Corn Sidedress Nitrogen Response Trials on Clay Soils
(Peel SCIA Major Grant Project)

Purpose:

This project was initiated to evaluate the appropriateness of side dress nitrogen application systems for use on heavy textured unimproved soils.

Methods:

A 15 foot wide, skip row liquid fertilizer applicator was built utilizing an old six row corn planter frame (Figure 1.). Three fertilizer application coulters were mounted to the frame and plumbed to an added fertilizer tank. The system was operated with a used ground drive piston pump donated by the University of Guelph/OMAFRA.

The applicator was calibrated to deliver 50, 100 and 150 lbs/ac of actual nitrogen from 28% Urea Ammonium Nitrogen (UAN). Eight sites across Peel Region were selected based on cooperator interest and soil type. Two to three replicates of four treatments were applied post emergently to corn which was in the 6-9 leaf stage during the middle of June 2008. Treatments were randomly assigned to plots. Plots were 6 or 12 rows wide and ranged in length from 500 to 2000 feet.

Figure 1. Custom Build Six Row Nitrogen Applicator with Three Fertilizer Coulters Adapted from a Used Corn Planter.




Results:

Table 1. Additional Nitrogen Applied at the Sites as Preplant or Starter

Site	Additional N as Starter or Preplant (lbs/ac N)	Total N (lbs/ac N)
PN08TA	31	31, 81, 131, 181
PN08HJ1	24	24, 74, 124, 174
PN08HJ2	24	24, 74, 124, 174
PN08GMC	30	30, 80, 130, 180
PN08GMO	16	16, 66, 116, 166

Table 2. Yield Results from Side Dress N Rate Applications to Corn

Site	PN08TA		PN08HJ1		PN08HJ2		PN08GMC		PN08GMO	
NRate (lbs/ac side dress)	H2O	Yield	H2O	Yield	H2O	Yield	H2O	Yield	H2O	Yield
0	24.8 a[1]	175.0 c	24.7 a	167.5 c	23.8 a	115.7 a	25.1 a	141.1 c	28.9 a	145.7 b
50	24.9 a	180.8 b	23.8 a	176.9 b	24.2 a	151.2 b	25.5 a	152.8 b	28.5 ab	175.2 a
100	25.1 a	183.5 b	24.2 a	186.8 a	23.8 a	172.6 c	25.5 a	163.6 a	27.7 bc	184.4 a
150	25.3 a	190.4 a	24.0 a	185.5 a	23.6 a	180.3 d	25.0 a	162.2 a	27.5 c	186.5 a
CV[2]	1.1	0.9	1.8	1.6	1.3	1.7	2.1	1.7	2.1	4.8

[1] Yields followed by the same letter within a column are not different from each other 9 times out of 10.
[2] CV is coefficient of variation and numbers under 10 suggest the statistics well accounts for the variation in the data at a site.

Table 2 summarizes the harvest moisture and yield data associated with the side dress nitrogen treatments. Additional nitrogen to no more then 30 lbs of actual N was applied either with the planter or pre plant. With the exception of the PN08GMO site, no differences in harvest moisture were detected between the various N treatments.

At two of the five sites reported (PN08TA, PN08GMO), no significant difference was observed in grain yield between the 50 and 100 lb/ac N rates. At two of the sites (PN08TA, PN08HJ2) there was a significant yield increase at the 150 over the 100 lb/ac NRate. Simply observing the yield data presented in Table 2 would lead people to believe that there was benefit to increasing the N rates 4 of the five sites above the 50 lb/ac rate. However, observation of yield data alone can significantly bias the true value of adding additional fertilizer since it does not account for the added revenue associated with increased nitrogen application relative to the cost of the nitrogen required to attain the greater yield.

For a real understanding of the value of added fertilizer, an economic analysis of the yield results relative to the increased cost of fertilizer application must occur using realistic prices of the grain and fertilizer. Table 3 summarizes the economic impact of N rate choices. The analysis below assumes a corn price of $5.25/bu and $0.85/lb for nitrogen.

Table 3. Economic Analysis of Targeting MERN N Rate (assuming Corn @ $5.25 and N at $0.85)

		Economic N Rate	Maximum N Rate	Difference
PN08TA	**Nitrogen Rate (lb-N/ac)**	102	117	
	Yield (bu/ac)	191.41	192.67	
	Gross Return ($/ac)	**916.52**	**909.94**	6.58
		Economic N Rate	**Maximum N Rate**	**Difference**
PN08HJ2	**Nitrogen Rate (lb-N/ac)**	81	157	
	Yield (bu/ac)	178.14	184.28	
	Gross Return ($/ac)	**864.53**	**832.26**	32.27
		Economic N Rate	**Maximum N Rate**	**Difference**
PH08HJ1	**Nitrogen Rate (lb-N/ac)**	149	179	
	Yield (bu/ac)	177.80	180.20	
	Gross Return ($/ac)	**804.98**	**792.36**	12.62
		Economic N Rate	**Maximum N Rate**	**Difference**
PN08GMC	**Nitrogen Rate (lb-N/ac)**	105	119	
	Yield (bu/ac)	167.6	168.8	
	Gross Return ($/ac)	**790.75**	**784.56**	6.19
		Economic N Rate	**Maximum N Rate**	**Difference**
PN08GMO	**Nitrogen Rate (lb-N/ac)**	97	146	
	Yield (bu/ac)	158.92	162.91	
	Gross Return ($/ac)	**751.86**	**730.90**	20.96

The results in Table 3. consider the entire N rate applied at each site (preplant + starter + side dress) and determines the economics under the nitrogen rate that maximizes yield potential and compares it to the rate of nitrogen that maximizes gross economic return. Note that in all cases the economic rate of nitrogen is below the maximum rate of nitrogen that gave the highest corn yield. The economic difference in return to the producer ranges from $6.19 to $32.27 per acre. The dollar difference is influenced by the slope of the response curve of yield to increasing nitrogen rate. The bigger the response the greater is the economic difference. The added corn yield at the maximum nitrogen rate is more costly to achieve then the yield below this level of nitrogen input. Under the financial parameters used,

Table 4. Economic Analysis of Site PN08TA

	Lowest N Rate	Economic N Rate	Maximum N Rate	Difference
(5.25 /bu and 0.85 /lb N)				
Nitrogen Rate (lb-N/ac)	31.00	**101.65**	117.13	
Yield (bu/ac)	153.90	191.41	192.67	
Gross Return ($/ac)	781.60	**916.52**	**909.94**	**6.58**
(4.50/bu and 0.60/lb N)				
Nitrogen Rate (lb-N/ac)	31.00	**104.38**	117.13	
Yield (bu/ac)	153.90	191.82	192.67	
Gross Return ($/ac)	673.93	**798.55**	**794.72**	**3.83**
5.25/bu and 0.60/lb N)				
Nitrogen Rate (lb-N/ac)	31.00	**106.20**	117.13	
Yield (bu/ac)	153.90	192.04	192.67	
Gross Return ($/ac)	789.35	**942.50**	**939.22**	**3.28**

Tables 4 and 5 highlight the effect of changes in the price of corn and nitrogen on the economic maximum nitrogen rate for a given field. In Table 4 where the range in yield over the rates tested was only 15.4 bu/ac, the changes in price had little effect on the economic rate of nitrogen to be targeted. In Table 5 where the yield difference across the rates of nitrogen evaluated was 40.8 bu/ac, the changes in price have a larger effect on the target nitrogen rate.

These multi rate trials to study economic nitrogen response should be conducted for several years to understand the trend in economic rates associated with the characteristics of a given field.

Summary:

The target rate for nitrogen should be based on targeting the economic rate of nitrogen, not the rate that maximizes corn yield. This is because the cost of nitrogen required to maximize yield is usually higher then the added grain harvest achieved with the higher nitrogen rate.

Table 5. Economic Analysis of Site PN08GMO

	Lowest N Rate	Economic N Rate	Maximum N Rate	Difference
($5.25/bu and $0.85/lb N)				
Nitrogen Rate (lb-N/ac)	16	97	146	
Yield (bu/ac)	135.03	158.92	162.91	
Gross Return ($/ac)	695.31	**751.86**	**730.90**	**20.96**
($4.50/bu and $0.60/lb N)				
Nitrogen Rate (lb-N/ac)	16	106	146	
Yield (bu/ac)	135.03	160.20	162.91	
Gross Return ($/ac)	598.03	**657.48**	**645.30**	**12.18**
($5.25/bu and $0.60/lb N)				
Nitrogen Rate (lb-N/ac)	16	112	146	
Yield (bu/ac)	135.03	160.92	162.91	
Gross Return ($/ac)	699.31	**777.92**	**767.48**	**10.44**

Next Steps:

More plots should be conducted to build the database of corn response to nitrogen on the clay soils of Peel Region.

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