PROJECT # CARP 9602
MANAGEMENT OF FALL AND EARLY SPRING SEEDED HERBICIDE TOLERANT CANOLA

THREE YEAR SUMMARY OF RESULTS (1996-98)

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Executive Summary

The potential of fall seeded canola was shown in studies conducted at the University of Saskatchewan in the 1970's. However, winter annual weeds and the risk of fall germination were a problem. The introduction of canola cultivars that are resistant to broad-spectrum herbicides meant that winter annual weeds could be controlled. Therefore, the Scott Research Farm began to reevaluate fall seeding in 1993. The risk of fall germination is still a concern and efforts are underway to attempt to address this issue.

Herbicide tolerant canola provides alternative herbicide options to the application of soil-incorporated herbicides, a practice that may delay spring seeding. In the past, some growers have employed cultural weed control methods in canola by delaying their spring seeding. Thus, herbicide tolerant canolas may provide growers with an opportunity to seed at earlier than traditional seed dates.

Numerous studies evaluating the effect of fall and early spring seeding of herbicide tolerant canola were conducted at Scott from 1996-98. Fall seeded canola yielded 95% and 153% of early spring and mid-May seeded canola, respectively (Table 1). This was calculated by averaging the yields of best agronomic treatment from each of the seed date experiments covered in this report. Included in that calculation are three studies in which establishment of fall seeded canola was poor due to soil crusting or wind damage on fallow. Fall and early spring seeded yields were similar in experiments where there were not establishment problems.

Fall and early spring seeding results in early maturity, high seed oil concentration, and large seed size. Early maturity avoids late season environmental stress as well as late season insect attack. It also reduces the risk of fall frost damage to immature seed.

Table 1: Yield of Canola Seeded at Three Seed Dates, Scott 1996-1998.

	All Experiments*		Good Establishment**	
Seed Date	Mean Yield (kg/ha)	Yield Expressed as a % of mid-May	Mean Yield (kg/ha)	Yield Expressed as a % of mid-May
Late Fall	1352	153	1442	173
Early Spring	1426	161	1393	167
mid-May	882	100	833	100

*mean of 13 experiments from 1996-98– includes 3 experiments in which fall seeded canola established poorly on tilled fallow.
** mean of 10 experiments from 1996-98.

Spring frost was not a problem in this study. Fall and early spring seeded canola, if acclimated to cool air temperatures, survived spring frosts as low as -8° C.

Climate Data

Growing season precipitation at Scott was 26% above the long term normal in 1996 but well below normal in 1997 and 1998 (Table 2). Mean monthly air temperatures in 1996 were near normal (Table 3). Late seeded stubble crops were adversely affected by lack of rainfall after the first week of August. There was only 3.1 mm of rain from August 1 to August 31 in 1996.

Precipitation in 1997 was below normal in both July and August. June air temperatures were 2 ° C above normal, which had a negative impact on the yield of crops flowering in this time period, particularly on stubble. The combination of above normal July air temperatures and below normal July precipitation resulted in very poor stubble crop yields.

Growing season precipitation in 1998 was about 48% of the long term normal. May was the third driest on record at Scott. However, in spite of the low precipitation, fall and early spring canola yields were excellent. June air temperatures were near normal and precipitation was received during the critical flowering period. Heat and drought in July dramatically reduced the yield of late seeded crops.

Table 2: Growing season precipitation (mm) at Scott 1996-98.

Month	Long-Term Normal (mm)	1996 (mm)	1997 (mm)	1998 (mm)
April	23.0	18.6	15.0	12.1
May	36.0	43.9	27.0	5.4
June	60.0	63.8	68.0	63.5
July	59.0	116.4	26.0	11.2
August	45.0	39.3	29.0	14.0
Total	223.0	282.0	165.0	106.2

Table 3: Mean monthly air temperatures (° C) at Scott 1996-98.

Month	Long-Term Normal (° C)	1996 (° C)	1997 (° C)	1998 (° C)
April	3.0	5.0	2.0	7.0
May	10.2	11.0	9.7	12.9
June	14.5	15.0	16.7	14.3
July	16.8	17.0	17.8	18.3
August	15.8	15.0	15.8	19.2

Experiment FS-1: Effect of Seed Date, Seed Rate, and Fertilizer Placement on Quest Canola Seeded on Fallow and Stubble

1.0 Objective

To determine the effect of seed rate and fertilizer placement on the emergence, development, yield, and quality of Quest canola seeded in late fall, early spring, and mid-May.

2.0 Methods

The experimental design was a split-split plot. Seed date was the main treatment (Table 4). Seed rate was the sub-treatment and fertilizer placement the sub-sub treatment. Plot size was 2 X 8 meters. Experiments were seeded on both fallow and wheat stubble. Plots were seeded with a Versatile 2000 hoe-drill. The canola cultivars were Roundup Ready RT-73 in 1996 and Quest in 1997-98.

Table 4: Seeding Dates for Experiment FS-1

Seed Date Treatment*	1996	1997	1998
Late October	Oct. 31, 1995	Oct. 28, 1996	Oct. 30 , 1997
Early Spring	May 2, 1996	April 25, 1997	April 16, 1998
Mid-May	May 23, 1996	May 15, 1997	May 19, 1998

* late October (seed as close to freeze-up as possible);
early spring (seed as soon as land was passable with seeding equipment);
mid-May (traditional seed date).

There were two seed rate treatments: 6.7 kg/ha and 13.5 kg/ha. The fertilizer treatments were 0 kg N/ha, 52 kg N/ha seed placed at time of seeding, 52 kg N/ha mid-row band at time of seeding and 52 kg N/ha surface broadcast in the early spring. The rates for the fertilizer treatments in the 1996 experiment were low and were increased in 1997. Therefore, fertilizer effects will only be reported for 1997 and 1998. Broadcast fertilizer treatments were applied on April 25 and April 9 in 1997 and 1998, respectively. All seed was treated with a fungicide/insecticide seed treatment.

Weed control was achieved by applying 450 g ai/ha of glyphosate at the 2 to 3 leaf stage of canola. There was no pre-seeding weed control for the late October and early spring seed dates. The mid-May seeded plots received a pre-seed treatment of glyphosate at 450 g ai/ha approximately 1 week prior to seeding.

Data collected included emergence dates, plant establishment (#/m^2), flowering dates, crop height, swath date, crop yield, seed weight (thousand kernel weight), seed protein, and seed oil content.

3.0 Fallow Results

3.1 Effect of Seed Date on Time of Emergence, Flowering, Swathing and Combining of Canola seeded on Fallow

Emergence dates were recorded when rows could be visually distinguished. Emergence of late fall seeded canola occurred in April in all three years. Early spring emergence ranged from 8 to 16 days after seeding (Table 5). The emergence of mid-May seeded canola ranged from 6 to 13 days after seeding. Flowering dates for fall seeded canola were advanced by up to 16 and 36 days relative to the April and mid-May seed dates, respectively. Swath dates for the fall-seeded canola were up to 8 and 21 days earlier then the April and mid-May seed dates, respectively. The combine dates for fall-seeded canola were up to 5 and 18 days earlier than early spring and mid-May seed dates, respectively.

Table 5: Effect of Seed Date on Time of Canola Emergence, Days to 50% Flower, Swath Date and Combining Date when seeded on Fallow, Scott Research Farm 1996-1998.

Year	Seed Date	Emergence Date	Date at 50% Flower	Swath Date	Combining Date
1996	Fall	April 29	June 14	Aug. 1	Aug. 13
	Early Spring	May 10	June 27	Aug. 9	Aug. 16
	mid-May	May 29	July 9	Aug. 12	Aug. 27
1997	Fall	April 29	June 10	July 28	Aug. 8
	Early Spring	May 8	June 19	Aug. 5	Aug. 13
	mid-May	May 28	July 2	Aug. 11	Aug. 20
1998	Fall	April 21	June 1	July 24	Aug. 7
	Early Spring	April 30	June 17	July 27	Aug. 14
	mid-May	May 26	July 6	Aug 14	Aug. 25

3.2 Effect of Seed Date on Plant Emergence, Crop Height, and Crop Yield of Canola Seeded on Tilled Fallow

Emergence of fall-seeded canola on tilled fallow was poor in both 1996 and 1997 (Table 6). Spring soil crusting was the major problem in 1996. The fallow emergence was very spotty and plant emergence counts in 1996 do not accurately reflect the uneven emergence. In 1997, wind erosion in the early spring caused severe sand blasting of the emerged seedlings.

Fall and early spring seeded crops were shorter than the mid-May seeded crops. In 1998, fall and early spring seeded crops did not lodge, while there was considerable lodging in the mid-May seeded crop.

Table 6: Effect of Seed Date on Plant Emergence, Crop Height, and Crop Yield of Canola on Tilled Fallow, Scott Research Farm 1996-1998.

Year	Seed Date	Plant Emergence (#/m^2)	Crop Height (cm)	Crop Yield (kg/ha)
1996	Fall	30	74	670**
	Early Spring	212	71	1520
	mid-May	127	81	670
	LSD (P=0.05)	20	6	140
1997	Fall	50	79	1226**
	Early Spring	173	87	1461
	mid-May	160	93	1001
	LSD (P=0.05)	21	6	138
1998	Fall	143	74	2484
	Early Spring	132	95	2103
	mid-May	146	121	828
	LSD (P=0.05)	NS	5	44

** Emergence problems due to surface crusting in 1996 and sand blasting in 1997.

Poor plant establishment on fallow in 1996 resulted in lower fall-seeded yields relative to the early spring seeded crop although they were equal to or better than the mid-May seeded crop. In 1997, low plant numbers and above normal air temperatures the first two weeks of June may account for the fall-seeded canola being lower yielding than the early spring seeded canola. Highest yields in 1998 were obtained with the fall-seeded canola although excellent yields were also obtained with the April seed date. Terminal drought and heat stress resulted in lowest yields for the mid-May seed date throughout the 3 years of the study. Overall, the most consistent yields on fallow were obtained with the early spring seed date.

3.3 Effect of Seed Date on Seed Characteristics (Thousand Kernel Weight, Protein and Oil Concentration) of Canola Seeded on Fallow, Scott Research Farm 1996-1998.

Highest seed weights were attained from fall and early spring seeding in 2 of the 3 years (Table 7). Mid-May seeded canola generally had the highest protein content and lowest oil content.

Table 7: Effect of Seed Date on Thousand Kernel Weight (TKW), Protein and Oil Concentration of Canola Seeded on Fallow, Scott Research Farm 1996-98

Year	Treatment	TKW (grams)	Protein Concentration (%)	Oil Concentration (%)
1996	Fall	3.34	27.4	42.2
	Early Spring	3.71	24.6	46.4
	Mid-May	2.49	27.6	40.9
	LSD (P=0.05)	0.11	0.4	2.6
1997	Fall	2.54	24.5	43.3
	Early Spring	2.69	25.9	42.7
	Mid-May	2.67	26.4	41.9
	LSD (P=0.05)	0.06	0.5	0.6
1998	Fall	3.95	25.0	44.7
	Early Spring	2.98	25.2	43.6
	Mid-May	2.13	28.6	37.9
	LSD (P=0.05)	0.14	0.5	1.1

3.4 Seed Rate Effect

Table 8 is a statistical summary of the effect of seed rate on plant establishment and crop yield over the three years. Actual data is not presented. Doubling the seed rate resulted in significantly higher plant establishments in each year. However, there was no effect on crop yield. There was no seed date by seed rate interaction for plant establishment or crop yield in any of the years. Therefore, response to seed rate was consistent over the three seed dates. Canola has a tremendous ability to compensate for low plant densities, thus it is unlikely that an increased seed rate is required for fall seeding. The high seed rate in 1996 did not compensate for poor stand establishment on the surface crusted fallow.

Table 8 : Effect of Increasing Seed Rate from 6.7 kg/ha to 13.5 kg/ha on plant emergence and crop yield of canola seeded on 3 seed dates – statistical summary. P-values less than 0.05 are a significant treatment effect.

P-value	1996		1997		1998	
	Plants/m2	Crop Yield	Plants/m2	Crop Yield	Plants/m2	Crop Yield
SEED RATE EFFECT	0.00	0.41	0.00	0.10	0.00	0.06
SEED DATE X SEED RATE INTERACTION	0.13	0.32	0.43	0.14	0.42	0.25

3.5 Fertilizer Placement Effect

Nitrogen fertilizer application produced minimal responses on fallow, therefore discussion will be limited to a few points. Seed date and fertilizer interactions on stubble are discussed in detail later in the report.

Seed placed nitrogen fertilizer caused a 30 to 50% reduction in plant stand in 1997 and 1998, respectively (data not shown). Nitrogen fertilizer application had no effect on crop yield on fallow in 1997 and a slight increase in yield in 1998 (145 kg/ha). There was no seed date X fertilizer placement interactions for yield in 1997 and 1998.

Nitrogen application caused slight increases in seed protein (0.5 to 1.0%) and similar decreases in seed oil concentration

4.0 Stubble Results

4.1 Effect of Seed Date on Time of Emergence, Flowering, Swathing and Combining of Canola seeded on Stubble

The effect of seed date on crop development is similar to the results obtained on fallow (Table 9).

Table 9: Effect of Seed Date on Time of Canola Emergence, Days to 50% Flower, Swath Date and Combining Date on Stubble, Scott Research Farm 1996-1998.

Year	Seed Date	Emergence Date	Date at 50% Flower	Swath Date	Combining Date
1996	Fall	April 29	June 14	Aug. 1	Aug. 13
	Early Spring	May 10	June 27	Aug. 9	Aug. 16
	mid-May	May 29	July 9	Aug. 19	Aug. 27
1997	Fall	April 29	June 10	July 21	July 28
	Early Spring	May 8	June 18	July 25	Aug. 6
	mid-May	May 28	July 2	Aug. 11	Aug. 20
1998	Fall	April 21	June 4	July 24	Aug. 7
	Early Spring	April 30	June 17	July 27	Aug. 10
	mid-May	May 26	July 6	Aug 10	Aug. 19

4.2 Effect of Seed Date on Plant Emergence, Crop Height, and Crop Yield of Canola Seeded on Stubble

Plant emergence on stubble was consistently good over the three seed dates (Table 10). There was no problem with surface crusting or sandblasting of fall seeded canola.

Seed date effect on crop height was similar to the fallow studies. Fall and early spring seeded canola was shorter than mid-May seeded canola.

Stubble yields of fall and early spring seeded canola were higher than mid-May seeded canola throughout the three years of the study. Early spring seeded canola had the highest yield in 1996 while fall seeded canola yielded the highest in 1997. There was no significant yield difference between fall and early spring seeded canola on stubble in 1998.

Table 10: Effect of Seed Date on Plant Emergence, Crop Height, and Crop Yield of Canola Seeded on Stubble, Scott Research Farm 1996-1998.

Year	Seed Date	Plant Emergence (#/m^2)	Crop Height (cm)	Crop Yield (kg/ha)
1996	Fall	104	70	1340
	Early Spring	170	68	1580
	mid-May	107	83	910
	LSD (P=0.05)	35	3	110
1997	Fall	138	57	721
	Early Spring	120	72	487
	mid-May	181	71	398
	LSD (P=0.05)	29	4	123
1998	Fall	148	64	1457
	Early Spring	100	85	1553
	mid-May	109	117	789
	LSD (P=0.05)	37	7	218

4.3 Effect of Seed Date on Seed Characteristics (Thousand Kernel Weight, Protein and Oil Concentration) of Canola Seeded on Stubble, Scott Research Farm 1996-1998.

In 1996 and 1998, fall and early spring seeded canola produced the largest seed (Table 11). The mid-May seeded canola produced the largest seed in 1997. Fall seeded canola had nearly double the thousand-kernel weight of mid-May seeded canola in 1998.

Seed date had no significant impact on oil concentration in 1996. In 1997, fall and mid-May seeded canola had slightly higher oil percentages than the early seed date. In 1998, the fall and early spring seeded canola had about 6% higher oil content than the mid-May seed date. In most cases, seed protein dropped as oil percentage increased.

Table 11: Effect of Seed Date on Thousand Kernel Weight (TKW), Protein and Oil Concentration of Canola Seeded on Stubble, Scott Research Farm 1996-98.

Year	Treatment	TKW (grams)	Protein Concentration (%)	Oil Concentration (%)
1996	Fall	4.08	19.0	44.3
	Early Spring	4.31	18.9	45.3
	Mid-May	3.22	19.4	43.2
	LSD (P=0.05)	0.35	NS	NS
1997	Fall	2.44	26.2	41.8
	Early Spring	2.14	27.1	40.1
	Mid-May	2.73	26.3	42.0
	LSD (P=0.05)	0.06	0.7	1.6
1998	Fall	4.13	25.2	46.1
	Early Spring	3.08	22.4	45.7
	Mid-May	2.16	27.9	39.9
	LSD (P=0.05)	0.23	1.8	1.5

4.4 Seed Rate Effect

Seed rate effects on stubble were similar to those on fallow. Increasing the seed rate from 6.7 to 13.5 kg/ha increased plant establishment but had no impact on final crop yield. There was no seed rate by seed date interaction for crop yield in any of the years. This would suggest that a 6.7 kg/ha seed rate is an adequate seed rate for fall or spring seeding on stubble.

4.5 Fertilizer Placement Effect

a) Effect Of Fertilizer Placement On Crop Establishment

Seed placed fertilizer reduced the plant stands by 24 and 73% in 1997 and 1998, respectively (Table 12). Mid-row band and spring broadcast fertilizer had no effect on plant establishment in 1997. Spring broadcast fertilizer had no effect on plant establishment in 1997 but mid-row banded fertilizer reduced plant stand slightly in 1998.

Table 12: Effect of fertilizer placement on plant establishment – average of 3 seed dates (late fall, early spring, mid-May) seeded on stubble, Scott, 1997-98.

Fertilizer Placement	Plants/m2 – 1997	Plants/m2 – 1998
0 kg/ha N.	159	143
52 kg/ha seed-placed	128	82
52 kg/ha mid-row band	150	106
52 kg/ha broadcast	147	145
LSD (P=0.05)	19	18

Seed date and fertilizer placement interactions for crop establishment is illustrated in Figure 1. There was an interaction between seed date and fertilizer placement (P=0.10) in 1997. Seed placed fertilizer reduced plant emergence in both fall seeded and early spring canola but did not reduce plant establishment in mid-May seeded canola. This may be due to good seedbed moisture conditions at the time of the mid-May seeding. The good mid-May seedbed conditions are reflected in high plant establishment numbers for that seed date (Table 10). There was no seed date X fertilizer placement interaction for plant establishment in 1998.

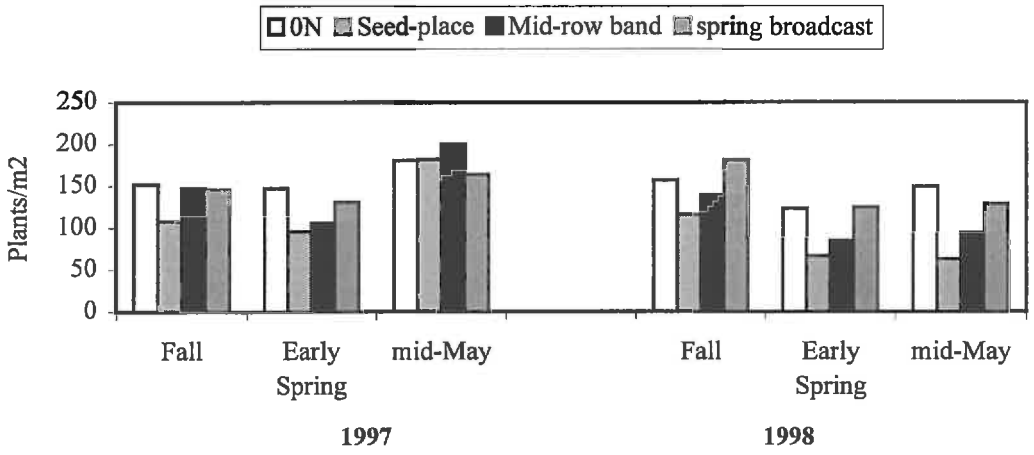

Figure 1: Effect of Nitrogen fertilizer placement on canola establishment (plants/m2) seeded in late fall, early spring, and mid-May, Scott 1997-98.

b) Effect Of Fertilzer Placement On Crop Yield

There was a significant increase in canola yield due to nitrogen fertilizer application to fall and early spring seeding in both 1997 and 1998 (Figure 2). There was a response to nitrogen application for fall seeded canola in both years, however fertilizer placement had no effect. Early spring seeded canola showed a small N response to spring broadcasting in 1997 and all placements produced a yield response in 1998. The mid-May seed date did not produce a yield response to fertilizer application in both years. The terminal drought and late season heat stress were the growth limiting factors for the mid-May seed dates, therefore there was no response to nitrogen. Fall and early spring seeding may increase the probability of getting an economic benefit from fertilizer input application.

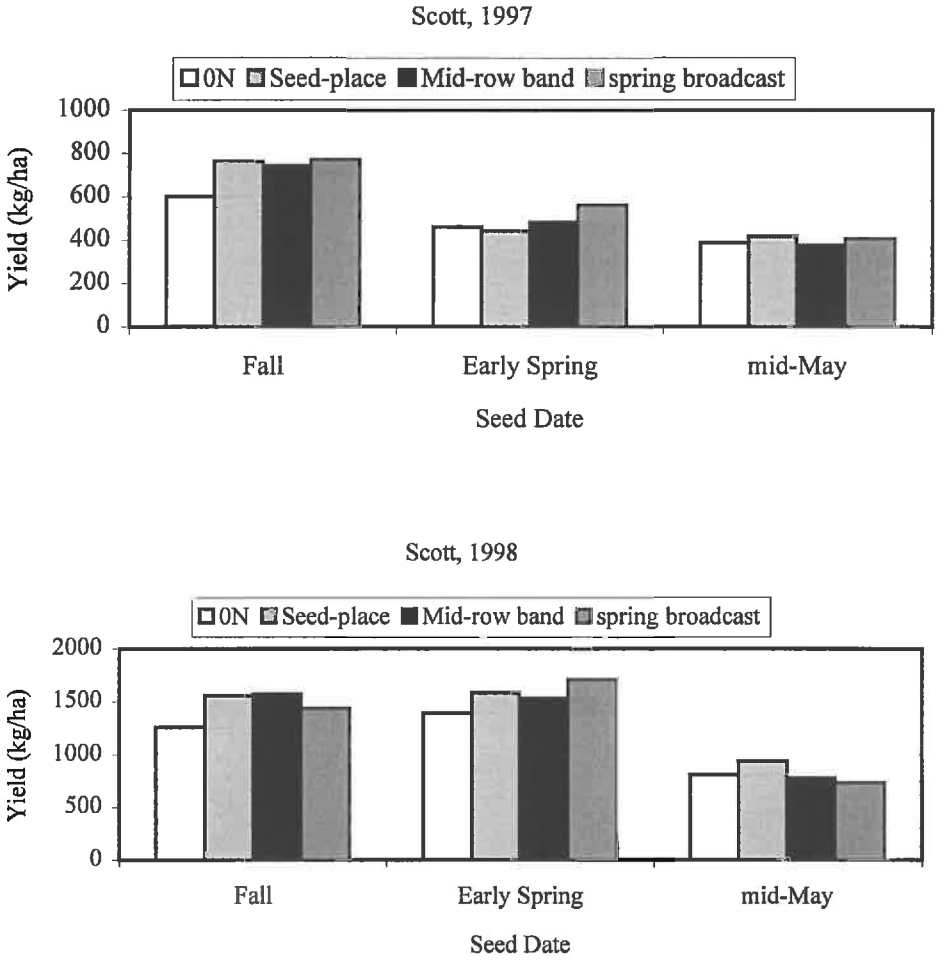

Figure 2: Effect of Fertilizer Application (52 kg N/ha) and Fertilizer Placement on Yield of Canola Seeded on Wheat Stubble at 3 Seed Dates (Scott, 1997, 1998)

c) Effect of N Fertilizer Application on Seed Protein and Oil Concentration

Nitrogen fertilizer application increased seed protein from 1 to 2% over the two years of the study (Table 13). Nitrogen fertilizer application reduced oil content by about 4% and 2% in 1997 and 1998, respectively.

Table 13: Effect of N Fertilizer Application on Seed Protein and Oil Concentration (Mean of Three Seed Dates) Scott 1997-98.

Fertilizer Placement	1997		1998	
	Protein (%)	Oil (%)	Protein (%)	Oil (%)
0 kg/ha Nitrogen	24.8	44.3	24.7	45.8
52 kg/ha N seed-placed	26.9	40.9	25.6	43.0
52 kg/ha N mid-row band	27.1	40.4	25.4	43.3
52 kg/ha N spring broadcast	27.3	39.7	24.9	43.3
LSD (P=0.05)	0.5	0.7	0.6	0.6

4.6 Conclusions

Fall and early spring seeded canola produced higher yields, larger seed and higher seed oil concentrations than did canola seeded at the traditional time in mid-May. Advancement in days to flowering allowed the fall and early seeded canola to flower and set seed at low air temperatures. Early maturity allowed the canola crop to avoid late season terminal drought and heat stress. Avoidance of late summer stress allowed the crop to respond more consistently to the addition of fertilizer inputs.

Fall seeded canola that was seeded on tilled fallow had establishment problems in 2 of the 3 years. Establishment risk can be reduced by seeding into standing stubble, or on fields that have adequate trash cover to deter soil crusting and wind erosion.

Producers who are fall seeding canola should seed at the same rates as they do in the spring.

5.0 Effect of Seed Depth and Seed Treatment on Fall Dormant Seeded Canola

5.1 Objectives:

To determine the effects of seed depth and seed treatment on the emergence and yield of spring canola seeded in late October.

5.2 Methods

Experiments were conducted on both fallow and wheat stubble in 1997 and 1998. In 1997 experimental design was a randomized complete block. Seed depth treatments were: broadcast, optimum (1/2"-1") and deep (2"). Roundup Ready Quest canola was seeded on Oct. 28, 1996. The seed was treated with Vitavax RS.

In 1998, experimental design was a split-plot. Seed depth was the main plot and fungicide seed treatment was the sub-plot. Seed depth treatments were the same as 1997. Fungicide seed treatments were: bare canola seed (*cv.* Quest) and Vitavax RS seed treatment. In 1998, the broadcast seeded plots received a tine harrowing shortly after seeding. Seed date was Oct. 30, 1997.

Canola was seeded with a hoe-drill. In 1997, 45 kg/ha of 11-51-0 fertilizer was seed-placed at time of seeding on both stubble and fallow. In 1998, a blend of-9-17-15-8 was seed-placed at a rate of 85 kg/ha on both stubble and fallow. Nitrogen requirements on stubble were met by broadcasting 170 kg/ha of 46-0-0 in April. Glyphosate was applied post-emergent at 450 g ai/ha for weed control.

Data collection included emergence dates, plant establishment (#/m^2), flowering dates, maturity dates, and crop yield.

5.3 Results

Emergence dates for treatments were not recorded in 1997. The fallow study in 1997 was severely damaged by wind erosion, therefore data is not reported.

In 1998, broadcast seeding delayed emergence by 4 to 5 days relative to the optimum seed depth (Table 14). Deep seeding delayed emergence of fall seeded canola by 2 to 3 days in 1998. Delays in emergence were reflected in delays in time to 50% flowering and maturity. Broadcast and deep seeding generally resulted in lower plant populations and reduced yields (Figure 7).

Table 14: Effect of Seed Depth on Emergence Date, Date at 50% Flower, and Maturity Date on Canola seeded in late October on Fallow and Stubble, Scott 1997-98.

	Seed Depth	Emergence Date	Date at 50% Flower	Maturity Date
Stubble 1997	Broadcast	N/R*	June 18	July 29
	Optimum	N/R	June 12	July 23
	Deep	N/R	June 12	July 23
Fallow 1998	Broadcast	Apr. 30	June 8	Aug. 4
	Optimum	Apr. 26	June 4	July 31
	Deep	Apr. 30	June 6	Aug. 2
Stubble 1998	Broadcast	Apr. 28	June 6	July 24
	Optimum	Apr. 23	June 3	July 22
	Deep	Apr. 28	June 6	July 24

** Not recorded

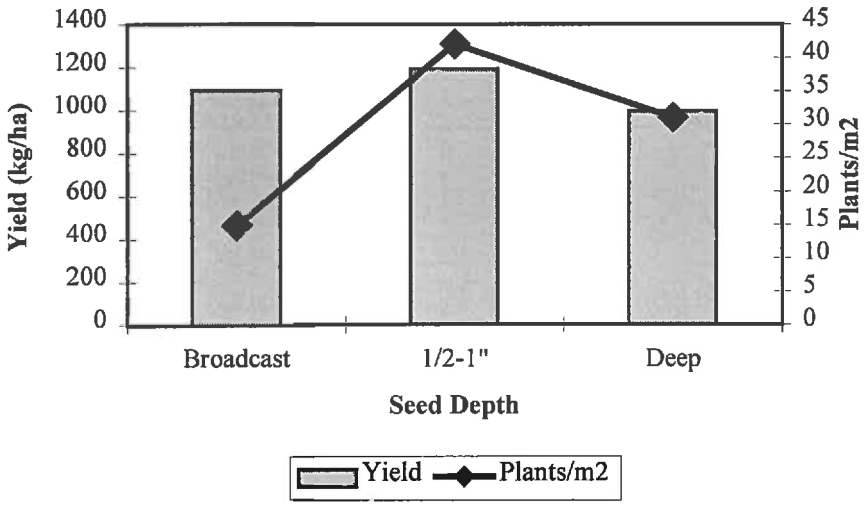

Figure 7: Effect of Seed Depth on Canola Establishment (plants/m2) and Yield (kg/ha) – Average of 3 experiments, Scott 1997-98.

a) Effect of Fungicide Seed Treatment on Establishment and Yield of Fall Seeded Canola

Vitavax RS seed treatment improved both plant establishment and/or crop yield of fall seeded canola in four out of five studies conducted at Scott in 1997-98 (Table 15).

Table 15: Effect of Fungicide Seed Treatment on Establishment (plants/m^2) and Yield (kg/ha) of Fall Seeded Canola, Scott 1998

	Plants/m^2	Crop Yield (kg/ha)
Bare Seed	8	1463
Vitavax RS	25	1753
LSD (P=0.05)	9	216

5.5 Additional seed depth studies on fall seeded canola – 1997

Two experiments conducted in 1997 demonstrated the effect of seed depths on fall seeded canola. Quest canola was seeded at a depth of ½", 1", 2" and 3" on fallow and stubble. Highest canola establishment and yields were obtained when canola was seeded at a ½ to 1" depth (Figure 8). Plant density and yield declined dramatically when canola was seeded deeper than 1".

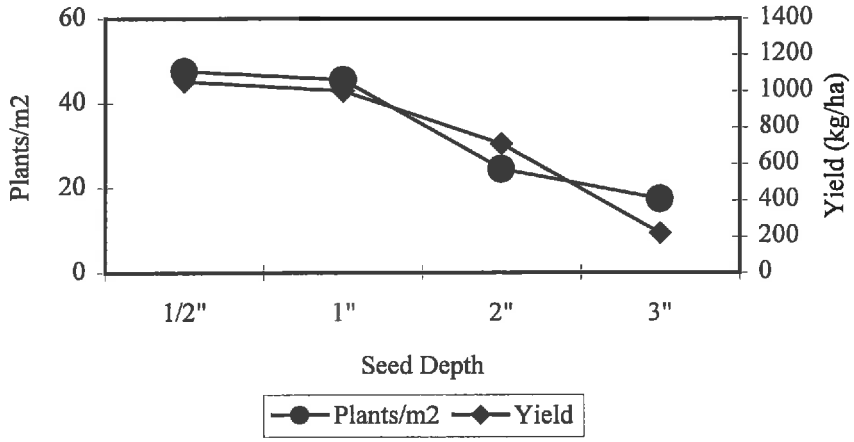

Figure 8: Effect of Seed Depth on Plant Establishment and Yield of Fall Seeded Quest Canola - Mean of Two Experiments, Scott 1997.

5.6 Conclusions

Fall seeded canola should be seeded at depth of less than one inch. Broadcast seeding is not a satisfactory method of seeding in the late fall in west central Saskatchewan. Fall seeded canola seed should be treated with a registered fungicide.

6.0 Can Fall Seeded Canola Tolerate Higher Levels of Seed Placed Nitrogen Than Spring Seeded Canola?

6.1 Objectives:

Fall seeded canola is emerging at a time when soil conditions are generally good. Crops generally tolerate higher levels of seed placed nitrogen under good soil moisture conditions. A study was conducted in 1998 to investigate whether fall seeded canola could tolerate higher levels of seed placed nitrogen than spring seeded canola.

6.2 Methods

Experimental design was a split-split plot. Fertilizer rate (0, 45, 90, 135 kg N/ha) was the main plot. Seed date was the sub-plot and fertilizer placement (seed-place, banded below seed) was the sub-sub plot. Quest canola was seeded on October 30, April 16 and May 6. The plots were direct seeded with a Versatile 2000 hoe-drill into standing stubble.

Data collection included canola establishment (plants/m2) and crop yield.

6.3 Results

a) Fertilizer Rate Effect

Plant numbers declined as fertilizer rate increased (Table 16). The 45 kg N/ha application rate resulted in a slight increase in yield when averaged across all three seed dates.

Table 16: Effect of N fertilizer rate on canola establishment – Average of 3 Seed Dates, Scott, 1998.

Fertilizer Rate	Canola Establishment (plants/m^2)	Canola Yield (kg/ha)
0 kg N/ha	143	803
45 kg N/ha	83	899
90 kg N/ha	50	788
135 kg N/ha	30	714
LSD (P=0.05)	27	79

b) Seed Date Effect

The mid-May seed date had the lowest plant establishment numbers (Table 17). Fall seeded canola had 15% higher yields than April and over 2.5 times the yield of May seeded canola.

Table 17: Effect of Seed Date on Canola Establishment (plants/m^2) and Yield (kg/ha), Scott, 1998.

Seed Date	Canola Establishment (plants/m^2)	Canola Yield (kg/ha)
October	87	1070
April	83	929
May	58	404
LSD (P=0.05)	19	79

c) Nitrogen Placement Effect

Nitrogen placed below the seed had 18% higher plant numbers than seed placed fertilizer (data not shown). Nitrogen placement had no effect on crop yield.

d) Interactions

Plant establishment is the most important variable to consider when evaluating the effect of seed placed fertilizer. There were no interactions for plant establishment. All seed dates responded similarly to fertilizer rate and placement. Fall seeded canola showed similar plant reduction trends to seed-placed fertilizer rates as the other seed dates (Figure 9).

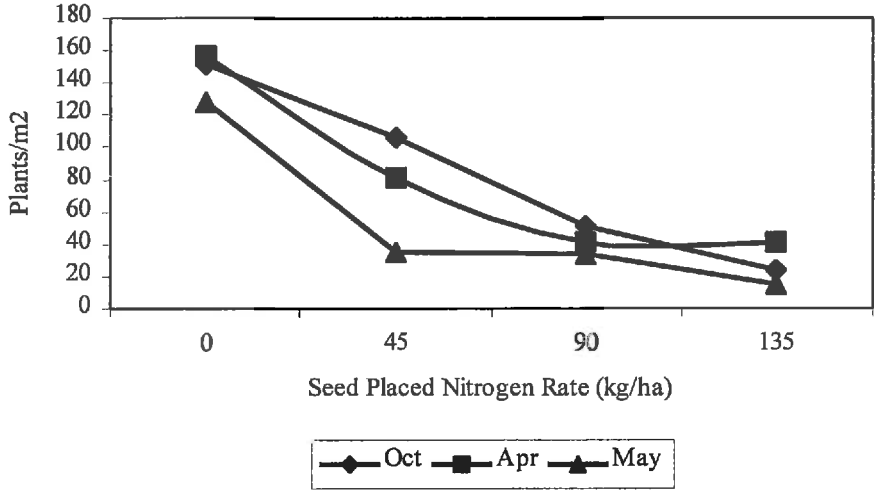

Figure 9: Effect of seed placed nitrogen rate (kg/ha) on plant establishment of canola seeded in late October, April and May, Scott, 1998.

6.4 Conclusions

Fall seeded canola is sensitive to seed placed fertilizer. Growers should follow seed-placed fertilizer guidelines developed for spring seeding if they are considering fall seeding.

7.0 Effect of Phosphorus and Potassium Fertilizer Application and Placement on Fall and Early Spring Seeded Canola

7.1 Objectives

Phosphorus fertilization has been shown to be beneficial to crops emerging in cool soils. Potassium uptake is also temperature sensitive, however canola does not normally respond to potash fertilization. The objective of this experiment is to determine if there is any interaction between seed date and phosphorus and potassium fertilization.

7.2 Methods

The experimental design was split-plot. Seed date was the main plot while phosphorus and potassium fertilization was sub-plot. Main plot treatments were fall, early spring, and mid-May seed dates. Sub-plot treatments were 0 P&K check, P_2O_5 seed placed, P_2O_5 banded below seed, K_2O seed placed, K_2O banded below seed, and P_2O_5 & K_2O applied in combination (seed-placed and banded below seed). Rate of P_2O_5 was 22.5 kg/ha and K_2O was 22.5 kg/ha. In 1998, the seed placed treatments were dropped and all treatments were applied below the seed.

Quest was the canola cultivar used in both years of the study. The seed dates in 1997 were Oct. 29, April 25, and May 16. The seed dates in 1998 were Oct. 30, April 16, and May 19. Weed

control was achieved by a post-emergent application of glyphosate at 450 gai/ha. A fungicide/insecticide seed treatment was applied to the seed. Experiments were seeded on wheat stubble in both years.

Soil tests indicated the soils had marginal levels of phosphorus but were sufficient in potassium (Table 18). The soils were deficient in chloride in both years.

Table 18: Soil test levels of phosphorus, potassium, and chloride (kg/ha) at the 0-30 cm depth, and soil test recommendations (kg/ha) for 1997-98, Scott.

	Phosphorus		Potassium		Chloride	
	Soil Test Level (kg/ha)	Recommended Appication Rate (kg/ha)	Soil Test Level (kg/ha)	Recommended Appication Rate (kg/ha)	Soil Test Level (kg/ha)	Recommended Appication Rate (kg/ha)
1997	56	20-25	1051	0-15	12	15-20
1998	32	25-30	482	5-15	15	15-20

Data collected included plant emergence and crop yield. Only crop yield data is reported.

7.3 Results

a) Seed Date Effect

Highest yields were obtained with the fall seed date in 1997 while the fall and early spring seed date were the highest yielding in 1998 (Table 19).

Table 19: Yield of canola seeded at three seed dates, Scott 1997-98.

Seed Date	1997 Yield (kg/ha)	1998 Yield (kg/ha)
Fall	905	1352
Early Spring	678	1464
mid-May	732	917
LSD (P=(0.05)	151	257

b) Phosphorus and Potassium Fertilizer Effect

Phosphorus and potassium applied in combination and banded below the seed was the only treatment that had a significantly higher yield than the check in 1997 (Table 20).

Table 20: Effect of phosphorus and potassium chloride fertilization on yield of canola – mean of October, April, and May seed dates, Scott, 1997.

Fertilizer Treatment	Yield (kg/ha)
No P and K	767
22.5 kg/ha P_2O_5 *	743
22. 5 kg/ha K_2O *	718
P_2O_5 and K_2O combined – seed place **	836
P_2O_5 and K_2O combined – below seed **	876
LSD (P=0.05)	91

* Mean of seed-placed and banded treatments
** Applied at a rate of 22.5 kg/ha of each nutrient

There was no yield response to phosphorus, potassium, or the phosphorus/potassium combination in 1998 (Table 21).

Table 21: Effect of phosphorus and potassium chloride fertilization on yield of canola – mean of October, April, and May seed dates, Scott, 1998.

Fertilizer	Crop Yield (kg/ha)
No P and K	1247
22.5 kg/ha P_2O_5	1277
22. 5 kg/ha K_2O	1190
P_2O_5 and K_2O combined **	1264
LSD (P=0.05)	NS

** Applied at a rate of 22.5 kg/ha of each nutrient. All fertilizer treatments were applied below the seed in 1998.

c) Seed Date and PK Interactions

There was a seed date X phosphorus/potassium fertilizer interaction in 1997 (Figure 10). Fall seeded canola showed a 16% increase in yield due to phosphorus applied below the seed. Potassium and phosphorus application applied in combination increased the yield of fall-seeded canola by more than 46%, independent of placement. The early spring and mid-May seed dates failed to show any detectable yield responses to any of the fertilizer treatments.

There was no seed date X PK fertilizer interactions in 1998. None of the seed dates responded to phosphorus or potassium fertilization.

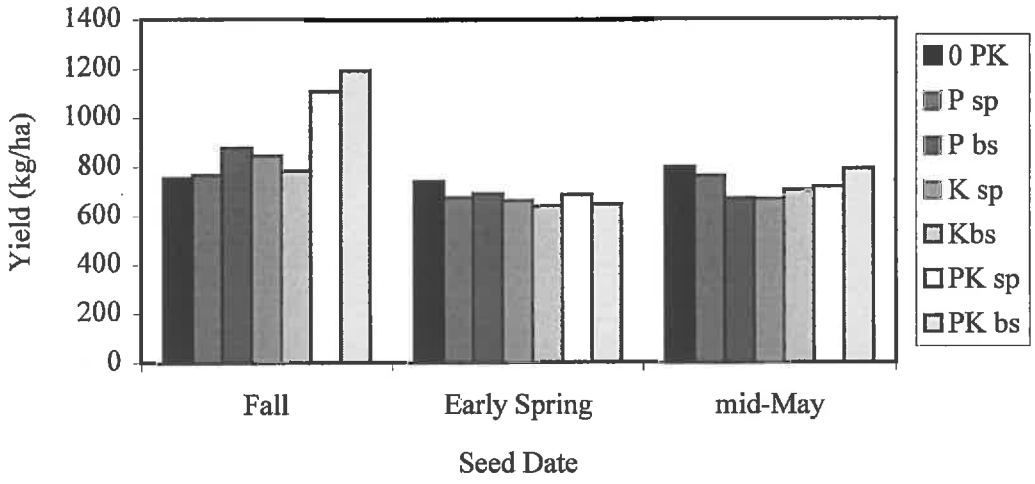

Figure 10: Effect of phosphorus and potassium chloride fertilization on yield of canola seeded on three seed dates, Scott 1997.

7.4 Conclusions

This study does not provide any conclusive results, however it does indicate that future studies on the interaction of seed date with phosphorus and/or potassium chloride fertilization may be warranted.

7.5 Other Experiments

Many other experiments were conducted in this time period. There was no effect of seed size or age of seedlot on establishment or yield of fall seeded canola. Freshly harvested canola seed showed no advantage over seed that was stored for a year.

In order for fall seeding to be widely adapted by farmers, the window for seeding has to be expanded. With current technology, growers have to seed as close to freeze-up as possible to ensure the seed does not imbibe water. Experiments were conducted to evaluate the potential of using abscissic acid analogues as a germination inhibitor to reduce the risk of premature germination. Some of the treatments provided a slightly positive effect, however they did not provide adequate safety to advance the date for fall seeding.

7.6 Impact Of Project

Numerous extension activities were generated by this research. This included grower meetings, media releases, seminars, and field days.

A number of preliminary recommendations for fall seeding have been developed for producers based on studies covered in this report. They are:

1) Seed as close to freeze-up as possible. In the moist dark brown, black, and grey soil climatic zones, set a target seed date near Oct.31. In the brown soil zone, set a target date of Nov. 5 to 7.
2) Seed at normal seed rates. Studies at Scott indicate a 6.7 kg/ha seed rate for Argentine canola is adequate.
3) Seeding a herbicide tolerant canola is recommended since winter annual weeds can be easily controlled with post-emergent herbicides.
4) Use seed treated with a broad spectrum fungicide (Vitavax RS, Premiere Plus, etc.) A fungicide treatment can make a dramatic improvement in crop establishment.
5) It is best to place the seed ½ to 1" deep in the soil. Broadcast seeding has caused variable emergence particularly if the soil surface is dry. Deep seeding can also reduce emergence and yields.
6) Best results have been obtained when seeding into standing stubble or chemical fallow. Seeding on tilled fallow increases the risk of soil crusting and wind damage in the spring. Avoid fields that are prone to surface crusting or spring flooding. Problems were encountered at Melfort when using disk openers on heavy clay soils with high levels of crop residue.
7) Seed place or side-band phosphorus fertilizer at soil test recommended rates. Nitrogen fertilizer can be banded prior to seeding, side-banded at seeding, or broadcast in early spring. Apply nitrogen at soil test recommendations. If seed placing nitrogen, do not exceed provincial recommendations for spring seeded canola. Sulphur is also an important nutrient for canola production. It can be applied at seeding or broadcast in the spring. Use a readily available sulphate formulation of sulphur fertilizer.
8) Watch emergence closely in the spring. Keep an eye out for flea beetles if afternoon air temperatures are greater than 15° C. If flea beetles destroy more than 25% of the cotyledons, treat with a foliar insecticide.
9) Emergence of the fall-seeded crop normally occurs in late April. A thin stand (10 to 20 plants per square meter) can produce good yields if the plants are distributed evenly.
10) Spray for weeds early (1 to 2 leaf stage). The primary weed problems in fall seeded canola are winter annuals (stinkweed, flixweed, shepherd's purse) so early control is necessary. One herbicide application is normally sufficient since the fall-seeded crop competes well with late emerging weeds.

7.7 Future Emphasis

In the future, research will concentrate on fine-tuning fall seeded canola production and reducing risk of premature fall germination. Studies are underway to evaluate the potential of polymer seed coats that could give producers more time for seeding in the fall. Growth analysis studies are underway to obtain a better understanding of how seed date impacts crop biomass accumulation and crop yield components.

7.8 Acknowledgements

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