

Determining Economically Optimum Nitrogen Rate on Corn

Study ID: 0416147202202

County: Richardson

Soil Type: Monona silt loam 1-6% slopes; Marshall silty clay loam 2-6% slopes; Judson silt loam 2-6% slopes

Planting Date: 4/27-28/22

Harvest Date: 10/1-3/22

Seeding Rate: 32,000

Row Spacing (in): 30

Hybrid: Pioneer® P1572

Reps: 5

Previous Crop: Soybean

Tillage: Strip-till

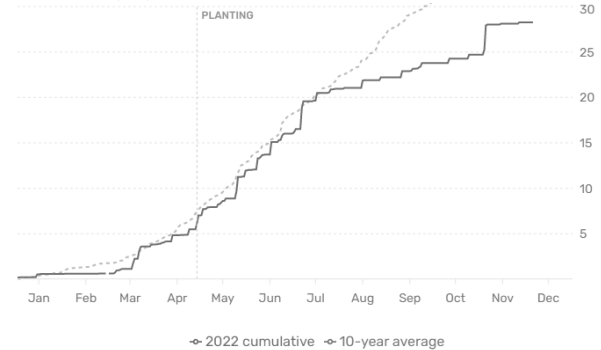
Herbicides: **Pre:** 0.825 oz/ac Basis® Blend, 1.4 pt/ac atrazine 4L, 16 oz/ac dicamba **Post:** 2.2 qt/ac Keystone® NXT, 24 oz/ac glyphosate, 5.33 oz/ac mesotrione

Foliar Fungicides: 7 oz/ac Veltima® on 7/13/22

Fertilizer: Anhydrous ammonia on 11/26/21 and 11/29/21 varied based on treatments tested; 74 lb/ac 11-52-0 contributing 8 lb N/ac; variable-rate gypsum averaging 124 lb/ac; variable-rate 0-0-60 averaging 124 lb/ac

Irrigation: None

Rainfall (in):



Baseline Soil Samples, 0-6" (11/24/2021):

	pH	BpH	OM LOI %	Melich-III P ppm	Nitrate-N ppm	Bray P1 ppm	Sulfate-S ppm	-----Melich III----- K	Ca	Mg	Na	CEC me/100g	Sand (%)	Silt (%)	Clay (%)
Zone 2	6.4	6.7	4.1	32	5.3	24	7	308	2607	194	6	17	19	60	20
Zone 5	6.3	6.7	4.2	26	3.4	20	11	217	2813	255	9	18.8	19	60	20
Zone 6	6.6	6.8	4	24	4.7	18	9	218	2739	220	7	17.1	19	62	18
Zone 7	6.2	6.7	4.1	23	3.9	17	11	175	2636	249	11	17.9	17	62	20
Zone 8	6.6	6.8	3.6	20	3.6	15	9	222	2834	263	11	18.1	17	58	24

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 zone 2. 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 74 lb/ac of 11-52-0 (contributing 8 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).

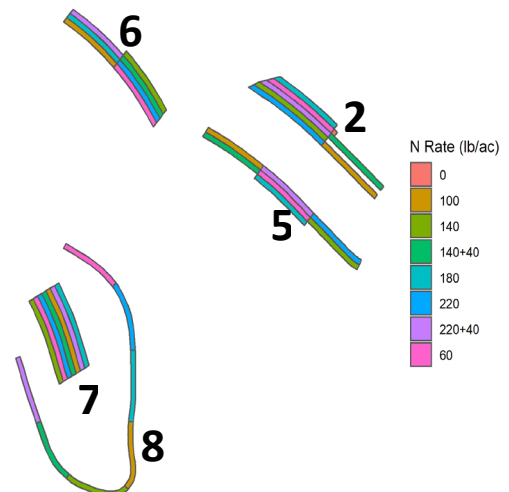


Figure 1. Nitrogen treatment map showing N rates applied with anhydrous ammonia. Treatments with sidedress application of 40 lb N/ac are indicated with "+40". Zones are numbered (2, 5, 6, 7, and 8).

Results:

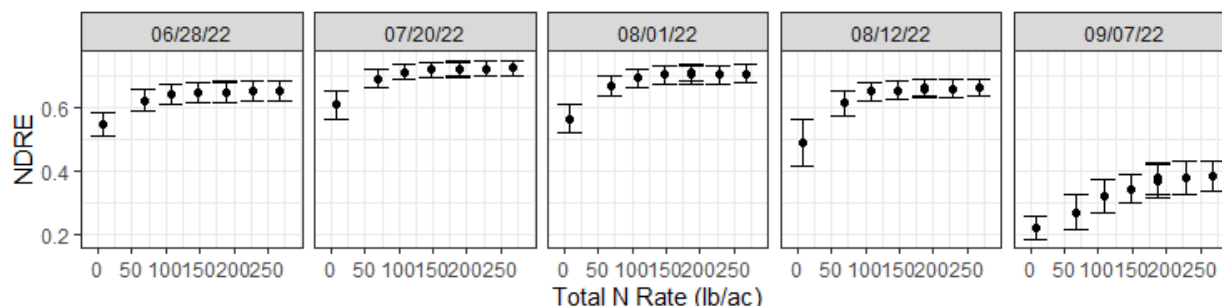


Figure 2. NDRE mean and standard deviation bars by total N applied for four imagery dates across all zones.

	Yield (bu/ac) [†]	lb N/bu grain	Marginal Net Return [‡] (\$/ac)
68 lb N/ac	189 D*	0.36 F	1,213 C
108 lb N/ac	227 C	0.48 E	1,442 B
148 lb N/ac	234 BC	0.64 D	1,470 AB
148+40 lb N/ac	245 A	0.77 C	1,525 A
188 lb N/ac	242 AB	0.77 C	1,507 AB
228 lb N/ac	239 AB	0.94 B	1,472 AB
228+40 lb N/ac	247 A	1.08 A	1,504 AB
P-Value	<0.0001	<0.0001	<0.0001

*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.

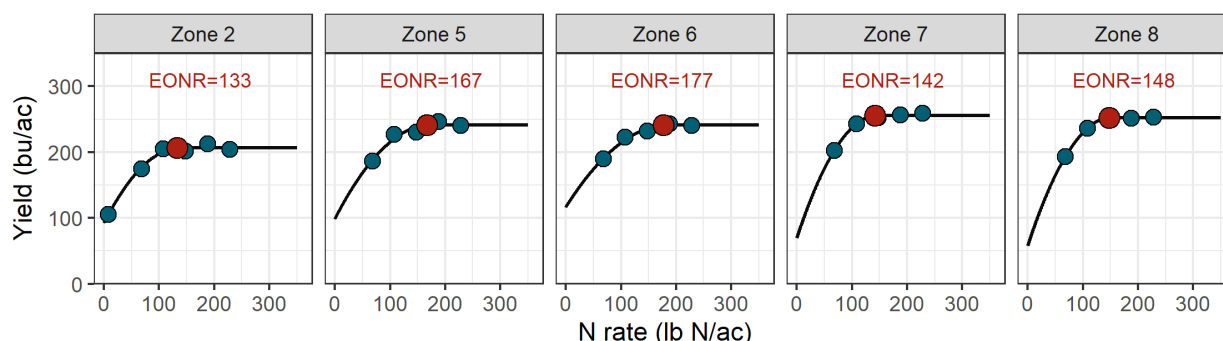


Figure 3. Corn yield by N rate for pre-plant N treatments. Economic optimum N rate is indicated with a red dot. Corn price is \$6.57/bu and N fertilizer price is \$0.45/lb.

Summary:

- The EONR varied by zone, ranging from 133 lb N/ac to 177 lb N/ac and resulting in yield at EONR ranging from 207 to 256 bu/ac.
- NUE at EONR ranged from 0.55 lb N/bu of grain in zone 7 to 0.74 lb N/bu of grain in zone 6.
- The small block that had no anhydrous ammonia applied (only 8 lb N/ac from 11-52-0 contribution) yielded 106 bu/ac and had an NUE of 0.08 lb N/bu grain.
- The sidedress treatment 148+40 did not result in higher yields compared to the 188 lb/ac treatment applied entirely in the fall.

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