

Updated Nitrogen Rate Guidelines for Manitoba: CWRS Wheat and Grain Corn

John Heard, Manitoba Agriculture



Background

- Nitrogen (N) guidelines for milling wheat and corn required updating to account for the large yield increases in recent years through improved genetics, pest management and production practices.
- The following proposals Manitoba soil test based guidelines are

Hard red spring wheat

Phase 1; In March 2009 the MB Soil Fertility Advisory Committee adopted the revised N rate guidelines for spring wheat, barley and canola presented at their annual meeting.

The revised guidelines were presented as an excel based Nitrogen rate calculator to optimize return to applied N fertilizer based on crop and fertilizer N prices. <https://www.gov.mb.ca/agriculture/crops/soil-fertility/nitrogen-rate-calculator.html>

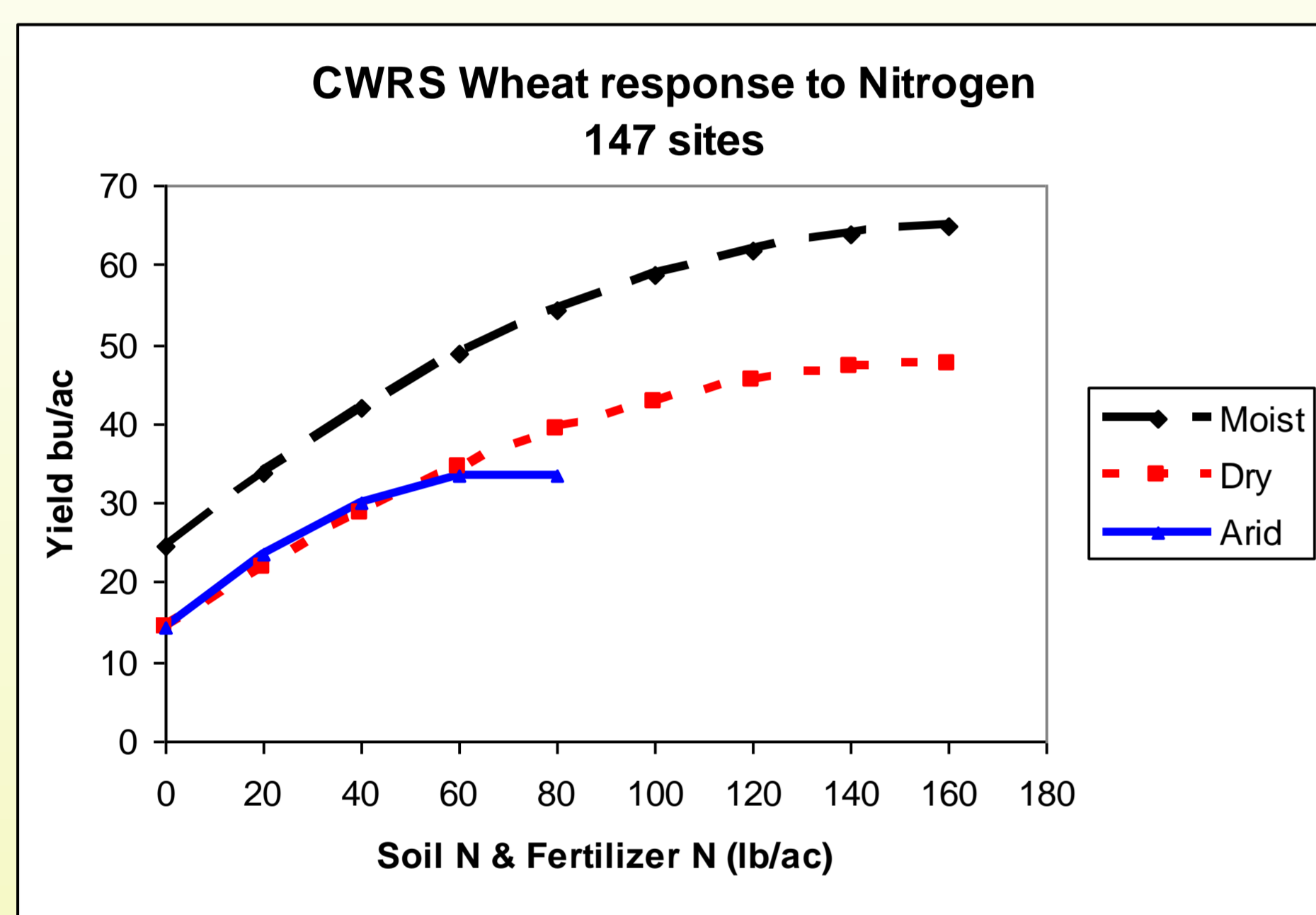
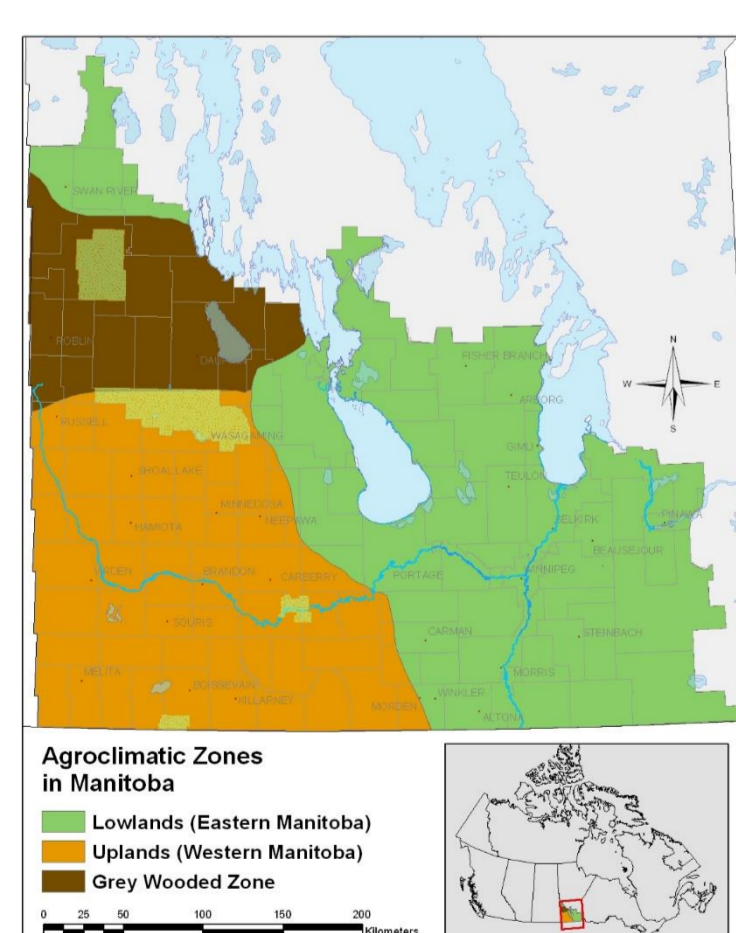


Figure 1. Hard red spring wheat yield response to N supply according to moisture regime.

Moist environment (25 sites), $Y = 24.75 + 0.4902x - 0.0015x^2$ $R^2 = 0.9927$
 Dry environment (67 sites), $Y = 14.22 + 0.4159x - 0.0013x^2$ $R^2 = 0.9436$
 Arid environment (55 sites), $Y = 14.22 + 0.5464x - 0.0038x^2$ $R^2 = 0.8175$



Moisture	Location	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

Figure 2. Moisture categories in Manitoba according to location and soil characteristics.

Phase 2: Since the adoption of the 2009 guidelines hard red spring wheat yields have advanced greatly with the introduction of new varieties. Recent research by University of Manitoba² with modern varieties and production practices was conducted with summary rate results in Table 1.

Table 1. Optimum N Rate for High Yielding Spring Wheat in Manitoba (Mangin and Flaten, 2018²)

Site-Yr	Spring soil N (0-24") lb N/ac	Economically opt N rate* lb N/ac	N supply (Soil & Opt N rate) lb N/ac	Yield at Opt N Rate Bu/ac	N Supply per bushel lb N/bu
Brunkild 2016	40	140	180	75	2.4
Carman 2017	43	140	183	96	1.9
Brunkild 2017	43	140	183	110	1.7
Melita 2016	43	80	123	60	2.1
Carberry 2016	89	50	139	95	1.5
Melita 2017	11	140	151	74	2.0
Gross Isle 2017	65	110	175	75	2.3
Mean			162	84	2.0

*Wheat prices from Jan 5, 2018, Nitrogen prices based on 5-years AVG urea price (\$0.43/lbs N)

N supply per bushel values were similar to those of CWRS wheat observed in MWBGA³ on-farm-tests across Manitoba.

Average yield, N supply (soil nitrate-N plus fertilizer) and N supply per bu achieved (and range) are summarized by wheat class:

- 10 sites of CWRS yielding 70 bu/ac with 135 lb N/ac supplying **2.0** lb N/bu achieved (1.7-2.3)
- 16 sites of CNHR yielded 72 bu/ac with 158 lb N/ac supplying 2.3 lb N/bu achieved (1.4-3.1)*
- 3 sites of CPS yielding 72 bu/ac with 127 lb N/ac supplying 1.7 lb N/bu achieved (1.5-1.9)
- 1 site of GP yielded 85 bu/ac with 135 lb N/ac supplying 1.6 lb N/bu.

* N supply per bu values were greater for CNHR, possibly due to the growers' high fertilization for a greater yield goal than what was achieved.

Proposal: Based on these rationale, the suggested guidelines for hard red spring wheat are presented in Table 2.

Table 2. Proposed nitrogen guidelines (lb N/ac) for hard red spring wheat in Manitoba..

SOIL MOISTURE CATEGORY	NITROGEN Guidelines (lb/ac)			
	ARID*	DRY*	MOIST*	High yield wheat**
TARGET YIELD (bu/ac)	35	45	65	85
Fall Soil NO ₃ -N Lb/ac in 0-24"				Or 2.0 lb N/bu
Rating				
0 VL	50	130	140	170
10 VL	40	120	130	160
20 VL	30	110	120	150
30 L	20	100	110	140
40 M	10	90	100	130
50 M	0	80	90	120
60 H	0	70	80	110
70 H	0	60	70	100
80 VH	0	50	60	90
90 VH	0	40	50	80
100 VH+	0	30	40	70

* N for optimum return with Wheat at \$6/bu and N at \$0.50/lb N.

** based upon a N supply requirement of 2 lb N/bu.

Grain corn

Proposed: Nineteen N rate studies have been conducted between 2001-2017 in Manitoba⁴. Yield potentials tended to be either high (14 sites >150 bu/ac) or low-modest (5 sites of 100-125 bu/ac) based on weather and management. Quadratic response functions were calculated separately for these yield potentials (Figure 3)

The r² was weak for high yield sites, perhaps due to high mineralization, estimated to be some 148-178 lb N/ac in 2016-17 sites.

Mineralization was not predictable based on soil organic matter (r² = 0.04).

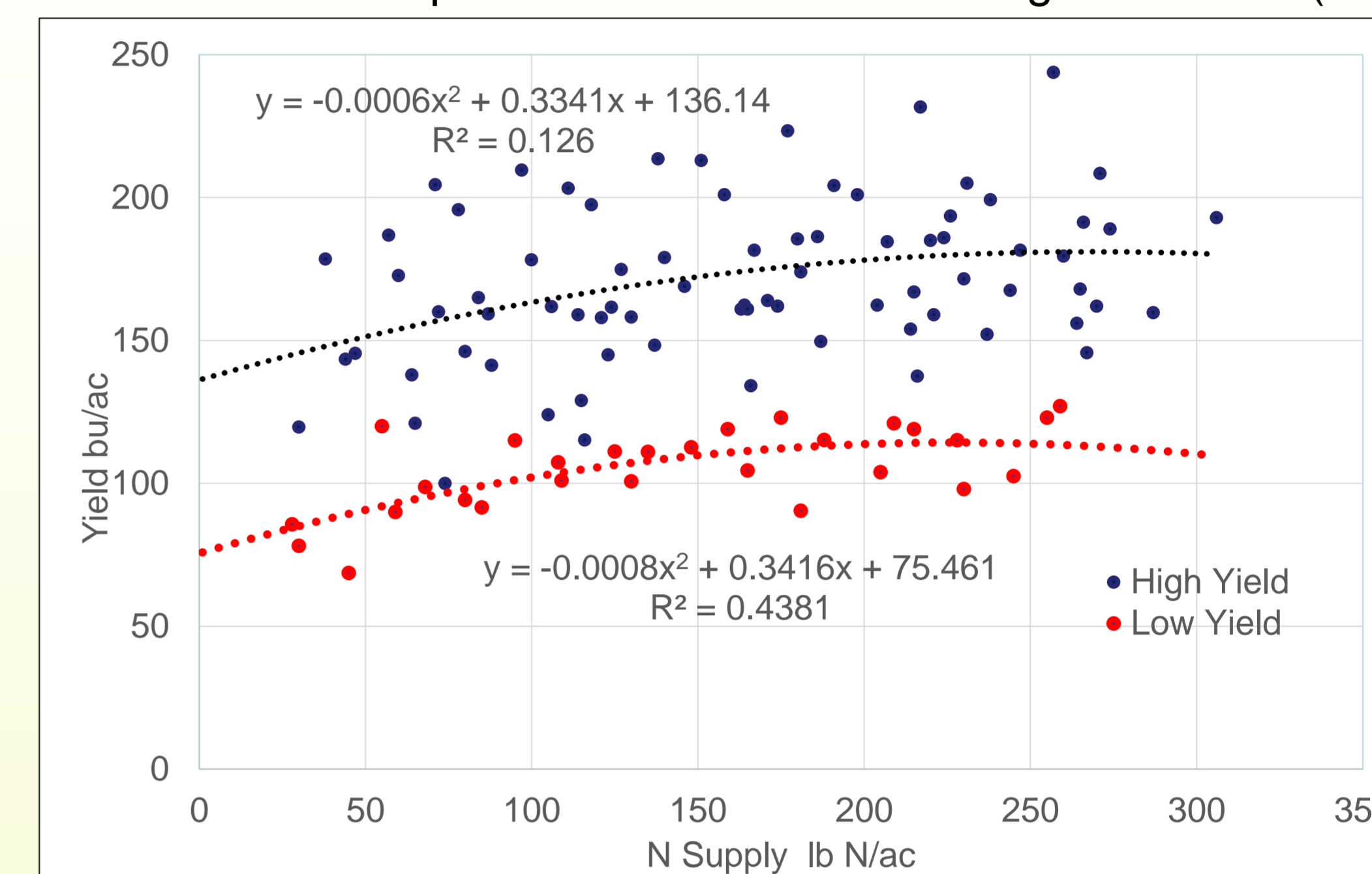


Figure 3. Grain corn response to nitrogen supply in 2001-17 (Heard, 2018⁴)

Using the quadratic to calculate the most economic N supply for corn at a \$4/bu corn and N at \$0.5 /lb N, was:

High yield sites: 173 lb N/ac for 176 bu./ac, or **0.99** lb N/bu

Lower yield sites: 134 lb N/ac for 111 bu/ac or **1.21** lb N/bu

N supply per bushel values are identical to those observed in MCGA^{5,6} on-farm-tests of nitrogen rates and timing on corn:

- 4 sites yielding 152-173 bu/ac with mean of **0.95** lb N/bu (0.6 to 1.2)
- 8 sites yielding 120-144 bu/ac with mean of **1.19** lb N/bu (0.99 – 1.46)
- 5 manured sites yielded 112-146 bu/ac with mean of 1.36 lb N/bu (0.73-1.82), generally due to over supplementation of N for yields achieved.

Since corn research in N is ongoing by University of Manitoba, N rate guidelines in Table 3 should be considered interim.

Table 3. Proposed interim nitrogen guidelines for grain corn in Manitoba.

TARGET YIELD (bu/ac)	NITROGEN Guidelines (lb/ac)					
	Former				Interim	
	85	100	115	130	Medium 125 bu/ac (or 1.2 lb N/bu)	High >150 bu/ac (or 1 lb N/bu)
Fall Soil NO ₃ -N lb/ac in 0-24"						
Rating						
0 VL					150	175
10 VL					140	165
20 VL	80	125	170	220	130	155
30 L	55	100	145	195	120	145
40 M	30	75	125	170	110	135
50 M	5	55	100	145	100	125
60 H	0	30	75	120	90	115
70 H	0	5	50	95	80	105
80 VH	0	0	25	70	70	95
90 VH	0	0	0	50	60	85
100 VH+	0	0	0	25	50	75

This will be proposed to the 2019 Manitoba Soil Fertility Advisory Committee meeting.

References: attached