2012 Corn and Soy Starter Fertilizer Update

Introduction

High fertilizer prices coupled with higher yields and decreasing soil fertility have increased the importance of economically effective fertilizer management. This project is evaluating starter fertilizer strategies in both corn and soybeans. Recent work in corn suggests that the placement method is important for providing the greatest yield response for both P and K fertilizers, and that on sites with low P and K testing soils, that a balanced fertility program (i.e. including both P and K fertilizers in the starter fertilizer blend) is essential to realizing full yield potential. This may provide significantly higher net returns over broadcasting or not applying fertilizer.

Corn

Work on micronutrient fertilizer response in corn has been neglected, despite the fact that micronutrients are expected to suffer from the same issues as P and K; decreases in soil quantities due to increasing yields over time, and in the case of sulphur, decreasing deposition. In response to these developments, this project is building on previous starter fertilizer research by evaluating corn yield response and economic returns to the application of sulphur and zinc through pre-manufactured micronutrient starter blends as well as traditionally starter fertilizer sources. It is also examining the importance of including potassium in sulphur and zinc fertilizer blends.

Starter fertilizers were evaluated on eleven sites in 2012. Six of the sites were "farmer" starter fertilizer sites where only the core starter fertilizer blends investigating the relative importance of phosphorous, sulfur, zinc and potassium nutrition in dry starter fertilizer blends were evaluated. The remaining five sites were "intensive" sites which investigated the contributions of the core starter fertilizer blends as well as some other dry/liquid fertilizers, and alternative placement options towards increasing corn productivity. When included in dry fertilizer blends, nutrients were applied at rates providing 17 lb-N/ac, 40 lb-P_2O_5/ac, 30 lb-K_2O/ac, 10 lb-S/ac, and 1 lb-Zn/ac, all applied in a 2"x2" band. Liquid fertilizer treatments consisted of 6-24-6 which was applied at 5 gal/ac in-furrow. During the growing season, some plant tissue samples were taken from the "farmer" sites to evaluate the relative crop nutrition at these sites, and the relationship between critical concentrations and yield response potential at these sites.

Soil test results of the 2012 corn starter locations are summarized in Table 1, and ranged from highly responsive to rarely responsive for both phosphorous and potassium.

Table 1. Soil Test Results at Corn Starter Fertilizer Locations (2012)

Trial Type	Location	Soil pH	Phosphorous Soil Test (ppm)	Potassium Soil Test (ppm)
Intensive Trials	Alma	6.9	35	115
	Elora	7.5	9	55
	Bornholm	7.4	20	90
	Lucan	6.8	9	96
	Strathroy	5.7	11	83
Farmer Trials	Wallacetown	6.1	9	83
	Drumbo	6.6	29	139
	Paris	6.3	11	82
	Highgate	6.2	8	120
	Chatham	5.7	15	176
	Ridgetown	6.4	20	141

Yield results for the “intensive” starter fertilizer trials were averaged across all five locations, and are presented in Table 2.

Table 2. Average Corn Yields and Starter Fertilizer Yield Responses Across Five “Intensive” Trial Locations (2012)

Treatment	All Sites	Yield Response
	--- Yield (bu/ac) ---	
Control	145	-
MAP	156	11
MAP+S	153	8
MAP+S+Zn	156	11
MAP+S+Zn+K	163	18
6-24-6 @ 5 gal/ac	155	10
6-24-6 @ 5 gal/ac + K	163	18
LSD 5%	6	
LSD 10%	5	

When yields were averaged across all intensive sites, significant increases in corn yields were observed for all starter fertilizers. Inclusion of sulfur and zinc did not appear to produce yield responses greater than that of MAP alone. The highest yield responses appeared to be associated with starter fertilizers which included potassium (MAP + S + Zn + K, and 6-24-6 + K), which appeared to be significantly higher than the control and all other starter fertilizer treatments. This potassium impact was no doubt a response to working with soils that, across the 5 intensive sites, had a K soil test that averaged 88 PPM.

The influence of the placement of starter fertilizer blends containing S and Zn was investigated at four of the intensive sites where the MAP + S + Zn treatment was applied as the standard 2X2 band, and also as a “split” in-furrow and 2X2 application delivering the same overall rate, but were two-thirds of the fertilizer was delivered in the 2X2 band and one-third was placed in the seed furrow. (Table 3**).** When averaged across all sites, no significant increase in yield was observed for delivering part of the fertilizer blend in-furrow.

Table 3. Corn Yield Response to Split-Application Placement of MAP + S + Zn Starter Fertilizer Across Four Intensive Starter Fertilizer Sites (2012)

Treatment	All Sites	Yield Response
MAP+S+Zn	154	-
MAP+S+Zn Split	158	4
LSD 5%	7	
LSD 10%	6	

As a result of poor growing conditions, harvest data from the Drumbo “farmer” trial was highly variable and was dropped

from the analysis. Yield results for the "farmer" starter fertilizer trials were averaged over all locations, and are presented in Table 4**.**

Table 4. Average Corn Yields and Starter Fertilizer Yield Responses Across Five "Farmer" Trial Locations (2012)

Treatment	Yield	Yield Response
	------ bu/ac ------	
Control	165	-
MAP	173	8
MAP+S	167	2
MAP+S+Zn	164	-1
MAP+S+Zn+K	169	4
LSD 5%	NS	
LSD 10%	6	

When yields were averaged across all farmer sites, significant increases in corn yields was only observed for the MAP starter treatment, and only at an LSD of 10%. Inclusion of sulfur, zinc or potassium into starter fertilizer blends did not provide any significant benefit above MAP.

When corn tissue nutrient concentrations were averaged across all farmer sites, all nutrients appeared to range from slightly below to well above critical concentrations (Table 5), suggesting that on average yield responses to these nutrients may not be expected. Average tissue P concentrations were slightly lower than critical at the vegetative stage, while average yield response to starter P was significantly positive. Average tissue Zn concentrations at tasseling were at critical concentrations, but no yield enhancements were observed for including Zn in MAP starter blends.

Table 5. Critical Corn Tissue Nutrient Concentrations and Average Corn Tissue Nutrient Concentrations for Control and MAP + S + Zn + K Treatments Across Six "Farmer" Trial Locations (2012)

	Critical	Average Control	Average MAP + S + Zn + K
	-------- *Concentrations at Vegetative Stage* --------		
Tissue P (%)	0.35	0.34	0.34
Tissue Zn (ppm)	20	33	35
	-------- *Concentrations at Silking Stage* --------		
Tissue P (%)	0.28	0.50	0.49
Tissue K (%)	1.2	3.4	3.5
Tissue Zn (ppm)	20	20	19
Tissue S (%)	0.14	0.18	0.19

Overall, these results appear to support the requirement for addressing proper P and K nutrition in corn, particularly at sites with low soil tests. No enhanced yield responses to including S and Zn in starter fertilizer blends was observed at these sites in 2012. We will re-examine the treatment list and conduct further investigations in 2013.

Soybeans

Soybeans are usually grown in Ontario without added fertilizer. However, soil fertility levels may no longer be at sufficient

levels to maximize profits in many areas of the province. Potassium is of particular concern for sustainable soybean production. Broadcasting fertilizer may not be the most cost effective method for soybean production in the 21st century.

Five soybean trials in 2012 evaluated various liquid and dry starter fertilizer sources. Manganese was included to determine if soil applied manganese fertilizer can effectively increase soybean yields and net returns. Seed placed liquid fertilizer mixed with liquid inoculants were also evaluated for the potential of this combination to increase soybean profits.

Soil test results from the soybean locations are shown in table #6.

Table 6: Soil Test Results at Soybean Starter Fertilizer Locations (2012)

Location	**Soil pH**	**Phosphorus (P) ppm**	**Potassium (K) ppm**
Orangeville	7.1	16	86
Canfield	6.7	32	189
Lucan	7.8	31	157
Varna	7.8	7	52
Kenilworth	7.9	7	80

There were 8 common treatments across 4 of the sites. These sites were located at Varna, Lucan, Canfield and Orangeville. There was no statistically significant yield response to any of the fertilizer treatments when the yields were average across these four sites in 2012. See table #7.

Table 7: Average Yield Differences Across 4 Sites with 8 Common Treatments (2012)

Treatment	**Average Yield Across 4 Sites (bu/ac)**	**Yield Advantage (bu/ac)**	**LSD (5%)**
Untreated	47.1	-	a
25P + 40K (Bcast)	47.6	0.5	a
25P + 40K (2x2)	47.1	-0.1	a
25P w/ seed	47.2	0.1	a
25P + 5Mn	46.7	-0.4	a
2-20-18	45.6	-1.6	a
2-20-18 + Inoc.	46.2	-0.9	a
50N + 28S	47.0	-0.1	a

There were 5 common treatments across all 5 sites. See table 8 for results. None of the fertilizer treatments provided extra yield over the untreated check.

Table 8: Average Yield Differences Across 5 Sites with 5 Common Treatments (2012)

Treatment	**Average Yield Across 5 Sites (bu/ac)**	**Yield Advantage (bu/ac)**	**LSD (5%)**
Untreated	43.4	-	a
25P + 40K (Bcast)	43.5	0.1	a
25P w/ seed	44.2	0.8	a

25P + 5Mn	43.7	0.3	a
2-20-18 + Inoc.	42.6	-0.8	a

One site in 2012 showed a response to fertilizer. Table #9 shows the Varna trial results. A fertilizer blend of 25P + 40K was the most responsive, showing yield increases of 5.1 bu/ac when broadcast and 4.4 bushels when placed in a band 2 inches to the side and 2 inches below the seed. There was also a significant response (5 bu/ac) to the blend of 25P + 5Mn placed in furrow directly with the seed. This site had the lowest P and K soil tests (table #6) of any of the sites in 2012.

Table 9: Yield Response at the Hill and Hill Location (2012)

Treatment	Average Yield (bu/ac)	Yield Advantage (bu/ac)	LSD (5%)
25P + 40K (Bcast)	51.2	**5.10**	a
25P + 5Mn IF	51.1	**5.00**	a
25P + 40K (2X2)	50.5	**4.40**	a
2-20-18 + Inoc	48.8	**2.70**	ab
25P IF	48.7	**2.60**	ab
Untreated	46.1	**-**	b
50N + 28S	45.7	**-0.40**	b
3 gal. 2-20-18	45.4	**-0.70**	b

Trial results from the 2012 growing season do not support the use of starter fertilizer for soybean production. Yield results averaged across all sites showed no yield response to broadcast P and K, 2 X 2 P and K, in furrow P, liquid N, P, K, Mn, S, N, or inoculants mixed with liquid fertilizer. Yield responses were only evident when the soil test was extremely low as in the Varna site, but even at this site a broadcast application of P and K provided as much yield as any other method of fertilizer application. The 2012 growing season was very dry at all 5 trial locations. These extreme conditions may have influenced the yield results. Similar trials will be conducted in 2013 to further evaluate starter fertilizer use in soybeans.

Objectives and Activities

The specific objectives of this research are to:

1) Corn: Evaluate the potential for corn yield response to sulphur and zinc when applied with the starter fertilizer blend, and evaluate differences in net economic responses for various products and rates. The importance of potassium in these micronutrient starter blends will also be investigated.

Eleven trials were conducted in 2012 to address the corn objectives, while similar trials will again be conducted in 2013. Proper attention to P and K fertility management appeared to deliver increases in corn yields, particularly on lower testing sites. Including S and Zn in fertilizer blends did not appear to enhance yield response to starter fertilizers in 2012.

2) Soybeans: Evaluate the potential for soybean yield response to various starter fertilizer products and rates and evaluate which combinations provide the greatest net economic returns. Evaluate safe rates of MAP fertilizer which can be safely applied with soybean seed without reductions in seed viability. Assess the ability of manganese included in soybean starter fertilizer to correct manganese deficiency. Investigate the potential for yield interactions between soybean starter fertilizers and liquid inoculants.

Five trials were conducted in 2012 to address the soybean objectives above. Similar trials will be conducted in 2013. No significant yield differences were observed in 2012 with any of the treatments unless the soil test was very low. Various rates of MAP were tested to assess the seed safety of applying MAP in furrow. There were no significant

stand reductions until the rate of MAP was 100 lbs/ac in 15 inch rows. A minimum of two years of data will need to be collected before safe rates can be established. Trial results from 2012 do not support the use of starter fertilizers to increase soybean yield unless soil tests are extremely low.