Nightshade and lambsquarters control in cabbage - Oakes. Greenland, Richard G. This experiment was at the Oakes Irrigation Research Site. It consisted of two separate studies.

The direct-seeded cabbage weed control study was on a Hecla sandy loam soil with pH 7.1 and 2.5% soil organic matter that had been planted to potato the previous year. Treflan at 1 pt/acre was applied on April 28 to the entire study and incorporated, along with other PPI treatments, with two passes of a field cultivator. 'Bronco' cabbage was direct seeded on April 28 in 18" rows with an in-row spacing of 7". Plants were later thinned to a 14" in-row spacing.

The transplanted cabbage weed control study was on an Embden sandy loam soil with pH 7.0 and 2.9% soil organic matter that had been planted to field corn the previous year. The corn was flailed in the fall and the field was disked in the spring prior to establishing the study. 'Bronco' cabbage was started from seed in the greenhouse and transplanted to the field on May 6. It was planted in 18" rows with an in-row spacing of 12".

For both studies, appropriate fertilizer and insecticides were used when needed. A row of barley cover crop was planted between and parallel to the cabbage rows. Fusilade + NIS (12 oz/acre + 0.5%) was applied to both studies on June 9 and June 25. The Fusilade was to kill the barley cover crop and any grass weeds. Cabbage was harvested on Sept. 8 or 9.

Results

Direct-seeded cabbage: Surpass applied either PPI or PRE injured cabbage, gave fair to poor nightshade control, and reduced cabbage yield, head size, and number of heads. Valor burned the cabbage leaves, but the cabbage recovered and cabbage yield was not reduced. Valor gave excellent nightshade and lambsquarters control. Authority gave good control of lambsquarters but did not control nightshade, resulting in cabbage yield and head size reductions. Stinger gave good control of nightshade. Dacthal gave good control of nightshade and lambsquarters. Authority followed by Valor or Stinger, and Dacthal followed by Valor or Stinger gave the best weed control and highest cabbage yields.
Transplanted cabbage: Surpass injured both barley and cabbage, did not adequately control weeds, and eliminated cabbage yield. Treflan + Goal gave fair to good control of weeds, injured barley, and resulted in a slight cabbage yield reduction. Adding Stinger to the Treflan + Goal improved weed control and increased cabbage yield. Authority did not control nightshade, resulting in reduced cabbage yield and head size. Valor burned the cabbage leaves, but the cabbage recovered and yields were not reduced. Valor gave excellent control of nightshade and good control of lambsquarters. The best weed control and highest cabbage yields were when Authority and Valor were used together.

Table 1. Cabbage weed control treatment application data at the Oakes Irrigation Research Site in 2004.

Application timing	Date	Time	Barley height	Cabbage height	Cabbage growth stage	Weed height	Weed growth stage
Direct-seeded study							
PPI	April 28	8:55 am	0	0	0	0	0
PRE	May 6	9:55 am	0	0	0	0	0
PRE2	May 17	11:40 am	3"	0.5"	cot	¼ to ¾"	cot to 2 lf
POST1	June 10	10:30 am	10"	5"	4 lf	1 to 2"	2 to 8 lf
POST2	June 14	3:00 pm	9"(dying)	5"	5 lf	1 to 3"	cot. to 10 lf
Transplanted study							
PPI	May 6	9:20 am	0	0	0	0	0
PRE	May 6	11:25 am	0	0	0	0	0
POST1	May 10	9:10 am	0	3.5"	2 lf	0	0
POST2	May 17	11:15 am	1"	3.5"	2 lf	<¼"	cot.
POST3	May 27	11:15 am	4"	3"	2.5 lf	½"	cot to 2 lf
POST4	June 10	9:35 am	7"	5"	7 lf	¼ to 2"	cot to 4 lf

Treatments were applied with a CO_2-pressurized backpack sprayer using AI 110-04 flat fan nozzles, 45 gpa, at 50 psi.

Table 2. Yield data in the Oakes Irrigation Research Site 2004 weed control study in direct-seeded cabbage.

Herbicides	Rates	Application timing[1]	Number of heads	Yield	Head size
			1000s/acre	tons/acre	lbs/head
Surpass	1 pt	PPI	6.2 bc[2]	5.5 d	1.9 c
Surpass	2 pt	PPI	3.3 c	5.0 d	2.8 b
Surpass	1 pt	PRE	12.3 ab	15.7 cd	2.4 c
Surpass	2 pt	PRE	8.3 bc	13.6 cd	2.5 c
Dacthal + Stinger	10 lbs + ⅓ pt	PRE2 + POST2	11.6 ab	32.3 ab	6.4 a
Dacthal + Valor	10 lbs + 2 oz	PRE2 + POST2	11.6 ab	30.4 ab	5.3 ab
Authority	2 oz	POST1	11.6 ab	20.4 bc	3.4 bc
Authority + Valor	2 oz + 2 oz	POST1 + POST2	17.1 a	40.2 a	5.1 ab
Authority + Stinger	2 oz + ⅓ pt	POST1 + POST2	16.3 a	38.9 a	5.0 ab
Hand weeded check			16.7 a	41.1 a	5.1 ab
Probability			0.003	<0.0001	0.002
C.V. (%)			41	35	37

[1]See Table 1 for explanation of application timings.
[2]Values in the same column followed by the same letter are not significantly different at the 0.05 level.

Table 3. Injury to barley and cabbage in the Oakes Irrigation Research Site 2004 weed control study in direct-seeded cabbage.

Herbicides	Rates	Application timing[1]	Barley Injury Jun 11	Cabbage injury Jun 11	Cabbage injury Jun 22	Cabbage injury Jul 20	Cabbage stand Jul 20
			0 to 10[2]				1000s/A
Surpass	1 pt	PPI	2.5	3.0	1.3	0.3	12.4
Surpass	2 pt	PPI	4.8	6.3	4.3	0.0	7.5
Surpass	1 pt	PRE	1.5	1.5	0.8	0.3	13.9
Surpass	2 pt	PRE	3.5	4.5	3.0	0.0	11.3
Dacthal + Stinger	10 lbs + ⅓ pt	PRE2 + POST2	0.3	2.5	1.3	0.0	11.7
Dacthal + Valor	10 lbs + 2 oz	PRE2 + POST2	0.5	1.3	5.8	0.3	13.2
Authority	2 oz	POST1	1.3	2.8	0.5	0.8	13.7
Authority + Valor	2 oz + 2 oz	POST1 + POST2	0.8	0.8	5.0	0.0	18.6
Authority + Stinger	2 oz + ⅓ pt	POST1 + POST2	1.3	2.0	0.8	0.0	15.8
Hand weeded check			0.5	1.5	0.5	0.0	16.9
Probability			<.0001	<.0001	<.0001	0.24	0.04
LSD (0.05)			1.4	1.7	2.1	—	5.9
C. V. (%)			56	46	62	272	30

[1]See Table 1 for explanation of application timings.
[2]Ratings: 0 is no effect (no crop injury); 10 is complete crop kill.

Table 4. Control of hairy nightshade and lambsquarters in the Oakes Irrigation Research Site 2004 weed control study in direct-seeded cabbage.

Herbicides	Rate	Application timing[1]	Hairy nightshade control			Lambsquarters control		
			Jun 11	Jun 22	Jul 20	Jun 11	Jun 22	Jul 20
			---------- 0 to 10[2] ----------					
Surpass	1 pt	PPI	5.3	4.0	0.5	9.0	8.8	7.5
Surpass	2 pt	PPI	7.0	4.8	0.0	9.5	9.5	8.3
Surpass	1 pt	PRE	7.5	5.8	1.5	9.5	9.3	8.5
Surpass	2 pt	PRE	8.8	7.5	4.0	10.0	9.8	8.3
Dacthal+Stinger	10 lbs + ⅓ pt	PRE2+POST2	8.3	8.8	8.8	9.8	10.0	9.8
Dacthal+Valor	10 lbs + 2 oz	PRE2+POST2	8.5	10.0	10.0	10.0	10.0	9.8
Authority	2 oz	POST1	4.3	5.3	2.0	9.5	10.0	8.5
Authority+Valor	2 oz + 2 oz	POST1+POST2	4.5	10.0	10.0	9.5	10.0	9.0
Authority+Stinger	2 oz + ⅓ pt	POST1+POST2	5.0	8.0	7.5	9.0	9.8	8.5
Handweeded check			2.8	9.3	7.0	8.3	10.0	10.0
Probability			<.0001	<.0001	<.0001	0.009	0.006	0.002
LSD (0.05)			1.3	0.9	1.1	0.9	0.7	1.1
C. V. (%)			15	9	14	6	5	9

[1]See Table 1 for explanation of application timings.
[2]Ratings: 0 is no effect (no weed control); 10 is complete weed kill.

Table 5. Yield data in the Oakes Irrigation Research Site 2004 weed control study in transplanted cabbage.

Herbicides	Rates	Application timing[1]	Number of heads	Yield	Head size
			1000s/A	tons/A	lbs/head
Surpass	1.5 pt	PPI	0.0 e[2]	0.0 h	—
Treflan; Goal 2XL	1 pt; 2 pt	PPI; PRE	18.5 abc	27.7 c-f	3.0 fgh
Treflan; Dacthal; Stinger	1 pt; 8 lbs; ⅓ pt	PPI; POST1; POST4	20.0 a	34.5 b-e	3.4 ef
Treflan; Goal 2XL; Stinger	1 pt; 2 pt; ⅓ pt	PPI; PRE; POST4	17.8 abc	35.6 bc	3.9 def
Surpass	1.5 pt	POST1	0.0 e	0.0 h	—
Treflan; Authority	1 pt; 2 oz	PPI; POST2	16.7 abc	17.7 g	2.1 h
Treflan; Valor	1 pt; 2 oz	PPI; POST2	15.6 bc	37.4 b	4.9 bc
Treflan; Authority + Valor	1 pt; 2 oz + 2 oz	PPI; POST2	11.3 d	32.9 b-e	5.8 a
Treflan; Authority	1 pt; 2 oz	PPI; POST3	20.3 a	33.8 b-e	3.3 efg
Treflan; Valor; Authority	1 pt; 2 oz; 2 oz	PPI; POST2; POST3	15.6 bc	47.1 a	6.0 a
Authority	2 oz	POST2	17.4 abc	21.6 fg	2.4 gh
Valor	2 oz	POST2	16.0 bc	33.4 b-e	4.4 cd
Authority + Valor	2 oz + 2 oz	POST2	14.9 cd	41.1 ab	5.6 ab
Authority; Stinger	2 oz; ⅓ pt	POST2; POST4	16.0 bc	25.7 d-g	3.2 efg
Authority	2 oz	POST3	20.3 a	25.2 efg	2.5 gh
Authority + Valor	2 oz + 2 oz	POST3	18.5 abc	37.2 b	4.0 cde
Hand weeded check			19.2 ab	34.9 bcd	3.6 def
Probability			<0.0001	<0.0001	<0.0001
C.V. (%)			17	23	17

[1]See Table 1 for explanation of application timings.
[2]Values in the same column followed by the same letter are not significantly different at the 0.05 level.

Table 6. Injury to barley and cabbage, cabbage stand, and control of lambsquarters in the Oakes Irrigation Research Site 2004 weed control study in transplanted cabbage.

Herbicide	Rates	Application timing[1]	Barley injury Jun 9	Cabbage injury Jun 9	Cabbage injury Jun 24	Cabbage injury Jul 21	Cabbage stand Jul 21	Lambsquarters control Jun 9	Lambsquarters control Jun 24	Lambsquarters control Jul 21
			---- 0 to 10[2] ----				1000s/A	---- 0 to 10[2] ----		
Surpass	1.5 pt	PPI	3.8 fg[3]	5.5 g	4.5 e	5.3 d	17.5 c-f	4.8 d	3.0 e	0.0 f
Treflan; Goal 2XL	1 pt; 2 pt	PPI; PRE	4.3 g	2.0 bcd	0.5 a	0.0 a	21.4 abc	9.3 ab	7.5 d	6.8 d
Treflan; Dacthal; Stinger	1 pt; 8 lbs; ⅓ pt	PPI; POST1; POST4	0.8 abc	1.5 abc	0.3 a	0.0 a	21.8 ab	9.8 a	9.5 ab	9.0 bc
Treflan; Goal 2XL; Stinger	1 pt; 2 pt; ⅓ pt	PPI; PRE; POST4	4.3 g	1.5 abc	0.3 a	0.0 a	22.4 ab	8.5 b	9.0 bc	8.3 c
Surpass	1.5 pt	POST1	2.6 def	3.8 ef	4.4 de	2.3 c	16.9 c-f	5.8 c	3.0 e	1.9 e
Treflan; Authority	1 pt; 2 oz	PPI; POST2	1.0 abc	2.0 bcd	0.8 ab	1.0 b	20.7 a-d	10.0 a	9.8 ab	9.3 ab
Treflan; Valor	1 pt; 2 oz	PPI; POST2	2.5 de	3.3 def	2.8 cd	0.0 a	16.9 def	10.0 a	9.5 ab	8.3 c
Treflan; Authority + Valor	1 pt; 2 oz + 2 oz	PPI; POST2	2.8 ef	4.5 fg	3.8 de	0.0 a	13.7 f	10.0 a	10.0 a	10.0 a
Treflan; Authority	1 pt; 2 oz	PPI; POST3	1.3 bc	1.0 ab	0.0 a	0.5 ab	21.8 ab	10.0 a	10.0 a	9.8 ab
Treflan; Valor; Authority	1 pt; 2 oz; 2 oz	PPI; POST2; POST3	3.3 efg	3.3 def	3.0 cd	0.0 a	14.5 f	10.0 a	10.0 a	10.0 a
Authority	2 oz	POST2	0.5 abc	1.0 ab	0.0 a	1.0 b	22.8 ab	10.0 a	9.5 ab	9.3 ab
Valor	2 oz	POST2	1.5 cd	4.0 ef	2.0 bc	0.0 a	15.6 ef	10.0 a	9.3 abc	7.3 d
Authority + Valor	2 oz + 2 oz	POST2	1.3 bc	2.8 cde	2.8 cd	0.0 a	15.2 f	10.0 a	10.0 a	9.8 ab
Authority; Stinger	2 oz; ⅓ pt	POST2; POST4	0.3 ab	1.0 ab	1.0 ab	0.0 a	19.9 a-d	10.0 a	9.8 ab	9.3 ab
Authority	2 oz	POST3	0.5 abc	0.5 a	0.3 a	0.3 a	23.7 a	10.0 a	10.0 a	10.0 a
Authority + Valor	2 oz + 2 oz	POST3	1.5 cd	2.0 bcd	0.8 ab	0.0 a	19.4 b-e	10.0 a	10.0 a	9.8 ab
Hand weeded check			0.0 a	1.3 ab	1.3 ab	0.0 a	19.6 a-e	2.5 e	8.5 c	9.3 ab
Probability			<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001
C. V. (%)			42	39	65	79	16	7	6	8

[1]See Table 1 for explanation of application timings.
[2]Ratings: 0 is no effect (no weed control or no crop injury); 10 is complete weed or crop kill.
[3]Values in the same column followed by the same letter are not significantly different at the 0.05 level.

Table 7. Control of hairy nightshade and eastern black nightshade in the Oakes Irrigation Research Site 2004 weed control study in transplanted cabbage.

Herbicide	Rates	Application timing[1]	Hairy nightshade control			Eastern black nightshade control		
			June 9	June 24	July 21	June 9	June 24	July 21
			---------- 0 to 10[2] ----------					
Surpass	1.5 pt	PPI	6.8 c[3]	6.0 e	7.5 cd	8.8 c	8.3 de	10.0 a
Treflan; Goal 2XL	1 pt; 2 pt	PPI; PRE	9.8 a	9.5 ab	8.0 bcd	9.5 abc	10.0 a	9.5 a
Treflan; Dacthal; Stinger	1 pt; 8 lbs; ⅓ pt	PPI; POST1; POST4	6.8 c	8.8 abc	9.5 ab	7.3 d	9.3 abc	9.5 a
Treflan; Goal 2XL; Stinger	1 pt; 2 pt; ⅓ pt	PPI; PRE; POST4	9.5 a	10.0 a	10.0 a	9.8 ab	10.0 a	10.0 a
Surpass	1.5 pt	POST1	8.8 ab	8.2 bcd	6.2 de	9.0 abc	9.0 bcd	9.7 a
Treflan; Authority	1 pt; 2 oz	PPI; POST2	7.0 c	6.0 e	3.8 f	7.5 d	7.3 f	6.5 d
Treflan; Valor	1 pt; 2 oz	PPI; POST2	10.0 a	10.0 a	9.5 ab	10.0 a	10.0 a	10.0 a
Treflan; Authority + Valor	1 pt; 2 oz + 2 oz	PPI; POST2	10.0 a	10.0 a	9.3 abc	10.0 a	10.0 a	9.8 a
Treflan; Authority	1 pt; 2 oz	PPI; POST3	9.3 a	8.0 cd	6.5 de	9.3 abc	8.8 cd	7.8 c
Treflan; Valor; Authority	1 pt; 2 oz; 2 oz	PPI; POST2; POST3	10.0 a	10.0 a	10.0 a	10.0 a	10.0 a	10.0 a
Authority	2 oz	POST2	7.5 bc	7.0 de	5.0 ef	7.3 d	7.8 ef	6.3 d
Valor	2 oz	POST2	9.8 a	10.0 a	9.8 ab	9.8 ab	10.0 a	10.0 a
Authority + Valor	2 oz + 2 oz	POST2	10.0 a	10.0 a	9.8 ab	10.0 a	10.0 a	10.0 a
Authority; Stinger	2 oz; ⅓ pt	POST2; POST4	8.8 ab	9.3 abc	9.5 ab	7.5 d	9.8 ab	9.0 ab
Authority	2 oz	POST3	9.5 a	8.8 abc	8.0 bcd	9.0 bc	9.3 abc	8.3 bc
Authority + Valor	2 oz + 2 oz	POST3	10.0 a	10.0 a	10.0 a	10.0 a	10.0 a	10.0 a
Hand weeded check			6.3 c	9.5 ab	9.3 abc	7.0 d	9.8 ab	9.8 a
Probability			<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
C. V. (%)			13	11	16	8	6	9

[1]See Table 1 for explanation of application timings.
[2]Ratings: 0 is no weed control; 10 is complete weed control.
[3]Values in the same column followed by the same letter are not significantly different at the 0.05 level.

Canola Herbicide Systems Langdon 2004 (Lukach)

Roundup Ready and Liberty canola was seeded at 5 lb/a on May 27. Soil crusting reduced stands. Treatments on June 22 were finished at 11:45am and applied to predominantly 2 leaf canola. The treatments June 29 were finished at 10am and were applied to five leaf canola. Conditions on June 22 were 56F, 40RH, 11mph northwest wind with a cloudy sky. Conditions on June 29 were 75F, 55RH, 9mph west wind and a clear sky. A drift shield was used on both dates. Applications were made using a CO_2 pressurized sprayer, mounted on tractor 3-point. Five nozzles in 20 inch spacing were used with DG8001.5 tips at 35psi and 4.2mph applying 10 gal/a solution. Harvest plot size was 4.3 x 20 feet. The trial had a RCBD design with 3 replications.

Canola Herbicide Systems Langdon 2004	Treatment	Rate	Canola Stage	Yield	Test Weight	Height	Canola Stand	Phys Mature	Lodge
		fl oz/a product	Leaf	lb/a	lb/bu	cm	plant/ft2	days	1-9
DeKalb 223 RR	Roundup Ultrarmax II +AMS	10.7 + 4.2 lb/a	2	--	--	--	--	--	--
DeKalb 223 RR	UltMx+AMS / UltMx II+AMS	10.7+4.2 lb/a / 10.7+4.2 lb/a	2 & 5	--	--	--	--	--	--
DeKalb 223 RR	Roundup UltraMax II +AMS	21.4 + 4.2 lb/a	5	1164	50	109	3	93	6
DeKalb 223 RR	----	----	----	445	48	85	4	91	7
Hyclass 2061 RR	Roundup Ultrarmax II +AMS	10.7 + 4.2 lb/a	2	1939	50	102	7	93	3
Hyclass 2061 RR	UltMx+AMS / UltMx II+AMS	10.7+4.2 lb/a / 10.7+4.2 lb/a	2 & 5	1892	50	98	8	93	5
Hyclass 2061 RR	Roundup UltraMax II +AMS	21.4 + 4.2 lb/a	5	1683	49	109	6	92	4
Hyclass 2061 RR	----	----	----	646	50	108	5	93	5
HyClass910 RR	Roundup Ultrarmax II +AMS	10.7 + 4.2 lb/a	2	1694	51	119	6	92	3
HyClass910 RR	UltMx+AMS / UltMx II+AMS	10.7+4.2 lb/a / 10.7+4.2 lb/a	2 & 5	1955	50	120	7	93	3
HyClass910 RR	Roundup UltraMax II +AMS	21.4 + 4.2 lb/a	5	1847	50	111	5	93	3
HyClass910 RR	----	----	----	555	51	106	7	93	6
Hyola 357 magnum RR	Roundup Ultrarmax II +AMS	10.7 + 4.2 lb/a	2	1535	50	103	6	92	6
Hyola 357 magnum RR	UltMx+AMS / UltMx II+AMS	10.7+4.2 lb/a / 10.7+4.2 lb/a	2 & 5	1968	49	106	7	92	5
Hyola 357 magnum RR	Roundup UltraMax II +AMS	21.4 + 4.2 lb/a	5	2014	50	100	6	93	4
Hyola 357 magnum RR	----	----	----	640	50	102	5	91	7
Invgor 2663 Hybrid	Liberty+Select+AMS	17 +3 + 3 lb/a	2	1749	51	116	7	93	4
Invgor 2663 Hybrid	Liberty+Select+AMS / Liberty+AMS	17 +3 + 3 lb/a / 17 + 3 lb/a	2 & 5	2101	51	122	8	93	3
Invgor 2663 Hybrid	Liberty+Select+AMS	28 +3 + 3 lb/a	5	1975	51	122	8	92	3
Invgor 2663 Hybrid	----	----	----	704	51	106	7	92	5
Invigor 2663 Saved seed Treated	Liberty+Select+AMS	17 +3 + 3 lb/a	2	1815	51	130	7	93	5
Invigor 2663 Saved seed Treated	Liberty+Select+AMS / Liberty+AMS	17 +3 + 3 lb/a / 17 + 3 lb/a	2 & 5	1822	51	130	8	93	5
Invigor 2663 Saved seed Treated	Liberty+Select+AMS	28 +3 + 3 lb/a	5	1559	51	114	7	93	5
Invigor 2663 Saved seed Treated	----	----	----	604	50	107	6	93	5
Invigor 2663 Saved seed UN-Treated	Liberty+Select+AMS	17 +3 + 3 lb/a	2	1475	50	104	5	94	3
Invigor 2663 Saved seed UN-Treated	Liberty+Select+AMS / Liberty+AMS	17 +3 + 3 lb/a / 17 + 3 lb/a	2 & 5	1602	51	111	4	94	3
Invigor 2663 Saved seed UN-Treated	Liberty+Select+AMS	28 +3 + 3 lb/a	5	1560	51	109	5	93	5
Invigor 2663 Saved seed UN-Treated	----	----	----	487	49	106	5	93	5
C.V. %				16	1	7	19	1	37
LSD 5%				368	1	12	2	NS	3

DeKalb 223 with very low stand not reported.

Canola Herbicide Systems, Williston 2004. Plots were planted on May 5 at 500,000 pls/a with 85 lbs/a N broadcast prior to planting and 12 lbs/a P2O5 applied with the seed. Early 3-leaf growth stage treatments were applied on June 14 with wind SE at 2-4 mph, temperature at 66 F, RH 50%, 50% clear sky and plant and soil surfaces dry with 60 F soil temperature at 4 inches. Canola emergence was very uniform, but it was noted that plots seeded with bin run seed were in the 2-leaf growth stage on June 14. The 5-leaf treatments were applied on June 19 with wind W at 2 mph, temperature at 45 F, RH 70%, 95% clear sky and plant and soil surfaces dry with 54 F soil temperature at 4 inches. Canola seeded with bin run seed were in the 4-leaf stage. We used a small plot sprayer with wind cones, mounted on a G-Allis Chalmers tractor to apply the treatments, delivering 10 gals/a at 40 psi through 8001 flat fan nozzles to a 10 ft wide area the length of 15 by 25 ft plots. First rain received after application was 0.06 inches on June 26. The experiment was a randomized complete block design with four replications. Russian thistle density averaged 1 plant/2ft2. Green foxtail density was 3-5 plants/ft2 and kochia density averaged 1 plants/ft2. Plots were evaluated for crop injury on 6/19/04 and on 6/26/04 and weed control on July 31. Canola was machine harvested on August 20. Harvested plot size was 80 sq. ft.

Cultivar	Treatment [a]	Leaf Stage	Rate	Stand Establ.	-- Control --- Grft	KOCZ	Ruth[b]	Plt Ht	Test Weight	Seed Oil[c]	Seed Yield
			lb ai/a	plts/ft2	------	%	-----	inch	lbs/bu	%	lbs/a
One application											
DKL223	RUMII+AMS	5-lf	0.375	8.4	98	94	96	33	51.7	39.8	1731
Hyclass 2061	RUMII+AMS	5-lf	0.375	8.0	99	95	96	37	49.9	42.6	1503
Hyola 357RR	RUMII+AMS	5-lf	0.375	11.5	98	93	97	31	51.4	41.3	1889
Hyclass 910	RUMII+AMS	5-lf	0.375	9.5	98	96	99	37	51.3	41.8	1509
Two applications											
DKL223	RUMII+AMS	3&5lf	0.375	7.3	99	99	99	35	51.0	40.6	1699
Hyclass 2061	RUMII+AMS	3&5lf	0.375	7.9	99	99	99	34	50.0	41.6	1429
Hyola 357RR	RUMII+AMS	3&5lf	0.375	9.4	99	99	98	32	51.5	41.2	1784
Hyclass 910	RUMII+AMS	3&5lf	0.375	8.7	99	99	99	35	51.2	40.7	1534
Invigor2663	[#]Lib+Select+AMS	5-lf	0.364+3	8.4	95	82	83	38	52.2	40.6	1726
Invigor2663	[$]Lib+Select+AMS	5-lf	0.364+3	7.7	92	72	78	39	51.3	42.4	1474
Invigor2663	[&]Lib+Select+AMS	5-lf	0	7.2	0	0	0	38	51.2	40.8	898
EXP MEAN				8.5	89	84	86	35	51.1	41.2	1562
C.V. %				14.3	2	6	3	8	1.2	3.4	8
LSD 5%				1.8	4	9	5	4	.9	NS	184

[a] - Trt = Treatment; RUMII = RoundUp UltraMaxII; AMS = Ammonium Sulfate (liquid);
All AMS applied at 3 lb/a. Lib = Liberty
[#] - F1 Commercial Seed with Helix Xtra
[$] - Bin run seed with Helix Xtra
[&] - Bin run seed; no Helix Xtra; no herbicide
[b] - Grft = Green foxtail; KOCZ = Kochia; Ruth = Russian thistle;
[c] - Seed oil content from an NMR machine, adjusted to 8.5% moisture.

Summary: No crop injury was noted for any treatment. There were no yield differences between one vs two applications of Roundup. Treatments using bin run seed (Invigor 2663) yielded less than the treatment using the F1 commercial seed. No Liberty+Select herbicide was applied to one bin run seed treatment and no Helix Xtra was used. That treatment yielded only 61% of the treatment using Helix Xtra treated seed and sprayed with Liberty+Select. Stand counts taken after emergence indicate no differences between bin run seed and F1 commercial seed, though the bin run seed tended to have less plants.

Clethodim formulations in canola. Zollinger, Richard K. And Jerry L. Ries. An experiment was conducted near Prosper, ND, to evaluate crop response and weed efficacy to POST applied treatments. Invigor '2373' glufosinate-resistant canola was planted on May 17, 2004. POST treatments were applied on June 18, 2004 at 7:30 am with 47 F air, 48 F soil surface, 81% relative humidity, 0% clouds, 5 to 10 mph NW wind, dry soil surface, moist subsoil, and no dew present to V4 to V6 canola with good crop vigor. Weed species present were: 1 to 4 inch (20 to 50/yd^2) volunteer wheat. Treatments were applied to the center 6.7 feet of the 10 by 40 foot plots with a backpack-type plot sprayer delivering 8.5 gpa at 40 psi through 8001 TeeJet flat-fan nozzles. The experiment had randomized complete block design with three replications per treatment.

On June 25 (7 DAT), there was differential growth in rep 1 and 2 where canola in untreated plots was taller but there were no differences in 3 rep. Plots with stunted plants did not follow a pattern. For example, treatment 2 showed just as much stunting as treatments containing either form of clethodim.
On July 16 (28 DAT), no injury was observed with any treatment and there was no delay in flowering. Ratings were the same for wheat. (Dept. of Plant Sciences, North Dakota State University, Fargo).

Table. Clethodim formulations in canola (Zollinger and Ries).

		14 DAT		28 DAT	
Treatment[1]	Rate	Injury	V. wheat	Injury	V. wheat
	(product/A)	(%)	(%)	(%)	(%)
Liberty+AMS	28fl oz+3 lb	13	80	0	80
Liberty+Select+AMS	28fl oz+4fl oz+3 lb	18	99	0	99
Liberty+V-10137+AMS	28fl oz+8fl oz+3 lb	15	99	0	99
Liberty+V-10137+AMS	28fl oz+4fl oz+3 lb	13	99	0	99
Untreated		0	0	0	0
LSD (0.05)		20	5	0	5

AMS = ammonium sulfate; V-10137 = 1 EC clethodim from Valent.

Clethodim formulations applied at two crop stages. Zollinger, Richard K. and Jerry L. Ries. An experiment was conducted near Prosper, ND, to evaluate crop response and weed efficacy to clethodim formulations applied POST and LPOST. Volunteer wheat seed was spread to the entire study followed by the planting of Hyola '357RR' glyphosate-resistant canola on May 17, 2004. POST treatments were applied on June 17 at 10:10 am with 69 F air, 79 F soil surface, 47% relative humidity, 30% clouds, 2 to 4 mph W wind, dry soil surface, damp subsoil, good crop vigor, and no dew present to V5 to V6 canola. Weed species present: 2 to 5 inch (10 to 30/yd^2) volunteer wheat. LPOST treatments were applied on June 25 at 1:30 pm with 64 F air, 67 F soil, 47% relative humidity, 100% clouds, 3 to 8 mph NW wind, dry soil surface, moist subsoil, excellent crop vigor, and no dew present to V8 to 50% bolt initiation. Weeds species present were: 2 to 7 inch (10 to 30/yd^2) volunteer wheat. Treatments were applied to the center 5 feet of the 6.5 by 25 foot plots with a backpack-type plot sprayer delivering 8.5 gpa at 40 psi through 8001 TeeJet flat-fan nozzles. The experiment had a randomized complete block design with three replicates per treatment.

No injury was observed and all treatments controlled grasses at 7 and 14 DAT. On 21 and 28 DAT, canola plants that were treated when bolting (LPOST) were slightly delayed in flowering and there was no difference in amount of delay from clethodim rate or formulation. (Dept. of Plant Sciences, North Dakota State University, Fargo).

Table. Clethodim formulations applied at two crop stages (Zollinger and Ries).

		POST and LPOST Applications					
		7 DAT		14 DAT		28 DAT	
Treatment[1]	Rate	Injury	V. wht[2]	Injury	V. wht	Injury	V. wht
	(product/A)	(%)	(%)	(%)	(%)	(%)	(%)
POST							
Select+PO+AMS	6fl oz+1% v/v+2.5 lb	0	99	0	99	0	99
V-10137+PO+AMS	12fl oz+1% v/v+2.5 lb	0	99	0	99	0	99
V-10137+NIS+AMS	12fl oz+0.25% v/v+2.5 lb	0	99	0	99	0	99
V-10137+PO+AMS	9fl oz+1% v/v+2.5 lb	0	99	0	99	0	99
V-10137+AMS	9fl oz+2.5 lb	0	99	0	99	0	99
LPOST							
Select+PO+AMS	6fl oz+1% v/v+2.5 lb	0	99	0	99	0	99
V-10137+PO+AMS	12fl oz+1% v/v+2.5 lb	0	99	0	99	0	99
V-10137+NIS+AMS	12fl oz+0.25% v/v+2.5 lb	0	99	0	99	0	99
V-10137+PO+AMS	9fl oz+1% v/v+2.5 lb	0	99	0	99	0	99
V-10137+AMS	9fl oz+2.5 lb	0	99	0	99	0	99
Untreated		0	0	0	0	0	0
LSD (0.05)		0	0	0	0	0	0

[1]PO = petroleum oil concentrate = Herbimax; AMS = ammonium sulfate; V-10137 = 1 EC clethodim from Valent; NIS = nonionic surfactant = R=11.
[2]V. wheat = volunteer wheat.

Late application of clethodim in canola. (Kirk Howatt, Ronald Roach, and Janet Davidson-Harrington). This study was conducted to determine if V10137, a new clethodim formulation, was more injurious to canola at late application stages than current clethodim formulations, specifically Select. 'Rider'canola was seeded May 6. Treatments were applied to 9- to 12-inch, bolting canola and 2 to 5 inch, early tiller yellow foxtail on June 22 with 57 F air temperature, 61% RH, 70% cloud cover, 4 mph west wind, and 57 F soil temperature. Treatments were applied with a backpack sprayer delivering 8.5 gpa at 40 psi through TT 11001 flat-fan nozzles to a 7 ft wide area the length of 10 by 30 ft plots. The experiment had a randomized complete-block design with four replicates. Foxtail population was estimated to be 50 plants per ft^2.

Table. Canola response and yellow foxtail control with clethodim.

		June 28	July 15	
Treatment[1]	Rate	Canola	Canola	Yellow foxtail
	oz ai/A	%	%	%
Clethodim+PO+AMS	1.5+1%+32	5	0	20
V10137+PO+AMS	1.5+1%+32	4	14	98
V10137+NIS+AMS	1.5+0.125%+32	8	1	97
V10137+AMS	1.5+48	2	1	0
Untreated	0	1	0	0
CV		60	113	41
LSD (P=0.05)		4	6	27

[1]Clethodim was Select from Valent; PO was petroleum oil adjuvant; AMS was ammonium sulfate; V10137 was a new formulation of clethodim from Valent; and NIS was nonionic surfactant.

A study conducted in 2003 indicated that V10137, 3% to 16% injury, caused less injury than current clethodim formulations, 3% to 59% injury. Injury response of canola was not as severe in 2004 as in 2003, and maximum injury was caused by V10137 in 2004 rather than the current clethodim formulation. Slight injury to untreated canola was caused by weather conditions and environment. Clethodim and V10137 caused similar levels of canola injury on June 28, but all injury ratings were less than 10%. On July 15, V10137 with PO and AMS caused 14% injury, which was the only treatment with greater injury than the untreated.

Weed control with ACCase inhibitors was slower this year than usual because of the cool weather. Herbicide treatments gave 30% to 40% yellow foxtail control on June 28 (data not shown). Many of the yellow foxtail plants treated with clethodim plus PO and AMS or with V10137 plus AMS recovered from early season injury and were indiscernible from untreated foxtail by July 15, resulting in 20% and 0% control, respectively. Clethodim essentially gave 0% control in three of the four replications with one rep providing 80% control, leading to the high LSD for foxtail control. V10137 with NIS or PO provided 97% and 98% control, respectively. After observing the unusual control with clethodim, treatments were resprayed on tillered yellow foxtail that was 4 to 8 inches tall in a fallow area. All treatments provided greater than 95% control of foxtail. The weather this spring may have been a contributing factor to poor control of yellow foxtail with clethodim.

Weed control in carrots - Oakes. Greenland, Richard G. Only a few herbicides are available for weed control in carrots. Treflan, Lorox, Poast and Fusilade are the most commonly used. In this study we evaluated several new herbicides and herbicide combinations for use in carrots. This study was on a sandy loam soil at the Oakes Irrigation Research Site, in a field which was cropped to potato the previous year. The field was disked once, then it was field cultivated three times to smooth the seedbed and incorporate fertilizer and herbicides. 'Niagra' carrot was planted on May 27 at a rate of 800,000 seeds/acre in 18" rows with 3 lines per row. At the same time a barley cover crop was planted between and parallel to the carrot rows. The study was surface drip irrigated. Herbicides were applied with a CO_2-pressurized backpack sprayer using AI 110-04 flat fan nozzles, 45 gpa, at 57 psi. See Table 1 for application timings. Hairy nightshade was the predominant weed, with some Eastern black nightshade also present. Weed and injury ratings were taken on June 29, July 14, and August 3. Carrots were harvested as processing carrots in late September.

Results. Axiom reduced carrot stand and slightly injured carrots when applied PRE or at the high (15 oz) rate when applied PPI. It gave good control of nightshade early but lost its effectiveness as the season progressed. Axiom reduced carrot number, yield, length, and size. Valor reduced carrot stand, especially at the 1 oz rate applied PRE. It gave poor to fair control of hairy nightshade. The reduced stand and failure to control nightshade resulted in carrot number and yield reductions. Balance Pro applied POST2 or POST3 did not injure carrots or reduce carrot stand. But it did not control nightshade either, causing reduction of carrot yield, size, and length. Callisto yellowed, bleached and burned the carrot leaves when applied postemergence, which reduced carrot yield. It gave excellent control of nightshade. Authority caused minor injury to carrots but they recovered quickly. It gave fair to poor control of nightshade, resulting in reduced carrot yield and root size. Lorox did not injure carrot. It did not control nightshade when applied only PRE, but it gave excellent nightshade control when applied both PRE and POST. Dacthal, in combination with Lorox, also controlled nightshade. Lorox applied both PRE and POST, and the Lorox/Dacthal combinations gave the highest carrot numbers, yield, and root size. None of the new herbicides performed as well as the standards.

Table 1. Carrot weed control treatment application data at the Oakes Irrigation Research Site in 2004.

Application timing	Date	Time	Barley height	Carrot height	Carrot growth stage	Weed height	Weed growth stage
PPI	May 27	10:55 am	0	0	0	0	0
PRE	May 27	4:40 pm	0	0	0	0	0
POST1	June 10	9:55 am	2"	0	0	¼"	cot to 2 lf
POST2	June 30	10:30 am	4"(dying)	3"	3 lf	1 to 6"	4 to 10 lf
POST3	July 9	2:25 pm	—	6"	5 lf	up to 12"	begin bloom

Treflan (1.5 pt/A PPI on May 27) and Fusilade + NIS (12 oz/acre + 0.5% on June 17) were applied to the entire study.

Table 2. Crop injury and stand reduction by herbicides in the Oakes Irrigation Research Site 2004 carrot weed control study.

Herbicide(s)	Rates	Application timing[1]	Crop Injury June 29	Crop Injury July 14	Crop Injury Aug 3	Stand rating June 29	Stand rating July 14
			----------	----------	0 to 10[2]	----------	----------
-							
Axiom	10 oz	PPI	1.5 d[3]	0.3 ab	0.0 a	6.8 abc	7.5 abc
Axiom	15 oz	PPI	2.5 e	1.3 cd	0.0 a	5.8 cd	6.8 cde
Axiom	10 oz	PRE	3.3 e	2.8 e	0.0 a	3.0 e	5.0 gh
Axiom	15 oz	PRE	3.3 e	1.5 cd	0.0 a	3.5 e	4.8 h
Lorox	1 lb	PRE	0.8 a-d	0.0 a	0.0 a	7.3 ab	7.8 ab
Lorox	1.5 lbs	PRE	0.8 a-d	0.0 a	0.0 a	7.3 ab	7.5 abc
Valor	0.5 oz	PRE	0.3 ab	0.3 ab	0.0 a	5.0 d	5.8 fg
Valor	1 oz	PRE	0.8 a-d	0.3 ab	0.0 a	3.8 e	4.3 h
Lorox + Dacthal	1 lb + 8 lbs	PRE + POST1	1.3 cd	0.0 a	0.0 a	7.0 ab	7.5 abc
Dacthal + Lorox	8 lbs + 1 lb	POST1 + POST2	0.5 abc	0.0 a	0.0 a	7.3 ab	7.8 ab
Lorox + Lorox	1 lb + 1.5 lbs	PRE + POST2	0.6 a-d	0.0 a	0.0 a	8.0 a	8.3 a
Lorox + Authority	1 lb + 2 oz	PRE + POST2	0.8 a-d	1.3 cd	0.0 a	6.3 bc	6.5 def
Lorox + Valor	1 lb + 2 oz	PRE + POST2	0.3 ab	4.0 f	0.0 a	7.3 ab	6.5 def
Lorox + Balance Pro	1 lb + 1 oz	PRE + POST2	0.0 a	2.8 e	0.0 a	7.0 ab	7.3 bcd
Lorox + Callisto	1 lb + 3 oz	PRE + POST2	0.5 abc	5.8 g	2.8 c	7.5 a	6.3 ef
Valor + Valor	0.5 oz + 1.5 oz	PRE + POST3	1.0 a-d	2.7 e	0.3 ab	8.1 a	7.6 abc
Valor + Authority	0.5 oz + 2 oz	PRE + POST3	0.8 a-d	2.8 e	0.0 a	6.8 abc	7.3 bcd
Lorox + Authority	1 lb + 2 oz	PRE + POST3	0.5 abc	2.5 e	0.0 a	7.8 a	8.3 a
Lorox + Valor	1 lb + 2 oz	PRE + POST3	0.3 ab	2.8 e	0.8 b	7.3 ab	7.3 bcd
Lorox + Balance Pro	1 lb + 1 oz	PRE + POST3	1.0 bcd	2.0 de	0.0 a	7.0 ab	7.8 ab
Lorox + Callisto	1 lb + 3 oz	PRE + POST3	0.8 a-d	2.5 e	3.8 d	8.0 a	8.3 a
Hand weeded check			0.8 a-d	1.0 bc	0.8 b	8.0 a	7.8 ab
Probability			<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
C.V. (%)			68	37	103	13	10

[1]See Table 1 for explanation of application timings.
[2]Crop injury ratings are from 0 to 10: 0 = no crop injury, 10 = all carrots dead. For stand ratings: 0 = no plants, 10= perfect stand.
[3]Values in the same column followed by the same letter are not significantly different at the 0.05 level.

Table 3. Hairy nightshade and eastern black nightshade control by herbicides in the Oakes Irrigation Research Site 2004 carrot weed control study.

Herbicides	Rates	Application timing[1]	Hairy Nightshade June 29	Hairy Nightshade July 14	Hairy Nightshade Aug 3	Eastern Black Nightshade June 29	Eastern Black Nightshade July 14	Eastern Black Nightshade Aug 3
			---- 0 to 10[2] ----					
Axiom	10 oz	PPI	7.5 bcd[3]	6.3 e-h	4.0 def	8.8 a-e	8.0 def	5.8 h
Axiom	15 oz	PPI	7.8 a-d	6.0 f-i	3.3 def	9.5 ab	9.3 abc	8.3 b-f
Axiom	10 oz	PRE	8.3 abc	7.0 d-g	4.8 cd	9.8 a	9.0 a-d	7.5 d-g
Axiom	15 oz	PRE	8.3 abc	7.3 c-g	3.8 def	9.8 a	9.3 abc	8.5 a-f
Lorox	1 lb	PRE	6.3 cde	4.3 hi	3.5 def	7.8 ef	8.0 def	6.3 gh
Lorox	1.5 lbs	PRE	6.3 cde	4.5 hi	3.0 def	8.8 a-e	7.8 ef	7.5 d-g
Valor	0.5 oz	PRE	6.0 de	4.0 i	1.8 f	9.0 a-d	8.5 cde	8.3 b-f
Valor	1 oz	PRE	8.5 ab	7.0 d-g	5.3 cd	9.3 abc	8.8 b-e	7.3 e-h
Lorox + Dacthal	1 lb + 8 lbs	PRE + POST1	9.8 a	9.8 a	9.3 ab	9.8 a	9.5 abc	8.8 a-e
Dacthal + Lorox	8 lbs + 1 lb	POST1 + POST2	9.8 a	10.0 a	10.0 a	9.8 a	10.0 a	10.0 a
Lorox + Lorox	1 lb + 1.5 lbs	PRE + POST2	6.9 b-e	9.8 ab	9.2 ab	7.9 def	9.9 ab	9.3 abc
Lorox + Authority	1 lb + 2 oz	PRE + POST2	6.5 b-e	7.5 b-g	4.5 de	8.0 def	9.5 abc	7.0 fgh
Lorox + Valor	1 lb + 2 oz	PRE + POST2	6.0 de	9.3 abc	8.5 ab	8.5 b-f	10.0 a	9.8 ab
Lorox + Balance Pro	1 lb + 1 oz	PRE + POST2	7.3 b-e	7.5 b-g	4.5 de	8.5 b-f	9.0 a-d	7.5 d-g
Lorox + Callisto	1 lb + 3 oz	PRE + POST2	7.0 b-e	10.0 a	9.8 a	8.8 a-e	10.0 a	10.0 a
Valor + Valor	0.5 oz + 1.5 oz	PRE + POST3	6.1 de	8.4 a-e	5.0 cd	8.2 c-f	9.6 abc	9.2 abc
Valor + Authority	0.5 oz + 2 oz	PRE + POST3	6.3 cde	7.0 d-g	5.0 cd	8.8 a-e	9.8 ab	7.8 c-g
Lorox + Authority	1 lb + 2 oz	PRE + POST3	6.8 b-e	8.0 a-f	4.3 de	8.0 def	9.8 ab	7.3 e-h
Lorox + Valor	1 lb + 2 oz	PRE + POST3	8.0 a-d	8.5 a-d	7.0 bc	8.0 def	9.5 abc	9.0 a-d
Lorox + Balance Pro	1 lb + 1 oz	PRE + POST3	5.3 e	4.8 hi	2.3 ef	8.5 b-f	7.0 f	8.5 a-f
Lorox + Callisto	1 lb + 3 oz	PRE + POST3	6.3 cde	5.8 ghi	10.0 a	8.3 c-f	8.5 cde	9.8 ab
Hand weeded check			5.3 e	6.0 f-i	10.0 a	7.5 f	7.8 ef	9.8 ab
Probability			0.0002	<0.0001	<0.0001	0.0008	<0.0001	<0.0001
C.V. (%)			20	21	29	10	9	13

[1]See Table 1 for explanation of application timings.
[2]Ratings are from 0 to 10: 0 = no weed control or crop injury, 10 = complete weed control or all carrots dead.
[3]Values in the same column followed by the same letter are not significantly different at the 0.05 level. No significant differences between values in column without letters.

Table 4. Number of roots and yield of carrots in the Oakes Irrigation Research Site 2004 carrot weed control study.

Herbicides	Rates	Application timing[1]	Number of carrot roots (by carrot dia.) >1.5"	1 to 1.5"	US #1	total	Carrot yield (by carrot diameter) >1.5"	1 to 1.5"	US #1	total
			---------------- 1000s/acre ----------------				---------------- tons/acre ----------------			
Axiom	10 oz	PPI	27 g-j[2]	53 abc	100 b-g	182 a-e	3.6 hij	3.5 a-f	8.1 e-h	13.4 d-h
Axiom	15 oz	PPI	36 e-i	27 c-g	64 e-h	156 b-f	6.0 e-j	1.8 d-h	7.8 e-h	13.8 e-g
Axiom	10 oz	PRE	33 e-j	19 d-g	54 f-i	90 gj	6.1 d-j	1.1 e-h	7.3 fgh	11.8 fgh
Axiom	15 oz	PRE	34 f-i	19 efg	53 ghi	91 hi	6.0 d-j	1.3 e-h	7.3 fgh	11.1 fgh
Lorox	1 lb	PRE	25 g-j	29 c-g	77 d-h	144 d-h	4.2 g-j	2.0 c-h	7.1 fgh	9.6 fgh
Lorox	1.5 lbs	PRE	17 hij	77 a	112 b-e	196 a-d	2.5 hij	4.5 ab	7.5 e-h	9.4 fgh
Valor	0.5 oz	PRE	17 ij	23 c-g	42 hi	64 ij	2.8 hij	1.6 e-h	4.5 gh	6.3 gh
Valor	1 oz	PRE	8 ij	2 g	11 i	30 j	2.4 ij	0.2 h	2.5 h	7.9 fgh
Lorox + Dacthal	1 lb + 8 lbs	PRE + POST1	92 abc	10 fg	107 b-f	174 b-e	25.6 b	1.1 fgh	26.7 b	41.9 ab
Dacthal + Lorox	8 lbs + 1 lb	POST1 + POST2	122 a	24 c-g	148 ab	213 ab	32.4 a	2.2 b-h	34.6 a	50.6 a
Lorox + Lorox	1 lb + 1.5 lbs	PRE + POST2	102 ab	38 b-f	148 ab	212 abc	27.0 ab	3.0 a-g	30.3 ab	44.8 ab
Lorox + Authority	1 lb + 2 oz	PRE + POST2	28 g-j	50 a-d	97 b-g	140 d-h	5.7 f-j	4.1 abc	10.5 c-g	15.2 d-g
Lorox + Valor	1 lb + 2 oz	PRE + POST2	58 d-f	36 b-f	102 b-f	151 c-g	12.6 cd	2.8 b-g	15.6 cd	22.1 cde
Lorox + Balance Pro	1 lb + 1 oz	PRE + POST2	47 d-h	33 c-f	85 d-h	137 d-h	8.7 d-h	2.7 b-g	11.5 c-f	15.3 def
Lorox + Callisto	1 lb + 3 oz	PRE + POST2	63 c-f	21 efg	85 d-h	129 e-h	15.8 c	1.2 gh	17.0 c	26.3 c
Valor + Valor	0.5 oz + 1.5 oz	PRE + POST3	67 cde	66 ab	137 abc	211 abc	11.9 c-f	5.3 a	17.3 c	23.8 cd
Valor + Authority	0.5 oz + 2 oz	PRE + POST3	36 e-i	46 b-e	86 c-h	142 d-h	6.5 e-i	3.6 a-e	10.2 d-g	15.5 def
Lorox + Authority	1 lb + 2 oz	PRE + POST3	69 bcd	55 abc	129 a-d	211 abc	10.3 c-g	4.1 a-d	14.7 cde	23.2 cde
Lorox + Valor	1 lb + 2 oz	PRE + POST3	33 e-j	46 a-e	117 bcd	159 b-f	5.6 e-j	3.7 a-e	11.0 c-g	15.1 d-g
Lorox + Balance Pro	1 lb + 1 oz	PRE + POST3	2 j	44 b-e	59 fgh	104 f-i	0.2 j	2.6 b-g	3.2 h	4.5 h
Lorox + Callisto	1 lb + 3 oz	PRE + POST3	54 d-g	33 c-f	99 b-g	151 c-g	12.1 cde	2.5 b-g	14.9 cd	21.9 cde
Hand weeded check			117 a	44 a-e	177 a	246 a	25.8 b	3.7 a-e	29.9 ab	39.9 b
Probability			<0.0001	0.002	<0.0001	<0.0001	<0.0001	0.004	<0.0001	<0.0001
C.V. (%)			44	57	37	27	42	59	34	32

[1]See Table 1 for explanation of application timings.
[2]Values in the same column followed by the same letter are not significantly different at the 0.05 level.

Table 5. Carrot root characteristics for the Oakes Irrigation Research Site 2004 carrot weed control study.

Herbicides	Rates	Application timing	Average root length	Average root size	Multiple root	US #1 yield	Uniformity	Overall score
			inches	oz/root	-------- %	---------	1 to 5	1 to 10
Axiom	10 oz	PPI	5.6 hi[2]	2.7 def	26 b-f	62	2.4 a-d	6.4 a-e
Axiom	15 oz	PPI	5.6 hi	3.5 def	30 def	57	2.3 b-e	6.1 cde
Axiom	10 oz	PRE	6.0 f-i	4.2 c-f	34 ef	62	2.4 a-d	6.5 a-e
Axiom	15 oz	PRE	5.8 hi	4.4 cde	27 b-f	70	2.3 b-e	6.1 cde
Lorox	1 lb	PRE	5.8 hi	2.4 ef	11 abc	63	2.4 a-d	6.3 b-e
Lorox	1.5 lbs	PRE	6.3 d-h	2.1 ef	0 a	79	2.4 a-d	6.1 cde
Valor	0.5 oz	PRE	6.1 f-i	3.2 def	10 ab	83	2.0 de	6.0 ef
Valor	1 oz	PRE	6.5 c-h	7.7 ab	45 f	45	1.9 e	5.6 f
Lorox + Dacthal	1 lb + 8 lbs	PRE + POST1	7.1 a-e	8.2 a	32 def	65	2.4 a-d	6.4 a-e
Dacthal + Lorox	8 lbs + 1 lb	POST1 + POST2	7.2 a-d	7.6 ab	28 b-f	69	2.6 ab	6.5 a-d
Lorox + Lorox	1 lb + 1.5 lbs	PRE + POST2	7.6 ab	6.5 abc	28 b-f	66	2.9 a	6.6 abc
Lorox + Authority	1 lb + 2 oz	PRE + POST2	6.8 a-g	4.0 c-f	19 a-e	70	2.6 ab	6.5 a-d
Lorox + Valor	1 lb + 2 oz	PRE + POST2	6.9 a-f	5.2 cd	22 b-e	71	2.6 ab	6.6 ab
Lorox + Balance Pro	1 lb + 1 oz	PRE + POST2	6.2 e-h	4.1 c-f	20 a-e	73	2.5 abc	6.4 a-e
Lorox + Callisto	1 lb + 3 oz	PRE + POST2	7.4 abc	6.4 abc	29 c-f	64	2.5 abc	6.4 a-e
Valor + Valor	0.5 oz + 1.5 oz	PRE + POST3	6.6 b-h	4.0 c-f	17 a-e	72	2.4 a-d	6.5 a-e
Valor + Authority	0.5 oz + 2 oz	PRE + POST3	6.3 d-h	3.9 def	17 a-e	61	2.1 cde	6.4 a-e
Lorox + Authority	1 lb + 2 oz	PRE + POST3	6.0 f-i	3.6 def	24 b-e	63	2.4 a-d	6.4 a-e
Lorox + Valor	1 lb + 2 oz	PRE + POST3	5.9 ghi	3.0 def	22 b-e	72	2.5 abc	6.5 a-d
Lorox + Balance Pro	1 lb + 1 oz	PRE + POST3	5.2 i	1.8 f	12 a-d	72	2.0 de	6.0 def
Lorox + Callisto	1 lb + 3 oz	PRE + POST3	6.9 a-f	4.9 cd	25 b-e	68	2.6 ab	6.6 ab
Hand weeded check			7.7 a	5.3 bcd	24 b-e	74	2.8 a	6.8 a
Probability			<0.0001	<0.0001	0.04	0.13	0.006	0.009
C.V. (%)			11	36	58	19	13	5

[1]See Table 1 for explanation of application timings.

[2]Values in the same column followed by the same letter are not significantly different at the 0.05 level. No significant differences between values in the column without letters.

Chickling vetch response to herbicides. Kirk A. Howatt, Ronald F. Roach, and Janet D. Harrington. (Plant Sciences Department, North Dakota State University, Fargo, ND 58105-5051) Chickling vetch is an annual legume that has no herbicides approved for in-crop use in the United States. A study was established near Fargo, ND, to evaluate the response of chickling vetch to several herbicides that are potential registration candidates. The PPI treatment was applied and incorporated with two passes of a field cultivator operating 3 inches deep, chickling vetch was seeded, and PRE treatments were applied on June 22 with 74 F air temperature, 38% relative humidity, 80% cloud cover, and 5 to 6 mph northwest wind. POST treatments were applied to 2- to 4-inch tall chickling vetch on July 16 with 74 F air temperature, 74% relative humidity, 10% cloud cover, and 5 mph northwest wind. All treatments were applied with a backpack sprayer delivering 8.5 gpa at 35 psi through TT 11001 flat-fan nozzles to an area 7 ft wide and the length of 10- by 35-ft plots. The experiment had a randomized complete-block design with four replicates.

Table. Chickling vetch response to herbicides near Fargo, ND, in 2004.

Treatment[1]	Rate[2]	Timing	July 23 Chickling vetch	August 13 Chickling vetch
	oz ai/A		%	%
Trifluralin	12	PPI	5	31
Pendimethalin	16	PRE	7	30
Sulfentrazone	3	PRE	0	8
Metribuzin	8	PRE	28	45
Imazethapyr	0.75	PRE	4	20
Bromoxynil + clethodim + PO	4 + 1.5 + 0.25G	POST	83	90
Bentazon + clethodim + PO	12 + 1.5 + 0.25G	POST	5	25
2,4-DB + clethodim + PO	8 + 1.5 + 0.25G	POST	53	43
Imazethapyr + clethodim + PO	0.75 + 1.5 + 0.25G	POST	8	28
Thifensulfuron + clethodim + PO	0.25 + 1.5 + 0.25G	POST	20	63
Thifensulfuron + 2,4-DB + clethodim + PO	0.25 + 8 + 1.5 + 0.25G	POST	25	70
Untreated	0		0	0
CV			21	25
LSD (P=0.05)			6	13

[1] PO = petroleum oil concentrate, Herbimax from Loveland Industries, Greeley, CO 80632.
[2] 2,4-DB rates expressed in ae; and G = gallons per acre.

Sulfentrazone resulted in the least amount of injury, 0% to 8%, and presented the best potential for registration. PRE imazethapyr, which is used in other legume crops, gave a minimal 4% injury during the July 23 evaluation. However, stunting and chlorosis, 20% injury, was observed August 13 on chickling vetch in plots treated with PRE imazethapyr. POST imazethapyr resulted in similar late-season injury development. Thifensulfuron, another ALS-inhibiting herbicide, caused 20% to 25% injury as stunting and chlorosis July 23, and injury worsened to 63% to 70% by August 13. Trifluralin, pendimethalin, bentazon, and imazethapyr gave less than 10% injury July 23, but injury on August 13 ranged from 20% to 31%. Metribuzin and bromoxynil produced substantial necrotic injury and stand loss. The herbicide 2,4-DB, which is used in alfalfa, also caused more injury than anticipated. Chickling vetch did not die from 2,4-DB, but leaves and stems expressed moderate epinasty and 43% to 53% injury.

Dry bean tolerance to Spartan. Delahoyde, Eric S., Richard K. Zollinger, and Jerry L. Ries. Experiments were conducted to evaluate the tolerance of six dry bean types to Spartan. At Buffalo, ND, tillage preparation was performed with a field cultivator implement and was followed by the planting of 'T-39' Black bean, 'IU465' Great Northern bean, 'Vista' Navy bean, '312' Pink bean, 'Maverick' Pinto bean, and 'Garnett' Small Red bean on May 27, 2004. PRE treatments were applied on May 27 at 2:00 pm with 59 F air, 55 F soil surface, 34% relative humidity, 0% clouds, 3 to 8 mph N wind, dry soil surface, and moist subsoil. Soil texture in this experiment was a loam. Soil pH for the experiment ranged from 7.8 to 8.3, soil organic matter ranged from 4.5 to 5.5%, EC ranged from 0.3 to 0.7, and CEC ranged from 0 to 22.5%.

At Minot, ND, tillage preparation was performed with a field cultivator implement and was followed by the planting of 'T-39' Black bean, 'IU465' Great Northern bean, 'Vista' Navy bean, '312' Pink bean, 'Maverick' Pinto bean, and 'Garnett' Small Red bean on June 4, 2004. PRE treatments were applied on June 4 at 8:15 am with 65 F air, 60 F soil surface, 85% relative humidity, 100% clouds, 0 to 5 mph E wind, dry soil surface, and moist subsoil. Soil pH was extremely variable in this experiment, ranging from 5.2 to 8.1. Soil texture for the experiment was a silt loam. Soil organic matter ranged from 2.5 to 3.5%, EC ranged from 0.15 to 0.35, and CEC ranged from 0 to 0.5%.

Treatments were applied to the center 6.7 feet of 10 by 25 foot plots with a backpack-type sprayer delivering 17 gpa at 40 psi through 8002 TeeJet flat fan nozzles. The experiments were arranged in a randomized complete block design with three replications per treatment.

At Buffalo, herbicide was incorporated into the soil by 2.82 inches of rainfall within four days of application. None of the bean types exhibited injury symptoms until 21 days after treatment (DAT) and 11 days after bean emergence. Primary injury symptoms included stunted growth, wrinkling of leaf tissue, necrotic leaf spotting, chlorosis, and veinal discoloration. At 21 DAT, the Black and Navy bean types showed 7% injury at 8 oz/A (Table 1). No significant injury symptoms were observed in the other bean types. At 42 DAT, slight to moderate injury symptoms were observed in the Black, Navy, Pink, Pinto, and Small Red bean types at 5.33 oz/A and 8 oz/A. At 84 DAT, 6 to 8% injury was observed across the Black, Navy, Pink, and Small Red bean types at 8 oz/A. Overall, 0 to 2% injury was observed at sulfentrazone rates of 4 oz/A or less. Treatment rates less than 8 oz/A caused 10% injury or less. The 5.33 oz/A and 8 oz/A treatments exhibited slight to moderate injury symptoms early in the growing season, but symptoms declined as the season progressed. In this experiment, injury appeared to be correlated most strongly to Spartan rate than any other factor. Injury increased as Spartan rate increased.

At Minot, herbicide was incorporated into the soil by 0.62 inches of rain two days after application. Visible injury symptoms were not observed until 14 days after treatment (DAT) and four days after bean emergence. At 14 DAT, injury symptoms were observed in the Black, Navy, Pink, Pinto, and Small Red bean types (Table 2). Black and Navy bean were most affected by Spartan injury at 14 DAT. Primary injury symptoms included stunted growth, slow emergence, leaf wrinkling, chlorosis, and necrotic leaf spotting. At 35 DAT, all bean types showed Spartan injury symptoms. Spartan injury was most severe in the Navy bean type, as significant injury occurred at all treatment rates. Greater than 10% injury was also observed in the Black and Pink bean types at rates greater than 2 oz/A. Spartan injury was observed at rates greater than 4 oz/A in the Great Northern and Pinto bean, but symptoms were less severe than the other bean types. At 77 DAT, injury symptoms were observed across all bean types. Spartan injury to all bean types at 77 days was generally less severe than 35 days, but injury still persisted in the Black, Navy, Pink, and Small Red bean types. Great Northern and Pinto bean types showed less than 7% injury at all treatment rates at 77 DAT. Navy bean was most susceptible to Spartan injury in this experiment, followed by Pink, Black, Small Red, Pinto, and Great Northern. In this experiment, Spartan injury appeared to be more strongly correlated to soil pH than any other factor. Spartan injury was more severe in high pH plots than low pH plots.

In other research, Spartan injury increased as soil pH increased because the Spartan was more soluble in the soil solution. Additionally, Spartan injury decreased as soil organic matter increased because the herbicide was adsorbed to the organic matter. (Department of Plant Sciences, North Dakota State University, Fargo).

Table 1. Dry bean tolerance to Spartan, Buffalo (Delahoyde, Zollinger, and Ries).

Treatment	Rate	Black			Great Northern			Navy		
		21 DAT	42 DAT	84 DAT	21 DAT	42 DAT	84 DAT	21 DAT	42 DAT	84 DAT
	(oz/A)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)
PRE										
Spartan	2	0	0	0	0	0	0	0	0	0
Spartan	3	0	2	0	0	0	0	0	2	0
Spartan	4	0	5	2	0	2	0	0	5	2
Spartan	5.33	0	10	0	0	0	0	0	10	0
Spartan	8	7	24	6	2	5	0	7	24	6
Untreated		0	0	0	0	0	0	0	0	0
LSD (0.05)		6	10	5	3	4	0	6	10	5

Table 1 continued. Dry bean tolerance to Spartan, Buffalo (Delahoyde, Zollinger, and Ries).

Treatment	Rate	Pink			Pinto			Small Red		
		21 DAT	42 DAT	84 DAT	21 DAT	42 DAT	84 DAT	21 DAT	42 DAT	84 DAT
	(oz/A)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)
PRE										
Spartan	2	0	0	0	0	0	0	0	0	0
Spartan	3	0	0	0	0	0	0	0	0	0
Spartan	4	0	2	0	0	0	0	0	2	0
Spartan	5.33	0	8	2	0	4	0	0	2	2
Spartan	8	2	22	8	3	9	0	0	9	6
Untreated		0	0	0	0	0	0	0	0	0
LSD (0.05)		2	9	3	2	4	0	0	4	5

Table 2. Dry bean tolerance to Spartan, Minot (Delahoyde, Zollinger, and Ries)

Treatment	Rate	Black			Great Northern			Navy		
		14 DAT	35 DAT	77 DAT	14 DAT	35 DAT	77 DAT	14 DAT	35 DAT	77 DAT
	(oz/A)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)
PRE										
Spartan	2	0	0	0	0	0	0	0	24	17
Spartan	3	7	10	7	0	2	0	0	34	43
Spartan	4	8	16	9	2	5	2	2	47	38
Spartan	5.33	19	20	14	0	4	2	0	55	62
Spartan	8	48	58	38	2	5	6	18	73	87
Untreated		0	0	0	0	0	0	0	0	0
LSD (0.05)		10	8	5	4	7	6	11	13	38

Table 2 continued. Dry bean tolerance to Spartan, Minot (Delahoyde, Zollinger, and Ries)

Treatment	Rate	Pink			Pinto			Small Red		
		14 DAT	35 DAT	77 DAT	14 DAT	35 DAT	77 DAT	14 DAT	35 DAT	77 DAT
	(oz/A)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)
PRE										
Spartan	2	0	8	7	0	0	0	0	2	0
Spartan	3	0	21	15	3	2	0	0	16	3
Spartan	4	0	29	27	2	6	2	2	17	7
Spartan	5.33	2	30	29	7	13	7	8	16	12
Spartan	8	6	31	38	13	11	5	16	25	19
Untreated		0	0	0	0	0	0	0	0	0
LSD (0.05)		4	17	24	7	9	7	5	22	26

Weed control programs in dry beans. Zollinger, Richard K. and Jerry L. Ries. An experiment was conducted near Prosper, ND, to evaluate weed control and crop injury to treatments applied PPI, PRE, and POST in dry beans. The study was established on May 28, 2004 followed by the application of PPI treatments 7-days prior to planting (7-DBP-PPI) at 9:35 am with 50 F air, 53 F soil at a 4 inch depth, 65% relative humidity, 85% clouds, 3 to 5 mph N wind, dry soil surface, and moist subsoil. PPI treatments were applied on June 7 at 11:50 am with 85 F air, 71 F soil at a 4 inch depth, 33% relative humidity, 30% clouds, 4 to 6 mph W wind, dry soil surface, moist subsoil, and followed immediately by incorporation the 7-DPP-PPI and PPI treatments with a roto-tiller operating at a 2 inch depth. Two rows of Pinto 'Maverick' and Navy 'Vista' dry bean was planted following treatment incorporation. PRE treatments were applied following planting at 1:05 pm with 82 F air, 74 F soil at a 4 inch depth, 40% relative humidity, 30% clouds, 10 to 15 mph NW wind, dry soil surface, and moist subsoil. POST treatments were applied at 8:45 am with 78 F air, 79 F soil surface, 68% relative humidity, 10% clouds, 0 to 3 mph N wind, moist soil surface, moist subsoil, and no dew present to V5 to V7 pinto bean and V5 to V6 navy bean. Weed species present were: 3 to 8 inch (5 to 25/yd^2) green foxtail; 3 to 8 inch (5 to 25/yd^2) yellow foxtail; 4 to 8 inch (1 to 5/yd^2) redroot pigweed; 3 to 6 inch (1 to 2/yd^2) common lambsquarters; 3 to 5 inch (<1/yd^2) kochia; 3 to 5 inch (1 to 2/yd^2) hairy nightshade and 3 to 5 inch (1 to 2/yd^2) swamp smartweed. Treatments were applied to the center 6.7 feet of the 10 by 40 foot plots with a backpack-type plot sprayer delivering 17 gpa at 40 psi through 8002 TeeJet flat-fan nozzles for PPI and PRE treatments and 8.5 gpa at 40 psi through 8001 TeeJet flat-fan nozzles for POST treatments. The experiment had randomized complete block design with three replications per treatment.

Eptam was incorporated immediately after application. Pursuit and Pursuit Plus was applied seven days before planting and incorporate prior to planting. Injury was slight speckling to small areas of burn. Seven day before planting (7-DBP) followed by POST treatments, PPI followed by POST treatments, and most POST treatments controlled all grass and broadleaf weeds present. Dual Magnum plus Sandea (halosulfuron) did not provide adequate weed control. (Dept. of Plant Sciences, North Dakota State University, Fargo).

Table. Weed control programs in dry beans (Zollinger and Ries).

		Dry bean injury									
		July 21		July 28		July 28					
Treatment[1]	Rate	Pinto	Navy	Pinto	Navy	Fxtl[2]	Rrpw	Colq	Kochia	Hans	Swsw
	(product/A)	--- (%) ---		--- (%) ---		------------- (%) -------------					
7-DBP-PPI/POST											
Pursuit/Basagran+Poast[3]+ PO+28% N	0.72oz/1.6pt+1.6pt+ 1% v/v+1qt	20	20	0	0	99	99	99	99	99	99
Pursuit Plus/Basagran+Poast+ PO+28% N	1.25oz/1.6pt+1.6pt+ 1% v/v+1qt	20	20	0	0	99	99	99	99	99	99
PPI/POST											
Eptam/Reflex+NIS	3.5pt/10fl oz+0.25% v/v	10	10	0	0	72	99	78	48	99	77
Eptam/Reflex+NIS	4.5pt/10fl oz+0.25% v/v	10	10	0	0	99	99	99	99	99	99
Prowl H_2O/Basagran+Poast+ Raptor+PO+28% N	3pt/1.6pt+1.6pt+ 2fl oz+1% v/v+1qt	20	20	0	0	99	99	99	99	99	99
PRE											
Dual Magnum+Sandea	1pt+0.5oz	0	0	0	0	40	99	72	28	0	72
Dual Magnum+Sandea	1pt+0.66oz	0	0	0	0	40	99	83	47	0	82
POST											
Pursuit+NIS	0.72oz+0.25% v/v	0	0	0	0	87	99	73	82	99	99
Raptor+NIS	2fl oz+0.25% v/v	0	0	0	0	99	99	75	90	99	99
Basagran+Poast+Raptor+ NIS+28% N	1.6pt+1.6pt+2fl oz+ 0.25% v/v+1qt	10	10	0	0	99	99	99	99	99	99
Basagran+Poast+Raptor+ PO+28% N	1.6pt+1.6pt+2fl oz+ 1% v/v+1qt	13	13	0	0	99	99	99	99	99	99
Basagran+Poast+Raptor+ Reflex+Renegade	0.6pt+0.6pt+0.9fl oz+ 4fl oz+1% v/v	20	20	0	0	87	99	99	99	99	99
Basagran+Poast+Raptor+ Reflex+Select+Renegade	0.6pt+0.6pt+0.9fl oz+ 4fl oz+2fl oz+1% v/v	20	20	0	0	99	99	99	99	99	99
Untreated											
LSD (0.05)		4	4	0	0	10	0	10	4	1	3

[1]PO = petroleum oil concentrate = Herbimax; 28% N = 28% nitrogen; NIS = nonionic surfactant = R-11; Renegade = methylated seed oil basic pH blend.
[2]Fxtl = green and yellow foxtail.
[3]Basagran+Poast = Rezult Copack.

Table cont. Weed control programs in dry beans (Zollinger and Ries).

Treatment[1]	Rate	August 11						Yield	
		Fxtl[2]	Rrpw	Colq	Kochia	Hans	Swsw	Pinto	Navy
	(product/A)	(%)						cwt/A	cwt/A
7-DPP-PPI/POST									
Pursuit/Basagran+Poast[3]+ PO+28% N	0.72oz/1.6pt+1.6pt+ 1% v/v+1qt	99	99	99	99	99	99		
Pursuit Plus/Basagran+Poast+ PO+28% N	1.25oz/1.6pt+1.6pt+ 1% v/v+1qt	99	99	99	99	99	99		
PPI/POST									
Eptam/Reflex+NIS	3.5pt/10fl oz+0.25% v/v	72	99	99	99	99	99	10.8	10.2
Eptam/Reflex+NIS	4.5pt/10fl oz+0.25% v/v	99	99	99	99	99	99	11.2	10.7
Prowl H_2O/Basagran+Poast+ Raptor+PO+28% N	3pt/1.6pt+1.6pt+ 2fl oz+1% v/v+1qt	99	99	99	99	99	99		
PRE									
Dual Magnum+Sandea	1pt+0.5oz	33	99	63	20	0	72	8.7	7.5
Dual Magnum+Sandea	1pt+0.66oz	42	99	72	40	0	77	9.1	7.8
POST									
Pursuit+NIS	0.72oz+0.25% v/v	85	99	70	75	99	99		
Raptor+NIS	2fl oz+0.25% v/v	99	99	70	90	99	99		
Basagran+Poast+Raptor+ NIS+28% N	1.6pt+1.6pt+2fl oz+ 0.25% v/v+1qt	99	99	99	99	99	99		
Basagran+Poast+Raptor+ PO+28% N	1.6pt+1.6pt+2fl oz+ 1% v/v+1qt	99	99	99	99	99	99		
Basagran+Poast+Raptor+ Reflex+Renegade	0.6pt+0.6pt+0.9fl oz+ 4fl oz+1% v/v	90	99	99	99	99	99		
Basagran+Poast+Raptor+ Reflex+Select+Renegade	0.6pt+0.6pt+0.9fl oz+ 4fl oz+2fl oz+1% v/v	99	99	99	99	99	99		
Untreated		0	0	0	0	0	0	0	0
LSD (0.05)		5	0	8	3	3	3	2.3	2.6

[1]PO = petroleum oil concentrate = Herbimax; 28% N = 28% nitrogen; NIS = nonionic surfactant = R-11; Renegade = methylated seed oil basic pH blend.
[2]Fxtl = green and yellow foxtail.
[3]Basagran+Poast = Rezult Copack.

Dry edible bean desiccation. Zollinger, Richard K. and Jerry L. Ries. An experiment was conducted near Hatton, ND, to evaluate dry edible bean desiccation from Valor with adjuvants. Four rows of Navy 'Vista' bean per plot were planted on June 9, 2004. Weeds were controlled with two applications of Rezult Copack plus hand-weeding. Desiccation treatments were applied on September 17 at 11:30 am with 72 F air, 73 F soil surface, 63% relative humidity, 0% clouds, 2 to 5 mph S wind, moist soil surface and subsoil, and no dew present to naturally senescent dry bean. Dry bean senescence at application was quantified in the following manner: 25 to 75% leaf drop, 0 to 10% vine senescence, 100% green to yellow colored pods, and 0% leathery pods. Treatments were applied to the center two rows of the 10 by 40 foot plots with a backpack-type plot sprayer delivering 34 gpa at 40 psi through 8004 TeeJet flat fan nozzles. The experiment had a randomized complete block design with three replicates per treatment.

Valor has shown activity as a dry bean desiccant and enhancement from primarily oil based adjuvants. Data shows speed and level of desiccation from various adjuvant types with Valor applied at 1.5oz/A. Treatments were included to compare blends of nonionic and organosilicone surfactants, petroleum oil, methylated seed oil (MSO), basic pH blend (BB), deposition aid, drift retardants, and fertilizer for herbicide specificity. MSO and MSO & BB adjuvants with Valor gave the greatest and most rapid dry bean desiccation. Superb HC (high emulsifier concentration petroleum oil), which is used at half the rate of most petroleum oil adjuvants plus InterLock (deposition aid + drift retardant), also gave high and rapid bean desiccation. Organosilicone surfactants which reduce surface tension of spray droplets to increase canopy penetration did not improve desiccation. These data support previous research which indicated oil adjuvants improve dry bean desiccation with Valor. (Dept. of Plant Sciences, North Dakota State University, Fargo).

Table. Dry edible bean desiccation (Zollinger and Ries).

		3 DAT				7 DAT				14 DAT			
Treatment[1]	Rate	leaf	vine	gr/ye[2]	leather	leaf	vine	gr/ye	leather	leaf	vine	gr/ye	leather
	(productA)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)
Valor+Herbimax	1.5oz+1.0 qt	74	22	76	24	82	49	48	52	69	48	46	54
Valor+Soy-Stik	1.5oz+1.5 pt	82	31	76	27	86	52	42	58	98	87	11	89
Valor+Base	1.5oz+1.5 pt	71	30	74	26	81	52	41	58	93	91	11	89
Valor+Renegade	1.5oz+1.5 pt	71	22	79	21	80	48	48	52	93	84	25	75
Valor+ Placement+Preference	1.5oz+ 2.0fl oz+0.25% v/v	70	16	84	20	74	41	56	47	80	68	36	64
Valor+ Interlock+Preference	1.5oz+ 2.0fl oz+0.25% v/v	69	12	83	17	74	40	52	48	86	79	35	65
Valor+ Interlock+ClassAct NG	1.5oz+ 2.0fl oz+0.25% v/v	67	17	84	16	71	33	56	44	87	75	32	68
Valor+ Interlock+AG 03019	1.5oz+ 2.0fl oz+0.5% v/v	69	13	83	17	72	31	56	44	82	66	33	67
Valor+ Interlock+Superb HC	1.5oz+ 2.0fl oz+0.5% v/v	73	31	75	25	84	46	43	57	92	83	10	90
Valor+ AG 04020+Preference	1.5oz+ 2.0fl oz+0.25% v/v	69	14	84	16	73	32	51	49	77	65	38	62
Valor+Rivet	1.5oz+0.5% v/v	70	24	74	26	79	33	54	46	87	55	35	65
Valor+Syl-Tac	1.5oz+4.0fl oz	69	15	80	20	74	28	55	45	82	53	38	62
Untreated		62	11	85	16	64	16	62	38	69	53	38	62
LSD (0.05)		2	2	2	4	2	4	3	4	2	3	3	3

[1]Herbimax and Superb HC = petroleum oil concentrate; Soy-Stik = methylated seed oil (MSO); Base and Renegade = MSO basic pH blend; Placement = AMS + drift retardant; Preference = nonionic surfactant; InterLock = deposition + drift retardant; ClassAct NG (NextGeneration) = surfactants + fertilizer; AG 03019 and AG 04020 are proprietary adjuvants from Agriliance; Rivet = MSO + organosilicone surfactant; Syl-Tac = ethylated seed oil + organosilicone surfactant.

[2]gr/ye = green to yellow colored pods.

Herbicide timing and cultivation in dry bean, Kegode and Ciernia. Combinations of cultivation and a preemergence application of Spartan were used to control redroot pigweed in drybean in an experiment at Prosper. Cultivation timings were determined by the emergence model *Weedcast* and redroot pigweed was the target species used. Redroot pigweed (rrpw) comprised greater than 60% of the total weed population whereas 30% of the population consisted of grasses, mostly foxtail. Navigator navy bean was seeded in 30 in. rows June 4. After planting selected Spartan treatments were applied using a 4-nozzle bike sprayer equipped with XR8002 tips that delivered 17 gpa at 40 psi. At application air temperature was 71 F, wind South at 10, RH 48%, sky sunny, and soil surface dry. Selected treatments were cultivated July 15 (15 and 30% rrpw emergence) when dry beans were V5 and 8 in. tall and redroot pigweed was 4-8 leaf and 2-6 in. tall. Grasses were controlled with an application of Select plus Scoil on July 9. Selected treatments were cultivated again August 4 (60% rrpw emergence). Cultivation at 15 and 30% rrpw emergence was performed on the same date due to inaccessibility of fields at the 15% rrpw emergence timing. A visual evaluation for redroot pigweed control was made August 17 and the center 2 rows of each plot were harvested Oct. 18. Plots were 4 rows wide by 25 ft. long and the trial was a randomized complete block design with 4 replicates.

Herbicide	Timing	Rate	Cultivation timing	Rrpw control	Dry bean yield
				%	*lb/A*
Select	Post	8 fl oz.	15% rrpw emergence	43	2062
Select	Post	8 fl oz.	30% rrpw emergence	63	2197
Select	Post	8 fl oz.	60% rrpw emergence	89	2280
Select	Post	8 fl oz.	15 and 30% rrpw emergence	95	2287
Select	Post	8 fl oz.	15 and 60% rrpw emergence	93	2302
Select	Post	8 fl oz.	30 and 60% rrpw emergence	95	2177
Select	Post	8 fl oz.	15, 30, and 60% rrpw emergence	74	1768
Spartan + Select	Pre + Post	4 oz + 8 fl oz	15% rrpw emergence	83	2061
Spartan + Select	Pre + Post	4 oz + 8 fl oz	30% rrpw emergence	93	2307
Spartan + Select	Pre + Post	4 oz + 8 fl oz	60% rrpw emergence	96	1867
Untreated control	-	-	None	0	2170
Weed free control	-	-	None	100	2572
Reps				4	4
C.V. %				21	14
LSD 5%				23	NS

Cultivation at either 15 or 30% rrpw emergence did not adequately control pigweed; however dry bean yields did not differ significantly from the weed free control. Inclusion of Spartan with cultivation at either 15 or 30% rrpw emergence improved pigweed control but not dry bean yield. Treatments that had two cultivations had 93% or greater weed control which was higher then when only one cultivation was used at either 15 or 30% rrpw emergence. Though it is unclear why weed control was low (74%) following cultivation at 15, 30, and 60% rrpw emergence, cultivation at 60% rrpw emergence caused some injury to dry bean. Use of Spartan (Pre) and cultivation at 30% rrpw emergence appeared to be the best treatment.

Evaluation of dry pea tolerance to fall- vs. spring-applied Spartan in a loam soil. Jenks, Markle, and Willoughby. 'Majoret' dry pea was seeded April 26 at 120 lb/A into 7.5-inch rows. Individual plots were 10 x 30 ft and replicated three times. Fall herbicide treatments were applied October 6, 2003 with a bicycle sprayer delivering 20 gpa at 30 psi through XR 80015 nozzles. Air and soil temperatures were 84 and 63 F, respectively, relative humidity was 14%. Spring treatments were applied April 26 with a tractor sprayer delivering 20 gpa at 30 psi through XR 80015 nozzles. Air and soil temperatures were 64 and 53 F, respectively, relative humidity was 17%. The primary weed evaluated was kochia. The study was conducted on a loam soil with soil pH 6.0 and 3.0% organic matter.

There was essentially no visible crop injury with any fall or spring treatment. There was no significant difference in plant stand for any treatment. There were no significant differences in yield between any treatments. We included two untreated treatments in the study.

All Spartan treatments provided excellent kochia control. The dry pea crop was excellent and was very competitive with weeds.

Table. Evaluation of dry pea tolerance to fall- vs. spring-applied Spartan in a loam soil

			Dry pea		Yield	Test Wt.	Kochia	
Treatment	Rate	Timing	May 26	Jul 27	Aug 12		Jun 16	Jul 27
			pl/m row	% injury	lb/A	lb/bu	— % control —	
Untreated			10.4	0	2953	64.2	0	0
Spartan	2 oz	Fall	9.6	0	3167	64.5	93	100
Spartan	3 oz	Fall	9.5	0	3208	64.5	93	100
Spartan	4 oz	Fall	9.7	0	3181	64.3	98	100
Spartan	5.33 oz	Fall	10.4	2	2929	64.5	100	100
Spartan	2 oz	Spring	10.4	0	2922	64.7	83	100
Spartan	3 oz	Spring	10.2	0	3167	64.7	95	100
Spartan	4 oz	Spring	11.1	0	3378	64.7	98	100
Spartan	5.33 oz	Spring	10.0	0	3182	64.7	100	100
Untreated			10.0	0	2992	64.6	0	0
LSD (0.05)			NS	2	NS	NS	8	1
CV			8.2	548	9	0.8	6	0

Effect of seeding depth on dry pea tolerance to sulfentrazone in a loam soil. Jenks, Markle, and Willoughby. 'Majoret' dry pea was seeded April 26 at 120 lb/A into 7.5 inch rows at either 1- or 2-inch seeding depth. Individual plots were 10 x 30 ft and replicated three times. Herbicide treatments were applied preemergence (PRE) on May 4 with a bicycle sprayer delivering 20 gpa at 30 psi through XR 80015 nozzles, air and soil temperatures were 58 and 50 F, respectively, and relative humidity was 33%. Postemergence (POST) treatments were applied June 18 with a bicycle sprayer delivering 10 gpa at 40 psi through XR 8001 nozzles, air and soil temperatures were 60 and 57 F, respectively, and relative humidity was 33%. Dry peas were 8-inches tall and kochia was 1-inch at time of POST application. The study was conducted on a loam soil with soil pH 4.6 and 4.0% organic matter.

Dry pea stand seeded at 2-inch depths was significantly higher than at 1-inch depth. However, there was essentially no crop injury from Spartan treatments at either depth. Basagran caused slight crop injury. In July, kochia control was excellent with any Spartan treatment. Kochia control with Basagran was 7-13% lower compared to Spartan. The dry pea crop was good and was quite competitive with weeds. Dry pea yield in Spartan treatments was higher than in the Basagran or untreated treatments. We expect that very little Spartan injury occurred since the soil pH was very low.

Table. Effect of seed depth on dry pea tolerance to sulfentrazone in a loam soil.

			Dry pea		Kochia		Yield	Test Wt
Treatment[a]	Rate	Timing	May 26	Jul 26	Jun 17	Jul 26	Aug 20	
1-inch depth			pl / m row	% injury	— % control —		lb/A	lb/bu
Untreated			8.0	0	0	0	2525	65.2
Spartan	2.67 oz	PRE	8.3	0	100	96	3149	65.6
Spartan	4 oz	PRE	7.6	0	100	100	3013	65.6
Spartan	5.33 oz	PRE	7.7	0	100	100	3222	65.6
Basagran	1 pt	POST	7.8	4	0	87	2769	65.6
Handweeded check[b]			8.6	2	0	92	2916	65.8
2-inch depth								
Unteated			9.8	0	0	0	2817	65.5
Spartan	2.67 oz	PRE	9.5	0	99	100	3084	65.7
Spartan	4 oz	PRE	9.5	1	100	100	3034	65.4
Spartan	5.33 oz	PRE	10.6	0	100	100	3113	65.8
Basagran	1 pt	POST	9.3	5	0	93	2526	65.8
Handweeded check[b]			8.7	7	0	96	2479	66.0
LSD (0.05)			1.5	3	1	4	425	NS
CV			10.2	109	0	3	9	0.5

[a]Select was applied with COC at 5 oz + 1% v/v, respectively, to all treatments.
[b]Handweeded checks were treated with Basagran at 0.5 pt and Select at 5 oz to aid hand weeding.

Evaluation of dry pea tolerance to fall- vs. spring-applied Spartan in a sandy loam soil. Jenks, Markle, and Willoughby. 'Majoret' dry pea was seeded April 26 at 120 lb/A into 7.5-inch rows. Individual plots were 10 x 30 ft and replicated 3 times. Fall herbicide treatments were applied October 6, 2003 with a bicycle sprayer delivering 20 gpa at 30 psi through XR 80015 nozzles. Air and soil temperatures were 84 and 63 F, respectively, relative humidity was 14%. Spring treatments were applied April 26 with a tractor sprayer delivering 20 gpa at 30 psi through XR 80015 nozzles. Air and soil temperatures were 72 and 56 F, respectively, relative humidity was 18%. The primary weeds evaluated were green and yellow foxtail (Foxtail), kochia, wild buckwheat (Wibw), Russian thistle (Ruth), redroot pigweed (Rrpw), and common lambsquarters (Colq). The study was conducted on a sandy loam soil with soil pH 6.4 and 1.6% organic matter.

There was no visible crop injury with any fall or spring treatment. There was no significant difference in plant stand for any treatment. There were no significant differences in yield between the herbicide treatments. We included two untreated treatments in the study. Dry pea yield in one of the untreated treatments was the only yield significantly lower than other treatments. We noted during the growing season that crop stand in the third replication appeared somewhat lower than the other reps, but with little visible differences between treatments in that rep. It turned out that there was a significant yield difference between reps. However, within each replication the higher Spartan rates yielded as much or more than lower rates.

At the July rating, Spartan provided excellent control of all broadleaf weeds.

Table. Evaluation of dry pea tolerance to fall- vs. spring-applied Spartan in a sandy loam soil

Treatment	Dry pea				Foxtail		Kochia		Wibw		Ruth		Rrpw		Colq	
	May 26	Jul 13 injury	Yield Aug 12	T.W. Aug 12	Jun 15	Jul 13	Jun 15	Jul 13	Jun 15	Jul 13	Jun 15	Jul 13	Jun 15	Jul 13	Jun 15	Jul 13
	pl/m row	%	lb/A	lb/bu	% control											
Untreated	8.9	0	1551	63.3	0	0	0	0	0	0	0	0	0	0	0	0
Fall Spartan																
2 oz	8.0	0	2187	63.9	10	89	97	97	88	96	93	100	20	94	98	100
3 oz	8.3	0	2214	63.8	8	89	97	99	89	94	94	100	25	96	98	100
4 oz	9.8	1	2095	64.3	17	91	99	100	92	99	95	98	47	97	100	100
5.33 oz	9.1	0	2511	63.9	13	89	100	100	93	98	98	100	48	96	100	100
Spring Spartan																
2 oz	8.2	0	2265	63.7	11	88	90	99	80	95	62	96	25	97	100	99
3 oz	9.3	0	2347	64.0	10	90	99	99	83	95	92	100	26	96	100	100
4 oz	9.0	0	2505	64.2	15	89	98	100	91	95	99	100	25	94	100	100
5.33 oz	8.3	0	2604	64.4	23	89	98	99	92	99	96	100	57	98	100	100
Untreated	8.6	0	2195	64.3	0	0	0	0	0	0	0	0	0	0	0	0
LSD (0.05)	NS	NS	391	NS	NS	6	6	2	10	6	18	4	28	5	2	1
CV	8.3	548	10	0.9	103	5	4	2	8	5	15	3	60	4	2	0

Effect of seeding depth on dry pea tolerance to sulfentrazone in a sandy loam soil. Jenks, Markle, and Willoughby. 'Majoret' dry pea was seeded April 26 at 120 lb/A into 7.5-inch rows at either 1- or 2-inch seeding depth. Individual plots were 10 x 30 ft and replicated three times. Herbicide treatments were applied preemergence (PRE) on May 5 with a bicycle sprayer delivering 20 gpa at 30 psi through XR 80015 nozzles, air and soil temperatures were 51 and 49 F, respectively, and relative humidity was 40%. Postemergence (POST) treatments were applied on June 18 with a bicycle sprayer delivering 10 gpa at 40 psi through XR 8001 nozzles, air and soil temperatures were 62 and 56 F, respectively, and relative humidity was 31%. Dry peas were 12-inches tall and kochia was 2-inches at time of POST application. The study was conducted on a sandy loam soil with soil pH 5.3 and 2.8% organic matter. We expect that very little Spartan injury occurred since the soil pH was very low.

There were no significant differences in crop stand between the 1- and 2-inch seeding depths. There was essentially no visual crop injury from Spartan treatments at either depth. Basagran caused approximately 5% injury. In July, kochia control was excellent with any Spartan treatment. Kochia control with Basagran was generally about 10% less than with Spartan. The dry pea crop was excellent and was very competitive with weeds. There was no significant difference in dry pea yield between treatments.

Table. Effect of seeding depth on dry pea tolerance to sulfentrazone in a sandy loam soil.

			Dry Pea		Kochia		Yield	Test Wt
Treatment[a]	Rate	Timing	May 27	Jul 13	Jun 16	Jul 13	Aug 12	
1-inch depth			pl / m row	% injury	% control		lb/A	lb/bu
Untreated			10.0	0	0	0	3386	64.6
Spartan	2.67 oz	PRE	10.0	0	85	100	3468	64.7
Spartan	4 oz	PRE	11.3	0	100	100	3501	65.4
Spartan	5.33 oz	PRE	9.7	1	100	100	3337	65.2
Basagran	1 pt	POST	9.5	5	0	88	3452	65.1
Handweeded check[b]			9.9	5	0	100	3313	65.3
2-inch depth								
Untreated			11.3	0	0	0	3496	64.7
Spartan	2.67 oz	PRE	11.2	0	96	98	3709	65.2
Spartan	4 oz	PRE	10.1	0	95	100	3531	64.7
Spartan	5.33 oz	PRE	9.5	0	100	99	3788	64.7
Basagran	1 pt	POST	10.1	5	0	91	3618	64.8
Handweeded check[b]			9.2	5	0	100	3551	64.9
LSD (0.05)			NS	1	5	5	NS	NS
CV			10.8	10	6	4	7	1.3

[a]*Select was applied with COC at 5 oz + 1% v/v, respectively, to all treatments.*
[b]*Handweeded checks were treated with Basagran at 0.5 pt and Select at 5 oz to aid hand weeding.*

Weed control in no-till dry pea (Williston). Jenks, Riveland, Markle, and Willoughby. 'Scuba' dry pea was direct seeded May 4 into durum wheat stubble at 195 lb/A into 7-inch rows. Individual plots were 10 x 30 ft and replicated three times. Herbicide treatments were applied preemergence (PRE) May 7 with a bicycle sprayer delivering 20 gpa at 30 psi through XR 80015 nozzles. Air and soil temperatures were 68 and 57 F, respectively, relative humidity was 20%. Postemergence (POST) treatments were applied June 14 with a bicycle sprayer delivering 10 gpa at 40 psi through XR 8001 nozzles. Air and soil temperatures were 79 and 66 F, respectively, relative humidity was 28%. Plant sizes at time of application were green foxtail (Grft) at 0.5- to 1.5-inch, Russian thistle (Ruth) at 0.5- to 1.5-inch, and kochia emerging to 0.5-inch. The study was conducted on a loam soil with pH 5.5 and OM 2.3%. The primary weeds present were green foxtail (Grft), Russian thistle (Ruth) and kochia (Kocz).

Dry pea density tended to decrease with higher Spartan rates. Visible crop injury increased with higher Spartan rates. However, dry pea yield was not reduced despite the slight impact on crop density and visible injury. Sencor applied PRE with Spartan also caused moderate crop injury, but with no impact on dry pea yield.

All treatments provided good to excellent control of green foxtail, Russian thistle, and kochia. Treatments with Spartan provided slightly better weed control compared to total postemergence treatments.

Table. Weed control in no-till dry pea (Williston 2004).

			Dry pea			Grft		Ruth		Kochia	
Treatment[a]	Rate	Timing	Jun 2	Jun 6	Jun 30	Jun 6	Jun 30	Jun 6	Jun 30	Jun 6	Jun 30
			#/m row	% injury		— % control —					
Raptor + Basagran + NIS + 28% N	4 oz + 1 pt + 0.25% v/v + 1 qt	POST	9.0	0	6	0	90	0	91	0	93
Spartan/ Select + COC	2.67 oz/ 5 fl oz + 1% v/v	PRE/ POST	7.5	7	5	93	100	100	100	100	100
Spartan/ Select + COC	4 oz/ 5 fl oz + 1% v/v	PRE/ POST	7.0	13	10	96	100	98	100	100	100
Spartan/ Select + COC	5.33 oz/ 5 fl oz + 1% v/v	PRE/ POST	6.1	19	19	99	100	100	100	100	100
Basagran + Poast + COC	2 pt + 1 pt + 2 pt	POST	10.0	0	4	0	91	0	99	0	95
Spartan/ Basagran + Poast + COC	2.67 oz/ 1 pt + 1 pt + 2 pt	PRE/ POST	8.1	7	5	94	98	100	100	100	100
Spartan + Sencor/ Select + COC	4 oz + 0.25 lb/ 5 fl oz + 1% v/v	PRE/ POST	7.3	15	27	98	100	100	100	100	100
Untreated			8.3	0	0	0	0	0	0	0	0
LSD (0.05)			1.5	3	6	3	4	2	2	NS	6
CV			10.6	25	36	2	3	2	2	0	4

[a] *Roundup UltraMax II plus AMS was applied PRE to each treatment at 11 oz + 2.5 gal/100gal.*

Weed control in no-till dry pea (Minot). Jenks, Markle, and Willoughby. 'Majoret' dry pea was direct-seeded April 26 into wheat stubble at 120 lb/A into 7.5-inch rows. Individual plots were 10 x 30 ft and replicated three times. Herbicide treatments were applied preemergence (PRE) on May 4 with a bicycle sprayer delivering 20 gpa at 30 psi through XR 80015 nozzles. Air and soil temperatures were 49 and 52 F, respectively, relative humidity was 47%. Postemergence (POST) treatments were applied on June 17 with a bicycle sprayer delivering 10 gpa at 40 psi through XR 8001 nozzles. Air and soil temperatures were 62 and 56 F, respectively, relative humidity was 69%. Plant sizes at POST application were green foxtail (Foxt) at 1- to 2-inches, redroot pigweed (Rrpw) at 1- to 2-inches, and wildbuckwheat (Wibw) at 1- to 2-inches. The study was conducted on a loam soil with pH 5.5 and OM 3.1%. The primary weeds present were green and yellow foxtail (Fxtl), redroot pigweed (Rrpw), and wild buckwheat (wibw).

None of the treatments reduced crop density compared to the untreated check. However, Sencor applied PRE and treatments containing Basagran caused slight to moderate visible crop injury at the July rating. Yield with Basagran alone was slightly lower, which was likely due to moderate crop injury and slightly lower broadleaf weed control compared to other treatments.

All treatments provided good to excellent control of redroot pigweed and wild buckwheat. Spartan at the low rate (2.67 oz) and Basagran alone provided slightly less control of redroot pigweed and wild buckwheat compared to other treatments. Spartan alone did not control the foxtail species. Select and Poast provided good foxtail control.

Table. Weed control in no-till dry pea (Minot 2004).

			Dry pea		Yield	TW	Fxtl		Rrpw		Wibw	
Treatment[a]	Rate	Timing	Jun 3	Jul 10	Aug 13		Jun 14	Jul 10	Jun 14	Jul 10	Jun 14	Jul 10
			#/m row	% inj	lb/A	lb/bu	% control					
Raptor[b] + Basagran	4 oz + 1 pt	POST	8.7	13	2796	64.8	0	94	0	92	0	90
Spartan/ Select + COC	2.67 oz/ 5 fl oz + 1% v/v	PRE/ POST	9.5	1	3100	65.6	60	95	76	83	77	88
Spartan/ Select + COC	4 oz/ 5 fl oz + 1% v/v	PRE/ POST	8.9	2	2850	64.6	71	97	90	91	87	95
Spartan/ Select + COC	5.33 oz/ 5 fl oz + 1% v/v	PRE/ POST	9.4	0	3119	64.7	73	97	90	90	93	96
Basagran + Poast + COC	2 pt + 1 pt + 2 pt	POST	8.7	17	2606	65.0	0	89	0	86	0	85
Spartan/ Basagran + Poast + COC	2.67 oz/ 1 pt + 1 pt + 2 pt	PRE/ POST	8.9	14	2926	65.7	58	93	73	93	77	95
Spartan + Sencor/ Select + COC	4 oz + 0.33 lb/ 5 fl oz + 1% v/v	PRE/ POST	8.4	21	2906	65.7	67	97	88	94	87	92
Untreated			9.0	0	2190	64.6	0	0	0	0	0	0
Handweeded check[c]			8.3	7	2846	65.1	0	0	0	0	0	0
LSD (0.05)			NS	5	346	NS	16	3	20	9	18	5
CV			8.3	33	7	0.8	25	2	25	8	22	4

[a]*Roundup UltraMax II plus AMS was applied PRE to each treatment at 11 oz + 2.5 gal/100gal.*
[b]*Raptor was applied with NIS and 28% N at 0.25% v/v + 1 qt.*
[c]*Select plus COC at 5 oz + 1% v/v were applied to aid handweeding.*

Weed control in conventional-till dry pea (Minot). Jenks, Markle, and Willoughby. 'Majoret' dry pea was seeded April 26 into wheat stubble at 120 lb/A into 7.5-inch rows. Individual plots were 10 x 30 ft and replicated three times. Herbicide treatments were applied preplant incorporated (PPI) on April 26 with a tractor sprayer delivering 20 gpa at 30 psi through XR 80015 nozzles. Air and soil temps were 54 and 45F, respectively, RH was 23%. Preemergence (PRE) treatments were applied May 4 with a bicycle sprayer delivering 20 gpa at 30 psi through XR 80015 nozzles. Air and soil temps were 70 and 56 F, respectively, and RH was 21%. Postemergence (POST) treatments were applied June 17, with a bicycle sprayer delivering 10 gpa at 40 psi through XR 8001 nozzles. Air and soil temps were 59 and 56 F, respectively, and RH was 75%. Plant sizes at POST application were green foxtail (Foxt) at 1- to 2-inches, redroot pigweed (Rrpw) at 1-inch, and wild buckwheat (Wibw) at 1- to 3-inches. The study was conducted on a loam soil with pH 4.7 and OM 3.1%.

None of the treatments significantly reduced crop density compared to the untreated. There was minimal injury from Spartan even at the higher rates. Sencor + Sonalan and Basagran caused moderate visible crop injury, there was no significant yield reduction from any treatment. However, there was wide variability in yield between reps due, in part, to dry conditions in early May and a hail storm on June 6 that may have caused significant crop injury. Even though there was no statistical difference in yield, there was a trend for higher yield in the treatments containing Spartan. Spartan + Select provided excellent control of foxtail, pigweed, and wild buckwheat. Prowl followed by Raptor provided good control as well. Spartan treatments generally provided 10-20% better control of wild buckwheat than other treatments. Foxtail control was slightly better with treatments containing Select compared to other treatments.

			Dry pea		Yield	TW	Fxtl		Rrpw		Wibw	
Treatment	Rate	Timing	Jun 3	Jul 10	Aug 17		Jun 14	Jul 10	Jun 14	Jul 10	Jun 14	Jul 10
			#/m row	% inj	lb/A	lb/bu	% control					
Prowl H20/ Raptor + NIS + 28% N	2 pt/ 4 oz + 0.25% v/v + 1 qt	PPI/ POST	8.0	4	1885	65.1	79	97	72	98	65	87
Raptor + Basagran + NIS + 28% N	4 oz + 0.5 pt + 0.25% v/v + 1 qt	POST	9.5	7	2053	65.3	0	83	0	93	0	79
Spartan/ Select + COC	2.67 oz/ 5 fl oz + 1% v/v	PRE/ POST	8.2	1	2252	65.4	85	94	97	100	97	96
Spartan/ Select + COC	4 oz/ 5 fl oz + 1% v/v	PRE/ POST	8.2	4	2397	65.4	92	97	100	100	98	99
Spartan/ Select + COC	5.33 oz/ 5 fl oz + 1% v/v	PRE/ POST	7.5	4	2207	65.1	93	96	100	100	100	98
Sonalan + Sencor/ Select + COC	2 pt + 0.33 lb/ 5 fl oz + 1% v/v	PPI/ POST	8.5	23	2156	64.9	92	99	88	94	68	80
Spartan/ Basagran + Poast + COC	2.67 oz/ 1 pt + 1 pt + 2 pt	PRE/ POST	7.8	13	2470	65.2	73	87	100	100	100	98
Basagran + Poast + COC	2 pt + 1 pt + 2 pt	POST	8.7	19	1804	65.2	0	77	0	88	0	76
Sonalan + Spartan/ Select + COC	2 pt + 4 oz/ 5 fl oz + 1% v/v	PPI/ POST	8.9	1	2484	65.4	96	99	100	100	98	96
Handweeded check[b]			8.3	0	2654	65.5	89	99	87	100	73	99
Untreated			9.6	0	1672	64.6	0	0	0	0	0	0
LSD (0.05)			NS	6	NS	NS	5	5	8	5	6	8
CV			11.3	49	19	0.6	5	4	7	4	5	6

[b]Treflan was applied at 2 pt/A PPI followed by Select plus COC at 5oz/A + 1% v/v POST to aid handweeding.

Volunteer canola control in dry pea. Jenks, Markle, and Willoughby. Majoret dry peas were seeded May 18 at 120 lb/A into 7.5-inch rows. Canola was seeded over the top to simulate a volunteer canola (VC) situation. Individual plots were 10 x 30 ft and replicated 3 times. Herbicide treatments were applied preemergence (PRE) on May 18 with a bicycle sprayer delivering 20 gpa at 30 psi with XR 80015 nozzles. Air and soil temperatures were 80 and 61 F, respectively, relative humidity was 18%. Postemergence treatments were applied to 3-leaf canola on June 18 with a bicycle sprayer delivering 10 gpa at 40 psi through XR 8001 nozzles. Air and soil temperatures were 62 and 61 F, respectively, relative humidity was 41%. Treatments to 6-leaf canola were applied in the same fashion on June 28. Air and soil temperatures were 82 and 78 F, respectively, relative humidity was 29%.

In peas, soil-applied Spartan provided about 83% VC control, while Sencor provided 98% control. Sencor applied postemergence provided good (89%) VC control at the 3-leaf stage, but reduced to 72% at the 6-leaf stage. Although the Sencor treatments generally provided acceptable VC control, Bayer representatives are not eager to promote Sencor due to crop injury concerns. VC control with MCPA amine and Basagran was good to excellent at the 3-leaf stage, but very poor when applied at the 6-leaf stage. Raptor provided good to excellent VC control at either stage.

Table. Volunteer canola control in dry pea (2004).

Treatment	Rate	Timing	Volunteer Canola Jul 8	Volunteer Canola Jul 28
			% control	
Spartan	4 oz	PRE	83	83
Sencor	0.375 lb	PRE	99	98
Sencor	0.25 lb	3-leaf	76	89
Sencor	0.25 lb	6-leaf	31	72
MCPA amine	8 fl oz	3-leaf	84	95
MCPA amine	8 fl oz	6-leaf	23	37
Basagran	0.5 pt	3-leaf	70	86
Basagran	0.5 pt	6-leaf	12	7
Raptor + NIS + 28% N	4 fl oz + 0.25% v/v + 2.5% v/v	3-leaf	97	98
Raptor + NIS + 28% N	4 fl oz + 0.25% v/v + 2.5% v/v	6-leaf	40	85
Untreated			0	0
LSD (0.05)			11	7
CV			12	6

Weed control with soil- and POST-applied herbicides in field pea. Gregory J. Endres and Blaine G. Schatz. (Carrington Research Extension Center, North Dakota State University, Carrington, ND 58421) Weed control and field pea response to selected soil- and POST-applied herbicides were evaluated in a randomized complete-block design with three replicates. The experiment was conducted on a Heimdahl loam soil with 8.0 pH and 3.3% organic matter at the NDSU Carrington Research Extension Center. The trial area was tilled with a disk followed by two passes with a Melroe culti-harrow on October 20, 2003. Herbicide treatments were applied to 5- by 25-ft plots with a pressurized hand-held plot sprayer at 18 gal/A and 30 psi through 8002 flat-fan nozzles. Fall sulfentrazone treatments were applied October 28 to a dry soil surface with 39 F, 66% RH, 25% clear sky, and 2 mph wind. Snowfall occurred 1 d following herbicide application. PPI treatments were applied on April 29 with 54 F, 86% RH, and 95% clear sky and immediately incorporated to a 2.5- to 3-inch depth using a roto-tiller. The trial area was cultivated twice on May 7 with a Melroe culti-harrow at a 2-inch depth prior to seeding, except fall treatments which were harrowed once at a 0.5- to 1-inch depth. On May 7, inoculated 'Integra' field pea was seeded in 7-inch rows at a pure live seed rate of 300,000 seeds/A. PRE treatments were applied to a dry soil surface on May 8 with 61 F, 49% RH, 20% clear sky, and 13 mph wind. Rainfall totaled 1.04 inches 1 wk following PRE application. POST treatments were applied on June 9 with 54 F, 63% RH, 35% clear sky, and 12 mph wind to 4- to 5-inch tall field pea, 2- to 3-leaf green and yellow foxtail, 0.5- to 2-inch tall common lambsquarters, 2-leaf (0.5- to 1-inch tall) hairy and eastern black nightshade, cotyledon- to 2-leaf (0.5-inch tall) prostrate and redroot pigweed, and 1-inch tall annual smartweed. Average plant density in untreated plots was estimated: field pea = 8 plants/ft^2, foxtail = 36 plants/ft^2, common lambsquarters = 3 plants/ft^2, nightshade = 6 plants/ft^2 and annual smartweed = 2 plants/ft^2. The trial was harvested with a plot combine on August 19.

Fall-applied sulfentrazone generally provided less broadleaf weed control compared to spring-applied sulfentrazone (Table 1). Fall-applied sulfentrazone at 0.25 lb/A did not improve broadleaf weed control compared to the lower rate. PRE sulfentrazone+imazethapyr provided excellent broadleaf weed control of 98-99%, while foxtail was suppressed at 65-72% and pea yield was less compared to the other sulfentrazone treatments (Table 2). Weed control was good to excellent with PPI pendimethalin followed by POST bentazon+sethoxydim+imazamox, 86-99%, and PPI pendimethalin&imazethapyr followed by POST bentazon+sethoxydim, 80-99%. PRE imzaethapyr+glyphosate provided 66-97% weed control, while PRE imazethapyr+pendimethalin provided at least 92% control of all weeds on August 13. Broadleaf weed control ranged from 32-76% with PRE thifesulfuron+glyphosate followed by POST sethoxydim. Imazamox at 0.023 lb/A provided similar weed control and pea yield compared to 0.031 lb/A. All POST imazamox+bentazon+sethoxydim treatments generally provided greater than 90% control of weeds except for common lambsquarters and resulted in similar yield. However, imazamox at 0.016 lb/A +bentazon at 1 lb/A +sethoxydim at 0.2 lb/A +MSO+UAN injured pea 12-18%. Fomesafen+sethoxydim suppressed broadleaf weeds, but severely injured pea 48-68% and reduced yield.

Table 1. Weed control in field pea, Carrington, 2004.

			7/9					8/13				
Treatment[1]	Application timing	Rate	Fox-tail spp.[2]	Common lambs-quarters	Night-shade spp.[2]	Pig-weed spp.[2]	Annual smart-weed	Fox-tail spp.	Common lambs-quarters	Night-shade spp.	Pig-weed spp.	Annual smart-weed
		lb ai/A	----------	----------	----------	----------	----------	%	----------	----------	----------	----------
Sulfentrazone/Sethoxydim+MSO	Fall/POST	0.188/0.2+2pt	98	92	77	81	68	96	89	73	77	68
Sulfentrazone/Sethoxydim+MSO	Fall/POST	0.25/0.2+2pt	97	85	87	80	53	96	80	73	82	68
Pendimethalin/Bentazon+ sethoxydim+imazamox+ MSO+UAN	PPI/ POST	1.5/ 1+0.2+0.16+1% v/v+2pt	98	96	99	96	93	98	89	95	97	86
Imazethapyr/Bentazon+ sethoxydim+MSO+UAN	PPI/ POST	0.031/ 1+0.2+2pt+2pt	98	76	96	85	96	88	73	75	86	91
Pendimethalin&imazethapyr/ Bentazon+sethoxydim+MSO+ UAN	PPI/ POST	0.5&0.033/ 1+0.2 +2pt+2pt	98	86	95	88	99	98	83	80	97	96
Imazethapyr+sulfentrazone	PRE	0.031+0.188	72	99	98	99	99	65	99	99	99	99
Imazethapyr+glyphosate	PRE	0.031+0.75(ae)	66	85	97	83	94	68	72	88	89	89
Imazethapyr+pendimethalin	PRE	0.031+1.5	91	96	98	94	81	92	96	93	96	95
Sulfentrazone/Sethoxydim+MSO	PRE/POST	0.188/0.2+2pt	96	98	98	96	83	96	99	83	96	84
Thifensulfuron+glyphosate+NIS/ Sethoxydim+MSO	PRE/ POST	0.008+0.75(ae)+0.25 %v/v / 0.2+2pt	96	47	67	60	32	97	48	65	68	40
Thifensulfuron+glyphosate+NIS/ Sethoxydim+MSO	PRE/ POST	0.014+0.75(ae)+0.25 %v/v / 0.2+2pt	97	47	68	58	48	97	40	69	76	47
Bentazon+sethoxydim+MSO+ UAN	POST	1+0.2+2pt+2pt	96	83	69	68	86	96	72	71	72	83
Imazethapyr+NIS	POST	0.031+0.25%	80	75	99	93	89	86	73	85	98	87
Imazamox+NIS	POST	0.031+0.25%	83	72	99	96	80	78	74	96	96	91
Imazamox+NIS	POST	0.023+0.25%	81	73	99	96	98	78	70	98	99	99
Imazamox+bentazon+sethoxydim +NIS+UAN	POST	0.031+0.188+0.038+ 0.25%v/v+2pt	94	86	99	99	89	91	81	99	98	99
Imazamox+bentazon+sethoxydim + MSO+UAN	POST	0.016+1+0.2+1%v/v +2pt	91	91	99	99	89	93	92	99	98	96
Imazamox+bentazon+sethoxydim +MSO+UAN	POST	0.016+0.5+0.1+1% v/v+2pt	90	89	96	96	89	91	87	98	97	86
Fomesafen+sethoxydim+COC	POST	0.19+0.2+0.5%v/v	99	68	97	83	63	94	40	78	83	61
Untreated	x	x	0	0	0	0	0	0	0	0	0	0
LSD (0.05)			4	12	17	4	24	8	14	11	10	14

[1]MSO=Destiny, a methylated seed oil from Agriliance, St. Paul, MN; Pendimethalin=Prowl$H_2$0, BASF; UAN=urea ammonium nitrate; Pendimethalin&imazethapyr=Pursuit Plus, BASF; NIS=Preference, a nonionic surfactant from Agriliance; glyphosate=Roundup UltaMax (3.7 lb ae/gal), Monsanto; COC=Hi-Per-Oil, a petroleum-based oil from Agriliance.

[2]Foxtail spp.=Yellow and green; Nightshade spp.=hairy and eastern black; Pigweed spp.=Redroot and prostrate.

Table 2. Field pea response to herbicide treatments, Carrington, 2004.

Treatment[1]	Application timing	Rate	Stand	Crop injury 6/23	Crop injury 7/9	Seed yield
		lb ai/A	plants/A	-------- % --------		bu/A
Sulfentrazone/Sethoxydim+MSO	Fall/POST	0.188/0.2+2pt	285847	0	0	73.2
Sulfentrazone/Sethoxydim+MSO	Fall/POST	0.25/0.2+2pt	264345	0	0	76.1
Pendimethalin/ Bentazon+sethoxydim+imazamox+MSO+UAN	PPI/ POST	1.5/1+0.2+0.16+1%v/v+2pt	241578	0	0	76.9
Imazethapyr/Bentazon+sethoxydim+MSO+UAN	PPI/POST	0.031/1+0.2+2pt+2pt	221341	2	6	76.3
Pendimethalin&imazethapyr/ Bentazon+sethoxydim+MSO+UAN	PPI/ POST	0.5&0.033/1+0.2+2pt+2pt	244108	0	0	77.2
Imazethapyr+sulfentrazone	PRE	0.031+0.188	250432	0	0	57.3
Imazethapyr+glyphosate	PRE	0.031+0.75(ae)	254226	0	0	81.4
Imazethapyr+pendimethalin	PRE	0.031+1.5	250432	0	0	77.4
Sulfentrazone/Sethoxydim+MSO	PRE/POST	0.188/0.2+2pt	247902	0	0	78.2
Thifensulfuron+glyphosate+NIS/ Sethoxydim+MSO	PRE/ POST	0.008+0.75(ae)+0.25%v/v/ 0.2+2pt	217547	0	0	77.5
Thifensulfuron+glyphosate+NIS/ Sethoxydim+MSO	PRE/ POST	0.014+0.75(ae)+0.25%v/v/ 0.2+2pt	258021	0	0	75.6
Bentazon+sethoxydim+MSO+UAN	POST	1+0.2+2pt+2pt	266875	2	0	77.8
Imazethapyr+NIS	POST	0.031+0.25%	246638	0	0	85.1
Imazamox+NIS	POST	0.031+0.25%	268139	0	0	77.5
Imazamox+NIS	POST	0.023+0.25%	255491	0	0	69.0
Imazamox+bentazon+sethoxydim+NIS+UAN	POST	0.031+0.188+0.038+0.25%v/v+2pt	294700	0	0	72.6
Imazamox+bentazon+sethoxydim+MSO+UAN	POST	0.016+1+0.2+1%v/v+2pt	274463	18	12	68.4
Imazamox+bentazon+sethoxydim+MSO+UAN	POST	0.016+0.5+0.1+1%v/v+2pt	276993	7	8	72.7
Fomesafen+sethoxydim+COC	POST	0.19+0.2+0.5%v/v	254226	68	48	54.9
Untreated	x	x	264345	0	0	69.6
LSD (0.05)			NS	2	3	13.0

[1]MSO=Destiny, a methylated seed oil from Agriliance, St. Paul, MN; Pendimethalin=ProwlH_20, BASF; UAN=urea ammonium nitrate; Pendimethalin&imazethapyr=Pursuit Plus, BASF; NIS=Preference, a nonionic surfactant from Agriliance; glyphosate=Roundup UltaMax (3.7 lb ae/gal), Monsanto; COC=Hi-Per-Oil, a petroleum-based oil from Agriliance.

PPO inhibitors before flax and sunflower. (Kirk Howatt, Ronald Roach, and Janet Davidson). 'ND009' flax and 'DKF 29-90' sunflower was seeded on June 21. Preemergence treatments were applied to 1 to 2 leaf yellow foxtail and 2 inch redroot pigweed and wild buckwheat on June 22 with 68 F air temperature, 40% RH, 90% cloud cover, 2 mph west wind, and 64 F soil temperature. Postemergence treatments were applied to 4 to 5 inch tall flax and 4-leaf sunflower on July 21 with 75 F air temperature, 80% RH, partly cloudy sky, 4 to 5 mph west wind, and 75 F soil temperature. All treatments were applied with a backpack sprayer delivering 8.5 gpa at 40 psi through TT 11001 flat-fan nozzles to a 7 ft wide area the length of 10 by 30 ft plots. The experiment was a randomized complete-block design with four replicates.

Table. PPO inhibitors before flax and sunflower.

			June 24			June 28			July 27		
Treatment[1]	Rate	Application	Yeft	Rrpw	Wibw	Yeft	Rrpw	Wibw	Flax	Rrpw	Wibw
	oz ai or ae/A		%	%	%	%	%	%	%	%	%
Carf+MSO / Brox&MCPA	0.25 + 1% / 7.2	PRE / POST	33	78	45	33	97	89	1	97	23
Carf+MSO / Brox&MCPA	0.375 + 1% / 7.2	PRE / POST	49	79	53	43	98	88	1	94	45
Carf+Glyt / Brox&MCPA	0.25 + 9 / 7.2	PRE / POST	15	70	48	99	98	90	6	90	92
Carf+Glyt / Brox&MCPA	0.375 + 9 / 7.2	PRE / POST	9	65	38	96	96	86	16	89	81
Glyt / Brox&MCPA	9 / 7.2	PRE / POST	5	9	6	91	90	55	14	82	58
Glyt+Suen	9+3	PRE	13	65	40	96	98	89	0	95	92
Glyt+Suen / Brox&MCPA	9+3 / 7.2	PRE / POST	9	48	33	94	90	85	15	80	87
Carf+Glyt+Suen	0.25 + 9 + 3	PRE	13	60	38	98	97	93	3	91	92
Glyt	12	PRE	0	0	0	91	96	64	0	88	92
CV			45	17	39	5	4	11	69	6	10
LSD (P=0.05)			10	13	19	7	5	13	6	8	11

[1]MSO was Scoil methylated seed oil adjuvant; "/" identifies the portions of the treatment were separated in time.

PRE Glyphosate at 9 oz ae/A followed by bromoxynil and MCPA gave less than 58% wild buckwheat control on July 27. Addition of carfentrazone or sulfentrazone in the PRE portion of the treatment improved buckwheat control to 81% to 92%. Including carfentrazone and sulfentrazone with glyphosate did not increase control over carfentrazone or sulfentrazone with glyphosate. PRE glyphosate at 12 oz ae/A also provided 92% wild buckwheat control. Carfentrazone followed by bromoxynil and MCPA gave less than 50% control of wild buckwheat.

Flax response to mesotrione. (Kirk Howatt, Ronald Roach, and Janet Harrington). 'ND009' flax was seeded May 4. Preemergence treatments were applied May 4 with 58 F air temperature, 19% RH, clear sky, 4 to 6 mph north wind, and 52 F soil temperature. Postemergence treatments were applied to 4 inch tall flax, 6 inch tall wild mustard, vining wild buckwheat, and 2 inch tall redroot pigweed on June 22 with 53 F air temperature, 68% RH, 100% cloudcover, 3 to 4 mph west wind, and 58 F soil temperature. All treatments were applied with a backpack sprayer delivering 8.5 gpa at 40 psi through TT 11001 flat-fan nozzles to a 7 ft wide area the length of 10 by 30 ft plots. The experiment was a randomized complete-block design. Flax was harvested with a small-plot combine on September 27.

Table. Flax response to mesotrione.

			June 29				July 21				Sept. 27
Treatment[1]	Rate	Application	Flax	Wimu	Wibw	Rrpw	Flax	Wimu	Wibw	Rrpw	Yield
	oz ai/A		%	%	%	%	%	%	%	%	bu/A
Mesotrione	1	PRE	4	75	0	76	0	60	45	43	12
Mesotrione	1.5	PRE	5	88	0	89	0	88	38	62	14
Mesotrione	3	PRE	10	94	0	94	0	95	38	78	17
Sulfentrazone	4	PRE	3	33	86	96	0	45	48	57	17
Mesotrione+PO	1+1%	POST	24	65	28	60	4	96	88	84	20
Mesotrione+PO	1.5+1%	POST	26	66	28	60	6	96	81	77	16
Mesotrione+PO	3+1%	POST	29	65	23	60	7	96	83	88	22
Sulfentrazone+ thifensulfuron+NIS	4+ 0.056+0.25%	POST	13	69	88	81	1	89	95	92	21
Bromoxynil&MCPA	7.2	POST	3	90	90	75	1	95	86	68	21
Bromoxynil&MCPA+ mesotrione+PO	4+ 1+1%	POST	3	93	84	78	0	94	75	77	28
Bromoxynil&MCPA+ thifensulfuron+NIS	6+ 0.056+0.25%	POST	0	90	84	76	1	99	90	93	26
Untreated	0		0	0	0	0	0	0	0	0	15
CV			42	10	12	10	143	7	17	11	25
LSD (P=0.05)			6	9	7	10	3	7	16	13	8

[1]PO was Herbimax; and NIS was Activator 90.

PRE Mesotrione caused 10% injury or less to flax but gave less than 50% control of wild buckwheat and less than 80% control of redroot pigweed. As a result of poor weed control, yield of flax treated with PRE mesotrione was not different from untreated flax. POST mesotrione was more effective in controlling buckwheat and pigweed, generally providing greater than 80% broadleaf weed control on July 21, but flax exhibited significant bleaching injury on June 29, 24% to 29%. Plant recovered but 4% to 7% injury was still observed on July 21. POST mesotrione injury was reduced to 3% on June 29 when bromoxynil and MCPA was included. Bromoxynil and MCPA plus mesotrione gave 94% mustard control, 75% buckwheat control, and 77% pigweed control on July 21 and resulted in 28 bu flaxseed per acre.

Broadleaf weed control in Flax, Langdon 2004 (Lukach)

Nekoma flax was seeded May 27 at 40 lb/a. The experiment was over sprayed with 5 oz/a Select plus 1% petroleum oil on June 19. Treatments on June 25, applied to 2.5 inch tall flax, were finished at 3pm. All treatments which had not received a herbicide at 2.5 inches tall received MCPAester at 0.5 pt/a on June 28 because large wild mustard in bud stage were causing serious competition. The treatments July 6 were on six inch tall flax and finished at noon. Conditions on June 25 were 58F, 65RH, 7mph north wind with cloudy sky. Conditions on June 28 were 72F, 46RH, 10mph west wind with a clear sky. Conditions on July 6 were 63F, 56RH, 8mph north wind with a clear sky. A drift shield was used on all dates. Applications were made using a CO2 pressurized sprayer, mounted on tractor 3-point. Five nozzles in 20 inch spacing were used with DG8001.5 tips at 35psi and 4.2mph applying 10 gal/a solution. The trial had a RCBD design with four replications.

Broadleaf weed control in Flax, Langdon 2004		Flax at	Crop	Stand	Chlor				------------------- Aug 23 ------------------					
Treatment	Rate	Applic.	Inj	Redu	osis	Height		maturity	kocz	wibu	wimu	cano	coma	Yield
	oz/a product	inch	%	%	0 - 5	cm	cm	1 - 10	---------------		%	-------------		bu/a
BroAd + HarmonyGT	9.6 +.44	2.5	7	0	2	29	56	6	40	97	98	100	98	5
BroAd + HarGT	9.6 +.22	2.5	7	0	1	27	59	6	30	96	100	100	100	4
BroAd + HarGT	9.6 +.12	2.5	4	0	0	31	59	5	58	94	100	99	90	13
BroAd + HarGT	9.6 +.06	2.5	4	0	0	31	61	5	74	88	100	100	100	9
Bronate Advanced	9.6	2.5	0	0	0	31	58	4	60	85	100	75	70	7
Bronate Advanced	11.4	2.5	5	0	0	33	58	4	65	68	100	90	75	9
Bronate Advanced	17.1	2.5	8	0	0	25	58	3	79	79	100	85	90	10
BroAd / BroAd	9.6 / 9.6	2.5 / 6	13	0	0	28	54	4	96	95	100	90	99	8
CurtailM	21.3	2.5	7	0	1	38	59	4	38	60	99	96	30	5
CurtailM	28	2.5	8	0	2	35	56	4	23	95	100	99	100	4
CurtailM	16	2.5	0	0	0	36	58	5	33	71	98	80	50	3
Clarity	2	2.5	23	0	1	29	47	5	96	95	23	10	10	3
Clarity + HarGT	2+ 0.06	2.5	5	0	1	33	58	4	90	85	78	83	90	8
Clarity+HarGT+PO	2+ 0.3 +1%	2.5	30	0	1	28	60	6	95	85	63	78	70	7
BroAd+Buctril+HarGT+PO	9.6+9.6+.03+1%	2.5	5	0	1	32	58	5	63	87	100	83	100	10
BroAd+Buctril+HarGT	9.6+9.6+.03	2.5	3	0	0	33	59	5	73	86	100	95	75	7
BroAd+Buctril+HarGT+PO twice	9.6+9.6+.03+1%	2.5 & 6	8	0	0	23	57	7	100	100	100	100	98	8
Sparten / BroAd	4 / 9.6	2.5 / 6	11	0	1	30	57	5	97	98	91	98	95	10
Sparten + BroAd	4+9.6	2.5	50	11	2	21	55	7	85	82	66	85	75	4
Sparten+NIS / BroAd	4+.25% / 9.6	2.5 / 6	30	0	1	26	56	7	98	98	77	94	93	7
CurM+ Clarity+ HarGT+ PO	16+ 2+ 0.03+ 1%	2.5	37	20	1	28	54	8	98	87	100	83	93	4
CurM+ HarGT+ PO	16 + 0.03 +1%	2.5	13	0	1	33	64	6	64	95	100	100	98	7
HarGT + MCPAe + NIS	0.06 + 8 + .25%	2.5	8	0	0	29	52	5	3	96	100	100	100	2
HarGT+ MCPAe + PO	0.06 + 8 + 1%	2.5	7	0	2	28	59	6	33	94	100	100	100	5
MCPAe / BroAd+Buctril	8 \ 9.6+9.6													
+HarGT+PO	+.03+1%	3.5 / 6	5	0	1	20	51	6	90	85	100	95	85	7
MCPAe / BroAd+Buctril+HarGT	9.6+9.6+.03	3.5 / 6	4	0	3	24	52	6	97	63	100	90	73	5
MCPAe / BroAd + HarGT	9.6 +.44	3.5 / 6	8	0	4	23	48	6	73	95	100	100	100	3
MCPAe / BroAd + HarGT	9.6 +.22	3.5 / 6	13	0	2	20	49	5	73	97	100	100	100	3
MCPAe / BroAd + HarGT	9.6 +.12	3.5 / 6	13	0	3	23	57	6	61	87	100	100	100	4
MCPAe / BroAd + HarGT	9.6 +.06	3.5 / 6	13	0	2	26	54	6	73	81	100	95	95	3
MCPAe / Bronate Advanced	9.6	3.5 / 6	8	0	1	26	52	5	78	65	99	75	40	7
MCPAe	8.0	3.5	0	0	0	33	56	5	0	0	99	72	0	4
C.V. %			58	395	69	16	10	22	20	18	6	14	21	48
LSD 5%			11	5	1	6	8	2	18	21	8	17	34	4

NIS = AdWet90, PO = Vigor

Chlorosis 0=green, 5=yellow, Height measured July 13 and Aug 23. Maturity on Aug 23 1=end of bloom, 10 =early bloom

Flax yield was limited by the August 20 frost which also stopped kochia growth in the trial area. Flax growth should have supported 25-30 bu/a yields. Correlation of single variable measured to yield was low. The kochia in the area are sulfonylurea resistant. The Sparten applications were made to post emergent flax. The buctril mix with bronate is an attempt to increase contact control of kochia and wild buckwheat while reducing flax curling from MCPAe.

Volunteer canola control in flax. Jenks, Markle, and Willoughby. Neche flax was seeded May 18 at 60 lb/A into 7.5-inch rows. Canola was seeded over the top to simulate a volunteer canola (VC) situation. Individual plots were 10 x 30 ft and replicated 3 times. Herbicide treatments were applied preemergence (PRE) on May 18 with a bicycle sprayer delivering 20 gpa at 30 psi with XR 80015 nozzles. Air and soil temperatures were 80 and 61 F, respectively, relative humidity was 18%. Postemergence treatments were applied to 3-leaf canola on June 18 with a bicycle sprayer delivering 10 gpa at 40 psi through XR 8001 nozzles. Air and soil temperatures were 59 and 60 F, respectively, relative humidity was 42%. Treatments to 6-leaf canola were applied in the same fashion on June 28. Air and soil temperatures were 80 and 79 F, respectively, relative humidity was 31%.

In flax, soil-applied Spartan provided poor VC control. Bronate Advanced and MCPA ester provided excellent VC control when applied at the 3-leaf stage, but control dropped 10-15% when applied at the 6-leaf stage. Harmony GT provided only fair VC control early and poor control with the late application.

Table. Volunteer canola control in flax (2004).

			Volunteer Canola	
Treatment	Rate	Timing	Jul 8	Jul 28
			— % control —	
Spartan	4 oz	PRE	56	49
Bronate Advanced	0.8 pt	3-leaf	98	94
Bronate Advanced	0.8 pt	6-leaf	70	79
MCPA ester	0.5 pt	3-leaf	82	95
MCPA ester	0.5 pt	6-leaf	48	85
Harmony GT	0.25 oz	3-leaf	83	72
Harmony GT	0.25 oz	6-leaf	23	33
Untreated			0	0
LSD (0.05)			19	22
CV			19	20

Flax Weed Control (Gregoire, 2004) Flax was sprayed at 4:00 p.m. June 14th near Webster, North Dakota. The temperature during application was 62ø, relative humidity near 56% and clear skies. The flax was 3-4" tall. Treatments were applied with a CO2 pressurized back pack sprayer using 8.5 gpa at 40 psi and 8001 nozzles. Treatments were arranged in RCBD and replicated 3 times. Wild mustard, redroot pigweed, kochia and other broadleaf weeds were in the 4 leaf stage. Spartan was sprayed postemergence at the same time as other treatments. Treatments were evaluated July 9th for injury and July 28th for weed control.

			7/9/04	7/28/04		
	Treatment	Product	Injury	Wild Oat	Kochia	Yield
		Oz Per Acre	Inch height reduction	-Percent Control-		bu/A
1	Select	5 OZ/A	0.0	100	100	26
	Bronate Advanced	12.8 OZ/A				
	PO	1% V/V				
2	Select	5 OZ/A	10.7	98	100	18
	Bronate Advanced	12.8 OZ/A				
	PO	1% V/V				
	Harmony GT	0.165 OZ/A				
3	Select	5 OZ/A	8.7	100	100	19
	Bronate Advanced	12.8 OZ/A				
	PO	1% V/V				
	Harmony GT	0.082 OZ/A				
4	Select	5 OZ/A	13.0	98	100	14
	Bronate Advanced	12.8 OZ/A				
	PO	1% V/V				
	Harmony GT	0.33 OZ/A				
5	Select	5 OZ/A	1.0	18	100	23
	PO	1% V/V				
	Curtail M	24 OZ/A				
	Harmony GT	0.33 OZ/A				
6	Assure	5 OZ/A	3.0	99	0	20
	PO	1% V/V				
	Curtail M	24 OZ/A				
	Clarity	2 OZ/A				
7	Spartan	4 OZ/A	0.0	0	78	23
	LSD (P=.05)		1.24	12	0	6.4

The addition of Harmony GT to Select/Bronate Advanced tank mix significantly increased flax injury compared to the Select/Bronate tank mix. The terminal buds were killed and yield came from auxiliary bud growth. The stems of Harmony GT treated flax were green at harvest. The addition of Harmony GT to Select/Curtail tank mix did not differ from the Select/Bronate Advanced tank mix for kochia control injury or yield. However, due to ALS resistant kochia in this plot area, kochia control was not adequate. The Clarity/Curtail M tank mix severely reduced wild oat control with Assure. Spartan applied post emergence did not injure flax. The Summer was record cool and wet and may have contributed to injury development.

<u>Flax response to V10137, a new clethodim formulation</u>. (Kirk Howatt, Ronald Roach, and Janet Harrington). 'ND009' flax was seeded May 4. Treatments were applied to 4-inch tall flax, 6-inch tall wild mustard, 2-inch tall redroot pigweed, 3-leaf yellow foxtail, and 4-leaf volunteer oat on June 22 with 53 F air temperature, 65% RH, 100% cloud cover, 3 to 4 mph west wind, and 58 F soil temperature. Treatments were applied with a backpack sprayer delivering 8.5 gpa at 40 psi through TT 11001 flat-fan nozzles to a 7 ft wide area the length of 10 by 30 ft plots. The experiment had a randomized complete-block design with four replicates.

Table. Flax response and weed control with V10137.

		June 29					July 21					August 10		
Treatment[1]	Rate	Flax	Wimu	Rrpw	Yeft	Oat	Flax	Wimu	Rrpw	Yeft	Oat	Rrpw	Yeft	Oat
	oz ai/A	%	%	%	%	%	%	%	%	%	%	%	%	%
Clethodim+PO+AMS	2 + 1% + 32	0	0	0	83	81	0	0	0	99	99	0	99	99
V10137+NIS+AMS	2 + 0.25% + 32	1	0	0	84	80	0	0	0	99	99	0	99	99
V10137+NIS+AMS	1.5 + 0.25% + 32	0	0	0	81	81	0	0	0	99	99	0	99	99
Clet+brox&MCPA+ PO+AMS	2 + 7.1 + 1% + 32	0	90	71	79	78	0	91	64	99	99	50	99	99
V10137+brox&MCPA+ PO+AMS	2 + 7.1 + 1% + 32	1	90	66	80	78	0	93	59	99	99	33	99	99
V10137+brox&MCPA+ NIS+AMS	2 + 7.1 + 0.25% + 32	1	90	70	84	83	0	93	69	98	99	68	99	99
V10137+brox&MCPA+ NIS+AMS	1.5 + 7.1 + 0.25% + 32	0	90	70	83	84	0	94	60	99	99	50	99	99
V10137+brox&MCPA+ AMS	2 + 7.1 + 32	4	90	71	85	65	0	91	60	99	99	60	99	99
V10137+brox&MCPA+ AMS	1.5 + 7.1 + 32	5	89	83	85	85	0	93	60	98	99	53	99	99
Untreated	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CV		156	1	7	3	18	0	4	18	1	0	17	0	0
LSD (P=0.05)		3	1	4	3	19	0	3	9	1	0	8	0	0

[1]Clethodim was Select; PO was herbimax; AMS was ammonium sulfate; V10137 was a new clethodim formulation; and NIS was Activator 90.

V10137 at 1.5 or 2 oz ai/A performed similar to clethodim at 2 oz ai/A, providing 98% to 99% control of yellow foxtail and volunteer oat on July 21. V10137 caused 5% flax injury or less on June 29, but injury was not apparent on July 21. Clethodim did not antagonize control of wild mustard with bromoxynil and MCPA, which provided 91% to 94% control on July 21. Redroot pigweed control varied from 33% to 83%, but there was not a consistent trend in effect of clethodim formulation or clethodim application rate. Pigweed control was less than 70% with bromoxynil and MCPA on August 10, and a preharvest glyphosate application would have been necessary to improve harvest efficiency.

Flax response to thifensulfuron rate, Fargo. (Kirk Howatt, Ronald Roach, Janet Harrington). 'ND009' flax was seeded May 4, 2004. An experiment was established to determine the rate of thifensulfuron to provide 90% control of redroot pigweed in flax and evaluate the effect of this rate on flax. Treatments were applied to 3 inch tall flax and 1 to 2 inch tall redroot pigweed on June 22 with 53 F air temperature, 68% RH, 100% cloud cover, 2 to 3 mph wind, and 58 F soil temperature. Treatments were applied to 6 inch tall flax and 3 to 5 inch tall redroot pigweed on June 29 with 81 F air temperature, 37% RH, clear sky and 3 mph west wind. All treatments were applied with a backpack sprayer delivering 8.5 gpa at 40 psi through TT 11001 flat-fan nozzles to a 7 ft wide area the length of 10 by 30 ft plots. The experiment was a randomized compete-block design with four replicates. Flax was harvested with a small-plot combine on September 27.

Table. Flax response to thifensulfuron rate, Fargo.

					Flax			
		Flax at	Rrpw		July 27			Sept. 27
Treatment	Rate	application	July 21	Aug. 04	Stand	Height	Bolls	Yield
	oz ai/A	inches	%	%	no./m	inches	no./plant	bu/A
Broomoxynil&MCPA+ thifensulfuron	6 + 0.22	3	98	99	19	25	34	30
Brox&MCPA+thif	6 + 0.11	3	97	97	18	24	34	29
Brox&MCPA+thif	6 + 0.06	3	99	98	18	22	35	27
Brox&MCPA+thif	6 + 0.03	3	98	94	19	23	35	28
Brox&MCPA	6	3	87	80	18	24	32	23
Brox&MCPA+thif	6 + 0.22	6	91	95	17	23	31	23
Brox&MCPA+thif	6 + 0.11	6	94	93	18	23	30	22
Brox&MCPA+thif	6 + 0.06	6	89	88	16	23	30	20
Brox&MCPA+thif	6 + 0.03	6	84	85	17	25	36	20
Brox&MCPA	6	6	66	67	16	24	37	16
Untreated	0		0	0	15	23	28	9
CV			3	5	12	7	3	14
LSD (P=0.05)			3	6	3	2	12	4

Weather conditions caused slight chlorosis and stunting in all treatments, but herbicide treatments did not cause greater injury than in the untreated flax (data not shown). Thifensulfuron at as low a rate as 0.03 oz ai/A increased control of redroot pigweed obtained with bromoxynil and MCPA. Tank-mix with thifensulfuron at 0.03 oz ai/A applied when flax was 3 inches tall, 1 to 2 inch tall pigweed, provided 94% pigweed control. When plants were larger, thifensulfuron at 0.11 oz ai/A with bromoxynil and MCPA was required for greater than 90% pigweed control. Better pigweed control resulted in greater yield of flax treated with thifensulfuron compared with flax treated with bromoxynil and MCPA alone. Thifensulfuron did not affect flax stand, height, or boll production on July 27.

<u>Flax response to thifensulfuron rate, Prosper</u>. (Kirk Howatt, Ronald Roach, Janet Harrington). An experiment was established to determine the rate of thifensulfuron to provide 90% control of redroot pigweed in flax and evaluate the effect of this rate on flax. 'ND009' flax was seeded May 4. Treatments were applied to 3 to 4 tall inch flax and 0.5 to 1 inch tall redroot pigweed on June 14 with 72 F air temperature, 47% RH, 30% cloud cover, 0 to 2 mph north wind, and 74 F soil temperature. Treatments were applied to 6 inch flax and 2 to 4 inch redroot pigweed on June 25 with 78 F air temperature, 32% RH, 97% cloud cover, and 7 to 9 mph northwest wind. All treatments were applied with a backpack sprayer delivering 8.5 gpa at 40 psi through TT 11001 flat-fan nozzles to a 7 ft wide area the length of 10 by 30 ft plots. The experiment was a randomized complete-block design with four replicates. Flax could not be harvested because of severe lodging.

Table. Flax response to thifensulfuron rate, Prosper.

		Flax at	July 01			July 16			July 27	August 04			August 12	
Treatment	Rate	application	Chlor.[1]	Stunt.[2]	Rrpw	Chlor.	Stunt.	Rrpw	Flax	Chlor.	Stunt.	Rrpw	Height	Bolls
	oz ai/A	inches	%	%	%	%	%	%	no./m	%	%	%	inches	no./plant
Bromoxynil&MCPA+ thifensulfuron	6 + 0.22	3	1	24	99	0	0	99	23	0	0	99	26	26
Brox&MCPA+thif	6 + 0.11	3	2	21	99	0	0	99	23	0	0	99	23	35
Brox&MCPA+thif	6 + 0.06	3	0	13	98	0	0	98	21	0	0	96	25	37
Brox&MCPA+thif	6 + 0.03	3	1	23	97	0	0	94	25	0	0	94	25	43
Brox&MCPA	6	3	0	10	88	0	0	76	23	0	0	80	25	32
Brox&MCPA+thif	6 + 0.22	6	14	35	85	0	9	96	22	0	0	97	25	35
Brox&MCPA+thif	6 + 0.11	6	9	29	85	0	9	96	20	0	0	97	26	34
Brox&MCPA+thif	6 + 0.06	6	2	20	80	0	6	92	20	0	0	95	26	32
Brox&MCPA+thif	6 + 0.03	6	4	18	80	0	4	86	19	0	0	87	24	35
Brox&MCPA	6	6	2	13	63	0	0	61	25	0	0	65	26	30
Untreated	0		0	0	0	0	0	0	18	0	0	0	25	32
CV			82	25	3	0	143	5	14	0	0	6	8	2
LSD (P=.05)			4	7	3	0	5	6	5	0	0	7	3	7

[1]Chlor. was visually estimated chlorosis of flax.
[2]Stunt. was visually estimated stunting of flax.

Minimal chlorosis remained on July 1 from herbicides applied to 3 inch flax, but treatments on 6 inch flax caused as much as 14% chlorosis. Chlorosis of flax was not observed on other evaluation dates. Herbicides caused 10% to 35% stunting of flax on July 1. Inclusion of thifensulfuron with bromoxynil and MCPA increased the severity of stunting, but only 6-inch flax demonstrated greater stunting as thifensulfuron rate increased. Thifensulfuron stunting of flax was still apparent on July 16 but had disappeared by August 4, and flax height in herbicide plots was similar to untreated flax on August 12. Flax population and boll production were essentially similar across herbicide treatments, with the exception that bromoxynil and MCPA plus thifensulfuron at 0.03 oz ai/A applied to 3-inch flax resulted in more bolls per plant than most treatments and thifensulfuron at 0.22 oz ai/A applied to 3-inch flax resulted in fewer bolls per plant. Thifensulfuron at 0.03 oz ai/A at the 3-inch application increased bromoxynil and MCPA control of redroot pigweed from 76% to 94%, but thifensulfuron at 0.06 was necessary to give greater than 90% pigweed control for the 6-inch application.

Flax response to thifensulfuron, Williston 2004. 'Neche' flax was planted on Re-crop (land cropped to durum wheat in 2003) in 6 inch rows at 40 lbs/a on June 2. The early treatments were applied on June 26 to 3 inch flax and low populations of Russian thistle, common lambsquarters, redroot pigweed and green foxtail, all less than one tall, with 53 F, 72% RH, 5% clear sky and 0-2 mph SE wind and moist plants and dry topsoil at 75 F. Later treatments were applied on July 3 to six inch flax and to 2-3 inch weed species named above, with 71 F, 55% RH, 95% clear sky and 3-5 mph NNW wind and dry plants and dry topsoil at 66 F. We used a small plot sprayer with wind cones, mounted on a G-Allis Chalmers tractor to apply the treatments, delivering 8.6 gals/a at 30 psi through 8001vs flat fan nozzles to a 6.67 ft wide area the length of 10 by 25 ft plots. First rain received after the early application was 0.06 inches on June 26,about 10 hours after application. First rain received after the later application was 0.10 inches on July 4 The experiment was a randomized complete block design with four replications. Select at 8 oz/a product was applied to the whole plot area to control grassy weeds. Broadleaf weed control was not rated. Plots were evaluated for crop injury on July 8 by visually rating plant chlorosis and stunting. On July 31 crop injury was visually rated by recording the delay in flowering and reduction in plant height. Flax was machine harvested for yield on October 3.

			July 8		July 31			
	Rate		Crop Inj*		Crop Inj$		Test	Seed
Treatment [a]	oz/a	Stage	Chlor	Snt	Flwer	Ht	Weight	Yield
		in.	-- %	---	-- %	---	lbs/bu	bus/a
Brox&MCPA5+Thif-sg	6+0.22	3	8	35	11	1	53.4	25.9
Brox&MCPA5+Thif-sg	6+0.11	3	7	29	10	1	53.7	27.5
Brox&MCPA5+Thif-sg	6+0.06	3	6	25	6	0	53.5	25.7
Brox&MCPA5+Thif-sg	6+0.03	3	5	21	7	0	53.6	26.2
Brox&MCPA5	6	3	1	14	3	1	53.6	23.2
Brox&MCPA5+Thif-sg	6+0.22	6	10	18	9	18	53.4	21.3
Brox&MCPA5+Thif-sg	6+0.11	6	15	15	12	21	53.7	21.9
Brox&MCPA5+Thif-sg	6+0.06	6	8	15	8	10	53.3	23.8
Brox&MCPA5+Thif-sg	6+0.03	6	7	13	6	6	53.7	28.0
Brox&MCPA5	6	6	0	6	2	1	53.8	23.1
Untreated	0	0	0	0	0	0	53.7	25.3
EXP MEAN			6	17	7	5	53.6	24.7
C.V. %			33	27	33	55	.4	9.4
LSD 5%			3	7	3	4	NS	3.3

* - Crop injury as measured by Chlor=plant chlorosis and Snt= plant stunting.
$ - Crop injury as measured by Flwr=delay in flowering date and Ht= plant height reduction.

Summary: Flax injury occurred as delay of flowering and as plant height reduction. Thifensulfuron delayed flowering and thus maturity date for all treatments but the delay was greatest at the highest application rates. Thifensulfuron appeared to reduce plant height only at the 6 inch application date and especially at the two highest application rates. Flax yields were reduced 15% at these rates.

Flax response to application timing, Fargo. (Kirk Howatt, Ronald Roach, and Janet Harrington). An experiment was established to determine the response of flax to thifensulfuron at various application timings for improvement of redroot pigweed control. 'ND009' flax was seeded May 4. All treatments were applied with a backpack type sprayer delivering 8.5 gpa at 35 or 40 psi through TT 11001 flat fan nozzles to a 7 ft wide area the length of 10 by 30 ft plots (Table 1). The experiment was a randomized complete block design with four replicates.

Table 1. Application conditions.

Application timing	2-inch flax	4-inch flax	6-inch flax	8-inch flax	10-inch flax
Date	June 14	June 22	June 25	June 29	July 1
Temperature, F	74	53	63	81	70
RH, %	50	68	46	37	45
Sky, % cloud cover	40	100	96	0	0
Wind, mph and direction	5, N	2 to 3, W	7 to 9, NW	3, W	5 to 7 NE
Soil temperature, F	70	58	-	-	75

Table 2. Flax response to application timing, Fargo.

			July 01		July 21			July 27		August 04		Sept. 27
Treatment[1]	Rate	Timing	Chlor.[2]	Stunt.[3]	Chlor.	Stunt.	Stand	Height	Bolls	Chlor.	Stunt.	Yield
	oz ai/A	inches	%	%	%	%	no./m	inches	no./plant	%	%	bu/A
Bromoxynil&MCPA+	6 +	2	16	38	0	0	19	25	35	0	0	26
thifensulfuron+clethodim+PO	0.22 +1+1%											
Brox&MCPA+thif+clet+PO	6 + 0.06 +1+1%	2	19	23	0	0	20	24	33	0	0	25
Brox&MCPA+thif+clet+PO	6 + 0.22 +1+1%	4	14	30	0	1	21	24	41	0	0	27
Brox&MCPA+thif+clet+PO	6 + 0.06 +1+1%	4	10	30	0	0	18	23	32	0	0	24
Brox&MCPA+thif+clet+PO	6 + 0.22 +1+1%	6	15	28	0	1	19	23	30	0	0	20
Brox&MCPA+thif+clet+PO	6 + 0.06 +1+1%	6	11	20	0	0	19	22	40	0	0	22
Brox&MCPA+thif+clet+PO	6 + 0.22 +1+1%	8	5	0	0	5	19	24	34	0	0	19
Brox&MCPA+thif+clet+PO	6 + 0.06 +1+1%	8	5	1	0	4	18	23	27	0	0	22
Brox&MCPA+thif+clet+PO	6 + 0.22 +1+1%	10	0	0	0	5	17	20	31	0	0	17
Brox&MCPA+thif+clet+PO	6 + 0.06 +1+1%	10	0	0	0	6	17	23	29	0	0	19
Untreated	0		0	0	0	0	14	21	32	0	0	7
CV			51	46	0	111	11	6	20	0	0	18
LSD (P=0.05)			6	10	0	3	3	2	9	0	0	5

[1]PO was Herbimax petroleum oil concentrate.
[2]Chlor. was visually estimated chlorosis of flax.
[3]Stunt. was visually estimated stunting of flax.

Herbicide treatments caused short-term chlorosis and stunting regardless of thifensulfuron rate or application timing, but chlorosis was not observed by July 21 (Table 2). Herbicides did not shorten flax compared with the untreated on July 27, but delaying application tended to reduce plant height. Delaying application also tended to reduce flax population, but flax in all herbicide treatments had a higher population than the untreated. Thifensulfuron rate did not affect seed yield within application timing, but delaying application reduced seed yield. Herbicide application to 4-inch flax or less resulted in the highest flax yield.

Flax response to application timing, Prosper. (Kirk Howatt, Ronald Roach, and Janet Harrington). An experiment was established to determine the response of flax to thifensulfuron at various application timings for improved redroot pigweed control. 'ND009' flax was seeded May 7. All treatments were applied with a backpack sprayer delivering 8.5 gpa at 40 psi through TT 11001 flat-fan nozzles to a 7 ft wide area the length of 10 by 30 ft plots (Table 1). The experiment was a randomized complete-block design with four replications. Flax was not harvested because of severe lodging.

Table 1. Application conditions.

Treatment	2-inch flax	4-inch flax	6-inch flax	8-inch flax	10-inch flax
Date	June 7	June 14	June 22	June 25	June 29
Temperature, F	77	72	72	78	82
RH, %	76	47	29	32	38
Sky, % cloud cover	10	30	60	97	0
Wind, mph and direction	6 to 8, SW	0 to2, N	2, W	7 to 9, NW	7 to 10, W
Soil temperature, F	67	74	70	-	-

Table 2. Flax response to application timing, Prosper.

			July 01		July 16		July 27	August 04		August 12	
Treatment[1]	Rate	Timing	Chlor.[2]	Stunt.[3]	Chlor.	Stunt.	Stand	Chlor.	Stunt.	Height	Bolls
	oz ai/A	inches	%	%	%	%	no./m	%	%	inches	no./plant
Bromoxynil&MCPA+	6 +	2	0	20	0	0	23	0	0	26	31
thifensulfuron+clethodim+PO	0.22+1+1%										
Brox&MCPA+thif+clet+PO	6 + 0.06 +1+1%	2	0	21	0	0	25	0	0	26	38
Brox&MCPA+thif+clet+PO	6 + 0.22 +1+1%	4	0	15	0	4	21	0	0	23	32
Brox&MCPA+thif+clet+PO	6 + 0.06 +1+1%	4	0	19	0	4	22	0	0	25	36
Brox&MCPA+thif+clet+PO	6 + 0.22 +1+1%	6	0	13	0	9	20	0	0	24	39
Brox&MCPA+thif+clet+PO	6 + 0.06 +1+1%	6	4	25	0	14	24	0	0	26	45
Brox&MCPA+thif+clet+PO	6 + 0.22 +1+1%	8	9	10	0	14	23	0	0	25	37
Brox&MCPA+thif+clet+PO	6 + 0.06 +1+1%	8	8	8	0	10	19	0	0	24	43
Brox&MCPA+thif+clet+PO	6 + 0.22 +1+1%	10	6	0	0	15	20	0	0	27	35
Brox&MCPA+thif+clet+PO	6 + 0.06 +1+1%	10	4	0	0	11	21	0	0	26	37
Untreated	0		0	0	0	0	17	0	0	26	24
CV			65	27	0	44	12	0	0	10	2
LSD (P=0.05)			3	5	0	5	4	0	0	4	11

[1]PO was Herbimax petroleum oil concentrate.
[2]Chlor. was visually estimated chlorosis of flax.
[3]Stunt. was visually estimated stunting of flax.

All herbicide treatments caused chlorosis of less than 10%, but chlorosis from 2-inch and 4-inch applications was not visible on July 1. Chlorosis was not observed on August 4. Flax stunted from herbicide, 10% to 25%, had recovered by August 4. Flax population tended to be greater with herbicide than in untreated plots. Flax tended to produce more bolls per plant when thifensulfuron was included at 0.06 oz ai/A compared with 0.22 zo ai/A. Flax treated with herbicide produced more bolls, but there was not a strong trend for reduced boll numbers with delayed herbicide application.

Fall vs. spring herbicide applications for weed control in lentil. Jenks, Markle, and Willoughby. 'Mountrail' durum was seeded April 23 at 120 lb/A into 7.5-inch rows. Spartan was applied preemergence at 5.33 oz in durum in Spring 2003 (April 29). Individual plots were 10 x 30 ft and replicated 3 times. Plot corners were maintained from 2003 to 2004. Spartan, Prowl, Pursuit, and Sonalan were applied to durum stubble in Fall 2003 (Oct 6) and preemergence (PRE) in Spring 2004 (May 10). Merrit lentils were seeded May 6, 2004 at 80 lb/A into 7.5-inch rows.

Spring 2003 treatments were applied April 29 with a bicycle sprayer delivering 20 gpa at 30 psi through XR 80015 nozzles. Air and soil temperatures were 49 and 51 F, respectively, relative humidity was 47%. Fall 2003 treatments were applied October 6 with a bicycle sprayer delivering 20 gpa at 30 psi through XR 80015 nozzles. Air and soil temperatures were 82 and 65 F, respectively, relative humidity was 12%. Meritt lentils were then seeded May 6 at 80 lb/A into 7.5-inch rows. Herbicide treatments were applied preemergence (PRE) May 10 with a bicycle sprayer delivering 20 gpa at 30 psi through XR 80015 nozzles. Air and soil temperatures were 48 and 51 F, respectively, relative humidity was 26%.

Spartan alone or tank mixed with Prowl or Sonalan reduced lentil densities. Spartan tank mixed with Prowl or Sonalan reduced crop densities and increased visible crop injury more than when the herbicides were applied alone. Crop injury was consistently higher with the spring application compared to the fall application. Prowl alone or tank mixed with Pursuit provided better kochia control when applied in the spring, but also resulted in more crop injury. Spartan generally provided good to excellent kochia control. The Spartan application in the previous year (Spring 2003) caused moderate crop injury, but only provided 76% kochia control.

The PRE treatments were applied on May 10. Within three days, 1.3 inches of precipitation fell in the form of rain and snow. Within three weeks after the PRE application, the area had 3.2 inches of precipitation and generally cold conditions.

Table. Fall vs. spring herbicide applications for weed control in lentil.

			Lentil			Kochia	
Treatment[a]	Rate	Timing	Jun 4	Jun 18	Jul 13	Jun 22	Jul 13
	product / A		pl / m row	—% injury—		—% control —	
Spartan	5.33 oz	Spring 2003	10.8	27	16	82	76
Spartan	2.67 oz	Fall 2003	11.4	16	10	95	89
Spartan	4 oz	Fall 2003	9.6	29	23	97	91
Spartan	2.67 oz	PRE 2004	8.2	46	42	92	79
Prowl	3 pt	Fall 2003	13.7	9	5	77	62
Prowl H20	2 pt	PRE 2004	13.6	27	16	90	72
Prowl + Pursuit	3 pt + 2 fl oz	Fall 2003	12.9	10	4	81	65
Prowl H20 + Pursuit	2 pt + 1 fl oz	PRE 2004	12.0	19	14	93	88
Spartan + Prowl	2.67 oz + 3 pt	Fall 2003	10.0	33	21	98	94
Spartan + Prowl H20	2.67 oz + 2 pt	PRE 2004	4.5	82	75	99	89
Sonalan	3 pt	Fall 2003	12.3	12	5	70	56
Sonalan	2 pt	PRE 2004	14.0	14	8	77	61
Spartan + Sonalan	2.67 oz + 3 pt	Fall 2003	9.7	40	31	97	94
Spartan + Sonalan	2.67 oz + 2 pt	PRE 2004	5.4	73	60	92	82
Handweeded check			14.1	--	--	--	--
LSD (0.05)			3.1	27	22	14	15
CV			17.0	55	60	10	12

[a]*Assure II plus COC at 8 oz + 1% v/v, respectively, were applied postemergence in 2004 to all treatments.*

Lentil response to preemergence herbicides. Jenks, Markle, and Willoughby. 'Merrit' lentils were direct-seeded May 6 at 80 lb/A into 7.5-inch rows. Individual plots were 10 x 30 ft and replicated 3 times. Herbicide treatments were applied preemergence (PRE) on May 10 with a bicycle spray delivering 10 gpa at 40 psi through XR 8001 nozzles. Air and soil temperatures were 54 and 56 F, respectively, relative humidity was 22%.

Express and Harmony GT applied PRE caused moderate to severe lentil injury at the June and July ratings. Harmony GT caused more visible crop injury as well as a greater reduction in crop density. Aim caused little or no crop injury. 2,4-D ester caused very severe crop injury and reduced crop density by one-half.

The PRE treatments were applied on May 10. Within three days, 1.3 inches of precipitation fell in the form of rain and snow. Within three weeks after the PRE application, the area had 3.2 inches of precipitation and generally cold conditions.

Table. No-till lentil response to preemergence herbicides.

			Lentil			
Treatment[a]	Rate	Timing	Jun 3	Jul 6	Jun 22	Jul 13
	product / A		plants / m row		——% injury ——	
Roundup UltraMax II	11 fl oz	PRE	13.8	11.0	0	0
Express	0.167 oz	PRE	14.5	10.1	18	14
Express	0.33 oz	PRE	13.2	10.7	23	23
Harmony GT	0.3 oz	PRE	12.7	8.5	50	53
Harmony GT	0.6 oz	PRE	13.3	7.9	83	78
Aim	0.5 fl oz	PRE	15.0	10.1	2	3
2,4-D ester	0.5 pt	PRE	7.3	4.6	87	87
Untreated			15.2	10.2	0	0
LSD (0.05)			2.4	2.4	8	9
CV			10.5	14.8	14	16

[a]*Roundup UltraMax II at 11 oz plus AMS at 2.5 gal/100 gal were applied PRE with all treatments.*

Lentil tolerance to herbicides. Jenks, Markle, and Willoughby. Merrit lentils were seeded May 6 in a conventional-till system at 80 lb/A into 7.5-inch rows. Individual plots were 10 x 30 ft and replicated 3 times. Herbicide treatments were applied preplant incorporated (PPI) May 6 with a tractor sprayer delivering 20 gpa at 30 psi through XR 80015 nozzles. Air and soil temperatures were 52 and 50 F, respectively, relative humidity was 26%. Preemergence (PRE) treatments were applied May 10 with a bicycle sprayer delivering 20 gpa at 30 psi through XR 80015 nozzles. Air and soil temperatures were 56 and 55 F, respectively, relative humidity was 23%. Postemergence treatments were applied at 2-node, and 5-node lentils on June 3, and June 16, respectively, with a bicycle sprayer delivering 10 gpa at 40 psi through XR 8001 nozzles. Air and soil temperatures were 83 and 64 F, respectively, relative humidity was 32% on June 3. Air and soil temperatures were 60 and 54 F, respectively, relative humidity was 70% on June 16. The primary weeds evaluated were redroot pigweed (Rrpw), kochia, and wildbuckwheat (Wibw).

All herbicide treatments caused moderate to severe crop injury. Spartan, Express, and Harmony GT applied PRE reduced crop density. Spartan tank mixed with Prowl caused more crop injury than either herbicide applied alone. Sencor applied PRE or POST caused severe crop injury. Prowl caused more injury applied PRE than PPI, but kochia and pigweed control was significantly less PPI than PRE.

The injury observed in this study may be viewed as a worst case scenario given the weather conditions of 2004. The PRE treatments were applied on May 10. Within three days, 1.3 inches of precipitation fell in the form of rain and snow. Within three weeks after the PRE application, the area had 3.2 inches of precipitation and generally cold conditions.

Table. Conventional-till lentil tolerance to PRE and POST herbicides

			Lentil			Rrpw		Kocz		Wibw	
Treatment	Rate	Timing	Jun 3	Jun 23	Jul 13	Jun 23	Jul 13	Jun 23	Jul 13	Jun23	Jul13
	product / A		# / m row	—% injury —		% control					
Sonalan	2 pt	PPI	13.4	18	20	94	82	91	78	93	83
Prowl H20	2 pt	PPI	14.1	15	15	86	61	82	47	81	53
Prowl H20	2 pt	PRE	13.4	30	37	96	87	95	88	85	37
Spartan	1.5 oz	PRE	7.6	43	44	96	83	100	98	89	62
Spartan	2 oz	PRE	5.3	69	73	100	96	100	98	98	76
Spartan	2.5 oz	PRE	4.7	77	68	100	92	100	100	98	89
Spartan	3 oz	PRE	3.8	83	82	100	97	100	99	100	96
Spartan + Prowl H20	1.5 oz + 2 pt	PRE	6.8	73	68	100	95	100	95	99	81
Spartan + Prowl H20	2.5 oz + 2 pt	PRE	5.3	86	77	100	96	100	100	99	93
Sencor	0.33 lb	PRE	13.1	42	65	98	95	98	93	85	33
Sencor / Sencor	0.167 lb / 0.167 lb	2-node / 5-node	14.1	85	85	100	95	100	93	100	89
Sencor	0.167 lb	5-node	14.0	43	44	90	52	83	35	85	23
Untreated			14.6	0	0	0	0	0	0	0	0
Express	0.33 oz	PRE	12.4	21	31	30	10	0	3	13	0
Harmony GT	0.6 oz	PRE	10.5	75	68	100	100	0	0	50	0
LSD (0.05)			2.0	14	21	5	18	6	11	10	19
CV			11.6	16	24	3	14	4	10	8	21

No-till lentil tolerance to herbicides (Williston). Jenks, Riveland, Markle, and Willoughby. 'Richlea' lentils were seeded May 4 at the Williston REC. Individual plots were 10 x 30 ft and replicated 3 times. Herbicide treatments were applied preemergence (PRE) on May 7 with a bicycle sprayer delivering 20 gpa at 30 psi through XR 80015 nozzles. Air and soil temperatures were 68 and 57 F, relative humidity was 20%. The 3-node treatment was applied June 2 with a bicycle sprayer delivering 10 gpa at 40 psi through XR 8001 nozzles. Air and soil temperatures were 78 and 64 F, relative humidity was 49%. The primary weeds evaluated were green foxtail (Grft), Russian thistle (Ruth), and kochia. Glyphosate was applied with each PRE treatment. Select was applied postemergence to control grasses.

None of the treatments in this study are labeled for use with the exception of glyphosate alone. Prowl is labeled as a PPI application. All herbicide treatments in the study caused visible crop injury. All Spartan treatments caused a slight reduction in lentil density, but yields were generally as high as other treatments. Prowl, Pursuit, and Sencor applied alone or as a tank mix caused slight to moderate crop injury. Express and Harmony GT applied PRE with glyphosate also caused slight to moderate crop injury. Spartan provided good to excellent weed control. Prowl, Sencor, and Pursuit generally provided less Russian thistle control compared to Spartan.

Table. No-till lentil tolerance to herbicides (Williston).

			Lentil			Grft		Ruth		Kocz		
Treatment[a]	Rate	Timing	Jun 2	Jun 6	Jun 30	Jun 6	Jun 30	Jun 6	Jun 30	Jun 6	Jun 30	Yield
	product / A		# / m row	% injury		% control						lb/A
Prowl H20	2 pt	PRE	12.4	10	12	93	95	70	53	92	92	990
Spartan	1 oz	PRE	11.7	16	18	37	95	78	83	97	97	1550
Spartan	1.5 oz	PRE	9.8	23	22	53	95	96	91	100	100	1530
Spartan	2 oz	PRE	9.3	24	33	58	95	96	99	100	100	1400
Pursuit	0.72 oz	PRE	16.2	9	12	82	95	67	70	100	88	1400
Spartan + Prowl H20	1 oz + 2 pt	PRE	10.8	21	22	96	95	99	88	100	97	1560
Spartan + Prowl H20	2 oz + 2 pt	PRE	8.9	30	25	97	95	95	91	100	100	1730
Sencor + Prowl H20	0.25 lb + 2 pt	PRE	12.7	15	13	93	95	78	67	100	100	1540
Prowl H20 + Sencor/ Sencor	2 pt + 0.167 lb/ 0.167 lb	PRE/ 3-node	13.7	18	17	96	95	92	86	100	99	1470
Express	0.083 oz	PRE	15.5	10	12	0	95	13	0	0	0	1190
Express	0.167 oz	PRE	13.7	11	12	0	95	20	0	0	0	1040
Harmony GT	0.125 oz	PRE	14.6	8	17	0	95	7	0	0	0	1140
Harmony GT	0.25 oz	PRE	15.0	9	23	0	95	7	7	0	0	1100
Roundup	11 fl oz	PRE	15.1	0	2	0	95	0	0	0	0	1160
Untreated			14.1	0	0	0	0	0	0	0	0	1280
LSD (0.05)			2.9	6	12	11	NS	17	15	7	10	NS
CV			13.2	25	46	14	0	19	18	7	10	21

[a]*Each PRE treatment was applied with Roundup UltraMax II at 11 oz. Select at 5 oz plus COC at 1%v/v was also applied POST to each treatment for grass control.*

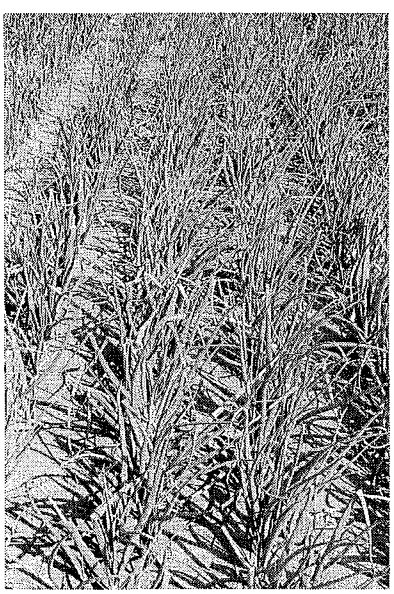
Broadleaf weed control in onion. Paul Hendrickson and Harlene Hatterman-Valenti. An experiment was conducted at the Carrington Research Extension Center to evaluate broadleaf weed control in onion. 'Teton' onion was seeded April 28, 2004 in 4-inch paired rows on 16-inch centers at 167,000 seeds/A. The experimental design was a randomized complete block design with four replicates. Application dates, timings, and environmental conditions are listed in Table 1. Post-emergence treatments of bromoxynil and/or oxyfluorfen were applied through XR 11006 flat fan nozzles delivering 40 gpa at 30 psi. All other treatments were applied through XR 8003 flat fan nozzles delivering 20 gpa at 30 psi. Best management practices were used for fertility, disease, insect, and grass control. All herbicide treatments were applied to 6 ft by 25 ft plots with a CO_2 hand-boom sprayer. The onions were harvested October 3, placed in a forced air drier for 48 hours, and graded by the end of October. Split and diseased bulbs were graded as culls regardless of diameter.

V-10146 caused significant crop injury (Table 2). Crop injury was minimal with all other herbicide treatments. Most of the wild mustard had emerged by the PRE1 timing and was controlled by PRE1applications that included glyphosate and bromoxynil (data not shown). With the exception of treatments 15 and 16, weed control was near 100% when evaluated 6/22, 7/19, and Oct 31 (data not shown). The weed-free check had the highest numerical number of bulbs/acre, yield of 3-4.5 inch onions, and total yield.

2004 was unusually cool. The onions did not mature, resulting in soft bulbs that did not cure in the drier. The immature onions probably would develop a high percentage of sprout damage and neck rot in storage.

Table 1. Application dates, timings, and environmental conditions.

Application date:	5/6	5/16	6/3	6/14	6/22	6/29	7/7	7/12
Timing:	PRE	PRE1	flag-leaf	1-leaf	2-leaf	3-leaf	4-leaf	5-leaf
Air Temp. (F):	45	53	74	54	64	82	69	81
Soil Temp. (F):	52	59	69	60	71	82	72	82
Relative Humidity (%):	56	42	63	87	52	37	57	60
Wind Velocity (MPH):	9	9	10	4	7	7	6	11
% Cloud Cover:	5	30	30	100	100	0	20	0


(8/4/04) Treatment 18


Treatment 19

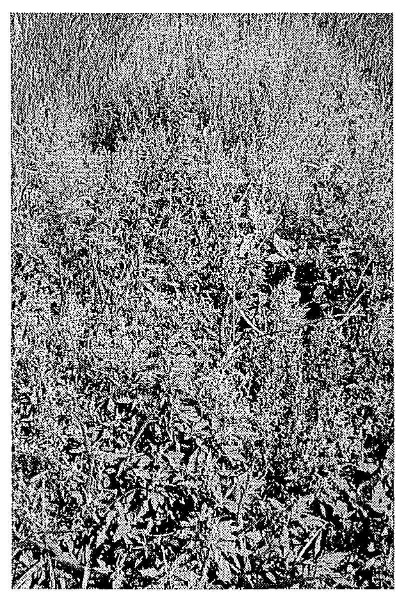

Treatment 20

Table 2. Onion tolerance and weed control.

Trt	Treatment[a]	Rate	Stg	Onion injury		Weed control		
						Wimu	Rrpw	Colq
				6/22	7/15	7/7		
No.		lb ai/A[b]		%		#/100ft2		
1	Dacthal	7.5	PRE1	5	5	0	0	0
	Brox+Oxyfl	0.25+0.125	2-lf					
	Pendimethalin	0.71	3-lf					
	Brox+Oxyfl	0.375+0.125	5-lf					
2	Pend	0.63	PRE1	6	6	0	0	0
	Brox+Oxyfl	0.375+0.125	2-lf					
	Flumioxazin	0.0625	3-lf					
	Brox+Oxyfl	0.375+0.125	5-lf					
3	Pend+Glyt	0.63+0.375	PRE2	14	16	0	0	0
	Brox+Oxyfl	0.25+0.125	2-lf					
	Pend	0.71	3-lf					
	Brox+Oxyfl	0.375+0.125	5-lf					
4	Pend+Glyt	0.63+0.375	PRE2	5	5	0	0	0
	Brox+Oxyfl+Pend	0.25+0.125+0.71	2-lf					
	Brox+Oxyfl	0.375+0.125	5-lf					
5	Pend+Glyt	0.63+0.375	PRE2	6	10	0	0	0
	Brox+Oxyfl	0.25+0.125	2-lf					
	Brox+Oxyfl+Pend	0.375+0.125+0.71	5-lf					
6	Broxl+Pend	0.25+0.412	PRE1	6	6	0	0	0
	Brox+Oxyfl	0.375+0.125	2-lf					
	Pendimethalin	0.71	3-lf					
	Brox+Oxyfl	0.375+0.125	5-lf					
7	Pend+Glyt	0.63+0.375	PRE2	1	10	0	0	0
	Brox+Oxyfl+Pend	0.375+0.125+1	3-lf					
8	Pend+Glyt	0.63+0.375	PRE2	9	8	5	7	8
	Brox+Oxyfl+Pend	0.375+0.125+1	4-lf					
9	Pendimethalin	0.63	flag-lf	4	11	2	4	5
	Brox+Oxyfl	0.25+0.125	2-lf					
	Brox+Oxyfl+Dual	0.375+0.125+0.95	5-lf					
10	Pendimethalin	0.63	flag-lf	6	6	0	0	5
	Brox+Oxyfl	0.25+0.125	2-lf					
	Brox+Oxyfl+Outlook	0.375+0.125+0.75	5-lf					
11	Pendimethalin	0.63	flag-lf	8	9	0	0	1
	Brox+Oxyfl	0.25+0.125	2-lf					
	Brox+Oxyfl+Pend	0.375+0.125+1	5-lf					
12	Pend+Oxyfl	0.63+0.0625	1 lf	8	11	0	0	0
	Brox+Oxyfl	0.25+0.125	2-lf					
	Brox+Oxyfl+Outlook	0.375+0.125+0.75	5-lf					
13	Pendimethalin	0.63	PRE1	4	10	1	1	5
	Flumioxazin	0.094	2-lf					
	Brox+Oxyfl+Outlook	0.375+0.125+0.75	5-lf					
14	Pendimethalin	0.63	PRE1	8	11	0	0	0
	Brox+Oxyfl	0.25+0.125	1 lf					
	Brox+Oxyfl+Outlook	0.375+0.125+.75	5-lf					
15	V-10146	0.2	flag-lf	55	93	0	0	1
16	V-10146+NIS	0.2+0.25% v/v	1 lf	28	86	0	5	96
17	Brox+Pend	0.25+0.63	PRE2	15	8	0	0	0
	Brox+Oxyfl+Pend	0.375+0.125+0.63	2-lf					
	Brox+Oxyfl	0.375+0.125	5-lf					
18	Broxynil	0.25	PRE2	5	10	0	0	0
	Brox+Oxyfl+Pend	0.375+0.125+0.63	2-lf					
	Brox+Oxyfl+Pend	0.375+0.125+0.63	4-lf					
19	Handweeded Chk	-		0	0	0	0	1
20	Untreated	-		0	0	11	55	391
LSD (P=.05)				8	7	3	16	124

[a]Glyt = Glyphomax Plus (3 lb/gal). [b]Glyphosate = lb ae/A.

Table 3. Onion yield.

Trt	Treatment[a]	Rate	Timing	Yield					# of
				1-2.25"	2.25-3"	3-4.5"	Total	Culls	bulbs
No.		lb ai/A[b]		cwt/A					1000's/A
1	Dacthal	7.5	PRE1	38	172	248	457	6	109.5
	Brox+Oxyfl	0.25+0.125	2-lf						
	Pendimethalin	0.71	3-lf						
	Brox+Oxyfl	0.375+0.125	5-lf						
2	Pend	0.63	PRE1	59	224	255	538	13	134.3
	Brox+Oxyfl	0.375+0.125	2-lf						
	Flumioxazin	0.0625	3-lf						
	Brox+Oxyfl	0.375+0.125	5-lf						
3	Pend+Glyt	0.63+0.375	PRE2	32	118	296	446	3	98.5
	Brox+Oxyfl	0.25+0.125	2-lf						
	Pend	0.71	3-lf						
	Brox+Oxyfl	0.375+0.125	5-lf						
4	Pend+Glyt	0.63+0.375	PRE2	66	228	222	517	15	141.6
	Brox+Oxyfl+Pend	0.25+0.125+0.71	2-lf						
	Brox+Oxyfl	0.375+0.125	5-lf						
5	Pend+Glyt	0.63+0.375	PRE2	33	244	274	551	6	125.2
	Brox+Oxyfl	0.25+0.125	2-lf						
	Brox+Oxyfl+Pend	0.375+0.125+0.71	5-lf						
6	Broxl+Pend	0.25+0.412	PRE1	40	240	280	559	6	132.0
	Brox+Oxyfl	0.375+0.125	2-lf						
	Pendimethalin	0.71	3-lf						
	Brox+Oxyfl	0.375+0.125	5-lf						
7	Pend+Glyt	0.63+0.375	PRE2	47	271	222	540	7	134.8
	Brox+Oxyfl+Pend	0.375+0.125+1	3-lf						
8	Pend+Glyt	0.63+0.375	PRE2	39	213	263	514	10	118.0
	Brox+Oxyfl+Pend	0.375+0.125+1	4-lf						
9	Pendimethalin	0.63	flag-lf	32	214	245	491	19	126.6
	Brox+Oxyfl	0.25+0.125	2-lf						
	Brox+Oxyfl+Dual	0.375+0.125+0.95	5-lf						
10	Pendimethalin	0.63	flag-lf	31	222	276	530	2	123.4
	Brox+Oxyfl	0.25+0.125	2-lf						
	Brox+Oxyfl+Outlook	0.375+0.125+0.75	5-lf						
11	Pendimethalin	0.63	flag-lf	31	300	230	561	15	138.8
	Brox+Oxyfl	0.25+0.125	2-lf						
	Brox+Oxyfl+Pend	0.375+0.125+1	5-lf						
12	Pend+Oxyfl	0.63+0.0625	1 lf	49	274	218	540	4	137.9
	Brox+Oxyfl	0.25+0.125	2-lf						
	Brox+Oxyfl+Outlook	0.375+0.125+0.75	5-lf						
13	Pendimethalin	0.63	PRE1	45	317	267	628	9	144.3
	Flumioxazin	0.094	2-lf						
	Brox+Oxyfl+Outlook	0.375+0.125+0.75	5-lf						
14	Pendimethalin	0.63	PRE1	32	225	289	547	7	119.3
	Brox+Oxyfl	0.25+0.125	1 lf						
	Brox+Oxyfl+Outlook	0.375+0.125+.75	5-lf						
15	V-10146	0.2	flag-lf	8	9	4	20	4	25.4
16	V-10146+NIS	0.2+0.25% v/v	1 lf	0	0	0	0	0	0.0
17	Brox+Pend	0.25+0.63	PRE2	27	278	310	614	3	128.0
	Brox+Oxyfl+Pend	0.375+0.125+0.63	2-lf						
	Brox+Oxyfl	0.375+0.125	5-lf						
18	Brox	0.25	PRE2	57	204	215	476	0	122.8
	Brox+Oxyfl+Pend	0.375+0.125+0.63	2-lf						
	Brox+Oxyfl+Pend	0.375+0.125+0.63	4-lf						
19	Handweeded Chk	-	-	34	307	319	658	2	139.8
20	Untreated	-	-	0	0	0	0	0	0.0
LSD (P=.05)				19	97	104	117	15	25.8

[a]Glyt = Glyphomax Plus (3 lb/gal). [b]Glyphosate = lb ae/A.

Broadleaf Weed Control in Onion, Absaraka. H. Hatterman-Valenti, C. Schumacher, P. Mayland, and P. Hendrickson

A trial was conducted at the NDSU Horticulture Research Arboretum, Absaraka ND to identify the most effective mixture of herbicides and application timings to minimize onion yield reduction. The soil was a loam with 2 % O.M. and 7.1 pH, with potato as the previous crop. Onion variety 'Teton' pelleted seed (Seminis Inc., Caldwell, ID 83605) was planted on May 18 using a Stanhay four row double- row planter unit, with 4 inch paired rows and 14 inches between main rows. Herbicides were applied as a delayed preemergence just before onion emergence (Pre), when the flag leaf emerged (0 leaf), at the first, second, third, fourth and fifth leaf stages, depending on the treatment needs. Herbicide treatments were applied with a CO_2 – pressurized backpack sprayer to 6 foot wide and 30 foot long plots arranged in a randomized complete block with 4 replications. On June7 and July 16, 28% liquid nitrogen was broadcast at a rate of 20 gpa over the whole trial. The non-weedy checks were weeded three times (1st week of June, July and August). Crop injury and percent weed control were evaluated after early (1-3 leaf) applications and late (4-5 leaf) applications (Table 2). The week of October 11 the middle two rows of each plot were harvested for grade and yield analysis. After harvest, onions were allowed to cure in the greenhouse for 3 weeks and then were graded (Table 1). Split, diseased and double bulbs were graded as culls regardless of diameter.

Herbicide application dates, timings, and environmental conditions for HRA, 2004.

Application Date:	6/2/2004	6/3/2004	6/16/2004	6/17/2004	7/9/2004	8/5/2004	8/5/2004
Onion Stage	PRE	0 - lf	1 - lf	2 - lf	3 -lf	5-lf PRE	5 - lf
Air Temp., (F):	68	68	74	75	73	76	76
% Relative Humidity:	69	69	42	41	64	41	41
Wind Velocity, (MPH):	6.4	6.4	9.3	9.2	3.6	13	13
Soil Temp., (F):	59	59	69	69	67	78	78
% Cloud Cover:	100	100	70	70	0	80	80
Operating Pressure:	30	25	30	30	30	30	30
Nozzle Type:	flat fan	flat fan	flat fan	flat fan	flat fan	flat fan	flat fan
Nozzle Size:	8002	11002	8002	8005	8005	8002	8005
Spray Volume, GPA:	15	15	20	50	50	20	50

Results: Due to cool and cloudy weather, early season treatments exhibited limited weed control and little crop injury. The first tank mix application of bromoxynil and oxyfluorfen was on a warm sunny day, June 17, but resulted in poor weed control (data not shown). The lack of control early in the growing season resulted in large weeds. Therefore, the second application of bromoxynil and oxyfluorfen exhibited partial control and allowed continued competition. Treatments that had a 5th leaf application and a higher amount of active ingredient generally showed better late season control. The additional nitrogen application contributed to most of the crop visual injury, which is why the handweeded and untreated checks show injury. Weeding of the handweeded checks once a month was not sufficient to reduce weed competition due to high weed pressure. Treatments 12 and 14 had better residual activity and as a result had greater cwt/A than other treatments. The lack of early and season long weed control reduced onion yield.

Table 1. Onion injury and weed control 7 days and 2 weeks after fifth leaf treatments.

				Injury	Control			Injury	Control		
			Leaf	------------ 7 DAT ------------				------------ 2WAT ------------			
Trt	Herbicide	Rate (lb ai/A)	Stage	Onion	Rrpw*	Colq	Copu	Onion	Rrpw	Colq	Copu
				------------------------------------ % ------------------------------------							
1	Dacthal	7.5	Pre	20	34	55	76	4	16	44	18
	Buctril+Goal	0.25+0.125	2 lf								
	Prowl	0.71	3 lf								
	Buctril+Goal	0.375+0.125	5 lf								
2	Prowl	0.62	Pre	34	56	58	91	9	86	88	0
	Buctril+Goal	0.375+0.125	2,5 lf								
	Flumioxazin	0.0625	3 lf								
3	Prowl	0.63	Pre	25	34	46	85	5	14	58	18
	Buctril+Goal	0.25+0.125	2 lf								
	Prowl	0.71	3 lf								
	Buctril+Goal	0.375+0.125	5 lf								
4	Prowl	0.63	Pre	23	41	50	86	5	14	100	0
	Buctril+Goal+Prowl	0.25+0.125+0.71	2 lf								
	Buctril+Goal	0.375+0.125	5 lf								
5	Prowl	0.63	Pre	24	40	40	88	2	23	65	0
	Buctril+Goal	0.25+0.125	2 lf								
	Buctril+Goal+ Prowl	0.375+0.125+0.71	5 lf								
6	Bromoxynil	0.25	Pre	26	38	60	80	5	13	78	0
	Prowl	0.412	Pre								
	Buctril+Goal	0.375+0.125	2,5 lf								
	Prowl	0.71	3 lf								
7	Prowl	0.63	Pre	25	36	49	66	1	14	64	51
	Buctril+Goal+ Prowl	0.375+0.125+1	3 lf								
8	Prowl	0.63	Pre	26	30	39	65	4	15	38	58
	Buctril+Goal+ Prowl	0.375+0.125+1	4 lf								
9	Prowl	0.625	0 lf	26	34	48	90	4	10	56	0
	Buctril+Goal	0.25+0.125	2 lf								
	Buctril+Goal+ Dual	0.375+0.125+0.95	5 lf								
10	Prowl	0.625	0 lf	21	33	41	89	1	33	79	0
	Buctril+Goal	0.25+0.125	2 lf								
	Buctril+Goal	0.375+0.125	5 lf								
	Outlook	0.75	5 lf								
11	Prowl	0.625	0 lf	25	33	60	91	4	14	43	18
	Buctril+Goal	0.25+0.125	2 lf								
	Buctril+Goal+ Prowl	0.375+0.125+1	5 lf								
12	Prowl+ Goal	0.70+0.0625	1 lf	25	31	60	92	6	10	56	0
	Buctril+Goal	0.25+0.125	2 lf								
	Buctril+Goal	0.375+0.125	5 lf								
	Outlook	0.75	5 lf								
13	Prowl	0.625	Pre	33	65	45	81	9	54	64	0
	Valor	0.094	2 lf								
	Buctril+Goal	0.375+0.125	5 lf								
	Outlook	0.75	5 lf								
14	Prowl	0.625	Pre	20	24	65	88	4	14	78	0
	Buctril+Goal	0.187+0.0625	1 lf								
	Buctril+Goal	0.375+0.125	5 lf								
	Outlook	0.75	5 lf								
15	Prowl	0.625	1 lf	29	9	0	0	9	1	1	0
	Buctril+Goal	0.25+0.125	2 lf								
16	Buctril+Goal	0.25+0.125	2 lf	26	10	5	0	8	1	3	0
	Prowl	0.625	5 lf								
17	Handweeded Check	-	-	18	80	100	100	0	100	100	100
18	Untreated Control			15	10	5	38	0	1	1	3
---------------------LSD (P=0.05)-----------------------				10	26	28	19	5	34	50	21

* Rrpw = *Amaranthus retroflexus*, Colq = *Chenopoduim album*, Copu = *Portulaca oleracea*

Table2. Effect of herbicide treatments on onion yield and grade.

Trt			Leaf	---------------------------Yield (cwt/A)-------------------------				
no.	Herbicide	Rate(lb ai/A)	Stage	1-2 ¼ in	2 ¼-3 in	3 in or >	Total	Culls
1	Dacthal	7.5	Pre	67.9 *	83.3	66.9	218.1	3.5
	Buctril+Goal	0.25+0.125	2 lf					
	Prowl	0.71	3 lf					
	Buctril+Goal	0.375+0.125	5 lf					
2	Prowl	0.62	Pre	63.4	66.6	31.6	161.6	3.0
	Buctril+Goal	0.375+0.125	2,5 lf					
	Flumioxazin	0.0625	3 lf					
3	Prowl	0.63	Pre	68.2	66.8	77.5	212.5	2.5
	Buctril+Goal	0.25+0.125	2 lf					
	Prowl	0.71	3 lf					
	Buctril+Goal	0.375+0.125	5 lf					
4	Prowl	0.63	Pre	57.4	52.7	92.5	202.6	2.8
	Buctril+Goal+ Prowl	0.25+0.125+0.71	2 lf					
	Buctril+Goal	0.375+0.125	5 lf					
5	Prowl	0.63	Pre	57.4	45.6	30.0	133.0	5.5
	Buctril+Goal	0.25+0.125	2 lf					
	Buctril+Goal+ Prowl	0.375+0.125+0.71	5 lf					
6	Buctril+Prowl	0.25+0.412	Pre	62.5	79.9	83.0	225.4	3.2
	Buctril+Goal	0.375+0.125	2,5 lf					
	Prowl	0.71	3 lf					
7	Prowl	0.63	Pre	42.0	25.1	9.5	76.5	6.0
	Buctril+Goal+ Prowl	0.375+0.125+1	3 lf					
8	Prowl	0.63	Pre	54.1	24.1	6.6	84.9	8.8
	Buctril+Goal+ Prowl	0.375+0.125+1	4 lf					
9	Prowl	0.625	0 lf	72.9	23.0	6.0	102.0	7.6
	Buctril+Goal	0.25+0.125	2 lf					
	Buctril+Goal+ Dual	0.375+0.125+0.95	5 lf					
10	Prowl	0.625	0 lf	94.4	51.8	28.9	175.0	6.9
	Buctril+Goal	0.25+0.125	2 lf					
	Buctril+Goal	0.375+0.125	5 lf					
	Outlook	0.75	5 lf					
11	Prowl	0.625	0 lf	83.8	38.7	15.5	137.9	5.8
	Buctril+Goal	0.25+0.125	2 lf					
	Buctril+Goal+ Prowl	0.375+0.125+1	5 lf					
12	Prowl	0.70.6255	1 lf	60.0	131.0	164.3	355.3	7.6
	Goal	0.0625	1 lf					
	Buctril+Goal	0.25+0.125	2 lf					
	Buctril+Goal	0.375+0.125	5 lf					
	Outlook	0.75	5 lf					
13	Prowl	0.625	Pre	75.3	81.6	66.1	223.0	3.8
	Valor	0.094	2 lf					
	Buctril+Goal	0.375+0.125	5 lf					
	Outlook	0.75	5 lf					
14	Prowl	0.625	Pre	81.6	145.7	180.2	407.5	2.4
	Buctril+Goal	0.187+0.0625	1 lf					
	Buctril+Goal	0.375+0.125	5 lf					
	Outlook	0.75	5 lf					
15	Prowl	0.625	1 lf	41.2	16.9	0.8	58.9	6.5
	Buctril+Goal	0.25+0.125	2 lf					
16	Buctril+Goal	0.25+0.125	2 lf	59.7	36.9	6.5	103.1	6.3
	Prowl	0.625	5 lf					
17	Handweeded Check	-	-	67.7	60.9	35.2	163.8	5.4
18	Untreated Control	-	-	15.3	0.0	0.0	15.3	16.1
----------------------LSD (P=0.05)--------------------------				30.68	55.01	80.74	129.33	4.62

Weed control and potato yield results from applications of Spartan (sulfentrazone) herbicide Harlene M. Hatterman-Valenti and Paul G. Mayland.

Russet Burbank potatoes were planted May 14, 2004 on the Northern Plains Potato Growers research site near Tappen, ND. The design was a randomized complete block with the rows spaced on 36 inch centers and 12 inch spacing between the seed pieces. The soil is a Maddock fine loamy sand with 2.1% organic matter and 7.8 pH. The delayed preemergence treatments were applied June 4th. Applications were made using a backpack CO2 4-nozzle sprayer with 8002 flat fan nozzles, 30 psi and 20 gpa. The few plants starting to emerge were covered prior to herbicide application. On July 14 the sulfentrazone treatments were oversprayed with clethodim for setaria control.

Tubers were harvested September 29th and put into storage until October 28, when they were graded for yield. Two 20 tuber samples were taken for evaluations. The first sample was evaluated for specific gravity and fry quality two months after harvest. The second sample will be evaluated in three months.

Crop safety, weed control and potato yield with sulfentrazone.

Rating date	Soltu	Cheal	Amare	Amapa	Setvi	Amapa	Amare	Setvi	Cheal	10/28 total cwt/a	10/28 market-able cwt/a
	8/3					9/21					
Treatment ai oz/a	Phyto	Control									
1 Sulfent* 1.5	0	89	90	58	55	31	46	60	73	315	119
2 Sulfent 1.87	0	96	94	66	56	44	65	65	64	319	109
3 Sulfent 2.25	0	99	94	74	54	73	80	49	80	351	139
4 Sulfent 3.0	0	90	90	84	63	70	88	55	63	357	141
5 Metri 12.0 +Pend 15.8	0	100	100	96	91	99	95	94	96	362	162
6 Untreated	0	0	0	0	0	0	0	0	0	284	86
LSD (P=.05)	0	9	7	15	12	14	12	26	17	59	38

*Sulfent = Sulfentrazone (Spartan), Metri = Metribuzin (Sencor), Pend = Pendimethalin (Prowl)

All the potatoes were weighed on the University of Minnesota scale in East Grand Forks, MN in cooperation with Jeff Miller. Metribuzin + pendimethalin and the high rate of sulfentrazone had the highest total yields of 362.3 cwt/a and 357.0 cwt/a respectively. As the rate for sulfentrazone declined the overall yields of 351, 319, and 315 cwt/a, declined. The untreated check treatments had an average of 283.5 cwt/a. When the 4 oz or less tubers (culls) are removed from the total yield metribuzin + pendimethalin resulted in the highest yield of 162 cwt/a, sulfentrazone 3, 2.25, 1.87 and 1.5 oz ai/a yielded 141, 139, 109 and 119 cwt/a respectively. The untreated yielded 86 cwt/a of marketable tubers.

Sulfentrazone 2.25 and 3 oz ai/a gave acceptable season long control of redroot pigweed. Common lambsquarter , Palmer pigweed and green foxtail control decreased during the growing season to unacceptable levels while the metribuzin + pendimethalin gave season long control of the four weed species.

No crop injury was seen at the late field evaluations. No significant differences in fry color, hollow heart or specific gravity was noted between any of the treatments.

Weed control and potato yield results from applications of Valor (flumioxazin) and V-10146. Harlene M. Hatterman-Valenti and Paul G. Mayland. Russet Burbank potatoes were planted May 14, 2004 on the Northern Plains Potato Growers research site near Tappen, ND. An RCB design was used with row spacing of 36 inches and seed spacing in the row of 12 inches. The soil is a Maddock fine loamy sand with 2.1% organic matter and a 7.8 pH. The delayed pre-emergence treatments were applied on June 4. A few of the plants had started to emerge. These were covered with soil prior to spraying. Applications were made using a 4-nozzle CO2 backpack sprayer with 8002 flat fan nozzles, 30 psi and 20 gpa on 2 rows of the 4-row plot. Treatment 5 and clethodim in treatment 4 were applied post emergence on July 14. Tubers were harvested September 29 and put in storage until October 28 when they were graded for yield. Two 20 tuber samples were taken for evaluations. The first sample was evaluated for hollow heart, specific gravity and fry quality two months after harvest. The second set of tubers will be evaluated about three months later.

Flumioxazin (Valor) and V-10146 crop safety, weed control and yields in irrigated potatoes

Treatment No. Name	Rate oz ai/a	Soltu 6/29 % Phyto	Setvi 8/3 % Control	Amare 8/3 % Control	Amapa 8/3 % Control	Cheal 8/3 % Control	Setvi 9/21 % Control	Amare 9/21 % Control	Amapa 9/21 % Control	Cheal 9/21 % Control	Soltu 10/28 marketable cwt/A
1. flumioxazin dimethenamide	0.765 10.1	14	96	100	100	100	96	100	99	95	237
2. flumioxazin s-metolachlor	0.765 15.2	10	98	100	99	100	96	100	99	94	205
3. flumioxazin pendimethalin	0.765 15.8	11	75	100	96	100	43	100	100	81	200
4. V-10146 clethodim COC	3.2 3.0 32.0 oz	0	96	100	100	100	97	100	100	98	220
5. V-10146 NIS	3.2 0.25%	1	20	99	96	30	13	35	33	26	107
6. metribuzin s-metolachlor	9.0 15.2	1	99	100	100	100	100	100	100	96	197
7. metribuzin pendimethalin	9.0 15.8	3	91	100	95	100	94	93	99	95	163
8. Untreated		0	0	0	0	0	0	0	0	0	86
LSD (P=.05)		4	4	1	3	7	12	9	9	13	47

All of the potatoes were weighed on the University of Minnesota scale in East Grand Forks, MN in cooperation with Jeff Miller. Acceptable early injury was noted with the flumioxazin treatments while later evaluations exhibited no injury. All treatments except V-10146 post emergence gave acceptable to excellent total weed control. Post emergence V-10146 exhibited early knockdown of the pigweeds however the late evaluation showed poor season long control. There were no significant yield differences between any of the flumioxazin combinations, the pre-emergence treatment of V-10146 and metribuzin + s-metolachlor.

Carfentrazone-ethyl (Aim) as a desiccant on dryland potatoes. Harlene M. Hatterman-Valenti and Paul G. Mayland Shepody potatoes were planted May 27 on the NDSU research site near Prosper, ND to evaluate late season desiccation and storage quality of potatoes following various applications of carfentrazone. The trial was conducted on a clay loam soil with 3.4% O.M. and 6.5 pH. Spring wheat was the previous crop. Plots were 2 rows by 20 ft arranged in a randomized complete block design with three replicates. The potato seed pieces were planted in 36 inch rows at 12 inch intervals. A fungicide maintenance program was utilized throughout the growing season. The desiccant treatments were applied using a CO2 backpack sprayer equipped with 8002 flat fan nozzles using 30 GPA and a pressure of 30 psi.

Application Date:	Sept 1	Sept 10	Sept 17
Application Timing	'A'	'B'	'C'
Time of Day	11:00	9:00	10:00
Air Temp. °F	63	61	62
% R.H.	97	94	80
Wind Velocity (mph)	5	2	7
Dew Present	Yes	Yes	Yes
% Cloud Cover	100	15	5

Potato desiccation with carfentrazone-ethyl

Rating date:					---9/17/04--		---- 9/28/04---	
Rating data type: Desiccation					Leaf	Stem	Leaf	Stem
Days after application 'C'					0	0	11	11
Treatment interval:					---16 da-a---		---27 da-a---	
Trt No.	Treatment Name	Rate	Rate Unit	Appl Code				
1	carfentrazone	0.05	lb ai/a	C	0	0	82	72
	MSO	1	%v/v	C				
2.	carfentrazone	0.075	lb ai/a	C	0	0	82	72
	MSO	1	% v/v	C				
3.	carfentrazone	0.09	lb ai/a	C	0	0	85	77
	MSO	1	% v/v	C				
4.	diquat	0.5	lb ai/a	C	0	0	80	70
	NIS	0.25	% v/v	C				
5.	carfentrazone	0.05	lb ai/a	AB	67	43	95	83
	MSO	1	%v/v	AB				
6.	carfentrazone	0.075	lb ai/a	AB	60	43	97	92
	MSO	1	% v/v	AB				
7.	carfentrazone	0.09	lb ai/a	AB	63	43	90	82
	MSO	1	% v/v	AB				
8.	diquat	0.5	lb ai/a	AB	55	37	72	60
	NIS	0.25	% v/v	AB				
9.	Untreated				0	0	0	0
LSD (P=.05)					10	10	9	10

Split applications of carfentrazone starting prior to initial senescence gave the best overall leaf and stem desiccation when compared to diquat single or split and single applications of carfentrazone. Carfentrazone at 0.075 lb ai/a applied twice 10 days apart gave excellent leaf and stem desiccation. Heavy dew at application timing 'A' may have decreased the activity of the diquat.

Weed control in pumpkin - Oakes. Greenland, Richard G. Weed control is difficult in pumpkins because few herbicides are available for pumpkin production. A new herbicide, Sandea, recently came on the market for use in pumpkins. We tested this herbicide along with others at the Oakes Irrigation Research Site on a sandy loam soil on a field that had been in field corn the previous year and had been disked twice and field cultivated three times. Pumpkins were planted on May 27 in 8-ft rows and an in-row spacing of 1 ft. Pumpkin plants were later thinned to an in-row spacing of 3 ft. The study was irrigated with underground drip irrigation. PRE treatments were applied on May 27. The POST treatment was applied on June 23 with pumpkins 3 to 5 inches tall and 10 to 15 inches across and weeds 1 to 3 inches tall. All Treatments were applied with a CO2-pressurized backpack sprayer using AI 110-04 flat fan nozzles, 45 gpa, at 50 psi.

Table 1. Pumpkin injury and control of redroot pigweed, lambsquarters, and hairy nightshade by herbicides in the Oakes Irrigation Research Site 2004 pumpkin weed control study.

		Application	Pumpkin injury		Pigweed		Lambsquarters		Hairy nightshade	
Herbicides	Rates	timing	June 18	July 22	June 18	July 22	June 18	July 22	June 18	July 22
			---------- 0 to 10[1] ----------							
Authority	3 oz	PRE	3.3	0.5	9.0	7.5	10.0	10.0	7.3	5.3
Outlook	1 pt	PRE	4.3	2.8	9.8	9.3	7.0	4.0	8.5	6.0
Raptor	5 oz	PRE	0.5	0.8	10.0	10.0	7.5	7.0	8.0	8.0
Authority + Raptor	2 oz + 4 oz	PRE	2.0	0.0	9.8	8.8	10.0	9.5	6.8	5.8
Outlook + Raptor	1 pt + 4 oz	PRE	4.0	0.5	10.0	10.0	9.3	7.3	8.8	7.8
Outlook + Authority	1 pt + 2 oz	PRE	3.0	0.3	9.5	9.0	10.0	9.8	9.3	6.8
Sandea	½ oz	PRE	2.3	6.5	10.0	10.0	10.0	10.0	3.0	0.3
Outlook + Sandea	1 pt + ½ oz	PRE	3.5	3.5	10.0	10.0	9.8	9.8	6.8	2.0
Sandea + NIS	½ oz + ¼ %	POST	0.0	3.5	4.8	9.5	6.5	3.5	6.0	5.0
Outlook; Sandea + NIS	1 pt; ½ oz+¼%	PRE; POST	3.8	2.8	10.0	10.0	6.8	2.8	7.8	6.3
Handweeded check			0.0	0.0	9.0	9.8	8.8	10.0	8.5	9.8
Unweeded check			0.0	6.5	6.0	7.5	5.5	2.5	4.3	5.3
Probability			<.0001	<.0001	<.0001	0.0001	<.0001	<.0001	<.0001	<.0001
LSD(0.05)			1.0	1.3	1.0	1.2	1.3	1.5	1.8	1.5
C.V. (%)			32	39	7	9	11	14	18	19

[1]Ratings from 0 to 10 with 0 = no pumpkin injury, no weed control; 10 = complete death of pumpkin or weed completely controlled.

Table 2. Early stand, number and yield of pumpkins, fruit size, and overall pumpkin quality score in the Oakes Irrigation Research Site 2004 pumpkin weed control study.

Herbicide	Rates	Application timing	Early stand[1]	Number of pumpkins marketable	Number of pumpkins total	Pumpkin yield marketable	Pumpkin yield total	Fruit size	Overall score
			------------- 1000s/acre	-------------		------ tons/acre ------		lbs/fruit	1 to 10
Authority	3 oz	PRE	4.0 c[2]	2.0 b	3.6 ab	14.9 bc	21.2 c	15.3 ab	7.5 ab
Outlook	1 pt	PRE	4.6 bc	0.8 d	2.4 cde	3.7 de	6.9 ef	9.6 c	6.8 c
Raptor	5 oz	PRE	4.1 c	2.1 b	3.2 bc	15.1 b	20.3 c	13.8 b	7.6 a
Authority + Raptor	2 oz + 4 oz	PRE	4.7 abc	2.1 b	3.2 abc	16.4 b	21.5 bc	15.4 ab	7.5 ab
Outlook + Raptor	1 pt + 4 oz	PRE	5.4 a	1.9 b	2.6 cd	15.9 b	17.5 cd	17.6 a	7.5 ab
Outlook + Authority	1 pt + 2 oz	PRE	4.4 bc	2.3 b	3.5 ab	19.2 b	27.4 b	16.2 ab	7.5 ab
Sandea	½ oz	PRE	4.6 bc	0.9 d	1.5 f	2.9 de	3.9 fg	6.4 d	6.8 c
Outlook + Sandea	1 pt + ½ oz	PRE	5.0 ab	1.7 bc	2.5 cde	8.4 cd	12.7 de	9.6 c	7.1 bc
Sandea + NIS	½ oz + ¼%	POST	4.7 abc	0.9 cd	1.6 ef	4.2 de	5.8 fg	8.9 cd	7.1 bc
Outlook; Sandea + NIS	1 pt; ½ oz+¼%	PRE; POST	4.4 bc	0.9 d	2.0 def	3.4 de	7.3 ef	7.2 cd	6.9 c
Handweeded check			4.6 bc	3.3 a	4.1 a	28.4 a	33.6 a	17.2 a	7.6 a
Unweeded check			4.6 bc	0.3 d	0.3 g	0.5 e	0.5 g	5.0 cd	6.9 abc
Probability			0.04	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.001
C. V. (%)			11	35	25	42	28	18	5

[1]Plant stand before thinning. Pumpkins were later thinned to one plant every 3 ft (about 1940 plants/acre).
[2]Values in the same column followed by the same letter are not significantly different at the 0.05 level.

Results. Outlook injured pumpkins early but the injury soon disappeared. The July 18 injury ratings (Table 1) reflect the reduced growth of pumpkins caused by weed competition, which was most severe with the Sandea PRE treatment. Authority gave good to excellent control of all weeds except hairy nightshade. Outlook gave good control of pigweed but poor control of lambsquarters and hairy nightshade. Raptor controlled pigweed and gave good control of nightshade and fair to good control of lambsquarters. Sandea gave excellent pigweed control, but poor nightshade control. It controlled lambsquarters when applied PRE but not when applied POST. Yields were lower with Sandea and Outlook treatments due to weed competition. Best yields were with the hand weeded check and with treatments containing Authority (Table 2). The most promising herbicides for pumpkin tested in this study were Authority in combination with either Outlook or Raptor. However, none of these three herbicides is currently labeled for pumpkin production.

Grassy weed control in safflower, Williston 2004. (Riveland and Bradbury) 'Finch' safflower was planted on land cropped to durum wheat in 2003 using 7 inch rows at 30 lbs/a on May 15. The treatments were applied on June 16 to 4 to 6-leaf safflower, green foxtail 2-4 leaf and wild oats 4-6 leaf stage with 66 F, 42% RH, 5% clear sky and 3-6 mph W wind and dry topsoil at 70 F and dry plant surfaces. Russian thistle (1-2 inches tall), common lambsquarters (1 inch tall), and wild mustard (4-6 inches tall) were present. We used a small plot sprayer with wind cones, mounted on a G-Allis Chalmers tractor to apply the treatments, delivering 10 gals/a at 40 psi through 8001 flat fan nozzles to a 6.67 ft wide area the length of 10 by 25 ft plots. First rain received after application was 0.06 inches on June 26. The experiment was a randomized complete block design with four replications. Plots were evaluated for crop injury and weed control on August 17. Wild oat density averaged 1-5 plants/ft2 and green foxtail density averaged 10 plants\ft2. Safflower was machine harvested on October 14.

Treatment [a]	Product Rate	Crop inj.	- Control- Grft	Wioa	Test Weight	Yield	Seed Oil
	oz/a		%	%	lbs/bu	lbs/a	%
Poast+COC	8+1%vv	0	95	93	42.2	1224	33.0
AssureII+COC	8+1%vv	3	97	98	42.3	1117	33.2
Select+COC	8+1%vv	0	98	99	42.3	1138	33.7
Select+COC	12+1%vv	1	99	99	42.2	1343	33.8
Poast+COC	16+1%vv	0	97	98	42.7	1355	33.6
Select+COC	6+1%vv	0	99	99	42.2	1389	34.3
Select+HarmGT+COC	8+.2+1%vv	5	98	99	40.9	1544	33.9
Assure+HrmGT+COC	8+.2+1%vv	5	98	99	41.1	1546	32.6
Poast+HrmGT+COC	16+.2+1%vv	3	95	99	41.9	1553	33.4
Untreated	0	0	0	0	41.8	809	33.7
HIGH MEAN		5	99	99	42.7	1553	34.3
LOW MEAN		0	0	0	40.9	809	32.6
EXP MEAN		2	88	88	42.0	1302	33.5
C.V. %		147	2	3	1.4	15	1.9
LSD 5%		3	3	4	NS	288	NS
LSD 1%		NS	4	6	NS	389	NS
# OF REPS		4	4	3	2	4	2
F-TRT		3	939	478	1.8	6	1.2

[a] - COC = Petroleum Oil Concentrate; Herbimax from Loveland. HarmGT or HRMGT = Harmony GT

Summary: Minor crop injury was noted for any treatment combination containing Harmony GT. All treatments gave good control of green foxtail and wild oats, resulting in yield increases when compared to the weedy check. Harmony GT gave excellent control (not shown) of Russian thistle, common lambsquarters and wild mustard, and tended to increase yields over the grass herbicide treatments alone.

BROADLEAF WEED CONTROL IN SAFFLOWER

Broadleaf weed control in safflower, Williston 2004. (Riveland and Bradbury)
'Finch' safflower was planted on land cropped to durum wheat in 2003 using 7 inch rows at 30 lbs/a on May 15. The treatments were applied on June 16 to 4 to 6-leaf safflower; redroot pigweed, Russian thistle and common lambsquarters 1-2 inches with 65 F, 42% RH, 15% clear sky and 1-4 mph SW wind and dry topsoil at 67 F and dry plant surfaces. We used a small plot sprayer with wind cones, mounted on a G-Allis Chalmers tractor to apply the treatments, delivering 10 gals/a at 40 psi through 8001 flat fan nozzles to a 6.67 ft wide area the length of 10 by 25 ft plots. First rain received after application was 0.06 inches on June 26. The experiment was a randomized complete block design with four replications. Poast was applied to the entire plot area to control grassy weeds. Plots were evaluated for crop injury and weed control on August 16. Weed density averaged 1-2 plants/ft2. Safflower was machine harvested on October 14.

Treatment [a]	Product Rate	Crop Inj.	--Weed Control-- Ruth	Colq	Rrpw	Test Weight	Yield	Seed Oil
	oz/a	%	-------	%	-------	lbs/bu	lbs/a	%
Harmony GT+NIS	0.167+0.25%	0	81	75	94	42.2	1702	32.7
Harmony GT+NIS	0.20+0.25%	1	85	88	96	41.9	1666	32.2
Harmony GT+NIS	0.25 +0.25%	6	86	92	99	40.8	1641	33.0
Harmony GT+NIS	0.30 +0.25%	8	83	95	98	41.5	1595	32.5
Harmony GT+NIS	0.4+0.25%	11	85	91	98	41.7	1443	32.4
Glean+NIS	0.25 +0.25%	8	71	93	98	41.4	1479	32.2
Ally+NIS	0.08+0.25%	14	79	92	99	40.0	1520	31.6
Harmony GT+Glean+NIS	0.167+0.167	6	78	93	98	41.9	1591	32.2
HarmonyGT+Glean+NIS	0.20+0.20	18	79	91	99	42.2	1393	31.9
Upbeet+NIS	0.75 +0.25%	10	63	32	69	41.5	1342	32.6
Upbeet+NIS	0.25 +0.25%	1	21	0	0	42.0	1183	32.4
Upbeet+NIS	0.5 +0.25%	1	31	23	0	42.4	1295	31.8
Upbeet+Harmony GT+NIS	0.5 +0.167	4	70	83	96	41.9	1455	32.5
Spartan	4.0	21	81	82	97	40.9	1312	31.9
Weedy check	0.0	0	0	0	0	43.4	1553	34.1
EXP MEAN		7	66	69	76	41.7	1478	32.4
C.V. %		50	26	20	16	1.4	15	1.6
LSD 5%		5	25	23	17	1.3	NS	1.1

[a] - NIS Non ionic surfactant - Activator 90

Summary: Upbeet did not adequately control any of the broadleaf weeds present. Spartan, Ally, the higher rates of Harmony GT alone and the combination of Glean with Harmony GT caused significant crop injury but gave excellent control of weeds present. Test weights and seed oil content were reduced for many treatments, a result of delayed flowering.

Kochia control. Zollinger, Richard K. and Jerry L. Ries. An experiment was conducted near Sibley, ND, to evaluate kochia control. PRE treatments were applied on May 4, 2004 at 12:30 pm with 52 F air, 49 F soil at a 4 inch depth, 35% relative humidity, 0% clouds, 5 to 10 mph N wind, dry soil surface, and dry subsoil. POST treatments were applied on July 1 at 12:00 pm with 76 F air, 82 F soil surface, 27% relative humidity, 20% clouds, 5 to 10 mph N wind, dry soil surface, dry subsoil, and no dew present. Weed species present were: 2 to 6 inch (5 to 20/ft^2) kochia. Treatments were applied to the center 6.7 feet of the 10 by 40 foot plots with a backpack-type plot sprayer delivering 17 gpa at 40 psi through 8002 TeeJet flat-fan nozzles for PRE treatments and 8.5 gpa at 40 psi through 8001 TeeJet flat-fan nozzles for POST treatments. The experiment had randomized complete block design with three replications per treatment.

Results of this study were unusual mainly because of abnormal growing conditions. At May 18 (14 DAT PRE), kochia was emerging but stand was not heavy enough to rate. On June 1 (28 DAT PRE), a heavy population of kochia had emerged and most was no more than button stage but a few plant up to 1 inch tall. On June 8 (35 DAT PRE), most kochia was 1 inch tall but some up to 3 inches tall. On July 1, ratings were taken immediately before POST treatments were applied. Kochia was stunted due to extended cold weather even though the prior 7-10 days were warm. The kochia had not yet resumed normal growth. Soil was sandy and dry and it was apparent that little rain had fallen. No other weeds were present. At July 29, less control in POST only treatments were due to ALS resistant kochia. About 20 to 30% of the population appeared resistant. (Dept. of Plant Sciences, North Dakota State University, Fargo).

Table. Kochia control (Zollinger and Ries).

		PRE Applications			POST Application	
		28 DAT	35 DAT	58 DAT	14 DAT	28 DAT
Treatment[1]	Rate	Kochia	Kochia	Kochia	Kochia	Kochia
	(product/A)	------- (%) -------			---- (%) ----	
PRE/POST						
Prowl/Beyond+NIS+28% N	3.6pt/4fl oz+0.25% v/v+1qt	80	70	60	88	96
ProwlH$_2$O/Beyond+NIS+28% N	3.14pt/4fl oz+0.25% v/v+1qt	80	70	50	82	87
Spartan+ProwlH$_2$O/ Beyond+NIS+28% N	3oz+3.14pt/ 4fl oz+0.25% v/v+1qt	97	98	92	85	97
Spartan+ProwlH$_2$O/ Beyond+NIS+28% N	2oz+3.14pt/ 4fl oz+0.25% v/v+1qt	98	96	92	83	96
Spartan+ProwlH$_2$O/ Beyond+NIS+28%	1oz+3.14pt/ 4fl oz+0.25% v/v+1qt	95	92	87	85	96
ProwlH$_2$O/Beyond+PO+28% N	3.14pt/4fl oz+1% v/v+1qt	80	70	50	82	94
Spartan+ProwlH$_2$O/ Beyond+PO+28% N	2oz+3.14pt/ 4fl oz+1% v/v+1qt	98	96	83	80	95
Spartan/Beyond+PO+28% N	2oz/fl oz+1% v/v+1qt	97	96	94	83	96
POST						
Beyond+NIS+28% N	4fl oz+0.25% v/v+1qt				75	80
Beyond+PO+28% N	4fl oz+1% v/v+1qt				50	73
Untreated		0	0	0	0	0
LSD (0.05)		3	4	6	4	6

[1]NIS = nonionic surfactant = R-11; 28% N = 28% nitrogen; PO = petroleum oil concentrate = Herbimax.

Express on imidazolinone-resistant sunflower varieties. Zollinger, Richard K. and Jerry L. Ries. An experiment was conducted near Prosper, ND, to evaluate crop injury to Express applied POST to two imidazolinone-resistant sunflower varieties. Separate studies of Mycogen '8N429CL' and Seeds2000 'Charger' imidazolinone-resistant sunflower was planted on May 18, 2004 followed by an application of Dual Magnum and Spartan applied PRE to control weeds. Seeds2000 sunflower POST treatments were applied on June 28 at 1:45 pm with 79 F air, 95 F soil surface, 24% relative humidity, 20% clouds, 10 to 15 mph W wind, dry soil surface, moist subsoil, good crop vigor, and no dew present to 4 to 11 inch (V6 to V10) sunflower. Mycogen sunflower POST treatments were applied on July 1 at 12:40 am with 83 F air, 98 F soil surface, 26% relative humidity, 5% clouds, 6 to 9 mph E wind, dry soil surface, moist subsoil, good crop vigor and no dew present to 4 to 14 inch (V6 to V12) sunflower. Treatments were applied to the center 6.67 feet of the 10 by 40 foot plots with a backpack-type plot sprayer delivering 8.5 gpa at 40 psi through 11001 Turbo TeeJet flat-fan nozzles. The experiment had randomized complete block design with three replications per treatment.

The objective of this study was to evaluate affect of Express herbicide (ALS - sulfonylurea) on two varieties of Clearfield sunflower (ALS - imidazolinone-resistant). Express was applied at the X rate of 0.25 oz/A and 0.38, 0.5, and 1 oz/A. Sunflower injury increased as Express rate increased. Sunflower injury symptoms were stunting, and fusing and malformation of sunflower heads. Express at 0.25 oz/A gave 15 to 30% injury and sunflower did not recover after 42 DAT. This support previous findings that resistance in conventional sunflower is chemistry specific. Express cannot be used on Clearfield sunflower. Beyond cannot be used on Express resistant sunflower. No other ALS herbicides other than those recommended can be used either on Clearfield or Express resistant sunflower. (Dept. of Plant Sciences, North Dakota State University, Fargo).

Table Express on imidazolinone-resitant sunflower varieties (Zollinger and Ries).

		Seeds2000 'Charger'			Mycogen '8N429CL'	
Treatment[1]	Rate	14 DAT	28 DAT	42 DAT	14 DAT	28 DAT
	(product/A)	------ % injury ------			--- % injury ---	
Express+Select+NIS	0.25oz+6oz+0.5% v/v	30	21	15	19	20
Express+Select+NIS	0.376oz+6oz+0.5% v/v	40	40	33	35	29
Express+Select+NIS	0.5oz+6oz+0.5% v/v	55	46	38	45	35
Express+Select+NIS	1oz+6oz+0.5% v/v	65	63	49	74	51
Beyond+MSO+28% N	4fl oz+1% v/v+1qt	8	0	4	15	13
Untreated		0	0	0	0	0
LSD		2	3	5	4	4

[1]Express = Express 50 SG; NIS = nonionic surfactant = R-11; MSO = methylated seed oil = Scoil; 28% N = 28% nitrogen.

Imidazolinone-resistant sunflower weed control. Zollinger, Richard K. and Jerry L. Ries. An experiment was conducted near Carrington, ND, to evaluate weed control from PRE and POST applied herbicides in imidazolinone-resistant sunflower. Mycogen '8N429CL' imidazolinone-resistant sunflower was planted on June 4, 2004. PRE treatments were applied on June 9 at 1:30 pm with 66 F air, 65 F soil at 4 inch depth, 39% relative humidity, 80% clouds, 4 to 7 mph NW wind, dry soil surface, and moist subsoil. POST treatments were applied on July 12 at 11:30 am with 77 F air, 95 F soil surface, 72% relative humidity, 0% clouds, 7 to 12 mph W wind, dry to moist soil surface, moist subsoil, good crop vigor, and no dew present to 12 to 16 inch (V8 to V10) sunflower. Weed species present were: 4 to 7 inch (20 to 30/yd^2) green and yellow foxtail; 5 to 7 inch (0 to 3/yd^2) redroot pigweed; 4 to 6 inch (0 to 2/yd^2) common lambsquarters; and 6 to 10 inch (<1/yd^2) swamp smartweed. Treatments were applied to the center 6.7 feet of the 10 by 40 foot plots with a backpack-type plot sprayer delivering 17 gpa at 40 psi through 8002 TeeJet flat-fan nozzles for PRE treatments and 8.5 gpa at 40 psi through 8001 TeeJet flat-fan nozzles for POST treatments. The experiment had randomized complete block design with three replications per treatment.

This study was used for a weed control and demonstration trial at the Carrington Research and extension Center for the International Sunflower Conference. Treatments were applied late to large grass and broadleaf weeds because a major rain event prevented application to smaller weeds. Application was made before the top-soil was dry so herbicides could affect weeds as early as possible. Most PRE or PRE/POST treatments controlled grass and broadleaf weeds. A few products not labeled in the U.S. were used as a comparison to U.S. products and treatments. Clearsol (imazapyr) @ 80 g/ha = 1.14 oz ai/A or 1 fl oz/A Arsenal. Canaplus = 50% ai alkyl aryl polyglycol ether NIS, so Activator 90 at 0.25 % v/v used as a substitute. Intervix (imazamox + imazapyr @ 60 g/ha (41.25 + 18.75 g/ha) = 0.58 + 0.267 oz ai/A = 4.64 fl oz Beyond + 1 fl oz Arsenal. Tween 20 is a nonionic surfactant and is used on a limited basis in the U.S. Pulsar (imazamox) = Beyond was used at 6 fl oz/A + Tween 20 at 0.25% v/v. Intervex, which contained Arsenal had better weed control than other international products used to compare but residue would severally limit crop rotation the next year if used here. (Dept. of Plant Sciences, North Dakota State University, Fargo).

Table. Imidazolinone-resistant sunflower weed control (Zollinger and Ries).

Treatment[1]	Rate	July 26 Fxtl	July 26 Rrpw	July 26 Colq	July 26 Smwe	August 12 Fxtl	August 12 Rrpw	August 12 Colq	August 12 Smwe
	(product/A)	------ (%) ------				------ (%) ------			
PRE									
Prowl H_2O+Spartan	2.1pt+3.5oz	50	92	92	62	55	92	92	79
PRE/POST									
Prowl H_2O/Beyond+ NIS+28%	2.1pt/4fl oz+ 0.25% v/v+1qt	79	89	89	91	94	99	99	99
Outlook/Beyond+ NIS+28%	10fl oz/4fl oz+ 0.25% v/v+1qt	90	91	91	91	99	99	99	99
Dual Magnum/Beyond+ NIS+28%	1.67pt/4fl oz+ 0.25% v/v+1qt	93	93	93	93	95	99	99	99
Surpass/Beyond+ NIS+28%	2pt/4fl oz+ 0.25% v/v+1qt	95	99	99	99	98	99	99	99
POST									
Beyond+NIS+28%	4fl oz+0.25% v/v+1qt	70	70	70	70	79	86	86	86
Beyond+NIS+28%	8fl oz+0.25% v/v+1qt	71	71	71	71	87	89	89	89
Beyond+MSO+28%	4fl oz+1% v/v+1qt	70	70	70	70	74	88	86	86
Clearsol+Canaplus	4.57fl oz+0.5% v/v	68	89	89	70	75	91	94	82
Intervex+Tween 20	17.1fl oz+0.25% v/v	75	81	81	86	90	95	97	97
Pulsar+Tween 20	6fl oz+0.25% v/v	80	83	90	81	79	88	90	88
Untreated		0	0	0	0	0	0	0	0
LSD (0.05)		8	5	4	11	9	7	7	12

[1]NIS = nonionic surfactant = R-11; 28% N = 28% nitrogen; Clearsol = imazapyr; Canaplus = 50% ai alkyl aryl polyglycol ether nonionic surfactant; Intervex = imazamox + imazapyr; Tween 20 = nonionic surfactant; Pulsar = imazamox.

Weed management strategies in imidazolinone-resistant sunflower. Gregory J. Endres and Blaine G. Schatz. (Carrington Research Extension Center, North Dakota State University, Carrington, ND 58421) Weed control and crop response were investigated with selected PRE and POST herbicides in imidazolinone-resistant (Clearfield™) sunflower. The trial had a randomized complete block design with three replicates. The experiment was conducted on a loam soil with 8.0 pH and 3.3% organic matter at the NDSU Carrington Research Extension Center. The trial area was tilled with a disk followed by two passes with a Melroe culti-harrow on October 20, 2003. Herbicide treatments were applied to 10 by 25 ft plots with a CO_2 pressurized hand-held plot sprayer. Fall sulfentrazone treatments were applied October 28 at 18 gal/A and 30 psi through 8002 flat fan nozzles on a dry soil surface with 39 F, 66% RH, 25% clear sky, and 2 mph wind. Snowfall occurred 1 d following herbicide application. Seeds 2000 'Viper' was planted in 30-inch rows without any prior spring tillage on May 28, 2004 and hand-thinned to 20,000 plants/A on June 25. Growing-season herbicide treatments were applied at 10 gal/A and 30 psi through 8001 flat fan nozzles. PRE treatments were applied on a dry soil surface on May 28 with 73 F, 44% RH, 75% clear sky, and 16 mph wind. Glyphosate at 0.75 ae/A was applied across the trial on May 28. Rainfall totaled 2.27 inches during May 29 to 30. POST treatments were applied on July 3 with 69 F, 82% RH, 100% cloudy sky, and 7 mph wind to V6- to V8-stage sunflower, tillering green and yellow foxtail, and 2- to 12-inch tall common lambsquarters, 1- to 3-inch tall hairy and Eastern black nightshade, 1- to 3-inch tall prostrate and redroot pigweed, and 1- to 10-inch tall annual smartweed. Late POST treatments were applied on July 9 with 59 F, 90% RH, clear sky, and 8 mph wind to V8-stage sunflower, 6-inch tall green and yellow foxtail, and 6- to 12-inch tall common lambsquarters, 2- to 4-inch tall hairy and Eastern black nightshade, 2- to 8-inch tall prostrate and redroot pigweed, and 6- to 12-inch tall annual smartweed. Weed densities on July 8 were: foxtail = 46 plants/ft^2, common lambsquarters = 1 plant/ft^2, nightshade = 4 plants/ft^2, and annual smartweed = 14 plants/ft^2. The trial was hand harvested and seeds threshed with a plot combine on November 3.

With the exception of common lambsquarters, broadleaf weed control was poor (0-60%) with fall- or spring-applied sulfentrazone (Table 1) and yield was reduced compared to treatments that included imazamox (Table 2). POST Imazamox following sulfentrazone, pendimethalin, or the combination provided 80 to 99% control of all weeds, except annual smartweed (74-86%). Imazamox + MSO improved control of foxtail and smartweed compared to NIS with the POST but not the LPOST application timing. Weed control tended to improve with the POST vs. LPOST application timing, especially when visually evaluated two wk after application. Height reduction generally occurred with treatments that included imazamox, but the generally adequate weed control contributed to highest yields in the trial.

Table 1. Weed control in imidazolinone-resistant sunflower, Carrington, ND, 2004.

Herbicide[1]			2 wk after POST application					4 wk after POST application				
Treatment	Rate	Timing	fota[2]	colq[3]	nish[4]	piwe[5]	smwe[6]	fota	colq	nish	piwe	smwe
	ai/A		% control									
untreated check	x	x	0	0	0	0	0	0	0	0	0	0
Sulfentrazone/ Sethoxydim+MSO	0.188/0.2	Fall/ POST	74	88	56	40	40	88	81	37	13	0
Sulfentrazone/ Sethoxydim+MSO	0.25/0.2	Fall/ POST	76	87	60	40	42	89	86	50	13	0
Sulfentrazone/ Sethoxydim+MSO	0.188/0.2	PRE/ POST	76	50	60	40	27	88	48	35	13	0
Sulfentrazone/ Imazamox+NIS	0.094/ 0.031	PRE/ POST	80	82	99	99	82	92	85	98	99	80
Pendimethalin/ Imazamox+NIS	1.3/0.031	PRE/ POST	90	83	99	99	74	96	86	99	99	74
Pendimethalin/ Imazamox+MSO	1.3/0.031	PRE/ POST	94	96	99	99	84	98	97	99	99	79
Pendimethalin+ sulfentrazone/ Imazamox+MSO	1.3+0.094/0 .031	PRE/ POST	94	94	99	99	86	97	88	99	99	83
Imazamox+NIS	0.031	POST	77	75	93	99	77	88	74	91	99	72
Imazamox+MSO	0.031	POST	86	85	96	99	91	97	83	99	99	83
Imazamox+NIS	0.031	LPOST	69	72	75	77	73	72	68	76	92	72
Pendimethalin/ Imazamox+NIS	1.3/0.031	PRE/ LPOST	73	73	90	82	70	77	72	93	95	69
Imazamox+MSO	0.031	LPOST	72	71	82	87	72	76	76	86	92	73
Pendimethalin/ Imazamox+MSO	1.3/0.031	PRE/ LPOST	76	77	86	85	70	82	80	95	99	70
LSD (0.05)			7	15	13	6	13	4	14	22	17	10

[1]Treatments: MSO=Destiny, a methylated seed oil from Agriliance, St. Paul, MN, at 32 fl oz/A with sethoxydim and 1% v/v with imazamox; NIS=Preference, a nonionic surfactant from Agriliance, at 0.25% v/v. All imazamox treatments include UAN at 2.5% v/v. Timing: Fall=October 28, 2003; PRE=May 28, 2004; POST=July 3; LPOST=July 9.

[2]fota=green and yellow foxtail.

[3]colq=commom lambsquarters.

[4]nish=hairy and Eastern black nightshade.

[5]piwe=prostrate and redroot pigweed.

[6]smwe=annual smartweed.

Table 2. Imidazolinone-resistant sunflower response to herbicides, Carrington, ND, 2004.

Herbicide[1]			Plant stunting[2]		Seed
Treatment	Rate	Timing	2 WAA	4 WAA	yield
	ai/A		—— % ——		lb/A
untreated check	x	x	0	0	481
Sulfentrazone/Sethoxydim+MSO	0.188/0.2	Fall/POST	3	0	961
Sulfentrazone/Sethoxydim+MSO	0.25/0.2	Fall/POST	0	0	850
Sulfentrazone/Sethoxydim+MSO	0.188/0.2	PRE/POST	0	0	796
Sulfentrazone/Imazamox+NIS	0.094/0.031	PRE/POST	19	6	1324
Pendimethalin/Imazamox+NIS	1.3/0.031	PRE/POST	18	14	1328
Pendimethalin/Imazamox+MSO	1.3/0.031	PRE/POST	14	16	1451
Pendimethalin+sulfentrazone/Imazamox+MSO	1.3+0.094/0.031	PRE/POST	16	12	1193
Imazamox+NIS	0.031	POST	18	9	1403
Imazamox+MSO	0.031	POST	19	11	1381
Imazamox+NIS	0.031	LPOST	15	3	1315
Pendimethalin/Imazamox+NIS	1.3/0.031	PRE/LPOST	0	0	1398
Imazamox+MSO	0.031	LPOST	17	10	1304
Pendimethalin/Imazamox+MSO	1.3/0.031	PRE/LPOST	0	0	1297
LSD (0.05)			8	10	336

[1]Treatments: MSO=Destiny, a methylated seed oil from Agriliance, St. Paul, MN, at 32 fl oz/A with sethoxydim and 1% v/v with imazamox; NIS=Preference, a nonionic surfactant from Agriliance, at 0.25% v/v. All imazamox treatments include UAN at 2.5% v/v. Timing: Fall=October 28, 2003; PRE=May 28, 2004; POST=July 3; LPOST=July 9.
[2]WAA= wk after POST application.

Clearfield sunflower response to Raptor and insecticide tank mixtures, Carrington, 2004. (Endres) Crop response was investigated with tank mixtures of Raptor and selected insecticides in Clearfield sunflower. The trial had a randomized complete block design with three replicates. The experiment was conducted at the NDSU Carrington Research Extension Center on a loam soil with 7.1 pH and 3.3% organic matter with soybean as the previous crop. Seeds 2000 'Viper' was planted in 30-inch rows on May 28, 2004 and hand-thinned to 20,000 plants/A on June 25. Treatments were applied to 10 by 25 ft plots with a CO_2 pressurized hand-held plot sprayer at 14 gal/A and 30 psi through 8001 flat fan nozzles on July 7 with 58 F, 92% RH, 75% clear sky, and 8 mph wind to V8-stage sunflower. PPI Sonalan at 0.75 lb/A, PRE Spartan at 0.19 lb/A, between-row cultivation, and hand weeding were used to maintain a weed-free trial. The trial was hand harvested and seeds threshed with a plot combine on November 3.

No plant chlorosis was visually detected 1, 2, and 4 wk after treatment (data not shown). Slight plant height reduction generally occurred 2 and 4 wk after treatment (Table). Seed yield was similar among treatments.

Table. Clearfield sunflower response to Beyond and insecticide tank mixtures.

Herbicide		Plant stunting[1]			Seed
Treatment[2]	Rate	1	2	4	yield
	fl oz/A		%		lb/A
untreated check	x	0	0	0	1487
Beyond	4	0	5	4	1802
Beyond+Furadan	4+16	0	6	2	1622
Beyond+Lorsban	4+24	0	3	7	1461
Beyond+AsanaXL	4+9.7	0	0	3	1276
LSD (0.05)		NS	NS	NS	NS

[1]wk after treatment application.

[2]Beyond tank mixtures included NIS (Preference, a nonionic surfactant from Agriliance, St. Paul, MN) at 0.25% v/v and UAN at 2.5% v/v.

Tribenuron-resistant sunflower weed control. Zollinger, Richard K. and Jerry L. Ries. An experiment was conducted near Carrington, ND, to evaluate weed control from Express in tribenuron-resistant sunflower. Pioneer 'XF3312' tribenuron-resistant sunflower was planted on June 4, 2004. PRE applications were applied on June 9 at 1:10 pm with 64 F air, 64 F soil at 4 inch depth, 42% relative humidity, 80% clouds, 4 to 6 mph NW wind, dry soil surface, and moist subsoil. POST treatments were applied on July 12 at 12:00 pm with 78 F air, 95 F soil surface, 68% relative humidity, 0% clouds, 6 to 10 mph W wind, dry to moist soil surface, moist subsoil, good crop vigor, and no dew present 12 to 16 inch (V8 to V10) sunflower. Weed species present were: 5 to 8 inch (20 to 30/yd^2) green foxtail and 5 to 8 inch (20 to 30/yd^2) yellow foxtail. Treatments were applied to the center 6.7 feet of the 10 by 40 foot plots with a backpack-type plot sprayer delivering 17 gpa at 40 psi through 8002 TeeJet flat-fan nozzles for PRE treatments and 8.5 gpa at 40 psi through 8001 TeeJet flat-fan nozzles for POST treatments. The experiment had randomized complete block design with three replications per treatment.

This study was used for a weed control and demonstration trial at the Carrington Research and extension Center for the International Sunflower Conference. The study was placed in the field in a location were few broadleaf weeds were present. Grass population was so heavy it strongly out-competed broadleaf weeds for survival. Treatments were applied late to large grass weeds because a major rain event prevented application to smaller weeds. Application was made before the top-soil was dry so allow herbicides could affect weeds as soon as possible. Dual or Prowl H_2O increased foxtail control over Spartan which had minimal affect on grasses. Of the adjuvants tested, MSO enhanced grass control the most. (Dept. of Plant Sciences, North Dakota State University, Fargo).

Table. Tribenuron-resistant sunflower weed control (Zollinger and Ries).

Treatment[1]	Rate	July 26 Fxtl[2]	August 12 Fxtl
	(product/A)		
PRE/POST			
Dual Magnum/Express+Select+PO	1.67pt/0.25oz+8fl oz+1% v/v	70	94
Prowl H_2O/Express+Select+PO	2.63pt/0.25oz+8fl oz+1% v/v	78	89
Prowl H_2O/Express+Select+PO	2.63pt/0.5oz+8fl oz+1% v/v	80	95
Spartan/Express+Select+PO	3oz/0.25oz+8fl oz+1% v/v	70	71
Spartan/Express+Select+PO	3oz/0.5oz+8fl oz+1% v/v	71	82
POST			
Express+Select+PO	0.25oz+8fl oz+1% v/v	70	68
Express+Select+PO	0.5oz+8fl oz+1% v/v	73	71
Express+Select+SylTac	0.25oz+8fl oz+4fl oz	63	63
Express+Select+Liberate	0.25oz+8fl oz+0.25% v/v	60	60
Express+Select+Quad 7	0.25oz+8fl oz+1% v/v	75	78
Express+Select+MSO	0.25oz+8fl oz+1% v/v	78	91
Untreated		0	0
LSD (0.05)		4	5

[1]Express = Express 50 SG; PO = petroleum oil concentrate = Herbimax; SylTac = methylated seed oil (MSO) + organosilicone surfactant; Liberate = nonionic surfactant; Quad 7 = basic pH blend; MSO = Scoil.
[2]Fxtl = green and yellow foxtail.

Tribenuron formulations and weed control. Zollinger, Richard K. and Jerry L. Ries. An experiment was conducted near Casselton, ND, to evaluate weed efficacy from two tribenuron formulations with adjuvants. Tribenuron-resistant sunflower, Pioneer 'XF3312', was planted on June 11, 2004. POST treatments were applied on July 1 at 8:40 am with 70 F air, 78 F soil surface, 50% relative humidity, 5% clouds, 4 to 6 mph NE wind, dry soil surface, moist subsoil, poor to fair crop vigor, and no dew present to cotyledon to V4 sunflower. Weed species present: 2 to 7 inch (5 to $25/yd^2$) common cocklebur. Treatments were applied to the center 6.7 feet of the 10 by 40 foot plots with a backpack-type plot sprayer delivering 8.5 gpa at 40 psi through 8001 TeeJet flat-fan nozzles. The experiment had a randomized complete block design with three replicates per treatment.

Tribenuron does not usually provide adequate common cocklebur control. Tribenuron (Express) resistant sunflower is in development by sunflower breeders across the U.S. and on release could provide economical and effective weed control. Common cocklebur is a common weed infesting sunflower and no herbicide is currently registered in sunflower for control. Selecting adjuvants that increase weed control from tribenuron may provide better control. Tribenuron solubility increases as spray solution pH increases. Increasing spray solution pH may increase the amount of tribenuron absorbed and eventual weed control. Basic pH blend (BB) adjuvants increase spray solution pH thus increasing the tribenuron solubility. Methylated seed oil (MSO) type adjuvants increase the amount of herbicide absorbed by dissolving cuticular waxes that act as a barrier to herbicide absorption. MSO & BB adjuvants appear to solubilize tribenuron and dissolve common cocklebur leaf cuticle for greater herbicide absorption and improved weed control. The Express SG formulation of tribenuron is a new formulation in development from DuPont and has properties which raise the pH of the spray solution. Express SG at 0.33 oz/A (0.01 lb ai/A) with adjuvants gave common cocklebur control similar to Express XP at 0.33 oz/A (0.016 lb ai/A). Addition of BB adjuvant alone or with MSO to the SG formulation of tribenuron did not increase common cocklebur control suggesting that the SG formulation performed the same function as the BB adjuvant in increased spray solution pH and solubilizing tribenuron. No injury was observed from either formulation. (Dept. of Plant Sciences, North Dakota State University, Fargo).

Table. Tribenuron formulations and weed control (Zollinger and Ries).

		Cocb (28 DAT)	
Treatment[1]	Adjuvant rate	75 XP[2]	50 SG[3]
	(product/A)	(%)	(%)
Tribenuron+			
R-11	0.25% v/v	33	37
R-11+AMS	0.25% v/v+1.0 lb	42	33
Herbimax	1.0 qt	40	42
Herbimax+AMS	1.0 qt+1.0 lb	45	42
Scoil	1.5 pt	67	63
Scoil+AMS	1.5 pt+1.0 lb	57	62
Quad 7	1% v/v	62	62
Renegade	1.5 pt	72	69
Z-64	1.5 pt	69	68
Huntsman+TBP	0.1% v/v+0.1% v/v	58	43
Class Act NG	2.5% v/v	50	38
LSD (0.05)		9	9

[1]Tribenuron was included according to footnotes 2 and 3; R-11 = nonionic surfactant; AMS = ammonium sulfate; Herbimax = petroleum oil concentrate; Scoil = methylated seed oil; Quad 7 = basic pH blend; Renegade = methylated seed oil basic pH blend; Z-64 = methylated seed oil basic pH blend + 28% nitrogen + surfactant; Huntsman = Surfonic L68-28X; TBP = tribasic phosphate; Class Act NG (Next Generation) = surfactants + fertilizer.

[2]75 XP = Express 75 XP, tribenuron at 0.33 oz/A.

[3]50 SG = Express 50 SG, tribenuron at 0.33 oz/A.

Express with adjuvants. Zollinger, Richard K. and Jerry L. Ries. An experiment was conducted near Casselton, ND, to evaluate common cocklebur control from Express. Pioneer 'XF3312' tribenuron-resistant sunflower was planted on June 11, 2004. POST applications were made on July 1 at 9:25 am with 71 F air, 87 F soil surface, 43% relative humidity, 3 to 5 mph NE wind, dry soil surface, moist subsoil, poor crop vigor, and no dew present to V2 to V4 sunflower. Weeds species present were: 2 to 7 inch (10 to 50/yd^2) common cocklebur. Treatments were applied to the center 6.7 feet of the 10 by 40 foot plots with a backpack-type plot sprayer delivering 8.5 gpa at 40 psi through 8001 TeeJet flat-fan nozzles. The experiment had a randomized complete block design with three replications per treatment.

This study was conducted in Express-resistant sunflower at a location with a heavy infestation of common cocklebur. Common cocklebur was used as a target species because Express does not normally control this weed. The SG formulation has additives that increase spray water pH making Express more soluble. The order of adjuvant enhancement of Express SG was MSO Basic pH Blend > Basic pH Blend > PO > NIS. Renegade applied on an area basis gave greater cocklebur control than on a % v/v basis. This likely would apply to most oil based adjuvants. (Dept. of Plant Sciences, North Dakota State University, Fargo).

Table. Express with adjuvants (Zollinger and Ries).

Treatment[1]	Rate	28 DAT Cocb
	(product/A)	--- (%) ---
Express SG +	0.33oz +	
Preference+28% N	0.5% v/v+1qt	37
Class Act Next Generation	2.5% v/v	42
Destiny+28% N	1% v/v+1qt	58
Prime Oil+28% N	0.5% v/v+1qt	40
Hi-Per-Oil+28% N	0.5% v/v+1qt	40
Rivet+28% N	0.5% v/v+1qt	52
AG 01023+28% N	0.5% v/v+1qt	50
AG 01034+28% N	0.25% v/v+1qt	48
AG 04029	0.5% v/v	45
AG 03002	1% v/v	30
AG 03002	2% v/v	40
Quad 7	1% v/v	69
Reddy It+28% N	0.3% v/v+1qt	42
Sure Up+28% N	0.5% v/v+1qt	47
Base	1% v/v	64
Renegade	1% v/v	57
Renegade	1.5pt	71
Renegade	2% v/v	71
Z-64	1% v/v	72
LSD (0.05)		7

[1]Preference = nonionic surfactant; 28% N = 28% nitrogen; Class Act Next Generation = surfactants + fertilizers; Destiny = methylated seed oil (MSO); Prime Oil and Hi-Per-Oil = petroleum oil concentrates; Rivet = MSO organosilicone surfactant; AG - 01023, 01034, 04029, and 03002 are proprietary adjuvants from Agriliance; Quad 7 = basic pH blend; Reddy It = MSO complex surfactant blend; Sure Up = water conditioner; Base and Renegade = MSO basic pH blend; Z-64 = MSO basic pH blend + 28% N + surfactants.

Adjuvants rate based on spray volume and area of coverage. Zollinger, Richard K. and Jerry L. Ries. An experiment was conducted near Casselton, ND, to evaluate weed control when applying adjuvants at a percent volume basis versus at an area basis. Treatments were applied on July 1, 2004 at 8:05 am with 66 F air, 81 F soil surface, 57% relative humidity, 5% clouds, 4 to 7 mph NE wind, dry soil surface, moist subsoil, and no dew present to 2 to 6 inch (1 to 3/ft^2) common cocklebur. Treatments were applied to the center 6.7 feet of the 10 by 40 foot plots with a backpack-type plot sprayer delivering 8.5 gpa at 40 psi through 8001 TeeJet flat-fan nozzles. The experiment had a randomized complete block design with three replicates per treatment.

Many herbicide labels that allow application with oil adjuvants recommend oil adjuvants rates at 1% v/v. At 1% v/v, herbicides applied at high spray volumes may have sufficient adjuvant for optimal weed control while the amount of oil adjuvant at low spray volumes may be inadequate. Pesticide Use Surveys conducted in North Dakota show that over 88% of herbicides are applied at 10 gpa or less. Data show that weed control from Express applied with adjuvants gave greater control at 1.5 pt/A than at 1% v/v and 2% v/v. North Dakota State University routinely recommends oil adjuvants at 1.5 pt/A to maintain sufficient adjuvant concentration in the spray tank regardless of spray volume used. Basic pH blend (BB) adjuvants are recommended and used at 1% v/v because previous research has shown adequate weed control in a wide range of spray volumes. However, these data support BB use in at least a 2% v/v concentration. Adjuvant rate may not be as critical if higher herbicide rates are used or if herbicides are applied to susceptible weeds species. (Dept. of Plant Sciences, North Dakota State University, Fargo).

Table. Adjuvants rate based on spray volume and area of coverage (Zollinger and Ries).

		Cocb (28 DAT), adjuvant rate		
		1% v/v	2 % v/v	
Treatment[1]	Rate	(0.68 pt/A)	(1.4 pt/A)	1.5 pt/A
	(product/A)	(%)	(%)	(%)
Express+Quad 7	0.33	42	69	
Express+Scoil	0.33	35	44	57
Express+Renegade	0.33	42	64	74
LSD (0.05)			5[2]	

[1]Express = Express 50 SG; Quad 7 = basic pH blend; Scoil = methylated seed oil (MSO); Renegade = MSO basic pH blend.

[2]LSD of 5 can be used to compare any two values in table.

Volunteer canola control in sunflower. Jenks, Markle, and Willoughby. Express-tolerant sunflowers were seeded May 18 at 20,000 plants/A into 30-inch rows. Canola was seeded over the top to simulate a volunteer canola (VC) situation. Individual plots were 10 x 30 ft and replicated 3 times. Herbicide treatments were applied preemergence (PRE) on May 18 with a bicycle sprayer delivering 20 gpa at 30 psi with XR 80015 nozzles. Air and soil temperatures were 80 and 61 F, respectively, relative humidity was 18%. Postemergence treatments were applied to 3-leaf canola on June 18 with a bicycle sprayer delivering 10 gpa at 40 psi through XR 8001 nozzles. Air and soil temperatures were 58 and 60 F, respectively, relative humidity was 34%. Treatments to 6-leaf canola were applied in the same fashion on June 28. Air and soil temperatures were 80 and 78 F, respectively, relative humidity was 31%.

In Express-tolerant sunflower, soil-applied Spartan provided good VC control. Spartan was included in dry pea, flax and sunflower in this study. VC with Spartan was good in the dry pea and sunflower studies, but poor in the flax study. In the flax study, VC control in the first rep was similar to control in the dry pea and sunflower studies, but control was poor in the second and third reps. A soil test showed that soil pH in the second rep was 7.2, whereas soil pH in the first rep was 4.6. Organic matter was similar for both reps. The higher injury in a lower pH area is not what we normally expect. We typically see more injury in higher pH soils. Express and Assert provided good to excellent VC control at either application stage.

Table. Volunteer canola control in sunflower (2004).

			Volunteer Canola	
Treatment Name	Rate	Timing	Jul 8	Jul 28
			% control	
Spartan	4 oz	PRE	91	88
Express + NIS	0.167 oz + 0.125% v/v	3-leaf	99	99
Express + NIS	0.167 oz + 0.125% v/v	6-leaf	63	90
Assert + NIS	0.8 pt + 0.25% v/v	3-leaf	91	91
Assert + NIS	0.8 pt + 0.25% v/v	6-leaf	51	84
Untreated			0	0
LSD (0.05)			8	7
CV			7	5