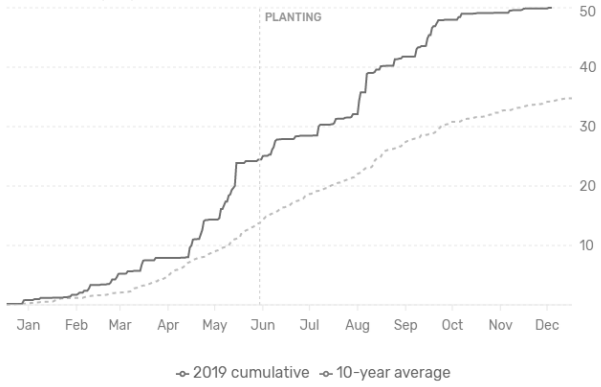
Determining Optimum Nitrogen Rate on Corn

Study ID: 0416147201903
County: Richardson
Soil Type: Nodaway silt loam occasionally flooded; Zook silty clay loam occasionally flooded
Planting Date: 6/13/19
Harvest Date: 11/9/19
Seeding Rate: 33,000
Row Spacing (in): 30
Variety: Pioneer® P1197
Reps: 5
Previous Crop: Soybean
Tillage: Tilled following flooding and soil deposition in May
Herbicides: ***Pre:*** 28 oz/ac WeedMaster® and 29 oz/ac glyphosate on 4/15/19 ***Post:*** 2.25 qt/ac Keystone® NXT, 5.3 oz/ac Callisto®, and 32 oz/ac glyphosate on 6/28/19
Seed Treatment: Poncho® 1250 + VOTiVO® and Raxil®
Foliar Insecticides: 2 oz/ac Province® and 4 oz/ac Brigade® 2 EC 8/23/19
Foliar Fungicides: 10 oz/ac Headline AMP® on 8/23/19
Fertilizer: 194 lb/ac 0-0-60, 91 lb/ac gypsum, and variable rate 11-52-0 (209-245 lb/ac in research blocks) on 4/15/19
Irrigation: None
Rainfall (in):



Introduction: The objective of this study was to utilize precision ag technology to conduct on-farm research on nitrogen rates. A variable rate nitrogen prescription was developed to apply five blocks of five nitrogen rates on the go as anydrous ammonia was applied (Figure 1). Plots were 300' long by 30' wide. The field received anhydrous ammonia on April 15, 2019 at 7" depth with strip-till following a previous crop of soybeans. As-applied fertilizing maps were used to evaluate the accuracy of fertilizer application. The field was flooded twice in May and 2-6" of soil was deposited on the field. The field was tilled and planted on June 13. The field also received a variable rate application of 11-52-0 on April 15, 2019 with N contribution in the research area ranging from 23 lb N/ac to 27 lb N/ac; therefore, values in the results table and graph reflect the total N applications of 130 lb N/ac, 160 lb N/ac, 190 lb N/ac, 220 lb N/ac and 240 lb N/ac.

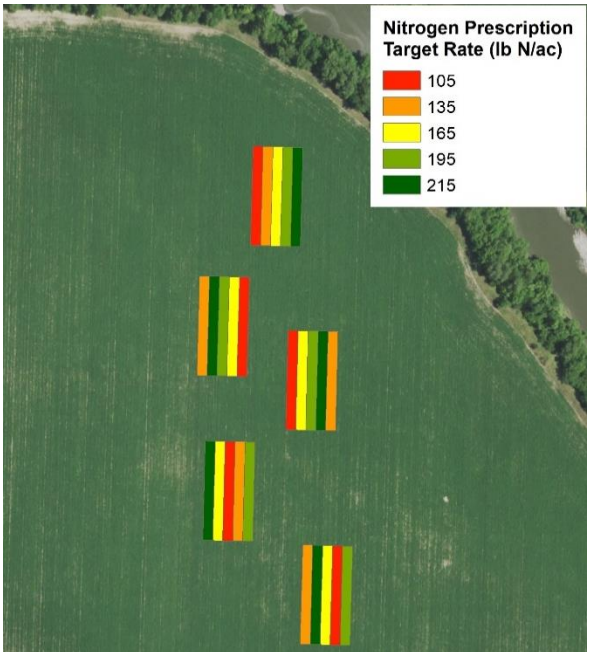


Figure 1. Nitrogen prescription map (lb N/ac)

Throughout the growing season multispectral imagery was collected using a DJI™ Inspire 2 drone equipped with a MicaSense® RedEdge™ 5-band sensor. Imagery was obtained on July 13, July 20, August 3, and August 13. The normalized difference red edge (NDRE) index was calculated for each flight date. The objective of collecting drone imagery was to: 1) evaluate the potential of using imagery of varying nitrogen rate blocks applied with variable rate technology to direct in-season N management, 2) determine how low the lowest N rate needs to be to detect differences soon enough to make a timely in-season application, and 3) relate NDRE values for varying nitrogen rates to crop yield at the end of the season.

Yield monitor data were collected at the end of the growing season and post-processed to remove errors with Yield Editor software from the USDA. Additionally, yield data points from 50' on each end of the 300'-long blocks were removed to eliminate areas where fertilizer application did not closely match the target rate.

Results:

Anhydrous Ammonia Prescription Rate (lb N/ac)	Total N Rate (lb N/ac)	Moisture (%)	Yield (bu/ac)†	lb N/bu grain	Marginal Net Return‡ ($/ac)
105	130	18.3 A*	207 A	0.63 E	756.17 AB
135	160	18.1 AB	212 A	0.76 D	765.09 A
165	190	18.1 AB	206 A	0.93 C	734.21 AB
195	220	18.0 B	207 A	1.07 B	730.43 AB
215	240	18.0 AB	203 A	1.18 A	710.25 B
P-Value	-	0.060	0.576	<0.0001	0.080

*Values with the same letter are not significantly different at a 90% confidence level.
†Yield values are from cleaned yield monitor data. Bushels per acre adjusted to 15.5% moisture.
‡Marginal net return based on $3.83/bu corn and $0.28/lb N ($452/ton anhydrous).

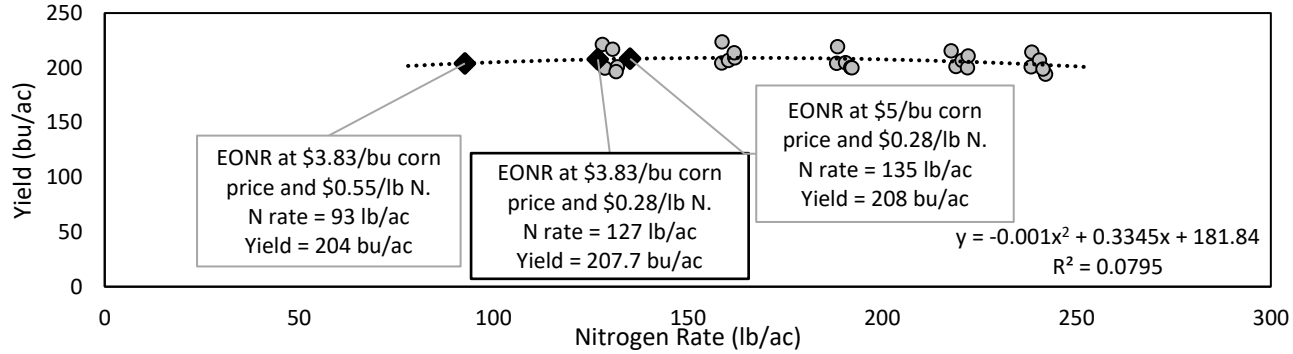


Figure 2. Yield versus nitrogen rate with economic optimum nitrogen rates (EONR) indicated at three price points.

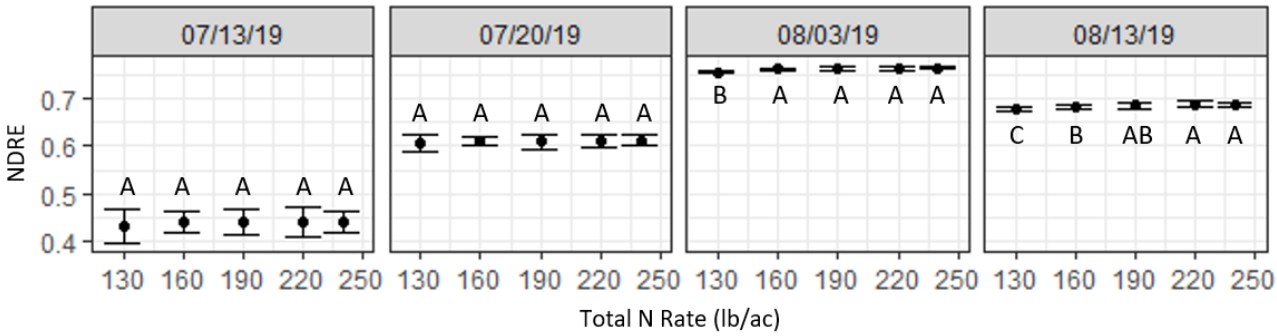


Figure 3. Normalized difference red edge (NDRE) index values for five nitrogen rates across four imagery dates with standard deviation indicated with bars. Significance letters apply within date; values with same letter are not significantly different at a 90% confidence level.

Summary:

- At this year's corn price of $3.83/bu and N price of $0.28/lb N, the economic optimum N rate was 127 lb/ac and yielded 207 bu/ac (Figure 2).
- Analysis of NDRE imagery showed no differences between the five N rates tested on July 13 and July 20 (Figure 3). On August 3, the lowest total N rate (130 lb N/ac) was significantly lower in NDRE than the other four rates. By August 13, the 160 lb N/ac rate had NDRE values lower than the 220 lb N/ac and 240 lb N/ac treatments. This demonstrated that for this year and the rates tested, the NDRE imagery was able to pick up on differences in N rate starting at the August 3 date.

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