Corn Yield Response to Split-Application Nitrogen in Eastern Ohio (2016)

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Objective

To determine the effects of nitrogen rates on corn yields and use currently available soil tests, tissue tests, and crop removal rates to measure soil nitrogen availability.

Background

Crop Year:	2016
Location:	Zanesville, OH
County:	Muskingum
Previous Crop:	Soybean
Row Spacing:	30 in
Tillage:	No Till

Field 1

Soil Type:	Zanesville Silt Loam
N Source:	Granular urea and 28% UAN
Planting Date:	25 Apr
Harvest Date:	10 Oct
Soil Test:	pH 6.4
	P 28 ppm M3
	K 146 ppm M3
Seeding Rate:	32,000

Field 2

Soil Type:	Watertown Sandy Loam
N Source:	28% UAN
Planting Date:	27 May
Harvest Date:	10 Nov
Soil Test:	pH 6.3
	P 56 ppm M3
	K 62 ppm M3
Seeding Rate:	34,000

Methods

Two trials were planted to evaluate corn yield response to nitrogen. Participating farmers had similar practices with regard to herbicide program, traits and soil testing. Fertility application differed in regards to source and timing. Field 1 was planted one month earlier than Field 2 and harvested one month earlier. All plots were replicated 3 times in a randomized complete block design except where noted. Fertility rates were established in accordance with the constraints of each production system employed by the producer. Plots were field length and equipment dictated planting and harvesting width. Yields were measured with a grain cart and corrected to 15% moisture.

Preplant soil samples, grain samples, and tissue samples were collected and submitted to a laboratory for analysis. Five twelve-inch cores were collected in each plot for composite soil samples for soil nitrogen tests. Starting nitrogen (soil test) and applied nitrogen was subtracted from nitrogen removed (grain and stover) as a projection of nitrogen that would be present at the end of the season. This was compared to a post-harvest soil nitrogen test (soil test value minus projected value). This compares the projected nitrogen estimate that would be excess in the soil after harvest to an actual laboratory estimate of soil nitrogen test after harvest.

Fertility Application Field 1

Applications of 100lb of N were applied to all plots at planting with the balance of the treatments applied at sidedress with 28% urea ammonia nitrate (UAN). At planting fertilizer was applied through the planter in granular form at a rate of 97 lbs of N, 62 lbs of P_20_5, and 70 lbs of K_20 per acre.

Fertility Application Field 2

Liquid nutrients were applied at planting through the planter injection system. 28% UAN was applied in rates of 0, 20, 36 and 48 gal/ac. 30 gal/ac of 28% UAN was applied at sidedress to all treatments. Additional at-planting fertility included 200 lbs/ac of 9-23-30, 5 gal/ac of 9-18-9, 1 gal per acre of 0-0-26-17S, 3 pt/ac Zn, and 1 pt/ac Ca across all treatments

Results

Table 1. Corn Yield Response to N Rate Field 1.

Treatment (Total lbs N/ac)	Yield[z] (bushels/acre)	Applied Nitrogen Use (lb N/bu)[y]	Return after N[x]	Post-season plant available N (lbs)[w]
0	107.3 A	0.0	$ 375.43	144.1 B
100	203.5 B	0.5	$ 667.25	132.8 B
160	196.9 B	0.8	$ 617.27	105.6 B
220	191.9 B	1.1	$ 572.77	41.4 A

[z]Overall Mean: 174.9 bu/a; LSD (*P*<0.05): 38.7
[y]Applied nitrogen divided by final yield
[x]Corn at $3.50 and nitrogen at $0.45
[w]Accounts for applied nitrogen, grain/stover removal, and pre- /post-harvest soil nitrogen test. Overall Mean: 105.9 bu/a; LSD (*P*<0.05): 57.2

Table 2. Laboratory test results for corn R1 ear leaf samples, stalk nitrate test samples, and harvest grain samples for nitrogen treatments in Field 1.

Treatment (Total lbs N/ac)	Average R1 Ear Leaf Percent Nitrogen[z]	Average Corn Stalk Nitrate (ppm Nitrate N)[y]	Average Grain Percent Nitrogen
0	3.22 A	24 A	1.51
100	3.50 AB	159 A	1.49
160	3.48 AB	853 A	1.53
220	3.76 B	2480 B	1.52

[z]R1 ear leaf overall mean: 3.49; LSD (P<0.05): 0.35
[y]Stalk nitrate overall mean 879; LSD (P<0.05): 952

Table 3. Corn Yield Response to N Rate Field 2 (Conventional Till).

Treatment (Total lbs N/ac)	N (Reps) [z]	Yield[y] (bushels/acre)	Applied Nitrogen Use (lb N/bu)[x]	Return after N[w]	Post-season plant available N (lbs)[v]
122	3	169.3	0.7	$ 537.72	120.4
182	2	174.4	1.0	$ 528.34	97.7
230	3	168.2	1.4	$ 485.31	69.7
266	3	165.4	1.6	$ 459.25	71.9

[z]One plot dropped for harvest due to mechanical error
[y]Overall Mean: 168.9 bu/a
[x]Applied nitrogen divided by final yield
[w]Corn at $3.50 and nitrogen at $0.45
[v]Accounts for applied nitrogen, grain/stover removal, and pre- /post-harvest soil nitrogen test.

Table 4. Laboratory test results for corn R1 ear leaf samples, stalk nitrate test samples, and harvest grain samples for nitrogen treatments in Field 2.

Treatment (Total lbs N/ac)	Average R1 Ear Leaf Percent Nitrogen[z]	Average Corn Stalk Nitrate (ppm Nitrate N)	Average Grain Percent Nitrogen
122	2.86 A	1532	1.55
182	3.39 B	3173	1.39
230	3.41 B	1315	1.54
266	3.67 B	1337	1.39

[z]R1 ear leaf overall mean: 3.32; LSD (P<0.05): 0.40

Summary

The 2016 growing season in Muskingum County was characterized by above normal rainfall in April that delayed planting and below normal rainfall for the rest of the season. Total rainfall from 1 Apr to 30 Sep was 17.46 in, which is 4.24 in below normal for the time period (Zanesville Municipal Airport, USW00093824). Application rates of nitrogen were not significantly different for yield with the exception of the 0 rate at Field 1 (Table 1). No differences were detected between applications of nitrogen at Field 2 (Table 3). Under these field conditions lower rates of nitrogen were adequate for the growing season, however multi-year testing should be used to determine appropriate N rates that would account for patterns of higher rainfall and other environmental variability.

The calculation on post-season plant available nitrogen (lbs) was completed as an estimate of nitrogen still available after harvest and to reflect mineralization by the plant (Table 1 and Table 3). Corn ear leaf samples collected at R1 show significant differences and in both trials the lowest nitrogen rate returned the lowest percent nitrogen values in the ear leaf (Table 2 and Table 4). Corn stalk nitrate values were significantly different at Field 1 with only the highest nitrogen showing a significant difference from other treatments. Percent nitrogen in grain samples showed no response to nitrogen rates. The data presented here should be considered in context with other replicated and multi-year research.

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