MB-09

Fertilizer by Weed Management Study:

1997
Annual Report

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Forward

The Fertilizer by Weed Management Study was initiated to determine the effect of fertilizer timing and placement in conservation tillage with weed management. The major sponsor of the project is the Canadian Fertilizer Institute with Monsanto Canada Inc. and Ciba Canada Inc. providing additional support.

Note: The data presented within this report are preliminary in nature and should not be taken out of context from other research. Basic agronomic and weed management data are presented in this report. Additional information will become available from further laboratory analysis of 1997 samples. The data from other years and further statistical analysis are required before the data can be generalized. The data should not be used without the permission of the authors.

Executive Summary

1997 saw the completion of year two of the Fertilizer by Weed Management Study, a joint venture among Agriculture and Agri-Food Canada, the Canadian Fertilizer Institute, Novartis Canada Inc, and Monsanto Canada Inc. Management studies were conducted at Brandon, Melfort, and Beaverlodge to address the issue of the effect of timing, placement, and soil disturbance level of nitrogen fertilizer application on weed management. Field and growth room research on the impact of MAP and KCl on weed competition was conducted as part of an MSc. program by Kristen Callow.

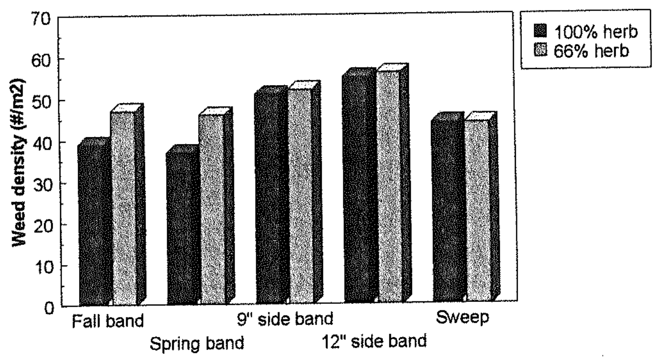
Results from the nitrogen management study indicated that no single N fertilizer management approach provided the best crop establishment or yield at all three sites. Generally the poorest results occurred in the treatments seeded with sweeps, especially for canola. For the first time the twelve inch row-spacing side banded treatment performed poorer than the side banded nine inch row-spacing treatments. This occurred at Brandon and Melfort and was particularly evident in the canola crop. Fall banding out performed spring banding in wheat at Beaverlodge. The reverse was true at Melfort while the two random bands performed similarly at Brandon. The reduced herbicide rate treatments provided similar yields to full rate treatments for wheat and canola at Brandon and Melfort, but lower yields occurred at Beaverlodge, particularly in wheat. Research on wheat development at the three sites indicated that wheat was generally seeded deeper in the sweep treatments. Plant development, as measured by Haun stage, indicated that herbicide rate did not influence development at any site. Similarly, fertilizer management did not influence plant development at Brandon and Melfort; however, at Beaverlodge the sweep seeded plots developed the fastest while the twelve-inch side-banded treatments developing the slowest.

In general, the reduced rate of herbicide applied in 1996 did not result in greater weed recruitment prior to crop seeding or in-crop spraying in 1997; however, weed densities were greater in reduced rate plots after herbicide application in 1997 at Melfort and Beaverlodge. The impact of fertilizer timing, placement, and level of soil disturbance on weed densities varied by site. Weed densities were greater in sweep treatments in canola, but not necessarily in wheat. In some cases sweep seeding resulted in more weeds present at the time of in-crop spraying while in other cases densities were greater in the July counts. This may be due to the timing of seeding in relation to soil temperature and weed seedling recruitment (ie emergence patterns). At Melfort and Brandon, weed densities were greater prior to seeding or in-crop spraying in the two pass seeding systems where fertilizer was random banded in the fall or spring compared to the side banded treatments. At Melfort, weed densities were greater in the twelve inch side-banded plots compared to the nine inch side-banded plots, while the reverse was true at Beaverlodge.

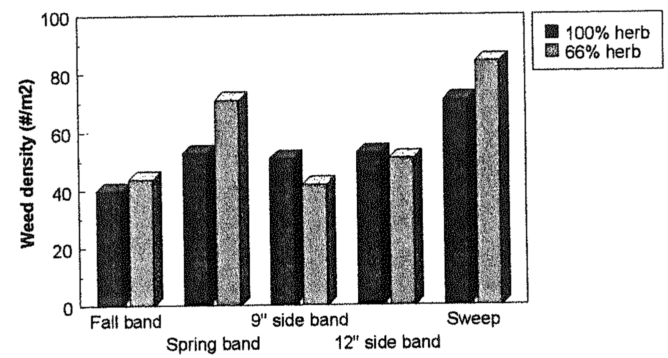
An initial economic analysis was conducted on the Brandon 1997 data to determine the appropriateness of using an economic contribution approach. This approach subtracts the costs of production from gross returns. The cost of production were determined by adding the cost of field operations based on the Saskatchewan Custom Rate Guide to the actual cost of purchased inputs. Gross returns were determined using crop yield and grade to calculate dollar returns per hectare. The analysis indicated similar returns for treatments in wheat with the nine inch side band treatment performing the best and good returns from canola seeded on random fall or spring fertilizer bands and the nine inch side band treatment.

Data from one field season on the impact of MAP and KCl on wild oat competition in wheat and flax indicated that the crops grown at the sandy loam site were more responsive to fertilizer than at the clay loam site, that wheat was more consistent in its fertilizer response than flax, as rates of fertilizer increased the expected yield decline did not occur, side banding provided higher yields than seed placed fertilizer, and that the presence of wild oats reduced crop yield. More detailed research on the relative response of wheat, flax, and wild oat to MAP and KCl has been initiated in growth chambers.

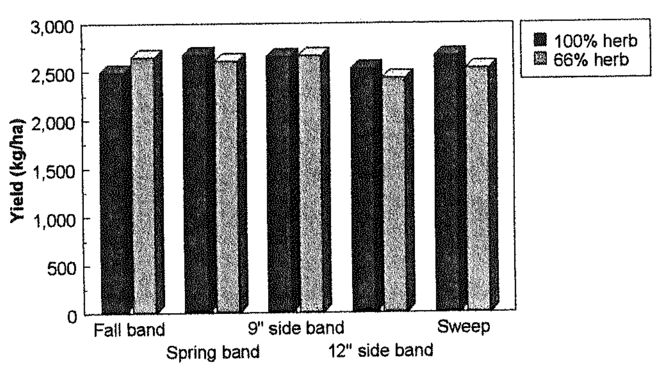
Brandon
Wheat July-1997



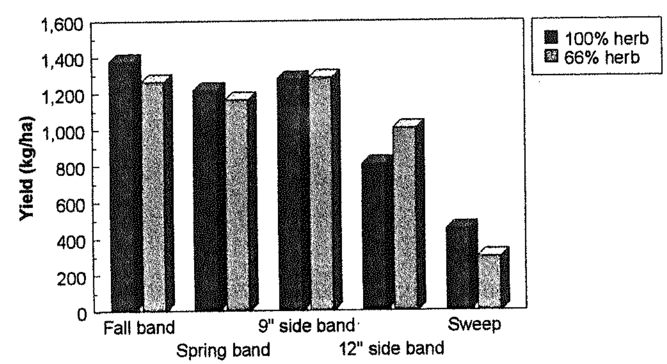
Brandon
Canola July-1997



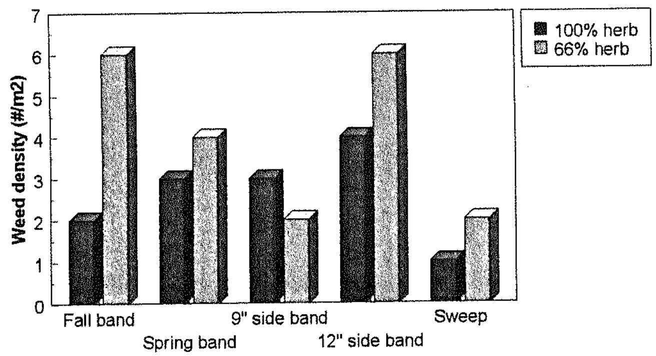
Brandon
Wheat Yield-1997



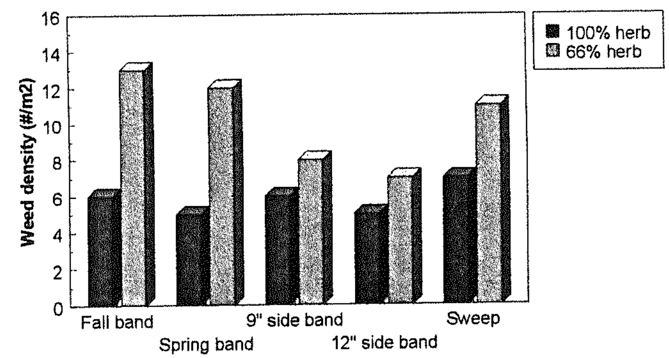
Brandon
Canola Yield-1997



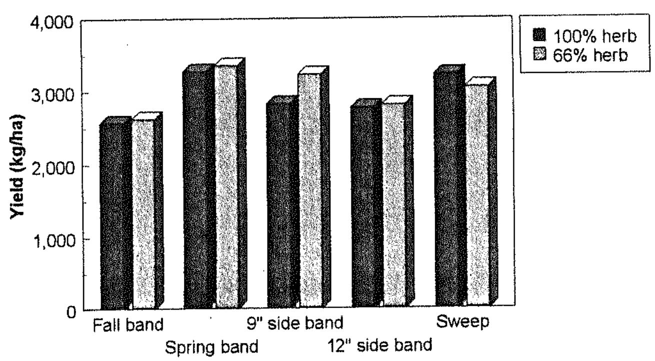
Melfort
Wheat July-1997



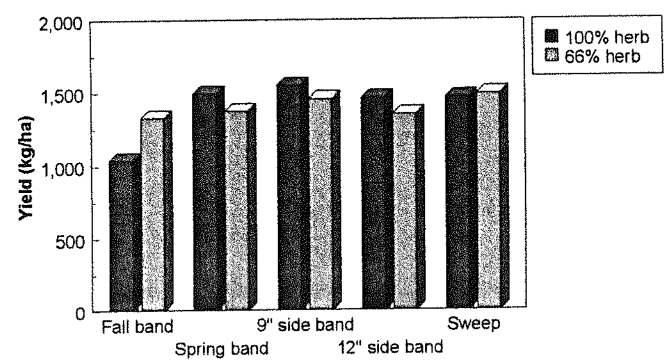
Melfort
Canola July-1997



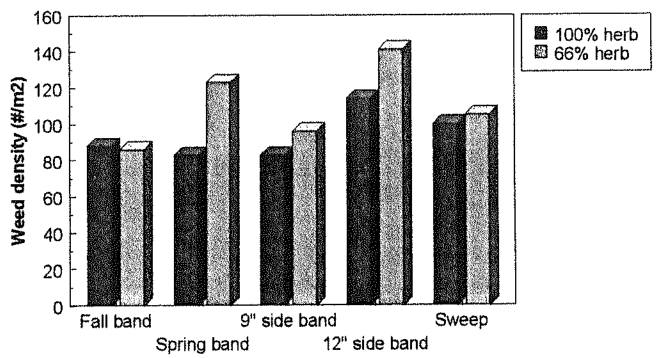
Melfort
Wheat Yield-1997



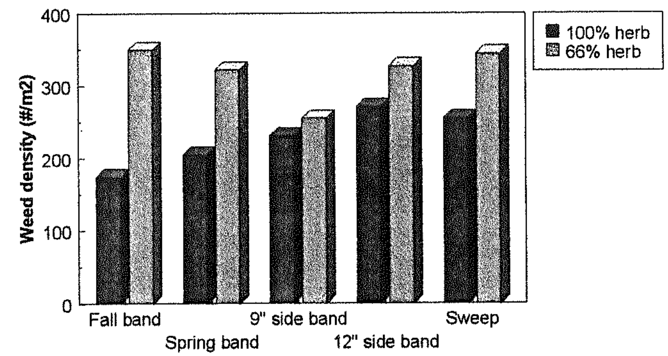
Melfort
Canola Yield-1997



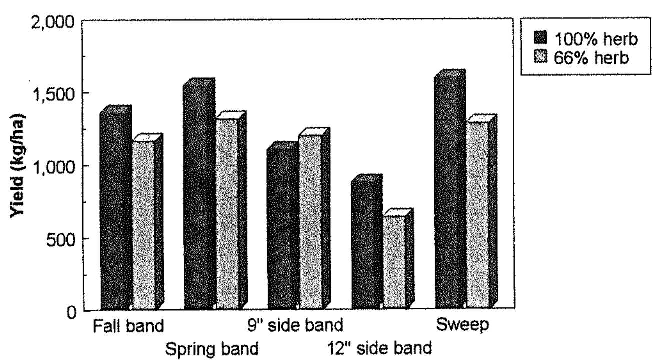
Beaverlodge
Wheat July-1997



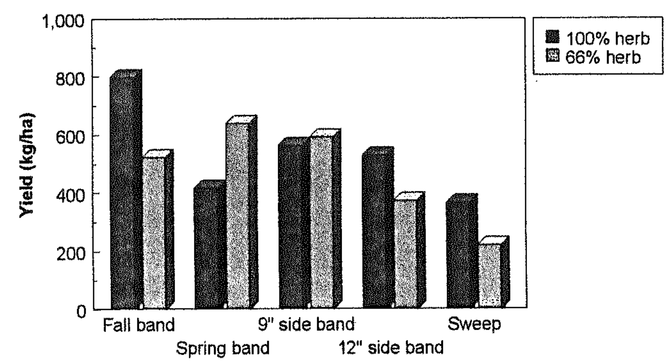
Beaverlodge
Canola July-1997



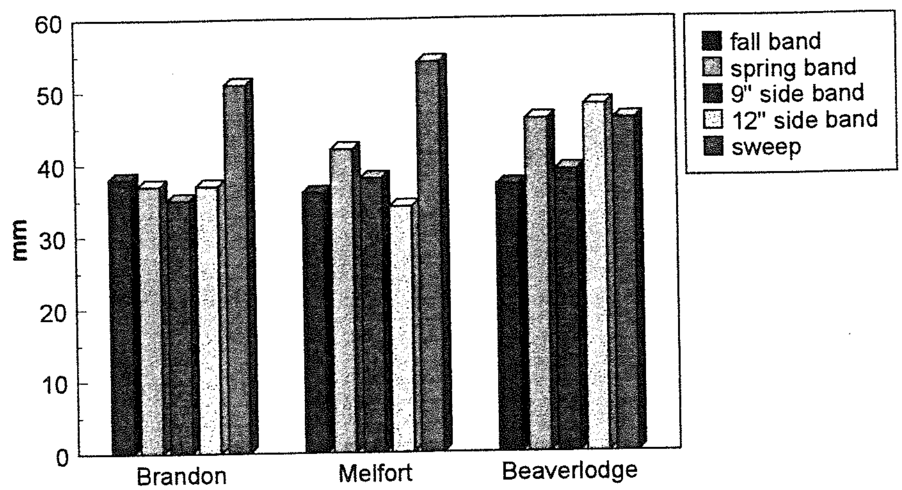
Beaverlodge
Wheat Yield-1997



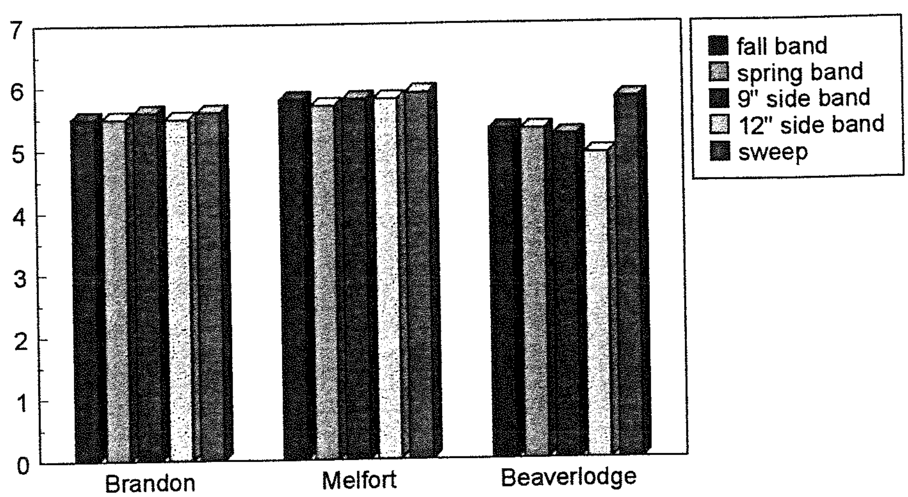
Beaverlodge
Canola Yield-1997



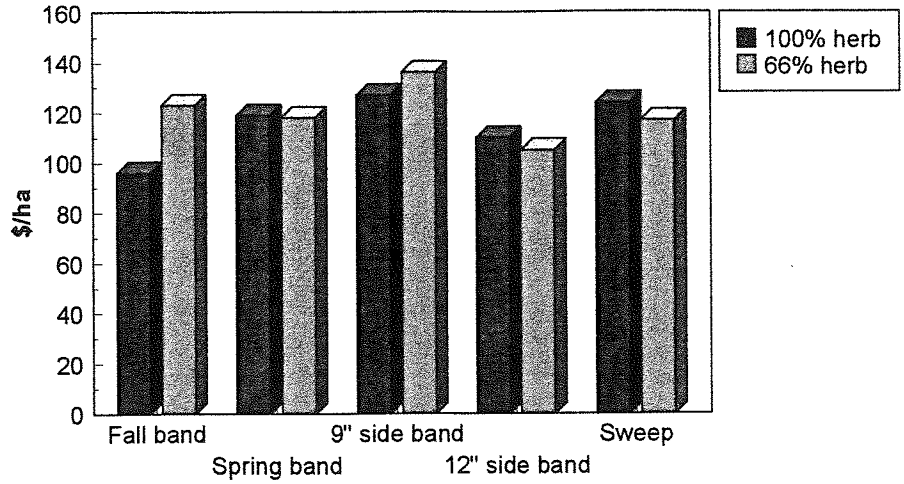
Seeding Depth



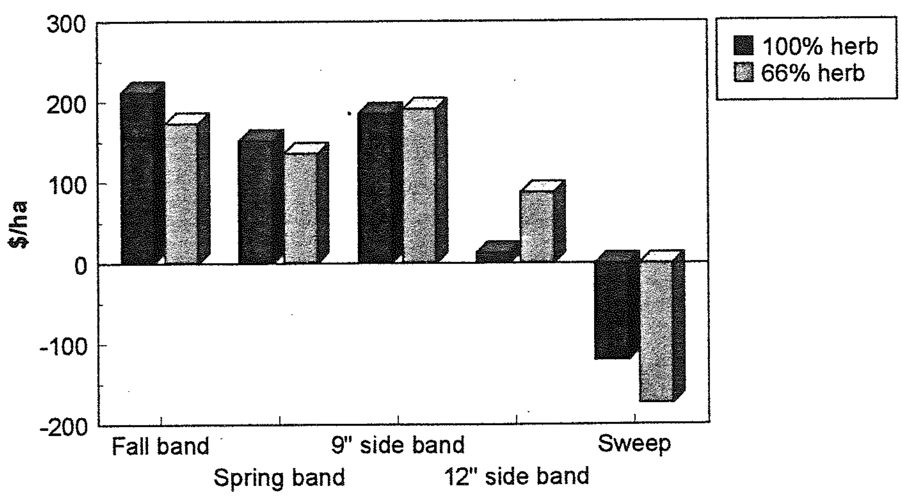
Haun Stage of Spring Wheat 100% Herbicide Rate



Brandon
Net Returns Wheat - 1997



Brandon
Net Returns Canola - 1997



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Introduction

Objectives:

1) To determine the impact of fertilizer placement and timing in direct-seeding systems on N fertilizer-use efficiency, herbicide usage, and weed communities. This objective is being met through the establishment of a short-term management study in three agroecological zones of the Black soil zone.

2)To determine the impact of P and K fertilizer on weed-crop competition. This objective is being met through a graduate student MSC. thesis project.

Background:

Direct-seeding systems are the most rapidly evolving agricultural technology in western Canada. Direct economic and soil conservation benefits have been documented at the farm and research level and have become the driving forces behind producer adoption of these conservation-tillage systems. Because the term direct seeding encompasses a broad range of one- and two-pass fertilization and seeding systems, questions have arisen regarding the relative efficiency of these different approaches. The most commonly asked questions relate to the effects of soil disturbance and fertilizer placement on crop yields, weed management, and production economics.

Potential Impact and Benefits:

The project will provide a knowledge base for efficient fuel, fertilizer, and herbicide usage thereby optimizing net-returns at a cropping-systems level for the Black Soil Zone. The data generated from this research will be the largest data base dealing in an integrated manner with the impact of fertilizer placement on weeds in direct-seeding systems and will be of interest to producers and the agro-industry. The principles elucidated will have regional and national application. The commercialization of this knowledge will occur through field days, presentation at grower meetings, and through the publication of results in the farm press, industry and extension publications and scientific journals. As decision support systems are developed, this data will be useful for predicting the response of crops, weed communities, and soils to direct-seeding systems and recommending appropriate management options.

Project Description:

I) Protocol for Management Studies:

a) General description:

The management studies were set up in a split-split plot design with 4 replicates. Plots were 7.3m X 15.0m in size. Crops (wheat and canola) were the main plot, fertilizer placement was the sub-plot, and herbicide rate was the sub-sub plot. For the sake of statistical analysis, all agronomic data was analysed by crop separately. Once several years of data are collected, weed community analysis by multivariate ordination will be done with using all plots in the analysis (wheat and canola plots used together).

In order to reduce site to site variability, seeding was done at all sites using identical seeders. Conservapak zero-tillage air seeders setup to seed on 9 inch and 12 inch row spacings were used (one pair of seeders at each site). For the sweep seeding, sweeps were purchased from a common sourse and used at all locations.

b) Core Treatments at each site:

-each of the following fertilizer treatment will be conducted in wheat and canola at 100% and 66% of in-crop herbicide rates with treatments being continuous (in same plot with crop rotating annually) for 5 years (1 startup year plus 2 cycles of crop rotation).

Treatment	Spacing of fertilizer (in)	Row spacing of seed (in)
fall band	12	9
spring band	12	9
side band at seeding	9	9
side band at seeding	12	12
one pass sweeps	9	9

Note; additional fertilizer treatments have been added at Melfort and Beaverlodge but are not summarized in this years report.

c) Agronomic Information:

I)Fertility: 66% of soil test recommendations for N

-approximately 85lb/ac at Melfort, 70 lb/ac at Beaverlodge, 65 lb/ac at Brandon

-$P_2 0_5$: recommended rate (adjust N)

-S: elemental as required

ii)Crops: Teal wheat-common source from Melfort

Seed at 2 bu/ac (160 kg/ha)

Quest RR canola- common source from Monsanto

Seed at 7 kg/ha plus Furadan or Counter

iii)Herbicides: Pre-seeding, pre-harvest, and post-harvest as required at each site

In-crop use common treatments

Roundup in canola (1.24L/ha (0.5 l/ac) = 1X, 0.82L/ha=66%)

Horizon plus target in wheat

(Horizon rate wild oat rate 230ml/ha(56gai/ha)=1X and reduced rate of 172.5ml/ha=75%X and 60% of wild oat and green foxtial rate). Reduced rate for Horizon changed based on dose response information from Ciba's data base. Target is to be used as a tank mix (it should control most weeds at all sites). 1X rate = 1.0 L/ha and 66% =0.66L/ha (Note that 1.0l/ha is at the low end of the recommended range, but should still suppress cleavers and other difficult to control weeds).

iv)Fungicides: As needed at each site

d)Data Collection:

I)Crop data: -crop stand prior to tillering (4-1m row counts per plot for wheat & canola using 4-0.25 m2 quadrats per plot for sweeps)

-head count 4 1m row per plot in wheat

-crop height in canola and wheat

ii)Haun Stage (wheat only):

-Haun stage and depth of seeding at 5-6 lf stage (GS 32 start of elongation) in full and reduced rate herbicide plots. Collect 20 plants/plot at 5-6 leaf stage in wheat.

iii)Nutrient dynamics:

-biomass at heading of weeds and crop

-1 of $1m^2$ quadrat per plot (separate weeds and crop) dry weight (also give biomass data to Derksen for weeds) and send ground samples to Grant (need about 25 grams, but for weeds send what there is).

iv)Yield: -per plot

-seed quality (1000k count, protein, green seed in canola, etc?)

-oil content for canola at Beaverlodge ??

e)Soil Sampling:

-soil moisture: 0-6, 6-12, 12-24, 24-36 spring and fall
-archive samples each year
-soil fertility: fall for N and P
0-6 and 6-24

f)Weeds:

-for counts use 20 0.5 X 0.5 m^2 ($0.25m^2$) quadrats per plot (always take the same # crop rows per quadrat). For very dense weed species devide quadrat into 4, count in one quarter of the quadrat, and multiply by 4 for density per quadrat on input sheets.

-count all weeds by species (density/quadrat)
Pre-seeding, pre-spray (in-crop), and residual weed community (July)
-send electronic files to Derksen for analysis (format to be sent out)

-emergence: estimate number of days difference in emergence between each dominate weed and the crop (Derksen will do detailed emergence sampling)

-need a weedy check in each plot (make tarp to cover about $2m^2$ so that a $1m^2$ weedy quadrat remains after spraying. Need a weed count at spraying and in July in this quadrat that is separate from "20 quadrat" count. Harvest and thrash separately from main plot to obtain an estimate of crop yield loss due to weeds (i.e., sample of crop yield, weed yield)

-crop tolerance 7 DAT on 0-100 ECW scale for wheat and canola

1997 Results

Crop Agronomy

prepared by Adrian Johnston and George Clayton

Brandon

Growing conditions started out drier than normal in May and June, however, improved with above average precipitation in July. Air temperatures were above normal through the June to August growing period. Poor crop emergence was recorded with the sweep seeded treatment, likely a result of the poor spring rainfall conditions (Table 1). However, this was not reflected in subsequent wheat grain yield or protein. Spring banding prior to seeding, and side banded on 9" row spacing, were the best yielding wheat treatments, while side banding on 12" spacing was the lowest yielding treatment. No significant difference was recorded in crop emergence, grain yield or grain protein as a result of reduced herbicide rate. Poor spring moisture conditions negatively influenced canola crop emergence with sweep seeding (Table 2). Canola seedling stand was also low with the 12" side band drill, reflecting the impact of high N rates close to the seed row with this crop (Johnston et al., 1997). These reduced seedling stands were reflected in lower canola grain yields, and higher grain protein. Dockage assessment of the canola samples revealed high levels of wild mustard, resulting in the low grain yield. It was surprising to see the 12" side band treatment grain yields as being lower than the other treatments, as past research has generally found that the canola crop could compensate for poor plant stand with increased branching.

Melfort

The 1997 growing season in Melfort was good to excellent. With the exception of some high temperatures in late-July and early-August, there was good rainfall distribution. Area producers report canola (35-40 bu/ac) and wheat (45-50 bu/ac) yields as above average. We changed our method of harvesting this study in 1997, with a full 12' swath taken from the full 50' length of each plot. This was done to overcome any problems which may occur as a result of the various row spacing and sweep placement seeding methods used. For spring wheat, our crop emergence and grain yields were good, and our grain protein concentration indicates that we certainly are not over fertilizing our crop (Table 1). Wheat seedling emergence varied widely between treatments, with 9" side banding having the best stand, while the 12" side banding had the poorest stand. Similar to Brandon, we also recorded a poor wheat seedling stand with the sweep treatment. The low seedling numbers for the 12" side band at Melfort may be due to the short banding point we use on the drill. We substituted a shorter and narrower knife to avoid excessive soil disturbance when using the stock side banding knives on the Conserva-Pak seeder at the silty clay soil site. It would appear that we may not achieving adequate seed - fertilizer separation. Low grain yields and protein with fall band application indicate that there were overwinter losses of N with this treatment. While a poor seedling stand was recorded for the sweep treatment it appeared to have compensated for this by yielding with the best treatments. However, with the 12" side banding drill the poor seedling stand appears to have been reflected in poor grain yield, indicating that it was likely a fertilizer damage problem.

The canola story at Melfort in 1997 was really an unfortunate example of poor quality control. We received our canola seed in mid-May, and ended up with year old Quest canola seed from Monsanto. While the seed had reasonable germination (80%), it had very poor vigour (30%) resulting in a disastrous canola stand, and subsequent grain yield. We have expressed our disappointment to the local Monsanto Research Rep. (Rob Neyedley) about the seed and do not anticipate a problem in 1998. Canola seedling stands were similar to wheat, with the sweep and 12" side banding treatments having the poorest seedling stands. However, unlike the wheat this was not reflected in grain yield as these treatments were grouped with the highest yielding treatments. Fall banding of N had the lowest grain yield, again reflecting our results with spring wheat and our speculation of significant overwinter losses of N at this location. As recorded in 1996, herbicide rate had no effect on canola grain yields recorded.

Beaverlodge

The 1997 growing season was much like 1996 in that it was cold, wet and very difficult to get good seedbed conditions, particularly in direct seeding situations. Weed control in the area was inconsistent and weeds germinate and grew throughout the growing season. Consequently crop competition was important in 1997. Yields in the area were generally poor, harvesting was late or not at all and a number of hail storms travelled through the area in late September. The CFI trial site received a small amount of hail after the crop was swathed and before combining which resulted in some loss in the canola but left the wheat relatively unaffected.

For spring wheat, our crop emergence was relatively good except for the sweep treatment, which resulted in significantly less emergence than the emergence from the knife openers. Wheat yields ranged from 759 to 1439 kg/ha, poor yields for the second year in a row, a situation familiar with area producers in 1996 and 1997. Yield of wheat was significantly higher from the spring band, fall band and sweep treatment compared to low disturbance one pass seeding on 9 and 12" row space (Table 1). The poor emergence with the sweep treatment was not reflected in the final grain yield, a result much like that at Brandon in 1997. Herbicide rate resulted in significantly different wheat yields with the lower herbicide rate causing yield reductions. The herbicides were not that effective in Beaverlodge in 1997, mainly due to constant germination of weeds throughout the growing season. Consequently, the lower rate resulted in even more competition with the group, reducing yields further. Better growing conditions would have resulted in better crop competition than what occurred in 1997, a different result could be expected. Protein content ranged from 14.8 to 15.5% in wheat with the sweep treatment resulting in protein content of wheat that was less than from the treatments that were seeded with a knife opener. Canola yields ranged from 296 to 798 kg/ha, a result due to hail damage that occurred at least twice on the swath prior to combing (Table 2). The sweep treatment resulted in the lowest yield and fall banded fertilizer resulted in the highest yields. Grain protein was lower than what occurred at Melfort or Brandon, however the relationship between protein content and oil content is yet to be examined. There were no significant differences in oil content, which ranged aound 50% (data not shown).

References

Johnston, A.M., G.P. Lafond, J.T. Harapiak, and W.K. Head. 1997. No-till spring wheat and canola response to side banded anhydrous ammonia at seeding. J. Prod. Agric. 10: 452-458.

Objective A) Field Project

1) Summary of Production Information:

Location	Crop	Seeding Rate (kg/ha)	Fertilizer Rates (kg/ha)	Seeding Date	Harvest Date
Brandon	Wheat	120	46-0-0 @ 120 11-51-0 @ 50 0-0-0-90 @ 50	20/05/97	03/09/97
	Canola	7	46-0-0 @ 120 11-51-0 @ 50 0-0-0-90 @ 10	20/05/97	02/09/97
Melfort	Wheat	134	46-0-0 @ 140 11-51-0 @ 40	25/05/97	10/09/97
	Canola	7	46-0-0 @ 140 11-51-0 @ 40	25/05/97	09/09/97
Beaverlodge	Wheat	120	46-0-0 @ 130 11-51-0 @ 30	05/05/97	Swathed 04/09/97 Combined 25/09/97
	Canola	7	46-0-0 @ 130 11-51-0 @ 30	06/05/97	Swathed 04/09/97 Combined 25/09/97

2) Herbicide Information:

Location	Crop	Pre-seeding treatment (L/ha)	Date of Application	In-crop treatment (L/ha)	Date of Application
Brandon	Wheat	RoundUp 1.24 L/ha + 2,4-D 0.56 L/ha	16/05/97	Horizon + Target 1X and Reduced	11/06/97
	Canola	RoundUp 1.24 L/ha	16/05/97	RoundUp 1X and Reduced	16/06/97
Melfort	Wheat	RoundUp 1.24 L/ha + 2,4-D 0.56 L/ha	26/05/97	Horizon + Target 1X and Reduced	26/06/97
	Canola	RoundUp 1.24 L/ha	26/05/97	RoundUp 1X and Reduced	17/06/97
Beaverlodge	Wheat	RoundUp 1.24 L/ha + banvel 108 ml/acre 2,4-D 224 ml/ac	02/05/97 10/05/97	Horizon + Target 1X and Reduced	10/06/97
	Canola	RoundUp 1.24 L/ha	02/05/97	RoundUp 1X and Reduced	10/06/97

3) Agrometeorology

Location	Month	L-Term Average Precipitation (mm)	1997 Precipitation (mm)	L-Term Average Temperature (EC)	1997 Monthly Average Temperature (EC)
Brandon	May	49.0	14.4	10.8	9.5
	June	79.3	53.0	15.9	18.9
	July	73.0	98.0	19.0	19.6
	August	64.5	45.0	17.6	18.2
Melfort	May	41.4	31.0	10.6	8.8
	June	61.9	96.7	15.5	16.8
	July	66.6	48.6	17.6	18.5
	August	53.1	41.0	16.3	18.4
Beaverlodge	May	38.9		9.7	
	June	63.6		13.3	
	July	46.9		15.4	
	August	55.2		14.3	

Table 1. Wheat seedling establishment, grain yield and protein response to fertilizer N placement and herbicide rate at Brandon, Melfort and Beaverlodge, 1997.

Locations		Brandon			Melfort			Beaverlodge		
Treatments		Seedlings	Grain Yield	Grain Protein	Seedlings	Grain Yield	Grain Protein	Seedlings	Grain Yield	Grain Protein
N. Plmt.	Herbicide	Plants/m2	Kg/ha	%	Plants/m2	Kg/ha	%	Plants/m2	Kg/ha	%
1. Fall banded	Full	173	2499	14.2	231	2573	10.6	264	1360	15.5
	2/3	177	2647	14.3	249	2622	10.4	278	1163	15.6
2. Spr. banded	Full	167	2679	13.9	231	3275	11.3	286	1545	15.4
	2/3	170	2609	14.0	227	3356	11.6	247	1316	15.5
3. 9" side bd	Full	172	2660	14.0	276	2832	11.3	263	1107	15.1
	2/3	174	2664	14.1	272	3231	11.6	219	1199	15.2
4. 12" side bd	Full	177	2531	14.1	154	2779	11.3	282	879	15.8
	2/3	186	2427	14.4	162	2816	11.2	266	640	15.1
5. Sweep	Full	140	2644	14.0	214	3235	11.7	177	1592	14.8
	2/3	135	2532	14.1	184	3051	11.2	180	1286	14.7
1. Fall banded		175 a	2573 ab	14.2	242 b	2601 c	10.4 b	272 a	1261 ab	15.5 a
2. Spring banded		168 a	2644 a	14.0	229 b	3315 a	11.4 a	266 a	1431 a	15.4 a
3. 9" side banded		173 a	2662 a	14.1	274 a	3060 ab	11.5 a	241 a	1153 b	15.1 ab
4. 12" side banded		182 a	2479 b	14.2	158 d	2798 bc	11.2 a	274 a	759 c	15.5 a
5. Sweep		138 b	2588 ab	14.0	199 c	3143 a	11.5 a	178 b	1439 a	14.8 b
Full herbicide		166	2603	14.0	218	2965	11.3	254	1297 a	15.3
2/3 Herbicide		168	2576	14.2	219	3015	11.2	238	1121 b	15.2
Pr>f Fert tmt		0.0003	NS	NS	0.0001	0.0003	0.0005	0.0011	0.0001	0.0474
Herb tmt		NS	NS	NS	NS	NS	NS	NS	0.0350	NS
Fert x Herb		NS	NS	NS	NS	NS	NS	NS	NS	NS
CV		9	6	2	11	9	4	18	20	3

Table 2. Canola seedling establishment, grain yield and protein response to fertilizer N placement and herbicide rate at Brandon, Melfort and Beaverlodge, 1997.

Locations		Brandon			Melfort			Beaverlodge		
Treatments		Seedlings	Grain Yield	Grain Protein	Seedlings	Grain Yield	Grain Protein	Seedlings	Grain Yield	Grain Protein
N. Plmt.	Herbicide	Plants/m2	Kg/ha	%	Plants/m2	Kg/ha	%	Plants/m2	Kg/ha	%
1. Fall banded	Full	66	1378	22.3	64.3	1040	23.6		798	17.9
	2/3	54	1262	22.8	55.2	1329	23.6		524	17.3
2. Spr. banded	Full	59	1217	21.9	73.0	1494	23.6		418	17.4
	2/3	70	1163	21.1	60.7	1374	23.4		640	17.9
3. 9" side bd	Full	61	1278	21.9	68.4	1550	23.9		563	17.8
	2/3	58	1284	22.1	69.4	1457	23.5		593	17.7
4. 12" side bd	Full	43	810	23.0	55.8	1463	23.4		530	17.9
	2/3	41	1004	22.7	47.2	1353	23.4		374	17.8
5. Sweep	Full	19	452	22.7	44.0	1467	23.9		368	17.1
	2/3	18	298	22.9	41.8	1489	23.4		223	17.0
1. Fall banded		60 a	1320 a	22.6 ab	59.7 ab	1184 b	23.6		660	17.6
2. Spring banded		65 a	1190 a	21.5 c	66.8 a	1434 a	23.5		529	17.7
3. 9" side banded		60 a	1281 a	22.0 bc	68.9 a	1503 a	23.7		578	17.7
4. 12" side banded		42 b	907 b	22.9 a	51.5 bc	1408 a	23.4		453	17.9
5. Sweep		19 c	375 c	22.8 ab	42.9 c	1478 a	23.6		296	17.1
Full herbicide		50	1027	22.4	61.1	1403	23.7		535	17.6
2/3 Herbicide		49	1002	22.3	54.9	1400	23.5		471	17.5
Pr>f Fert tmt		0.0001	0.0001	0.0012	0.0006	0.0086	NS		NS	NS
Herb tmt		NS	NS	NS	NS	NS	NS		NS	NS
Fert x Herb		0.0848	NS	NS	NS	NS	NS		NS	NS
CV		14	16	3	20	12	2		54	3

Impact of row spacing, fertilizer management and herbicide rate on plant development in spring wheat in 1997. Prepared by Guy Lafond

Objective:

To determine the effects of nitrogen management, row spacing and herbicide rate on seeding depth, main stem Haun stage and plant development in spring wheat at three locations, Brandon, Melfort and Beaverlodge.

Materials and Methods:

Twenty wheat plants per plot were collected from the five core nitrogen management treatments of the CFI project. Each plant was scored for actual depth of seeding, main stem Haun stage and each tiller on each plant was identified and scored for plant development according to the method developed by Klepper et al. (1983). The plants were collected on June 24th in Brandon, on July 1st in Melfort and on June 20th in Beaverlodge.

The analysis of the data for seeding depth and main stem Haun stage was done using an analysis of variance and the N Management x Herbicide Rate x Rep interaction was used as the error term. The main stem Haun stage is a good indicator of rate of emergence as shown by Lafond and Baker (1986).

The analysis of the data for the tillers present was done in three steps. The first step consisted in determining the number of plants from each plot which had a specific tiller and converting this value into a proportion. The second step consisted in doing an $\arcsin((x)^{.5})$ transformation of the proportion for each tiller as developed by Snedecor and Cochran (1976). With $n<50$, in this case 20, values of 0% were given a value of 1/4n or 0.0125 and values of 100% values (n-1/4)/n or 0.9875 (Snedecor and Cochran, 1976). The analysis of variance was done on the transformed values and the reported values in the tables are untransformed. The probability values indicated for the contrasts associated with nitrogen management and herbicide rate are based on the analysis of the transformed values. The approach for presenting the data is similar to the one used by Wilkins et al. (1988).

Results and Discussion:

Seeding Depth

Overall seeding depth was similar between the three locations. At Melfort and Brandon, the sweep treatment was much deeper than the other treatments while at Beaverlodge it was more similar. The variability in seeding depth , as indicated by the standard errors, was greatest at Beaverlodge and similar between Melfort and Brandon (Table 1).

Table 1. The effects of nitrogen management on seeding depth (mm) of spring wheat at three locations in 1997.

Nitrogen Management	Brandon	Melfort	Beaverlodge
Fall banding	38	36	37
Spring banding	37	42	46
Side-banding at seeding on 12" spacing	37	34	48
Side-banding at seeding on 9" spacing	35	38	39
Sweep	51	54	46
Mean	40	41	43
s.e.	10	8	24

Main Stem Haun stage

The difference in rates of herbicides used had no effect at all three locations. The nitrogen management treatments had no effect on main stem Haun stage values at Melfort and Brandon. This implies that regardless of how the plants are orientated, in this case spread out as with the sweep treatment or in single rows of different spacings (Table 2). However, this was not the case at Beaverlodge where the values for the sweep treatment were significantly higher than the other treatments. In fact, the plants growing on 12" rows were exactly one leaf behind the sweep treatments. Assuming 100 growing degree-days per leaf (0° C base temperature), this represents a potential difference of 5 days between the emergence of sweep and side-banding treatment. The small difference between 9" and 12" is more than likely due to the deeper planting with the 12" spacing.

Table 2. The effects of nitrogen management and herbicide rate on main stem Haun stage of spring wheat at three locations in 1996.

Nitrogen Management	Brandon		Melfort		Beaverlodge	
	100%	66%	100%	66%	100%	66%
Fall banding	5.5	5.5	5.8	5.9	5.3	5.5
Spring banding	5.5	5.6	5.7	5.8	5.3	5.4
Side-banding at seeding on 12" spacing	5.5	5.4	5.8	5.8	4.9	4.7
Side-banding at seeding on 9" spacing	5.6	5.5	5.8	5.8	5.2	5.4
Sweep	5.6	5.6	5.9	6.0	5.8	5.8
Mean	5.5	5.5	5.8	5.9	5.3	5.4
s.e.	0.3		0.4		0.6	
Contrast[1]						
Herbicide 100% vs 66%	ns		ns		ns	
Fall Banding vs Spring Banding	ns		ns		ns	
Sweep vs Pre-Seed banding	ns		ns		*	
Pre-seed banding vs Side-banding	ns		ns		ns	
9" vs 12"	ns		ns		*	
9" vs Sweep	ns		ns		**	
12" vs Sweep	ns		ns		*	

[1] Values followed by **, * and ns are significant at the 1% level, 5% level or not significant.

Plant Development:

Brandon: The two rates of herbicide used did not affect the frequency of the various tillers present (Table 3). In the case of the fall banding vs the spring banding nitrogen treatments, the only difference was a higher frequency of the T0 with fall banding. The frequency of T3, T11 and T21 was greatest for the spring banded treatments than the treatments where nitrogen was side-banded at seeding time. Frequency of tillers was similar between the 9" and 12" spacing. The frequency of most tillers was greatest for the sweep treatments than the 9" or 12" spacings.

Melfort: The only tiller frequencies affected by herbicide rate were T11 where the high rate had less of an effect than the lower rate (Table 4). The frequency of T0 was greater for the fall banding than the spring banding treatments. The frequency of T3, T01, T11 and T21 was greatest for the sweep than the pre-seed banding treatments. The deeper planting could have favored the sweep treatment in 1997. The timing of the N application, pre-seed vs side-banding at seeding and the 9" or 12" spacing had no effect on the frequencies of the various tillers produced. Relative to the 9" and 12" spacing, with the nitrogen applied during the seeding operation, the sweep treatments had a higher frequency of T3, T11 and T21.

Beaverlodge: Overall tiller development and frequency was much lower at this site than at the other sites. The two rates of herbicides used did not affect the frequency of the tillers present (Table 5). The sweep treatment had a higher frequency of T0 and T1 than the pre-seed banding treatments. The pre-seed banding treatments had similar tiller frequencies as the side-banding treatment and the same for the 9" and 12" spacing with the nitrogen applied in a side-band at seeding time. The frequency of T1 was greater for the sweep than the 9" or 12" spacing.

Table 3. The effects of nitrogen management and herbicide rate on plant development in spring wheat at Brandon in 1997. The values represents the percentage of plant having a particular tiller.

Nitrogen Management	T0		T1		T2		T3		T01		T11		T21	
	100%	66%	100%	66%	100%	66%	100%	66%	100%	66%	100%	66%	100%	66%
Fall banding	16	15	90	90	67	81	21	28	8	0	5	3	0	1
Spring banding	6	13	90	93	76	83	28	20	0	0	3	8	0	3
Side-banding at seeding on 12" spacing	6	6	83	78	69	55	25	15	0	0	5	0	0	0
Side-banding at seeding on 9" spacing	13	9	84	78	78	71	28	30	0	0	5	5	4	0
Sweep	13	13	91	90	87	79	59	53	1	0	20	18	10	11
Mean	**11**	**11**	**88**	**86**	**76**	**74**	**32**	**29**	**2**	**0**	**8**	**7**	**3**	**3**
Contrast[1]														
Herbicide 100% vs 66%	ns		ns		ns		ns		ns		ns		ns	
Fall Banding vs Spring Banding	*		ns		ns		ns		ns		ns		ns	
Sweep vs Pre-Seed banding	ns		ns		ns		***		ns		***		***	
Pre-seed banding vs Side-banding	*		**		ns		ns		ns		ns		ns	
9" vs 12"	ns		ns		ns		ns		ns		ns		ns	
9" vs Sweep	ns		*		ns		***		ns		***		***	
12" vs Sweep	*		*		**		***		ns		***		***	

[1] Values followed by ***, **, * or ns are significant at the p<1%, p<5%, p<10% or not significant.

Table 4. The effects of nitrogen management and herbicide rate on plant development in spring wheat at Melfort in 1997. The values represents the percentage of plant having a particular tiller.

Nitrogen Management	T0		T1		T2		T3		T01		T11		T21	
	100%	66%	100%	66%	100%	66%	100%	66%	100%	66%	100%	66%	100%	66%
Fall banding	31	35	90	98	74	77	3	0	0	0	9	1	0	0
Spring banding	14	21	89	94	76	88	9	11	0	0	6	5	0	0
Side-banding at seeding on 12" spacing	19	29	99	96	90	83	8	8	0	0	0	0	0	0
Side-banding at seeding on 9" spacing	19	23	91	98	79	90	14	4	0	0	3	3	1	0
Sweep	33	29	94	99	89	90	41	26	1	0	31	20	4	4
Mean	**23**	**27**	**93**	**97**	**82**	**85**	**15**	**10**	**0**	**0**	**11**	**6**	**1**	**1**
Contrast[1]														
Herbicide 100% vs 66%	ns		ns		ns		ns		ns		***		ns-	
Fall Banding vs Spring Banding	*		ns		ns		ns		ns		ns		ns	
Sweep vs Pre-Seed banding	ns		ns		ns		***		**		***		***_	
Pre-seed banding vs Side-banding	ns		ns		ns		ns		ns		ns		ns-	
9" vs 12"	ns		ns		ns		ns		ns		ns		ns-	
9" vs Sweep	ns		ns		ns		***		ns		***		**	
12" vs Sweep	ns		ns		ns		***		ns		***		**_	

[1] Values followed by ***, **, * and ns are significant at p<1%, p< 5%, p<10% or not significant.

Table 5. The effects of nitrogen management and herbicide rate on plant development in spring wheat at Beaverlodge in 1997. The values represents the percentage of plant having a particular tiller.

Nitrogen Management	T0		T1		T2		T3		T01		T11		T21		T31	
	100%	66%	100%	66%	100%	66%	100%	66%	100%	66%	100%	66%	100%	66%	100%	66%
Fall banding	3	1	21	25	5	4	0	0	0	0	0	1	0	0	0	0
Spring banding	4	1	14	39	3	15	0	0	0	0	0	0	0	0	0	0
Side-banding at seeding on 12" spacing	5	3	26	20	1	1	0	0	0	0	0	0	0	0	0	0
Side-banding at seeding on 9" spacing	1	4	28	25	1	6	0	0	0	0	0	0	0	0	0	0
Sweep	9	6	53	61	13	18	1	0	0	0	0	0	0	0	0	0
Mean	4	3	28	34	5	9	0	0	0	0	0	0	0	0	0	0
Contrast[1]																
Herbicide 100% vs 66%	ns		ns		ns		-		-		-		-		-	
Fall Banding vs Spring Banding	ns		ns		ns		-		-		-		-		-	
Sweep vs Pre-Seed banding	*		**		ns		-		-		-		-		-	
Pre-seed banding vs Side-banding	ns		ns		ns		-		-		-		-		-	
9" vs 12"	ns		ns		ns		-		-		-		-		-	
9" vs Sweep	ns		**		ns		-		-		-		-		-	
12" vs Sweep	ns		**		ns		-		-		-		-		-	

[1] Values followed by ***, ** , * or ns are significant at the p<1%, p<5%, p<10% level or not significant.

References:

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Weed Community Analysis

prepared by D. Derksen and K. McGillivray

Broadleaf and grass weeds species were present within the study. Species perennation included annual, biennial, and perennial. Both native and introduced species were present. The weed communities were reflective of the agroecological zone in which the research was conducted.

The number of individual weeds were counted by species prior to seeding, at the seedling stage, and at maturity. Counts were conducted in twenty quadrats randomly placed quadrats following a "W" pattern across each plot. Total weed densities were calculated as the average density of all individuals of all species per metre squared in each plot. In order to assess spacial as well as density aspects of the weed community, relative abundance values were calculated by species per plot and averaged by experimental factor, such as fertilizer treatment. Relative abundance was calculated as: (relative density + relative frequency)/2. Relative density was calculated as: number of individuals for a given species within the 20 quadrats for each plot divided by the total number of individuals within the plot. Relative frequency was calculated as the proportion of quadrats in which the species was present per plot divided by the total frequency of all species.

Summary of results

In general, the reduced rate of herbicide applied in 1996 did not result in greater weed recruitment prior to crop seeding or in-crop spraying in 1998; however, weed densities were greater in reduced rate plots after herbicide application in 1998 at Melfort and Beaverlodge. The lack of difference between reduced and full rate herbicide usage at Brandon may be due to the lower overall weed density at this site.

The impact of fertilizer timing, placement, and level of soil disturbance on weed densities varied by site. Weed densities were greater in sweep treatments in canola, but not necessarily in wheat. In some cases sweep seeding resulted in more weeds present at the time of in-crop spraying while in other cases densities were greater in the July counts. This may be due to the timing of seeding in relation to soil temperature and weed seedling recruitment (ie emergence patterns). Research at Brandon, indicated that weed seedling recruitment patterns were similar for fall and side banded treatments, but were different in the sweep treatments (Figures 1, 2, and 3). Seeding with sweeps resulted in a greater number of weeds emerging earlier.

At Melfort and Brandon, weed densities were greater prior to seeding or in-crop spraying in the two pass seeding systems where fertilizer was random banded in the fall or spring compared to the side banded treatments. At Melfort, weed densities were greater in the 12" side banded plots compared to the 9" side banded plots, while the reverse was true at Beaverlodge. Hopefully, future data will aid in the understanding of this anomaly.

Brandon

Prior to crop seeding, weed densities were similar in all treatments for wheat (Tables 1, 4-18). Weed densities were higher in the fall and spring band treatments for canola. Herbicide input level the previous year did not affect weed densities before seeding.

Prior to in-crop herbicide application weed densities were again similar in all treatments for wheat with the fall and spring band having greater weed densities than the side band or sweep treatments. Herbicide input level the previous year did not affect weed densities before seeding.

July weed counts revealed that weeds densities were greater in the side banding treatments for wheat compared to random banding in the fall or spring. In canola plots, weed densities were greater in the spring band compared to fall banding and were highest in the sweep treatments, due to high levels of soil disturbance and low crop stands. Reducing herbicide rates did not significantly increase weed densities.

Melfort

Prior to crop seeding, weed densities were greater for fall banded versus spring banded treatments in wheat, with the spring banding treatment having the lowest weed density of all treatments (Tables 2, 19-33). Side banding on nine or twelve inch row spacings had more weeds than the sweep treatment. Herbicide input level the previous year did not affect weed densities before seeding. Weed densities in canola were similar for all treatments.

Prior to in-crop herbicide application, the sweep treatments had the highest weed densities in the wheat plots. Spring banding treatments had higher weed densities than fall banding with side banding treatments being intermediate between fall banding and sweep treatments. Herbicide input level the previous year did not affect weed densities before seeding for wheat or canola. Spring banding treatments had greater weed densities than the other canola plots which were not different from one another.

July weed counts revealed that weed densities in the reduced herbicide rate plots in canola and wheat were higher than where the full rate was used. In wheat, weed densities were greater in fall banding and the 12" row spacing plots compared to other treatments (especially at reduced herbicide rates). In canola, the weed densities were lower in the side banded treatments with reduced herbicide rate compared to random banding in the fall or spring and to sweep treatments.

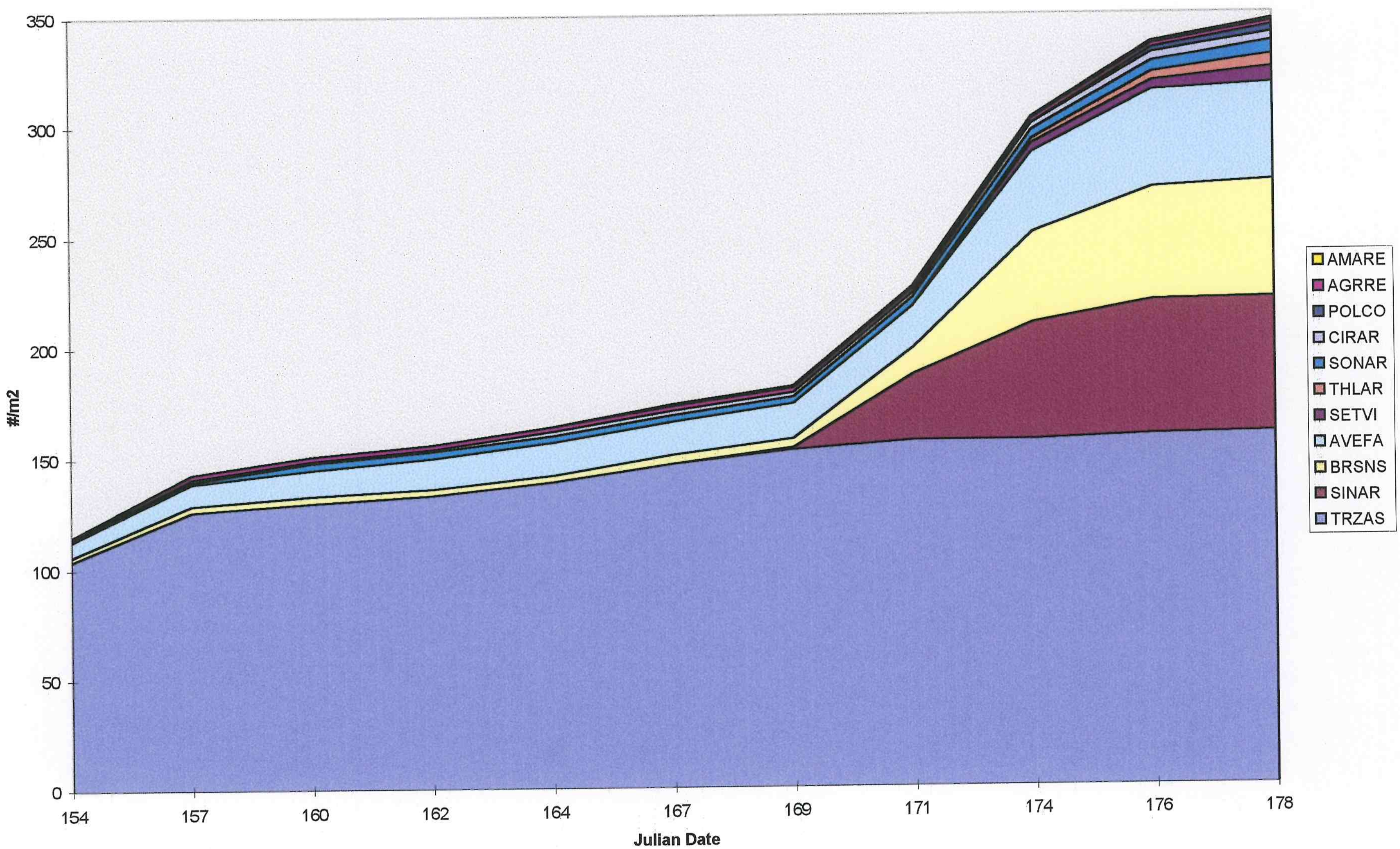
Beaverlodge

Prior to crop seeding, weed densities were greater for fall banding compared to spring banding in wheat with all other plots having similar densities. Weed densities were similar in all canola plots (Table 3, 34-48). Herbicide input level the previous year did not affect weed densities before seeding for either canola or wheat.

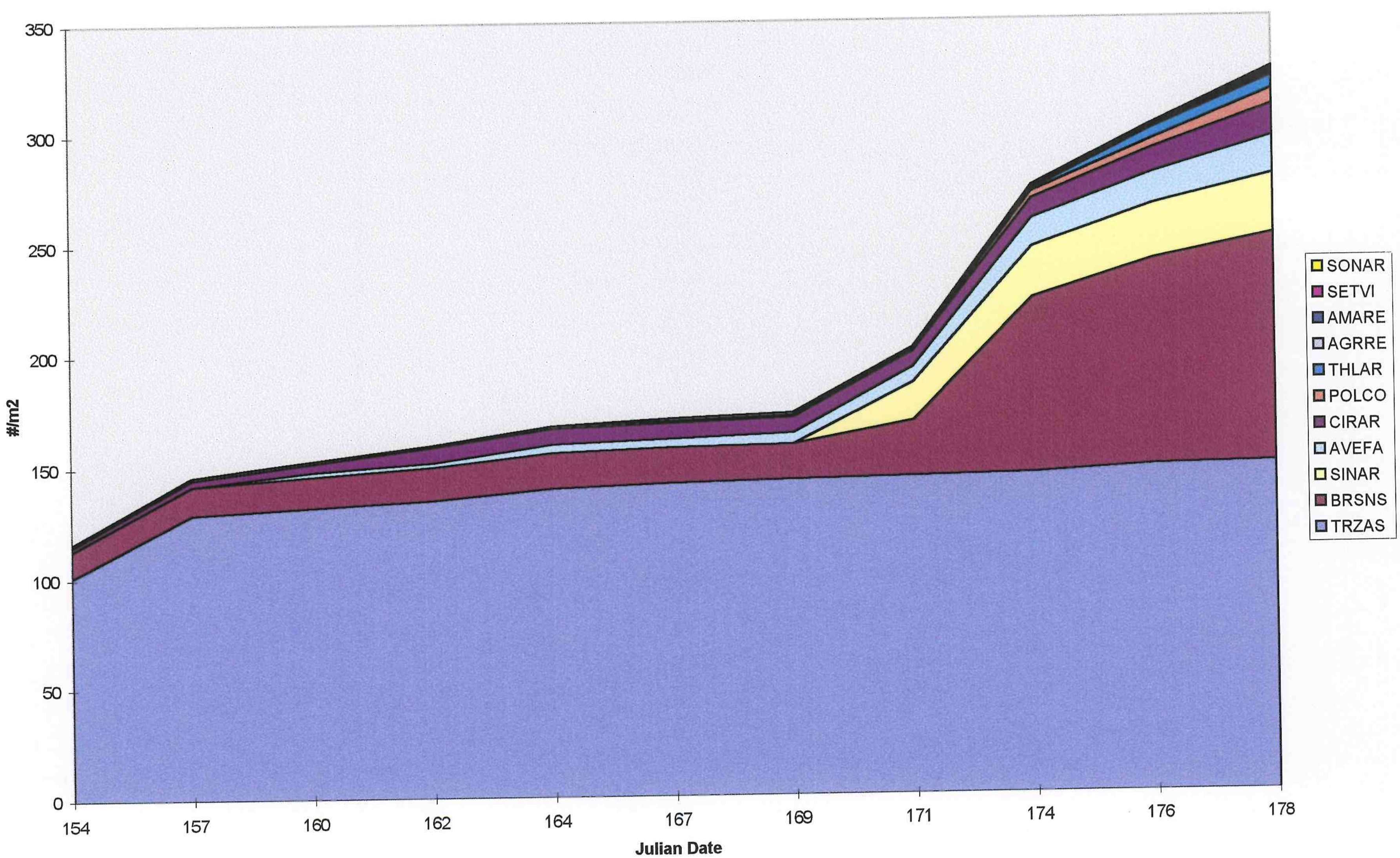
Prior to in-crop herbicide application, weed densities were similar in wheat except for the low-input 9" side band which had higher densities of weeds compared to the low-input 12" side band treatment. In canola, fall banded treatments had more weeds than spring banded treatments, 9" side banding had more weeds than 12" side banding, and the sweep treatments had the greatest number of weeds. Herbicide input level the previous year did not affect weed densities before seeding in wheat or canola.

July weed counts revealed that the low herbicide rate treatments had more weeds than the full rate treatments in canola, but not in wheat. Fertilizer treatments did not significantly impact weed densities at this stage in either wheat or canola.

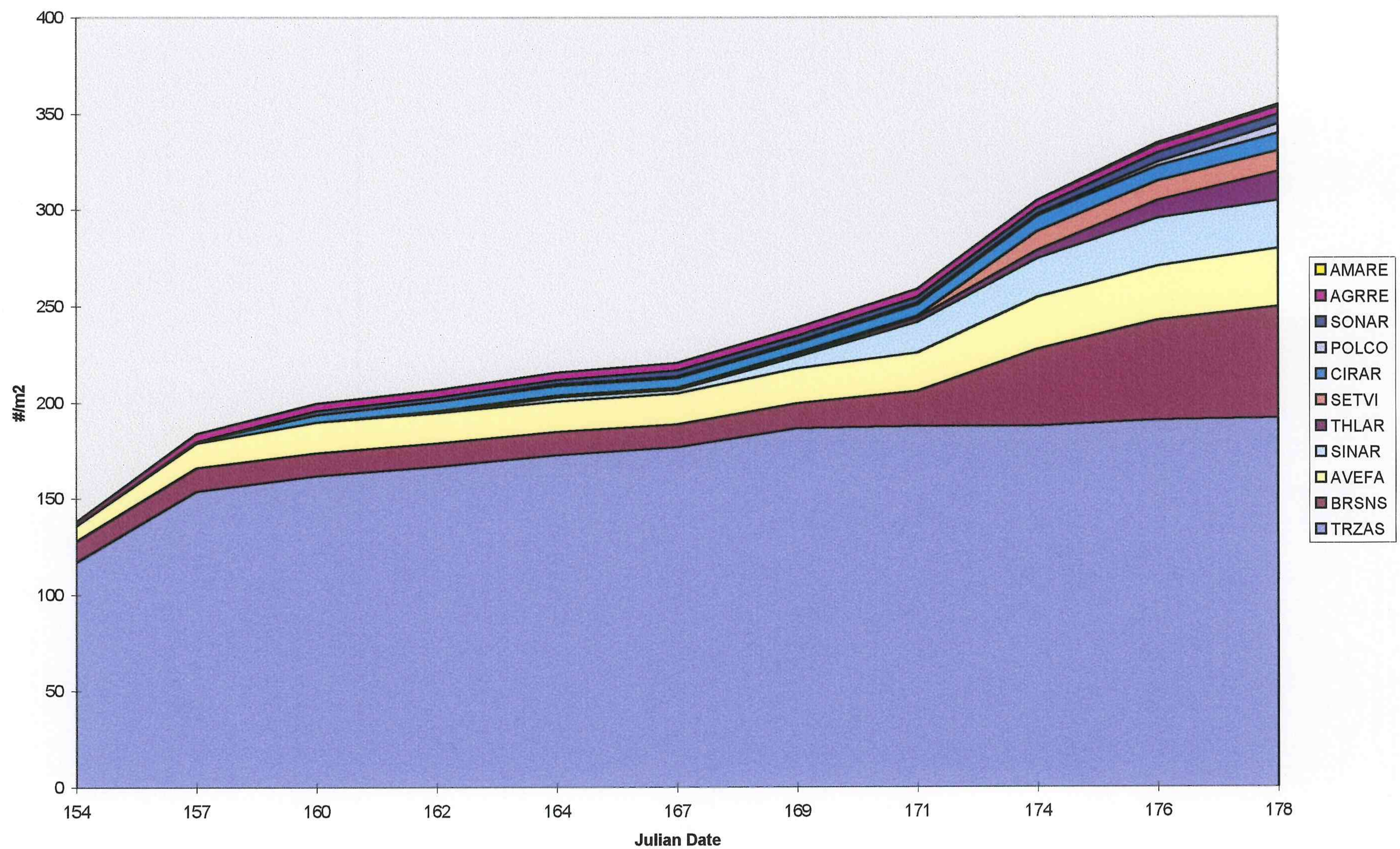
Weed Emergence on Fall Band Treatment



Weed Emergence on 9" Side Band Treatment



Weed Emergence on Sweep Treatment



MB-09

Fertilizer by Weed Management Study:

1997
Annual Report

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Forward

The Fertilizer by Weed Management Study was initiated to determine the effect of fertilizer timing and placement in conservation tillage with weed management. The major sponsor of the project is the Canadian Fertilizer Institute with Monsanto Canada Inc. and Ciba Canada Inc. providing additional support.

Note: The data presented within this report are preliminary in nature and should not be taken out of context from other research. Basic agronomic and weed management data are presented in this report. Additional information will become available from further laboratory analysis of 1997 samples. The data from other years and further statistical analysis are required before the data can be generalized. The data should not be used without the permission of the authors.

Executive Summary

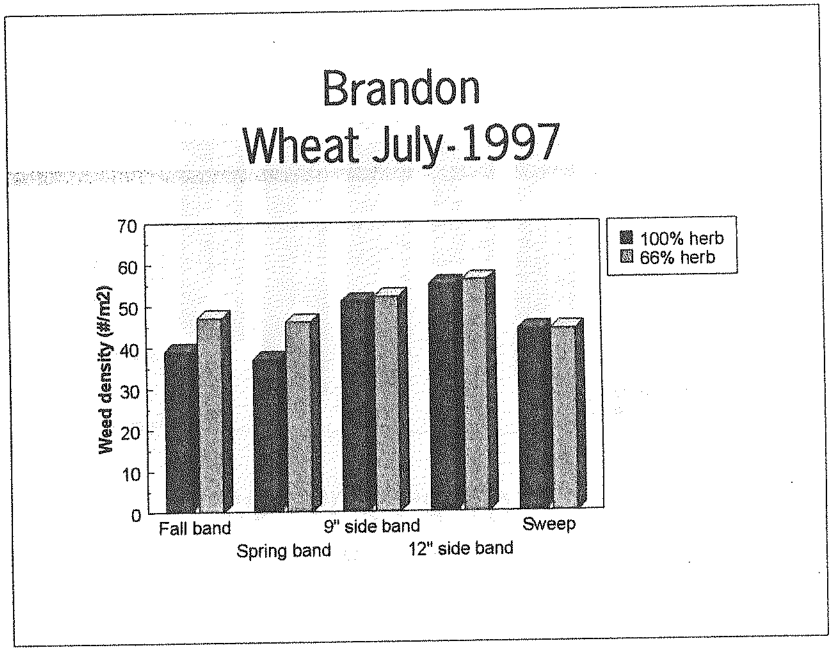
1997 saw the completion of year two of the Fertilizer by Weed Management Study, a joint venture among Agriculture and Agri-Food Canada, the Canadian Fertilizer Institute, Novartis Canada Inc, and Monsanto Canada Inc. Management studies were conducted at Brandon, Melfort, and Beaverlodge to address the issue of the effect of timing, placement, and soil disturbance level of nitrogen fertilizer application on weed management. Field and growth room research on the impact of MAP and KCl on weed competition was conducted as part of an MSc. program by Kristen Callow.

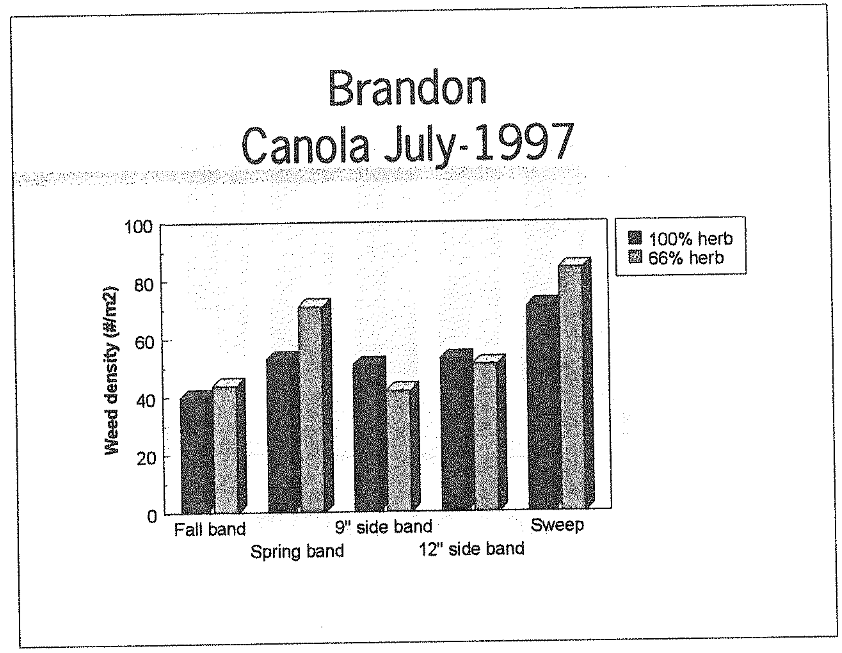
Results from the nitrogen management study indicated that no single N fertilizer management approach provided the best crop establishment or yield at all three sites. Generally the poorest results occurred in the treatments seeded with sweeps, especially for canola. For the first time the twelve inch row-spacing side banded treatment performed poorer than the side banded nine inch row-spacing treatments. This occurred at Brandon and Melfort and was particularly evident in the canola crop. Fall banding out performed spring banding in wheat at Beaverlodge. The reverse was true at Melfort while the two random bands performed similarly at Brandon. The reduced herbicide rate treatments provided similar yields to full rate treatments for wheat and canola at Brandon and Melfort, but lower yields occurred at Beaverlodge, particularly in wheat. Research on wheat development at the three sites indicated that wheat was generally seeded deeper in the sweep treatments. Plant development, as measured by Haun stage, indicated that herbicide rate did not influence development at any site. Similarly, fertilizer management did not influence plant development at Brandon and Melfort; however, at Beaverlodge the sweep seeded plots developed the fastest while the twelve-inch side-banded treatments developing the slowest.

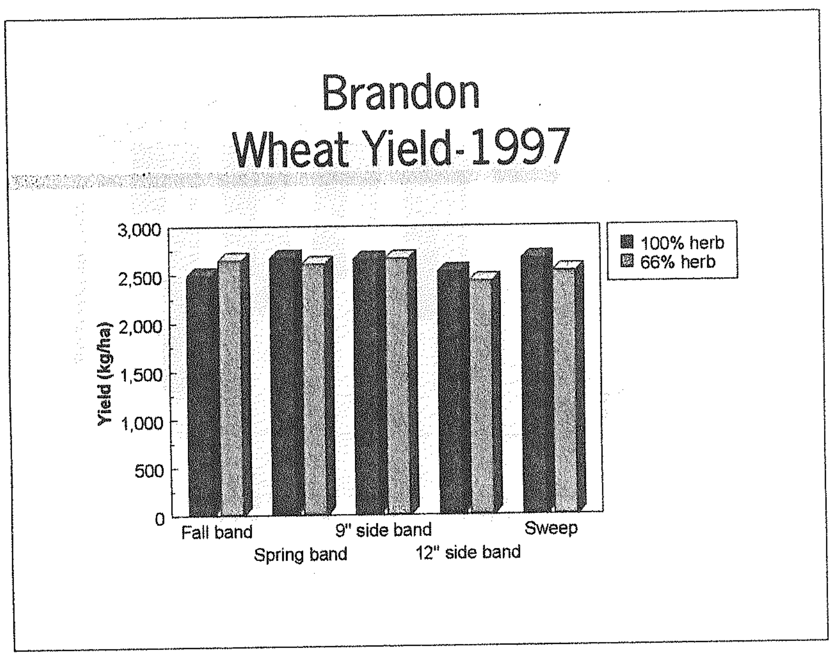
In general, the reduced rate of herbicide applied in 1996 did not result in greater weed recruitment prior to crop seeding or in-crop spraying in 1998; however, weed densities were greater in reduced rate plots after herbicide application in 1998 at Melfort and Beaverlodge. The impact of fertilizer timing, placement, and level of soil disturbance on weed densities varied by site. Weed densities were greater in sweep treatments in canola, but not necessarily in wheat. In some cases sweep seeding resulted in more weeds present at the time of in-crop spraying while in other cases densities were greater in the July counts. This may be due to the timing of seeding in relation to soil temperature and weed seedling recruitment (ie emergence patterns). At Melfort and Brandon, weed densities were greater prior to seeding or in-crop spraying in the two pass seeding systems where fertilizer was random banded in the fall or spring compared to the side banded treatments. At Melfort, weed densities were greater in the twelve inch side-banded plots compared to the nine inch side-banded plots, while the reverse was true at Beaverlodge.

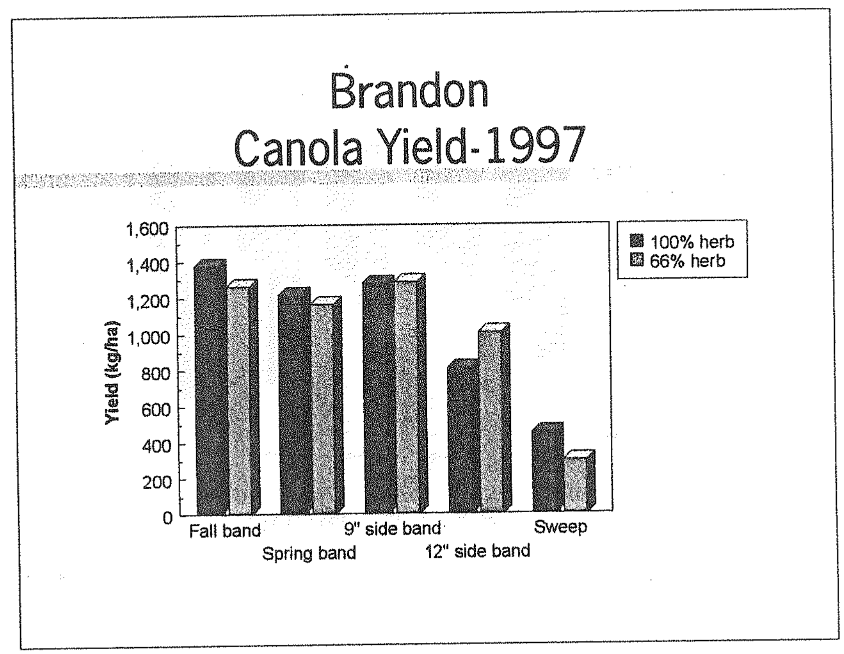
An initial economic analysis was conducted on the Brandon 1997 data to determine the appropriateness of using an economic contribution approach. This approach subtracts the costs of production from gross returns. The cost of production were determined by adding the cost of field operations based on the Saskatchewan Custom Rate Guide to the actual cost of purchased inputs. Gross returns were determined using crop yield and grade to calculate dollar returns per hectare. The analysis indicated similar returns for treatments in wheat with the nine inch side band treatment performing the best and good returns from canola seeded on random fall or spring fertilizer bands and the nine inch side band treatment.

Data from one field season on the impact of MAP and KCl on wild oat competition in wheat and flax indicated that the crops grown at the sandy loam site were more responsive to fertilizer than at the clay loam site, that wheat was more consistent in its fertilizer response than flax, as rates of fertilizer increased the expected yield decline did not occur, side banding provided higher yields than seed placed fertilizer, and that the presence of wild oats reduced crop yield. More detailed research on the relative response of wheat, flax, and wild oat to MAP and KCl has been initiated in growth chambers.

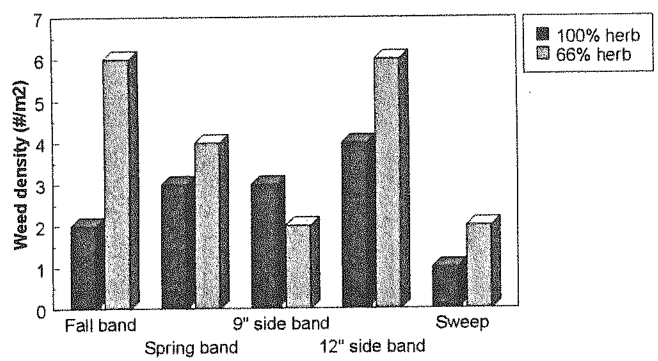

Brandon
Wheat July-1997
Weed density (#/m2)
0
10
20
30
40
50
60
70
Fall band
Spring band
9" side band
12" side band
Sweep
100% herb
66% herb


Brandon
Canola July-1997
Weed density (#/m2)
0
20
40
60
80
100
Fall band
Spring band
9" side band
12" side band
Sweep
100% herb
66% herb

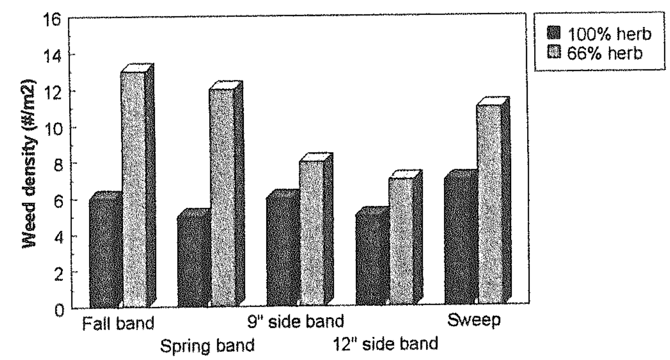

Brandon
Wheat Yield-1997
Yield (kg/ha)
0
500
1,000
1,500
2,000
2,500
3,000
Fall band
Spring band
9" side band
12" side band
Sweep
100% herb
66% herb


Brandon
Canola Yield-1997
Yield (kg/ha)
0
200
400
600
800
1,000
1,200
1,400
1,600
Fall band
Spring band
9" side band
12" side band
Sweep
100% herb
66% herb

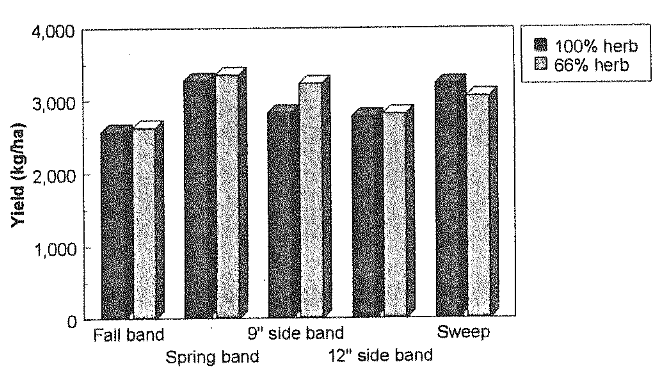
Melfort
Wheat July-1997



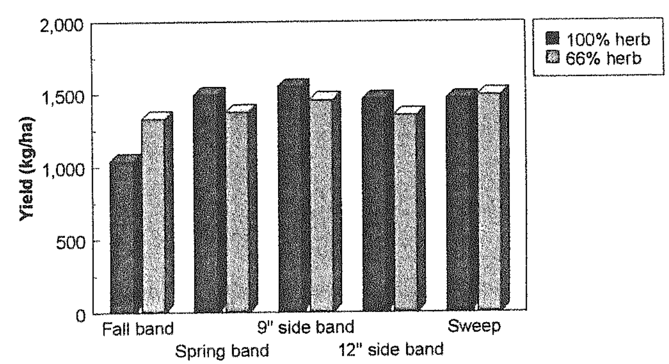
Melfort
Canola July-1997

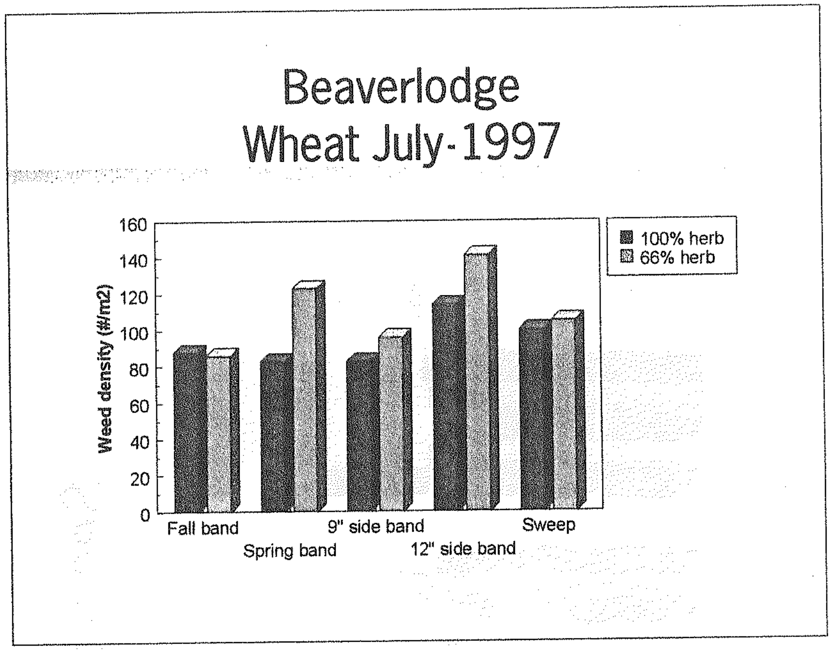


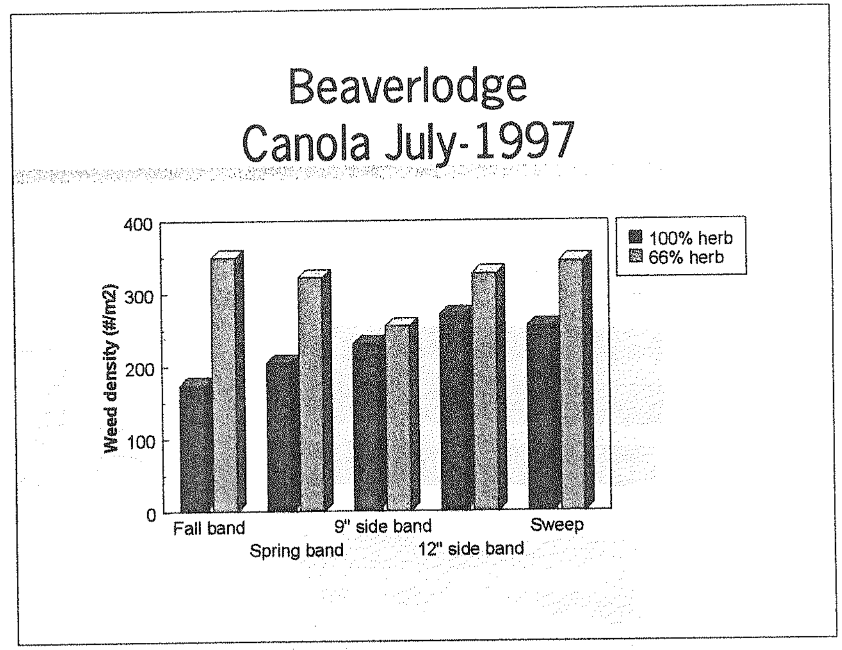
Melfort
Wheat Yield-1997

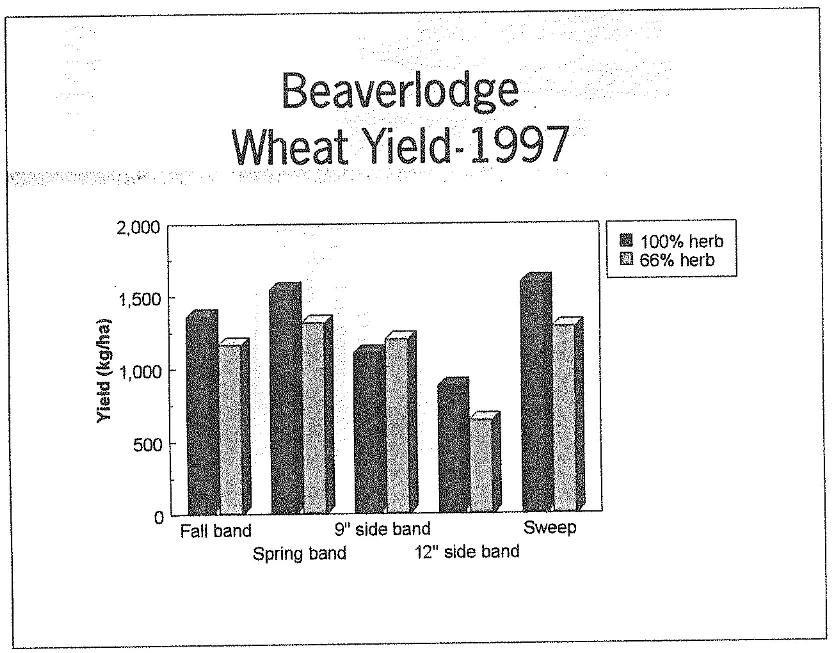


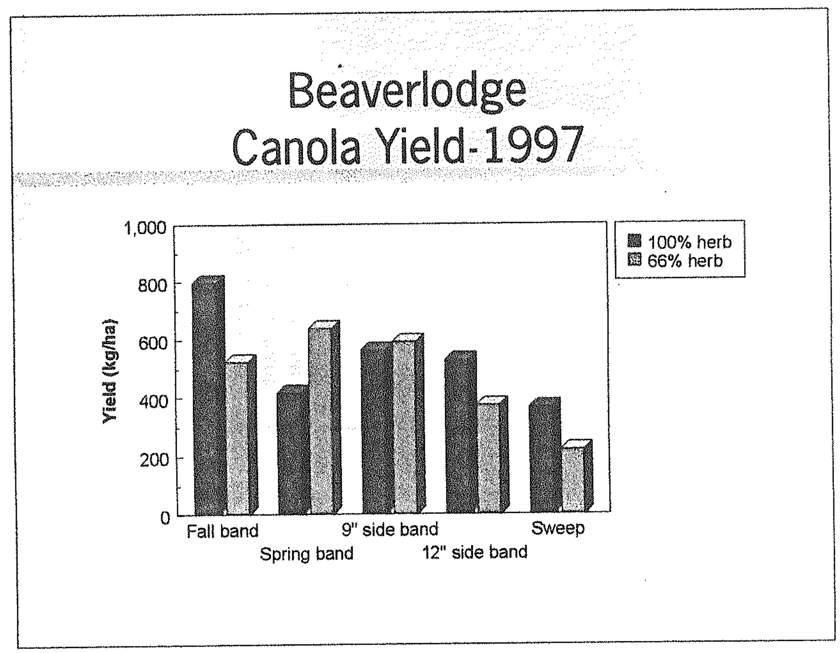
Melfort
Canola Yield-1997



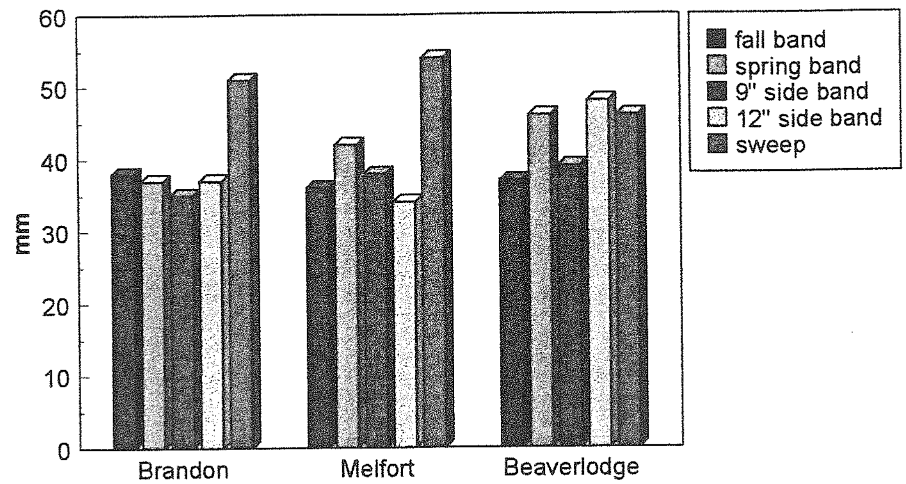

Beaverlodge
Wheat July-1997
Weed density (#/m2)
0
20
40
60
80
100
120
140
160
Fall band
Spring band
9" side band
12" side band
Sweep
100% herb
66% herb


Beaverlodge
Canola July-1997
Weed density (#/m2)
0
100
200
300
400
Fall band
Spring band
9" side band
12" side band
Sweep
100% herb
66% herb

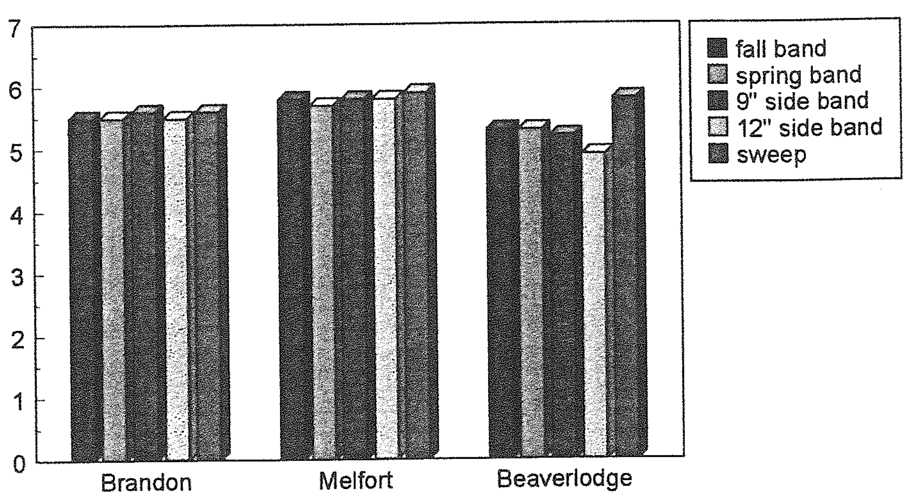

Beaverlodge
Wheat Yield-1997
Yield (kg/ha)
0
500
1,000
1,500
2,000
Fall band
Spring band
9" side band
12" side band
Sweep
100% herb
66% herb


Beaverlodge
Canola Yield-1997
Yield (kg/ha)
0
200
400
600
800
1,000
Fall band
Spring band
9" side band
12" side band
Sweep
100% herb
66% herb

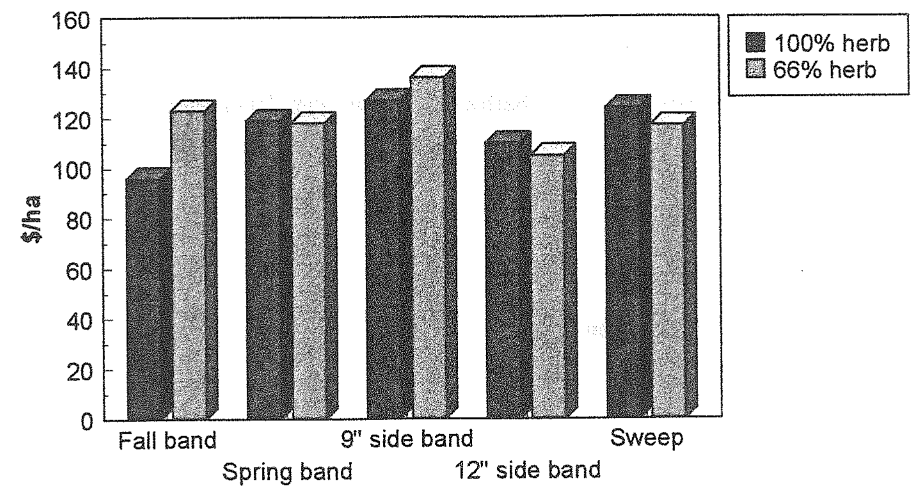
Seeding Depth



Haun Stage of Spring Wheat 100% Herbicide Rate



Brandon
Net Returns Wheat - 1997



Brandon
Net Returns Canola - 1997

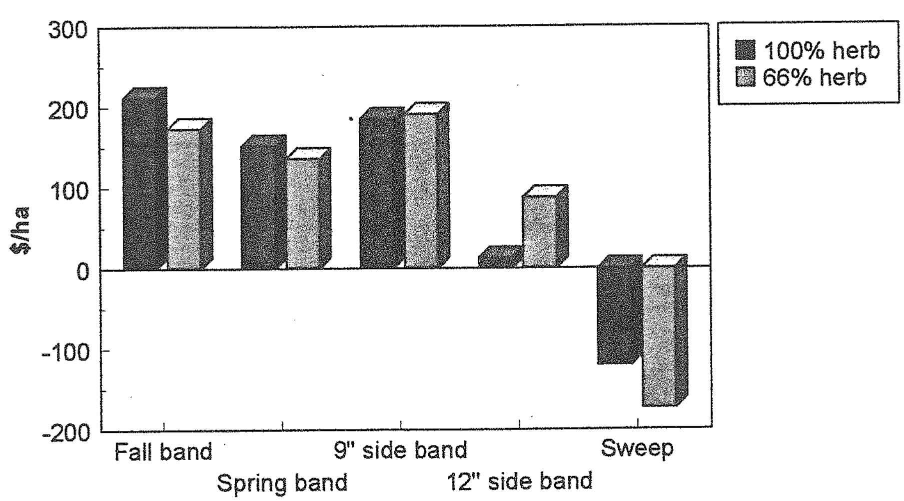


Table of Contents

Introduction

Objectives:

1) To determine the impact of fertilizer placement and timing in direct-seeding systems on N fertilizer-use efficiency, herbicide usage, and weed communities. This objective is being met through the establishment of a short-term management study in three agroecological zones of the Black soil zone.

2)To determine the impact of P and K fertilizer on weed-crop competition. This objective is being met through a graduate student MSC. thesis project.

Background:

Direct-seeding systems are the most rapidly evolving agricultural technology in western Canada. Direct economic and soil conservation benefits have been documented at the farm and research level and have become the driving forces behind producer adoption of these conservation-tillage systems. Because the term direct seeding encompasses a broad range of one- and two-pass fertilization and seeding systems, questions have arisen regarding the relative efficiency of these different approaches. The most commonly asked questions relate to the effects of soil disturbance and fertilizer placement on crop yields, weed management, and production economics.

Potential Impact and Benefits:

The project will provide a knowledge base for efficient fuel, fertilizer, and herbicide usage thereby optimizing net-returns at a cropping-systems level for the Black Soil Zone. The data generated from this research will be the largest data base dealing in an integrated manner with the impact of fertilizer placement on weeds in direct-seeding systems and will be of interest to producers and the agro-industry. The principles elucidated will have regional and national application. The commercialization of this knowledge will occur through field days, presentation at grower meetings, and through the publication of results in the farm press, industry and extension publications and scientific journals. As decision support systems are developed, this data will be useful for predicting the response of crops, weed communities, and soils to direct-seeding systems and recommending appropriate management options.

Project Description:

I) Protocol for Management Studies:

a) General description:

The management studies were set up in a split-split plot design with 4 replicates. Plots were 7.3m X 15.0m in size. Crops (wheat and canola) were the main plot, fertilizer placement was the sub-plot, and herbicide rate was the sub-sub plot. For the sake of statistical analysis, all agronomic data was analysed by crop separately. Once several years of data are collected, weed community analysis by multivariate ordination will be done with using all plots in the analysis (wheat and canola plots used together).

In order to reduce site to site variability, seeding was done at all sites using identical seeders. Conservapak zero-tillage air seeders setup to seed on 9 inch and 12 inch row spacings were used (one pair of seeders at each site). For the sweep seeding, sweeps were purchased from a common sourse and used at all locations.

b) Core Treatments at each site:

-each of the following fertilizer treatment will be conducted in wheat and canola at 100% and 66% of in-crop herbicide rates with treatments being continuous (in same plot with crop rotating annually) for 5 years (1 startup year plus 2 cycles of crop rotation).

Treatment	Spacing of fertilizer (in)	Row spacing of seed (in)
fall band	12	9
spring band	12	9
side band at seeding	9	9
side band at seeding	12	12
one pass sweeps	9	9

Note; additional fertilizer treatments have been added at Melfort and Beaverlodge but are not summarized in this years report.

c) Agronomic Information:

I)Fertility: 66% of soil test recommendations for N

-approximately 85lb/ac at Melfort, 70 lb/ac at Beaverlodge, 65 lb/ac at Brandon

-P_2O_5: recommended rate (adjust N)

-S: elemental as required

ii)Crops: Teal wheat-common source from Melfort

Seed at 2 bu/ac (160 kg/ha)

Quest RR canola- common source from Monsanto

Seed at 7 kg/ha plus Furadan or Counter

iii)Herbicides: Pre-seeding, pre-harvest, and post-harvest as required at each site

In-crop use common treatments

Roundup in canola (1.24L/ha (0.5 l/ac) = 1X, 0.82L/ha=66%)

Horizon plus target in wheat

(Horizon rate wild oat rate 230ml/ha(56gai/ha)=1X and reduced rate of 172.5ml/ha=75%X and 60% of wild oat and green foxtial rate). Reduced rate for Horizon changed based on dose response information from Ciba's data base. Target is to be used as a tank mix (it should control most weeds at all sites). 1X rate = 1.0 L/ha and 66% =0.66L/ha (Note that 1.0l/ha is at the low end of the recommended range, but should still suppress cleavers and other difficult to control weeds).

iv)Fungicides: As needed at each site

d)Data Collection:

I)Crop data: -crop stand prior to tillering (4-1m row counts per plot for wheat & canola using 4-0.25 m2 quadrats per plot for sweeps)

-head count 4 1m row per plot in wheat

-crop height in canola and wheat

ii)Haun Stage (wheat only):

-Haun stage and depth of seeding at 5-6 lf stage (GS 32 start of elongation) in full and reduced rate herbicide plots. Collect 20 plants/plot at 5-6 leaf stage in wheat.

iii)Nutrient dynamics:

-biomass at heading of weeds and crop

-1 of $1m^2$ quadrat per plot (separate weeds and crop) dry weight (also give biomass data to Derksen for weeds) and send ground samples to Grant (need about 25 grams, but for weeds send what there is).

iv)Yield: -per plot

-seed quality (1000k count, protein, green seed in canola, etc?)

-oil content for canola at Beaverlodge ??

e)Soil Sampling:

-soil moisture: 0-6, 6-12, 12-24, 24-36 spring and fall

-archive samples each year

-soil fertility: fall for N and P

0-6 and 6-24

f)Weeds:

-for counts use 20 0.5 X 0.5 m^2 (0.25m^2) quadrats per plot (always take the same # crop rows per quadrat). For very dense weed species devide quadrat into 4, count in one quarter of the quadrat, and multiply by 4 for density per quadrat on input sheets.

-count all weeds by species (density/quadrat)

Pre-seeding, pre-spray (in-crop), and residual weed community (July)

-send electronic files to Derksen for analysis (format to be sent out)

-emergence: estimate number of days difference in emergence between each dominate weed and the crop (Derksen will do detailed emergence sampling)

-need a weedy check in each plot (make tarp to cover about 2m^2 so that a 1m^2 weedy quadrat remains after spraying. Need a weed count at spraying and in July in this quadrat that is separate from "20 quadrat" count. Harvest and thrash separately from main plot to obtain an estimate of crop yield loss due to weeds (i.e., sample of crop yield, weed yield)

-crop tolerance 7 DAT on 0-100 ECW scale for wheat and canola

1997 Results

Crop Agronomy

prepared by Adrian Johnston and George Clayton

Brandon

Growing conditions started out drier than normal in May and June, however, improved with above average precipitation in July. Air temperatures were above normal through the June to August growing period. Poor crop emergence was recorded with the sweep seeded treatment, likely a result of the poor spring rainfall conditions (Table 1). However, this was not reflected in subsequent wheat grain yield or protein. Spring banding prior to seeding, and side banded on 9" row spacing, were the best yielding wheat treatments, while side banding on 12" spacing was the lowest yielding treatment. No significant difference was recorded in crop emergence, grain yield or grain protein as a result of reduced herbicide rate. Poor spring moisture conditions negatively influenced canola crop emergence with sweep seeding (Table 2). Canola seedling stand was also low with the 12" side band drill, reflecting the impact of high N rates close to the seed row with this crop (Johnston et al., 1997). These reduced seedling stands were reflected in lower canola grain yields, and higher grain protein. Dockage assessment of the canola samples revealed high levels of wild mustard, resulting in the low grain yield. It was surprising to see the 12" side band treatment grain yields as being lower than the other treatments, as past research has generally found that the canola crop could compensate for poor plant stand with increased branching.

Melfort

The 1997 growing season in Melfort was good to excellent. With the exception of some high temperatures in late-July and early-August, there was good rainfall distribution. Area producers report canola (35-40 bu/ac) and wheat (45-50 bu/ac) yields as above average. We changed our method of harvesting this study in 1997, with a full 12' swath taken from the full 50' length of each plot. This was done to overcome any problems which may occur as a result of the various row spacing and sweep placement seeding methods used. For spring wheat, our crop emergence and grain yields were good, and our grain protein concentration indicates that we certainly are not over fertilizing our crop (Table 1). Wheat seedling emergence varied widely between treatments, with 9" side banding having the best stand, while the 12" side banding had the poorest stand. Similar to Brandon, we also recorded a poor wheat seedling stand with the sweep treatment. The low seedling numbers for the 12" side band at Melfort may be due to the short banding point we use on the drill. We substituted a shorter and narrower knife to avoid excessive soil disturbance when using the stock side banding knives on the Conserva-Pak seeder at the silty clay soil site. It would appear that we may not achieving adequate seed - fertilizer separation. Low grain yields and protein with fall band application indicate that there were overwinter losses of N with this treatment. While a poor seedling stand was recorded for the sweep treatment it appeared to have compensated for this by yielding with the best treatments. However, with the 12" side banding drill the poor seedling stand appears to have been reflected in poor grain yield, indicating that it was likely a fertilizer damage problem.

The canola story at Melfort in 1997 was really an unfortunate example of poor quality control. We received our canola seed in mid-May, and ended up with year old Quest canola seed from Monsanto. While the seed had reasonable germination (80%), it had very poor vigour (30%) resulting in a disastrous canola stand, and subsequent grain yield. We have expressed our disappointment to the local Monsanto Research Rep. (Rob Neyedley) about the seed and do not anticipate a problem in 1998. Canola seedling stands were similar to wheat, with the sweep and 12" side banding treatments having the poorest seedling stands. However, unlike the wheat this was not reflected in grain yield as these treatments were grouped with the highest yielding treatments. Fall banding of N had the lowest grain yield, again reflecting our results with spring wheat and our speculation of significant overwinter losses of N at this location. As recorded in 1996, herbicide rate had no effect on canola grain yields recorded.

Beaverlodge

The 1997 growing season was much like 1996 in that it was cold, wet and very difficult to get good seedbed conditions, particularly in direct seeding situations. Weed control in the area was inconsistent and weeds germinate and grew throughout the growing season. Consequently crop competition was important in 1997. Yields in the area were generally poor, harvesting was late or not at all and a number of hail storms travelled through the area in late September. The CFI trial site received a small amount of hail after the crop was swathed and before combining which resulted in some loss in the canola but left the wheat relatively unaffected.

For spring wheat, our crop emergence was relatively good except for the sweep treatment, which resulted in significantly less emergence than the emergence from the knife openers. Wheat yields ranged from 759 to 1439 kg/ha, poor yields for the second year in a row, a situation familiar with area producers in 1996 and 1997. Yield of wheat was significantly higher from the spring band, fall band and sweep treatment compared to low disturbance one pass seeding on 9 and 12" row space (Table 1). The poor emergence with the sweep treatment was not reflected in the final grain yield, a result much like that at Brandon in 1997. Herbicide rate resulted in significantly different wheat yields with the lower herbicide rate causing yield reductions. The herbicides were not that effective in Beaverlodge in 1997, mainly due to constant germination of weeds throughout the growing season. Consequently, the lower rate resulted in even more competition with the group, reducing yields further. Better growing conditions would have resulted in better crop competition than what occurred in 1997, a different result could be expected. Protein content ranged from 14.8 to 15.5% in wheat with the sweep treatment resulting in protein content of wheat that was less than from the treatments that were seeded with a knife opener. Canola yields ranged from 296 to 798 kg/ha, a result due to hail damage that occurred at least twice on the swath prior to combing (Table 2). The sweep treatment resulted in the lowest yield and fall banded fertilizer resulted in the highest yields. Grain protein was lower than what occurred at Melfort or Brandon, however the relationship between protein content and oil content is yet to be examined. There were no significant differences in oil content, which ranged aound 50% (data not shown).

References

Johnston, A.M., G.P. Lafond, J.T. Harapiak, and W.K. Head. 1997. No-till spring wheat and canola response to side banded anhydrous ammonia at seeding. J. Prod. Agric. 10: 452-458.

Objective A) Field Project

1) Summary of Production Information:

Location	Crop	Seeding Rate (kg/ha)	Fertilizer Rates (kg/ha)	Seeding Date	Harvest Date
Brandon	Wheat	120	46-0-0 @ 120 11-51-0 @ 50 0-0-0-90 @ 50	20/05/97	03/09/97
	Canola	7	46-0-0 @ 120 11-51-0 @ 50 0-0-0-90 @ 10	20/05/97	02/09/97
Melfort	Wheat	134	46-0-0 @ 140 11-51-0 @ 40	25/05/97	10/09/97
	Canola	7	46-0-0 @ 140 11-51-0 @ 40	25/05/97	09/09/97
Beaverlodge	Wheat	120	46-0-0 @ 130 11-51-0 @ 30	05/05/97	Swathed 04/09/97 Combined 25/09/97
	Canola	7	46-0-0 @ 130 11-51-0 @ 30	06/05/97	Swathed 04/09/97 Combined 25/09/97

2) Herbicide Information:

Location	Crop	Pre-seeding treatment (L/ha)	Date of Application	In-crop treatment (L/ha)	Date of Application
Brandon	Wheat	RoundUp 1.24 L/ha + 2,4-D 0.56 L/ha	16/05/97	Horizon + Target 1X and Reduced	11/06/97
	Canola	RoundUp 1.24 L/ha	16/05/97	RoundUp 1X and Reduced	16/06/97
Melfort	Wheat	RoundUp 1.24 L/ha + 2,4-D 0.56 L/ha	26/05/97	Horizon + Target 1X and Reduced	26/06/97
	Canola	RoundUp 1.24 L/ha	26/05/97	RoundUp 1X and Reduced	17/06/97
Beaverlodge	Wheat	RoundUp 1.24 L/ha + banvel 108 ml/acre 2,4-D 224 ml/ac	02/05/97 10/05/97	Horizon + Target 1X and Reduced	10/06/97
	Canola	RoundUp 1.24 L/ha	02/05/97	RoundUp 1X and Reduced	10/06/97

3) Agrometeorology

Location	Month	L-Term Average Precipitation (mm)	1997 Precipitation (mm)	L-Term Average Temperature (EC)	1997 Monthly Average Temperature (EC)
Brandon	May	49.0	14.4	10.8	9.5
	June	79.3	53.0	15.9	18.9
	July	73.0	98.0	19.0	19.6
	August	64.5	45.0	17.6	18.2
Melfort	May	41.4	31.0	10.6	8.8
	June	61.9	96.7	15.5	16.8
	July	66.6	48.6	17.6	18.5
	August	53.1	41.0	16.3	18.4
Beaverlodge	May	38.9		9.7	
	June	63.6		13.3	
	July	46.9		15.4	
	August	55.2		14.3	

Table 1. Wheat seedling establishment, grain yield and protein response to fertilizer N placement and herbicide rate at Brandon, Melfort and Beaverlodge, 1997.

Locations		Brandon			Melfort			Beaverlodge		
Treatments		Seedlings	Grain Yield	Grain Protein	Seedlings	Grain Yield	Grain Protein	Seedlings	Grain Yield	Grain Protein
N. Plmt.	Herbicide	Plants/m2	Kg/ha	%	Plants/m2	Kg/ha	%	Plants/m2	Kg/ha	%
1. Fall banded	Full	173	2499	14.2	231	2573	10.6	264	1360	15.5
	2/3	177	2647	14.3	249	2622	10.4	278	1163	15.6
2. Spr. banded	Full	167	2679	13.9	231	3275	11.3	286	1545	15.4
	2/3	170	2609	14.0	227	3356	11.6	247	1316	15.5
3. 9" side bd	Full	172	2660	14.0	276	2832	11.3	263	1107	15.1
	2/3	174	2664	14.1	272	3231	11.6	219	1199	15.2
4. 12" side bd	Full	177	2531	14.1	154	2779	11.3	282	879	15.8
	2/3	186	2427	14.4	162	2816	11.2	266	640	15.1
5. Sweep	Full	140	2644	14.0	214	3235	11.7	177	1592	14.8
	2/3	135	2532	14.1	184	3051	11.2	180	1286	14.7
1. Fall banded		175 a	2573 ab	14.2	242 b	2601 c	10.4 b	272 a	1261 ab	15.5 a
2. Spring banded		168 a	2644 a	14.0	229 b	3315 a	11.4 a	266 a	1431 a	15.4 a
3. 9" side banded		173 a	2662 a	14.1	274 a	3060 ab	11.5 a	241 a	1153 b	15.1 ab
4. 12" side banded		182 a	2479 b	14.2	158 d	2798 bc	11.2 a	274 a	759 c	15.5 a
5. Sweep		138 b	2588 ab	14.0	199 c	3143 a	11.5 a	178 b	1439 a	14.8 b
Full herbicide		166	2603	14.0	218	2965	11.3	254	1297 a	15.3
2/3 Herbicide		168	2576	14.2	219	3015	11.2	238	1121 b	15.2
Pr>f Fert tmt		0.0003	NS	NS	0.0001	0.0003	0.0005	0.0011	0.0001	0.0474
Herb tmt		NS	NS	NS	NS	NS	NS	NS	0.0350	NS
Fert x Herb		NS	NS	NS	NS	NS	NS	NS	NS	NS
CV		9	6	2	11	9	4	18	20	3

Table 2. Canola seedling establishment, grain yield and protein response to fertilizer N placement and herbicide rate at Brandon, Melfort and Beaverlodge, 1997.

Locations		Brandon			Melfort			Beaverlodge		
Treatments		Seedlings	Grain Yield	Grain Protein	Seedlings	Grain Yield	Grain Protein	Seedlings	Grain Yield	Grain Protein
N. Plmt.	Herbicide	Plants/m2	Kg/ha	%	Plants/m2	Kg/ha	%	Plants/m2	Kg/ha	%
1. Fall banded	Full	66	1378	22.3	64.3	1040	23.6		798	17.9
	2/3	54	1262	22.8	55.2	1329	23.6		524	17.3
2. Spr. banded	Full	59	1217	21.9	73.0	1494	23.6		418	17.4
	2/3	70	1163	21.1	60.7	1374	23.4		640	17.9
3. 9" side bd	Full	61	1278	21.9	68.4	1550	23.9		563	17.8
	2/3	58	1284	22.1	69.4	1457	23.5		593	17.7
4. 12" side bd	Full	43	810	23.0	55.8	1463	23.4		530	17.9
	2/3	41	1004	22.7	47.2	1353	23.4		374	17.8
5. Sweep	Full	19	452	22.7	44.0	1467	23.9		368	17.1
	2/3	18	298	22.9	41.8	1489	23.4		223	17.0
1. Fall banded		60 a	1320 a	22.6 ab	59.7 ab	1184 b	23.6		660	17.6
2. Spring banded		65 a	1190 a	21.5 c	66.8 a	1434 a	23.5		529	17.7
3. 9" side banded		60 a	1281 a	22.0 bc	68.9 a	1503 a	23.7		578	17.7
4. 12" side banded		42 b	907 b	22.9 a	51.5 bc	1408 a	23.4		453	17.9
5. Sweep		19 c	375 c	22.8 ab	42.9 c	1478 a	23.6		296	17.1
Full herbicide		50	1027	22.4	61.1	1403	23.7		535	17.6
2/3 Herbicide		49	1002	22.3	54.9	1400	23.5		471	17.5
Pr>f Fert tmt		0.0001	0.0001	0.0012	0.0006	0.0086	NS		NS	NS
Herb tmt		NS	NS	NS	NS	NS	NS		NS	NS
Fert x Herb		0.0848	NS	NS	NS	NS	NS		NS	NS
CV		14	16	3	20	12	2		54	3

Impact of row spacing, fertilizer management and herbicide rate on plant development in spring wheat in 1997. Prepared by Guy Lafond

Objective:

To determine the effects of nitrogen management, row spacing and herbicide rate on seeding depth, main stem Haun stage and plant development in spring wheat at three locations, Brandon, Melfort and Beaverlodge.

Materials and Methods:

Twenty wheat plants per plot were collected from the five core nitrogen management treatments of the CFI project. Each plant was scored for actual depth of seeding, main stem Haun stage and each tiller on each plant was identified and scored for plant development according to the method developed by Klepper et al. (1983). The plants were collected on June 24th in Brandon, on July 1st in Melfort and on June 20th in Beaverlodge.

The analysis of the data for seeding depth and main stem Haun stage was done using an analysis of variance and the N Management x Herbicide Rate x Rep interaction was used as the error term. The main stem Haun stage is a good indicator of rate of emergence as shown by Lafond and Baker (1986).

The analysis of the data for the tillers present was done in three steps. The first step consisted in determining the number of plants from each plot which had a specific tiller and converting this value into a proportion. The second step consisted in doing an $\arcsin((x)^{.5})$ transformation of the proportion for each tiller as developed by Snedecor and Cochran (1976). With $n<50$, in this case 20, values of 0% were given a value of 1/4n or 0.0125 and values of 100% values (n-1/4)/n or 0.9875 (Snedecor and Cochran, 1976). The analysis of variance was done on the transformed values and the reported values in the tables are untransformed. The probability values indicated for the contrasts associated with nitrogen management and herbicide rate are based on the analysis of the transformed values. The approach for presenting the data is similar to the one used by Wilkins et al. (1988).

Results and Discussion:

Seeding Depth

Overall seeding depth was similar between the three locations. At Melfort and Brandon, the sweep treatment was much deeper than the other treatments while at Beaverlodge it was more similar. The variability in seeding depth , as indicated by the standard errors, was greatest at Beaverlodge and similar between Melfort and Brandon (Table 1).

Table 1. The effects of nitrogen management on seeding depth (mm) of spring wheat at three locations in 1997.

Nitrogen Management	Brandon	Melfort	Beaverlodge
Fall banding	38	36	37
Spring banding	37	42	46
Side-banding at seeding on 12" spacing	37	34	48
Side-banding at seeding on 9" spacing	35	38	39
Sweep	51	54	46
Mean	40	41	43
s.e.	10	8	24

Main Stem Haun stage

The difference in rates of herbicides used had no effect at all three locations. The nitrogen management treatments had no effect on main stem Haun stage values at Melfort and Brandon. This implies that regardless of how the plants are orientated, in this case spread out as with the sweep treatment or in single rows of different spacings (Table 2). However, this was not the case at Beaverlodge where the values for the sweep treatment were significantly higher than the other treatments. In fact, the plants growing on 12" rows were exactly one leaf behind the sweep treatments. Assuming 100 growing degree-days per leaf (0° C base temperature), this represents a potential difference of 5 days between the emergence of sweep and side-banding treatment. The small difference between 9" and 12" is more than likely due to the deeper planting with the 12" spacing.

Table 2. The effects of nitrogen management and herbicide rate on main stem Haun stage of spring wheat at three locations in 1996.

Nitrogen Management	Brandon		Melfort		Beaverlodge	
	100%	66%	100%	66%	100%	66%
Fall banding	5.5	5.5	5.8	5.9	5.3	5.5
Spring banding	5.5	5.6	5.7	5.8	5.3	5.4
Side-banding at seeding on 12" spacing	5.5	5.4	5.8	5.8	4.9	4.7
Side-banding at seeding on 9" spacing	5.6	5.5	5.8	5.8	5.2	5.4
Sweep	5.6	5.6	5.9	6.0	5.8	5.8
Mean	5.5	5.5	5.8	5.9	5.3	5.4
s.e.	0.3		0.4		0.6	
Contrast[1]						
Herbicide 100% vs 66%	ns		ns		ns	
Fall Banding vs Spring Banding	ns		ns		ns	
Sweep vs Pre-Seed banding	ns		ns		*	
Pre-seed banding vs Side-banding	ns		ns		ns	
9" vs 12"	ns		ns		*	
9" vs Sweep	ns		ns		**	
12" vs Sweep	ns		ns		*	

[1] Values followed by **, * and ns are significant at the 1% level, 5% level or not significant.

Plant Development:

Brandon: The two rates of herbicide used did not affect the frequency of the various tillers present (Table 3). In the case of the fall banding vs the spring banding nitrogen treatments, the only difference was a higher frequency of the T0 with fall banding. The frequency of T3, T11 and T21 was greatest for the spring banded treatments than the treatments where nitrogen was side-banded at seeding time. Frequency of tillers was similar between the 9" and 12" spacing. The frequency of most tillers was greatest for the sweep treatments than the 9" or 12" spacings.

Melfort: The only tiller frequencies affected by herbicide rate were T11 where the high rate had less of an effect than the lower rate (Table 4). The frequency of T0 was greater for the fall banding than the spring banding treatments. The frequency of T3, T01, T11 and T21 was greatest for the sweep than the pre-seed banding treatments. The deeper planting could have favored the sweep treatment in 1997. The timing of the N application, pre-seed vs side-banding at seeding and the 9" or 12" spacing had no effect on the frequencies of the various tillers produced. Relative to the 9" and 12" spacing, with the nitrogen applied during the seeding operation, the sweep treatments had a higher frequency of T3, T11 and T21.

Beaverlodge: Overall tiller development and frequency was much lower at this site than at the other sites. The two rates of herbicides used did not affect the frequency of the tillers present (Table 5). The sweep treatment had a higher frequency of T0 and T1 than the pre-seed banding treatments. The pre-seed banding treatments had similar tiller frequencies as the side-banding treatment and the same for the 9" and 12" spacing with the nitrogen applied in a side-band at seeding time. The frequency of T1 was greater for the sweep than the 9" or 12" spacing.

Table 3. The effects of nitrogen management and herbicide rate on plant development in spring wheat at Brandon in 1997. The values represents the percentage of plant having a particular tiller.

Nitrogen Management	T0		T1		T2		T3		T01		T11		T21	
	100%	66%	100%	66%	100%	66%	100%	66%	100%	66%	100%	66%	100%	66%
Fall banding	16	15	90	90	67	81	21	28	8	0	5	3	0	1
Spring banding	6	13	90	93	76	83	28	20	0	0	3	8	0	3
Side-banding at seeding on 12" spacing	6	6	83	78	69	55	25	15	0	0	5	0	0	0
Side-banding at seeding on 9" spacing	13	9	84	78	78	71	28	30	0	0	5	5	4	0
Sweep	13	13	91	90	87	79	59	53	1	0	20	18	10	11
Mean	**11**	**11**	**88**	**86**	**76**	**74**	**32**	**29**	**2**	**0**	**8**	**7**	**3**	**3**
Contrast[1]														
Herbicide 100% vs 66%	ns		ns		ns		ns		ns		ns		ns	
Fall Banding vs Spring Banding	*		ns		ns		ns		ns		ns		ns	
Sweep vs Pre-Seed banding	ns		ns		ns		***		ns		***		***	
Pre-seed banding vs Side-banding	*		**		ns		ns		ns		ns		ns	
9" vs 12"	ns		ns		ns		ns		ns		ns		ns	
9" vs Sweep	ns		*		ns		***		ns		***		***	
12" vs Sweep	*		*		**		***		ns		***		***	

[1] Values followed by ***, **, * or ns are significant at the p<1%, p<5%, p<10% or not significant.

Table 4. The effects of nitrogen management and herbicide rate on plant development in spring wheat at Melfort in 1997. The values represents the percentage of plant having a particular tiller.

Nitrogen Management	T0		T1		T2		T3		T01		T11		T21	
	100%	66%	100%	66%	100%	66%	100%	66%	100%	66%	100%	66%	100%	66%
Fall banding	31	35	90	98	74	77	3	0	0	0	9	1	0	0
Spring banding	14	21	89	94	76	88	9	11	0	0	6	5	0	0
Side-banding at seeding on 12" spacing	19	29	99	96	90	83	8	8	0	0	0	0	0	0
Side-banding at seeding on 9" spacing	19	23	91	98	79	90	14	4	0	0	3	3	1	0
Sweep	33	29	94	99	89	90	41	26	1	0	31	20	4	4
Mean	**23**	**27**	**93**	**97**	**82**	**85**	**15**	**10**	**0**	**0**	**11**	**6**	**1**	**1**
Contrast[1]														
Herbicide 100% vs 66%	ns		ns		ns		ns		ns		***		ns-	
Fall Banding vs Spring Banding	*		ns		ns		ns		ns		ns		ns	
Sweep vs Pre-Seed banding	ns		ns		ns		***		**		***		***_	
Pre-seed banding vs Side-banding	ns		ns		ns		ns		ns		ns		ns-	
9" vs 12"	ns		ns		ns		ns		ns		ns		ns-	
9" vs Sweep	ns		ns		ns		***		ns		***		**	
12" vs Sweep	ns		ns		ns		***		ns		***		**_	

[1] Values followed by ***, **, * and ns are significant at p<1%, p< 5%, p<10% or not significant.

Table 5. The effects of nitrogen management and herbicide rate on plant development in spring wheat at Beaverlodge in 1997. The values represents the percentage of plant having a particular tiller.

Nitrogen Management	T0		T1		T2		T3		T01		T11		T21		T31	
	100%	66%	100%	66%	100%	66%	100%	66%	100%	66%	100%	66%	100%	66%	100%	66%
Fall banding	3	1	21	25	5	4	0	0	0	0	0	1	0	0	0	0
Spring banding	4	1	14	39	3	15	0	0	0	0	0	0	0	0	0	0
Side-banding at seeding on 12" spacing	5	3	26	20	1	1	0	0	0	0	0	0	0	0	0	0
Side-banding at seeding on 9" spacing	1	4	28	25	1	6	0	0	0	0	0	0	0	0	0	0
Sweep	9	6	53	61	13	18	1	0	0	0	0	0	0	0	0	0
Mean	4	3	28	34	5	9	0	0	0	0	0	0	0	0	0	0
Contrast[1]																
Herbicide 100% vs 66%	ns		ns		ns		-		-		-		-		-	
Fall Banding vs Spring Banding	ns		ns		ns		-		-		-		-		-	
Sweep vs Pre-Seed banding	*		**		ns		-		-		-		-		-	
Pre-seed banding vs Side-banding	ns		ns		ns		-		-		-		-		-	
9" vs 12"	ns		ns		ns		-		-		-		-		-	
9" vs Sweep	ns		**		ns		-		-		-		-		-	
12" vs Sweep	ns		**		ns		-		-		-		-		-	

[1] Values followed by ***, ** , * or ns are significant at the p<1%, p<5%, p<10% level or not significant.

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Weed Community Analysis

prepared by D. Derksen and K. McGillivray

Broadleaf and grass weeds species were present within the study. Species perennation included annual, biennial, and perennial. Both native and introduced species were present. The weed communities were reflective of the agroecological zone in which the research was conducted.

The number of individual weeds were counted by species prior to seeding, at the seedling stage, and at maturity. Counts were conducted in twenty quadrats randomly placed quadrats following a "W" pattern across each plot. Total weed densities were calculated as the average density of all individuals of all species per metre squared in each plot. In order to assess spacial as well as density aspects of the weed community, relative abundance values were calculated by species per plot and averaged by experimental factor, such as fertilizer treatment. Relative abundance was calculated as: (relative density + relative frequency)/2. Relative density was calculated as: number of individuals for a given species within the 20 quadrats for each plot divided by the total number of individuals within the plot. Relative frequency was calculated as the proportion of quadrats in which the species was present per plot divided by the total frequency of all species.

Summary of results

In general, the reduced rate of herbicide applied in 1996 did not result in greater weed recruitment prior to crop seeding or in-crop spraying in 1998; however, weed densities were greater in reduced rate plots after herbicide application in 1998 at Melfort and Beaverlodge. The lack of difference between reduced and full rate herbicide usage at Brandon may be due to the lower overall weed density at this site.

The impact of fertilizer timing, placement, and level of soil disturbance on weed densities varied by site. Weed densities were greater in sweep treatments in canola, but not necessarily in wheat. In some cases sweep seeding resulted in more weeds present at the time of in-crop spraying while in other cases densities were greater in the July counts. This may be due to the timing of seeding in relation to soil temperature and weed seedling recruitment (ie emergence patterns). Research at Brandon, indicated that weed seedling recruitment patterns were similar for fall and side banded treatments, but were different in the sweep treatments (Figures 1, 2, and 3). Seeding with sweeps resulted in a greater number of weeds emerging earlier.

At Melfort and Brandon, weed densities were greater prior to seeding or in-crop spraying in the two pass seeding systems where fertilizer was random banded in the fall or spring compared to the side banded treatments. At Melfort, weed densities were greater in the 12" side banded plots compared to the 9" side banded plots, while the reverse was true at Beaverlodge. Hopefully, future data will aid in the understanding of this anomaly.

Brandon

Prior to crop seeding, weed densities were similar in all treatments for wheat (Tables 1, 4-18). Weed densities were higher in the fall and spring band treatments for canola. Herbicide input level the previous year did not affect weed densities before seeding.

Prior to in-crop herbicide application weed densities were again similar in all treatments for wheat with the fall and spring band having greater weed densities than the side band or sweep treatments. Herbicide input level the previous year did not affect weed densities before seeding.

July weed counts revealed that weeds densities were greater in the side banding treatments for wheat compared to random banding in the fall or spring. In canola plots, weed densities were greater in the spring band compared to fall banding and were highest in the sweep treatments, due to high levels of soil disturbance and low crop stands. Reducing herbicide rates did not significantly increase weed densities.

Melfort

Prior to crop seeding, weed densities were greater for fall banded versus spring banded treatments in wheat, with the spring banding treatment having the lowest weed density of all treatments (Tables 2, 19-33). Side banding on nine or twelve inch row spacings had more weeds than the sweep treatment. Herbicide input level the previous year did not affect weed densities before seeding. Weed densities in canola were similar for all treatments.

Prior to in-crop herbicide application, the sweep treatments had the highest weed densities in the wheat plots. Spring banding treatments had higher weed densities than fall banding with side banding treatments being intermediate between fall banding and sweep treatments. Herbicide input level the previous year did not affect weed densities before seeding for wheat or canola. Spring banding treatments had greater weed densities than the other canola plots which were not different from one another.

July weed counts revealed that weed densities in the reduced herbicide rate plots in canola and wheat were higher than where the full rate was used. In wheat, weed densities were greater in fall banding and the 12" row spacing plots compared to other treatments (especially at reduced herbicide rates). In canola, the weed densities were lower in the side banded treatments with reduced herbicide rate compared to random banding in the fall or spring and to sweep treatments.

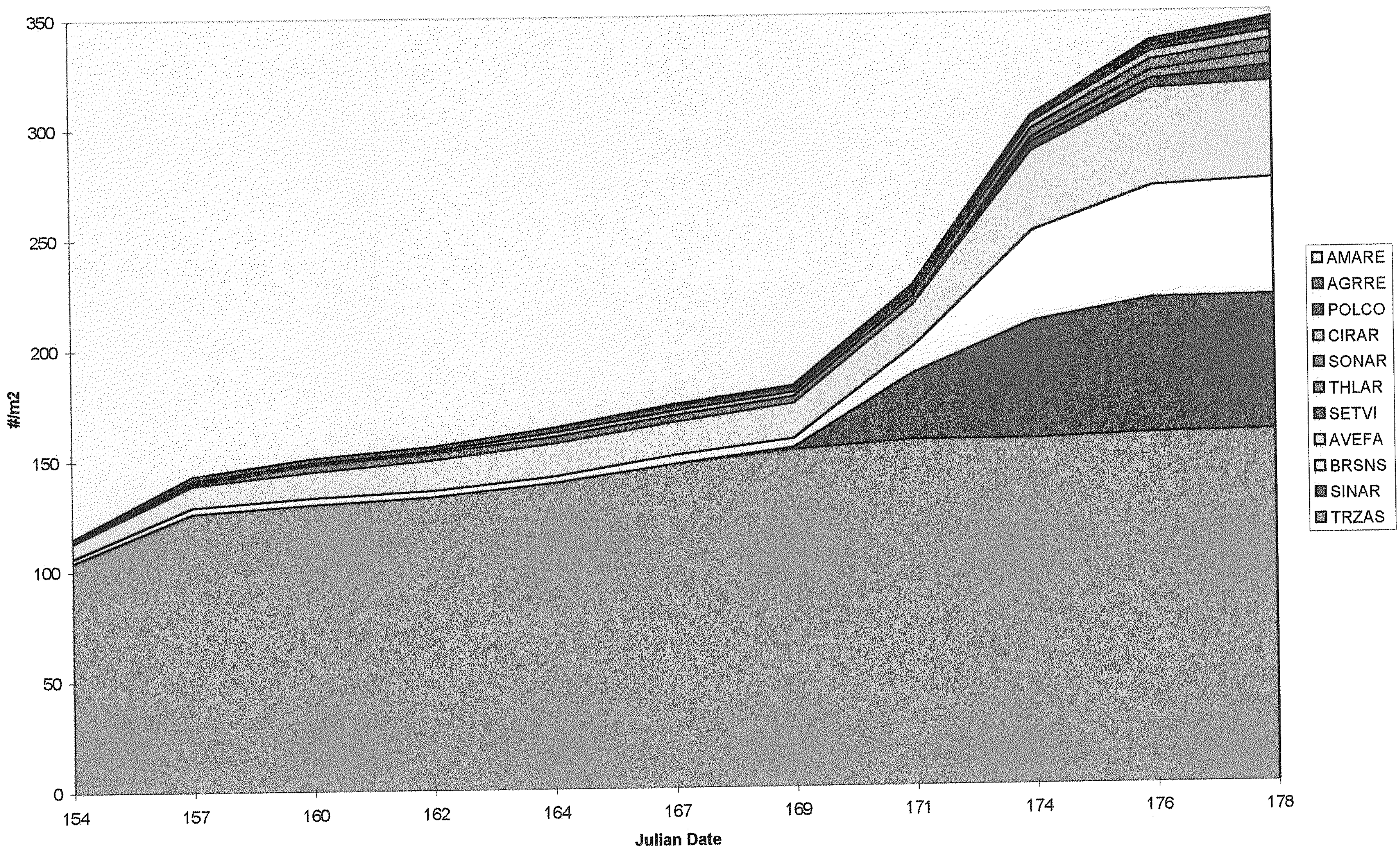
Beaverlodge

Prior to crop seeding, weed densities were greater for fall banding compared to spring banding in wheat with all other plots having similar densities. Weed densities were similar in all canola plots (Table 3, 34-48). Herbicide input level the previous year did not affect weed densities before seeding for either canola or wheat.

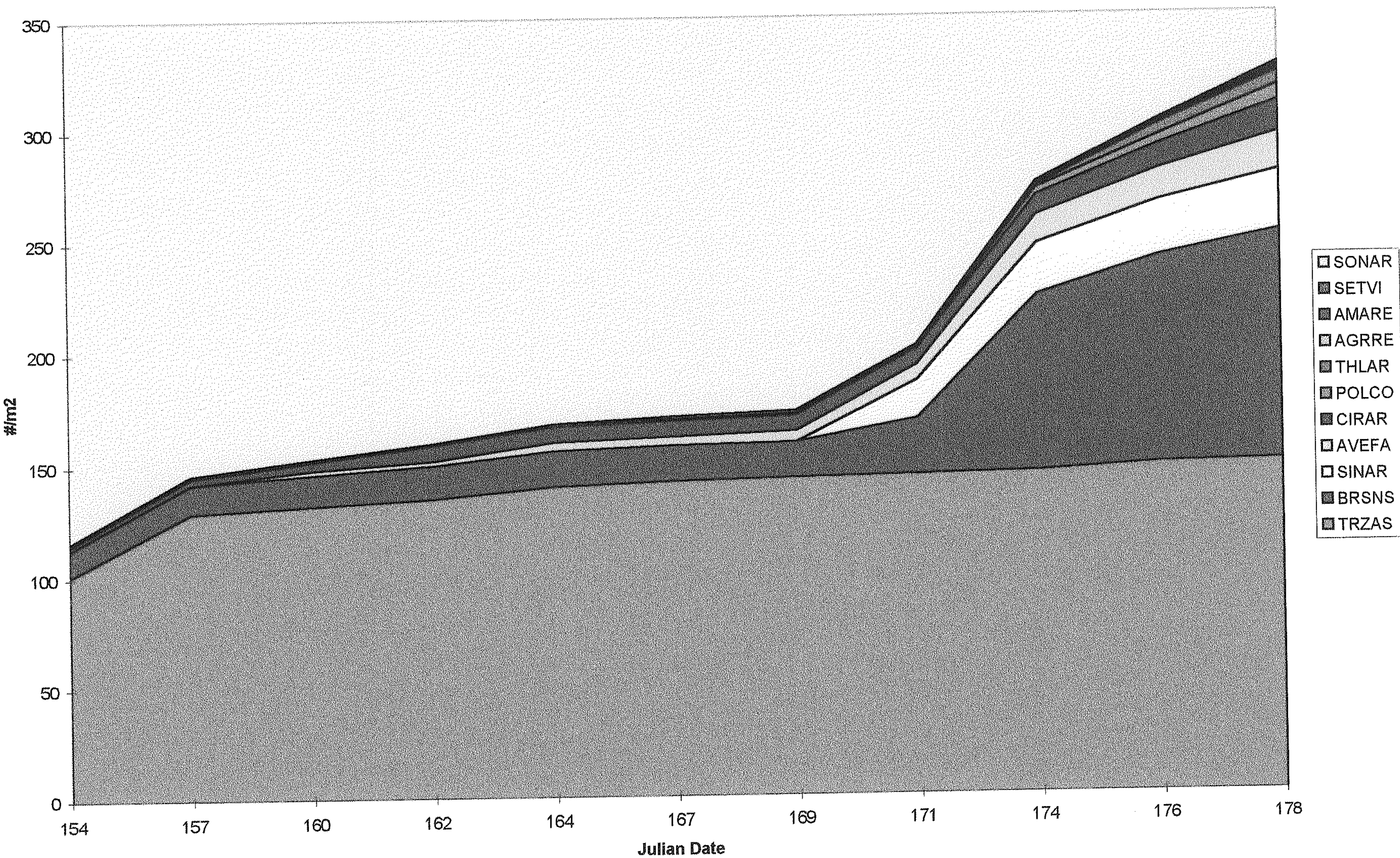
Prior to in-crop herbicide application, weed densities were similar in wheat except for the low-input 9" side band which had higher densities of weeds compared to the low-input 12" side band treatment. In canola, fall banded treatments had more weeds than spring banded treatments, 9" side banding had more weeds than 12" side banding, and the sweep treatments had the greatest number of weeds. Herbicide input level the previous year did not affect weed densities before seeding in wheat or canola.

July weed counts revealed that the low herbicide rate treatments had more weeds than the full rate treatments in canola, but not in wheat. Fertilizer treatments did not significantly impact weed densities at this stage in either wheat or canola.

Weed Emergence on Fall Band Treatment



Weed Emergence on 9" Side Band Treatment



Weed Emergence on Sweep Treatment

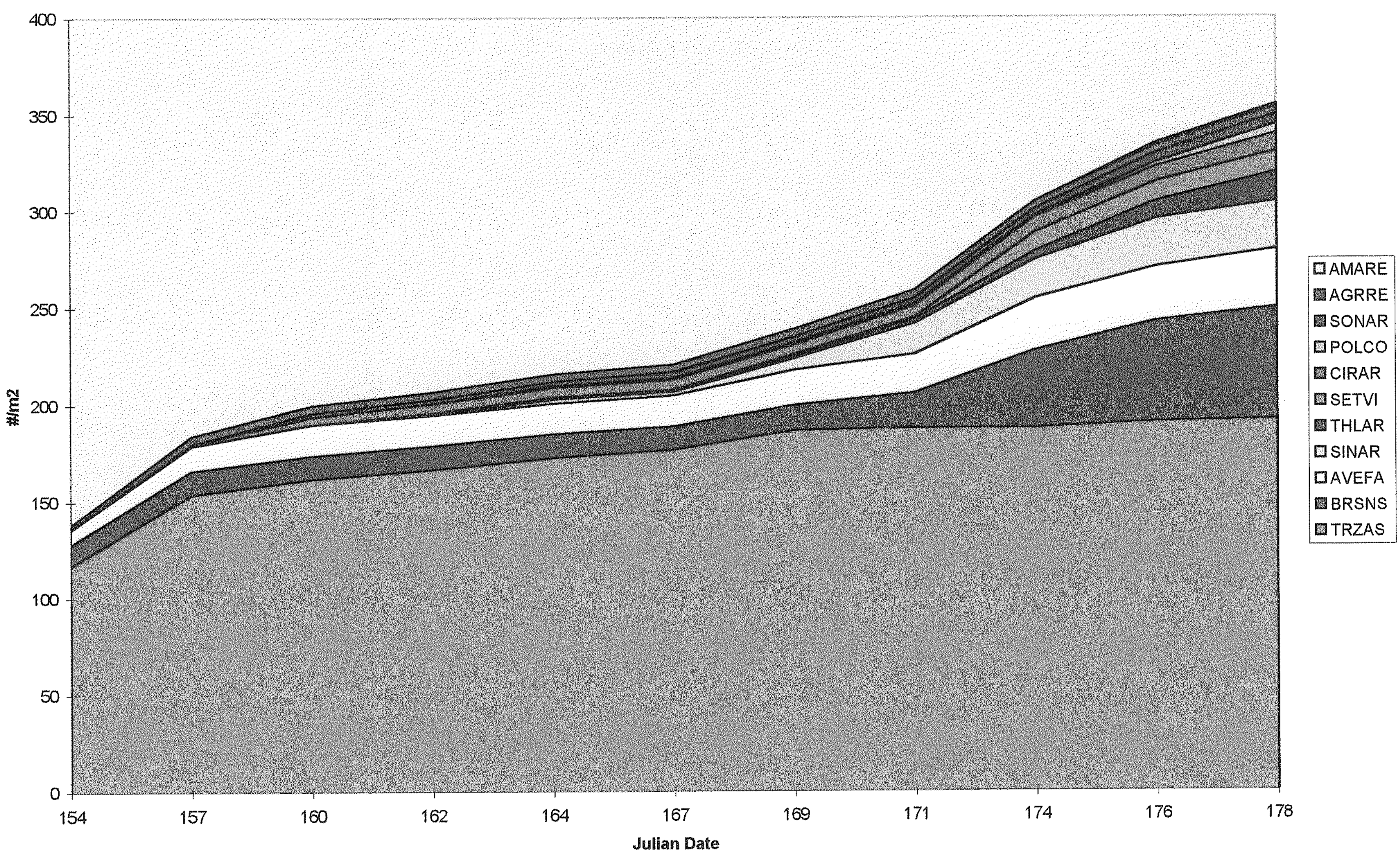


Table 1.0 Average total density (+/- SE) of all weed species at Brandon in 1997.

Crop	Fertilizer application	Herbicide Rate	Pre-seeding Count	Pre-spray Count	July Count
Wheat	Fall Band	100 %	3.6 ± 0.6	6.5 ± 0.8	38.7 ± 8.0
Wheat	Fall Band	66 %	4.1 ± 2.2	10.0 ± 1.9	47.3 ± 10.5
Wheat	Spring Band	100 %	3.1 ± 0.9	11.4 ± 2.6	37.2 ± 4.6
Wheat	Spring Band	66 %	3.0 ± 1.1	10.6 ± 3.1	45.5 ± 7.5
Wheat	Side Band 9"	100 %	1.2 ± 0.5	12.0 ± 2.0	51.2 ± 6.7
Wheat	Side Band 9"	66 %	4.2 ± 0.4	12.7 ± 2.4	52.2 ± 9.4
Wheat	Side Band 12"	100 %	3.9 ± 1.7	14.8 ± 4.5	55.1 ± 11.5
Wheat	Side Band 12"	66 %	3.2 ± 1.4	18.1 ± 6.2	55.6 ± 11.1
Wheat	Sweeps	100 %	5.5 ± 1.5	15.3 ± 4.8	44.1 ± 7.4
Wheat	Sweeps	66 %	6.3 ± 1.2	18.4 ± 8.3	44.4 ± 6.4
Canola	Fall Band	100 %	10.3 ± 6.6	12.5 ± 4.0	40.0 ± 12.3
Canola	Fall Band	66 %	11.6 ± 6.0	16.5 ± 4.2	44.3 ± 9.5
Canola	Spring Band	100 %	5.1 ± 3.4	15.7 ± 3.8	52.7 ± 9.9
Canola	Spring Band	66 %	4.0 ± 1.6	26.2 ± 8.3	71.1 ± 21.5
Canola	Side Band 9"	100 %	3.2 ± 0.8	16.4 ± 6.2	51.2 ± 13.9
Canola	Side Band 9"	66 %	1.6 ± 0.9	11.8 ± 3.8	42.0 ± 3.0
Canola	Side Band 12"	100 %	1.5 ± 0.6	10.7 ± 2.4	53.3 ± 9.0
Canola	Side Band 12"	66 %	1.6 ± 1.0	11.6 ± 5.4	50.9 ± 8.8
Canola	Sweeps	100 %	2.6 ± 2.0	12.3 ± 3.1	71.4 ± 17.9
Canola	Sweeps	66 %	4.1 ± 2.6	18.6 ± 6.8	84.0 ± 21.1

Table 1b. Orthogonal contrasts comparing the average total density of all weeds at Brandon in 1997.

Orthogonal contrasts	Pre-seed Counts	Pre-spray Counts	July Counts
	p value	p value	p value
Wheat (Rec. vs low herbicide)	ns	ns	ns
Canola (Rec. vs low herbicide)	ns	ns	ns
Wheat (rec. herb) Fall vs Spring band	ns	ns	ns
Wheat (rec. herb) Fall + Spring vs Side band	ns	ns	<0.06
Wheat (rec. herb) Side band (9" vs 12")	ns	ns	ns
Wheat (rec. herb) Side band 9" vs Sweep	ns	ns	ns
Wheat (low herb) Fall vs Spring band	ns	ns	ns
Wheat (low herb) Fall + Spring vs Side band	ns	ns	ns
Wheat (low herb) Side band (9" vs 12")	ns	ns	ns
Wheat (low herb) Side band 9" vs Sweep	ns	ns	ns
Canola (rec. herb) Fall vs Spring band	<0.082	ns	ns
Canola (rec. herb) Fall + Spring vs Side	<0.0122	ns	ns
Canola (rec. herb) Side band (9" vs 12")	ns	ns	ns
Canola (rec. herb) Side band 9" vs Sweep	ns	ns	<0.078
Canola (low herb) Fall vs Spring band	<0.0122	<0.058	<0.020
Canola (low herb) Fall + Spring vs Side	<0.004	<0.0087	ns
Canola (low herb) Side band (9" vs 12")	ns	ns	ns
Canola (low herb) Side band 9" vs Sweep	ns	ns	<0.0004

Table 2.0 Average total density (+/- SE) of all weed species at Melfort in 1997.

Crop	Fertilizer application	Herbicide Rate	Pre-seeding Count	Pre-spray Count	July Count
Wheat	Fall Band	100 %	208.5 ± 66.2	144.8 ± 10.0	2.0 ± 0.5
Wheat	Fall Band	66 %	224.6 ± 55.1	159.1 ± 33.8	5.9 ± 0.7
Wheat	Spring Band	100 %	5.2 ± 1.3	220.5 ± 23.1	2.9 ± 0.5
Wheat	Spring Band	66 %	12.4 ± 7.9	213.2 ± 23.1	3.9 ± 0.8
Wheat	Side Band 9"	100 %	145.4 ± 18.7	203.6 ± 27.6	2.7 ± 0.3
Wheat	Side Band 9"	66 %	102.6 ± 22.6	199.7 ± 14.1	2.1 ± 0.5
Wheat	Side Band 12"	100 %	138.4 ± 24.8	182.8 ± 8.9	4.3 ± 1.0
Wheat	Side Band 12"	66 %	87.8 ± 27.4	225.8 ± 23.9	5.7 ± 0.9
Wheat	Sweeps	100 %	49.4 ± 7.7	286.7 ± 24.7	1.3 ± 0.5
Wheat	Sweeps	66 %	53.4 ± 11.9	269.4 ± 18.2	2.2 ± 0.4
Canola	Fall Band	100 %	23.8 ± 9.1	116.8 ± 11.5	6.3 ± 1.5
Canola	Fall Band	66 %	25.8 ± 6.0	106.8 ± 13.1	13.2 ± 1.6
Canola	Spring Band	100 %	3.6 ± 1.1	186.5 ± 50.8	5.0 ± 0.4
Canola	Spring Band	66 %	7.3 ± 2.9	139.4 ± 16.7	12.0 ± 1.9
Canola	Side Band 9"	100 %	25.2 ± 8.2	101.9 ± 12.2	5.5 ± 0.5
Canola	Side Band 9"	66 %	26.9 ± 7.7	123.1 ± 23.1	7.5 ± 1.0
Canola	Side Band 12"	100 %	18.4 ± 9.3	104.0 ± 5.4	5.4 ± 1.0
Canola	Side Band 12"	66 %	26.4 ± 12.2	109.6 ± 13.2	6.5 ± 0.6
Canola	Sweeps	100 %	20.8 ± 7.9	141.9 ± 30.0	6.8 ± 0.7
Canola	Sweeps	66 %	25.1 ± 15.8	136.5 ± 14.8	10.9 ± 0.6

Table 2b. Orthogonal contrasts comparing the average total density of all weeds at Melfort in 1997.

Orthogonal contrasts	**Pre-seed Counts**	**Pre-spray Counts**	**July Counts**
	p value	p value	p value
Wheat (Rec. vs low herbicide)	ns	ns	<0.0181
Canola (Rec. vs low herbicide)	ns	ns	<0.0001
Wheat (rec. herb) Fall vs Spring band	<0.0001	<0.0099	ns
Wheat (rec. herb) Fall + Spring vs Side	ns	ns	ns
Wheat (rec. herb) Side band (9" vs 12")	ns	ns	ns
Wheat (rec. herb) Side band 9" vs Sweep	<0.0021	<0.0048	ns
Wheat (low herb) Fall vs Spring band	<0.0001	<0.0616	<0.0963
Wheat (low herb) Fall + Spring vs Side band	ns	ns	ns
Wheat (low herb) Side band (9" vs 12")	ns	ns	<0.0039
Wheat (low herb) Side band 9" vs Sweep	ns	<0.0170	ns
Canola (rec. herb) Fall vs Spring band	ns	<0.0169	ns
Canola (rec. herb) Fall + Spring vs Side	ns	<0.0183	ns
Canola (rec. herb) Side band (9" vs 12")	ns	ns	ns
Canola (rec. herb) Side band 9" vs Sweep	ns	ns	ns
Canola (low herb) Fall vs Spring band	ns	ns	ns
Canola (low herb) Fall + Spring vs Side	ns	ns	<0.0001
Canola (low herb) Side band (9" vs 12")	ns	ns	ns
Canola (low herb) Side band 9" vs Sweep	ns	ns	<0.0069

Table 3.0 Average total density (+/- SE)of all weed species at Beaverlodge in 1997.

Crop	Fertilizer application	Herbicide Rate	Pre-seed Count	Pre-spray Count	July Count
Wheat	Fall Band	100 %	82.1 ± 48.9	179.4 ± 16.9	87.9 ± 15.9
Wheat	Fall Band	66 %	141.5 ± 47.2	254.7 ± 38.7	85.6 ± 13.4
Wheat	Spring Band	100 %	81.9 ± 59.8	249.3 ± 55.8	83.3 ± 20.0
Wheat	Spring Band	66 %	61.7 ± 27.9	199.5 ± 29.9	123.9 ± 43.0
Wheat	Side Band 9"	100 %	40.9 ± 21.1	275.2 ± 38.8	82.9 ± 10.4
Wheat	Side Band 9"	66 %	73.5 ± 32.1	369.3 ± 21.6	95.5 ± 25.1
Wheat	Side Band 12"	100 %	59.4 ± 44.3	286.4 ± 25.9	113.6 ± 34.4
Wheat	Side Band 12"	66 %	65.4 ± 35.9	138.4 ± 30.8	140.7 ± 13.1
Wheat	Sweeps	100 %	100.3 ± 71.2	210.1 ± 11.4	100.9 ± 19.3
Wheat	Sweeps	66 %	99.6 ± 44.2	289.6 ± 69.9	104.9 ± 31.6
Canola	Fall Band	100 %	17.8 ± 5.2	557.8 ± 52.5	174.4 ± 34.9
Canola	Fall Band	66 %	18.4 ± 5.7	448.9 ± 102.3	350.4 ± 94.5
Canola	Spring Band	100 %	27.9 ± 7.0	307.0 ± 68.1	204.7 ± 22.1
Canola	Spring Band	66 %	36.1 ± 18.6	466.5 ± 48.0	322.1 ± 78.6
Canola	Side Band 9"	100 %	6.1 ± 2.1	457.2 ± 53.7	230.5 ± 26.8
Canola	Side Band 9"	66 %	6.1 ± 1.8	536.1 ± 99.3	255.8 ± 67.0
Canola	Side Band 12"	100 %	30.0 ± 22.4	338.4 ± 79.8	271.6 ± 53.6
Canola	Side Band 12"	66 %	8.9 ± 2.0	360.9 ± 61.3	327.0 ± 68.0
Canola	Sweeps	100 %	18.2 ± 12.3	678.0 ± 113.3	255.4 ± 36.7
Canola	Sweeps	66 %	7.6 ± 3.3	664.0 ± 192.5	344.1 ± 63.1

Table 3b. Orthogonal contrasts comparing the average total density of all weeds at Beaverlodge in 1997.

Orthogonal contrasts	**Pre-seed Counts**	**Pre-spray Counts**	**July Counts**
	p value	p value	p value
Wheat (Rec. vs low herbicide)	ns	ns	ns
Canola (Rec. vs low herbicide)	ns	ns	<0.0002
Wheat (rec. herb) Fall vs Spring band	ns	ns	ns
Wheat (rec. herb) Fall + Spring vs Side band	ns	ns	ns
Wheat (rec. herb) Side band (9" vs 12")	ns	ns	ns
Wheat (rec. herb) Side band 9" vs Sweep	ns	ns	ns
Wheat (low herb) Fall vs Spring band	<0.0645	ns	ns
Wheat (low herb) Fall + Spring vs Side band	ns	ns	ns
Wheat (low herb) Side band (9" vs 12")	ns	<0.0244	ns
Wheat (low herb) Side band 9" vs Sweep	ns	ns	ns
Canola (rec. herb) Fall vs Spring band	ns	<0.0149	ns
Canola (rec. herb) Fall + Spring vs Side	ns	ns	ns
Canola (rec. herb) Side band (9" vs 12")	ns	ns	ns
Canola (rec. herb) Side band 9" vs Sweep	ns	<0.0310	ns
Canola (low herb) Fall vs Spring band	ns	ns	ns
Canola (low herb) Fall + Spring vs Side	ns	ns	ns
Canola (low herb) Side band (9" vs 12")	ns	<0.0848	ns
Canola (low herb) Side band 9" vs Sweep	ns	ns	ns

Table 4.0 Weed relative abundance and density by crop prior to crop seeding at Brandon in 1997.

Weed Species	Wheat RelAb	Wheat $\#/m^2$	Canola RelAb	Canola $\#/m^2$
Quackgrass	22.4	1.0	8.4	0.3
Mustard species	18.9	0.8	18.0	1.5
Dandelion	16.7	0.7	7.5	0.2
Canada thistle	11.8	0.3	11.4	0.4
Stinkweed	6.9	0.2	26.0	0.4
Wild buckwheat	4.5	0.1	2.7	0.2
Volunteer wheat	3.4	0.1	12.8	0.5
Pigweed species	3.3	0.1	0.6	0.1
Goatsbeard species	2.9	0.1	0.4	0.0
Shepherds purse	2.8	0.2	7.5	0.7
Nightflowering catchfly	1.5	0.1	0.5	0.0
Biennial wormwood	1.1	0.0	.	.
American dragonhead	0.8	0.0	1.0	0.0
Vetch species	0.8	0.0	.	.
Perennial sowthistle	0.6	0.0	.	.
Wild oat	0.5	0.0	0.0	0.0
Volunteer maple	0.4	0.0	.	.
Sweet clover species	0.3	0.0	.	.
Narrow leaved hawks beard	0.2	0.0	2.8	0.2
Mouse ear chickweed	0.2	0.0	0.1	0.0
Flixweed	.	.	0.1	0.0
Prickly lettuce	.	.	0.1	0.0

Relative Abundance values (RelAb) were calculated by plot for each weed species: (relative density + relative frequency)/2. Relative density was calculated as: number of individuals for a given species within the 20 quadrats for each plot divided by the total number of individuals within the plot. Relative frequency was calculated as the proportion of quadrats in which the species was present per plot divided by the total frequency of all species.

Table 5.0 Weed relative abundance and density by crop prior to in-crop spraying at Brandon in 1997.

Weed Species	Wheat RelAb	Wheat #/m²	Canola RelAb	Canola #/m²
Mustard species	44.0	4.8	22.2	4.2
Canada thistle	26.9	3.2	26.5	3.7
Perennial sowthistle	17.1	3.6	5.4	0.6
Wild buckwheat	7.7	0.8	14.2	3.0
Wild oat	3.1	0.3	8.7	1.0
Quackgrass	0.4	0.1	0.6	0.1
Dandelion	0.3	0.0	.	.
Goatsbeard species	0.1	0.0	.	.
Vetch species	0.1	0.0	0.1	0.0
Green foxtail	0.1	0.0	0.3	0.1
Common lambsquarters	0.1	0.0	0.7	0.1
Sweet clover species	0.1	0.0	.	.
Nightflowering catchfly	0.0	0.0	0.1	0.0
Stinkweed	0.0	0.0	2.5	0.5
Shepherds purse	.	.	0.5	0.1
Narrow leaved hawks beard	.	.	0.1	0.0
Yellow whitlow grass	.	.	0.0	0.0
Thyme leaved spurge	.	.	0.0	0.0
False ragweed	.	.	0.0	0.0
Round-leaved mallow	.	.	0.0	0.0
Smartweed species	.	.	0.5	0.0
Volunteer wheat	.	.	17.6	1.8

Relative Abundance values (RelAb) were calculated by plot for each weed species: (relative density + relative frequency)/2. Relative density was calculated as: number of individuals for a given species within the 20 quadrats for each plot divided by the total number of individuals within the plot. Relative frequency was calculated as the proportion of quadrats in which the species was present per plot divided by the total frequency of all species.

Table 6.0 Weed relative abundance and density by crop in July at Brandon in 1997.

Weed Species	Wheat RelAb	Wheat #/m²	Canola RelAb	Canola #/m²
Volunteer canola	20.2	7.9	.	.
Perennial sowthistle	19.0	8.7	4.6	1.1
Canada thistle	16.6	7.9	10.3	3.7
Wild mustard	16.2	8.7	22.0	16.8
Wild buckwheat	15.9	7.5	10.9	5.4
Shepherds purse	3.5	2.8	0.9	0.4
Stinkweed	2.5	0.9	4.4	1.6
Green foxtail	2.2	1.2	1.0	0.3
Common lambsquarters	1.0	0.5	1.7	0.6
Wild oat	0.7	0.2	3.4	1.2
Worm seed mustard	0.7	0.2	0.2	0.0
Quackgrass	0.5	0.4	0.1	0.1
Nightflowering catchfly	0.2	0.0	0.4	0.2
Narrow leaved hawks beard	0.2	0.0	0.8	0.1
Prostrate pigweed	0.1	0.0	.	.
Volunteer maple	0.1	0.0	.	.
Redroot pigweed	0.1	0.0	0.1	0.0
American dragonhead	0.1	0.0	.	.
Bluebur	0.0	0.0	0.0	0.0
Canada fleabane, Horseweed	0.0	0.0	0.0	0.0
Sweet clover species	0.0	0.0	0.1	0.0
Mouse ear chickweed	0.0	0.0	.	.
Round-leaved mallow	0.0	0.0	0.0	0.0
Prickly lettuce	0.0	0.0	.	.
Smartweed species	0.0	0.0	.	.
Goatsbeard species	0.0	0.0	0.0	0.0
False ragweed	.	.	0.0	0.0
Volunteer barley	.	.	0.0	0.0
Dandelion	.	.	0.0	0.0
Volunteer wheat	.	.	39.1	24.5
Vetch species	.	.	0.0	0.0

Relative Abundance values (RelAb) were calculated by plot for each weed species: (relative density + relative frequency)/2. Relative density was calculated as: number of individuals for a given species within the 20 quadrats for each plot divided by the total number of individuals within the plot. Relative frequency was calculated as the proportion of quadrats in which the species was present per plot divided by the total frequency of all species.

Table 7.0 Weed relative abundance and density by fertilizer treatment in wheat prior to crop seeding at Brandon in 1997.

Weed Species	Fall band		Spring band		Spring band 9"		Spring band 12"		Sweep	
	RelAb	#/m²	RelAb	#/m²	RelAb	#/m²	RelAb	#/m²	RelAb	#/m²
Mustard species	39.1	2.2	14.5	0.5	8.7	0.2	21.4	0.4	11.0	0.6
Wild buckwheat	10.0	0.3	2.4	0.1	3.8	0.1	3.4	0.1	2.7	0.1
Quackgrass	9.7	0.2	29.5	0.7	22.2	1.0	17.2	1.0	33.5	2.4
Stinkweed	9.3	0.3	8.9	0.3	11.0	0.4	2.0	0.1	3.6	0.1
Dandelion	8.4	0.2	14.6	0.5	24.9	0.6	14.0	0.3	21.8	1.7
Volunteer wheat	7.0	0.2	1.7	0.1	2.0	0.1	5.3	0.1	1.1	0.0
Pigweed species	6.1	0.2	3.2	0.1	3.8	0.1	1.0	0.0	2.3	0.1
Canada thistle	2.7	0.1	6.1	0.2	22.3	0.3	17.1	0.3	10.8	0.4
Goatsbeard species	2.5	0.1	7.8	0.3	.	.	2.4	0.2	1.8	0.1
Volunteer maple	2.0	0.1	.	.	.	.	.	.	.	.
Vetch species	1.9	0.1	.	.	.	.	1.9	0.1	.	.
Wild oat	0.9	0.0	0.9	0.0	.	.	.	.	0.5	0.0
Nightflowering catchfly	0.4	0.0	0.8	0.0	.	.	4.0	0.3	2.4	0.1
Biennial wormwood	.	.	2.5	0.0	.	.	1.5	0.0	1.4	0.1
Shepherds purse	.	.	5.8	0.4	.	.	6.6	0.6	1.8	0.1
Mouse ear chickweed	.	.	0.8	0.0	.	.	.	.	.	.
Narrow leaved hawks beard	.	.	.	.	.	.	1.0	0.0	.	.
American dragonhead	.	.	0.6	0.0	0.7	0.0	1.1	0.1	1.6	0.1
Sweet clover species	.	.	.	.	0.7	0.0	.	.	0.7	0.0
Perennial sowthistle	.	.	.	.	.	.	.	.	3.0	0.1

Relative Abundance values (RelAb) were calculated by plot for each weed species: (relative density + relative frequency)/2. Relative density was calculated as: number of individuals for a given species within the 20 quadrats for each plot divided by the total number of individuals within the plot. Relative frequency was calculated as the proportion of quadrats in which the species was present per plot divided by the total frequency of all species.

Table 8.0 Weed relative abundance and density by fertilizer treatment in canola prior to crop seeding at Brandon in 1997.

Weed Species	Fall band		Spring band		Spring band 9"		Spring band 12"		Sweep	
	RelAb	#/m²	RelAb	#/m²	RelAb	#/m²	RelAb	#/m²	RelAb	#/m²
Volunteer wheat	33.2	2.2	16.3	0.3	6.7	0.1	4.0	0.1	3.5	0.1
Mustard species	24.4	5.2	21.8	1.1	18.1	0.5	14.3	0.4	11.3	0.6
Stinkweed	12.4	0.4	12.5	0.3	25.6	0.5	34.6	0.2	45.0	0.4
Quackgrass	9.0	0.8	6.3	0.2	12.5	0.3	4.0	0.1	10.5	0.1
Canada thistle	4.1	0.5	21.1	0.4	16.6	0.3	6.7	0.1	8.6	0.6
Wild buckwheat	4.0	0.9	2.3	0.2	4.6	0.1	0.7	0.0	2.0	0.1
American dragonhead	3.9	0.1	0.3	0.0	.	.	.	.	0.7	0.1
Pigweed species	3.2	0.5	.	.	.	.	.	.	.	.
Shepherds purse	3.1	0.3	10.5	1.6	5.5	0.2	11.1	0.5	7.4	0.9
Dandelion	2.0	0.1	5.9	0.3	4.8	0.1	16.5	0.1	8.2	0.3
Prickly lettuce	0.4	0.0	.	.	.	.	.	.	.	.
Wild oat	0.2	0.0	.	.	.	.	.	.	.	.
Mouse ear chickweed	.	.	.	.	0.6	0.0	.	.	.	.
Narrow leaved hawks beard	.	.	2.7	0.2	5.1	0.3	3.9	0.1	2.5	0.3
Flixweed	.	.	0.3	0.0	.	.	.	.	.	.
Nightflowering catchfly	.	.	0.3	0.0	.	.	2.1	0.0	0.4	0.0
Goatsbeard species	.	.	.	.	.	.	2.1	0.0	.	.

Relative Abundance values (RelAb) were calculated by plot for each weed species: (relative density + relative frequency)/2. Relative density was calculated as: number of individuals for a given species within the 20 quadrats for each plot divided by the total number of individuals within the plot. Relative frequency was calculated as the proportion of quadrats in which the species was present per plot divided by the total frequency of all species.

Table 9.0 Weed relative abundance and density by fertilizer treatment in wheat prior to in-crop spraying at Brandon in 1997.

Weed Species	Fall band		Spring band		Spring band 9"		Spring band 12"		Sweep	
	RelAb	#/m^2	RelAb	#/m^2	RelAb	#/m^2	RelAb	#/m^2	RelAb	#/m^2
Mustard species	36.5	2.9	56.9	5.8	37.0	3.7	43.4	4.8	46.0	6.9
Canada thistle	29.8	2.5	18.6	2.0	35.9	4.4	29.5	4.2	20.8	3.1
Perennial sowthistle	16.7	1.6	11.9	2.0	19.5	3.4	18.5	6.3	19.0	4.9
Wild buckwheat	9.9	0.8	9.4	1.0	3.9	0.5	4.4	0.5	11.0	1.4
Wild oat	6.1	0.4	3.1	0.3	0.8	0.1	2.9	0.4	2.6	0.5
Dandelion	0.4	0.0	.	.	1.0	0.1	.	.	.	.
Green foxtail	0.3	0.0	.	.	.	.	.	.	0.2	0.0
Goatsbeard species	0.3	0.0	.	.	0.3	0.0	.	.	.	.
Quackgrass	.	.	.	.	1.2	0.3	0.6	0.2	.	.
Common lambsquarters	.	.	.	.	0.4	0.0	.	.	.	.
Nightflowering catchfly	.	.	.	.	.	.	0.2	0.0	.	.
Sweet clover species	.	.	.	.	.	.	.	.	0.3	0.0
Stinkweed	.	.	.	.	.	.	.	.	0.2	0.0
Vetch species	.	.	.	.	.	.	0.5	0.1	.	.

Relative Abundance values (RelAb) were calculated by plot for each weed species: (relative density + relative frequency)/2. Relative density was calculated as: number of individuals for a given species within the 20 quadrats for each plot divided by the total number of individuals within the plot. Relative frequency was calculated as the proportion of quadrats in which the species was present per plot divided by the total frequency of all species.

Table 10.0 Weed relative abundance and density by fertilizer treatment in canola prior to in-crop spraying at Brandon in 1997.

Weed Species	Fall band		Spring band		Spring band 9"		Spring band 12"		Sweep	
	RelAb	#/m^2	RelAb	#/m^2	RelAb	#/m^2	RelAb	#/m^2	RelAb	#/m^2
Canada thistle	29.1	3.8	27.5	4.3	28.2	4.4	28.7	3.6	18.9	2.5
Volunteer wheat	24.0	2.6	12.1	1.8	11.9	0.9	16.4	1.0	23.6	2.5
Mustard species	15.9	2.8	25.9	6.7	26.1	4.3	26.9	3.8	16.2	3.2
Wild buckwheat	14.6	2.8	16.6	4.9	13.2	2.1	7.4	1.0	19.2	4.4
Wild oat	6.2	1.1	7.1	1.0	8.3	0.9	10.5	0.8	11.3	1.3
Perennial sowthistle	4.5	0.6	5.5	1.0	6.5	0.4	4.3	0.3	6.2	1.0
Stinkweed	1.9	0.2	2.8	0.8	2.7	0.6	2.2	0.3	2.8	0.4
Green foxtail	1.1	0.4	.	.	0.2	0.0	.	.	0.4	0.1
Common lambsquarters	0.9	0.1	0.7	0.2	0.4	0.1	1.1	0.2	0.3	0.1
Shepherds purse	0.7	0.1	0.1	0.1	0.3	0.0	1.2	0.1	0.3	0.1
Smartweed species	0.5	0.1	.	.	0.6	0.1	0.7	0.1	0.4	0.0
Nightflowering catchfly	0.4	0.1	0.2	0.0	.	.	.	.	.	.
Narrow leaved hawks beard	0.3	0.0	.	.	0.1	0.0	.	.	.	.
Quackgrass	.	.	1.3	0.2	0.7	0.0	0.5	0.0	0.4	0.0
Yellow whitlow grass	.	.	0.1	0.0	.	.	.	.	.	.
Thyme leaved spurge	.	.	0.1	0.0	.	.	.	.	.	.
False ragweed	.	.	.	.	0.2	0.0	.	.	.	.
Round-leaved mallow	.	.	.	.	0.2	0.0	.	.	.	.
Vetch species	.	.	.	.	0.4	0.1	.	.	.	.

Relative Abundance values (RelAb) were calculated by plot for each weed species: (relative density + relative frequency)/2. Relative density was calculated as: number of individuals for a given species within the 20 quadrats for each plot divided by the total number of individuals within the plot. Relative frequency was calculated as the proportion of quadrats in which the species was present per plot divided by the total frequency of all species.

Table 11.0 Weed relative abundance and density by fertilizer treatment in wheat in July at Brandon in 1997.

Weed Species	Fall band		Spring band		Spring band 9"		Spring band 12"		Sweep	
	RelAb	#/m^2	RelAb	#/m^2	RelAb	#/m^2	RelAb	#/m^2	RelAb	#/m^2
Perennial sowthistle	22.3	8.1	18.0	6.2	18.2	9.6	19.2	11.5	17.6	7.9
Wild buckwheat	18.4	8.1	18.1	8.5	11.6	6.0	12.8	6.2	18.7	8.8
Volunteer canola	17.9	7.0	21.3	7.1	19.3	9.0	20.1	8.4	22.3	8.1
Wild mustard	16.1	9.4	17.0	8.1	16.1	10.2	15.9	8.3	15.7	7.7
Canada thistle	13.4	5.4	13.2	5.6	21.6	10.9	17.9	10.1	16.7	7.5
Green foxtail	3.1	1.7	1.3	0.5	3.3	2.1	2.5	1.5	0.7	0.3
Shepherds purse	3.1	1.7	4.3	2.5	2.0	1.1	5.4	6.4	2.8	2.3
Common lambsquarters	1.4	0.5	1.4	1.0	1.4	0.6	0.4	0.1	0.5	0.1
Stinkweed	1.1	0.3	2.6	1.3	4.8	1.7	1.3	0.6	2.7	0.7
Wild oat	0.5	0.2	0.9	0.2	0.5	0.2	1.3	0.5	0.4	0.2
Worm seed mustard	0.5	0.1	1.0	0.2	0.3	0.1	0.2	0.1	1.2	0.6
Narrow leaved hawks beard	0.4	0.1	.	.	0.2	0.1	.	.	0.3	0.1
Prostrate pigweed	0.3	0.1	.	.	0.1	0.0	0.2	0.1	.	.
American dragonhead	0.2	0.1	.	.	.	.	0.1	0.1	.	.
Volunteer maple	0.2	0.0	0.2	0.0	0.1	0.0	0.1	0.0	.	.
Redroot pigweed	0.2	0.0	.	.	0.2	0.1	.	.	0.1	0.0
Canada fleabane, Horseweed	0.2	0.0	.	.	.	.	.	.	.	.
Nightflowering catchfly	0.2	0.0	0.1	0.0	0.1	0.0	0.3	0.1	0.2	0.1
Mouse ear chickweed	0.1	0.1	.	.	.	.	.	.	.	.
Round-leaved mallow	0.1	0.0	.	.	.	.	.	.	.	.
Prickly lettuce	0.1	0.0	.	.	.	.	.	.	.	.
Bluebur	0.1	0.0	.	.	.	.	0.1	0.1	.	.
Quackgrass	.	.	0.7	0.4	.	.	1.9	1.4	.	.
Sweet clover species	.	.	.	.	.	.	.	.	0.1	0.0
Smartweed species	.	.	.	.	.	.	0.1	0.0	.	.
Goatsbeard species	.	.	.	.	0.1	0.0	.	.	.	.

Relative Abundance values (RelAb) were calculated by plot for each weed species: (relative density + relative frequency)/2. Relative density was calculated as: number of individuals for a given species within the 20 quadrats for each plot divided by the total number of individuals within the plot. Relative frequency was calculated as the proportion of quadrats in which the species was present per plot divided by the total frequency of all species.

Table 12.0 Weed relative abundance and density by fertilizer treatment in canola in July at Brandon in 1997.

Weed Species	Fall band		Spring band		Spring band 9"		Spring band 12"		Sweep	
	RelAb	#/m²	RelAb	#/m²	RelAb	#/m²	RelAb	#/m²	RelAb	#/m²
Volunteer wheat	39.2	18.7	38.2	24.9	41.2	21.8	38.8	22.7	38.0	34.5
Wild mustard	19.7	11.3	24.5	19.6	19.0	11.0	23.0	16.6	23.6	25.5
Canada thistle	12.2	4.1	9.6	3.3	12.8	4.7	8.5	2.8	8.4	3.6
Wild buckwheat	11.0	4.0	13.3	8.8	11.0	4.3	9.5	3.7	9.7	6.5
Perennial sowthistle	5.1	1.2	3.5	0.9	3.5	0.7	4.8	1.2	6.0	1.8
Stinkweed	4.1	0.8	3.8	2.1	3.3	1.1	6.0	2.0	4.6	1.9
Green foxtail	2.7	0.8	0.9	0.2	0.1	0.1	0.5	0.2	0.6	0.2
Narrow leaved hawks beard	2.0	0.3	0.4	0.1	1.0	0.2	0.3	0.1	0.3	0.1
Common lambsquarters	1.5	0.4	1.9	0.8	2.0	0.6	1.6	0.7	1.6	0.5
Wild oat	1.3	0.3	2.6	0.6	3.3	0.9	4.8	1.7	5.1	2.5
Shepherds purse	0.3	0.1	0.9	0.5	1.4	0.5	1.1	0.4	0.8	0.4
Quackgrass	0.2	0.2	.	.	0.2	0.3	.	.	.	.
Sweet clover species	0.2	0.0	.	.	.	.	0.1	0.0	0.1	0.0
Bluebur	0.1	0.0	.	.	0.1	0.0	.	.	.	.
Nightflowering catchfly	0.1	0.0	0.4	0.2	0.7	0.4	0.3	0.1	0.4	0.2
Dandelion	0.1	0.0	.	.	.	.	.	.	.	.
Worm seed mustard	0.1	0.0	0.1	0.0	0.1	0.0	0.3	0.1	0.2	0.1
Redroot pigweed	.	.	.	.	.	.	0.1	0.0	0.3	0.1
Canada fleabane, Horseweed	.	.	.	.	.	.	.	.	0.1	0.0
False ragweed	.	.	.	.	.	.	0.2	0.0	.	.
Volunteer barley	.	.	.	.	.	.	.	.	0.1	0.0
Round-leaved mallow	.	.	.	.	0.1	0.0	.	.	.	.
Goatsbeard species	.	.	.	.	.	.	.	.	0.1	0.0
Vetch species	.	.	.	.	.	.	0.1	0.0	.	.

Relative Abundance values (RelAb) were calculated by plot for each weed species: (relative density + relative frequency)/2. Relative density was calculated as: number of individuals for a given species within the 20 quadrats for each plot divided by the total number of individuals within the plot. Relative frequency was calculated as the proportion of quadrats in which the species was present per plot divided by the total frequency of all species.

Table 13.0 Weed relative abundance and density by herbicide treatment in wheat pre-seeding at Brandon in 1997.

Weed Species	Full rate		Reduced Rate	
	RelAb	#/m^2	RelAb	#/m^2
Mustard species	23.0	0.8	14.9	0.8
Quackgrass	18.2	0.7	26.7	1.4
Canada thistle	15.8	0.3	7.8	0.2
Dandelion	12.3	0.4	21.2	0.9
Stinkweed	8.7	0.3	5.2	0.2
Wild buckwheat	4.7	0.1	4.2	0.1
Pigweed species	3.5	0.1	3.1	0.1
Shepherds purse	3.1	0.3	2.6	0.2
Volunteer wheat	2.8	0.1	4.1	0.1
Goatsbeard species	2.3	0.1	3.5	0.1
Nightflowering catchfly	2.0	0.2	1.0	0.0
Biennial wormwood	1.2	0.0	1.0	0.0
Wild oat	0.9	0.0	.	.
American dragonhead	0.6	0.0	1.0	0.0
Perennial sowthistle	0.6	0.0	0.6	0.0
Volunteer maple	0.4	0.0	0.4	0.0
Mouse ear chickweed	.	.	0.3	0.0
Narrow leaved hawks beard	.	.	0.4	0.0
Sweet clover species	.	.	0.5	0.0
Vetch species	.	.	1.5	0.1

Relative Abundance values (RelAb) were calculated by plot for each weed species: (relative density + relative frequency)/2. Relative density was calculated as: number of individuals for a given species within the 20 quadrats for each plot divided by the total number of individuals within the plot. Relative frequency was calculated as the proportion of quadrats in which the species was present per plot divided by the total frequency of all species.

Table 14.0 Weed relative abundance and density by herbicide treatment in canola pre-seeding at Brandon in 1997.

Weed Species	Full rate		Reduced Rate	
	RelAb	#/m^2	RelAb	#/m^2
Stinkweed	21.0	0.4	31.0	0.3
Mustard species	17.6	1.4	18.3	1.7
Volunteer wheat	15.4	0.6	10.1	0.5
Canada thistle	13.3	0.4	9.5	0.3
Dandelion	10.5	0.2	4.4	0.2
Quackgrass	8.4	0.3	8.5	0.3
Shepherds purse	7.4	0.7	7.7	0.7
Narrow leaved hawks beard	2.4	0.1	3.2	0.2
American dragonhead	1.8	0.1	0.1	0.0
Wild buckwheat	1.0	0.2	4.5	0.3
Pigweed species	0.7	0.2	0.5	0.0
Nightflowering catchfly	0.3	0.0	0.8	0.0
Flixweed	0.1	0.0	.	.
Wild oat	.	.	0.1	0.0
Mouse ear chickweed	.	.	0.2	0.0
Prickly lettuce	.	.	0.2	0.0
Goatsbeard species	.	.	0.8	0.0

Relative Abundance values (RelAb) were calculated by plot for each weed species: (relative density + relative frequency)/2. Relative density was calculated as: number of individuals for a given species within the 20 quadrats for each plot divided by the total number of individuals within the plot. Relative frequency was calculated as the proportion of quadrats in which the species was present per plot divided by the total frequency of all species.

Table 15.0 Weed relative abundance and density by herbicide treatment in wheat prior to in-crop spraying at Brandon in 1997.

Weed Species	Full rate		Reduced Rate	
	RelAb	$\#/m^2$	RelAb	$\#/m^2$
Mustard species	45.7	5.0	42.3	4.6
Canada thistle	27.8	3.4	26.1	3.0
Perennial sowthistle	13.9	2.2	20.4	5.1
Wild buckwheat	8.0	0.8	7.4	0.8
Wild oat	3.8	0.4	2.4	0.2
Quackgrass	0.3	0.1	0.4	0.1
Dandelion	0.2	0.0	0.4	0.0
Common lambsquarters	0.1	0.0	.	.
Sweet clover species	0.1	0.0	.	.
Green foxtail	0.1	0.0	0.1	0.0
Stinkweed	0.1	0.0	.	.
Nightflowering catchfly	.	.	0.1	0.0
Goatsbeard species	.	.	0.2	0.0
Vetch species	.	.	0.2	0.0

Relative Abundance values (RelAb) were calculated by plot for each weed species: (relative density + relative frequency)/2. Relative density was calculated as: number of individuals for a given species within the 20 quadrats for each plot divided by the total number of individuals within the plot. Relative frequency was calculated as the proportion of quadrats in which the species was present per plot divided by the total frequency of all species.

Table 16.0 Weed relative abundance and density by herbicide treatment in canola prior to in-crop spraying at Brandon in 1997.

Weed Species	Full rate		Reduced Rate	
	RelAb	$\#/m^2$	RelAb	$\#/m^2$
Canada thistle	29.5	3.8	23.4	3.6
Mustard species	22.3	3.7	22.1	4.6
Volunteer wheat	17.8	1.7	17.4	1.8
Wild buckwheat	11.4	1.9	17.0	4.2
Wild oat	8.9	1.0	8.5	1.0
Perennial sowthistle	5.0	0.6	5.8	0.7
Stinkweed	2.9	0.5	2.0	0.4
Common lambsquarters	0.5	0.1	0.8	0.2
Smartweed species	0.5	0.0	0.5	0.0
Shepherds purse	0.4	0.0	0.7	0.1
Quackgrass	0.2	0.0	1.0	0.1
Green foxtail	0.2	0.0	0.5	0.2
Vetch species	0.2	0.1	.	.
Round-leaved mallow	0.1	0.0	.	.
Nightflowering catchfly	0.1	0.0	0.2	0.0
Narrow leaved hawks beard	0.1	0.0	0.1	0.0
Yellow whitlow grass	.	.	0.0	0.0
Thyme leaved spurge	.	.	0.0	0.0
False ragweed	.	.	0.1	0.0

Relative Abundance values (RelAb) were calculated by plot for each weed species: (relative density + relative frequency)/2. Relative density was calculated as: number of individuals for a given species within the 20 quadrats for each plot divided by the total number of individuals within the plot. Relative frequency was calculated as the proportion of quadrats in which the species was present per plot divided by the total frequency of all species.

Table 17.0 Weed relative abundance and density by herbicide treatment in wheat in July at Brandon in 1997.

Weed Species	Full rate		Reduced Rate	
	RelAb	#/m^2	RelAb	#/m^2
Volunteer canola	19.1	7.4	21.3	8.5
Perennial sowthistle	18.1	7.1	20.0	10.3
Wild buckwheat	17.0	7.7	14.8	7.3
Canada thistle	16.5	7.8	16.6	8.0
Wild mustard	16.2	8.2	16.1	9.2
Shepherds purse	4.9	4.4	2.1	1.2
Stinkweed	2.8	0.9	2.2	0.9
Green foxtail	1.3	0.6	3.0	1.8
Wild oat	0.8	0.2	0.7	0.2
Common lambsquarters	0.7	0.2	1.4	0.8
Quackgrass	0.6	0.5	0.4	0.3
Worm seed mustard	0.6	0.1	0.7	0.3
Narrow leaved hawks beard	0.3	0.1	0.1	0.0
Prostrate pigweed	0.3	0.1	.	.
Nightflowering catchfly	0.2	0.0	0.2	0.0
American dragonhead	0.1	0.0	.	.
Redroot pigweed	0.1	0.0	0.1	0.0
Volunteer maple	0.1	0.0	0.2	0.0
Canada fleabane, Horseweed	0.1	0.0	.	.
Mouse ear chickweed	0.0	0.0	.	.
Round-leaved mallow	0.0	0.0	.	.
Prickly lettuce	0.0	0.0	.	.
Smartweed species	0.0	0.0	.	.
Bluebur	.	.	0.1	0.0
Sweet clover species	.	.	0.1	0.0
Goatsbeard species	.	.	0.0	0.0

Relative Abundance values (RelAb) were calculated by plot for each weed species: (relative density + relative frequency)/2. Relative density was calculated as: number of individuals for a given species within the 20 quadrats for each plot divided by the total number of individuals within the plot. Relative frequency was calculated as the proportion of quadrats in which the species was present per plot divided by the total frequency of all species.

Table 18.0 Weed relative abundance and density by herbicide treatment in canola in July at Brandon in 1997.

Weed Species	Full rate		Reduced Rate	
	RelAb	#/m^2	RelAb	#/m^2
Volunteer wheat	40.3	24.2	37.9	24.8
Wild mustard	21.9	16.9	22.0	16.7
Canada thistle	10.4	3.5	10.2	3.9
Wild buckwheat	9.6	3.9	12.1	7.0
Perennial sowthistle	4.7	1.1	4.5	1.2
Stinkweed	4.2	1.2	4.6	1.9
Wild oat	2.7	0.9	4.1	1.5
Common lambsquarters	2.0	0.8	1.5	0.4
Green foxtail	1.4	0.4	0.6	0.2
Narrow leaved hawks beard	0.9	0.1	0.7	0.1
Shepherds purse	0.9	0.5	0.9	0.3
Nightflowering catchfly	0.4	0.2	0.4	0.2
Worm seed mustard	0.2	0.1	0.1	0.0
Redroot pigweed	0.1	0.0	0.1	0.0
Quackgrass	0.1	0.1	0.1	0.1
Sweet clover species	0.1	0.0	0.1	0.0
Goatsbeard species	0.1	0.0	.	.
Dandelion	0.0	0.0	.	.
Canada fleabane, Horseweed	.	.	0.0	0.0
False ragweed	.	.	0.1	0.0
Volunteer barley	.	.	0.0	0.0
Bluebur	.	.	0.1	0.0
Round-leaved mallow	.	.	0.0	0.0
Vetch species	.	.	0.0	0.0

Relative Abundance values (RelAb) were calculated by plot for each weed species: (relative density + relative frequency)/2. Relative density was calculated as: number of individuals for a given species within the 20 quadrats for each plot divided by the total number of individuals within the plot. Relative frequency was calculated as the proportion of quadrats in which the species was present per plot divided by the total frequency of all species.

Table 19.0 Weed relative abundance and density by crop prior to crop seeding at Melfort in 1997.

Weed Species	Wheat RelAb	Wheat #/m^2	Canola RelAb	Canola #/m^2
Mustard species	46.4	83.6	0.5	0.1
Dandelion	43.7	16.7	77.9	17.4
Wild oat	3.2	0.7	1.6	0.2
Cleavers	1.3	0.4	3.3	0.6
Redroot pigweed	1.0	0.2	1.4	0.1
Wild buckwheat	0.8	0.3	1.0	0.2
Volunteer wheat	0.7	0.1	7.6	1.0
Cinquefoil	0.6	0.1	1.4	0.1
Stinkweed	0.6	0.3	3.2	0.3
Pygmy flower	0.3	0.1	.	.
Common lambsquarters	0.3	0.1	0.3	0.0
Shepherds purse	0.3	0.0	0.2	0.0
Quackgrass	0.2	0.0	0.6	0.1
Smartweed species	0.1	0.1	.	.
Flixweed	0.1	0.0	0.2	0.0
Canada thistle	0.1	0.0	0.3	0.0
Sweet clover species	0.0	0.0	0.0	0.0
Perennial sowthistle	0.0	0.0	0.0	0.0
American dragonhead	.	.	0.1	0.0
Yellow whitlow grass	.	.	0.2	0.0
Italian ryegrass	.	.	0.2	0.0
Green foxtail	.	.	0.0	0.0

Relative Abundance values (RelAb) were calculated by plot for each weed species: (relative density + relative frequency)/2. Relative density was calculated as: number of individuals for a given species within the 20 quadrats for each plot divided by the total number of individuals within the plot. Relative frequency was calculated as the proportion of quadrats in which the species was present per plot divided by the total frequency of all species.

Table 20.0 Weed relative abundance and density by crop prior to in-crop spraying at Melfort in 1997.

Weed Species	Wheat RelAb	Wheat #/m^2	Canola RelAb	Canola #/m^2
Mustard species	52.1	162.5	0.4	0.2
Green foxtail	15.5	23.6	23.4	38.2
Dandelion	11.3	8.5	11.9	9.8
Redroot pigweed	4.5	3.7	4.3	3.3
Cleavers	4.1	4.6	8.0	10.4
Wild oat	3.7	2.7	23.5	33.1
Wild buckwheat	3.1	1.4	4.5	2.7
Stinkweed	2.2	1.7	9.0	15.7
Barnyard grass	0.9	0.8	3.0	3.0
Common lambsquarters	0.8	0.4	3.9	3.0
Shepherds purse	0.8	0.6	1.8	3.0
Narrow leaved hawks beard	0.3	0.1	0.2	0.1
Canada thistle	0.3	0.1	2.7	1.7
Cinquefoil	0.2	0.1	0.2	0.1
Flixweed	0.1	0.0	0.0	0.0
Perennial sowthistle	0.0	0.0	0.8	0.6
Sweet clover species	0.0	0.0	0.1	0.0
Pygmy flower	0.0	0.0	0.1	0.1
Common mallow	0.0	0.0	.	.
Common chickweed	0.0	0.0	0.2	0.3
Vetch species	0.0	0.0	.	.
Prickly lettuce	0.0	0.0	.	.
Prostrate knotweed	0.0	0.0	.	.
Bluebur	0.0	0.0	0.0	0.0
Quackgrass	.	.	0.1	0.0
Hares ear mustard	.	.	0.0	0.0
Yellow whitlow grass	.	.	0.0	0.0
Hempnettle	.	.	0.1	0.0
Italian ryegrass	.	.	0.1	0.0
Common purslane	.	.	0.1	0.1
Common groundsel	.	.	0.4	0.2
Volunteer wheat	.	.	1.4	1.2

Relative Abundance values (RelAb) were calculated by plot for each weed species: (relative density + relative frequency)/2. Relative density was calculated as: number of individuals for a given species within the 20 quadrats for each plot divided by the total number of individuals within the plot. Relative frequency was calculated as the proportion of quadrats in which the species was present per plot divided by the total frequency of all species.

Table 21.0 Weed relative abundance and density by crop in July at Melfort in 1997.

Weed Species	Wheat RelAb	Wheat $\#/m^2$	Canola RelAb	Canola $\#/m^2$
Dandelion	61.8	1.8	19.9	1.5
Wild buckwheat	14.4	0.5	36.0	2.7
Green foxtail	6.5	0.3	3.8	0.3
Wild oat	6.0	0.3	11.1	0.9
Cleavers	3.8	0.2	17.3	1.6
Canada thistle	3.1	0.1	6.1	0.5
Mustard species	2.5	0.1	.	.
Narrow leaved hawks beard	0.5	0.0	0.1	0.0
Cinquefoil	0.4	0.0	1.0	0.1
Shepherds purse	0.4	0.0	0.2	0.0
Redroot pigweed	0.3	0.0	.	.
Stinkweed	0.2	0.0	1.5	0.1
Common lambsquarters	.	.	0.3	0.0
Barnyard grass	.	.	1.9	0.1
Sweet clover species	.	.	0.2	0.0
Smartweed species	.	.	0.1	0.0
Perennial sowthistle	.	.	0.5	0.1

Relative Abundance values (RelAb) were calculated by plot for each weed species: (relative density + relative frequency)/2. Relative density was calculated as: number of individuals for a given species within the 20 quadrats for each plot divided by the total number of individuals within the plot. Relative frequency was calculated as the proportion of quadrats in which the species was present per plot divided by the total frequency of all species.

Table 22.0 Weed relative abundance and density by fertilizer treatment in wheat prior to crop seeding at Melfort in 1997.

Weed Species	Fall band		Spring band		Spring band 9"		Spring band 12"		Sweep	
	RelAb	#/m²	RelAb	#/m²	RelAb	#/m²	RelAb	#/m²	RelAb	#/m²
Mustard species	64.1	199.4	10.8	4.0	57.4	97.4	58.1	90.9	41.8	26.1
Dandelion	21.6	12.4	80.9	4.6	32.5	23.3	33.5	19.6	50.0	23.8
Wild oat	5.8	2.0	3.8	0.1	2.2	0.5	2.6	0.8	1.7	0.3
Cleavers	2.2	0.9	1.3	0.0	1.7	0.5	0.4	0.1	1.1	0.4
Stinkweed	1.6	0.6	.	.	0.7	0.9	0.1	0.0	0.4	0.1
Wild buckwheat	1.5	0.5	.	.	0.7	0.3	1.3	0.5	0.4	0.1
Common lambsquarters	0.9	0.2	.	.	0.3	0.1	0.2	0.1	0.2	0.0
Redroot pigweed	0.9	0.2	.	.	2.0	0.3	1.1	0.2	1.2	0.3
Volunteer wheat	0.7	0.2	1.8	0.1	.	.	0.6	0.1	0.5	0.1
Cinquefoil	0.4	0.1	0.6	0.0	1.6	0.6	0.4	0.1	.	.
Shepherds purse	0.2	0.0	0.8	0.0	.	.	0.2	0.0	0.2	0.0
Quackgrass	.	.	.	.	0.2	0.0	0.3	0.1	0.5	0.1
Pygmy flower	.	.	.	.	0.2	0.0	0.3	0.1	1.1	0.2
Canada thistle	.	.	.	.	0.2	0.1	0.1	0.0	0.2	0.0
Flixweed	.	.	.	.	0.2	0.0	.	.	0.6	0.1
Sweet clover species	.	.	.	.	0.1	0.0	.	.	.	.
Smartweed species	.	.	.	.	0.1	0.0	0.6	0.5	.	.
Perennial sowthistle	.	.	.	.	.	.	0.1	0.0	.	.

Relative Abundance values (RelAb) were calculated by plot for each weed species: (relative density + relative frequency)/2. Relative density was calculated as: number of individuals for a given species within the 20 quadrats for each plot divided by the total number of individuals within the plot. Relative frequency was calculated as the proportion of quadrats in which the species was present per plot divided by the total frequency of all species.

Table 23.0 Weed relative abundance and density by fertilizer treatment in canola prior to crop seeding at Melfort in 1997.

Weed Species	Fall band		Spring band		Spring band 9"		Spring band 12"		Sweep	
	RelAb	#/m^2	RelAb	#/m^2	RelAb	#/m^2	RelAb	#/m^2	RelAb	#/m^2
Dandelion	46.2	15.0	94.7	5.2	78.0	23.4	89.4	21.5	81.1	21.7
Volunteer wheat	21.6	3.9	4.6	0.2	4.1	0.5	1.8	0.2	5.8	0.4
Stinkweed	10.2	1.2	.	.	2.9	0.4	0.9	0.1	2.0	0.1
Cleavers	7.7	2.1	.	.	4.5	0.7	2.9	0.2	1.2	0.1
Wild buckwheat	3.8	0.9	.	.	0.5	0.1	0.7	0.1	.	.
Wild oat	2.8	0.6	.	.	1.5	0.3	0.8	0.1	2.7	0.1
Redroot pigweed	2.2	0.3	.	.	2.6	0.3	0.5	0.0	1.7	0.1
Cinquefoil	1.6	0.3	0.7	0.1	1.6	0.2	1.0	0.1	2.1	0.2
Mustard species	1.0	0.3	.	.	.	.	1.1	0.1	0.2	0.0
Quackgrass	0.8	0.1	.	.	1.2	0.1	.	.	0.9	0.1
Shepherds purse	0.7	0.1	.	.	0.2	0.0	0.3	0.0	.	.
American dragonhead	0.4	0.1	.	.	.	.	.	.	.	.
Canada thistle	0.4	0.1	.	.	0.8	0.1	.	.	0.3	0.0
Common lambsquarters	0.4	0.1	.	.	1.3	0.2	.	.	.	.
Sweet clover species	0.2	0.1	.	.	.	.	.	.	.	.
Green foxtail	0.2	0.0	.	.	.	.	.	.	.	.
Flixweed	.	.	.	.	.	.	.	.	1.0	0.1
Yellow whitlow grass	.	.	.	.	0.7	0.1	0.3	0.0	.	.
Italian ryegrass	.	.	.	.	.	.	.	.	1.0	0.1
Perennial sowthistle	.	.	.	.	.	.	0.2	0.0	.	.

Relative Abundance values (RelAb) were calculated by plot for each weed species: (relative density + relative frequency)/2. Relative density was calculated as: number of individuals for a given species within the 20 quadrats for each plot divided by the total number of individuals within the plot. Relative frequency was calculated as the proportion of quadrats in which the species was present per plot divided by the total frequency of all species.

Table 24.0 Weed relative abundance and density by fertilizer treatment in wheat prior to in-crop spraying at Melfort in 1997.

Weed Species	Fall band		Spring band		Spring band 9"		Spring band 12"		Sweep	
	RelAb	#/m²	RelAb	#/m²	RelAb	#/m²	RelAb	#/m²	RelAb	#/m²
Mustard species	45.6	100.4	53.3	172.3	50.0	148.4	53.0	157.9	58.7	233.5
Green foxtail	18.1	25.8	14.4	19.9	16.4	24.5	14.5	21.3	14.4	26.3
Dandelion	9.7	6.2	10.7	7.2	13.4	12.8	13.3	10.5	9.5	5.9
Wild oat	6.1	4.5	3.5	2.9	4.0	3.1	3.5	2.5	1.2	0.5
Cleavers	5.4	5.7	2.6	1.8	3.8	4.7	5.0	6.5	3.8	4.4
Redroot pigweed	5.2	3.7	6.1	7.5	2.8	1.8	3.4	1.7	4.9	3.7
Wild buckwheat	3.9	1.8	4.3	1.8	2.5	1.0	2.9	1.3	2.0	1.1
Stinkweed	2.3	1.8	2.0	1.5	3.3	3.4	1.2	0.8	2.1	1.1
Barnyard grass	1.9	2.1	0.1	0.1	0.8	0.4	0.7	0.4	1.2	1.1
Common lambsquarters	0.9	0.4	1.6	0.7	0.4	0.2	0.2	0.1	0.8	0.6
Shepherds purse	0.3	0.3	0.7	1.0	1.6	1.2	0.6	0.4	0.6	0.2
Narrow leaved hawks beard	0.2	0.1	0.4	0.1	0.3	0.1	0.6	0.2	0.1	0.0
Pygmy flower	0.1	0.1	.	.	.	.	.	.	.	.
Cinquefoil	0.1	0.0	0.1	0.1	0.4	0.2	0.2	0.4	.	.
Perennial sowthistle	0.1	0.0	.	.	.	.	.	.	0.1	0.0
Sweet clover species	0.1	0.0	.	.	0.1	0.0	.	.	.	.
Canada thistle	.	.	0.2	0.1	0.1	0.1	0.5	0.3	0.5	0.2
Flixweed	.	.	.	.	0.1	0.0	0.2	0.1	.	.
Prickly lettuce	.	.	.	.	.	.	0.1	0.0	.	.
Bluebur	.	.	.	.	.	.	0.1	0.0	.	.
Common mallow	.	.	0.1	0.1	.	.	.	.	.	.
Prostrate knotweed	.	.	.	.	0.1	0.0	.	.	.	.
Common chickweed	.	.	0.1	0.1	.	.	.	.	.	.
Vetch species	.	.	.	.	.	.	.	.	0.1	0.0

Relative Abundance values (RelAb) were calculated by plot for each weed species: (relative density + relative frequency)/2. Relative density was calculated as: number of individuals for a given species within the 20 quadrats for each plot divided by the total number of individuals within the plot. Relative frequency was calculated as the proportion of quadrats in which the species was present per plot divided by the total frequency of all species.

Table 25.0 Weed relative abundance and density by fertilizer treatment in canola prior to in-crop spraying at Melfort in 1997.

Weed Species	Fall band		Spring band		Spring band 9"		Spring band 12"		Sweep	
	RelAb	#/m²	RelAb	#/m²	RelAb	#/m²	RelAb	#/m²	RelAb	#/m²
Wild oat	24.1	31.1	21.1	34.8	23.1	29.7	23.5	30.3	25.6	39.6
Green foxtail	23.2	33.1	27.2	56.7	19.6	24.3	21.9	27.4	24.9	49.5
Dandelion	11.3	8.6	10.4	8.8	14.5	13.2	13.4	10.4	10.2	8.0
Cleavers	10.0	13.3	8.9	13.6	8.8	12.1	6.2	5.4	6.0	7.5
Stinkweed	7.0	7.2	8.9	27.7	8.1	10.6	11.3	18.4	9.5	14.8
Redroot pigweed	6.2	5.2	3.9	3.4	3.7	2.7	2.9	1.4	4.7	3.9
Wild buckwheat	4.7	2.7	3.8	2.5	4.2	2.4	4.5	2.3	5.1	3.7
Common lambsquarters	3.5	2.2	4.3	3.5	3.8	2.8	3.5	2.3	4.4	4.0
Canada thistle	2.2	1.4	2.9	2.0	2.1	1.1	4.2	2.8	2.0	1.2
Shepherds purse	1.9	2.5	2.0	5.9	2.5	4.8	1.0	0.6	1.6	1.2
Volunteer wheat	1.7	1.4	2.0	1.7	1.3	1.1	0.8	0.7	1.1	1.1
Perennial sowthistle	1.4	1.4	0.4	0.3	0.9	0.5	0.2	0.1	0.9	0.8
Barnyard grass	1.2	1.0	2.1	2.4	4.7	4.7	4.0	3.5	3.2	3.7
Cinquefoil	0.5	0.3	.	.	0.2	0.1	0.4	0.2	.	.
Common groundsel	0.2	0.1	0.3	0.1	0.2	0.1	0.9	0.5	0.2	0.1
Pygmy flower	0.2	0.1	0.1	0.1	0.3	0.1	0.1	0.0	.	.
Mustard species	0.2	0.2	0.9	0.7	0.2	0.1	0.3	0.1	0.3	0.1
Sweet clover species	0.2	0.1	0.1	0.1	0.1	0.0	0.1	0.1	.	.
Hempnettle	0.1	0.1	.	.	0.1	0.1	0.1	0.0	.	.
Narrow leaved hawks beard	0.1	0.1	0.2	0.1	0.2	0.3	0.2	0.2	0.1	0.0
Common chickweed	0.1	0.0	.	.	0.6	1.7	.	.	0.1	0.0
Quackgrass	.	.	0.1	0.0	0.2	0.2	.	.	.	.
Hares ear mustard	.	.	.	.	.	.	0.1	0.0	.	.
Flixweed	.	.	0.2	0.1	.	.	.	.	.	.
Yellow whitlow grass	.	.	.	.	0.2	0.1	.	.	.	.
Italian ryegrass	.	.	0.2	0.1	0.1	0.0	.	.	0.1	0.0
Bluebur	.	.	.	.	0.1	0.1	.	.	.	.
Common purslane	.	.	.	.	.	.	0.4	0.4	.	.

Relative Abundance values (RelAb) were calculated by plot for each weed species: (relative density + relative frequency)/2. Relative density was calculated as: number of individuals for a given species within the 20 quadrats for each plot divided by the total number of individuals within the plot. Relative frequency was calculated as the proportion of quadrats in which the species was present per plot divided by the total frequency of all species.

Table 26.0 Weed relative abundance and density by fertilizer treatment in wheat in July at Melfort in 1997.

Weed Species	Fall band		Spring band		Spring band 9"		Spring band 12"		Sweep	
	RelAb	#/m^2	RelAb	#/m^2	RelAb	#/m^2	RelAb	#/m^2	RelAb	#/m^2
Dandelion	61.5	2.3	54.0	1.8	67.9	1.5	49.7	2.3	75.8	1.3
Wild buckwheat	14.6	0.6	20.2	0.7	7.0	0.1	17.8	0.8	12.3	0.2
Green foxtail	11.1	0.5	4.2	0.2	6.5	0.3	7.7	0.5	3.3	0.1
Cleavers	5.0	0.2	6.1	0.2	2.6	0.1	3.9	0.3	1.2	0.0
Wild oat	3.4	0.2	8.5	0.3	10.9	0.3	7.3	0.5	.	.
Shepherds purse	1.9	0.1	.	.	.	.	.	.	.	.
Canada thistle	1.5	0.1	4.9	0.2	2.3	0.1	5.9	0.3	1.0	0.0
Narrow leaved hawks beard	0.5	0.0	.	.	.	.	1.1	0.1	1.0	0.0
Mustard species	0.4	0.0	0.7	0.0	.	.	6.1	0.3	5.4	0.1
Redroot pigweed	.	.	1.4	0.1	.	.	.	.	.	.
Cinquefoil	.	.	.	.	1.7	0.0	0.6	0.0	.	.
Stinkweed	.	.	.	.	1.2	0.0	.	.	.	.

Relative Abundance values (RelAb) were calculated by plot for each weed species: (relative density + relative frequency)/2. Relative density was calculated as: number of individuals for a given species within the 20 quadrats for each plot divided by the total number of individuals within the plot. Relative frequency was calculated as the proportion of quadrats in which the species was present per plot divided by the total frequency of all species.

Table 27.0 Weed relative abundance and density by fertilizer treatment in canola in July at Melfort in 1997.

Weed Species	Fall band		Spring band		Spring band 9"		Spring band 12"		Sweep	
	RelAb	#/m²	RelAb	#/m²	RelAb	#/m²	RelAb	#/m²	RelAb	#/m²
Wild buckwheat	37.9	3.4	45.0	3.7	34.7	2.0	28.3	1.5	33.8	3.1
Dandelion	22.0	2.3	14.7	1.1	15.9	0.9	28.6	1.6	18.1	1.4
Cleavers	19.8	2.2	22.4	2.2	22.7	1.8	8.5	0.5	13.0	1.1
Wild oat	6.9	0.7	7.1	0.5	10.8	0.7	14.6	1.1	15.9	1.6
Stinkweed	4.3	0.2	0.8	0.1	.	.	.	.	2.3	0.1
Canada thistle	3.6	0.4	4.7	0.5	7.7	0.6	13.5	0.9	1.1	0.1
Green foxtail	2.4	0.2	1.6	0.1	2.4	0.1	2.6	0.2	9.9	1.0
Cinquefoil	2.1	0.3	.	.	2.2	0.2	0.4	0.0	0.4	0.0
Barnyard grass	0.7	0.1	1.5	0.1	2.7	0.1	1.5	0.1	3.2	0.3
Perennial sowthistle	0.3	0.0	2.1	0.3	.	.	.	.	.	.
Shepherds purse	.	.	.	.	.	.	.	.	1.1	0.1
Common lambsquarters	.	.	.	.	0.4	0.0	0.5	0.0	0.7	0.1
Narrow leaved hawks beard	.	.	.	.	.	.	0.6	0.0	.	.
Sweet clover species	.	.	.	.	.	.	0.7	0.1	0.5	0.0
Smartweed species	.	.	.	.	0.5	0.0	.	.	.	.

Relative Abundance values (RelAb) were calculated by plot for each weed species: (relative density + relative frequency)/2. Relative density was calculated as: number of individuals for a given species within the 20 quadrats for each plot divided by the total number of individuals within the plot. Relative frequency was calculated as the proportion of quadrats in which the species was present per plot divided by the total frequency of all species.

Table 28.0 Weed relative abundance and density by herbicide treatment in wheat pre-seeding at Melfort in 1997.

Weed Species	Full rate		Reduced Rate	
	RelAb	#/m^2	RelAb	#/m^2
Mustard species	48.2	92.8	44.7	74.3
Dandelion	42.1	14.0	45.4	19.4
Wild oat	2.9	0.6	3.6	0.8
Cleavers	1.5	0.4	1.2	0.4
Redroot pigweed	1.2	0.3	0.9	0.1
Stinkweed	0.8	0.6	0.3	0.1
Wild buckwheat	0.6	0.1	1.0	0.4
Cinquefoil	0.5	0.1	0.7	0.2
Shepherds purse	0.5	0.0	0.1	0.0
Common lambsquarters	0.4	0.1	0.2	0.1
Volunteer wheat	0.3	0.1	1.1	0.1
Pygmy flower	0.3	0.0	0.4	0.1
Smartweed species	0.2	0.2	0.1	0.0
Flixweed	0.2	0.0	0.1	0.0
Quackgrass	0.2	0.1	0.2	0.0
Canada thistle	0.1	0.0	0.1	0.0
Perennial sowthistle	0.1	0.0	.	.
Sweet clover species	.	.	0.1	0.0

Relative Abundance values (RelAb) were calculated by plot for each weed species: (relative density + relative frequency)/2. Relative density was calculated as: number of individuals for a given species within the 20 quadrats for each plot divided by the total number of individuals within the plot. Relative frequency was calculated as the proportion of quadrats in which the species was present per plot divided by the total frequency of all species.

Table 29.0 Weed relative abundance and density by herbicide treatment in canola pre-seeding at Melfort in 1997.

Weed Species	Full rate		Reduced Rate	
	RelAb	#/m^2	RelAb	#/m^2
Dandelion	78.2	15.6	77.6	19.1
Volunteer wheat	8.9	1.0	6.3	1.0
Stinkweed	4.1	0.4	2.3	0.3
Cleavers	2.9	0.5	3.7	0.7
Redroot pigweed	1.7	0.2	1.1	0.1
Cinquefoil	0.9	0.1	1.9	0.2
Wild oat	0.7	0.1	2.5	0.3
Quackgrass	0.7	0.1	0.5	0.1
Wild buckwheat	0.6	0.1	1.4	0.3
Common lambsquarters	0.5	0.1	0.2	0.0
Mustard species	0.3	0.0	0.7	0.1
Yellow whitlow grass	0.2	0.0	0.2	0.0
Canada thistle	0.2	0.0	0.4	0.0
Flixweed	0.1	0.0	0.3	0.0
Shepherds purse	0.1	0.0	0.3	0.0
American dragonhead	.	.	0.2	0.0
Italian ryegrass	.	.	0.4	0.0
Sweet clover species	.	.	0.1	0.0
Green foxtail	.	.	0.1	0.0
Perennial sowthistle	.	.	0.1	0.0

Relative Abundance values (RelAb) were calculated by plot for each weed species: (relative density + relative frequency)/2. Relative density was calculated as: number of individuals for a given species within the 20 quadrats for each plot divided by the total number of individuals within the plot. Relative frequency was calculated as the proportion of quadrats in which the species was present per plot divided by the total frequency of all species.

Table 30.0 Weed relative abundance and density by herbicide treatment in wheat prior to in-crop spraying at Melfort in 1997.

Weed Species	Full rate		Reduced Rate	
	RelAb	#/m^2	RelAb	#/m^2
Mustard species	51.5	158.4	52.7	166.5
Green foxtail	16.3	25.6	14.8	21.5
Dandelion	10.6	7.7	12.1	9.4
Redroot pigweed	4.5	3.2	4.4	4.2
Cleavers	4.0	4.6	4.2	4.7
Wild oat	3.7	2.6	3.6	2.8
Wild buckwheat	3.1	1.4	3.1	1.3
Stinkweed	2.6	2.3	1.7	1.2
Shepherds purse	1.0	0.6	0.5	0.6
Barnyard grass	1.0	0.8	0.8	0.8
Common lambsquarters	0.9	0.5	0.6	0.3
Narrow leaved hawks beard	0.3	0.1	0.3	0.1
Canada thistle	0.2	0.1	0.3	0.2
Cinquefoil	0.1	0.2	0.2	0.1
Flixweed	0.1	0.0	0.0	0.0
Bluebur	0.0	0.0	.	.
Pygmy flower	.	.	0.1	0.0
Prickly lettuce	.	.	0.0	0.0
Common mallow	.	.	0.0	0.0
Sweet clover species	.	.	0.1	0.0
Prostrate knotweed	.	.	0.0	0.0
Perennial sowthistle	.	.	0.1	0.0
Common chickweed	.	.	0.0	0.0
Vetch species	.	.	0.0	0.0

Relative Abundance values (RelAb) were calculated by plot for each weed species: (relative density + relative frequency)/2. Relative density was calculated as: number of individuals for a given species within the 20 quadrats for each plot divided by the total number of individuals within the plot. Relative frequency was calculated as the proportion of quadrats in which the species was present per plot divided by the total frequency of all species.

Table 31.0 Weed relative abundance and density by herbicide treatment in canola prior to in-crop spraying at Melfort in 1997.

Weed Species	Full rate		Reduced Rate	
	RelAb	#/m^2	RelAb	#/m^2
Green foxtail	23.8	41.3	23.0	35.0
Wild oat	23.4	32.8	23.6	33.4
Dandelion	11.5	9.2	12.4	10.4
Stinkweed	9.6	18.6	8.4	12.8
Cleavers	7.2	8.0	8.7	12.7
Wild buckwheat	4.4	2.4	4.5	3.0
Redroot pigweed	4.1	2.9	4.5	3.7
Common lambsquarters	3.8	2.8	4.0	3.1
Barnyard grass	3.3	3.2	2.8	2.9
Canada thistle	2.7	1.7	2.7	1.6
Shepherds purse	2.4	4.4	1.1	1.5
Volunteer wheat	1.8	1.7	0.9	0.6
Common groundsel	0.6	0.3	0.2	0.1
Perennial sowthistle	0.5	0.3	1.0	0.9
Mustard species	0.2	0.2	0.6	0.3
Italian ryegrass	0.1	0.0	0.0	0.0
Pygmy flower	0.1	0.1	0.2	0.1
Cinquefoil	0.1	0.0	0.3	0.2
Hempnettle	0.1	0.0	0.0	0.0
Sweet clover species	0.1	0.1	0.1	0.0
Flixweed	0.1	0.0	.	.
Narrow leaved hawks beard	0.1	0.0	0.3	0.2
Common chickweed	0.0	0.0	0.3	0.7
Common purslane	0.0	0.0	0.1	0.1
Quackgrass	.	.	0.1	0.1
Hares ear mustard	.	.	0.0	0.0
Yellow whitlow grass	.	.	0.1	0.0
Bluebur	.	.	0.0	0.0

Relative Abundance values (RelAb) were calculated by plot for each weed species: (relative density + relative frequency)/2. Relative density was calculated as: number of individuals for a given species within the 20 quadrats for each plot divided by the total number of individuals within the plot. Relative frequency was calculated as the proportion of quadrats in which the species was present per plot divided by the total frequency of all species.

Table 32.0 Weed relative abundance and density by herbicide treatment in wheat in July at Melfort in 1997.

Weed Species	Full rate		Reduced Rate	
	RelAb	#/m^2	RelAb	#/m^2
Dandelion	67.1	1.6	56.5	2.1
Wild buckwheat	11.1	0.3	17.7	0.7
Wild oat	5.9	0.2	6.1	0.3
Green foxtail	5.9	0.2	7.2	0.4
Cleavers	3.6	0.1	4.0	0.2
Canada thistle	3.0	0.1	3.3	0.1
Mustard species	2.2	0.1	2.8	0.1
Shepherds purse	0.8	0.0	.	.
Stinkweed	0.5	0.0	.	.
Redroot pigweed	.	.	0.6	0.0
Narrow leaved hawks beard	.	.	1.0	0.0
Cinquefoil	.	.	0.9	0.0

Relative Abundance values (RelAb) were calculated by plot for each weed species: (relative density + relative frequency)/2. Relative density was calculated as: number of individuals for a given species within the 20 quadrats for each plot divided by the total number of individuals within the plot. Relative frequency was calculated as the proportion of quadrats in which the species was present per plot divided by the total frequency of all species.

Table 33.0 Weed relative abundance and density by herbicide treatment in canola in July at Melfort in 1997.

Weed Species	Full rate		Reduced Rate	
	RelAb	#/m^2	RelAb	#/m^2
Wild buckwheat	40.5	2.2	31.4	3.2
Dandelion	17.2	1.0	22.5	2.0
Cleavers	14.8	0.9	19.8	2.3
Wild oat	12.4	0.8	9.8	1.0
Canada thistle	4.3	0.3	7.9	0.7
Green foxtail	4.1	0.3	3.5	0.4
Stinkweed	2.8	0.2	0.1	0.0
Barnyard grass	1.8	0.1	2.0	0.2
Cinquefoil	0.9	0.1	1.1	0.1
Perennial sowthistle	0.4	0.0	0.6	0.1
Smartweed species	0.2	0.0	.	.
Sweet clover species	0.2	0.0	0.3	0.0
Common lambsquarters	0.2	0.0	0.4	0.0
Shepherds purse	0.2	0.0	0.3	0.0
Narrow leaved hawks beard	.	.	0.2	0.0

Relative Abundance values (RelAb) were calculated by plot for each weed species: (relative density + relative frequency)/2. Relative density was calculated as: number of individuals for a given species within the 20 quadrats for each plot divided by the total number of individuals within the plot. Relative frequency was calculated as the proportion of quadrats in which the species was present per plot divided by the total frequency of all species.

Table 34.0 Weed relative abundance and density by crop prior to crop seeding at Beaverlodge in 1997.

Weed Species	Wheat RelAb	Wheat #/m^2	Canola RelAb	Canola #/m^2
Mustard species	52.7	70.5	0.5	0.1
Red clover	20.7	4.9	15.2	1.4
Dandelion	14.0	2.2	32.6	2.4
Quackgrass	9.8	2.5	26.2	4.6
Stinkweed	2.4	0.4	19.2	6.8
Common lambsquarters	0.2	0.0	3.0	1.6
Pineappleweed	0.1	0.0	1.2	0.3
Volunteer wheat	0.1	0.0	1.4	0.1
Bluebur	0.1	0.0	0.4	0.4
Cinquefoil	.	.	0.4	0.0

Relative Abundance values (RelAb) were calculated by plot for each weed species: (relative density + relative frequency)/2. Relative density was calculated as: number of individuals for a given species within the 20 quadrats for each plot divided by the total number of individuals within the plot. Relative frequency was calculated as the proportion of quadrats in which the species was present per plot divided by the total frequency of all species.

Table 35.0 Weed relative abundance and density by crop prior to in-crop spraying at Beaverlodge in 1997.

Weed Species	Wheat RelAb	Wheat #/m^2	Canola RelAb	Canola #/m^2
Volunteer canola	36.6	117.0	.	.
Wild oat	33.1	100.9	38.5	278.3
Wild buckwheat	8.7	7.5	11.2	29.0
Stinkweed	6.8	9.5	15.7	82.2
Bluebur	4.2	4.0	5.6	9.3
Common lambsquarters	2.2	1.5	5.6	8.0
Dandelion	2.1	0.7	3.2	3.4
Quackgrass	2.0	1.5	3.8	12.2
Common groundsel	1.4	1.0	8.6	48.2
Ball mustard	1.3	0.9	2.3	3.1
Red clover	1.3	0.6	2.3	2.4
Prostrate knotweed	0.1	0.0	0.1	0.1
Corn spurry	0.1	0.0	0.0	0.1
Vetch species	0.1	0.0	0.0	0.0
Shepherds purse	0.1	0.0	.	.
Narrow leaved hawks beard	0.0	0.0	0.1	0.0
Storks bill	0.0	0.0	0.1	0.0
Broadleaved plantain	0.0	0.0	0.2	0.1
Cranesbill	0.0	0.0	0.0	0.0
Flixweed	.	.	0.0	0.0
Hempnettle	.	.	0.0	0.0
Pineappleweed	.	.	0.1	0.4
Smartweed species	.	.	0.0	0.0
Cinquefoil	.	.	0.0	0.0
Wild tomato	.	.	0.0	0.0
Perennial sowthistle	.	.	0.1	0.0
Volunteer wheat	.	.	2.0	3.9
Speedwell	.	.	0.4	0.6

Relative Abundance values (RelAb) were calculated by plot for each weed species: (relative density + relative frequency)/2. Relative density was calculated as: number of individuals for a given species within the 20 quadrats for each plot divided by the total number of individuals within the plot. Relative frequency was calculated as the proportion of quadrats in which the species was present per plot divided by the total frequency of all species.

Table 36.0 Weed relative abundance and density by crop in July at Beaverlodge in 1997.

Weed Species	Wheat RelAb	Wheat #/m^2	Canola RelAb	Canola #/m^2
Wild oat	35.4	42.9	23.4	77.8
Wild buckwheat	29.2	32.0	14.0	33.2
Common groundsel	8.6	9.3	14.2	57.7
Quackgrass	7.2	7.9	4.6	14.9
Dandelion	6.1	3.0	4.7	5.3
Bluebur	3.7	1.3	1.8	1.6
Stinkweed	2.3	1.3	12.1	26.9
Narrow leaved hawks beard	1.8	1.5	4.1	15.9
Volunteer canola	1.5	0.7	0.0	0.0
Red clover	1.2	0.6	9.8	23.1
Common lambsquarters	1.2	0.5	4.0	3.7
Prostrate knotweed	0.4	0.2	0.5	0.6
Ball mustard	0.4	0.1	0.6	0.5
Speedwell	0.4	0.2	0.1	0.1
Cleavers	0.1	0.1	0.4	0.5
Common chickweed	0.1	0.0	0.1	0.0
Foxtail barley	0.1	0.0	.	.
Shepherds purse	0.1	0.0	0.1	0.1
Corn spurry	0.0	0.0	0.1	0.2
Broadleaved plantain	0.0	0.0	0.1	0.1
Hempnettle	0.0	0.0	0.1	0.1
Canada thistle	0.0	0.0	.	.
Perennial sowthistle	0.0	0.0	0.1	0.1
Storks bill	0.0	0.0	0.1	0.0
Cranesbill	0.0	0.0	0.0	0.0
Purple leaf willowherb	0.0	0.0	0.1	0.1
Smartweed species	0.0	0.0	0.1	0.1
Pygmy flower	0.0	0.0	0.1	0.1
Wild rose	0.0	0.0	.	.
Vetch species	0.0	0.0	0.1	0.2
Flixweed	.	.	0.0	0.0
Field horsetail	.	.	0.0	0.0
Round-leaved mallow	.	.	0.2	0.2
Pineappleweed	.	.	0.2	0.3
Cinquefoil	.	.	0.1	0.1
Volunteer wheat	.	.	4.5	10.4

Relative Abundance values (RelAb) were calculated by plot for each weed species: (relative density + relative frequency)/2. Relative density was calculated as: number of individuals for a given species within the 20 quadrats for each plot divided by the total number of individuals within the plot. Relative frequency was calculated as the proportion of quadrats in which the species was present per plot divided by the total frequency of all species.

Table 37.0 Weed relative abundance and density by fertilizer treatment in wheat prior to crop seeding at Beaverlodge in 1997.

Weed Species	Fall band		Spring band		Spring band 9"		Spring band 12"		Sweep	
	RelAb	#/m²	RelAb	#/m²	RelAb	#/m²	RelAb	#/m²	RelAb	#/m²
Mustard species	71.4	102.7	34.1	57.6	55.2	46.7	47.4	53.7	55.2	92.1
Quackgrass	11.2	3.1	12.6	2.8	9.4	3.2	8.2	2.2	7.4	1.5
Dandelion	9.2	1.4	11.3	1.4	17.1	3.2	14.1	2.0	18.3	3.2
Red clover	6.7	4.2	40.5	9.6	15.0	3.6	26.0	4.1	15.6	2.8
Stinkweed	1.5	0.4	1.4	0.4	1.9	0.3	4.1	0.5	3.0	0.4
Common lambsquarters	.	.	.	.	0.7	0.1	0.2	0.0	0.2	0.0
Bluebur	.	.	.	.	0.3	0.1	.	.	.	.
Pineappleweed	.	.	.	.	0.2	0.1	.	.	0.4	0.1
Volunteer wheat	.	.	.	.	0.3	0.0	.	.	.	.

Relative Abundance values (RelAb) were calculated by plot for each weed species: (relative density + relative frequency)/2. Relative density was calculated as: number of individuals for a given species within the 20 quadrats for each plot divided by the total number of individuals within the plot. Relative frequency was calculated as the proportion of quadrats in which the species was present per plot divided by the total frequency of all species.

Table 38.0 Weed relative abundance and density by fertilizer treatment in canola prior to crop seeding at Beaverlodge in 1997.

Weed Species	Fall band		Spring band		Spring band 9"		Spring band 12"		Sweep	
	RelAb	#/m^2	RelAb	#/m^2	RelAb	#/m^2	RelAb	#/m^2	RelAb	#/m^2
Quackgrass	40.1	6.3	43.5	12.7	17.2	0.9	15.6	1.6	14.4	1.3
Stinkweed	39.1	9.7	12.5	10.8	11.6	0.9	19.0	10.5	13.6	2.0
Dandelion	14.9	1.4	18.2	2.2	43.5	2.5	43.8	3.3	42.3	2.5
Red clover	2.4	0.2	20.7	3.1	21.0	1.4	15.2	1.3	16.8	1.1
Volunteer wheat	1.9	0.3	0.3	0.0	1.4	0.1	1.3	0.1	2.0	0.1
Common lambsquarters	1.6	0.2	2.4	2.0	1.3	0.0	0.9	0.1	9.0	5.7
Bluebur	.	.	0.9	0.9	.	.	1.1	1.3	.	.
Pineappleweed	.	.	0.4	0.1	2.1	0.1	2.3	1.3	1.4	0.2
Mustard species	.	.	0.6	0.2	1.7	0.2	.	.	.	.
Cinquefoil	.	.	0.4	0.1	0.3	0.0	0.8	0.0	0.5	0.1

Relative Abundance values (RelAb) were calculated by plot for each weed species: (relative density + relative frequency)/2. Relative density was calculated as: number of individuals for a given species within the 20 quadrats for each plot divided by the total number of individuals within the plot. Relative frequency was calculated as the proportion of quadrats in which the species was present per plot divided by the total frequency of all species.

Table 39.0 Weed relative abundance and density by fertilizer treatment in wheat prior to in-crop spraying at Beaverlodge in 1997.

Weed Species	Fall band		Spring band		Spring band 9"		Spring band 12"		Sweep	
	RelAb	#/m²	RelAb	#/m²	RelAb	#/m²	RelAb	#/m²	RelAb	#/m²
Wild oat	39.1	119.5	37.0	112.3	30.1	98.4	31.4	77.2	27.8	97.1
Volunteer canola	29.3	69.1	33.2	88.9	44.9	198.7	40.0	114.9	35.7	113.2
Wild buckwheat	7.4	4.3	9.1	8.8	6.8	4.4	9.3	7.7	11.0	12.4
Stinkweed	6.8	7.4	7.1	7.2	4.6	12.3	5.5	5.3	10.2	15.2
Bluebur	6.0	11.6	2.9	1.3	1.8	0.8	4.7	2.6	5.5	4.0
Dandelion	3.7	1.1	1.1	0.4	2.7	0.9	1.8	0.7	1.1	0.6
Quackgrass	2.7	1.7	1.8	1.2	2.6	2.3	1.6	1.1	1.2	1.3
Common lambsquarters	1.6	0.6	2.0	1.3	1.5	0.6	1.7	1.0	4.0	3.8
Common groundsel	1.5	0.8	1.3	0.8	1.3	1.0	1.9	1.3	1.1	1.2
Red clover	1.4	0.7	1.8	0.8	1.5	0.6	1.2	0.5	0.5	0.2
Ball mustard	0.5	0.2	2.3	1.3	1.9	2.2	0.7	0.2	1.4	0.7
Cranesbill	0.1	0.0	.	.	.	.	.	.	.	.
Shepherds purse	.	.	.	.	.	.	0.3	0.1	.	.
Narrow leaved hawks beard	.	.	.	.	.	.	.	.	0.2	0.1
Storks bill	.	.	.	.	.	.	0.1	0.0	.	.
Broadleaved plantain	.	.	.	.	0.1	0.0	.	.	.	.
Prostrate knotweed	.	.	0.1	0.0	.	.	.	.	0.3	0.1
Corn spurry	.	.	.	.	0.3	0.2	.	.	0.1	0.0
Vetch species	.	.	0.3	0.1	.	.	.	.	.	.

Relative Abundance values (RelAb) were calculated by plot for each weed species: (relative density + relative frequency)/2. Relative density was calculated as: number of individuals for a given species within the 20 quadrats for each plot divided by the total number of individuals within the plot. Relative frequency was calculated as the proportion of quadrats in which the species was present per plot divided by the total frequency of all species.

Table 40.0 Weed relative abundance and density by fertilizer treatment in canola prior to in-crop spraying at Beaverlodge in 1997.

Weed Species	Fall band		Spring band		Spring band 9"		Spring band 12"		Sweep	
	RelAb	#/m²	RelAb	#/m²	RelAb	#/m²	RelAb	#/m²	RelAb	#/m²
Wild oat	34.6	239.6	40.7	239.7	38.8	304.6	40.2	214.2	38.2	393.3
Stinkweed	17.3	99.5	15.4	62.1	15.9	67.5	11.4	33.3	18.5	148.6
Wild buckwheat	12.4	37.2	13.9	39.9	10.3	22.2	9.8	14.5	9.4	31.3
Common groundsel	8.8	68.4	2.8	3.9	11.2	64.9	10.7	47.2	9.5	56.9
Quackgrass	7.2	31.0	3.9	10.5	3.2	7.4	3.4	9.2	1.5	2.8
Bluebur	4.9	9.1	6.3	10.1	4.6	6.0	5.7	7.7	6.5	13.8
Common lambsquarters	4.5	7.1	6.1	7.1	5.4	8.3	4.7	7.3	7.4	10.5
Ball mustard	3.0	3.4	2.5	4.6	1.4	3.2	2.5	1.7	2.2	2.4
Volunteer wheat	2.2	3.4	2.6	5.2	2.0	4.4	1.6	2.7	1.3	3.7
Dandelion	2.2	1.2	2.4	1.2	3.9	5.0	6.4	8.2	1.4	1.7
Red clover	1.7	1.4	2.8	2.0	2.4	2.8	2.0	2.4	2.6	3.2
Speedwell	0.4	0.3	0.3	0.3	0.1	0.1	0.3	0.3	0.7	2.2
Pineappleweed	0.2	1.4	.	.	0.1	0.0	0.1	0.4	.	.
Storks bill	0.2	0.1	.	.	0.1	0.0	0.2	0.1	.	.
Hempnettle	0.1	0.2	.	.	.	.	.	.	0.1	0.0
Broadleaved plantain	0.1	0.1	.	.	0.3	0.2	0.3	0.1	0.4	0.3
Prostrate knotweed	0.1	0.0	.	.	0.0	0.0	0.3	0.3	0.1	0.1
Narrow leaved hawks beard	0.1	0.0	0.2	0.1	0.1	0.0	.	.	.	.
Corn spurry	0.1	0.1	.	.	.	.	0.1	0.1	0.1	0.1
Flixweed	0.1	0.1	.	.	.	.	.	.	.	.
Cranesbill	.	.	0.1	0.1	.	.	.	.	.	.
Smartweed species	.	.	.	.	0.1	0.1	.	.	.	.
Cinquefoil	.	.	.	.	0.1	0.1	0.1	0.1	.	.
Wild tomato	.	.	0.1	0.0	.	.	.	.	.	.
Perennial sowthistle	.	.	.	.	0.1	0.1	0.1	0.0	0.2	0.1
Vetch species	.	.	.	.	.	.	.	.	0.1	0.1

Relative Abundance values (RelAb) were calculated by plot for each weed species: (relative density + relative frequency)/2. Relative density was calculated as: number of individuals for a given species within the 20 quadrats for each plot divided by the total number of individuals within the plot. Relative frequency was calculated as the proportion of quadrats in which the species was present per plot divided by the total frequency of all species.

Table 41.0 Weed relative abundance and density by fertilizer treatment in wheat prior to in July at Beaverlodge in 1997.

Weed Species	Fall band		Spring band		Spring band 9"		Spring band 12"		Sweep	
	RelAb	$\#/m^2$	RelAb	$\#/m^2$	RelAb	$\#/m^2$	RelAb	$\#/m^2$	RelAb	$\#/m^2$
Wild oat	30.8	32.3	41.2	48.4	38.6	41.3	38.7	61.0	27.6	31.8
Wild buckwheat	26.7	28.8	31.6	32.5	25.9	21.8	25.1	30.0	36.5	47.3
Quackgrass	12.6	10.5	6.6	6.9	8.5	11.1	4.2	7.5	4.1	3.8
Dandelion	8.9	3.8	5.2	2.2	5.5	2.1	5.6	3.6	5.3	3.2
Common groundsel	5.5	4.5	6.2	9.7	10.0	7.9	11.5	16.4	9.6	8.0
Stinkweed	3.6	1.9	1.0	0.5	1.9	1.1	2.3	1.2	2.9	1.7
Bluebur	2.6	0.9	3.0	0.9	2.4	0.8	3.8	1.3	6.8	2.9
Volunteer canola	2.4	0.9	0.6	0.2	2.0	0.9	1.9	1.7	0.4	0.1
Red clover	2.3	1.0	0.7	0.4	0.8	0.3	0.9	0.5	1.3	0.7
Common lambsquarters	1.9	0.7	0.2	0.1	0.8	0.3	1.8	0.9	1.0	0.4
Narrow leaved hawks beard	1.0	0.8	1.7	1.2	0.9	0.3	2.2	2.5	3.0	2.5
Common chickweed	0.4	0.2	.	.	.	.	.	.	.	.
Speedwell	0.4	0.2	0.6	0.3	0.2	0.1	.	.	0.6	0.3
Foxtail barley	0.3	0.1	.	.	.	.	0.1	0.0	.	.
Corn spurry	0.2	0.1	.	.	.	.	0.1	0.0	.	.
Purple leaf willowherb	0.1	0.0	.	.	.	.	.	.	.	.
Ball mustard	0.1	0.0	0.4	0.1	0.3	0.1	0.8	0.3	0.2	0.1
Hempnettle	0.1	0.0	.	.	0.1	0.1	.	.	.	.
Cleavers	0.1	0.0	.	.	.	.	0.4	0.3	0.2	0.2
Pygmy flower	.	.	.	.	0.1	0.1	.	.	.	.
Shepherds purse	.	.	0.1	0.0	0.1	0.0	.	.	0.1	0.0
Canada thistle	.	.	.	.	0.2	0.1	.	.	.	.
Storks bill	.	.	.	.	0.2	0.1	.	.	.	.
Cranesbill	.	.	.	.	0.2	0.0	.	.	.	.
Broadleaved plantain	.	.	.	.	0.1	0.1	.	.	0.1	0.0
Prostrate knotweed	.	.	0.7	0.2	0.9	0.7	0.3	0.1	0.1	0.0
Smartweed species	.	.	.	.	.	.	0.1	0.0	.	.
Wild rose	.	.	.	.	0.1	0.2	.	.	.	.
Perennial sowthistle	.	.	.	.	0.1	0.0	.	.	0.1	0.0
Vetch species	.	.	.	.	.	.	.	.	0.1	0.1

Relative Abundance values (RelAb) were calculated by plot for each weed species: (relative density + relative frequency)/2. Relative density was calculated as: number of individuals for a given species within the 20 quadrats for each plot divided by the total number of individuals within the plot. Relative frequency was calculated as the proportion of quadrats in which the species was present per plot divided by the total frequency of all species.

Table 42.0 Weed relative abundance and density by fertilizer treatment in canola prior to in July at Beaverlodge in 1997.

Weed Species	Fall band		Spring band		Spring band 9"		Spring band 12"		Sweep	
	RelAb	#/m²	RelAb	#/m²	RelAb	#/m²	RelAb	#/m²	RelAb	#/m²
Wild oat	18.9	62.7	21.6	61.0	27.1	82.2	26.2	94.4	23.3	88.7
Wild buckwheat	14.2	28.9	16.7	37.3	14.4	26.7	10.4	24.7	14.0	48.5
Common groundsel	13.5	63.5	10.6	36.9	15.7	59.7	18.8	84.5	12.3	43.6
Stinkweed	10.8	20.7	14.2	35.8	12.4	20.8	10.9	23.3	12.3	33.8
Volunteer wheat	9.7	21.0	5.1	11.6	1.3	1.6	1.1	1.7	5.2	15.9
Red clover	9.3	17.5	9.1	24.3	8.2	16.0	10.0	22.2	12.5	35.6
Dandelion	6.3	7.4	3.0	2.7	4.3	3.9	4.9	6.1	4.7	6.4
Quackgrass	5.5	13.7	8.7	39.6	4.5	13.6	3.2	5.3	1.2	2.3
Common lambsquarters	3.8	3.5	4.3	3.7	5.0	3.6	3.3	3.3	3.8	4.5
Narrow leaved hawks beard	3.0	17.5	2.9	6.7	3.1	12.0	6.2	28.3	5.2	15.0
Bluebur	1.8	2.0	1.2	1.2	1.5	1.2	1.6	1.5	2.8	2.3
Prostrate knotweed	0.9	1.5	0.4	0.2	0.3	0.3	0.6	1.1	0.2	0.2
Ball mustard	0.8	0.6	0.2	0.2	0.5	0.3	0.9	0.9	0.5	0.6
Pineappleweed	0.4	0.9	0.2	0.2	0.1	0.1	0.2	0.3	.	.
Round-leaved mallow	0.3	0.3	.	.	0.2	0.1	.	.	0.4	0.4
Vetch species	0.2	0.3	0.1	0.0	0.1	0.5	.	.	.	.
Cinquefoil	0.1	0.1	.	.	0.2	0.1	0.0	0.0	.	.
Broadleaved plantain	0.1	0.1	.	.	0.1	0.1	.	.	0.2	0.1
Pygmy flower	0.1	0.2	0.1	0.1	0.1	0.0	0.3	0.2	0.1	0.1
Field horsetail	0.1	0.0	.	.	.	.	.	.	.	.
Perennial sowthistle	0.1	0.1	.	.	0.1	0.1	0.2	0.3	0.2	0.2
Shepherds purse	0.1	0.0	0.4	0.5	.	.	.	.	.	.
Smartweed species	0.0	0.0	0.3	0.3	.	.	0.0	0.0	.	.
Corn spurry	0.0	0.0	0.2	0.2	.	.	0.1	0.1	0.1	0.5
Storks bill	0.0	0.0	0.1	0.1	0.1	0.1	.	.	0.1	0.0
Volunteer canola	.	.	.	.	.	.	0.1	0.0	.	.
Flixweed	.	.	0.0	0.0	.	.	.	.	.	.
Purple leaf willowherb	.	.	0.0	0.0	.	.	0.2	0.4	.	.
Hempnettle	.	.	.	.	.	.	.	.	0.4	0.3
Cleavers	.	.	0.6	0.9	0.4	0.3	0.6	0.7	0.3	0.8
Cranesbill	.	.	.	.	0.1	0.1	.	.	.	.

Common chickweed	.	.	.	.	.	.	0.3	0.2	.	.
Speedwell	.	.	.	.	0.2	0.1	.	.	0.2	0.2

Relative Abundance values (RelAb) were calculated by plot for each weed species: (relative density + relative frequency)/2. Relative density was calculated as: number of individuals for a given species within the 20 quadrats for each plot divided by the total number of individuals within the plot. Relative frequency was calculated as the proportion of quadrats in which the species was present per plot divided by the total frequency of all species.

Table 43.0 Weed relative abundance and density by herbicide treatment in wheat prior to seeding at Beaverlodge in 1997.

Weed Species	Full rate		Reduced Rate	
	RelAb	#/m^2	RelAb	#/m^2
Mustard species	51.8	65.6	53.5	75.5
Red clover	21.3	3.5	20.2	6.2
Dandelion	14.7	1.7	13.3	2.8
Quackgrass	10.2	1.8	9.4	3.3
Stinkweed	1.6	0.2	3.2	0.5
Pineappleweed	0.2	0.0	0.1	0.0
Volunteer wheat	0.1	0.0	.	.
Common lambsquarters	0.1	0.0	0.3	0.0
Bluebur	.	.	0.1	0.0

Relative Abundance values (RelAb) were calculated by plot for each weed species: (relative density + relative frequency)/2. Relative density was calculated as: number of individuals for a given species within the 20 quadrats for each plot divided by the total number of individuals within the plot. Relative frequency was calculated as the proportion of quadrats in which the species was present per plot divided by the total frequency of all species.

Table 44.0 Weed relative abundance and density by herbicide treatment in canola prior to seeding at Beaverlodge in 1997.

Weed Species	Full rate		Reduced Rate	
	RelAb	#/m^2	RelAb	#/m^2
Dandelion	32.3	2.4	32.8	2.3
Quackgrass	30.0	5.4	22.3	3.7
Stinkweed	20.8	7.6	17.6	5.9
Red clover	10.5	1.1	19.9	1.8
Common lambsquarters	3.4	2.2	2.7	1.0
Pineappleweed	1.4	0.6	1.1	0.1
Volunteer wheat	0.8	0.1	1.9	0.1
Bluebur	0.4	0.5	0.3	0.4
Cinquefoil	0.3	0.0	0.5	0.0
Mustard species	.	.	0.9	0.2

Relative Abundance values (RelAb) were calculated by plot for each weed species: (relative density + relative frequency)/2. Relative density was calculated as: number of individuals for a given species within the 20 quadrats for each plot divided by the total number of individuals within the plot. Relative frequency was calculated as the proportion of quadrats in which the species was present per plot divided by the total frequency of all species.

Table 45.0 Weed relative abundance and density by herbicide treatment in wheat prior to in-crop spraying at Beaverlodge in 1997.

Weed Species	Full rate		Reduced Rate	
	RelAb	$\#/m^2$	RelAb	$\#/m^2$
Volunteer canola	39.2	123.6	34.0	110.3
Wild oat	31.3	91.4	34.8	110.4
Wild buckwheat	8.7	7.2	8.7	7.8
Stinkweed	6.1	8.9	7.5	10.0
Bluebur	3.9	2.3	4.4	5.8
Quackgrass	2.7	2.1	1.2	1.0
Common lambsquarters	2.1	1.6	2.2	1.3
Dandelion	1.8	0.6	2.4	0.8
Common groundsel	1.5	1.1	1.3	1.0
Ball mustard	1.1	0.6	1.6	1.2
Red clover	1.1	0.5	1.5	0.6
Corn spurry	0.1	0.1	0.0	0.0
Prostrate knotweed	0.1	0.0	0.1	0.0
Narrow leaved hawks beard	0.1	0.0	.	.
Broadleaved plantain	0.0	0.0	.	.
Shepherds purse	0.0	0.0	0.1	0.0
Vetch species	0.0	0.0	0.1	0.0
Storks bill	.	.	0.0	0.0
Cranesbill	.	.	0.0	0.0

Relative Abundance values (RelAb) were calculated by plot for each weed species: (relative density + relative frequency)/2. Relative density was calculated as: number of individuals for a given species within the 20 quadrats for each plot divided by the total number of individuals within the plot. Relative frequency was calculated as the proportion of quadrats in which the species was present per plot divided by the total frequency of all species.

Table 46.0 Weed relative abundance and density by herbicide treatment in canola prior to in-crop spraying at Beaverlodge in 1997.

Weed Species	Full rate		Reduced Rate	
	RelAb	#/m^2	RelAb	#/m^2
Wild oat	38.4	266.5	38.6	290.0
Stinkweed	16.7	85.3	14.6	79.1
Wild buckwheat	10.6	24.4	11.7	33.6
Common groundsel	7.7	45.3	9.6	51.2
Common lambsquarters	5.6	7.4	5.6	8.7
Bluebur	5.1	9.2	6.1	9.4
Quackgrass	4.3	15.3	3.4	9.1
Dandelion	3.3	3.4	3.1	3.5
Ball mustard	2.6	3.2	2.1	2.9
Red clover	2.4	2.4	2.2	2.3
Volunteer wheat	1.8	3.4	2.1	4.3
Speedwell	0.7	1.2	0.1	0.1
Broadleaved plantain	0.2	0.1	0.2	0.1
Storks bill	0.1	0.1	0.0	0.0
Narrow leaved hawks beard	0.1	0.1	0.0	0.0
Prostrate knotweed	0.1	0.1	0.1	0.1
Hempnettle	0.1	0.1	.	.
Pineappleweed	0.1	0.1	0.1	0.6
Wild tomato	0.0	0.0	.	.
Smartweed species	0.0	0.0	.	.
Cinquefoil	0.0	0.0	0.1	0.0
Corn spurry	0.0	0.0	0.1	0.1
Perennial sowthistle	0.0	0.0	0.1	0.1
Flixweed	.	.	0.0	0.0
Cranesbill	.	.	0.0	0.1
Vetch species	.	.	0.0	0.0

Relative Abundance values (RelAb) were calculated by plot for each weed species: (relative density + relative frequency)/2. Relative density was calculated as: number of individuals for a given species within the 20 quadrats for each plot divided by the total number of individuals within the plot. Relative frequency was calculated as the proportion of quadrats in which the species was present per plot divided by the total frequency of all species.

Table 47.0 Weed relative abundance and density by herbicide treatment in wheat in July at Beaverlodge in 1997.

Weed Species	Full rate		Reduced Rate	
	RelAb	#/m^2	RelAb	#/m^2
Wild oat	37.8	42.7	33.0	43.2
Wild buckwheat	27.7	27.2	30.6	36.9
Common groundsel	8.0	6.7	9.1	11.8
Quackgrass	7.7	9.0	6.8	6.9
Dandelion	6.4	3.0	5.9	2.9
Bluebur	4.3	1.4	3.2	1.3
Stinkweed	2.0	0.9	2.7	1.7
Narrow leaved hawks beard	1.9	1.3	1.7	1.6
Common lambsquarters	1.1	0.5	1.2	0.5
Red clover	1.0	0.4	1.4	0.7
Volunteer canola	0.8	0.2	2.1	1.2
Prostrate knotweed	0.5	0.2	0.3	0.2
Ball mustard	0.5	0.1	0.3	0.1
Speedwell	0.1	0.0	0.6	0.3
Perennial sowthistle	0.1	0.0	.	.
Purple leaf willowherb	0.1	0.0	.	.
Pygmy flower	0.1	0.0	.	.
Hempnettle	0.1	0.0	0.0	0.0
Storks bill	0.0	0.0	0.0	0.0
Shepherds purse	.	.	0.1	0.0
Canada thistle	.	.	0.1	0.0
Cleavers	.	.	0.3	0.2
Cranesbill	.	.	0.1	0.0
Foxtail barley	.	.	0.2	0.1
Broadleaved plantain	.	.	0.1	0.1
Smartweed species	.	.	0.1	0.0
Wild rose	.	.	0.0	0.1
Corn spurry	.	.	0.1	0.0
Common chickweed	.	.	0.2	0.1
Vetch species	.	.	0.0	0.0

Relative Abundance values (RelAb) were calculated by plot for each weed species: (relative density + relative frequency)/2. Relative density was calculated as: number of individuals for a given species within the 20 quadrats for each plot divided by the total number of individuals within the plot. Relative frequency was calculated as the proportion of quadrats in which the species was present per plot divided by the total frequency of all species.

Table 48.0 Weed relative abundance and density by herbicide treatment in canola in July at Beaverlodge in 1997.

Weed Species	Full rate		Reduced Rate	
	RelAb	#/m^2	RelAb	#/m^2
Wild oat	23.5	70.5	23.4	85.1
Common groundsel	14.4	46.6	14.0	68.8
Wild buckwheat	13.5	23.8	14.4	42.6
Stinkweed	13.1	25.6	11.2	28.2
Red clover	10.3	21.1	9.2	25.0
Volunteer wheat	5.5	10.5	3.4	10.2
Dandelion	5.2	5.1	4.1	5.4
Quackgrass	4.0	8.4	5.2	21.4
Common lambsquarters	3.6	2.8	4.4	4.6
Narrow leaved hawks beard	3.3	10.0	4.8	21.7
Bluebur	1.4	1.0	2.2	2.3
Cleavers	0.4	0.6	0.3	0.5
Prostrate knotweed	0.4	0.2	0.6	1.0
Ball mustard	0.3	0.1	0.9	0.8
Round-leaved mallow	0.2	0.2	0.2	0.2
Pygmy flower	0.1	0.1	0.1	0.1
Corn spurry	0.1	0.1	0.0	0.2
Common chickweed	0.1	0.1	.	.
Pineappleweed	0.1	0.2	0.2	0.4
Speedwell	0.1	0.0	0.1	0.1
Purple leaf willowherb	0.1	0.1	0.1	0.1
Perennial sowthistle	0.0	0.0	0.2	0.2
Storks bill	0.0	0.0	0.1	0.1
Smartweed species	0.0	0.0	0.1	0.1
Field horsetail	0.0	0.0	.	.
Cinquefoil	0.0	0.0	0.1	0.1
Vetch species	0.0	0.0	0.1	0.3
Volunteer canola	0.0	0.0	.	.
Flixweed	0.0	0.0	.	.
Shepherds purse	.	.	0.2	0.2
Hempnettle	.	.	0.1	0.1
Cranesbill	.	.	0.0	0.0
Broadleaved plantain	.	.	0.2	0.1

Relative Abundance values (RelAb) were calculated by plot for each weed species:(relative density + relative frequency)/2. Relative density was calculated as:number of individuals for a given species within the 20 quadrats for each plot divided by the total number of individuals within the plot. Relative frequency was calculated as the proportion of quadrats in which the species was present per plot divided by the total frequency of all species.

Economics

prepared by D. Derksen, K. McGillivray, and R. Zentner

An economic analysis was done for the Brandon data from 1997 to provide a template for further analysis of all data and to provide a forum for discussion to establish a consensus on an approach for this type of analysis. R. Zentner, and agricultural economist from AAFC at Swift Current, provided input into the methodology and reviewed the output.

The objective of the economic analysis used for this data was to provide information on the economic contribution of the different treatments i.e.: a simple return versus costs of production balance sheet approach. When the project is completed, R. Zentner is interested in conducting a more thorough analysis. For the current approach, economic returns were calculated based on yield and crop grade with appropriate dollar returns based on elevator pricing in January of 1998. Although pricing varies throughout the year, differences will not impact on relative comparisons between treatments. Input costs were based on actual seed, fertilizer, and herbicide costs with operational costs (seeding, spraying, etc) based on recommended custom rates (Saskatchewan 1996).

Please review the following information and provide feedback for improvements.

Basic Custom Work Rates (Economic Values 1997)

Equipment Operations (labor @ $9.00/hr)

SP Swather 24-26 $18.93/ha

SP Combine Rotary Medium $36.36/ha

Air Hoe Drill, Zero Till, 40' with 225 HP 4x4 $21.66/ha

Air Seeder, Min Till, 40-41' with 225 HP 4x4; fueled as 185 HP $16.77/ha

Sprayer 80-90', with 85HP 2WD (includes water hauling) $ 6.53/ha

Packer Harrow Bar, 60' with 150 HP 4x4 $ 6.22/ha

Banding, 48' with 225 HP 4x4; fueled as 185 HP $10.62/ha

Costs for FWMS trial 1997

(Includes Equipment, Tractor, labour, fuel, etc.)

Treatment #1

Fall Band $ 10.62/ha

Zero Till Hoe Drill $ 21.66/ha

Treatment #2

Spring Band	$ 10.62/ha
Zero Till Hoe Drill	$ 21.66/ha

Treatment #3 and #4

Zero Till Hoe Drill	$ 21.66/ha

Treatment #5

Minimum Till Seeder	$ 16.77/ha
Packer Harrow Bar	$ 6.22/ha

Sprayer	$ 6.53/ha
Swather SP	$ 18.93/ha
Combine SP	$ 36.36/ha

Economic Information for CFI trial Brandon 1997

Treatment	Crop	Yield Kg/ha.	Grade	* Protein	Oil		Greens %	$/tonne
1	Wheat	2499	#2 Red			15		$131.82
2	Wheat	2647	#2 Red			15.2		$131.82
3	Wheat	2679	#2 Red			14.9		$131.82
4	Wheat	2610	#2 Red			14.8		$131.82
5	Wheat	2660	#2 Red			14.9		$131.82
6	Wheat	2664	#2 Red			15		$131.82
7	Wheat	2531	#2 Red			14.8		$131.82
8	Wheat	2427	#2 Red			15.2		$131.82
9	Wheat	2644	#2 Red			14.8		$131.82
10	Wheat	2532	#2 Red			14.9		$131.82
11	Canola	1378	#1 Canada	22.3	45.7		0.30	$369.00
12	Canola	1262	#1 Canada	22.8	45.3		0.60	$369.00
13	Canola	1217	#1 Canada	21.9	46		0.40	$369.00
14	Canola	1163	#1 Canada	21.1	45.8		0.70	$369.00
15	Canola	1278	#1 Canada	21.9	45.7		0.50	$369.00
16	Canola	1284	#1 Canada	21.7	45.4		0.20	$369.00
17	Canola	810	#1 Canada	23	43.2		0.60	$369.00
18	Canola	1004	#1 Canada	22.7	44.6		1.30	$369.00
19	Canola	452	#1 Canada	22.7	44.3		1.00	$369.00
20	Canola	298	#1 Canada	22.9	43.3		1.00	$369.00

* Protein for Wheat from Grain Commission

1997 Grain Prices

Wheat #2 Red Hard Red Spring 15% Protein $131.82 / tonne Range (14.75% -15.25%)

Wheat #2 Red Hard Red Spring 14.5% Protein $125.82 / tonne Range (14.25% -14.75%)

Wheat #2 Red Hard Red Spring 14.0% Protein $119.82 / tonne Range (13.75% -14.25%)

Canola #1 Canada (less 3% greens) $8.25/bus. $369.00 / tonne

Fertilizer Prices	1997 Prices
46-0-0	$360.00 / tonne
11-52-0	$400.00 / tonne

Seed Prices	1997 Prices	
Teal Wheat	$8.50/bus	
Barrie Wheat	$15.50/bus	
Roundup Ready Canola	$2.50/lb	$5.51/kg
Technical Fee	$15.00/ac	$36.75/ha

Chemical Prices	1997 Prices
Counter 5G Seed Treatment	$2.15/kg
Roundup (356g/L)	$8.95/L
2-4D Amine (500g/L)	$4.20/L
Target (3 chemical combined)	$10.60/ha for rec. rate
Horizon,Score (240g/L)	$13.50/ha for rec. rate
Lorsban (480g/L)	$15.80/ha for rec. rate
Tilt (250g/L)	$28.10/ha for rec. rate

Net Returns for Wheat at Brandon in 1997

	Fall Band 100%	Fall Band 66%	Spring Band 100%	Spring Band 66%	9" Side Band 100%	9" Side Band 66%	12" Side Band 100%	12" Side Band 66%	Sweeps 100%	Sweeps 66%
Returns	329.41	348.92	353.14	344.05	350.64	351.16	333.63	319.92	348.53	333.76
Expenses	233.97	225.77	233.97	225.77	223.35	215.15	223.35	215.15	224.68	216.48
Net	95.44	123.15	119.17	118.27	127.29	136.01	110.28	104.77	123.85	117.28

Net Returns for Canola at Brandon in 1997

	Fall Band 100%	Fall Band 66%	Spring Band 100%	Spring Band 66%	9" Side Band 100%	9" Side Band 66%	12" Side Band 100%	12" Side Band 66%	Sweeps 100%	Sweeps 66%
Returns	508.48	465.67	449.07	429.14	471.58	473.79	298.8	370.47	166.78	109.96
Expenses	296.74	292.98	296.74	292.98	286.12	282.36	286.12	282.36	287.45	283.69
Net	211.73	172.69	152.33	136.16	185.45	191.43	12.76	88.11	-120.71	-173.72

THE IMPACT OF MONOAMMONIUM PHOSPHATE AND POTASSIUM CHLORIDE ON WEED / CROP COMPETITION.

Contributed By: K. A. Callow

Introduction

Fertilizer placement directly affects a crops' ability to compete with weeds and is a component of integrated weed management (IWM) that the producer can manipulate. This project is part of a Prairie Crops Group initiative and is sponsored by the Canadian Fertilizer Institute (CFI).

The use of fertilizer is a key factor in crop production. Of all of the factors that influence production, nutrients are one of the few that producers can control or manage. Effective use of fertilizer inputs is one of the keys to profitable grain and oilseed farming. The agronomic and economic benefits are well known to the producer, however, proper rate and placement can maximize economic yield response while minimizing overall inputs.

Field Experiments

Objective

To determine the optimal rate and placement of monoammonium phosphate (MAP) and potassium chloride (KCl) that will increase wheat and flax competitiveness against wild oats.

Agronomic Information

Varieties

Flax - Norlin
Wheat - Teal
Wild oats - *Avena fatua* L.

Seeding, Row Spacing and Tillage

The wheat and flax were direct seeded at 100 kg ha^{-1} and 40 kg ha^{-1} respectively, in rows 9 inches (22.5 cm) apart using a conserva pak seeder.

Soil Type and Sites

Two locations were chosen based on their differential soil types:
Location 1) sandy loam soil -> high K_2O, marginal - average P_2O_5.
Location 2) clay loam soil -> average K_2O, marginal P_2O_5.
*****note:** Manitoba soils are generally inherently rich in K_2O.

Fertilizer

MAP: 11-52-0
Wheat Rates: 10, 20, 40, 80 and 120 kg ha^{-1} of actual P_2O_5.
Flax Rates: 8, 10, 15, 20, and 40 kg ha^{-1} of actual P_2O_5.

KCl: 0-0-60
Wheat Rates: 10, 20, 40, 80 and 120 kg ha^{-1} of actual K_2O.
Flax Rates: 10, 15, 20, 30, and 40 kg ha^{-1} of actual K_2O.
Nitrogen: 34-0-0
Banded across plots in an east to west direction at 62 kg ha^{-1} or 70 lbs ac^{-1}.

Experimental Design
A split plot factorial design was used. Rate and placement of fertilizer comprised the main plot effects (10 levels + one control). +/- weeds (2 levels) comprised the subplots. A RCBD was used with main plots randomized within blocks.

8 experiments (trials) were conducted, 4 at each site. They consisted of:

1. Wheat +/- wild oats, phosphorus banded and seed placed.
2. Wheat +/- wild oats, potassium banded and seed placed.
3. Flax +/- wild oats, phosphorus banded and seed placed.
4. Flax +/- wild oats, potassium banded and seed placed.

There was a total of 22 treatments replicated 4 times. Each treatment was be 2m x 8m.

Weed Application and Densities
Wild oats were spread in half of each plot (ie. 2 m). Densities of 50 wild oats m^{-2} and 20-25 wild oats m^{-2} were used in wheat and flax respectively, as these densities are conducive to yield loss in the aforementioned crops. All other weed species were controlled by herbicide application.

Data Collected
1. Crop Counts (CC1) - 2 counts in each treatment based on a 1m length.
2. Wild oat densities 1 and 2 (WODEN1 and WODEN2) - 2 counts in each treatment base on .5 m^2 quadrats.
3. Biomass 1 (BM1CROP AND BM1WEED) - occurred in mid June. One .25 m^2 was harvested out of each treatment. Treatments with both crop and wild oats present were separated.
4. Biomass 2 - same as above but occurred at the end of July (heading of wheat and full boll formation of flax.
5. Crop Yield (CYIELD).
6. Weed Yield (WYIELD).
7. Dockage - yield of other weeds not supposed to be present.
8. 1000 Kernel Weights (1000K) of both crops and wild oats.
9. Tissue Nutrient Analysis - completed by NORWEST LABS (Wpg. MB.), on biomass 1 and 2 for N, P, K, Mg, Na and Ca.
10. Grain Analysis - in the process of being completed on all wheat and wild oat samples by NORWEST LABS for N, P, K, Mg, Na and Ca.
11. Oil Analysis - yet to be completed on all flax samples by Beverlodge Research Station.

12. Wheather data.
13. Soil data - from each location.

Growth Chamber Experiments

Objective

To determine growth response of wheat, flax and wild oats to MAP and KCl at 10, 20 and 40 kg ha^{-1} of actual P_2O_5 and K_2O. This will help to establish when each of these species are competing most strongly for the above nutrients.

Materials and Methods

Pots:
Plastic pots were used. Holding approximately 1 kg of soil.

Soil:
Low P soil was attained from location 2 (used in field experiments).
Low K soil was attained from an area other than what was used in the field experiments.

Experimental Design
Treatments involved:
- -species (3)
- -rates (3)
- -replications (3)
- -harvests (5)
- -soil type (1)

Organized in a Completely Randomized Design (CRD).

Data Collection

1. Growth stage of each species at each harvest.
2. Dry weights of each species at each harvest.
3. Tissue nutrient analysis.

Analysis

Biomass over time will be plotted for each species/nutrient/rate/soil type combination. Relative growth rate comparisons will also be made.

SUMMARY OF 1997 FIELD SEASON RESULTS

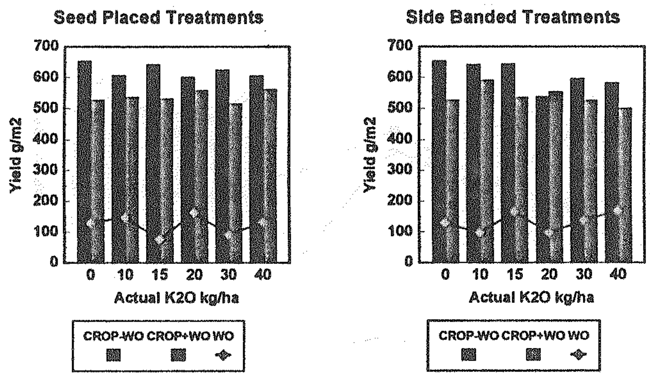
1) FLAX TRIALS

DEPENDENT VARIABLE SIGNIFICANT TREATMENT EFFECTS								
DEPENDENT VARIABLE	FLAX K - SL		FLAX K - CL		FLAX P - SL		FLAX P - CL	
	NT	T	NT	T	NT	T	NT	T
CC1	ns	-	ns	-	ns	-	ns	-
WODEN1	+++	+++	ns	++	+++	+++	+++	+++
WODEN2	+++	+++	ns	++	+++	+++	+++	+++
BM1CROP	ns	+*	ns	ns	ns	ns	ns	ns
BM1WEED	+++	+++	ns	+*	+++	+++	++	+++
BM2CROP	ns	ns	+	ns	+	+*	+++	+++
BM2WEED	+++	+++	+++	+++	+++	+++	+++	+++
CYIELD	++	++	++	+	++	++	+++	+++
WYIELD	+++	+++	+++	+++	+++	+++	+++	+++
DOCKAGE	ns	+*	+++	+++	++	+++	+++	+++
% DOCKAGE	ns	ns	+*	++	+	+	ns	+*
WO %DOCK	+++	+++	+++	+++	+++	+++	+++	+++
1000K CROP	ns	ns	ns	ns	ns	ns	+	+
1000K WEED	+++	+++	+++	+++	+++	+++	+++	+++

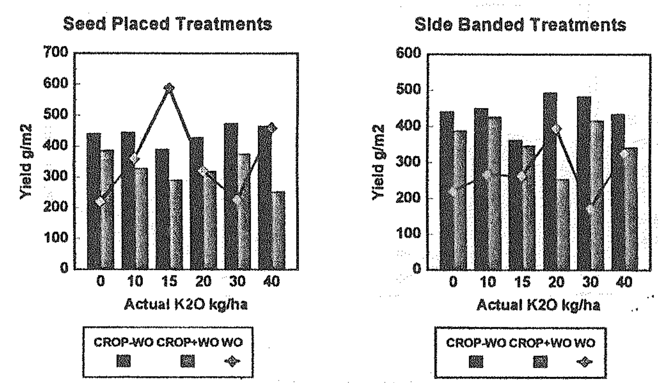
NT = non transformed data ; T = transformed data
+*, +, ++, +++ and ns are significant at .05 < p < .1, p < .05, p < .001, p < .0001 and non significant respectively.

YIELD MEANS (kg ha^{-1}) AND STANDARD ERRORS								
RATE (kg ha-1) PLACEMENT (SP / SB) +/- WO	FLAX K - SL		FLAX K - CL		FLAX P - SL		FLAX P - CL	
	MEAN	SE	MEAN	SE	MEAN	SE	MEAN	SE
0 (CONTROL) -	2055.6	65	1644.4	255	2013.8	53	1804.0	176
+	1866.8	93	1250.8	316	1783.7	99	1434.9	129
8 SP -					2033.6	68	2111.6	87
+					1891.9	13	1306.1	95
8 SB -					1948.3	51	2108.9	113
+					1818.1	117	1282.4	148
10 SP -	2064.8	112	1710.0	313	1950.1	47	2133.1	91
+	1806.4	79	1253.3	217	1577.7	101	1239.5	103
10 SB -	2039.5	31	1957.6	130	2182.8	276	2102.5	97
+	1753.8	28	1476.8	129	1596.6	64	1087.0	168
15 SP -	2175.2	33	1784.1	313	1849.7	242	1992.2	137
+	1982.8	68	1108.4	220	1618.5	120	1194.8	97
15 SB -	2091.3	35	1668.5	250	1902.2	37	2121.4	44
+	1840.8	48	1109.7	280	1631.8	53	1160.0	184
20 SP -	1848.9	135	1810.8	147	1986.7	114	2058.6	103
+	1739.2	202	1166.8	192	1625.9	113	1351.47	103
20 SB -	2065.9	93	2041.5	110	2017.1	152	1976.5	105
+	1748.0	131	1167.1	212	1643.1	50	1615.1	132
30 SP -	2149.2	27	1627.6	231				
+	1847.7	84	1356.0	156				
30 SB -	1996.4	94	1939.9	154				
+	1756.2	137	1389.69	94				
40 SP -	1957.5	101	1836.84	259	2063.2	95	2080.9	94
+	1610.0	83	907.6	241	1554.9	127	1650.0	192
40 SB -	1978.4	93	1641.6	210	1851.2	49	2046.8	118
+	1937.2	60	1321.4	308	1598.7	114	1003.1	160

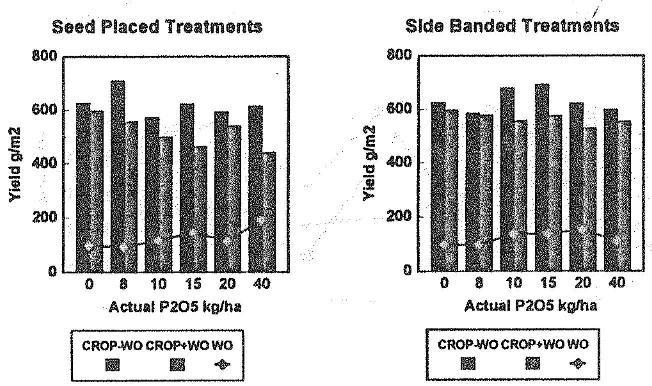
Flax / KCl: SL Soil
Biomass II



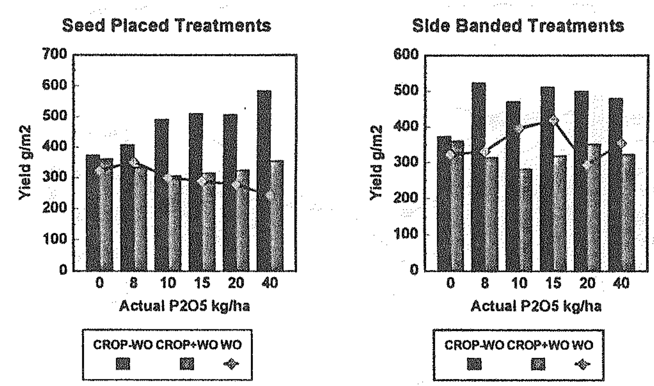
Flax / KCl: CL Soil
Biomass II



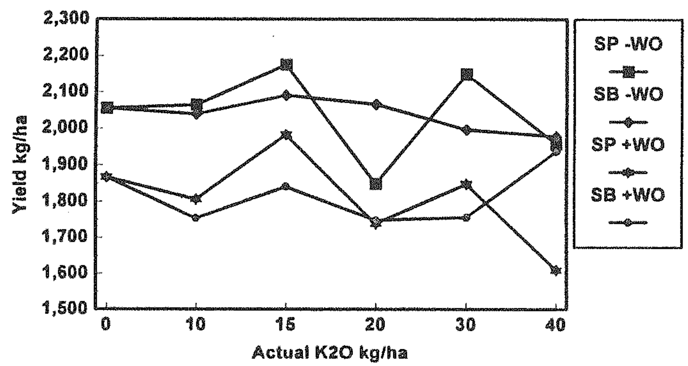
Flax / MAP: SL Soil
Biomass II



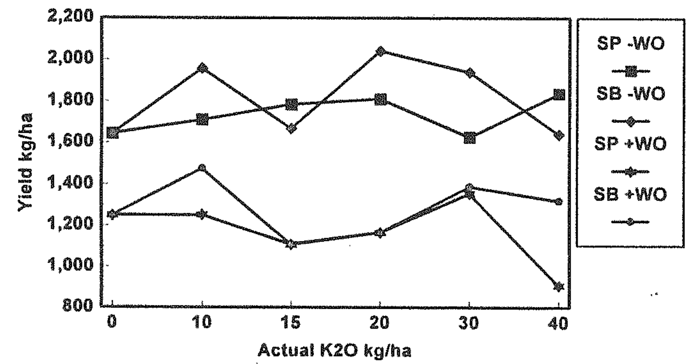
Flax / MAP: CL Soil
Biomass II



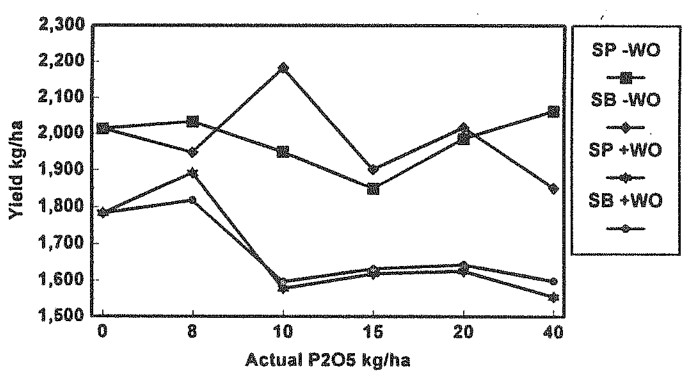
Flax / KCl
SL Soil - High K



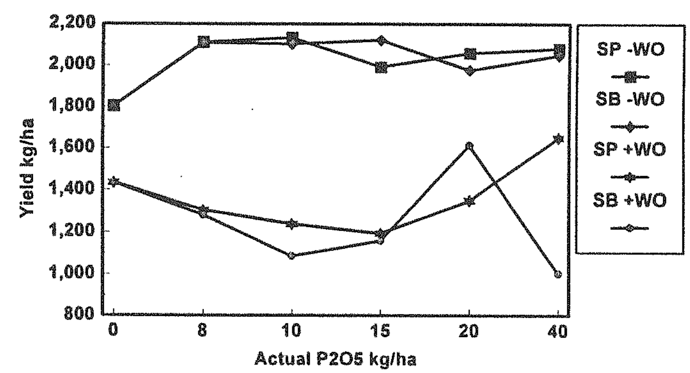
Flax / KCl
CL Soil - Average K



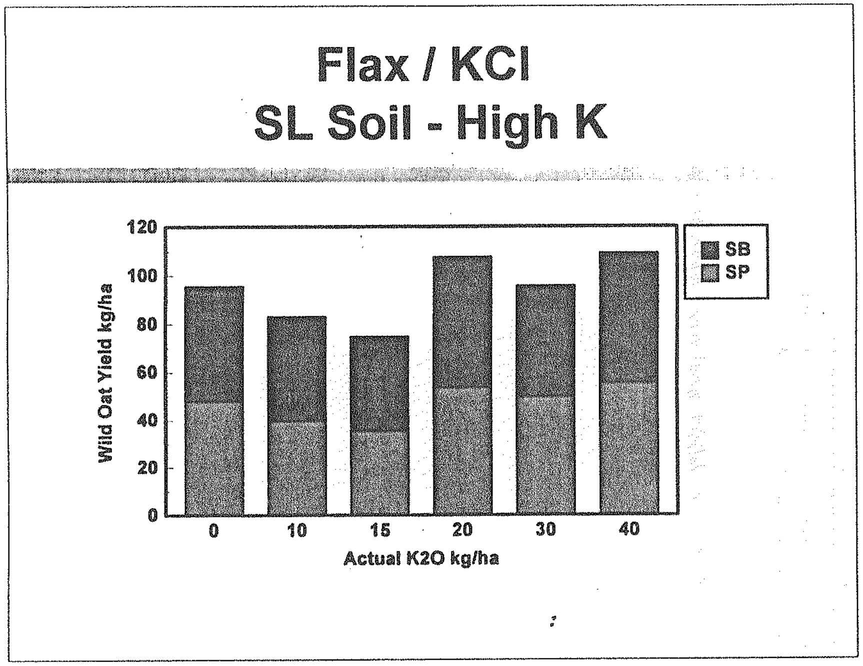
Flax / MAP
SL Soil - Average P

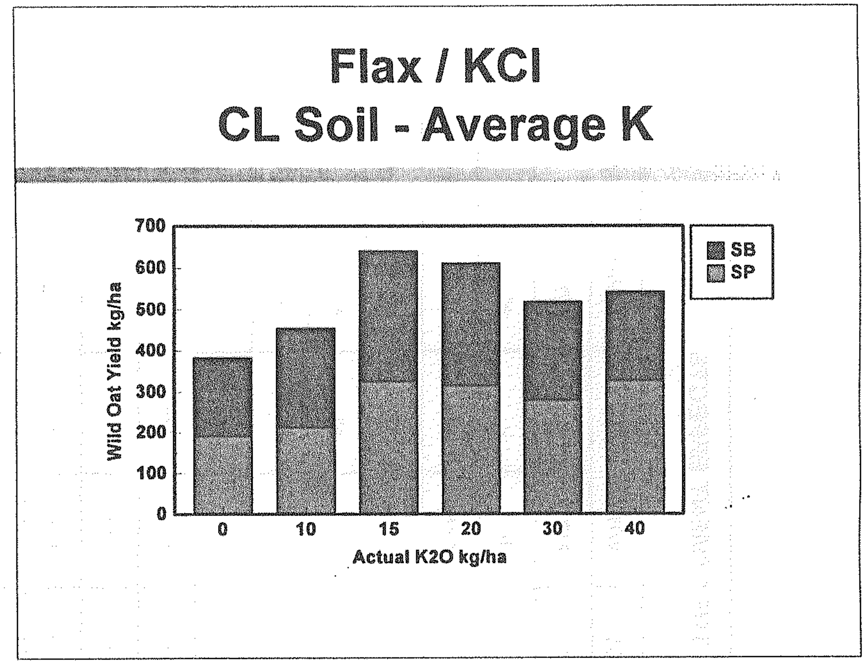


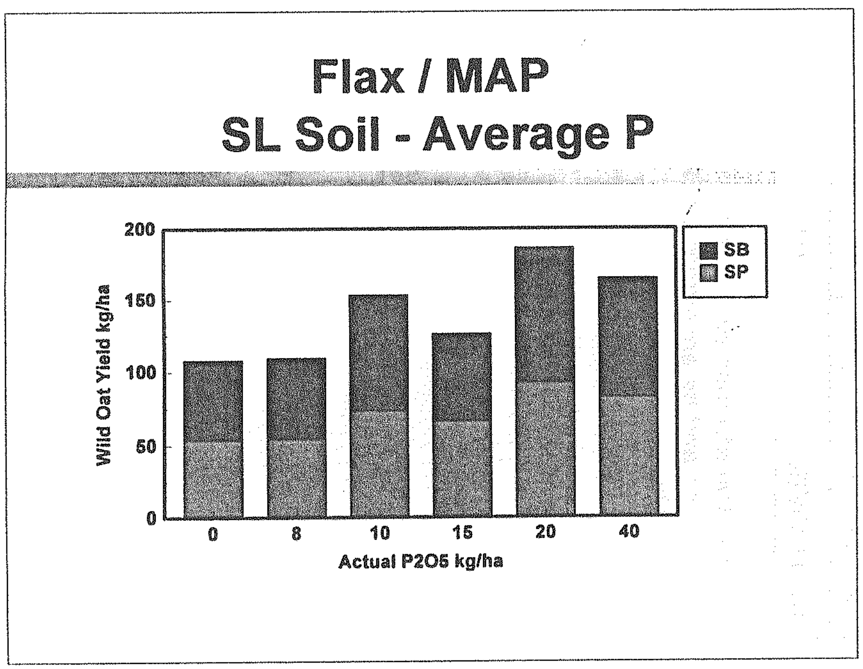
Flax / MAP
CL Soil - Marginal P

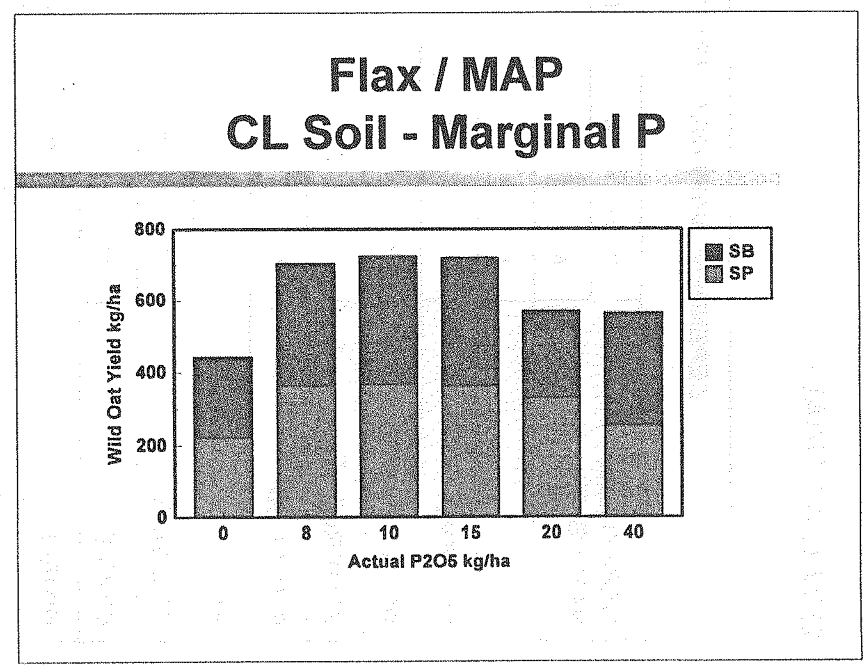


** High K = >600 ppm; Average K = 387 ppm; Average P = 23 ppm; Marginal P = 14 ppm









** High K = >600 ppm; Average K = 387 ppm; Average P = 23 ppm; Marginal P = 14 ppm

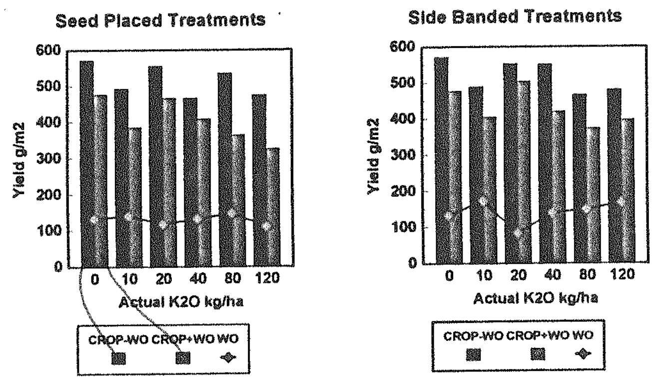
2) WHEAT TRIALS

DEPENDENT VARIABLE SIGNIFICANT TREATMENT EFFECTS								
DEPENDENT VARIABLE	WHEAT K - SL		WHEAT K - CL		WHEAT P - SL		WHEAT P - CL	
	NT	T	NT	T	NT	T	NT	T
CC1	+	-	ns	-	ns	-	+*	-
WODEN1	+++	+++	ns	+	+++	+++	+++	+++
WODEN2	+++	+++	+*	+	+++	+++	+++	+++
BM1CROP (4 wk after emergence)	+*	+	ns	+*	+*	+*	+++	+++
BM1WEED	+++	+++	ns	+	+++	+++	+++	+++
BM2CROP (heading)	+	+	+	+	+*	+*	+	+
BM2WEED	+++	+++	+++	+++	+++	+++	+++	+++
CYIELD	+++	+++	+++	++	+++	++	+++	+++
WYIELD	+++	+++	+++	+++	+++	+++	+++	+++
DOCKAGE	+++	+++	+*	+	+++	+++	+++	+++
% DOCKAGE	+++	+++	ns	ns	+	+*	+++	+++
WO %DOCK	+++	+++	+++	+++	+++	+++	+++	+++
1000K CROP	+*	+*	+*	+*	ns	ns	+*	+*
1000K WEED	+++	+++	+++	+++	+++	+++	+++	+++

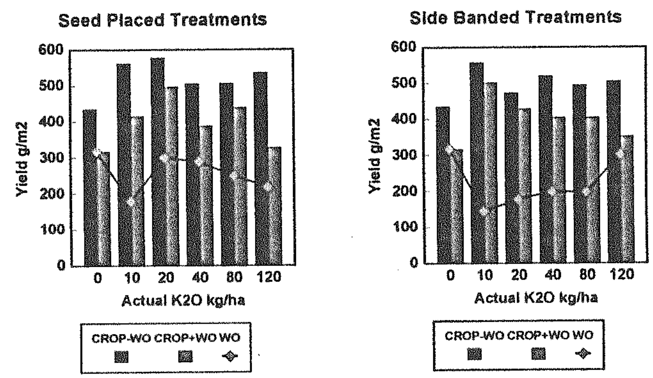
NT = non transformed data ; T = transformed data
+*, +, ++, +++ and ns are significant at .05 < p < .1, p < .05, p < .001, p < .0001 and non significant respectively.

YIELD MEANS (kg ha^{-1}) AND STANDARD ERRORS								
RATE (kg ha-1) PLACEMENT (SP / SB) +/- WO	WHEAT K - SL		WHEAT K - CL		WHEAT P - SL		WHEAT P - CL	
	MEAN	SE	MEAN	SE	MEAN	SE	MEAN	SE
0 (CONTROL) -	2231.2	128	2444.9	373	1856.1	132	2729.9	32
+	1937.9	170	1996.0	270	1431.2	121	2187.0	138
10 SP -	2082.0	152	2791.9	166	1952.9	172	2916.3	127
+	1671.2	112	2317.4	139	1494.3	91	2418.3	69
10 SB -	1959.4	64	2857.4	199	1839.4	131	2906.6	111
+	1531.9	44	2177.6	336	1549.7	116	2379.5	93
20 SP -	2083.4	106	2935.6	97	1899.0	114	2884.1	69
+	1613.3	118	2089.0	191	1651.1	101	2695.1	32
20 SB -	2265.9	106	2571.8	252	1958.2	60	3028.1	80
+	1823.0	21	2226.4	145	1591.1	66	2915.1	97
40 SP -	1913.0	110	2827.2	65	1951.7	62	3126.3	48
+	1405.4	124	1930.7	118	1681.8	89	2910.1	23
40 SB -	2058.2	34	2926.6	189	1931.2	150	3205.1	93
+	1640.1	90	1874.0	198	1376.2	291	2729.6	137
80 SP -	1940.4	65	2587.8	171	1880	160	3288.8	114
+	1340.3	53	2028.1	246	1593.5	132	2875.2	189
80 SB -	2020.9	111	2659.6	155	1977.1	123	3322.7	49
+	1524.5	136	1968.5	113	1627.1	211	3007.6	260
120 SP -	1669.2	95	2775.5	83	1923.4	71	3271.5	82
+	1207.8	63	2103	231	1622.9	124	2605.8	367
120SB -	1985.1	94	2646.6	143	2009.2	126	3641.2	126
+	1558.0	93	1941.2	414	1731.7	128	3018.4	259

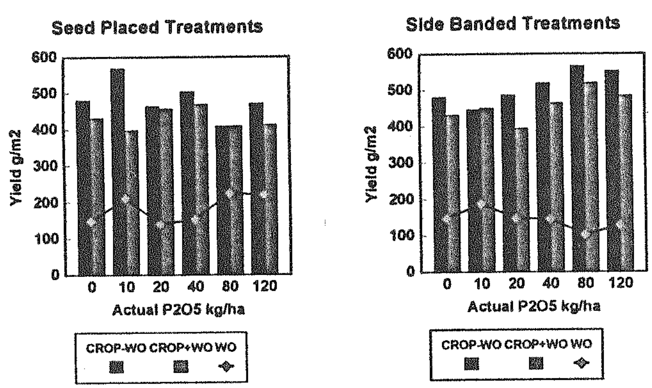
Wheat / KCl: SL Soil
Biomass II (at heading)



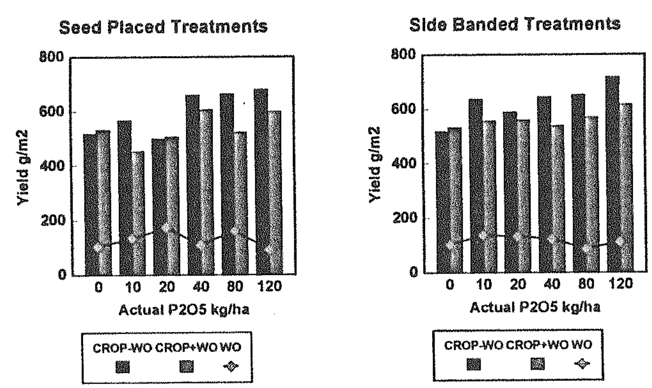
Wheat / KCl: CL Soil
Biomass II



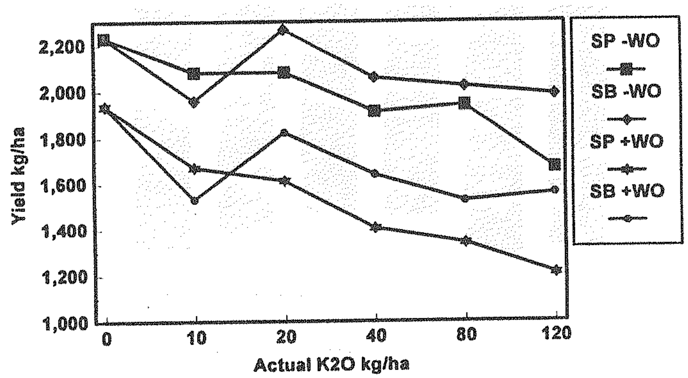
Wheat / MAP: SL Soil
Biomass II



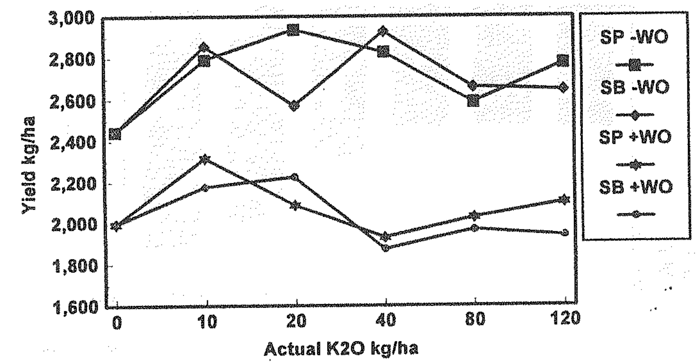
Wheat / MAP: CL Soil
Biomass II



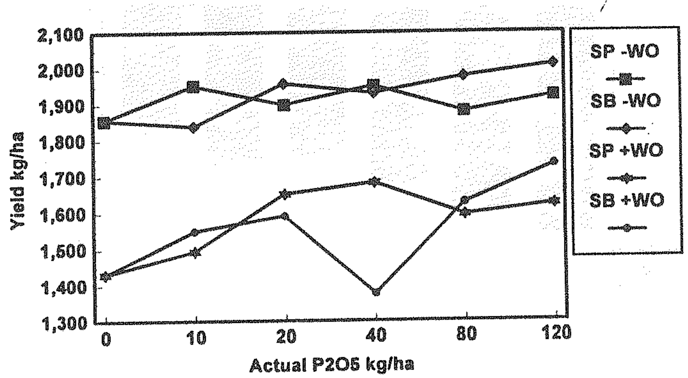
Wheat / KCl
SL Soil - High K



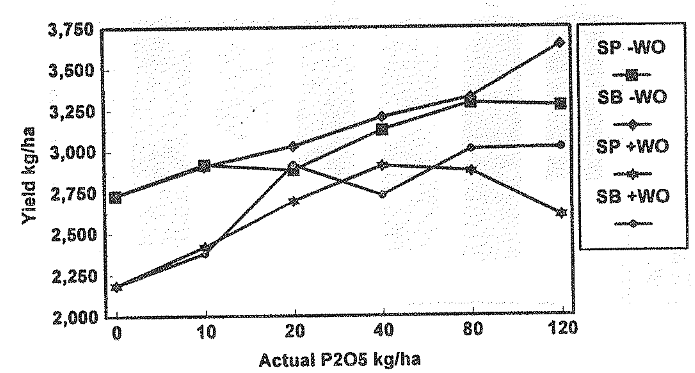
Wheat / KCl
CL Soil - Average K



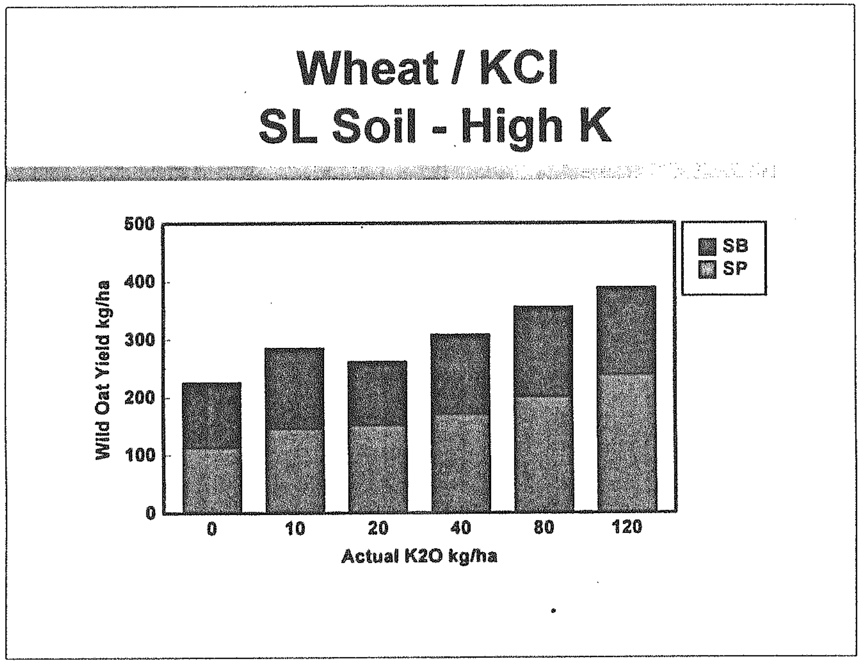
Wheat / MAP
SL Soil - Marginal P

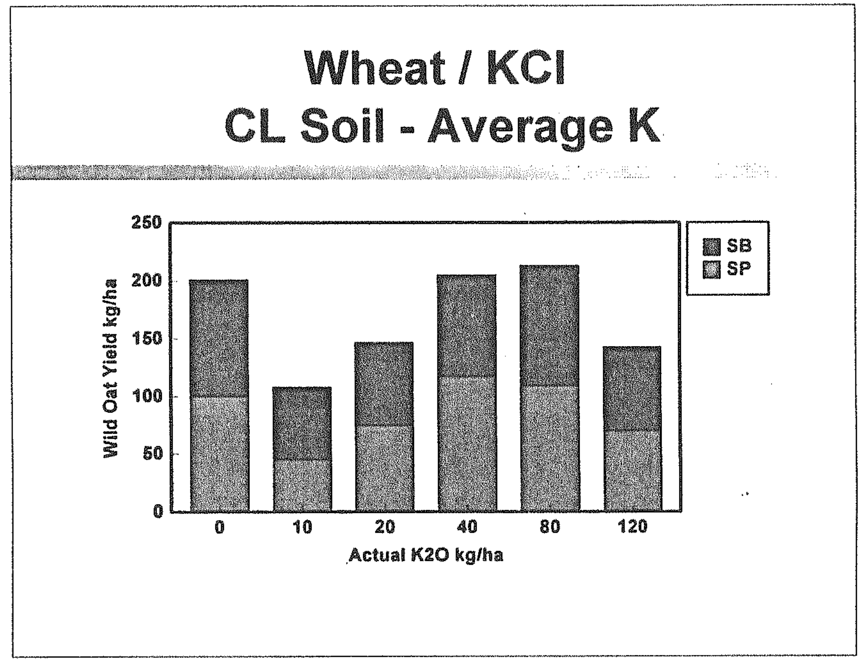


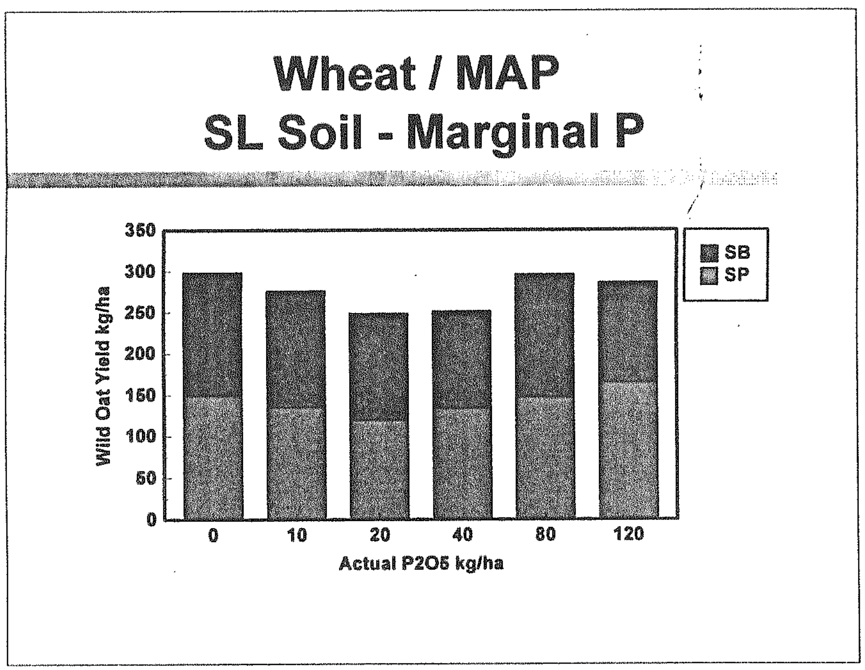
Wheat / MAP
CL Soil - Marginal P

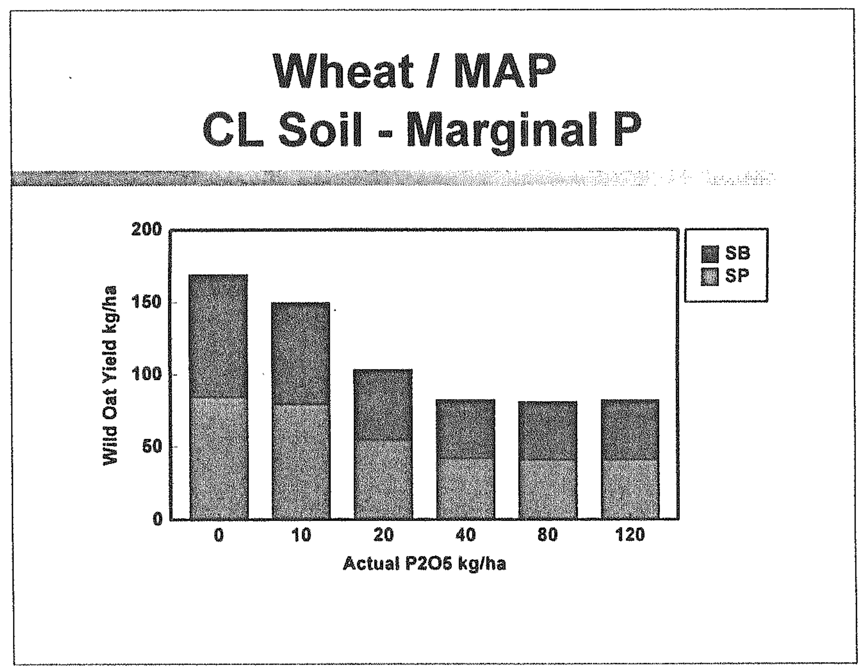


** High K = >600 ppm; Average K = 355 ppm; Marginal P = 13 - 19 ppm









** High K = >600 ppm; Average K = 355 ppm; Marginal P = 13 - 19 ppm

SUMMARY OF PRELIMINARY RESULTS

Data from one field season on the impact of MAP and KCl on wild oat competition in wheat and flax indicate interesting trends: i) crops grown at the sandy loam site were more responsive to fertiizer than at the clay loam site, ii) wheat was more consistent in its fertilizer response than flax, iii) as rates of fertilizer increased the expected yield decline due to toxicity did not necessarily occur, iv) side banding generally provided higher crop yields whereas, seed placement increased yields at lower rates, and v) the presence of wild oats reduced crop yield.

Further analysis of field data involving tissue nutrient concentrations and more detailed research on the relative response of wheat, flax and wild oat to MAP and KCl occurring in growth chambers will aid in understanding how and when each species is competing most strongly for the above nutrients.