Project Title: Nitrogen Management Review in Seed Corn Production

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Executive Summary

Nitrogen application rates for grain crops that meet, but do not exceed, the economic rates for that crop have been shown to maximize economic returns to the farmer. It has also been demonstrated that exceeding this rate increases the risk of environmental harm. With relatively low yields of seed corn compared to commercial corn, there is the question of whether the rates of nitrogen applied are appropriate for providing optimum return to the growers for the money spent on nitrogen fertilizer. Presently, most of the current research and promotion of maximum economic returns has focused on field corn and the primary objective of this project is to address the limited information relating to seed corn production in Ontario.

These two components were addressed in this project. The first component involved surveying seed corn growers to better understand how they select a nitrogen rate (Appendix A – Growers Survey form). Based on the survey responses, many producers select their nitrogen rates based on their commercial corn requirements and as expected the average nitrogen rate used by the 30 seed corn growers in the survey was high at 148.6 kg N/ha. This nitrogen rate is considerable higher then the MERN (Maximum Economic Rate of Nitrogen) (second project component) for these fields which was determined by field experiments conducted this summer. These field experiments evaluated the optimal nitrogen rates for seed corn production with the ultimate goal to produce an experimentally derived MERN (Maximum Economic Rate of Nitrogen) for seed corn. In all cases, the derived MERN of 36.8 kg N/ha was considerably lower than the nitrogen rate (148.6 kg N/ha) used by the grower. Seed corn growers could reduce costs and thereby, benefit by reducing their nitrogen application rates.

The MERN was compared to the OMAFRA recommendations for commercial field corn “N-Calculator”. Using the N-Calculator, seven out of the 11 field trials were within 30 kg N/ha of the MERN. As mentioned, the N-calculator was derived for commercial corn hybrids primarily due to lack of seed corn data. Results obtained in this project look promising and the future development of a seed corn N calculator can be developed using the field corn N-calculator as a base. Deliverables from this research would indicate the strengths and weaknesses of these N management options and outline techniques for improving N management in seed corn production both from environmental and economical perspectives.

The development of a MERN (Maximum Economic Rate of Nitrogen) for seed corn and the promotion of this instrument (Best Management Manual, presentations, etc) will assist Ontario seed corn growers, the seed corn industry and other stakeholders to meet these and future challenges head-on. Ontario economic development and competitiveness could be further advanced by promoting better farming practices that benefit the environment, society and the seed corn industry.

This project is the first comprehensive study examining the status of N management employed by seed corn growers in the province and will promote better farming practices that benefit the environment, society and the seed corn industry. The information will become part of the Best Management Practices for Seed Corn Production Manual/Website.

BACKGROUND

Ontario is a world-class producer of seed corn, due to the region's exceptional combination of climate, soils, production expertise and infrastructure. As with other production areas, the competitive nature of the North American seed corn industry has had a significant impact in Ontario. The Ontario seed corn industry has gone through significant changes in recent years and challenges such as the loss of acreage to US seed corn production areas and decreased acreage needs from companies will remain. Environmental concerns with nutrient and pest management and competition for land base with other rotational crops are part of these production challenges. One advantage the Ontario seed corn industry possesses is “quality”. Maintaining our productivity and quality under variable growing conditions in the future is critical to the ongoing viability of the Ontario industry.

Sustainable and dependable production not only increases our competitiveness against US production areas but is the key to the future health and growth (jobs) of the seed corn industry in Ontario. Being proactive and meeting these challenges will maintain the Ontario seed corn industry’s reputation for dependable yields and providers of superior quality seed corn.

Efficient use of nitrogen fertilizer plays a large role in developing more sustainable corn cropping systems. Farmers, for various reasons, tend to apply nitrogen at a rate higher than the maximum economic rate of nitrogen (MERN) required for that field. Since the MERN for a field can vary from year to year, depending on weather and management, the tendency has been to fertilize at rates that minimize risk of yield loss from under-fertilization, rather than the rate that would provide maximum returns over a longer period of time. Reductions in fertilizer nitrogen use, while environmentally more sustainable, is associated by many producers with high financial risk due to the yield loss associated with sub-optimum nitrogen supply to the crop. Growers are not willing or able to shoulder the liability of following university/government “recommended N rates” particularly if they are viewed as being lower than commonly accepted rates or if they go against seed corn company recommendations. In addition, the seed corn industry requires any modifications to N use practices must be economically sustainable and must not jeopardize the competitiveness of Ontario seed corn production in comparison to the US.

This project will build on the “validation” efforts being undertaken to validate N use rates and assist the seed corn industry to feel comfortable with using recommended nitrogen rates which may be lower then traditional used. The maximum economic rate of nitrogen for seed corn could provide the industry with a competitive advantage and enhance both the economic and environmental sustainability of seed corn production in Ontario.

Materials and Methods:

The study was established in the spring of 2007 at eight different seed corn fields in Chatham-Kent. This area is the primary seed production area for Ontario. At five locations 5 different nitrogen rates (0, 50, 100, 150 and 200 kg N/ha) were broadcast applied by hand before planting. The nitrogen was incorporated into the soil by the cooperating farmer within 24 hours of application. At three other locations, the same five nitrogen rates were broadcast on the surface prior to planting as previously described but an additional five nitrogen rates were sidedressed after the crop had emerged. Plots were of sufficient size to allow growers to conduct normal field operations through them. All locations had 5 replications of nitrogen rates. All locations were tilled after broadcast fertilizer application and the grower planted all plots.

At all locations the grower was responsible for all aspects of crop production except for fertility and harvest. All nitrogen, phosphorus and potassium fertilizers were applied to plots by the researchers. The researchers scouted and harvested the plots at each location. Growers tilled, planted, controlled pests and detasseled the fields as normal. This was done to keep the trial as close as possible to actual field conditions.

Preplant soil nitrate samples were collected prior to planting from the 0 N plots at each location. Sidedress N samples were collected from the 0 N plots at each location in mid June. Cores for nitrate were collected to a depth of 30 cm. There were 5 cores collected from each 0 N plot at each sampling date. Cores were mixed together and analyzed for nitrate-N and ammonium-N by Agri-Food Laboratories (Guelph).

Table 1 gives the names of the locations, the soil textures and the average preplant and sidedress nitrate-N concentrations for each site.

Table 1 Locations, soil textures and nitrate-N concentrations for eight seed corn locations, 2007

Location	Soil Texture	Preplant nitrate-N (mg/kg)	Pre Sidedress nitrate-N (mg/kg)
1	Silt loam	11.98	18.89
2	Loam	11.81	14.46
3	Sandy Loam	9.93	17.80
4	Silt loam	12.55	21.42
5	Loam	13.82	27.10
6	Silty clay	11.09	21.00
7	Silty clay	11.67	14.60
8	Silty clay	9.10	15.35

A survey was conducted of 30 randomly selected seed corn growers in the Municipality of Chatham-Kent. In the survey, growers were asked various questions about their seed corn operations and how their fertilizer use decisions are made on their acreage (Appendix A).

Results

Plots were hand harvested, ears were shelled, grain moistures taken, grain weights were taken and yields were calculated corrected to 15.5% moisture. Yield response curves were analyzed using SAS and Maximum Economic Rates of Nitrogen (MERN) were calculated. Table 2 shows the probability of response, type of response, MERN and the N recommendations based on both the Pre-Sidedress Nitrogen Test (PSNT) and the Ontario Nitrogen Calculator (N-Calculator) for the eight different locations.

Table 2: Probability of response, response type and MERN of seed corn for eight site locations, 2007.

Location	Probability of response	Response Type	MERN (kg N/ha)	N Recommended (PSNT) (kg N/ha)	N Recommended (N-Calculator) (kg N/ha)*
1	0.6267	Curvilinear	47	39	109
2	0.0068	Curvilinear	64	81	75
3	0.4439	Rate 2 Max	46	49	130
4	0.0591	Curvilinear	70	14	68
5	0.7997	Curvilinear	0	40	115
6 broadcast	0.1479	Linear	0	18	24
7 broadcast	0.5339	Linear	0	80	29
8 broadcast	0.1766	Curvilinear	71	73	31
6 sidedress	0.0266	Rate 2 Max	49	18	24
7 sidedress	0.1065	Curvilinear	0	80	29
8 sidedress	0.1367	Curvilinear	58	73	31

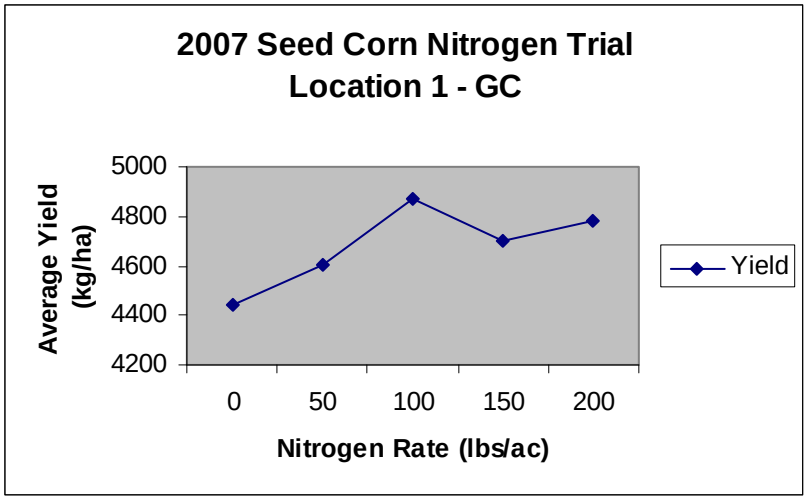
* the N rate is the OMAFRA nitrogen calculator recommendation for the expected yield of each inbred.

The average MERN for all locations and application methods was 36.8 kg N/ha. In all cases, the MERN was lower than the nitrogen rate used by the grower. Seed corn growers could benefit by reducing the nitrogen rates that they use.

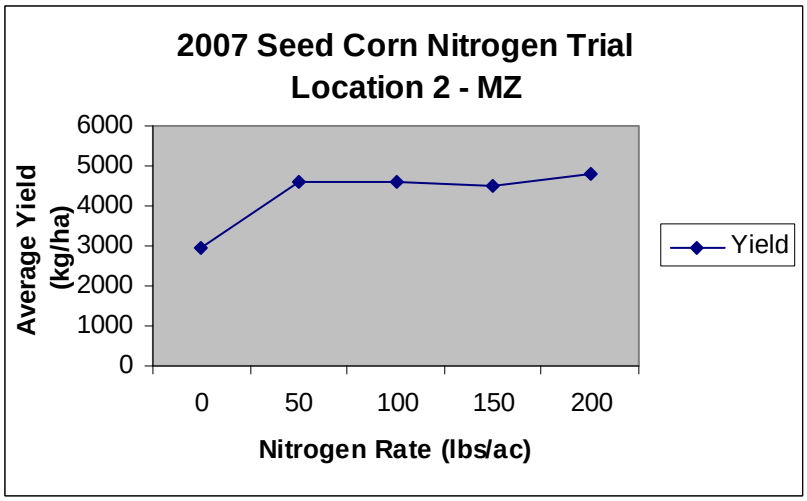
Figures 1-8 shows the nitrogen response at each location. Figures 9 and 10 show soil nitrate vs. MERN at preplant and sidedress time.

Both time of soil testing showed a declining MERN as the soil nitrate level increased. However r^2 for both soil nitrate sampling times were extremely low. The preplant soil nitrate test had an r^2 of 0.145, while the sidedress soil nitrate test had an r^2 of 0.0517. The soil nitrate test was not a good indicator of MERN in 2007.

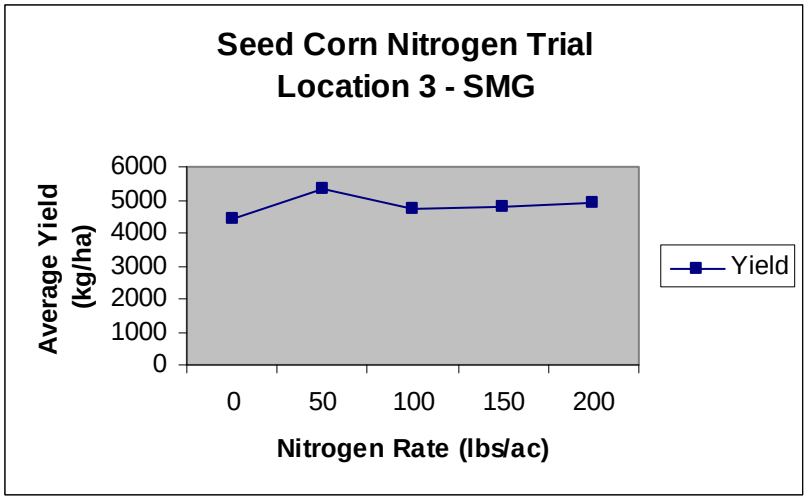
The seed corn growers' survey indicated that the average nitrogen rate used by the 30 seed corn growers in the survey was 148.6 kg N/ha.



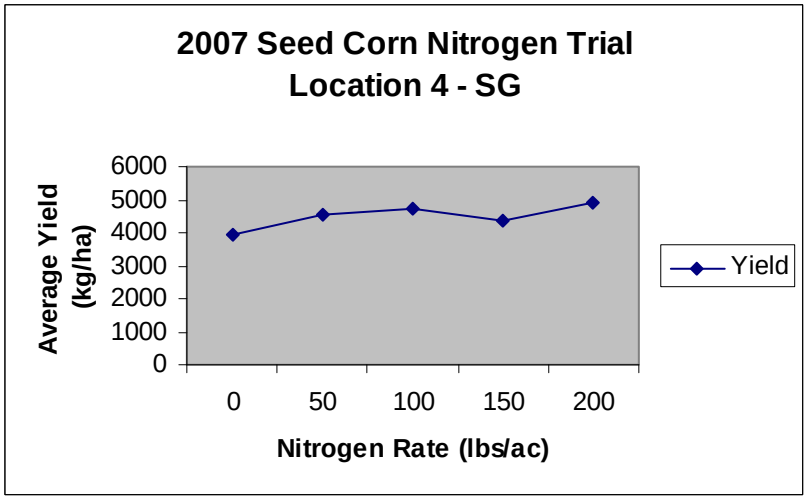
Location 1 - GC	MERN (kg N/ha)	Recommended N test (kg N/ha)	N Calculator (kg N/ha)*	Grower N Rate (lbs/ac)
	47.2	38.7	109	161



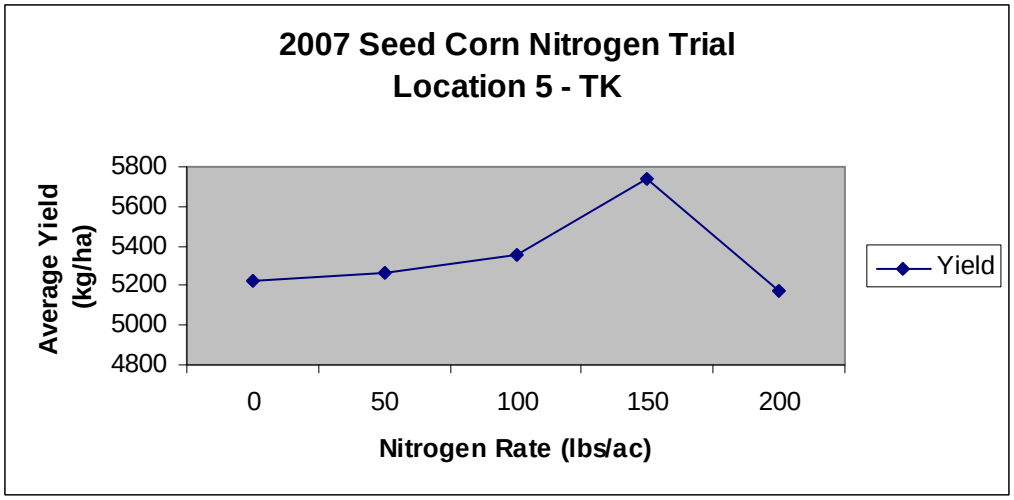
Location 2 - MZ	MERN (kg N/ha)	Recommended N test (kg N/ha)	N Calculator (kg N/ha)*	Growers N Rate (lbs/ac)
	63.9	81.2	75	140



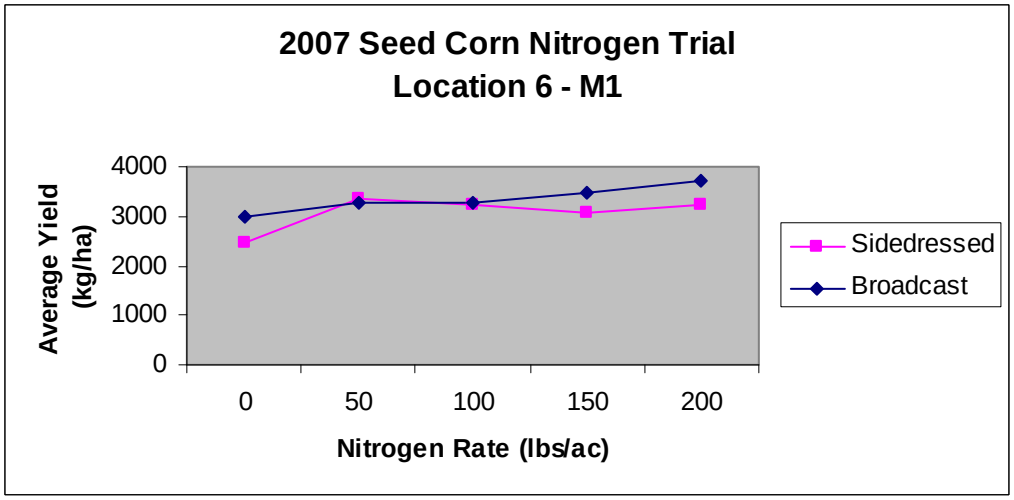
Location 3 - SMG	MERN (kg N/ha)	Recommended N test (kg N/ha)	N Calculator (kg N/ha)*	Growers N Rate (lbs/ac)
	45.4	49.1	130	155



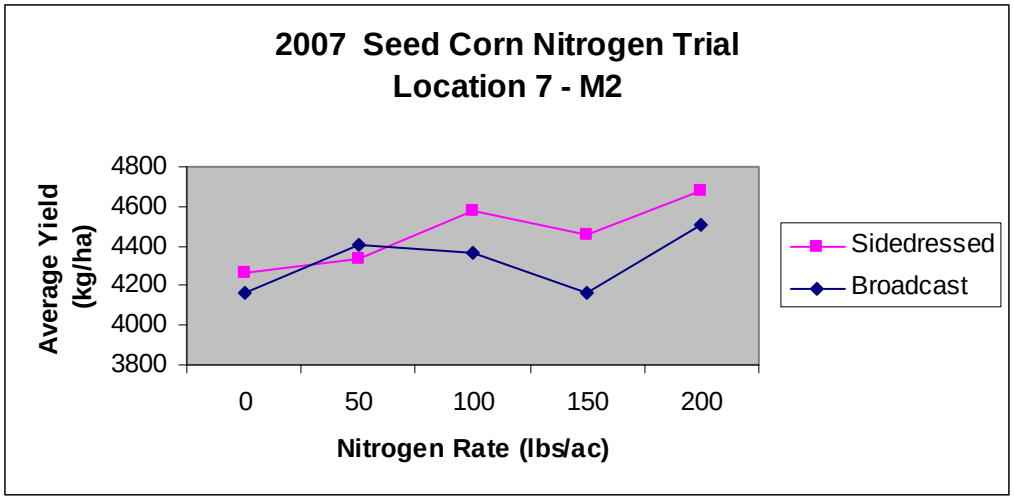
Location 4 - SG	MERN (kg N/ha)	Recommended N test (kg N/ha)	N Calculator (kg N/ha)	Growers N Rate (lbs/ac)
	69.7	14.4	68	170



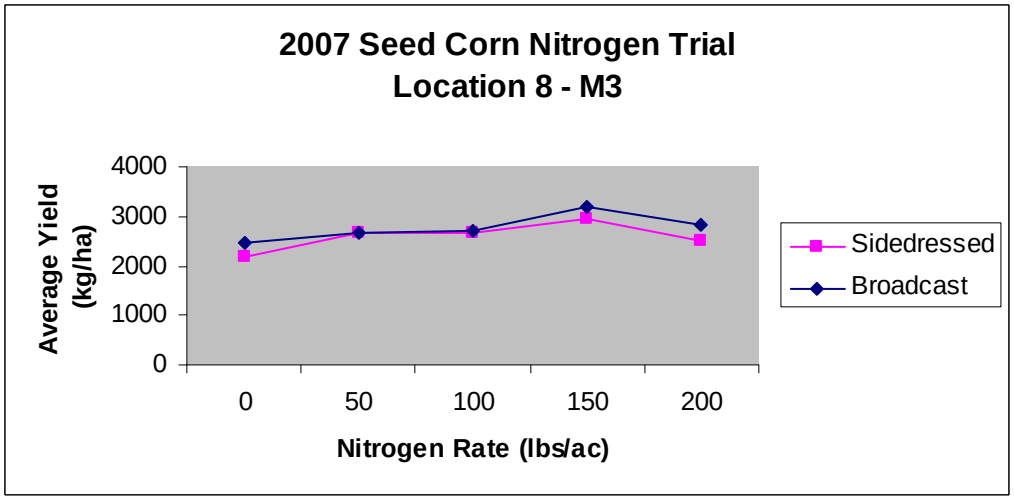
Location 5 - TK	MERN (kg N/ha)	Recommended N test (kg N/ha)	N Calculator (kg N/ha)	Growers N Rate (lbs/ac)
	0	40.2	115	125



Location 6 – M1	MERN (kg N/ha)	Recommended N test (kg N/ha)	N Calculator (kg N/ha)	Growers N Rate
6 Broadcast	0	18.4	24	120
6 Sidedress	49.2	18.4	24	120



Location 7 – M2	MERN (kg N/ha)	Recommended N test (kg N/ha)	N Calculator (kg N/ha)	Growers N Rate
7 broadcast	0	79.8	29	120
7 sidedress	0	79.8	29	120



Location 8 – M3	MERN (kg N/ha)	Recommended N test (kg N/ha)	N Calculator (kg N/ha)	Growers N Rate
8 broadcast	70.8	72.6	31	120
8 sidedress	58.1	72.6	31	120

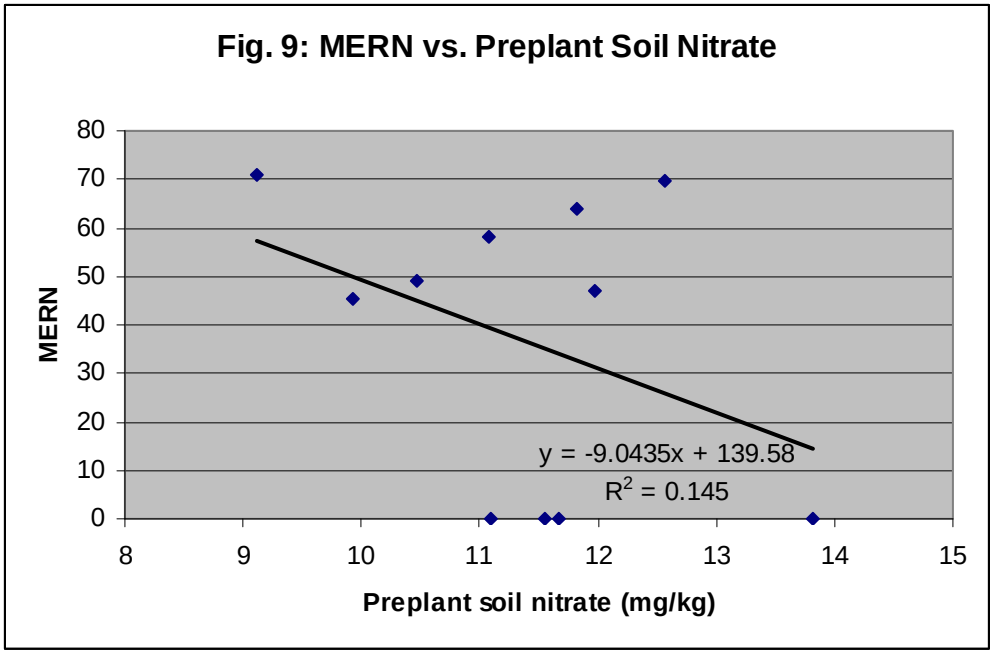


Fig. 9: MERN vs. Preplant Soil Nitrate
MERN
Preplant soil nitrate (mg/kg)
y = -9.0435x + 139.58
R2 = 0.145
0
10
20
30
40
50
60
70
80
8
9
10
11
12
13
14
15

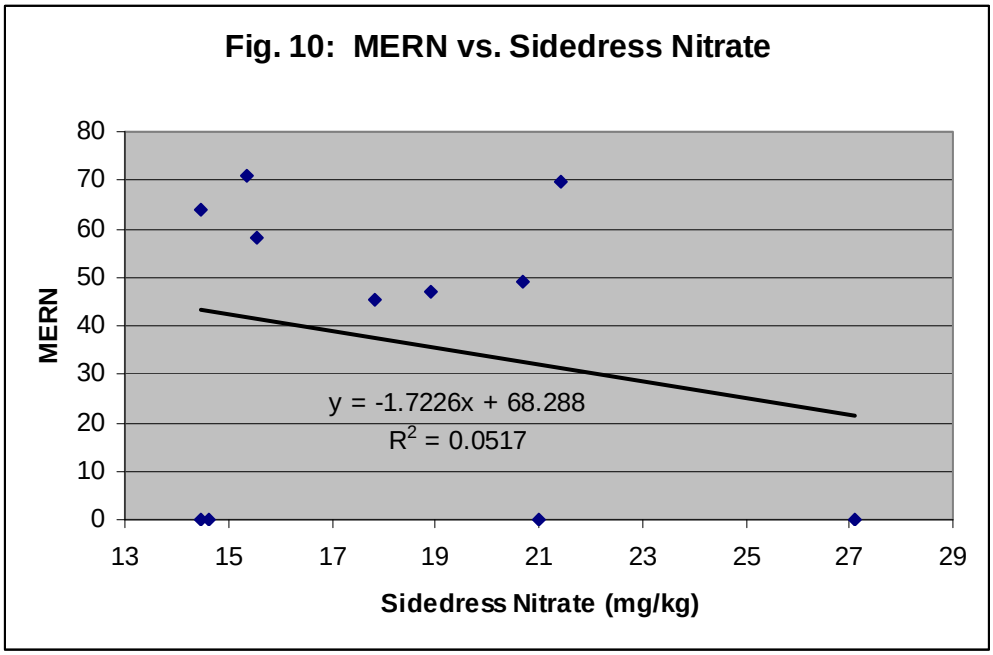


Fig. 10: MERN vs. Sidedress Nitrate
MERN
Sidedress Nitrate (mg/kg)
y = -1.7226x + 68.288
R2 = 0.0517
0
10
20
30
40
50
60
70
80
13
15
17
19
21
23
25
27
29

N- Calculator Example – Derived MERN (63.9 N kg/ha) versus 75 N kg/ha.

Results:

Version 2.06117 November 28, 2007

Review of Inputs:

Field Name:	**Location 2- MZ**
Region:	Western Ontario
Soil Type:	Loam
Expected Yield:	70 bu/ac
Heat Units:	3,200 CHU
Previous Crop:	Soybeans
Expected Corn Price:	$ 5.00 /bu
Fertilizer Type:	Urea
Fertilizer Price:	$ 590.00 /tonne
Nitrogen Price:	$ 0.58 /lb
Starter Nitrogen:	0 lb/ac
Manure Credit:	0 lb/ac

	Imperial lb/ac	Metric kg/ha
Base Nitrogen Requirement:	28	32
Yield Adjustment:	54	60
Heat Unit Adjustment:	20	23
Previous Crop Adjustment:	- 27	- 30
Price Ratio Adjustment:	- 9	-10
Total N Recommendation:	66	75
Starter N Deduction:	0	0
Manure Credit Deduction:	0	0
Preplant Recommendation:	66	75
Sidedress Recommendation:	53	60

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Appendix A

Seed Corn Grower Nitrogen Use Survey Form

Grower Name: _____

Address: _____

Phone Number: _____

BACKGROUND INFORMATION

1) Number of Total Acres Farmed _____

2) Number of Seed Corn Acres _____

3) Company or Companies _____

Pioneer Hi Bred _____

Syngenta _____

Maizex _____

Pride _____

Hyland _____

Other _____

Nitrogen Use Information:

4 a) What is your typical total N rate for seed corn?
(actual lbs N/acre) _____

b) Commercial corn _____

5) How do you determine your seed corn Nitrogen Rate?
_____

_____

6) Seed Corn N applications
a) Pre-plant timing:
Source_____
28 % Urea Anhydrous CAN Other

Method of Application _____

b) At planting
Source_____
28 % Urea Anhydrous CAN Other

Method of Application _____

c) Post-planting
Source_____
28 % Urea Anhydrous CAN Other

Method of Application _____

7) Manure application prior to 2007 crop :

1 year prior 2 to 3 yrs or > 3 years

8) a) Traditional previous crop _____

b) Cover crop (i.e – Red Clover) _____

9) Soil series and texture (ex - Brookston Clay or Clay loam)

_____

10) a) Average commercial corn yields for past 10 year

_____

_____

b) Average seed corn yields _____

11) Soil Organic Matter (%) _____

<2 2 to 4 >4

12) Crop Heat Unit rating for you farm?

_____