On-Farm Corn and Soybean Fertilizer Demonstration Trials

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Introduction

All cropping systems require nutrient inputs to maintain crop yields. However, excess fertilizer, especially nitrogen (N) and phosphorus, can increase problems with water quality. It is important for farmers to use the appropriate rates and methods of fertilizer application to optimize yields and minimize the impact on the environment. The purpose of these trials was to investigate the effect of various fertilizer practices on crop yield.

Materials and Methods

In 2017, 23 trials utilizing various methods of fertilizing corn and soybean were conducted (Table 1). All trials were conducted on-farm by farmer cooperators. Strips were arranged in a randomized complete block design with at least three replications/treatment. Strip width and length varied from field-to-field depending on field and equipment size. All strips were machine harvested for grain yield.

Several of the corn trials investigated applying a base rate of N or manure in the fall or spring with or without an additional application of N side-dressed. Other trials investigated various rates and methods of side-dressing N. In Trials 1, 10, 15, and 20, an application of N in the fall or spring with or without additional side-dressed N was investigated. In Trial 2, a V4 side-dress application of N was compared with splitting the N between a V4 and V12 application using a variable rate with the V12 application. In Trials 3, 4, 5, 6, 7, 8, 9, 18, and 19, strips receiving a starter fertilizer application were compared with strips without. In Trials 11, 12, 13 and 14 a Y-drop side-dress application of N was compared with a coulter application. Two rates of side-dress N were compared in Trial 16. In Trial 17, commercial N was compared with manure N. In Trial 21, side-dress N using a variable rate was compared with a standard rate.

In Trial 22, starter fertilizer plus Generate® was compared with no starter on soybeans. Generate® is marketed by Agnition as a stimulant for microorganisms to liberate nutrients. In Trial 23, Fast2Grow® was foliar-applied to soybeans at V5 and compared with soybeans that did not receive the application. Fast2Grow® is marketed as a poultry manure derived bio-stimulant.

Results and Discussion

Most of the corn trials investigating the application of additional N following a base rate of N or manure did not show an economical response to the additional N. In Trial 1, the side-dress application 50 lb/acre N to corn at the V6 crop growth stage on corn ground after the preplant application of 125 lb/acre did not increase the corn yield compared with the preplant application alone (Table 2). In Trial 10, there was no difference in yield with a side-dress application of 40 lb N/acre compared with 75 lb N/acre on corn at the V6 crop growth stage on corn ground following a preplant application of 130 lb

N/acre. In Trial 15, there was no yield advantage to side-dressing an additional 60 lb/acre N to V5 corn on soybean ground following a fall application of 160 lb/acre N. In Trial 20, there was a large corn yield response to side-dressing an additional 40-80 lb N/acre following 120 lb/acre N at planting. This trial was conducted on soybean ground on very sandy soil with irrigation. The source of N was ESN, which is marketed by Midwestern BioAg as a slow release N. In Trial 2, conducted on soybean ground, there was no difference in corn yield between strips that received an additional variable rate application of 70 lb N/acre side-dressed at V12 following a side-dress application of 150 lb/acre at V4 compared with strips that only received the V4 application. In Trials 11, 12, 13, and 14, there was no difference in corn yield between strips where the N was side-dressed with Y-drop versus with coulters. In Trial 16, there was no difference in corn yield between strips that received a rate of 160 lb N/acre compared with a rate of 200 lb N/acre side-dressed to corn at the V2 stage of crop growth on corn ground. In Trial 17, conducted on soybean ground, there was no difference in corn yield between strips that received commercial N fertilizer of 155 lb N/acre and strips that received a similar rate of N in liquid swine manure. In Trial 21, conducted on soybean ground, corn that received a variable rate of N side-dressed to VT corn, with an average of 51 lb N/acre, yielded the same as corn that received a side-dress application of 60 lb N/acre following the application of 80 lb N/acre at planting.

In most trials, N rates of about 100 to 150 lb/acre were sufficient to get optimum corn yields on soybean ground. At current corn and N prices, the recommended rate of N would be approximately 125 lb/acre on soybean ground. This is the Maximum Return to Nitrogen rate calculated using the corn nitrogen rate calculator at http://extension.agron.iastate.edu/soilfertility/nrate.aspx. Weather conditions are important in determining how corn responds to N rates and application timings, so different results might be seen in other years.

In Trials 4, 5, and 9, there was not a significant yield increase from the in-furrow starter fertilizer application of four gallons/acre of 6-24-6-0.05Zn ($P = 0.05$), but there was a significant yield increase of two to five bushels/acre in Trials 3, 6, and 7 ($P \leq 0.08$), and a significant yield decrease of five bushels/acre in Trial 8 ($P = 0.03$). There was not a yield increase with the application of five lb/acre N starter in a 2 x 2 placement in Trial 18, but there was a yield increase of four bushels/acre in Trial 19 with the in-furrow application of three gallons/acre of 6-24-6 plus Micro 500 and Generate®. The soil test levels of P and K were optimum or higher in all of the trials, which would have reduced the likelihood of a yield response.

In the soybean trials, the application of starter fertilizer plus Generate® did not effect the soybean yield in Trial 22 (Table 3). In Trial 23, the Fast2Grow® foliar application did not result in a yield increase.

NOTE: The results presented are from replicated demonstration trials. Statistics are used to detect differences at a location and should not be interpreted beyond the single location.

Table 1. Hybrid, row spacing, planting date, planting population, previous crop, and tillage practices in the 2017 fertilizer trials on corn and soybean.

Exp. no.	Trial	County	Hybrid	Row spacing (in.)	Planting date	Planting population (seeds/ac)	Previous crop	Tillage
170115	1	Lyon	Dekalb DKC54-38	30	5/12/17	35,000	Corn	Conventional
170116	2	Osceola	Pioneer PO157	30	5/7/17	VR 30,000-33,000	Soybean	Strip-till
170132	3	Osceola	Pioneer PO339 AMXT	30	4/24/17	35,000	Corn	Conventional
170133	4	Osceola	Pioneer PO506AM	30	5/7/17	35,000	Soybean	Conventional
170134	5	Osceola	Dekalb DKC55-20	30	5/7/17	35,000	Soybean	Conventional
170135	6	Osceola	Dekalb DKC53-56	30	5/7/17	35,000	Soybean	Conventional
170136	7	Osceola	Pioneer PO216AM	30	5/8/17	33,000	Soybean	Conventional
170137	8	Osceola	Dekalb DKC52-68	30	5/8/17	36,000	Soybean	Conventional
170138	9	Osceola	Dekalb DKC49-72	30	5/8/17	36,000	Soybean	Conventional
170203	10	Crawford	Curry 830-26	30	4/21/17	35,000	Corn	Fall disk, spring field cultivate
170309	11	Monona	LG 2549VT2	30	5/25/17	32,000	Soybean	No-till
170603	12	Pottawattamie	Stein 9536	30	4/16/17	39,000	Soybean	No-till
170639	13	Montgomery	Stein 9536	30	4/16/17	39,000	Corn	Disk, field cultivate
170640	14	Cass	Epley ESSB1625RR	30	5/31/17	32,000	Soybean	Disk, field cultivate
170708	15	Henry	Pioneer PO825AM	30	4/24/17	32,000	Soybean	Field cultivate
170710	16	Washington	Cropland CG6594	30	4/21/17	34,000	Corn	Fall chisel, spring field cultivate
170108	17	Lyon	Dekalb DKC 54-38	30	4/25/17	36,000	Soybean	Strip-till
170814	18	Bremer	Pioneer P1197AM	30	4/25/17	34,000	Soybean	No-till
170148	19	Osceola	Pioneer PO339	30	5/7/17	VR 32,000-35,000	Soybean	Strip-till
170901	20	Muscatine	Dekalb DKC61-79 RIBAF2	30	5/11/17	35,600	Soybean	Disked
170308	21	Monona	LG 2549VT2	30	5/24/17	32,000	Soybean	No-till
170149	22	Osceola	Pioneer PI8T85R	30	5/30/17	VR 123,000-150,000	Corn	Strip-till
170643	23	Adair	NK S26-P3	30	5/5/17	160,000	Soybean	No-till

Table 2. Yield from corn fertilizer trials in 2017.

Exp. no.	Trial	Treatment	Yield (bu/ac)	P-value
170115	1	125 lb/ac N as urea preplant	219 a	0.27
		125 lb/ac N as urea preplant plus 50 lb/ac N as urea side-dress at V6	223 a	
170116	2	70 lb/ac N as NH3 side-dress at V4 plus variable rate 32% UAN (average 70 lb/ac N) side-dress with Y-drop at V12	221 a	0.11
		150 lb/ac N as NH3 side-dress at V4	214 a	
170132	3	4 gal/ac of 6-24-6-0.05Zn starter applied in-furrow	245 a	0.05
		No Starter	240 b	
170133	4	4 gal/ac of 6-24-6-0.05Zn starter applied in-furrow	250 a	0.23
		No Starter	252 a	
170134	5	4 gal/ac of 6-24-6-0.05Zn starter applied in-furrow	246 a	0.62
		No Starter	243 a	
170135	6	4 gal/ac of 6-24-6-0.05Zn starter applied in-furrow	259 a	0.02
		No Starter	257 b	
170136	7	4 gal/ac of 6-24-6-0.05Zn starter applied in-furrow	247 a	0.08
		No Starter	245 a	
170137	8	4 gal/ac of 6-24-6-0.05Zn starter applied in-furrow	220 a	0.03
		No Starter	225 b	
170138	9	4 gal/ac of 6-24-6-0.05Zn starter applied in-furrow	251 a	0.40
		No Starter	252 a	
170203	10	130 lb/ac N as 32% UAN preplant plus 40 lb/ac N side-dress as 32% UAN at V6	222 a	0.76
		130 lb/ac N as 32% UAN preplant plus 75 lb/ac N side-dress as 32% UAN at V6	222 a	
170309	11	80 lb/ac N as 28% UAN at planting plus 60 lb/ac side-dress as 32% UAN with Y-drop at V8	203 a	0.52
		80 lb/ac N as 28% UAN at planting plus 60 lb/ac side-dress as 32% UAN with coulter at V8	208 a	
170603	12	140 lb/ac N as NH3 preplant plus 40 lb/ac side-dress as 32% UAN with Y-drop at V6	223 a	0.18
		140 lb/ac N as NH3 preplant plus 40 lb/ac side-dress as 32% UAN with coulter at V6	215 a	
		140 lb/ac N as NH3 preplant	220 a	
170639	13	140 lb/ac N as NH3 preplant plus 40 lb/ac side-dress as 32% UAN with Y-drop at V6	236 a	0.83
		140 lb/ac N as NH3 preplant plus 40 lb/ac side-dress as 32% UAN with coulter at V6	235 a	
170640	14	100 lb/ac side-dress as 32% UAN with Y-drop at V8	186 a	
		100 lb/ac side-dress as 32% UAN with coulter at V8	184 a	0.59
170708	15	160 lb/ac N as anhydrous in the fall plus 60 lb/ac N as 32% UAN side-dress at V5	217 a	0.30
		160 lb/ac N as anhydrous in the fall	222 a	
170710	16	200 lb/ac N as anhydrous side-dressed at V2	256 a	0.38
		160 lb/ac N as anhydrous side-dressed at V2	252 a	
170108	17	51 lb/ac N as 32% UAN preplant plus 3 lb/ac N in liquid 2-16-14 at planting plus 104 lb/ac N as 32% UAN side-dress with Y-drop at V12	258 a	0.33
		2,800 gal liquid swine manure applied in the fall (150 lb/ac N)	260 a	

Table 2. Yield from corn fertilizer trials in 2017 (cont.).

Exp. no.	Trial	Treatment	Yield (bu/ac)[a]	P-value[b]
170814	18	10,000 gal/ac liquid swine manure (120 lb/ac N) applied in the fall plus 5 lb/ac N as 32% UAN starter applied 2X2	241 a	0.78
		10,000 gal/ac liquid swine manure (120 lb/ac N) fall applied	238 a	
170148	19	3 gal/ac 6-24-6 plus 1 qt/ac Micro 500 plus 1 pt/ac Generate in starter in-furrow	214 a	<0.01
		No starter	210 b	
170901	20	120 lb/ac N as ESN preplant	62 a	0.02
		120 lb/ac N as ESN preplant plus 40 lb/ac N side-dressed as ESN at V5	184 b	
		120 lb/ac N as ESN preplant plus 80 lb/ac N side-dressed as ESN at V5	225 b	
170308	21	80 lb/ac N as 28% UAN at planting plus 60 lb/ac N as 32% UAN at VT	193 a	0.34
		80 lb/ac N as 28% UAN at planting plus Optryx variable rate N (2-630 lb/ac with mean of 51 lb/ac) as 32% UAN at VT	198 a	

[a]Values denoted with the same letter within a trial are not statistically different at the significance level of 0.05.
[b]P-value = the calculated probability that the difference in yields can be attributed to the treatments and not other factors. For example, if a trial has a P-value of 0.10, then we are 90 percent confident the yield differences are in response to treatments. For P = 0.05, we would be 95 percent confident.

Table 3. Yield from soybean fertilizer trials in 2017.

Exp. no.	Trial	Treatment	Yield (bu/ac)[a]	P-value[b]
170149	22	2 gal/ac 3-18-18 starter applied 2X2 plus 1 pt/ac Generate	54 a	0.53
		No starter	53 a	
170643	23	Fast2Grow at 32 oz/ac at V5	56 a	0.63
		Control	57 a	

[a]Values denoted with the same letter within a trial are not statistically different at the significance level of 0.05.
[b]P-value = the calculated probability that the difference in yields can be attributed to the treatments and not other factors. For example, if a trial has a P-value of 0.10, then we are 90 percent confident the yield differences are in response to treatments. For P = 0.05, we would be 95 percent confident.