Cor8-2011 - Starter Fertilizers for Corn Revisited: 2011 Summary

CROP ADVANCES

Field Crop Reports

Volume 8 — February 2, 2012

Field Crops Team, Agriculture Development Branch
Ministry of Agriculture, Food and Rural Affairs
In partnership with
Ontario Soil and Crop Improvement Association
And other Agricultural Organizations and Businesses

http://www.ontariosoilcrop.org/cropadvances.htm

Starter Fertilizers for Corn Revisited: 2011 Summary

Purpose:

It has been long recognized that proper use of starter fertilizers can increase corn yields and net profits. Numerous options are available in choice of product, placement and rate of starter fertilizers, with these choices having impacts on profits because of either the size of yield response and/or cost of application. A multi-year study was initiated in 2008 designed to evaluate yield and economic response of corn to various starter fertilizer products, placement options and rates when bulk N fertilizer was either applied pre-plant or side-dress. This report summarizes results from 2011 for starter fertilizer treatments that were common across the various sites.

Methods:

Starter fertilizer experiments were analyzed in a strip block design with starter fertilizer as the main plot, with the treatments randomized on a minimum of 2 replicates across five sites in Southern Ontario. Starter fertilizer treatments which varied in product, placement (in-furrow vs. 2" by 2" band) and rate were randomly assigned to each replicate. Sites received 140 to 155 lb-N/ac applied as either preplant urea or side-dressed UAN at the 6-8 leaf stage. To investigate the yield response to placement of potassium fertilizer, three sites (Alma, Bornholm, Elora) included a broadcast potash application made as 200lb/ac of muriate of potash (0-0-60) as a split effect to the main starter plots. To investigate the impact of N application timing on starter fertilizer response, a pre-plant nitrogen application was included at one trial location (Elora) as a split effect to the main starter plots. To investigate the difference in response to broadcast phosphorous, a 200lb/ac broadcast MAP (11-52-0) application was also included as a split effect at Elora.

Figure 1. Research planter equipped with liquid and dry starter systems for making accurate treatnment and rate comparisons.

Break even yield response is calculated for each of the starter fertilizers and is included in Table 1. The break even yield represents the grain corn yield response, after drying, required to cover the product cost of the starter fertilizer. The assumptions were: net corn price after drying of $5.75/bu; UAN (28%) at $1.99/US Gal.;10-34-0 at $5.68/US Gal.; Alpine 6-24-6 at $6.09/US gal.; 2-20-18 at $7.03/US Gal.; urea at $0.33/lb; MAP at $0.39/lb; muriate of potash at $0.33/lb; 7-34-19 at $0.37/lb; and 5-20-20 at $0.27/lb. The break even yield calculation does not consider equipment or time costs associated with starter fertilizer application.

Results:

Starter fertilizer response was dependent on P and K soil test level, while at Elora and Bornholm preplant nitrogen applications limited yields relative to side-dressing. No consistent yield response was observed with the 10gal/ac UAN treatment across sites in 2011.

For sites with the lowest K testing soils (Orangeville 55 PPM; Elora 58 PPM; Alma 69 PPM), positive yield responses were only observed for starters including K. The greatest yield responses on these sites were associated with high rate starter fertilizers (i.e. banded dry fertilizers) which included N, P and K. No difference is response between K and non-K starters was observed at the higher test sites (Bornholm 92 PPM; Lucan 196 PPM). When K was broadcast on the low K testing soils at Elora and Alma, yields for most treatments increased to where they were similar to yields for the highest starter K rates (i.e. 5-20-20 @ 200lb/ac 2x2). Response between K and non-K starters became negligible, unlike 2010 results where a K starter response was still observed after broadcasting in Elora. The highest rate K starters did not demonstrate any yield response to broadcast K. Broadcast K did not appear to improve yield response at the higher K testing soil at Bornholm.

On sites with the lowest P testing soils (Elora 5 PPM; Bornholm 15 PPM; Orangeville 18 PPM), yields responses to starters containing N and P only were minimal relative to the control. At these sites, starter responses were not observed until K was also included, which could be a result of the fact that these sites also had low K fertility. This suggests that the benefits of P starters are negated when other nutrient deficiencies exist. No response to N and P only starter fertilizers was observed relative to the control at sites with higher testing P soils (Alma 37 PPM; Lucan 50 PPM) where K fertility was also high. When P was broadcast in Elora, no yield response was observed for the control or other starter fertilizer treatments where yields were generally equal to the non-broadcast yields.

Based on fall 2011 retail prices and an expected after drying corn price of $5.75/bu, the break even corn yield response to starters from the 2011 trial ranged from 4 bu/ac for the 10 US gal/ac of UAN, 5-6 bu/ac for the 5 US gal/ac in-furrow liquids and 75 lb/ac 2x2 solid fertilizer treatments; 9 bu/ac for the 200 lb/ac of 5-20-20; and 18 bu/ac for the combination liquid in-furrow and dry/liquid 2x2 band treatment (see Table 2).

At the highest testing site (Lucan), no economic yield response for any starter fertilizers was observed. While broadcast K applications demonstrated an economic response relative to the control treatments at the lowest testing sites (Alma, Elora), an economic response to starter fertilizers above and beyond the broadcast K only treatment was rarely observed. For the non-broadcast K treatments at all sites except Lucan, the 5-20-20 was the only starter treatment to have an economic response across all sites. Other responsive treatments included UAN in 2x2, 6-24-6 in-furrow and split 7-34-19 (3 sites each). There did not appear

to be any consistency in the degree of economic response for fertilizer type (liquid or dry) or placement (in-furrow or 2x2). Overall, inclusion of K in a starter treatment, especially for lower testing soils, appeared to have an important economic impact.

Figure 2. Corn with potassium deficiency symptoms from the Elora plots where no K was appplied (soils test level for K was 58).

Summary:

Over the 4 years of this study a wide range in yield responses and profits were obtained based on choice and rate of starter fertilizers applied (Table 1 & 2). The study has shown that on fields with medium to low soil P and K tests that profitable yield responses are more likely to occur when N, P and K based starters are applied when compared to starters that contain only N and P. The results of this study clearly suggest that for soils with less than adequate P and K levels that K should be included in the starter fertilizer regardless of position of application (i.e. in-furrow or in a 2" x 2" band). On average across the 4 years on sites with inadequate P and K soil tests, economic yield response was observed for both in-furrow and 2x2 band applications, although yield response potential was greater for the 2x2 fertilizer band as corn yields were still responsive to starter fertilizer rates beyond those recommended for in-furrow applications (Table 2). However, substantial (profitable) yield responses are still possible on less than adequate P and K fertility soils if the only starter option is to apply in furrow N, P and K based starter fertilizers.

Table 1. Average corn yields and net economic responses to starter fertilizer treatments with and without K across 11 field site years where soil test K values were 80 PPM^{+} or less from 2008 to 2011 in Ontario.

Starter	Yield (bu/ac @ 15.5%)	Net Economic Response^{++} ($/ac above control)
Control (no fertilizer)	148	-
10-34-0 @ 5 US Gal/ac IF	154	+ $9
6-24-6 @ 5 US Gal/ac IF	164	+ $65
11-52-0 @ 75 lb/ac 2x2	160	+ $42
5-20-20 @ 200 lb/ac 2x2	177	+ $113
+ mean soil tests across all field sites tested of 16 PPM and 67 PPM for P and K respectively ++ net economic response above control treatment ($ gain - $ cost), based on the same corn price and fertilizer cost assumptions as described in Table 1		

Table 2. Corn yield response to various starter fertilizers. (Five Ontario sites in 2011)

Starter Treatment	Break Even[+]	Alma 2011		Bornholm 2011		Elora 2011		Lucan 2011	Orangeville 2011
		No BC	BC 0-0-60	No BC	BC 0-0-60 + 46-0-0	No BC	BC 0-0-60	No BC	No BC
	---------- bu/ac ----------								
No Starter	-	186	**202**	190	**182**	125	**189**	215	108
UAN @ 10 gal/ac; 2x2	3.5	192	203	182	178	**130**	185	206	**127**
10-34-0 @ 5 gal/ac; IF	4.9	182	200	**198**	**187**	109	181	215	**114**
6-24-6 @ 5 gal/ac; IF	5.3	182	204	**199**	185	**149**	190	211	**127**
2-20-18 @ 5 gal/ac; IF	6.1	182	197	185	185	**171**	189	213	114
MAP @ 75 lb/ac; 2x2	5.0	187	200	172	177	122	190	214	**117**
Split MAP @ 25 lb/ac IF + 50lb/ac 2x2	5.0	178	201	185	184	116	193	215	113
Split 7-34-19 @ 25 lb/ac IF + 50 lb/ac 2x2	4.8	194	202	193	183	**166**	184	216	**133**
5-20-20 @ 200 lb/ac; 2x2	9.4	**199**	202	**200**	184	**202**	189	214	**124**
6-24-6 @ 5 gal/ac IF + 5-20-20 @ 200 lb/ac 2x2 + UAN @ 10 gal/ac 2x2	18.2	204	203	198	183	**204**	203	213	**139**
LSD (10%) [++]		12.9	12.9	11.4	11.4	17.1	17.1	3.8	9.8
Soil Test P:K (PPM)		37:69		15:92		5:58		50:196	18:55

+ Break even yield represents the grain corn yield response, after drying, required to cover the product cost of the starter fertilizer. The assumptions were: net corn price after drying of $5.75/bu; UAN (28%) at $1.99/US Gal.;10-34-0 at $5.68/US Gal.; Alpine 6-24-6 at $6.09/US gal.; 2-20-18 at $7.03/US Gal.; urea at $0.33/lb; MAP at $0.39/lb; muriate of potash at $0.33/lb; 7-34-19 at $0.37/lb; and 5-20-20 at $0.27/lb. The break even yield calculation does not consider equipment or time costs associated with starter fertilizer application.

Underlined values represent treatments, at a given location, where returns on fertilizer investment were optimized (i.e. value of increased corn yields > cost of the fertilizer)

++ LSD is the smallest yield difference required between starter treatments within the same column for a less than 10% chance that the observed yield difference was not due to effects other than the starter treatments.

BC = broadcast application of fertilizer and IF = in furrow application of fertilizer

Next Steps:

2011 was the final year of this project, but some questions remain to be addressed regarding starter fertilizer and need investigation in future research projects:

1) This research confirms the strong responses to both P and K starter fertilizers on low testing sites, supporting the use of this practice, but further research is required to investigate the differences in yield potential between continual incremental fertilizer applications (i.e. fertilizing for removal) versus a buildup and maintenance approach.
2) Investigation into the degree of improvement in efficiency of starter fertilizer applications relative to broadcast (i.e. amount of broadcast fertilizer needed to elicit the same response as starter)?

Acknowledgements:

Support for the 2011 portion of this project was supplied by the Grain Farmers of Ontario, AAC FIP program. Technical assistance supplied by K. Janovicek, B. Rosser and J. Deen, University of Guelph. Additional support for the project was received from Alpine Plant Foods. The availability of John Deere tractors in support of these studies is greatly appreciated from the company.

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