2021 NCSARE Annual Report

(Bonus Year 2020/2021 and 2021/2022)

Project Title: Precision Winter Cereal Rye Cover Cropping for Improving Farm Profitability and Environmental Stewardship

Project Objective/Outcomes: To determine the impact of precision planted WHCC on crop yield, farmer economic risk, and nitrogen loss reduction.

Learning outcomes: The research project will generate knowledge on adaptive cover crop management that would allow WHCC to be precision planted ahead of crops in non-intersecting zones. Precision planted WHCC in strips could inform farmers to lower WHCC seeding rates, adjust the N need for corn crop, while improving soil health, maintaining significant nitrate-N loss reduction via tile drainage and crop yields.

Specific Objective:

1. Determine the impact of precision planted (skipping the crop row) winter hardy cover crops (WHCC) on cash crop N need (for corn and soybean) and yield.

2. Investigate the impact of precision planted WHCC (cereal rye and crimson clover) on the soil health and nitrogen loss reduction effectiveness.

3. Determine the impact of precision planted WHCC on farmer profitability and economic risks, relative to conventional planted and no cover crop cropping systems.

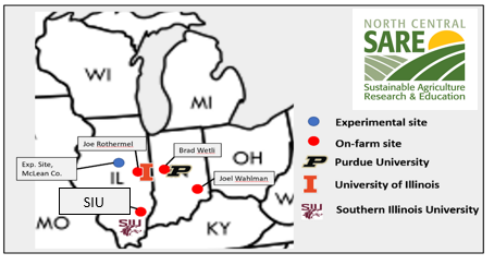
4. Effectively educate farmers in the North Central regions about the implications of the advance cover crop management practices investigated in this study

2 On-farm research experiments

On-Farm experiment 1 is designed to quantify the impact of cover crop planting method and cover crop species on the optimum N fertilizer rate needed for maximum profitability. Therefore, 6 cover crop treatments will be evaluated: zero control, no cover control, conventional cereal rye, conventional crimson clover, precision cereal rye, precision crimson clover. Each treatment, except for the zero control, will receive 7 N fertilizer rates ranging from 0 to 250 lbs N/acre in the corn years to determine if a N credit can be quantified. Treatments will be replicated 4 times within a split plot experimental design.

On-Farm experiment 2 is designed to determine how cover crop planting methods, cover crop species, and seeding rate impact cash crop yield (corn and soybean) and profitability. Treatments will consist of 12 cover crop treatments: zero control, no cover crop control, conventional planted cereal rye-full rate (full recommended seeding rate), conventional planted crimson clover-full rate, conventional planted cereal rye-reduced rate (50% of the full seeding rate), conventional planted crimson clover-reduced rate, precision cereal rye-full rate, precision cereal rye-reduced rate, precision planted crimson clover-full rate, precision planted crimson clover-reduced rate, rotational (rotation of crimson clover before corn and cereal rye before soybean) precision planted-full rate, rotational precision planted-reduced rate. Treatments will be replicated 4 times within a completely randomized block experimental design.

All on-farm research sites established in 2020/2021 and 2021/2022



3 On-farm locations established in 2020/2021

Benton County, IN (Central IN)*On-Farm Experiment 2*

Champaign County, IL (Central IL)*On-Farm Experiment 1*

Jennings County, IN (Southern IN)*On-Farm Experiment 1&2*

SIU Experiments (multiple sites) *On-Farm Experiment 2*

3 On-farm locations established in 2021/2022

Benton County, IN (Central IN) *On-Farm Experiment 2*

Champaign County, IL (Central IL)*On-Farm Experiment 1*

Jennings County, IN (Southern IN)*On-Farm Experiment 1&2*

Carbondale, IL (Southern IL) *On-Farm Experiment 1 &2*

Camel, IL (Southern IL) *On-Farm Experiment 2*

Measurements collected at all sites in 2020/2021 bonus year.

- **Cover Crop Planting and Performance –***Impact of cover crop species, planting method, nitrogen fertilizer rate and cover crop seeding rate on cover crop aboveground biomass and N update.*
- **Cash Crop Planning and Sampling** *Impact of cover crop species, planting method, nitrogen fertilizer rate and cover crop seeding rate on plant population and aboveground plant nitrogen uptake.*
- **Cash Crop Yield--** *Impact of cover crop species, planting method, nitrogen fertilizer rate and cover crop seeding rate on cash crop yield and yield components.*

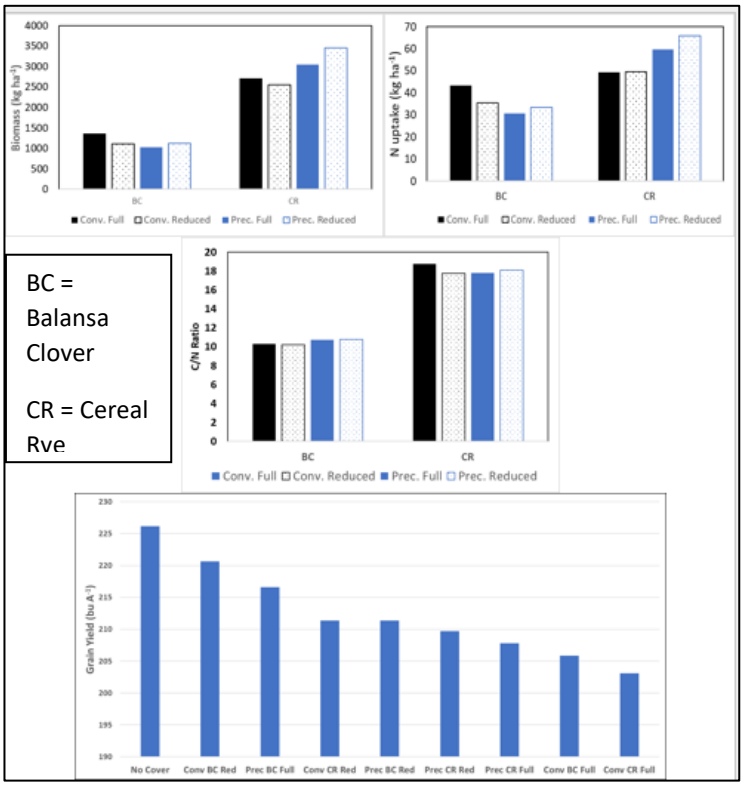
Note: These measures were collected at all sites however preliminary data is shown in this report from data that has been fully process.

Photos from both Champaign County, IL and Jennings County, IN

Champaign County, IL (Central IL Site)

Jennings County IN (Southern IN Site)

Champaign County, IL location: Preliminary Data

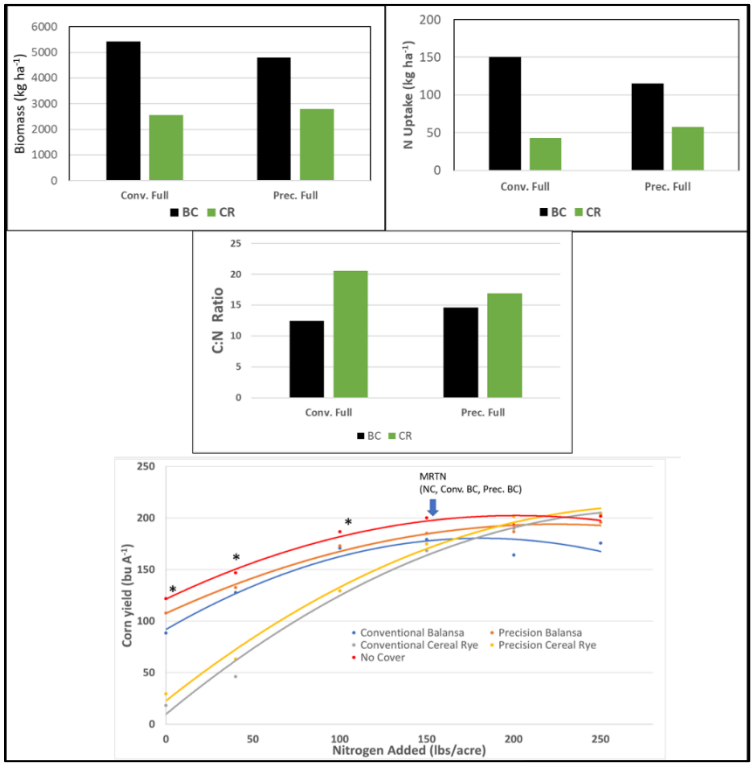


BC = Balansa Clover

CR = Cereal Rye

At the Central, IL site in Champaign County, we observed that with 50 and 75% less cover crop seed the same aboveground biomass and N uptake for both cereal rye and balansa clover was produced. We also observed an impact of seeding method for cereal rye, where aboveground biomass and N uptake was greater where cereal rye was precision planted. Average aboveground biomass level for balansa clover was approximately 1000 kg ha^{-1} and average N uptake was 35 kg ha^{-1}. Cereal rye biomass was 3000 kg ha^{-1} with an N uptake average of 55 kg ha^{-1}. The C:N ration of the balansa clover was 10, which was drastically lower that cereal rye at 18. A lower C:N ratio results in greater decomposition and nutrient release potential post termination. The corn yield of the no cover crop control was numerically greater than all treatments but was not significantly different relative the Conventional planted balansa clover with a reduced seeding rate and precision planted clover with the full seeding rate. The no cover crop control was significantly different than all CR treatment despite seeding rate or planting method and the precision planting balansa reduced and conventional full rate (this treatment has significant vole damage). Yield results from this trial demonstrate potential yield advantages with the inclusion of balansa clover. This could be due to a more favorable soil nitrogen environment where greater available soil N at planting was present due to balansa clover fixing nitrogen from the atmosphere relative to scavenging it from the soil. The corn nitrogen uptake data, once processed, should give further insights on this hypothesis.

Jennings County, IN location: Preliminary Data



At the Jennings County site in southern IN, we observed drastically greater balansa clover biomass relative to the central, IL site. Southern IN balansa clover biomass was on average 4900 kg ha^{-1} and in central IL the clover biomass was 1000 kg ha^{-1}. This demonstrates that the clover is drvien by heat units. Additonally, the clvoer biomass nitrogen uptake followed the same trend when comparing the central and southern sites, where in the south balansa clover biomass nitrogen uptake was 130 kg $ha^{-1}$and in the central location it was only 35 kg ha^{-1}. As for the cereal rye in the southern site, we controlled the aboveground biomass to approximately 2400 kg ha^{-1} with a nitrogen uptake average of 50 kg ha^{-1}. The cereal rye biomass was controlled in attempts to reduce the potential of nitrogen immobilization due to the C:N ratio. Similar to the results in the central IL site, cover crop planting method did not impact the cover crop biomass or nitrogen uptake.

In this study protocal, we applied increasing rates of nitrogen fertilizer in a combination of two timings at planting and sidedress at rates ranging from 0-250 lbs A^{-1} across all cover crop treatments to quantify a potential nitrogen credit. With zero nitrogen applied, we observed similar yield for the control and balansa clover treatments and both were 75 bu A^{-1} greater than the cereal rye treatment. With only 40 lbs A^{-1} fertilizer N applied at planting, the balansa clover yield was 79 bu A^{-1} greater relative to the cereal rye treatment. Balansa clover resulted in a 45 bu A^{-1} advance compared to cereal rye with a total of 100 lbs A^{-1} of nitrogen fertilizer applied. The Maximum Return on Nitrogen applied for the control and clover treatments was 150 lbs A^{-1} and for cereal rye treatments the MRTN was atleast 250 lbs A^{-1}. Yield differences at nitrogen fertilizer rates from 0-100 lbs A^{-1} between the control and balansa clover treatments relative to cereal rye demonstrates the aggressive nitrogen scavenging and slow nitrogen release nature of cereal rye realtive to balansa clover species, which seems to scavenge less soil nitrogen, results in less nitrogen immobilization and greater yield potential.