2021 Final Report Summary Sheet

Grantee Information

Project Title: Next Generation Cover Cropping in Corn-Soybean Rotation to Improve Farm Benefits and Decrease Environmental Losses in South and Central Illinois

Institution: Southern Illinois University Carbondale

Primary Investigator: Amir Sadeghpour, Andrew Margenot, Jon Schoonover, Karl Williard, Karla Gage, Shalamar Armstrong

NREC Project # 2021-4-2061150-303

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:

The project is going as planned. Since most of our samples were collected at the end of the season we requested a no-cost extension for both SIU and U of I.

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:

Please see our response to the previous section.

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:

To accommodate interseeding we established a new herbicide protocol and assessed whether that half a rate of residual herbicide vs. full herbicide management would impact the establishment of cover crops and corn yield. We found that corn yield was not impacted by presence of cover crops and that cover crops emerged under full and half rate herbicide protocols. This requires further evaluation as we move forward with our project.

We also tested a hybrid rye as a supplemental trial to assess inclusion of a new easily decomposable rye vs. typical rye cover crops that resulted in greater biomass and nutrient removal. Hybrid rye decomposed similar to typical rye and did not improve the following corn yield. This will be re-evaluated for another year.

Also, from the initial data collected as preliminary data to write the proposal, we have published an article:

Journal Articles:

Sadeghpour, A., O. Adeyemi, D. Hunter, Y. Luo, S. Armstrong. 2021. Precision planting impacts on winter cereal rye growth, nutrient uptake, spring soil temperature, and adoption cost. Renewable Agriculture and Food Systems (In publication process).
https://doi.org/10.1017/S1742170520000411

We are working on two separate manuscripts to compare skipping the corn row (STCR) practice with normal planting on (1) winter cereal rye forage production potential (if harvested) and (2) corn N requirement. Data on corn N requirement was presented at the ASA-CSSA-SSSA meeting in 2021 and a brief summary of that is reported here.

Sadeghpour. A, O.R. Zandvakili, O. Adeyemi, D. Hunter, S. Armstrong. 2021. Precision Planting of Winter Cereal Rye Impacts Corn Yield and Nitrogen Requirement. ASA, CSSA, SSSA, Salt Lake City, UT, November 7-10 [Invited Talk].

Kula, C., G. Sener, C. Vick, A. Sadeghpour. 2021. Decomposition of winter cereal rye influenced by hybrid, seeding rate, and soil type. ASA, CSSA, SSSA, Salt Lake City, UT, November 7-10 [Poster].

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:

Sadeghpour, A., J. McGrath, J. Schoonover, K. Williard 2021. Precision nitrogen management of corn; next generation of cover cropping. Nutrient Research and Education Council Field Day, Carbondale, IL. July 9.

Sadeghpour, A. 2021. Cover crop management prior to corn. Belleville Research Center Field Day, Belleville, IL. July 8.

The main objective of this proposal is to evaluate the efficacy of precision cover crop management to optimize agronomic and environmental ecosystem services within the Illinois growing environments. Specifically, we will evaluate altering **planting dates by interseeding** and use precision planting of cover crops to skip the corn/soybean row – known as **"skip row" planting** and evaluate whether **"skip row"** allows for **delayed termination** of cover crop mixtures. Within this main objective, our proposal aims to:

1) Assess the efficacy of interseeder technology for timely cover crop establishment of legumes and winter cereal in Illinois growing environments
2) Determine the impact of clover/rye mixture establishment and termination date on cover crop N uptake, soybean and corn yield and following cash crop production in rotation
3) Evaluate the influence of interseeded, skip row, and conventional cover crop planting and termination date on nitrate leaching in a corn-soybean rotation relative to intensified **cash cropping systems**
4) Assess soil health and economic benefits of each cover cropping systems vs. intensified cash cropping over time
5) Include a final report at the conclusion of this project to address each of the sub-objectives stated above.

Management Dates:

- **May 13th-** Plot planted, 2" x 2" UAN Nitrogen applied at planting, rate of 40 lbs. N/acre.
- **May 14th-** Plot sprayed (PRE), see diagram 1.1 for rates.
- **May 27th-** Summer '21 Lysimeters installed. Lysimeters were placed 16" below soil surface.
- **June 1st-** Plot evaluations, evaluations taken on weed management in relation to preemergence herbicide application.
- **June 2nd-** V3 corn tissue/biomass samples collected.
- **June 4th-** Calibrated drill for plot interseeding. Rates were set at **a.)** 90 lbs/A. VNS Cereal Rye **b.)** 20 lbs/A Crimson Clover
- **June 7th-** Plot Side-dressed, rate of 160 lbs. N/acre
    - Sp./Sum. '21 aggregate samples Collected.
    - Enzyme soil samples collected/shipped
- **June 14th-** Plot sprayed with postemergence herbicide. See diagram 1.1 for rates
- **June 15th-** Plot interseed treatments planted.
- **June 21st-** V6 corn tissue/biomass samples collected.
- **July 15th-** VT corn tissue/biomass samples collected.
    - Enzyme soil samples collected/shipped
- **October 6th-** Ear data collected from non-harvest rows.
- **October 7th-** Plot harvest completed.
- **October 21st-** Summer lysimeter removal/fall lysimeter replacement completed.
- **October 22nd-** Fall '21-Spring '22 cover crops planted.

501 *4*	**502** *6*	**503** *2*	**504** *11*	**505** *8*	**506** *9*	**507** *1*	**508** *3*	**509** *5*	**510** *10*	**511** *7*
401 *1*	**402** *8*	**403** *9*	**404** *10*	**405** *3*	**406** *5*	**407** *6*	**408** *7*	**409** *2*	**410** *11*	**411** *4*
301 *10*	**302** *5*	**303** *3*	**304** *7*	**305** *4*	**306** *6*	**307** *2*	**308** *11*	**309** *8*	**310** *9*	**311** *1*
201 *11*	**202** *6*	**203** *2*	**204** *4*	**205** *8*	**206** *9*	**207** *1*	**208** *10*	**209** *5*	**210** *7*	**211** *3*
101 *7*	**102** *9*	**103** *5*	**104** *10*	**105** *1*	**106** *3*	**107** *8*	**108** *4*	**109** *6*	**110** *2*	**111** *11*

Figure 1. 2021 NREC Plot Chemical Plan

PRE: Verdict (14 fl. Oz.); Aatrex (16 fl. Oz.) **POST:** Round-Up Power Max, Liberty 280 (32 fl. Oz./each); Dual II Magnum (1 pt./A); AMS Liquid (2.5% v/v)

PRE: Verdict (7 fl. Oz.) **POST:** Round-Up Power Max, Liberty 280 (32 fl. Oz./each); AMS Liquid (2.5% v/v)

PRE: Verdict (14 fl. Oz.) **POST:** Round-Up Power Max, Liberty 280 (32 fl. Oz./each); AMS Liquid (2.5% v/v)

501 *4*	**502** *6*	**503** *2*	**504** *11*	**505** *8*	**506** *9*	**507** *1*	**508** *3*	**509** *5*	**510** *10*	**511** *7*
401 *1*	**402** *8*	**403** *9*	**404** *10*	**405** *3*	**406** *5*	**407** *6*	**408** *7*	**409** *2*	**410** *11*	**411** *4*
301 *10*	**302** *5*	**303** *3*	**304** *7*	**305** *4*	**306** *6*	**307** *2*	**308** *11*	**309** *8*	**310** *9*	**311** *1*
201 *11*	**202** *6*	**203** *2*	**204** *4*	**205** *8*	**206** *9*	**207** *1*	**208** *10*	**209** *5*	**210** *7*	**211** *3*
101 *7*	**102** *9*	**103** *5*	**104** *10*	**105** *1*	**106** *3*	**107** *8*	**108** *4*	**109** *6*	**110** *2*	**111** *11*

1- No-CC	2- Normal CC	3- Normal CC	4- Skip-Row CC	5- Skip-Row CC	6- Interseed CC
7- Interseed CC	8- Wheat	9- Barley	10- Interseed CC	11- Interseed CC	

Figure 2. NREC Plot Cropping Plan.

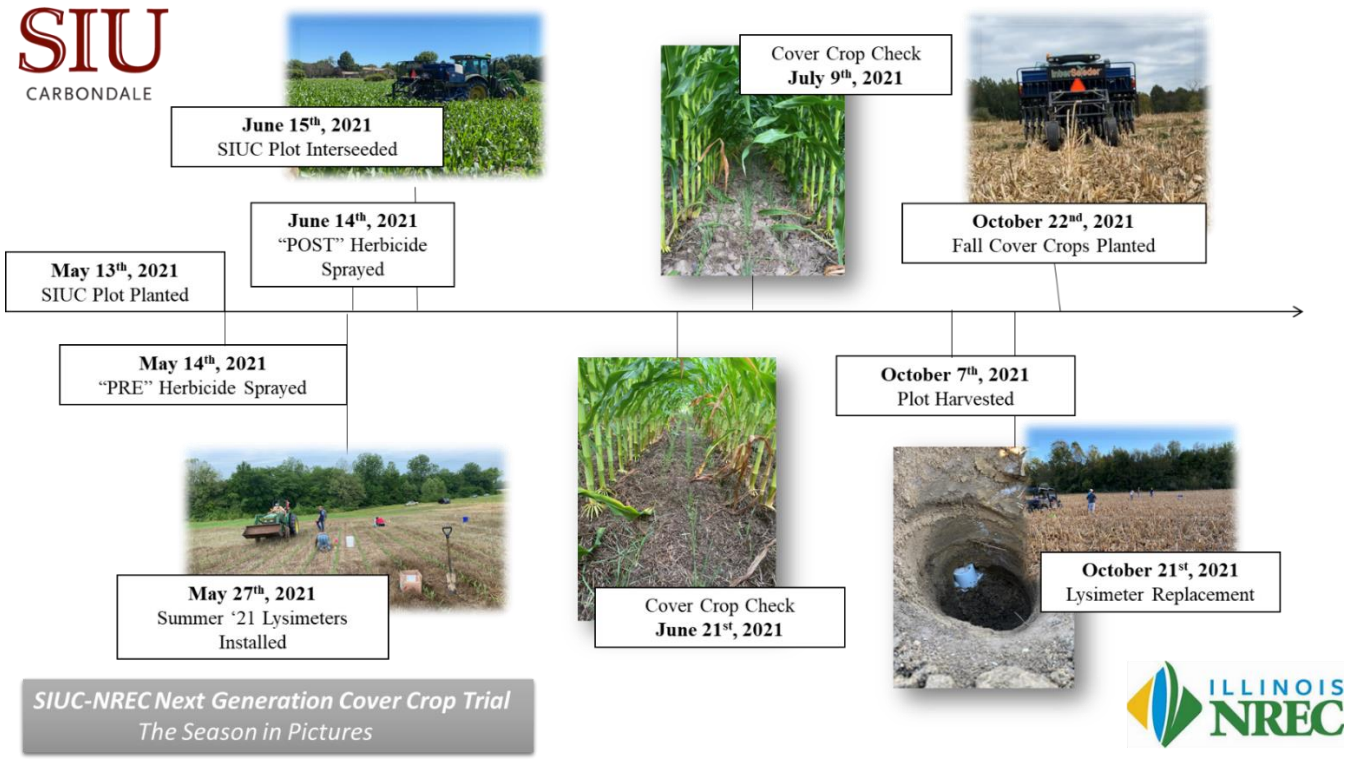

Figure 3. Schematic of trial management in 2021.

Preliminary Results:

Corn grain yields were high in 2021 and our corn grain yields ranged from 282 bu/acre in no-cover crop control, 280 bu/acre when interseeded with full residual herbicide and 271 bu/acre when interseeded at half residual herbicide. Statistical analysis indicated similar grain yields between interseeded and no cover crop treatments. Reduction in herbicide residual resulted in similar corn grain yield to the full residual treatments although the corn yields were 9 bu/acre lower. Both full residual and half residual treatments allowed for successful establishment of cover crops in June. Drought impacted the established cover crops indicating time of interseeding is critical to ensure not only well-emerged but well-established cover crop treatments.

Precision planting trials in Carbondale (ARC) and Belleville (BRC):

The main objective of these two trials are to assess corn N requirement following (1) a no-cover crop control, (2) normal planting of winter cereal rye (NP) and (3) precision planting of winter cereal rye (skipping the corn row; STCR). Nitrogen treatments were six rates of 0, 50, 100, 150, 200, and 250 lbs N/acre at sidedress time plus a 40 lbs N applied at planting (2 × 2).

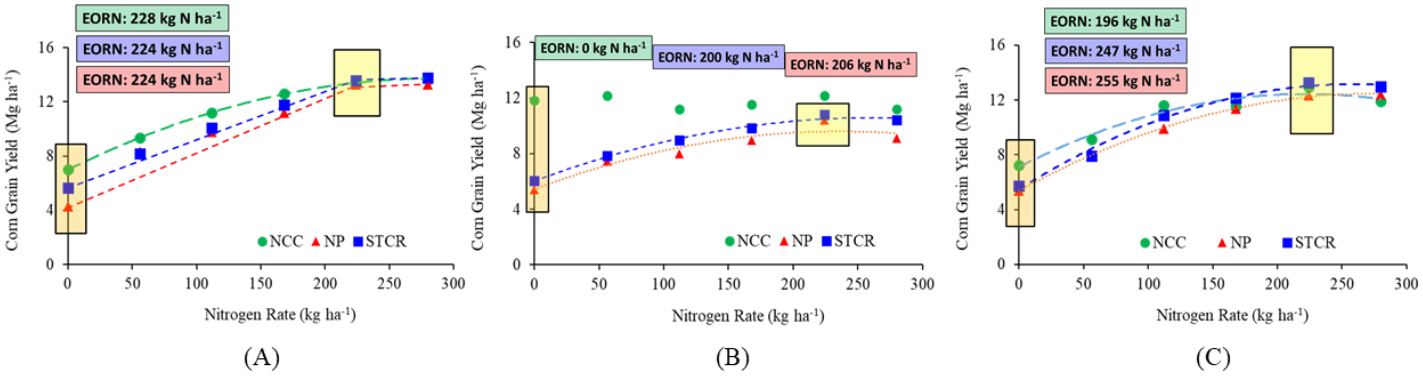

Figure 4. Economic optimum rate of N (EORN) in corn following a no-cover crop control (NCC), normal planting of winter cereal rye (NP) and precision planted winter cereal rye (STCR). A and C are trials at ARC in 2020 and 2021 and B is the trial at BRC in 2020.

Preliminary Results:

Our data indicated that by switching from NP to STCR, corn grain yield was increased and EORN was decreased suggesting the benefit of STCR as a practice to deal with planting winter cereal rye prior to corn. To further improve these practices, we need to assess integrated cover crop management practices with STCR especially seeding rate and termination date.

Hybrid Rye Trial:

The main objective of this trial is to evaluate whether a higher quality cereal rye (hybrid rye) could produce more biomass, recycle more N, and decompose faster as compared to a typical rye cover crop.

Treatments are (i) hybrid rye at 60 lbs/acre seeding rate; (ii) hybrid rye at 90 lbs/acre seeding rate; (iii) normal rye at 60 lbs/acre seeding rate; (ii) normal rye at 90 lbs/acre seeding rate.

Corn was planted into each cover crop after termination and managed with 40 lbs of starer N (2 × 2) plus 160 lbs of N at sidedress timing.

Preliminary Results:

Our data indicated that hybrid rye at high (HRHI) and low (HRLOW) seeding rates produce higher biomass than the normal rye at high seeding rate (NRHI). Overall, hybrid rye was more productive than normal rye (NRHI and NRLOW) (Fig 5A) but did not decompose faster and did not result in higher corn yields.

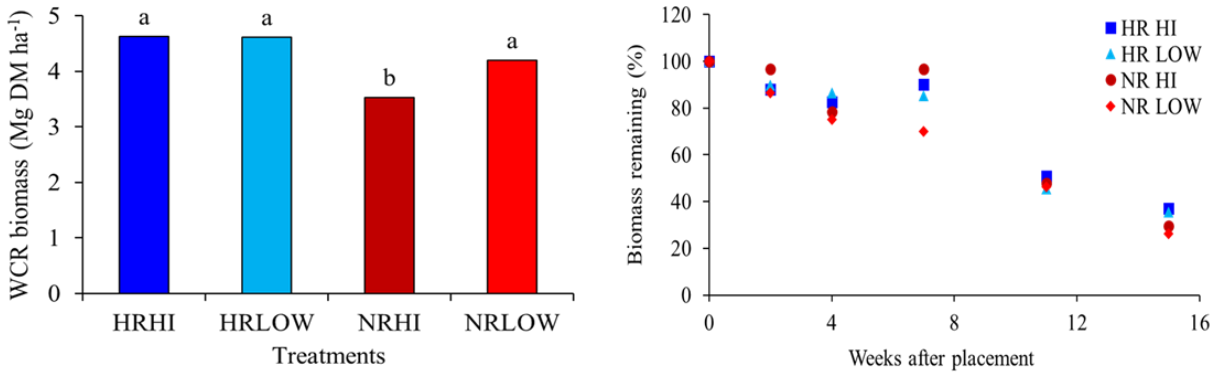

Figure 5. Biomass of hybrid rye at high (HRHI) and low seeding rates (HRLOW) versus normal rye at high (NRHI) and low seeding rates (NRLOW) in 2021 (A) and decomposition of each treatment during the corn growing season in 2021 (B).