Nitrogen Management Review in Seed Corn Production

Purpose:

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.

Methods:

The study was established in the spring of 2007 at eight different seed corn fields in Chatham-Kent county. 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 side-dressed 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 de-tasseled 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.

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.

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

Location	Soil Texture	Preplant nitrate-N (mg/kg)	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

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 recommendation (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)	Recommended N rate (kg N/ha)*
1	0.6267	Curvilinear	47.2	109
2	0.0068	Curvilinear	63.9	75
3	0.4439	Rate 2 Max	45.4	130
4	0.0591	Curvilinear	69.7	68
5	0.7997	Curvilinear	0	115
6 (Broadcast)	0.1479	Linear	0	24
7 (Broadcast)	0.5339	Linear	0	29
8 (Broadcast)	0.1766	Curvilinear	70.8	31
6 (Sidedress)	0.0266	Rate 2 Max	49.2	24
7 (Sidedress)	0.1065	Curvilinear	0	29
8 (Sidedress)	0.1367	Curvilinear	58.1	31

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

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 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. 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.

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 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.

Next Steps:

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.

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Project Contacts:

Albert Tenuta, OMAFRA, albert.tenuta@ontario.ca, 519-674-1617
Greg Stewart, OMAFRA, greg.stewart@ontario.ca, 519-824-4120 ext. 54865

Location of Project Final Report: