Nitrogen Timing and Placement for Corn Yield

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Objective

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

Background

Crop Year: 2016
County: Henry
Location: Napoleon, Ohio
Drainage: Systematic, 30' laterals
Previous Crop: Wheat
Variety: Pioneer 0993
Population: 34,800 seeds per acre
Plant Date: May 25, 2016
Harvest Date: November 12, 2016
Herbicide: 64 oz/ac Abunbit and CINCH ATZ
12.5 oz/ac Atrazine, 8 oz/ac Shredder
Fungicide: Aproach at VT
Soil Type: Hoytville, Nappanee clay loam
Tillage: Fall land level, No-till into Cereal Rye
Soil Test (grid avg): pH 5.9
P 40 ppm (Bray-P1)
K 222 ppm
O.M. 3.0%
CEC 16.3 meq/100g
Starter Fertilizer: 80-0-0
Pre-Sidedress Nitrogen Test: 6 ppm NO_3-N
Rainfall (May – August): 13.5"

Methods

Four corn nitrogen timing systems were replicated four times in a randomized complete block design. Plots were 24 rows wide (60 feet) by 600 feet long. The trial was planted, sprayed and harvested with commercial farm equipment. The sidedress treatments were made with commercial 28% UAN knife application equipment and late season nitrogen treatments were made with a high boy sprayer with drop tubes at each row. The total nitrogen budget for this farm was 200 units of nitrogen with a yield goal of 200 bushels per acre. All treatments received 80 units of nitrogen at planting (planter applied + pre-emerge). In this trial the sidedress treatment was made at V5 (June 29th), and the late season treatment was applied at V11 (July 22nd). Only rain between the two applications was a total of .6". The first significant rain (.5") fell 36 hours after late season application. A corn stalk nitrate test (CSNT) was taken for every replication and then averaged. Yields and moistures were measured using a calibrated yield monitor and shrunk to 15% moisture. Rainfall data was collected by the farmer at field level.

Treatments:
1. Check: Sidedress 28% (V5) 120 lbs N/acre
2. Placement: Root Applied 28% with drop tubes (V5) 120 lbs N/acre
3. Timing: Late Season 28% (V11) 120 lbs N/acre
4. Split: Sidedress 28% (V5) 60 lbs N/ac and Late Season 28% (V11) 60 lbs N/ac
5. Zero rate 48 lbs N/acre (unreplicated)

Results

Table 1. N Application Timing and Placement in Corn (28% UAN)

Nitrogen Application and Source**	Yield (bu/ac)	CSNT (ppm NO_3-N)	System Application Cost ($/ac)*	Return Minus Application Cost ($/ac)*
Check: Sidedress 28% (V5)	138.7 a	764	$9.25	$476
Placement: 28% at Root (V5)	140.0 a	1,154	$10.00	$480
Timing: Late Season (V10)	144.2 a	989	$10.00	$495
Split: 28% both times (V5 & V10)	139.1 a	1,014	$19.25	$468
Zero Rate (#48)	122.0 b	43	-	$427
LSD (P<.05, CV 5.95)	13.37			

*Based on $9.25 28% application, $10.00 highboy application and $3.50/bu corn. (Source: 2016 Ohio Custom Rates)

**All Systems used 120 lbs N/ac in season, 80 lbs N/ac at plant; zero rate unreplicated.

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 four replicated nitrogen timing systems in this 2016 trial (Table 1). CSNTs indicate that nitrate-nitrogen levels were at optimum ranges for all systems except the zero rate (Table 2). This site was under drought stress from planting until pollination and as such, these conditions could have affected nitrogen uptake and yield.

A standard economics calculation shows that the late season timing treatment (treatment 3) had the greatest economic return of $495/acre after nitrogen application costs. These returns will vary depending on each producer's equipment and nitrogen cost.

With the development and use of in-season nitrogen application equipment, the risk of N loss can be minimized by applying later in season when the corn crop needs it. Further research in the form of multi-year replication will add to the validity of these results.

Acknowledgement

The author expresses appreciation to on-farm collaborator Matt Eggers for conducting this trial and for Tri-flo, Inc for making the placement and timing treatments. Thanks to the Culman Lab at OARDC for processing CSNT tests and to the Ohio Corn Checkoff Board for supporting this research.