EFFECT OF TIME OF N APPLICATION FOR CORN[1]

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Background:

The economic benefit associated with the application of N fertilizers for corn has been known for over 5 decades. As a result, over 99 % of the farmers in Illinois apply N fertilizers when corn is grown. Unlike phosphorus and potassium, there is no good soil test to predict the amount of N needed, instead, farmers use a factor times yield potential with appropriate credits for legume and other N sources to set N rates. While this works well over a number of years, there are years when less N will optimize yield and as a result there is excess N in the system, some of which has the potential to contaminate water supplies. There are also years in which N loss from fertilizer may be high due to excessive wetness early in the season. Since a loss of N will result in less than optimum yield, some farmers apply extra N to compensate for this possibility. Development of a system that would predict in season need for N early enough to correct the problem with little or no yield loss would be beneficial to farmers and the general public. It would allow farmers to use less N with assurance that they could adjust during the growing season and still optimize yield. If this system resulted in less N being used, there is a good possibility that it could reduce the risk of environmental contamination.

The objectives of this study were to determine how late in the growing season corrective N applications could be applied to maintain optimum yield, and whether spectral reflectance from aerial photographs or SPAD meter readings would predict N deficiency.

Methods and Materials:

Field experiments were conducted at Urbana and DeKalb, Illinois (Table 1) to evaluate the effect of variable N rate and timing on corn grain yield. The effect of treatments on relative greenness was monitored throughout the season by use of the SPAD meter and by aerial photography. The relationship between greenness values and grain yield were determined.

Nitrogen was applied at rates ranging from 0 to180 lb N/acre in 30 lb increments, as preplant and in various combinations of dates from preplant through silking(R1) (Table 2). Treatments were applied in a randomized-complete block design, using urea-ammonium nitrate solution (28%N) as the N source. A tractor mounted applicator was used to inject the N solutions for the applications at planting time and at sidedressing. Subsequent applications were made with a specially designed, hand carried sprayer. At each application time after crop emergence, SPAD readings were taken on the leaf below the youngest fully-emerged (collar visible) leaf, and on the leaf below the ear leaf at and after R1. Grain yield was determined by harvesting a portion of the center two rows of each plot.

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Table 1. Characteristics of experimental areas

	Location		
	Urbana		DeKalb
	1997	1998	1998
Soil type	Plano sil	Elburn sil	Flanagan sil
Hybrid	Pioneer 3355	Pioneer 33A14	Pioneer 35N05
Date of planting	4/17	4/28	5/18

Results and discussion:

Corn grain yields were more than doubled with the application of N at Urbana in 1997 (Table 3). Other than at the 2 highest N rates, planting time application of 30 lb N/acre plus sidedress application resulted in significantly higher yield than did preplant application of comparable N rates. Comparable yields were obtained with post application rates applied as late as 4 weeks after sidedressing when the planting time rate was 90 lb N/acre. At this rate of N at planting, delaying post applications to 6 weeks after sidedressing resulted in a small but significant decrease in grain yield. When 120 and 150 lb N/acre was applied at planting time, post N applications as late as 4 and in some cases 6 weeks after sidedressing resulted in yields comparable to those from sidedress treatments (Table 3).

Grain yield increases associated with the application of N was somewhat less in 1998 than 1997 at Urbana (Table 4) and there were no consistent differences between planting time and sidedress N. Delaying the post N applications for as long as 6 weeks after sidedressing did not reduce yield response to N.

In contrast to the two years at Urbana, sidedressing did not yield as well as planting time application at DeKalb in 1998 (Table 5). For the most part, post applications delayed for as long as 6 weeks after sidedressing resulted in yields as high as those from N applied at planting time.

Summary:

Results of this study have shown that as long as 50% of the optimum N rate has been applied at planting time, application of the remainder of the N within 6 weeks after sidedressing will optimize yield in most instances. While the data are not shown, SPAD readings and spectral reflectance from aerial photos served as good predictors of the need for supplemental N during vegetative growth. In most cases, N deficiency symptoms developed early enough that a subsequent application of N would have resulted in little yield loss.

Table 2. Rate and time of N application by treatment.

	Time and rate (lbl/acre) of N application				
Treatment No.	At Planting	Sidedress	SD + 2 wk	SD + 4 wk	SD + 6wk
1	0				
2	30				
3	60				
4	90				
5	120				
6	150				
7	180				
8	30	30			
9	30	60			
10	30	90			
11	30	120			
12	30	150			
13	90		30		
14	90		60		
15	90		90		
16	90			30	
17	90			60	
18	90			90	
19	90				30
20	90				60
21	90				90
22	120		30		
23	120		60		
24	120			30	
25	120			60	
26	120				30
27	120				60
28	150		30		
29	150			30	
30	150				30

Table 3. Effect of time and rate of N application on corn grain yield, Urbana, 1997.

			Time of Post N Application				
Total N	Planting N	Post N	No Post	SD	SD+2 wks	SD + 4 wks	SD + 6wks
----------lb/acre----------			---------------------------------yield, bu/acre---------------------------------				
0	0	0	87				
30	30	0	111				
60	60	0	92				
90	90	0	129				
120	120	0	160				
150	150	0	183				
180	180	0	179				
60	30	30		112			
90	30	60		146			
120	30	90		174			
150	30	120		181			
180	30	150		181			
120	90	30			169	172	164
150	90	60			182	190	172
180	90	90			188	179	175
150	120	30			178	188	188
180	120	60			189	186	170
180	150	30			178	195	178

lsd = 19.7

Table 4. Effect of time and rate of N application on corn grain yield, Urbana, 1998.

			Time of Post N Application				
Total N	Planting N	Post N	No Post	SD	SD+2 wks	SD + 4 wks	SD + 6wks
----------lb/acre----------			--------------------yield, bu/acre--------------------				
0	0	0	101				
30	30	0	124				
60	60	0	123				
90	90	0	128				
120	120	0	168				
150	150	0	153				
180	180	0	155				
60	30	30		124			
90	30	60		148			
120	30	90		152			
150	30	120		157			
180	30	150		161			
120	90	30			159	169	152
150	90	60			167	172	161
180	90	90			177	155	152
150	120	30			165	165	160
180	120	60			164	168	165
180	150	30			184	183	164

lsd = 19.0

Table 5. Effect of time and rate of N application on corn grain yield, DeKalb, 1998.

			Time of Post N Application				
Total N	Planting N	Post N	No Post	SD	SD+2 wks	SD + 4 wks	SD + 6wks
-----------lb/acre-----------			---------------------------------yield, bu/acre---------------------------------				
0	0	0	130				
30	30	0	165				
60	60	0	180				
90	90	0	190				
120	120	0	197				
150	150	0	204				
180	180	0	211				
60	30	30		166			
90	30	60		175			
120	30	90		178			
150	30	120		193			
180	30	150		204			
120	90	30			198	198	191
150	90	60			184	194	206
180	90	90			203	203	192
150	120	30			197	202	206
180	120	60			198	203	203
180	150	30			207	190	201

lsd = 17.9

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