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Strategies For Split Nitrogen Applications

Overview is offered on over 60-site years of field data on corn grown in medium and fine-textured soils.

Split application of nitrogen (N) is a management strategy for corn that has been practiced on a limited basis for years. Coarse-textured, sandy soils have often received split applications to improve N uptake and efficiency and reduce leaching loss. Some N (less than half) is generally applied prior to or at planting and the rest (usually more than half) is sidedressed prior to tasseling. The sidedress applications may consist of either a single application or multiple applications, which are usually associated with irrigation. Because a greater portion of the N is applied closer to the time of maximum N uptake, split application strategies are often considered as being more efficient and environmentally sound. For these reasons and others, split application of N is becoming more popular on medium- and fine-textured soils. Additionally, as the price of N increases, growers will give greater consideration to N management practices that are more efficient and save money.

The purpose of this article is to present information and recommendations on split N application strategies, based on more than 60 site-years of field data

SUMMARY

Nitrogen timing, including split application, must be tailored to soil and climatic conditions. Factors such as 1) extra labor/time demand, 2) equipment needed, 3) carryover of unused N, 4) potential for using remote sensing or soil test to determine rate of sidedress application, and 5) input/output economics must be carefully considered on those soils where a yield response to split application is less likely. Decisions relating to time of N application are much less complicated on coarse-textured soils with irrigation or with high annual growing-season rainfall.

Table 1. Comparing preplant N to split N application using corn grain yield response as an indicator at 32 sites in southern Minnesota.

Sites	Total	Glacial till	Loess	Outwash
Number	32	14	11	7
N responsive	28	14	9	5
Preplant yield = Split yield	16	7	7	2
Preplant yield < Split yield	8	4	1	3
Preplant yield > Split yield	4	3	1	0

Table 2. Corn yield as affected by method of N application on fine-textured glacial-till soils.

Time of application		Year	
Preplant	12-inch corn	1991	1992
N rate (lbs/A)		bu/A	
0	0	84	107
30	0	129	132
60	0	143	144
30	30	161	141
90	0	158	156
30	60	157	137
120	0	165	164
30	90	182	153
	Advantage for split =	+11	-11

with corn on medium- and fine-textured soils in southern Minnesota.

Preplant vs. split

Experiments comparing spring preplant N with split N application for corn were conducted at 32 sites in southern Minnesota from 1989 to 1992. The sites were located on 14 fine-textured glacial-till soils, 11 medium-textured loess soils, and 7 coarse-textured, outwash (sandy) soils. Previous crops at these sites included primarily soybeans but also corn, oats, and rye.

Yield differences between the preplant and split application strategies are summarized in Table 1. Corn grain yield responded to N at 28 of the 32 sites (88%). Preplant application was equal to split application at 16 of the 28 responding sites (58%). Split application was superior to preplant application at 8 sites (28%). In all cases, excessive growing season rainfall and/or sandy soils occurred where split N application out-yielded preplant application. Preplant application was superior to split application at 4 sites (14%). The disadvantage for split application generally occurred on the glacial-till soils when above-normal, early-season rainfall was accompanied by insufficient uptake. A portion of the N applied midway between the corn rows apparently remained positionally unavailable.

Rainfall

Examples of how rainfall affected corn yield response to method of application on fine-textured soils in south central Minnesota are shown in Table 2. Soybeans were the previous crop on both sites. The first year, at a site in Waseca County where May/September rainfall was 56 percent above normal, yields were increased an average of 11 bu/A by the split-applied treatments. It is likely that a significant portion of the broadcast preplant-applied N was denitrified in this wet year.

In the second year, at a site in Blue Earth County where rainfall was only 16 percent above normal, yields were decreased an average of 11 bu/A by the split-applied treatments. Under these conditions, some N-deficiency symptoms were visible at the time of the sidedress application (12-inch tall corn). Apparently the initial 30-lb/A preplant broadcast rate was insufficient to sustain an adequate supply of N to the plant early in the season. The plants never seemed to recover completely. In addition, rainfall later in the season did not appear adequate to move sufficient N into the active root zone to overcome the early-season deficiency. These results lend credence to the suggestion that N banded at 20 to 30 lbs/A close to the row in starter may provide sufficient N for critical early-season growth until sidedressed N can be applied.

Continuous corn

Experiments were conducted in southeastern Minnesota from 1987 through 1997 to determine optimum N application method for continuous corn. An experiment on a Port Byron silt loam soil in Olmsted County from 1987 to 1990 provided information on N efficiency and water quality in addition to corn production (Figure 1). Yields were optimized when N was applied at 150 lbs/A. Highest yield and N efficiency and lowest nitrate-N concentration in the soil water at a 5-foot depth in September 1990 were obtained with the spring preplant treatment. Fall or split application of N did not improve corn yield and N efficiency, but did increase the potential for greater leaching losses of nitrate. Similarly, using excess N (225 lbs/A) did not increase yields or N efficiency but increased nitrate leaching potential.

Another study in Olmsted County compared various combinations of preplant and sidedress applications of N from 1992 to 1997. In these wetter than normal years, the 7-year average yield was 2 to 5 bu/A higher with split applications compared to a single preplant application. Applying a single sidedress application at the V6 to V7 stage reduced grain yield slightly.

Corn after soybeans

A 7-year study (1987 to 1993) was conducted on a Canisteo clay loam (pH 7.6) to determine the effect of fall, spring preplant, and split applications of N on corn yield, N recovery in the grain, and leaching loss of nitrate into tile lines. The split application treatment consisted of 40 percent of N applied during preplant and 60 percent sidedress at the V8 stage. N rate was 135 lbs/A for all treatments. Seven-year yield average and N recovery were highest for the split application (145 bu/A), intermediate for spring preplant and fall N plus nitrapyrin (N-Serve) treatments (139 bu/A), and lowest when N was applied late in October without N-Serve (131 bu/A). The greatest response to split N tended to occur in the wet years (1990 to 1993). Nitrate losses in subsurface tile drainage water, averaged across the four corn/soybean cycles, were greatest for fall N without N-Serve, intermediate for split N application, and least for fall N + N-Serve and spring preplant treatments. Nitrate losses in the soybean year following corn tended to be slightly greater for the spring and split application treatments, compared to the fall treatments.

A study on a Webster clay loam

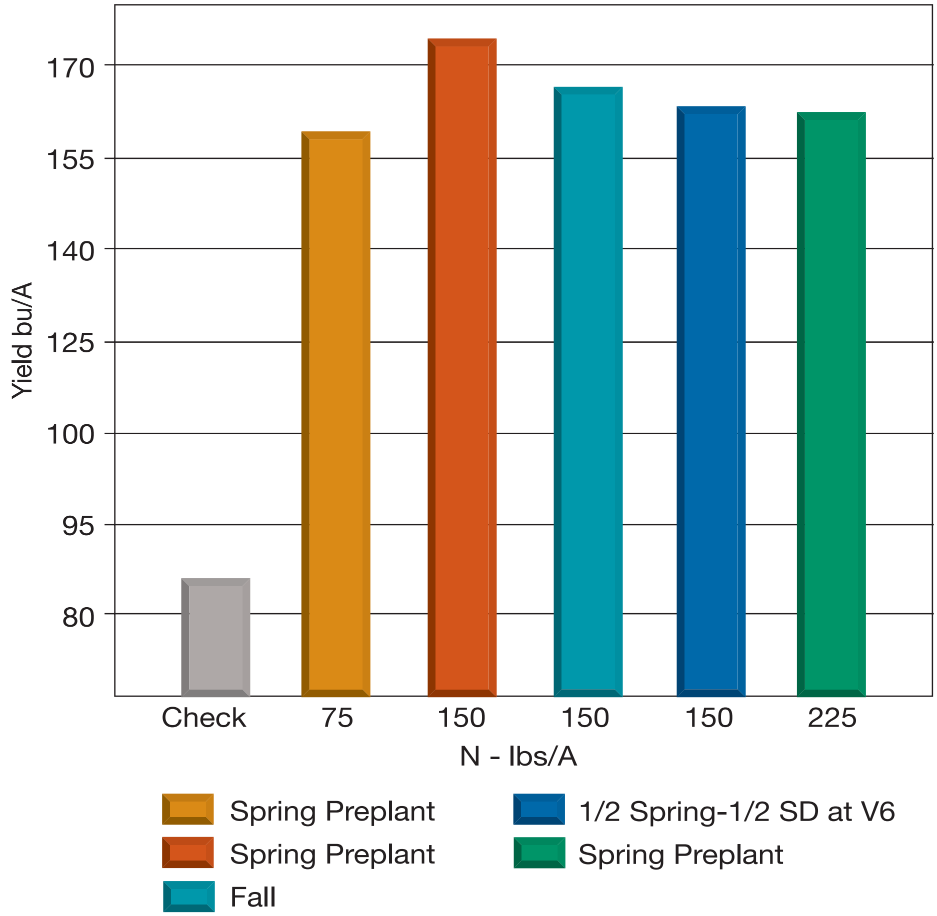

Figure 1. Continuous corn yields as affected by time, rate, and method of application, Olmsted County, 1987-90.

Table 3. Corn grain yield and N recovery as affected by N source and application time and method in a one-pass tillage system at Waseca, 2001-02.

Time of application and source of N					
Fall AA*	Preplant	Planting, UAN	Sidedress, UAN	Yield bu/A	N recovery %
None	None	None	None	118	
w/N-S, 100				167	63
w/N-S, 80		Dribble, 20		154	48
w/N-S, 80			Coulter, 20	169	60
w/N-S, 60		Dribble, 40		155	46
w/N-S, 60			Coulter, 40	169	56
	AA, 100			164	60
	AA w/N-S			165	59
	Urea bdct incorp.			165	63
	UAN bdct incorp.			163	59
		Dribble, 40	Coulter, 60	175	65
		Broadcast, 40	Coulter, 60	177	73

*w/N-S = with N-Serve

at Waseca in 2001-02 compared fall, spring preplant, planting time, and sidedress applications along with N sources and method of application in a "one-pass" tillage system. N treatments received 100 lbs/A, a rate about 15 percent less than recommended for an expected yield of 150 to 174 bu/A, but used so differences in application method/timing could be more clearly identified. Plots were field cultivated following broadcasting preplant urea and UAN. Dribble treatments were applied to soil surface within 2 inches of seed row with planter. Sidedress treatments of UAN were coulter-injected 4 inches deep midway between the rows at the V3 stage.

Averaged across both of these wetter-than-normal growing seasons, grain yield (Table 3) and N recovery were greatest when a majority of the N (60 lbs/A) was sidedressed as UAN. Yields were not statistically lower when a combination of either 20 or 40 lbs/A of N was sidedressed in conjunction with N at 80 or 60 lbs/A as fall-applied anhydrous ammonia with N-serve. Yields and N recovery were significantly lower when 80 or 60 lbs/A was applied in the fall and the remaining 20 or 40 lbs/A as UAN was dribbled next to the row at planting. Because phytotoxicity symptoms were not observed, we concluded that some of the surface-dribbled UAN was lost to the atmosphere. However we cannot dismiss the fact that some phytotoxicity may have affected early root growth, but we never observed it.

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