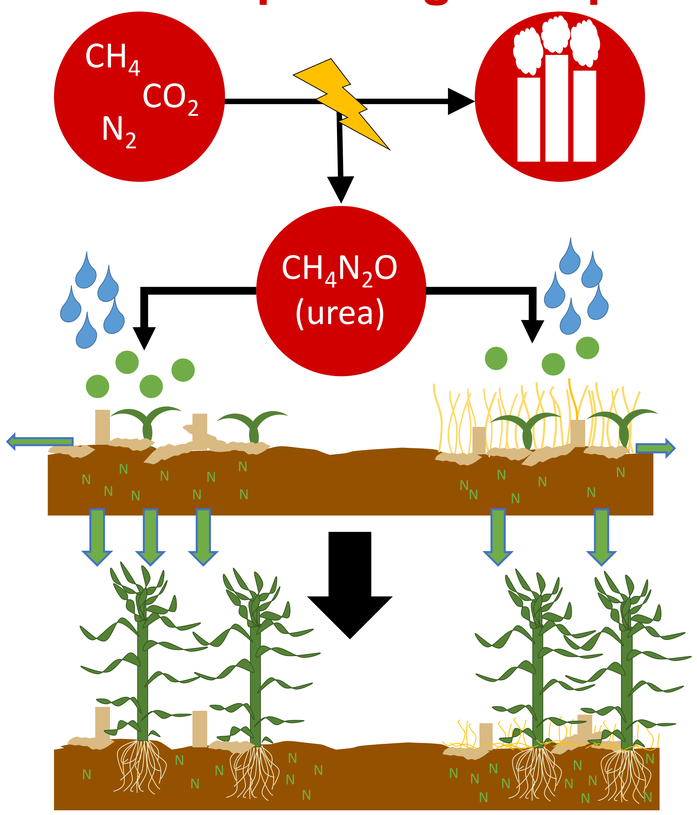
The Impact of a Rye Cover Crop on Nitrogen Efficiency in a No-Till Corn Cropping System

Jackson S. Stansell[a], Leonardo M. Bastos[b], Laura J. Thompson[c], Richard B. Ferguson[b]

[a] – John A. Paulson School of Engineering and Applied Sciences, Harvard University, Cambridge, MA 02138, USA, [b] – Department of Agronomy and Horticulture, University of Nebraska – Lincoln, Lincoln, NE, USA 68508, [c]– Southeast Research and Extension District, University of Nebraska – Lincoln Extension, Ithaca, NE 68033

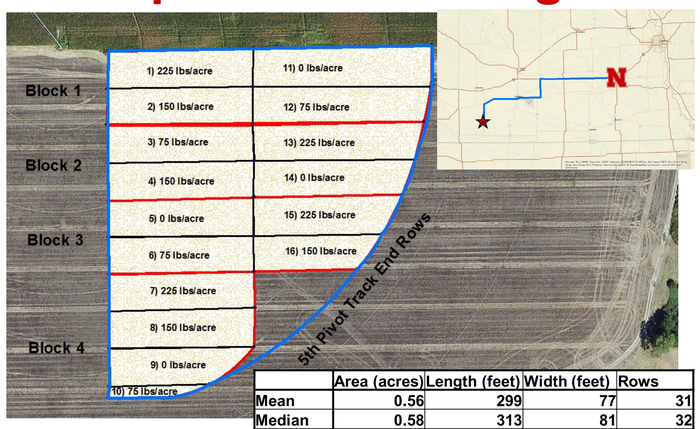
Cover Crop Nitrogen Impact



Objectives

1. Determine to what extent a rye cover crop changes the nitrogen efficiency of a corn cropping system without statistical reduction in crop performance.
2. Predict an optimal nitrogen rate for this system.

Experimental Design



	Area (acres)	Length (feet)	Width (feet)	Rows
Mean	0.56	299	77	31
Median	0.58	313	81	32
Std. Dev.	0.14	62	14	6
Minimum	0.11	133	25	10
Maximum	0.76	383	83	33

Methods

Results

Normalized difference red edge (NDRE) index can be modeled as a quadratic function of nitrogen application rate and used to find an optimal nitrogen rate (ONR).

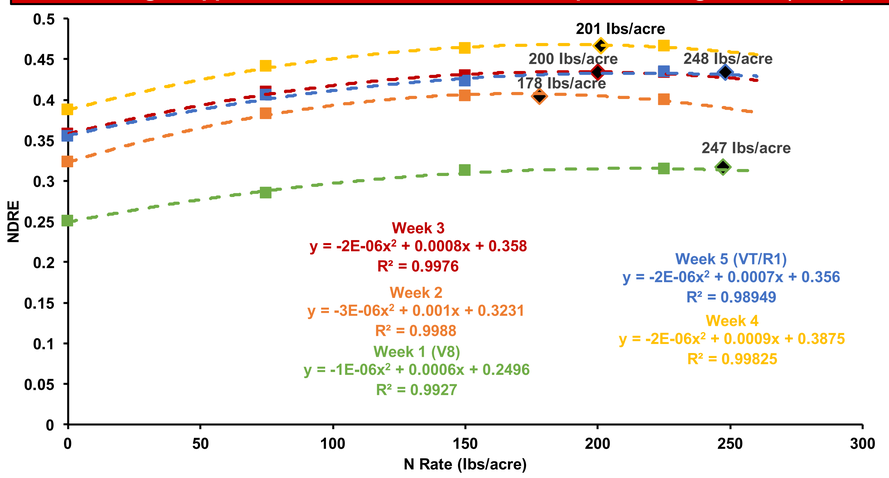


Figure 1 – Quadratic model of NDRE versus nitrogen application rate. Optimal nitrogen rate is shown by the black diamonds. Data spans growth stages from V8 (Week 1) to VT/R1 (Week 5)

Nitrogen application rates of 150 lbs/acre and 225 lbs/acre have statistically equivalent crop performance.

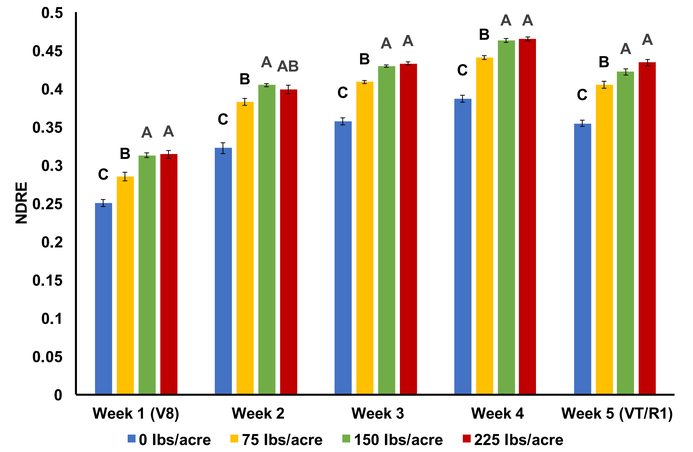


Figure 2 –NDRE versus nitrogen application rate by week. Treatments labeled with the same letter within each week are not statistically different by Tukey-Kramer test at α = .05..

This cover cropping system offers significant financial savings for the grower and reductions in environmental impact.

N-Rate (lbs/acre)	Cost ($/acre)	Savings ($/acre)	Reduction in Urea (lbs/acre)	Carbon Emissions (lbs/acre)	Emissions Reductions (lbs/acre)
225	36.69	0.00	0	382.5	0
247	40.28	-3.59	-22	419.9	-37.4
178	29.03	7.66	47	302.6	79.9
200	32.62	4.08	25	340	42.5
201	32.78	3.91	24	341.7	40.8
248	40.44	-3.75	-23	421.6	-39.1
170	27.72	8.97	55	289	93.5
150	24.46	12.23	75	255	127.5

Table 1 – Financial and environmental benefits by potential nitrogen application rates for this system. Monetary figures based on urea cost of $326.16 per ton on May 1, 2017 according to Farm Futures. Carbon emissions figures based on urea production data from IFDC.

Preliminary NDRE aerial imagery demonstrates some visible differences in performance between treatments.

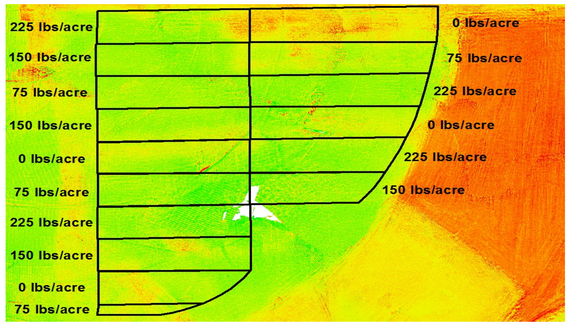


Figure 3 – The NDRE colormap generated from reflectance data collected on 7/27/17 visibly displays performance differences between treatments by plot. Images will be re-stitched and quantitatively analyzed.

Conclusion

Rye cover crops show the potential to decrease nitrogen demands for a corn-cropping system up to 75 pounds per acre leading to significant financial and environmental benefits.

Future Work

1. Obtain residue samples late in the season to determine C/N content, density of residue, and extent of decomposition in order to evaluate nitrogen cycling.
2. Analyze yield data versus nitrogen application rate to find an optimal nitrogen rate and compare to in-season predictions to determine the optimal nitrogen rate for this system.
3. Repeat the study to control for environmental factors, including a non-cover crop control in the experimental design.

This program was supported by Grant Program no. 2017-67032-26018 from the USDA National Institute of Food and Agriculture. Without the help of John Parrish, Joel Crowther, Glen Slater, McKenna Schuck, and Bryce Bauer, this work would not have been possible.