Assessing Fertility Options in Soybean Production

Purpose:

Traditionally, soybeans in Ontario have been grown without added fertilizer. Nutrition had been provided by nitrogen fixation in the nodules of soybean roots, and residual phosphorus and potassium left behind by previous crops. In recent years, crop rotations have turned to shorter intervals between soybean crops; this short interval is leading to nutrient deficiencies and yield losses in some areas. This raises the question of what should be done to maintain or boost yields in terms of fertilization.

This project will assess (2009-2011) if added fertilizer, in a variety of blends and placements, can increase soybean yield responses. The project will also look at what types of soils will have the greatest responses based on the existing fertility.

Methods:

Two field scale trials with three replications were conducted in 2009 and three were conducted in 2010. In 2009 both sites were low fertility sites, with one located near Orangeville and the other located near Monkton. In 2010 two sites were low fertility, one was located near Lucan and the other near Bornholm; there was also a high fertility site selected near Stratford. Each plot within a trial was either 10' or 20' wide with a length of at least 1000 feet. In 2009 both sites were conventional tillage and in 2010 the site near Lucan was conventional tillage while the other two were no-till. Trials were planted with a Kearney 15" vacuum planter. Yields were measured using a calibrated weigh wagon.

Trials included the following treatments:

Treatment	Description
Untreated	No fertilizer added
3 gallons 6-24-6	Liquid fertilizer applied in row with the seed
40 P + 70 K Inc.	Fertilizer blend broadcast and incorporated to apply 40 lbs P_2O_5 and 70 lbs K_2O
25 P with seed	MAP granular fertilizer applied in row with the seed
40 P + 70 K Inc. + 3 gallons 6-24-6	Dry fertilizer broadcast and incorporated as well as liquid fertilizer applied in row with the seed
40 P + 70 K 2X2 Band	Fertilizer applied in a band 2 inches to the side and 2 inches below the seed

Results:

The 2009 growing season was cool and wet. Above average rainfall during July and August and excellent fall weather was experienced at both sites. There was no significant insect or disease pressure, but soybean aphids were present late in the

growing season in 2009. In 2010 it was a fantastic growing season with many sites achieving above average yields. Due to the excellent season, and soybeans' ability to adapt in favorable growing conditions, it is possible that the results of the fertilizer applications may have been diminished.

Table 1: Soil Test Values for Fertility Trials (2009-2010)

Location	Soil test values		Tillage
	P	K	
Dufferin 2009	25	103	Spring Cultivate
Monkton 2009	7	118	Spring Cultivate
Lucan 2010	8	147	Spring Cultivate
Stratford 2010	47	200	No-till
Bornholm 2010	19	89	No-till

Table 1 shows the existing soil fertility for sites used in this study. "Stratford" was a higher fertility site, while the remainder were considered low fertility sites. Table 1 also shows tillage method before planting.

Yield responses to added fertilizer were relatively small. Below, in Table 2, is a summary of the yield results from 2009 and 2010. The table also shows the increase in yield for each treatment, or 'advantage,' over the untreated check.

Table 2: Yield Summary for 5 Field Scale Fertility Trials (2009-2010)

Treatment	Average Yield (bu/ac)	Advantage (bu/ac)	LSD (5%)
Untreated	48.7	-	c
3 gallons 6-24-6	50.8	2.1	b
40 P + 70 K Inc.	51.0	2.3	ab
25 P with seed	51.8	3.1	ab
40 P + 70 K Inc. + 3 gallons 6-24-6	52.3	3.6	a
40 P + 70 K 2X2 Band	52.3	3.6	a

The above table shows that adding some fertility in the spring will increase yield, however the gains are not necessarily going to be economical considering the cost of fertilizer and soybean prices at the time of harvest. The table below, Table 3, has the treatments ordered from least economical to most economical based on the price of application and the yield gain that was achieved by each treatment.

Table 3: Average Economic Benefit based on Soybean Yields and Fertilizer Inputs 2010

Treatment	AVERAGE Yield (bu/ac)	Yield Advantage (bu/ac)	Cost ($/ac)	Net Response ($/ac) @ $10/bu Soys
Untreated	48.7	-	-	**-**
40 P + 70 K Inc. + 3 gallons 6-24-6	52.3	3.6	$67.00	**-$31.00**
40 P + 70 K Inc.	51.0	2.3	$51.50	**-$28.50**
40 P + 70 K 2X2 Band	52.3	3.6	$51.50	**-$15.50**
3 gallons 6-24-6	50.8	2.1	$15.50	**$5.50**
25 P with seed	51.8	3.1	$12.50	**$18.50**

The data above in Table 3 shows that the two treatments with the lowest yield advantage also had the lowest input cost. This in turn meant that they provided the most net income.

Summary:

1) Soybean yields were improved when using a fertilizer application before seeding. The treatment that has showed the greatest response at all sites has been 40P + 70K dry, granular fertilizer applied in a band 2 inches beside, and below the seed.
2) Adding fertilizer at a high fertility site did not produce the same type of yield response as it did at a low fertility site. The only statistically significant response at the high fertility site was to the 2 X 2 band.
3) MAP with the seed and 3 gallons of 6-24-6 were the only economically profitable treatments. There is concern that MAP with the seed could cause fertilizer burn so more study will be needed to determine the feasibility of this approach.

Next Steps:

One new type of fertilizer was used at one site this year and showed promising results. The treatment was 3 U.S. gallons of 2-20-18 liquid fertilizer. This was applied directly with the seed in row at the time of planting. Out of all the treatments tested at the site it showed the most promising results, with a yield gain of 5.5 bu/ac. Below, Table 4, shows the results from this trial where this treatment was used in 2010.

Table 4: Yield Results from Soybean Fertility Trial in Lucan, 2010

Treatment Name	Average Yield (bu/ac)	Advantage (bu/ac)	Duncan's Multiple Range
Untreated	51.1	-	b
3 gallons 6-24-6	54.2	3.0	ab
40 P + 70 K Inc.	54.4	3.3	ab
25 P with Seed	52.9	1.8	ab
40 P + 70 K Inc. + 3 gallons 6-24-6	55.2	4.0	ab
40 P + 70 K 2x2 Band	56.0	4.9	a
40 P + 70 K + 25 P with Seed	54.3	3.2	ab
3 gallons 2-20-18	56.6	5.5	a

This was the second year of a 3 year project so additional data must be collected to make robust conclusions.

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