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Management for optimum yield of open pollinated and hybrid canola

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2000Annual Report

Prepared for:

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February, 2001

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Abstract

Many of the agronomic practices used for canola production were developed prior to 1980, although they have been updated somewhat with new information generated since that time. The check variety in use in 1980 was Regent. Based on relative variety comparisons, some that are currently being grown have much higher yield potential. For example, Quantum, an open pollinated conventional variety has a yield potential that is about 26% greater while, while the yield potential of the herbicide tolerant hybrid variety Invigor 2663 is about 45% greater. This research was initiated to determine whether current agronomic practices are adequate to take full advantage of the higher yield potential.

The study was initiated in 1999, and continued in 2000, with 2 experiments conducted at 3 locations (Scott, Melfort and Indian Head). One experiment focused on the impact of seeding rate, Nitrogen rate, and fungicides. Results from that study indicated that Invigor seed yield was 8% to 16% greater than Quantum when averaged across treatments suggesting nutrient and water requirements should be greater for Invigor 2663. A second study focusing on the impact of N fertilizer rates (0-150 kg/ha) indicated Invigor 2663 yield was higher at all Nitrogen rates than Quantum; suggesting more efficient use of nutrients and water resources.

At Scott Invigor yields were maximized at an N level of approximately 207 kg/ha versus 197 kg/ha for Quantum. At Indian Head, Invigor 2663 did not reach maximum yield at the highest N rate (150 kg/ha), possibly because residual soil N was much lower than at the other 2 locations. Quantum did appear to reach its maximum yield potential of 1947 kg/ha but was 729 kg/ha less than Invigor 2663. At Melfort Invigor 2663 appeared to reach its maximum yield potential while Quantum did not with both cultivars averaging 3043 kg/ha where 150 kg/ha of N was applied.

In the seed rate x N rate x fungicide study at Melfort, where plant densities were substantially reduced as a result of frost, a seed rate X nitrogen level interaction similar to that observed at Indian Head in 1999 was noted. Yield response to increased nitrogen was enhanced at higher seeding rates. The lack of a consistent response across locations and years indicates the interaction may only occur when plant densities are relatively low.

Although sclerotinia infection and estimated yield reductions were low at all locations, Ronilan applied at Scott and Melfort increased average yield by 152 kg/ha. At Melfort where the severity and incidence of infection was greatest Invigor 2663 biomass increased by 1386 kg/ha compared to only 197 kg/ha for Quantum when fungicides were applied.

Preliminary economic analyses showed that near optimum marginal returns occurred when N rates exceeded 100kg/ha. This applied to Invigor 2663 when canola was priced high and either cultivar when canola was priced low, for both N costs scenarios.

While these results underline the importance of following recommended guidelines for seeding rates, nitrogen rates, and fungicides when growing canola they also suggest that hybrid canola may require different management practices to take advantage of their higher yield potential. However, yield responses to additional N, higher seed rates, or fungicides may be highly dependent on soil and climatic conditions. **Results to date, while inconclusive do provide a strong indication that higher yielding cultivars use nitrogen more efficiently, but may also require more N to achieve optimum yield.** Results from research to be conducted in 2001 are expected to substantiate these claims and assist in identifying conditions under which yield responses are more likely to occur.

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Introduction:

Newer O.P. and hybrid canola varieties provide higher yield potential but the management strategies necessary to achieve optimum yield are not well understood. To better understand the levels of inputs required to optimize yield and to enhance producers ability to optimize return on their investment research in the second year of a three year study continued at Melfort, Indian Head, and Scott in the year 2000 with the following objective.

Objective: To evaluate the effect of seeding rate, fertilizer addition and fungicides on the optimum yield potential of hybrid and open pollinated canola in the Thick Black, Thin Black and Dark Brown soil zones.

In 2000 a second N rate study was initiated at all locations to provide a broader range of N application rates with the following objective.

Objective: To determine if more N is required to maximize yield of hybrid than OP cultivars because of the higher yield potential of hybrids.

Materials and Methods:

In 2000 field experiments were conducted at Melfort (Thick Black), Indian Head (Thin Black), and Scott (Dark Brown). The main experiment was established to evaluate the effect of seeding rate, fertilizer, and fungicides on the yield of both an open pollinated variety (Quantum) and Hybrid variety (Invigor 2663). A second study increased the range of N application rates . Background levels of nitrogen to 60 cm depth, phosphate to 15 cm, potassium to 15 cm and sulfur to 60 cm depth were measured in the fall of 1999 or prior to seeding in 2000. Plots at Scott were seeded on May 12th using a Versatile hoe drill on a 20 cm row spacing. Plots at Indian Head were seeded on May 3rd with a Conserva-Pak and 30 cm row spacing and at Melfort on May 7th with a 23 cm spacing . Plots were swathed between August 18th and 31st at Scott, on August 15th at Indian Head and between August 28th and September 6th at Melfort after all agronomic and pathology data was collected.

Main Experiment

The main experiment was designed as a 3 level factorial with a fungicide strip where N levels were 67%, 100% and 120% of a target N level. Factors in the main experiment included 2 canola cultivars (hybrid and open pollinated variety) and three seeding rates 2.7, 5.8 ,8.4 kg/ha in addition to three N levels. Seed rates were categorized as low, middle and high and N rates as low, target, and high. At Scott nitrogen as urea (46-0-0) was mid row banded at rates of 50 kg/ha , 73 kg/ha, and 95 kg/ha while the phosphorous-sulfur blend (5.5-25.5-25-8.5) was applied below the seed row to all treatments at rates of 45 kg/ha, 67 kg/ha, and 90 kg/ha. This resulted in N rates that represent a narrower range than was planned, due to an error in setting the low and high rates. At Indian Head urea was side banded at rates of 125 kg/ha, 187 kg/ha, and 249 kg/ha with a fertilizer blend of 14-20-10-10 also side banded at rates of 112 kg/ha 170 kg/ha, and 226 kg/ha to adjust P levels. Seed-fertilizer separation was approximately 2.5 cm to the side and 6.4 cm below the seed. At Melfort urea was side banded at rates of 90 kg/ha, 170 kg/ha and 250 kg/ha with a fertilizer blend of 5.5-25.5-25-8.5 also side banded at rates of 25 kg/ha, 75 kg/ha and 125 kg/ha. The following table summarizes soil nutrient and applied nutrient levels on the main experiment.

The fungicide strip received an application of Ronalin EG (vinclozolin at 500 g ai/ha) on July 7th at

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Scott and July 10th at Indian Head and 400 g ai/ha at Melfort on July 14th for control of sclerotinia. Weed control consisted of a spring application of Edge granular (ethafluralin at 1130 g ai/ha) at Indian Head and pre-emergent application of Roundup at all sites (445 g ai/ha of glyphosate at Scott and 890 g ai/ha at Indian Head and 660 g ai/ha at Melfort). At Scott an in crop application of Poast Ultra (sethoxydim at 211 g ai/ha) and Lontrel (clopyralid at 151 g ai/ha) was applied on June 13th. At Indian Head both cultivars received an in crop application of sethoxydim at 361 g ai/ha and clopyralid at 150 g ai/ha on June 7th . Plots at Melfort received sethoxydim at 222 g ai/ha on June 5th and June 19th and Muster (ethametsulfuron-methyl at 9 g ai/ha) on June 19th.

Table 1. Combined soil and fertilizer nutrient levels at each location.

	Scott			Indian Head			Melfort		
	67%	Target	133%	67%	Target	133%	67%	Target	133%
N to 60 cm	100	111	120	75	103	132	110	146	183
P to 15 cm	66	71	77	38	50	61	66	79	92
K to 15 cm	>600	>600	>600	560	560	560	>600	>600	>600
S to 60 cm	176	178	180	28	34	40	74	78	83

Data collection included plant counts (Scott: June 8th , Indian Head: May 30th, Melfort:June 16th), recording the start and end date of anthesis, seed maturity date, a disease survey prior to swathing (Scott:August 22nd-24th, Indian Head: August 10th, Melfort:August 30st) pre- harvest above ground biomass yields (Scott: August 22nd-24th, Indian Head: August 14th, Melfort: August 31st), and grain yield (Scott: August 31st, Indian Head: Aug. 29th, Melfort:October 2nd) with a small plot combine. Percent protein with NIR analyser was determined. Percent green seed of harvest grain samples and % oil have yet to be determined.

N Rate Study

This study was designed as a factorial experiment with 6 different rates of applied N; 0,30, 60, 90, 120 and 150 kg/ha. Soil test N levels revealed 77 kg/ha of N to 60 cm at Scott, 68 kg/ha at Melfort and 17 kg/ha at Indian Head. Target seed rate for Quantum was 9 kg/ha with the hybrid seed rate adjusted to give the same number of viable seeds/m2. N was midrow banded at Scott prior to seeding and side banded at Melfort and Indian Head as 46-0-0 at the time of seeding. A blend of 5.5-25.5-25-8.5 was placed below the seed on all plots at a rate of 130 kg/ha at Scott and Melfort. At Indian Head a blend of 14-20-10-10 was applied at 130 kg/ha. Weed control measures, harvest operations and data collection activities were the same as on the main experiment with the exception of Select (clethodim at 35.6 g ai/ha) applied to plots at Indian Head on May 25th. Plots at Scott were not sprayed with a fungicide due to lack of disease. Plots at Melfort and Indian Head were sprayed with Quadris (azoxystrobin 125 g ai/ha) at the 2 leaf stage. The Melfort plots also receive an additional application of Ronilan EG (vinclozolin at 400 g ai/ha) on July 14th.

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Results

1.0 Climatic Conditions

Scott and Melfort experienced below normal temperatures prior to July and below normal precipitation in May which hindered germination of small seeded crops (Table 1). June at Melfort was unusually cool averaging 2.5 Celsius less than the long term normal. Although frost in late May further reduced plant densities at both locations plant stands remained adequate. Rain near the beginning of June followed by above average precipitation in July ensured canopy closure by early July and adequate soil moisture for normal plant development. Indian Head in contrast to Melfort and Scott experienced moist but cool conditions after seeding with 8-10 days of cold wet weather with some snow. Moist conditions combined with below normal temperatures in June and warmer weather in July provided lush canopies similar to those experienced in 1999.

Table 1. Monthly precipitation and mean monthly temperatures at Scott, Melfort and Indian Head.

Month	Precipitation (mm)			Temperature (Celsius)		
	1999	2000	Long Term	1999	2000	Long Term
	Scott (long term:1950-1997)					
May	66	24	34	9.4	9.4	10.4
June	43	41	65	13.6	13.5	14.8
July	81	91	66	15.1	17.8	17.1
August	48	57	46	16.8	15.6	16.1
	Melfort (long term; 1950-1997)					
May	41	15	41	10.2	9.1	10.3
June	14	74	62	14	13	15.2
July	96	106	69	15.9	17.6	17.4
August	36	47	53	17	16.6	16.2
	Indian Head (long term: 1950-1997)					
May	67	68	50	10.4	10.1	10.8
June	116	105	74	14.5	13.1	15.9
July	84	46	62	16	18	18.5
August	88	63	53	16.6	16.4	17.5

At Scott suspected high levels of residual soil N were observed to run perpendicular across all 4 replicates of the main experiment resulting in high biomass and seed production. To ensure only treatment effects were contained in the data set, results from affected plots were deleted. At Melfort adjustments to the main experiment yield data were required to account for wind damage of the swath prior to threshing. Melfort plant densities in the main experiment were also reduced significantly as a result of an early season frost. To identify the impact of these site specific characteristics and to ensure the integrity of the statistical analyses no attempt was made to conduct a combined location analyses for main experiment results. The N rate studies at all locations avoided significant frost damage and problems associated with soil variability allowing data sets to be analysed across locations.

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EXPERIMENT 1 Cultivar x Seed Rate x Fertility Level x Fungicide

2.0 Cultivar Response

The hybrid cultivar (Invigor 2663) yielded more (8-16%) than Quantum at all locations in 2000 (Table 2). Although a different hybrid (Invigor 2273) was used in 1999, it yielded 5% more at one location but not the second location. Crop biomass production was higher for the hybrid at all locations similar to results from 1999. Plant densities were higher for Quantum at 2 locations in 2000, and similar at the third. At Melfort, frost in early May reduced plant densities to only 23 plants/m2 with the plant density of Quantum between 30% and 40% higher than Invigor 2663. Low plant densities at this location may have affected the relative performance of varieties. Protein yield was higher for the hybrid than for Quantum at all locations, but seed protein concentration for the hybrid was higher only at Melfort (26.0% vs 25.7%). Growth rate and period of anthesis were similar for both cultivars, although small and inconsistent differences were noted across locations, similar to observations made the previous year. Blackleg and sclerotinia were observed at very low levels, and cultivar differences were inconsistent.

Table 2. Grain yield, biomass and protein production, crop development and disease development with 2 canola cultivars across 3 locations in 2000.

	Scott		Melfort		Indian Head	
	Invigor 2663	Quantum	Invigor 2663	Quantum	Invigor 2663	Quantum
Grain yield (kg/ha)	1689 a	1460 b	2025 a	1872 b	2036 a	1788 b
Biomass yield (kg/ha)	5970 a	5468 b	7271 a	6473 b	9454 a	8487 b
Plant density (#/m^2)	66 b	75 a	19 b	27 a	110	
Protein yield (kg/ha)	404 a	348 b	526 a	480 b	489 a	429 b
Seeding to flowering (days)	54.7 a	52.2 b	62 b	63 a	61	
Seeding to maturity (days)	102		113.3 b	114.4 a	104	
Blackleg severity(0-5)	0.08		0.24 b	0.34 a	0.18 a	0.11 b
Blackleg incidence(%)	3.4		12.3		11.5 a	7.5 b
Sclerotinia (% yield loss)	0.5		5.1 a	3.1 b	0.9 a	0.3 b
Sclerotinia incidence (%)	1		26.2 a	16.6 b	3.4 a	1.2 b

Values at a location followed by different letters are different (P=0.05)

3.0 Response to Seed Rate

At Melfort where the low seeding rate produced a plant density of only 12 plants/m2 grain yield and protein yield were increased when seed rates of 5.8 kg/ha or greater were used. At other locations where plant densities were higher, seed rate did not affect grain or protein yield. Results from 1999 were similar in that increased seeding rates increased yield at one location but not the other. Low plant densities at Melfort were the result of frost shortly after emergence. Frost damage was noted at Scott however the extent of damage was lower. Biomass yield was unaffected by seed rate. Increased seeding rates also hastened onset of flowering and maturity at Melfort and maturity at Scott, similar to observations the previous year. Higher seeding rates had little or no impact on disease with only a slight

increase in sclerotinia infections observed at Melfort, similar to 1999.

Table 3. Grain yield, biomass and protein production, crop development and disease development with 3 seed rates across 3 locations in 2000.

location	Scott			Melfort			Indian Head		
seed rate	low	mid	high	low	mid	high	low	mid	high
Grain yield (kg/ha)		1575		1606 b	2123 a	2117 a		1912	
Biomass yield (kg/ha)		5719			6872			8971	
plant density (#/m^2)	46 c	61 b	105 a	12 c	24 b	34 a	69 c	111 b	149 a
Protein yield (kg/ha)		376		421 b	548 a	540 a		459	
seeding to flower (days)		53.3		63.7 a	62.6 b	61 c		61	
seeding to maturity (days)	102.5a	102b	101.5c	115.7a	113.6b	112.3c		104	
blackleg severity(0-5)		0.08			0.29			0.15	
blackleg incidence(%)		3.4			12.3			9.5	
sclerotinia (% yield loss)		0.5		3.3 b	4.6 a	4.4 ab		0.6	
sclerotinia incidence (%)		1		19.1 b	24.2 a	20.8 ab		2.3	

Values at a location followed by different letters are different (P=0.05)

4.0 Response to Fertility Level

Grain yield increased at all locations as fertility was increased (Table 4), similar to results from 1999. The relatively small yield increase at Scott, reflects the narrow range of N rates used at this location. Increased fertility also increased biomass production at 2 locations and protein yield at 1 location, again similar to 1999. Lower plant densities at Melfort likely contributed to a lower biomass response between low and high rates compared with Indian Head despite a larger increase in N at Melfort. Increased fertility had little or no impact on plant density and a small impact on plant development . Onset of flowering was delayed slightly at Melfort, and seed maturity by up to1.4 days at Scott and Melfort as fertility was increased. A similar increase in maturity was observed at Scott in 1999. Plant densities showed minor and inconsistent responses to fertility. Although higher fertility levels resulted in increased sclerotinia infections at Indian Head estimates of associated yield losses remained below 5%.

5.0 Response to Fungicides

Grain yield increases in response to fungicide treatment of 10% at Scott and 8% at Melfort occurred despite low levels of sclerotinia infection (P=0.10) (Table 5). At Melfort fungicides reduced protein content by 0.3%. Fungicides had little impact on maturity.

Table 4. Grain yield, biomass and protein production, crop development and disease development with 3 fertility levels across 3 locations in 2000.

location	Scott			Melfort			Indian Head		
fertility level	low	target	high	low	target	high	low	target	high
Grain yield (kg/ha)	1427 b	1632 ab	1666 a	1822 b	1964 a	2060 a	1412 c	1950 b	2074 a
Biomass yield (kg/ha)		5719		6326 b	6842 ab	7448 a	8274 b	8809 ab	9830 a
plant density (#/m^2)	64.9 b	71.2 ab	75.7 a	28.3 a	18.5 b	23.1 ab		109.8	
Protein yield (kg/ha)		376		462 b	509 a	538 a		459	
seeding to flower (days)		53.4		62.1b	62.5ab	62.8a		61	
seeding to maturity (days)	101.7 b	102.2 a	102.1 a	112.9 b	114.3 a	114.3 a		104	
blackleg severity(0-5)		0.08			0.29			0.15	
blackleg incidence(%)		3.4			12.3			9.5	
sclerotinia (% yield loss)		0.5			4.1		0.35 b	0.32 b	117 a
sclerotinia incidence (%)		1			21.4		1.2 b	2.0 ab	3.6 a

Values at a location followed by the same letter are not different (P=0.05)

Table 5. Influence of Ronilan fungicide on plant growth, biomass and grain yield, disease severity and incidence on the main experiment in 2000.

Fungicide	Scott		Melfort		Indian Head	
	Ronilan	No Ronilan	Ronilan	No Ronilan	Ronilan	No Ronilan
Biomass yield (kg/ha)	5719		6872		8971	
Grain yield (kg/ha)	1653 A	1497 B	2022 A	1875 B	1912	
Protein yield (kg/ha)	398 a	354 b	503		459	
blackleg severity(0-5)	0.08		0.29		0.15	
blackleg incidence(%)	3.8		12.3		9.5	
sclerotinia (% yield loss)	0.5		3.2 b	5.0 a	0.2 b	1.0 a
sclerotinia incidence (%)	1		18.5 b	24.3 a	1.0 b	3.6 a

Values at a location followed by different upper case (P=0.010) or lower case (P=0.05) letters are different.

6.0 Treatment Interactions

Seed Rate x Cultivar

At Indian Head Invigor 2663 plant densities increased by 105 plants /m2 compared to only 56 plants/m2 for Quantum when seed rates were increased from 2.7 kg/ha to 5.8 kg/ha. Larger seed size of Invigor and greater seedling vigour may have increased emergence and survival relative to Quantum.

Seed Rate x Fertility Level

A seed rate* fertility level interaction for grain yield was observed at Melfort in spite of the fact that plant densities ranged from only 12 to 32 plants/m2 (Table 6). A similar interaction was observed at Indian head in 1999 suggesting that a yield response to increased nitrogen may be enhanced by increasing seeding rates and plant populations. Plant densities at Indian Head in 1999 ranged from a low

of 42 plants/m2 to a high of 78 plants/m2. The inconsistent response across location years suggests this yield response may occur only within a finite range of plant densities that is unique for different soil and environmental conditions. Although infection levels were low a seed rate* fertility level interaction for sclerotinia infection at Melfort indicated canola was more vulnerable to sclerotinia at the mid seed rate when low levels of fertility were present but not at the high seed rate. This interaction and inconsistency was also observed at Melfort in 1999.

Table 6. Seed rate x nitrogen interactions for grain yield (kg/ha) on the main experiment at Melfort in 2000.

		N level		
		Low	Target	High
Seed Rate	Low	1511 e	1722 de	1585 e
	Middle	2110 ab	2002 bc	2257 a
	High	1845 cd	2167 ab	2340 a

Interactions followed by the same letter are not different (P=0.05).

Fertility Level x Cultivar
For the range of fertility levels investigated, the response of both cultivars to increased levels of fertility was the same, as in 1999.

Nitrogen* Fungicide
Although nitrogen level*fungicide interactions were observed for blackleg at Scott and sclerotinia at Indian Head, differences were small and infection levels too low to significantly impact crop growth or yield.

Fungicide x Cultivar
At Melfort Ronilan resulted in a greater biomass response when applied to Invigor 2663 (1386 kg/ha) than Quantum (197 kg/ha) which translated into significantly higher yields for treated Invigor than untreated Quantum (2097 kg/ha vs 1796 kg/ha). This yield difference could be linked to reductions in sclerotinia infection.

EXPERIMENT 2 Cultivar Responses to N Rates

7.0 Crop Response
As fertilizer N increased, the onset of flowering was increasingly delayed, duration of flowering was increased, and days to maturity was increased at Scott and Melfort. Averaged across locations at the 150 kg/ha N rate the start of flowering was delayed by approximately 1.6 days and the flowering period increased by an average of 1.5 days (Table 7). Seed maturity at Scott was delayed by an average of 6.7 days and at Melfort by 5.5 days. Both biomass and grain production increased with increasing levels of N in a similar fashion across locations. For the soil and climatic conditions under which the N rate trials were conducted applying 150 kg/ha of N resulted in an average biomass increase of 2601 kg/ha and 1115 kg/ha more canola.

Invigor tended to produced more biomass then Quantum for a given level of N and produced larger biomass increases with higher levels of N suggesting more efficient use of nutrient and water resources

(Table 8 and figure 1). The same trend was observed for grain production with Invigor yield at Indian Head increasing to 1623 kg/ha with an additional 150 kg/ha of N compared to 868 kg/ha for Quantum and at Scott by 1244 kg/ha compared to 953 kg/ha for Quantum. At Scott where residual levels of soil N to 60 cm were 77 kg/ha there was a tendency for Quantum grain yields to level off at approximately 120 kg/ha of applied N compared to 130 kg/ha for Invigor. At Indian Head where residuals levels of N were much lower (17 kg/ha) a linear increase in grain yield with increased N was observed for both cultivars. Invigor yields at both locations however tended to increase at a faster rate then Quantum. In contrast both cultivars at Melfort produced 851 kg/ha more canola with an additional 150 kg/ha of N.

This data is inadequate to draw any conclusions about whether N requirements are higher for hybrids. However, both cultivars responded to N rates much higher than soil tests would suggest. Numerous N rate experiments have shown highly variable yield responses between years and locations. Fertilizer N recommendations reflect 'normal' or 'average' conditions. Additional data needs to be collected to determine whether the current results are beyond what could be considered 'normal'. If they are, renewed extensive evaluation of fertilizer N requirements for canola would be warranted.

Table 7. Growth response to applied N on the N Rate study in 2000.

Applied N	seeding to flower (days)	flower (days)	seeding to maturity (days)		
			Scott	Melfort	Indian Head
0	56.2 d	21.7 b	97.6 d	107.5 d	104
30	56.7 cd	22.3 b	101.3 c	107.5 d	104
60	57.0 bc	23.5 a	101.3 c	108.3 d	104
90	57.2 abc	23.3 a	10.6 bc	109.6 c	104
120	57.3 ab	23.6 a	103.8 ab	111.0 b	104
150	57.8 a	23.3 a	104.3 a	113.0 a	104

values within columns followed by the same letter are not different (P=0.05)

Table 8. N x cultivar interaction for canola yield (kg/ha) on the N rate study in 2000.

Applied N	Scott		Melfort		Indian Head	
(kg/ha)	Invigor 2663	Quantum	Invigor 2663	Quantum	Invigor 2663	Quantum
0	1350 f	1311 f	2263 cd	2120 d	1053 f	1079 ef
30	2285 cd	1943 e	2530 c	2471 cd	1198 ef	1068 f
60	2162 d	1928 e	3093 a	2461 cd	1388 def	1545 cde
90	2371 bc	2211 cd	3068 a	2623 bc	2414 ab	1718 cd
120	2492 ab	2274 cd	2967 ab	2905 ab	2011 bc	1960 bc
150	2594 a	2264 cd	2981 ab	3105 a	2676 a	1947 bc

N level x cultivar interactions followed by the same letter are not different (P=0.05)

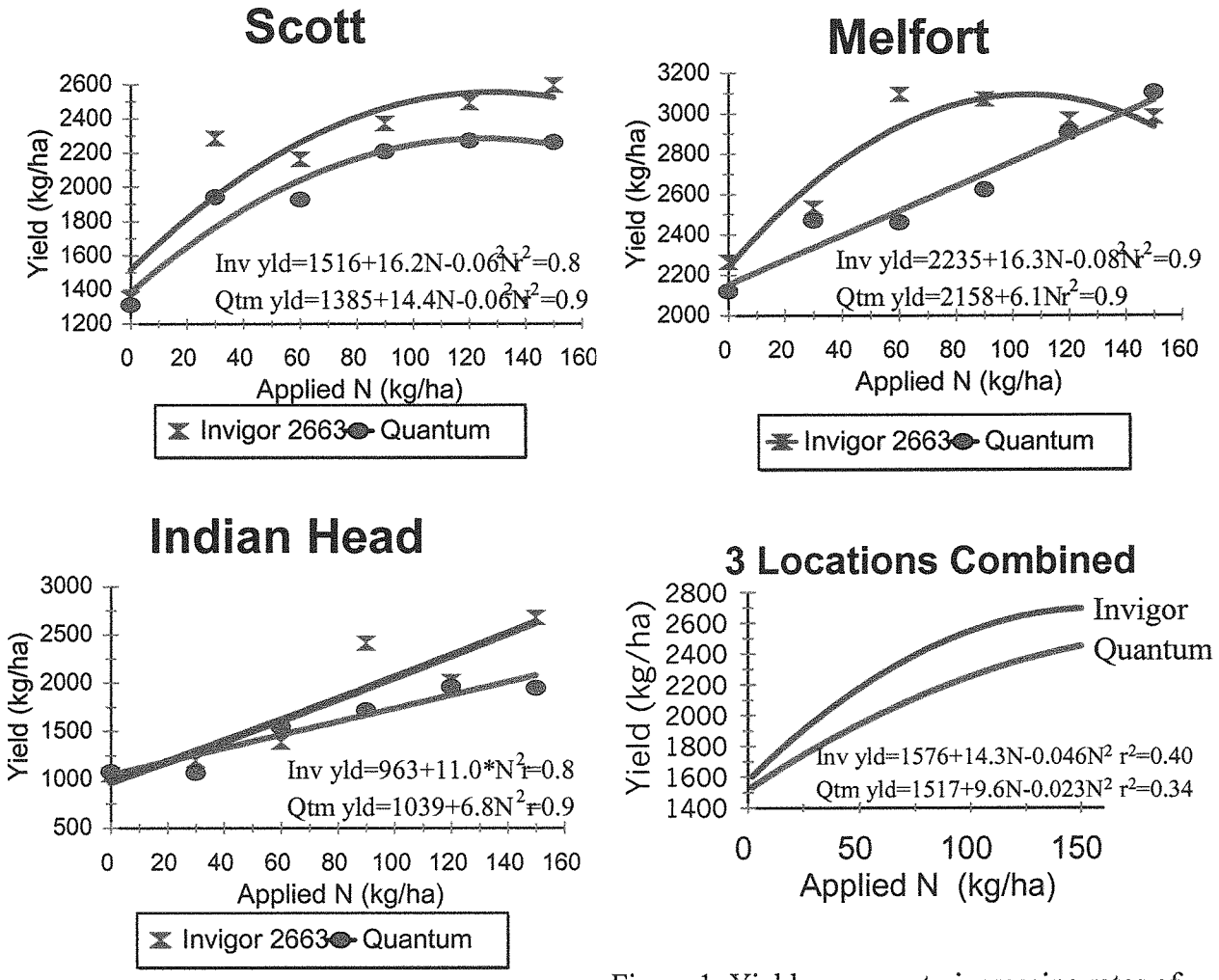

Figure 1. Yield response to increasing rates of applied N at Scott, Melfort, and Indian Head and when averaged across locations in 2000.

8.0 Economics / Marginal Returns

**** Economic results are preliminary and are based on data from 1 relatively favourable year for canola production. At this point, they may only reflect how N should have been managed in these 3 areas during 2000. Use of the data to predict expected responses in future should be viewed with caution.***

The preliminary economic analysis of the N response data was performed using 2 canola prices of $353/t ($8/bu) and $220/t ($5/bu)and 2 fertilizer N costs ($0.50 and $0.75 per kg of N). Also considered was the cost of seed which differed between the 2 cultivars. Invigor 2663 was more costly ($9.37/kg) than Quantum ($4.38/kg) and required more seed (11 vs 9 kg/ha) due to larger seed size. Other costs did not differ between cultivars or N rates.

The 2 factors that had the greatest impact on marginal returns were N rate and canola price (Figure 2). With the high price for canola, marginal returns increased dramatically with increased N, even at rates exceeding 100 kg/ha. With canola priced lower, returns from fertilizer N did not increase as

dramatically, but still showed substantial increases, and the optimum N rate was slightly lower than at the high canola price.

At low N rates, marginal returns from Invigor 2663 were less than for Quantum, but as N rates increased, marginal returns for Invigor 2663 were generally higher, but only at the high canola price. With the low canola price, marginal returns from Invigor 2663 were equal to Quantum at high N rates only.

Increasing the cost of N reduced marginal returns overall, but had minimal impact on responses due to canola price, N rate or cultivar.

Soil tests suggested that N rates between 35 and 85 kg/ha were required depending on location. These rates were much below the rates where marginal returns were near optimum with all canola or N prices or cultivars used at these locations in 2000.

Based on these results near optimum marginal returns occurred when N rates exceeded 100kg/ha. This applied to Invigor 2663 when canola was priced high and either cultivar when canola was priced low, for both N cost scenarios.

Similar economic analyses are planned for Experiment 1 for the upcoming year.

We hereby request funding for 2001-2002 to conduct research in the third year of this 3 year project.

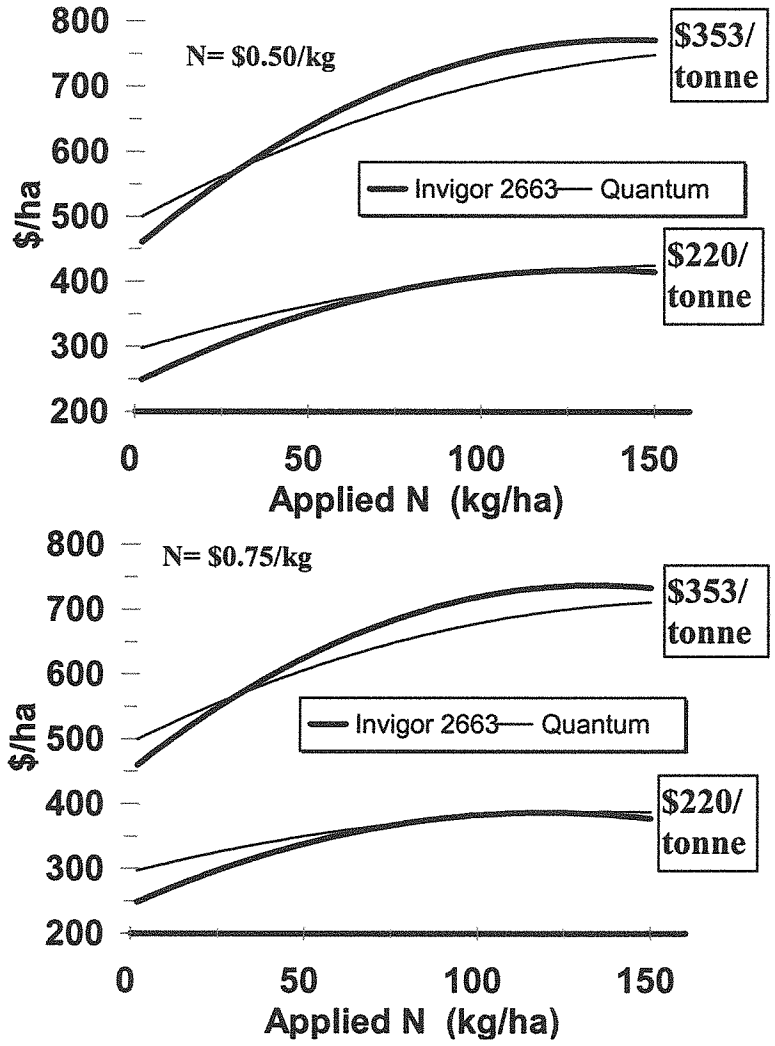

Figure 2. Marginal return of Invigor 2663 (seeded at 11kg/ha for $9.37/kg) versus Quantum (seeded at 9 kg/ha for $4.38/kg) for increasing amounts of applied N at $0.50/kg and $0.75/kg using N Rate study yields averaged across locations.