EVALUATING OPTIMUM SIDE-DRESS N APPLICATION RATES FOR CORN FOLLOWING SOYBEANS

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Introduction

Several grain crop producers in Southern Wisconsin have strived to minimize nitrogen (N) loss and improve profitability by side-dressing the majority of the crop's N requirement when the corn is 12-20 inches tall. Side-dressing minimizes the threat of N loss by leaching or denitrification, which often occurs when N is applied during the fall or spring. However, current UW recommendations do not provide an adjustment factor for side-dressed N. A group of grain producers participated in an on-farm N-rate study to evaluate optimum side-dress N rates for corn. From the study, questions arose whether the 40 pound N credit for soybeans should actually be increased.

Materials and Methods

A three year on-farm study (1999-2001) was conducted at 13 different locations across Dodge, Jefferson and Walworth Counties. A randomized block design with four N rates (80, 120, 160 or 200 lbs. actual N per acre) and three replications was used at each location. Except for starter fertilizer (between 20 and 30 units of N per acre), all nitrogen was side-dress as either anhydrous ammonia or 28% N solution when the corn was between 12-20 inches tall. To accurately determine each application rate, the anhydrous tank was weighed between treatments with a set of weigh pads and the 28% N solution was applied with a flow meter. Each experimental unit averaged 0.41 acres and yield was determined using a weigh wagon provided by a local seed dealer.

Soil test results from each location recommended 160 lbs. N per acre and a 40 lb. N credit for the soybeans grown the prior year. Soils in the study ranged from a Pella silt loam and Milford silty clay loam with 5-6% organic matter at the Kleiber farm to a Kidder silt loam with 2% organic matter at the Frison farm.

Results and Discussion

Corn yields did not increase when additional N was applied above the lowest N application rate (~80 lbs. N per acre) at 75% of the sites (Table 1). Although significant increases in yield were observed with higher N rates at 25% of the

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sites, the additional N needed to produce those yields was often uneconomical. At the Novak site in 2000 an additional 93 units of N were needed to obtain a significant yield increase of eight bushels per acre. Using anhydrous ($0.15 per unit N) Novak would have gained $2.05 per acre with $2 corn, but would have lost $6.32 per acre had he used 28% N ($0.24 per unit). The same trend held for both the Frison and Hoffman site during 2001. Unless the producer used a low cost N product such as anhydrous, it would have been unprofitable to apply higher rates of N to capture any significant yield increases.
The relationship between N rate and relative corn grain yield following soybeans for 12 on-farm trials between 1999 and 2001 is shown in Figure 1.

The question arose whether the lack of response to additional N over the 80-90 lb. minimum application rate on 75% of the sites was attributed to the improved utilization of the side-dressed N by the crop, or whether the soybeans are actually providing more than 40 lbs. of available N to the crop. Because of poor weather conditions during the spring of 2001, the Novak site was located on a field that had been corn the previous year. Similar to the results of 75% of the corn after soybean fields, this corn-after-corn location did not show an increase in yield with additional N added above the lowest N application rate (Table 2). At this site, an application rate of 81 lbs. N per acre yielded as well as every other rate up to 192 lbs. per acre. Because soybeans were not in the rotation, the optimum N rate would have been nearly 80 lbs. less than the UW recommendation and provide a cost savings of between $12 to $20 per acre. Additional studies will continue on corn-after-corn sites in the future to further verify these findings.

These results suggest that in most years if nitrogen is side-dressed, application rates for corn after soybeans could be reduced an additional 40 units from the current UW recommendation with little to no impact on yield. This could save producers an additional $6 to $10 per acre on N fertilizer expenses.

Obviously, side-dressing N has some inherent drawbacks, especially if the producer runs a large amount of acreage with minimal labor. However, producers that cultivate their fields on a regular basis could save a substantial amount on fertilizer costs by side-dressing N when the crop can most efficiently utilize it rather than making fall or preplant applications and experience N losses.

Table 1. Effect of N rate on corn grain yield following soybean for twelve on-farm trials, 1999-2001.

Year	Site	N rate	Yield	$P>F$	$LSD_{(0.05)}$	CV
		lb/a	bu/a			%
1999	Kleiber	77	155	0.46	5	1.5
		158	157			
		164	158			
		202	157			
	Novak	109	169	0.14	6	1.7
		132	176			
		145	172			
		173	173			
	Peirick	101	160	0.38	9	2.8
		116	155			
		167	159			
		201	154			
2000	Kleiber	80	170	0.46	12	3.4
		121	175			
		153	176			
		209	177			
	Novak	82	157 b*	0.04	7	2.5
		150	159 b			
		175	165 a			
		213	164 ab			
	Peirick	96	177	0.72	13	4.5
		108	182			
		148	180			
		196	183			
	Frison	42	164	0.58	14	4.3
		120	156			
		160	161			
		224	158			
	Hoffman Variety 1	82	177	0.43	7	1.8
		120	178			
		158	173			
		203	175			
	Hoffman Variety 2	82	180	0.81	8	2.1
		120	181			
		158	182			
		203	183			

* Values followed by different letters for individual sites are significantly different at the 0.05 probability level.

Table 1. Effect of N rate on corn grain yield following soybean for twelve on-farm trials, 1999-2001 (Continued).

	Site	N rate	Yield	*P>F*	$LSD_{(0.05)}$	CV
		lb/a	bu/a			%
2001	Frison	82	160 b *	0.05	3	1.3
		112	163 a			
		164	163 a			
		215	165 a			
	Hoffman	82	163 bc *	0.02	4	1.2
		120	166 b			
		150	170 a			
		195	170 a			
	Peirick	87	152 a	0.06	8	3.2
		120	145 ab			
		160	151 a			
		233	143 b			

* Values followed by different letters for individual sites are significantly different at the 0.05 probability level.

Table 2. Effect of N rate on corn grain yield following corn for one on-farm trial, 2001.

	Site	N rate	Yield	*P>F*	$LSD_{(0.05)}$	CV
		lb/a	Bu/a			%
2001	Novak	81	145	0.52	5	2.2
		111	147			
		156	145			
		192	147			

Table 3. Precipitation records collected from the Novak site, 1999-2001.

Year	April	May	June	July	August	Sept.	October
	Rainfall (inches)						
1999	6.2	4.5	5.2	4.4	1.9	3.25	0.65
2000	2.9	7.9	3.1	3.8	2.7	6.3	0.6
2001	2.8	6.3	3.5	1.5	3.4	7.4	3.9

Figure 1. Relationship between N rate and relative corn grain yield following soybeans for 12 on-farm trials, 1999 to 2001.