The Effect of Winter Annual Weed Control with 2,4-D Amine, and Pre-Seeding Burnoff with Glyphosate /Dicamba (Rustler) on Subsequent Canola Production.

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INTRODUCTION

The October application of 2,4-D to control winter annual weeds such as flixweed, stinkweed and shepherd's purse is recognized as a highly successful and inexpensive treatment. Alternative control methods require late fall or very early spring tillage to dislodge these overwintering species. Tillage results in moisture loss, contributes to erosion and often loosens the seed-bed making uniform emergence difficult. However, the application of 2,4-D in the fall on fields planned for canola the following spring is not presently recommended. The reason for this restriction is the concern that the amount of residual 2,4-D remaining in the soil the following May could be sufficient to injure canola seedlings.

The primary objective of this research was to determine if late fall or early spring applications of 2,4-D amine had an effect on subsequent canola emergence and growth. Other objectives were to determine if there was a differential response of canola to the presence of 2,4-D residue between seed placement methods, the effect of soil type (organic matter content) on canola response to 2,4-D, the effect a 0 to 10 day time interval between spring application of 2,4-D and seeding and the effect of potential residue from the dicamba portion of a pre-seeding burnoff treatment with Rustler on canola.

SUMMARY

A. Late Fall and Early Spring Application of 2,4-D Amine Effect on Brassica rapa and Brassica napus Canola.

Provincial weed control guidelines recommend the late fall application of 2,4-D at 0.34 to 0.45 litre/acre to control winter annual weeds only when spring wheat or durum is to be seeded the following spring. Because of this limitation the application of 2,4-D in late fall or early spring has not been an option for canola growers. This study was initiated to investigate the effects of late fall (mid-October) or late April application of 2,4-D amine at 0.34 and 0.68 litre/acre on subsequent canola emergence and yield. Research sites were established on Dark Brown, Thin Black and Grey-Wooded soil types to also determine the effect organic matter and soil type on possible residual 2,4-D.

Over the 3 years of the study there was no effect on Parkland and Bounty canola plant stands or yield at any of the locations from 0.34 or 0.68 litres/acre applied in mid-October. Late April application of 2,4-D amine at 0.34 litre/acre did not affect canola plant stand or yield at any location. The 0.68 litre/acre rate did reduce plant stand of both canola types on the Dark Brown soil at Scott.

Based on these results it is suggested that the mid-October application of 2,4-D amine could be an option for the control of winter annual weeds (stinkweed, flixweed,shepherd's-purse) prior to seeding canola the following spring.

B. 2,4-D Effect on Canola as Determined by the Time Interval Between Application and Seeding.

There have been isolated grower reports suggesting that 2,4-D applied a few days prior or at the time of seeding could be affective in controlling emerging stinkweed and/or wild mustard seedlings. Because of the minor differences between canola and the weed species this study was established to determine the effect of 2,4-D amine applied 10 to 0 days prior to seeding canola. Breakdown of 2,4-D is affected primarily by soil organic matter, moisture, temperature and time. This study was conducted on 3 soil types with organic matter contents of approximately 1% Grey-Wooded, 3.5% Dark Brown, and 5-6% Thin Black.

2,4-D amine at 0.45 litre/acre was applied 10, 7, 3, and 0 days prior to seeding Brassica rapa (Parkland) and Brassica napus (Bounty) canola.

In the Dark Brown soil at Scott reductions in canola stand and yield resulted from all 2,4-D treatments. In Parkland and Bounty plant stands were reduced 80 and 75% respectively when 2,4-D was applied the same day as seeding. When 2,4-D was applied 10 days prior to seeding canola stand reductions of 63 and 33% were observed for Parkland and Bounty respectively. Similarly yield reductions of 38 and 19% were recorded in Parkland and 29 and 21% in Bounty for applications at 0 and 10 days prior to seeding.

In the Thin Black soil at Lashburn there was no effect on the plant stand or yield of either canola type from any treatment. On the Grey-Wooded soil at Loon Lake

reductions were recorded from application at 0 days.

These results suggest that 2,4-D applied within 10 days of canola planting will cause significant stand and yield reductions in the lower organic soil. On higher organic matter (Black) soils the risk is greatly reduced.

C. Effect of Rustler (glyphosate/dicamba) Applied as a Pre-Seeding Burnoff prior to Canola.

The recent trend to direct seeding of all crops, including canola generally requires that a preseeding burnoff treatment for weed control be applied. In most fields glyphosate (Roundup) provides excellent control of emerged weeds and volunteer crops and leaves no residual that will affect canola seedlings. However, in fields where wild buckwheat is a significant weed problem, Roundup can provide less than acceptable control, particularly when the buckwheat has developed to the 4-leaf-stage or greater. In these cases growers are interested in the application of Rustler, a combination of glyphosate and dicamba.. The dicamba portion of the mixture is highly effective on wild buckwheat, but could also remain in the soil long enough to affect canola seedlings.

The objective of this research was to determine if Rustler applied preseeding has any detrimental effect on subsequent canola. Experiments were established in 1993 and 1994 on three soil types: Dark Brown (Scott); Thin Black (Lashburn); and Grey Wooded (Loon Lake). Rustler was applied at 0.45, 0.67, 1.0, and 1.25 litres/acre

(1.0 litre is recommended rate prior to planting cereals). Time intervals from application to seeding ranged from 9 to 17 days which is somewhat longer than the 5 to 10 days that would normally be the practice.

Minor visual symptoms of dicamba injury were observed at Scott from both the hoedrill and disc drill plantings, while at Lashburn disc drill planting showed small symptoms of injury. However, Parkland and Bounty canola plant stands and yields were not reduced by the treatment levels at any of the three locations. These results suggest the Rustler could be applied prior to seeding canola with the time intervals used in this study. Shorter time intervals between spraying and seeding could result in higher levels of dicamba present at the time of canola emergence.

D. Effect of Seed Placement Method (Hoe or Disc Drill) and Spring Applied 2,4-D Amine Rate on Brassica rapa and Brassica napus Canola.

Preliminary research conducted at the Scott Experimental Farm in the mid-1980's suggested that canola planted in soil containing 2,4-D residue was less likely to be injured when seeded with a drill fitted with the hoe-openers. It was hypothesized that the hoe-type opener would move the treated surface soil to the sides and away from the point of seedling emergence as compared to a double-disc opener which would place the seed in treated soil.

Research was conducted over three years (1992, 1993, and 1994) on three soil types: Dark Brown, Thin Black and Grey Wooded at Scott, Lashburn and Loon Lake, respectively. A narrow opener hoe-drill and a double-disc press drill were used to

seed canola into soil that had been treated with 0.34 or 0.68 litres/acre of 2,4-D amine a few days prior to seeding.

At Scott, both drills and both rates reduced the canola plant stand from 29 to 59%, but there was no difference between hoe opener or disc drill. Seed yield was not reduced by any of the treatments which illustrates the ability of canola to compensate for reduction in plant stands.

In the Thin Black soil at Lashburn and the Grey Wooded soil at Loon Lake there was no effect from any treatment on either canola type.

Results varied somewhat among years and locations, but overall they indicate there is no differential reaction to 2,4-D residue from the method of seed placement with either the hoe or double-disc opener.

MATERIALS and METHODS

All studies were conducted on 3 soil types, Dark Brown, (3.5% O. M.), Scott, Thin Black, (5.0% O. M.), Lashburn and Grey Wooded, (1.0% O. M.), Loon Lake.

A. Late Fall and Early Spring Application of 2,4-D Amine Effect on Brassica rapa and Brassica napus Canola.

2,4-D amine (500 gai/l) was applied to previously fallowed land at 0, 0.34 and 0.68 litres/acre on October 15, 21, 11 in 1991, 1992, 1993, and May 5, 10, 6 in the spring of 1992, 1993 and 1994. All treatments were applied with an air assisted sprayer in carrier volumes of 100 litres/hectare and pressure of 275 kPa. All plot areas had been previously treated with trifluralin (1100 gai/l) to assist in maintaining weed free conditions.

Parkland (B. rapa) and Bounty (B. napus) canola was seeded at 5 and 6 kg/hectare, respectively on May 23, 19, 25, at Scott, May 25, 27, 27 at Lashburn and May 31, 28, 31, at Loon Lake in 1992, 1993, 1994, respectively. Seed was placed 2 cm deep in 23 cm row width with a hoe drill. 40 kg/hectare of 12-51-0 fertilizer was placed with the seed. Emergence counts were determined approximately 10 days following complete emergence and reconfirmed later in the season. Visual ratings of percent injury were recorded at flowering based on stand reduction and maturity delay. Pod numbers per plant were determined from a 1 m length of row at 2 random locations in each plot. Seed yield was determined by harvesting a 5.8 m^2 area from

each plot with a small plot combine. Seed samples were dried to constant moisture (9.5%), cleaned, and weighed. On all samples, volume weight, seed weight, chlorophyll content and percentage green seed were determined.

Weather conditions varied considerably over the growing seasons and locations. Summary precipitation data are provided in Table 1A.

B. 2,4-D Effect on Canola as Determined by the Time Interval Between Application and Seeding.

2,4-D amine (500 gai/l) was applied to previously fallowed land at 0 and 0.45 litre/acre at intervals of 10, 7, 3 and 0 days prior to seeding canola in 1992, 1993, and 1994. All treatments were applied with an air assisted sprayer in carrier volumes of 100 litres/hectare at a pressure of 275 kPa. Parkland (B. rapa) and Bounty (B. napus) canola was seeded at 5 and 6 kg/hectare, respectively with a hoe drill on May 23, 19, 23 at Scott, May 27, 28, 27 at Lashburn and May 26, 28, 31 at Loon Lake, in 1992, 1993, 1994 respectively. Seed was placed 2 cm deep in 23 cm row width. 40 kg/hectare of 12-51-0 fertilizer was placed with the seed. The total plot area had been treated previously with trifluralin (1100 gai/hectare) to assist in maintaining weed free conditions.

Emergence counts were determined approximately 10 days following complete emergence and reconfirmed later in the season. Visual ratings of percent injury were recorded at flowering based on stand reduction and maturity delay. Pod numbers per plant were determined from a 1 m length of row at 2 random locations in each plot.

Seed yield was determined by harvesting a 5.8m^2 area from each plot with a small plot combine. Seed samples were dried to constant moisture (9.5%), cleaned, and weighed. On all samples, volume weight, seed weight, chlorophyll content and percentage green seed were determined.

Weather conditions varied considerably over the growing seasons and locations. Summary of precipitation data are provided in Table 1A.

C. Effect of Rustler (glyphosate/dicamba) Applied as a Pre-seeding Burnoff Prior to Canola.

Rustler herbicide was applied to previously fallowed land at 0, 0.45, 0.67, 1.0 and 1.25 litres/acre prior to seeding on May 5, 10, at Scott, May 21, 10, at Lashburn, and May 21, 10 at Loon Lake in 1993 and 1994 respectively. All treatments were made with an air assisted sprayer in carrier volumes of 100 litres/hectare and pressure of 275 kPa. All plot area had been previously treated with trifluralin (1100 gai/ha) to assist in maintaining weed free conditions.

Parkland (Brassica rapa) and Bounty (Brassica napus) canola was seeded at 5 and 6 kg/ha respectively on May 23, 19, at Scott, May 27, 27 at Lashburn and May 28, 31, at Loon Lake in 1993 and 1994 respectively. Seed was placed 2 cm deep in 23 cm row width with hoe and double disc drills. 12-51-0 at 40 kg/ha was placed with the seed.

Emergence counts were determined approximately 10 days following complete emergence and reconfirmed later in the season. Visual ratings of percent injury were

recorded at flowering based on stand reduction and maturity delay. Pod numbers per plant were determined from a 1 m length of row at 2 random locations in each plot, Seed yield was determined by harvesting a 5.8 m^2 area from each plot with a small plot combine. Seed samples were dried to constant moisture (9.5%), cleaned, and weighed. On all samples, volume weight, seed weight, chlorophyll content and percentage green seed were determined.

Weather conditions varied considerably over the growing seasons and locations. Summary precipitation data are provided in Table 1A.

D. Effect of Seed Placement Method (Hoe or Disc Drill) and Spring Applied 2,4-D Amine Rate on Brassica rapa and Brassica napus Canola.

2,4-D amine (500 gai/litre) was applied to previously fallowed land at 0, 0.34, 0.68 litres/acre on May 5, 10, 6, at Scott, May 5, 10, 10, at Lashburn, May 6, 12, 10, at Loon Lake in 1992, 1993, and 1994 respectively. All treatments were applied with an air assisted sprayer in carrier volumes of 100 litres/hectare and pressure of 275 kPa. All plot areas had been previously treated with trifluralin (1100 gai/hectare) to assist in maintaining weed free conditions.

Parkland (B. rapa) and Bounty (B. napus) canola was seeded at 5 and 6 kg/hectare respectively. Seed was placed 2 cm deep in 23 cm row width. Seed placement methods included; a narrow opener hoe drill which moved treated soil to each side of the hoe and double disc opener which placed seed directly into the treated soil. 40 kg/hectare of 12-51-0 fertilizer was placed with the seed. Seeding

dates were: May 23, 19, 25 at Scott, May 27, 28, 27 at Lashburn, May 26, 28, 31 at Loon Lake in 1992, 1993, and 1994 respectively. Emergence counts were determined approximately 10 days following complete emergence and reconfirmed later in the season. Visual ratings of percent injury were recorded at flowering based on stand reduction and maturity delay. Pod numbers per plant were determined from a 1 m length of row at 2 random locations in each plot. Seed yield was determined by harvesting a 5.8m^2 area from each plot with a small plot combine. Seed samples were dried to constant moisture (9.5%), cleaned, and weighed. On all samples, volume weight, seed weight, chlorophyll content and percentage green seed were determined.

Weather conditions varied considerably over the growing seasons and locations. Summary precipitation data are provided in Table 1A.

Table 1A. March - August Precipitation at Scott, Lashburn and Loon Lake, 1992, 1993 and 1994

	Precipitation (mm)									
	Scott				Lashburn			Loon Lake		
	1992	1993	1994	80 yr avg	1992	1993	1994	1992	1993	1994
March	5	17	1	16	4	12	2	10	1	4
April	17	45	5	23	16	90	6	18	39	9
May	41	22	54	36	64	24	64	53	13	67
June	11	101	55	60	19	103	98	67	92	67
July	164	83	60	59	57	30	42	40	73	36
August	32	39	73	45	36	62	48	23	57	45

Results and Discussion

A. Late Fall and Early Spring Application of 2,4-D Amine Effect on Brassica rapa and Brassica napus canola.

The mid-October application of 2,4-D amine at 0.34 or 0.68 litre/acre did not produce any visual symptoms, reduce plant stand or affect yield of either canola type planted the following spring at Scott (Table 1). The early spring application resulted in some injury symptoms, but only the 0.68 litre/acre rate significantly reduced the plant stand of both canola types. Yields were not significantly reduced by the spring applications, but there was a trend toward lower yield with the 0.68 litre/acre rate. There were no treatment effects on seed weight, green seed, chlorophyll content or pod number per plant (data not shown).

At Lashburn, on the higher organic matter soil none of the treatments had an effect on any of the growth and quality factors investigated (Table 2).

At Loon Lake, there was no effect from time of application or rate on canola plant stand and yield (Table 3). The 0.68 litre/acre rate applied in the spring of 1992 produced minor visual injury symptoms, but these disappeared as the growing season progressed.

Overall all years and locations there were no negative effects from the fall application of 2,4-D amine at 0.34 or 0.68 litre/acre. These results suggest that late fall application to control winter annual weeds at the rates currently recommended for fall application prior to cereals (0.34 - 0.45 litre/acre) could be safely applied the fall prior to planting canola.

Table 1. Effect of Fall and Early Spring Applied 2,4-D Amine on Emergence, Growth* and Yield of Brassica rapa and Brassica napus canola, Scott, 1992-1994.

	B. rapa		B. napus	
2,4-D Amine	Fall	Spring	Fall	Spring
(litre/acre)	% injury			
0.00	0	0	0	0
0.34	0	11	0	10
0.68	0	32	0	22
LSD (0.05)	4.1			
	Canola Plants			
(litre/acre)	(#/m²)		(#/m²)	
0.00	34	36	44	44
0.34	35	30	47	36
0.68	43	22	59	29
LSD (0.05)	9.5			
	Seed Yield (kg/ha)			
(litre/acre)				
0.00	1810	1790	2660	2700
0.34	1800	1660	2650	2700
0.68	1790	1580	2770	2370
LSD (0.05)	NS			

* 2,4-D amine applied in fall or early spring had no effect on seed weight, green seed, chlorophyll content, and pods per plant (data not shown).

Table 2. Effect of Fall and Early Spring Applied 2,4-D Amine on Emergence, Growth* and Yield of Brassica rapa and Brassica napus canola, Lashburn, 1992-1994.

	B. rapa		B. napus	
2,4-D Amine	Fall	Spring	Fall	Spring
(litre/acre)	% injury			
0.00	0	0	0	0
0.34	0	1	0	1
0.68	5	4	3	3
LSD (0.05)	NS			
	Plants/ m^2			
	(#/m^2)		(#/m^2)	
0.00	93	102	84	90
0.34	89	89	89	100
0.68	85	82	83	85
LSD (0.05)	NS			
	Seed Yield (kg/ha)			
0.00	1807	1877	1649	1743
0.34	1824	1988	1684	1755
0.68	1856	1895	1701	1758
LSD (0.05)	NS			
	Chlorophyll (ppm)			
0.00	12	10	63	68
0.34	11	14	66	68
0.68	12	21	66	68
LSD (0.05)	NS			

* 2,4-D amine applied in fall or early spring had no effect on seed weight or green seed content (data not shown)

Table 3. Effect of Fall and Early Spring Applied 2,4-D Amine on Emergence, Growth* and Yield of Brassica rapa and Brassica napus canola, Loon Lake, 1992-1994.**

	B. rapa				B. napus			
	1992		1994		1992		1994	
2,4-D Amine	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring
(litre/acre)				% injury				
0.00	0	0	0	0	0	0	0	0
0.34	0	5	0	0	0	5	0	0
0.68	0	15	0	0	0	15	0	0
				Plants/m^2				
0.00	125	93	132	130	97	97	88	85
0.34	123	122	127	116	112	105	92	96
0.68	106	133	112	126	118	94	94	94
LSD (0.05)	NS		NS		NS		NS	
				Seed Yield (kg/ha)				
0.00	1512	1262	1807	1977	922	775	1310	1398
0.34	1370	1265	1970	1885	845	775	1455	1390
0.68	1462	1220	1862	1857	775	730	1437	1390
LSD (0.05)	NS		NS		NS		NS	

* 2,4-D amine applied in fall or early spring had no effect on seed weight, green seed or chlorophyll content (data not shown).

** 1993 data not shown (drought).

B. 2,4-D Effect on Canola as Determined by the Time Interval Between Application and Seeding.

The application of 2,4-D amine at 0.45 litre/acre at 10, 7, 3 and 0 (same day) days prior to seeding produced extensive visual injury and reduced both canola plant stand and yield at Scott (Table 4). Injury levels declined as the time interval between application and seeding increased. Significant reductions in plant stand and yield were

observed at all treatment intervals and were more severe in Parkland (B. rapa) than in Bounty (B. napus). Ten days following application, plant stands were reduced 59 and 33% and yield 19 and 20% for Parkland and Bounty respectively.

At Lashburn in the higher organic matter soils there was no effect from the application of 2,4-D amine prior to or on the day of seeding on either canola type (Table 5).

At Loon Lake, visual injury was observed for all treatments and ranged from 38 to 18% on Parkland and 35 to 20% on Bounty when 2,4-D amine was applied at 0 and 10 days prior to seeding respectively (Table 6). Plant stands were significantly reduced from the 0 day interval in both canola types, but were not affected at 3, 7 and 10 day intervals.

These results indicate that the application of 2,4-D amine at or shortly prior to planting canola is a very high risk technique and should not be practiced on lower organic matter soils. On the high organic matter Thin Black soil at Lashburn no negative treatment effects were recorded suggesting that the amount of organic matter present can be an important factor in neutralizing (decomposition and/or adsorption) 2,4-D.

Table 4. 2,4-D Effect on Canola as Determined by the Time Interval Between Application and Seeding, Scott, 1993-1994.

Days between 2,4-D and Seeding	Parkland		(2,4-D litre/acre)	Bounty	
	0	0.45		0	0.45
	% injury				
0	0	77		0	61
3	0	73		0	39
7	0	51		0	19
10	0	38		0	18
	Plants/m^2				
0	41	8		57	14
3	37	12		55	19
7	37	16		55	30
10	34	14		46	31
LSD (0.05)	6.8				
	Yield kg/hectare				
0	2670	1660		3460	2450
3	2510	1660		3270	2690
7	2390	1910		3030	2730
10	2490	2020		3020	2390
LSD (0.05)	219				

Table 5. 2, 4-D Effect on Canola as Determined by the Time Interval Between Application and Seeding, Lashburn, 1993-1994

Days between 2,4-D and seeding	Parkland		(2,4-D litres/acre)	Bounty	
	0	0.45		0	0.45
	% injury				
0	0	2		0	2
3	0	1		0	1
7	0	0		0	0
10	0	0		0	0

	Plants/m²			
0	57	42	63	57
3	47	50	62	50
7	51	48	65	57
10	46	45	64	55
LSD (0.05)	NS			
0	1462	1285	1303	1255
3	1575	1503	1505	1573
7	1440	1346	1330	1370
10	1496	1510	1458	1461
LSD (0.05)	NS			

Table 6. 2, 4-D Effect on Canola as Determined by the Time Interval Between Application and Seeding, Loon Lake, 1993-1994

Days between 2,4-D and seeding	Parkland			Bounty	
	0	0.45	(2,4-D litre/acre)	0	0.45
	% injury				
0	0	38		0	35
3	0	22		0	25
7	0	20		0	21
10	0	18		0	20
	Plants/m²*				
0	62	17		67	21
3	59	64		65	72
7	52	74		61	68
10	69	65		65	69

* 1994 data only.

C. Effect of Rustler (glyphosate/dicamba) Applied as a Pre-Seeding Burnoff Prior to Canola Seeded with Hoe and Disc Opener Drills.

At Scott, pre-seeding Rustler produced some visual symptoms at 1.0 and 1.25 litres/acre, but did not reduce plant stand and yield (Table 7). Higher plant stands were established with the disc drill than with the hoe drill, but yield was somewhat higher with the hoe plantings. A trend toward reduced plant stands as Rustler rate increased in the disc drill plantings was noted.

At Lashburn (Table 8) and Loon Lake (Table 9) there was no effect on plant stand or yield from Rustler rate or seeding method, and there was no difference between canola types at any location. At Lashburn small visual injury symptoms (mainly flowering delay) were observed in the disc drill plantings.

Over the two years of this study at three locations the pre-seeding application of Rustler had no adverse effects on canola yield. It should be noted that the applications in this study ranged from 9 to 17 days prior to seeding canola. This may have facilitated a greater dissipation of the dicamba than would be obtained with applications made closer to the date of seeding.

Table 7. Effect of Rustler applied as a pre-seeding burnoff on canola seeded with hoe and disc drills, Scott, 1993-1994.

	Hoe drill			Disc drill		
Rustler Rate (litre/acre)	**Injury** (%)	**Plants** (#/m^2)	**Yield** (kg/ha)	**Injury** (%)	**Plants** (#/m^2)	**Yield** (kg/ha)
0	0	47	3002	0	74	2794
0.5	4	49	2945	1	67	2880
0.7	4	47	3084	0	67	2856
1.0	16	49	2938	9	65	2745
1.25	12	45	2925	8	60	2692
LSD (0.05)	3.7	NS	NS	3.7	NS	NS

* Rustler label rate for pre-seeding treatment of cereals is 480 g/ha (1.0 litre product/acre)

Table 8. Effect of Rustler applied as a pre-seeding burnoff on canola seeded with hoe and disc drills, Lashburn, 1993-1994.

	Hoe drill			Disc drill		
Rustler Rate (litre/acre)	**Injury** (%)	**Plants** (#/m^2)	**Yield** (kg/ha)	**Injury** (%)	**Plants** (#/m^2)	**Yield** (kg/ha)
0	0	125	1680	0	81	1810
0.5	0	146	1812	3	58	1806
0.7	0	136	1721	8	65	1855
1.0	0	143	1756	8	69	1863
1.25	0	142	1767	11	72	2086
LSD (0.05)	–	NS	NS	–	NS	NS

* Rustler label rate for pre-seeding treatment of cereals is 480 g/ha (1.0 litre product/acre)

Table 9. Effect of Rustler applied as a pre-seeding burnoff on canola seeded with hoe and disc drills, Loon Lake, 1994.

	Hoe drill			Disc drill		
Rustler Rate (litre/acre)	Injury (%)	Plants (#/m^2)	Yield (kg/ha)	Injury (%)	Plants (#/m^2)	Yield (kg/ha)
0	0	75	1443	0	65	811
0.5	0	83	1430	0	56	756
0.7	0	81	1443	0	58	762
1.0	0	78	1383	0	48	676
1.25	0	79	1268	0	56	891
LSD (0.05)	-	NS	NS	-	NS	NS

* Rustler label rate for pre-seeding treatment of cereals is 480 g/ha (1.0 litre product/acre)

D. Effect of Seed Placement Method (Hoe or Disc opener) and Spring Applied 2,4-D Amine Rate on Brassica rapa and Brassica napus canola.

Soil residual 2,4-D injured canola and reduced plant stand at Scott (Table 10). Injury from the 0.68 litre/acre rate was approximately 20% and varied little between seeding methods or canola types. Plant stand was reduced by both 2,4-D rates with similar results for both seeding methods and canola types. There was no yield reductions from either 2,4-D rate for seed placement method.

At Lashburn small visual injury symptoms were noted from the 0.68 litre/acre rate on both canola types with the disc drill seed placement method (Table 11). There were no effects on canola plant stand or yield.

Results were similar at Loon Lake and no reductions in plant stand or yield were recorded from the presence of 2,4-D residue (Table 12). Over both years and all locations the effect of seed placement methods were similar and not a factor in safening canola to potential 2,4-D residues. The presence of 2,4-D from applications

15 to 21 days previous to planting canola is a concern, particularly on soils with less than 5% organic matter.

There did not appear to be any close association between the effects of residual 2,4-D amine and the environmental conditions occurring in 1992, 1993, and 1994.

Table 10. Effect of Seed Placement Method and Spring Applied 2,4-D Amine Rate on Emergence, Growth* and Yield of Brassica rapa and Brassica napus canola, Scott, 1992 - 1994.

	B. rapa		B. napus	
2,4-D Amine	**Hoedrill**	**Discdrill**	**Hoedrill**	**Discdrill**
(litre/acre)		% injury		
0.00	0	0	0	0
0.34	5	4	6	5
0.68	26	19	18	22
		Canola plants/m^2		
0.00	44	47	48	75
0.34	28	35	39	41
0.68	18	28	34	32
LSD (0.05)		8.2		
		Seed Yield (kg/ha)		
0.00	2402	2074	3012	3013
0.34	2202	2158	3035	2968
0.68	2174	1999	2896	2839
LSD (0.05)		NS		

* The seed placement method used to seed into residue from 2,4-D amine applied in early spring had no effect on canola: pods/plant, seed weight, green seed and chlorophyll content.

Table 11. Effect of Seed Placement Method and Spring Applied 2,4-D Amine Rate on Emergence Growth* and Yield of Brassica rapa and Brassica napus canola, Lashburn, 1992 - 1994.

	B. rapa		B. napus	
2,4-D Amine	Hoedrill	Discdrill	Hoedrill	Discdrill
(litre/acre)	% injury			
0.00	0	0	0	0
0.34	0	5	0	6
0.68	3	9	3	13
	Canola plants/m^2**			
0.00	89	93	90	75
0.34	125	98	98	65
0.68	116	83	105	69
LSD (0.05)	NS			
0.00	1906	2021	1822	1767
0.34	1887	2011	1951	1703
0.68	1906	2041	1870	1591
LSD (0.05)	NS			

* The seed placement method used to seed into residue from 2,4-D amine applied in early spring had no effect on canola; pods/plant, seed weight, green seed and chlorophyll content (data not shown).

** Data from 1993 not included. (Seeding rate error).

Table 12. The effect of Seed Placement Method and Spring Applied 2,4-D Amine Rate on Emergence, Growth* and Yield of Brassica rapa and Brassica napus canola, Loon Lake, 1992 - 1994.**

	B. rapa		B. napus	
2,4-D Amine	Hoedrill	Discdrill	Hoedrill	Discdrill
(litre/acre)	% injury			
0.00	0	0	0	0
0.34	1	0	2	0
0.68	6	3	8	5
	Canola plants/m^2, 1992			
0.00	118	63	92	72
0.34	114	82	96	65
0.68	135	86	99	71
LSD (0.05)	NS			
	Canola plants/m^2, 1994			
0.00	120	73	121	89
0.34	95	52	134	104
0.68	104	58	138	86
LSD (0.05)	NS			
	Seed Yield (kg/ha), 1992			
0.00	1265	1065	760	475
0.34	1307	1152	715	602
0.68	1300	1225	700	572
LSD (0.05)	NS			
	Seed Yield (kg/ha), 1994			
0.00	1610	715	2172	1375
0.34	1577	1320	2202	1575
0.68	1617	1095	2122	1607
LSD (0.05)	165			

* The seed placement method used to seed into residue from 2,4-D amine applied in early spring had no effect on canola; pods/plant, seed weight, green seed and chlorophyll content (data not shown).

** 1993 data not included (drought).