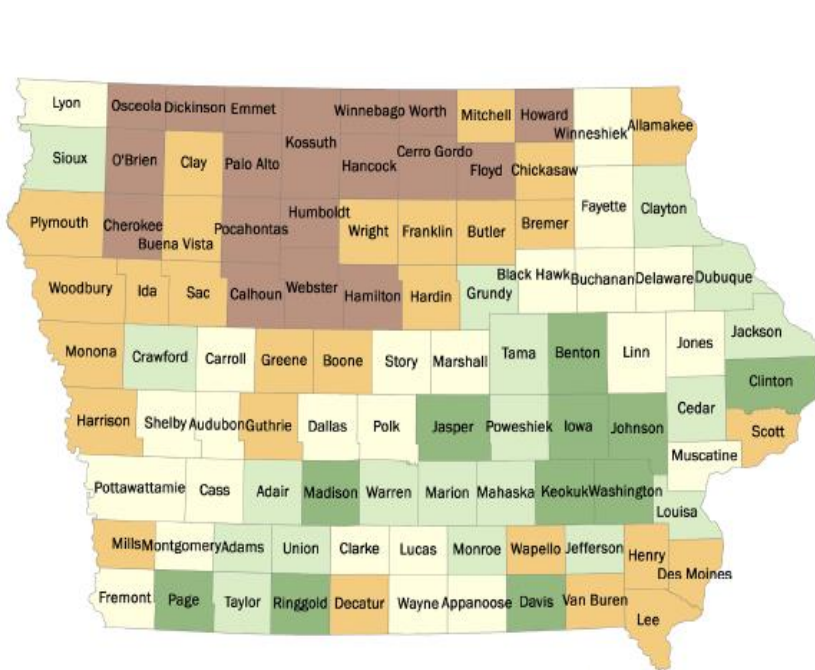


Win – Mapping Cover Crops in the “I” States: ‘15 – ‘16

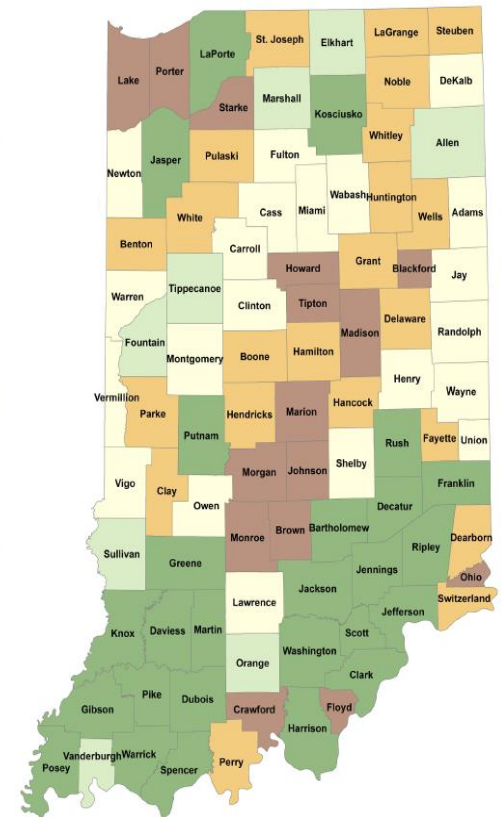
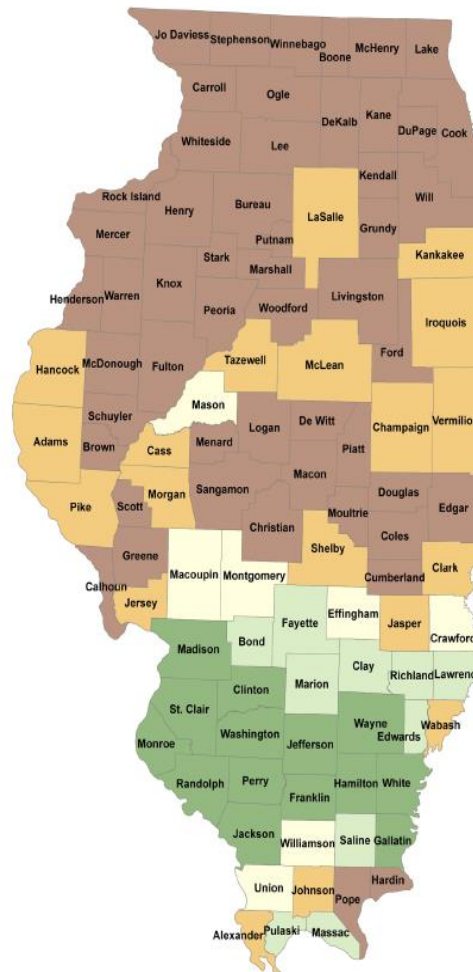
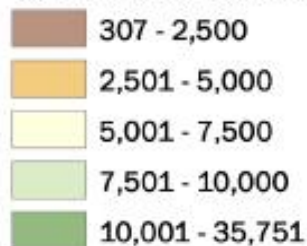
Iowa – 591,880A

Illinois – 488,626 A

Indiana – 794,724A

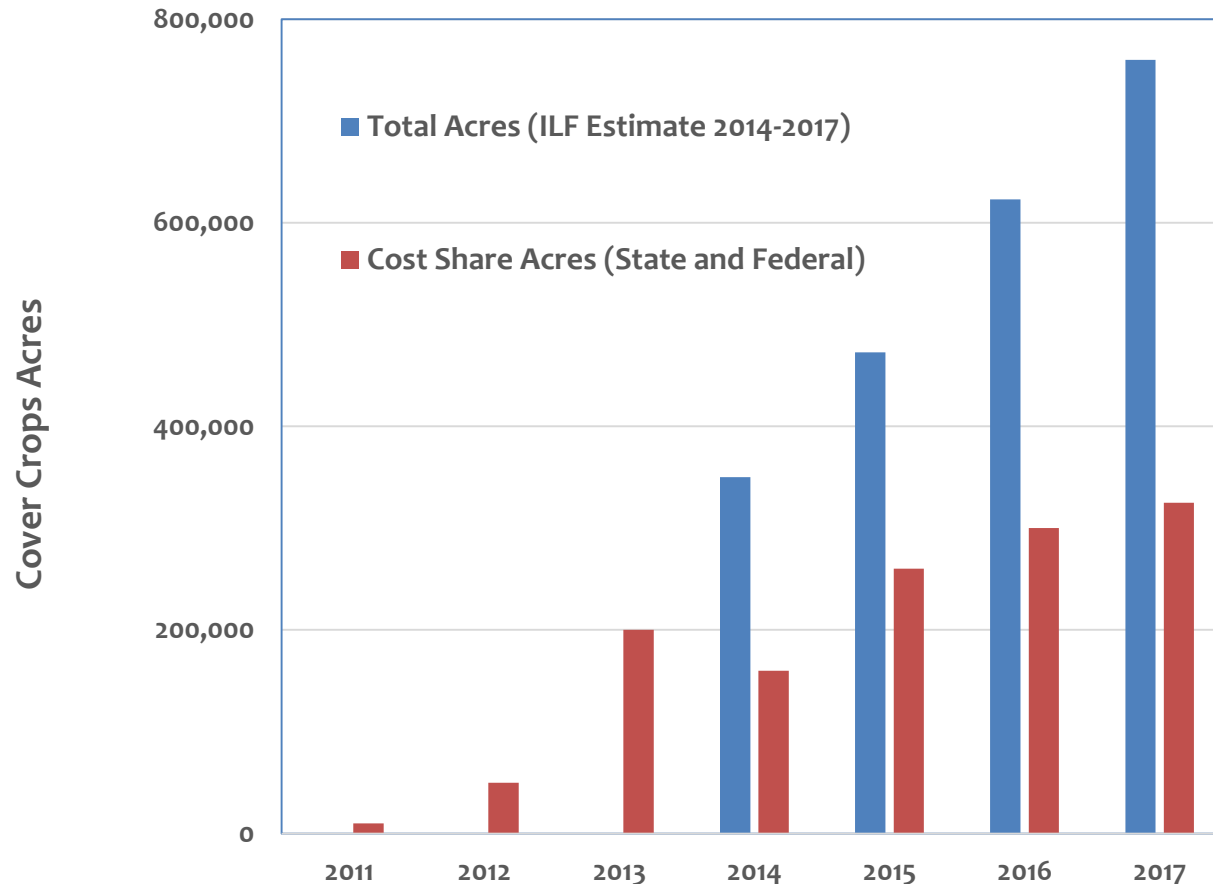


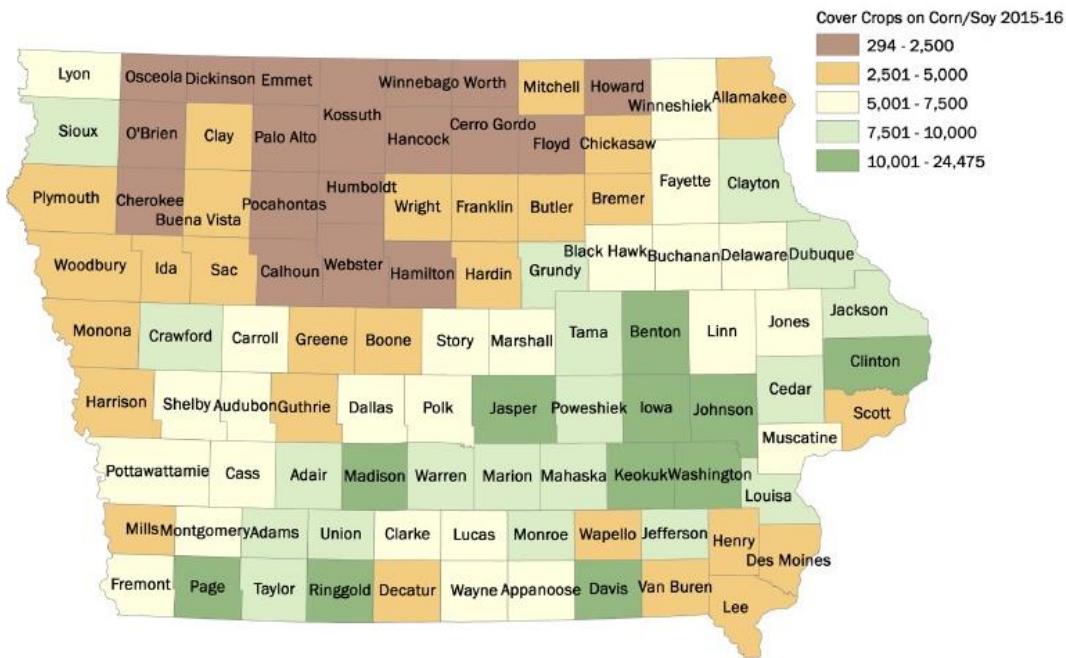
Cover Crops on Corn/Soy 2015-16



Win – Cover Crops Acres

760,000 A statewide in 2017





Iowa Cover Crop Acres 2015 – 2016

***“\$30-\$35/A cover crop cost protects
a \$5000-\$10,000/A asset.”***

- Iowa farmer new to cover crops

Final NCR-SARE Project Report:

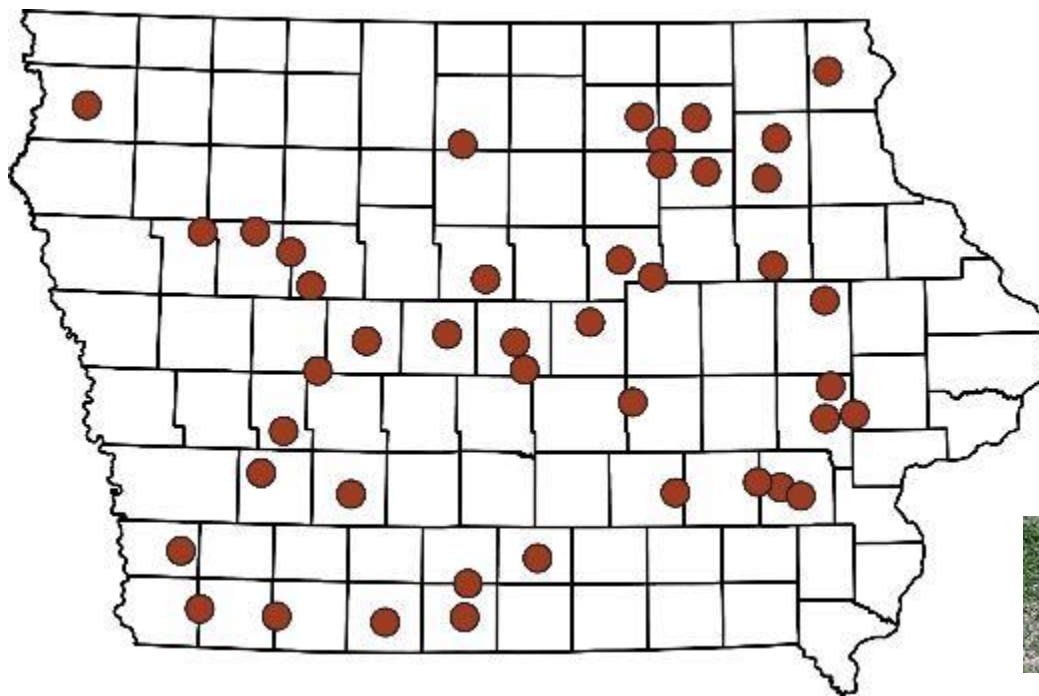
<https://projects.sare.org/project-reports/lnc15-375/>



Make Cover Crops Pay on your Farm

Farmer-led Research Results from PFI's Cooperators Program

1. Control Cover Crop Costs
2. Control Herbicide Costs
3. Avoid Cover Crop Establishment Failures
4. Avoid Redundant Expenses
5. Avoid Corn Yield Drag
6. Realize Soybean Yield Gains
7. Feed Cover Crops



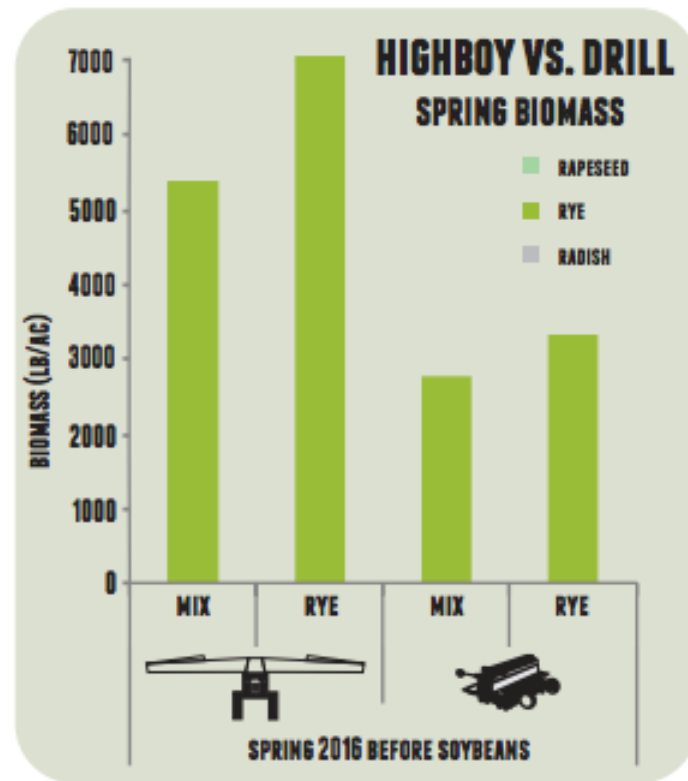
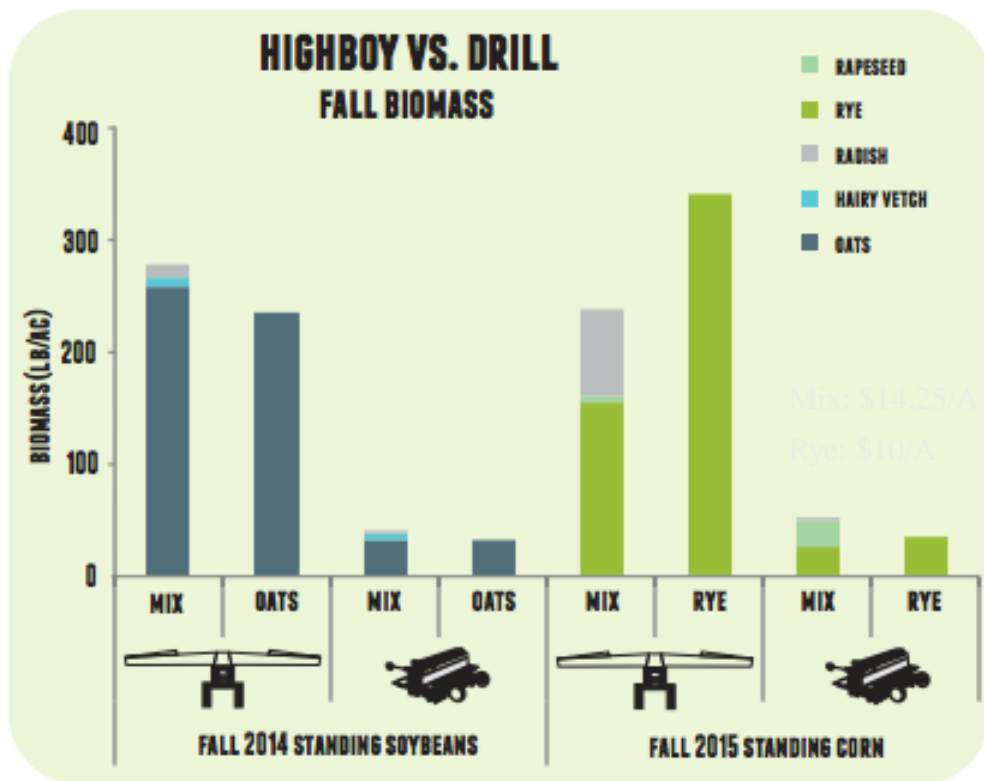
54 COOPERATORS TOOK PART IN **77** RESEARCH TRIALS
IN 2018



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FARMER-LED RESEARCH



1. Control Cover Crop Costs



Spring Nitrate Reduction and Seed Cost

23% Oats \$8/A

19% Oat Mix \$32/A

61% Rye \$10/A

48% Rye Mix \$14.25/A



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Cover Crop Variety Trial

- 49 cover crop entries
- 10-16 locations
- 5 years



GRASS:
Cereal Rye



BRASSICAS:
Rapeseed



LEGUMES:
Hairy Vetch



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Choosing a Cover Crop Species

Early Harvest (by Sept. 10)



Grass



Brassica



Legume

Late Harvest (after Sept. 30)
Aerial Seeding



Grass



Brassica

Late Harvest (by Sept. 30)
Drill Seeding



Grass



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**60" wide corn spacing accommodates all*

2. Control Herbicide Costs

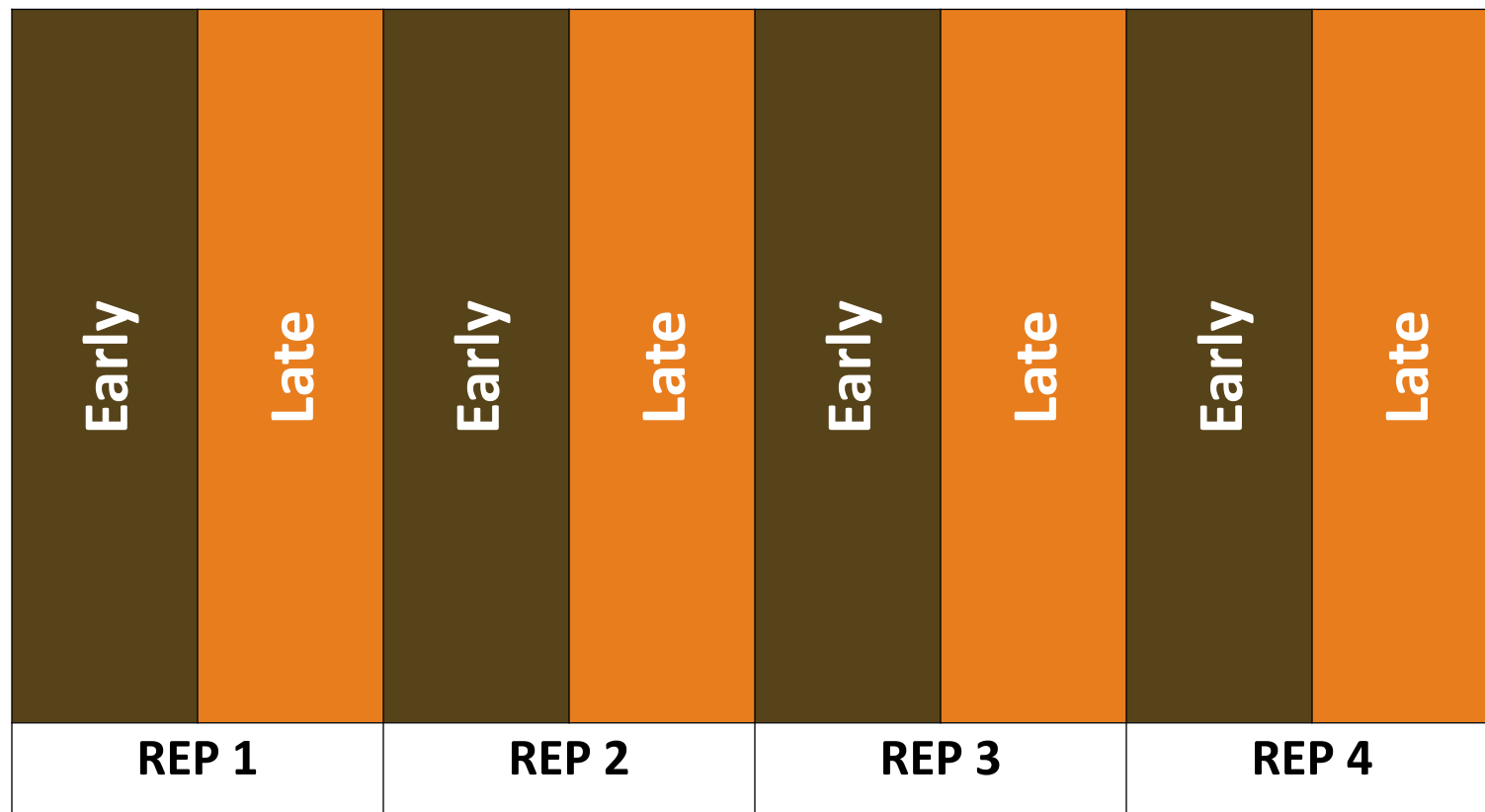


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Early vs. Late termination comparison

On-farm research design



Early = ~10 days prior to planting soybeans

Late = within 1 day of planting soybeans

Seeding soybeans into >7,000lb/ac cc



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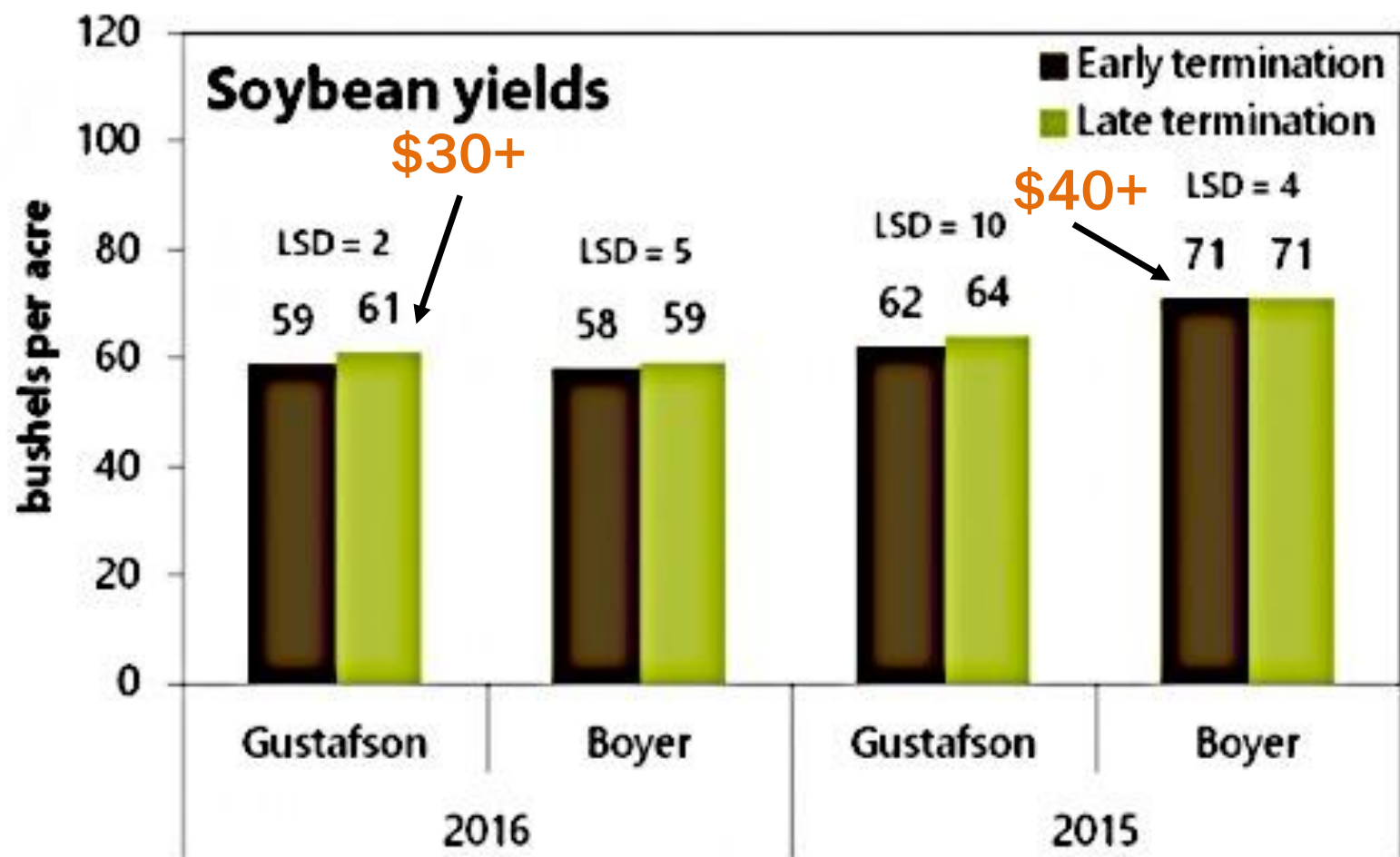


Mid-season “mulch” at Jeremy Gustafson’s on Aug. 6, 2016. Jeremy was able to eliminate two weed control passes in the late termination treatment.



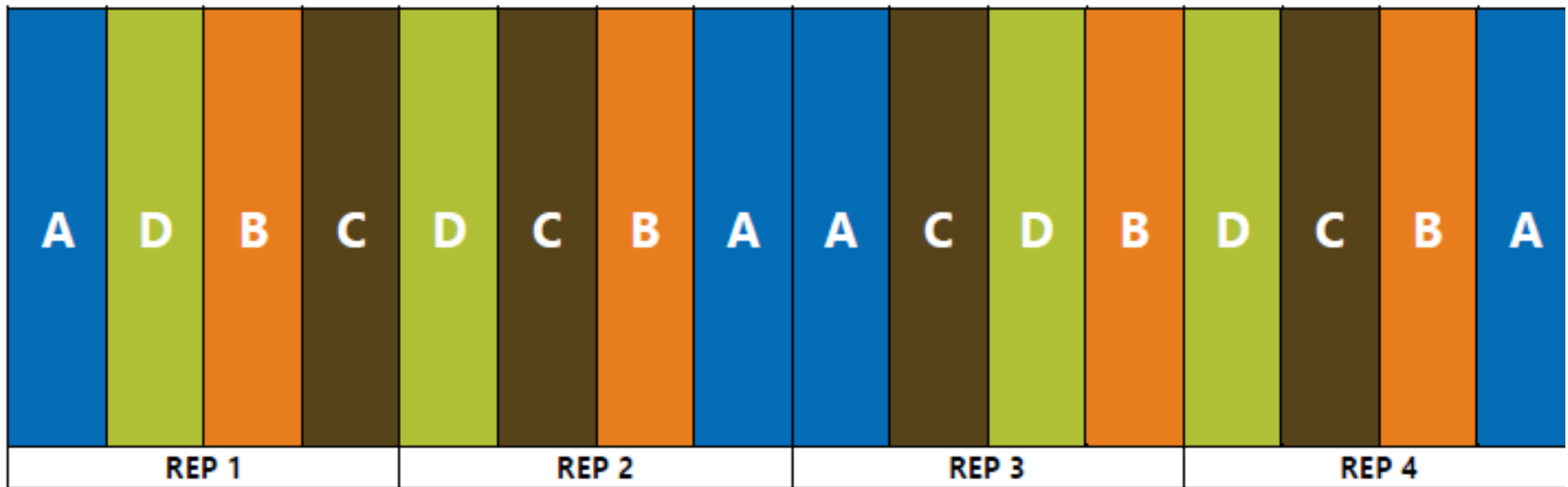
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Soybean yields for the early and late cover crop termination treatments at Jeremy Gustafson's and Jack Boyer's in 2016 and 2015. The least significant difference (LSD) at the $P \leq 0.05$ level is indicated above each pair of mean columns for both 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.

Trt	Cover crop?	Herbicide Program
A	No	Full program
B	Yes	Full program
C	Yes	Reduced-cost program
D	Yes	No-residual program





Treatment	Cost (\$/ac)	Revenue (\$/ac)*	ROI (\$/ac)
No-cover, full program	35.48	693.60	658.12
Cover, full program	66.73	667.59	600.86
Cover, reduced program	55.93	693.60	637.67
Cover, no-residual	44.60	693.60	649.00

*Soybean price = \$8.67/bu (Nov. 13)



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3. Avoid Cover Crop Failures

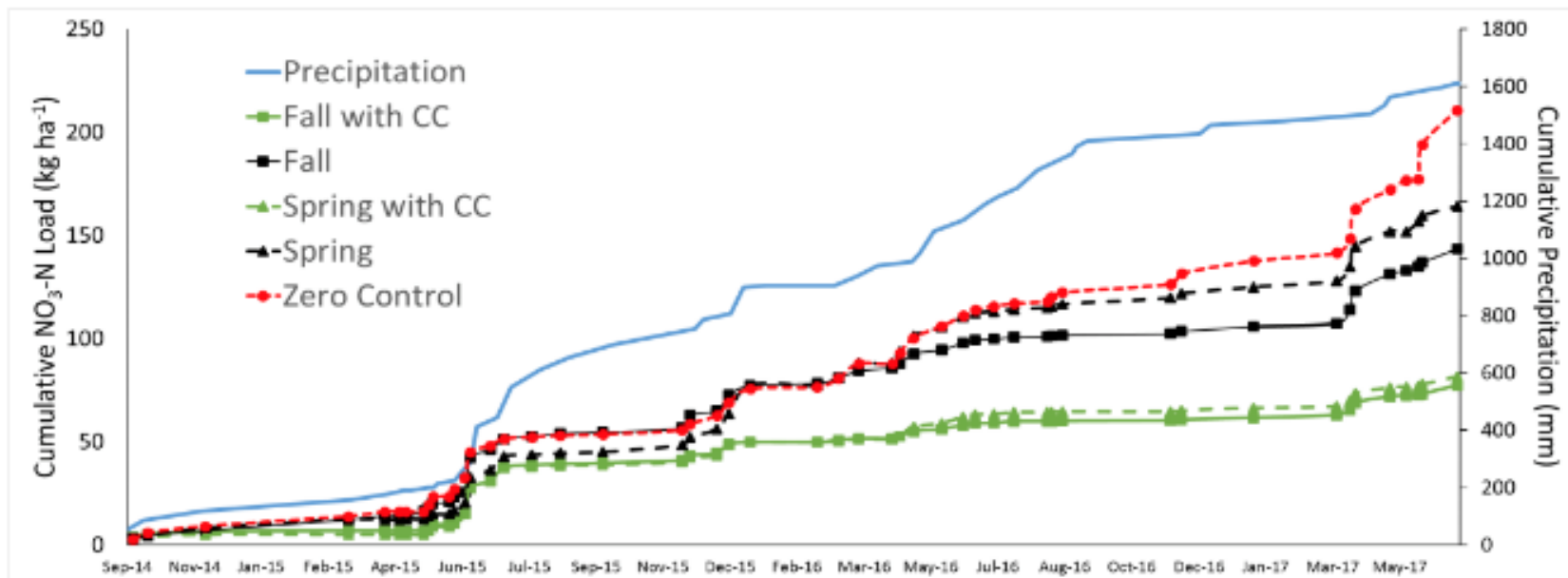
- Check herbicide label for potential carryover & grazing restriction
- Cereal rye only affected by 2x Dual II Magnum
- Vetch, lentil, and radish affected by:
 - Balance Flexx, Corvus, & Hornet
- Atrazine, Callisto, & Laudis caused no injury



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4. Avoid Redundant Expenses

Fall Nitrogen Stabilizer vs. Cover Crop



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



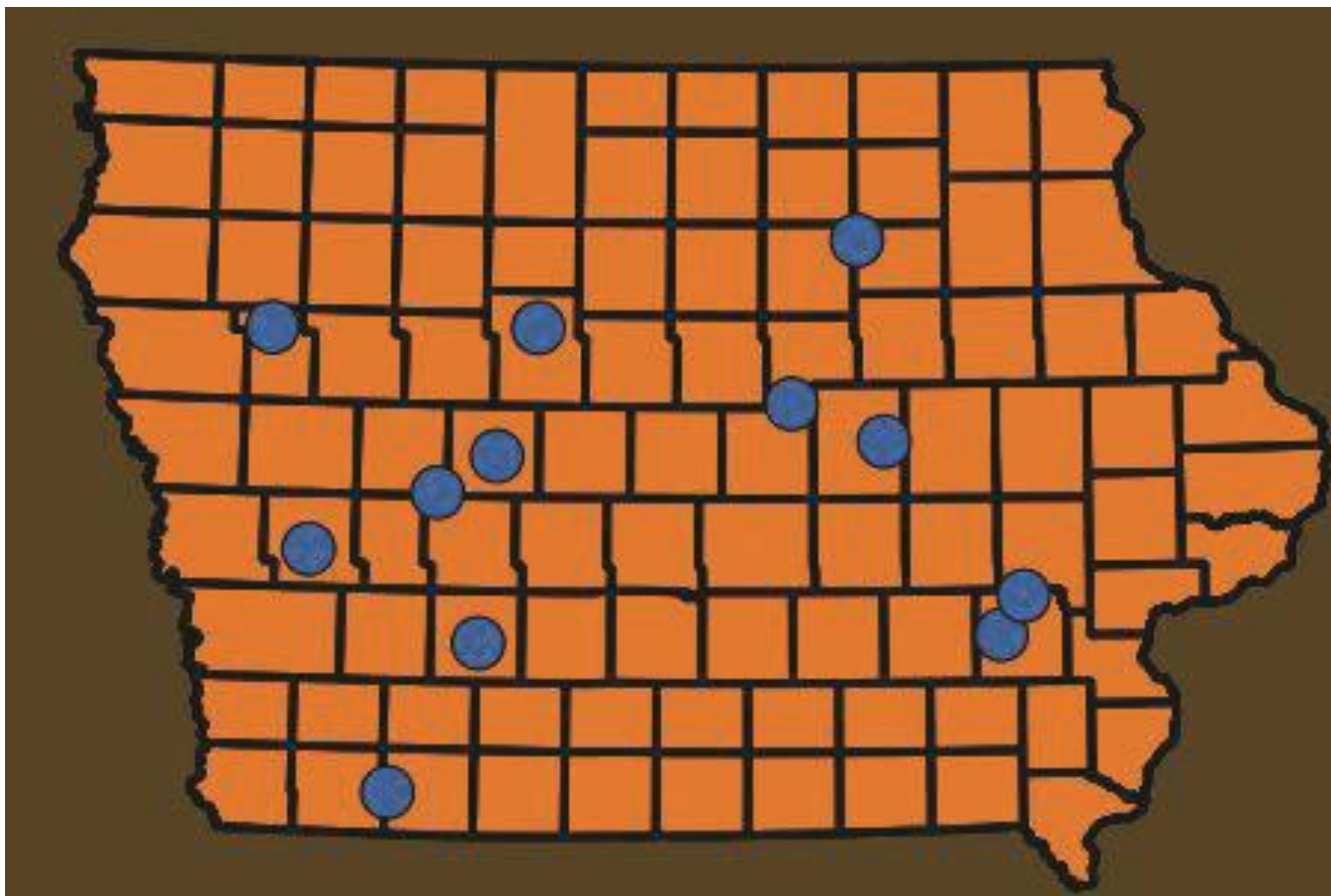
5. Avoid Corn Yield Drag



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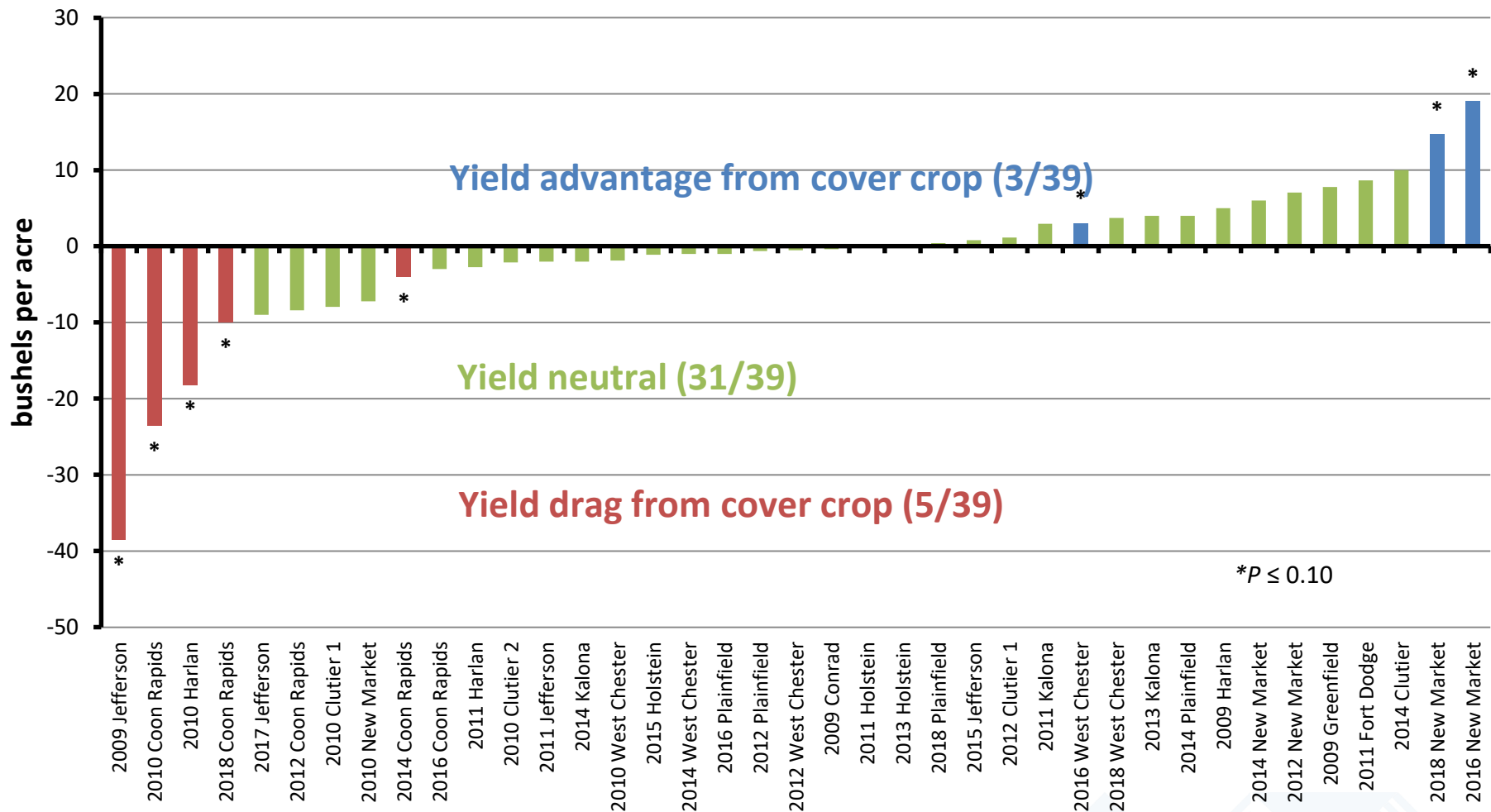
FARMER-LED RESEARCH

12 participating farmers from 2008 – 2018



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Apply Sufficient N at Planting



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Reduce Corn Seedling Disease Potential

Cover crops and seedling disease



Winter rye hosts corn pathogens

Bakker et al. 2017 *Phytopathology* 106:591



Pythium populations increased as rye roots senesced

Bakker et al. 2017 *Phytobiomes* 1:



Cover crop termination & corn seedling disease

Treatment 2015	Root rot incidence (%)	<i>Pythium</i> incidence (%)	<i>Fusarium</i> incidence (%)
No rye, check	8.3 b	2.8 c	61.1
Rye, spray 21 DBP	25.0 b	19.4 b	69.4
Rye, spray 14 DBP	25.0 b	13.9 bc	47.2
Rye, spray 10 DBP	80.6 a	38.9 a	75.0
Rye, spray 3 DBP	80.6 a	19.4 b	77.8
Rye, spray 1 DAP	83.3 a	25.0 b	50.0
<u>Pr</u> > F	<0.01	<0.01	0.25

IOWA STATE UNIVERSITY
Extension and Outreach

Acharva et al. 2017. Plant Disease 101:591

Iowa Nutrient Research Center

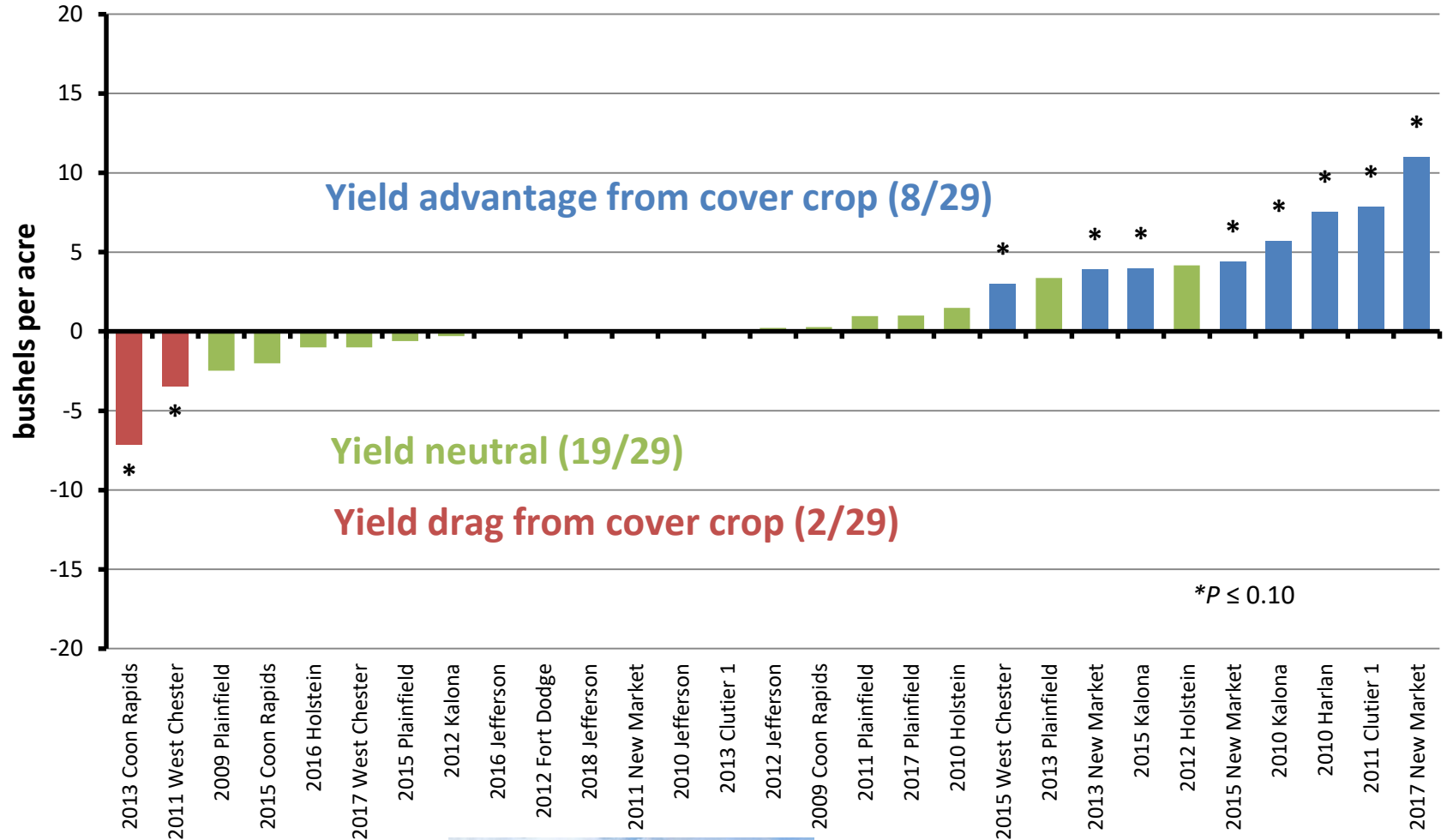
Camelina showed no increased *Pythium* incidence



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6. Improve Soybean Yield



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Cover crops and soil health

- Tea Bag
- Soil Decomposition Index



Red tea
(difficult to decompose)

Green tea
(easy to decompose)

- Index =
$$\frac{\% \text{ red tea decomp.}}{\% \text{ green tea decomp.}}$$



Dr. Marshall McDaniel, ISU



Teresa Middleton, ISU

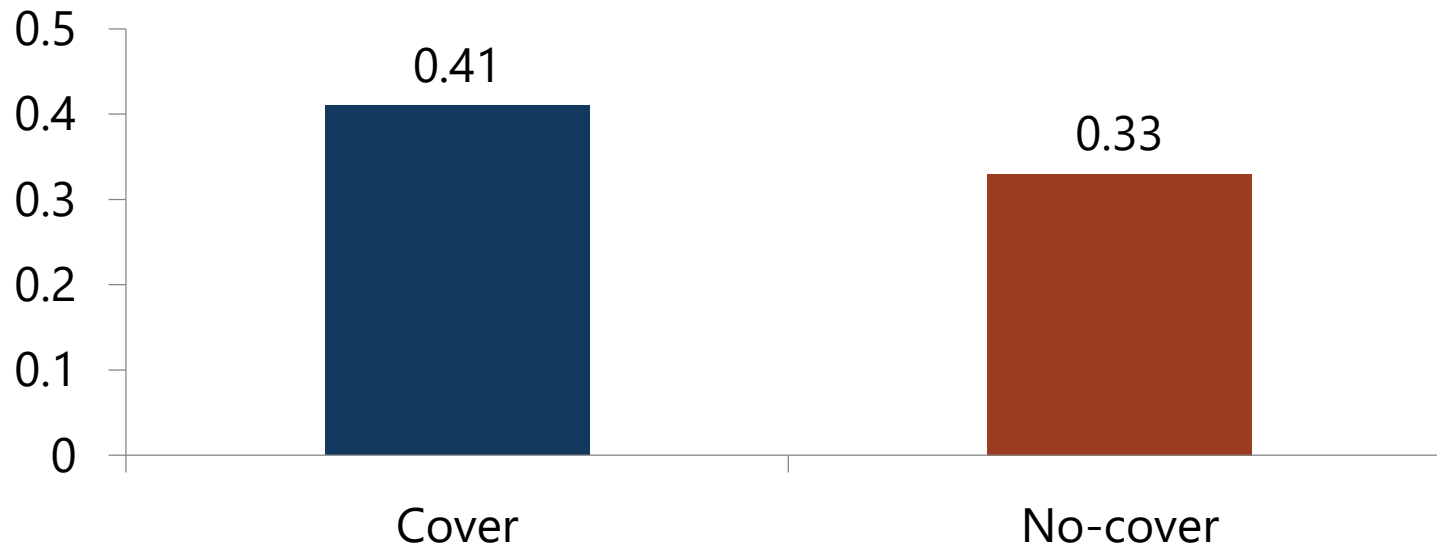


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Cover crops and soil health

Soil Health Index -- Stout Farm



- The closer to 1.00, the healthier the soil.
- Soil under the cover crop was better able to decompose the red tea (e.g., more microbial activity).



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7. Feed Cover Crop

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							



<https://www.extension.iastate.edu/agdm/crops/xls/a1-91economicsofcovercrops.xlsx>



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FARMER-LED RESEARCH

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

cover crops need to pay today!



Get Started:

- <https://www.card.iastate.edu/conservation/>
- Join Practical Farmers of Iowa
- Attend PFI Annual Conference at Scheman
January 18-19, 2019
- sarah@practicalfarmers.org or 515-232-5661



Cover Crop Decision Tree



Cover Crop Decision Tree



Seeding Rate Recommendations

based on pure live seed (PLS)

	Drilled/planted before Sept. 15	Aerial or High-clearance overseeded ~Aug. 15-Sept. 15	Drilled/planted after Sept. 15
Small Grains			
Winter cereal rye*	~55 lb/ac	60-75 lb/ac	60-75 lb/ac ¹
Winter triticale**	~55 lb/ac	60-75 lb/ac	60-75 lb/ac ¹
Winter wheat**	~55 lb/ac	60-75 lb/ac	60-75 lb/ac ¹
Winter barley***	~60 lb/ac	60-75 lb/ac ¹	X
Oats***	~60 lb/ac	60-75 lb/ac ¹	X
Cool-season grass			
Annual ryegrass**	~15 lb/ac	~20 lb/ac	X
Brassicas (must be planted with grasses)			
Rapeseed**	3-4 lb/ac	4-6 lb/ac	X
Brown mustard***	3-4 lb/ac	4-6 lb/ac ¹	X
Oilseed radish***	3-4 lb/ac	4-6 lb/ac ¹	X
Turnips***	3-4 lb/ac	4-6 lb/ac ¹	X
Legumes			
Hairy vetch**	15-20 lb/ac	X	X
Common vetch**	15-20 lb/ac	X	X
Winter lentil**	50 lb/ac	X	X
Winter pea**	60 lb/ac	X	X

When using a mixtures be sure to check applicable seeding rates or talk to your retailer.

* = should not winterkill ** = could winterkill *** = will winterkill X = not recommended for this time and planting

¹ If receiving cost-share through government programs, please see USDA-NRCS Agronomy Technical Note 38: Cover Crop Management at tinyurl.com/IANRCS38CCRecs for NRCS recommended rates.

If growing cover crops for livestock forage, use upper range of seeding rates and see: tinyurl.com/PFICornHerb-CC-Grazing and tinyurl.com/PFISoyHerb-CC-Grazing

Cover Crops and Heat Units

Legumes and brassicas need more heat units than small grains to be effective.

The number of heat units (base 50°F) remaining in Iowa declines dramatically throughout the month of September:

After Aug. 1: 1,385

After Sept. 1: 707

After Oct. 1: 246

Minimum Germination Soil Temperatures

Cereal rye: 34°F

Other small grains: 38°F

Annual ryegrass: 40°F

Mustard/Rapeseed: 40°F

Turnip/Radish: 45°F

Vetches: 60°F

Lentils/Pea: 41°F

Source: Midwest Cover Crops Field Guide: 2nd Edition