Corn Yield Response to Nitrogen Rate - Ridgeville

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Objective

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

Background

Crop Year: 2016
County: Henry
Location: Napoleon, Ohio
Drainage: systematic, 30' laterals
Previous Crop: Soybeans
Variety: Pioneer P0993
Population: 34,800 seeds per acre
Plant Date: May 24, 2016
Harvest Date: November 10, 2016
Herbicide: Abunbit, CinchATZ, Shredder
Fungicide: 6 oz/ac Approach at VT

Soil Type: Hoytville
Tillage: No-till into Cereal Rye
Soil Test (grid avg): pH 6.5
P 52 ppm (Bray-P1)
K 225 ppm
O.M. 4.2%
CEC 13.9 meq/100g
Starter Fertilizer: 48-0-0
Pre-Sidedress Nitrogen Test: 5 ppm NO_3-N
Nitrogen Source: 28% UAN
Rainfall (May – August): 13.5"

Methods

Five corn nitrogen rates were replicated four times in a randomized complete block design. Plots were 12 rows wide (30 ft), by 650 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 48 units of nitrogen at plant (planter applied + pre-emerge). The balance of the nitrogen was applied at sidedress at 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. Check (Zero/low Rate)
2. 80 lbs Total N/acre
3. 140 lbs N/acre
4. 200 lbs N/acre
5. 260 lbs N/acre

Results

Table 1. Corn Yield Response to Nitrogen Rate - Ridgeville

Nitrogen Rate (lbs/ac)*	Yield (bu/ac)		NUE (lbN/bu)	CSNT (ppm nitrate N)	Return Minus N Cost** ($/ac)
48	122.2	c	0.39	43	$408
80	148.6	b	0.54	1912	$487
140	178.7	a	0.78	617	$567
200	180.9	a	1.11	2469	$549
260	180.2	a	1.44	2588	$522
LSD (P<.05, CV 3.52)	9.69				

* 48 lbs/ac rate was unreplicated, planter applied only; rate not used in 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 no significant difference in yield among the 140-260 lb/acre rates in 2016. However, there was a statistically significant difference between the highest three rates and the 80 lb/acre rate. A CSNT indicates that optimal nitrate-N concentrations were achieved at the 80-140 lb/ac rates and that excess nitrogen was available to the crop at the 200-260 lb/ac rates. A CSNT for the lowest rate of 48 lb/acre 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 for this site is 140 lbs/ac of total nitrogen, netting $567/acre after nitrogen cost. At the economic optimum rate, the commercial nitrogen use efficiency (NUE) proved to be .78 lb of nitrogen per bushel of corn.

Economic optimum nitrogen rates vary greatly by nitrogen cost, corn price, soil type, rainfall timing and amounts, 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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