Optimal Nitrogen Rate for Corn on Two Mississippi River Alluvial Soils

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Abstract

Traditional methods for determining N requirements have been the calibration of yield response to applied N rates for different soils and years. Generally , higher N rates are required for maximum yield on the heavier-textured clay soils compared to sandier soil types. Field experiments were conducted at the Northeast Research Station (NERS) in St. Joseph, LA, from 2002 to 2012 calibrating yield response to N rate on Commerce silt loam (dryland) and Sharkey clay. On Sharkey clay, low-yield trials were not irrigated and high-yield trials were furrow irrigated. Economical N rates (EONR) were determined using a N price of $0.65 per pound (30-0-0-2 N solution) and corn at $5.50 per bushel. On Commerce silt loam, maximum yield occurred at about 220 lb N/acre and EONR occurred at about 190 lb N/acre. The present recommendation for non-irrigated alluvial silt loam soils is 140-180 lb N/acre. On Sharkey clay, maximum yield occurred at about 250 lb N/acre in both the low-yield and high-yield trials. The EONR was also similar at about 220 lb N/acre for both yield categories. The lack of differences in maximum yield and EONR between the two yield categories may have been due, in part, to higher than expected fertilizer N requirement in the low-yielding trials resulting from reduced fertilizer N efficiency. Current N recommendations for the alluvial clay soils is 180 – 240 lb N/acre.

Introduction

Traditional methods for determining N requirements have been the calibration of yield response to applied N rates for different soils and years. Consequently, required N rate values generated are average values across time that may or may not be adequate in a particular year. Generally, higher N rates are required for maximum yield on the heavier-textured clay soils compared to sandier soil types (Tremblay et al., 2012). Research indicates that this is due in large part to improved fertilizer N efficiency on the sandier soils probably related to deeper root profiles and better soil moisture status. New technologies such as remote sensing are currently being evaluated for improving fertilizer N calibrations in corn (Scharf et al., 2012). For determining the economic optimum N rate (EONR), N rate where the change in grain price equals the change in fertilizer cost, costs of fertilizer and price of corn must be considered. For example, as the costs of fertilizer increases the economic N rate decreases. Currently the LSU AgCenter's N recommendation for alluvial soils is 140-180 pounds/acre for non-irrigated soils and 180-240 pounds/acre for irrigated soils. Nitrogen calibration trials have been conducted at the Northeast Research Station (NERS) in St. Joseph over the years. This report summarizes N calibration data at the NERS on two alluvial soils over the last decade.

Materials and Methods

Field experiments were conducted at the NERS from 2002 to 2012 calibrating corn yield response to N rate on Commerce silt loam and Sharkey clay. These trials not only evaluated N rate, but also other practices such as N timing, hybrid, irrigation and seeding rate. Nitrogen rates varied depending on objectives of the experiment. A summary of the number of trials, yield ranges, and yield averages for each N rate and soil is reported in Table 1. For the Sharkey clay, trials were subdivided into low yield (less than 150 bushels per acre) and high yield (greater than 150 bushels per acre) trials. The low-yield trials were not irrigated and all but one of the high-yield trials were irrigated. Nitrogen was knifed-in as either 32-0-0 or 30-0-0-2 N solution at the early seeding stage. Grain yields are reported at 15.5% moisture. Economical N rates were determined using a N price of $0.65 per pound (30-0-0-2) and corn at $5.50 per bushel. Soil management practices included conventional tillage on Commerce and stale seedbed on Sharkey. Previous crop was cotton in all trials. Production practices as recommended by the LSU AgCenter were followed.

Results and Discussion

Nine trials were conducted on Commerce silt loam from 2002 to 2012 with yields ranging from 52.3 to 165.5 bushels per acre (Table 1). When no N was applied, yields averaged 52.3 bushels per acre. There was a wide range in yields for rates across years, suggesting that yield potential varied probably due largely to year effects and maybe to a lesser extent management factors. The response to N rate followed a curvilinear response, indicating that yield responses to added N decreased as N rate increased. Based on the model (curvilinear response), maximum yield (the top of the yield curve) occurred at about 220 pounds of N per acre and EONR occurred at about 190 pounds of N per acre (Fig. 1). The present N recommendation for non-irrigated alluvial soils is 140 – 180 pounds of N per acre.

Five low-yield (non-irrigated) and 12 high-yield (irrigated) trials were conducted on Sharkey clay from 2003 to 2012 (Table 1). Yields ranged from 15.6 to 144.7 bushels per acre in low-yield trials and 20.2 to 191.0 bushels per acre in high-yield trials (Fig. 2). The no-N control averaged 15.6 bushels per acre in the low-yield trials and 20.2 bushels per acre in the high-yield trials. The difference in yield potential in the low and high-yield trials was primarily irrigation (only one high-yield trial was not irrigated). Similar to Commerce trials, yield response to N rate was curvilinear regardless of yield potential. Yield was maximized at about 250 pounds of N per acre in both the low-yield and high-yield trials on the Sharkey clay (Fig. 2). The EONR was also similar at about 220 pounds of N per acre for both yield categories. The lack of differences in maximum yield and EONR between the two yield categories may have been due, in part, to higher than expected fertilizer N requirement in the low-yield trials resulting from reduced fertilizer N efficiency (Vanotti and Bundy, 1994).

Table 1. Trial description (number of trials, yield range, and yield average for each N rate and soil type at St. Joseph, 2002 – 2012.

Trial description	N rate, lb/acre 0	50	100	120	150	180	200	210	240	250	270
Commerce, silt loam											
Number of trials	7	-	-	4	9	8	1	8	7	1	-
Yield range, bu/a	16.2-116.8	-	-	108.3-190.8	113.6-192.0	117.6-198.7	161.7	117.9-197.1	116.2-192.6	165.5	-
Yield avg, bu/a	52.3	-	-	143.8	147.8	155.2	161.7	161.2	157.7	165.5	-
Sharkey clay, low-yield potential											
Number of trials	2	-	1	-	4	4	1	4	4	1	2
Yield range, bu/a	14.9-16.3	-	90.4	-	95.8-129.1	93.2-125.3	133.8	108.1-128.2	106.0-134.2	144.7	108.4-124.9
Yield avg, bu/a	15.6	-	90.4	-	110.6	108.5	133.8	117.1	120.2	144.7	116.7
Sharkey clay, high-yield potential											
Number of trials	8	1	1	-	5	10	1	11	11	1	7
Yield range, bu/a	3.9-41.1	84.8	138.4	-	147.3-169.1	127.6-214.9	179.5	138.7-235.1	147.3-231.5	191.0	157.7-219.1
Yield avg, bu/a	20.2	84.8	138.4	-	157.8	170.0	179.5	179.5	188.6	191.0	185.0

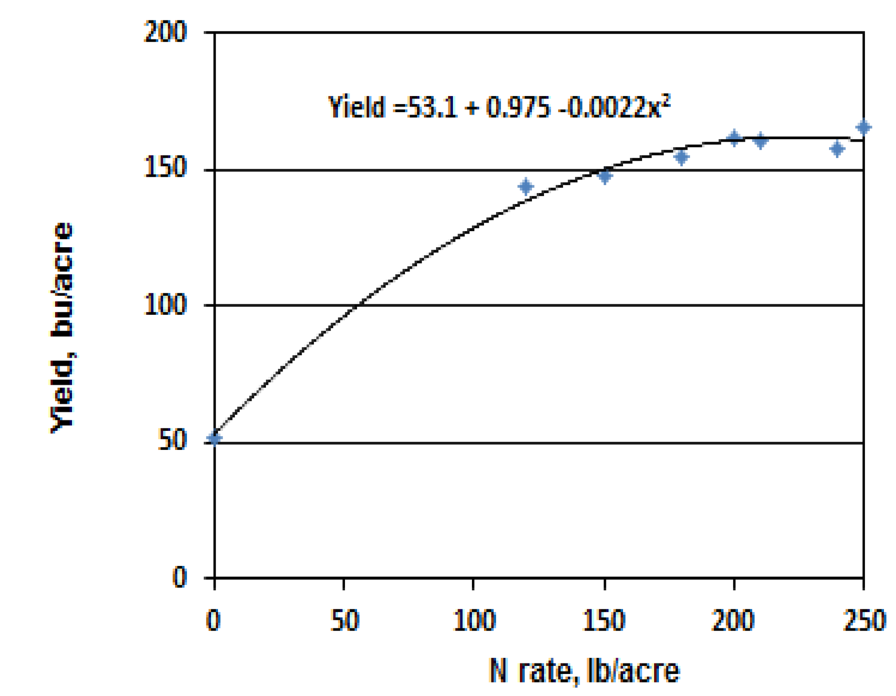

Fig. 1. Influence of N rate on corn yield on Commerce silt loam at St. Joseph, 2002 – 2012.

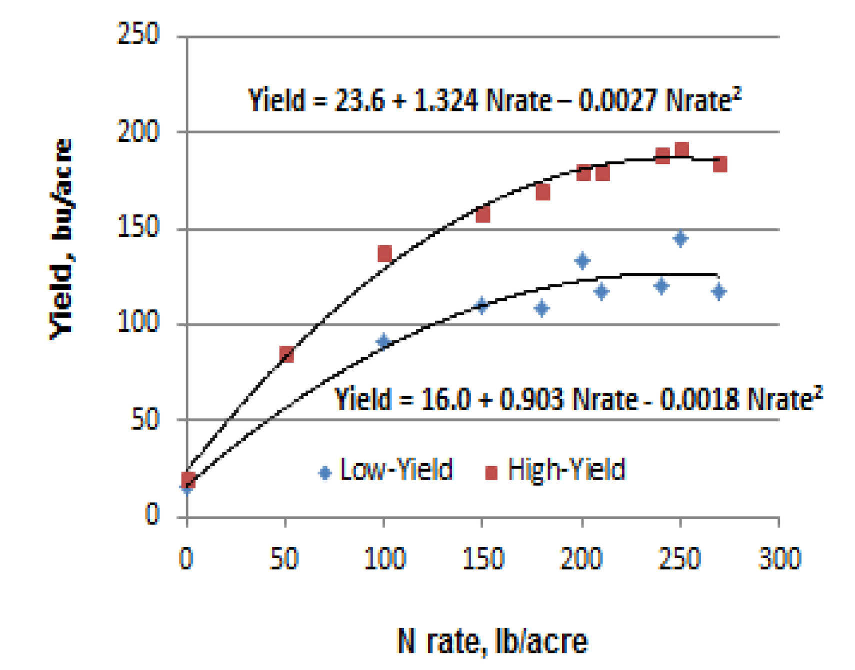

Fig. 2. Influence of N rate on corn yield at low and high yield potential on Sharkey clay at St. Joseph, 2003 – 2012.

References

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