Environmentally Sustainable Utilization of Nitrogen on Corn 2016 – Y Drop

Interim Report 2

(OSCIA Tier 2 - Ottawa Rideau)

Purpose:
To improve nitrogen use efficiency for sustainable corn production, while enhancing the environment. This project will evaluate the yield response to comparable nitrogen (N) rates applied at various timings, including a late application (Y-Drop) applied at the 10 to 14 leaf stage of corn, planting, broadcast or side-dressed applied nitrogen.

Background:
Recent research has shown that today's hybrids use more nitrogen (29%) post tassel than hybrids of the 1990's and earlier. Modern day hybrid's take up seven pounds more nitrogen. Up to 37% of the total N is taken up post tassel.

N uptake prior to flowering supports critical ear shoot development, kernel number and potential kernel size. Corn growers have traditionally targeted N availability to this period, and considered post-flowering application to be of little value.

Given the variability in soil type and seasonal environmental conditions, nitrogen use efficiency may be improved by applying split applications of nitrogen to align with periods of the crop growth where nitrogen need is greatest.

Recently new equipment (Figure 1) has become available to allow growers to apply N (Figure 2) at later growth stages. Research work in the United States has shown favorable yield increases and improved nitrogen utilization while minimizing potential water quality concerns. However, little research work has been conducted to date in Ontario assessing these corn nitrogen management changes.

Figure 1: Y Drop units attached to sprayer for late N Application

Figure 2: Y Drop units attached to sprayer for late N Application

Figure 3: Y Drop liquid N stream of late N beside the corn row.

Methods:

Ten farm locations in the Ottawa-Carleton, Lanark and Dundas counties, applied the 6 treatments (see Table 1), with 3 randomized replications of each treatments. Note: actual N rates at each site varied depending on the Grower Rate of each location.

Table 1: An example of the six treatments in 2016:

Trt #	Description
1	Starter N Only
2	75% Grower rate; Split with late Y-Drop
3	Grower Rate – standard
4	Grower Rate Split with late Y-drop
5	125% of the Grower Rate
6	125% of the Grower rate Split with late Y-drop
late Y-Drop is at V10 to V14 corn stage.	

A VERIS sensor was used at several location to measurer CEC, pH and Organic Matter to characterize the soils into management zones while enhancing our understanding of soil/nitrogen relationships (Figure 4). Pre-side-dress nitrogen test (PSNT) soil samples were taken from the *Starter N at Planting Only* (treatment 1) strips within the treatments at each site. At harvest, yield monitors were used to collect continuous side-by-side yield data to compare different N rates and application timings across the field management zones.

Results:

Table 2: 2016 Summary of 11 locations Yield and N Rates, PSNT results, Soil Texture and Previous Crop.

Treatment	Hilltone		Nandale		Vernon Valley	
	Total N	Yield (bu/ac)	Total N	Yield (bu/ac)	Total N	Yield (bu/ac)
Starter N Only	15	166	11	164	25	146
75% Grower Standard with YD	88	194	96	196	105	161
Grower Standard Rate	115	201	126	198	135	163
Grower Standard Split with YD	115	196	126	206	135	165
125 % Grower Standard with YD	145	201	171	214	165	166
125 % Grower Standard	145	202	171	198	165	164
Average (excluding 0 N)	122	193	138	196	141	161
MERN	106		97		85	
Average PSNT-May 25 (range)	18	(14-21)	19	(16-22)	21	(17-23)
Average PSNT-June 25 (range)	18	(11-24)	17	(13-21)	20	(17-24)
Previous Crop	Winter Wheat		Mixed Grain		Soybean	

Table 2 (con't): 2016 Summary of 11 locations Yield and N Rates, PSNT results, Soil Texture and Previous Crop.

Treatment	Jockbrae		Panmure		Kemp	
	Total N	Yield (bu/ac)	Total N	Yield (bu/ac)	Total N	Yield (bu/ac)
Starter N Only	34	136	32	152	36	223
75% Grower Standard with YD	114	166	112	170	124	224
Grower Standard Rate	144	157	148	172	154	221
Grower Standard Split with YD	144	161	147	178	154	227
125 % Grower Standard with YD	184	167	182	179	194	225
125 % Grower Standard	184	165	182	176	194	224
Average (excluding 0 N)	154	158	154	171	164	224
MERN	116		107		0	
Average PSNT-May 25 (range)	17	(15-19)	21	(19-23)	20	(18-21)
Average PSNT-June 25 (range)	26	(17-34)	21	(15-27)	19	(16-21)
Previous Crop	Soybean		Corn		Winter Wheat	

Treatment	Vanden Bosch		Brugmans		Schouten Dairy	
	Total N	Yield (bu/ac)	Total N	Yield (bu/ac)	Total N	Yield (bu/ac)
Starter N Only	75	120	24	183	27	182
75% Grower Standard with YD	147	159	109	207	117	214
Grower Standard Rate	170	156	139	204	147	219
Grower Standard Split with YD	171	161	139	211	147	213
125 % Grower Standard with YD	195	162	179	210	187	213
125 % Grower Standard	195	158	179	210	187	220
Average (excluding 0 N)	176	153	149	204	157	210
MERN	171		101		116	
Average PSNT-May 25 (range)	13	(11-14)	19	(14-25)		
Average PSNT-June 25 (range)						
Previous Crop	Corn		Soybeans		Soybeans	

Table 2 (con't): 2016 Summary of 11 locations Yield and N Rates, PSNT results, Soil Texture and Previous Crop.

Treatment	Double LL	
	Total N	Yield (bu/ac)
Starter N Only	33	180
75% Grower Standard with YD	123	197
Grower Standard Rate	155	200
Grower Standard Split with YD	149	204
125 % Grower Standard with YD	179	203
125 % Grower Standard	188	204
Average (excluding 0 N)	159	198
MERN	104	
Average PSNT-May 25 (range)	19	(14-23)
Average PSNT-June 25 (range)	26	(18-45)
Previous Crop	Winter Wheat	

Table 3: MERN (Most Economical Rate of Nitrogen) analysis 2016

Delta Yield Summary

Field	Nitrogen Rates (lb-N/ac) Low N	Non-Limiting N	Average Yelds (bu/ac) Zero-N 1 Low Avg	High-N 1 High Avg	Delta Yields (bu/ac) Delta Yield 1	Delta Yield MERN Estimate (lb-N/ac) Delta Yield 1
Jockbrae	34	184	136	166	30	116
Panmure	32	182	152	178	26	107
Nandale	11	171	164	206	42	109
Vandenbosch	75	195	120	160	40	171
Brugmans	24	179	183	210	27	101
Vernon Valley	25	165	146	165	19	85
Schouten Dairy	27	187	182	217	35	116
Double LL	33	188	180	204	24	104
Hilltone	15	145	166	202	36	106
Kemp	36	194	223	225	2	0

Summary:
2016 is year two a three project. At all but one site (Nandale) there was no advantage to the late applied (Y-Drop) nitrogen. At the Nandale site there was a yield increase by increasing the N rate and split applying with the late applied (Y-Drop) nitrogen. The additional N cost of (30 lbs N/ac) $15.00 per acre plus an additional cost of $15 per acre for Y Drop application is $60.00 per acre Note there is no cost included for any trampling damage of the late application. With a 16 bu/ac increase at $4.50 per bushel, that would be an additional $72.00 per acre for a net return of $12.00 per acre at this site only.

Although the weather in 2016 was quite dry in May and particularly in June prior to the late applied (Y-Drop) nitrogen, there were high available soil nitrate (NO_3) levels as shown by the PSNT (Pre-Sidedress Nitrogen Test) results taken on May 25th and again on June 25th. From table 4, Pre-Sidedress Nitrogen Soil Test (PSNT) fertilizer N recommendations (OMAFRA), the N recommendation was 100 down to 0 pounds per acre. Other factors that will need to be considered are hybrid response, crop rotation, planting timing and fungicide use. This may explain the lack of response to Y Drop and higher N rates in 2016.

Further analysis to be done of the yield data may show some potential opportunity to variable rate apply N. The yield, and Veris maps will be analyzed to determine which is the best correlation to these zones.

Table 4: Pre-Sidedress Nitrogen Soil Test (PSNT) fertilizer N recommendations based on soil nitrate concentration (PPM) and expected yield (bu/acre).

Soil Nitrate (PPM)	Expected Yield (bu/ac)					
	120	143	167	191	215	239
	Sidedress Nitrogen Fertilizer Recommendation (lb N/acre)					
0.0	176	197	218	240	261	282
2.5	163	184	205	225	246	267
5.0	151	171	191	211	231	252
7.5	138	158	177	197	216	236
10.0	126	144	163	182	201	221
12.5	113	131	149	168	187	206
15.0	99	117	135	153	172	190
17.5	83	102	120	138	156	175
20.0	57	86	105	123	141	159
22.5	0	60	88	107	126	144
25.0	0	0	63	90	110	128
27.5	0	0	0	66	92	111
30.0	0	0	0	0	68	93
32.5	0	0	0	0	0	69
35.0	0	0	0	0	0	0

Next Steps:

2016 was the second of a three project. Plots are planned to be setup, monitored and harvested again in 2017 and a final report to be summarize the three year trial. Further analysis of the 2015 and 2016 yield monitor harvest data is underway for each location. Data from the VERIS measurements of CEC, pH and Organic Matter and soil characteristics will be over-laid with the yield data to evaluate the correlation between these information layers to see if this can be used to explain the soil/nitrogen relationship and potential management zones. These results will be added to the report when available. Results to date have been presented at several local Soil & Crop Improvement Association – Annual Meetings in eastern Ontario and will be at the 2017 Eastern Ontario Crop Conference.

Acknowledgements:

Grower co-operators involved in the 2016 project are: Brugmans Farms, Cedar Lodge Farms, Double L Farms, Hilltone Farms Ltd., Jockbrae Farms Ltd., Kemp Farms Inc., Nandale Farms Ltd., Panmure Farms Ltd., Schouten Dairy Farm, Vanden Bosch Farms and Vernon Valley Farms Ltd.

This project is also supported by several agri-business partners; 360 Yield Center, Cropland Consulting Inc., Dekalb, DuPont Pioneer, GPS Ontario, OMAFRA, OSCIA, Ottawa-Carleton SCIA, P.T. Sullivan Agro Inc., & SGS Agri-Food Laboratories. Funding for this project is in part from the Ontario Soil & Crop Improvement Association – Tier Two grant and the Ottawa Valley Seed Growers Association.

Project Contacts:

Scott Banks, OMAFRA Kemptville – Scott.Banks@ontario.ca
Sean Cochrane, Dekalb, Monsanto Canada Inc. - sean.j.cochrane@monsanto.com
Paul Hermans, Dupont-Pioneer - Paul.Hermans@pioneer.com
Paul Sullivan, P.T. Sullivan Agro Inc. - paul@sullivanagro.ca

Location of Project Final Report:

Crop Advances, Ontario Soil & Crop Improvement Association at:
http://www.ontariosoilcrop.org/