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On-Farm Corn and Soybean Fertilizer Trials

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Introduction

All cropping systems require fertilizer 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 2016, 18 trials utilizing various methods of fertilizing corn were conducted (Table 1) and six trials investigated the effect of a foliar fertilizer product on soybean (Table 2). All trials were conducted on-farm by farmer cooperators. Strips were arranged in a randomized complete block design with at least three replications per treatment. Strip width and length varied from field-to-field depending on field and equipment size. All strips were machine harvested for grain yield.

Many 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 at planting or side-dressed. In Trials 1, 6, 7, 10, and 18, a fall application of manure or N with or without additional N at planting or side-dressed was investigated. In Trials 3, 4, 5, 9, 11, and 14, a preplant application of N was applied with or without additional N after planting or side-dressed. In Trial 2, four rates of N (0, 50, 100, and 150 lb/acre) were applied preplant. In Trial 8, two rates of N (0 and 90 lb/acre) were applied side-dressed. Five trials (12, 13, 15, 16, and 17) investigated the effect of starter fertilizer on corn yield.

In all of the soybean fertilizer trials, Fast2Grow® was foliar-applied to soybean at V2 to V5 and compared with soybean 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 of a variable rate of 35 to 70 lb/acre N to corn at the V18 crop growth stage after the fall application of 3,500 gal/acre of liquid swine manure increased the corn yield by four bushels/acre, but this would not likely have paid for the additional N (Table 3). There also was a yield response to the additional N applied after the fall application of cattle manure in Trial 7, but the response was not likely sufficient to pay for the N. In Trials 3, 4, 5, 10, 11, and 14 there was no yield response to the additional N applied. In Trial 9, the additional 30 lb/acre N applied side-dress following the 180 lb/acre N preplant resulted in a seven bushels/acre yield increase, which was likely enough to pay for the extra N application. In Trial 18, the additional 40 lb/acre N applied at planting following the fall application of 160 lb/acre N in 4,000 gal/acre of liquid swine manure resulted in a significant yield increase of 13 bushels/acre ($P < 0.01$). This may have been due to the very wet and warm December causing some N losses from the fall application.

There was a significant yield response to the N application in Trial 2 of up to 100 lb/acre. In Trial 6, the side-dress application of 200 lb/acre at crop growth stage V3 following the preplant application of 60 lb/acre yielded four bushels/acre more than the side-dress of 160 lb/acre, but the extra 40 lb/acre would not likely have been economical. In Trial 8, there was no significant yield increase with the side-dress application of 90 lb/acre compared with no N application. The yields were very low in this trial, perhaps because of the late planting and poor soil, and the late side-dress application (R1) would have reduced the likelihood of response to the N. 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 12, 13, and 15, there was no significant yield increase from the in-furrow starter fertilizer application ($P = 0.05$), but there was a significant yield increase of five bushels/acre in Trial 16 ($P < 0.01$) and Trial 17 ($P = 0.06$). 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 Fast2Grow® foliar application did not result in a yield increase in any of the trials and resulted in a significant yield decrease of three bushels/acre ($P = 0.09$) in Trial 6 (Table 4).

Table 1. Hybrid, row spacing, planting date, planting population, previous crop, and tillage practices in the 2016 fertilizer trials on corn.

Exp. no.	Trial	County	Hybrid	Row spacing (in.)	Planting date	Planting population (seeds/ac)	Previous crop	Tillage
160138	1	Lyon	Dekalb DKC58-06	30	5/5/16	34,000	Soybean	No-till
160811	2	Fayette	Dekalb DK5806	20	5/25/16	36,000	Oats	No-till
160709	3	Henry	Dekalb DK61R79	30	4/15/16	34,800	Soybean	No-till
160102	4	Sioux	Pioneer PO589AM	30	5/16/16	34,000	Soybean	Conventional
160710	5	Henry	Pioneer P1197AM	30	4/16/16	34,800	Soybean	No-till
160702	6	Washington	Dekalb DK61-54	30	4/15/16	34,000	Corn	Fall chisel, Spring field cultivate
160213	7	Buena Vista	Golden Harvest GO14R38	30	5/18/16	35,000	Soybean	Disc, field cultivate
160654	8	Cass	Epley E2105GT	30	5/24/16	34,500	Soybean	Disked
160655	9	Cass	Epley E2105GT	30	5/21/16	34,500	Soybean	No-till
160657	10	Pottawattamie	Wyffles 4796	30	4/11/16	35,000	Soybean	No-till
160658	11	Pottawattamie	Dekalb DK4812	30	4/20/16	32,000	Soybean	No-till
160112	12	Lyon	Dekalb DK53-56	30	5/16/16	35,000	Soybean	Conventional
160122	13	Osceola	Dekalb DK53-56	30	4/16/16	37,500	Corn	Conventional
160215	14	Crawford	Golden Harvest GO14R38	30	5/6/16	32,000	Corn	Fall disked, Spring field cultivate & harrow
160144	15	Osceola	Channel 196-77	30	5/16/16	31,400	Soybean	Conventional
160145	16	Dickinson	Pioneer P0453	30	5/8/16	34,100	Soybean	Conventional
160640	17	Pottawattamie	Dekalb DK62-98	30	4/25/16	33,000	Soybean	No-till
160701	18	Washington	RobSeCo 6401	30	4/17/16	36,000	Soybean	Conventional

Table 2. Hybrid, row spacing, planting date, planting population, previous crop, and tillage practices in the 2016 fertilizer trials on soybean.

Exp. no.	Trial	County	Variety	Row spacing (in.)	Planting date	Planting population (seeds/ac)	Previous crop	Tillage
160643	1	Cass	4-star 2y262	30	7/1/16	160,000	Corn	No-till
160602	2	Cass	Epley ESB254NRR	30	5/30/16	128,000	Corn	No-till
160603	3	Cass	Epley ESB282	30	5/22/16	145,000	Corn	Disked
160606	4	Cass	Pioneer PI34T7	30	5/19/16	155,000	Corn	No-till
160647	5	Cass	Nutech 7307	30	5/10/16	160,000	Corn	No-till
160661	6	Adair	Pioneer P30t211	30	5/28/16	165,000	Corn	No-till

Table 3. Yield from on-farm corn fertilizer trials in 2016.

Exp. no.	Trial	Treatment	Yield (bu/ac)[a]	P-value[b]
160138	1	3,500 gal/ac liquid swine manure in the fall	259 a	0.01
		3,500 gal/ac liquid swine manure in the fall plus Encirca N Y-drop variable rate of 35 to 70 lb N/ac as 32% UAN at V18	263 b	
160811	2	No N fertilizer	117 a	<0.01
		50 lb/ac N as anhydrous ammonia preplant	151 b	
		100 lb/ac N as anhydrous ammonia preplant	201 c	
		150 lb/ac N as anhydrous ammonia preplant	222 c	
160709	3	150 lb/ac N as NH3 preplant	248 a	0.57
		150 lb/ac N as NH3 preplant + 25 lb/ac N as UAN pre-emergence	249 a	
160102	4	50 lb/ac N as urea preplant plus 100 lb/ac N as 28% UAN at V12	240 a	0.82
		150 lb/ac N as urea preplant	241 a	
		100 lb/ac N as urea preplant plus 50 lb/ac N as 28% UAN at V12	237 a	
		150 lb/ac N as 28% UAN at V12	241 a	
160710	5	150 lb/ac N as NH3 preplant	261 a	0.29
		150 lb/ac N as NH3 preplant + 25 lb/ac N as UAN pre-emergence	266 a	
160702	6	60 lb/ac N as NH3 in the fall plus 160 lb/ac N as NH3 side-dressed at V3	232 a	0.02
		60 lb/ac N as NH3 in the fall plus 200 lb/ac N as NH3 side-dressed at V3	236 b	
160213	7	2.5 T/ac cattle manure in fall and winter plus 50 lb/ac N as 32% UAN side-dress at V3	230 a	<0.01
		2.5 T/ac cattle manure in fall and winter plus 100 lb/ac N as 32% UAN side-dress at V3	236 b	
		2.5 T/ac cattle manure in fall and winter plus 150lb/ac N as 32% UAN side-dress at V3	240 c	
160654	8	90 lb/ac N as 28% UAN side-dressed at R1	108 a	0.30
		No N fertilizer	97 a	

Table 3. Yield from on-farm corn fertilizer trials in 2016 (cont.).

Exp. no.	Trial	Treatment	Yield (bu/ac)[a]	P-value[b]
160655	9	180 lb/ac N as NH3 preplant plus 30 lb/ac N as 28% at R1	162 a	0.05
		180 lb/ac N as NH3 preplant	155 b	
		170 lb/ac N as NH3 in the fall plus 100 lb/ac N as urea at V5	236 a	0.30
160657	10	170 lb/ac N as NH3 in the fall	234 a	
		160 lb/ac N as NH3 preplant plus 100 lb/ac N as urea at V5	219 a	0.56
160658	11	160 lb/ac N as NH3 preplant	215 a	
160112	12	2.75 gal/ac 10-34-0 plus 1 qt/ac zinc (8% chelated) starter fertilizer	207 a	0.19
		No starter fertilizer	202 a	
		4 gal/ac 6-24-6 starter fertilizer in-furrow	259 a	0.79
160122	13	No starter fertilizer	258 a	
160215	14	130 lb/ac N preplant as 32% UAN plus 5 lb/ac N starter as 9-18-9 plus 30 lb/ac N side-dressed at V5 as 32% UAN	254 a	0.16
		130 lb/ac N preplant as 32% UAN plus 5 lb/ac N starter as 9-18-9 plus 60 lb/ac N side-dressed at V5 as 32% UAN	256 a	
		130 lb/ac N preplant as 32% UAN plus 5 lb/ac N starter as 9-18-9 plus 90 lb/ac N side-dressed at V5 as 32% UAN	256 a	
160144	15	4 gal/ac 6-24-6 starter fertilizer in-furrow	208 a	0.09
		No starter fertilizer	210 a	
160145	16	4 gal/ac 6-24-6 starter fertilizer in-furrow	244 a	<0.01
		No starter fertilizer	239 b	
160640	17	5 gal/ac of 9-18-9 starter fertilizer in-furrow	211 a	0.06
		No starter fertilizer	206 a	
160701	18	160 lb/ac N in fall in 4,000 gal/ac of liquid swine manure	223 a	<0.01
		160 lb/ac N in fall in 4,000 gal/ac of liquid swine manure + 40 lb/ac N as UAN at planting	236 b	

[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 4. Yield from on-farm soybean fertilizer trials in 2016.

Exp. no.	Trial	Treatment	Yield (bu/ac)[a]	P-value[b]
160643	1	Fast2Grow at 32 oz/ac at V2	46 a	0.48
		Control	48 a	
160602	2	Fast2Grow at 32 oz/ac at V2	56 a	0.73
		Control	56 a	
160603	3	Fast2Grow at 32 oz/ac at V4 and 32 oz/ac at V5	56 a	0.75
		Control	57 a	
160606	4	Fast2Grow at 32 oz/ac at V5	70 a	0.40
		Control	69 a	
160647	5	Fast2Grow at 32 oz/ac at V5	55 a	0.11
		Control	56 a	
160661	6	Fast2Grow at 32 oz/ac at V5	59 a	0.09
		Control	62 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.