Influence of Late Nitrogen Applications on Corn Grain Yield on a Mississippi River Alluvial Silt Loam in Northeast Louisiana

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Introduction

Nitrogen (N) fertilization is a critical cultural practice required for producing maximum corn yield. Many factors, including soil type and crop management system, determine optimum N rates. Nitrogen is typically knifed-in soon after the crop has emerged and an adequate stand established. After fertilization, uncontrollable factors such as excessive or lack of rainfall, may produce soil conditions conducive to N fertilizer loss through denitrification and/or inefficient plant N uptake. Sometimes N applications are delayed or omitted due to inclement weather. While at other times, growers apply the recommended N rate for an expected yield potential; however, as the crop develops yield potential may be higher than expected and additional N may be required. In each of the above situations the question arises, can N applications as late as reproductive growth stages be effective? The objective of this trial was to evaluate late N applications on a Mississippi River alluvial silt loam.

Procedures

A field experiment was conducted in 2006 on Commerce silt loam at the Northeast Research Station near St. Joseph to evaluate the influence of N rate and timing on corn grain yield and N fertilizer use efficiency (NFUE). Early-season N (ESN) was injected at about the two-leaf growth stage as 32% URAN solution at N rates of 0, 120, 150, 180, 210 and 240 lb/acre. Late-season N (LSN) was broadcast at tassel emergence as ammonium nitrate at rates of 0 and 60 lb/acre on June 6, 2006, for each ESN rate, except for the no-N control. This resulted in a total of 11 treatments. Pioneer brand (PB) 33R81 was planted on March 16 at a seeding rate of approximately 30,000 seed/acre. Cultural practices as recommended by the LSU AgCenter were followed.

The experimental design was a randomized complete block with four replications. Grain yield, leaf N, kernel-N concentration, kernel-N uptake, and NFUE were measured. Grain yield was determined by machine harvest from the two middle rows of four-row plots and reported at 15.5% moisture. Yield components, ears/acre, kernel weight (g/100 seed), and ear size (kernels/ear) were also determined from the two middle rows. Twelve ear-leave samples were collected from the two center rows at tassel emergence (June 6). Total N was determined in the ear leaves and kernels by the LSU AgCenter's Soil and Plant Testing Lab. Kernel N uptake (lb N/acre) was calculated by multiplying kernel N concentration by grain yield. NFUE was calculated using the following formula: (kernel-N uptake for a given N rate – kernel-N uptake for the no-N control) / N rate. Calculations for kernel-N uptake and NFUE are based on dry weight. Statistical analyses were performed using the GLM procedure of SAS at probability level of 0.10.

Results and Discussion

Rainfall in 2006 was about normal except for the month of June (Table 1). June rainfall was well below the normal with a total for the month of only 0.38 inches. Even though June is the critical time the corn plant pollinates and begins grain fill, grain yields were excellent (Table 3).

There was a trend for ear-leaf N to increase as ESN rates increased (Table 2). Ear-leaf N at tassel emergence ranged from 1.65% for the no-N control to 3.34% for the ESN rate of 240 lb/acre. The published critical level for ear-leaf N at tassel is about 3.0%.

Grain yields for the ESN rates increased up to about 180 to 210 lb N/acre (Table 3). Unfortunately, rainfall did not occur for three to four weeks after LSN applications, so, not unexpectedly, there was little affect of LSN in either of the non-irrigated trials. Although not significant, there were some trends that indicated that late N increased grain yields. Grain yields were increased by late N 10.5% for the 120 lb/acre ESN rate and 7.8% for the 150 lb/acre ESN rate. Averaged across ESN rates, the 60 lb/acre late application produced grain yields of 156.9 bu/acre compared to 152.5 bu/acre when no late N was applied. Both kernel weight and ear size (kernels/ear), contributed to grain yield responses for the ESN rates (Table 3).

Kernel N and kernel-N uptake were increased by both the ESN and LSN applications (Table 4). Kernel N ranged from 1.11 to 1.37% for the ESN rates and 1.25 to 1.30% for the LSN rates. Similarly, kernel-N uptake ranged from 60.5 to 112.3 lb/acre for the ESN rates and 91.2 to 97.3 lb/acre for the LSN rates. NFUE decreased with late N for each ESN rate. When comparing equivalent N rates, the single application had higher NFUE values than the split application, early and late season. For the 180 lb/acre rate, NFUE for the single rate was 48.6% and 31.1% for the two-way split application.

The findings from this study are inconclusive. The lack of rain for three weeks after the late application may have minimized grain yield responses to the supplemental N due to lack of fertilizer activation. Additional years will be evaluated to fully elucidate corn's response to late N on this soil type.

Table 1. Rainfall received at the Northeast Research Station, 2006

Month	Rainfall
	inches
March	5.11
April	3.49
May	5.09
June	0.38
July	4.62
August	4.10

Table 2 . Influence of early-season N rates on ear-leaf N at tassel emergence on Commerce silt loam at St. Joseph, 2006.

Early N	Ear-leaf N
lb/acre	%
0	1.65
120	2.66
150	3.08
180	3.11
210	3.23
240	3.34
Average:	2.85
LSD (0.10):	**0.22**

Table 3. Influence of early-season and late-season N rates on grain yield and yield components, ears/acre, kernel weight, and kernels/ear, on Commerce silt loam at St. Joseph, 2006.

Early N	Late N	Total N applied	Grain yield	Ears	Kernel weight	Kernels
lb/acre	lb/acre	lb/acre	bu/acre	no/acre	g/100	no/ear
0*	-	0	20.0	27,570	22.8	81
120	0	120	108.3	27,740	28.1	354
120	60	180	119.7	28,280	30.1	358
150	0	150	142.7	27,450	32.6	406
150	60	210	153.9	28,280	32.9	420
180	0	180	164.0	28,320	34.0	433
180	60	240	164.5	28,810	34.2	425
210	0	210	175.8	28,570	34.9	449
210	60	270	170.3	27,990	35.9	432
240	0	240	171.9	28,470	35.9	426
240	60	300	176.2	27,160	37.3	442
Averages:			154.8	28,110	33.6	415
LSD (0.10):			**NS**	**NS**	**NS**	**NS**
Early N averages:						
150			114.0	28,010	29.1	356
180			148.3	27,870	32.8	413
210			164.3	28,570	34.1	429
240			173.1	28,280	35.4	441
270			174.1	27,820	36.6	434
LSD (0.10):			**13.9**	**NS**	**1.4**	**22**
Late N averages:						
0			152.5	28,110	33.1	414
60			156.9	28,100	34.1	415
LSD (0.10):			**NS**	**NS**	**0.9**	**NS**

*The no-N control data was not included in the statistical analyses.

Table 4. Influence of early-season and late-season N rates on grain yield, kernel N, kernel-N uptake, and N fertilizer use efficiency (NFUE) on Commerce silt loam at St. Joseph, 2006.

Early N	Late N	Total N applied	Kernel-N concentration	Kernel-N uptake	NFUE
----------lb/acre----------			%	lb/acre	%
0*	-	-	1.05	9.9	-
120	0	120	1.07	55.0	37.5
120	60	180	1.15	66.0	31.1
150	0	150	1.22	82.2	48.2
150	60	210	1.26	91.5	38.8
180	0	180	1.25	97.4	48.6
180	60	240	1.31	102.2	38.5
210	0	210	1.34	111.9	48.5
210	60	270	1.39	111.5	37.6
240	0	240	1.35	109.4	41.4
240	60	300	1.38	115.2	35.1
Mean:			1.27	94.2	40.6
LSD (0.10):			**NS**	**NS**	**NS**
Early N means:					
120			1.11	60.5	34.3
150			1.24	86.9	43.5
180			1.28	99.8	43.6
210			1.37	111.7	43.1
240			1.37	112.3	38.3
LSD (0.10):			**0.06**	**10.3**	**5.8**
Late N means:					
0			1.25	91.2	44.8
60			1.30	97.3	36.2
LSD (0.10):			**0.02**	**3.4**	**1.8**

*The no-N control data was not included in the statistical analyses.