Corn Yield Response to Nitrogen Rate - Delta

Eric Richer, Ohio State University Extension Educator, Fulton County, Ohio

Objective

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

Background

Crop Year: 2017
County: Fulton
Location: Delta, Ohio
Drainage: Random
Previous Crop: Corn
Variety: Shur Grow 69555
Population: 32,000 seeds per acre
Plant Date: May 30
Harvest Date: November 10

Soil Type: Pewamo CL, Lamson FSL
Soil Test (grid avg):
pH 5.9
P 20 ppm (Bray-P1)
K 126 ppm
O.M. 2.1%
CEC 10.4 meq/100cc

Tillage: Conventional
Herbicide: Tripleflex, Atrazine f,b, Roundup Powermax
Starter Fertilizer: 70-68-69-9S
Pre-Sidedress N Test: 14 ppm NO_3-N
Nitrogen Source: Anhydrous
Rainfall (May – August): 18.7”

Methods

Four corn nitrogen rates were replicated four times in a randomized complete block design. Additionally, an un-replicated zero rate was planted for approximately 300 feet as the check treatment. Plots were 16 rows wide (40 foot) by 2500 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 70 pounds of nitrogen per acre at planting. Corn was sidedressed with the balance of the total nitrogen rate for the trial when corn was at vegetative growth stage V6 (six leaf collars present). At approximately 5-10 days after black layer, a corn stalk nitrate test (CSNT) was measured by taking the average of 10 stalks or every treatment replication (4 tests for each treatment). 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. 0 lbs. Total N/acre (unreplicated)
2. 150 lbs. Total N/acre
3. 200 lbs. Total N/acre
4. 250 lbs. Total N/acre
5. 300 lbs. Total N/acre

Results

Table 1. Corn Yield Response to Nitrogen Rate – Delta

Nitrogen Rate* (lbs/ac)	Yield (bu/ac)		NUE (lbN/bu)	CSNT (ppm nitrate N)	Return Minus N Cost** ($/ac)
0	179.3	C	0.00	23	$628
150	215.7	B	0.70	667	$705
200	222.1	A	0.90	1305	$710
250	217.5	AB	1.15	1792	$678
300	218.1	AB	1.38	2250	$663
LSD (P<.05, CV 1.73)	5.62				

*Zero rate was unreplicated
**Based on $3.50/bu corn and $.34/lb N (Source: OSUE 2017 Corn Budget)

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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:

There was no statistically significant difference for yield among the 200-300 lb. nitrogen rates. Similarly, the 150, 250, and 300 lb. rates were statistically the same. CSNTs indicate that optimal nitrate-N concentrations where achieved at the 150 to 250 lb. rates and excess nitrate-N concentrations at the 300 lb, rate (see Table 2). A CSNT for the lowest rate of 0 lb Total N/acre was most likely yield limiting.

A standard economics calculation shows that the maximum economic return rate is 200 lbs of total nitrogen, netting $710/acre after nitrogen cost. At the economic optimum rate, the commercial nitrogen use efficiency (NUE) proved to be .90 lb of nitrogen per bushel of corn.

Economic optimum nitrogen rates vary greatly by nitrogen cost, corn price, crop rotation, 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.

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For more information, contact:
Eric Richer
OSU Extension –Fulton County
8770 State Route 108
Wauseon, Ohio 43567
Richer.5@osu.edu

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