Weed control and crop response in Roundup Ready canola. (Hendrickson, Swanson, Henson, and Valenti) The study was conducted at the NDSU Carrington Research Extension Center on a loam soil with a 7 pH and 3.3% organic matter. Roundup Ready canola 'DKL223' was seeded April 23, 2003 into 6-inch rows at 5 lb/A. Individual plots were 10 ft by 25 ft and arranged in a randomized complete block design with four replications. Herbicide treatments were applied with a CO_2 pressurized hand-held plot sprayer at 10 gal/A and 22 psi through XR80015 flat fan nozzles. EPOST herbicides were applied on May 21 with 49° F, 61% RH, 100% cloud cover, 9 mph wind, and 49° F soil temperature to 2-leaf canola, cotyledon redroot pigweed, cotyledon common lambsquarters, and 1-leaf green and yellow foxtail. MPOST herbicides were applied on May 26 with 61° F, 49% RH, 0% cloud cover, 8 mph wind, and 55° F soil temperature to 3- to 4-leaf canola, cotyledon to 1.5-inch redroot pigweed, cotyledon to 1.5-inch common lambsquarters, and 2-leaf green and yellow foxtail. LPOST herbicides were applied on May 31 with 58° F, 46% RH, 0% cloud cover, 8 mph wind, and 58° F soil temperature to 5- to 6-leaf canola, 1.5- to 2.5-inch redroot pigweed, 1.5- to 2.5-inch common lambsquarters, and 2- to 3-leaf green and yellow foxtail. The canola was harvested on August 11.

All herbicide applications provided greater than 97% redroot pigweed and common lambsqarters control when evaluated June 30 (Table). Green and Yellow foxtail control ranged from 75-88% at the EPOST timing, 92-99% at the MPOST timing, and 98-100% at the LPOST timing when evaluated June 30. None of the herbicides tested caused any visible crop injury (data not shown). Canola seed yield was similar among treatments, likely due to low weed densities.

Table. Weed control and crop response in Roundup Ready canola.

			Weed control									Canola
			Redroot pigweed			Common lambsquarters			Green and Yellow foxtail			Seed
Treatment[a]		Timing	6/5	6/13	6/30	6/5	6/13	6/30	6/5	6/13	6/30	Yield
	oz/A		%									lb/A
Roundup Ultramax	13	EPOST	99	100	100	99	99	100	74	81	81	2549
Roundup Ultramax	19.4	EPOST	100	100	100	99	100	98	81	93	88	2676
Roundup Weathermax	16	EPOST	98	100	100	98	100	100	79	85	75	2648
Roundup Ultramax	13	MPOST	99	100	100	100	100	100	97	96	92	2748
Roundup Ultramax	19.4	MPOST	100	100	100	100	100	100	98	94	92	2641
Roundup Weathermax	16	MPOST	100	100	100	99	100	100	96	98	99	2487
Glyphomax Plus+Stinger	16+3.8	MPOST	100	100	100	96	100	100	96	97	96	2749
Roundup Ultramax	13	LPOST	55	100	100	53	100	100	55	100	100	2281
Roundup Ultramax	19.4	LPOST	58	100	100	50	100	100	58	99	99	2250
Roundup Weathermax	16	LPOST	53	100	100	50	100	100	53	100	100	2562
Roundup Ultramax / Roundup Ultramax	13 / 13	EPOST / LPOST	100	100	100	100	100	100	99	100	99	2318
Roundup Weathermax / Roundup Weathermax	10.7 / 10.7	EPOST / LPOST	100	100	100	100	100	100	99	99	98	2514
Untreated check	0		0	0	0	0	0	0	0	0	0	2548
LSD (P=.05)			6	0	0	4	1	1	7	9	10	NS

[a] All treatments included ammonium sulfate at 16.7 lb/100gal.

Canola herbicide systems comparison. Jenks, Willoughby, and Markle. Various canola varieties were seeded May 15. Individual plots were 15 x 30 feet and replicated four times. Herbicide treatments were applied with a bicycle sprayer delivering 10 gpa at 40 psi through XR 8001 nozzles to 1- to 2-leaf canola on June 2, 3- to 4-leaf canola on June 10, and 5- to 6-leaf canola on June 18. On June 2, air and soil temperatures were 62 and 63 F, respectively and relative humidity was 64%. On June 10, air and soil temperatures were 61 and 65 F, respectively and relative humidity was 71%. On June 18, air and soil temperatures were 67 and 64 F, respectively and relative humidity was 66%.

			Canola		
			Height	Test wt	Yield
Treatment[a]	Rate	Timing	Jul 30	Aug 13	
			inches	lb/bu	lb/A
DKL223					
Roundup	13 fl oz	3-4 lf	38	54.0	2222
DKL 3455					
Roundup	13 fl oz	3-4 lf	42	53.1	1432
HYOLA 357RR					
Roundup	13 fl oz	3-4 lf	38	53.3	2128
CL905 RR					
Roundup	13 fl oz	3-4 lf	43	52.4	1759
45H21					
Roundup	13 fl oz	3-4 lf	44	53.5	1893
DKL223					
Roundup/	13 fl oz/	1-2 lf/	37	53.8	1906
Roundup	13 fl oz	5-6 lf			
DKL 3455					
Roundup/	13 fl oz/	1-2 lf/	42	53.4	1689
Roundup	13 fl oz	5-6 lf			
HYOLA 357RR					
Roundup/	13 fl oz/	1-2 lf/	35	53.3	2008
Roundup	13 fl oz	5-6 lf			
CL905 RR					
Roundup/	13 fl oz/	1-2 lf/	45	52.8	1672
Roundup	13 fl oz	5-6 lf			
45H21					
Roundup/	13 fl oz/	1-2 lf/	39	53.4	1828
Roundup	13 fl oz	5-6 lf			
InVigor 2663					
Liberty	34 fl oz	3-4 lf	44	54.1	1603
46A76					
Raptor +	4 fl oz +	3-4 lf	39	53.1	1327
NIS + 28% N	0.25% v/v + 1 qt				
LSD (0.05)			5	0.4	367
CV			9	0.5	14

[a]*Roundup treatments were Roundup UltraMax applied with AMS at 2.5 gal/100 gal; Liberty was applied with AMS at 8.82 gal/100 gal.*

Canola Herbicide Systems Study, Williston 2003. (Neil Riveland) All treatments were applied on June 16 with wind ESE at 2-3 mph, temperature at 73 F, RH 65%, 60% clear sky and plant and soil surfaces dry with 67 F soil temperature at 4 inches. Canola emergence was not uniform and therefore about 60-75% of the plants were in the 5-6 lf stage and 25-40% of the plants were in the 1-2lf stage. Weeds were emerged and were small. 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 0.46 inches on June 21. The experiment was a randomized complete block design with three replications. Russian thistle density averaged 1 plant/ft2. Green foxtail density was 3-5 plants/ft2 and common purslane density averaged 5 plants/ft2. Plots were evaluated for crop injury on 6/24/03 and weed control August 8. Canola was machine harvested on August 12. Harvested plot size was 80 sq. ft.

				8/8/03			Plant	Test	Seed	
Brand & Cultivar	Treatment[a]	Rate	Days[b]	Grft	Copu	Ruth	Hght	Wght	Oil[c]	Yield
		lbs ai/a			%		inch	lb/bu	%	lb/A
DKL 223	RUM	0.375	39	99	92	96	34	54	33	950
DKL34-55	RUM	0.375	44	99	96	98	38	53	36	870
Hyola 357RR	RUM	0.375	40	99	95	99	35	54	33	930
CL905RR	RUM	0.375	46	99	96	99	36	53	34	730
Pioneer 45H21	RUM	0.375	42	99	95	96	37	54	34	860
DKL 223	RUM	0.375	39	99	92	99	34	55	33	930
DKL34-55	RUM	0.375	43	99	96	99	34	53	35	760
Hyola 357RR	RUM	0.375	39	99	95	99	34	54	34	950
CL905RR	RUM	0.375	46	99	96	99	39	53	33	730
Pioneer 45H21	RUM	0.375	42	99	93	98	37	54	34	920
Invigor 2663	Liberty+AMS	0.443	46	99	97	92	44	54	34	850
46A76	Beyond+NIS+UAN	0.03	45	99	95	99	37	52	32	540
HIGH MEAN			46	99	97	99	44	55	36	950
LOW MEAN			39	99	92	92	34	52	32	540
EXP MEAN			43	99	95	98	37	54	34	840
C.V. %			1	0	3	3	6	1	2	12
LSD 5%			1	NS	NS	NS	4	1	1	174
# OF REPS			3	3	3	3	3	3	3	3

[a] -Trt = Treatment; RUM = RoundUp UltraMax; AMS = Ammonium Sulfate (liquid) at 3 lbs/A;
NIS = Non-ionic surfactant was Activator 90 from Loveland at 0.25%
UAN = Urea ammonium nitrate 28% at 0.25G

[b] -Days= days from planting to first flower

[c] - Seed oil content from an NMR machine, adjusted to 8.5% moisture.

Planted: May 16 on fallow.
Harvested: August 12

Summary: There was no crop injury noted for any treatment. Because of the erratic canola emergence and therefore the different canola stages within a plot, there was no attempt to apply the 1-2 and 3-4 leaf stage treatments. As a result all treatments were applied at the same crop leaf stage.

Comparison of clethodim formulations in canola. Kirk Howatt, Ronald Roach, and Janet Davidson-Harrington. ' DKL 223' canola was seeded May 2 at a location near Fargo, North Dakota. Treatments were applied to bolting 12" Canola and 3- to 4-leaf cereals on June 13 with 75° F, 46% relative humidity, clear sky, 2 to 4 mph wind, and soil temperature of 60° F. Treatments were applied with a backpack sprayer delivering 8.5 gpa at 35 psi through 8001 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 three replicates. Canola injury and volunteer cereal control were visually evaluated 7, 18, and 31 DAT. Canola injury 31 DAT was estimated maturity (mat.) delay.

		Jun 20			Jul 1			Jul 14		
Treatment[a]	Rate	Canola	Wheat	Barley	Canola	Wheat	Barley	Canola mat delay	Wheat	Barley
	oz/A	%			%			days	%	
Clethodim+PO	1.5+1%	39	55	57	59	85	86	21	99	99
V-10117+PO	1.4+1%	21	47	50	34	85	86	15	99	99
V-10137+PO	1.5+1%	7	47	45	3	85	85	6	99	99
Clethodim-P +PO	1.5+1%	6	42	45	3	84	84	5	99	99
V-10137	1.5	16	52	50	12	87	89	15	99	99
Untreated	0	0	0	0	0	0	0	0	0	0
LSD (P=0.05)		7	8	8	5	2	2	3	0	0
CV		33	12	13	17	2	2	22	0	0

[a]Clethodim was Select; V-10117 was experimental clethodim with 1.88 EC formulation; V-10137 was experimental clethodim with 0.94 EC formulation; and clethodim-P was Prism.

Herbicide application was delayed relative to suggested crop stage to provide a greater test of formulation efficacies on volunteer cereals. Select provided greater control of volunteer cereals than Prism 7 DAT, although all herbicides provided less than 60% control. All formulations provided at least 84% control of grasses 18 DAT with V-10137 providing slightly better control than other formulations. All formulations eventually provided complete control of volunteer cereals with very small differences in speed of activity.

Delayed herbicide application resulted in separation of product performance with respect to crop injury. Select caused much more injury than other formulations, 39% compared with 6 to 21% injury 7 DAT. Prism and V-10137+PO were the least injurious to canola. It was puzzling why V-10137+PO caused less injury than V-10137. Generally, adding PO would cause more injury and enhance weed control, but there was no indication of misapplication. These formulations will be tested again to further investigate this result. Plants expressing less than 5 to 15% injury 7 DAT were stunted and slightly deformed compared with untreated plants, but plants rated greater than 15% injury aborted existing inflorescences. New shoots produced flowers that eventually matured with seed, but shortened and fused flower petals were very common especially in Select-treated plots. Application after canola bolts is not recommended; however, V-10137 showed promise for increased crop safety while maintaining efficacy on large volunteer cereals.

Comparison of clethodim formulations to supplement glufosinate activity on grass weeds. (Kirk Howatt, Ronald Roach, and Janet Davidson-Harrington). 'DKL 223' canola was seeded May 21at Fargo, North Dakota. Treatments were applied to bolting 12-inch tall canola and 3- to 4-leaf volunteer cereals on June 19 with 71° F, 44% relative humidity, clear sky and 6 to 8 mph wind. Treatments were applied with a backpack sprayer delivering 8.5 gpa at 35 psi though 8001 flat-fan nozzles to a 7 ft wide area the length of 10 by 24 ft plots. The experiment was a randomized complete block design with four replicates. Canola injury and volunteer cereal control was visually evaluated 14 and 28 DAT.

Rating Date		Jul 1			Jul 14		
Treatment[a]	Rate	Canola	Wheat	Barley	Canola	Wheat	Barley
	oz/A	%					
Glufosinate+AMS	6+48	4	77	84	2	89	77
Glufosinate+clethodim+AMS	6+1+48	3	91	94	0	99	98
Glufosinate+V-10137+AMS	6+1+48	4	91	94	1	99	99
Glufosinate+V-10139+AMS	6+1+48	10	90	94	7	99	99
Glufosinate+V-10117+AMS	6+0.95+48	4	92	94	2	99	99
Untreated	0	0	0	0	0	0	0
LSD (P=0.05)		4	3	3	3	3	8
CV		59	3	3	96	2	7

[a] V-10137, V-10139, and V-10117 were experimental formulations of clethodim.

Glufosinate alone provided 77 and 84% control of wheat and barley, respectively, 14 DAT. Control of wheat with glufosinate continued to improve and was 89% 28 DAT, but barley was recovering as the season progressed. Addition of clethodim or new clethodim formulations improved control of volunteer cereals to at least 90% 14 DAT. Treatments containing any clethodim formulation provided 98 to 99% control of volunteer wheat and barley 28 DAT. Glufosinate caused injury that was not different from untreated plants. The formulation of clethodim in V-10139 caused increased injury compared with other herbicides but did not exceed 10%. Plants appeared to recover from herbicide injury as the season progressed.

Plant response to acetic acid concentration. (Kirk Howatt, Ronald Roach, and Janet Davidson-Harrington). 'Conlin' 2 row barley, 'Oxen' hard red spring wheat, 'Tradition' 6 row barley, 'Jerry' Oat, and 'Lebsock' durum were seeded May 2 in bioassay strips perpendicular to plot direction at a location near Fargo. Treatments were applied to 6-leaf wheat, 4- to 5-leaf durum, 5-leaf oat and barley, 1-inch redroot pigweed and common lambsquarters, and 1- to 2-leaf yellow foxtail on June 9 with 74° F, 45% relative humidity, cloudy sky, 8 mph southeast wind, and soil temperature of 57° F. Treatments were applied with a backpack sprayer delivering 8.5 gpa at 35 psi though 8001 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 replications.

		Jun 17							
Treatment[a]	Rate	2 row Barley	Wheat	6 row Barley	Oat	Durum	Rrpw	Colq	Yeft
	oz/A	%							
Acetic acid	20%	16	14	11	12	10	27	17	6
Acetic acid	10%	7	4	5	4	6	2	1	0
Acetic acid	5%	4	1	1	1	1	7	2	0
Acetic acid+NIS	10%+0.125%	25	9	14	17	15	15	7	6
Bromoxynil	4	2	3	3	4	9	22	17	2
Untreated	0%	1	0	0	1	0	2	1	0
LSD (P=0.05)		9	6	13	13	7	25	19	10
CV		44	49	89	73	53	81	95	159

[a]Bromoxynil&MCPA was 5 lb/gal formulation; V-10136 was an experimental herbicide.

Industrial vinegar, used at some locations for total vegetation control, is 20% acetic acid. Industrial vinegar was used as the acetic acid source in this experiment. Acetic acid effect on species was minimal. Addition of NIS improved control but did not provide commercially acceptable results. Bromoxynil did not control broadleaf weeds either indicating that weeds may have been shielded from herbicide application by the larger cereal plants.

Plant response to acetic acid application volume. (Kirk Howatt, Ronald Roach, and Janet Davidson-Harrington). 'Conlin' 2 row barley, 'Oxen' hard red spring wheat, 'Tradition' 6 row barley, 'Jerry' oat and 'Lebsock' durum were seeded May 2 in bioassay strips perpendicular to plot at a location near Fargo, North Dakota. Treatments were applied to 5 leaf barley and oat, 6 leaf wheat, 4.5 leaf durum, 1-inch redroot pigweed and common lambsquarters, and 1- to 2-leaf yellow foxtail on June 9 with 74°F, 48% relative humidity, cloudy sky, 8 mph southeast wind and soil temperature of 57° F. Treatments were applied with a backpack sprayer delivering 8.5 gpa at 35 psi through 8001 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.

				6/17/03							
Treatment	Rate	Nozzle size	Spray volume	2 row Barley	Wheat	6 row Barley	Oat	Durum	Rrpw	Colq	Yeft
	oz/A		gal/A	%							
Acetic acid	10%	8001	10	6	2	6	3	5	4	5	0
Acetic acid	10%	8002	20	6	4	4	4	2	4	3	0
Acetic acid	10%	8004	40	6	5	6	7	5	10	8	0
Acetic acid	10%	8006	60	9	9	8	6	9	6	4	0
Acetic acid	10%	8008	80	16	15	12	13	12	22	15	2
Bromoxynil	4	8001	10	22	7	4	6	4	14	36	1
Untreated				0	0	0	0	0	0	0	0
LSD (P=0.05)				20	8	5	6	3	11	15	2
CV				143	93	65	75	42	82	102	354

Industrial vinegar, used at some locations for total vegetation control, is 20% acetic acid. Industrial vinegar was used as the acetic acid source in this experiment. Acetic acid effect on species was minimal. Efficacy was similar for all species at volumes from 10 to 60 gpa. Application of 80 gpa tended to increase control, but result was far from total vegetation control. Bromoxynil did not control broadleaf weeds either indicating that weeds may have been shielded from herbicide application by the larger cereal plants.

Roundup WeatherMax with adjuvants. Zollinger, Richard K. and Jerry L. Ries. An experiment was conducted near Prosper, ND, to evaluate weed control from Roundup WeatherMax with adjuvants applied POST on non-cropland. POST treatments were applied on June 30, 2003 at 1:20 pm with 80 F air, 87 F soil surface, 42% relative humidity, 10% clouds, 5 to 10 mph S wind, dry soil surface, moist subsoil, and no dew present. Weed species present were: 2 to 8 inch (10 to 75/ft^2) yellow foxtail; 2 to 7 inch (5 to 15/yd^2) redroot pigweed; 2 to 5 inch (3 to 5/yd^2) common lambsquarters; 2 to 5 inch (1 to 5/yd^2) kochia; and 2 to 5 inch (1 to 5/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 flat fan nozzles. The experiment had a randomized complete block design with three replicates per treatment.

Table. Roundup WeatherMax with adjuvants (Zollinger and Ries).

		July 14					July 28				
Treatment[1]	Rate	Yeft	Rrpw	Colq	Koch	Cocb	Yeft	Rrpw	Colq	Koch	Cocb
Roundup WeatherMax+	22fl oz+	99	99	99	99	99	99	99	99	99	99
N-Pac AMS	5% v/v	99	99	99	99	99	99	99	99	99	99
Alliance	1.25% v/v	99	99	99	99	99	99	99	99	99	99
Roundup WeatherMax+	5.5fl oz+	90	75	70	99	99	90	70	75	99	99
N-Pac AMS	5% v/v	99	99	99	99	99	99	99	99	99	99
N-Pac AMS	2.5% v/v	99	99	99	99	99	99	99	99	99	99
Alliance	2% v/v	99	99	99	99	99	99	99	99	99	99
Alliance	1.25% v/v	99	99	99	99	99	99	99	99	99	99
Alliance	1% v/v	99	99	99	99	99	99	99	99	99	99
Alliance	0.75% v/v	99	99	99	99	99	99	99	99	99	99
Placement+Alliance	2fl oz+1.25% v/v	99	99	99	99	99	99	99	99	99	99
Placement+Alliance	2fl oz+0.75% v/v	99	99	99	99	99	99	99	99	99	99
Placement Propak	1% v/v	99	99	99	99	99	99	99	99	99	99
PlacementPropak+ Alliance	1% v/v+ 1% v/v	99	99	99	99	99	99	99	99	99	99
AG 02009	4qt	99	99	99	99	99	99	99	99	99	99
AG 02009	3qt	99	99	99	99	99	99	99	99	99	99
LSD (0.05)		0	0	0	0	0	0	0	0	0	0

[1]N-Pac AMS = liquid ammonium sulfate; Alliance = ammonium sulfate + water conditioning agents; Placement = drift retardant; Placement Propak = AMS fertilizer + drift retardant; AG 02009 is a proprietary adjuvant from Agriliance.

Low glyphosate rate and large weeds were used to differentiate adjuvant enhancement. Roundup WeatherMax is similar to a full adjuvant load 4.5 lb ae/gal glyphosate. Roundup WeatherMax applied with any additional adjuvant gave 99% weed control which indicates that the rate was too high in this study to evaluate adjuvant enhancement of glyphosate. WeatherMax applied alone at 5.5 fl oz did not give complete weed control probably because of insufficient adjuvant from the glyphosate formulation at the low rate used. (Dept. of Plant Sciences, North Dakota State University, Fargo).

Glyphosate with adjuvants, micronutrient, and deposition aid. Zollinger, Richard K. and Jerry L. Ries. An experiment was conducted near Prosper, ND, to evaluate weed control of treatments applied POST on non-cropland. On June 30, 2003, POST treatments were applied at 12:30 pm with 80 F air, 85 F soil surface, 40% relative humidity, 10% clouds, 5 to 10 mph S wind, dry soil surface, moist subsoil, and no dew present. Weed species present were: 2 to 8 inch (5 to 75/ft^2) yellow foxtail; 2 to 4 inch (5 to 15/yd^2) redroot pigweed; 2 to 8 inch (1 to 5/yd^2) common lambsquarters; 2 to 5 inch (<1/yd^2) common cocklebur; and 2 to 5 inch (<1/yd^2) kochia. 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 8001 flat fan nozzles. The experiment had a randomized complete block design with three replicates per treatment.

Table. Glyphosate with adjuvants, micronutrient, and deposition aid (Zollinger and Ries).

		July 14		July 28		
Treatment[1]	Rate	Yeft	Cocb	Yeft	Rrpw	Colq
	(product/A)	(%)	(%)	(%)	(%)	(%)
Buccaneer +	1pt	99	99	99	99	99
Premier 90+AMS	0.5% v/v+8.5lb/100gal	99	99	99	99	99
WC 334	2qt	83	75	80	70	70
One-Ap XL+WC 334	9lb/100gal+2qt	90	75	93	90	80
Liberate	2pt/100gal	99	99	99	99	99
Liberate	4pt/100gal	99	99	99	99	99
BlendMaster	1gal/100gal	99	99	99	99	99
Activator 90	4pt/100gal	99	99	99	99	99
Choice	2pt/100gal	99	99	99	99	99
N-Pac AMS	5% v/v	99	99	99	99	99
Alliance	1.25% v/v	99	99	99	99	99
AG 02009	0.75% v/v	95	85	95	80	85
Buccaneer Plus +	1pt	99	99	99	99	99
One-Ap XL	9lb/100gal	99	99	99	99	99
AMS	8.5lb/100gal	99	99	99	99	99
Dri-Gard	9lb/100gal	99	99	99	99	99
Guardian Plus	2.5gal/100gal	99	99	99	99	99
WC 334	2qt	85	70	80	80	70
Dri-Gard+WC 334	9lb/100gal+2qt	90	90	90	85	90
Guardian Plus+ WC 334	2.5gal/100gal+2qt	78	70	75	80	70
LSD (0.05)		3	4	3	3	4

[1]Premier 90, Liberate, and Activator 90 = nonionic surfactant; AMS, N-Pac, and Alliance = ammonium sulfate; WC 334 is a proprietary adjuvant from West Central; OneAp XL = AMS + nonionic surfactant + deposition + defoamer; BlendMaster = water conditioning agent + nonionic surfactants; Choice = water conditioning agent; Dri-Gard and Guardian Plus = AMS fertilizer + deposition + defoamer.

Low glyphosate rate and large weeds were used to differentiate adjuvant enhancement. Buccaneer is similar to a partial adjuvant load 3 lb ae/gal glyphosate and Buccaneer Plus is similar to a full adjuvant load 3 lb ae/gal glyphosate. Buccaneer and Buccaneer Plus applied alone without any additional adjuvant gave 99% weed control which indicated that the rate was too high in this study to evaluate adjuvant enhancement of glyphosate. Most adjuvants applied with Buccaneer/Plus also resulted in complete weed control. However, WC 334 applied alone or with other adjuvants antagonized weed control from Buccaneer or Buccaneer Plus. On July 14 (14 DAT) treatments gave 99% control of rrpw, colq, and kochia (data not shown). On July 28 (28 DAT) treatments gave 99% control of kochia and common cocklebur (data not shown). (Dept. of Plant Sciences, North Dakota State University, Fargo).

Application volumes and In-Place. Zollinger, Richard K. and Jerry L. Ries. An experiment was conducted near Buffalo, ND, to evaluate weed control from herbicides applied POST with and without In-Place at various application rates. POST treatments were applied on July 2, 2003 at 9:15 am with 82 F air, 88 F soil surface, 65% relative humidity, 0% clouds, 4 to 7 mph S wind, damp soil surface, moist subsoil, and no dew present to non-cropland. Weed species present were: 3 to 8 inch (5 to 25/yd^2) kochia; 2 to 8 inch (15 to 40/yd^2) biennial wormwood; 2 to 8 inch (5 to 30/ft^2) redroot pigweed; 1 to 4 inch (10 to 20/yd^2) eastern black nightshade; 4 to 12 inch (5 to 50/yd^2) green foxtail. Treatments were applied to the center 6.7 feet of the 10 by 40 foot plots with a plot sprayer mounted on a four wheeler. The experiment had a randomized complete block design with three replicates per treatment.

Table1. Treatment application rate setup.

Application Rate	Operating Pressure	Nozzle	Speed
(gpa)	(psi)	(size)	(mph)
2	15	11001	9
3	40	11001	10
5	40	11001	6
7	40	11001	4.2
10	10	11002	6

All herbicides gave the similar weed control regardless of application volume. (Dept. of Plant Sciences, North Dakota State University, Fargo).

Table 2. Application volumes and In-Place (Zollinger and Ries).

Treatment[1]	Rate	Application Rate	July 16						July 30					
			Grft	Koch	Rrpw	Biww	Ebns	Wibw	Grft	Koch	Rrpw	Biww	Ebns	Wibw
	(product/A)	(gpa)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)
Roundup UltraMax+ Bronc Max	1pt+ 2qt/100 gal	5	99	99	99	98	50	40	99	99	99	98	50	40
Roundup UltraMax+ Bronc Max+In-Place	1pt+ 2qt/100 gal+4fl oz	3	99	99	99	99	50	40	99	99	99	99	50	40
Roundup UltraMax+ Bronc Max+In-Place	1pt+ 2qt/100 gal+4fl oz	2	99	99	99	99	50	40	99	99	99	99	50	10
Puma+R-11	1pt+0.25% v/v	10	99	0	0	0	0	0	99	0	0	0	0	0
Puma+R-11+ In-Place	1pt+0.25% v/v+ 4fl oz	7	99	0	0	0	0	0	99	0	0	0	0	0
Puma+R-11+ In-Place	1pt+0.25% v/v+ 4fl oz	5	99	0	0	0	0	0	99	0	0	0	0	0
Clarity	3fl oz	5	0	50	50	50	50	50	0	50	50	50	50	50
Clarity+In-Place	3fl oz+1fl oz	3	0	50	50	50	50	50	0	50	50	50	50	50
Buctril	1pt	10	0	20	20	20	20	20	0	20	20	20	20	20
Buctril+In-Place	1pt+4fl oz	5	0	20	20	20	20	20	0	20	20	20	20	20
LSD (0.05)			0	0	0	1	0	0	0	0	0	1	0	0

[1]Bronc Max = water conditioning agent; R-11 = low foaming nonionic surfactant; In-Place = deposition and retention agent.

Fall-applied Spartan in chickpea. Jenks, Willoughby, and Markle. 'B-90' chickpeas were seeded April 24 into 7.5-inch rows at 180 lb/A. Individual plots were 10 x 30 ft and replicated three times. Fall and PRE treatments were applied on November 19 and April 24, respectively, with a bicycle sprayer delivering 20 gpa at 30 psi through XR 80015 nozzles. Air and soil temperatures were 40 and 32 F, respectively, and relative humidity was 63% on November 19. Air and soil temperatures were 70 and 65 F, respectively, and relative humidity was 28% on April 24. POST treatments were applied June 2 with a bicycle sprayer delivering 10 gpa at 40 psi through XR 8001 nozzles to 3- to 5-inch chickpeas. Air and soil temperatures were 65 and 67 F, respectively, and relative humidity was 58%. The primary weeds evaluated were kochia (Kocz), redroot pigweed (Rrpw), and wild buckwheat (Wibw).

			Kocz			Rrpw			Wibw		Yield	Test Wt
Treatment[a]	Rate	Timing	Jun 7	Jun 17	Jul 7	Jun 7	Jun 17	Jul 7	Jun 7	Jun 17	Aug 21	
			% control								lb/A	lb/bu
Spartan	3 oz	Fall	93	81	81	93	83	81	97	84	2320	61.5
Spartan	4 oz	Fall	99	97	93	100	87	87	95	90	2411	62.6
Spartan	5.33 oz	Fall	99	98	99	100	95	94	100	96	2793	62.4
Spartan / Tough	3 oz / 1.5 pt	Fall / POST	100	100	100	100	100	100	100	100	2406	62.6
Spartan / Tough	4 oz / 1.5 pt	Fall / POST	100	100	100	100	100	99	99	100	2048	62.2
Spartan / Tough	5.33 oz / 1.5 pt	Fall / POST	99	100	100	98	100	100	99	98	2846	62.4
Spartan	3 oz	PRE	100	100	96	94	90	91	95	90	2528	62.5
Spartan	4 oz	PRE	100	100	100	98	94	94	96	93	2302	62.4
Spartan / Tough	3 oz / 1.5 pt	PRE / POST	100	100	100	98	98	100	92	92	2870	62.4
Spartan / Tough	4 oz / 1.5 pt	PRE/ POST	100	100	100	100	100	100	97	97	2777	62.9
Tough	1.5 pt	POST	92	100	100	85	99	98	47	55	2263	62.5
Untreated			0	0	0	0	0	0	0	0	808	61.9
LSD (0.05)			7	7	9	9	8	6	8	13	658	NS
CV			4	5	6	6	5	4	6	9	16	0.9

[a]*Select + COC (5 fl oz + 1% v/v) was applied postemergence alone or with Tough to all treatments to control grasses.*

There was no visible chickpea injury with any treatment at any evaluation date. This study and others have demonstrated that chickpeas have excellent tolerance to Spartan.

Most herbicide treatments in this study provided good to excellent control of kochia, redroot pigweed, and wild buckwheat. Weed control with the low Spartan rate (3 oz) applied in the fall began to falter late in the growing season. Weed control was best where Tough was applied postemergence following Spartan. Tough applied alone provided excellent kochia and pigweed control, but did not control wild buckwheat.

There was a significant difference in chickpea yield between herbicide treatments; however, treatment yields were affected by where the replicates were located within the study area. Yields tended to be higher on the southern half of the study area, which remained more moist during the growing season. Therefore, we recommend that yield differences be disregarded.

Weed control in conventional-till chickpea. Jenks, Willoughby, and Markle. 'B-90' chickpeas were seeded April 28 into 7.5-inch rows at 180 lb/A. Individual plots were 10 x 30 ft and replicated three times. PPI and PRE treatments were applied April 28 and April 30, respectively, with a basket sprayer delivering 20 gpa at 30 psi through XR 80015 nozzles. On April 28, air and soil temperatures were 45 and 49 F, respectively, and relative humidity was 73%. On April 30, air and soil temperatures were 62 and 60 F, respectively, and relative humidity was 20%. POST and POST II treatments were applied June 2, and June 11, respectively, with a bicycle sprayer delivering 10 gpa at 40 psi through XR 8001 nozzles. On June 2, air and soil temperatures were 65 and 67 F, respectively, and relative humidity was 58%. On June 11, air and soil temperatures were 62 and 60 F, respectively, and relative humidity was 77%. The primary weeds evaluated were kochia (Kocz), redroot pigweed (Rrpw), and Biennial wormwood (Biww).

			Kocz		Rrpw		Biww		Yield	Test Wt
Treatment[a]	Rate	Timing	Jun 7	Jun 20	Jun 7	Jun 20	Jun 7	Jun 20	Aug 25	
			% control						lb/A	lb/bu
Spartan	2.67oz	PRE	99	98	93	87	97	94	3018	62.3
Spartan	4 oz	PRE	98	100	92	82	96	95	3130	61.4
Spartan	5.33 oz	PRE	100	100	100	100	100	100	2597	61.4
Balance + Spartan	2 oz + 4 oz	PRE	100	100	100	96	100	100	2959	62.4
Balance + Sonalan	2 oz + 2 pt	PPI	99	96	100	97	100	100	2112	62.1
Spartan + Sencor	4 oz + 0.33 lb	PRE	100	100	98	96	100	100	3199	61.4
Spartan + Sonalan	4 oz + 2 pt	PPI	94	93	100	100	93	81	2521	60.9
Sonalan + Sencor	2 pt + 0.33 lb	PPI	90	86	99	96	100	96	2271	62.2
Sonalan	2 pt	PPI	47	47	83	73	27	20		
Sonalan / Tough	2 pt / 1.5 pt	PPI	90	100	100	100	100	100	2309	60.8
Spartan / Tough	4 oz / 1.5 pt	PRE/ POST	100	100	100	100	100	100	2714	61.8
Spartan + Sonalan/ Sencor + Select	5.33 oz + 2 pt/ 0.25 lb + 5 fl oz	PPI/ POST	97	100	100	100	100	100	2460	62.6
Spartan + Sonalan/ Sencor/ Select	5.33 oz + 2 pt/ 0.25 lb/ 5 fl oz	PPI/ POST/ POSTII	95	98	98	99	98	99	2731	62.7
Spartan/ Sencor + Select	4 oz/ 0.25 lb + 5 fl oz	PPI/ POSTII	92	95	95	97	93	100	2359	61.7
Handweeded check[b]			100	100	100	100	100	100	2656	61.8
Untreated			0	0	0	0	0	0	559	62.8
LSD (0.05)			9	11	13	20	8	7	1129	1.6
CV			6	8	8	13	5	5	29	1.6

[a]*Select + COC (5 fl oz + 1%) was applied postemergence alone or with Tough or Sencor to all treatments to control grasses. For brevity, the Select treatments are not shown in the table for the Spartan and Sonalan treatments.*
[b]*Spartan + Treflan followed by Tough + Select were applied to aid handweeding.*

We evaluated several PPI, PRE, and POST herbicide treatments for chickpea tolerance and weed control.

Statistically, there was no significant yield difference between treatments. Yields were quite variable between reps, which was partially due to crop injury from herbicide carryover from 2002. In late May, the dry pea crop started to exhibit symptoms consistent with clopyralid injury. Unfortunately, we failed to remember that Curtail (clopyralid + 2,4-D) was applied to this field in 2002. Chickpea tolerance to herbicides in this study was not evaluated due to the confounding effect of the herbicide carryover from 2002. Chickpea injury due to Curtail carryover was more severe in this conventionally-tilled study compared to the no-till chickpea study in the same field.

Weed control in no-till chickpea. Jenks, Willoughby, and Markle. 'B-90' chickpeas were seeded April 28 into 7.5-inch rows at 180 lb/A. Individual plots were 10 x 30 ft and replicated three times. PRE treatments were applied April 30 with a basket sprayer delivering 20 gpa at 30 psi through XR 80015 nozzles. Air and soil temperatures were 55 and 53 F, respectively, and relative humidity was 27%. POST treatments were applied June 2 with a bicycle sprayer delivering 10 gpa at 40 psi through XR 8001 nozzles to 3- to 5-inch chickpeas. Air and soil temperatures were 65 and 67 F, respectively, and relative humidity was 58%. The primary weeds evaluated were kochia (Kocz), redroot pigweed (Rrpw), and biennial wormwood (Biww). Chickpeas were harvested Aug 25.

			Kocz		Rrpw		Biww		Chickpea	
Treatment	Rate	Timing	Jun 7	Jun 20	Jun 7	Jun 20	Jun 7	Jun 20	Yield	Test Wt
			% control						lb/A	lb/bu
Roundup + Spartan/ Select	13 fl oz + 2.67 oz/ 5 fl oz	PRE/ POST	79	84	88	85	77	78	2309	61.0
Roundup + Spartan/ Select	13 fl oz + 4 oz/ 5 fl oz	PRE/ POST	94	96	95	96	92	81	2440	63.4
Roundup + Spartan/ Select	13 fl oz + 5.33 oz/ 5 fl oz	PRE/ POST	100	97	100	98	99	96	2669	63.3
Roundup + Spartan + Balance/ Select	13 fl oz + 4 oz + 2 oz/ 5 fl oz	PRE/ POST	100	100	100	99	100	100	2722	62.2
Roundup + Spartan + Sencor/ Select	13 fl oz + 4 oz + 0.33 lb/ 5 fl oz	PRE/ POST	97	98	100	98	100	98	2633	62.7
Roundup + Spartan/ Tough + Select	13 fl oz + 4 oz/ 1.5 pt + 5 fl oz	PRE/ POST	100	100	100	100	100	100	2696	62.5
Roundup + Spartan/ Sencor + Select	13 fl oz + 4 oz/ 0.25 lb + 5 fl oz	PRE/ POST	95	100	98	100	100	100	2438	62.7
Handweeded check[b]			100	100	100	100	100	100	2638	62.2
Untreated			0	0	0	0	0	0	--	--
LSD (0.05)			6	5	7	4	4	3	NS	NS
CV			4	3	5	2	3	2	8	1.8

[a]*Roundup treatements were Roundup UltraMax applied with AMS at 2.5 gal/100 gal, Select was applied with COC at 1% v/v.*

[b]*Roundup + Spartan followed by Tough + Select were applied to aid in handweeding.*

Several PRE and POST herbicide treatments were evaluated for chickpea tolerance and weed control. Herbicide treatments included Spartan alone, Spartan tank mixed with Balance or Sencor, or Spartan followed postemergence by Tough or Sencor. All PRE treatments were tank mixed with Roundup UltraMax. Previous studies have shown Sencor applied postemergence to cause slight to moderate crop injury. Sencor applied postemergence is not a labeled treatment.

In late May, the chickpea crop started to exhibit symptoms consistent with clopyralid injury. Unfortunately, we failed to remember that Curtail (clopyralid + 2,4-D) was applied to this field in 2002. Chickpea tolerance to herbicides in this study was not evaluated due to the confounding effect of the herbicide carryover from 2002. Chickpea injury due to Curtail carryover was not as severe in this no-till study compared to the conventionally-tilled chickpea study.

All treatments provided excellent (>90%) kochia and redroot pigweed control, with the exception of the low Spartan rate (2.67 oz), which provided good control (80-89%) of kochia and pigweed. All treatments provided excellent biennial wormwood control with the exception of the two lower Spartan rates (2.67 and 4 oz). Statistically, there was no significant yield difference between herbicide treatments. The untreated check could not be harvested because it was completely overrun by kochia.

Weed control in no-till chickpea (Williston). Jenks, Willoughby, Markle, and Riveland. 'B-90' chickpeas were seeded May 25. Individual plots were 10 x 30 ft and replicated three times. PRE treatments were applied May 28 with a bicycle sprayer delivering 20 gpa at 30 psi through XR 80015 nozzles. Air and soil temperatures were 81 and 78 F, respectively, and relative humidity was 22%. POST treatments were applied June 16 with a bicycle sprayer delivering 10 gpa at 40 psi through XR 8001 nozzles to 3- to 4-inch chickpeas. Air and soil temperatures were 76 and 76 F, respectively, and relative humidity was 60%. Plant sizes at time of application were kochia (Kocz) at 1- to 3-inch, Russian thistle (Ruth) at 0.5-inch, volunteer wheat (Vwht) at 1-leaf, and green foxtail (Grft) at 2-leaf.

		Kocz		Ruth		Grft		Vwht	Injury	Yield	T. W.
		Jun	Jul	Jun	Jul	Jun	Jul	Jun	Jul		
Treatment[a]	Rate	16	10	16	10	16	10	16	10	Aug 26	
PRE/POST		% control							%	lb/A	lb/bu
Roundup + Spartan/ Select	13 fl oz + 2.67 oz/ 5 fl oz	95	89	100	86	92	95	91	0	1313	62.8
Roundup + Spartan/ Select	13 fl oz + 4 oz/ 5 fl oz	95	86	100	90	94	93	90	0	1353	62.0
Roundup + Spartan/ Select	13 fl oz + 5.33 oz/ 5 fl oz	96	89	100	93	95	98	92	0	1486	63.0
Roundup + Balance + Spartan/ Select	13 fl oz + 2 oz + 4 oz/ 5 fl oz	96	91	100	92	95	93	93	0	1414	62.1
Roundup + Spartan + Sencor/ Select	13 fl oz + 4 oz + 0.25 lb/ 5 fl oz	95	86	100	90	93	95	93	5	1270	63.2
Roundup + Spartan/ Tough + Select	13 fl oz + 4 oz/ 1.5 pt + 5 fl oz	92	95	96	97	91	94	94	0	1517	63.3
Roundup + Spartan/ Sencor + Select	13 fl oz + 4 oz/ 0.167 lb + 5 fl oz	95	93	100	93	92	92	92	18	1084	61.7
Untreated		0	0	0	0	0	0	0	0	88	54.0
LSD (0.05)		4	10	2	11	3	3	1	2	222	1.2
CV		2	7	1	8	2	2	3	35	11	1.1

[a]*Roundup treatments were Roundup UltraMax applied with AMS at 2.5 gal/100 gal, and Select treatments were applied with COC at 1% v/v.*

Herbicide treatments included Spartan alone, Spartan tank mixed with Balance or Sencor, or Spartan followed postemergence by Tough or Sencor. All PRE treatments were tank mixed with Roundup UltraMax. None of the treatments caused visible crop injury. Previous studies have shown Sencor applied postemergence to cause slight to moderate crop injury. Sencor applied postemergence is not a labeled treatment.

All treatments provided excellent control of kochia, Russian thistle, green foxtail, and volunteer wheat.

Weed control in CRP, 2003. Terry Gregoire. CRP fields near Minnewaukan and Cando were sprayed June 9th and June 18th, respectively. Canada Thistle and perennial sow thistle were the primary weeds at Minnewaukan. Canada thistle and dandelion were the primary weeds at Cando. Alfalfa and sweetclover were also present at Cando. Treatments were applied using a CO_2 pressurized backpack sprayer using 8.5 gpa at 40 PSI. The Minnewaukan site had a soil pH of 7.8 and a salinity of 2.3 mmoh/cm. The Cando site had a soil pH of 8.03 and a salinity of 4.0 mmoh/cm.

		% Biomass Reduction							
		Canada Thistle				Dandelion		Sowthistle	
		Site 1	Site 2	Site 1	Site 2	Site 1	Site 2	Site 1	Site 2
Treatment	Rate	6/26/03*	9/16/03	6/26/03**	9/16/03	6/26/03		9/16/03	
	Product/A								
untreated	0	0	0	0	0	0	0	0	0
Cimarron Max+Range Star+NIS	0.25 oz/a+1pt/a+0.25%	83	38	78	100	80	75	93	100
Cimarron Max+Range Star+NIS	0.5 oz/a+2 pt/a+0.25%	90	88	83	100	95	88	97	100
Tordon	1 pt/a	95	97	88	100	98	90	98	100
2,4-D	2 pt/a								
Curtail	2 pt/a	85	45	60	88	100	55	35	100

Site 1 - Minnewaukan
Site 2 - Cando
* 15 days after treatment
** 8 days after treatment

Only slight yellowing of grass was noted with Cimarron Max treatments. Tordon and Curtail did not yellow grass. Some lodging of grass was noted in the September evaluation in the Tordon treatment. Canada thistle percent control September 17, 2003 at Minnewaukan was acceptable with rate 2 of Cimarron Max and Tordon/2,4-D tank mix but not with Curtail or Rate 1 of Cimarron Max. Good control of Canada Thistle was obtained at Cando with all treatments. Treatments were applied at a later date in Cando to larger Canada thistle than at Minnewaukan. Sowthistle control was good at both sites with all treatments except Curtail at Minnewaukan at the June 26th evaluation. Sowthistle was not evaluated in September.

Raptor with adjuvants on dry edible bean. Zollinger, Richard K. and Jerry L. Ries. An experiment was conducted near Wahpeton, ND, to evaluate crop response and weed control of Raptor treatments applied POST. 'Vista' navy bean was planted on June 3, 2003. POST treatments were applied on July 7 at 11:30 am with 74 F air, 83 F soil surface, 44% relative humidity, 20% clouds, 4 to 7 mph NW wind, dry soil surface, moist subsoil, poor crop vigor, and no dew present to V2 to V3 navy bean. Weed species present were: 2 to 6 inch (5 to 50/yd^2) redroot pigweed; 2 to 4 inch (25 to 50/ft^2) common lambsquarters; 2 to 4 inch (3 to 10/yd^2) common ragweed; 2 to 6 inch (3 to 10/yd^2) common cocklebur; 4 to 10 inch (1 to 5/yd^2) yellow foxtail; and 4 to 10 inch (<1/yd^2) wild-proso millet. 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 flat fan nozzles. The experiment had a randomized complete block design with three replicates per treatment.

Conditions at application were ideal due to good soil moisture and warm temperatures. Dry bean were initially stressed at application from excess water but weed growth was good and uniform. Very little precipitation was measured and dry conditions existed for most of the growing season. Reduced rates of Raptor and Reflex were used to measure adjuvant enhancement. Raptor rate was 38% of the label rate and Reflex rate was slightly over 50% of the labeled rate. The weed spectrum was ideal to measure Raptor activity primarily on common lambsquarters and common cocklebur and Reflex activity primarily on common ragweed. The general order of adjuvant enhancement in weed control from Raptor and Reflex was MSO + basic blend = basic blend > MSO > PO > NIS or NIS + additive blends. The level of weed control was quite impressive considering the weed spectrum, weed size at application, and low herbicide rates used. (Dept. of Plant Sciences, North Dakota State University, Fargo).

Table. Raptor with adjuvants on dry edible bean (Zollinger and Ries).

Treatment[1]	Rate	July 21						August 4					
		Yeft	Wipm	Rrpw	Colq	Corw	Cocb	Yeft	Wipm	Rrpw	Colq	Corw	Cocb
	(product/A)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)
Raptor+Reflex+	1.5fl oz+0.4pt+												
Destiny	1% v/v	72	66	84	63	79	79	72	66	84	63	79	79
Scoil	1pt	70	60	82	68	83	73	70	60	82	68	73	73
Prime Oil	1% v/v	70	53	63	45	57	60	70	53	63	45	57	60
Hi-Per-Oil	0.5% v/v	67	47	63	52	55	62	67	47	63	52	55	62
AG 01023	0.5% v/v	63	43	60	40	52	57	63	43	60	40	52	57
Rivet	0.5% v/v	72	53	71	50	57	58	72	53	71	50	57	58
AG 03015	0.5% v/v	50	30	50	27	30	30	50	30	50	27	30	30
AG 01034	0.25% v/v	65	53	72	58	60	60	65	53	72	58	60	60
ClassAct NG	2.5% v/v	67	53	72	58	60	50	67	53	72	58	60	50
AG 02033	0.5% v/v	62	40	63	32	52	50	62	40	63	32	52	50
Phase	2pt/100gal	50	30	60	32	50	52	50	30	60	32	50	52
AG 03002	1% v/v	60	30	60	28	53	53	60	30	60	28	53	53
AG 02025	1.5% v/v	60	40	70	40	60	60	60	40	70	40	60	60
Preference	0.25% v/v	40	0	50	20	7	33	40	0	50	20	7	33
Active Plus	0.25% v/v	40	22	50	20	20	30	40	22	50	20	20	30
Herbimax	2pt	43	28	50	20	20	30	43	28	50	20	20	30
Bronc Plus	3% v/v	50	30	40	20	20	30	50	30	40	20	20	30
Silken	0.125% v/v	50	23	40	30	20	27	50	23	40	30	20	27
Silwett L-77	0.38pt/100gal	50	30	47	30	20	30	50	30	47	30	20	30
Quad 7	1% v/v	83	62	90	77	87	84	83	62	90	77	87	84
Renegade	1% v/v	86	73	94	76	87	91	86	73	94	76	87	91
Base	1% v/v	87	76	96	79	90	93	87	76	96	79	90	93
Z-64	1% v/v	86	74	94	78	86	93	86	74	94	78	86	93
LSD (0.05)		4	7	4	8	10	8	4	7	4	8	10	9

[1]Destiny and Scoil = methylated seed oil (MSO); Prime Oil, Hi-Per-Oil, and Herbimax = petroleum oil concentrates; 'AG' compounds are proprietary experimental adjuvants from Agriliance; Rivet and Phase = MSO + organosilicone surfactants; ClassAct NG (Next Generation) and Bronc Plus = surfactant + fertilizer; Quad 7 = basic pH blend; Preference and Active Plus = nonionic surfactant; Silken and Silwet L-77 = surfactants + silicone; Renegade and Base = MSO basic blend; Z-64 = MSO basic blend + 28-0-0 + surfactant.

Adjuvants with Raptor + Reflex. Zollinger, Richard K. and Jerry L. Ries. An experiment was conducted near Wahpeton, ND, to evaluate crop response and weed control of herbicides with various adjuvants applied POST. 'Vista' navy bean was planted on June 3, 2003. POST treatments were applied on July 7 at 12:15 pm with 76 F air, 84 F soil surface, 44% relative humidity, 20% clouds, 4 to 8 mph NW wind, dry soil surface, moist subsoil, poor crop vigor, and no dew present to V2 to V3 navy bean. Weed species present were: 1 to 5 inch (10 to 30/yd^2) redroot pigweed; 2 to 4 inch (1 to 3/yd^2) common cocklebur; 2 to 6 inch (5 to 15/yd^2) wild-proso millet; 1 to 5 inch (10 to 35/yd^2) common ragweed; 2 to 10 inch (5 to 20/ft^2) yellow foxtail; and 1 to 4 inch (5 to 10/yd^2) common lambsquarters. 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 flat fan nozzles. The experiment had a randomized complete block design with three replicates per treatment.

Table. Adjuvants with Raptor + Reflex (Zollinger and Ries).

		July 21			August 4		
Treatment[1]	Rate	Wipm	Colq	Corw	Wipm	Colq	Corw
	(product/A)	(%)	(%)	(%)	(%)	(%)	(%)
Raptor+Reflex+NIS	4fl oz+0.25pt	50	89	58	43	93	90
Raptor+Reflex+NIS	4fl oz+0.4pt	40	63	49	33	57	57
Raptor+Reflex+NIS	4fl oz+0.5pt	37	55	50	30	55	50
Raptor+Reflex+Linkage	4fl oz+4fl oz	57	74	82	48	75	72
Raptor+Reflex+Renegade	2fl oz+0.4pt	85	84	82	83	83	85
Basagran+Poast+Reflex+ Raptor+Renegade	0.6pt+0.6pt+0.3pt 0.9fl oz	92	92	96	94	95	95
LSD (0.05)		7	7	11	9	7	5

[1]NIS = nonionic surfactant = Activator 90 at 0.25% v/v; Linkage = basic pH blend at 1% v/v; Renegade = methylated seed oil basic blend at 1% v/v; Basagran+Poast = Rezult Copack.

All treatments completely controlled yellow foxtail, redroot pigweed, and common cocklebur. Conditions at application were ideal because of good soil moisture and warm temperatures. Dry bean were initially stressed at application from excess water but weed growth was good and uniform. Very little precipitation was measured and dry conditions existed for most of the growing season. The weed spectrum was ideal to measure Raptor activity primarily on common lambsquarters and Reflex activity primarily on common ragweed. Reduced rates of Raptor and Reflex were used to measure adjuvant enhancement. As the Reflex rate increased when applied with Raptor, control of wild-proso millet, common lambsquarters, and common ragweed decreased. The only explanation is that nonionic surfactant did not provide the necessary adjuvant load since full Raptor rates were used and both Raptor and Reflex activity increases with oil adjuvants. This mix is used by dry bean growers when common ragweed is present but adjuvant usage is restricted to NIS because of the Raptor label. Reducing the Raptor rate by 50% to 2 fl oz/A, which is half the label rate, and increasing the Reflex rate to 4 fl oz, which is slightly more than half the label rate for dry bean, and adding an MSO + basic pH blend adjuvant (Renegade) generally overcame the antagonism. The dry bean micro-rate treatment of one application of low rates of Basagran+Poast (Rezult Copack) + Raptor + Reflex + Renegade gave nearly complete weed control. (Dept. of Plant Sciences, North Dakota State University, Fargo).

Rezult with Raptor. Zollinger, Richard K. and Jerry L. Ries. An experiment was conducted near Prosper, ND, to evaluate weed control of treatments applied POST on non-cropland. On June 30, 2003, POST treatments were applied at 2:20 pm with 81 F air, 87 F soil surface, 42% relative humidity, 10% clouds, 5 to 10 mph S wind, dry soil surface, moist subsoil, and no dew present. Weed species present were: 2 to 8 inch (5 to 75/ft^2) yellow foxtail; 2 to 8 inch (5 to 15/yd^2) redroot pigweed; and 2 to 5 inch (3 to 5/yd^2) common lambsquarters. 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 8001 flat fan nozzles. The experiment had a randomized complete block design with three replicates per treatment.

Table. Rezult with Raptor (Zollinger and Ries).

		July 14			July 28		
Treatment[1]	Rate	Yeft	Rrpw	Colq	Yeft	Rrpw	Colq
	(product/A)	(%)	(%)	(%)	(%)	(%)	(%)
Basagran+Poast+	1.2pt+1.2pt+	60	40	40	63	30	43
Base	2pt	84	62	60	87	82	73
ROC	2pt	63	57	57	47	47	47
WECO-OS-1	2pt	90	68	68	99	53	52
WECO-OS-2	1pt	82	58	58	99	53	50
Super Spread MSO	1pt	86	60	60	83	63	63
Renegade	2pt	92	62	62	97	72	66
Syl-Tac	1pt	75	60	60	73	50	50
WECO-OS-1+In-Place	2pt+0.6pt	60	62	60	83	60	60
WECO-OS-2+In-Place	1pt+0.6pt	60	60	60	68	50	50
LSD (0.05)		10	6	5	5	5	6

[1]Basagran+Poast = Rezult Copack; Base and Renegade = MSO (methylated seed oil) basic blend; ROC = petroleum oil concentrate; WECO-OS-1 and 2 = proprietary adjuvants from Wilbur-Ellis; Super Spread MSO = methylated seed oil; Syl-Tac = silicone surfactant blend.

Basagran and Poast was applied as the Rezult Copack formulation. Low Rezult rates were applied to large weeds and was used to differentiate adjuvant enhancement. Weed control was variable but, in general, Rezult applied with Base and Renegade resulted in greatest weed control. WECO experimental adjuvants plus In-Place drift retardant gave less grass control but similar broadleaf weed control than Rezult applied only with both WECO adjuvants. (Dept. of Plant Sciences, North Dakota State University, Fargo).

Valor formulations on dry bean. Zollinger, Richard K. and Jerry L. Ries. An experiment was conducted near Prosper, ND, to evaluate crop response and weed control from Valor formulation treatments applied PRE. Two rows each of pinto 'Maverick' and navy 'Vista' dry bean was planted on June 12, 2003. PRE treatments were applied on June 13 at 11:15 am with 73 F air, 70 F soil surface, 45% relative humidity, 10% clouds, 5 to 10 mph NE wind, dry soil surface, moist subsoil, and no dew present. 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 flat fan nozzles. The experiment had a randomized complete block design with three replicates per treatment.

Table. Valor formulations on dry bean (Zollinger and Ries).

		June 27		July 11		August 8
Treatment	Rate	Injury	Fxtl	Injury	Fxtl	Fxtl
	(product/A)	(%)	(%)	(%)	(%)	(%)
Valor SX	3oz	87	83	99	91	91
Valor SX	6oz	96	99	99	95	95
Valor	3 oz	92	92	99	95	95
Valor	6oz	99	99	99	99	99
Valor 6	15oz	60	51	88	90	90
Valor 6	30oz	70	57	99	95	95
Valor 15	15oz	23	22	27	95	95
Valor 15	30oz	75	75	99	60	60
Valor 19	15oz	50	40	25	60	60
Valor 19	30oz	75	70	99	90	90
Spartan	4.5oz	2	50	0	80	80
Spartan	9oz	5	90	0	90	90
LSD (0.05)		5	9	4	3	3

The objective of the experiment was to evaluate different formulations of flumioxazin to improve dry bean safety. All treatments gave 99% redroot pigweed control. Grass was yellow foxtail and green foxtail in a 75:25 ratio. Injury ratings represent both pinto and navy varieties of dry beans. The low rate of each Valor formulation is equivalent in the amount of active ingredient and is the highest amount allowed by label. The high rate of each Valor formulation is equivalent in the amount of active ingredient and represents a 2X rate. All Valor treatments caused death or excessive dry bean injury. Valor formulations that resulted in less dry bean injury than the Valor 51WDG also resulted in less grass control. Spartan at 4.5 oz/A or 9 oz/A caused less than 5% injury only the June 27 (14 DAT) evaluation and injury was not observed July 11 (28 DAT) or August 8. (Dept. of Plant Sciences, North Dakota State University, Fargo).

Application timing in dry beans. Zollinger, Richard K. and Jerry L. Ries. An experiment was conducted near Prosper, ND, to evaluate crop response and weed control of treatments applied PPI, PRE, and POST. PPI treatments were applied on May 28, 2003 and incorporated with a roto-tiller operating at a 2 inch depth at 3:00 pm with 76 F air, 57 F subsoil at a 4 inch depth, 45% relative humidity, 10% clouds, 10 mph NW wind, dry soil surface, and a moist subsoil. The planting of 2 rows each of pinto 'Maverick' and navy 'Vista' dry bean followed incorporation. PRE treatments followed the planting of dry beans at 3:45 pm with 77 F air, 58 F subsoil at a 4 inch depth, 45% relative humidity, 10% clouds, 10 mph NW wind, dry soil surface and a moist subsoil. POST treatments were applied on June 30 at 11:30 am with 79 F air, 76 F soil surface, 50% relative humidity, 10% clouds, 5 to 10 mph S winds, dry soil surface, moist subsoil, good crop vigor, and no dew present. Weed species present were: 2 to 12 inch (5 to 50/ft^2) yellow foxtail; 1 to 4 inch (5 to 25/yd^2) hairy nightshade; 2 to 5 inch (5 to 20/yd^2) redroot pigweed, and 2 to 5 inch (5 to 20/yd^2) common lambsquarters. Treatments were applied to the center 6.7 feet of the 10 by 40 foot plots with a bicycle-wheel-type plot sprayer with an attached hood delivering 17 gpa at 40 psi through 8002 flat fan nozzles for the PPI and PRE treatments and a backpack-type plot sprayer delivering 8.5 gpa at 40 psi through 8001 nozzles for the POST treatments. The experiment had a randomized complete block design with three replicates per treatment.

All treatments gave 99% wild buckwheat control (data not shown). Injury ratings represent both dry bean varieties. Only treatments applied PPI followed by POST controlled grass and broadleaf weeds. (Dept. of Plant Sciences, North Dakota State University, Fargo)

Table. Application timing in dry beans (Zollinger and Ries).

Treatment[1]	Rate	June 13					June 25					July 14			July 28		
		DEB Injury	Yeft	Rrpw	Colq	Hans	DEB Injury	Yeft	Rrpw	Colq	Hans	Yeft	Rrpw	Colq	Yeft	Rrpw	Colq
	(product/A)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)
PRE																	
Outlook	16fl oz	3	85	93	92	93	0	88	90	87	92						
Sonalan	2pt	0	82	93	92	65	0	67	70	78	43						
PPI/POST																	
Outlook/Basagran+Poast+ Raptor+PO+28-0-0	16fl oz/1.6pt+1.6pt+ 2fl oz	17	83	92	90	90	0	90	82	72	60	99	99	99	97	99	90
Prowl/Basagran+Poast+ Raptor+PO+28-0-0	3.5pt/1.6pt+1.6pt+ 2fl oz	0	92	95	93	70	10	83	75	75	47	99	99	99	99	99	99
POST																	
Basagran+Poast+Raptor PO+28-0-0	1.6pt+1.6pt+2fl oz											50	70	70	60	50	70
Basagran+Poast+PO+28-0-0	1.6pt+1.6pt											80	50	50	85	50	50
Raptor+NIS	4fl oz											75	99	90	85	99	95
Basagran+Poast+Reflex+ Raptor+Renegade	0.6pt+0.6pt+0.3pt+ 1% v/v											85	95	90	70	95	90
LSD (0.05)		10	7	3	3	20	4	9	8	7	9	7	5	5	6	7	5

[1]Basagran+Poast = Rezult Copack; PO = petroleum oil concentrate = Herbimax at 1% v/v; 28-0-0 = urea ammonium nitrate at 1 qt/A; NIS = nonionic surfactant = Activator 90 at 0.25% v/v; Renegade = MSO (methylated seed oil) basic blend at 1% v/v.

Herbicide timing and cultivation in dry bean, Fargo, ND. Kegode and Ciernia. A combination of herbicide application timings with and without row crop cultivation was used to control broadleaf weeds in dry bean. Norstar navy bean was seeded in 30 in. rows May 27. PRE Spartan treatments were applied following planting using a 4-nozzle bicycle wheel sprayer equipped with XR8002 tips delivering 17 gpa at 40 psi. At application, air temperature was 75 F, RH 40%, wind 9 mph S, sky overcast and soil surface damp. All POST treatments were applied using XR8001 tips delivering 8.5 gpa at 34 psi. Early POST (EPOST) treatments were applied June 16 to unifoliolate beans 3 in. tall, 4-leaf redroot pigweed 1 in.tall, 3-leaf common cocklebur 1 in. tall, 5-leaf common lambsquarters 2 in. tall, 2-leaf venus mallow 1 in. tall, and 2-leaf biennial wormwood ½ in. tall. At application, air temperature was 75 F, RH 55%, wind N 3 mph, sky overcast and plant leaf surfaces dry. Late POST treatments were applied July 2 to two trifoliolate dry bean 5 in. tall, 2-3 in. venus mallow, 2-5 in. redroot pigweed, 2-5 in. common ragweed, 4-5 in. common cocklebur, and 2-4 in. common lambsquarters. At application, air temperature was 79 F, RH 51%, wind N 5 mph, sky hazy and plant leaf surfaces dry. Grasses were controlled with a broadcast application of Select plus Scoil June 19. Selected treatments were cultivated July 8. Weed control evaluations were made July 16 and July 30. Plots were 10 ft. by 30 ft. and the experiment was a randomized complete block design with 4 reps. The trial was not harvested due to water damage from excessive rainfall in late June.

				July 16				July 30				
Treatment	Timing	Cultiv -ation	Rate	Rrpw	Cocb	Cora	Vema	Rrpw	Cocb	Cora	Vema	Biww
			oz ai/A	% control								
Spartan	PRE	No	4	91	11	16	5	76	25	37	0	90
Spartan	PRE	Yes	4	94	84	61	68	96	44	35	50	96
Basagran+Scoil	EPOST	No	16+0.25G	65	70	81	94	8	19	54	36	35
Basagran+Scoil	EPOST	Yes	16+0.25G	86	89	92	93	43	50	70	76	61
Basagran+Scoil	LPOST	No	16+0.25G	53	51	65	78	0	39	39	28	79
Basagran+Scoil	LPOST	Yes	16+0.25G	63	68	80	82	26	45	63	96	79
Cult only		Yes		38	20	20	25	18	19	28	30	38
Hand-weeded		No		100	100	100	100	99	99	99	99	99
Untreated		No		0	0	0	0	0	0	0	0	0
C.V. %				15	12	11	9	21	46	34	21	15
LSD 5%				14	9	9	10	12	25	23	17	14
# of Reps				4	4	4	3	4	4	4	3	4

Weed control was generally higher on the July 16 evaluation compared to the evaluation of July 30. Biennial wormwood emerged late and control was evaluated only on July 30. PRE Spartan treatments with or without inter-row cultivation provided 90% or higher control of biennial wormwood. The Basagran plus Scoil treatments with or without inter-row cultivation provided 79% or less control of biennial wormwood. PRE Spartan with inter-row cultivation treatment provided 96% control of redroot pigweed whereas without inter-row cultivation redroot pigweed control with Spartan was 76%. Control of common cocklebur and common ragweed was highly variable and in general among treatments was 70% or less on July 30. The LPOST Basagran plus Scoil treatment with inter-row cultivation provided 90% control of Venice mallow, whereas all other treatments provided 76% or less control. Cultivation alone generally provided poor control of all weeds present.

Herbicide timing and cultivation in dry bean, Prosper, ND. Kegode and Ciernia. A combination of herbicide application timings with and without row crop cultivation was used to control broadleaf weeds. Norstar navy bean was seeded in 30 in. rows June 5. PRE Spartan treatments were applied after planting using a 4-nozzle bicycle wheel sprayer equipped with XR8002 tips delivering 17 gpa at 40 psi. At application air temperature was 80 F, RH 33%, wind NW 5 mph, sky clear and soil surface dry. All POST treatments were applied using XR8001 tips delivering 8.5 gpa at 34 psi. Early POST (EPOST) treatments were applied July 1 to two trifoliolate beans 6 in. tall, 6 to 8-leaf common lambsquarters 2-4 in. tall, 4 to 8-leaf redroot pigweed 1-4 in. tall, and 2-5 in. hairy nightshade. At application, air temperature was 88 F, RH 52%, wind S 9 mph, sky sunny and plant leaf surfaces dry. Late POST (LPOST) treatments were applied July 8 to three trifoliolate beans 7 in. tall, 3-8 in. redroot pigweed, 4-6 in. common lambsquarters, and 6-8 in. hairy nightshade. At application, air temperature was 68 F, RH 48%, wind N 5 mph, sky sunny and plant leaf surfaces dry. Selected treatments were cultivated July 15. Evaluations for weed control were made July 22 and August 6. The entire experiment was sprayed June 19 with Select plus Scoil to control grasses and Sept. 12 with Roundup to desiccate the crop. The center 2 rows of each plot were harvested Sept. 24. Plots were 10 ft. by 27 ft. and the experiment was a randomized complete block design with 4 reps.

				July 22				August 6			
Treatment	Timing	Cultiv-ation	Rate	Injury	Rrpw	Colq	Hans	Rrpw	Colq	Hans	Yield
			oz ai/A	%	---------- % control ----------						lb/A
Spartan	PRE	No	4	2	91	94	87	89	98	94	1590
Spartan	PRE	Yes	4	2	95	96	93	93	98	99	1727
Basagran+Scoil	EPOST	No	16+0.25G	0	26	38	44	15	72	73	673
Basagran+Scoil	EPOST	Yes	16+0.25G	0	78	88	80	48	81	74	1518
Basagran+Scoil	LPOST	No	16+0.25G	1	44	59	36	75	56	53	1205
Basagran+Scoil	LPOST	Yes	16+0.25G	1	89	89	84	80	89	73	1549
Cult only		Yes		0	23	35	39	24	24	31	701
Hand-weeded		No		0	97	98	97	99	99	99	1819
Untreated		No		0	0	0	0	0	0	0	233
C.V. %				118	14	15	15	13	14	18	22
LSD 5%				1	12	14	14	11	14	17	388
# of Reps				4	4	4	4	4	4	4	4

Spartan applied PRE provided 89% or better control of all weeds on August 6. Inter-row cultivation did not improve weed control or yield of dry bean significantly. The addition of inter-row cultivation to the EPOST Basagran plus Scoil treatment significantly improved control of redroot pigweed and dry bean yield compared to the Basagran plus Scoil EPOST treatment without inter-row cultivation. The addition of inter-row cultivation to the LPOST Basagran plus Scoil treatment significantly improved control of common lambsquarters and hairy nightshade, but not redroot pigweed or crop yield compared to the Basagran plus Scoil LPOST treatment without inter-row cultivation. Cultivation alone generally provided poor weed control and low yield of dry bean.

Weed control with soil- and POST-applied herbicides in field pea. Gregory J. Endres, Robert A. Henson, and Blaine G. Schatz. (Carrington Research Extension Center, North Dakota State Univ., 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 7.9 pH and 2.9% organic matter at Carrington, ND in 2003. The trial area was cultivated on May 15 with a Melroe culti-harrow. Herbicide treatments were applied at 18 gal/A and 30 psi through 8001 flat fan nozzles to 5 by 25 ft plots with a CO_2 pressurized hand-held plot sprayer. PPI treatments were applied on May 16 with 54 F, 86% RH, and 95% clear sky and immediately incorporated twice using a field cultivator plus harrow set at a 2- to 3-inch depth. On May 16, inoculated 'Integra' field pea was planted in 7-inch rows at pure live seed rates of 300,000 seeds/A. PRE treatments were applied on a dry soil surface on May 16 with 55 F, 92% RH, 10 mph wind, and100% cloudy sky. A total of 1.12 inches of rainfall occurred during the 2-day period following application of PRE treatments. POST treatments were applied on June 10 with 62 F, 75% RH, 9 mph wind, and 100% cloudy sky to 3- to 5-inch tall field pea, 2- to 4-leaf yellow and green foxtail, 0.5- to 2-inch tall common lambsquarters, 0.5- to 1-inch tall redroot and prostrate pigweed, and 1- to 3-inch tall volunteer flax. Average plant density in untreated plots on June 13: field pea = 9/ft^2, yellow and green foxtail = 45/ft^2, common lambsquarters = 3/ft^2, redroot and prostrate pigweed = 12/ft^2, and volunteer flax = 2/ft^2. The trial was harvested with a plot combine on August 26.

Good to excellent foxtail, common lambsquarters, and pigweed control (88 to 99%) and good volunteer flax control (81 to 84%) was achieved with PPI ethalfluralin+metribuzin, ethalfluralin+imazethapyr, and pendimethalin+ imazethapyr (Table 1). However, ethalfluralin+metribuzin caused 20 to 25% pea injury and reduced seed yield (Table 2). Sequential soil-applied/POST treatments provided 86 to 99% control of foxtail, common lambsquarters, and pigweed, and pea yield of 52.3 to 58.2 bu/A but injury ranged from 9 to 21%. PRE pendimethalin+imazethapyr improved foxtail control compared to imazethapyr. POST imazethapyr and imazamox generally provided similar weed control and pea yield. Imazamox at 0.03 lb/A + bentazon or bentazon+sethoxydim provided 83 to 86% control of foxtail and 98 to 99% control of common lambsquarters and pigweed. Treatments that included bentazon+sethoxydim injured pea 9 to 21% but yield ranged from 48.0 to 58.2 bu/A. POST metribuzin at 0.19 lb/A provided 93% volunteer flax control but pea injury ranged from 28 to 33%.

Table 1. Weed control in field pea, Carrington, 2003.

Treatment[1]	Rate	7/8 Foxtail spp.[2]	7/8 Common lambs-quarters	7/8 Pigweed spp.[2]	7/8 Vol. flax	7/30 Foxtail spp.	7/30 Common lambs-quarters	7/30 Pigweed spp.
	lb ai/A	% control						
Untreated	x	0	0	0	0	0	0	0
PPI								
Ethalfluralin+ metribuzin	0.75+0.38	88	99	98	81	92	98	97
Etha+imazethapyr	0.75+0.03	94	98	98	84	95	98	98
Pendimethalin+imep	0.52+0.03	90	98	98	82	91	98	99
Imep+sulfentrazone	0.03+0.19	73	99	99	73	70	99	99
Pend/Bentazon+ sethoxydim+ imazamox+COC+ 28%N (POST)	1.46/0.8+ 0.2+0.015+1%+2 pt	96	99	99	76	98	98	99
PRE								
Imep	0.03	72	98	99	67	70	98	99
Imep+pend	0.03+0.52	81	97	99	62	83	98	99
Imep&glyphosate	0.05&0.56	75	98	98	78	75	99	99
Imep&glyt/Bent+seth +COC (POST)	0.05&0.56/0.8+0. 2+2pt	86	92	96	57	87	91	99
Imep&glyt+glyt/ Bent+seth+COC (POST)	0.03&0.37+ 0.28/ 0.8+0.2+2pt	90	92	93	69	89	93	95
POST								
Bent+seth+COC	0.8+0.2+2pt	85	99	58	33	84	97	67
Imep+NIS	0.03+0.25%	80	52	99	33	80	67	99
Immx+NIS	0.03+0.25%	78	63	99	33	79	70	99
Immx+bent+NIS+ 28%N	0.03+0.19+ 0.25%+2pt	85	98	99	33	83	98	99
Immx+bent+seth+ NIS+28%N	0.03+0.3+0.075+ 0.25%+2pt	86	98	99	43	86	99	99
Immx+bent+seth+ NIS+28%N	0.015+0.8+0.2+0. 25%+2pt	80	96	99	50	75	99	99
Immx+bent+seth+ COC+28%N	0.015+0.8+0.2+1 %+2pt	80	96	96	37	73	99	99
Metr+seth+COC	0.13+0.2+2pt	82	99	76	60	78	99	82
Metr+seth+COC	0.19+0.2+2pt	88	99	81	93	79	99	84
LSD (0.05)		8	9	9	21	11	4	8

[1]COC=Hasten, a methylated seed oil from Wilbur-Ellis, Fresno, CA; NIS=Preference, a nonionic surfactant from Agriliance, St. Paul, MN.

[2]Foxtail spp.=Yellow and green; Pigweed spp.=Redroot and prostrate.

Table 2. Field pea response to herbicide treatments, Carrington, 2003.

Treatment[1]	Rate	Crop injury 6/26	Crop injury 7/8	Seed yield
	lb ai/A	%	%	bu/A
Untreated	x	0	0	31.6
PPI				
Ethalfluralin+metribuzin	0.75+0.38	25	20	45.3
Etha+imazethapyr	0.75+0.03	4	5	53.8
Pendimethalin+imep	0.52+0.03	0	0	60.4
Imep+sulfentrazone	0.03+0.19	17	13	55.7
Pend/Bentazon+sethoxydim+ imazamox+COC+28%N (POST)	1.46/0.8+0.2+0.015+1%+2pt	21	18	52.3
PRE				
Imep	0.03	0	0	52.7
Imep+pend	0.03+0.52	0	0	57.0
Imep&glyphosate	0.05&0.56	0	0	56.4
Imep&glyt/Bent+seth+COC (POST)	0.05&0.56/0.8+0.2+2pt	11	12	54.0
Imep&glyt+glyt/Bent+seth+COC (POST)	0.03&0.37+0.28/0.8+0.2+2pt	12	9	58.2
POST				
Bent+seth+COC	0.8+0.2+2pt	13	10	48.0
Imep+NIS	0.03+0.25%	0	0	51.2
Immx+NIS	0.03+0.25%	0	0	50.6
Immx+bent+NIS+28%N	0.03+0.19+0.25%+2pt	0	3	44.5
Immx+bent+seth+NIS+28%N	0.03+0.3+0.075+0.25%+2pt	19	15	54.9
Immx+bent+seth+NIS+28%N	0.015+0.8+0.2+0.25%+2pt	16	12	50.5
Immx+bent+seth+COC+28%N	0.015+0.8+0.2+1%+2pt	16	14	53.4
Metr+seth+COC	0.13+0.2+2pt	17	14	48.6
Metr+seth+COC	0.19+0.2+2pt	33	28	58.9
LSD (0.05)		8	7	12.6

[1]COC=Hasten, a methylated seed oil from Wilbur-Ellis, Fresno, CA; NIS=Preference, a nonionic surfactant from Agriliance, St. Paul, MN.

Volunteer flax and canola control in field pea, Fargo. (Kirk Howatt, Ronald Roach, and Janet Davidson-Harrington). 'Integra' field pea was seeded May 2 at a location near Fargo, North Dakota. Preemergence (PRE) treatments were applied May 8 with 64° F, 65% relative humidity, cloudy sky, and 12 mph wind. Post emergence treatments (POST) were applied to 3-inch field pea and flax and 4- to 6-leaf canola on June 2 with 69° F, 20% relative humidity, cloudy sky, and southeast wind at 12 mph. All treatments were applied with a backpack sprayer delivering 8.5 gpa a 35 psi through 8001 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.

Rating Date		Application	Jun 11			Jun 18			Sep 3
Treatment	Rate	timing	Field pea	Flax	Canola	Field pea	Flax	Canola	Yield
	oz/A				%				bu/A
Metribuzin	3	PRE	0	2	32	0	2	5	18
Metribuzin	4.5	PRE	5	10	65	0	7	65	18
Metribuzin	6	PRE	6	31	70	1	15	81	24
Metribuzin	1	POST	1	2	17	2	15	54	14
Metribuzin	2	POST	4	0	32	0	2	55	16
Metribuzin	3	POST	14	17	55	5	17	70	16
Bentazon+PO	16+0.25G	POST	5	15	98	9	5	99	23
Acifluorfen	4	POST	7	72	65	7	68	67	17
MCPA	4	POST	31	29	81	31	0	92	21
Untreated	0		0	0	0	0	0	0	14
LSD (P=0.05)			6	26	25	7	28	31	7
CV			56	101	34	91	144	37	28

Field pea showed significant injury (31%) from application of MCPA, and the injury did not diminish as the season progressed. POST application of 3 oz/A metribuzin resulted in 14% field pea injury on June 11, but symptoms subsided and injury was only 5% on June 18. Other treatments caused less than 10% injury on either evaluation date.

Acifluorfen provided the best suppression of flax (72% control) and prevented significant flax growth when combined with plant competition. Other herbicides gave less than 20% flax control on June 18. Metribuzin at 6 oz/A PRE or bentazon or MCPA POST provided greater than 80% control of canola. Field pea yield was greatest when canola was controlled regardless of field pea injury and despite lack of flax control.

Volunteer flax and canola control in field pea, Carrington, 2003. (Endres, Gregory J. and Kirk A. Howatt) Control of volunteer flax and canola, and crop response were evaluated with selected PRE and POST herbicides in field pea. Experiment design was a randomized complete block with four replicates. The experiment was conducted on a Heimdahl loam soil with 7.9 pH and 2.9% organic matter with field history of flax in 2002. Flax and canola seed was broadcast on May 20 and the trial area was harrowed twice on May 23. On May 27, inoculated 'Integra' field pea was planted in 7-inch rows at 300,000 pure live seeds/A. Herbicide treatments were applied at 8.5 gal/A at 30 psi through 8001 flat fan nozzles to 5 by 25 ft plots with a CO_2 pressurized hand-held plot sprayer. PRE treatments were applied on a dry soil surface on May 27 with 77 F, 44% RH, and 95% cloudy sky. A low density of volunteer flax was present. Rainfall totaled 0.93 inches of during the 14-day period following application of PRE treatments. POST treatments were applied on June 10 with 61 F, 76% RH, 8 mph wind, and 100% cloudy sky to 2-inch tall field pea, 1- to 1.5-inch tall flax, and cotyledon to 2-leaf canola. Average plant density in untreated plots: field pea = 8/ft^2, flax = 9/ft^2, and canola = 2/ft^2. Sethoxydim was applied across the trial on June 23 for grass control. The trial was harvested with a plot combine on August 26.

POST metribuzin at 2 and 3 oz/A and bentazon provided 86 to 99% canola control one month after application (Table). However, bentazon injured pea and reduced seed yield. POST metribuzin at 3 oz/A provided 79% and 99% control of flax and canola, respectively, and 1% pea injury one month after application (Table). Pea yield with POST metribuzin at 3 oz/A was 48.9 bu/A, which was higher than yield with the untreated check and herbicide treatments that significantly injured flax.

Table. Volunteer flax and canola control in field pea (Endres and Howatt).

		Volunteer flax		Volunteer canola		Field pea			
Treatment[a]	Rate	6/26	7/10	6/26	7/10	6/17	6/26	7/8	Seed yield
	(oz ai/A)	% control				% injury			bu/A
PRE									
metribuzin	3	10	20	76	44	0	0	0	40.3
metribuzin	4.5	71	48	96	77	15	15	11	42.8
metribuzin	6	77	66	97	79	18	25	23	36.6
POST									
metribuzin	1	76	65	88	69	0	0	0	51.1
metribuzin	2	91	69	99	89	12	3	1	46.9
metribuzin	3	94	79	99	99	12	1	1	48.9
bentazon+PO	16+0.25	0	0	98	86	0	20	20	40.0
acifllluorfen	3	35	45	69	40	2	1	0	43.7
MCPA	4	0	0	84	71	27	21	17	35.2
untreated	---	0	0	0	0	0	0	0	31.6
LSD (0.05)		14	16	7	14	4	8	5	8.2

[a]PO=HI-PER-OIL, a petroleum oil from Agriliance, St. Paul, MN.

Volunteer canola and flax control in dry pea. Jenks, Willoughby, and Markle. 'Majoret' dry peas were seeded April 29 at 160 lb/A. Canola and flax were seeded immediately following the peas to simulate a volunteer situation. Individual plots were 10 x 30 ft and replicated three times. PRE treatments were applied May 1 with a bicycle sprayer delivering 20 gpa at 30 psi through XR 80015 nozzles. Air and soil temperatures were 59 and 56 F, respectively, and relative humidity was 27%. POST treatments were applied May 31 with a bicycle sprayer delivering 10 gpa at 40 psi through XR 8001 nozzles to 4-inch dry pea. Air and soil temperatures were 56 and 61 F, respectively, and relative humidity was 47%. Volunteer canola and flax stages were 2-leaf and 2-inch, respectively. Select was applied over the entire study to control grass weeds three hours after the POST treatment on May 31. Dry peas were harvested Aug 1.

			Vol. Canola		Vol. Flax		Dry pea			
Treatment[a]	Rate	Timing	Jun 20	Jul 21	Jun 20	Jul 21	Jun 20	Jul 21	Yield	Test wt.
			——————% control ——————				—% injury —		lb/A	lb/bu
Sencor	0.25 lb	PRE	91	93	68	56	0	0	2152	65.1
Sencor	0.375 lb	PRE	98	100	87	84	0	0	2396	65.5
Sencor	0.5 lb	PRE	100	100	94	93	2	1	2440	65.3
Spartan + Pursuit	4 oz+ 1 fl oz	PRE	94	99	71	79	0	0	2380	65.5
Spartan	4 oz	PRE	44	73	0	2	0	0	1535	65.2
Pursuit	1 fl oz	PRE	81	92	59	84	0	0	2078	65.6
Sencor	0.083 lb	POST	72	78	32	12	0	0	1590	65.5
Sencor	0.167 lb	POST	94	97	43	21	0	0	1984	65.5
Sencor	0.25 lb	POST	98	99	82	72	8	5	2321	65.6
Raptor + Basagran	2 fl oz + 1 pt	POST	100	100	5	2	0	2	1717	65.7
Basagran	2 pt	POST	100	100	4	2	3	0	1382	65.6
Ultra Blazer	0.75 pt	POST	98	98	99	96	18	8	2308	64.9
MCPA amine	4 fl oz	POST	78	82	7	5	6	0	1350	65.6
Untreated			0	0	0	0	0	0	1055	65.2
LSD (0.05)			14	8	10	15	5	3	715	NS
CV			10	5	13	20	107	131	22	0.5

[a]*Basagran was applied with 1% v/v COC, and Ultra Blazer was applied with 0.25% v/v NIS on June 5.*

Volunteer canola population was variable due to flea beetle pressure early in the season. Most treatments provided excellent volunteer canola control by the July 21 evaluation. Spartan alone, and Sencor at 0.083 lb POST provided only fair volunteer canola control and MCPA amine provided good control. Ultra Blazer and Sencor applied PRE at 0.5 lb provided the best volunteer flax control at 96, and 93%, respectively, at the July 21 evaluation. Although Ultra Blazer caused significant visible dry pea injury, especially at the June 20 evaluation, dry peas treated with Ultra Blazer yielded very well compared to other treatments.

Weed control in conventional till dry pea. Jenks, Willoughby, and Markle. 'Majoret' dry peas were seeded April 28 at 150 lb/A. Individual plots were 10 x 30 ft and replicated three times. PPI and PRE treatments were applied April 28 and April 30, respectively, with a basket sprayer delivering 20 gpa at 30 psi through XR 80015 nozzles. On April 28, air and soil temperatures were 43 and 47 F, respectively, and relative humidity was 77%. On April 30, air and soil temperatures were 60 and 61 F, respectively, and relative humidity was 21%. POST treatments were applied May 31 with a bicycle sprayer delivering 10 gpa at 40 psi through XR 8001 nozzles to 2- to 3-inch dry pea. Air and soil temperatures were 61 and 64 F, respectively, and relative humidity was 37%. Kochia (Kocz) was 0.25- to 1-inch at time of application. Dry peas were harvested Aug 1.

			Kocz		Dry Pea	
Treatment	Rate	Timing	May 31	Jun 20	Yield	Test wt
			—% control—		lb/A	lb/bu
Prowl/ Raptor + NIS + 28% N	3 pt/ 4 oz + 0.25% v/v + 1 qt	PPI/ POST		76	1990	64.2
Raptor + Basagran + NIS + 28% N	4 oz + 0.5 pt + 0.25% v/v + 1 qt	POST		100	2015	64.3
Spartan/ Select + COC	2.67 oz/ 5 fl oz + 1% v/v	PRE/ POST	100	100	2408	64.1
Spartan/ Select + COC	4 oz/ 5 fl oz + 1% v/v	PRE/ POST	100	100	1901	61.4
Spartan/ Select + COC	5.33 oz/ 5 fl oz + 1% v/v	PRE/ POST	100	100	2063	63.9
Sonalan + Sencor/ Select + COC	2 pt + 0.33 lb/ 5 fl oz + 1% v/v	PPI/ POST	97	97	1643	63.4
Spartan/ Basagran + Poast + COC	2.67 oz/ 1 pt + 1 pt + 2 pt	PRE/ POST	100	100	2187	61.9
Basagran + Poast + COC	2 pt + 1 pt + 2 pt	POST		100	2096	63.5
Sonalan + Spartan/ Select + COC	2 pt + 4 oz/ 5 fl oz + 1% v/v	PPI/ POST	100	100	2114	64.1
Untreated			0	0	1888	64.5
LSD (0.05)			4	12	NS	NS
CV			2	8	24	2.7

We evaluated several PPI, PRE, and POST herbicide treatments for dry pea tolerance and weed control. All treatments provided excellent kochia control with the exception of Prowl followed by Raptor, which provided only fair kochia control.

Statistically, there was no significant yield difference between treatments. Yields were quite variable between reps, which was partially due to crop injury from herbicide carryover from 2002. In late May, the dry pea crop started to exhibit symptoms consistent with clopyralid injury. Unfortunately, we failed to remember that Curtail (clopyralid + 2,4-D) was applied to this field in 2002. Dry pea tolerance to herbicides in this study was not evaluated due to the confounding effect of the herbicide carryover from 2002. Dry pea injury due to Curtail carryover was more severe in this conventionally-tilled study compared to the no-till study in the same field.

Weed control in no-till dry pea. Jenks, Willoughby, and Markle. 'Majoret' dry peas were seeded April 28 at 150 lb/A. Individual plots were 10 x 30 ft and replicated three times. PRE treatments were applied April 30 with a basket sprayer delivering 20 gpa at 30 psi through XR 80015 nozzles. Air and soil temperatures were 57 and 55 F, respectively, and relative humidity was 24%. POST treatments were applied May 31 with a bicycle sprayer delivering 10 gpa at 40 psi through XR 8001 nozzles to 2- to 3-inch dry peas. Air and soil temperatures were 61 and 64 F, respectively, and relative humidity was 37%. Kochia (Kocz) was 0.25- to 1-inch on May 31. Dry peas were harvested Aug 1.

			Kocz		Dry pea	
Treatment[a]	Rate	Timing	May 31	Jun 20	Yield	Test wt
			—% control—		lb/A	lb/bu
Roundup/ Raptor + Basagran + NIS + 28% N	13 fl oz/ 4 oz + 1 pt + 0.25% v/v + 1 qt	PRE/ POST		100	2444	64.8
Roundup + Spartan/ Select + COC	13 fl oz + 2.67 oz/ 5 fl oz + 1% v/v	PRE/ POST	97	99	2774	64.4
Roundup + Spartan/ Select + COC	13 fl oz + 4 oz/ 5 fl oz + 1% v/v	PRE/ POST	99	98	2693	64.3
Roundup + Spartan/ Select + COC	13 fl oz + 5.33 oz/ 5 fl oz + 1% v/v	PRE/ POST	100	100	2395	64.2
Roundup/ Basagran + Poast + COC	13 fl oz/ 2 pt + 1 pt + 2 pt	PRE/ POST		100	2583	64.6
Roundup + Spartan/ Basagran + Poast + COC	13 fl oz + 2.67 oz/ 1 pt + 1 pt + 2 pt	PRE/ POST	95	100	2694	64.9
Roundup + Spartan + Sencor/ Select + COC	13 fl oz + 4 oz + 0.33 lb/ 5 fl oz + 1% v/v	PRE/ POST	98	100	2610	64.9
Untreated			0	0	2618	65.3
Handweeded check[b]			100	100	2796	65.0
LSD (0.05)			5	2	NS	0.6
CV			3	1	12	0.6

[a]*Roundup treatments were Roundup UltraMax applied with AMS at 2.5 gal/100 gal.*
[b]*Roundup UltraMax followed by Select + COC were applied to aid handweeding.*

We evaluated several PRE and POST herbicide treatments for dry pea tolerance and weed control. All treatments provided excellent kochia control.

Statistically, there was no significant yield difference between treatments. Yields were somewhat variable between reps, which was partially due to crop injury from herbicide carryover from 2002. In late May, the dry pea crop started to exhibit symptoms consistent with clopyralid injury. Unfortunately, we failed to remember that Curtail (clopyralid + 2,4-D) was applied to this field in 2002. Dry pea tolerance to herbicides in this study was not evaluated due to the confounding effect of the herbicide carryover from 2002. Dry pea injury due to Curtail carryover was not as severe in this no-till study compared to the conventionally-tilled study in the same field.

Weed control in no-till dry pea (Williston). Jenks, Willoughby, Markle, and Riveland. 'Scuba' dry peas were seeded May 25. Individual plots were 10 x 30 ft and replicated three times. PRE treatments were applied May 28 with a bicycle sprayer delivering 20 gpa at 30 psi through XR 80015 nozzles. Air and soil temperatures were 81 and 77 F, respectively, and relative humidity was 24%. POST treatments were applied June 16 with a bicycle sprayer delivering 10 gpa at 40 psi through XR 8001 nozzles to 2- to 4-inch peas. Air and soil temperatures were 77 and 75 F, respectively, and relative humidity was 58%. Plant sizes at time of application were kochia (Kocz) at 1- to 3-inch, Russian thistle (Ruth) at 0.5-inch, volunteer wheat (Vwht) at 1-leaf, and green foxtail (Grft) at 2-leaf.

		Kocz		Ruth		Vwht		Grft		Injury		Yield	Test Wt.
Treatment[a]	Rate	Jun 16	Jul 10	Jun 16	Jul 10	Jun 16	Jul 10	Jun 16	Jul 10	Jun 16	Jul 10	Aug 12	
PRE/POST		% control								— % —		lb/A	lb/bu
Roundup/ Raptor + Basagran + NIS + 28% N	13 fl oz/ 4 oz + 1 pt + 0.25% v/v + 1 qt	90	93	95	88	99	96	58	96	0	6	1151	63.3
Roundup + Spartan/ Select + COC	13 fl oz + 2.67 oz/ 5 fl oz + 1% v/v	88	85	100	96	99	94	89	94	0	0	1350	62.3
Roundup + Spartan/ Select + COC	13 fl oz + 4 oz/ 5 fl oz + 1% v/v	95	90	100	93	97	94	92	94	0	0	1388	62.0
Roundup + Spartan/ Select + COC	13 fl oz + 5.33 oz/ 5 fl oz + 1% v/v	96	93	100	94	98	97	95	97	0	0	1435	62.3
Roundup/ Basagran + Poast + COC	13 fl oz/ 2 pt + 1 pt + 2 pt	92	90	91	84	97	72	47	74	0	13	922	64.5
Roundup + Spartan/ Basagran + Poast + COC	13 fl oz + 2.67 oz/ 1 pt + 1 pt + 2 pt	86	93	95	95	95	88	85	89	0	6	1222	63.5
Roundup + Spartan + Sencor/ Select + COC	13 fl oz + 4 oz + 0.25 lb/ 5 fl oz + 1% v/v	96	90	99	95	94	92	96	92	4	0	1138	61.9
Untreated		0	0	0	0	0	0	0	0	0	0	263	54.8
LSD (0.05)		4	9	10	11	3	5	12	5	1	2	225	3.1
CV		3	6	6	7	2	4	7	4	178	43	12	2.9

[a]*Roundup formulation used was Roundup UltraMax applied with AMS at 2.5 gal/100 gal.*

Basagran + Raptor, Basagran + Poast, and various Spartan treatments were evaluated for weed control in dry pea. Roundup UltraMax was applied preemergence in all treatments. Spartan alone and Spartan + Sencor treatments were tank mixed with Roundup UltraMax. Select was applied postemergence following most Spartan treatments. Only Spartan + Sencor caused slight crop injury.

All treatments provided good to excellent kochia and Russian thistle control. The low Spartan rate tended to provide slightly less kochia control. All treatments provided excellent control of volunteer wheat; however, Basagran + Raptor and Basagran + Poast (2 pt +1pt) provided poor green foxtail control. Foxtail control was significantly better where a lower rate of Basagran was applied with Poast (1 pt + 1 pt), which suggests that the Basagran severely antagonized the foxtail control in the two treatments. Select provided good to excellent volunteer wheat and green foxtail control.

Flax response to Thifensulfuron. (Kirk Howatt, Ronald Roach, and Janet Davidson-Harrington). 'Pembina' flax was seeded April 29 at a location near Fargo, North Dakota. Treatments (3-inch) were applied to 3-inch flax and 2 to 3 leaf redroot pigweed and common lambsquarters on June 3 with 66° F, 35% relative humidity, cloudy sky, 10 mph wind, and soil temperature of 61° F. Treatments (6-inch) were applied to 8-inch flax, 3- to 4-inch redroot pigweed and 3- to 5-inch common lambsquarters on June 16 with 72° F, 50% relative humidity, 2 mph wind and soil temperature of 63° F. All treatments were applied with a backpack sprayer delivering 8.5 gpa at 35 psi through 8001 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. Grass weeds were controlled with clethodim. Flax injury and broadleaf weed control were visually evaluated, weed populations were counted at the end of the season, and components of flax yield were measured at maturity including number of bolls per 20 plants, stems per m of row, and seed yield.

		Jul 1			Jul 23			Aug 14				
Treatment[a]	Rate	Flax	Rrpw	Colq	Maturity delay	Rrpw	Colq	Rrpw	Colq	Flax	Flax	Yield
	oz/A		%		days	%		plants/m^2		bolls	stems	bu/A
3-inch flax												
Bromoxynil&MCPA+thif	6+0.22	0	99	99	6	97	99	11	14	281	65	24
Brox&MCPA+thifensulfuron	6+0.11	0	98	98	5	95	98	57	2	315	48	22
Brox&MCPA+thif	6+0.06	0	96	99	3	96	99	18	3	309	51	21
Brox&MCPA+thif	6+0.03	0	97	99	3	93	99	37	5	287	57	21
Bromoxynil&MCPA	6	0	69	97	2	37	99	148	2	286	48	22
6-inch flax												
Brox&MCPA+thif	6+0.22	15	87	87	5	91	99	41	7	325	47	16
Brox&MCPA+thif	6+0.11	16	86	91	3	83	99	109	22	297	43	17
Brox&MCPA+thif	6+0.06	15	79	86	4	82	96	102	24	288	45	18
Brox&MCPA+thif	6+0.03	11	79	84	2	81	97	121	8	286	57	15
Bromoxynil&MCPA	6	1	25	86	1	40	95	181	20	253	51	17
Untreated	0	0	0	0	0	0	0	193	109	197	30	13
LSD (P=0.05)		8	9	6	1	6	3	66	22	76	20	6
CV		101	8	5	26	5	2	49	76	18	29	23

[a] Bromoxynil&MCPA was 5 lb/gal formulation.

Thifensulfuron at 0.03 to 0.22 oz/A caused stunting and chlorosis of flax (11 to 16% injury) when applied after plants reached 6 inches in height. Application of thifensulfuron to 3-inch flax did not elicit noticeable plant response throughout vegetative and early flowering stages. Flax receiving any herbicide treatment appeared to have delayed maturity. Estimated maturity delay increased as thifensulfuron rate increased but was not affected by growth stage at application. The maturity delay was thought to be a result of extended flowering since all treatments began flowering at essentially the same time; however, number of bolls did not support this. Fewer bolls were produced on plants in untreated plots, but boll production did not increase as weed control increased. Weed competition caused fewer stems to survive to maturity in untreated plots compared with several herbicide treatments, but number of stems was essentially similar across all herbicide treatments. Greater yield produced by flax treated when 3 inches tall could not be attributed to trends in greater boll or stem numbers and was probably a result of earlier weed control.

Bromoxynil&MCPA at 6 oz/A gave a maximum of 40% redroot pigweed control on July 23. Addition of thifensulfuron substantially improved pigweed control at both application timings. Thifensulfuron at 0.03 oz/A and greater controlled nearly all pigweed plants present at the 3-inch flax application (minimum 93% control), but subsequent pigweed emergence resulted in populations later in the season. Only 0.22 oz/A thifensulfuron with Bromoxynil&MCPA provided greater than 90% control of pigweed when applications were made to 6-inch flax. All herbicide treatments provided 95 to 99% common lambsquarters control on July 23, and late emergence was not as common as for redroot pigweed. Minimizing the duration of early season weed competition by applying herbicides at the earlier timing was more important than maximizing efficacy for achieving the greatest yield. Delaying herbicide application until all broadleaf weeds had emerged resulted in lower yield even when efficacy was high and the larger weeds were more likely to survive the herbicide application.

Comparison of clethodim formulations in flax. (Kirk Howatt, Ronald Roach, and Janet Davidson-Harrington). 'Pembina' flax was seeded April 29 at a location near Fargo, North Dakota. Treatments were applied to 8-inch flax, 3-inch yellow foxtail and redroot pigweed, and 3- to 5-inch common lambsquarters on June 16 with 72° F, 50% relative humidity, wind velocity of 2 mph, and soil temperature of 63° F. Treatments were applied with a backpack sprayer delivering 8.5 gpa at 35 psi through 8001 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.

		Jul 1				Jul 14	Jul 23	
Treatment[a]	Rate	Flax	Yeft	Rrpw	Colq	Yeft	Rrpw	Yeft
	oz/A					%		
Clethodim+PO	1.5+1%	0	89	0	0	99	0	0
V-10117+PO	1.4+1%	0	90	0	0	99	0	0
Clethodim-P+PO	1.5+1%	0	93	0	0	99	0	0
V-10137	1.5	0	92	0	0	99	0	0
Clethodim+brox&MCPA+PO	1.5+7.4+1%	3	92	67	87	99	75	89
V-10117+bromoxynil&MCPA+PO	1.4+7.4+1%	7	94	47	87	99	73	93
Clethodim-P+brox&MCPA+PO	1.5+7.4+1%	7	91	40	82	99	75	88
V-10137+bromoxynil&MCPA	1.5+7.4	10	93	50	90	99	75	95
Bromoxynil&MCPA	7.4	5	0	30	87	0	72	96
Untreated	0	0	0	0	0	0	0	0
LSD (P=0.05)		3	7	15	9	0	8	5
CV		64	5	37	13	0	13	6

[a] Clethodim was Select; V-10117 was experimental clethodim with 1.88 EC formulation; clethodim-P was Prism; V-10137 was experimental clethodim with 0.94 EC formulation; and Bromoxynil&MCPA formulation was 5 lb/gal formulation.

Clethodim formulations with or without PO did not visibly injure flax. Bromoxynil&MCPA caused 5% injury to flax July 1. Addition of V-10137 to bromoxynil&MCPA resulted in greater injury than from bromoxynil&MCPA alone. Clethodim formulations that required PO adjuvant did not increase flax injury compared to bromoxynil&MCPA. All clethodim formulations provided similar yellow foxtail control, and addition of bromoxynil&MCPA did not affect clethodim efficacy. Clethodim provided 89 to 94% control of foxtail on July 1 and 99% control on July 14. Addition of clethodim formulations increased the speed of redroot pigweed control with bromoxynil&MCPA but did not affect the final pigweed control achieved (72 to 75% on July23). Bromoxynil&MCPA provided better control of common lambsquarters than redroot pigweed. Lambsquarters control with bromoxynil&MCPA was not influenced by clethodim on July 1 but was slightly antagonized by Select and Prism on July 23. Experimental clethodim formulations did not reduce broadleaf weed control or increase flax injury but did provide foxtail control similar to current commercial formulations.

Weed control in flax. Jenks, Willoughby, and Markle. 'Cathay' flax was seeded May 14 at 60 lb/A. Individual plots were 10 x 30 ft and replicated three times. PRE treatments were applied May 14 with a bicycle sprayer delivering 20 gpa at 30 psi through XR 80015 nozzles. Air and soil temperatures were 48 and 53 F, respectively, and relative humidity was 92%. POST treatments were applied June 13 to 4- to 6-inch flax with a bicycle sprayer delivering 10 gpa at 40 psi through XR 8001 nozzles. Air and soil temperatures were 72 and 60 F, respectively, and relative humidity was 57%. Plant sizes on June 13 were redroot pigweed (Rrpw) at 1-inch, common lambsquarters (Colq) at 2- to 3-inch, wild buckwheat (Wibw) at 2- to 3-inch, and Pennsylvania smartweed (Pnsw)at 1- to 3-inch. Flax was harvested September 5.

		Rrpw			Colq			Wibw			Pnsw			Flax				
Treatment	Rate	Jun 7	Jul 1	Jul 30	Jun 7	Jul 1	Jul 30	Jun 7	Jul 1	Jul 30	Jun 7	Jul 1	Jul 30	Jun 7	Jul 1	Jul 30	Yld	Test Wt
		% control												% injury			bu/ A	#/bu
Untreated		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15	51.8
PRE																		
Spartan	2.67 oz	77	50	91	100	83	96	77	58	88	0	48	85	0	0	0	17	53.1
Spartan	5.33 oz	90	73	93	100	95	98	89	75	91	20	64	89	0	0	0	21	53.3
Spartan	10.67 oz	99	96	98	100	100	100	94	91	97	70	77	90	12	0	1	19	53.6
PRE/POST																		
Spartan/ Harmony[a]	4 oz/ 0.167 oz	86	100	100	100	100	100	86	98	97	0	99	99	0	27	10	18	53.8
Spartan/ Harmony[a]	4 oz/ 0.25 oz	85	100	100	100	100	100	85	99	98	0	99	100	0	35	11	17	53.7
Spartan/ Bronate[b]	2.67 oz/ 11.4 fl oz	75	92	98	98	100	100	75	99	95	0	91	92	0	11	1	23	53.6
POST																		
Bronate[b]	11.4 fl oz	0	91	95	0	100	100	0	97	99	0	95	98	0	11	2	19	53.7
LSD (0.05)		6	23	4	2	18	5	5	24	4	6	28	9	2	2	2	NS	0.9
CV		5	18	3	1	12	3	5	18	3	31	23	7	58	12	37	16	0.9

[a]*Harmony GT*
[b]*Bronate Advanced*

Spartan applied PRE did not cause any visible flax injury except when applied at 10.67 oz, which is 2-4 times the normal use rate. Harmony GT caused significant crop injury, and tended to reduce yields compared to Bronate Advanced. No adjuvant was applied with Harmony GT.

All postemergence treatments provided excellent weed control. Weed control increased as Spartan rate increased. Weed control ratings with Spartan alone were lower at the July 1 evaluation compared to June 7, but then increased at the July 30 evaluation. Weed growth may have slowed or stopped in July due to dry conditions or due to additional activation of Spartan following a single rain event on July 18. June and July were very dry with the only significant rainfall on July 18 (0.55 in).

Split Applications for Broadleaf Weed Control in Flax. (Gregoire, 2003) Flax was sprayed at 3:30 p.m. June 13th for broadleaf weeds near Webster, North Dakota. The temperature during application was 73°, relative humidity near 48% and clear skies. A second application for split treatments was applied June 18th with sunny skies and 70°F temperature. The flax was 3-4" tall at first application and 8" tall at second application. Treatments were applied with a CO_2 pressurized back pack sprayer using 8.5 gpa at 40 psi and 8001 nozzles. Treatments were arranged in RCBD and replicated 4 times. Wild mustard, redroot pigweed and other broadleaf weeds were in the 4 leaf stage June 13th and 6 leaf stage June 18th . The Dicamba formulation used was marketed as 4.0 lb a.i/a Clarity. Spartan was sprayed at the postemergence at the same time as other treatments. Treatments were evaluated June 26th for injury and July 14th for weed control.

		6/26/03	7/14/03		
Treatment	Rate	Injury[a]	Wioa	Wimu	Rrpw
	product/A	inch	Percent Control		
untreated		0	0	0	0
Clarity	2 oz	1.0	0.0	57.5	100.0
Clarity+MCPA+Clarity+MCPA	1+4/1+4 oz	6.5	0.0	100.0	95.0
Curtail	24 oz	1.5	0.0	100.0	100.0
Bronate Advanced	12.8 oz/a	1.0	0.0	100.0	100.0
Bronate Advanced/Bronate Advanced	6.4/6.4 oz	3.0	0.0	100.0	100.0
Spartan	4 oz	0.0	0.0	75.0	100.0
Harmony GT/Bronate Advanced	0.165/9.7 oz	3.3	0.0	100.0	100.0
Harmony GT+NIS	0.165 oz+0.5%	4.3	0.0	100.0	100.0
Poast+MSO	1 pt+1 pt	0.0	100.0	0.0	0.0
Bronate Advanced+Poast+MSO/Bronate Advanced	6.4 oz+1pt+1pt+6.4 oz	2.8	100.0	100.0	100.0
Bronate Advanced/Spartan	6.4 oz/4 oz	8.3	0.0	87.5	97.5

[a]Injury=height reduction

Summary

Severe flax injury resulted from addition of MCPA to Clarity in split treatments. Bronate Advanced was more injurious to flax when applied as a split application of ½ normal use rate, than compared to full rate applied once. Spartan applied postemergence to 4" tall flax did not injure flax but when applied with Bronate as a tank mix, severe flax injury occurred. Harmony GT was generally less injurious when applied with Bronate Advanced than when applied alone and observation notes indicated less yellowing occurred with the tank mix.

Flax response to application timing of POST herbicides. Gregory J. Endres and Blaine G. Schatz. (Carrington Research Extension Center, North Dakota State Univ., Carrington, ND 58421) The trial was conducted to evaluate flax response to three application timings of selected POST herbicides. The experimental design was a randomized complete block with a split-plot arrangement (main plots=herbicide application timing and subplots=herbicide treatments) and three replicates. The trial was conducted on a conventional-tilled, loam soil with 6.8 pH and 3.2% organic matter at Carrington, ND in 2003. 'Cathay' flax was seeded on May 15 at the rate of 42 lb/A. Herbicide treatments were applied to the center 6.7 ft of 10- by 25-ft plots with a CO_2 pressurized hand-held plot sprayer delivering 10 gal/A at 30 psi through 8002 flat fan nozzles for the PRE treatment and 17 gal/A at 35 psi through 80015 flat fan nozzles for POST treatments. PRE sulfentrazone was applied on May 16 with 63 F, 60% RH, 100% cloudy sky and dry soil surface. Total rainfall was 0.96 inches during the 2 days following sulfentrazone application. Early POST (POST A) treatments were applied on June 9 with 67 F, 75% RH, and 10 mph wind to 1- to 2-inch tall flax. Mid POST (POST B) treatments were applied on June 18 with 71 F, 42% RH, and 6 mph wind to 6- to 7-inch tall flax, 4- to 6-inch tall green and yellow foxtail, 3- to 7-inch tall wild buckwheat, 2- to 6-inch tall common lambsquarters, 1- to 2-inch tall prostrate pigweed, and 3- to 8-inch tall redroot pigweed. Late POST (POST C) treatments were applied on June 27 with 63 F, 81% RH, and 9 mph wind to 10- to 15-inch tall flax, 8- to 10-inch tall green and yellow foxtail, 6- to 8-inch tall wild buckwheat, 4- to 10-inch tall common lambsquarters, and 6- to 12-inch tall redroot pigweed. Average plant density in untreated plots on July 3: flax = 93/ft^2, redroot and prostrate pigweed = 4/ft^2, and yellow and green foxtail, wild buckwheat, and common lambsquarters = 1/ft^2. The trial was harvested on September 4 with a plot combine.

Due to generally low weed density, weed competition with flax was expected to be minimal. Averaged across herbicide treatments, broadleaf weed control was 85% with early herbicide application compared to 71 to 75% with the 2 later applications (data not shown). Flax injury (growth reduction) evaluated 7 days after herbicide application was less with flax at 1- to 2-inch height compared to later flax stages (Table 1). Days to bloom was shorter, bloom duration extended, and seed yield and oil content generally were higher with the first two herbicide application timings compared to the late timing. Plant injury occurred with all herbicide treatments and ranged from 17 to 42% with treatments that included clopyralid&MCPA or thifensulfuron (Table 2). Also, plant height was reduced 2 to 6 inches, days to bloom extended 1 to 5 days, and physiological maturity extended 1 to 4 days. However, flax yield generally was similar to the untreated check. Flax injury was 13% or less with bromoxynil&MCPA or bromoxynil&MCPA+clethodim+COC applied to 1- to 2-inch or 6- to 7-inch tall flax (Table 3). However, at each herbicide application timing, yield was similar among treatments.

Table 1. Flax response to three application timings across herbicide treatments, Carrington, ND, 2003.

	Flax						
Herbicide application timings[1]	Injury[2]	Days to bloom	Bloom duration	PM[3]	Seed yield	Test weight	Oil content
	%	days	days	days	bu/A	lb/bu	%
POSTA	14	52	21	92	42.9	54.1	41.4
POSTB	23	52	21	90	46.0	54.1	40.8
POSTC	26	56	17	91	39.9	54.1	40.4
LSD (0.05)	8	1	1	NS	3.8	NS	0.5

[1]POSTA=1- to 2-inch tall flax; POSTB=6- to 7-inch tall flax; POSTC=10- to 15-inch tall flax.

[2]Injury=% growth reduction by visual evaluation 7 d after treatment.

[3]PM=Physiological maturity from seeding date.

Table 2. Agronomic traits of flax as influenced by herbicide treatment, Carrington, ND, 2003.

Herbicide			Plant	Days to		Seed
Treatment[1]	Rate	Injury[2]	height	bloom	PM[3]	yield
	lb ai/A	%	inch	days	days	bu/A
Bromoxynil&MCPA	0.23&0.23	8	14	53	90	43.9
Clopyralid&MCPA	0.07&0.39	20	12	53	91	40.3
Bromoxynil&MCPA+clopyralid& MCPA	0.23&0.23+0.07&0.39	26	12	54	91	40.5
Bromoxynil&MCPA+clethodim+COC	0.23&0.23+0.08+2pt	13	13	52	90	45.6
Sulfentrazone(PRE)/Bromoxynil& MCPA+clethodim+COC	0.19/0.23&0.23+ 0.08+2pt	11	14	52	90	47.5
Clopyralid&MCPA+clethodim+COC	0.07&0.39+0.08+2pt	17	13	53	92	45.1
Bromoxynil&MCPA+clopyralid& MCPA+clethodim+COC	0.23&0.23+0.07&0.39+ 0.08+2pt	42	11	54	91	40.7
Bromoxynil&MCPA+thifensulfuron	0.23&0.23+0.008	38	10	56	93	40.8
Bromoxynil&MCPA+thifensulfuron	0.23&0.23+0.004	34	10	56	93	42.2
Untreated Check	x	0	16	51	89	42.8
LSD (0.05)		7	2	1	1	4.5

[1]COC=Scoil, a methylated seed oil from AGSCO, Grand Forks, ND.

[2]Injury=% growth reduction by visual evaluation 7 d after treatment.

[3]PM=Physiological maturity from seeding date.

Table 3. Flax injury and yield as impacted by three application timings of POST herbicides, Carrington, ND, 2003.

		Herbicide application timing[1]					
		POSTA		POSTB		POSTC	
Herbicide		Flax					
Treatment[2]	Rate	Injury[3]	Yield	Injury	Yield	Injury	Yield
	lb ai/A	%	bu/A	%	bu/A	%	bu/A
Bromoxynil&MCPA	0.23&0.23	2	42.6	7	49.6	17	39.5
Clopyralid&MCPA	0.07&0.39	20	34.3	25	45.4	15	41.1
Bromoxynil&MCPA+clopyralid& MCPA	0.23&0.23+0.07&0.39	17	43.7	22	41.6	38	36.4
Bromoxynil&MCPA+clethodim+COC	0.23&0.23+0.08+2pt	8	44.7	13	48.2	18	44.0
Sulfentrazone(PRE)/Bromoxynil& MCPA+clethodim+COC	0.19/0.23&0.23+ 0.08+2pt	7	50.4	8	47.8	18	44.2
Clopyralid&MCPA+clethodim+COC	0.07&0.39+0.08+2pt	12	42.6	15	51.2	25	41.4
Bromoxynil&MCPA+clopyralid& MCPA+clethodim+COC	0.23&0.23+0.07&0.39+ 0.08+2pt	27	40.8	38	45.5	62	35.7
Bromoxynil&MCPA+thifensulfuron	0.23&0.23+0.008	25	42.7	50	43.4	40	36.3
Bromoxynil&MCPA+thifensulfuron	0.23&0.23+0.004	25	45.0	50	43.9	28	37.5
Untreated Check	x	0	42.2	0	43.0	0	43.3
Interaction of Timing x Herbicide: LSD (0.05)		13	NS	13	NS	13	NS

[1]POSTA=1- to 2-inch tall flax; POSTB=6- to 7-inch tall flax; POSTC=10- to 15-inch tall flax.

[2]COC=Scoil, a methylated seed oil from AGSCO, Grand Forks, ND.

[3]Injury=% growth reduction by visual evaluation 7 d after treatment.

Mustard tolerance to herbicides. Jenks, Willoughby, and Markle. 'Pennant' mustard was seeded May 14. Individual plots were 10 x 30 ft and replicated three times. PPI treatments were applied April 29 with a basket sprayer delivering 20 gpa at 30 psi through XR 80015 nozzles. POST treatments were applied June 5 with a bicycle sprayer delivering 10 gpa at 40 psi through XR 8001 nozzles to 5- to 7-leaf mustard. Air and soil temperatures were 72 and 68 F, respectively, and relative humidity was 46%. Assure II was applied over the entire study to control grass weeds on June 9.

			Mustard Injury			Yield	Test Wt
Treatment	Rate	Timing	Jun 12	Jun 19	Jul 14	Aug 7	
			——————% ——————			lb/A	lb/bu
Stinger	5.33 fl oz	POST	0	0	0	721	55.7
Muster + NIS	0.3 oz + 0.25% v/v	POST	42	42	14	854	55.1
Muster + Assure II + COC	0.3 oz + 8 fl oz + 1% v/v	POST	62	68	33	690	56.4
Aim + COC	0.5 oz + 1% v/v	POST	52	27	14	833	56.5
Aim + Assure II + COC	0.5 oz + 8 fl oz + 1% v/v	POST	60	33	19	844	56.0
Sonalan	2 pt	PPI	8	3	1	1142	55.9
Sonalan	2.5 pt	PPI	19	12	8	953	56.2
Sonalan	3 pt	PPI	21	13	12	906	56.1
Untreated			0	0	0	898	56.3
LSD (0.05)			9	8	8	NS	NS
CV			18	21	40	20	0.9

Stinger and Sonalan at 2 pt/A were the only treatments that did not cause significant visible mustard injury at the June 12 evaluation. Although mustard treated with Stinger showed the least crop injury all season, it tended to yield low compared to the other treatments, because of the weed spectrum in the plot.

Weed control on onion at Absaraka, ND. Harlene M. Hatterman-Valenti and Paul G. Mayland.

Onion seed ('Teton) were planted April 24 at the Horticulture Research and Arboretum site near Absaraka, ND. The study was conducted on loam soil with 2 % organic matter and 7.1 pH, with potato as the previous crop. Herbicides were applied as a delayed preemergence just before onion emergence (PRE); when onion had one true-leaf (POST1); at the onion two true-leaf stage (POST2); at the onion three true-leaf stage (POST3); and at the onion four to five true-leaf stage (POST4). Plots were four rows by 30 ft arranged in a randomized complete block design with four replicates and a running check area between plots. The entire trial was sprayed with 28% UAN on June 5 for ancillary weed control and with a postemergence grass herbicide on June 9. The hand-weeded plots were weeded three times (1st wk of June, July, and August). Only the middle two rows were harvested for grade and yield analysis.

Application Date:	May 20	Jun 5	Jun 5	Jun 11	Jul 10	Aug 20
Time of Day:	15:00	10:00	11:30	15:30	10:30	18:00
Air Temp. (F):	58	65	71	71	62	84
% Rel. Humidity:	38	69	50	50	90	65
Wind Velocity (MPH):	5.5	3.5	2.9	11	6	6
Dew Presence (Y/N):	N	N	N	N	N	N
Soil Temp. (F):	55	57	59	67	64	87
Soil Moisture:	Adequate	Adequate	Adequate	Adequate	Adequate	Adequate
% Cloud Cover:	10	5	3	60	40	10
Operating Pressure:	30 psi	30 psi	30 psi	30 psi	30 psi	30 psi
Nozzle Type:	flat fan	flat fan	flat fan	flat fan	flat fan	flat fan
Nozzle Size:	11002	11002	11002	8005	11002	8005
Nozzle Spacing (in):	19	19	19	19	19	19
Ground Speed (MPH):	3.5	3.5	3	3	3.5	3
Spray Volume (GPA):	15	15	20	50	15	50

Treatments with balance pro, python, callisto (pre & post), and the high rates of valor and nortron caused unacceptable onion injury (>50% at 57DAA and >30 at 100 DAA) and results will not presented. Some of the injury may have been attributed to spray contact for a few seedlings just starting to emerge, but the main cause for the injury was poor tolerance by the crop. A majority of the treatments did not provide season-long weed control which reduced yield substantially (data not shown). Treatments with yields similar to the monthly hand-weeded plots are provided below. Clearly good initial weed control is very important for onion establishment and the number of bulb/A. However, late season weed control is also important due to continual weed flushes throughout the growing season and the influence of these weeds on the final grade for the onion.

						57 DAA					131 DAA						
Name	Prod. rate		Timing	Onion	Fipc	Rrpw	Colq	Bygr	Yeft	Rrpw	Colq	Bygr	Yeft	1¾-2.5 in	2.5-3 in	>3 in
				% Injury					% Control						cwt/A	
Dacthal	10	lb/A	PRE	14 ef	83 efg	89 b-e	95 abc	88 a-g	100 a	89 ab	74 a-d	97 a	98 a	45 ab	105 a	117 ab
Buctril+Goal	24+8	oz/a	POST2													
Prowl	24	oz/a	POST3													
Buctril+Goal	24+8	oz/a	POST4													
Prowl	24	oz/a	PRE	15 ef	96 a-d	98 abc	100 a	93 a-f	100 a	87 ab	40 d-i	99 a	83 abc	53 ab	66 abc	123 ab
Buctril+Goal	24+8	oz/a	POST2													
Valor	2	oz/a	POST3													
Buctril+Goal	24+8	oz/a	POST4													
Nortron	64	oz/a	PRE	18 e	94 a-e	99 ab	100 a	81 efg	100 a	86 ab	43 c-h	100 a	70 abc	32 ab	52 abc	112 ab
Buctril+Goal	24+8	oz/a	POST2													
Buctril+Goal	24+8	oz/a	POST4													
Prowl	24	oz/a	PRE	16 ef	99 abc	99 ab	99 a	81 efg	95 a	58 b-e	60 a-e	100 a	87 abc	27 ab	71 abc	78 ab
Buctril+Goal	24+8	oz/a	POST2													
Prowl	24	oz/a	POST3													
Buctril+Goal	24+8	oz/a	POST4													
Prowl	24	oz/a	POST1	13 efg	78 g	80 ef	93 a-d	98 abc	100 a	13 fg	10 f-i	100 a	96 a	79 a	23 bc	9 b
Buctril+Goal	24+8	oz/a	POST2													
Surpass	35	oz/a	POST3													
Buctril+Goal	24+8	oz/a	POST4													
Prowl	24	0 d	POST1	14 ef	78 g	88 cde	75 f	84 d-g	100 a	80 a-d	47 c-g	100 a	60 abc	61 ab	86 ab	123 ab
Aim	0.33	oz/a	POST1													
Buctril+Goal	24+8	oz/a	POST2													
Surpass	35	oz/a	PRE	44 c	94 a-e	99 ab	99 a	99 ab	100 a	92 a	45 c-h	100 a	83 abc	14 ab	55 abc	245 a
Buctril+Goal	24+8	oz/a	POST2													
Buctril+Goal	24+8	oz/a	POST4													
Nortron	128	oz/a	PRE	15 ef	65 h	70 f	81 ef	88 a-g	100 a	17 fg	10 f-i	90 a	63 abc	57 ab	51 abc	24 b
Buctril+Goal	24+8	oz/a	POST2													
Nortron	64	oz/a	POST3													
Buctril+Goal	24+8	oz/a	POST4													
Handweeded				0 i	100 a	100 a	100 a	80 fg	97 a	76 a-d	37 d-i	98 a	83 abc	37 ab	61 abc	160 ab

Broadleaf weed control in onion. Hendrickson and Swanson. An experiment was conducted at the Carrington Research Extension Center to evaluate broadleaf weed control in onion. 'Teton' onion was seeded May 2, 2003 in 3-inch paired rows on 18-inch centers at 167,000 seeds/A. The experimental design was a randomized complete block design with four replicates. Pre-emergence herbicide treatments PRE1 and 2 were applied May 7 (53° F air, 45° F soil, 76 % RH, 5 mph, and 0% clouds) and May 14 (47° F air, 47° F soil, 93 % RH, 0 mph, and 0% clouds) through XR 8003 flat fan nozzles delivering 20 gpa at 22psi. Post-emergence herbicide treatments to flag leaf (POST 0) and 3-leaf (POST 3) onion were applied May 27 (59° F air, 64° F soil, 81 % RH, 10 mph, and 100% clouds) and June 25 (55° F air, 59° F soil, 89 % RH, 11 mph, and 40% clouds) through XR 8003 flat fan nozzles delivering 20 gpa at 22psi. Bromoxynil and oxyfluorfen were applied to 1-leaf (POST 1) and 2-leaf (POST 2 and 2a) onion June 11 (64° F air, 61° F soil, 80 % RH, 11 mph, and 80% clouds), June 18 (69° F air, 67° F soil, 48 % RH, 7 mph, and 0% clouds), and June 19 (65° F air, 68° F soil, 62 % RH, 8 mph, and 20% clouds) through XR 11006 flat fan nozzles delivering 40 gpa at 30 psi. Due to excellent weed control in the treated plots, a second application of bromoxynil + oxyfluorfen 0.375 + 0.125 lb/A was not applied at the 5-leaf stage. Best management practices were used for fertility and disease, insect, and grass control. All herbicide treatments were applied with a CO_2 hand-boom sprayer. The onions were harvested September 25.

When evaluated July 30, ethofumesate applied PRE 1 at 1.5 lb/A was the only herbicide treatment that did not provided greater than 90% redroot pigweed and common lambsquarters control (Table 1). PRE 1 applications of flumioxazin at 0.047 and 0.094 lb/A and ethofumesate at 3 lb/A caused significant crop injury and a reduction in the number of harvested bulbs and yield (Tables 1 and 2). Bromoxynil applied PRE 2 at 0.25 lb/A and bromoxynil + oxyfluorfen applied POST 1 at 0.375 + 0.125 lb/A caused crop injury but there was no reduction in yield. An application of bromoxynil + oxyfluorfen POST 1 at 0.187 + 0.0625 lb/A did not cause any significant crop injury. There was no benefit of applying bromoxynil and oxyfluorfen separately (POST 2 and 2a) when compared to a tank mix application POST 2 (Trt No. 10 and 11 vs. 14).

Table 1. Onion tolerance and weed control.

No.	Treatment	Timing	Rate	Onion			Weed control			
				Crop injury	Stand reduction	Growth reduction	redroot pigweed		common lambsquarters	
				6/16	7/30	7/30	6/16	7/30	6/16	7/30
			lb ai/A	%	%	%	%	%	%	%
1	Dacthal	PRE 1	7.5	0	0	0	95	99	94	100
	Brox+Oxyfl	POST 2	0.375+0.125							
	Pendimethalin	POST 3	0.625							
2	Flumioxazin	PRE 1	0.047	24	8	4	98	99	98	95
3	Flumioxazin	PRE 1	0.094	38	34	4	100	97	100	98
4	Pendimethalin	PRE 1	0.62	3	0	0	93	91	86	83
	Flumioxazin	POST 2	0.047							
5	Ethofumesate	PRE 1	1.5	5	0	5	93	59	73	33
6	Ethofumesate	PRE 1	3	14	31	18	98	96	92	92
7	Ethofumesate	PRE 1 & POST 3	1.5 & 2	4	8	4	93	100	73	100
	Brox+Oxyfl	POST 2	0.375+0.125							
8	Pendimethalin	POST 0 & 3	0.625	3	0	0	100	100	96	100
	Brox+Oxyfl	POST 1	0.187+0.0625							
9	Pendimethalin	POST 0 & 3	0.0625	3	0	0	100	99	99	100
	Brox / Oxyfl	POST 2 / 2a	0.375 / 0.125							
10	Pendimethalin	POST 0 & 3	0.0625	1	5	5	100	100	95	100
	Oxyfl / Brox	POST 2 / 2a	0.125 / 0.375							
11	Bromoxynil	PRE 2	0.25	21	0	0	100	96	100	100
	Pendimethalin	POST 0 & 3	0.412 & 0.625							
	Brox+Oxyfl	POST 2	0.375+0.125							
12	Pendimethalin	POST 0 & 3	0.625	20	0	0	100	100	100	100
	Brox+Oxyfl	POST 1	0.375+0.125							
13	Pendimethalin	POST 0 & 3	0.625	1	0	0	99	100	95	100
	Brox+Oxyfl	POST 2	0.375+0.125							
14	Pendimethalin	POST 0	0.625	1	0	0	99	100	97	100
	Brox+Oxyfl	POST 2	0.375+0.125							
	s-Metolachlor	POST 3	0.95							
15	Pendimethalin	POST 0	0.625	3	0	0	100	99	98	100
	Brox+Oxyfl	POST 2	0.375+0.125							
	s-Dimethenamid	POST 3	0.75							
16	Pendimethalin	POST 0	0.625	3	0	0	100	100	98	100
	Brox+Oxyfl	POST 2	0.375+0.125							
	Sulfentrazone	POST 3	0.14							
17	Pendimethalin	POST 0	0.625	4	0	0	99	92	96	95
	Sulfentrazone	POST 3	0.14							
18	Handweed check			0	0	0	100	100	100	100
19	Untreated check			0	8	28	0	0	0	0
	LSD (0.05)			6	15	11	6	12	7	9

Table 2. Onion yield.

Trt				Days to	Yield							# of
no.	Treatment	Timing	Rate	1/2 down	<2.25"	2.25-3"	3-4"	4-4.5"	>4.5"	Total	Culls	bulbs
			lb ai/A	days	cwt/acre							1000's/A
1	Dacthal	PRE 1	7.5	128	2.5	93.2	686.8	76.2	10.7	869.4	13.4	122.5
	Brox+Oxyfl	POST 2	0.375+0.125									
	Pendimethalin	POST 3	0.625									
2	Flumioxazin	PRE 1	0.047	134	2.7	48.3	374.8	139.3	19.1	584.2	9.5	76.2
3	Flumioxazin	PRE 1	0.094		0.0	17.2	243.7	99.8	29.0	389.8	24.7	46.3
4	Pendimethalin	PRE 1	0.62	130	4.8	82.4	603.5	47.4	13.6	751.6	7.0	107.1
	Flumioxazin	POST 2	0.047									
5	Ethofumesate	PRE 1	1.5	133	25.9	144.7	232.3	5.4	0.0	408.4	7.7	93.9
6	Ethofumesate	PRE 1	3		10.4	39.0	267.7	81.4	5.9	404.5	39.7	75.3
7	Ethofumesate	PRE 1 & POST 3	1.5 & 2	128	10.0	73.3	552.0	56.9	7.9	700.1	9.5	104.4
	Brox+Oxyfl	POST 2	0.375+0.125									
8	Pendimethalin	POST 0 & 3	0.625	126	4.1	66.2	768.0	42.9	6.4	887.5	8.8	120.7
	Brox+Oxyfl	POST 1	0.187+0.0625									
9	Pendimethalin	POST 0 & 3	0.0625	126	4.9	43.2	769.6	99.2	0.0	916.9	6.4	99.8
	Brox / Oxyfl	POST 2 / 2a	0.375 / 0.125									
10	Pendimethalin	POST 0 & 3	0.0625	128	5.9	64.2	692.9	72.8	22.2	858.0	14.1	114.3
	Oxyfl / Brox	POST 2 / 2a	0.125 / 0.375									
11	Bromoxynil	PRE 2	0.25	129	2.9	73.1	726.9	77.6	14.3	894.8	1.4	119.8
	Pendimethalin	POST 0 & 3	0.412 & 0.625									
	Brox+Oxyfl	POST 2	0.375+0.125									
12	Pendimethalin	POST 0 & 3	0.625	127	6.8	86.0	675.9	51.7	6.1	826.5	4.5	118.0
	Brox+Oxyfl	POST 1	0.375+0.125									
13	Pendimethalin	POST 0 & 3	0.625	128	2.7	80.5	768.4	33.1	0.0	884.8	10.2	126.1
	Brox+Oxyfl	POST 2	0.375+0.125									
14	Pendimethalin	POST 0	0.625	126	0.7	102.3	645.5	70.3	0.0	818.8	12.0	114.4
	Brox+Oxyfl	POST 2	0.375+0.125									
	s-Metolachlor	POST 3	0.95									
15	Pendimethalin	POST 0	0.625	128	4.8	80.3	731.0	37.7	0.0	853.7	3.4	119.3
	Brox+Oxyfl	POST 2	0.375+0.125									
	s-Dimethenamid	POST 3	0.75									
16	Pendimethalin	POST 0	0.625	127	5.0	70.8	705.1	41.1	0.0	822.0	14.2	119.3
	Brox+Oxyfl	POST 2	0.375+0.125									
	Sulfentrazone	POST 3	0.14									
17	Pendimethalin	POST 0	0.625	128	8.2	132.3	556.8	42.4	0.0	739.6	3.2	118.9
	Sulfentrazone	POST 3	0.14									
18	Handweed check			127	3.2	69.7	588.3	69.9	20.0	751.0	11.6	106.6
19	Untreated check			126	25.6	155.0	94.4	0.0	0.0	275.0	2.5	77.1
	LSD (0.05)			4	8.0	66.6	155.6	61.7	22.4	144.6	20.4	23.8

Broadleaf weed control in onion sets. Hendrickson and Swanson. An experiment was conducted at the Carrington Research Extension Center to evaluate broadleaf weed control in onion sets. 'Vaquero' onion sets were hand-planted May 3, 2003 in 12-inch rows at 135,000 bulbs/A on 6-foot wide raised beds. The experimental design was a randomized complete block design with four replicates. Preemergence herbicide treatments were applied May 7 (48° F air, 42° F soil, 84 % RH, 7 mph, and 0% clouds) through XR 8003 flat fan nozzles delivering 20 gpa at 22 psi. Bromoxynil + oxyfluorfen at 0.375 + 0.125 lb/A was applied to 3-leaf onion May 26 (73° F air, 72° F soil, 28 % RH, 6 mph, and 0% clouds) through XR 11006 flat fan nozzles delivering 40 gpa at 30 psi. Post-emergence herbicide treatments were applied to 4-leaf onion May 31 (40° F air, 53° F soil, 92 % RH, 0 mph, and 0% clouds) through XR 8003 flat fan nozzles delivering 20 gpa at 22 psi. Best management practices were used for fertility and disease, insect, and grass control. All herbicide applications were applied with a CO_2 hand-boom sprayer. The onions were harvested September 17.

Table. Onion injury and yield, and broadleaf weed control.

			Onion						Weed control			
Trt[a]			Crop injury				# of	Split	Rrpw	Colq	Rrpw	Colq
No.	Treatment	Rate	5/23	6/10	Yield	Culls	bulbs	bulbs	7/30		9/5	
Preemergence		lb ai/A	%		cwt/A		1000's/A	%	%		Density/50 ft^2	
1	Mesatrione	0.187	35	89	41	21	11.6	6	75	81	9	5
2	Pendimethalin	0.625	0	9	259	118	59.9	5	86	89	13	8
3	Flufenacet	0.6	3	8	163	174	36.8	16	100	96	6	6
4	Acetochlor	1.75	5	11	164	237	36.8	33	99	98	6	4
5	Flumetsulam	0.5	3	23	56	21	47.6	2	85	90	12	9
6	Isoxaflutole	0.0312	0	21	132	96	42.9	9	66	77	13	7
7	Dacthal	0.096	0	8	344	274	34.0	26	88	91	8	4
8	Flumioxazin	0.096	10	15	288	208	55.1	12	100	100	2	0
9	Sulfentrazone	0.14	38	76	76	49	34.1	7	100	100	2	1
10	s-Dimethenamid	0.955	0	8	140	188	37.4	29	93	94	10	6
3-leaf stage												
11	Mesatrione	0.187	0	40	45	16	23.8	4	95	97	8	6
12	Flufenacet	0.6	3	11	140	225	36.1	28	97	99	4	2
13	Acetochlor	1.75	0	11	165	323	36.1	48	92	100	3	2
14	Flumetsulam	0.5	3	24	193	50	96.7	2	100	100	0	0
15	Isoxaflutole	0.0312	0	9	148	126	54.5	14	88	97	11	5
16	Dacthal	0.096	0	11	251	252	51.1	21	97	100	7	4
17	Flumioxazin	0.096	0	15	186	343	36.1	52	100	100	1	0
18	Sulfentrazone	0.14	0	33	135	114	59.2	7	100	100	0	0
19	s-Dimethenamid	0.955	3	8	203	203	50.4	13	100	98	5	3
20	Pendimethalin	0.625	0	13	206	275	43.6	31	71	84	10	7
21	Handweed check		0	0	176	249	49.0	23	100	100	0	0
22	Untreated check		0	0	50	13	36.8	-	0	0	688	488
LSD (P=.05)			5	8	133	115	22.8	26	15	12	20	38

[a]Trt's 1-20 included an application of bromoxynil+oxyfluorfen at 0.375+0.125 lb ai/A on May 26 to 3-leaf onion. Trt's 11-20 included a preemergence application of pendimethalin at 0.625 lb ai/A on May 7.

Sencor tank mixes in potato, Tappen, ND. Kegode and Ciernia. Research was conducted to evaluate weed control options in irrigated potato. Russet Burbank potato was planted in 36 in. rows on May 13 and hilled on June 10. PRE treatments were applied June 10 to the center 2 rows of plots using a 4-nozzle bicycle wheel sprayer equipped with XR8002 tips and delivering 17 gpa at 38 psi. At application, air temperature was 60 F, RH 57%, wind 4 mph N, sky overcast and soil surface dry. Any emerged potato plants were covered with soil by hand. POST treatments were applied June 30 to 16 in. potato using the same sprayer equipped with XR8001 tips and delivering 8.5 gpa at 34 psi. At application, air temperature was 85 F, RH 40%, wind 7 mph S, sunny sky and the plant surface moisture dry. Weeds present were 3-leaf green foxtail 1 to 2 in. tall and 3-leaf redroot pigweed 1 in. tall. Visual evaluations for crop injury were made June 24 and for weed control July 9 and July 22. The center 2 rows of each plot were harvested for graded yield Sept. 26. Maintenance insecticides and fungicides were applied as needed. Plots were 4 rows wide by 25 ft. long and the experiment was a randomized complete block design with 3 reps.

			June 24	July 9			July 22			Yield					
Treatment	Timing	Rate	Injury	Injury	Rrpw	Grft	Injury	Rrpw	Grft	<4 oz	4-6 oz	6-12 oz	12-16 oz	>16 oz	Total
		oz ai/A	%	%	% control		%	% control		cwt/A					
Untreated		0	0	0	0	0	0	0	0	16	83	177	100	5	381
Sencor+Outlook	PRE	12+10.24	0	1	99	99	0	99	99	12	83	190	111	8	405
Sencor+Spartan	PRE	12+2.67	0	0	99	99	0	99	99	11	101	182	92	15	401
Sencor+Valor	PRE	12+1	4	7	99	99	2	99	99	11	78	159	111	6	367
Sencor+Define	PRE	12+9	0	1	99	99	0	99	99	10	87	185	104	6	393
Sencor+DualII Mag	PRE	12+22	2	1	99	99	0	99	99	13	73	184	98	10	378
Sencor+DualII Mag+ Sencor	PRE POST	12+22+ 8	0	0	99	99	0	99	99	17	97	189	98	9	410
Sencor+Prowl+ Sencor+Matrix+NIS	PRE POST	12+11.88+ 8+0.25+0.125%	0	0	99	99	0	99	99	14	88	195	100	8	404
C.V. %			154	200	1	1	275	1	1	26	19	12	25	64	7
LSD 5%			2	NS	1	1	NS	1	1	NS	NS	NS	NS	NS	NS
# of Reps			3	3	3	3	3	3	3	3	3	3	3	3	3

Weed populations were relatively low (< 1/ft^2) consequently control of green foxtail and redroot pigweed was excellent. Sencor plus Valor (PRE) caused significant injury to potato, when compared to the untreated control, but this injury did not affect potato yield significantly.

Spartan and valor in potato, Tappen, ND. Kegode and Ciernia. Research was conducted on weed control in irrigated potato. Russet Burbank potato was planted in 36 in. rows on May 13 and hilled on June 10. PRE treatments were applied June 10 to the center 2 rows of plots using a 4-nozzle bicycle wheel sprayer equipped with XR8002 tips and delivering 17 gpa at 38 psi. At application, air temperature was 60 F, RH 57%, wind 4 mph N, sky overcast and soil surface dry. Any emerged potato plants were covered with soil by hand. POST treatments were applied June 30 to 16 in. potato using the same sprayer equipped with XR8001 tips and delivering 8.5 gpa at 34 psi. At application, air temperature was 85 F, RH 40%, wind 7 mph S, sky sunny and the plant surface moisture dry. Weeds present were 3-leaf green foxtail 1 to 2 in. tall and 3-leaf redroot pigweed 1 in. tall. Visual evaluations for crop injury were made on June 24 and for weed control on July 9 and July 22. The center 2 rows of each plot were harvested for graded yield on Sept. 24. Maintenance insecticides and fungicides were applied as needed. Plots were 4 rows wide by 25 ft. long and the experiment was a randomized complete block design with 3 reps.

			June 24	July 9			July 22			Yield					
Treatment	Timing	Rate	Injury	Injury	Rrpw	Grft	Injury	Rrpw	Grft	<4 oz	4-6 oz	6-12 oz	12-16 oz	>16 oz	Total
		oz ai/A	%	%	% control		%	% control		cwt/A					
Valor	PRE	1	0	3	99	96	1	99	96	10	57	233	74	8	380
Valor	PRE	1.5	3	9	99	96	4	99	98	11	47	210	100	5	373
Valor+Outlook	PRE	1+10.24	3	2	99	99	1	99	99	8	58	233	104	14	418
Valor+Outlook	PRE	1.5+10.24	5	7	99	99	4	99	99	7	49	230	84	17	387
Valor+Matrix+NIS	PRE+POST	1+0.25+0.25%	0	3	99	99	0	99	99	7	59	230	74	18	389
Spartan+Outlook	PRE	3+10.24	0	1	99	99	1	99	94	11	55	218	79	14	378
Spartan+Prowl	PRE	3+16.5	0	0	99	99	0	99	99	13	80	251	81	12	437
Spartan+Matrix+NIS	PRE+POST	3+0.25+0.25%	0	0	99	99	0	99	99	9	74	237	68	15	403
Sencor+Prowl	PRE	8+16.5	1	0	99	99	0	99	99	9	54	247	98	10	417
Untreated		0	0	0	0	0	0	0	0	10	58	253	99	13	432
C.V. %			152	71	1	2	148	1	3	27	19	18	31	54	16
LSD 5%			3	3	1	4	3	1	5	NS	19	NS	NS	NS	NS
# of Reps			3	3	3	3	3	3	3	3	3	3	3	3	3

Weed populations were relatively low (< 1/ft^2) that resulted in excellent control of green foxtail and redroot pigweed. Potato injury was detected among three treatments that included Valor, however no significant differences in yield were detected.

Weed control in irrigated potato with Matrix combinations. Harlene M. Hatterman-Valenti and Paul G. Mayland. A study was conducted at the Northern Plains Potato Grower's Association Irrigation Research site near Tappen, ND to evaluate PRE and POST Matrix and new products either tank-mixed or applied sequentially for crop safety and weed control in Russet Burbank potato. The study was conducted on loamy sand soil with 1.8% organic matter and 7.6 pH. Sudangrass was grown during 2002 and an alfalfa/brome mixture cropped for hay prior to 2002. Plots were 4 rows by 30 ft arranged in a randomized complete block design with three replicates. Seed pieces (2 oz) were planted on 36 inch rows and 12 inch spacing on May 12, 2003. Treatments were applied to the middle 2 rows. Methylated seed oil at 1% v/v was used with all POST applications. In addition, ammonium sulfate at 17 lb/100 gal was added to Matrix + Eptam. Crop injury and weed control were evaluated 28 and 49 days after treatment. Water was not limiting as irrigation was scheduled every 3 to 4 d once potato had emerged following hilling. Potato were machine harvested September 30 and graded by October 14. Application, environmental, crop, and weed data are listed below:

Date:		6/10/03	7/1/03
Treatment:		PRE	POST
Sprayer:	gpa:	15	15
	psi:	30	30
	nozzle:	8002	8002
Temperature:	Air (F):	56	82
	Soil (4 inch):	61	84
Rel. hum. (%):		82	59
Wind (mph):		6	9
Soil moisture:		adequate	adequate
Cloud cover (%):		5	10
Potato:	Height (inch):	0	14

Green and yellow foxtail, common lambsquarters, redroot pigweed, and wild buckwheat were present in the trial. Unfortunately, weed populations in the untreated control and border check areas were insufficient for meaningful weed control data. However, the Matrix + Eptam treatment had some common lambsquarters and foxtail, especially in one replicate. The presence of these weeds may have influenced yield.

Treatments with Valor caused significant potato injury at both evaluations (Table 1). Injury consisted of necrotic lesions near the stem base and plant stunting. Potato yield and grade indicated that the herbicide injury did result in fewer tubers that were at least 6 oz and lowered the total marketable yield. However, only Matrix + Valor PRE significantly reduced total marketable yield in comparison to Outlook PRE + Matrix POST, the highest yielding treatment.

Table 1. Potato injury, grade and yield following Matrix combinations.

	Application		Crop injury		Hollow	Yield				Specific
Treatment	method	Rate	7/8	7/29	heart	4–6 oz	6–12 oz	> 12 oz	US #1	gravity
		(oz ai/A)		%				cwt/A		
Matrix + Outlook	PRE	0.38+10.6	2	0	17	66	184	156	413	1.0888
Matrix + Valor	PRE	0.38+1.5	10	7	17	60	168	124	364	1.0851
Matrix + Spartan	PRE	0.38+1.5	6	0	17	70	198	140	416	1.0882
Matrix + Sencor	PRE	0.38+8	4	0	17	72	206	142	432	1.0889
Outlook + Matrix	PRE+POST	10.6+0.38	6	2	33	60	174	200	449	1.0875
Valor + Matrix	PRE+POST	1.5+0.38	11	8	33	86	158	148	403	1.0866
Spartan + Matrix	PRE+POST	1.5+0.38	4	0	17	62	190	172	436	1.0870
Matrix + Eptam	POST	0.38+14	0	0	33	60	164	148	392	1.0877
Sencor	PRE	10.2	4	0	17	52	172	166	399	1.0902
Untreated			0	0	17	72	174	126	383	1.0877
LSD (P=0.05)			3	2	20	40	62	54	84	0.0067

Valor on irrigated potato. Harlene M. Hatterman-Valenti and Paul G. Mayland.
A study was conducted at the Northern Plains Potato Grower's Association Irrigation Research site near Tappen, ND to determine the effect of Valor on growth, processing and storage properties on Russet Burbank potato. The study was conducted on loamy sand soil with 1.8% organic matter and 7.6 pH. Sudangrass was grown during 2002. Prior to 2002, an alfalfa/brome mixture was cropped for hay. Plots were four rows by 30 ft arranged in a randomized complete block design with three replicates. Seed pieces (2 oz) were planted on 36 inch rows and 12 inch spacing on May 12. Herbicides were applied to the middle two rows immediately following hilling using a CO_2 sprayer.

Application Date:	June 4	Sprayer:	CO_2 backpack
Time of Day:	17:20		
Air Temperature (F):	72	gpa:	15
% Relative Humidity:	70	psi:	30
Wind Velocity (MPH):	5.4	nozzle:	11002
Dew Presence (Y/N):	N		
Soil Temperature (F):	68		
Soil Moisture:	Adequate		
% Cloud Cover:	100		

Valor at 4X (6 oz/A) caused small necrotic lesions near the plant stem base and noticeable stunting throughout the growing season. The addition of Outlook did not significantly change the phytotoxicity. Injury appeared to delay maturity. Potatoes in the Valor treated plot were greener than those in the Sencor + Outlook plots in early September.

Herbicides did not affect the number of potatoes with knobs, growth cracks (culls) or hollow heart. There was significant difference between the high rate of Valor alone and Valor + Outlook compared to Sencor + Outlook on specific gravity. Marketable yield was also reduced when the 4X rate of Valor alone or with Outlook was applied. This was attributed to fewer tubers weighing at least 6 ounces.

			Injury			Yield						Spec
Treatment	Product rate	Height	June 26	July 15	Sept 4	<4 oz	4-6 oz	6-12 oz	> 12 oz	US#1	Culls	grav
		(in.)		%				cwt/A				
Valor	3 oz/A	13 a	11 b	10 b	54 a	17 a	54 a	169 abc	151 a	374 a	24 a	1.088 ab
Valor	6 oz/A	11 b	34 a	23 a	66 a	16 a	66 a	140 c	99 b	305 b	23 a	1.085 bc
Valor	3 oz/A	13 a	14 b	6 bc	70 a	20 a	70 a	163 abc	131 ab	363 a	25 a	1.084 c
Outlook	14 fl oz/A											
Valor	6 oz/A	10 c	35 a	28 a	53 a	17 a	53 a	142 bc	98 b	293 b	20 a	1.084 c
Outlook	14 fl oz/A											
Sencor DF	11 oz/A	13 a	3 c	2 cd	76 a	19 a	76 a	186 a	147 a	408 a	23 a	1.089 a
Outlook	14 fl oz/A											
Handweeded		13 a	0 c	0 d	75 a	17 a	75 ab	175 ab	152 a	402 a	21 a	1.087 abc

Means followed by same letter do not significantly differ (P=.05, LSD)

Cultivation timing in potato, Fargo, ND. Kegode and Ciernia. This study compared PRE treatments with and without cultivation for weed control in nonirrigated potato. The timing of the cultivations was determined by the prediction model *WeedCast* which was used to simulate emergence of redroot pigweed (Rrpw). Red Norland potato was planted May 27 in 36 in. rows. Half the treatments received a PRE application of 4 oz .ai. Sencor plus 0.375 oz. ai. Matrix. These treatments were applied May 28 using a 4-nozzle bicycle wheel sprayer equipped with XR8002 tips and delivering 17 gpa at 38 psi. At application, air temperature was 77 F, RH 31%, wind 6 mph NW, sky clear and soil surface dry. Cultivation treatments consisted of two passes using a potato cultivator/hiller. Cultivation timings were on June 16 (15% Rrpw emergence), July 7 (30% Rrpw emergence), and July 17 (60% Rrpw emergence) and designated plots were cultivated: (i) three times at 15, 30, and 60% Rrpw predicted emergence; (ii) two times at 30 and 60% predicted Rrpw emergence; and (iii) one time at 60% predicted Rrpw emergence. Weed control evaluations were made July 28 and August 13. The center 2 rows of each plot were harvested for total yield Sept. 16. Maintenance insecticides and fungicides were applied as needed. Plots were 4 rows wide by 25 ft. long and the experiment was a split plot design in a randomized complete block with 4 reps. The whole plot was cultivation timing and the subplot was with or without herbicide.

			July 28			August 13		
Treatment[a]	Timing[b]	Rate	Fxtl	Rrpw	Wimu	Fxtl	Rrpw	Yield
		oz ai/A	---------- % control ----------					cwt/A
Cultivation only	0	0	0	0	0	0	0	12
Herbicide only	PRE	4+0.375	40	51	80	33	51	38
Cultivation only	15,30,60	0	71	38	45	76	45	45
Herbicide+Cultivation	PRE+15,30,60	4+0.375	94	99	99	95	99	49
Cultivation only	30,60	0	28	19	32	33	26	31
Herbicide+Cultivation	PRE+30,60	4+0.375	65	64	83	67	72	39
Cultivation only	60	0	23	15	18	30	18	23
Herbicide+Cultivation	PRE+60	4+0.375	58	72	96	64	74	41
C.V. %			42	46	34	42	38	53
LSD 5%			29	30	34	31	27	NS
# of Reps			4	4	3	4	4	4

[a] Cultivation = two passes with a potato cultivator/hiller; Herbicide = Sencor plus Matrix

[b] Cultivation treatments were applied at 15, 30, and 60% predicted redroot pigweed emergence; Herbicide applied preemergence to crop and weeds.

PRE herbicide plus three cultivations at 15, 30, and 60% predicted Rrpw emergence resulted in the highest control of redroot pigweed and foxtail on August 13 when compared with cultivation only and herbicide only treatments. Herbicide improved overall weed control for all cultivation treatments. Monthly precipitation received during the study was: 4.17 in. (June), 1.42 in. (July), 0.72 in. (August), and 1.15 in (September). Because precipitation was low during the tuber bulking period yields were relatively low.

Aim as a desiccant on dryland and irrigated potato. Harlene M. Hatterman-Valenti and Paul G. Mayland.

A study was conducted at the Northern Plains Potato Grower's Association Irrigation Research site near Tappen, ND and the NDSU research site near Prosper, ND to evaluate desiccation with Aim and effects on potato quality following storage. The study near Tappen was conducted on loamy sand soil with 1.6% organic matter and 7.2 pH. Sudangrass was grown during 2002 and an alfalfa/brome mixture cropped for hay prior to 2002. The study near Prosper was conducted on a clay loam soil with 3.2% O. M., 6.4 pH, and spring wheat as the previous crop. Plots were 4 rows by 30 ft arranged in a randomized complete block design with three replicates. Russet Burbank (Tappen) and Red Norland (Prosper) seed pieces (2 oz) were planted on 36 inch rows and 12 inch spacing on May 12 and May 26, respectively. Desiccants were applied to the middle 2 rows using a CO_2 sprayer equipped with 8002 flat fan nozzles with a spray volume of 20 GPA and a pressure of 30 psi. Plots were harvested September 18 and October 6 at Prosper and Tappen, respectively.

	Prosper		Tappen	
Application Date:	Aug 21	Aug 29	Sept 4	Sept 12
Time of Day:	11:00	9:30	13:00	8:45
Air Temp.(F):	69	53	78	59
% Rel. Humidity:	61	83	28	63
Wind Velocity(MPH):	11	6.3	11	6
Dew Presence (Y/N):	N	N	N	N
Soil Temp.(F):	75	66	73	65
Soil Moisture:	Inadequate	Inadequate	Adequate	Adequate
% Cloud Cover:	2	30	2	95

Aim alone had slower burndown than reglone or reglone followed by aim. However, by 15 days after application (DAA) all desiccants had similar leaf and stem necrosis. Little grade or yield differences occurred between treatments. Fry samples, dark end and reducing sugar concentrations are currently being conducted on samples with repeat testing following five months of storage.

			7 DAA		15 DAA		Yield					Skin		Specific
Treatment	Rate	Unit	Leaf necrosis	Stem necrosis	Leaf necrosis	Stem necrosis	<4 oz	4-6 oz	6-12 oz	12-16 oz	US#1	set	Culls	gravity
Prosper			%				cwt/A					psi	cwt/A	
Aim	3.2	fl oz/a	82 b	25 b	100 a	98 a	40 a	85 b	226 a	14 a	325 ab	69 a	5 a	1.076 a
MSO	1	% v/v												
Aim	3.2	fl oz/a												
MSO	1	% v/v												
Reglone	2	pt/a	90 a	35 a	100 a	98 a	38 a	97 ab	215 a	8 a	320 b	71 a	4 a	1.077 a
NIS	0.25	% v/v												
Aim	3.2	fl oz/a												
MSO	1	% v/v												
Reglone	2	pt/a	86 ab	40 a	99 a	99 a	40 a	95 ab	215 a	11 a	321 ab	69 a	5 a	1.077 a
NIS	0.25	% v/v												
Reglone	2	pt/a												
NIS	0.25	% v/v												
Untreated			12 c	0 c	32 b	15 b	44 a	99 a	243 a	11 a	353 a	74 a	4 a	1.077 a
Tappen														
Aim	3.2	fl oz/a	78 b	60 b	94 a	93 a	13 a	87 a	185 a	119 ab	399 a		2 a	1.085 ab
MSO	1	% v/v												
Aim	3.2	fl oz/a												
MSO	1	% v/v												
Reglone	2	pt/a	95 a	76 a	97 a	94 a	15 a	83 a	180 a	117 ab	386 a		2 a	1.081 b
NIS	0.25	% v/v												
AIM	3.2	fl oz/a												
MSO	1	% v/v												
Reglone	2	pt/a	93 a	76 a	97 a	95 a	13 a	97 a	165 a	100 b	368 a		2 a	1.084 ab
NIS	0.25	% v/v												
Reglone	2	pt/a												
NIS	0.25	% v/v												
Untreated			14 c	4 c	44 b	26 b	15 a	91 a	174 a	142 a	414 a		3 a	1.086 a

Means followed by same letter do not significantly differ (P=.05, LSD)

ET as a dessicant on potato. Harlene M. Hatterman-Valenti and Paul G. Mayland.
A study was conducted at the Northern Plains Potato Grower's Association Irrigation Research site near Tappen, ND to determine the effect of split applications of ET 2.5% EC and ET 10% OD in comparison to a commercial standard for potato desiccation. The study was conducted on loamy sand soil with 1.8% organic matter and 7.6 pH. Sudangrass was grown during 2002. Prior to 2002, an alfalfa/brome mixture was cropped for hay. Plots were four rows by 30 ft arranged in a randomized complete block design with three replicates. Seed pieces (2 oz) were planted on 36 inch rows and 12 inch spacing on May 12. Desiccants were applied to the middle two rows using a CO_2 sprayer with a seven day interval for split applications.

Application Date:	Sept 4	Sept 12
Sprayer:		
gpa:	15	15
psi:	30	30
nozzle:	8002	8002
Time of Day:	12:30	8:30
Air Temp.:	76 F	59 F
% Relative Hum.:	35	62
Wind Velocity:	11 MPH	6 MPH
Dew Presence (Y/N):	N	N
Soil Temp.:	71 F	65 F
Soil Moisture:	adequate	adequate
% Cloud Cover:	2	95

ET 2.5% EC provided quicker and better vine and leaf desiccation than the 10% OD formulation. The higher the rate of ET provided better the desiccation after the first application. The single application of ET at 5.5 oz/A gave equivalent or better burndown compared to split applications. All were equal in burndown 20 days after application (DAA).

No.	Treatment	Product rate	8DAA Leaf necrosis	8DAA Stem necrosis	15DAA Leaf necrosis	15DAA Stem necrosis	22DAA Leaf necrosis	22DAA Stem necrosis
			---------- % ----------					
1	ET 2.5% EC	2.7 oz/A	47 c	8 c	78 b	47 bc	95 a	88 ab
	Dynamic(COC)	1 %v/v						
	ET 2.5% EC	2.7 oz/A						
	Dynamic(COC)	1 %v/v						
2	ET 10% OD	0.7 oz/A	23 d	5 cd	60 c	38 c	89 b	80 b
	Dynamic	1 %v/v						
	ET 10% OD	0.7 oz/A						
	Dynamic	1 %v/v						
3	ET 2.5%	4.1 oz/A	65 b	17 b	87 ab	52 b	93 ab	91 ab
	Dynamic	1 %v/v						
	ET 2.5%	2.7 oz/A						
	Dynamic	1 %v/v						
4	ET 2.5%	5.5 oz/A	68 b	22 b	85 b	48 b	95 a	90 ab
	Dynamic	1 %v/v						
	Request(AMS)	2 qt/A						
5	Reglone	24 oz/A	82 a	35 a	96 a	75 a	97 a	97 a
	L-77	38 oz/A						
	Reglone	24 oz/A						
	L-77	38 oz/A						
6	UNTREATED		2 e	0 d	8 d	3 d	38 c	20 c

Means followed by same letter do not significantly differ (P=.05, LSD)

SPARTAN ON SAFFLOWER

Spartan on safflower, Williston 2003. (Riveland and Bradbury) 'Montola 2003' safflower was planted on fallowed land in 6-inch rows at 40 lbs/a on June 1. The PPI treatments were applied on June 1 with 54 F, 80% RH, 60% clear sky and 4-5 mph E wind and dry topsoil at 56 F. Treatments were incorporated first with a triple-K having roller baskets working parallel to the treatment application. The second incorporation was perpendicular to the treatment application with a multi-weeder and all plots were worked in this manner. The PE treatments were applied June 4 with 54 F, 86% RH, 0% clear sky and 4-5 mph SW wind with a damp soil surface and a 4 inch temperature of 60 F. We used a small plot sprayer with wind cones, mounted on a G-Allis Chalmers tractor to apply the treatments, delivering 20 (for the PPI treatments) and 10 gals/a (for the PE treatments) at 40 psi through 8002 and 8001 flat fan nozzles, respectively, to a 6.67 ft wide area the length of 10 by 25 ft plots. First rain received after PPI application was 0.01 inches on June 1 and 2 and 0.05 on June 4 after PE applications with 0.39 inches recorded on June 5. The experiment was a randomized complete block design with four replications. Stand counts were taken on June 27; two three foot squares per plot or a total of 18 ft2. Weed control ratings were on July 19. Only green foxtail was present with a density of 30-40 plts/ft2. Safflower was machine harvested on September 22.

Treatment	Type	Product Rate	Grft Ctrl	Test Weight	Yield	Seed Oil	Stand	Stand in
		oz/a	%	lbs/bu	lbs/a	%	#/ft2	% of ck
Treflan 4EC	PPI	32.0	98	39.8	1093	36.3	9.8	98
Sonalan 3EC	PPI	32.0	99	39.4	1107	35.2	10.5	106
Sonalan 3EC	PPI	42.7	98	39.7	1046	35.7	10.1	101
Spartan 75WGF	PE	2.0	28	39.0	479	35.6	10.0	101
Spartan 75WGF	PE	2.7	78	39.4	796	36.4	8.9	89
Spartan 75WGF	PE	3.3	70	39.4	734	36.3	8.1	81
Spartan 75WGF	PE	4.0	78	39.8	756	36.8	7.8	78
Spartan 75WGF	PE	5.3	91	38.7	468	36.8	6.2	62
Weedy Check		0.0	0	39.0	551	36.3	10.0	100
EXP MEAN			71	39.4	781	36.2	9.0	
C.V. %			15	3.3	21	2.1	15.7	
LSD 5%			15	NS	239	NS	2.1	

Summary: Spartan applied PE to safflower caused significant stand losses of22% and 38% at the highest application rates - 4 and 5.3 oz/a product. Corresponding yield losses were 31% and 57% compared to the Treflan treatment. Lower rates of Spartan tended to reduce safflower stands and yield also, the exception being the lowest application rate (2 oz/a product), which did not reduce safflower stands but did not control green foxtail.

BROADLEAF WEED CONTROL IN SAFFLOWER

Broadleaf weed control in safflower, Williston 2003. (Riveland and Bradbury)'Finch' safflower was planted notill on land cropped to hrw wheat in 2002 using 7 inch rows at 30 lbs/a on April 30. The treatments were applied on June 13 to 6 to 8-leaf safflower, prostrate pigweed 1-2 inches and Russian thistle 1-3 inches with 79 F, 32% RH, 95% clear sky and 2-4 mph SSE wind and damp topsoil at 74 F but dry plant surfaces. 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 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 0.38 inches on June 21. The experiment was a randomized complete block design with four replications. Plots were evaluated for crop injury and Russian thistle control on June 29 and September 4. Prostrate pigweed control was rated only on September 4. Russian thisle density averaged 1 plant/2ft2. Prostrate pigweed density averaged 1 plant/ft2. Safflower was machine harvested on September 4.

Treatment[a]	Rate Product	6-29 Crop	9-4 Injury	6/29 Ruth	9/4 Prpw	9/4 Ruth	Test Wght	Yield	Seed Oil
	oz/a			%	%	%	lbs/bu	lbs/a	%
Harmony GT+NIS	0.167+0.25%	3	3	93	97	91	43	581	34
Harmony GT+NIS	0.20+0.25%	3	0	94	98	93	44	528	34
Harmony GT+NIS	0.25+0.25%	9	1	97	99	96	43	624	34
Harmony GT+NIS	0.3+0.25%	5	3	99	99	98	43	509	33
Harmony GT+NIS	0.4+0.25%	13	13	97	98	95	44	436	33
Glean+NIS	0.2+0.25%	15	6	99	98	96	43	523	33
Ally+NIS	0.08+0.25%	23	15	99	98	99	43	457	33
Harmony GT+Glean+NIS	0.17+0.17+0.25%	8	4	98	99	97	43	487	33
Harmony GT+Glean+NIS	0.2 +0.2+0.25%	6	5	94	98	97	43	498	33
Tough	24	41	39	80	69	36	43	368	33
Upbeet	0.25	0	0	0	23	0	43	544	33
Upbeet	0.5	1	3	26	15	25	42	460	33
Upbeet+Harmony GT+NIS	0.5+0.167+0.25%	3	1	94	95	98	44	517	33
Weedy Check	0.0	0	0	0	0	0	42.1	481	33
EXP MEAN		9	7	76	78	73	43.0	501	33
C.V. %		101	100	10	19	10	1.7	18	1.2
LSD 5%		13	9	10	22	10	1.0	126	.6

[a] - NIS Non ionic surfactant - Activator 90

Summary: Triflusulfuron (Upbeet) and Pyridate (Tough) did not adequately control Russian thistle or prostrate pigweeed. Pyridate significantly injured safflower while Triflusulfuron had no injurious affect. The combination of Triflusulfuron and thifensulfuron gave good weed control. Chlorsulfuron (glean), metsulfuron (Ally) and the highest application rate of thifensulfuron also cause significant crop injury but gave excellent control of weeds present.

GRASSY WEED CONTROL IN SAFFLOWER

Grassy weed control in safflower, Williston 2003. (Riveland and radbury)
'Montola 2003' safflower was planted notill on recrop land (cropped to durum wheat in 2002) in 7 inch rows at 30 lbs/a on April 30. The treatments were applied on June 14 to 5 to 7-leaf safflower, green foxtail 2-6 leaf and volunteer durum from 4-lf to boot with 63 F, 72% RH, 95% clear sky and 4-6 mph SE wind with dry topsoil at 61 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 8.5 gals/a at 30 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 0.38 inches on June 21. The experiment was a randomized complete block design with four replications. Plots were evaluated for crop injury and weed control on June 26 and again on September 4 for weed control. Green foxtail density ranged from 20-25 plants/ft2. Volunteer durum had an average density of 3 plants/ft2. Safflower was machine harvested on September 6.

Treatment[a]		Rate Product	Grft	Vodu	Vodu	Test Weight	Yield	Seed Oil
		oz/A	%	%	%	lbs/bu	lbs/a	%
Poast+PO	1.5EC	8+1%	83	74	53	40.1	718	37.2
Poast+PO	1.5EC	16+1%	86	79	80	39.5	852	36.8
Poast+MSO	1.5EC	8+0.5%	84	84	76	39.6	865	35.8
Select+PO	2EC	4+1%	75	85	69	39.4	840	36.7
Select+PO	2EC	6+1%	80	87	90	39.6	843	36.3
Select+PO	2EC	8+1%	90	89	97	39.8	899	36.4
Select+PO	2EC	12+1%	94	93	99	39.5	890	36.1
Assure II+PO	0.88EC	7+1%	92	94	99	39.6	825	36.0
Assure II+PO	0.88EC	8+1%	95	96	99	39.5	884	36.2
Untreated		0	0	0	0	40.6	517	36.7
EXP MEAN			78	78	76	39.7	813	36.4
C.V. %			8	9	6	0.9	9	1.2
LSD 5%			9	10	6	0.5	104	0.6

[a] PO = Petroleum Oil Concentrate; Herbimax from Loveland
MSO = Methylated Seed Oil; MSO from Loveland

Summary: No crop injury was noted for any treatment at any time. All treatments resulted in yield increases when compared to the weedy check. Poast treatments and the 4 oz/a Select treatment gave the lowest control of both green foxtail and volunteer durum.

Clethodim formulations in sunflower. Zollinger, Richard K. and Jerry L. Ries. An experiment was conducted near Prosper, ND, to evaluate grass control with clethodim formulations applied POST. Wheat, to simulate a volunteer crop was spread and tilled, followed by planting Pioneer '03BM0024' sunflower on May 29, 2003. POST treatments were applied on June 30 at 11:45 am with 79 F air, 85 F soil surface, 50% relative humidity, 10% clouds, 5 to 8 mph S wind, dry soil surface, moist subsoil, good crop vigor, and no dew present to V6 to V8 sunflower. Weed species present were: 3 to 8 inch (50 to 75/ft^2) yellow foxtail; and 4 to 6 inch (15 to 25/yd^2) volunteer wheat. Treatments were applied to the center 6.7 feet of the 10 by 25 foot plots with a backpack-type plot sprayer delivering 8.5 gpa at 40 psi through 8001 flat fan nozzles. The experiment had a randomized complete block design with four replicates per treatment.

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

		July 14		July 28	
Treatment[1]	Rate	Wheat	Yeft	Wheat	Yeft
	(product/A)	(%)	(%)	(%)	(%)
Clethodim+PO	6fl oz	89	79	99	99
Clet+Express+PO	6fl oz+0.25oz	70	70	80	75
Clet(V-10117)+PO	6fl oz	96	91	99	99
Clet(V-10117)+Express+PO	6fl oz+0.25oz	76	71	86	81
Clet(V-10137)+PO	13fl oz	94	88	99	99
Clet(V-10137)+Express	13fl oz+0.25oz	85	80	98	96
Clet(V-10137)+Express+PO	13fl oz+0.25oz	76	74	94	92
Clet(V-10139)+PO	8fl oz	95	85	99	99
Clet(V-10139)+Express+PO	8fl oz+0.25oz	60	58	75	70
Clet(Arrow)+PO	6fl oz	92	93	96	96
Clet(Arrow)+Express	6fl oz+0.25oz	50	50	60	50
Clet(Arrow)+Express+PO	6fl oz+0.25oz	75	68	90	79
Assure II+PO	8fl oz	90	80	97	94
Assure II+Express+PO	8fl oz+0.25oz	74	64	96	87
Untreated		0	0	0	0
LSD (0.05)		6	6	3	4

[1]Clethodim = Select unless otherwise noted with trade or experimental number in parenthesis; PO = petroleum oil = Herbimax at 1% v/v; 'V' compounds are proprietary experimental herbicides from Valent; clethodim (Arrow) = Makhteshim Agan.

Express-resistant sunflower is in development and may be registered in 2005. Express controls many broadleaf weeds but antagonizes most postemergence grass herbicides. Large, well-tillered wheat and yellow foxtail were used to measure herbicide compatibility and potential antagonism of clethodim formulations and Assure II applied with Express. Experimental formulations of clethodim (V-101xx) contain a lower active ingredient and higher adjuvant load than the commercial formulation (Select or Arrow). Express antagonized all clethodim formulations and Assure II, except V-10137. Express with V-10137 without PO gave similar grass control as V-10137 applied with PO. V-10137 applied with Express without PO gave 98% wheat control and 96% yellow foxtail control, compared to 94% and 92%, respectively when PO was added. It appears that the V-10137 clethodim formulation contains an adjuvant load necessary to control grasses and overcome Express antagonism without adding an oil adjuvant. No Express-resistant sunflower injury was observed with any treatment. (Dept. of Plant Sciences, North Dakota State University, Fargo).

Imidazolinone-resistant sunflower response to soil residues of ALS-inhibiting herbicides. (Kirk Howatt, Ronald Roach, Janet Davidson-Harrington). 'Mycogen 8N 429 CL' imidazolinone- (IMI-) resistant sunflower was seeded May 22 at Fargo and May 30 at Casselton, North Dakota. Preemergence treatments were applied at Fargo on May 23 with 57° F, 53% relative humidity, clear sky, 12 mph southeast wind, and soil temperature of 53° F. Preemergence treatments were applied at Casselton on June 4 with 58° F, 60% relative humidity, cloudy sky, 7 mph south wind, and soil temperature of 60° F. Treatments were applied with a backpack sprayer delivering 8.5 gpa at 35 psi through 8001 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. Imazamox was applied post emergence to the entire study area to control broadleaf and grass weeds.

Table 1. Imidazolinone-resistant sunflower response to soil residues of ALS-inhibiting herbicides, Fargo.

		Jun 13			Jul 1		Jul 14	Oct 27
Treatment	Rate	Chlorosis	Stunt	Population	Chlorosis	Stunt	Sunflower	Yield
	oz/A	%		Plt/10m	%			lb/A
Imazethapyr	0.5	0	0	47	0	0	0	1250
Imazethapyr	0.25	0	0	36	0	0	0	1160
Imazethapyr	0.12	0	0	43	0	0	0	1210
Metsulfuron	0.06	0	0	42	0	0	0	1210
Metsulfuron	0.03	0	0	44	0	0	0	1150
Metsulfuron	0.015	0	0	47	0	0	0	1280
Flucarbazone	0.42	0	0	52	0	0	0	1290
Flucarbazone	0.21	0	0	48	0	0	0	960
Flucarbazone	0.1	0	0	45	0	0	0	1150
Sulfentrazone	3	0	0	53	0	0	0	1060
Untreated	0	0	0	43	0	0	0	1190
LSD (P=0.05)		0	0	11	0	0	0	380
CV		0	0	16	0	0	0	23

Table 2. Imidazolinone-resistant sunflower response to soil residues of ALS-inhibiting herbicides, Casselton.

		Jun 20		
Treatment	Rate	Chlorosis	Stunt	Population
	oz/A	%		Plts/10m
Imazethapyr	0.5	0	0	33
Imazethapyr	0.25	0	0	40
Imazethapyr	0.12	0	0	36
Metsulfuron	0.06	0	0	38
Metsulfuron	0.03	0	0	37
Metsulfuron	0.015	0	0	41
Flucarbazone	0.42	0	0	32
Flucarbazone	0.21	0	0	39
Flucarbazone	0.1	0	0	37
Sulfentrazone	3	0	0	30
Untreated	0	0	0	36
LSD (P=0.05)		0	0	10
CV		0	0	20

Soil condition and moisture at seeding resulted in emergence and establishment problems (Tables 1 and 2) resulting in lower plant population than desired. Lower population combined with significant Canada thistle competition resulted in diminished seed yield (Table 1). Soil residues of ALS-inhibiting herbicides did not cause visible chlorosis or stunting, and plant populations were not different in herbicide-treated plots compared with untreated (Tables 1 and 2). Yield did not differ among treatments (Table 1). The study at Casselton was terminated mid-season because of environment effect on sunflower. Previous greenhouse experiments showed that incorporation of these herbicides at the middle rate included in this study caused measurable sunflower injury. This research showed that reseeding with IMI-resistant sunflower after ALS-inhibiting herbicides had been applied was safe. The level of safety likely is dependent on non-incorporation of herbicide residues. Herbicide-resistant sunflower seed technologies may provide flexibility to reseed sunflower after a crop failure when ALS-inhibiting herbicides have been applied.

Crop response and weed control in imidazolinone-resistant sunflower, Carrington, 2003. (Endres and Howatt) Crop response and weed control were investigated with selected PRE and POST herbicides in imidazolinone-resistant (Clearfield™) sunflower. PRE imidazolinone and sulfonylurea herbicides were selected to simulate impact of soil residue on the sunflower. The trial had a randomized complete block design with four replicates. The experiment was conducted on a loam soil with 6.8 pH and 3.1% organic matter at the NDSU Carrington Research Extension Center. The trial area was tilled with a Melroe culti-harrow on May 21. Herbicide treatments were applied to 10 by 30 ft plots with a CO_2 pressurized hand-held plot sprayer at 17 gal/A and 35 psi through 8002 flat fan nozzles. PPI treatments were applied on a dry soil surface on May 22 with 72 F, 20% RH, 65% clear sky, and 5 mph wind, and immediately incorporated twice with the culti-harrow at a 2- to 3-inch depth. Mycogen '8N429CL' was planted on May 22 in 30-inch rows. PRE treatments were applied on a dry soil surface on May 22 with 71 F, 20% RH, 85% clear sky, and 6 mph wind. Rainfall totaled 1.10 inches during May 22 to June 9. POST treatments were applied on June 27 with 55 F, 96% RH, 50% clear sky, and 5 mph wind to V8-stage sunflower, 1-leaf to 2-tiller green and yellow foxtail, jointing wild oat, and 1- to 4-inch tall broadleaf weeds. Clethodim at 0.13 lb/A + MSO at 2 pt/A was applied on July1 to plots with PRE treatments and untreated checks. The trial was harvested with a plot combine on October 21.

Sunflower stand and seed yield did not differ among treatments (Table 1). Sunflower plant chlorosis (data not shown) and early height reduction was not detected with PRE treatments. Minor plant stunting was noted with PPI and POST treatments and later in the season with PRE treatments. Lack of crop response with PRE treatments may have been due to delayed rainfall after herbicide application. High rates of imazethapyr and metsulfuron provided excellent control of pigweed. Wild buckwheat control ranged from 79 to 89% control with PPI pendamethalin+imazethapyr at 0.52+0.031 lb/A (Table 2). Ethafluralin/imazamox provided excellent weed control. PRE pendimethalin/imazamox provided good to excellent broadleaf control.

Table 1. Imidazolinone-resistant sunflower response to herbicides.

Herbicide			Stand		Plant stunting[1]			Seed
Treatment[2]	Rate	Timing	6/13	7/25	2	4	8	yield
	ai/A		plants/A		%			lb/A
Imazethapyr	0.5 oz	PRE	22325	18332	0	0	3	1901
Imazethapyr	0.25 oz	PRE	25229	23595	0	0	0	1537
Imazethapyr	0.125 oz	PRE	18332	18332	0	0	0	1702
Metsulfuron	0.06 oz	PRE	18695	17243	0	0	12	1281
Metsulfuron	0.03 oz	PRE	21599	21780	0	0	0	1516
Metsulfuron	0.015 oz	PRE	18876	18150	0	0	1	1634
Flucarbazone	0.42 oz	PRE	20510	20691	0	0	6	1495
Flucarbazone	0.21 oz	PRE	23232	22143	0	0	0	1686
Flucarbazone	0.105 oz	PRE	22506	21417	0	0	0	1557
Sulfentrazone	3 oz	PRE	18332	17969	0	0	8	1596
Pendimethalin/Imazamox+NIS+UAN	0.98 lb/0.031 lb	PRE/ POST	18876	19239	15	5	x	1562
Ethafluralin/Imazamox+NIS+UAN	1.1 lb/0.031 lb	PPI/ POST	21962	21417	10	0	x	1563
Pendamethalin+Imazethapyr	0.52 lb+0.031 lb	PPI	23777	23414	3	0	x	1254
Imazamox+NIS+UAN	0.031 lb	POST	23232	23051	15	5	x	1074
untreated check	x	x	17061	16335	0	0	0	1239
LSD (0.05)			NS	NS	8	NS	NS	NS

[1]PRE=wk after sunflower emergence; POST=wk after application.

[2]NIS=Preference, a nonionic surfactant from Agriliance, St. Paul, MN, at 0.25% v/v; UAN at 2.5% v/v.

Table 2. Weed control in imidazolinone-resistant sunflower.

Herbicide			July 14, 2003				July 25, 2003				
Treatment[1]	Rate	Timing	grass[2]	piwe[3]	wibw	smwe	fota[4]	wioa	piwe	wibw	smwe
	lb/A		% control								
Pendimethalin/ Imazamox+NIS+UAN	0.98/0.031	PRE/ POST	78	99	95	99	76	97	98	83	92
Ethafluralin/ Imazamox+NIS+UAN	1.1/0.031	PPI/ POST	96	99	99	91	95	98	99	99	97
Pendamethalin+ Imazethapyr	0.52+0.031	PPI	77	99	89	75	76	78	99	79	88
Imazamox+NIS+UAN	0.031	POST	72	82	65	82	74	90	90	69	92
LSD (0.05)			7	3	13	NS	6	12	7	13	NS

[1]NIS=Preference, a nonionic surfactant from Agriliance, St. Paul, MN, at 0.25% v/v; UAN at 2.5% v/v.

[2]grass=green and yellow foxtail, and wioa.

[3]piwe=prostrate and redroot pigweed.

[4]fota=green and yellow foxtail.

Imidazolinone-resistant sunflower and subsequent crop evaluations. (Hendrickson and Henson) The objective of the study was to evaluate the crop tolerance of imidazolinone resistant sunflower and the subsequent crop response to imazamox and imazamox + imazapyr. The study was conducted at the NDSU Carrington Research Extension Center on a loam soil with a 7.2 pH and 3.7% organic matter. Imidazolinone resistant sunflower 'Mycogen 81359 CL' was planted May 30, 2002 in 30-inch rows at 16,500 seeds/A. Individual plots were 45 ft by 40 ft and arranged in a randomized complete block design with three replications. Imazamox and imazamox +imazapyr were applied at a 1X and 2X rate with a CO_2 pressurized hand-held plot sprayer delivering 10 gal/A at 20 psi through XR80015 flat fan nozzles on June 27 with 65° F, 82% RH, 30% cloud cover, 8 mph wind, and 78° F soil temperature to V3 sunflower. The 1X and 2X rates of imazamox were 0.0312 and 0.0625 lb ai/A. The 1X and 2X rates for imazamox +imazapyr were 0.022 + 0.01 and 0.044 + 0.2 lb ai/A. A nonionic surfactant 'Preference' and 28% UAN liquid fertilizer were applied with each herbicide treatment at 0.25% v/v and 1% v/v, respectively. The sunflowers were cultivated to control a low population of grass and broadleaf weeds in the untreated check plots. The sunflowers were harvested on October 21. To evaluate the subsequent crop response to imazamox and imazamox + imazapyr, each main plot was split in to 15 ft by 40 ft subplots and planted to barley 'Drummond', hard red spring wheat (HRSW) 'Russ', and corn 'DKL 35-51 RR/YG' in the spring of 2003. The barley and HRSW were seeded on April 28 in 6-inch rows at 1.2 million pls/A. The corn was planted May 13 in 30-inch rows at 25,000 seeds/A. The barley, HRSW, and corn were harvested August 8, August 12, and October 13; respectively.

Imazamox and imazamox +imazapyr did not visually injure the sunflowers when evaluated for overall crop injury, chlorosis, and height reduction 14 and 31 days after application (data not shown). Seed yields for the 1X applications of imazamox and imazamox +imazapyr were 2239 and 2261 lb/A, respectively. The 2X application rate for each treatment reduced seed yields by 16% when compared to the 1X application rate. The seed yield for the untreated check was 1716 lb/A. The seed yield LSD (p=0.05) was 225 lb/A. The herbicide treatments did not affect sunflower test weights, with a mean test weight of 30 lb/bu. The herbicide treatments did not cause any noticeable crop injury to the barley, HRSW, or corn planted the subsequent year (data not shown). The herbicide treatments also did not cause a reduction in grain yield or test weight for the subsequent crops. The mean grain yield and test weight was 64.1 bu/A and 47.0 lb/bu for barley and 57.5 bu/A and 63.4 lb/bu for HRSW. The mean corn yield was 103.5 bu/A.

Biennial wormwood control in Clearfield sunflower, Fargo, ND. Kegode and Ciernia. This study investigated the use of PRE and POST treatments with and without cultivation on biennial wormwood control in Clearfield sunflower. Mycogen 8N429CL sunflower was seeded June 2 in 30 in. rows. Spartan (PRE) treatments were applied after planting using a 4-nozzle bicycle wheel sprayer with XR8002 tips delivering 17 gpa at 43 psi. At application, air temperature was 70 F, RH 60%, wind S 6 mph, sky overcast and soil surface dry. POST treatments were applied July 3 using XR8001 tips that delivered 8.5 gpa at 34 psi. At application, sunflower was 6-leaf and 6 in. tall, common cocklebur 2-5 in. tall, Venice mallow 2 to 4-leaf and 1-2 in. tall, and biennial wormwood 1 in. tall. Selected treatments were cultivated July 8 and weed control evaluations were made July 18 and 30. The center 2 rows of reps 1 through 3 were harvested Oct. 17. The experiment was a randomized complete block design with 4 reps.

				July 18			July 30			
Treatment	Timing	Rate	Cultiv -ation	Injury	Cocb	Vema	Cocb	Vema	Biww	Yield
		oz ai/A		%	---------- % control ----------					lb/A
Spartan	PRE	4	No	0	31	88	59	82	97	813
Spartan	PRE	4	Yes	1	87	94	73	91	99	1049
Beyond	POST	0.5	No	2	85	35	80	24	-	938
Beyond	POST	0.5	Yes	3	91	89	76	64	72	909
Spartan + Beyond	PRE + POST	4 + 0.5	No	5	89	86	85	80	99	982
Spartan + Beyond	PRE + POST	4 + 0.5	Yes	4	96	97	96	98	99	988
Cult only		0	Yes	0	49	56	28	33	35	722
Hand-weeded		0	No	0	98	99	99	99	99	960
Untreated		0	No	0	0	0	0	0	0	511
C.V. %				126	9	9	14	11	13	12
LSD 5%				3	9	9	14	10	14	187
# of Rep				4	4	4	4	4	4	3

Late emergence as well as insufficient density of biennial wormwood prevented evaluation on July 18. On July 30, Spartan and Spartan plus Beyond treatments provided 97% or greater control of biennial wormwood. Beyond plus inter-row cultivation provided 72% control of biennial wormwood, and lack of biennial wormwood in plots treated with Beyond only prevented evaluation of this treatment. Spartan (PRE) plus Beyond (POST) with or without inter-row cultivation provided the highest control of the three weeds that were present in this study. However, there was some injury associated with the Spartan plus Beyond treatment that probably reduced yield, though not significantly.

Inter-row cultivation applied alone provided poor control of biennial wormwood, common cocklebur, and Venice mallow. However, when inter-row cultivation was added to the Spartan treatment, the control of redroot pigweed was improved significantly. The addition of inter-row cultivation to Beyond and Spartan plus Beyond treatments significantly improved control of Venice mallow compared to similar treatments without inter-row cultivation.

Tribenuron-resistant sunflower response to soil residues of ALS-inhibiting herbicides. (Kirk Howatt, Ronald Roach, and Janet Davidson-Harrington). An experimental line of tribenuron- (SU-) resistant sunflower was seeded May 21 at Fargo, and May 30 at Casselton, North Dakota. Preemergence treatments were applied at Fargo on May 23 with 57° F air temperature, 53% humidity, clear sky, southeast 12 mph wind, and soil temperature of 53° F. Preemergence treatments were applied at Casselton on June 4 with 58° F, 60% relative humidity, cloudy sky, 7 mph south wind, and soil temperature of 53° F. Treatments were applied with a backpack sprayer delivering 8.5 gpa at 35 psi through 8001 flat-fan nozzles to a 7 ft wide are the length of 10 by 30 ft plots. The experiment was a randomized complete block design with four replicates. Tribenuron and clethodim were applied to control weeds in the study areas.

Table 1. Tribenuron-resistant sunflower response to soil residues of ALS-inhibiting herbicides, Fargo.

		Jun 13			Jul 01		Jul 14	Oct 27
Treatment	Rate	Chlorosis	Stunt	Density	Chlorosis	Stunt	Sunflower	Yield
	oz/A	%		Plts/10m	%			lb/A
Imazethapyr	0.5	0	0	36	0	0	0	1780
Imazethapyr	0.25	0	0	36	0	0	0	1630
Imazethapyr	0.12	0	0	38	0	0	0	1580
Metsulfuron	0.06	0	0	34	0	0	0	1560
Metsulfuron	0.03	0	0	38	0	0	0	1700
Metsulfuron	0.015	0	0	34	0	0	0	1670
Flucarbazone	0.42	0	0	40	0	0	0	1800
Flucarbazone	0.21	0	0	30	0	0	0	1720
Flucarbazone	0.1	0	0	33	0	0	0	1670
Sulfentrazone	3	0	0	32	0	0	0	1650
Untreated	0	0	0	37	0	0	0	1710
LSD (P=0.05)		0	0	9	0	0	0	260
CV		0	0	17	0	0	0	11

Table 2. Tribenuron-resistant sunflower response to soil residues of ALS-inhibiting herbicides, Casselton.

		6/20/03		
Treatment[a]	Rate	Chlorosis	Stunt	Density
	oz/A	%		Plts/10m
Imazethapyr	0.5	0	0	44
Imazethapyr	0.25	0	0	45
Imazethapyr	0.125	0	0	48
Metsulfuron	0.06	0	0	46
Metsulfuron	0.03	0	0	47
Metsulfuron	0.015	0	0	45
Flucarbazone	0.42	0	0	48
Flucarbazone	0.21	0	0	49
Flucarbazone	0.105	0	0	46
Sulfentrazone	3	0	0	45
Untreated	0	0	0	49
LSD (P=0.05)		0	0	8
CV		0	0	12

Soil condition and moisture at seeding resulted in emergence and establishment problems at Fargo (Table 1) resulting in lower plant population than desired. Canada thistle was adequately controlled by the broadcast application of tribenuron, resulting in greater seed yield from SU- resistant than IMI-resistant sunflower studies. Soil residues of ALS-inhibiting herbicides did not cause visible chlorosis or stunting, and plant populations were not different in herbicide-treated plots compared with untreated (Tables 1 and 2). Yield did not differ among treatments (Table 1). The study at Casselton was terminated mid-season because of environment effect on sunflower. Previous greenhouse experiments showed that incorporation of these herbicides at the middle rate included in this study caused measurable sunflower injury. This research showed that reseeding with IMI-resistant sunflower after ALS-inhibiting herbicides had been applied was safe. The level of safety likely is dependent on non-incorporation of herbicide residues. Herbicide-resistant sunflower seed technologies may provide flexibility to reseed sunflower after a crop failure when ALS-inhibiting herbicides have been applied.

Crop response and weed control in tribenuron-resistant sunflower, Carrington, 2003. (Endres and Howatt) Crop response and weed control were investigated with selected PRE imidazolinone and sulfonylurea herbicides to simulate impact of soil residue on tribenuron-resistant sunflower. The trial had a randomized complete block design with four replicates. The experiment was conducted on a loam soil with 7.2 pH and 3.9% organic matter at the NDSU Carrington Research Extension Center. The trial area was tilled with a Melroe culti-harrow on May 22. Herbicide treatments were applied to 10 by 30 ft plots with a CO_2 pressurized hand-held plot sprayer at 20 gal/A and 30 to 35 psi through 8002 flat fan nozzles. Pioneer '03BM0024' was planted on May 22 in 30-inch rows. PRE treatments were applied on a dry soil surface on May 23 with 63 F, 57% RH, 100% cloudy sky, and 15 mph wind. Rainfall totaled 1.10 inches during May 23 to June 9. The POST treatment was applied on June 27 with 55 F, 96% RH, 50% clear sky, and 5 mph wind to V8- to V10-stage sunflower, 1- to 15-inch common lambsquarters (3/ft^2), 1- to 5-inch tall redroot and prostrate pigweed (15/ft^2), and 3- to 5-inch tall hairy and eastern black nightshade (1/ft^2). Clethodim at 0.13 lb/A + MSO at 2 pt/A was applied on July 1 to plots with PRE treatments and untreated checks.

Sunflower stand did not differ among treatments (Table). Sunflower plant chlorosis and early height reduction was not detected (data not shown). Minor plant stunting was noted later in the season. Lack of crop response may have been due to delayed rainfall after PRE herbicide application. High rates of imazethapyr and metsulfuron provided excellent control of pigweed. Tribenuron+clethodim generally provided good to excellent weed control.

Table. Crop response and weed control with PRE herbicides in tribenuron-resistant sunflower.

Herbicide		Sunflower stand		Sufl	Weed control[1]		
Treatment	Rate	6/17	7/25	stunting[2]	colq	piwe[3]	nish[4]
	oz ai/A	plants/A		%	%		
PRE							
Imazethapyr	0.5	16154	15065	3	85	98	96
Imazethapyr	0.25	17061	17969	4	79	89	83
Imazethapyr	0.125	13794	12887	3	71	87	71
Metsulfuron	0.06	15065	14883	6	75	92	66
Metsulfuron	0.03	16335	15972	7	73	79	75
Metsulfuron	0.015	11072	11072	9	52	64	45
Flucarbazone	0.42	13250	14157	5	0	43	0
Flucarbazone	0.21	14702	13976	11	0	26	0
Flucarbazone	0.105	12342	13068	8	0	20	0
Sulfentrazone	3	13431	13250	7	67	68	76
POST							
Tribenuron+clethodim+PO[5]	0.25+1.5	17787	18332	x	97	79	85
untreated check	x	15791	16154	0	0	0	0
LSD (0.05)		NS	NS	NS	18	22	10

[1]PRE=June 30; POST=July 29.
[2]PRE=8 wk after sunflower emergence.
[3]piwe=redroot and prostrate pigweed.
[4]nish=hairy and eastern black nightshade.
[5]PO=Peptoil at 2 pt/A.

Canada thistle control in Express-resistant sunflower. Zollinger, Richard K. and Jerry L. Ries. An experiment was conducted near Moorhead, MN, to evaluate Canada thistle control using split applications of Express with adjuvants. Pioneer '03BM0024' sunflower was planted on May 28, 2003. EPOST (early postemergence) treatments were applied on June 18 at 1:00 pm with 78 F air, 90 F soil surface, 31% relative humidity, 10% clouds, 3 to 5 mph E wind, dry soil surface, moist subsoil, good crop vigor, and no dew present to cotyledon to V4 sunflower. Weed species present were: 1 to 4 inch (5 to 20/yd^2) Canada thistle. POST treatments were applied on July 3 at 3:00 pm with 90 F air, 100 F soil surface, 45% relative humidity, 10% clouds, 0 to 2 mph E wind, moist soil surface, moist subsoil, good crop vigor, and no dew present to V4 to V10 sunflower. Weed species present were: 1 to 8 inch (10 to 20/yd^2) Canada thistle. 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 flat fan nozzles. The experiment had a randomized complete block design with three replicates per treatment.

Table. Canada thistle control in Express-resistant sunflower (Zollinger and Ries).

		July 2	July 17	July 31
Treatment[1]	Rate	Cath	Cath	Cath
	(product/A)	(%)	(%)	(%)
EPOST/POST				
Express+Acivator 90/Express+Activator 90	0.25oz/0.25oz	57	79	79
Express+Linkage/Express+Linkage	0.25oz/0.25oz	75	94	94
Express+Herbimax/Express+Herbimax	0.25oz/0.25oz	70	84	84
Express+Scoil/Express+Scoil	0.25oz/0.25oz	70	85	85
Express+Base/Express+Base	0.25oz/0.25oz	77	95	95
Express+Z-64/Express+Z-64	0.25oz/0.25oz	80	94	94
Express+Renegade/Express+Renegade	0.25oz/0.25oz	78	95	95
Express+Vortex/Express+Vortex	0.25oz/0.25oz	57	86	86
LSD (0.05)		7	3	3

[1]Activator 90 = nonionic surfactant at 0.25% v/v; Linkage = basic pH blend at 1% v/v; Herbimax = petroleum oil at 1% v/v; Scoil = methylated seed oil (MSO) at 1% v/v; Base and Renegade = MSO basic blend at 1% v/v; Z-64 = MSO basic blend + 28-0-0 + surfactant at 1% v/v; Vortex = MSO + water conditioning agent at 2 pt/100 gallon.

The July 2 ratings are 14 DAT of EPOST applications and July 17 and 31 are 14 and 28 DAT after POST applications, or 42 DAT after EPOST. Express-resistant sunflower are in development and will possibly be registered in 2005. Express controls many broadleaf weeds but antagonizes most postemergence grass herbicides. Previous research has shown basic pH blend adjuvant enhancement of sulfonylurea herbicides by increasing pH of the spray carrier and increasing herbicide solubility. Beyond is registered for use in Clearfield (imidazolinone resistant) sunflower. Express and Beyond have a similar broadleaf weed control spectrum, except Express is more active on Canada thistle. This study was conducted to observe adjuvant enhancement of Express from sequentially applied treatments on a difficult to control perennial species. Many different classes of adjuvants were used. Express rate used in each application was half of the total amount allowed by label. General impression of Canada thistle control at 14 DAT after second application was impressive. Express is registered for use in small grains and is exclusively applied with phenoxy herbicides which increases the speed of activity. Weed control data from Express applied alone is deficient. At 14 and 28 DAT after second application, Canada thistle control was 79% to 95%. Basic pH blend and MSO + basic pH blend type adjuvants gave the greatest enhancement of Canada thistle control. Sunflower injury was not visible at any treatment. (Dept. of Plant Sciences, North Dakota State University, Fargo).

Canada thistle control with Express and adjuvants. Zollinger, Richard K. and Jerry L. Ries. An experiment was conducted near Moorhead, MN, to evaluate Canada thistle control when Express was applied with adjuvants to Express-resistant sunflower. Pioneer '03BM0024' sunflower was planted on May 28, 2003. POST treatments were applied on June 18 at 12:45 pm with 78 F air, 90 F soil surface, 31% relative humidity, 10% clouds, 3 to 5 mph E wind, dry soil surface, moist subsoil, good crop vigor, and no dew present to cotyledon to V4 sunflower. Weed species present were: 1 to 4 inch (5 to 20/yd^2) Canada thistle. 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 flat fan nozzles. The experiment had a randomized complete block design with three replicates per treatment.

Table. Canada thistle control with Express and adjuvants (Zollinger and Ries).

		July 2	July 28
Treatment[1]	Rate	Cath	Cath
	(product/A)	(%)	(%)
Express+Activator 90	0.33oz	60	72
Express+Liberate	0.33oz	50	73
Express+Liberate	0.33oz	70	80
Express+Linkage	0.33oz	73	87
Express+Silken	0.33oz	43	74
Express+Herbimax	0.33oz	57	74
Express+Scoil	0.33oz	70	86
Express+Phase	0.33oz	57	70
Express+Base	0.33oz	73	94
Express+Z-64	0.33oz	70	90
Express+Renegade	0.33oz	75	90
Express+Vortex	0.33oz	73	72
LSD (0.05)		6	5

[1]Activator 90 = nonionic surfactant at 0.25% v/v; Liberate = nonionic surfactant at 1 pt/100 gallon for treatment two and 2 pt/100 gallon for treatment three; Linkage = basic pH blend at 1% v/v; Silken = nonionic surfactant with silicone at 4 pt/100 gallon; Herbimax = petroleum oil at 1% v/v; Scoil = methylated seed oil (MSO) at1% v/v; Phase = MSO + organosilicone surfactant at 2 pt/100 gallon; Base and Renegade = MSO basic blend at 1% v/v; Z-64 = MSO basic blend + 28-0-0 + surfactant at 1% v/v; Vortex = MSO + water conditioning agent at 2 pt/100 gallon.

Express-resistant sunflower are in development and may be registered in 2005. Express controls many broadleaf weeds but antagonizes most postemergence grass herbicides. Previous research has shown basic pH blend adjuvant enhancement of sulfonylurea herbicides by increasing pH of the spray carrier and increasing herbicide solubility. Beyond is registered for use in Clearfield (imidazolinone resistant) sunflower. Express and Beyond have a similar broadleaf weed control spectrum, except Express is more active on Canada thistle. This study was conducted to observe adjuvant enhancement of Express on a difficult to control perennial species. Many different classes of adjuvants were used. Rate of Express was 0.33 oz/A, which was intermediate in range to what will be labeled. General impression of Canada thistle control at 7 (data not shown) and 14 DAT was disappointing because slow speed of activity was unexpected. Express is registered for use in small grains and is exclusively applied with phenoxy herbicides which increases the speed of activity. Weed control data from Express applied alone is deficient. At 28 DAT, Canada thistle control had increased to a range of 70% to 95%. The class of adjuvants that promoted the greatest control of Canada thistle was MSO + basic pH blend (Base, Renegade, and Z-64). (Dept. of Plant Sciences, North Dakota State University, Fargo).

Volunteer sulfonylurea-resistant sunflower control. (Kirk Howatt, Ronald Roach, and Janet Davidson-Harrington). 'DKF 29-90' tribenuron- (SU-) resistant sunflower was seeded May 21 at Fargo, North Dakota. Treatments were applied to 6-inch sunflower on June 19 with 71° F, 44% relative humidity, clear sky, 6 to 8 mph southeast wind, and soil temperature of 65° F. Treatments were applied with a backpack sprayer delivering 8.5 gpa at 35 psi through 8001 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. Sunflower control was visually evaluated.

Treatment[a]	Rate	Jun 20 Sunflower	Jul 1 Sunflower	Jul 14 Sunflower
	oz /A		%	
2,4-D Ester	6	59	91	98
Dicamba	2	51	75	85
Thifensulfuron+NIS	0.45+0.25%	15	10	0
Metsulfuron+NIS	0.06+0.25%	15	15	12
Fluroxypyr	2	61	91	94
Mesotrione+PO+AMS	1.5+1%+11.6	2	96	99
Flucarbazone+NIS	0.42+0.25%	12	10	7
Bromoxynil&MCPA	8	70	96	97
Untreated	0	0	0	0
LSD (P=0.05)		8	7	10
CV		17	9	13

[a] Bromoxynil&MCPA was 5 lb/gal formulation.

Injury observed on SU-resistant sunflower after thifensulfuron or metsulfuron application was consistent with previous experience. It has been shown that herbicides other than tribenuron can significantly injure SU-resistant sunflower, but injury response varies widely. Flucarbazone did not control SU-resistant sunflower, but flucarbazone has not been very effective in providing complete control of conventional sunflower in previous research. Treatments containing auxinic herbicides, 2,4-D, dicamba, fluroxypyr, and bromoxynil&MCPA, provided greater than 50% sunflower control 1 DAT. Bromoxynil&MCPA caused the most rapid injury development because bromoxynil added necrotic symptoms to the typical epinasty observed from auxinic herbicides. Dicamba provided 85% control of sunflower July 14 compared with 94 to 98% control with other auxinic herbicides. Mesotrione injury to sunflower was not pronounced immediately. Mesotrione provided 96% control on July 1, and sunflower condition continued to decline resulting in the most complete control July 14.