On-Farm Corn, Soybean, and Alfalfa Fertilizer Trials

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Introduction

All cropping systems require fertilizer inputs in order to maintain crop yields. However, excess fertilizer, especially nitrogen 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 2015, 10 trials utilizing various methods of fertilizing corn were investigated (Table 1). One trial investigated the use of foliar fertilizer on soybean (Table 2), and one trial investigated the yield response of alfalfa to potassium fertilizer (Table 3). All trials were conducted on-farm by farmer cooperators using the farmer's equipment. Strips were arranged in a randomized complete block design with at least three replications per treatment, except for the alfalfa trial, which had two replications. Strip length and width varied from field to field depending on field and equipment size. All strips were machine harvested for yield.

Trial 1 investigated the response of corn to two rates of side-dressed nitrogen (N) following an alfalfa crop. Trials 2 and 3 investigated a preplant N application with or without additional N side-dressed. In Trial 4, 150 lb/acre N was applied either all preplant, split between preplant and side-dress, or all side-dress. In Trial 5, two timings of an additional 40 lb/acre N following a fall application of 150 lb/acre N as liquid swine manure was investigated. Trials 8 and 9 investigated a fall application of liquid swine manure with or without additional N in the spring. Trial 6 compared two N rates on corn to no N. Trial 7 investigated the use of 6-24-6 pop-up starter fertilizer on corn yield. Trial 10 investigated the corn yield response to the foliar application of 8 lb/acre N as CoRon® (25-0-0). The CoRon also contained 0.5 percent boron.

In Trial 11, soybean yield response to the foliar application of 5.5 oz/acre of Fulltec Arrow to R1 soybeans was investigated. Fulltec Arrow is marketed by Spraytec and contains N, phosphorus, potassium, boron, calcium, chlorine, and amino acids. Trial 12 investigated the effect of potassium fertilizer on alfalfa yield.

Results and Discussion

There was a significant increase in corn yield of 23 bushels/acre ($P < 0.01$) to the sidedress application of 50 lb/acre N following an alfalfa crop in Trial 1 (Table 4). There was an additional yield increase of 5 bushels/acre with an additional 50 lb/acre N (100 lb/acre total), although it is unlikely the 100 lb/acre rate would be economical with current corn and N prices. It is not unusual for corn to respond to some additional N following an alfalfa crop. A common recommendation is to apply 0-30 lb/acre of N.

In Trials 2 and 3 there was not a corn yield response to additional side-dressed N following a preplant application, indicating a preplant application of 190 lb/acre in Trial 2

and the preplant application of 130 lb/acre in Trial 3 were sufficient to maximize corn yields. Trial 2 was planted on soybean ground and Trial 3 was on corn ground. In Trial 4 there was no difference in corn yield among the three application timings for 150 lb/acre (P = 0.42). None of the three trials (5, 8, and 9) with fall applications of swine manure containing from 150 to 170 lb/acre N showed a corn yield increase with additional nitrogen applications in the spring. Trial 5 was on corn ground and Trials 8 and 9 were on soybean ground.

In Trial 6, there was a significant yield increase of 41 bushels/acre with the corn that received 160 lb/acre N compared with the corn that received no N (P = 0.10). The yields were very low and variable in this study due to spring flooding and water-logged soils.

In Trial 7, there was no effect of the pop-up starter fertilizer on corn yields. The soil test was 45-80 ppm for P (Very High) and 229-268 ppm for K (High to Very High). A fall manure application contained 245 lb/acre N. The high testing soil and high N rate would have reduced the chance for a response to the starter. In Trial 10, the yield increase of four bushels/acre with the foliar application of CoRoN was not a statistically significant yield increase (P = 0.11). There was a total of 220 lb/acre of N applied to this field prior to the foliar application and the field was corn in 2014.

At current corn and N prices, the recommended rate of N would be approximately 125 lb/acre on soybean ground and 175 lb/acre on corn 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. Based on these recommendations, it is not surprising that there was no yield response to additional N in Trials 2, 5, 8, and 9. It is a little surprising the maximum yield of 262 bushels/acre was obtained with only 130 lb/acre N on corn ground in Trial 3. Weather conditions are important in determining how corn responds to N rates and application timings, so different results may be seen in other years.

There was a significant soybean yield increase of three bushels/acre with the foliar application of Fulltec Arrow to R1 soybeans (Table 5). Since this product contains several macronutrients and micronutrients, it is unknown whether the yield response was due to one or several of the nutrients. A response to micronutrients would be more likely on eroded or sandy soils with low organic matter or very low or high pH, and a response to macronutrients would be more likely on low testing soils. The soil type was silt loam with 0-2 percent slope with 3 percent organic matter and pH of 6.4. Soil tested high in both P and K, so a yield response would not be expected.

In Trial 12, the alfalfa that received an application of 50 lb/acre K_2O between the second and third cuttings yielded more in the third cutting than the alfalfa that received no potassium (P = 0.10). However, the alfalfa from the “treated” plots yielded more in the second cutting (data not shown), so the yield difference may not be due to the fertilizer application (Table 6). Soil tested 100-137 ppm for K (Very Low-Low) prior to the K application.

Table 1. Hybrid, row spacing, planting date, planting population, previous crop, and tillage practices in the 2015 on-farm fertilizer trials on corn.

Exp. no.	Trial	County	Hybrid	Row spacing (in.)	Planting date	Planting population (seeds/ac)	Previous crop	Tillage
150802	1	Bremer	Pioneer P0636 AMX	30	5/30/15	33,500	Alfalfa	No-till
150693	2	Montgomery	Stein R9208VT2	22 twin row	4/20/15	45,000	Soybean	Field cultivate
150220	3	Crawford	Mycogen 2G685	30	4/27/15	32,000	Corn	Disk, field cultivate
150117	4	Sioux	Pioneer PO157AM	30	4/30/15	34,000	Soybean	Conventional
150101	5	Lyon	Pioneer PO297	20	4/17/15	34,500	Corn	Conventional
150715	6	Wapello	Pioneer 636	30	4/5/15	34,000	Soybean	Field cultivate
150124	7	Osceola	DeKalb DK4812	30	4/29/15	35,980	Soybean	Conventional
150170	8	Lyon	DeKalb DK4929	30	5/1/15	VR 33,000	Soybean	Strip till
150704	9	Washington	DynaGro 52VC91	30	4/27/15	36,000	Soybean	Conventional
150307	10	Monona	Nutech 713	38 twin row	5/1/15	34,000	Corn	Fall and spring disk

Table 2. Variety, row spacing, planting date, planting population, previous crop, and tillage practices in the 2015 on-farm fertilizer trial on soybean.

Exp. no.	Trial	County	Variety	Row spacing (in.)	Planting date	Planting population (seeds/ac)	Previous crop	Tillage
150649	11	Cass	Asgrow 2433	15	6/25/15	150,000	Corn	Vertical till

Table 3. Variety, planting date, and tillage practices in the 2015 fertilizer on-farm trial on alfalfa.

Exp. no.	Trial	County	Variety	Planting date	Tillage
150801	12	Fayette	Mixed	8/15/13	No-till

Table 4. Yield from on-farm corn fertilizer trials in 2015.

Exp. no.	Trial	Treatment	Yield (bu/ac)[a]	P-value[b]
150802	1	No N fertilizer	155 a	<0.01
		N sidedressed at 50 lb/ac (28% UAN banded on surface at V8)	178 b	
		N sidedressed at 100 lb/ac (28% UAN banded on surface at V8)	183 c	
150693	2	190 lb/ac N preplant as anhydrous ammonia	219 a	0.78
		190 lb/ac N preplant as anhydrous ammonia plus 100 lb/ac N side-dressed over the top as urea to V4 corn	218 a	
150220	3	130 lb/ac N preplant as 32% UAN	262 a	0.18
		130 lb/ac N preplant as 32% UAN plus 30 lb/ac as 32% UAN to V4 corn	265 a	
		130 lb/ac preplant as 32% UAN plus 60 lb/ac as 32% UAN to V4 corn	260 a	
		130 lb/ac N preplant as 32% UAN plus 90 lb/ac as 32% UAN to V4 corn	261 a	
150117	4	150 lb/ac N applied as anhydrous ammonia on 4/8	224 a	0.42
		100 lb/ac N applied as anhydrous ammonia on 4/8 plus 50 lb/ac N applied to V7 corn as urea on 6/19	226 a	
		150 lb/ac N applied to V7 corn as urea on 6/19	228 a	
150101	5	150 lb/ac N as liquid swine manure in the fall of 2014 plus 40 lb/ac as 32% UAN surface broadcast before planting	197 a	0.80
		150 lb/ac N as swine manure in fall plus 40 lb/ac N as 32% UAN sidedressed at V10	196 a	
150715	6	N at 0 lb/ac	76 a	0.10
		N at 135 lb/ac preplant as anhydrous ammonia	101 a	
		N at 165 lb/ac preplant as anhydrous ammonia	117 a	
150124	7	Pop-up starter at 4 gal/ac of 6-24-6	233 a	0.38
		No starter	232 a	
150170	8	170 lb/ac N as liquid swine manure in the fall of 2014	207 a	0.78
		170 lb/ac N as liquid swine manure in the fall plus 18 lb/ac N as 32% UAN injected immediately after planting	208 a	
150704	9	160 lb/ac N in fall as injected swine manure	233 a	0.30
		160 lb/ac N in fall as injected swine manure + 40 lb/ac N as 32% UAN with the planter	241 a	
150307	10	Coron (25-0-0) plus Cide Winder (adjuvant) at 3.2 gal/ac plus 4 oz/ac foliar applied to V5 corn	196 a	0.11
		No foliar fertilizer	192 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 5. Yield from a soybean fertilizer trial in 2015.

Exp. no.	Trial	Treatment	Yield (bu/ac)[a]	P-value[b]
150649	11	Spraytec Fulltec Arrow (3-7-5), containing 2.2% B, 5% Ca, 5% Cl and amino acids, foliar applied at 5.5 oz/acre at R1	48 a	0.03
		No foliar fertilizer	45 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 6. Yield from an alfalfa fertilizer trial in 2015.

Exp. no.	Trial	Treatment	Yield (tons/ac)[a]	P-value[b]
150801	12	No K applied	0.41	0.10
		100 lb/acre K applied after second cutting on 8/10	0.57	

[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