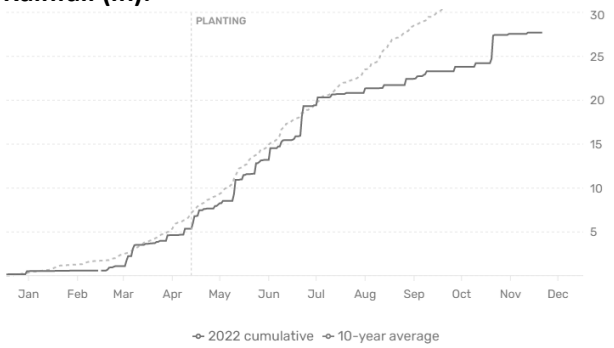
Determining Economically Optimum Nitrogen Rate on Corn

Study ID: 0416147202201
County: Richardson
Soil Type: Kennebec silt loam rarely flooded; Zook silty clay loam occasionally flooded; Judson silt loam 2-6% slopes; Kipson-Benfield silty clay loam 7-17% slopes
Planting Date: 4/27/22
Harvest Date: 10/7-8/22
Seeding Rate: 33,000
Row Spacing (in): 30
Hybrid: Pioneer® P1572
Reps: 4
Previous Crop: Soybean
Tillage: Strip-till
Herbicides: ***Pre:*** 0.825 oz/ac Basis® Blend, 1.4 pt/ac atrazine 4L, 16 oz/ac dicamba ***Post:*** 2.2 qt/ac Keystone® NXT, 24 oz/ac glyphosate, 5.33 oz/ac mesotrione

Foliar Fungicides: 7 oz/ac Veltyma® on 7/13/22
Fertilizer: Anhydrous ammonia on 11/24/21 varied based on treatments tested; 44 lb/ac 11-52-0 contributing 5 lb N/ac; variable-rate gypsum averaging 113 lb/ac; variable-rate 0-0-60 averaging 113 lb/ac
Irrigation: None
Rainfall (in):



Baseline Soil Samples, 0-6" (11/22/21):

								-------Melich III-------					Sand	Silt	Clay
	pH	BpH	OM LOI %	Melich III P ppm	Nitrate – N ppm N	Bray P1 ppm	Sulfate-S ppm S	K	Ca	Mg	Na	CEC me/100g	(%)	(%)	(%)
Zone 2	6.8	6.9	2.9	41	5.1	31	9	168	1824	165	10	11.3	33	53	14
Zone 5	6.7	6.9	2.4	28	2.8	21	10	98	1895	171	12	11.7	31	55	14
Zone 7	6.8	6.9	4	38	3.8	29	8	170	2330	211	10	14.3	31	55	14
Zone 8	6.1	6.7	3.4	19	4.2	14	13	137	2300	305	12	16.8	33	51	16

Introduction: This study utilized variable-rate nitrogen application technology to evaluate nitrogen rates in contrasting field zones. A variable-rate nitrogen prescription was developed to apply blocks of nitrogen rates approximately 300' long by 30' wide (Figure 1). An anhydrous rate of 0 lb N/ac was established by turning the applicator off for a small area in zones 2 and 5. Nitrogen was applied as anhydrous ammonia on November 21, 2021, at a depth of 7" with strip-till following a previous crop of soybeans. As-applied fertilizer maps were used to evaluate the accuracy of fertilizer application. The field also received a flat rate of 44 lb/ac of 11-52-0 (contributing 5 lb N/ac). Two of the treatments evaluated sidedress applications of 40 lb N/ac as 32% UAN stabilized with N-Fixx® XLR at V10 on June 21, 2022. A rainfall event of 0.25" was received the night of the application.

Multispectral imagery was collected using a DJI™ Inspire 2 drone equipped with a MicaSense® RedEdge-MX™ five-band sensor. The normalized difference red edge (NDRE) index was calculated for each flight date (Figure 2). Yield monitor data were collected at the end of the growing season and post-processed to remove errors. Yields from the small 0 lb N/ac anhydrous rate blocks were determined by hand harvesting. Additionally, yield data points that correspond to areas where the fertilizer application rate was more than 10% above or below the target rate were eliminated. The economic optimum nitrogen rate (EONR) was calculated for each zone using the pre-plant N treatments (Figure 3).

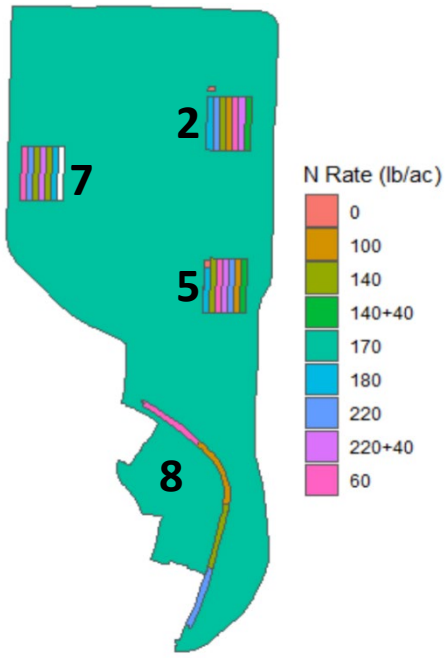


Figure 1. Nitrogen treatment map showing N rates applied with anhydrous ammonia. Treatments with sidedress application of 40 lb N/ac are indicated with "+40". Zones are numbered (2, 5, 7, and 8).

Results:

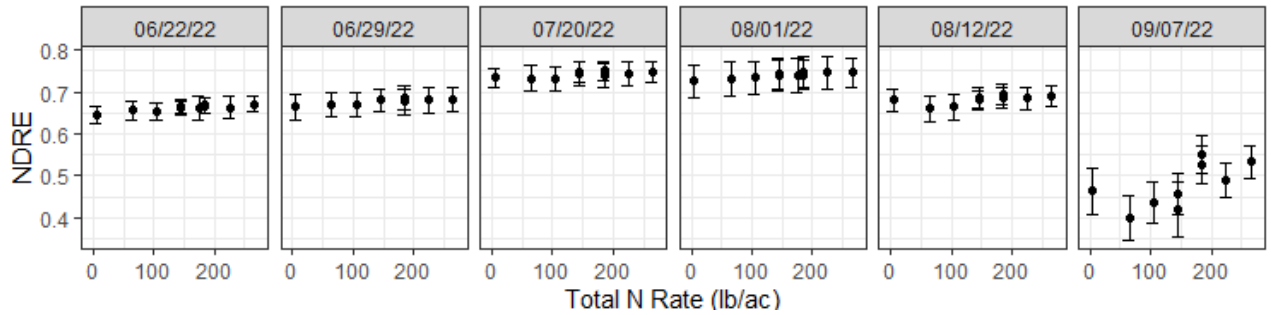


Figure 2. NDRE mean and standard deviation by total N applied for seven imagery dates across all zones.

Because zone 8 only had four of the N rates represented and was in a different landscape position with lower yields, it is not included in the table below.

Nitrogen rate (lb/ac)	Yield (bu/ac)†	lb N/bu grain	Marginal Net Return‡ ($/ac)
5 lb N/ac	244 B	0.02 G	1599 A
65 lb N/ac	260 AB	0.25 F	1678 A
105 lb N/ac	271 A	0.39 E	1732 A
145 lb N/ac	276 A	0.52 D	1750 A
185 lb N/ac	275 A	0.67 C	1720 A
225 lb N/ac	273 A	0.85 B	1695 A
145+40 lb N/ac	274 A	0.67 C	1717 A
225+40 lb N/ac	275 A	0.97 A	1686 A
P-Value	0.01	<0.0001	0.165

*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 corrected to 15.5% moisture.
‡Marginal net return based on $6.57/bu corn and $0.45/lb N.

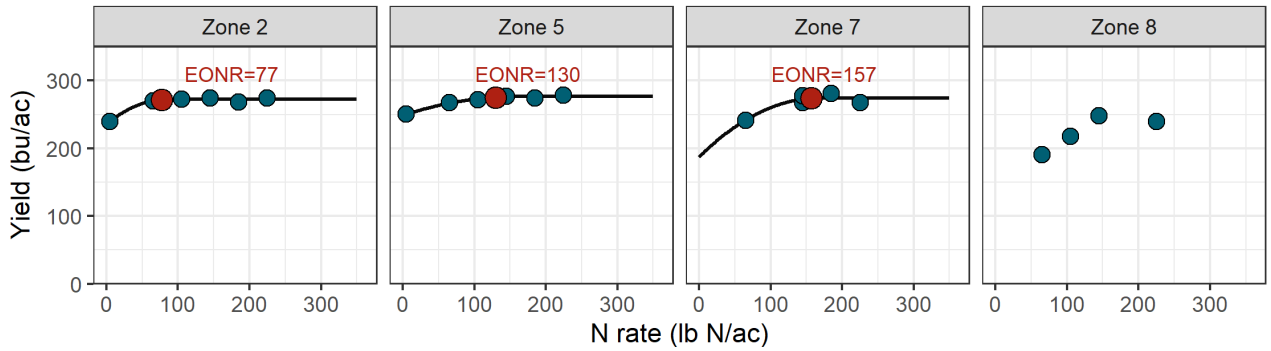


Figure 3. Corn yield by N rate for pre-plant N treatments. Economic optimum N rate is indicated with a red dot. Corn price is $6.57/bu and N fertilizer price is $0.45/lb.

Summary:

- The EONR varied by zone, ranging from 77 lb N/ac to 157 lb N/ac and resulting in a yield of 274 bu/ac. EONR was not able to be calculated for zone 8 due to variation in yield response to N, but lower yields at the 65 lb N/ac rate indicate that this zone has a higher N requirement relative to the other zones.
- NUE at EONR ranged from 0.28 lb N/bu of grain in zone 2 to 0.57 lb N/bu of grain in zone 7.
- The study revealed high inherent N supplying capacity in this field with yields of 240 to 250 bu/ac with only 5 lb N/ac applied.
- Sidedress application did not result in higher yields compared to similar N rates applied entirely in the fall.

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