Dry Bean Intensive Management Soil Health Study
(Interim Report)

Purpose:

Dry bean yields are influenced by a number of factors. Disease can have a big impact on yields. Although they are N-fixing legumes they don't usually produce enough for optimum yields thus requiring additional fertilizer nitrogen or manure. Part of this study explores nitrogen rate requirements of dry beans.

Many growers try to plant dry beans on their best fields or on rented fields coming out of hay. Fields receiving regular amounts of manure are also targets as they have proven to produce the highest yields. The second part of this study will evaluate the soil health of the dry bean fields using a number of soil health indicators. A good correlation between soil health indicators and yield could be used to help a grower predict which fields will produce the highest dry bean yields.

Methods:

The fields were set up with small plots replicated four times and longer strips in the field replicated three times. Fertility, nitrate and potentially mineralizable nitrogen (PMN) soil samples were taken from each of the treatments. 15cm cores were taken for the fertility, PMN and aggregate stability analysis and 30cm cores for the nitrates. Four rates of nitrogen (0, 35, 70, 105 kg N/ha) were applied to the small plots and strips. Three locations down the strip were selected, loosely based on topography (upper, mid and lower slope position), where crop growth (10 plant dry matter, plant height and development stage measured at 4, 6 and 8 weeks after planting), water infiltration and soil compaction measurements were taken. Hand harvest yields samples were collected at the end of the season. Plot combine yields were taken from the small plots and the grower harvested and weighed the strips.

Results:

2012 Eight fields were chosen for the study in the London to Kippen area. Table 1 below provides the average scores of seven of the soil health indicators used on the fields. The scoring of these indicators (out of 100) is based on the Cornell Soil Health Assessment. More information can be found at http://soilhealth.cals.cornell.edu/. Four of the soil health indicators are chemical (nutrient) based. The scoring for each is based on adequate nutrient levels or pH. Six out of the eight sites had lower than optimal phosphorus levels and five out of the eight had lower micronutrient (magnesium, manganese and zinc) levels. The potassium and pH levels were optimal at all sites. Potentially mineralizable nitrogen (PMN) indicator is an indicator of the capacity of the soil microbial community to convert (mineralize) nitrogen tied up in complex organic residues into a plant available form of ammonium. Only two of the sites scored in the mid-range and the rest had low scores. PMN is a biological indicator as is soil organic matter. There were three sites that scored in the mid-range for organic matter. The final indicator, aggregate stability is considered a physical indicator. In this test aggregates 0.25mm to 2mm are subjected to 1.25 cm of rainfall for five minutes representing an intense rainstorm. Three sites scored high for this indicator, four scored moderate and

one poor. Poor aggregate stability usually means the soil is prone to sealing over and crusting, reducing yield potential and slowing water infiltration into the soil. These factors are commonly referred to as problems in edible bean production. Soils with poor aggregate stability are more prone to soil erosion. Overall scores were calculated by averaging the P, K, pH and micronutrient scores then averaging that number with the OM, aggregate stability and PMN scores. Three of the sites had very good overall scores, all above 60. One was borderline poor at 35 and the rest were good. Table 2 shows the surface hardness scores (compaction) and infiltration rates. There were some differences from site to site. Field history information will be combined with the other data that has not been analyzed yet to complete the soil health assessment on these fields. The intensive sampling done in this project also will provide us with an opportunity to assess the variability of soil health indicators within a field. The statistical analysis did not reveal any significant correlations for yield and the soil health indicators. This could mean that there was not a significant difference in the soil health of the sites.

Table 1. Average Soil Health Indicator Scores 2012

Location	P	K	PMN	pH	OM	Micro-nutrient	Aggregate Stability	Overall
	Score (0-100)							
KippenC	90	100	14	100	29	43	46	43
KippenJ	50	100	10	100	34	73	41	42
ExeterD	54	96	30	100	26	40	71	50
ExeterRS	31	100	26	100	17	89	16	35
StMarysH	100	100	14	100	58	98	71	61
LondonE	67	100	49	100	71	100	81	73
LondonC	50	100	10	100	33	43	50	42
StMarysP	22	100	48	99	56	90	67	62

Table 2. Surface Hardness and Water Infiltration Rates 2012

Location	Surface Hardness (0 to 6") Score (out of 100)	Water Infiltration (mm/hr)
KippenC	13	194
KippenJ	19	230
ExeterD	31	158
ExeterRS	10	97
StMarysH	18	208
LondonE	13	195
LondonC	5	105
StMarysP	--	169

2013 Seven sites were selected this year in a similar geographic area to last year. The range in total scores was less than the first year. A few of the PMN analysis have not come back from the lab yet so PMNs were not included in any of the overall scores. The range of phosphorus scores was also less than last year. The three lower scores had medium P soil tests. The potassium scores show a low probability for response to added fertilizer according to the Ontario recommendations. PMN scores were low except at the St Mary's site. It is likely higher due to the dairy manure on the farm. Organic matter scores were good except for a couple of sites which were low. Many of the sites were below adequate levels of at least one of magnesium, zinc or manganese. Aggregate stability scores were very good at one site, good at four, fair at one and poor at one. The range of overall scores was less than last year with four very good and the rest good.

Table 3. Average Soil Health Indicator Scores 2013

Location	P	K	PMN	pH	OM	Micro-nutrient	Aggregate Stability	Total
	Score (0-100)							
Brucefield	79	100	NA	100	38	58	40	54
Kippen	77	100	NA	100	54	45	18	51
Exeter1	45	92	10	100	57	80	60	65
Exeter2	46	100	NA	100	35	60	35	49
St.Mary's1	93	98	40	100	63	57	62	71
London	49	100	12	100	67	38	75	71
St.Mary's2	100	100	11	100	63	69	65	73

Summary:

It is hard to draw too many conclusions at this point as the second year data has not been analyzed yet. The soil health indicators did show differences between the sites. Fields under good soil management practices generally had higher soil health scores.

Next Steps:

Complete the analysis of all of the data. The study will continue for two more years.

Acknowledgements:

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