2017 Final Report Summary Sheet

Grantee Information

Project Title: Cereal Rye Ahead of Corn: N Catch and Release

Institution: University of Illinois

Primary Investigator: Gentry

NREC Project # 2017-3-360350-314

Is your project on target from an IMPLEMENTATION standpoint? ☐ Yes ☐ No

If you answered "no" please explain:

Is your project on target from a BUDGET standpoint? ☐ Yes ☒ No

If you answered "no" please explain:

We were able to save money on Agri Drain installations and flow monitoring equipment. We also saved $4000 because we did not sample soil at harvest due to very dry soil conditions. If we carry a balance surplus through this year, we will credit it in 2019 and reduce the renewal budget accordingly.

Based on what you know today, will you meet the objectives of your project on-time and on-budget? ☒ Yes ☐ No

If you answered "no" please explain:

Have you encountered any issues related to this project? ☐ Yes ☒ No

If you answered "yes" please explain:

Have you reached any conclusions related to this project that you would like to highlight? ☒ Yes ☐ No

If you answered "yes" please explain:

- Cereal rye growth and N uptake was increased with fall anhydrous ammonia application.
- Cereal rye accumulated approximately 40% of the fall fertilizer N.
- Cereal rye biomass doubled in 11 days accumulating 150 GDD's from April 2-13.
- A full N application in the spring one month prior to corn planting produced the greatest corn yields.
- Our preliminary data suggest that terminating cereal rye early in the spring will be critical when proceeding corn.

Have you completed any outreach activities related this project? Or do you have any activities planned?

☒ **Yes** ☐ **No**

If you answered "yes" please explain and provide details for any upcoming outreach:

This information was presented at 3 meetings last year and at the national Agronomy meetings in FL.

2017 Annual Report for NREC Project

Cereal Rye Ahead of Corn: N catch and release

Lowell Gentry, Dan Schaefer, and Emerson Nafziger
University of Illinois at Urbana-Champaign

Synopsis:

Preliminary results from our currently funded NREC projects demonstrate that cereal rye after corn has great potential to take up soil nitrate, thereby decreasing nitrate concentrations and loads in tile drainage water; however, can we grow cereal rye ahead of corn and get the same soil health and water quality benefits without jeopardizing corn yields? Cereal rye has been shown to negatively affect corn yields and a number of factors likely contribute such as N immobilization, allelopathy, soil moisture and temperature, and disease. Unfortunately, our results have shown that a radish and oat mixture following corn did not produce sufficient biomass or accumulate enough N to affect tile nitrate loss. Therefore, we believe that it is critical to develop a system's approach to overcome the yield depression associated with cereal rye ahead of corn. The main objective of this study is to learn how to best manage cereal rye as a winter cover crop before corn in either a corn/soybean rotation or in continuous corn. Our experimental design will accommodate three corn N fertilizer treatments (fall split vs. spring vs. side-dress split) with and without cereal rye and also with three spring cover crop termination dates (approximately 2 weeks apart). This approach will allow us to investigate N release from the cover crop under various N fertilizer regimes and to evaluate N immobilization vs. allelopathy in regard to negative cover crop effects on the subsequent corn crop. In addition, soil sampling and early season corn growth measurements will provide evidence as to what soil N pool was accessed by cereal rye. We hope this study can identify the combination of management practices that generates sufficient cereal rye growth to attain the numerous benefits and ecosystem services provided by the cover crop and still produce maximum corn yield.

Objectives:

The main objective of this study is to learn how to best manage cereal rye as a winter cover crop before corn in either a corn/soybean rotation or in continuous corn. Our experimental design will accommodate three corn N fertilizer treatments (50% fall/25% planting/25% side-dress; 100% spring pre-plant; 25% planting/75% side-dress) with and without cereal rye and three spring cover crop termination dates (approximately 2 weeks apart). This design will allow us to investigate N release from the cover crop under various N fertilizer regimes and to evaluate N immobilization vs. allelopathy in regard to negative cover crop effects on the subsequent corn crop.

Length of Project:

This project has completed the 1st year of funding.

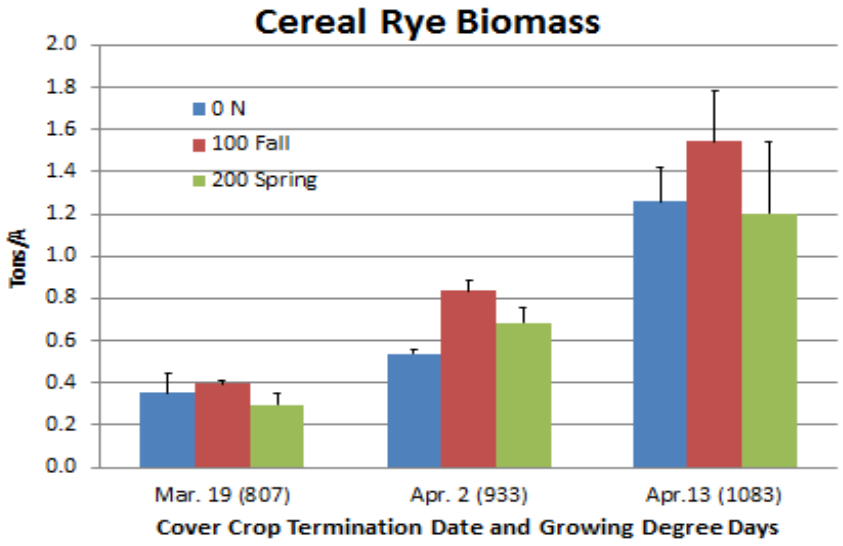
Field Operations:
Field work was timely at this site. Dry summer conditions created crop stress, but corn yields were surprising good.

- Oct. 18, 2016: Cereal rye planted
- Nov. 1, 2016: Fall N fertilizer applied and strips made
- Mar. 9, 2017: Spring N fertilizer applied and strips made
- Mar. 19, 2017: Termination of cereal rye (T1); biomass collected
- April 2, 2017: Termination of cereal rye (T2); biomass collected
- April 13, 2017: Termination of cereal rye (T3); biomass collected; and soil sampled for inorganic N
- April 14, 2017: Corn planted

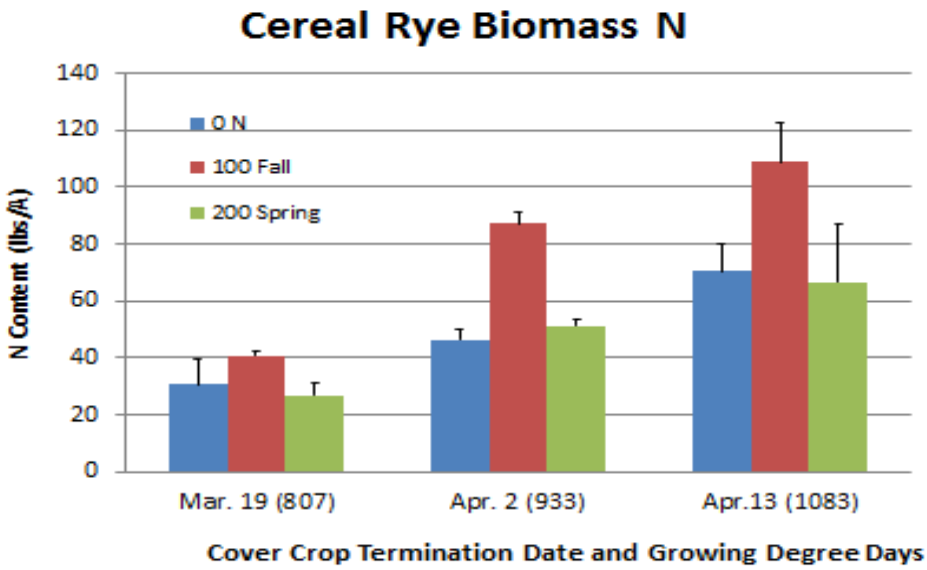
- May 16, 2017: Side-dress N applied
- June 5, 2017: V7 corn biomass harvest
- June 6, 2017: Soil sampled for inorganic N
- Sept. 23, 2017: Corn harvest
- October 18, 2017: Cereal rye planted
- November 1, 2017: fall anhydrous applied and strips made

Results:

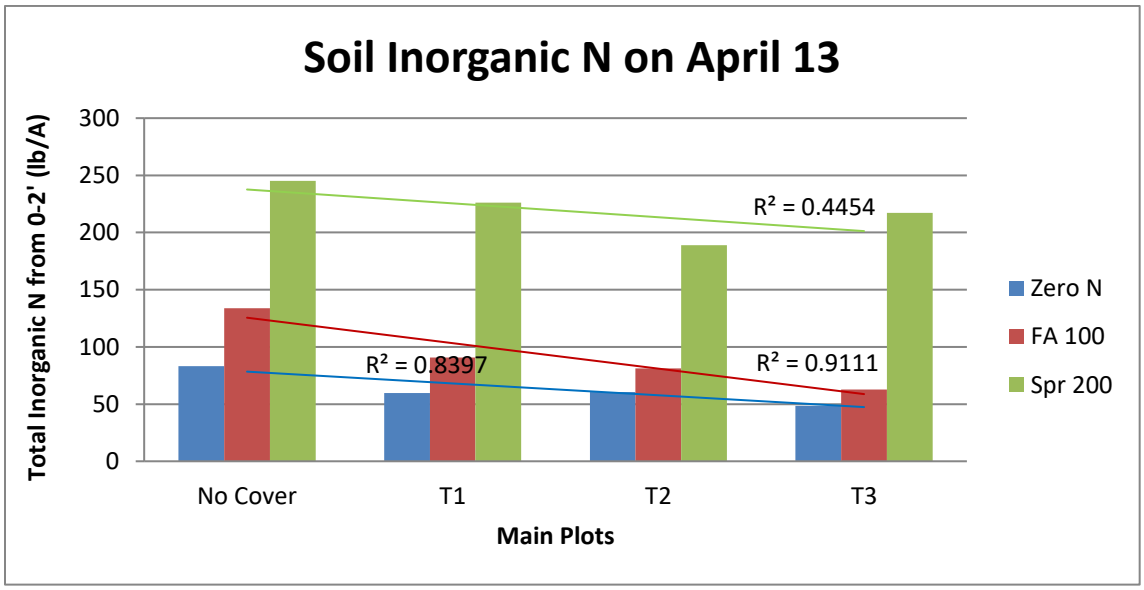
Cereal rye biomass production was excellent this past winter and spring; as temperatures were mild and rainfall abundant. Fall N application increased above-ground biomass production of cereal rye at the later termination dates. **Note**: treatments are labelled on the graphs in reference to how much N had been applied prior to corn planting: 0 N = (25% planting/75% side-dress); 100 Fall = (50% fall/25% planting/25% side-dress); and 200 Spring = (100% spring pre-plant). Error bars designate standard deviations.



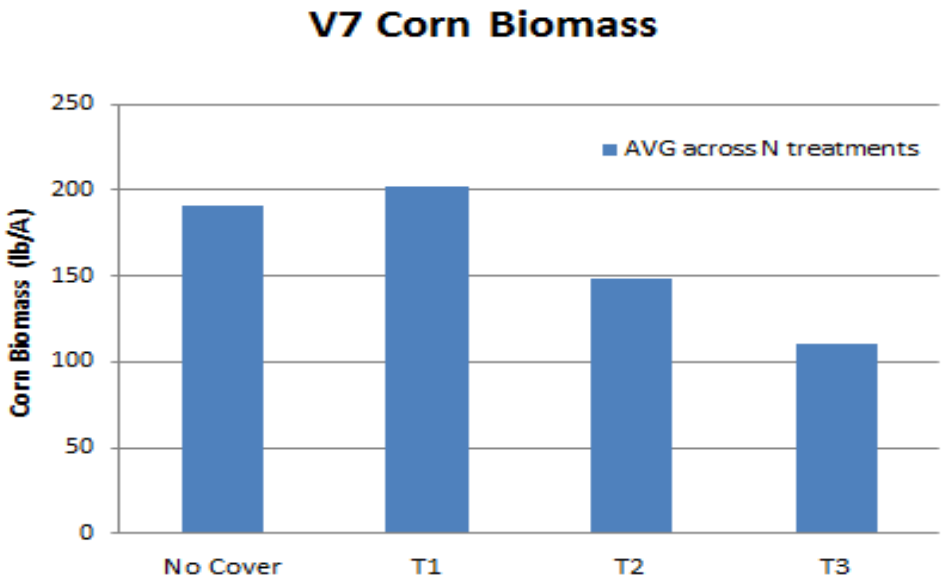
Accumulation of growing degree days was well above average this past winter and spring and cereal rye was in boot stage when terminated on April 13.



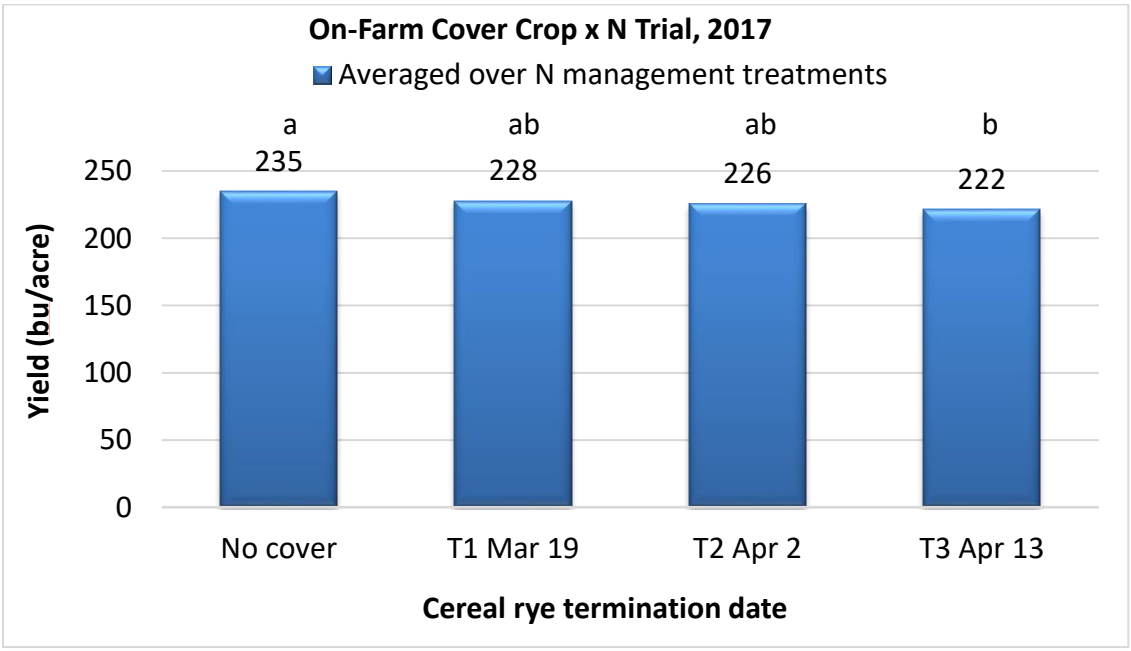
Total above ground biomass N of cereal rye was greatly increased by fall N application, reaching a high of 110 lb/A at T3 (April 13). We found approximately 40% of the fall N application in the above ground biomass of cereal rye at the latest termination date.



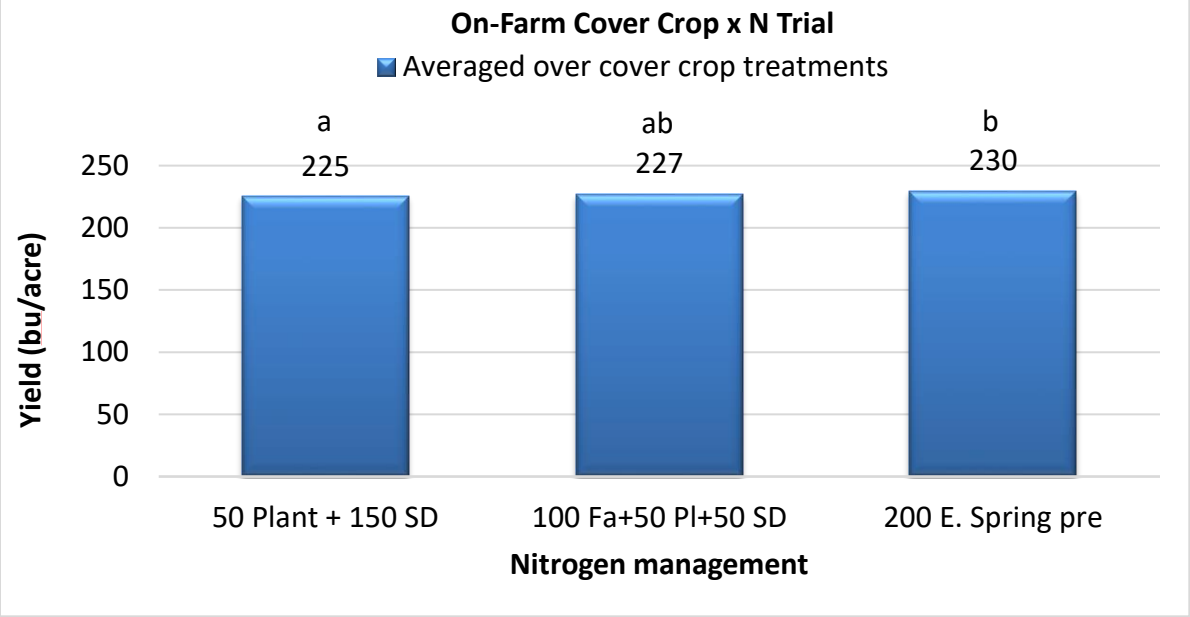
Soil inorganic N in the top 2 feet of soil was greatest for the No Cover treatments and declined with cover crop growth. Plots that received fall N showed the greatest decline in inorganic N suggesting uptake of the fertilizer by the cereal rye.



When corn grown without cereal rye (No Cover) reached the V7 growth stage (52 days after planting), we harvested corn above ground biomass. There was no difference in corn biomass between the No Cover and the T1 (March 19) treatments; however, early corn growth was negatively affected by the later cover crop termination dates. Corn biomass was 25 to 40% less in the T2 and T3 treatments and corn growth was delayed as T2 and T3 treatments were at the V5 to V6 stage.



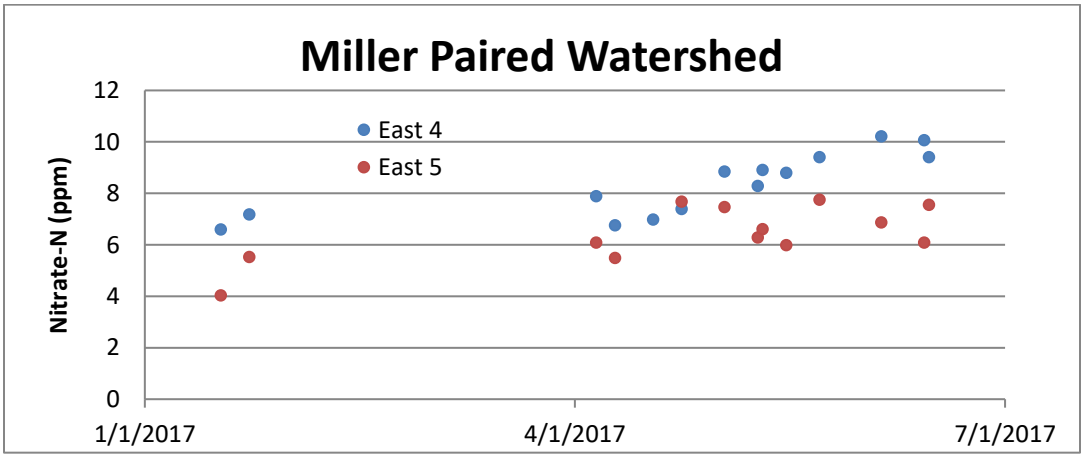
Corn grain yields averaged over N management systems ranged from 222 to 235 bu/A. Cover crop treatments significantly reduced corn yields compared to the No Cover treatment.



Corn grain yields averaged over cover crop treatments (including No Cover) were in a tight range but showed significant differences among N systems. We found that a full rate application of anhydrous N in the spring one month prior to planting corn produced the greatest corn yields. Waiting to apply N as a starter at planting followed by a side-dress application produced the least corn yield.

Piatt County Study:

At the Piatt County farm of Eric Miller, we planted corn across a pair of adjacent tile systems this year. Following corn harvest, cereal rye was planted on Oct. 31 on the south field (East-5) of the pair. We will use the 3-way split application (50% fall/25% spring/25% side-dress) for the N system. Both fields received 100 lbs/A of anhydrous ammonia on Nov. 24, 2017. These strips will be freshened in the spring and planted to corn.



Baseline data shows that Tile East-5 has a little higher nitrate concentration than the corresponding tile (East-4). These two fields were managed exactly the same (1st year corn) this summer; however, a slight difference in tile nitrate exits. This demonstrates the importance of gathering baseline data prior to treatment initiation in a paired watershed/field study.

Highlights in 2017

- Cereal rye growth and N uptake was increased with fall anhydrous ammonia application.
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Outreach:

Part of this information was presented by Lowell Gentry at 3 meetings in Illinois in 2017 (Champaign County Farm Bureau, June 23; NREC meeting and in Princeton, June 27; Douglas County NRCS, July 12). This entire dataset was presented at the Annual Meetings of the ASA/CSSA/ SSSA in Tampa FL, October 24.

2017 Project Budget ($43,987):

Expenditures		
Salary & Wages	$5,113	
Fringe Benefits	$1,933	
Materials and Supplies	$7,823	
Equipment (ISCOs)		$0
Travel		$896
Services	$1,921	
U of I Indirect Cost		$1,963
Total		$19,649
Balance	$24,338	

We saved approximately $3000 on equipment because the owner had paid and installed the two Agri-Drain structures and we recycled two pressure transducers (Solinst, Inc.) from a recently concluded study. We saved $4000 because we did not sample soil at harvest due to very dry soil conditons at this site. Also, we have yet to purchase the trialer to haul our Gator because Dan Schaefer has let us borrow his personal trailer. We will either buy his trailer or purchase our own this year. In addition, there is a $2500 encumberance for a purchase order that we have not used yet for corn grain analysis. If we carry a balance surplus through this year, we will credit it in 2019 and reduce the renewal budget accordingly.

We thank NREC for their support of this new study. Overall, we are very excited about our preliminary results and believe this study can greatly add to our understanding of the challenges of successfully using cereal rye ahead of corn.