Including Zinc and Sulphur in Starter Fertilizer Blends for Corn: 2013 Summary

Purpose:

Research on micronutrient response in corn in Ontario has received a modest effort, despite that micronutrients are expected to suffer from the same issues as P and K; decreases in soil quantities with increasing yields over time, and in the case of sulphur, decreasing deposition. 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 traditional starter fertilizer blends. It is also examining the importance of including potassium in sulphur and zinc fertilizer blends.

Methods:

Starter fertilizers were evaluated at ten locations in 2013. Four locations were "intensive" which investigated the yield response to phosphorous, potassium, sulfur and zinc nutrition in dry starter fertilizer blends, as well as other dry/liquid fertilizers and alternative placement options. Six locations were "farmer" trials where only the core P,K,S and Zn starter fertilizer blends were investigated. When included in dry fertilizer blends, nutrients were applied at rates providing 12 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. "Split" treatments investigated the yield response to applying 2/3 of product in 2"x2" band and 1/3 in-furrow. In 2013, two different P-S-Zn products were compared within most trials. One was mono-ammonium phosphate (MAP) blended with S and Zn products, while the another was MESZ (Micro Essentials Sulphur Zinc) which consists of each fertilizer particle containing P-S-Zn with ½ the sulfur in elemental form. Liquid fertilizer treatments consisted of 6-24-6 or 2-20-18 applied at 5 gal/ac in-furrow. At silking, ear leaf tissue samples were taken to evaluate crop nutrition and the relationship between critical concentrations and yield response at these sites. When interpreting results, means followed by the same letter are not significantly different at the 5% level. Comparisons are valid across fertilizer treatments, within locations only.

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

Results:

Soil test results for the 2013 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 For Ten Sulphur And Zinc Starter Fertilizer Trial Locations In Ontario, 2013

Trial Type	Location	Texture	Soil pH	Organic Matter	Soil Test P (ppm)	Soil Test K (ppm)
Intensive Trials	Alma	Silt Loam	7.3	4.1	35	84
	Elora	Silt Loam	7.5	3.0	9	46
	Bornholm	Silt Loam	7.5	3.8	29	104
	Strathroy	Sandy Loam	6.7	2.8	25	103
Farmer Trials	Glen Morris	Sandy Loam	5.8	2.5	22	143
	Paris	Sandy Loam	6.2	1.8	32	160
	Wallacetown	Sandy Loam	7.1	3.0	9	45
	Ridgetown	Loamy Sand	7.0	2.8	15	98
	Chatham	Silty Clay Loam	6.2	3.8	16	166
	Ancaster	Silt Loam	6.6	3.2	8	40

Table 2. Average Corn Yields And Yield Responses To Starter Fertilizer Across The Five "Intensive" Starter Trials In Ontario, 2012

Treatment	Alma	Elora	Bornholm	Strathroy
	-------------------- *yield (bu/ac)** --------------------			
Control	157 A	68 D	182 A	175 A
MAP†	158 A	72 D	186 A	179 A
MAP + S†	156 A	77 CD	188 A	190 A
MESZ†		99 BC	186 A	178 A
MAP + S + Zn †	161 A	87 BCD	189 A	179 A
Split MAP + S + Zn†	166 A	82 CD	195 A	189 A
MAP + S + Zn High††	176 A	109 B	194 A	188 A
MAP + K + S + Zn†	168 A	139 A	185 A	188 A
6-24-6 @ 5 gal/ac	163 A	100 BC	184 A	184 A
2-20-18 @ 5 gal/ac		106 B	185 A	173 A
6-24-6 @ 5 gal/ac + K†††	161 A	142 A	186 A	183 A
5-20-20 @ 200 lb/ac	172 A	160 A	185 A	178 A

† Where included, nutrients were applied at rates providing 12 lb-N/ac, 40 lb-P_2O_5/ac, 30 lb-K_2O/ac, 10 lb-S/ac, and 1 lb-Zn/ac
†† Nutrients were applied at rates providing 21 lb-N/ac, 71 lb-P_2O_5/ac, 53 lb-K_2O/ac, 18 lb-S/ac, and 2 lb-Zn/ac
††† K was applied at a rate providing 30 lb-K_2O/ac

At the three intensive starter fertilizer locations with soil test P and K ratings ranging from medium to high (Alma, Bornholm, Strathroy), no response to any of the starter fertilizer treatments was observed (Table 2). At Elora where soil test P and K ratings were low, the highest yields were always obtained when the starter fertilizer was delivering a high amount of K (MAP + S + Zn + K, 6-24-6 + K and 5-20-20). Yields for these treatments were significantly higher than all other starter fertilizer treatments. While including S or Zn with MAP did not result in significant yield responses over MAP alone at Elora, using MESZ as a S and Zn source did. No significant yield advantage for placing part of the MAP + S + Zn treatment ("Split MAP + S + Zn") in-furrow was observed relative to placing it all in a 2x2 band at any location.

Table 3. Average Corn Yields And Yield Responses To Starter Fertilizer Across Six "Farmer" Starter Trials In Ontario, 2013.

Treatment†	**Glen Morris**	**Paris**	**Wallace town**	**Ridgetown**	**Chatham**	**Ancaster**
	*yield (bu/ac)**					
Control	168 B	162 B	186 A	151 B	146 C	131 B
MAP	178 A	172 AB	195 A	165 A	175 A	148 A
MAP+S	173 AB	174 AB	188 A	172 A	166 AB	147 AB
MAP+S+Zn		177 A	196 A	168 A	156 BC	142 AB
MESZ	174 A	180 A	183 A	168 A	158 BC	141 AB
MAP+S+Zn+K	173 A	185 A	196 A	164 A	167 AB	156 A

† Where included, nutrients were applied at rates providing 12 lb-N/ac, 40 lb-P_2O_5/ac, 30 lb-K_2O/ac, 10 lb-S/ac, and 1 lb-Zn/ac

At the six "farmer" trials, significant yield responses for starter MAP is observed at 4 of the 6 trials (Table 3), most of which tested in the medium range for soil test P. Inclusion of S and/or Zn with MAP did not result in any significant increases in yield over MAP alone at any of the locations. Similarly, no significant yield response for MESZ was observed at any of the six locations either. Including K did not appear to enhance the yield response to starter fertilizer at these locations in 2013.

When ear leaf tissue nutrient analysis at silking time was investigated at the intensive trials (Table 4), the only location with nutrient concentrations below critical values was Elora. This was consistent with yield response as it was the only location where yield response was observed for starter fertilizers. Large yield responses to deficient nutrients were only fully recognized until other deficiencies were addressed. At Elora for example, yield response to starter P was minimal until K requirements were also addressed.

At the six farmer trials, most nutrient concentrations were at or above critical concentrations (Table 5). Significant yield responses were observed for most instances where concentrations were below critical values. This was particularly evident for phosphorous where significant yield responses to starter P was observed even where ear leaf concentrations were above critical values. Across all ten trials, there were only two instances of sulphur, and no instances of zinc being below critical value. This would support the overall lack of response to starter Zn and S except for at a few locations in 2013.

Table 4. Critical And Average Ear Leaf Tissue Concentrations Of Control Plots Of Four "Intensive" Trials Sampled At Silking, 2013.

Nutrient	Critical Concentration	Alma	Elora	Bornholm	Strathroy
		-------*Tissue Nutrient Concentrations* -------			
P	0.28 (%)	0.29	0.18	0.29	0.35
K	1.2 (%)	2.0	0.5	1.8	2.3
S	0.14 (%)	0.17	0.08	0.16	0.16
Zn	20 (ppm)	29	21	26	20

Table 5. Critical And Average Ear Leaf Tissue Concentrations Of Control Plots Of Six "Farmer" Trials Sampled At Silking, 2013.

Nutrient	Critical Concentration	Glen Morris	Paris	Wallace town	Ridgetown	Chatham	Ancaster
		-------*Tissue Nutrient Concentrations* -------					
P	0.28 (%)	0.33	0.33	0.32	0.32	0.26	0.23
K	1.2 (%)	2.5	2.1	2.4	2.4	2.1	1.0
S	0.14 (%)	0.16	0.11	0.15	0.17	0.14	0.18
Zn	20 (ppm)	24	27	20	22	26	30

Summary:

These results support the importance of addressing P and K nutrition as a base requirement to maintain high corn yields. At locations with multiple nutrient deficiencies, yield responses were limited until all were addressed. Ear leaf nutrient concentrations suggest that S and Zn deficiency was not an issue at most locations in 2013. This was supported by final yields where no significant response was observed for adding S and/or Zn with MAP in starter fertilizer blends, and where only one location demonstrated a significant yield response to MESZ over MAP. Split applying the N, P, S and Zn starter blend through banding and in-furrow did not provide a significant yield response over banding alone at any location.

Next Steps:

This was the last year of a two year project.

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Project Contact:

Greg Stewart, OMAFRA, greg.stewart1@ontario.ca