

Fertility Options for Soybean Production (Final Report)

Purpose:

Traditionally, soybeans in Ontario have been grown without added fertilizer unless soil test values are low. Nitrogen is provided by fixation in the nodules of soybean roots, and phosphorus and potassium was only supplied if soil tests were low. In recent years, yields have increased and crop rotations have shortened between soybean crops; this short interval is leading to nutrient deficiency symptoms being observed more often.

This project was designed to assess if fertilizer, in a variety of blends and placements, can increase soybean yields. The project also evaluated what soil types would have the greatest responses based on the existing soil test levels.

Methods:

Five field scale trials were established in 2012 with an additional five trials in 2013. The five trials were established at Lucan, Varna, Kenilworth, Orangeville and Canfield in 2012. Of these five locations, two were planted using conventional tillage methods, while the other three were planted in no-till conditions. In 2013 the trials were established at Goderich, Lucan, Woodstock, Strathroy, and Caledonia. Of these 3 were no-till. Each plot within the trial was 20 feet wide by at least 1000 feet long. There were eight treatments randomized and replicated three times in 2012. There were 6 treatments in 2013. Trials were planted with a Kearney 15" vacuum planter. All fertilizer treatments were applied by the planter at the time of planting.

Table 1. Trials included the following treatments:

Treatment	Description
Untreated	No fertilizer added.
25P + 40K (Bcast and Incorp.)	Fertilizer blend broadcast and incorporated to apply 25 lbs P ₂ O ₅ and 40 lbs K ₂ O.
25P + 40K (2x2 Band)	Fertilizer blend banded 2" down and 2" over from the seed to apply 25 lbs P ₂ O ₅ and 40 lbs K ₂ O.
25P (In Furrow)	MAP granular fertilizer applied in row with the seed to provide 25lbs actual P ₂ O ₅
25P + 5Mn (In Furrow)	Same as above, with the addition of 5lbs of Manganese.
3 gallons 2-20-18 (not included in 2013)	Alpine liquid fertilizer applied in row with seed.
3 gallons 2-20-18 + Inoculant	Same as above, with the addition of Optimize liquid inoculant mixed into fertilizer tank.
50N + 28S (Bcast and Incorp.) (not included in 2013)	Fertilizer blend of Ammonium Sulphate and ESN broadcast and incorporated to apply 50lbs N and 28 lbs S actual.

Results:

The 2012 growing season produced fantastic soybean yields. Early planting was achieved in most areas; however many areas also experienced a prolonged period without moisture after planting which impacted yields. Differences between fertilizer treatments were visible early in the season. The 2013 growing season was more typical with considerable moisture in the spring and fall.

Table 2, below, shows the existing soil fertility and tillage method for the sites used in this study.

Table 2: Soil Test Values for Fertility Trials (2012-13)

Year	Location	Soil test values (ppm)		Tillage
		P	K	
2012	Lucan	31	157	No-Till
	Varna	7	52	Conventional
	Kenilworth	7	80	Conventional
	Orangeville	16	86	No-Till
	Canfield	32	189	No-Till
2013	Goderich	14	94	No-Till
	Lucan	11	118	Conventional
	Woodstock	22	99	No-Till
	Strathroy	15	107	No-Till
	Caledonia	17	121	Conventional

There were eight common fertilizer treatments across four of the sites in 2012. There was no statistically significant yield response to any of the fertilizer treatments when the yields were average across these four sites (Table 3).

Table 3: Average Yield Differences across 4 Sites (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 in furrow	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

Crop Advances: Field Crop Reports

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 2012 site, but even at this site a broadcast application of P and K provided as much yield as any other method of fertilizer application. 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.

Table 4: Average Yield across all Sites (2012 – 2013)

Treatment	Average Yield Across 4 Sites (bu/ac)	Yield Advantage (bu/ac)	LSD (5%)
Untreated	44.4	-	a
25P + 40K (Bcast)	45.4	1.0	a
25P + 40K (2x2)	45.3	0.9	a
25P in furrow	45.4	1.0	a
25P + 5Mn	45.4	1.0	a
2-20-18 + Inoc.	44.8	0.4	a

There were 6 common treatments across all the sites in 2012 and 2013 (Table 4). There was no statistical yield response to any of the fertilizer applied averaged across all sites. Yield responses were only evident when the soil test was low, but even in those situations a broadcast application of P and K provided as much yield as any other method of fertilizer application. Average soil test value at these sites was 11 ppm for P and 92 ppm for K (Table 5).

Table 5: Average Yield at 3 Low Soil Testing Sites (Varna 2012, Lucan 2013, Strathroy 2013) P = 11 ppm, K = 92 ppm.

Treatment	Average Yield Across 4 Sites (bu/ac)	Yield Advantage (bu/ac)	LSD (5%)
Untreated	45.3	-	b
25P + 40K (Bcast)	49.5	4.2	a
25P + 40K (2x2)	49.8	4.5	a
25P in furrow	49.3	4.0	a
25P + 5Mn	50.4	5.1	a
2-20-18 + Inoc.	48.6	3.3	a

Trial results from the 2012 – 2013 show a large yield gain (4-5 bu/ac) to applying fertilizer when soil tests are low. However, the results do not support the use of starter fertilizer for soybean production when soil test levels are adequate. It should be noted that starter fertilizers, especially dry fertilizer or liquid fertilizer with an inoculant did show

similar yield gains to broadcast fertilizer at the low testing sites. Therefore a producer could use starter fertilizer applied through the planter and gain similar yields to a broadcast treatment. At one of the sites there was an advantage to banding over broadcast if soil test levels were low.

Summary:

- 1) Response to fertilizer can be significant where soil tests are low, approximately 5 bushels/acre in this study
- 2) Soybean yield gains were not found to any of the fertilizer combinations assessed if soil tests values for P and K were adequate
- 3) Spring applied broadcast fertilizer provided the same yield response on average compared to banding. At very low testing sites banding does provide a slight benefit over broadcast
- 4) 50 lbs/acre of MAP applied in furrow in 15" rows provided similar yield gains to fertilizer blends with both P and K.
- 5) Soybeans did not respond to nitrogen and sulphur fertilizer

Next Steps:

This was the final year of this project.

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