A Nitrogen Rate of Return Calculator for Wheat, Barley & Canola in Manitoba

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Background

Manitoba fertilizer guidelines for nitrogen (N) on wheat, barley and canola have not been updated since closure of the provincial soil test lab in the early 1990's. Through the cooperation of Westco Fertilizers (now Viterra) access was granted to research results from 278 N rate studies in Manitoba and eastern Saskatchewan. A description of this process is described by Karamanos et al, 2009.

Production systems had changed considerably since the previous recommendations had been made: moving away from summer fallow to continuous cropping, reducing tillage intensity, higher diversity of crops in rotation, including pulses and higher yield expectations due to technological and varietal improvements.

Yield responses for wheat and barley were separated into 3 agro-climatic environments (moist, dry and arid) based on agro-climatic zones and soil characteristics (Figure 1 and Table 1). Canola studies were predominantly in the moist agro-climatic environment with insufficient sites to represent the dry and arid environments.

The nitrate-N soil test for the 0-24" depth remains the basis for the guidelines.

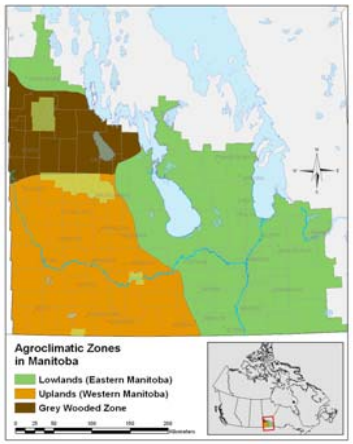

Figure 1. Agro-climatic zones in Manitoba. Climate in the Uplands area (SW) tends to have lower rainfall and greater evapotranspiration than the lowlands and gray wooded zones.

Table 1. Agro-climatic environment (A-C Env) categories based on agro-climatic zones and soil characteristics.

A-C Env	Location	Soil Texture/Drainage
Moist	Lowlands	Any texture, poorly drained
	Uplands	Heavy textured
		Grey wooded soils
Dry	Lowlands	Light textured, moderately drained
	Uplands	Light textured grey wooded soils
		Other textures moderately to poorly drained
Arid	Lowlands and Uplands	Light textured, well drained soils

N Response Curves for Wheat, Barley and Canola

The average yield response to total nitrogen (fertilizer plus soil nitrate-N in 0-24") is presented for the various crop-environment combinations (Figures 2-4). The greater yield of hybrid canola compared to open pollinated (OP) canola is evident in Figure 4.

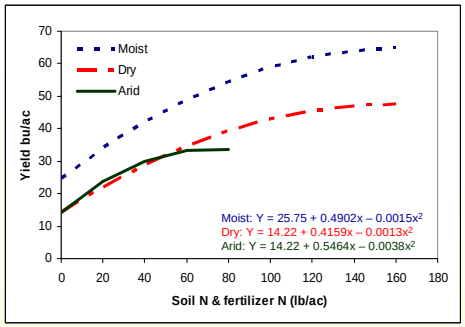

Figure 2. CWRS wheat response to N; 147 sites in three agro-climatic environments

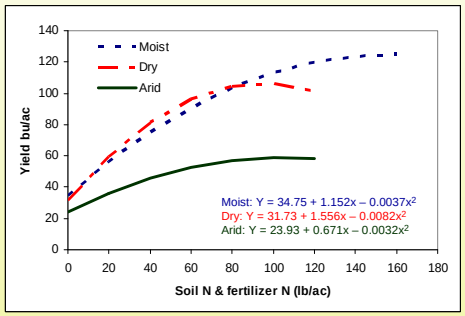

Figure 3. Barley response to N; 97 sites in three agro-climatic environments.

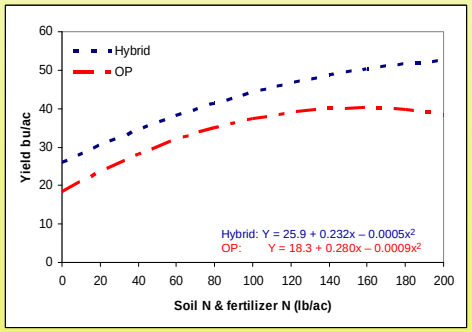

Figure 4. Hybrid and open pollinated (OP) canola response to N; 34 sites in the Moist agro-climatic environment.

Turbulent crop prices and nitrogen costs prompted development of an economic return component when presenting these guidelines. An Excel spreadsheet format according to Rankin (2005) was modified to accommodate the different crop-environment combinations and inclusion of soil N test results (Figure 5-7).

Nitrogen Rate of Return Calculator

Nitrogen Rate of Return Calculator
Wheat, Barley, Canola & Hybrid Canola
Manitoba

Fertilizer N data	
Fertilizer Type	UREA
Cost/tonne	$500
%N	46
Cost/Unit of N	$0.49
Fertilizer N increment	10
Crop price increment, $	$0.50
Soil test N (0-24") lb N/acre	30
Fertilizer price increment, $/tonne	$100

Yellow Cells Can be Modified

Crop and Economic data	Current N Rate (lb N/acre): Moist	Dry	Arid
CWRS Wheat	90	70	40
Barley	90	50	40
Canola	70		
Canola (hybrid)	120		
Expected prices ($/bushel):			
CWRS Wheat	$5.00		
Barley	$2.50		
Canola	$8.00		
Canola (hybrid)	$8.00		

Figure 5. View of input screen from the N Calculator.

Go to Total Net Return Below

N Rate (lb /acre)	Average yield (bu /ac.)	Yield Increase from 0 lb. N* (bu /ac.)	Expected CWRS Wheat Price $3.50	$4.00	$4.50	$5.00	$5.50	$6.00	$6.50
			Net Return ($/ac.)** CWRS Wheat:N Price Ratio 7.1	8.1	9.1	10.1	11.1	12.1	13.2
30	34.5	9.0	$16.6	$21.0	$25.5	$30.0	$34.5	$39.0	$43.5
40	37.0	11.4	$20.3	$26.0	$31.7	$37.4	$43.1	$48.9	$54.6
50	39.2	13.8	$23.1	$29.9	$36.7	$43.5	$50.3	$57.2	$64.0
60	41.1	15.6	$24.9	$32.7	$40.5	$48.3	$56.1	$63.9	$71.7
70	42.8	17.3	$25.9	$34.5	$43.2	$51.8	$60.5	$69.1	$77.8
80	44.2	18.7	$26.0	$35.3	$44.7	$54.0	$63.4	$72.7	$82.1
90	45.4	19.9	$25.1	$35.1	$45.0	$54.9	$64.9	$74.8	$84.8
100	46.3	20.8	$23.4	$33.8	$44.1	$54.5	$64.9	$75.3	$85.7
110	47.0	21.4	$20.7	$31.4	$42.1	$52.8	$63.6	$74.3	$85.0

*Yield responses are averages from 67-site years
Current N rate from your soil test report or common practice
**Net Return = (wheat price x yield increase) - (N price x N rate)
Net return in blue represents maximum ± $0.50 for the CWRS Wheat:N Price Ratio range in this table and in Orange within $1.00 of maximum

Figure 6. Screen shot of return $/ac to N for wheat in a dry agro-climatic environment with crop price as a variable (input data from Figure 5).

N Rate (lb /acre)	Yield Increase from 0 lb. N* (bu /ac.)	Expected N Fertilizer Price ($/t urea) $200	$300	$400	$500	$600	$700	$800
		Net Return ($/ac.)** CWRS Wheat:N Price Ratio 25.3	16.9	12.7	10.1	8.4	7.2	6.3
30	9.0	$38.9	$35.9	$33.0	$30.0	$27.0	$24.1	$21.1
40	11.4	$49.3	$45.3	$41.4	$37.4	$33.5	$29.5	$25.6
50	13.6	$58.3	$53.4	$48.5	$43.5	$38.6	$33.6	$28.7
60	15.6	$66.1	$60.2	$54.3	$48.3	$42.4	$36.5	$30.5
70	17.3	$72.6	$65.7	$58.7	$51.8	$44.9	$38.0	$31.1
80	18.7	$77.7	$69.8	$61.9	$54.0	$46.1	$38.2	$30.3
90	19.9	$81.6	$72.7	$63.8	$54.9	$46.0	$37.2	$28.3
100	20.8	$84.2	$74.3	$64.4	$54.5	$44.7	$34.8	$24.9
110	21.4	$85.5	$74.6	$63.7	$52.8	$42.0	$31.1	$20.2

*Yield responses are averages from 67-site years
Current N rate from your soil test report or common practice
**Net Return = (wheat price x yield increase) - (N price x N rate)
Net return in blue represents maximum ± $0.50 for the CWRS Wheat:N Price Ratio range in this table and in Orange within $1.00 of maximum

Figure 7. Screen shot of return $/ac to N for wheat in a dry agro-climatic environment with urea fertilizer cost as a variable (input data from Figure 5).

It is apparent that the N rate to maximize return to N is influenced by crop price and N cost, but is often less than growers suspect. Users may also assess the economic risk of under/over fertilizing. This calculator is available on the Manitoba Agriculture, Food and Rural Initiatives website at:
http://www.gov.mb.ca/agriculture/financial/farm/nitrogencalc.html .

References

Karamanos, R., J. Heard and T. Jensen. 2009. A public-private cooperative model for updating nitrogen fertilizer recommendations – the Manitoba experience. Better Crops Vol. 93. No. 3.

Rankin, M.2005. Nitrogen $ Rate of Return Calculator Version 3. University of Wisconsin – Extension: http//www.uwex.edu/ces/crops/NComparison.htm