Intensive Management to Increase Soybean Yield and Seed Quality (SMART 2 Project)

FINAL

Purpose:

Farm yields of soybeans have been relatively stagnant over the past two decades in Ontario. With higher commodity prices soybean growers are seeking solutions to overcome the limitations on soybean yields. Improving seed quality in the absence of any significant disease or pest pressure is also a challenge. Current agronomic recommendations in Ontario are based on research with relatively narrow objectives that focus on simple effects of a few factors at a time. Management needs to consider additive and synergistic effects on yield, seed quality, and profitability. This project studied the possible additive effects of inputs on different varieties as well as the effects of late maturing bean varieties for a given region. A “kitchen sink” approach was applied at the field scale level to assess the impacts of multiple inputs on soybean yields and seed quality. This treatment package was also broken down into its individual components and applied on 8 different varieties on small plots by the University of Guelph.

Methods:

Field scale treatments included:

1. Adapted variety – Untreated
2. Adapted variety – *Kitchen Sink
3. +200 CHU variety – Untreated
4. +200 CHU variety – *Kitchen Sink

***Kitchen Sink** treatment consisted of Cruiser Maxx seed treatment, Hi Coat inoculant, Quilt foliar fungicide, a higher seeding rate (250,000 seeds/acre), 50 lbs/acre of nitrogen in the form of ESN and ammonium sulphate, 3 gallons/acre of 2-20-18 liquid applied in furrow, 6L of SRN (slow release nitrogen) and 2L of 3-16-16 foliar fertilizer. +200 CHU refers to a variety that is 200 Crop Heat Units (CHU’s) longer than recommended for the given area.

Trials were established at 15 sites across Ontario from 2011-2013. There were a wide range of CHU zones. Trials were conducted in the following counties; Kent, Lambton, Middlesex, Haldimand, Norfolk, Perth, Huron, and Wellington.

The spring of 2011 was cold and wet, which delayed planting by about 2 weeks. These trials were planted in late May or early June. However, the August-October period of the growing season was outstanding, and resulted in above average yields.

In 2012, the spring conditions were almost the polar opposite of 2011. The weather was warm and dry for the early part of the season. Early planting took place for these trials. In many areas conditions were dry for an extended period of time. Once again, the August-October period of the growing season was forgiving and excellent yields were realized in these trials.

The spring of 2013 started dry and then turned wet. All the trials were seeded during the traditional planting window of May. Seeding dates ranged from May 9th to May 20th. Yields proved to be excellent with average yields over 50 bu/ac in these trials.

Results:

Planting a longer maturing soybean variety provided 2.1 bu/ac more yield across the three years of this study. This was the +200 CHU treatment. The "kitchen sink" approach added another 4.9 bu/ac on average across the three years of this study. The results were extremely consistent across locations and years. The cost of the kitchen sink approach in this study was approximately $140 per acre. The parallel small plot trials with the U of G that tested 8 different varieties at each site showed a response up to 10 bu/ac with some varieties. Extending the maturity by growing a variety that was +200 CHU longer than recommended was an effective way of increasing yields without added input costs.

Figure 1 & 2. These pictures show plant growth differences between with the Kitchen Sink treatment (left side of each picture) versus untreated beans (right side of each picture). The picture on the left was taken in a field near Caledonia, while the picture on the right was taken in a field near Delhi.

Table 1 shows the yield averages for each treatment and Table #2 reports the results of the seed analysis.

There was no statistical difference in moisture, oil, protein, or visual seed quality on average across the sites. There was a slight seed size increase in the Kitchen Sink treatment in this study. The seed size was also slightly larger for the longer day bean varieties. This could explain part of the increased yield.

On average, there was no impact on seed germination as a result of the Kitchen Sink treatment being applied. The germination of the longer season varieties (+200) was slightly higher than the adapted varieties. The difference in germination between the adapted and the longer day beans is most likely related to variety differences and not directly related to the maturity of these varieties.

Table 1. Field Scale Yield Results (2011-2013)

Treatment	Average Yield Across All Sites (15 sites) (bu/ac)	Advantage over Adapted Untreated
Adapted - Untreated	49.4	-
Adapted - Kitchen Sink	54.5	5.1
+200 CHU - Untreated	51.5	2.1
+200 CHU - Kitchen Sink	56.4	4.9

Table 2. Summary of Seed Analysis Results from 2011-2013

	Adapted Untreated	Adapted Kitchen Sink	+200 CHU Untreated	+200 CHU Kitchen Sink
Moisture	12.6%	12.6%	12.5%	12.4%
Oil	20.9	21.0	21.0	20.9
Protein	40.4	40.0	40.3	40.3
100 Sd Wgt (g)	15.6	15.7	15.8	16.4
Visual*	1.3	1.2	1.3	1.3
Germination**	92.9	91.5	95.3	95.1
*Visual seed quality 1 = Excellent, 5 = Poor, ** Germination was only tested in 2012 and 2013.				

The Delhi location (Table #3) showed noticeable differences to the Kitchen Sink treatment on harvested seed quality and germination. This was likely the result of the seed used in the spring to establish this trial. This certified seed used was infected with a small amount of phomopsis seed decay. This resulted in phomopsis seed decay in the trial. The foliar fungicide likely was the main factor increasing germination by reducing the amount of phomopsis.

Table 3. Summary of Seed Analysis and Yield Results from Delhi, 2012

Measurement	Delhi Location			
	Adapted Untreated	Adapted Kitchen Sink	+200 CHU Untreated	+200 CHU Kitchen Sink
Yield (bu/ac)	41.1	44.1	45.3	48.4
Moisture	21.1%	21.2%	19.5%	19.3%
Oil	21.6	21.3	22.3	22.2
Protein	40.3	40.5	37.6	37.7
100 Sd Wgt (g)	20.0	20.3	16.3	17.0
Germination	63.0%	65.3%	86.7%	89.0%
Visual*	2.7	2.7	2.7	2.7
* 1 = excellent, 5 = poor				

The Courtland location shown in Table #4 also showed noticeable effects from the Kitchen Sink treatment on seed quality and germination. This was likely due to the presence of white mould, especially in the Kitchen Sink treatment. A higher seeding rate contributed to this problem. Although seed size and yield were higher with the Kitchen Sink treatment seed germination was considerably lower especially for the adapted variety.

Table 4. Summary of Seed Analysis and Yield Results from Courtland, 2013

	Courtland Location			
Measurement	**Adapted Untreated**	**Adapted Kitchen Sink**	**+200 CHU Untreated**	**+200 CHU Kitchen Sink**
Yield (bu/ac)	43.1	48.7	40.0	45.1
Moisture	11.3%	10.8%	11.1%	11.2%
Oil	19.6	19.8	20.3	19.4
Protein	41.1	40.3	40.7	41.1
100 Sd Wgt (g)	12.8	14.5	12.6	16.9
Germination	90.3%	72.0%	95.0%	94.0%
Visual*	1.0	1.0	1.0	1.0
*1= excellent, 5 = poor				

Summary:

1) An average yield gain of 5.1 bu/ac for adapted varieties and a gain of 4.9 bu/ac for long maturing varieties was realized when seed treatments, nitrogen fertilizer, a higher seeding rate, foliar fungicides and foliar fertilizer were applied together in 2011-13 (Kitchen Sink treatment). This approach was not economically profitable on average.
2) An average yield gain of 2.1 bu/ac was realized when a variety that was 200 CHU's longer than recommended was planted in any given area. This translated to a harvest delay of approximate 8 days in the fall. This strategy proved to be a viable way to increase soybean yields and profits.
3) There was no statistical difference in moisture, oil, protein, germination, or visual seed quality on average. There was a slight seed size increase to the Kitchen Sink treatment in this study. The seed size was also slightly higher for the longer day bean varieties. This could explain part of the increased yield.
4) In the presence of phomopsis seed decay (1 trial in 15 trials) germination was increased with in the Kitchen Sink treatment. This was likely from the use of a foliar fungicide. In the presence of significant white mould disease pressure seed quality decreased with the use of the Kitchen sink treatment for the adapted variety. This was likely due to the higher seeding rate used in this treatment.
5) Intensive management of soybeans is an effective way to increase yields and in some cases seed quality, especially seed size. However, yield increases did not offset the cost of the inputs used in this study.

Next Steps:

This was the final year of a three year project.

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