Tillage, fertilizer and herbicide effects on weeds in canola
Final report
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Introduction

A project to identify which combination of seedbed preparation system (conventional, reduced till and direct seeding), nitrogen fertilizer and herbicide application provides acceptable control of cruciferous weeds and maintains high canola (*Brassica napus* L. and *Brassica campestris* L.) yields on cereal stubble was initiated at the Melfort Research Station in the fall of 1991.

Materials and methods

The experiment was designed as a split-split plot with seedbed preparation in the main plots, crop/post-emergent herbicide in the subplots and fertilizer application method in the sub-subplots The seedbed preparation systems included: a) conventional, fall tillage to incorporate trifluralin with tillage in the spring for weed control; b) reduced, fall tillage to incorporate trifluralin with chemical weed control in the spring; and, c) direct seeding, no fall or spring tillage with chemical weed control in both fall and spring. Glyphosate (Roundup) was used to replace tillage for fall and spring weed control. Both Polish and Argentine canolas were grown with and without Muster within each seedbed preparation system. In addition a delayed seeding treatment using Polish with glyphosate treatment before emergence was also included. Within each of these seedbed/herbicide systems nitrogen fertilizer was applied by fall banding, fall broadcasting and spring broadcasting. Early snow in October 1991, prevented the application of all fall treatments, so treatments were applied as soon as possible in the spring. Treatments were applied as planned in the fall of 1992 and 1993. Dates of major field operations are included in Table 1.

All tillage operations were performed with a field cultivator. Pre-emergence trifluralin and glyphosate spraying was done with a three point hitch sprayer and 100 L of water per hectare. Two or three tillage operations were done before application of trifluralin, followed by two more tillage operations. Pre-seeding tillage involved one pass with the cultivator followed by harrow-packing. All fertilizer treatments were applied with a hoe press drill; eight centimeters deep for deep banding, and just above the ground surface for the broadcast operations. Seeding was done with a hoe press drill, with 40 kg/ha of 11-51-0 fertilizer seed placed. Post emergent spray treatments were applied with a shrouded push sprayer and 100 L of water per hectare. Plots were harvested with a plot combine as they matured.

Samples were taken from a 0.5 m2 area before and after spraying, for crop and weed counts and staging. The grain samples were cleaned and dried to a constant weight before weighing. Plant samples were counted, staged, dried and then weighed. All data, except growth stages, was analyzed by analysis of variance using the GLM procedure of SAS. The growth stages were analyzed by contingency table analysis using the JMP statistical package from SAS.

Results

Canola

Leaf area

1993 sampling. Only tillage system and crop had a significant effect on leaf area. Delayed seeding delayed leaf area development (Table 2). Trifluralin/spring tillage also delayed leaf area development. At the second sampling date, following Muster application, Muster treatments had reduced leaf area development compared to the unsprayed checks and Polish had a slightly higher leaf area than Argentine canola.

1994 sampling. At site 1994-2 no factors were significant due to very high variability in the measurements. At site 1994-1, fertilizer method, crop, tillage system X fertilizer method, crop X tillage system, crop X fertilizer method and the crop X tillage system X

fertilizer method interactions were all significant. The values in the Argentine + Muster treatments are much more variable in their interaction with the other treatments than the other crop treatments (Table 3). However, in general the glyphosate (no tillage, no trifluralin) treatments produced less leaf area than the other treatments, likely because wild oat control was poor and competition more severe. Polish canola developed its leaf area faster than Argentine.

Growth analysis

1993 sampling. Growth stage was determined June 21 and July 3 in 1993. All factors, and interactions, except fertilizer placement method had a significant effect on growth stage in the early sampling, while all factors and interactions were significant by the final sampling in early July (Table 4). The data shows some anomalous values that due not support a consistent explanation, e.g. the lower development stage of Tobin with Muster compared to the Tobin check a week before the Muster was applied (Table 5).

However some general patterns exist and conclusions can be made. The seedbed preparation treatments represent points on the gradient from no tillage to both spring and fall tillage before seeding. As the level of tillage increased, the rate of development decreased at both sampling dates, with the highest level of tillage (two tillages) reduced development by approximately 1.0 and 0.6 growth stages compared with no tillages and one tillage, respectively.. Fall banding of fertilizer partially disturbed the soil and reduced the rate of development for the untilled seedbed, relative to the rate in untilled seedbeds with broadcast fertilizer (Table 5).

Polish canola requires a shorter growing season than Argentine varieties and showed more rapid development. The plants in the delayed seeding treatment had not developed as far as any other treatments at the first sampling date, but had caught up to the Argentine crops by the second date. Delayed seeding of Polish canola tended to reduce the range of effect of tillage amount on development.

1994 sampling. Growth stage was determined on June 22 at both sites. Crop/herbicide treatment was significant at both sites (Table 4). Neither fertilizer application method nor tillage system were significant. The crop X fertilizer and crop X fertilizer X tillage interactions were significant at both sites and crop X tillage was significant only at site 2. There were insufficient plants available in the delayed seeding treatment for analysis.

As in 1993, Polish canola was at a higher stage of development at sampling time than Argentine (Table 6). There was little response of stage of development to tillage in 1994, except in the site 1 Polish canola check - fall banded treatment and at site 2, where, as in 1993, increasing tillage reduced development. In site 1 there is no trend with tillage, while in site 2, there is a trend increased tillage increasing development stage.

Yield

1992 experiment. Early snow prevented the application of trifluralin/tillage in the fall of 1991. It was applied as early as possible in the spring of 1992. The plots receiving both trifluralin and glyphosate in the spring had much higher yield than those receiving either alone (Table 7). Delayed seeding had less of a negative impact on Polish canola yield in 1992 than in the other years, perhaps due to the first effective rain of the season falling near the delayed seeding date. Argentine canola yield was similar to Polish, perhaps due to frost injury suffered in August.

1993 and 1994 experiments. Tillage system, fertilizer timing, crop/herbicide combination and the crop X tillage system interaction were significant in at least 2 out of the four site-years recorded (Table 8). Data are presented for these factors in all site-years.

At site 1993-1 the spring broadcast fertilizer had significantly lower yield then other fertilizer treatments, while in 1994-1 fall broadcast had the lowest yield (Table 9). In the other two sites, fertilizer application had no significant effect on yield.

At site 1993-1 fall incorporated trifluralin plus spring tillage had the lowest yield. Both 1994 sites reduced yield where trifluralin/fall tillage were not used. Wild oat was a significant weed problem in both 1994 sites.

Delayed seeding Polish canola reduced yield compared to normal seeding dates except at site 1993-1 where the reduction only occurred where there was no trifluralin/tillage application. Polish canola had a slight yield advantage over Argentine in sites 1993-2 and 1994-1.

Weed populations

All weeds found within the sampling areas were identified and counted at one site in 1992, one site in 1993 and two in 1994. Cleavers was present at all four sites that were sampled. In 1992, treatments containing glyphosate had higher populations than those containing trifluralin alone (Table 10). Delayed seeding reduced cleavers populations at all four sites. However, at sites 1992 and 1994-2 the cleavers population recovered by the second sampling date. The 1993 population was very low, and was significantly reduced by the trifluralin/tillage treatments. Populations were higher in the 1994 sites, with similar results. In addition, only at site 1994-2, Muster application also controlled the cleavers.

Wild oat was also present at both 1994 sites. Treatments containing trifluralin had significantly fewer wild oat plants than those without (Table 11). Delayed seeding also tended to reduce wild oat populations, particularly at the first sampling date. By the second date, wild oat populations in the delayed seeding treatments without trifluralin had grown to nearly the same numbers as the early seeding. Green foxtail was also present, at low densities, at site 1994-1. It showed a population increase with spring broadcast fertilizer.

Wild buckwheat was present at sites 1992 and 1994-1. Trifluralin/tillage treatments reduced it to half (Table 12). Delayed seeding gave nearly complete control.

Stinkweed was present at site 1994-1. Tillage systems containing glyphosate had reduced populations compared to trifluralin/tillage (Table 13). Delayed seeding provided nearly complete control, regardless of tillage/herbicide system.

Wild mustard was present at site 1994-2. At the first sampling time delayed seeding reduced populations (Table 14). By the second sampling date, these population densities had recovered, except with the glyphosate/no tillage treatment, which provided better control than any treatment containing trifluralin. Perhaps wild oat suppressed wild mustard, and where the trifluralin treatment reduced wild oat populations, wild mustard was able to become more numerous.

Lamb's quarters were present only in the 1992 site. Trifluralin/tillage reduced them significantly compared to glyphosate alone (Table 15). Delayed seeding reduced the lamb's quarters population to about half of that in normal seeding dates but the differences were reduced by the late sampling date.

Conclusions

Fertilizer application method had little consistent effect on canola growth, development or yield. Yield was reduced at one site with fall broadcasting of fertilizer. Broadcast fertilizer stimulated green foxtail germination at one site. Otherwise fertilizer method had little influence on weed populations. Fertilizer methods which provide a general fertility increase and are not associated with the crop seed row generally have little influence on weed populations. This study did not test near-row banding, which has been suggested to improve the crop's ability to compete with weeds.

In 1993, a relatively dry year, reduced tillage (which was associated with trifluralin application), particularly avoiding spring tillage, increased leaf area, hastened development and improved seed yield. The reverse was true in 1994 a moister year. The 1994 sites also had higher wild oat populations which were reasonably well controlled by the trifluralin application.

The use of trifluralin and tillage compared to glyphosate without tillage showed a reduction in cleavers, wild oat, wild buckwheat and lamb's quarters. Stinkweed and wild mustard populations were substantially reduced with glyphosate.

As expected, Polish canola developed faster and had higher leaf area than Argentine under all management combinations for normal seeding dates. Delayed seeding usually

produced a crop that was smaller, later and in most cases had lower yield. It also tended to reduce early season weed populations. It may be a viable strategy for organic or very low input production systems.

Table 1. Dates of major field operations (day/month) at each site.

Operation	Year and site					
	1991-1992		1992-1993		1993-1994	
	1	2	1	2	1	2
Fall tillage	30/04	07/05	28/09	10/09	12/10	12/10
Fall treflan	25/05	25/05	30/09	17/09	15/10	15/10
Fall round-up	13/05	13/05	06/10	22/10	22/10	22/10
Fall fertilizer	10/05	10/05	01/10	18/09	19/10	19/10
Spring tillage	25/05	25/05	19/05	18/05	20/05	20/05
Spring round-up	20/05	20/05	20/05	19/05	31/05	30/05
Spring fertilizer	28/05	28/05	26/05	18/05	26/05	27/05
Normal seeding	25/05	25/05	26/05	18/05	27/05	28/05
Late seeding	03/06	03/06	07/06	04/06	14/06	14/06
Late round-up	10/06	10/06	12/06	09/06	17/06	17/06
Muster	26/06	-----	28/06	28/06	06/07	06/07

Table 2. Leaf area per plant of canola grown under different crop/herbicide, fertilizer placement and tillage systems at site 1993-1.

Fertilizer method	Crop / herbicides					
	Excel check	Excel Muster	Tobin check	Tobin Muster	Tobin delayed	Mean
	cm^2 $plant^{-1}$					
June 21						
Fall band	40.1	12.5	14.1	20.1	0.01	17.5
Fall broad	11.2	12.5	16.8	9.1	0.01	10.2
Spring broad	9.1	7.2	15.6	17.2	1.93	10.6
Mean	19.6	10.7	15.5	15.4	0.62	12.6
July 3						
Fall band	197.4	128.0	147.7	109.5	34.5	125.6
Fall broad	114.2	134.3	201.0	204.9	51.8	120.0
Spring broad	71.8	82.4	87.9	94.3	33.0	95.1
Mean	128.2	113.5	147.3	133.3	39.6	113.3

Table 3. Leaf area per plant of canola grown under different crop/herbicide, fertilizer placement and tillage systems at site 1994-1.

Fertilizer x Tillage system[1]	Crop / herbicide				
	Excel check	Excel Muster	Tobin check	Tobin Muster	Mean
	cm^2 $plant^{-1}$				
Fall band					
RU + RU	85.5	57.4	76.3	56.2	68.9
TR + RU	85.3	93.4	117.9	125.4	105.5
TR + Till	81.8	72.4	112.7	125.9	98.2
Mean	84.2	74.4	102.3	104.8	91.4
Fall Broad					
RU + RU	61.1	44.4	70.7	79.1	63.8
TR + RU	81.3	56.1	140.0	142.9	105.1
TR + Till	59.4	77.4	93.7	92.0	80.6
Mean	67.3	59.3	102.1	104.7	83.4
Spring broad					
RU + RU	63.6	58.7	90.9	64.0	69.3
TR + RU	87.6	92.1	81.1	135.5	99.1
TR + Till	76.6	96.4	101.1	170.8	111.2
Mean	75.9	84.6	91.0	123.4	93.7
Mean					
RU + RU	70.0	53.0	79.3	67.4	67.4
TR + RU	84.7	80.5	113.0	135.4	103.4
TR + Till	72.6	82.1	103.3	129.6	96.9
Mean	75.8	72.4	98.4	111.3	89.5

[1] Tillage system key: RU + RU = fall Roundup followed by spring Roundup
TR + RU = fall Treflan followed by spring Roundup
TR + Till = fall Treflan followed by spring tillage.

Table 4. Contingency table analysis of transformed growth stage of canola grown and sampled on two dates at one site in 1993 and on one date in two sites in 1994.

Source	df	June 1993	July 1993	Site 1 1994	Site 2 1994
		ChiSquare			
Tillage (T)	2	609.7 **	531.9**	0.01	0.04
Crop (C)	4	1450.8**	1508.5**	584.3**	480.8**
T x C	8	161.6**	151.9**	12.7	25.8**
Fertilizer (F)	2	0.4	13.8**	0.01	0.01
T x F	4	11.7*	23.1**	0.01	0.01
C x F	8	97.8**	122.0**	26.1**	21.3**
T x C x F	16	176.0**	325.2**	60.7**	96.7**

*, ** significant at $P \leq 0.05$ and 0.01 respectively.

Table 5. Mean transformed growth stage in response to crop/herbicide system, fertilzer placement, and tillage/herbicide system on two dates in 1993.

Fertilizer x Tillage system[1]	Crop / herbicide						
	Excel check	Excel Muster	Tobin check	Tobin Muster	Tobin delayed	Mean	Mean (seedbed preparation)
	growth stage						
June 21							
Fall band							
RU + RU	3.7	3.7	4.5	4.9	2.2	3.8	
TR + RU	3.3	3.4	4.3	4.5	2.3	3.6	
TR + Till	3.1	2.6	3.7	3.3	1.7	2.9	
Mean	3.4	3.2	4.2	4.3	2.1	3.4	
Fall Broad							
RU + RU	3.4	3.8	5.4	5.0	2.2	4.0	
TR + RU	3.7	3.7	4.0	3.4	2.3	3.5	
TR + Till	3.4	3.3	3.1	3.2	1.6	2.9	
Mean	3.5	3.6	4.2	3.9	2.0	3.5	
Spring broad							
RU + RU	3.8	3.6	5.3	4.7	2.2	4.0	3.9
TR + RU	3.0	2.8	4.7	4.9	2.4	3.6	3.5
TR + Till	2.4	2.7	3.9	2.8	1.9	2.8	2.9
Mean	3.1	3.0	4.6	4.2	2.2	3.5	
Mean	3.3	3.3	4.4	4.1	2.1		
July 3							
Fall band							
RU + RU	7.3	7.9	9.1	9.4	7.1	8.1	
TR + RU	6.9	7.0	7.9	9.3	7.1	7.6	
TR + Till	7.1	7.1	8.3	7.8	6.2	7.3	
Mean	7.1	7.4	8.5	8.8	6.8	7.7	
Fall Broad							
RU + RU	7.5	8.0	9.1	9.0	6.9	8.1	
TR + RU	7.1	8.6	8.5	8.7	6.5	7.8	
TR + Till	6.5	6.7	8.3	7.1	7.1	7.1	
Mean	7.0	7.8	8.6	8.3	6.8	7.7	
Spring broad							
RU + RU	7.8	7.2	9.4	9.2	7.5	8.3	8.2
TR + RU	7.2	7.6	9.2	9.0	6.8	8.0	7.8
TR + Till	6.4	6.9	7.6	8.7	6.8	7.3	7.2
Mean	7.1	7.2	8.7	9.0	7.0	7.8	
Mean	7.1	7.5	8.6	8.7	6.8		

[1] Tillage system key: RU + RU = fall Roundup followed by spring Roundup
TR + RU = fall Treflan followed by spring Roundup
TR + Till = fall Treflan followed by spring tillage.

Table 6. Mean transformed growth stage in response to crop/herbicide system, fertilizer placement, and tillage/herbicide system at two sites in 1994.

Fertilizer x Tillage system[1]	Crop / herbicide					
	Excel check	Excel Muster	Tobin check	Tobin Muster	Mean	Mean (seedbed preparation)
	Growth stage					
Site 1 (Skwk)						
Fall band						
RU + RU	6.1	5.9	8.0	7.3	6.8	
TR + RU	6.1	6.1	7.8	7.6	6.9	
TR + Till	6.4	5.4	7.2	7.5	6.6	
Mean	6.2	5.8	7.7	7.5	6.8	
Fall Broad						
RU + RU	6.4	6.4	7.6	7.5	7.0	
TR + RU	5.8	5.6	7.3	7.8	6.6	
TR + Till	5.9	5.9	7.2	7.4	6.6	
Mean	6.0	6.0	7.4	7.6	6.8	
Spring broad						
RU + RU	6.0	6.1	7.5	7.6	6.8	6.9
TR + RU	6.2	6.0	7.9	7.1	6.8	6.8
TR + Till	5.9	6.3	7.3	6.9	6.6	6.6
Mean	6.0	6.1	7.6	7.2	6.7	
Mean	6.1	6.0	7.6	7.4		
Site 2 (Ingrm)						
Fall band						
RU + RU	4.7	4.6	5.0	6.1	5.1	
TR + RU	4.6	4.7	4.9	5.3	4.9	
TR + Till	4.8	4.8	5.7	7.0	5.6	
Mean	4.7	4.7	5.2	5.9	5.1	
Fall Broad						
RU + RU	4.6	4.3	5.3	6.4	5.2	
TR + RU	4.2	4.9	5.0	6.0	5.0	
TR + Till	5.1	5.0	5.6	6.6	5.6	
Mean	4.6	4.7	5.3	6.3	5.2	
Spring broad						
RU + RU	4.5	4.5	5.1	5.8	5.0	5.1
TR + RU	4.4	4.4	4.9	6.0	4.9	4.9
TR + Till	5.0	4.7	5.4	5.1	5.1	5.4
Mean	4.6	4.5	5.2	5.6	5.0	
Mean	4.6	4.6	5.2	5.9		

[1] Tillage system key: RU + RU = fall Roundup followed by spring Roundup
TR + RU = fall Treflan followed by spring Roundup
TR + Till = fall Treflan followed by spring tillage.

Table 7. Seed yield of canola grown under different tillage system and crop/herbicide treatments in 1992.

Tillage system[1]	Crop / herbicide					
	Excel check	Excel Muster	Tobin check	Tobin Muster	Tobin delayed	Mean
	kg ha^{-1}					
RU + RU	780	700	980	720	690	780
TR + RU	1360	1450	1500	1540	1370	1440
TR + Till	790	1040	1260	980	840	980
Mean	980	1060	1250	970	1080	

[1] Tillage system key: RU + RU = fall Roundup followed by spring Roundup
TR + RU = fall Treflan followed by spring Roundup
TR + Till = fall Treflan followed by spring tillage.

Table 8. Analysis of variance of canola yield at two sites in 1993 and 1994.

Source	df	Location			
		Site 1 1993	Site 2 1993	Site 1 1994	Site 2 1994
		Mean Square			
Tillage (T)	2	839784+	520233	6587673**	1570854*
Crop (C)	4	637660**	2121548**	296026**	8157726**
T x C	8	112633+	113903	320571**	334129**
Fertilizer (F)	2	503515**	53622	1059493**	73443
T x F	4	53633	94067+	35455	9295
C x F	8	42300	45210	72390	56002
T x C x F	16	70232	30767	43803	38067

+, *, ** significant at $P \leq 0.01$, 0.05 and 0.01 respectively.

Table 9. Seed yield of canola grown with different fertilizer application methods at two sites in 1993 and 1994.

Fertilizer method	Canola yield			
	Site 1 1993	Site 2 1993	Site 1 1994	Site 2 1994
	kg ha^{-1}			
Fall band	1300	680	1680	1100
Fall broadcast	1230	690	1680	930
Spring broadcast	1120	620	1730	1210

Table 10. Seed yield of canola grown under different crop/herbicide and tillage systems at two sites in 1993 and 1994.

Tillage system[1]	Crop / herbicide					Mean
	Excel check	Excel Muster	Tobin check	Tobin Muster	Tobin delayed	
	kg ha^{-1}					
Site 1993-1						
RU + RU	1420	1360	1240	1190	900	1220
TR + RU	1540	1340	1230	1230	1300	1330
TR + Till	1190	1220	1010	950	1080	1090
Mean	1380	1310	1160	1120	1090	
Site 1993-2						
RU + RU	490	270	900	1100	320	560
TR + RU	490	520	1230	790	520	770
TR + Till	600	530	850	320	322	620
Mean	530	440	910	990	390	
Site 1994-1						
RU + RU	730	540	860	840	490	690
TR + RU	1280	1300	1630	1500	830	1310
TR + Till	1280	1380	1470	1560	500	1230
Mean	1080	1090	1330	1300	610	
Site 1994-2						
RU + RU	1710	1760	1470	1730	990	1530
TR + RU	2260	2180	1960	1890	990	1850
TR + Till	2140	2150	1770	1840	650	1700
Mean	2030	2020	1730	1820	880	

[1] Tillage system key: RU + RU = fall Roundup followed by spring Roundup
TR + RU = fall Treflan followed by spring Roundup
TR + Till = fall Treflan followed by spring tillage.

Means are all off?

Table 11. Cleavers population density in canola crops grown under different tillage systems and crop/herbicide treatments in 1992, 1993 and 1994.

Treatment	Site							
	1992		1993-1		1994-1		1994-2	
	Early	Late	Early	Late	Early	Late	Early	Late
	number 0.25 m^2							
Tillage system[1]								
RU +RU	3.6	3.3	0.2	-	12.9	8.6	19.2	6.8
TR + RU	4.8	4.3	0.05	-	5.9	6.5	4.6	2.4
TR + Till	1.6	0.8	0.05	-	7.4	7.5	7.5	3.4
Crop/herbicide								
Excel check	4.3	2.9	0.19	-	11.4	9.8	10.7	4.6
Excel Muster	4.7	3.4	0.17	-	12.0	7.3	14.3	1.6
Polish check	3.2	3.3	0.05	-	9.9	8.5	13.3	5.3
Polish Muster	2.5	1.6	0.03	-	9.6	7.9	11.3	0.9
Polish delay	1.9	2.6	0.05	-	0.4	4.3	2.6	8.6

[1] Tillage system key: RU + RU = fall Roundup followed by spring Roundup
TR + RU = fall Treflan followed by spring Roundup
TR + Till = fall Treflan followed by spring tillage.

Table 12. Wild oat population density in canola crops grown under different tillage systems and crop/herbicide treatments in 1992, 1993 and 1994.

Treatment	Site							
	1992		1993-1		1994-1		1994-2	
	Early	Late	Early	Late	Early	Late	Early	Late
	number 0.25 m^2							
Tillage system[1]								
RU +RU	0.2	0.03	-	-	52.1	38.9	43.5	45.2
TR + RU	0.0	0.0	-	-	16.5	11.2	14.3	10.8
TR + Till	0.0	0.0	-	-	11.9	6.3	17.1	12.2
Crop/herbicide								
Excel check	-	-	-	-	30.5	18.6	26.4	15.9
Excel Muster	-	-	-	-	41.1	20.7	35.1	26.7
Polish check	-	-	-	-	23.9	17.6	29.2	26.4
Polish Muster	-	-	-	-	32.5	26.4	30.6	23.4
Polish delay	-	-	-	-	5.8	10.7	3.6	18.2

[1] Tillage system key: RU + RU = fall Roundup followed by spring Roundup
TR + RU = fall Treflan followed by spring Roundup
TR + Till = fall Treflan followed by spring tillage.

Table 13. Wild buckwheat population density in canola crops grown under different tillage systems and crop/herbicide treatments in 1992, 1993 and 1994.

Treatment	Site							
	1992		1993-1		1994-1		1994-2	
	Early	Late	Early	Late	Early	Late	Early	Late
	number 0.25 m^2							
Tillage system[1]								
RU +RU	2.4	3.0	-	-	3.2	2.0	-	-
TR + RU	0.9	0.2	-	-	1.9	1.0	-	-
TR + Till	0.6	0.1	-	-	2.2	0.3	-	-
Crop/herbicide								
Excel check	1.9	1.4	-	-	3.1	1.2	-	-
Excel Muster	2.4	1.2	-	-	3.8	1.6	-	-
Polish check	0.5	1.3	-	-	2.3	0.8	-	-
Polish Muster	1.8	1.4	-	-	2.7	0.8	-	-
Polish delay	0.0	0.3	-	-	0.1	1.3	-	-

[1] Tillage system key: RU + RU = fall Roundup followed by spring Roundup
TR + RU = fall Treflan followed by spring Roundup
TR + Till = fall Treflan followed by spring tillage.

Table 14. Stinkweed population density in canola crops grown under different tillage systems and crop/herbicide treatments in 1994.

Treatment	Site 1994-1	
	Early	Late
	number 0.25 m^2	
Tillage system[1]		
RU +RU	0.2	0.2
TR + RU	0.2	0.2
TR + Till	1.2	1.1
Crop/herbicide		
Excel check	0.7	0.7
Excel Muster	0.8	0.2
Polish check	0.7	0.8
Polish Muster	0.6	0.6
Polish delay	0.1	0.4

[1] Tillage system key: RU + RU = fall Roundup followed by spring Roundup
TR + RU = fall Treflan followed by spring Roundup
TR + Till = fall Treflan followed by spring tillage.

Table 15. Wild mustard population density in canola crops grown under different tillage systems and crop/herbicide treatments in 1994.

Treatment	Site 1994-1	
	Early	Late
	number 0.25 m^2	
Tillage system[1]		
RU +RU	1.3	0.4
TR + RU	1.3	2.2
TR + Till	2.0	2.1
Crop/herbicide		
Excel check	2.7	1.4
Excel Muster	2.3	1.1
Polish check	1.4	1.3
Polish Muster	1.1	1.0
Polish delay	0.3	3.2

[1] Tillage system key: RU + RU = fall Roundup followed by spring Roundup
TR + RU = fall Treflan followed by spring Roundup
TR + Till = fall Treflan followed by spring tillage.

Table 16. Lamb's quarters population density in canola crops grown under different tillage systems and crop/herbicide treatments in 1994.

Treatment	Site 1994-1	
	Early	Late
	number 0.25 m^2	
Tillage system[1]		
RU +RU	10.5	9.3
TR + RU	5.2	1.6
TR + Till	6.9	2.9
Crop/herbicide		
Excel check	8.9	5.6
Excel Muster	8.6	5.5
Polish check	7.1	4.1
Polish Muster	8.4	4.5
Polish delay	4.7	3.2

[1] Tillage system key: RU + RU = fall Roundup followed by spring Roundup
TR + RU = fall Treflan followed by spring Roundup
TR + Till = fall Treflan followed by spring tillage.