Comparing Nitrogen Rates and Sources and Crop Rotation Effects on Corn Yield on Lakebed Soils

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Objective

To observe yield response and post-mortem stalk nitrate nitrogen concentration of corn when urea-ammonium nitrate (UAN) or anhydrous ammonia is supplied at different rates on lakebed soils. Observe yield response to continuous corn and soybean-corn rotation.

Background

Cooperator:	OARDC NW Branch	Variety:	Pioneer 34B24
County:	Wood	Fertilizer:	See Results
Soil Type:	Hoytville Clay	Planting Date:	May 2, 2001
Tillage:	Field Cultivator	Seeding Rate:	30,000 seeds/A
Soil Test:		Row Spacing:	30 inches
Corn-Corn:	pH 6.2, P 40 ppm, K 164 ppm	Harvest Date:	October 30, 2001\
Soy-Corn:	pH 5.9, P 38 ppm, K 153 ppm	Harvest Pop.:	26,000 plants/A (avg.)

Methods

This is the fourth year of a multi-year nitrogen study on corn at the Ohio Agricultural Research and Development Center's Northwestern branch near Hoytville. Starter nitrogen at the rate of 40 lbs. nitrogen per acre was applied in a 2 x 2 placement to all plots. Plot design was a randomized split block with four replications. Main plots were the rates of nitrogen applied. Subplots were the two sources of sidedress nitrogen. Each subplot consisted of four rows 70 feet long in which the center two were harvested for grain yield.

At V5-V6 stage of corn growth, UAN (28-0-0) or anhydrous ammonia (82-0-0) was applied at 0, 20, 80, 140, and 200 pounds of N per acre to make a total nitrogen application of 40, 60, 120, 180, and 240 pounds of actual N per acre. The UAN was applied with a solid-stream injector behind a no-till coulter. In the fall, a stalk nitrate test was taken at one to three weeks after the black layer stage. Five eight-inch stalk samples (sections from 6 inches to 14 inches above the ground) were collected from each plot and sampled separately. The samples were collected and sent to A&L Laboratories, Fort Wayne, Ind.

In 2000, a second series of plots following corn were added to the experiment to separate out the nitrogen contribution from soybeans as a previous crop. This is the second year of this addition.

Results

Table 1. Crop Yield (15% moisture) for Crop Sequences and End-of Season Stalk Nitrate Levels.[1] .

Total Nitrogen Rate (lbs/A)	Soybeans-Corn		Corn-Corn		Soybeans-Corn
	Corn Yield (bu/A)	Harvest Moisture (%)	Corn Yield (bu/A)	Harvest Moisture (%)	Post Mortem Stalk NO_3-N (ppm)
40	151.8 c	18.8	101.2 c	18.8 a	52
60	157.4 c	18.6	111.2 c	18.8 a	54
120	179.4 b	17.6	146.4 b	17.6 b	248
180	182.5 ab	17.8	155.9 ab	16.8 b	320
240	188.6 a	18	161.3 a	17.0 b	341
LSD (0.05)	9.1	NS	11.3	0.92	NS
CV (%)	3.4	5	5.4	4.7	95

[1] Means in the same column followed by the same letter are not significantly different.

Table 2. Effects of Two Sources of Nitrogen on Corn Yield (15% moisture) in Two Crop Rotations.[1] .

Source	Soybeans-Corn		Corn-Corn	
	Corn Yield (bu/A)	Harvest Moisture (%)	Corn Yield (bu/A)	Harvest Moisture (%)
Anhy. NH_3	173.7	18.2	140.2 a	17.4 a
UAN	170.2	18.1	130.2 b	18.2 b
LSD (0.05)	NS	NS	9.2	0.54
CV (%)	5	2.4	6.8	3

[1] Means in the same column followed by the same letter are not significantly different.

Summary and Notes

The highest yield for 2001 was obtained with the two highest nitrogen rates for both crop sequences. The 120-lb/A rate was significantly different from the highest rate for both rotations. This is different from the three previous years where there was no yield difference in the 120, 180, and 240 pound per acre nitrogen rate. Yield results from all years will be assembled into a yield response curve in the future. Data from the University of Illinois indicates that at least eight years of data is needed to produce a yield response curve with confidence.

A pronounced difference in the 2001 data from previous years comes in the post-mortem or end-of-season stalk nitrate results. The postmortem NO_3-N stalk tests have been suggested as a possible measure of nitrogen availability to the plant during the growing season. Iowa State data

suggests that stalk N levels less than 250 PPM indicate a high probability that higher N rates would have increased yield. NO_3-N at 250 to 700 PPM is considered close to the minimal amount to meet crop needs. Test results at the 701 to 2,000 PPM level indicates a high probability that N was within the range for optimum corn yield. Test results greater than 2,000 PPM indicates N availability was greater than crop needs for optimum yield.

In the three previous years, nitrogen rates producing the highest yield also produced stalk nitrate levels near or well into the optimum range of 700 to 2,000 as suggested by Iowa State data. In 2001, even the highest rate of nitrogen produced stalk nitrate levels of only 341 PPM. This seems to indicate that nitrogen was mobilized from the stalk to meet late season demands of the plant due to the growing season and rainfall conditions. This points out that caution should be used in interpreting single-year results with the stalk nitrate test with consideration given to weather conditions and other factors influencing stalk quality. Stalk lodging was not a problem in the experimental plots but was in commercial fields in the area. The nitrogen data may provide some indication of lower stalk quality in the area.

This is only the second year of including continuous corn in the study. In 2000 no differences were noted in the yield of corn-corn and soybean-corn rotations. Comparing the 2001 data of the two crop sequences, the greatest benefit from soybean was at the two lowest nitrogen rates where an average yield increase of 48 bu/A was realized. At the three highest rates, the benefit from soybean was less with a 29 bu/A increase.

Nitrogen effects on corn moisture have been noted in past research on nitrogen response. The soybean-corn rotation showed no differences in moisture content at harvest. The corn after corn did show a significant difference in corn moisture at harvest with the 40 and 60 pound total nitrogen rates showing 1.2, 2, and 1.8 points higher moisture than the 120, 180, or 240 rate respectively.

No significant differences in yield were noted with the two sources in the soybean-corn treatment, but a difference was noted in the corn-corn with the yield advantage to anhydrous ammonia despite the injection placement of the UAN. Grain moisture was also significantly higher in the UAN plots.

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