A NITROGEN RATE OF RETURN CALCULATOR FOR WHEAT, BARLEY AND CANOLA IN MANITOBA

John Heard[1] and Rigas E. Karamanos[2]
[1]Manitoba Agriculture, Food and Rural Initiatives, Carman, MB R0G 0J0; [2]Viterra Inc., 10507 Barlow Trail SE, Calgary, AB T2C 4M5

Abstract

Nitrogen (N) general guidelines in Manitoba are reviewed by a panel of government, industry and university experts on an annual basis and revisions as well as additions and corrections are reflected in the Soil Fertility Guide that is published (as well as posted on the web-site) by Manitoba Agriculture, Food and Rural Initiatives. However, a comprehensive review of the N databases for barley, wheat and canola has not been undertaken since September 1990. Post 1988 database of experiments conducted by Western Cooperative Fertilizers Limited was utilized to revise target yields and recommendations derived thereof in the last revision of the Manitoba provincial recommendations. Two hundred and sixty seven experiments with N as the primary focus were analyzed individually and in groups as follows: 97 experiments with barley, 145 with wheat were organized based on the classification used in the 1990 revision in those conducted in moist, dry and arid regions of the province, whereas 25 experiment with canola were analyzed as one group. Target yields and recommendations derived are compared to those of the 1977 and 1990 provincial databases. The results have form the basis for revised tables in the Soil Fertility Guide and allow development of a web-based tool to derive N net economic return using soil test values (http://www.gov.mb.ca/agriculture/financial/farm/nitrogencalc.html).

Introduction

Fertilizer nutrient recommendation guidelines for the province of Manitoba prior to the privatization of the provincial soil testing laboratory in 1992 were developed by the Manitoba Soil Fertility Sub-Council and were approved by the Manitoba Soil Fertility Advisory Committee. The Department of Soil Science at the University of Manitoba served as the repository of the "approved" recommendations of the time. Provincial fertilizer recommendations have not been updated or revised for wheat, barley, canola or flax since 1992 with last documented revisions in September 1990. Since the original studies were conducted to develop the current recommendations, Manitoba has moved away from summer fallow to continuous cropping, have reduced tillage intensity, has a greater diversity of crops, including pulses in the rotation, and have higher yield expectations due to technological and varietal improvements.

Database

Viterra (through amalgamation of Westco) has a database of soil fertility trials conducted over the past decades including more recent trials than those utilized in constructing the current N recommendations. To enhance the database, it was decided that experiments conducted in South Eastern Saskatchewan, especially those on the highway 16 corridor from Yorkton, Saskatchewan to the Saskatchewan-Manitoba border are also included. Seven hundred and eleven experiments

with nitrogen (N) as the primary focus were thus identified; however, it was deemed that experiment prior to 1987-88 growing season (370) were carried out with parameters already identified as outdated in the current database, hence, they were excluded from further analysis. Of the remaining 341 experiments, a further 74 were omitted as soil test data for the experimental sites were not available. The make-up of the 267 experiments utilized in this study is shown in Fig. 1.

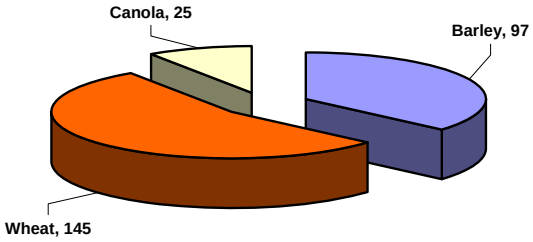

Figure 1. Make-up of the database of post 1987 experiments utilized to revise current N recommendations.

The nomenclature utilized in the September 1990 revision of the N guidelines was followed to maintain consistency and direct comparison of the current to the previous database. Hence, based on the experimental location, experiments for barley and wheat were classified into the categories, namely, those that were carried out under Arid, Dry and Moist conditions (not irrigated experiments were included in the database). The nomenclature utilized in the Soil Fertility Guide is different, as the conditions identified are Dry, Moist and Ideal. It is conceivable that there is a close relationship and correspondence between the three categories in the two sets of guidelines. However, the original one was retained to facilitate direct comparison to the previous provincial soil testing database. The distribution of experiments for each crop is provided in Fig. 2.

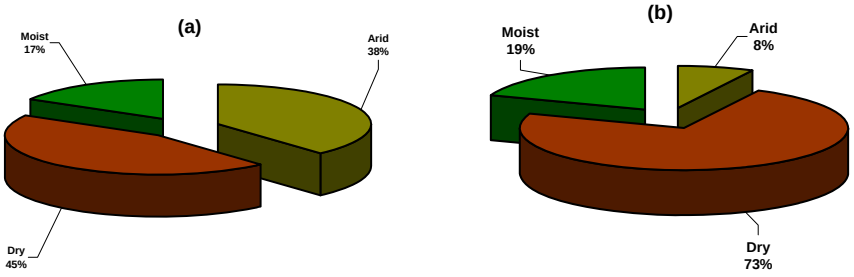

Figure 2. Proportion of the barley and wheat experiments carried out in the Moist, Dry and Arid regions of Manitoba.

Canola experiments were kept in one group as was the case in the previous database. The proportion of experiments in each of the major Soil Climatic Zones (SCZ) (Meyers and Karamanos 1997) is shown in Fig. 3.

One hundred and fifty two experiments with phosphorus (P) were compiled for the P recommendation guideline revision (Figure 4).

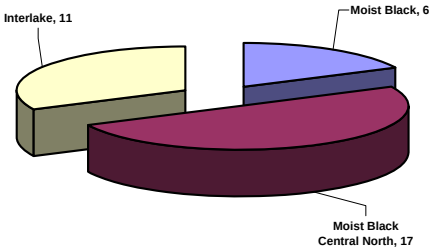

Figure 3. Number of canola experiments included in the database on a per SCZ basis.

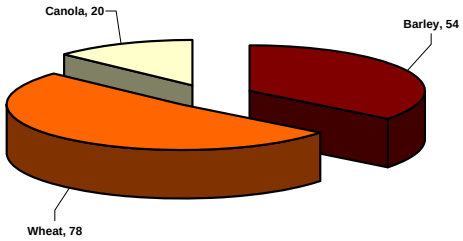

Figure 4. Number of P experiments for each of the main crops included in the database.

Recommendations

Barley

Overall barley grain yield increases with N fertilizer application ranged from -10.9 to 62.9 bu/acre (Fig. 5) and were a function of soil test N and agroecological conditions.

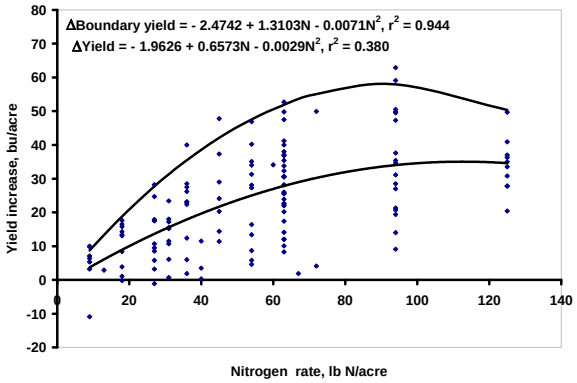

Figure. 5. Yield response of barley to N application under non-restricted (boundary) and average overall conditions.

Grain yields derived with experiments in the current database, when experiments were grouped into those carried out in each of the three soil moisture categories, are compared to those of the 1990 revision in Fig. 6. Although the concept of N supply (soil test N + ½ of fertilizer N) has been abandoned since 1990, yield increases are plotted versus N supply to provide a direct comparison of the current to the 1990 database.

Average grain yields in the current database were significantly greater under moist conditions, which reflects the greater yield potential of newer cultivars and improvement in cultivation practices. Cultivation practices may be the reason why grain yields under dry conditions were slightly greater in the current compared to the 1990 database, especially at higher N application rates. Essentially grain yields under arid conditions were similar, since moisture use was the

main limiting factor in both cases. A comparison of grain yields under the three soil moisture regimes as a function of soil + fertilizer N is afforded in Fig. 7.

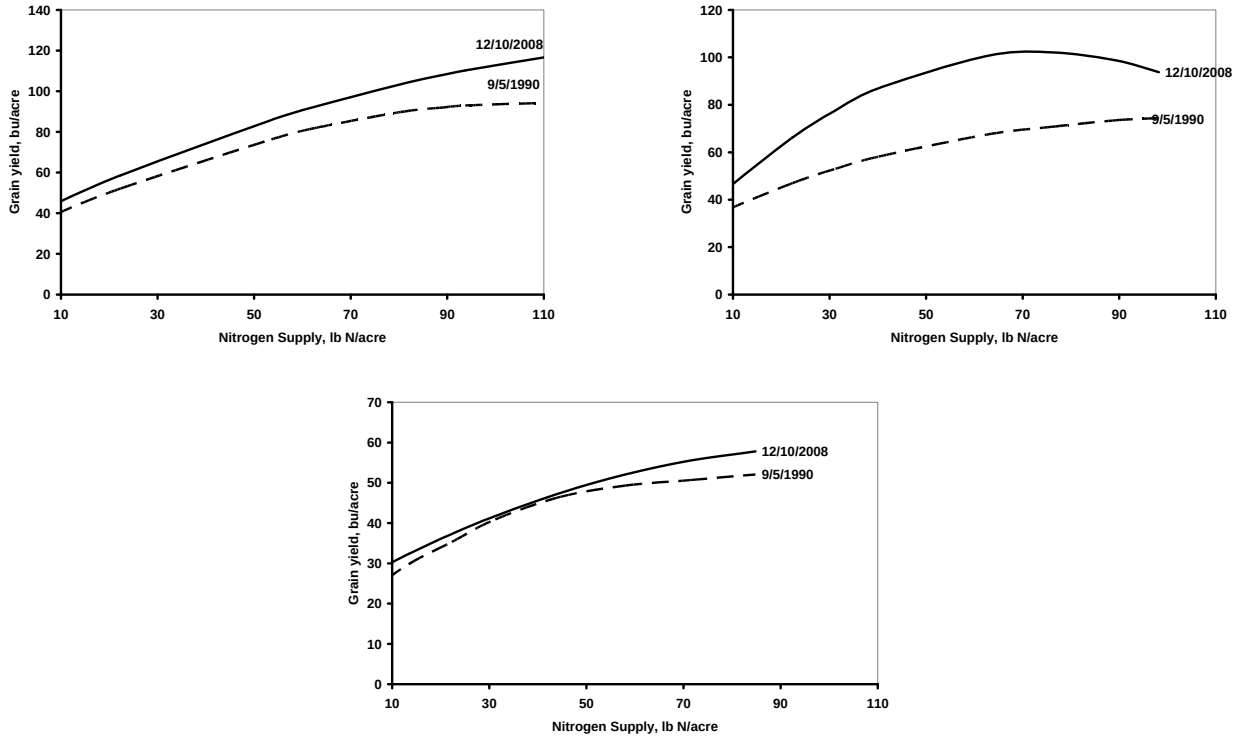

Figure 6. Comparison of average barley yield responses as a function of N supply (soil test N + ½ of fertilizer N) under moist, dry and arid conditions.

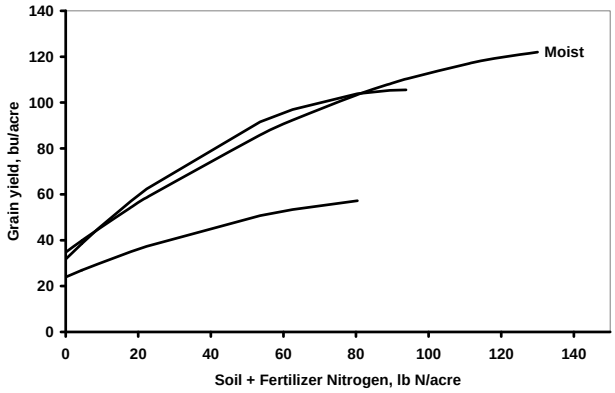

Figure 7. Comparison of average barley grain yields under the three soil moisture regimes as a function of soil + fertilizer N.

CWRS Wheat

Overall CWRS wheat grain yield increases with N fertilizer application ranged from -0.9 to 41.8 bu/acre (Fig. 8) and were a function of soil test N and agroecological conditions.

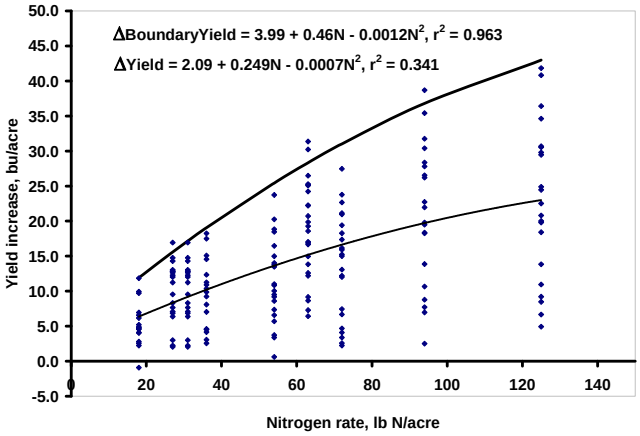

Figure. 8. Yield response of wheat to N application under non-restricted (boundary) and average overall conditions.

Similarly to barley, grain yields derived with experiments in the current database when experiments were grouped into those carried out in each of the three soil moisture categories are compared to those of the 1990 revision in Fig. 9. Average CWRS wheat grain yields in the current database were significantly greater under moist, slightly greater under dry and similar under arid conditions, reflecting the same conditions as those described for barley.

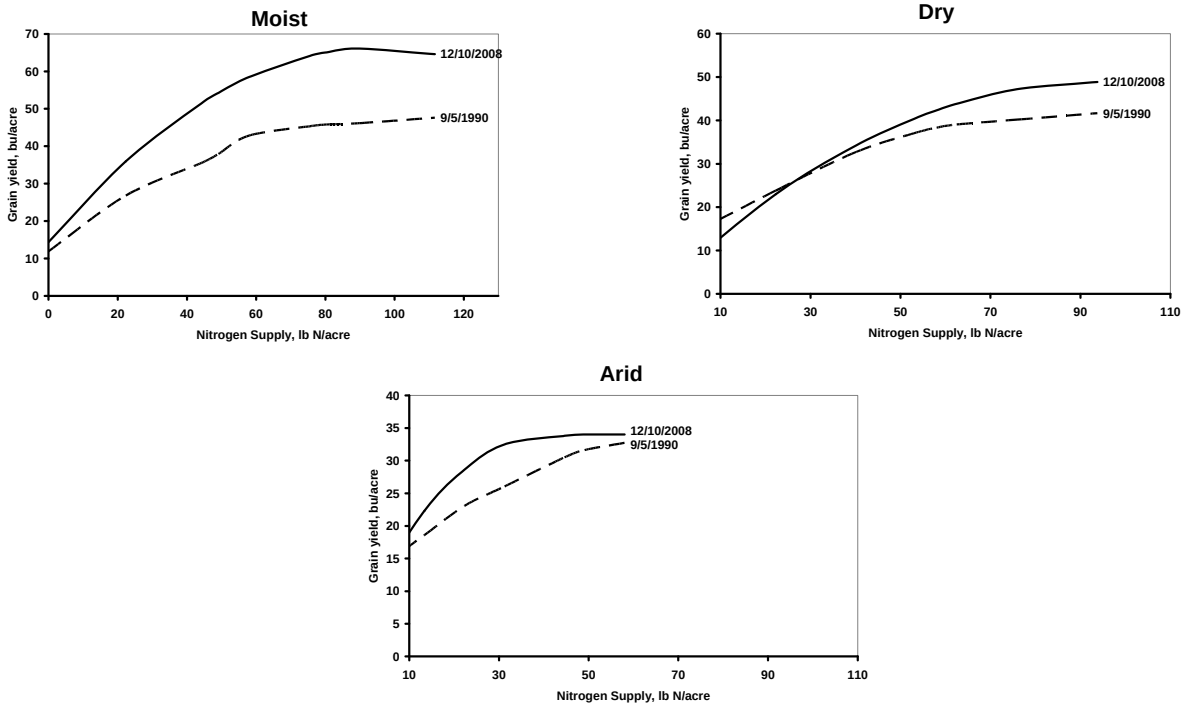

Figure 9. Comparison of average yield responses as a function of N supply (soil test N + ½ of fertilizer N) under moist, dry and arid conditions.

A comparison of grain yields under the three soil moisture regimes as a function of soil + fertilizer N is afforded in Fig. 10.

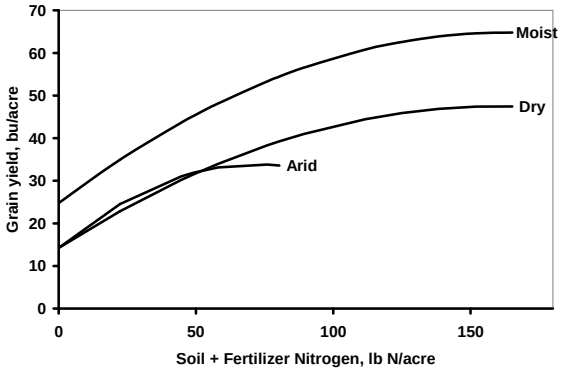

Figure 10. Comparison of average CWRS wheat grain yields under the three soil moisture regimes as a function of soil + fertilizer N.

Canola

Target yields in the 1990 edition of the Manitoba Agriculture provincial soil testing laboratory tables ranged from 7.1 to 40.2 bu/acre (Table 1).

Table 1. Average canola seed target yields in the September 5, 1990 revision of the Manitoba Agriculture database (bu/acre)

Fert. N	Soil NO_3-N															
lb/acre	0	4	9	13	18	22	27	31	36	40	45	49	54	67	71	80
0	7.1	8.9	10.6	12.1	13.5	14.9	16.2	17.5	18.6	19.6	20.5	21.4	22.2	23.4	24.4	25.0
18	9.6	11.5	12.8	14.7	16.0	17.3	18.5	19.8	21.1	22.3	23.0	23.6	24.9	26.1	26.8	27.5
36	12.1	14.1	15.3	17.2	18.5	19.8	21.1	22.3	23.6	24.9	25.5	26.1	27.5	28.7	29.3	30.0
54	14.7	16.6	17.9	19.8	21.1	22.3	23.6	24.9	26.1	27.5	28.1	28.7	30.0	31.3	31.9	32.5
72	17.2	19.1	20.4	22.3	23.6	24.9	26.1	27.5	28.7	30.0	30.6	31.3	32.5	33.8	34.5	35.0
90	18.3	21.7	23.0	24.9	26.1	27.5	28.7	30.0	31.3	32.5	33.2	34.2	35.0	36.4	37.0	37.7
110	22.3	24.3	25.5	27.5	28.7	30.0	31.3	32.7	34.2	35.0	35.7	37.0	37.7	38.9	39.5	40.2
125	24.9	26.8	28.3	30.0	31.3	32.7	34.2	35.7	37.0	37.7	38.2	39.5	40.2			
145	27.5	29.3	31.3	32.5	34.2	35.7	37.0	38.2	39.5	40.2						
160	30.0	31.9	33.8	35.0	37.0	38.2	39.5									
180	32.5	34.5	36.4	37.7	39.5											

Although the average maximum yield of conventional canola cultivars in the current database was essentially identical to the one in the 1990 revision, that of the unfertilized control was 2.5-fold higher reflecting the increased N fertility in the last two decades. On average, the maximum yield for hybrid canola cultivars was 11.5 bu/acre (or 28%) higher, which is close agreement with the research data published by Karamanos et al. (2005) for the western Canadian prairie soils, who found that maximum hybrid canola cultivar yield was 34% greater than that of conventional canola cultivars.

Target yields derived in this study for conventional and hybrid canola cultivars are shown in Tables 2 and 3.

Table 2. Average conventional canola cultivar seed target yields in the current database (bu/acre)

Fert. N	Soil NO_3-N															
lb/acre	0	4	9	13	18	22	27	31	36	40	45	49	54	67	71	80
0	18.3	19.5	20.7	21.9	23.1	24.2	25.2	26.3	27.3	28.3	29.2	30.1	30.9	33.3	34.0	35.4
0	18.3	19.5	20.7	21.9	23.1	24.2	25.2	26.3	27.3	28.3	29.2	30.1	30.9	33.3	34.0	35.4
18	23.1	24.2	25.2	26.3	27.3	28.3	29.2	30.1	30.9	31.8	32.6	33.3	34.0	36.0	36.5	37.6
36	27.3	28.3	29.2	30.1	30.9	31.8	32.6	33.3	34.0	34.7	35.4	36.0	36.5	38.0	38.5	39.2
72	34.1	34.8	35.4	36.0	36.6	37.1	37.6	38.1	38.5	38.9	39.3	39.6	39.9	40.5	40.6	40.8
90	36.6	37.2	37.7	38.1	38.5	38.9	39.3	39.6	39.9	40.1	40.3	40.5	40.6	40.8	40.8	40.7
110	38.7	39.1	39.4	39.7	40.0	40.2	40.4	40.6	40.7	40.8	40.8	40.8	40.8	41.0	41.0	41.0
107	38.5	38.9	39.2	39.5	39.8	40.1	40.3	40.5	40.6	40.7	41.0	41.0	41.0			
145	40.7	40.8	40.8	40.8	40.8	40.8	40.7	41.0	41.0	41.0						
160	40.8	40.8	40.7	40.6	41.0	41.0	41.0									
180	41.0	41.0	41.0	41.0	41.0											

Table 3. Average hybrid canola cultivar seed target yields in the current database (bu/acre)

Fert. N	Soil NO_3-N															
lb/acre	0	4	9	13	18	22	27	31	36	40	45	49	54	67	71	80
0	25.9	26.9	27.9	28.9	29.9	30.8	31.7	32.7	33.5	34.4	35.3	36.1	36.9	39.2	39.9	41.3
18	29.9	30.8	31.7	32.7	33.5	34.4	35.3	36.1	36.9	37.7	38.4	39.2	39.9	42.0	42.6	43.9
36	33.5	34.4	35.3	36.1	36.9	37.7	38.4	39.2	39.9	40.6	41.3	42.0	42.6	44.4	45.0	46.1
54	36.9	37.7	38.4	39.2	39.9	40.6	41.3	42.0	42.6	43.2	43.9	44.4	45.0	46.6	47.1	48.0
72	40.0	40.7	41.4	42.1	42.7	43.3	43.9	44.5	45.1	45.6	46.1	46.7	47.1	48.5	48.9	49.6
90	42.7	43.3	43.9	44.5	45.1	45.6	46.2	46.7	47.2	47.6	48.1	48.5	48.9	50.0	50.3	50.9
110	45.4	45.9	46.4	46.9	47.4	47.8	48.3	48.7	49.1	49.5	49.8	50.1	50.5	51.3	51.5	51.9
125	47.1	47.5	48.0	48.4	48.8	49.2	49.6	49.9	50.3	50.6	50.9	51.1	51.4			
145	49.0	49.4	49.8	50.1	50.4	50.7	51.0	51.2	51.5	51.7						
160	50.2	50.5	50.8	51.1	51.3	51.6	51.8									
180	51.5	51.7	51.9	52.1	52.2											

Net Return to N Fertilization

To derive economic return comparisons to N fertilization the principle of net return as described by Rankin (2005):

Net Return = (wheat price x yield increase) - (N price x N rate) [Eq. 1]

and using Equation 2 and the parameters in Table 49:

$$\{a + b \times (N_{rate}+N_{residual}-N_{ideal})^2 + c \times (N_{rate}+N_{residual}-N_{ideal})\} - \{b \times (N_{residual}-N_{ideal})^2 + c \times (N_{residual}-N_{ideal})\} \quad \text{[Eq. 2]}$$

Table 4. Parameters used in Equation 2 to derive grain yield increases.

Crop	Soil type – moisture supply conditions	a	b	c
CWRS	Moist	0	-0.0015	0.4902
wheat	Dry	0	-0.0013	0.4159
	Arid	0	-0.0038	0.5464
Barley	Moist	-1.6996	-0.0026	0.8195
	Dry	2.2188	-0.0032	0.63997
	Arid	1.601	-0.0011	0.343
Canola	All	0	-0.0009	0.2311
Hybrid canola	All	0	-0.0005	0.202

Three examples with CWRS wheat under Moist, Dry and Arid conditions for a range of wheat prices ($3.50 to $6.50/bushel) and two prices of N - 50¢ and $1.00 per lb of N, represented by (a) and (b) in all three examples – are provided in Fig. 11, 12 and 13. An average soil test of 40 lb

N/acre (0-24” depth) was used in all three examples. The CWRS Wheat:N Price Ratio in the graphs represent the average “grain buying power” of CWRS wheat or, in other words, the lb N that one would purchase with one bushel of CWRS wheat at the given price for wheat and fertilizer N. It is apparent that as the crop price increases, the spread in N fertilizer rate at which the average maximum net return from N fertilization with two greatly different fertilizer N prices narrows. The actually spread, of course, will vary depending on the N soil test and could be further refined by narrowing the crop and fertilizer N price increments. Similar trends are observed with barley and canola, when the principle of net return is utilized for these crops.

References

Karamanos, R.E. Goh, T.B. and Poisson, D.P. 2005. Nitrogen, Phosphorus and Sulfur Fertilization of Hybrid Canola. J. Plant Nutr., 28: 1145 - 1161.

Meyers, P. and Karamanos, R.E. 1997. Soil climatic zones of the Canadian prairies. Proc. 34th Annual Alberta Soil Science Workshop, Edmonton, Alberta.

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

(a)

Nitrogen $ Rate of Return Calculator
Manitoba (Arid)

Go to Marginal Revenue Chart | Go to Fertilizer as variable | Return to Data Entry

Fertilizer N data	
Fertilizer Type	UREA
Cost/ton	$510
%N	46
Cost/Unit of N	$0.50
Fertilizer N increment	10
Crop price increment, $	$0.50
Soil test N (0-24") lb N/acre	40

Go to Total Net Return Below

			Expected CWRS Wheat Price						
			$3.50	$4.00	$4.50	$5.00	$5.50	$6.00	$6.50
N Rate	Average yield	Yield Increase from 0 lb. N*	Net Return ($/ac.)** CWRS Wheat:N Price Ratio						
(lb./acre)	(bu./ac.)	(bu./ac.)	6.9	7.9	8.9	9.9	10.9	11.9	12.9
0	30.0	0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
10	32.0	2.0	$2.1	$3.1	$4.2	$5.2	$6.2	$7.2	$8.2
20	33.3	3.3	$1.6	$3.2	$4.9	$6.6	$8.2	$9.9	$11.6
30	33.8	3.9	($1.6)	$0.3	$2.2	$4.1	$6.1	$8.0	$9.9
40	33.6	3.6	($7.5)	($5.7)	($3.9)	($2.1)	($0.3)	$1.5	$3.3
50	32.6	2.6	($16.0)	($14.7)	($13.4)	($12.1)	($10.8)	($9.5)	($8.2)
60	30.9	0.9	($27.2)	($26.8)	($26.3)	($25.9)	($25.5)	($25.1)	($24.6)
70	30.0	0.0	($35.3)	($35.3)	($35.3)	($35.3)	($35.3)	($35.3)	($35.3)
80	30.0	0.0	($40.3)	($40.3)	($40.3)	($40.3)	($40.3)	($40.3)	($40.3)

Current N Rate →

*Yield responses are averages from 55-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

(b)

Nitrogen $ Rate of Return Calculator
Manitoba (Arid)

Go to Marginal Revenue Chart | Go to Fertilizer as variable | Return to Data Entry

Fertilizer N data	
Fertilizer Type	UREA
Cost/ton	$1,010
%N	46
Cost/Unit of N	$1.00
Fertilizer N increment	10
Crop price increment, $	$0.50
Soil test N (0-24") lb N/acre	40

Go to Total Net Return Below

			Expected CWRS Wheat Price						
			$3.50	$4.00	$4.50	$5.00	$5.50	$6.00	$6.50
N Rate	Average yield	Yield Increase from 0 lb. N*	Net Return ($/ac.)** CWRS Wheat:N Price Ratio						
(lb./acre)	(bu./ac.)	(bu./ac.)	3.5	4.0	4.5	5.0	5.5	6.0	6.5
0	30.0	0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
10	32.0	2.0	($2.8)	($1.8)	($0.8)	$0.2	$1.3	$2.3	$3.3
20	33.3	3.3	($8.3)	($6.6)	($5.0)	($3.3)	($1.7)	$0.0	$1.7
30	33.8	3.9	($16.5)	($14.5)	($12.6)	($10.7)	($8.8)	($6.8)	($4.9)
40	33.6	3.6	($27.3)	($25.5)	($23.6)	($21.8)	($20.0)	($18.2)	($16.4)
50	32.6	2.6	($40.7)	($39.4)	($38.1)	($36.8)	($35.5)	($34.2)	($32.9)
60	30.9	0.9	($56.9)	($56.4)	($56.0)	($55.6)	($55.1)	($54.7)	($54.3)
70	30.0	0.0	($69.9)	($69.9)	($69.9)	($69.9)	($69.9)	($69.9)	($69.9)
80	30.0	0.0	($79.8)	($79.8)	($79.8)	($79.8)	($79.8)	($79.8)	($79.8)

Current N Rate →

*Yield responses are averages from 55-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 11. Net return to N fertilizer application at two N prices 50¢ (a) and $1.00 (b) per lb of N for a soil with 40 lb N/acre in the 0-24” depth under Arid soil type – moisture supply category.

(a)

Nitrogen $ Rate of Return Calculator
Manitoba (Moist)

Go to Marginal Revenue Chart | Go to Fertilizer Price as variable | Return to Data Entry

Fertilizer N data	
Fertilizer Type	UREA
Cost/ton	$510
%N	46
Cost/Unit of N	$0.50
Fertilizer N increment	10
Crop price increment, $	$0.50
Soil test N (0-24") lb N/acre	40

N Rate	Average yield	Yield Increase from 0 lb. N*	Go to Total Net Return Below	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						
(lb./acre)	(bu./ac.)	(bu./ac.)		6.9	7.9	8.9	9.9	10.9	11.9	12.9
50	56.7	14.8		$26.5	$33.8	$41.2	$48.6	$56.0	$63.4	$70.7
60	58.8	16.8		$28.6	$37.0	$45.4	$53.8	$62.2	$70.6	$79.0
70	60.5	18.6		$29.7	$39.0	$48.3	$57.5	$66.8	$76.1	$85.4
80	62.0	20.0		$29.7	$39.7	$49.8	$59.8	$69.8	$79.8	$89.8
Current N Rate → 90	63.1	21.2		$28.7	$39.3	$49.9	$60.5	$71.1	$81.7	$92.2
100	64.0	22.0		$26.7	$37.7	$48.7	$59.7	$70.7	$81.7	$92.7
110	64.5	22.6		$23.6	$34.9	$46.1	$57.4	$68.7	$80.0	$91.3
120	64.8	22.8		$19.4	$30.8	$42.2	$53.6	$65.1	$76.5	$87.9
130	64.7	22.8		$14.2	$25.6	$37.0	$48.4	$59.8	$71.1	$82.5

*Yield responses are averages from 25-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

(b)

Nitrogen $ Rate of Return Calculator
Manitoba (Moist)

Go to Marginal Revenue Chart | Go to Fertilizer Price as variable | Return to Data Entry

Fertilizer N data	
Fertilizer Type	UREA
Cost/ton	$1,010
%N	46
Cost/Unit of N	$1.00
Fertilizer N increment	10
Crop price increment, $	$0.50
Soil test N (0-24") lb N/acre	40

N Rate	Average yield	Yield Increase from 0 lb. N*	Go to Total Net Return Below	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						
(lb./acre)	(bu./ac.)	(bu./ac.)		3.5	4.0	4.5	5.0	5.5	6.0	6.5
50	56.7	14.8		$1.8	$9.1	$16.5	$23.9	$31.3	$38.7	$46.0
60	58.8	16.8		($1.0)	$7.4	$15.8	$24.2	$32.6	$41.0	$49.4
70	60.5	18.6		($4.9)	$4.4	$13.7	$23.0	$32.2	$41.5	$50.8
80	62.0	20.0		($9.8)	$0.2	$10.2	$20.2	$30.2	$40.3	$50.3
Current N Rate → 90	63.1	21.2		($15.7)	($5.2)	$5.4	$16.0	$26.6	$37.2	$47.8
100	64.0	22.0		($22.7)	($11.7)	($0.7)	$10.3	$21.3	$32.3	$43.3
110	64.5	22.6		($30.8)	($19.5)	($8.2)	$3.1	$14.4	$25.6	$36.9
120	64.8	22.8		($39.9)	($28.5)	($17.1)	($5.6)	$5.8	$17.2	$28.6
130	64.7	22.8		($50.0)	($38.6)	($27.3)	($15.9)	($4.5)	$6.9	$18.3

*Yield responses are averages from 25-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 12. Net return to N fertilizer application at two N prices 50¢ (a) and $1.00 (b) per lb of N for a soil with 40 lb N/acre in the 0-24" depth under Moist soil type – moisture supply category.

(a)

Nitrogen $ Rate of Return Calculator
Manitoba (Dry)

Go to Marginal Revenue Chart | Go to Fertilizer Price as variable | Return to Data Entry

Fertilizer N data	
Fertilizer Type	UREA
Cost/ton	$510
%N	46
Cost/Unit of N	$0.50
Fertilizer N increment	10
Crop price increment, $	$0.50
Soil test N (0-24") lb N/acre	40

N Rate	Average yield	Yield Increase from 0 lb. N*	Go to Total Net Return Below	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						
(lb./acre)	(bu./ac.)	(bu./ac.)		6.9	7.9	8.9	9.9	10.9	11.9	12.9
30	37.0	8.2		$13.5	$17.6	$21.7	$25.8	$29.9	$34.0	$38.1
40	39.2	10.4		$16.2	$21.4	$26.6	$31.8	$37.0	$42.2	$47.4
50	41.1	12.3		$18.0	$24.2	$30.4	$36.5	$42.7	$48.9	$55.0
60	42.8	14.0		$18.9	$25.9	$32.9	$39.9	$46.9	$54.0	$61.0
Current N Rate → 70	44.2	15.5		$18.8	$26.6	$34.3	$42.0	$49.8	$57.5	$65.2
80	45.4	16.6		$17.9	$26.2	$34.5	$42.8	$51.2	$59.5	$67.8
90	46.3	17.5		$16.0	$24.8	$33.6	$42.3	$51.1	$59.9	$68.7
100	47.0	18.2		$13.3	$22.4	$31.5	$40.6	$49.6	$58.7	$67.8
110	47.4	18.6		$9.6	$18.9	$28.2	$37.5	$46.7	$56.0	$65.3

*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

(b)

Nitrogen $ Rate of Return Calculator
Manitoba (Dry)

Go to Marginal Revenue Chart | Go to Fertilizer Price as variable | Return to Data Entry

Fertilizer N data	
Fertilizer Type	UREA
Cost/ton	$1,010
%N	46
Cost/Unit of N	$1.00
Fertilizer N increment	10
Crop price increment, $	$0.50
Soil test N (0-24") lb N/acre	40

N Rate	Average yield	Yield Increase from 0 lb. N*	Go to Total Net Return Below	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						
(lb./acre)	(bu./ac.)	(bu./ac.)		3.5	4.0	4.5	5.0	5.5	6.0	6.5
30	37.0	8.2		($1.3)	$2.8	$6.9	$11.0	$15.1	$19.2	$23.3
40	39.2	10.4		($3.5)	$1.7	$6.9	$12.1	$17.3	$22.5	$27.7
50	41.1	12.3		($6.7)	($0.5)	$5.7	$11.8	$18.0	$24.2	$30.3
60	42.8	14.0		($10.8)	($3.7)	$3.3	$10.3	$17.3	$24.3	$31.3
Current N Rate → 70	44.2	15.5		($15.7)	($8.0)	($0.3)	$7.5	$15.2	$22.9	$30.6
80	45.4	16.6		($21.6)	($13.3)	($5.0)	$3.3	$11.6	$20.0	$28.3
90	46.3	17.5		($28.4)	($19.7)	($10.9)	($2.1)	$6.7	$15.4	$24.2
100	47.0	18.2		($36.1)	($27.0)	($17.9)	($8.9)	$0.2	$9.3	$18.4
110	47.4	18.6		($44.8)	($35.5)	($26.2)	($16.9)	($7.6)	$1.7	$11.0

*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 13. Net return to N fertilizer application at two N prices 50¢ (a) and $1.00 (b) per lb of N for a soil with 40 lb N/acre in the 0-24" depth under Dry soil type – moisture supply category.

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Holiday Inn Airport
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Program Chair:

John Lamb
University of Minnesota
St. Paul, MN 55108
(612) 625-1772
JohnLamb@umn.ed

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