

Can Manitoba growers fertilize for most economic yield and meet nitrate-N limits?

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Background

- currently residual nitrate-N limits exist for manured land and are proposed for all cropland in Manitoba.
- it is well known that often high rates of nitrogen (N) are required to optimize returns for growers.
- there is concern that such post-harvest nitrate limits may not be achievable with present nitrogen rates
- Ontario studies with corn indicate that the nitrogen rates required to achieve the most economic rate of N (MERN) do not lead to excessive residual N accumulations (Figure 1).
- residual N levels did increase as nitrogen rates exceed the MERN rate, producing a "hockey stick" shaped response. Similar responses were observed with canola in Ontario.

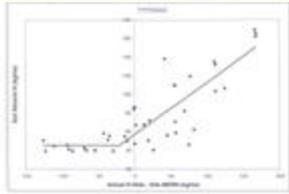


Figure 1. Residual soil mineral N ($\text{NH}_4\text{-N}$ and $\text{NO}_3\text{-N}$) following corn harvest relative to the deviation of applied N from the most economic rate for each site (Reid et al, 2005).

- an analysis of residual N vs MERN was determined on 3 N rate studies in Manitoba to determine if a similar patterns in nitrate levels exist here.

Method

- Three N rate studies determined the residual or post-harvest nitrate-N levels as follows:
 1. Corn – 4 site years of corn response data from 5 N rates (0, 50, 100, 150 and 200 lb N/ac) with residual soil sampling to 48" (Heard, 2008)(Figure 2).
 2. Canola – 3 site years of hybrid canola response data from 4 N rates (0, 30, 60 and 90 lb N/ac) with residual soil sampling to 48" (Day et al, 2008).
 3. Dry beans – 3 site years of dry bean response data from 5 N rates (0, 40, 80, 120 and 160 lb N/ac) with residual soil sampling to 24" (McAndrew, 2002).
- The MERN for each crop and site was determined using a quadratic response curve, current crop and fertilizer prices and an Economic Optimum N Rate Calculator (Figures 3-5).

The residual soil nitrate levels are graphed in Figures 6-7.



Figure 2. Post harvest nitrate-N sampling to 48" following corn and canola in 2007.

Crop Yield Response and MERN

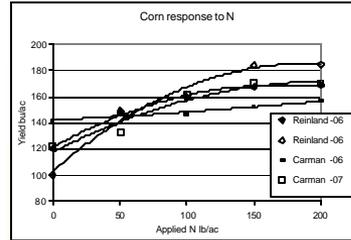


Figure 3. Corn response to applied N.

- initial soil nitrate levels in 0-24" (0-48") were 30, 74 (178), 87 (167) and 65 (70) lb N/ac for Reinland-06, Reinland-07, Carman-06 and Carman-07, respectively.
- high yields were obtained.
- calculated MERN for corn at \$5/bu and N at \$0.60/lb were 130, 160, 0 and 150 lb N/ac for Reinland-06, Reinland-07, Carman-06 and Carman-07, respectively.

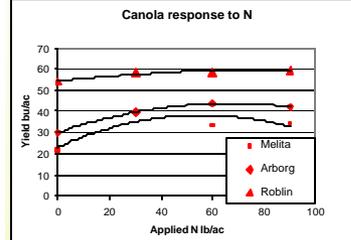


Figure 4. Canola response to applied N.

- initial soil nitrate levels in 0-24" were 24, 40 and 159 lb N/ac at Melita, Arborg and Roblin, respectively.
- medium to high yield was obtained.
- calculated MERN for canola at \$12/bu and N at \$0.60/lb were 50, 60 and 40 lb N/ac at Melita, Arborg and Roblin, respectively.

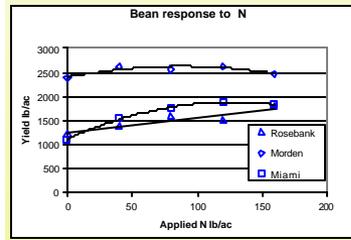


Figure 5. Bean response to applied N.

- initial soil nitrate levels in 0-24" were 44, 127 and 53 lb N/ac at Miami, Morden and Rosebank, respectively. The Rosebank location had a history of hog manure applications.
- medium to high yield was obtained.
- calculated MERN for beans at \$35/cwt and N at \$0.60/lb were 110, 60 and 160 lb N/ac at Miami, Morden and Rosebank, respectively.

Results

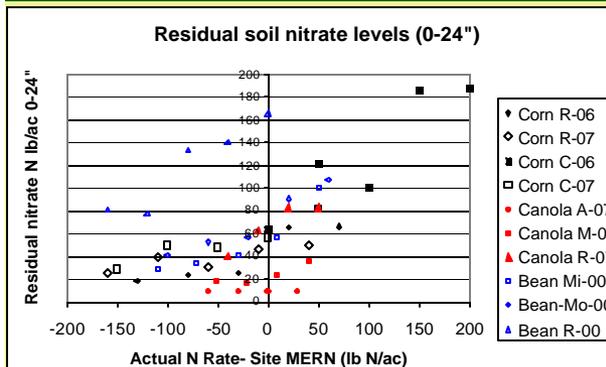


Figure 6. Residual nitrate-N in 0-24" relative to the deviation of applied N from

- A similar "hockey stick" pattern is observed as in the Ontario studies
- nitrate-N levels did increase with applied N – but generally only increase greatly when rates exceed the MERN rate (Fig 6).
- the exception is beans at Rosebank (Bean R-00), which despite a modest initial nitrate-N level and very profitable yield response to the maximum N rate applied, had a large amount of residual N, possibly due to previous manure applications.
- At other sites the combination of good yields with the MERN resulted in a range of nitrate levels between 10-70 lb N/ac.

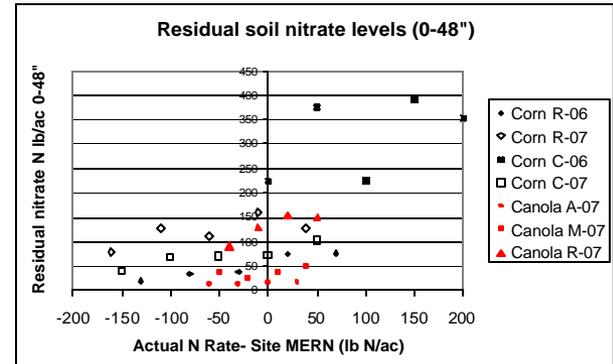


Figure 7. Residual nitrate-N in 0-48" relative to the deviation of applied N from the MERN rate.

- residual N levels at MERN rates did exceed 100 lb N/ac in the 0-48" depth in 3 studies (Figure 6). These high levels occurred at sites with high initial soil N levels in 0-24" (Canola R-07) or the 0-48" depth (Corn R-07, Corn C-06).

Summary

- at the MERN rate, residual N levels ranged between 10-70 lb nitrate-N/ac
- highest residual N amounts were observed from sites with a history of manure or high subsoil nitrate-N.
- unlike Ontario, residual nitrate-N in Manitoba is rarely all lost and can be tapped by following crops through the use of soil testing.
- it appears that growers fertilizing at MERN rates and achieving good to high yields will be able to meet nitrate-N limits.
- these observations are from a very small data set and similar analysis should be done for more crops and soils in Manitoba.

Acknowledgements

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References

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