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Corn Response to Nitrogen Rates

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Abstract

The purpose of this study was to evaluate the nitrogen (N) fertilization responses of four differing hybrids each year, rotated with soybeans, over a 3-yr period. Multiple rates of N fertilizer were spring applied, with the intent to measure yield response to N and nitrate concentrations at the end of the growing season. This allows the determination of N requirements for each corn hybrid and evaluation of N management practices over time.

Disciplines

Agricultural Science | Agriculture

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Introduction

The purpose of this study was to evaluate the nitrogen (N) fertilization responses of four differing hybrids each year, rotated with soybeans, over a 3-yr period. Multiple rates of N fertilizer were spring applied, with the intent to measure yield response to N and nitrate concentrations at the end of the growing season. This allows the determination of N requirements for each corn hybrid and evaluation of N management practices over time.

Materials and Methods

The soils in the plot areas consisted of a mix of Floyd loams and Clyde silty clay loams. Soil fertility for the 2004 through 2006 plots averaged 17.3 ppm P_20_5 (optimum by Bray-P) and 141.2 ppm K_20 (optimum by ammonium acetate K) with 6.65 pH and 4.72% organic matter. The experiment was a split plot, randomized complete block design (whole plot was fertilizer, split plot was hybrid) with three replications, and plots were 15 ft × 60 ft long. Previous crop was soybeans. The studies were in conventional tillage systems (no fall tillage followed by spring field cultivation prior to planting after N applications).

The N treatments are 0, 60, 90, 120, 150, and 180 lb N/acre. From 2004 through 2006, granulated urea (46-0-0) was spread and incorporated into the soil with a field cultivator in late April. Corn varieties were planted 2.0 in. deep in late April of each year. The plots were sprayed with a soil-applied preemergent herbicide followed by a postemergent broadleaf herbicide. The plots were machine harvested for yield in mid-October of each year with stalk test samples taken for nitrate concentration.

Results and Discussion

Hybrid yields were averaged due to similar responses to nitrogen rates. Specific hybrid responses are available upon request. With no N applied, corn yielded 119.2, 96.0, and 140.9 bushels/acre for 2004, 2005, and 2006, respectively (Tables 1–3). The higher corn yields in 2006, regardless of N rate are reflective of minimal rainfall events from May through September, which reduced N leaching. Fall 2006 stalk N concentrations also reflect more accurate readings, because no heavy rains causing N leaching losses occurred (Table 1). The optimum N rate for 2006 was the 120 lb rate. The 150 and 180 lb N rate gave an additional 4.0 and 4.8 bushels/acre, respectively, but the additional N cost would require a 5.9 bushel increase for each additional 30 lb N.

In 2005, corn yields responded positively to each N rate. Fall stalk N concentrations were low except the marginal reading at the 180 lb N rate. This probably occurred because May through July rainfall totaled 16.14 in., almost twice that of 2006 and resulted in excessive N leaching through the soil profile (Table 2).

In 2004, excessive flooding occurred from 11.24 in. of rain in May (Table 3). A 2-day rain event (5.36 in.) plus a single-day rain event (2.0 in.) for a 7-day time period in May caused considerable N leaching. Fall stalk samples were in the low range, regardless of N rate.

The results presented in this report are from a 3-yr period and therefore are not meant as long-term N recommendations. They do, however, represent responses for the specific years comparing several hybrids with different growing season weather conditions present.

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Table 1. Corn grain yield, N concentrations, N cost, and growing season rainfall, 2006.

N rate per acre	Yield average 4 hybrids (bu/ac)	Fall N conc. average[1] (ppm)	N cost[2] ($/ac)	Corn bushels needed to pay for additional rate of N/ac[3]	2006 April–Sept rainfall (in.)
0	140.9	20	--	--	April – 4.79
60	190.5	20	$23.48	11.74	May – 1.33
90	203.1	68	$35.22	17.61	June – 4.55
120	208.8	564	$46.96	23.48	July – 2.31
150	212.8	1767	$58.70	29.35	Aug – 2.68
180	217.6	2915	$70.43	35.22	Sept – 4.94
Average	195.6				Total – 20.6

[1]N concentration in stalk (Low=<250 ppm, Marginal=250-700 ppm, Optimal=700-2000 ppm, Excess=>2000 ppm).
[2]Nitrogen (46-0-0) cost=$0.18/lb product or $0.3913/lb actual N/acre.
[3]Price of corn/bushel=$2.

Table 2. Corn grain yield, N concentrations, N cost, and growing season rainfall, 2005.

N rate per acre	Yield average 4 hybrids (bu/ac)	Fall N conc. average[1] (ppm)	N cost[2] ($/ac)	Corn bushels needed to pay for additional rate of N/ac[3]	2005 April–Sept rainfall (in.)
0	96.0	21	--	--	April – 2.34
60	135.4	20	$21.26	10.63	May – 4.34
90	161.1	120	$31.89	15.95	June – 7.94
120	172.0	86	$42.52	21.26	July – 3.86
150	175.1	64	$53.15	26.58	Aug – 5.97
180	199.9	442	$63.78	31.89	Sept – 6.62
Average	156.6				Total – 31.07

[1]N concentration in stalk (Low=<250 ppm, Marginal=250-700 ppm, Optimal=700-2000 ppm, Excess=>2000 ppm).
[2]Nitrogen (46-0-0) cost=$0.163/lb product or $0.3543/lb actual N/acre.
[3]Price of corn/bushel=$2.

Table 3. Corn grain yield, N concentrations, N cost, and growing season rainfall, 2004.

N rate per acre	Yield average 4 hybrids (bu/ac)	Fall N conc. average[1] (ppm)	N cost[2] ($/ac)	Corn bushels needed to pay for additional rate of N/ac[3]	2004 April - Sept rainfall (in.)
0	119.2	20	--	--	April – 1.75
60	154.0	20	$19.24	9.62	May – 11.24
90	171.5	20	$28.86	14.43	June – 2.92
120	179.2	20	$38.48	38.48	July – 6.11
150	196.1	150	$48.10	24.05	Aug – 2.90
180	188.1	155	$57.72	28.86	Sept – 2.24
Average	168.0				Total – 27.16

[1]N concentration in stalk (Low=<250 ppm, Marginal=250-700 ppm, Optimal=700-2000 ppm, Excess=>2000 ppm).
[2]Nitrogen (46-0-0) cost=$0.1475/lb product or $0.3206/lb actual N/acre.
[3]Price of corn/bushel=$2.