Corn Yield Response to Nitrogen Rate - Lyons

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Objective

To determine the effects of nitrogen rate on corn grain yield and profitability.

Background

Crop Year: 2016
County: Fulton
Location: Lyons, Ohio
Drainage: Random
Previous Crop: Corn
Variety: Dekalb 4812
Population: 33,300 seeds per acre
Plant Date: April 24, 2016
Harvest Date: October 15, 2016
Herbicide: Triple Flex and Atrazine (Pre-emerge)

Soil Type: Blount, Mermill
Tillage: Fall chisel f.b. spring finisher
Soil Test (grid avg):pH 6.2
P 50 ppm (Bray-P1)
K 127 ppm
O.M. 2.8%
CEC 9.4 meq/100g
Starter Fertilizer: 84-0-72/ac
Pre-Sidedress Nitrogen Test: 18 ppm NO_3-N
Rainfall (May – August): 11.6”

Methods

Five corn nitrogen rates were replicated four times in a randomized complete block design. Plots were 16 rows wide (40 feet) by 2000 feet long. The trial was planted, sprayed and harvested with commercial farm equipment. The treatments were made with commercial nitrogen application equipment. All treatment received 84 units of nitrogen at plant (planter applied + pre-emerge). Corn was sidedressed with the balance of the total N rate for the trial when corn was at vegetative growth stage V5-V6. A corn stalk nitrate test (CSNT) was taken by averaging 1 test of 12 stalks for every treatment replication (4 tests for each treatment) at black layer. Yields and moistures were measured using a calibrated yield monitor and shrunk to 15% moisture. Rainfall data was recorded by farmer at field level.

Treatments:
1. 84 lbs Total N/ac (Zero/Low Rate))
2. 165 lbs Total N/ac
3. 180 lbs Total N/ac
4. 230 lbs Total N/ac
5. 280 lbs Total N/ac

Results

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Nitrogen Rate (lbs/ac)*	Yield (bu/ac)		NUE (lb N/bu)	CSNT (ppm nitrate N)	Return Minus N Cost** ($/ac)
84	180.0	c	0.47	114	$595
165	184.7	b	0.89	1528	$577
180	184.7	b	0.97	2058	$571
230	192.3	a	1.20	2048	$576
280	191.7	a	1.46	5556	$553
LSD (P<.05, CV 1.23)	3.56				

* 84 lbs/ac rate was unreplicated, planter applied only; not used in yield discussion.
**Based on $3.50/bu corn and $.42/lb N (Source: OSUE 2016 Corn Budget)

Table 2. Nitrate Concentration Categories		
Nitrate-Nitrogen ppm	**Rating**	**Interpretations**[+]
Less than 250	Low	Nitrogen was likely yield limiting during the growing season, especially if the test result is less than 250 ppm.
250-2,000	Optimal	Grain yield was not limited by the amount of nitrogen available to the crop. *Note* : the high end of this category is appropriate when nitrogen prices are low and corn prices high. The low end of this category is appropriate when nitrogen prices are high and corn prices low.
Greater than 2,000	Excess	Excessive nitrogen available to the crop, or some other production factor limited crop growth and yield.

[+]*Corn Stalk Nitrate Tests-Research and Recommendation Update* , Purdue University, 15 September 2014.

Discussion:
This trial showed that there was a significant difference in yield between the 230-280 lbs/ac rates and the 165-180 lbs/ac rates in 2016. The higher rates produced an additional 7 bu/ac of yield over the the 165-180 lbs/ac rates. A CSNT indicates that optimal nitrate-N concentrations were achieved at the 165 lbs/ac rate and that excess nitrogen was available to the crop at the 180-280 lbs/ac rates. A CSNT for the lowest rate of 84 lbs/ac indicates the rate was most likely yield limiting. Limited rainfall in the early-mid growing season could have limited nitrogen uptake and thus yield in this trial.

A standard economics calculation shows that the maximum economic return rate (replicated) is 165 lbs of total nitrogen/acre, netting $577/acre after nitrogen cost. At the economic optimum rate, the commercial nitrogen use efficiency (NUE) proved to be .89 lb of nitrogen per bushel of corn.

Economic optimum nitrogen rates vary greatly by nitrogen cost, corn price, soil type, rainfall timing and amount, application practices and other factors. Conducting nitrogen rate trials on a specific farm is the best way to determine the economic optimum rate for that farm.

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