1999 RESEARCH PROGRESS REPORT

ISSN-0090-8142

Doubletree Hotel - World Arena
COLORADO SPRINGS, COLORADO

March 9-11, 1999

FORWARD

The 1999 Research Progress Report of the Western Society of Weed Science (WSWS) is a compilation of contributed results of research investigations by weed scientists in the western United States. The overall objectives of the Research Progress Report is to provide an avenue for the presentation and exchange of on-going research to the weed science community. The information in this report is preliminary; therefore, it is neither intended for publication, nor for the development of endorsements or recommendations.

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WSWS appreciates the time and effort of the chair and chair-elect of each project and the authors who shared their research results with other members of WSWS.

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1999

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PROJECT 1

WEEDS OF RANGE AND FOREST

Jim Olivarez, Chair

Perennial grass competition to control foxtail barley (*Hordeum jubatum* L.). Tom D. Whitson, Jerry M. Langbehn, and Kristi K. Rose. (Department of Plant Sciences, University of Wyoming, Laramie, Wyoming 82071). Foxtail barley is a short-lived perennial that often reproduces by seed and is common in pastures and meadows with alkaline soils. It is palatable to livestock until maturity when awns form which may cause injury to an animal's ears, eyes, nose, and throat when grazed. This experiment was conducted near Thermopolis, WY to determine if cool-season perennial grasses could be established and become competitive with foxtail barley. Grasses were selected that tolerate high pH with alkali outcrops. The five grass varieties were Jose tall wheatgrass, Prairieland altai wildrye, Newhy hybrid wheatgrass, Pryor slender wheatgrass, and Shoshone beardless wildrye. The site was rototilled and seeded on August 13, 1997. Plots were arranged in a randomized complete block design with three replications. Pryor slender wheatgrass was seeded at a rate of 12 PLS/A and the other four at 10 PLS/A. Visual evaluations were made September 1, 1998. Jose tall wheatgrass had an 82% stand, which corresponded with the greatest control of 57%. Newhy hybrid wheatgrass had the second densest stand of 70%, which controlled 47% of the foxtail barley. (Wyoming Agric. Exp. Sta., Laramie, WY 82071 SR 1726.)

Table. Grass stands and corresponding foxtail barley control

Grass variety	% Grass stand (Ave.)	% Foxtail barley control
Jose tall wheatgrass	82	57
Newhy hybrid wheatgrass	70	47
Prairieland altai wildrye	03	02
Pryor slender wheatgrass	10	03
Shoshone beardless wildrye	03	00

The competitive effects of five cool-season grasses on downy brome and musk thistle. Kristi K. Rose, Tom D. Whitson, and David W. Koch. (Department of Plant Sciences, University of Wyoming, Laramie, WY 82071). Downy brome (*Bromus tectorum* L.) is difficult to control because it has a two to five-year seed life in soils on arid rangeland. The use of herbicides requires sequential applications to provide long-term control of downy brome. Musk thistle (*Carduus nutans* L.) forms dense stands crowding out desirable forage. Even though chemicals are an effective control for musk thistle, reapplication is required until a depletion of the seed bank is achieved. A study was conducted near Riverside, WY to determine the competitive ability of five cool-season grasses on downy brome and musk thistle. The study site was sprayed June 10, 1993 with picloram at 0.5 lb ai/A to eliminate musk thistle and seeded to five cool-season grasses on May 3, 1994. Grasses seeded were Bozoisky Russian wildrye (*Psathyrostachys juncea*), Critana thickspike wheatgrass (*Elymus lanceolatus*), Hycrest crested wheatgrass (*Agropyron cristatum)*, Luna pubescent wheatgrass (*Elytrigia intermedia*), and Sodar streambank wheatgrass (*Elymus lanceolatus)*. All areas were seeded with 10 lbs PLS/acre except Russian wildrye, which was seeded at 6 lbs. PLS/acre. This experiment was a randomized complete block design with three replications. Soils were sandy loam with 73% sand, 12% silt, 15% clay, 1.7% organic matter, and a pH of 6.9. Dry matter yields were determined by harvesting four (¼) meter^2 quadrats by species. Samples were harvested on August 27, 1996 and July 19, 1997 then oven-dried and weighed. Areas seeded to Luna pubescent wheatgrass, Hycrest crested wheatgrass, and Sodar streambank wheatgrass provided 100%, 100%, and 99% downy brome control in 1997, respectively. That same year musk thistle was reduced 97% in the crested wheatgrass stand and 100% in the area seeded to pubescent wheatgrass. In 1998 all grasses provided 100% control of the downy brome and all the grasses except Hycrest crested wheatgrass reduced musk thistle to a higher level than the previous year. The perennial grasses in this study became better established and more competitive the third year after seeding. (Wyoming Agric. Exp. Sta., Laramie, WY 82071 SR 1719.)

Table 1. The competitive effects of five cool-season grasses on downy brome.

Perennial grass	Grass Production lbs (DM)/A 1996	1997	1998	D. Brome Production lbs (DM)/A 1996	1997	1998	% reduction 1996	1997	1998
(Critana) thickspike wheatgrass	720	1305	2203	830	34	0	32	80	100
(Bozoisky) Russian wildrye	818	1261	1589	670	47	0	45	73	100
(Sodar) streambank wheatgrass	1032	1484	2270	188	1	0	85	99	100
(Luna) pubescent wheatgrass	1558	2252	2298	0	0	0	100	100	100
(Hycrest) crested wheatgrass	1451	2369	2794	113	0	0	91	100	100
Unseeded control	0	0	0	1215	172	833	0	0	0

Table 2. The competitive effects of five cool-season grasses on musk thistle.

Perennial grass	Thistle Production lbs (DM)/A 1997	1998	% reduction 1997	1998
(Critana) thickspike wheatgrass	761	6	66	99
(Bozoisky) Russian wildrye	959	187	57	83
(Sodar) streambank wheatgrass	347	139	84	88
(Luna) pubescent wheatgrass	0	0	100	100
(Hycrest) crested wheatgrass	68	102	97	91
Unseeded control	2221	1120	0	0

The effects of various herbicides on silky crazyweed (*Oxytropis sericea* Nutt. ex T. & G.). Tom D. Whitson and Kristi K. Rose. (Department of Plant Sciences, University of Wyoming, Laramie, Wyoming 82071). Silky crazyweed is a poisonous, perennial legume that is harmful to all livestock species. It has been reported to cause abortions in cattle and sheep. Once an animal has eaten this plant they seek out more of it. This experiment was conducted on rangeland having uniform stands of silky crazyweed near Buford, WY to determine which herbicides effectively control silky crazyweed. Soils had a pH of 6.8 and contained 3.2% organic matter 53.2% sand, 30.1% silt, and 16.7% clay. Plots were arranged in a randomized complete block design with four replications. Applications were made on 7-12-95 and 6-17-96. Evaluations were made 8-17-98. The plots were evaluated by counting the number of plants per plot then comparing to the control. The plots were visually evaluated to determine control of fringed sagebrush (*Artemisia frigida* Willd.) and three-tip sagebrush (*Artemisia tripartita* Rydb.), labeled % other control. Selected plots were clipped using a ¼ meter quadrat then dried in a 60° C oven and weighed to determine lb/A. All metsulfuron applications greater than 0.12 oz/A provided excellent control of silky crazyweed at either time of application. When silky crazyweed was controlled, yields of perennial grasses were doubled. When the associated cushion community species were also controlled perennial grass yields were 5.8 times as high in experiment one and 3.2 times as high in experiment two. (Wyoming Agric. Exp. Sta., Laramie, WY 82071 SR 1714.)

Table 1. Control of silky crazyweed with various herbicides applied 7-12-95.

Treatment	Rate lb/A	% crazyweed control	% other control[c]	wt. (lb/A)
Metsulfuron[a]	0.06 oz	88	00	
Metsulfuron[a]	0.12	100	10	
Metsulfuron[a]	0.18	100	25	
Metsulfuron[a]	0.24	100	10	429
Metsulfuron[a]	0.3	100	18	
Metsulfuron[a] + 2,4-D (LVE)[b]	0.06 + 2.0	100	84	
Metsulfuron[a] + 2,4-D (LVE)[b]	0.12 + 2.0	99	75	
Metsulfuron[a] + 2,4-D (LVE)[b]	0.18 + 2.0	85	70	
Metsulfuron[a] + 2,4-D (LVE)[b]	0.24 + 2.0	100	86	1139
Metsulfuron[a] + 2,4-D (LVE)[b]	0.3 + 2.0	100	95	
Untreated	------	00	00	196

[a]All treatments had the surfactant Activator 90 added at 0.25% v/v. [b](LVE)=Low Volatile Ester
[c]% other control includes associated species including fringed sagebrush and three-tip sagebrush.

Table 2. Control of silky crazyweed with various herbicides applied 6-17-96.

Treatment	Rate lb/A	% crazyweed control	% other control[c]	wt. (lb/A)
Metsulfuron[a]	0.06 oz	97	00	
Metsulfuron[a]	0.12	94	00	
Metsulfuron[a]	0.18	81	04	
Metsulfuron[a]	0.24	99	00	
Metsulfuron[a]	0.3	100	00	639
Metsulfuron[a] + 2,4-D (LVE)[b]	0.06 + 2.0	99	20	
Metsulfuron[a] + 2,4-D (LVE)[b]	0.12 + 2.0	100	59	
Metsulfuron[a] + 2,4-D (LVE)[b]	0.18 + 2.0	100	23	
Metsulfuron[a] + 2,4-D (LVE)[b]	0.24 + 2.0	99	45	
Metsulfuron[a] + 2,4-D (LVE)[b]	0.3 + 2.0	100	60	880
Untreated	------	00	00	277

[a]All treatments had the surfactant Activator 90 added at 0.25% v/v. [b](LVE)=Low Volatile Ester
[c]% other control includes associated species including fringed sagebrush and three-tip sagebrush.

Meadow knapweed control with imazapic. Sandra L. Shinn and Donald C. Thill. (Plant Science Division, University of Idaho, Moscow, ID 83844-2339) A study was established on unimproved pasture land near St. Maries, Idaho to evaluate meadow hawkweed control with imazapic and picloram. Soil type at St. Maries was a silt loam (36% sand, 6% clay, 58% silt, pH 6.3, and 5.1% organic matter). Herbicide treatments were arranged as a 2 (fertilizer) by 12 (herbicide) factorial randomized complete - split block design with four replications. Herbicides were applied with a CO_2 pressurized backpack sprayer calibrated to deliver 94 L/ha at 250 kPa (Table 1). Fertilizer (112 kg N/ha as ammonium sulfate (21-0-0-24)) was applied during spring 1998 to one half of each replicate, while no fertilizer was applied to the other half. Meadow hawkweed control was evaluated visually, and plant counts and biomass were taken on June 25, 1998, at the flowering stage. Plants were counted and cut from a 0.25 m^2 area, dried for 72 hours and weighed.

Table 1. Application data.

Application timing	October 7, 1997	April 21, 1998
Meadow hawkweed stage	5 to 6 leaves	10 to 12 leaves
Air temperature (C)	11	22
Relative humidity (%)	61	45
Wind (km/h)	1	4
Cloud cover (%)	95	10
Soil temperature (C at 5 cm)	5	11

The fertilizer by treatment interaction was not significant. However, the addition of fertilizer increased meadow hawkweed biomass 8% and increased percent control 8% compared to no fertilizer. Plant density was not affected by fertilizer. Picloram applied in the fall or spring controlled meadow hawkweed 100% and reduced plant density 93 to 100%, and biomass 69 to 100% compared to the untreated control (Table 2). Imazapic applied alone (spring) and sequentially (fall and spring) visually suppressed meadow hawkweed 14 to 24%. Imazapic applied alone in the spring reduced plant density 15 to 36% and biomass 29 to 52%. Fall applied imazapic did not control meadow hawkweed.

Table 2. Meadow hawkweed percent control, plant density and biomass.

Treatment	Rate	Application timing[1]	Control	Density	Biomass
	kg/ha		%	plants/m^2	g/m^2
Imazapic[2]	0.07	F	0	352	182
Imazapic	0.14	F	0	360	232
Imazapic	0.21	F	0	485	162
Picloram	0.42	F	100	28	58
Imazapic + imazapic	0.07 + 0.14	F + S	16	290	92
Imazapic + imazapic	0.07 + 0.07	F + S	15	472	151
Imazapic + imazapic	0.14 + 0.07	F + S	16	408	133
Imazapic	0.07	S	14	274	88
Imazapic	0.14	S	17	344	131
Imazapic	0.21	S	24	362	100
Picloram	0.42	S	100	0	0
Untreated check[3]	--	--	--	426	184
LSD (0.05)			9	115	94

[1] F = fall application, S = spring application

[2] All imazapic treatments were applied with a methylated seed oil plus surfactant at 1.25% v/v.

The effects of various herbicides on houndstongue (*Cynoglossum officinale* L.). Tom D. Whitson, Kristi K. Rose, and Mike Wille. (Department of Plant Sciences, University of Wyoming, Laramie, WY 82071). Houndstongue is an introduced, biennial. Houndstongue as fresh forage or hay has an accumulative toxin causing liver cells to stop reproducing in grazing animals. This experiment was conducted near Ten Sleep, WY to determine herbicide efficacy for control of houndstongue. Herbicides were applied at the early vegetative stage on June 5, 1997. During application air temperature was 79F, relative humidity 70%, soil temperature at 1 inch 75F, 4 inches 64F, on a clear, calm day. Soils were sandy clay loam with 47% sand, 25% silt, 28% clay and a pH of 6.3 with 4.8% organic matter. The experiment was arranged as a randomized complete block design with three replications. Evaluations were made August 12,1997 and September 2, 1998. In 1997 2,4-D (LVE) at 2.0 lb ai/A and the combination of 2,4-D (LVE) + metsulfuron at 2.0 lb ai/A and 8.5 g ai/A (0.5 oz. product) controlled 100% of the houndstongue. Imazapic at 0.19 lb ai/A (12 oz. product), picloram + metsulfuron at 0.25 lb + 8.5 g/A and 0.5 lb + 8.5 g/A provided 99, 97, 96% control of houndstongue, respectively, while metsulfuron alone at 8.5 g and picloram alone at 0.5 lb/A controlled 95 and 92% of the houndstongue. In 1998, all treatments except picloram alone provided 100% control of the bolted plants. Control of the seedlings was greater than 89% with 2,4-D at 2.0 lbs./A, metsulfuron at 17 g/A and the combination of 2,4-D + metsulfuron at 2.0 + 8.5 g/A. Although not looked at in this study other studies have shown metsulfuron has stopped seed development of houndstongue. Therefore, adding 8.5 g to the mixture may eventually deplete the seed bank reducing the need for repeated treatments. (Wyoming Agric. Exp. Sta., Laramie, WY 82071 SR 1717.)

Table. Control of houndstongue with various herbicides.

Treatment	Rate ai/A	1997 % Control (Ave.)	1998 % Control (Ave.) Bolting	Seedlings
2,4-D (LVE)[a]	2.0 lb	100	100	93
2,4-D (LVE)[a] + metsulfuron[b]	2.0 lb + 8.5 g	100	100	89
Metsulfuron[b]	8.5 g	95	100	71
Metsulfuron[b]	17 g	72	100	91
Picloram	0.25 lb	75	83	55
Picloram	0.5 lb	92	96	44
Picloram + metsulfuron[b]	0.25 lb + 8.5 g	97	100	85
Picloram + metsulfuron[b]	0.5 lb + 8.5 g	96	100	45
Imazapic	0.19 lb	99	100	56
Untreated	----	0	0	0

[a](LVE)=Low Volatile Ester, [b]These herbicides were applied with 0.25% v/v, Activator 90 surfactant

The effects of late summer applications of various herbicides on Russian knapweed (*Centaurea repens L.*). Tom D. Whitson, Wayne R. Tatman, Steve D. AAgard, and Kristi K. Rose. (Department of Plant Sciences, University of Wyoming, Laramie, WY 82071). Russian knapweed is a highly competitive perennial commonly found on sub-irrigated areas and riparian zones. This experiment was conducted on uniform stands of Russian knapweed on rangeland near Rock River, WY to evaluate late summer applications of various herbicides for Russian knapweed control. Plots were 10 by 27 ft. arranged in a randomized complete block design with four replications. Application information was taken on August 21, 1995 when the Russian knapweed growth stage was 65% bloom and 35% bud, temperature: air 81F, soil surface 70F, 1 inch 72F, 2 inches 71F, 4 inches 70F with 81% relative humidity, clear skies, and no wind. Soils were a loamy sand with 70% sand, 13% silt, 17% clay with 3.4% organic matter and a pH of 7.9. Evaluations were made August 7, 1997 and September 26, 1998. In 1997 applications of picloram at 0.5, 0.75, and 1.0 lb/A controlled 95, 98 and 100 % of the Russian knapweed respectively. In 1998 the same treatments controlled 92, 98, and 100% of the knapweed. Perennial grasses established well and should provide competition for many years. (Wyoming Agric. Exp. Sta., Laramie, WY 82071 SR 1725.)

Table. Control of Russian knapweed with various herbicides.

Herbicide	Rate (lb/A)	1997 % Control	1998 % Control
Picloram[a]	0.125	29	13
Picloram[a]	0.25	66	33
Picloram[a]	0.375	84	82
Picloram[a]	0.5	95	92
Picloram[a]	0.75	98	98
Picloram[a]	1.0	100	100
Picloram + 2,4-D[a]	0.25 + 1.0	66	85
Picloram	0.25	60	50
Clopyralid[a]	0.125	08	03
Clopyralid[a]	0.25	28	03
Clopyralid[a]	0.375	51	0
Clopyralid[a]	0.5	53	18
Picloram + triclopyr	0.25 + 0.5	73	60
Dicamba[a]	2.0	13	05
Untreated	------	0	0

[a]X-77 added to treatment @ 0.25% v/v.

The effects of various herbicides on Russian knapweed (*Centaurea repens* L.). Tom D. Whitson and Kristi K. Rose. (Department of Plant Sciences, University of Wyoming, Laramie, WY 82071). Russian knapweed is a highly competitive perennial commonly found throughout the west on sub-irrigated areas and riparian zones. Studies were conducted on uniform stands of Russian knapweed near Rock River, WY. Plots were 10 by 27 feet and arranged in a randomized complete block design with four replications. Humidity was 70%, 5-10 mph wind, temperature 55°F, soil temperature, surface 35°F, and 4 in. 40°F. Herbicides were applied on October 10, 1990, at 41 lb pressure, 30 gpa. Evaluations were made August 28, 1991 and September 26, 1998. The 1991 treatments which provided excellent control one year after treatment became well established to western wheatgrass and blue grama and continued to provide sustainable control seven years later. Those original treatments continuing to provide good control included picloram at various rates and combinations applied at 0.125lbs/A or higher, except when applied with dicamba. (Wyoming Agric. Exp. Sta., Laramie, WY 82071 SR 1718.)

Table. Control of Russian knapweed with various herbicides.

Treatment	Rate	1991 % Control	1998 %Control
Picloram	0.5	86	77
Picloram + 2,4-D	0.5 + 2.0	85	85
Picloram + Silwet	0.5 + 0.1	70	85
Picloram + Enhanse	0.5 + 0.5	85	75
Picloram + L1-700	0.5 + 0.1	85	40
Picloram	1.0	97	97
Picloram	0.125	95	88
Untreated	----	00	00
Dicamba	1.0	25	13
Dicamba	2.0	27	30
Dicamba + Picloram	1.0 + 0.5	69	33
Picloram	0.25	51	03
Dicamba + Picloram	0.5 + 0.125	29	07
Metsulfuron + X-77	0.031+ 0.25% v/v	00	13
Metsulfuron + X-77	0.063 + 0.25% v/v	07	03
Metsulfuon + 2,4-D	0.031 + 2.0 + 0.25% v/v	00	00
Chlorsulfuron + X-77	0.031+ 0.25% v/v	03	00
Chlorsulfuron + X-77	0.063 + 0.25% v/v	19	50
Clopyralid + 2,4-D	0.19 + 1.0	18	08
Clopyralid	0.195	28	00

Spotted knapweed control with imazapic. Sandra L. Shinn and Donald C. Thill. (Plant Science Division, University of Idaho, Moscow, ID 83844-2339) A study was established on unimproved pasture land near St. Maries, Idaho, and at Farragut State Park near Athol, Idaho to evaluate spotted knapweed control with imazapic and picloram. Soil type at St. Maries was a silt loam (39.6% sand, 4.4% clay, 56% silt, pH 6.3, and 5.5% organic matter). Soil type at Farragut State Park was a sandy loam (60% sand, 6% clay, 34% silt, pH 7.3 and 5.7% organic matter). Herbicide treatments were arranged as a 2 (fertilizer) by 12 (herbicide) factorial randomized complete - split block design with four replications and individual plots were 2.4 by 12.2 m. Herbicides were applied with a CO_2 pressurized backpack sprayer calibrated to deliver 94 L/ha at 234 kPa (Table 1). Fertilizer [112 kg N/ha as ammonium sulfate (21-0-0-24)] was applied during spring 1998 to one half of each replicate, while no fertilizer was applied to the other half. Spotted knapweed control was evaluated visually, and plant counts and biomass were taken at the flowering stage on June 25 at St. Maries and June 29,1998, at Farragut State Park. Plants were counted and cut from a 0.25 m^2 area of each plot, dried for 72 hours and weighed.

Table 1. Application data.

	St. Maries		Farragut State Park	
Application timing	October 7, 1997	April 21, 1998	October 6, 1997	May 5, 1998
Spotted knapweed stage	5 to 6 leaves	8 to 10 leaves	5 to 6 leaves	8 to 10 leaves
Air temperature (C)	11	22	11	30
Relative humidity (%)	61	40	65	39
Wind (km/h)	1	3	2	2
Cloud cover (%)	95	20	100	0
Soil temperature at 5 cm (C)	5	11	9	11

The fertilizer by treatment by location interaction was not significant, thus data were combined across locations. Plant density, biomass and percent control was not affected by fertilizer. Picloram applied in the fall or spring controlled spotted knapweed 98 to 100%, reduced plant density 97 to 100%, and reduced biomass 100% compared to the untreated control (Table 2). Imazapic did not control spotted knapweed.

Table 2. Spotted knapweed percent control, plant density and biomass.

Treatment	Rate	Application timing[a]	Control	Density	Biomass
	kg/ha		%	plants/m^2	g/m^2
Imazapic[b]	0.07	F	0	233	227
Imazapic	0.14	F	0	129	192
Imazapic	0.21	F	0	156	190
Picloram	0.42	F	98	3	0
Imazapic + imazapic	0.07 + 0.14	F + S	0	159	143
Imazapic + imazapic	0.07 + 0.07	F + S	0	144	167
Imazapic + imazapic	0.14 + 0.07	F + S	0	177	169
Imazapic	0.07	S	0	146	181
Imazapic	0.14	S	0	155	163
Imazapic	0.21	S	0	179	154
Picloram	0.42	S	100	0	0
Untreated check	–	–	–	140	139
LSD (0.05)			4	108	111

[a] F = fall application, S = spring application

[b] All imazapic treatments were applied with a methylated seed oil plus surfactant at 1.25% v/v.

Screening imazapic for spotted knapweed, Canada thistle, and perennial sowthistle control. Rodney G. Lym. (Plant Sciences Department, North Dakota State University, Fargo, ND 58105). Imazapic has been used for rangeland renovation including leafy spurge control and has a narrower weed control spectrum than the more commonly used picloram plus 2,4-D. The purpose of this research was to evaluate imazapic for broadleaf weed control in pastures infested with spotted knapweed, Canada thistle, and perennial sowthistle.

An experiment to evaluate imazapic applied alone or with picloram for spotted knapweed control was established on a moderate infestation of spotted knapweed near Hawley, MN. Herbicides were applied on June 13, 1997 (spring) or September 18, 1997 (fall) using a hand-boom sprayer delivering 8.5 gpa at 35 psi. All treatments containing imazapic were applied with a methylated seed oil (MSO) at 1 qt/A. The experiment was in a randomized complete block design with four replications and each plot was 10 by 30 feet. Evaluations were based on visible percent stand reduction compared to an untreated control.

Imazapic applied alone in the spring or fall did not control spotted knapweed (Table 1). Control averaged less than 30% and some grass injury was observed following the spring applied treatments. Picloram at 4 oz/A applied alone or with imazapic provided nearly complete spotted knapweed control.

The second experiment evaluated imazapic applied alone or with clopyralid plus 2,4-D for Canada thistle and perennial sowthistle control. The experiment was established near Fargo, ND, in a dense stand of both weed species. Herbicides were applied as previously described except the application equipment was a tractor mounted sprayer. Treatments were applied on May 29 to weeds in the vegetative growth stage or September 15, 1997 to weeds rosette growth stage. respectively. All imazapic treatments were applied with an MSO at 1 qt/A.

Imazapic spring applied alone provided short-term control of Canada thistle but not perennial sowthistle (Table 2). For instance, imazapic applied at 3 oz/A provided 79% Canada thistle control in July but control declined to 6% by October 1997. The same treatment averaged less than 50% perennial sowthistle control even 1 MAT (month after treatment). Clopyralid plus 2,4-D at 3 plus 16 oz/A provided approximately 90% control of both species 1 MAT when applied in the spring or fall and control was similar whether applied alone or with imazapic. Clopyralid plus 2,4-D spring applied provided season-long Canada thistle and perennial sowthistle control and fall-applied provided good perennial sowthistle but not Canada thistle control in the spring following spring.

In general, imazapic provided poor spotted knapweed, Canada thistle, and perennial sowthistle control when applied alone regardless of application date. The addition of imazapic to picloram or clopyralid plus 2,4-D did not result in improved weed control compared to the pyridinecarboxylic acid herbicides applied alone.

Table 1. Imazapic applied alone and with picloram in June or September for spotted knapweed control.

Treatment	Rate	August 1997 Control	August 1997 Grass inj.	May 1998 Control	May 1998 Grass inj.	Aug 1998 Control
Spring applied	— oz/A —	%				
Imazapic + MSO[a]	2 + 1 qt	28	5	23	0	10
Imazapic + MSO[a]	2.5 + 1 qt	5	11	0	0	0
Imazapic + MSO[a]	3 + 1 qt	13	16	13	0	0
Imazapic + picloram + MSO[a]	2 + 4 + 1 qt	100	20	99	0	100
Imazapic + picloram + MSO[a]	2.5 + 4 + 1 qt	100	27	97	0	99
Picloram	4	100	5	99	0	99
Fall applied						
Imazapic + MSO[a]	2 + 1 qt			21	0	5
Imazapic + MSO[a]	2.5 + 1 qt			24	0	5
Imazapic + MSO[a]	3 + 1 qt			11	0	13
Imazapic + picloram + MSO[a]	2 + 4 + 1 qt			99	13	100
Imazapic + picloram + MSO[a]	2.5 + 4 + 1 qt			100	18	99
Picloram	4			99	7	100
LSD (0.05)		21	22[b]	30	7	11

[a]Methylated seed oil was Sun-It by AGSCO.
[b]LSD = (0.10).

Table 2. Imazapic applied alone or with clopyralid plus 2,4-D in May or September 1997 for Canada thistle and perennial sowthistle control.

		Canada thistle				Perennial sowthistle			
		1997			1998	1997			1998
Treatment	Rate	July	Aug	Oct	May	July	Aug	Oct	May
Spring applied	oz/A	% control							
Imazapic + MSO[a]	2 + 1 qt	73	53	18	..	20	9	18	..
Imazapic + MSO[a]	2.5 + 1 qt	76	42	6	..	23	35	26	..
Imazapic + MSO[a]	3 + 1 qt	79	68	6	..	40	34	44	..
Imazapic + clopyralid + 2,4-D[b] + MSO[a]	2 + 3 +16 + 1 qt	91	84	10	..	97	95	79	..
Imazapic + clopyralid + 2,4-D[b] + MSO[a]	2.5 + 3 + 16 + 1 qt	90	84	34	..	85	88	51	..
Clopyralid + 2,4-D[b]	3 + 16	96	91	63	..	90	84	65	..
LSD (0.05)		8	23	27		26	39	34[c]	
Fall applied									
Imazapic + MSO[a]	2 + 1 qt	..	..	19	25	..	..	19	51
Imazapic + MSO[a]	2.5 + 1 qt	..	..	17	49	..	..	14	61
Imazapic + MSO[a]	3 + 1 qt	..	..	18	58	..	..	19	68
Imazapic + clopyralid + 2,4-D[b] + MSO[a]	2 + 3 + 16 + 1 qt	..	..	86	33	..	..	93	60
Imazapic + clopyralid + 2,4-D[b] + MSO[a]	2.5 + 3 +16 + 1 qt	..	..	96	35	..	..	96	71
Clopyralid + 2,4-D[b]	3 + 16	..	..	87	15	..	..	87	89
LSD (0.05)				11	23			10	27

[a]Methylated seed oil was Sun-It by AGSCO

[b]Commercial formulation - Curtail.

[c]LSD = 0.10.

The effects of various herbicides on plains pricklypear (*Opuntia polyacantha* Haw.). Tamra R. Jensen, Tom D. Whitson, and Kristi K. Rose. (Department of Plant Sciences, University of Wyoming, Laramie, WY 82071). Pricklypear is a native forb usually growing on dry, sandy soil. This plant reduces the utilization of desirable forages because livestock avoid feeding on or in close proximity to it. This experiment was conducted on uniform stands of plains pricklypear on rangeland near Lusk, WY to determine which herbicides most effectively control pricklypear. Herbicides were applied July 2, 1996 when pricklypear was in bloom. The air temperature was 105F, relative humidity 20 %, soil temperature at the surface 105F, 1 inch 105F, 2 inches 100F, 4 inches 95F, and a 5 mph wind. Percent reduction was based on plant counts taken on August 11, 1997 and September 4, 1998. One year after treatment 2,4-D (A) + picloram 1.0 + 0.25 lb/A reduced pricklypear by 86%. The second year after herbicide application all treatments containing picloram at rates higher than 0.125 lb/A provided satisfactory to excellent control of pricklypear. Past experiments indicate that three years are required to obtain maximum pricklypear control. (Wyoming Agric. Exp. Sta., Laramie, WY 82071 SR 1727.)

Table. Control of plains pricklypear with various herbicides.

Treatment	Rate (lb/A)	1997 % Reduction (Ave.)	1998 % Reduction (Ave.)
2,4-D (A)[a] + picloram	0.5 + 0.125	78	91
2,4-D (A)[a] + picloram	0.75 + 0.188	81	97
2,4-D (A)[a] + picloram	1.0 + 0.25	86	92
2,4-D (LVE)[b]	2.0	66	8
Picloram + 2,4-D (LVE)[b]	0.125 + 0.5	84	77
Picloram + 2,4-D (LVE)[b]	0.5 + 1.0	83	96
Untreated	-----	00	00

[a](A)=Amine, [b](LVE)=Low Volatile Ester

The effects of various picloram rates on plains pricklypear (*Opuntia polyacantha* Haw.). Tom D. Whitson, William R. Taylor, Tamra R. Jensen, and Kristi K. Rose. (Department of Plant Sciences, University of Wyoming, Laramie, Wyoming 82071). Pricklypear is a native species and usually grows on dry, sandy soil. This plant reduces the utilization of desirable forage species because livestock avoid feeding on or in close proximity to it. This experiment was conducted near Lusk, WY to determine which herbicide rate most effectively controls pricklypear. The plots were arranged in a randomized complete block design with three replications. The herbicide was applied on July 10, 1995 when the pricklypear was in bloom stage. Evaluations were made September 4, 1998. Higher rates of picloram more effectively reduced the amount of pricklypear with the 0.25 lb/A rate reducing pricklypear by 89% and the 0.5 lb/A rate by 96%. (Wyoming Agric. Exp. Sta., Laramie, WY 82071 SR 1715.)

Table. Control of plains pricklypear with various picloram rates.

Treatment	Rate (lb/A)	% Control
picloram	0.031	45
picloram	0.062	48
picloram	0.094	47
picloram	0.125	76
picloram	0.25	89
picloram	0.5	96
Untreated	-----	13

The influence of picloram, 2,4-D, or picloram + 2,4-D on prickly pear cover and control on Colorado rangeland. James R. Sebastian and K.G. Beck. (Department of Bioagriculture Sciences and Pest Management, Colorado State University, Fort Collins, CO 80538) An experiment was established near Kersey, CO to evaluate prickly pear (OPUPO) control with 2,4-D, picloram, picloram + 2,4-D, or pre-mixed picloram + 2,4-D. The experiment was designed as a randomized complete block with four replications.

Herbicides were applied to OPUPO at the vegetative growth stage on August 2, 1996. All treatments were applied with a CO_2-pressurized backpack sprayer using 11003LP flat fan nozzles at 21 gal/A, 14 psi. Other application information is presented in Table 1. Main plot size was 10 by 30 feet.

Visual evaluations for control and cover compared to non-treated control plots were collected in June 1997 and August 1998, approximately 1 and 2 years after treatment (YAT). A point frame was used in 1997, but this method missed low growing vegetation. A Daubenmire frame was used in 1998 to remedy the problem. Cover data are means from 10 point frames or 0.1 m^2 quadrats per plot (40 total quadrats per treatment).

OPUPO died slowly after treatments were applied. All treatments controlled less than 63% of OPUPO 1 YAT (Table 2). When treatments were evaluated 2 YAT, control ranged from 34 to 94%. More than 85% of OPUPO was controlled 2 YAT with 0.25 lb of picloram or more. It required 0.38 lb of picloram to decrease OPUPO cover to zero 2 YAT, whereas 0.3 lb of picloram plus 1 lb of 2,4-D decreased OPUPO cover to zero. OPUPO was controlled poorly by 2, 4-D alone. (Weed Research Laboratory, Colorado State University, Fort Collins, CO 80523).

Table 1. Application data for prickly pear control on Colorado rangeland.

Environmental data			
Application date	August 2, 1996		
Application time	10:30 AM		
Air temperature, F	83		
Relative humidity, %	50		
Wind speed, mph	2 to 4		

Application date	species	growth stage	height (in.)
August 3, 1996	OPUPO	vegetative	3 to 6
	ARTFI	flower	18 to 36
	CARSP	vegetative	8 to 9
	ORYHY	late boot	14 to 23
	SPOCR	late boot	9 to 12
	STICO	late boot	24 to 36

Table 2. The influence of picloram, 2,4-D, or picloram + 2,4-D on prickly pear cover and control on Colorado rangeland.

		Prickly Pear			
Herbicide[a]	Rate	Control		Cover	
	(lb ai/A)	1997	1998	1997	1998
		%			
Picloram	0.06	29	55	6	14
	0.13	19	70	9	9
	0.2	13	55	4	10
	0.3	35	87	5	2
	0.4	29	91	5	0
Picloram[b] + 2,4-D	0.13 + 0.5	30	70	6	4
2,4-D	2.0	21	6	12	43
Picloram[c] + 2,4-D	0.07 + 0.25	18	34	9	17
	0.13 + 0.5	35	75	5	3
	0.2 + 0.71	24	70	7	5
	0.3 + 1.0	48	88	3	0
	0.4 + 1.5	63	94	2	0
Control		0	0	7	40
LSD (0.05)		26	21	6	8

[a] X-77 surfactant added to all treatments at 0.25% v/v.
[b] Picloram plus the amine formulation of 2,4-D.
[c] Premixed formulation of picloram + amine formulation of 2,4-D (Grazon P&D).

The effect of various herbicides on Douglas rabbitbrush (*Chrysothamnus viscidiflorus* (Hook.) Nutt.). Tom D. Whitson, Les Burrough, Leroy Jons, and Kristi K. Rose. (Department of Plant Sciences, University of Wyoming, Laramie, WY 82071). Douglas rabbitbrush is a native, perennial shrub. It grows in dry areas often in the same habitat as sagebrush. It increases with overgrazing and is difficult to control. Studies were conducted on uniform stands of Douglas rabbitbrush near Evanston, WY to determine the efficacy of various herbicides applied to Douglas rabbitbrush during active stem growth. Plots were 10 by 27 feet and arranged in a randomized complete block design with four replications. Herbicides were applied June, 4, 1997. Evaluations were made September 16, 1998. Triclopyr 4E + 2,4-D (LVE) at 0.25 + 2.0 lb/A and Triclopyr 4E + picloram at 1.0 + 0.25 lb/A reduced the Douglas rabbitbrush by 97 and 94%, respectively. (Wyoming Agric. Exp. Sta., Laramie, WY 82071 SR 1716.)

Table. Control of douglas rabbitbrush with various herbicides.

Treatment	Rate lb/A	% Control
Triclopyr 4E[a]	0.5	01
Triclopyr 4E[a]	1.0	06
Triclopyr 4E[a]	2.0	09
Picloram	0.25	10
Picloram	0.5	00
Triclopyr 4E[a] + 2,4-D (LVE)[b]	0.5 + 2.0	40
Triclopyr 4E[a] + 2,4-D (LVE)[b]	0.25 + 2.0	97
Triclopyr 4E[a] + picloram	0.5 + 0.25	73
Triclopyr 4E[a] + picloram	1.0 + 0.25	94
2,4-D (LVE)[b]	2.0	13
Picloram + 2,4-D (LVE)[b]	0.25 + 2.0	80
Picloram + 2,4-D (A)[c]	0.25 + 1.0	55
Triclopyr 4E + 2,4-D (A)[c] + picloram	0.25 + 0.5 + 0.13	09
untreated	-----	00

[a](4E)=4lb/gal ester, [b](LVE)=Low Volatile Ester, [c](A)=Amine

The effect of various herbicides on Douglas rabbitbrush (*Chrysothamnus viscidiflorus* (Hook.) Nutt.). Tom D. Whitson, Doug Reynolds, Roger Cox, and Kristi K. Rose. (Department of Plant Sciences, University of Wyoming, Laramie, WY 82071). Douglas rabbitbrush is a native, perennial shrub which grows on dry areas often in the same habitat types sagebrush. This plant increases with overgrazing forming monocultures. This experiment was conducted on uniform stands of Douglas rabbitbrush on rangeland near Saratoga, WY. The plots were 20 feet wide by 27 feet long arranged in a randomized complete block design with four replications. Soils were sandy loam with 73% sand, 10% silt, 17% clay, 1.2% organic matter, and a pH of 7.1. Herbicides were applied June 6, 1996 to rabbitbrush in active foliar growth. The wind was calm, skies clear, temperature: air, 82°F, soil 1 in., 90°F, 2 in., 82°F, 4 in., 82°F and moisture was adequate for active growth. Evaluations were made September 15, 1998. Picloram at 0.5, triclopyr 4E + picloram at 0.5 + 0.25, and 1.0 + 0.25 lb/A controlled Douglas rabbitbrush by 100, 98, and 98% respectively. Following control, western wheatgrass and prairie junegrass stands increased dramatically. (Wyoming Agric. Exp. Sta., Laramie, WY 82071 SR 1718.)

Table. Control of Douglas rabbitbrush with various herbicides.

Treatment	Rate lb/A	% Control
Triclopyr 4E[a]	0.5	19
Triclopyr 4E[a]	1.0	25
Triclopyr 4E[a]	2.0	48
Picloram	0.25	65
Picloram	0.5	100
Triclopyr 4E[a] + 2,4-D (LVE)[b]	0.5 + 2.0	56
Triclopyr 4E[a] + 2,4-D (LVE)[b]	0.25 + 2.0	29
Triclopyr 4E[a] + picloram	0.5 + 0.25	98
Triclopyr 4E[a] + picloram	1.0 + 0.25	98
2,4-D (LVE)[b]	2.0	76
Picloram + 2,4-D (LVE)[b]	0.25 + 2.0	100
Picloram + 2,4-D (A)[c]	0.25 + 1.0	97
Triclopyr 4E[a] + 2,4-D (A)[c] + picloram	0.25 + 0.5 + 0.13	52
untreated	-----	00

[a](4E)=4lb/gal ester, [b](LVE)=Low Volatile Ester, [c](A)=Amine

The effect of various herbicides on gray rabbitbrush (*Chrysothamnus nauseosus* (Pallas) Britt.). Tom D. Whitson, Doug Reynolds, Roger Cox, and Kristi K. Rose. (Department of Plant Sciences, University of Wyoming, Laramie, WY 82071). Gray rabbitbrush a perennial, native shrub (also called rubber rabbitbrush) grows in dry areas often in association with big sagebrush. Gray rabbitbrush often forms monocultural stands, which indicates overgrazing. It is a resprouter which makes control very difficult. An experiment was established June 6, 1996 on uniform stands of gray rabbitbrush near Saratoga, WY. Plots were 20 feet wide by 27 feet long arranged in a randomized complete block design with four replications. Soils were sandy loam with 73% sand, 10% silt, 17% clay, 1.2% organic matter, and a pH of 7.1. Herbicides were applied June 6, 1996 and a second application was made as a split-plot application June 9, 1997. Evaluations were made September 15, 1998. Picloram + 2,4-D (LVE) at 0.25 + 2.0, 2,4-D (LVE) at 2.0, and triclopyr 4E + 2,4-D (LVE) at 0.25 + 2.0 provided controls of 94,93, and 92% respectively. (Wyoming Agric. Exp. Sta., Laramie, WY 82071 SR 1724.)

Table. Control of gray rabbitbrush with various herbicides.

Treatment	Rate lb/A	% Control
Triclopyr 4E[a]	0.5	19
Triclopyr 4E[a]	1.0	73
Triclopyr 4E[a]	2.0	86
Picloram	0.25	20
Picloram	0.5	39
Triclopyr 4E[a] + 2,4-D (LVE)[b]	0.5 + 2.0	89
Triclopyr 4E[a] + 2,4-D (LVE)[b]	0.25 + 2.0	92
Triclopyr 4E[a] + picloram	0.5 + 0.25	76
Triclopyr 4E[a] + picloram	1.0 + 0.25	88
2,4-D (LVE)[b]	2.0	93
Picloram + 2,4-D (LVE)[b]	0.25 + 2.0	94
Picloram + 2,4-D (A)[c]	0.25 + 1.0	84
Triclopyr 4E[a] + 2,4-D (A)[c] + picloram	0.25 + 0.5 + 0.13	81
untreated	-----	00

[a](4E)=4lb/gal ester, [b](LVE)=Low Volatile Ester, [c](A)=Amine

The effects of various herbicides on gray rabbitbrush (*Chrysothamnus nauseosus (Pallas) Britt.*). Tom D. Whitson, Doug Reynolds, and Kristi K. Rose. (Department of Plant Sciences, University of Wyoming, Laramie, WY 82071). Gray rabbitbrush a perennial, native shrub grows in dry areas often in the same habitat as big sagebrush. Gray rabbitbrush is an invader that may indicate overgrazing if it is found in dense stands. It is a re-sprouter making it very difficult to control. Studies were conducted on dense stands of gray rabbitbrush near Saratoga, WY. Herbicides were applied July 14, 1998 with a Burch Wet Blade® mower at 2.5 gallons per acre. Plots were 300 feet long by 11 feet wide arranged in randomized complete blocks with three replications. Soils had 1.1 % organic matter, 90% sand, 3% silt, 7% clay, with a pH of 7.5. During application skies were clear, relative humidity 23%, no wind, air temperature 93°F, soil temperatures, surface 95°F, 1 in. 92°F, 2 in. 88°F, and 4 in. 87°F. Gray rabbitbrush was in the bud stage at application. Evaluations were made September 14, 1998, two months following application. Picloram at 0.5 lb/A reduced the gray rabbitbrush re-sprouting by 93%. Other treatments were only partially effective. Evaluations in 1999 will be more conclusive. (Wyoming Agric. Exp. Sta., Laramie, WY 82071 SR 1720.)

Table. Control of gray rabbitbrush with various herbicides using a Burch Wet Blade® mower.

Treatment	Rate lb/A	% Reduction
Picloram	0.5	93
Triclopyr 4E	2.0	27
Picloram + 2,4-D amine	1.0+0.25	42
Mow only	--	0
Picloram	0.25	45
Triclopyr 4E+ imazapyr	2.0+0.25	23
Imazapic	0.25	2
Clopyralid	0.38	7

The effects of various herbicides on broom snakeweed (*Gutierrezia sarothrae* (Pursh) Britt. & Rusby). Tamra R. Jensen, Tom D. Whitson, and Kristi K. Rose. (Department of Plant Sciences, University of Wyoming, Laramie, WY 82071). Broom snakeweed is a native perennial, which is highly toxic during leaf formation. If cattle or sheep eat this plant it may cause weak calves and lambs or abortions. Broom snakeweed intermixed with grasses reduces utilization of pastures and rangeland. This experiment was conducted to determine which herbicides most effectively control broom snakeweed. Plots were 10 by 27 feet arranged as a randomized complete block design with four replications. The herbicides were applied to a uniform stand of broom snakeweed near Lusk, WY July 2, 1996 when plants were in the pre-bloom stage. The air temperature was 96F, relative humidity 20%, soil temperature surface 100F, 1 inch 95F, 2 inches 85F, 4 inches 85F, wind 1-3 mph. Soils were a clay loam with 38% sand, 32% silt, 30% clay, with 2% organic matter and a pH of 7.2. Evaluations were made August 11, 1997 and September 4, 1998. Applications of 2,4-D (A) + picloram at 0.75 + 0.188 and 1.0 + 0.25 lb/A controlled 92 and 94% of the broom snakeweed in 1997. In 1998 2,4-D (A) + picloram at 0.75 + 0.188, 1.0 + 0.25, and picloram + 2,4-D (LVE) at 0.25 + 1.0 lb/A reduced the broom snakeweed by 96, 98, and 97% respectively. (Wyoming Agric. Exp. Sta., Laramie, WY 82071 SR 1722.)

Table. Control of broom snakeweed with various herbicides.

		% Control	
Treatment	Rate (lb/A)	1997	1998
2,4-D (A)[a] + picloram	0.5 + 0.125	70	90
2,4-D (A)[a] + picloram	0.75 + 0.188	92	96
2,4-D (A)[a] + picloram	1.0 + 0.25	94	98
2,4-D (LVE)[b]	2.0	46	73
Picloram + 2,4-D (LVE)[b]	0.125 + 0.5	72	86
Picloram + 2,4-D (LVE)[b]	0.25 + 1.0	89	97
Untreated	-----	18	00

[a](A)=Amine, [b](LVE)=Low Volatile Ester

The influence of picloram, 2,4-D, or picloram + 2,4-D on broom snakeweed and wild tarragon on Colorado rangeland. James R. Sebastian and K.G. Beck. (Department of Bioagricultural Sciences and Pest Management, Colorado State University, Fort Collins, CO 80538) An experiment was established near Laporte, CO to evaluate broom snakeweed (GUESA) and wild tarragon (ARTDR) control with 2,4-D, picloram, picloram + 2,4-D, or premixed picloram + 2,4-D. The experiment was designed as a randomized complete block with four replications.

Herbicides were applied to GUESA and ARTDR at late bud growth stage on August 7, 1996. All treatments were applied with a CO_2-pressurized backpack sprayer using 11003LP flat fan nozzles at 21 gal/A, 14 psi. Other application information is presented in Table 1. Main plot size were 20 by 30 feet.

Visual evaluations for control and cover compared to non-treated control plots were collected in July 1997 and August 1998, approximately 1 and 2 years after treatment (YAT). A Levy and Madden point frame was used in 1997, but changed to a Daubenmire frame in 1998 to detect lower growing vegetation. The point frame did not provide accurate cover measurements of the low growing blue grama with taller GUESA canopy. Cover data are means from 10 point frames or 0.1 m^2 quadrats per plot (40 total quadrats per treatment).

All treatments controlled GUESA 5 to 99% 1 YAT and 8 to 100% 2 YAT (Table 2). It required 0.3 lb/A of picloram to have greater than 86% GUESA control or 0.2 lb/A + 0.71 lb/A picloram plus 2,4-D to have 76% or greater GUESA control 1 or 2 YAT. It required 0.3 lb/A picloram plus 1.0 lb/A 2,4-D to decrease OPOPU cover to 0. Similar rates of picloram plus 2,4-D premixed or field mixed provided the same GUESA and ARTDR control. GUESA and ARTDR was controlled poorly by 2,4-D alone. ARTDR had 5 to 96% control 1 YAT and 0 to 94% 2 YAT. More than 81% of ARTDR was controlled with 0.4 lb picloram or 0.3 + 1.0 lb/A of picloram plus 2,4-D 1 or 2 YAT.

Table 1. Application data for the influence of picloram, 2,4-D, or picloram + 2,4-D on broom snakeweed and wild tarragon on Colorado rangeland.

Environmental data	
Application date	August 7, 1996
Application time	7:30 AM
Air temperature, F	68
Relative humidity, %	70
Wind speed, mph	0 to 4

Application date	species	growth stage	height (in)
August 7, 1996	GUESA	Late bud	7 to 12
	TARSP	Bud	9 to 14
	AGRSM	Vegetative	9 to 14
	BOUGR	Flower	2 to 3
	HORJU	Late flower	5 to 6

Table 2. The influence of picloram, 2,4-D, or picloram + 2,4-D on broom snakeweed and wild tarragon on Colorado rangeland.

Herbicide[a]	Rate	Broom Snakeweed				Wild Tarragon		
		Control		Cover		Control		Cover
	(lb ai/A)	1997	1998	1997	1998	1997	1998	1998
		%						
Picloram	0.06	5	8	23	12	5	0	1
	0.13	45	33	13	21	54	34	11
	0.2	56	39	6	17	59	30	8
	0.3	86	86	2	3	79	64	6
	0.4	93	96	1	0	90	84	2
Picloram[b] + 2,4-D	0.13 + 0.5	66	59	5	11	63	48	7
2,4-D	2.0	34	33	12	15	28	26	6
Picloram[c] + 2,4-D	0.07 + 0.25	21	20	15	19	29	13	11
	0.13 + 0.5	59	48	4	11	60	35	9
	0.2 + 0.71	81	76	1	9	80	69	8
	0.3 + 1.0	90	94	2	0	91	81	1
	0.4 + 1.5	99	100	0	0	96	94	1
Control		0	0	15	32	0	0	7
LSD (0.05)		18	21	7	11	19	19	7

[a] X-77 surfactant added to all treatments at 0.25% v/v.
[b] Picloram plus the amine formulation of 2,4-D.
[c] Premixed formulation of picloram + amine formulation of 2,4-D.

Evaluation of diflufenzopyr with auxin herbicides for leafy spurge control. Rodney G. Lym. (Department of Plant Sciences, North Dakota State University, Fargo, ND 58105). Diflufenzopyr is an auxin transport inhibitor (ATI), which suppresses the transport of naturally occurring IAA and synthetic auxin-like compounds in plants. In general, diflufenzopyr interferes with the auxin balance needed for plant growth. The purpose of this research was to evaluate diflufenzopyr applied with various auxin herbicides for leafy spurge control.

BAS-662 (formally known as SAN-1269) is a combination of dicamba plus diflufenzopyr (SAN-836) in a ratio of 2.5:1 dicamba:diflufenzopyr. In the first experiment this pre-mixed treatment was compared to diflufenzopyr applied with other auxin herbicides in the same ratio of 2.5:1. The application rate for all herbicides was reduced approximately 50% from the normal use rate for season-long control to more quickly determine if diflufenzopyr caused increased leafy spurge control when applied with an auxin herbicide. The experiment was established at the Ekre Research Station, near Walcott, ND, on June 12, 1997. The leafy spurge was in the true-flower growth stage and 18 to 36 inches tall. The herbicides were applied using a hand-boom sprayer delivering 8.5 gpa at 35 psi. The plots were 10 by 30 feet and replicated four times in a randomized complete block design. All treatments were applied with the surfactant X-77 plus 28% N at 0.25% + 1.25% (v/v), respectively. Leafy spurge foliage injury was visually evaluated 1 MAT (month after treatment) and control based on percent stand reduction compared to the untreated check was evaluated 3 and 12 MAT.

Leafy spurge foliage injury increased dramatically when diflufenzopyr was applied with an auxin herbicide compared to the herbicide applied alone (Table 1). For example, foliage injury increased from 76 to 93% when diflufenzopyr was applied with dicamba and from 56 to 99% when diflufenzopyr was applied with picloram compared to the herbicides applied alone. The largest increase in foliage injury (38 to 95%) occurred when quinclorac was applied with diflufenzopyr compared to quinclorac applied alone.

Leafy spurge control with dicamba, picloram, and fluroxypyr was better 3 MAT when the herbicides were applied with diflufenzopyr compared to the herbicides applied alone (Table 1).
For instance, leafy spurge control with fluroxypyr increased from 28 to 76% 3 MAT when diflufenzopyr was added and from 10 to 47% when diflufenzopyr was applied with picloram. Since the herbicides were applied at below the normal use rate, leafy spurge control declined rapidly the following growing season. However, control 12 MAT was increased when diflufenzopyr was applied with dicamba and quinclorac and tended to be increased with picloram plus 2,4-D compared to the herbicides applied alone 3 MAT.

The second experiment evaluated leafy spurge control with dicamba applied in mid-summer or fall alone or with diflufenzopyr in a commercial mixture. The experiment was established near Fargo in 1997 and herbicides were applied as previously described on July 22 (summer) or September 15 (fall) when leafy spurge was in the true-flower to seed-set or fall regrowth growth stages, respectively. All treatments were applied with surfactant X-77 and 28% N at 0.25% plus 1.25%, respectively. Leafy spurge growth had been delayed in the spring because of flooding in the area.

Leafy spurge foliage injury 1 MAT increased when diflufenzopyr was applied with dicamba compared to dicamba alone, similar to the first study (Tables 1 and 2). Leafy spurge control the following growing season was much better when dicamba was applied with diflufenzopyr compared to dicamba alone, especially for the fall applied treatments (Table 2). For instance, leafy spurge control averaged 96% 11 MAT with dicamba plus diflufenzopyr at 16 plus 6.4 oz/A compared to only 20% with dicamba applied alone and was similar to the standard treatment of picloram plus 2,4-D. Control 13 MAT was or tended to be increased with all dicamba plus diflufenzopyr treatments compared to dicamba alone. Again, dicamba plus diflufenzopyr at 16 plus 6.4 oz/A provided similar control (61%) to the standard picloram plus 2,4-D treatment.

The third experiment was established near Valley City, ND on September 17, 1997 when leafy spurge was in the fall regrowth growth stage to evaluate the effect of diflufenzopyr applied with auxin herbicides and imazapic at recommended rates. As observed in the previous studies leafy spurge control increased or tended to increase when diflufenzopyr was applied with an auxin herbicide, especially dicamba and picloram (Table 3). Leafy spurge control averaged 54% 12 MAT when diflufenzopyr was applied with dicamba compared to only 20% when dicamba was applied alone. Control increased from 66 to 90% when diflufenzopyr was applied with picloram compared to the herbicide alone. Leafy spurge control also tended to increase when diflufenzopyr was applied with imazapic even though that herbicide is classified as a ALS inhibitor.

The fourth experiment was established to evaluate the optimum ratio of diflufenzopyr with various herbicides. The diflufenzopyr ratio was varied from the standard ratio of 2.5:1 herbicide:ATI to 5:1 and 10:1. The experiment was established near Jamestown and Valley City, North Dakota, in early June 1998 when leafy spurge was in the true-flower growth stage. Both initial foliage injury 1 MAT and top growth control 3 MAT were higher when diflufenzopyr was applied with dicamba and quinclorac compared to the herbicide alone (Table 4). However, injury and control were similar regardless of the diflufenzopyr rate. For instance, leafy spurge control with dicamba applied alone averaged 84% 3 MAT but increased to an average of 97% when applied with diflufenzopyr. Control with quinclorac alone averaged 78% but increased to an average of 97% when applied with diflufenzopyr. Control was also increased to 78% when diflufenzopyr was applied with glyphosate plus 2,4-D compared to 44% with the herbicides alone.

In summary, both initial and long-term leafy spurge control increased when diflufenzopyr was applied with auxin herbicides and with imazapic. Leafy spurge control 3 MAT was similar regardless of the ratio of diflufenzopyr to herbicide. Diflufenzopyr could be used to increase long-term leafy spurge control with herbicides or allow the use of reduced herbicide rates without a subsequent loss in control.

Table 1. Leafy spurge control with auxin herbicides applied alone and with diflufenzopyr in June 1997.

Treatment	Rate	Foliage inj[a] 1 MAT[b]	Control 3 MAT[b]	Control 12 MAT[b]
	— oz/A —	%		
Dicamba	4	76	5	0
Dicamba + diflufenzopyr[c]	4 + 1.6	93	43	38
Picloram	2	56	10	0
Picloram + diflufenzopyr	2 + 0.8	99	47	6
2,4-D	4	81	40	4
2,4-D + diflufenzopyr	4 + 1.6	98	45	5
Picloram + 2,4-D	2 + 4	68	64	3
Picloram + 2,4-D + diflufenzopyr	2 + 4 + 0.8	95	71	25
Quinclorac	8	38	88	71
Quinclorac + diflufenzopyr	8 + 3.2	95	96	90
Fluroxypyr	4	78	28	4
Fluroxypyr + diflufenzopyr	4 + 1.6	100	76	16
LSD (0.05)		9	34	23

[a]Based on foliage topgrowth injury with 0 = no injury and 100 = all topgrowth killed.
[b]Months after treatment.
[c]Commercial mixture of dicamba plus diflufenzopyr - Distinct (BAS-662).

Table 2. Dicamba applied in mid-summer or fall alone and with diflufenzopyr for leafy spurge control.

Time applied and treatment	Rate	Foliage inj[a]. 1 MAT[b]	Control 11 MAT[b]	Control 13 MAT[b]
	- oz/A -	%		
Mid-summer				
Dicamba + diflufenzopyr[c]	4+1.6	36	38	8
Dicamba + diflufenzopyr[c]	8+3.2	80	38	23
Dicamba	4	10	6	3
Dicamba	8	66	23	6
Picloram + 2,4-D	4 + 16	97	34	18
Fall applied				
Dicamba + diflufenzopyr[c] fall	8+3.2		77	23
Dicamba + diflufenzopyr[c] fall	16+6.4		96	61
Dicamba fall	8		28	8
Dicamba fall	16		20	5
Picloram + 2,4-D fall	8 + 16		94	63
LSD (0.05)		22	26	20

[a]Based on foliage topgrowth injury with 0 = no injury and 100 = all topgrowth killed.
[b]Months after treatment.
[c] Commercial mixture of dicamba plus diflufenzopyr - Distinct (BAS-662).

Table 3. Diflufenzopyr applied with various herbicides in the fall for leafy spurge control.

Treatment	Rate	Control	
		9 MAT[a]	12 MAT[a]
	——— oz/A ———	—— % ——	
Dicamba + X-77 + 28% N	32 + 0.25% + 1.25%	65	20
Dicamba + diflufenzopyr[b] + X-77 + 28% N	32 + 12.8 + 0.25% + 1.25%	78	54
Picloram	8	89	66
Picloram + diflufenzopyr	8 + 3.2	100	90
Picloram + 2,4-D	8 + 16	95	78
Picloram + 2,4-D + diflufenzopyr	8 + 16 + 3.2	99	88
Quinclorac + Scoil[c]	16 + 1 qt	99	89
Quinclorac + diflufenzopyr + Scoil[c]	16 + 6.4 + 1 qt	100	95
Imazapic + Sunit[c] + 28% N	2 + 1 qt + 1 qt	95	84
Imazapic + diflufenzopyr + Sunit[c] + 28% N	2 + 0.8 + 1 qt + 1 qt	99	96
LSD (0.05)		14	16

[a] Months after treatment.
[b] Commercial mixture of dicamba plus diflufenzopyr - Distinct (BAS-662).
[c] Methylated seed-oil by AGSCO.

Table 4. Diflufenzopyr applied at various ratios with herbicides for leafy spurge control averaged over two locations in North Dakota.

Treatment	Rate	Foliage injury 1 MAT[a]	Control 3 MAT[a]
	——— oz/A ———	—— % ——	
Dicamba + X-77 + 28% N	2 + 0.25% + 1 qt	64	84
Dicamba + diflufenzopyr + X-77 + 28% N	2 + 3.2 + 0.25% + 1 qt	67	94
Dicamba + diflufenzopyr + X-77 + 28% N	2 + 6.4 + 0.25% + 1 qt	78	99
Dicamba + diflufenzopyr + X-77 + 28% N	2 + 12.8 + 0.25% + 1 qt	70	98
Quinclorac + Scoil[b]	12 + 1 qt	47	78
Quinclorac + diflufenzopyr + Scoil[b]	12 + 1.6 + 1 qt	61	96
Quinclorac + diflufenzopyr + Scoil[b]	12 + 3.2 + 1 qt	60	97
Quinclorac + diflufenzopyr + Scoil[b]	12 + 4.8 + 1 qt	66	98
Glyphosate + 2,4-D[c]	6 + 10	88	44
Glyphosate + 2,4-D[c] + diflufenzopyr	6 + 10 + 6.4	84	78
LSD (0.05)		8	8

[a] Months after treatment.
[b] Methylated seed-oil by AGSCO.
[c] Commercial formulation - Landmaster BW.

Evaluation of imazapic for leafy spurge control. Rodney G. Lym. (Plant Sciences Department, North Dakota State University, Fargo, ND 58105). Imazapic (Plateau) has been registered for leafy spurge control in non-cropland. The label states that imazapic should be applied with a methylated seed oil (MSO) adjuvant plus 28% urea nitrogen. Also, the manufacturer recommends imazapic be applied in the fall prior to a killing frost or as a split application in the fall and the following spring. The purpose of these experiments was to evaluate imazapic for leafy spurge control and grass injury applied alone or with a MSO adjuvant in the spring or fall for 3 years, or for leafy spurge control under trees.

The first experiment evaluated leafy spurge control with imazapic applied in mid-summer or fall for 3 years at two locations in North Dakota. The herbicide treatments were applied using a tractor-mounted sprayer delivering 8.5 gpa at 35 psi. The plots were 10 by 30 feet and replicated four times with the herbicide treatments in a randomized complete block design. Herbicides were applied near Valley City or Jamestown on July 3, 1996, when the leafy spurge was in the flowering to seed-set growth stage. The air temperature was approximately 80 F and the soil temperature at the 4 inch depth was 57 F at Valley City and 69 F at Jamestown. The fall treatments were applied at both locations on September 9 when the leafy spurge was in the fall regrowth growth stage and the air temperature was in the mid 80s. Treatments were reapplied in 1997 and 1998 on similar dates.

Imazapic applied in mid-summer at Valley City did not control leafy spurge when visually evaluated the year of treatment (Table 1). However, control by imazapic at 2 and 4 oz/A averaged 94 and 99%, respectively in May 1997. Imazapic at 4 oz/A provided 93% leafy spurge control in September 1997 with minimal grass injury, but 4 oz/A is above the maximum labeled use rate of 3 oz/A. Imazapic fall-applied at 2 or 4 oz/A provided excellent leafy spurge control the following spring but grass injury was very noticeable and averaged 43%. Imazapic applied at 1 or 2 oz/A with MSO provided 92% leafy spurge control when evaluated in the fall 12 MAT, which was higher than the standard picloram plus 2,4-D treatment which averaged 47%.

Imazapic applied in July for 3 yr averaged >90% leafy spurge control 1 month after the last August treatment date (Table 1), with no visible grass injury. The grasses had recovered from the injury observed following the initial treatment and were not injured by the subsequent treatments. Leafy spurge control from imazapic fall-applied averaged above 80% following two annual applications and was similar to the standard treatment of picloram plus 2,4-D.

Leafy spurge control with imazapic applied in mid-summer tended to be less at Jamestown than Valley City (Tables 1 and 2). Only imazapic at 4 oz/A provided greater than 90% control in May 1997 at Jamestown (Table 2). Control averaged 99% in September following a second application of picloram plus 2,4-D, but only was 71% or less with a second application of imazapic. Grass injury could not be evaluated in September 1997 because of severe hail damage at the research location.

Imazapic applied in the fall at Jamestown provided excellent (99%) leafy spurge control in May 1997 regardless of application rate (Table 2). In contrast to the high grass injury at Valley City (Table 1), imazapic at 4 oz/A fall-applied averaged 18% grass injury and was the only treatment to injure grass at Jamestown (Table 2). Leafy spurge control averaged 97% 12 and 24 MAT with both imazapic applied alone at 4 oz/A or at 2 oz/A with MSO compared to 26% with picloram plus 2,4-D.

The second experiment evaluated leafy spurge control with imazapic on a sandy soil at Camp Grafton South, near McHenry, North Dakota, under full-grown ash trees (Table 3). The experiment was established on August 29, 1996, when leafy spurge was in the fall regrowth stage. The air temperature was 79 F and the soil temperature was 72 F at the 4 inch soil depth.

Leafy spurge control in June 1997 averaged 100% with imazapic applied at 2 and 3 oz/A compared to 89% with picloram plus 2,4-D (Table 3). There was 23% grass injury with imazapic applied at 3 oz/A. Control remained high 12 MAT with both imazapic treatments and averaged 95% control compared to 48% with picloram plus 2,4-D, and the grass had recovered. Control 15 MAT with imazapic applied at 3 oz/A averaged 84% and was the only treatment to maintain good control. There was no visible injury to the ash trees regardless of application rate.

In general, imazapic applied in the fall provided better leafy spurge control than the mid-summer treatment and control was sometimes improved when the herbicide was applied with a MSO or MSO plus 28% N compared to imazapic applied alone. Grass injury to cool season species tended to be higher when imazapic was applied in July compared to fall-applied, but the grasses recovered by 12 MAT.

Table 1. Imazapic for leafy spurge control annually applied in mid-summer or fall for 3 yr at Valley City, ND.

		Evaluation/year							
		Sept 1996		May 1997		Sept 1997		June 98	Aug 98
Treatment[a]	Rate	Control	Grass inj.	Control	Grass inj.	Control	Grass inj.	Control	Control
	— oz/A —	%							
Applied annually in July									
Imazapic	2	0	0	94	10	74	5	90	95
Imazapic	4	0	0	99	28	93	5	50	93
Imazapic + MSO[b]	1 + 1 qt	0	0	0	8	87	3	82	96
Imazapic + MSO[b]	2 + 1 qt	0	0	99	28	73	16	59	96
Picloram + 2,4-D	4 + 16	74	4	75	0	38	0	26	96
Applied annually in Sept.									
Imazapic	2			100	36	71	0	99	85
Imazapic	4			100	53	99	0	100	98
Imazapic + MSO[b]	1 + 1 qt			100	20	92	0	99	82
Imazapic + MSO[b]	2 + 1 qt			100	40	92	0	99	85
Picloram + 2,4-D	8 + 16			99	13	47	0	95	86
LSD (0.05)		34	NS	20	25	25	NS	26	10

[a]Initial treatments applied July 2 (summer) and September 9, 1996 (fall). All treatments were reapplied in 1997 and 1998.
[b]Methylated seed oil was SunIt by AGSCO.

Table 2. Imazapic for leafy spurge control annually applied in mid-summer or fall for 3 yr at Jamestown, ND.

		Sept 1996		May 1997		Sept 1997	June 1998		Aug 1998
Treatment[a]	Rate	Control	Grass inj.	Control	Grass inj.	Control	Control	Grass inj.	Control
	— oz/A —	%							
Applied annually in July									
Imazapic	2	0	0	0	0	0	34	0	22
Imazapic	4	13	14	92	1	71	96	2	99
Imazapic + MSO[b]	1 + 1 qt	28	0	33	0	13	58	0	36
Imazapic + MSO[b]	2 + 1 qt	17	0	72	0	45	85	0	82
Picloram + 2,4-D	4 + 16	46	0	15	0	99	42	0	87
Applied annually in Sept.									
Imazapic	2			99	5	28	97	0	45
Imazapic	4			100	18	97	100	23	99
Imazapic + MSO[b]	1 + 1 qt			99	6	70	99	0	29
Imazapic + MSO[b]	2 + 1 qt			100	6	96	100	6	96
Picloram + 2,4-D	8 + 16			95	0	26	97	0	26
LSD (0.05)		14	10	19	6	18	10	5	17

[a]Intial treatments applied July 2 (summer) and September 9, 1996 (fall). All treatments were reapplied at a similar date in 1997 and 1998.
[b]Methylated seed oil was Sun-It by AGSCO.

Table 3. Imazapic for leafy spurge control near trees established on Camp Grafton South near McHenry, ND.

		June 1997		Sept 1997		June 98
Treatment[a]	Rate	Control	Grass injury	Control	Grass injury	Control
	— oz/A —	%				
Imazapic + MSO[b] + 28% N	2 + 1 qt + 1 qt	100	11	93	0	56
Imazapic + MSO[b] + 28% N	3 + 1 qt +1 qt	100	23	96	3	84
Picloram + 2,4-D	8 + 16	89	0	48	0	6
LSD (0.05)		8	9	14	NS	32

[a]Treatments applied August 29, 1996.
[b]Methylated seed oil was Sun-It by AGSCO.

Yellow starthistle control with imazapic, picloram, clopyralid, 2,4-D, and dicamba. Sandra L. Shinn and Donald C. Thill. (Plant Science Division, University of Idaho, Moscow, ID 83844-2339). Two studies were established on unimproved pasture land near Lewiston, Idaho (upper and lower Tammany) to evaluate yellow starthistle control with imazapic, picloram, clopyralid, dicamba and 2,4-D. Soil type at lower Tammany was a silt loam (38% sand, 8% clay, 54% silt, pH 7.5, and 4.3% organic matter), and at upper Tammany the soil was a silt loam (38% sand, 10% clay, 52% silt, pH 7.3, and 5.4% organic matter). The experimental design was a randomized complete block with four replications and individual plots were 2.4 by 9.1 m. Herbicide treatments were applied postemergence on February 24, at lower Tammany and on March 18, 1998 at upper Tammany with a CO_2 pressurized backpack sprayer calibrated to deliver 94 L/ha at 206 kPa (Table 1). Yellow starthistle was evaluated visually, and plant counts and biomass were taken on June 12, at lower Tammany and June 22, 1998 at upper Tammany. Yellow starthistle plants were counted and cut from a 0.25 m^2 area, dried for 72 hours and weighed when the yellow starthistle flower had a firm bud.

Table 1. Application data.

	Lower Tammany	Upper Tammany
Yellow starthistle stage	5 to 8 leaves	5 to 8 leaves
Air temperature (C)	4	16
Relative humidity (%)	38	64
Wind (km/h)	5	3
Cloud cover (%)	40	10
Soil temperature (C at 5 cm)	5	10

At upper and lower Tammany, imazapic plus dicamba or 2,4-D visually controlled yellow starthistle 71 to 100%, reduced yellow starthistle plant density 98 to 100%, and biomass 96 to 100% compared to the untreated control (Table 2). Imazapic applied alone at both locations visibly suppressed the yellow starthistle 23 to 81%, reduced the plant density 77 to 96%, and biomass 71 to 96% compared to the untreated control. Clopyralid and picloram controlled the yellow starthistle nearly 100%.

Table 2. Yellow starthistle control, density and biomass.

Treatment	Rate	Lower Tammany			Upper Tammany		
		control	density	biomass	control	density	biomass
	kg/ha	%	plants/m^2	g/m^2	%	plants/m^2	g/m^2
Imazapic[1]	0.14	23	924	92	20	330	72
Imazapic	0.21	40	831	50	81	161	11
2,4-D	2.24	23	69	22	0	866	179
Clopyralid	0.42	100	0	0	100	36	2
Dicamba	1.12	75	2	4	100	0	0
Picloram	0.42	100	0	0	100	0	0
Imazapic + dicamba	0.14 + 1.12	100	0	0	96	19	1
Imazapic + 2,4D	0.14 + 2.24	85	1	0	90	89	13
Imazapic + dicamba	0.21 + 1.12	100	0	0	97	0	0
Imazapic + 2,4D	0.21 + 2.24	71	17	2	96	34	2
Untreated check	--	--	3994	318	--	3585	293
LSD (0.05)		39	1256	72	18	1085	71

[1] All imazapic treatments were applied with a methylated seed oil plus surfactant at 1.25% v/v.

Yellow starthistle control with imazapic. Sandra L. Shinn and Donald C. Thill. (Plant Science Division, University of Idaho, Moscow, ID 83844-2339) A study was established at two locations on unimproved pasture land near Lewiston, Idaho (upper and lower Tammany) to evaluate yellow starthistle control with imazapic and picloram. Soil type at lower Tammany was a silt loam (38% sand, 8% clay, 54% silt, pH 7.5, and 4.3% organic matter), and at upper Tammany soil was a silt loam (38% sand, 10% clay, 52% silt, pH 7.3, and 5.4% organic matter). Herbicide treatments were arranged as a 2 (fertilizer) by 15 (herbicide) factorial randomized complete - split block design with four replications and individual plots were 2.4 by 12.2 m. Herbicides were applied with a CO_2 pressurized backpack sprayer calibrated to deliver 93 L/ha at 230 kPa (Table 1). Fertilizer [112 kg N/ha as ammonium sulfate (21-0-0-24)] was applied during spring 1998 to one half of each replicate, while no fertilizer was applied to the other half. Yellow starthistle control was evaluated visually, and plant counts and biomass were taken when yellow starthistle plants had firm buds on June 15, at lower Tammany and June 22, 1998 at upper Tammany. Yellow starthistle plants were counted and cut from a 0.25 m^2 area, dried for 72 hours and weighed.

Table 1. Application data.

	Upper Tammany			Lower Tammany		
Application date	Sept 27, 1997	Nov 11, 1997	Mar 18, 1998	Sept 27, 1997	Nov 6, 1997	Feb 24, 1998
Application timing	PRE	POST	POST	PRE	POST	POST
Yellow starthistle stage	--	2 to 4 leaves	5 to 8 leaves	--	2 to 4 leaves	5 to 8 leaves
Air temperature (C)	14	12	16	16	15	4
Relative humidity (%)	48	68	38	48	60	64
Wind (km/h)	8	4	4	3	5	7
Cloud cover (%)	60	60	10	60	40	40
Soil temperature at 5 cm (C)	13	9	10	13	12	5

The fertilizer by treatment by location interaction was not significant, thus data were combined across locations. The addition of fertilizer increased yellow starthistle control 12% compared to no fertilizer. Plant density and biomass was not affected by fertilizer. Picloram applied in the fall or spring controlled yellow starthistle 99 to 100%, reduced plant density 89 to 99%, and reduced biomass 88 to 100% compared to the untreated control (Table 2). Sequential applications of imazapic applied in the fall and spring at 0.07 plus 0.14 kg/ha controlled yellow starthistle 83%, and reduced plant density 83% and biomass 95%. All other treatments controlled yellow starthistle less than 46%. Imazapic applied PRE reduced the yellow starthistle density 62 to 83%, but surviving plants were large and produced biomass similar to the untreated control. Imazapic at 0.21 kg/ha applied postemergence in the fall and spring reduced the yellow starthistle density 48 to 57% and biomass 37 to 87%.

Table 2. Yellow starthistle percent control, plant density and biomass.

Treatment	Rate	Application timing[a]	Control	Density	Biomass
	kg/ha		%	plants/m^2	g/m^2
Imazapic[b]	0.07	F - PRE	8	476	242
Imazapic	0.14	F - PRE	7	347	237
Imazapic	0.21	F - PRE	6	206	235
Imazapic	0.07	F - POST	0	1351	332
Imazapic	0.14	F - POST	24	1340	210
Imazapic	0.21	F - POST	18	649	182
Picloram	0.42	F - POST	99	1	0
Imazapic + imazapic	0.07 + 0.14	F + S - POST	83	207	15
Imazapic + imazapic	0.07 + 0.07	F + S - POST	24	537	84
Imazapic + imazapic	0.14 + 0.07	F + S - POST	42	206	28
Imazapic	0.07	S - POST	13	942	172
Imazapic	0.14	S - POST	34	396	89
Imazapic	0.21	S - POST	46	540	36
Picloram	0.42	S - POST	100	11	22
Untreated check	--	--	--	1242	287
LSD (0.05)			69	708	96

[a] F = fall application, S = spring application

[b] All imazapic treatments were applied with a methylated seed oil plus surfactant at 1.25% v/v.

Evaluation of diflufenzopyr with auxin herbicides for Canada thistle and spotted knapweed control. Rodney G. Lym. (Department of Plant Sciences, North Dakota State University, Fargo, ND 58105). The auxin transport inhibitor (ATI) diflufenzopyr suppresses the transport of naturally occurring IAA and synthetic auxin-like compounds in plants. The purpose of this research was to evaluate Canada thistle and spotted knapweed control by auxin herbicides applied with diflufenzopyr.

In the first experiment auxin herbicides were applied at approximately 50% below the normal use rate for season-long control to more quickly determine if diflufenzopyr caused increased weed control compared to the herbicides applied alone. The experiment was established near Fargo on June 13, 1997, with an air temperature of 82 F and a dew point of 66 F. Canada thistle was in the early bud growth stage and 4 to 16 inches tall. The herbicides were applied using a hand-boom sprayer delivering 8.5 gpa at 35 psi. The plots were 10 by 30 feet and treatments were replicated four times in a randomized complete block design. All treatments were applied with the surfactant X-77 at 0.25% plus 28% N at 1.25%, (v/v). Canada thistle foliage injury was visually evaluated 1 MAT (month after treatment) and control based on percent stand reduction compared to the control was evaluated 3 and 12 MAT.

Canada thistle foliage injury was increased when diflufenzopyr was applied with any of the herbicides evaluated (Table 1). Plants treated with diflufenzopyr plus an herbicide desiccated faster and tended to turn black in color rather than brown for plants treated with only a herbicide. The greatest increase in foliage injury occurred when diflufenzopyr was applied with picloram, 2,4-D, or quinclorac, which averaged 77% foliage injury 1 MAT compared to only 34% when the herbicides were applied alone.

Canada thistle control 3 MAT increased when diflufenzopyr was applied with dicamba, 2,4-D, quinclorac, and clopyralid compared to the herbicides applied alone (Table 1). The most dramatic increase occurred when diflufenzopyr was applied with quinclorac. Quinclorac generally is not toxic to Canada thistle, yet when applied with diflufenzopyr control 3 MAT averaged 67% compared to only 6% when the herbicide was applied alone. Control increased from 37 to 70% with dicamba and from 44 to 83% with 2,4-D when the herbicides were applied with diflufenzopyr compared to alone. No treatment provided satisfactory control 12 MAT.

The second experiment evaluated Canada thistle control with dicamba, quinclorac, and clopyralid plus 2,4-D at standard use rates alone and with diflufenzopyr at various ratios (herbicide:ATI) (Table 2). Treatments were applied on June 9,1998, near Fargo as previously described. Canada thistle plants were beginning to bolt and were 4 to 10 inches tall. Canada thistle control with quinclorac was greatly improved when the herbicide was applied with diflufenzopyr. However, control was similar regardless of the ratio of the ATI in the mixture. Initial control with dicamba and clopyralid plus 2,4-D was similar whether the herbicides were applied alone or with the ATI.

The third experiment evaluated diflufenzopyr applied with various herbicides for spotted knapweed control. The experiment was established near Hawley, MN, on June 12, 1997, and treatments were applied as previously described. The spotted knapweed was in the early bolt growth stage and 4 to 6 inches tall and had been mowed in August 1996. Spotted knapweed control was similar regardless of herbicide or the addition of diflufenzopyr (Table 3). Spotted knapweed control was quite variable over the entire experiment.

In summary, Canada thistle but not spotted knapweed control improved when diflufenzopyr was applied with an auxin herbicide compared to the herbicide alone. Control 2 MAT was similar regardless of the ratio of herbicide to diflufenzopyr.

Table 1. Canada thistle control with auxin herbicides applied In June 1997 either alone or with diflufenzopyr in June 1997.

Treatment	Rate	Foliage inj[a] 1 MAT[b]	Control 3 MAT[b]	12 MAT[b]
	— oz/A —	— % —		
Dicamba	4	54	37	15
Dicamba + diflufenzopyr[c]	4 + 1.6	76	70	11
Picloram	2	46	94	24
Picloram + diflufenzopyr	2 + 0.8	89	88	13
2,4-D	4	36	44	18
2,4-D + diflufenzopyr	4 + 1.6	65	83	18
Picloram + 2,4-D	2 + 4	63	93	24
Picloram + 2,4-D + diflufenzopyr	2 + 4 + 0.8	84	94	34
Quinclorac	8	19	6	1
Quinclorac + diflufenzopyr	8 + 3.2	76	67	11
Clopyralid	1.6	65	83	19
Clopyralid + diflufenzopyr	1.6 + 0.6	88	97	34
LSD (0.05)		13	21	NS

[a] Based on foliage topgrowth injury with 0 = no injury and 100 = all topgrowth killed.
[b] Months after treatment.
[c] Commercial mixture of dicamba plus diflufenzopyr - Distinct.

Table 2. Diflufenzopyr at various ratios with herbicides for Canada thistle control applied in June 1998.

Treatment	Rate	Control 2 MAT[a]
	— oz/A —	— % —
Dicamba + X-77 + 28% N	8 + 0.25% + 1 qt	81
Dicamba + diflufenzopyr + X-77 + 28% N	8 + 0.8 + 0.25% + 1 qt	84
Dicamba + diflufenzopyr + X-77 + 28% N	8 + 1.6 + 0.25% + 1 qt	84
Dicamba + diflufenzopyr + X-77 + 28% N	8 + 3.2 + 0.25% + 1 qt	96
Quinclorac + Scoil[b]	12 + 1 qt	5
Quinclorac + diflufenzopyr + Scoil[b]	12 + 1.6 + 1 qt	68
Quinclorac + diflufenzopyr + Scoil[b]	12 + 3.2 + 1 qt	51
Quinclorac + diflufenzopyr + Scoil[b]	12 + 4.8 + 1 qt	73
Clopyralid + 2,4-D[c]	4 + 16	94
Clopyralid + 2,4-D[c] + diflufenzopyr	4 + 16 + 2	97
Clopyralid + 2,4-D[c] + diflufenzopyr	4 + 16 + 4	100
Clopyralid + 2,4-D[c] + diflufenzopyr	4 + 16 + 8	100
LSD (0.05)		24

[a] Months after treatment.
[b] Methylated seed-oil by AGSCO.
[c] Commercial formulation-Curtail

Table 3. Diflufenzopyr with various herbicides for spotted knapweed control applied in June 1997.

Treatment[a]	Rate	Foliage injury 1 MAT[b]	3 MAT[b]	Control 12 MAT[b]	15 MAT[b]
	— oz/A —	— % —			
Dicamba	4	68	69	84	78
Dicamba + diflufenzopyr	4 + 1.6	63	48	48	51
Picloram	2	55	28	40	34
Picloram + diflufenzopyr	2 + 0.8	61	42	83	68
2,4-D	4	61	48	40	44
2,4-D + diflufenzopyr	4 + 1.6	70	71	79	76
Picloram + 2,4-D	2 + 4	40	25	36	33
Picloram + 2,4-D + diflufenzopyr	2 + 4 + 0.8	51	55	65	59
Quinclorac	8	46	50	50	66
Quinclorac + diflufenzopyr	8 + 3.2	57	68	85	82
Clopyralid	1.6	49	26	45	33
Clopyralid + diflufenzopyr	1.6 + 0.6	70	68	79	68
LSD (0.05)		NS	NS	NS	NS

[a] All treatments were applied with X-77 + 28% N at 0.25% + 1.25%, respectively.
[b] Months after treatment.

The effects of various herbicides on musk thistle. Tom D. Whitson, Kristi K. Rose and Linda M. Munk. (Department of Plant Sciences, University of Wyoming, Laramie, WY 82071). Musk thistle (*Carduus nutans* L.) forms dense stands crowding out desirable forage. Chemicals are an effective control for musk thistle. However, reapplication is required until a depletion of the seed bank is achieved. Studies were conducted near Riverside, WY to determine the efficacy of various herbicides on uniform stands of musk thistle. Soils had a 7.1 pH, 1.1% organic matter, 90%sand , 3% silt, and 7% clay. Plots were 10 by 27 feet and arranged in a randomized complete block design with four replications. Herbicide applications were made on May 3, 1998 while thistles were in pre-bloom and seedling stage of growth. Air temperature was 85°F with clear skies, a relative humidity of 10%, 2-3 mph wind, soil temperature at the surface of 118°F, and at 4 in 102°F. Evaluations were made August 18, 1998. Metsulfuron at 2.0 provided the highest control at 84% and also provided 100% seedhead reduction three months following application, treatments will be re-evaluated in 1999. (Wyoming Agric. Exp. Sta., Laramie, WY 82071 SR 1721.)

Table. Control of musk thistle with various herbicides.

Treatement	Rate (oz/A)	% Control	% Suppression	% Seedhead reduction
Metsulfuron[a]	0.5	35	100	100
Metsulfuron[a]	1.0	58	100	100
Metsulfuron[a]	1.5	73	100	100
Metsulfuron[a]	2.0	84	100	100
Imazapic[a]	6.0	00	11	13
Imazapic[a]	8.0	00	30	23
Imazapic[a]	10.0	00	48	25
Triasulfuron[a]	0.28	00	38	0
Triasulfuron[a]	0.56	04	75	13
Triasulfuron + dicamba[a]	4.0	03	78	25
Untreated	---	00	3	0

[a]All herbicides were applied with 0.25% v/v activator 90 surfactant.

The competitive effects of five cool-season grasses on Dalmatian toadflax (*Linaria genistifolia* ssp. *dalmatica* (L.) Maire and Petitmengin). Kristi K. Rose, Tom D. Whitson, and David W. Koch. (Department of Plant Sciences, University of Wyoming, Laramie, Wyoming 82071). Dalmatian toadflax is a noxious weed that invades rangeland and disturbed areas. Dalmatian toadflax is a short-lived perennial that dies back occasionally and has to reestablish from seed. Once established it can outcompete desirable forage. Dalmatian toadflax has a deep root system and waxy leaves, which makes it very difficult to control. A study was conducted on uniform stands of Dalmatian toadflax on the USDA High Plains Experiment Station near Cheyenne, WY to determine the competitive ability of five cool-season grasses on Dalmatian toadflax. The area was sprayed with picloram at 0.5 lb ai/A on September 10, 1994. The experiment was arranged as a randomized complete block design with three replications. The soils had a 6.5 pH, with 3% organic matter, 63% sand, 18% silt, and 19% clay. Tillage with a rototiller was followed by seeding on April 6, 1995 and August 15, 1995. The grasses seeded were Bozoisky Russian wildrye (*Psathyrostachys juncea*), Critana thickspike wheatgrass (*Elymus lanceolatus*), Hycrest crested wheatgrass (*Agropyron cristatum*), Luna pubescent wheatgrass (*Elytrigia intermedia*), and Sodar streambank wheatgrass (*Elymus lanceolatus*). Dry matter yields by species were determined by harvesting three 0.25 m^2 quadrats per plot on July 9, 1997 and July 6, 1998. Samples were oven dried and weighed then weights were used to calculate the lbs/A.

In the 1997 April seeding to Hycrest crested wheatgrass, Luna pubescent wheatgrass, and Critana thickspike wheatgrass competition reduced Dalmatian toadflax 91, 88, and 87%, respectively. Areas seeded to Luna pubescent wheatgrass produced the greatest biomass (3000 lb/A). The 1997 August seeding did not establish as quickly as the April seeding (Table 1). Because of the completion of the life-cycle of toadflax plants between 1997 and 1998 the August seeded grasses had a chance to effectively compete with Dalmatian toadflax In 1998 thickspike wheatgrass and crested wheatgrass, established in late summer, provided enough competition to reduce Dalmatian toadflax by 91 and 90%, respectively. The third year after grass establishment late summer seedings were all equal to or greater in competition than those established in spring. In 1998 the August seeding became fully established and reduced the amount of toadflax by a greater amount than the April seeding (Table 2). (Wyoming Agric. Exp. Sta., Laramie, WY 82071 SR 1728.)

Table 1. The competitive effects of five cool-season grasses on Dalmatian toadflax in 1997.

	April 6, 1995 seeding			August 15, 1995 seeding		
	lbs (DM)/A			lbs (DM)/A		
Perennial grass	Grass	Toadflax	% reduction	Grass	Toadflax	% reduction
(Hycrest) crested wheatgrass	2635	275	91	1537	1700	42
(Luna) pubescent wheatgrass	3000	355	88	1488	2133	27
(Critana) thickspike wheatgrass	2242	372	87	1195	1908	63
(Bozoisky) Russian wildrye	2341	1209	58	783	1714	38
(Sodar) streambank wheatgrass	1859	1614	44	947	2894	01
Unseeded control	339	2907	0	339	2907	0

Table 2. The competitive effects of five cool-season grasses on Dalmatian toadflax in 1998.

	April 6, 1995 seeding			August 15, 1995 seeding		
	lbs (DM)/A			lbs (DM)/A		
Perennial grass	Grass	Toadflax	% reduction	Grass	Toadflax	% reduction
(Hycrest) crested wheatgrass	1571	259	73	2129	93	90
(Luna) pubescent wheatgrass	1921	209	78	2135	230	76
(Critana) thickspike wheatgrass	1550	206	79	1485	86	91
(Bozoisky) Russian wildrye	2561	244	75	1796	273	72
(Sodar) streambank wheatgrass	1334	370	61	1491	173	82
Unseeded control	858	961	0	858	961	0

The influence of picloram or picloram plus 2,4-D applied for 1, 2, or 3 years on cover, density, and control of yellow toadflax on Colorado Rangeland. James R. Sebastian and K.G. Beck. (Department of Bioagriculture Sciences and Pest Management, Colorado State University, Fort Collins, CO 80538) An experiment was established near Camp Hale, CO to evaluate yellow toadflax (LINVU) control with picloram or picloram + 2,4-D applied over time. The experiment was designed as a split-plot with four replications. Herbicides treatments comprised the main plots (arranged as a randomized complete block) and treatments applied for 1,2, or 3 consecutive years constituted the split.

Herbicides were applied when LINVU was flowering on August 8, 1995 (1 year of treatment), August 20, 1996 (2 years of treatment), and August 13, 1997 (3 years of treatment). All treatments were applied with a CO_2-pressurized backpack sprayer using 11003LP flat fan nozzles at 21 gal/A, 14 psi. Other application information is presented in Table 1. Main plot size was 30 by 30 feet and sub-plots were 10 by 30 feet.

Baseline LINVU density and cover and grass cover were collected before initial applications and these data were collected each successive fall for the duration of the study. Cover and density values are means from three 0.1 m^2 quadrats per plot (12 total quadrats per treatment).

Visual evaluations compared to non-treated control plots were collected in October 1996, 1997, and 1998. Data from 1996 reflect LINVU collected 14 and 2 months after 1 and 2 years treatments were applied respectively; 1997 data were collected 26, 14, and 2 months after 1, 2, and 3 year treatments were applied, and 1998 data were collected 38, 26, and 14 months after 1, 2, and 3 year treatments (Table 2). There were progressively higher LINVU control with successive years of treatments, although not always significant. It took 3 consecutive years of picloram (1.0 lb/A) to get adequate LINVU control (93%). LINVU control decreased to 81% after 2 years and 60% after 1 year of picloram applied at 1.0 lb/A. LINVU cover and density decreased to 0 after 3 years of picloram at 1.0 lb/A or picloram + 2,4-D at 0.5 + 1.0 lb/A. Grass cover nearly doubled (from 48 to 83 or 86% respectively) from these treatments compared to non-treated control plots. Picloram + 2,4-D at 0.25 + 1.0 lb/A decreased LINVU density about 70% and had a similar effect on density as picloram at 1.0 lb/A applied for 3 years. However, picloram at 0.25 lb/A for 3 years did not decrease LINVU density. These data suggest picloram and 2,4-D performed synergistically at least at the lowest rate of picloram.

Table 1. Application data for the influence of picloram or picloram plus 2,4-D applied for 1, 2, or 3 years on cover, density, and control of yellow toadflax on Colorado rangeland.

Environmental data			
Application date	August 3, 1995	August 20, 1996	August 13, 1997
Application time	6:00 AM	9:00 AM	7:00 AM
Air temperature, C	16	14	11
Cloud cover, %	15	35	30
Relative humidity, %	64	63	68
Wind speed, mph	0	0 to 5	0

Application date	species	growth stage	height	density
	(in.)	(shoots/ft^2)		
August 3, 1995	LINVU	flowering	8 to 19	13 to 20
	POAPR	flowering	3 to 10	
	BROMA	flowering	10 to 19	
	AGRSM	late boot	3 to 10	
August 20, 1996	LINVU	flowering	7 to 19	15 to 21
	POAPR	flowering	2 to 6	
	BROMA	flowering	17 to 24	
	AGRSM	late boot	9 to 16	
August 13 1997	LINVU	flowering	8 to 19	13 to 17
	POAPR	flowering	6 to 12	
	BROMA	flowering	13 to 26	

Table 2. The influence of picloram or picloram plus 2,4-D applied for 1, 2, or 3 years on cover, density, and control of yellow toadflax on Colorado rangeland.

Herbicide[b]	Rate	Years of Treatment	Yellow Toadflax[a] Control			Yellow Toadflax[a] Cover			Yellow Toadflax[a] Density			Grass[a] Cover		
	(lb/A)		96	97	98	96	97	98	96	97	98	96	97	98
			------%------						-------(plants/0.1m^2)------			------%------		
picloram	0.25	1	0	0	4	55	55	62	16	11	10	37	53	63
		2	0	10	5	50	51	61	18	15	11	33	57	62
		3	0	15	10	52	69	61	18	19	10	35	48	61
picloram	0.5	1	30	9	5	42	43	70	15	13	13	44	62	58
		2	25	30	28	47	46	51	21	14	12	39	59	60
		3	28	38	60	21	26	18	9	13	3	46	59	79
picloram	0.8	1	41	19	8	27	37	48	8	13	10	40	48	58
		2	35	58	8	21	11	14	5	3	3	44	67	79
		3	43	51	78	41	28	4	14	6	1	39	62	83
picloram	1.0	1	60	34	28	19	26	35	5	7	6	56	65	70
		2	60	81	79	16	4	7	4	1	1	62	73	84
		3	60	75	91	20	11	0	6	3	0	52	69	86
picloram	0.25	1	18	0	0	38	53	68	13	13	13	44	53	59
+ 2,4-D	1.0	2	21	43	28	34	26	26	10	5	4	46	63	67
		3	18	34	50	36	40	22	14	13	4	49	64	83
picloram	0.5	1	73	58	59	3	6	11	1	1	1	53	67	79
+ 2,4-D	1.0	2	69	80	55	10	1	16	2	1	3	55	67	75
		3	64	74	86	18	13	0	6	3	0	55	71	83
control		1	0	0	0	60	63	76	21	17	15	26	42	40
		2	0	0	0	57	65	75	19	16	14	32	45	50
		3	0	0	0	41	49	53	15	13	11	27	39	48
LSD (0.05)			20	22	24	24	25	28	10	8	7	18	16	19

[a] 1996 data reflects LINVU cover, density, or control collected 14 and 2 months after 1 and 2 years of treatments were applied respectively; 1997 data were collected 26, 14, and 2 months after 1, 2, and 3 years after treatments were applied, and 1998 data were collected 38, 26, and 14 months after 1, 2, and 3 years of treatments were applied.

[b] X-77 surfactant added to all treatments at 0.25% v/v.

PROJECT 2

WEEDS OF HORTICULTURAL CROPS

Kai Umeda, Chair

Screening vegetables for tolerance to preemergence and postemergence herbicides, 1997 and 1998. Robert B. McReynolds and Gideon Abraham. (Cooperative Extension Service and Agricultural Experiment Station, North Willamette Research and Extension Center, Oregon State University, Aurora, OR 97002) The purpose of this project was to collect data on the tolerance of selected vegetables to some of the newer herbicides for which there is currently little information available. The vegetables grown in the trial were selected because there are few herbicides registered for use in them. The tolerance information collected from this project is intended to be used to support minor use request to IR-4 and the herbicide manufacturers.

Fourteen herbicides were applied as either preemergence or postemergence treatments to twenty different vegetables seeded in field trials located at the North Willamette Research and Extension Center in western Oregon. The plot design employed for the trials both years was randomized complete block with four replications. Treatments were applied across vegetable lines to plots 7 by 35 ft with a CO_2 backpack sprayer delivering 38 to 40 gpa at 38 psi. Carrier volume in both trials was from 1400 to 1450 ml/treatment. Fresh plant biomass was collected in order to measure the herbicide effects on plant growth in comparison to the untreated and handweeded controls. The method used to obtain biomass was to cut the plants at the soil line in a 0.6 meter length of row approximately 40 days after seeding. Root crops were not cut, but were pulled and the soil was removed prior to weighing. Yields of the mature vegetables was not measured.

The trial conducted in 1997 was directed seeded on June 10. The preemergence treatments were applied broadcast on June 11, 1997 (air temp. 55F, relative humidity 89%, wind SW 2 to 4 mph, sky 100% cloudy, soil temp. – 2 inch 57F) to a Woodburn Silt Loam soil. Rainfall recorded following the applications by the NOAA Station #356151-2 located at Aurora was 0.25 inches. The postemergence treatments were applied over the top on July 2, except for flumiclorac and imazamox which were applied the following day (July 2, air temp. 72F, relative humidity 60%, wind still, sky clear, soil temp. – 2 inch 81F and July 3, air temp. 69F, relative humidity 61%, wind still, sky clear, soil temp. – 2 inch 68F). The trial was sprinkler irrigated with 0.5 inches of water in the evening of July 3. Plant biomass weights were collected 44 days after planting on July 2.

The 1998 trial was established on July 4, with the direct seeding of the vegetable cultivars in an area of soil type similar to the 1997 trial. The preemergence treatments were applied on July 6 (air temp. 74F, relative humidity 76%, wind from NE 0 to 2 mph, sky clear, soil temp. - 2 inches 67F). The plot was sprinkler irrigated with 0.4 to 0.6 inches of water 3 hours after the treatments were applied. The postemergence treatments were applied on July 27 (air temp. 90F, relative humidity 54%, soil temp, - 2 inches 75F, wind still, sky clear). Biomass was collected 39 days after seeding on August 11.

The herbicide rates and application timing are listed in Table 1. The rates selected were based upon those used in other commodities or recommended by manufacturer representatives. Table 2. lists the mean fresh weight biomass in kg/0.6 meters of row for the untreated and the handweeded control. The biomass for the herbicide treatments are expressed as a percentage of the handweeded. The result listed for each treatment is the mean of both years. The crop group with the greatest degree of tolerance to all the herbicides was the cucurbit. The three cucurbits in the trial exhibited some measure of tolerance to all the herbicides except isoxaflutole. The cultivars within that group did not exhibit tolerance uniformly, but differed in their tolerance to each herbicide. Zucchini was the most tolerant of the three followed by cucumber. Brassica was the second most tolerant group. The cultivars in the group exhibited little tolerance to isoxaflutole and halosulfuron applied preemergence and to the postemergence treatments rimsulfuron, prosulfuron, and oxasulfuron. Rutabaga, turnip, radish and napa were comparable in their tolerance. Cauliflower and bok choy were the least tolerant of the brassica group. Carrot, parsley, cilantro, lettuce and basil were the most sensitive vegetables to all the herbicides tested. The least phytotoxic herbicide to the all the vegetable cultivars grown was azefenidin preemergnece. It was followed by flumiclorac postemergence. Fluamide and dimethenamid preemergence also showed good selectivity as did the postemergence treatment triaflusulfuron.

The results from these trials demonstrate the potential for using some of these herbicides for weed management in production of the vegetables grown in the trial. Each vegetable species grown exhibited good tolerance to at least one or more herbicides. Further testing of those with the greatest potential is needed in order to establish the optimum rates and timing for both effective weed control and crop safety.

Table 1. Treatment rates of preemergence and postemergence herbicides, NWREC, 1997 and 1998.

Preemergence Treatments	Rate	Postemergence Treatments	Rate
	lb/a		lb/a
Untreated		Thiazopyr	0.25
Handweeded		Triaflusulfuron	0.016
Azefenidin	0.025	Imazamox	0.04
Isoxaflutole	0.063	Prosulfuron	0.013
Rimsulfuron	0.016	Rimsulfuron	0.016
Sulfentrazone	0.19	CGA-248757	0.0045
Fluamide	0.25	Oxasulfuron	0.7
Halosulfuron	0.05	Flumiclorac	0.036
Dimethenamid	1	Dimethenamid	0.5

Table. 2 Herbicide phytotoxic effects on the percent of plant biomass in comparison to the handweeded control, 39 to 44 days after seeding, NWREC, 1997 and 1998.

Vegetable Variety	Untret[a] kg/0.6[b]	Han[b]	Azefe PREE	Sulfen PREE	Isoxafl PREE	Halos PREE	Fluami PREE	Rimsul PREE	Rimsul POST	Dimeth PREE	Dimeth POST	Thiaz POST	Prosu POST	Oxasu POST	248757 POST	Triaflu POST	Flumic POST	Imaza POST
Winter Squash G. Delicious	0.47	0.80	126	107	3	66	116	55	31	104	91	72	49	26	56	100	53	87
Zucchini Elite	0.61	0.77	135	90	1	61	141	65	29	152	46	122	58	44	84	112	105	139
Cucumber Panther	0.33	0.47	81	18	0	110	129	64	85	47	66	39	52	51	52	74	54	51
Cabbage Heads Up	0.21	0.25	117	123	0	0	56	24	60	37	39	26	1	14	37	65	59	17
Cauliflower Snowball Y	0.10	0.16	89	17	1	0	46	12	0	61	23	34	0	0	24	42	63	14
Kale Darkisor	0.13	0.17	102	109	0	0	64	8	16	81	44	44	0	1	34	57	83	27
Rutabaga Laurentian	0.30	0.34	100	112	7	0	81	42	0	104	64	44	0	0	33	87	109	56
Turnip Purple Top	0.60	0.67	72	100	44	13	96	28	0	87	70	63	0	0	26	88	105	48
Mustard Green India Mustard	0.41	0.51	108	92	0	0	46	13	0	36	58	51	0	0	66	38	98	25
Napa Cabbage Chorus	0.51	0.61	119	122	13	0	75	12	0	71	56	66	0	0	64	64	87	32

a Untret=Untreated, Han=Handweeded, Azefe=Azefenadin, Sulfen=Sulfentrazone, Isoxafl=Isoxaflutole, Halos=Halosulfuron, Fluami=Fluamide, Rimsul=Rimsulfuron, Dimeth=Dimethenamid, Thiaz=Thiazopyr, Pros=Prosulfuron, Oxasu=Oxasulfuron, 248757=CGA248757, Triflus=Triflusulfuron, Flumic=Flumiclorac, Imaza=Imazamox.

b kg/0.6m=kg of plant biomass/ 0.6 meters of row. 0=no biomass present and 100=biomass equal to handweeded control.

Table. 2 Cont'd. Herbicide phytotoxic effects on the percent of plant biomass in comparison to the handweeded control, 39 to 44 days after seeding, NWREC, 1997 and 1998.

Vegetable Variety	Untret[a] kg/0.6[b]	Han[b]	Azefe PREE	Sulfen PREE	Isoxafl PREE	Halos PREE	Fluami PREE	Rimsul PREE	Rimsul POST	Dimeth PREE	Dimeth POST	Thiaz POST	Prosu POST	Oxasu POST	248757 POST	Triaflu POST	Flumic POST	Imaza POST
Bok Choy Joi Choy	0.70	1.03	89	15	2	0	75	13	0	58	40	41	0	2	22	38	88	34
Radish Fuego	0.66	0.82	108	92	11	0	119	42	0	126	57	64	0	0	79	41	107	9
Swiss Chard Aceola Blanca	0.15	0.19	82	0	0	0	38	20	46	237	33	34	0	0	23	86	89	7
Spinach Baker	0.06	0.08	70	0	0	0	255	35	0	436	50	45	0	0	41	114	35	66
Cilantro Slobolt	0.05	0.11	40	0	4	0	57	33	4	30	59	56	0	2	14	37	35	75
Parsley Forest Green	0.01	0.02	109	0	0	0	56	0	0	0	29	54	0	0	25	14	79	0
Carrot Chantenay	0	0.01	75	38	0	0	113	50	0	73	0	25	0	0	25	63	25	0
Leaf Lettuce Parris Island	0.21	0.22	13	0	0	0	1	1	0	7	41	70	3	16	45	49	33	77
Basil Italian	0.04	0.06	53	97	0	19	6	46	0	2	33	11	8	20	21	48	40	2
Green Onion Ishikura	0.03	0.05	60	0	19	0	79	32	0	78	43	47	13	13	77	46	84	26

a Untret=Untreated, Han=Handweeded, Azefe=Azefenadin, Sulfen=Sulfentrazone, Isoxafl=Isoxaflutole, Halos=Halosulfuron, Fluami=Fluamide, Rimsul=Rimsulfuron, Dimeth=Dimethenamid, Thiaz=Thiazopyr, Pros=Prosulfuron, Oxasu=Oxasulfuron, 248757=CGA248757, Triflus=Triflusulfuron, Flumic=Flumiclorac, Imaza=Imazamox.

b kg/0.6m=kg of plant biomass/ 0.6 meters of row. 0=no biomass present and 100=biomass equal to handweeded control.

Tolerance of vegetables to herbicides. R. Edward Peachey and Carol Mallory-Smith. (Departments of Horticulture and Crop and Soil Science, Oregon State University, Corvallis, OR 97331) The objective of this trial was to determine weed control potential and tolerance of snap beans, broccoli, cauliflower, cabbage, carrots and beets to herbicides with low use rates. Plots 5 by 25 ft were established at the Vegetable Research Farm near Corvallis, OR. Crops were planted on 30 inch rows with a precision, direct-seed planter on July 9. Preemergence herbicides were applied on July 10 and postemergence herbicides applied on July 29. The experimental design was a split-plot with main effects of vegetable and herbicide. Plots were cultivated once at 3 WAP. The weeded checks were handweeded once to further minimize weed competition. Weeds at this site included nightshade, pigweed, lambsquarter and purslane. Emergence was evaluated 4 WAP by counting seedlings in 8.2 ft of row. Crop injury and weed control were evaluated at 5 WAP.

Very little injury was noted with azefenidin applied preemergence on all crops while weed control was good to exceptional. Broccoli and cabbage were more tolerant to sulfentrazone than cauliflower. Beets were very sensitive to sulfentrazone as we have noted in other experiments. Only snap beans tolerated halosulfuron. Cabbage was most tolerant to dimethenamid while carrots had a very low tolerance. Most crops were tolerant to fluthiamide with the exception of beets. However, weed control with fluthiamide was very poor. Isoxaflutole provided exceptional weed control but no crops survived at this rate.

Injury was much greater with the postemergence herbicides. Only snap beans tolerated imazamox and CGA-248757. The sulfonylurea herbicides of triflusulfuron, prosulfuron, rimsulfuron, and oxasulfuron caused injury to all crops with the exception of triflusulfuron on beets.

Of the herbicides tested, azefenidin was consistently evaluated as most promising across all crops. Sulfentrazone could have potential in broccoli and cabbage, but not cauliflower, beets or carrots. Cabbage, beets, and beans were sufficiently tolerant to dimethenamid. Imazamox, triflusulfuron, and flumiclorac may be useful only in snap beans.

Table 1. Vegetable crop emergence and tolerance to herbicides, Vegetable Research Farm, Corvallis, OR.

	Herbicide	Timing	Rate	Broccoli (var. Emperor)		Cauliflower (var. Snowman)		Cabbage (var. Market Victor)		Beets (var. Detroit Dark Red)		Carrots (var. Prospector)		Snap beans (OR91G)	
			lb ai/A	Emerge[a]	Injury[b]	Emerge	Injury	Emerge	Injury	Emerge	Injury	Emerge	Injury	Emerge	Injury
				%											
1	Untreated	-	0.000	55	0	67	0	72	0	70	10	62	7	93	0
2	Weeded check	-	0.000	85	0	81	3	52	0	47	3	87	10	84	3
3	Azafenidin	PES	0.025	69	0	98	7	74	0	80	0	86	7	75	7
4	Isoxaflutole	PES	0.063	4	100	9	100	0	100	0	100	2	100	60	100
5	Rimsulfuron	PES	0.016	41	77	18	77	41	37	41	83	99	17	75	17
6	Sulfentrazone	PES	0.188	87	0	63	40	81	0	10	98	98	20	80	8
7	Fluthiamide	PES	0.250	69	7	62	10	69	10	102	30	84	7	84	0
8	Halosulfuron	PES	0.050	28	100	2	100	0	100	0	100	48	100	92	3
9	Dimethenamid	PES	1.000	67	17	72	23	74	3	63	0	32	93	93	0
10	s-dimethenamid	POST	0.270	80	3	63	0	48	0	96	3	95	27	88	0
11	Triflusulfuron	POST	0.016	63	47	70	30	71	40	45	0	65	40	100	47
12	Imazamox	POST	0.024	50	80	54	73	63	67	61	67	55	47	78	27
13	Prosulfuron	POST	0.013	65	83	32	70	59	70	55	83	70	70	82	63
14	Rimsulfuron	POST	0.016	57	80	16	83	69	83	59	73	84	67	92	53
15	CGA-248757	POST	0.0045	67	53	60	70	76	80	16	73	73	17	98	13
16	Oxasulfuron	POST	0.700	76	60	56	73	85	73	76	57	70	63	91	57
17	Flumiclorac	POST	0.036	100	27	79	33	100	50	35	87	81	33	90	20
18	Dimethenamid	POST	0.500	67	40	65	10	81	23	51	53	74	17	88	27
19	Cloransulam	POST	0.048	79	80	60	67	74	70	70	57	78	40	93	25
	$FPLSD_{0.05}$			38	26	35	24	33	26	36	20	32	28	ns	18

[a] Emergence as a percent of the plot with greatest emergence.

[b] Estimated reduction in crop growth.

Table 2. Weed control in vegetables row crops with preeemergence and postemergence applications of herbicides, 5 WAP.

Herbicide	Timing	Rate	AMARE	SOLSA	CHEAL	POROL
		lbs ai/A	%			
1 Untreated	-	0.000	0	0	0	0
2 Weeded check	-	0.000	80	47	50	50
3 Azafenidin	PES	0.025	83	66	50	100
4 Isoxaflutole	PES	0.063	100	100	100	67
5 Rimsulfuron	PES	0.016	100	3	100	100
6 Sulfentrazone	PES	0.188	98	97	100	100
7 Fluthiamide	PES	0.250	68	0	0	100
8 Halosulfuron	PES	0.050	97	33	100	100
9 Dimethenamid	PES	1.000	100	100	100	100
10 S-dimethenamid	POST	0.270	33	33	0	67
11 Triflusulfuron	POST	0.016	42	42	50	33
12 Imazamox	POST	0.024	100	100	60	100
13 Prosulfuron	POST	0.013	97	50	100	100
14 Rimsulfuron	POST	0.016	98	78	70	100
15 CGA-248757	POST	0.0045	77	92	85	100
16 Oxasulfuron	POST	0.700	98	70	100	100
17 Flumiclorac	POST	0.036	98	58	100	100
18 Dimethenamid	POST	0.500	20	0	0	0
19 Cloransulam	POST	0.048	20	63	0	33
$FPLSD_{0.05}$			35	44	70	57

Screening of low rate herbicides in vegetable crops. Steven A. Fennimore and Stefan J. Richard. (Department of Vegetable Crops, University of California-Davis, Salinas, CA 93905) All indications are that pesticide use cancellations, as the result of the Food Quality Protection Act, will have major impacts on weed management programs in vegetable crops. Therefore, we are working to develop transition strategies such as alternative herbicides for vegetables. The objective of this study was to identify new potential herbicides for vegetable crops. Broccoli (Tracy), cantaloupe (PMR 45), carrot (Pak Mor F_1), iceberg lettuce (Magnum), red leaf lettuce (Flame MI), onion (White Ivory), snap bean (Quest), spinach (Liberty), sweet corn (Golden Gourmet), and processing tomato (Tracy) were screened in the field for tolerance to low-rate herbicides at the University of California/USDA Vegetable Research Station, Salinas, California. Preemergence herbicides and rates tested were: carfentrazone at 0.05 and 0.1, sulfentrazone at 0.25 and 0.5, cloransulam at 0.0156 and 0.0312, SAN582 (dimethenamid) at 0.94 and 1.172, halosulfuron at 0.032 and 0.047 and rimsulfuron at 0.0156 and 0.0313 lb. /A. The planting date was June 16, 1998, and the spray date was June 17, 1998. Stand counts were taken at 16 days after treatment (DAT), phytotoxicity assessments were taken 21, 34 and 48 DAT, weed densities were taken 41 DAT and crop biomass m^{-1} was taken at 50 DAT. Mean separation was performed using Fisher's protected LSD ($\alpha = 0.05$).

Broccoli tolerance to carfentrazone at 0.05 and 0.10 lb. /A and SAN582 at 1.172 lb. /A was acceptable (Table 1). Cantaloupe tolerance to carfentrazone at 0.05 lb. /A and halosulfuron at 0.032 and 0.047 lb. /A was acceptable (Table 1). Carrot injury resulting from carfentrazone at 0.05 lb. /A was within acceptable levels (Table 2). Both iceberg and red leaf lettuce were tolerant to carfentrazone at 0.05 lb. /A and 0.10 lb. /A (Tables 2 & 3). Bulb onion was tolerant to carfentrazone at 0.05 and 0.10 lb. /A (Table 3). Snap bean exhibited tolerance to carfentrazone at 0.05 and 0.10 lb. /A, SAN582 at 0.938 and 1.172 lb. /A, and halosulfuron at 0.032 and 0.047 lb. /A (Table 4). Spinach crop injury resulting from carfentrazone at 0.05 lb. /A and SAN582 at 0.938 lb. /A was acceptable (Table 4). Sweet corn tolerance to carfentrazone at 0.05 lb. /A, SAN582 at 0.938 and 1.172 lb. /A, halosulfuron at 0.032 and 0.047 lb. /A and rimsulfuron at 0.0156 lb. /A was acceptable (Table 5). Processing tomato tolerance to carfentrazone at 0.05 and 0.10 lb. /A and rimsulfuron at 0.0156 and 0.0313 lb. /A was within acceptable levels (Table 5). All treatments not previously mentioned resulted in unacceptable crop injury.

Table 1. Stand counts, crop phytotoxicity, and biomass for broccoli, and cantaloupe.

		Broccoli					Cantaloupe				
		Stand	Phytotoxicity [a]			Bio-mass	Stand	Phytotoxicity [a]			Bio-mass
Herbicide	lb. /A	m^{1}				g m^{-1}	m^{1}				g m^{-1}
Carfentrazone	0.05	29	0	0.3	0	33	17	0	0	0	50
Carfentrazone	0.1	27	0.8	0.5	0.3	27	14	1.0	0.3	0	53
Sulfentrazone	0.25	14	7.8	6.0	5.8	17	16	8.5	7.5	4.5	29
Sulfentrazone	0.5	2	9.8	9.3	9.5	6	8	9.0	8.5	8.3	4
Cloransulam	0.0156	40	9.0	10.0	10.0	0	12	9.3	10.0	10.0	0
Cloransulam	0.0312	30	9.0	10.0	10.0	0	7	9.5	10.0	10.0	0
SAN582	0.938	39	3.8	1.0	0	61	17	4.0	3.0	0	38
SAN582	1.172	35	0.5	0.3	0.3	57	10	4.3	0.5	0	38
Halosulfuron	0.032	29	9.0	9.8	10.0	0	21	1.3	0.8	0.8	61
Halosulfuron	0.047	31	9.3	9.5	9.8	1	15	1.3	2.5	0.3	55
Rimsulfuron	0.0156	43	5.3	3.3	0.8	25	9	6.0	5.8	4.3	42
Rimsulfuron	0.0313	46	8.5	8.8	8.5	9	11	9.0	9.3	10.0	23
Untreated	--	35	0	0	0	32	21	0	0	0	57
LSD		26.2	2.1	2.5	1.8	24	6.6	2.3	3.2	2.2	32
Days after treatment		16	21	34	48	50	16	21	34	48	50

[a] Crop phytotoxicity 0 = no injury, 10 = dead

Table 2. Stand counts, crop phytotoxicity, and biomass for carrot and iceberg lettuce.

		Carrot					Iceberg lettuce				
		Stand	Phytotoxicity [a]			Bio-mass	Stand	Phytotoxicity [a]			Bio-mass
Herbicide	lb. /A	m^{-1}				g m^{-1}	m^{-1}				g m^{-1}
Carfentrazone	0.05	41	2.3	1.8	0.8	14	12	0.5	0.5	1.0	105
Carfentrazone	0.1	22	2.0	2.3	0.5	10	12	1.5	0.8	0.8	76
Sulfentrazone	0.25	24	5.0	2.5	1.3	16	2	10.0	10.0	10.0	0
Sulfentrazone	0.5	16	8.3	5.8	4.0	7	0	10.0	10.0	9.5	5
Cloransulam	0.0156	35	8.8	8.8	7.5	2	10	9.3	10.0	10.0	0
Cloransulam	0.0312	35	9.3	9.8	9.5	1	8	9.5	10.0	10.0	0
SAN582	0.938	17	9.0	8.5	6.0	10	1	9.8	10.0	10.0	0
SAN582	1.172	15	8.5	7.5	5.0	7	2	9.5	10.0	10.0	0
Halosulfuron	0.032	44	6.5	7.0	6.5	4	11	9.3	10.0	10.0	0
Halosulfuron	0.047	33	8.3	8.5	5.5	5	10	9.5	10.0	10.0	0
Rimsulfuron	0.0156	42	3.3	2.5	1.0	11	12	9.0	9.8	10.0	0
Rimsulfuron	0.0313	35	7.3	6.0	2.3	10	17	9.3	10.0	10.0	0
Untreated	--	54	0	0	0	13	12	0	0	0	102
LSD		15.4	2.8	2.6	3.0	5	6.4	0.7	0.5	0.9	44
Days after treatment		16	21	34	48	50	16	21	34	48	50

[a] Crop phytotoxicity 0 = no injury, 10 = dead

Table 3. Stand counts, crop phytotoxicity, and biomass for red leaf lettuce, and onion.

		Red leaf lettuce					Onion				
		Stand	Phytotoxicity [a]			Bio-mass	Stand	Phytotoxicity [a]			Bio-mass
Herbicide	lb. /A	m^{-1}				g m^{-1}	m^{-1}				g m^{-1}
Carfentrazone	0.05	96	0.5	0.8	1.0	15	33	1.8	0.5	0	1
Carfentrazone	0.1	76	1.5	0.8	0.5	17	36	1.0	1.0	0.3	2
Sulfentrazone	0.25	2	10.0	10.0	10.0	0	15	9.5	9.3	8.3	0
Sulfentrazone	0.5	27	10.0	10.0	10.0	0	6	10.0	10.0	8.3	0
Cloransulam	0.0156	71	9.3	10.0	9.8	3	32	8.8	10.0	8.8	0
Cloransulam	0.0312	56	9.5	10.0	10.0	0	9	9.5	10.0	9.5	0
SAN582	0.938	22	9.8	10.0	9.8	4	30	8.0	4.8	3.8	1
SAN582	1.172	30	9.5	9.5	9.0	18	24	4.8	4.0	0.8	1
Halosulfuron	0.032	88	9.3	9.5	10.0	8	26	6.0	7.3	9.3	0
Halosulfuron	0.047	50	9.5	10.0	10.0	0	19	6.0	8.8	8.8	0
Rimsulfuron	0.0156	73	9.0	9.3	9.3	3	23	6.5	9.3	7.5	0
Rimsulfuron	0.0313	80	9.3	10.0	10.0	0	17	9.3	10.0	7.8	0
Untreated	--	82	0	0	0	13	35	0	0	0	1
LSD		35.7	1.2	0.8	1.4	14	14.8	3.1	2.3	4.0	1
Days after treatment		16	21	34	48	50	16	21	34	48	50

[a] Crop phytotoxicity 0 = no injury, 10 = dead

Table 4. Stand counts, crop phytotoxicity, and biomass for snap bean, and spinach.

		Snap bean					Spinach				
		Stand	Phytotoxicity [a]			Bio-mass	Stand	Phytotoxicity [a]			Bio-mass
Herbicide	lb. /A	m^{-1}				g m^{-1}	m^{-1}				g m^{-1}
Carfentrazone	0.05	16	0.5	0	0	34	9	1.0	0	0	118
Carfentrazone	0.1	13	0.8	0.5	0.5	34	5	4.3	3.0	2.8	46
Sulfentrazone	0.25	10	5.3	2.8	1.5	44	0	10.0	10.0	10.0	0
Sulfentrazone	0.5	8	6.8	4.5	3.3	33	0	10.0	10.0	10.0	0
Cloransulam	0.0156	10	5.8	3.0	2.3	23	3	9.3	10.0	10.0	0
Cloransulam	0.0312	11	4.0	2.3	2.0	35	3	9.8	10.0	10.0	0
SAN582	0.938	13	1.0	0.5	0.5	69	5	1.0	0	0	150
SAN582	1.172	12	1.3	0.8	0.3	43	4	3.3	2.3	0	48
Halosulfuron	0.032	11	1.3	0.8	0.8	74	2	9.3	10.0	10.0	0
Halosulfuron	0.047	15	0.8	0.8	0.3	50	2	10.0	10.0	10.0	0
Rimsulfuron	0.0156	11	2.8	1.0	0.3	47	4	7.3	7.3	7.5	40
Rimsulfuron	0.0313	12	5.8	3.8	1.5	32	6	9.0	7.5	10.0	0
Untreated	--	12	0	0	0	68	5	0.3	0	0	104
LSD		5.6	3.0	2.4	1.8	33	4.1	2.7	3.5	2.7	62
Days after treatment		16	21	34	48	50	16	21	34	48	50

[a] Crop phytotoxicity 0 = no injury, 10 = dead

Table 5. Stand counts, crop phytotoxicity, and biomass for sweet corn, and processing tomato.

		Sweet corn					Processing tomato				
		Stand	Phytotoxicity [a]			Bio-mass	Stand	Phytotoxicity [a]			Bio-mass
Herbicide	lb. /A	m^{-1}				$g\ m^{-1}$	m^{-1}				$g\ m^{-1}$
Carfentrazone	0.05	8	0.5	0	0	130	28	0.5	0.3	0	67
Carfentrazone	0.1	7	2.3	2.0	2.5	134	25	0.3	0.5	0.3	236
Sulfentrazone	0.25	8	5.8	2.5	2.3	84	16	8.8	6.8	6.5	33
Sulfentrazone	0.5	9	7.5	6.0	3.0	43	8	9.8	9.3	9.3	29
Cloransulam	0.0156	7	7.5	5.0	9.0	8	20	8.8	9.8	9.3	0
Cloransulam	0.0312	6	6.5	5.8	6.8	21	22	9.0	10.0	10.0	0
SAN582	0.938	7	1.8	0.3	0.8	114	20	3.3	3.3	1.3	83
SAN582	1.172	5	1.0	0.3	0.3	142	16	1.8	2.0	0.8	87
Halosulfuron	0.032	7	1.3	0.5	0.8	56	23	2.8	1.3	0.5	106
Halosulfuron	0.047	7	1.0	0.5	0	90	21	1.3	1.3	0.5	88
Rimsulfuron	0.0156	7	1.3	0.3	0.3	115	28	0.5	0.8	0	88
Rimsulfuron	0.0313	7	3.0	1.3	0	99	25	1.3	0.8	0.3	113
Untreated	--	5	0	0	0	87	42	0	0	0	58
LSD		ns	2.8	0.3	3.2	70	4.9	2.1	2.0	1.5	134
Days after treatment		16	21	34	48	50	16	21	34	48	50

[a] Crop phytotoxicity 0 = no injury, 10 = dead

Field evaluation of herbicides for vegetables. Carl E. Bell, Brent Boutwell, Milton E. McGiffen, Jr., and Eddy Ogbuchiekwe (Cooperative Extension, University of California, Holtville, CA 92250 and University of California Riverside, Riverside, CA 92521-0124) A field trial was conducted at the University of California Riverside Coachella Agricultural Research Station near Indio, CA to evaluate eight herbicides on ten vegetable crops grown in California. This field trial is the preliminary part of a larger effort by weed scientists working on vegetables within UC Cooperative Extension to identify newer herbicides as potential replacements for currently registered vegetable herbicides. Herbicides tested were carfentrazone, sulfentrazone, cloransulam, dimethenamid, halosulfuron, rimsulfuron, triflusulfuron, and imazamox. Vegetable crops were; sweet corn cv golden gourmet, broccoli cv sprinter, cantaloupe melon cv PMR45 improved, carrot cv pak more, green bean cv guest, lettuce cv flame, onion cv white ivory, spinach cv liberty, squash cv FMX541, and tomato cv tracey. Experimental design was a randomized complete block with three replications. Plot size was 6 raised beds, each 40 inches wide, by 8 feet. Preemergence applications were made with all herbicides except imazamox on March 5, 1998 and postemergence with all eight herbicides on March 30, 1998 when most of the crops had 2 to 4 true leaves. Application was made with a CO_2 pressured sprayer at 20 psi, using 8003 nozzles for a spray volume of 26 gpa. Soil type was a fine sand. Weather on March 5 was 65° F, clear with light winds, on March 30; the temperature was 75°F, clear, with light winds.

Data collected included visual evaluations of weed control, stand, and phytotoxicity 31 days after preemergence treatments and weed control and phytotoxicity 13 days after postemergence treatments. Weed control ratings are for a naturally occurring infestation of nettleleaf goosefoot, common lambsquarters, and little mallow. Crop biomass data were collected from all treatments as pounds of fresh weight per 1 meter of row on May 12, 1998. Results are shown in the Tables below.

Most of the vegetable crops, with the exception of melons, were tolerant to the preemergence application of carfentrazone (Table 1). The higher rate of carfentrazone was also very good at controlling the weeds present in the field (Table 2). Crop safety to triflusulfuron was also good, but weed control was poor. Sweet corn, carrot, green bean, squash, and tomato were generally tolerant of most of the herbicides when applied preemergence. Visual evaluations of crop stand were similar to the phytotoxicity ratings with regard to crop and herbicide effects (Table 2). Postemergence application of these same herbicides at the same rates caused very serious injury to the vegetables in most cases. The only exception was dimethenamid, which also did not control weeds. Crop biomass data was generally consistent with visual ratings (Table 3). Weed biomass data were not collected, but the presence of weeds in several of the untreated control plots had a negative effect on crop biomass. The results of this study, when compiled with others in California provide direction for more detailed future field trials with potential crop/herbicide combinations that may be able to eventually be used by vegetable farmers.

Table 1. Visual evaluations of phytotoxicity in a field trial comparing eight herbicides in ten vegetable crops.

Treatments	Rate	CROP									
		Sweet Corn	Broccoli	Melon	Carrot	Green bean	Lettuce	Onion	Spinach	Squash	Tomato
	lb/A	visual rating[a]									
Pre (31 DAT)											
Carfentrazone	0.015	0	2.01	6.67	0	2.67	0	1.33	1.67	0.33	0.67
Carfentrazone	0.05	0	2.33	2.5	0	2.0	0	0	2.33	0.33	2.0
Sulfentrazone	0.19	0.33	2.0	3.67	1.0	1.67	0.67	1.0	5.67	3.33	2.0
Cloransulam	0.04	1.33	7.67	2.67	2.0	3.33	8.67	4.67	5.67	3.33	3.0
Dimethenamid	1.0	0.33	3.67	5.0	1.67	3.0	8.0	2.33	3.67	1.67	2.33
Halosulfuron	0.047	0.33	7.33	7.33	2.0	2.67	7.67	4.0	7.33	2.0	1.33
Rimsulfuron	0.016	0.33	5.67	5.67	0	2.67	7.33	4.0	6.33	1.67	1.33
Triflusulfuron	0.016	0	1.67	1.67	0.67	1.0	1.67	1.0	2.67	1.67	0.67
Untreated control		0	0	0	0	0	0	0	0	0	0
Post (13 DAT)											
Carfentrazone	0.015	1.67	5.67	5.33	7.33	8.67	4.67	7.67	9.0	7.67	9.0
Imazamox	0.04	9.0	8.67	7.67	8.33	5.33	7.0	8.0	6.33	4.33	6.33
Sulfentrazone	0.19	7.67	3.67	9.0	5.67	6.33	7.33	6.67	9.0	9.33	9.0
Cloransulam	0.04	3.33	8.67	9.0	7.33	3.0	9.0	8.33	7.67	8.33	9.0
Dimethenamid	1.0	0.67	2.67	0.5	3.67	2.0	1.0	0.67	2.67	0.33	2.0
Halosulfuron	0.047	1.67	9.0	3.0	9.33	3.67	9.67	9.0	9.0	5.0	4.67
Rimsulfuron	0.016	4.33	9.0	5.0	9.0	9.0	9.67	9.0	9.0	9.67	5.0
Triflusulfuron	0.016	7.0	4.67	7.33	8.67	8.0	9.0	4.0	8.33	8.33	8.33
Untreated control		0	0	0	0	0	0	0	0	0	0

[a] Visual rating: 0 = no phytotoxicity, 10 = all plants dead.

Table 2. Visual evaluations of crop stand in a field trial comparing eight herbicides in ten vegetable crops.

Treatments	Rate	CROP[a]									WC
		Sweet Corn	Broccoli	Carrot	Green bean	Lettuce	Onion	Spinach	Squash	Tomato	
	lb/A	visual rating[b]									-- % --
Pre (31 DAT)											
Carfentrazone	0.015	10	9.33	10	9.0	10	8.0	7.67	9.67	8.67	55
Carfentrazone	0.05	10	5.67	10	8.67	10	9.33	7.0	8.33	8.33	98
Sulfentrazone	0.19	9.67	9.0	7.67	9.67	9.33	9.0	5.33	8.67	8.67	91
Cloransulam	0.04	8.67	7.33	7.33	9.0	1.67	5.0	4.67	8.0	8.33	44
Dimethenamid	1.0	9.67	7.33	8.33	8.67	2.67	7.67	6.33	8.33	8.0	44
Halosulfuron	0.047	9.67	9.0	10	9.33	3.0	7.67	3.33	8.33	8.67	90
Rimsulfuron	0.016	10	8.0	8.67	7.33	4.0	7.0	4.67	10	8.33	44
Triflusulfuron	0.016	10	10	10	9.67	9.67	9.33	7.0	8.33	9.33	21
Untreated control		10	10	10	10	10	10	10	10	10	0
Post (13 DAT)											
Carfentrazone	0.015										93
Imazamox	0.04										79
Sulfentrazone	0.19										99
Cloransulam	0.04										21
Dimethenamid	1.0										0
Halosulfuron	0.047										60
Rimsulfuron	0.016										66
Triflusulfuron	0.016										21
Untreated control											0

[a] Cantaloupe melon stands were too uneven to rate. Postemergence treatments were not evaluated for stand.
[b] Visual rating: 0 = no crop present, 10 = highest visual estimate of crop stand.

Table 3. Crop biomass measured May 12, 1998 in a field trial comparing eight herbicides in ten vegetable crops.

Treatments	Rate	CROP									
		Sweet Corn	Broccoli	Melon	Carrot	Green bean	Lettuce	Onion	Spinach	Squash	Tomato
	lb/A	pounds fresh weight per one meter of row, mean of three replications									
Pre (64 DAT)											
Carfentrazone	0.015	5.15	4.32 b	0.07	0.92 a	1.82 b	4.83 a	0.4 c	0.5	11.18 b	4.65
Carfentrazone	0.05	5.5	2.92 c	0.15	0.68 b	1.42 cd	5.32 a	0.62 a	0.4	12.75 a	3.72
Sulfentrazone	0.19	5.03	5.08 a	0.23	0.68 b	2.02 a	5.32 a	0.4 c	0.12	8.83 cd	5.13
Cloransulam	0.04	3.43	0.88 e	0.15	0.48 c	1.25 de	1.28 d	0.1 f	0.35	5.07 f	2.95
Dimethenamid	1.0	4.05	2.95 c	0.23	0.65 b	1.17 e	2.2 c	0.52 b	0.23	8.45 cd	3.85
Halosulfuron	0.047	3.95	1.7 d	0.23	0.62 b	1.92 ab	1.88 cd	0.12 ef	0.18	9.65 c	4.2
Rimsulfuron	0.016	4.18	1.27 de	0.15	0.48 c	1.08 e	1.95 c	0.27 d	0.15	6.82 e	4.5
Triflusulfuron	0.016	3.57	2.93 c	0.03	0.18 d	1.43 c	3.48 b	0.2 de	0.35	7.65 de	4.85
Untreated control		2.6	2.93 c	0.02	0.05 e	1.83 b	3.67 b	0.17 ef	0.47	7.12 e	3.23
Post (43 DAT)											
Carfentrazone	0.015	4.57 ab	1.87 bc	0	0.17 bc	0.17 fg	3.07 a	0.17 b	0 d	5.7 b	0 d
Imazamox	0.04	0 g	0.07 e	0	0.11 cd	1.58 a	2.15 b	0.02 cd	0.13 b	3.95 c	0.3 d
Sulfentrazone	0.19	2.93 d	3.47 a	0	0.55 a	0.37 ef	2.3 b	0.07 c	0 d	0 e	0 d
Cloransulam	0.04	1.87 e	0 e	0	0.02 e	0.7 c	0 d	0 d	0.1 bc	0.98 e	0.03 d
Dimethenamid	1.0	4.03 bc	2.2 b	0.03	0.05 de	1.47 ab	1.5 c	038 a	0.35 a	5.9 b	1.6 b
Halosulfuron	0.047	3.98 c	0 e	0.43	0 e	1.23 b	0 d	0 d	0 d	8.47 a	3.27 a
Rimsulfuron	0.016	5.0 a	0.02 e	0.2	0.03 e	0.07 g	0 d	0 d	0 d	0 e	2.9 a
Triflusulfuron	0.016	1.03 f	1.08 d	0.02	0.18 b	0.42 de	0 d	0.18 b	0.03 cd	2.35 d	0.92 b
Untreated control		1.35 ef	1.67 c	0.15	0.02 e	0.65 cd	1.0 c	0.2 b	0.42 a	6.3 b	1.78 b

Means within a column and within each application timing followed by the same letter are not significantly different (P<.05).

Postemergence weed control in newly planted one-year-old asparagus crowns. Robert J. Mullen and Ted Viss. A postemergence weed control trial in newly planted one-year-old asparagus crowns was established at Victoria Island Farms, west of Stockton, California on April 27, 1998. Three herbicides were evaluated for weed control efficacy and crop safety. The soil type at the trial site was an Egbert muck and the asparagus cultivar was $UC157_{F1}$. All treatments were applied over the asparagus crop fern and weeds with a handheld CO_2 backpack sprayer using 8002 nozzles at 40 psi in a spray volume of 30 gal/a water. At the time of treatment, weeds present included first true leaf to 6 inch tall lambsquarters (CHEAL), 4 to 8 inch tall London rocket (SSYIR), 3 to 5 inch tall prickly lettuce (LACSE), 2 to 3 inch tall redroot pigweed (AMARE), 2 to 14 inch diameter prostrate knotweed (POLAV) and 1 to 3 inch tall barnyardgrass (ECHCG); the young asparagus fern was 14 to 20 inches tall. There were four replications of each treatment in a randomized complete block design. Individual plots were single 60 inch beds measuring 25 feet in length.

An evaluation of weed control efficacy and crop phototoxicity was made on May 7, 1998. The best level of weed control occurred with the high rate of metribuzin, followed by the low-rate of metribuzin, and the linuron treatment. All treatments were weak in controlling prostrate knotweed and barnyardgrass. Halosulfuron was additionally ineffective in controlling lambsquarters, however, it was very effective in controlling a spotty infestation of 4 to 5 true leaf yellow nutsedge (CYPES) in the trial. All treatments demonstrated excellent safety to the crop fern.

Table. Postemergence weed control in newly planted one-year-old asparagus crowns.

Herbicide[2]	Rate oz or lb/A	Weed Control[1] CHEAL	SSYIR	LACSE	AMARE	POLAV	ECHCG	Asparagus[1] Injury
		%						
Metribuzin	0.50 lb	95	93	100	100	23	28	11
Metribuzin	1.00 lb	98	100	100	100	40	35	16
Linuron	1.00 lb	100	85	100	100	40	38	11
Halosulfuron + X77	0.50 oz	41	75	83	80	38	33	10
Halosulfuron + X77	1.00 oz	65	85	83	83	40	46	10
Untreated Control	-----	0	0	5	5	0	0	4

[1] 0 = no weed control, no crop injury.
10 = complete weed control, crop dead.
[2] Halosulfuron treatments included X77 at 0.25% (V/V).

Evaluation of herbicides for cantaloupe weed control. K. Umeda. (University of Arizona Cooperative Extension Maricopa County, Phoenix, AZ 85040) A small plot field study was conducted at the University of Arizona Maricopa Agricultural Center, Maricopa, AZ. Cantaloupes were planted in a single row on 40-inch beds, planted on every other bed, and furrow irrigated only on one side of the bed. The herbicide plots measured one bed by 30 ft in length and were replicated four times in a randomized complete block design. All herbicide applications were made using a CO_2 backpack sprayer equipped with a hand-held boom with two flat fan 8002 nozzle tips. The herbicide treatments were applied in 25 gpa of water pressurized to 40 psi. At the time of preemergence (PREE) applications, the air temperature was 86°F, the sky was clear, and there was a slight breeze. The soil was dry and temperature was 86°F. During postemergence (POST) applications, the air temperature was 84°F, the sky was overcast with no wind, and the soil was dry. The cantaloupe was at the 2-leaf stage with weeds ranging from the 4 to 6 leaf growth stage. Pigweeds and purple nutsedge were the dominant weeds present.

At 4 weeks after treatment (WAT), all PREE treatments were completely safe on cantaloupes. At 1 WAT of POST applications, marginally acceptable melon injury (11 to 19%) was observed. At 6 WAT, crop injury increased significantly for both halosulfuron and bentazon. Halosulfuron (POST) following bensulide (PREE) caused minimal crop injury. The pigweeds were marginally controlled when POST treatments followed PREE herbicides. Tumble pigweed was more difficult to control than prostrate pigweed. Halosulfuron gave good control of nutsedge at 6 WAT.

Table. Evaluation of herbicides for cantaloupe weed control.

Treatment	Rate	Timing	Cantaloupe Injury		Weed Control				
	(lb/A)		26 May	06 Jul	AMARA	AMAAL	AMABL	CYPRO	
					26 May	06 Jul	06 Jul	26 May	06 Jul
			%		%				
Untreated check			0	0	0	0	0	0	0
Bensulide	6.0	PREE	0	0	38	0	53	0	0
Clomazone	0.5	PREE	0	0	50	0	56	0	0
Ethafluralin	1.5	PREE	0	0	63	20	76	0	0
Ethafluralin +	1.5 +	PREE	0	0	56	30	71	0	0
Bensulide	4.0	PREE							
Bensulide +	4 +	PREE	0	0	50	20	79	0	0
Clomazone	0.5	PREE							
Clomazone +	0.5 +	PREE	4	0	60	18	81	0	0
Ethafluralin	0.8	PREE							
Bensulide +	4 +	PREE	15	47	85	0	83	55	88
Bentazon	0.5	POST							
Bensulide +	4 +	PREE	11	14	63	33	79	60	90
Halosulfuron	0.1	POST							
Clomazone +	0.5 +	PREE	19	30	89	18	84	66	0
Bentazon	0.5	POST							
Clomazone +	0.5 +	PREE	13	43	79	18	56	48	94
Halosulfuron	0.1	POST							
Ethafluralin +	0.75 +	PREE	13	38	81	43	73	69	94
Halosulfuron	0.1	POST							
LSD = (p=0.05)			4.3	21.8	16.5	39.5	33.4	16.2	45.0

Treatments applied on 27 Apr 1998 (PREE) and 20 May (POST).

Postemergence herbicide weed control in cantaloupes. K. Umeda. (University of Arizona Cooperative Extension Maricopa County, Phoenix, AZ 85040) Two small plot field tests were established within commercial cantaloupe fields near Scottsdale, AZ to evaluate and determine efficacy and safety of two postemergence herbicides. Test 1 evaluated the effect of the addition of an adjuvant on the efficacy or crop injury caused by halosulfuron or bentazon. Cantaloupes were planted on conventional 80-inch beds and germinated with sprinkler irrigation and then furrow irrigated for the remainder of the growing season. The treated plots measured 3.3 ft by 25 ft and treatments were replicated three times in a randomized complete block design. The herbicide treatments were applied with a hand-held boom equipped with two 8002 flat fan nozzle tips spaced 20 inches apart. The sprays were applied using a CO_2 backpack sprayer pressurized at 40 psi to deliver 30 gpa water. At the time of the applications, melons were at the early 1-leaf stage of growth and ivyleaf morningglory was at the cotyledon to 1-leaf growth stage. At the time of the first application for test 1, the sky was clear, the air temperature at 94°F, there was a slight breeze at less than 3 mph. The test site was sprinkler irrigated immediately after applications. The weather conditions during the second application date for test 1 was a clear sky, 110°F, with no wind. Cantaloupe was at the 2 to 3-leaf growth stage. Injured 1 to 2-leaf stage morningglory from the previous application of herbicides had new growth emerging. Test 2 was applied when the weather was clear, 108°F with a slight breeze. Visual weed control and crop safety were evaluated at various intervals after treatment.

In test 1 at 1 week after treatment (WAT), no significant cantaloupe injury was observed by halosulfuron or bentazon treatments ($\leq$ 10%). The addition of an adjuvant, Agridex, to halosulfuron or bentazon did not increase crop injury significantly compared to treatments without Agridex. The addition of Agridex to halosulfuron slightly improved morningglory control compared to without the use of an adjuvant. Agridex added to halosulfuron at 0.075 or 0.1 lb/A improved morningglory control slightly though not statistically significant. Bentazon at 1.0 lb/A plus Agridex gave very good morningglory control at 92%. At 2 WAT on 20 Aug, cantaloupe injury decreased for halosulfuron and bentazon treatments. A second application of halosulfuron at 0.05 lb/A did not cause additional crop injury. Weed control after 20 Aug was not evaluated due to accidental hand-hoeing. Test 2 showed that halosulfuron and bentazon caused minimal crop injury at 4 days after treatment (DAT) and injury was almost negligible ($\leq$5%) at 1 WAT. Halosulfuron was not effective against heavy populations of morningglory and all rates appeared similar providing 60-75% control at intervals during the month after treatments were applied. Bentazon at all rates caused morningglory leaf burning at 4 DAT but control decreased during the next month as morningglory regrew.

Table. Postemergence herbicide weed control in cantaloupes.

Treatment	Rate	Cantaloupe Injury				IPOHE Control			
		Test 1		Test 2		Test 1	Test 2		
	(lb/A)	13 Aug	20 Aug	24 Aug	27 Aug	13 Aug	24 Aug	27 Aug	15 Sep
		%				%			
Untreated check		0	0	0	0	0	0	0	0
Halosulfuron	0.05	7	0			75			
Halosulfuron + Agridex	0.05	10	3	3	0	82	62	67	60
Halosulfuron + Halosulfuron	0.05 + 0.05	8	3			78			
Halosulfuron	0.075	8	2			82			
Halosulfuron + Agridex	0.075	10	3	7	0	85	62	65	65
Halosulfuron	0.1	8	7			85			
Halosulfuron + Agridex	0.1	8	5	12	2	88	75	65	78
Bentazon	0.75	8	3			77			
Bentazon + Agridex	0.75	7	0	3	2	78	85	70	53
Bentazon	1	2	3			80			
Bentazon + Agridex	1	7	3	7	3	92	88	83	63
Bentazon + Agridex	1.5			8	5		88	85	80
LSD (p=0.05)		7.6	7.1	3.9	5.4	9.8	15.5	18	33.8

Test 1 applications made on 06 and 13 August 1998, Test 2 applications made on 20 Aug.
Agridex added to treatments at 1.0% v/v.

Response of cauliflower to several postemergence herbicides. Timothy W. Miller. Washington State University, Mount Vernon, WA 98273. Two weeds of considerable importance to cauliflower producers in northwestern Washington are common groundsel and shepherd's-purse. In addition to competing with the crop, seeds of these species frequently stick to the surface of the curd, detracting from cauliflower appearance and reducing its value. Trifluralin is used on nearly all commercial cauliflower fields in Washington state, but control of these two weed species by that product is nearly always incomplete, forcing producers to use expensive hand labor to achieve adequate weed control. To improve control of common groundsel and shepherd's-purse, four postemergence herbicides were tested for selectivity to cauliflower and efficacy on these two species. The study was conducted during 1998 in a commercial production cauliflower field near LaConner, Washington. Preplant incorporated trifluralin was applied to the field at 1.0 lb/A by the cooperator. Plots were established June 18 in 'Rivella' cauliflower. Plots were 10 by 15 ft and included two cauliflower rows. Treatments were applied on June 19 using a CO_2-pressurized backpack sprayer delivering 31.3 gpa at 43 psi (Table 1). Cauliflower injury was visually estimated June 25, and control of shepherd's-purse and common groundsel was visually estimated July 16. The experimental design was a randomized complete block with three replicates. A general linear models procedure was used to analyze the data. Means were separated using Fisher's Protected LSD.

Table 1. Application data.

6:00 p.m., June 19, 1998
Broadcast, postemergence
Crop 3- to 5-leaf
Weeds 2 to 5 in. tall
35% cloud cover
Winds 1 to 3 mph from SW
Air temp. = 18 C
Soil temp (6") = 12 C
Relative humidity = 45%
No dew; soil surface dry

Cauliflower injury at six days after treatment ranged from 17% with pyridate, to 5% with sulfentrazone, to none with clopyralid and dimethenamid (Table 2). Pyridate leaf injury was typified by yellowish mottling, and sulfentrazone injury by necrotic spots on the leaves. In both cases, treated plants appeared normal by the commercial harvest date. Clopyralid at 0.28 lb/A and both rates of sulfentrazone controlled greater than 90% of common groundsel by 27 days after treatment. None of these herbicides adequately controlled shepherd's-purse, although pyridate did suppress that species (68 to 78 % control).

Table 2. Weed control and cauliflower injury as affected by postemergence herbicide treatment.

Treatment[a]	Rate	Crop injury	Weed control: Shepherd's-purse	Weed control: Common groundsel
	lb/A	%	%	%
Clopyralid	0.14	0	20	57
Clopyralid	0.28	0	7	100
Pyridate	0.5	17	68	23
Pyridate	1.0	17	78	53
Sulfentrazone	0.125	5	35	93
Sulfentrazone	0.25	5	55	98
Dimethenamid	0.5	0	15	3
Untreated check	---	0	0	0
$LSD_{0.05}$	---	4	42	21

[a]Trifluralin at 1.0 lb/A trifluralin was applied to all plots (including the check).

Tolerance of sweet corn to diflufenzopyr/dicamba. Bill D. Brewster, Paul E. Hendrickson, and Carol A. Mallory-Smith. (Department of Crop and Soil Science, Oregon State University, Corvallis, OR 97331-3002) Three sweet corn cultivars were evaluated in separate field trials for tolerance to diflufenzopyr plus dicamba. Three trials were conducted at the Hyslop Research Farm near Corvallis. Trial design was a randomized complete block with five replications and 10 ft by 28 ft plots. Four rows spaced 30 inches apart were planted in each plot. The herbicide treatments were applied with a single-wheel, compressed-air, plot sprayer which delivered a spray volume of 20 gpa through XR8003 flat fan nozzle tips at 19 psi. The trials were watered by sprinkler irrigation and weed competition was reduced by a preemergence application of metolachlor/benoxacor and by hand-weeding. The primary ears were harvested from 12 ft of each of the middle two rows in each plot. Herbicide application information is provided in Table 1.

Visual injury ratings were higher in 'Jubilee' than in 'Crisp and Sweet 710' and 'Supersweet Jubilee' (Table 2). While there was little difference in injury to 'Jubilee' between the addition of a crop oil concentrate or a non-ionic surfactant, the addition of bentazon or liquid fertilizer greatly increased crop injury and sharply reduced ear yields.

Table 1. Herbicide application information.

Cultivar	'Crisp and Sweet 710'	'Jubilee'	'Supersweet Jubilee'
Application date	June 3, 1998	June 2, 1998	July 6, 1998
Stage of growth	3 leaf, 2-3 inches	3 leaf, 3 inches	4 leaf, 3-4 inches
Air temperature (F)	55	64	72
Soil temperature(F)	56	63	68
Relative humidity (%)	76	60	68

Table 2. Crop injury ratings and corn ear yields.

Treatment[a]	Rate	'Crisp and Sweet 710'[b]		'Jubilee'[c]		'Supersweet Jubilee'[d]	
		Injury	Ear yield	Injury	Ear yield	Injury	Ear yield
	lb/A	%	Ton/A	%	Ton/A	%	Ton/A
Diflufenzopyr/dicamba + non-ionic surfactant	0.088	4	10.4	2	8.8	3	6.7
Diflufenzopyr/dicamba + non-ionic surfactant	0.175	4	9.9	22	7.2	3	6.8
Diflufenzopyr/dicamba + crop oil concentrate	0.088	7	10.0	10	8.3	0	6.5
Diflufenzopyr/dicamba + crop oil concentrate	0.175	9	9.0	26	6.9	2	6.0
Diflufenzopyr/dicamba + bentazon + crop oil concentrate	0.088 + 0.75	5	9.8	30	6.2	2	6.3
Diflufenzopyr/dicamba + bentazon + crop oil concentrate	0.175 + 0.75	13	9.2	34	4.6	11	6.6
Diflufenzopyr/dicamba + R-11 + Solution 32	0.088	2	10.5	38	6.8	0	6.8
Diflufenzopyr/dicamba + R-11 + Solution 32	0.175	11	9.9	28	4.3	2	6.6
Bentazon + crop oil concentrate	0.75	3	10.6	0	9.6	0	6.8
Check	0	0	9.7	0	9.2	0	6.8
	$LSD_{0.05}$		ns		1.0		ns

[a]Non-ionic surfactant, 0.25% v/v; crop oil concentrate, 1% v/v, Solution 32 liquid fertilizer, 1% v/v.
[b]Planted May 6, evaluated July 20, harvested August 31, 1998.
[c]Planted May 5, evaluated July 14, harvested September 1, 1998.
[d]Planted June 15, evaluated August 20, harvested September 21, 1998.

Tolerance of three sweet corn cultivars to postemergence applications of s-dimethenamid and s-metolachlor. Bill D. Brewster, Paul E. Hendrickson, and Carol A. Mallory-Smith. (Department of Crop and Soil Science, Oregon State University, Corvallis, OR 97331-3002) s-Dimethenamid and s-metolachlor were applied postemergence to three cultivars of sweet corn to evaluate crop tolerance. Each cultivar was evaluated in a separate field trial. The trials were conducted at the Oregon State University Hyslop Research Farm near Corvallis, OR. The experimental design was a randomized block with five replications and 8 ft by 28 ft plots. Four corn rows, spaced 30 inches apart, were seeded in each plot. The soil was a Woodburn silt loam with an organic matter content of 2.6% and a pH of 5.5. The trials were sprinkler irrigated. Herbicide treatments were applied with a single-wheel, compressed-air, plot sprayer which applied 20 gpa at 19 psi through XR8003 flat fan nozzle tips. The primary ears were harvested from 12 ft of each of the middle two rows in each plot. The s-metolachlor formulation contained the safener benoxacor. Herbicide application information is presented in Table 1. Atrazine at 0.5 lb/A was applied preemergence to reduce weed competition; the trials were also hand-weeded.

Visual injury ratings varied considerably among the three trials (Tables 2-4). Very little visible injury occurred in the 'Crisp and Sweet 710' plots, but ear yields were lower at the higher rates of s-dimethenamid than in the s-metolachlor plots. The greatest amount of leaf burning and stunting occurred in the 'Supersweet Jubilee' trials, but yields were not affected.

Table 1. Herbicide application information, Hyslop Farm, 1998.

	'Crisp and Sweet 710'	'Jubilee'	'Supersweet Jubilee'
Planting date:	May 6	May 5	June 15
Application date:	June 2	June 2	July 6
Growth stage:	3 leaf, 2-3 inches	3 leaf, 3 inches	4 leaf, 3-4 inches
Air temperature (F):	77	68	75
Soil temperature (F):	66	64	72
Relative humidity (%):	47	51	60
Soil moisture:	dry on surface	dry on surface	dry on surface
Soil surface:	small clods	small clods	granular

Table 2. Visual injury ratings and ear yields of 'Crisp and Sweet 710' sweet corn.

		Corn			
		Injury			
Treatment	Rate	June 9	June 23	July 20	Ear yield
	lb/A	%			Ton/A
Dimethenamid	2.34	0	4	2	11.8
s-Dimethenamid	0.64	0	2	0	11.8
s-Dimethenamid	1.29	0	6	4	10.7
s-Dimethenamid	2.58	0	7	8	10.8
s-Metolachlor	1.3	0	0	0	12.1
s-Metolachlor	2.6	0	4	0	12.6
s-Metolachlor	5.2	0	9	0	12.3
Check	0	0	0	0	11.4
				$LSD_{0.05}$	1.3

Table 3. Visual injury ratings and ear yields of 'Supersweet Jubilee' sweet corn.

		Corn			
		Injury			
Treatment	Rate	July 9	July 20	August 20	Ear yield
	lb/A	%			Ton/A
Dimethenamid	2.34	10	29	10	6.3
s-Dimethenamid	0.64	0	6	7	6.0
s-Dimethenamid	1.29	0	30	13	6.3
s-Dimethenamid	2.58	14	42	20	5.9
s-Metolachlor	1.3	4	2	2	6.4
s-Metolachlor	2.6	12	3	0	6.4
s-Metolachlor	5.2	21	6	8	6.4
Check	0	0	0	0	5.8
					$LSD_{0.05}$ ns

Table 4. Visual injury ratings and ear yields of 'Jubilee' sweet corn.

		Corn			
		Injury			
Treatment	Rate	June 9	June 23	July 20	Ear yield
	lb/A	%			Ton/A
Dimethenamid	2.34	11	14	0	8.7
s-Dimethenamid	0.64	0	6	0	9.1
s-Dimethenamid	1.29	0	4	0	8.5
s-Dimethenamid	2.58	0	9	0	7.9
s-Metolachlor	1.3	0	6	0	9.0
s-Metolachlor	2.6	0	14	0	8.6
s-Metolachlor	5.2	17	18	0	8.3
Check	0	0	0	0	9.3
					$LSD_{0.05}$ ns

Response of three sweet corn cultivars to several herbicides. Timothy W. Miller and Carl R. Libbey. Washington State University, Mount Vernon, WA 98273. This field study was conducted during 1998 at the WSU Mt. Vernon Research and Extension Unit. One row each of three sweet corn cultivars ('Sheba' (super sweet), 'Golden Jubilee,' and 'Golden Jubilee Super Sweet') was seeded into 10 by 20-ft plots June 5. Preemergence herbicides were applied June 6 and postemergence July 8, using a tractor-mounted sprayer delivering 29.7 gpa at 15 psi. Sweet corn establishment was determined July 13 by counting the total number of corn plants in each row. Weed control was visually estimated July 3 and 17, and October 14. Ears were picked when ripe for fresh market, counted, and weighed (unhusked). 'Sheba' was picked September 14 and 23, and 'Golden Jubilee' and 'Golden Jubilee Super Sweet' October 5 and 14. The experimental design was a randomized complete block with four replicates. A general linear models procedure was used to analyze the data. Means were separated using Fisher's Protected LSD. Application data is listed in Table 1, weed control and stand establishment is listed in Table 2, and yield in Table 3.

Table 1. Application data.

Date:	6:00 a.m., June 6, 1998	7:00 a.m., July 8, 1998
Type:	Broadcast, preemergence	Broadcast, postemergence
Crop stage:	---	3 leaves
Weed stage:	---	2 to 4 in.
Cloud cover:	100%, high overcast	20%
Winds:	Calm	0 to 1 mph from S
Air temp.:	11 C	13 C
Soil temp (6"):	9 C	9 C
Relative humidity:	100%	100%
Comments:	No dew present; soil surface was damp.	Dew present; soil surface was damp.

Weed species present in the research plots were common chickweed, common groundsel, common lambsquarters, hedge mustard, henbit, pale smartweed, prostrate knotweed, and shepherd's-purse. Weed pressure in the check plots was extremely high, completely overwhelming the sweet corn by the end of the season and essentially eliminating yield from those plots. A more vigorous sweet corn crop would probably have been better able to compete with the weeds, but an extended dry period apparently affected the crop more than the weeds.

The species generally causing the most difficulty in the acetochlor and MON 58430 plots were prostrate knotweed and pale smartweed. Initial control was excellent (from 96 to 99%), but new *Polygonum* seedlings were apparent in all acetochlor plots and MON 58430 at 1.66 lb by July 17 (41 days after treatment, DAT). There was not a significant difference in weed control between the three rates of acetochlor, although the 2.0 lb rate appeared more effective by October 14 than the lower rates (differences were statistically nonsignificant). Weed control by MON 58430 at the 1.66 lb rate was inadequate, significantly lower than at the 3.33 lb rate on all evaluation dates. The 3.33 lb rate resulted in excellent weed control up to 41 DAT, but weed control fell to 55% by 137 DAT. Dimethenamid alone at 1.17 lb did not provide adequate weed control beyond the first week of July. The species generally causing the most difficulty in the dimethenamid plots were common lambsquarters and pale smartweed. BAS 656 H (dimethenamid-P) alone was also inadequate, but postemergence bentazon improved weed control to 99%. Weed control was still good (78%) by October 14. BAS 662 01 H had produced strong epinastic effects on the weed species not controlled by metolachlor (common lambsquarters, prostrate knotweed, and pale smartweed) at 9 DAT, and sweet corn in one replicate was also exhibiting some epinastic effects. Weed control from metolachlor + BAS 662 01 H remained excellent throughout the growing season.

There was an apparent difference in establishment between sweet corn cultivars ('Sheba' > 'Golden Jubilee Super Sweet' > 'Golden Jubilee'), but none of the herbicides at the tested rates significantly affected establishment within a variety. Sweet corn yields generally responded positively to increased weed control, particularly the later-maturing 'Golden Jubilee' and 'Golden Jubilee Super Sweet.' These cultivars produced more ears when treated with metolachlor + BAS 662 01 H or BAS 656 H + bentazon, and heavier ears when treated by those treatments or alachlor + bentazon or acetochlor at 2 lb. The earlier-maturing 'Sheba' showed reduced yield only when treated with MON 58430 at 1.66 lb or dimethenamid, which provided poor late-season weed control. Based on yield and establishment data, the super sweet cultivars tested were not more sensitive to these herbicides than the standard variety.

Table 2. Weed control and sweet corn establishment as affected by herbicide treatment.

Treatment[a]	Timing[b]	Rate	Weed control 7/3[c]	Weed control 7/17	Weed control 10/14	Establishment[d] GJ[e]	Establishment[d] GJSS[e]	Establishment[d] Sheba[e]
		lb/A	--------------%----------------			----------plants/20 ft----------		
Acetochlor	PRE	1.6	98	96	61	9.5	14.3	18.8
Acetochlor	PRE	1.8	99	96	54	7.0	12.8	15.5
Acetochlor	PRE	2.0	99	98	68	8.8	13.5	14.5
Dimethenamid	PRE	1.17	90	83	35	6.8	12.0	13.0
BAS 656 H	PRE	0.66	81	99	78	7.3	12.0	13.5
+ Bentazon	EPOE	1.0						
+ COC	EPOE	1.0% v/v						
Metolachlor	PRE	1.5	75	100	92	12.3	13.3	18.8
+ BAS 662 01 H	EPOE	0.175						
+ 32-0-0	EPOE	1.5% v/v						
+ NIS	EPOE	0.25% v/v						
Alachlor	PRE	4.0	98	100	93	8.0	9.3	18.0
+ Bentazon	EPOE	1.0						
+ COC	EPOE	1.0% v/v						
MON 58430	PRE	1.66	75	84	33	9.6	12.7	19.0
MON 58430	PRE	3.33	96	95	55	7.8	11.3	17.5
Untreated check	---	---	0	0	0	5.3	7.5	15.5
$LSD_{0.05}$	---	---	13	6	17	ns	ns	ns

[a]COC = crop oil concentrate; NIS = nonionic surfactant.
[b]PRE = preemergence to weeds, applied 6/6/98; EPOE = early postemergence, applied 7/8/98.
[b]On this date, only PRE treatments had been applied.
[c]Establishment evaluated 7/13/98.
[d]GJ = Golden Jubilee; GJSS = Golden Jubilee (super sweet); Sheba = Sheba (super sweet).

Table 3. Sweet corn yield[a] as affected by herbicide treatment.

Treatment[b]	Timing[c]	Rate	Number of ears GJ[d]	Number of ears GJSS[d]	Number of ears Sheba[d]	Weight of ears GJ[d]	Weight of ears GJSS[d]	Weight of ears Sheba[d]
			------------no./20 ft------------			------------kg/20 ft------------		
Acetochlor	PRE	1.6	11.3	14.3	20.8	2.83	3.47	5.60
Acetochlor	PRE	1.8	9.0	12.5	14.5	2.20	2.87	4.01
Acetochlor	PRE	2.0	15.0	19.0	16.0	4.01	5.07	4.39
Dimethenamid	PRE	1.17	4.8	5.0	7.5	1.25	1.17	1.50
BAS 656 H	PRE	0.66	17.5	20.0	17.8	4.98	5.86	4.97
+ Bentazon	EPOE	1.0 lb						
+ COC	EPOE	1.0% v/v						
Metolachlor	PRE	1.5	25.0	22.5	24.8	6.09	5.82	5.83
+ BAS 662 01 H	EPOE	0.175						
+ 32-0-0	EPOE	1.5% v/v						
+ NIS	EPOE	0.25% v/v						
Alachlor	PRE	4.0	15.3	14.3	19.3	3.79	4.09	5.25
+ Bentazon	EPOE	1.0						
+ COC	EPOE	1.0% v/v						
MON 58430	PRE	1.66	7.2	3.3	13.8	1.73	0.65	2.90
MON 58430	PRE	3.33	12.8	13.0	18.5	3.36	3.26	5.01
Untreated check		---	1.3	0.0	1.0	0.26	0.00	0.10
LSD		---	7.8	6.8	7.5	2.27	2.01	2.54

[a]Yield based on two pickings for each cultivar.
[b]COC = crop oil concentrate; NIS = nonionic surfactant.
[c] PRE = preemergence to weeds, applied 6/6/98; EPOE = early postemergence, applied 7/8/98.
[d]GJ = Golden Jubilee; GJSS = Golden Jubilee (super sweet); Sheba = Sheba (super sweet).

Volunteer potato management with herbicides and tillage. Timothy W. Miller and Carl R. Libbey. Washington State University, Mount Vernon, WA 98273. Volunteer potatoes are a major weed species in many regions where potatoes are produced. Two studies were conducted in 1998 at the WSU Mount Vernon Research and Extension Unit to test herbicide efficacy and combinations of glyphosate and tillage to control volunteer potatoes.

Herbicide study. This study compared volunteer potato control by various herbicides and herbicide combinations available for rotational crops grown in northwestern Washington. 'Russet Burbank' potatoes were planted in 10 by 20-ft plots April 24. Preplant incorporated and preemergence herbicides were applied May 8, and postemergence herbicides were applied June 2. All herbicide treatments were applied using a tractor-mounted sprayer delivering 29.7 gpa at 15 psi. Volunteer potato control was visually estimated on May 28 and June 15. The experimental design was a randomized complete block with four replicates. A general linear models procedure was used to analyze the data. Means were separated using Fisher's Protected LSD. Application data is listed in Table 1 and volunteer potato control is listed in Table 3.

Table 1. Application data, herbicide study.

Date:	6:20 a.m., May 8, 1998	6:00 a.m., May 29, 1998
Type:	Broadcast, preplant incorporated preemergence	Broadcast, postemergence
Potato stage:	---	4 to 6 in.
Cloud cover:	100%	0%, clear
Winds:	2 to 7 mph from SW	0 to 3 mph from N
Air temp.:	9 C	17 C
Soil temp (4"):	8 C	6 C
Relative humidity:	92%	66%
Comments:	No dew; soil surface dry	Dew present; soil surface damp

Glyphosate/tillage study. This study tested tillage with and without glyphosate to control volunteer potato in three rotational crops common in northwestern Washington: sweet corn, green peas, and pickling cucumbers. 'Russet Burbank' potatoes were planted into 20 by 30-ft plots May 7. Two treatments were applied to control volunteer potatoes prior to seeding the rotational crop: (1) tillage used when volunteer potatoes were 4 to 8 in. or 8 to 12 in. tall and followed by crop seeding, and (2) application of glyphosate + 32-0-0 (at 1.5 lb/A + 1.5% v/v, respectively) to volunteer potatoes at 4 to 8 in. or 8 to 12 in. tall and followed by tillage and crop seeding. Glyphosate treatments were applied on June 12 or 22 using a CO_2-pressurized backpack sprayer delivering 31.3 gpa at 43 psi (application data in Table 2; tillage, spray, and seeding dates in Table 4). No herbicides were applied to the rotational crops. Emerged potato plants were counted in each crop July 24 and August 18, and a general "establishment" rating of the crop and weeds other than volunteer potatoes was estimated August 25 (rating from 1 to 10, where 1 = very poor crop or few weeds, and 10 = full crop or heavy weed population). The experimental design was a split-plot, randomized complete block with three replicates. A general linear models procedure was used to analyze the data. Means were separated using Fisher's Protected LSD.

Table 2. Application data, glyphosate/tillage study.

Date:	10:00 p.m., June 12, 1998	8:00 a.m., June 22, 1998
Type:	Broadcast, postemergence	Broadcast, postemergence
Potato stage:	4 to 8 in.	8 to 12 in.
Cloud cover:	0%	25%
Winds:	5 to 7 mph from NW	1 to 4 mph from SW
Air temp.:	16 C	17 C
Soil temp (6"):	13 C	13 C
Relative humidity:	89%	88%
Comments:	No dew; soil surface dry	Dew present; soil surface damp

Herbicide study. Clomazone at either rate gave 100% control of volunteer potato 20 days after treatment (DAT); the sequential treatments with bentazon or bentazon + MCPA were largely ineffectual, however, because there was no potato regrowth at the time of postemergence application. Primisulfuron + dicamba and fluroxypyr + MCPA provided 94 and 91% volunteer potato control, respectively, at 17 DAT; no other treatments exceeded 90% control.

Table 3. Volunteer potato control from various herbicides and herbicide combinations.

Treatment[a]	Rate	Timing[b]	Volunteer potato control 5/28[c]	6/15
	lb/A		------- % --------	
Triasulfuron + bromoxynil + NIS	0.016 + 0.5	POST	--	76
Thifensulfuron + tribenuron + NIS	0.028 + 0.5	POST	--	80
+ bromoxynil	0.5			
Bromoxynil + MCPA	0.5 + 0.5	POST	--	39
Clopyralid + MCPA	0.122 + 0.69	POST	--	55
Fluroxypyr + MCPA	0.25 + 0.5	POST	--	91
Imazamethabenz + NIS	0.47	POST	--	41
Dicamba + pyridate + COC	0.063 + 0.71	POST	--	78
Primisulfuron + dicamba + NIS	0.031 + 0.063	POST	--	94
Halosulfuron + dicamba + NIS	0.063 + 0.063	POST	--	89
Imazamox + NIS	0.04	POST	--	81
Clomazone	0.5	PPI	100	78
+ bentazon + MCPA	0.5 + 0.25	POST		
Sulfentrazone	0.25	PRE	15	10
Cycloate	3.0	PPI	85	25
Ethofumesate	1.5	PRE	25	6
Pyrazon	2.75	PRE	35	14
Phen. + des. + etho.	0.5	POST	--	36
+ endothall	0.075	POST		
Triflusulfuron + des. + NIS	0.016 + 0.5	POST	--	70
Simazine	0.8	PRE	25	83
+ clopyralid	0.25	POST		
Clomazone	0.17	PPI	100	49
+ bentazon	0.5	POST		
Rimsulfuron + metribuzin + NIS	0.023 + 0.5	POST	--	18

[a]Phen. + des. + etho. = phenmedipham + desmedipham + ethofumesate in pre-packaged tank mixture; des. = desmedipham; COC = crop oil concentrate applied at 1.0% v/v; NIS = nonionic surfactant applied at 0.25% v/v.
[b]PPI = preplant incorporated, applied 5/8/98; PRE = preemergence, applied 5/8/98; POST = postemergence, applied 6/2/98.
[c]On this date, postemergence treatments had not yet been applied.

Glyphosate/Tillage study. There was a significant three-way interaction between (1) the volunteer potato management program employed, (2) the rotational crop being produced, and (3) the size of the volunteer potatoes when management was applied on crop establishment (Table 4). Crop establishment was generally best in the glyphsate-treated plots when potatoes were 8 to 12 in. in height. The three-way interaction was not significant for volunteer potato control or weed establishment. There was, however, a significant interaction between the management program employed and the rotational crop being produced, indicating that potato height at the time of tillage or spraying did not affect either volunteer potato control or weed establishment (three-way data in Table 4, two-way data in Table 5).

The glyphosate/tillage program was more effective for suppression of volunteer potatoes than tillage alone. Glyphosate application reduced volunteer potato counts 84, 79, and 68% in sweet corn, cucumbers, and green peas by July 24 (respectively), and 87, 84, and 77% by August 24. In all cases, green peas were more competitive with volunteer potatoes than either sweet corn or cucumbers (as based on volunteer potato counts), although the magnitude of the difference was more apparent in the non-sprayed plots than in the glyphosate-treated plots. The weed establishment data displayed similar results, with peas being more likely to form stands dense enough to suppress general weed establishment than either cucumbers or sweet corn.

Table 4. Influence of tillage and herbicide combinations at two volunteer potato growth timings in three rotational crops.

Treatment[a]	Spray date[b]	Tillage date(s)	Seeding date	Volunteer potato control 7/24	8/18	Establishment[c] Crop	Weed
				-- plants/plot --			
Till and seed; potatoes at 4 to 8"							
Peas	----	6/18, 6/22	6/23	9.0	13.0	6.3	6.0
Sweet Corn	----	6/18, 6/22	6/23	18.3	25.0	2.7	7.0
Cucumbers	----	6/18, 6/22, 6/29	6/30	22.7	24.3	4.7	8.3
Spray, till, and seed; potatoes at 4 to 8"							
Peas	6/12	6/18, 6/22	6/23	4.7	5.3	6.3	2.3
Sweet Corn	6/12	6/18, 6/22	6/23	5.0	5.7	4.3	8.7
Cucumbers	6/12	6/18, 6/22, 6/29	6/30	9.7	5.7	6.3	6.7
Till and seed; potatoes at 8 to 12"							
Peas	----	6/22	6/23	8.0	11.0	5.3	6.0
Sweet Corn	----	6/22	6/23	19.7	29.0	5.3	7.7
Cucumbers	----	6/22, 6/29	6/30	32.0	31.3	6.7	8.7
Spray, till, and seed; potatoes at 8 to 12"							
Peas	6/22	7/1, 7/9	7/10	0.7	0.3	10.0	1.0
Sweet Corn	6/22	7/1, 7/9	7/10	1.0	1.3	5.7	7.3
Cucumbers	6/22	7/1, 7/9	7/10	2.0	3.3	7.7	5.3

[a]First herbicide/tillage treatment applied when volunteer potatoes were at either 4 to 8" or 8 to 12"; plots were then seeded to peas, sweet corn, or cucumbers.
[b]Glyphosate + 32-0-0 at 1.5 lbs ai/A + 1.5% v/v.
[c]Establishment ratings from 1 to 10 (1 = very poor crop or few weeds; 10 = full crop or heavy weed population) on 8/25/98.

Table 5. Influence of tillage and herbicide combinations on volunteer potato growth and crop and weed establishment in three rotational crops.

Treatment[a]	Volunteer potato control 7/24	8/18	Establishment[b] Crop	Weed
	-- plants/plot --			
Spray, till, and seed				
Sweet corn	3.0	3.5	5.0	8.0
Cucumbers	5.8	4.5	7.0	6.0
Green peas	2.7	2.8	8.2	1.7
Till and seed				
Sweet corn	19.0	27.0	4.0	7.3
Cucumbers	27.3	27.8	5.7	8.5
Green peas	8.5	12.0	5.8	6.0

[a]First herbicide/tillage treatment applied at the time volunteer potatoes were at either 4 to 8" or 8 to 12"; plots were then seeded to peas, sweet corn, or cucumbers. Glyphosate + 32-0-0 was applied at 1.5 lbs ai/A + 1.5% v/v.
[b]Establishment ratings from 1 to 10 (1 = very poor crop or few weeds; 10 = full crop or heavy weed population) on 8/25/98.

Tolerance of cucumber, squash, and pumpkin to several herbicides. Timothy W. Miller and Carl R. Libbey. Washington State University, Mount Vernon, WA 98273. Because few herbicides are currently registered for use on cucurbits, three field studies were conducted at the WSU Mount Vernon Research and Extension Unit in Mount Vernon in 1998 to determine selectivity of several products on cucumber, squash, and pumpkins.

Cucurbit study. Two hills each of 'Howden' pumpkin, 'Munchkin' mini pumpkin, 'Table Ace' Danish squash, and 'Turbo' slicing cucumber were planted into 8 by 20-ft plots June 5. Preemergence herbicides were applied June 5, and postemergence dimethenamid was applied July 2. Both applications were made using a CO_2-pressurized backpack sprayer delivering 31.3 gpa at 43 psi. Cucurbit emergence (number of plants emerged/hill) was recorded June 24 and establishment (number of plants established/hill) was recorded July 17; weed control was also visually estimated on both dates. The experimental design was a randomized complete block with four replicates. A general linear models procedure was used to analyze the data. Means were separated using Fisher's Protected LSD. Application data is listed in Table 1 and weed control and cucurbit emergence and establishment in Table 4.

Table 1. Application data, cucurbit study.

Date:	3:00 p.m., June 5, 1998	7:00 a.m., July 2, 1998
Type:	Broadcast, preemergence	Broadcast, postemergence
Crop stage:	---	2- to 3-leaf
Weed stage:	---	2 to 4 in.
Cloud cover:	40%	100%, high overcast
Winds:	3 to 6 mph from W	1 to 3 mph from NW
Air temp.:	24 C	18 C
Soil temp (6"):	11 C	12 C
Relative humidity:	45%	38%
Comments:	No dew; soil surface dry	No dew; soil surface damp

Cucumber study. Preplant incorporated herbicides were applied July 9, and 10 by 20-ft plots were seeded to 'Calypso' pickling cucumber July 10. Preemergence herbicides were applied July 10 and postemergence herbicides were applied August 4. All herbicides were applied using a tractor-mounted sprayer delivering 29.7 gpa at 15 psi. Crop injury was visually estimated July 30, and August 13 and 24. Fruits were harvested September 8 from 1-m lengths of the middle four rows in plots where cucumber plants displayed less than 30% herbicide injury. Cucumber fruits were then graded by fruit diameter (CN = crooks and nubs (culls), #1 = 0.5 to 1.0 in., #2 = 1.0 to 1.5 in., #3 = 1.5 to 2.0 in., and #4 = over 2.0 in.), and number and weight of the fruits recorded. The experimental design was a randomized complete block with three replicates. Data were analyzed using a general linear models procedure. Means were separated using Fisher's Protected LSD. Application data is listed in Table 2 and cucumber injury and yield in Table 5.

Table 2. Application data, cucumber study.

Date:	7:15 a.m., July 9, 1998	6:50 a.m., July 10, 1998	6:15 a.m., August 4, 1998
Type:	Broadcast, preplant incorporated	Broadcast, preemergence	Broadcast, postemergence
Crop stage:	---	---	3- to 4-leaf
Weed stage:	---	---	2 to 4 in.
Cloud cover:	25%	0%, clear	0%, clear
Winds:	3 to 4 mph from NW	calm	3 to 5 mph from S
Air temp.:	16 C	16 C	14 C
Soil temp (4"):	11 C	11 C	19 C
Relative humidity:	98%	66%	88%
Comments:	Dew; soil surface damp	No dew; soil surface damp	Dew present; soil surface damp

Cucumber SU/IMI study. Preplant incorporated herbicides were applied July 8, and 10 by 20-ft plots were seeded to 'Calypso' pickling cucumber July 10. Preemergence herbicides were applied July 11 and postemergence herbicides were applied August 4. All herbicides were applied using a tractor-mounted sprayer delivering 29.7 gpa at 15 psi. Crop injury, harvest, experimental design, and data analysis were as in the cucumber study described above. Application data is listed in Table 3 and cucumber injury and yield in Table 6.

Table 3. Application data, cucumber SU/IMI study.

Date:	6:50 a.m., July 8, 1998	6:15 a.m., July 11, 1998	6:45 a.m., August 4, 1998
Type:	Broadcast, preplant incorporated	Broadcast, preemergence	Broadcast, postemergence
Crop stage:	---	---	3- to 4-leaf
Weed stage:	---	---	2 to 4 in.
Cloud cover:	25%	100%, overcast	0%, clear
Winds:	0 to 1 mph from SE	3 to 5 mph from N	3 to 5 mph from S
Air temp.:	12 C	15 C	17 C
Soil temp (4"):	11 C	17 C	18 C
Relative humidity:	99%	93%	80%
Comments:	Dew; soil surface damp	No dew; soil surface damp	No dew; soil surface damp

The major weed species present in the cucurbit study were common chickweed, common groundsel, Powell amaranth, common lambsquarters, and shepherd's-purse. Weed pressure was very low in the two cucumber studies, so weed control was not evaluated in those plots.

Cucurbit study. Weed control by azafenidin and thiazopyr was greater than 90% at 19 and 42 days after treatment (DAT). Dimethenamid alone applied either preemergence or postemergence was not adequate for these weed species. Azafenidin significantly decreased cucumber emergence and tended to decrease cucumber and mini pumpkin establishment; thiazopyr also appeared to decrease cucumber establishment.

Table 4. The effect of three herbicides on weed control and on emergence and establishment of four cucurbit cultivars.

			Weed control		Emergence[c]				Establishment[d]			
Treatment	Timing[a]	Rate	6/24[b]	7/17	DS	BP	MP	SC	DS	BP	MP	SC
		lb/A	------- % -------		------- plants/hill --------				------- plants/hill --------			
Azafenidin	PRE	0.25	96	96	4.4	1.1	3.8	4.0	4.5	0.9	2.9	1.5
Thiazopyr	PRE	0.75	91	94	4.4	1.4	4.6	6.1	4.4	1.5	3.9	1.5
Dimethenamid	PRE	1.0	83	81	4.4	1.8	4.9	6.3	4.3	1.9	4.8	5.8
Dimethenamid	POST	0.5	---	21	4.5	1.9	4.5	6.0	4.5	1.9	4.6	5.6
Untreated check	---	---	0	0	5.0	1.1	4.1	5.6	4.5	0.9	4.1	3.1
$LSD_{0.05}$	---	---	4	8	ns	ns	ns	1.0	ns	ns	ns	ns

[a]PRE = preemergence to weeds, applied 6/5/98; POST= postemergence, applied 7/2/98.
[b]On this date, postemergence dimethenamid had not yet been applied
[c]Emergence = number of plants emerging from a hill; DS = Danish squash, BP = big pumpkin, MP = mini pumpkin, SC = slicing cucumber.
[d]Establishment = number of plants established in a hill; DS = Danish squash, BP = big pumpkin, MP = mini pumpkin, SC = slicing cucumber.

Cucumber study. Cycloate, sulfentrazone, thiazopyr, and ethofumesate caused severe crop injury, ranging from 57 to 92%. Pendimethalin at 0.75 lbs ai/A caused 5% cucumber injury 20 DAT, while the 1.5 lb/A rate caused 23% injury. Injury from either pendimethalin treatment was not different from the untreated checks by 45 DAT. Dimethenamid and both bentazon + naptalam treatments resulted in greater than 20% crop injury at 9 DAT, although the crop rapidly recovered and injury levels were 10% or less by 20 DAT. Total number or weight of fruits resulting from pendimethalin, dimethenamid, or bentazon + naptalam treatments did not differ significantly from each other or the handweeded check.

Cucumber SU/IMI study. Rimsulfuron, nicosulfuron, prosulfuron, primisulfuron, imazamethabenz, imazethapyr, and imazamox caused severe crop injury, ranging from 48 to 90%. Halosulfuron injury at 9 DAT was 25%, but had decreased to 7% by 20 DAT. Clomazone alone caused slight injury at 22 DAT (from 7 to 8%), while ethalfluralin alone caused no visible symptoms. The sequential rimsulfuron treatments caused 57 and 50% cucumber injury by August 13 (ethalfluralin and clomazone, respectively), while halosulfuron with those products caused 23 and 20% injury, respectively. Damage from the sequential halosulfuron applications had decreased to 12 and 10% by 18 DAT (ethalfluralin and clomazone, respectively). Total number or weight of fruits resulting from halosulfuron, ethalfluralin, clomazone, or ethalfluralin/clomazone + halosulfuron sequential treatments did not differ significantly from each other or the handweeded check.

Table 5. Injury to and yield of cucumbers after treatment with various herbicides and herbicide combinations.

Treatment	Timing[a]	Rate	Crop injury 7/30[b]	Crop injury 8/13	Crop injury 8/24	Yield/plot[c] -- CN --- no.	kg	--- #1 --- no.	kg	--- #2 --- no.	kg	--- #3 --- no.	kg	--- #4 --- no.	kg	-- Total -- no.	kg
		lb/A	---	%	---												
Cycloate	PPI	1.5	85	82	70	---	---	---	---	---	---	---	---	---	---	---	---
Cycloate	PPI	3.0	92	95	93	---	---	---	---	---	---	---	---	---	---	---	---
Pendimethalin	PRE	0.75	5	5	0	37	1.80	16	0.08	2	0.12	27	3.76	7	1.43	59	7.13
Pendimethalin	PRE	1.5	23	10	7	31	1.87	19	0.10	3	0.25	20	2.75	8	1.53	57	6.67
Sulfentrazone	PRE	0.19	57	52	37	---	---	---	---	---	---	---	---	---	---	---	---
Sulfentrazone	PRE	0.25	72	75	68	---	---	---	---	---	---	---	---	---	---	---	---
Thiazopyr	PRE	0.5	75	63	55	---	---	---	---	---	---	---	---	---	---	---	---
Thiazopyr	PRE	0.75	82	88	83	---	---	---	---	---	---	---	---	---	---	---	---
Ethofumesate	PRE	0.5	70	52	15	---	---	---	---	---	---	---	---	---	---	---	---
Ethofumesate	PRE	1.0	90	75	63	---	---	---	---	---	---	---	---	---	---	---	---
Dimethenamid	POST	0.5	--	22	8	29	1.71	19	0.11	4	0.31	20	2.95	2	0.52	60	5.69
Dimethenamid	POST	0.75	--	20	7	30	1.82	26	0.14	4	0.32	21	3.03	6	1.43	61	6.81
Bentazon	POST	0.5	--	20	8	26	1.36	15	0.09	4	0.20	24	3.00	9	1.83	58	6.48
+ naptalam	POST	2.0															
Bentazon	POST	0.75	--	28	10	15	0.83	18	0.10	7	0.38	30	4.08	5	1.11	56	6.19
+ naptalam	POST	2.0															
handweeded	---	---	0	0	0	36	1.75	20	0.11	2	0.13	26	3.70	4	1.00	61	6.71
Untreated check	---	---	0	0	0	---	---	---	---	---	---	---	---	---	---	---	---
$LSD_{0.05}$	---	---	2	9	12	9	ns	ns	ns	ns	ns	ns	ns	3	ns	ns	ns

[a]PPI = preplant-incorporated, applied 7/9/98; PRE = preemergence to weeds, applied 7/10/98; POST= postemergence, applied 8/4/98.
[b]On this date, postemergence treatments had not yet been applied.
[c]Number and weight of cucumber fruits harvested per plot; CN = crooks and nubs (culls), grades #1 through #4, and total yield.

Table 6. Injury to and yield of cucumbers after treatment with sulfonylurea/imidazolinone herbicides and combinations.

Treatment[a]	Timing[b]	Rate	Crop injury 7/30[c]	Crop injury 8/13	Crop injury 8/24	Yield/plot[d] -- CN --- no.	kg	--- #1 --- no.	kg	--- #2 --- no.	kg	--- #3 --- no.	kg	--- #4 --- no.	kg	-- Total -- no.	kg
		lb/A	---	%	---												
Rimsulfuron	POST	0.023	--	52	53	---	---	---	---	---	---	---	---	---	---	---	---
Halosulfuron	POST	0.032	--	25	7	26	1.04	24	0.16	11	0.76	36	4.55	2	0.48	64	7.31
Nicosulfuron	POST	0.0156	--	48	73	---	---	---	---	---	---	---	---	---	---	---	---
Prosulfuron	POST	0.009	--	55	60	---	---	---	---	---	---	---	---	---	---	---	---
Primisulfuron	POST	0.0178	--	57	90	---	---	---	---	---	---	---	---	---	---	---	---
Imazamethabenz	POST	0.235	--	50	87	---	---	---	---	---	---	---	---	---	---	---	---
Imazethapyr	POST	0.047	--	50	62	---	---	---	---	---	---	---	---	---	---	---	---
Imazamox	POST	0.032	--	53	73	---	---	---	---	---	---	---	---	---	---	---	---
Ethalfluralin	PRE	1.12	0	0	0	37	1.98	20	0.09	2	0.12	27	3.63	4	0.79	59	7.04
Clomazone	PPI	0.125	8	0	0	39	1.99	9	0.05	2	0.17	22	3.10	5	1.16	59	6.89
Ethalfluralin	PRE	1.12	0	57	53	---	---	---	---	---	---	---	---	---	---	---	---
+ Rimsulfuron	POST	0.016															
Ethalfluralin	PRE	1.12	0	23	12	31	1.47	19	0.15	7	0.41	23	3.06	6	1.31	64	6.64
+ Halosulfuron	POST	0.016															
Clomazone	PPI	0.125	8	50	45	---	---	---	---	---	---	---	---	---	---	---	---
+ Rimsulfuron	POST	0.016															
Clomazone	PPI	0.125	7	20	10	36	2.00	30	0.22	7	0.34	26	3.28	4	0.84	61	7.03
+ Halosulfuron	POST	0.016															
handweeded	---	---	0	0	0	37	2.59	14	0.08	3	0.22	25	3.41	4	1.05	64	7.61
Untreated check	---	---	0	0	0	---	---	---	---	---	---	---	---	---	---	---	---
$LSD_{0.05}$	---	---	2	9	9	ns	0.63	ns	ns	5	0.21	ns	ns	ns	ns	ns	ns

[a]All sulfonylurea and imidazolinone herbicides were applied with 0.25% v/v nonionic surfactant (R-11).
[b]PPI = preplant-incorporated, applied 7/8/98; PRE = preemergence to weeds, applied 7/11/98; POST= postemergence, applied 8/4/98.
[c]On this date, postemergence treatments had not yet been applied; sequential treatments were ethalfluralin only or clomazone only.
[d]Number and weight of cucumber fruits harvested per plot; CN = crooks and nubs (culls), grades #1 through #4, and total yield.

Preemergence herbicide combinations for onion weed control study. K. Umeda, G. Gal, and B. Strickland. (University of Arizona Cooperative Extension Maricopa County, Phoenix, AZ 85040) A small plot field test was conducted at the University of Arizona Maricopa Agricultural Center, Maricopa, AZ. The field was prepared using typical cultural tillage and then conventional 40-inch beds were listed and shaped. Onion cv. Henry's Special was planted two seedlines per bed on 23 November 1997. The herbicide plots consisted of two beds by 25 ft long and treatments were replicated three times in a randomized complete block design. The PREE herbicide treatments were applied using a CO_2 backpack sprayer equipped with a hand-held boom with four flat fan 8002 nozzle tips spaced 20 in. apart. The herbicides were delivered in 22 gpa of water that was pressurized to 35 psi. The soil was dry and at 74°F immediately after planting. At the time of herbicide applications on 24 Nov, the sky had high scattered clouds, the air temperature was 82°F, and there was a slight breeze at less than 5 mph. The onions were furrow irrigated immediately after the herbicides were applied. Water was applied as necessary throughout the season. At various times during the growing season, crop measurements and visual estimates of weed control and crop injury were recorded.

DCPA at 9.0 lb/A, the commercial standard herbicide, slightly reduced the number of plants and shortened the onion height compared to the untreated check. Preemergence (PREE) herbicide treatments that reduced height similar to DCPA included pendimethalin, propachlor, metolachlor, dimethenamid, ethofumesate, and benefin. Visual estimates on 21 Jan did not indicate a significant stand reduction or crop injury compared to plant counts observed on 14 Jan. Treatments that caused minimal visible crop injury (<10%) were propachlor, benefin and lower rates of dimethenamid and ethofumesate. Moderate to acceptable injury (15%) was observed on onions treated by pendimethalin, metolachlor, dimethenamid, and ethofumesate. Treatments that significantly reduced crop stand were bensulide at 6.0 lb/A, lactofen, thiazopyr, and some combinations of the three herbicides. Combination treatments that caused marginally acceptable injury included pendimethalin plus metolachlor, ethofumesate plus pendimethalin, bensulide plus ethofumesate, ethofumesate plus dimethenamid, propachlor plus dimethenamid, propachlor plus ethofumesate, and propachlor plus benefin. Early weed control ratings showed that pendimethalin at 0.5 and 0.75 lb/A, ethofumesate, lactofen, thiazopyr applied alone gave acceptable control (>85%) of London rocket, sowthistle, and yellow sweetclover. Pendimethalin at 0.75 lb/A alone and lactofen gave season-long control of all weeds. Early weed control ratings of combination herbicide treatments demonstrated that pendimethalin or ethofumesate combined with other herbicides gave acceptable weed control. Propachlor, ethofumesate, or metolachlor at the lower rates with pendimethalin at 0.50 lb/A added as a tank-mix slightly improved weed control compared to each of the herbicides applied alone.

Table. Preemergence herbicide combinations for onion weed control study.

Treatment	Rate	Onion				Weed Control					
	(lb/A)	Stand	CSR	Height	Injury	SSYIR		SONOL		MEUOF	
		14 Jan	21 Jan	14 Jan	21 Jan	21 Jan	24 Apr	21 Jan	24 Apr	21 Jan	24 Apr
		no./plot	%	in./plant	%	%					
Untreated check		39.0	0	1.5	0	0	0	0	0	0	0
DCPA	9	32.3	0	1.2	0	77	0	83	93	77	0
Bensulide	4	17.0	0	0.9	17	17	0	82	32	52	0
Bensulide	6	17.3	47	0.9	35	50	23	87	58	63	17
Pendimethalin	0.5	30.0	0	1.1	10	96	70	98	83	95	77
Pendimethalin	0.75	29.7	0	1.0	13	99	90	99	99	96	90
Propachlor	4	29.0	0	1.2	0	17	17	83	0	83	0
Propachlor	8	28.0	0	1.1	5	48	33	88	0	87	17
Metolachlor	1	26.3	0	1.0	10	67	57	73	28	67	43
Metolachlor	2	34.0	0	1.3	10	68	33	88	23	78	23
Dimethenamid	0.5	25.0	0	1.3	3	70	17	87	17	83	17
Dimethenamid	1	33.0	0	1.1	10	70	50	85	33	83	17
Ethofumesate	1	28.0	0	1.2	7	60	33	87	0	87	60
Ethofumesate	2	22.3	0	1.2	17	86	50	95	0	93	67
Lactofen	0.25	7.0	73	1.0	30	99	96	99	86	99	91
Thiazopyr	0.1	11.0	99	0.6	-	98	47	99	17	99	23
Benefin	1.5	31.3	0	1.1	3	33	17	82	0	70	0
Pendimethalin + Bensulide	0.5 + 4	20.3	50	0.8	45	99	80	99	62	99	75
Pendimethalin + Propachlor	0.5 + 4	28.3	0	1.3	7	96	78	99	91	99	83
Pendimethalin + Metolachlor	0.5 + 1	31.3	0	1.2	13	98	78	99	82	99	78
Pendimethalin + Lactofen	0.5 + 0.25	5.3	96	0.7	90	99	96	99	96	99	98
Bensulide + Propachlor	4 + 4	22.0	0	1.0	25	88	60	92	47	90	48
Bensulide + Metolachlor	4 + 1	26.0	0	1.1	27	87	50	90	57	83	28
Bensulide + Ethofumesate	4 + 4	17.0	0	1.1	17	70	33	90	47	80	63
Bensulide + Benefin	4 + 1.5	12.7	83	0.9	50	72	33	96	72	93	40
Ethofumesate + Pendimethalin	1 + 0.5	29.7	0	1.1	13	98	77	99	90	96	92
Ethofumesate + Metolachlor	1 + 1	21.0	0	1.2	27	83	57	90	17	85	62
Ethofumesate + Dimethenamid	1 + 0.5	26.0	0	1.1	17	92	43	93	17	92	75
Ethofumesate + Thiazopyr	1 + 0.1	6.3	99	0.6	-	99	65	99	40	99	80
Propachlor + Dimethenamid	4 + 0.5	23.7	0	1.2	12	68	57	90	33	83	23
Propachlor + Ethofumesate	4 + 1	31.7	0	1.2	10	82	57	88	33	83	47
Propachlor + Thiazopyr	4 + 0.1	16.7	99	0.6	-	96	57	98	17	96	17
Propachlor + Benefin	4 + 1.5	23.3	0	1.0	17	70	17	90	23	80	17
LSD (p=0.05)		9.8	20.2	0.27	13.9	22.8	33.2	9.4	37.3	18.4	36.2

PREE applications made on 24 Nov 1997
Stand = number of plants/3 ft of row in 2 seedlines; CSR = crop stand reduction
Height measured for average of 10 plants per plot in inches

Postemergence herbicide efficacy and safety in onions. K. Umeda. (University of Arizona Cooperative Extension Maricopa County, Phoenix, AZ 85040) A small plot field test was conducted at the University of Arizona Maricopa Agricultural Center, Maricopa, AZ. Onions cv. Phoenix were planted two seedlines per bed on a conventional 40-inch bed on 24 November 1997 and then furrow irrigated. The plots consisted of two beds by 25 ft of row and treatments were replicated three times in a randomized complete block design. The postemergence (POST) herbicide sprays were applied using a CO_2 backpack sprayer equipped with a hand-held boom with two flat fan 8002 nozzles spaced 20 inches apart. The herbicides were applied in a volume of 22 gpa water pressurized to 40 psi. At the time of applications, the sky was partly overcast, the air temperature was 50°F, and there was no wind. The onions were at the flag-leaf plus one true leaf stage and the weeds present were London rocket at the 6 to 8 leaf stage, yellow sweetclover at the 2-trifoliolate stage, and annual sowthistle at the 4 leaf stage.

At 1 month after treatment, bromoxynil treatments gave very good control of most weeds. Bromoxynil at 0.375 lb/A controlled weeds that lasted for the remainder of the season. Oxyfluorfen at the higher rate or oxyfluorfen combination treatments gave acceptable weed control compared to the lower rate. Lactofen was comparable to oxyfluorfen against most of the weeds and was safe on onions. Sulfentrazone was not effective against any of the weeds and was safe on onions.

Table. Postemergence herbicide efficacy and safety in onions.

Treatment	Rate	Onion Injury		Weed Control							
	(lb/A)	17 Feb	23 Mar	SSYIR			SONOL		MEUOF		
				17 Feb	23 Mar	24 Apr	17 Feb	23 Mar	17 Feb	23 Mar	24 Apr
		%		%							
Untreated check		0	0	0	0	0	0	0	0	0	0
Bromoxynil	0.125	0	0	90	71	61	93	90	81	59	28
Bromoxynil	0.025	0	0	88	62	28	92	85	82	63	68
Bromoxynil	0.375	0	0	98	93	87	96	93	85	82	90
Oxyfluorfen	0.125	0	0	73	7	0	88	77	75	40	43
Oxyfluorfen	0.25	0	0	87	37	23	90	88	77	33	17
Oxyfluorfen + Bromoxynil	0.125 + 0.125	0	0	93	58	0	96	90	82	58	65
Bromoxynil + Pendimethalin	0.125 + 0.75	3	0	88	55	30	93	91	80	72	77
Pendimethalin + Oxyfluorfen	0.75 + 0.125	7	0	78	20	0	90	85	83	17	23
Lactofen	0.125	0	0	77	17	33	88	57	78	40	17
Sulfentrazone	0.063	0	0	0	0	0	0	0	0	0	0
Sulfentrazone	0.094	0	0	0	0	0	0	0	0	0	0
LSD (p=0.05)		6.4	0	8.9	34	45.4	4.7	27.9	7.6	36.1	39.7

Onions treated on 22 January 1998.

Herbicides for weed control in green peas. Timothy W. Miller and Carl R. Libbey. Washington State University, Mount Vernon, WA 98273. Several herbicides were tested for efficacy and crop safety to green peas in 1998 at the WSU Mount Vernon Research and Extension Unit. 'Charo' green peas were used for three herbicide studies. The first compared preplant incorporated (PPI) and preemergence (PRE) herbicides used alone and in combination, the second compared postemergence (POST) herbicides used alone and in combination, and the third was a plant back study to determine the potential for herbicides used in green peas to persist in the soil and injure rotational crops. Weed species in all plots included henbit, common chickweed, common groundsel, shepherd's-purse, Powell amaranth, common lambsquarters, and pale smartweed.

PPI/PRE study. PPI and PRE treatments were applied May 21 and 23, respectively; plots measured 10 by 20-ft and were seeded May 22. All herbicide treatments were applied using a tractor-mounted sprayer delivering 29.7 gpa at 15 psi (Table 1). Crop injury and general weed control was visually estimated June 12. A 1-m^2 quadrat was placed within each plot July 29, and pea plants in the quadrat were counted, and yield components determined. The experimental design was a randomized complete block with four replicates. A general linear models procedure was used to analyze the data. Means were separated using Fisher's Protected LSD.

Table 1. Application data, PPI/PRE study.

Date:	6:10 a.m., May 21, 1998	5:30 a.m., May 23, 1998
Type:	Broadcast, preplant incorporated	Broadcast, preemergence
Cloud cover:	100%, light drizzle	100%, high overcast
Winds:	3 to 5 mph from S	0 to 2 mph from S
Air temp.:	9 C	11 C
Soil temp (4"):	9 C	9 C
Relative humidity:	98%	96%
Comments:	No dew; soil surface wet	No dew; soil surface damp

POST study. Plots measured 10 by 20-ft and were seeded May 22. POST herbicides were applied June 12, when peas were at the 4-leaf stage. All herbicide treatments were applied using a tractor-mounted sprayer delivering 29.7 gpa at 15 psi (Table 2). Crop injury and general weed control was visually estimated June 24. A 1-m^2 quadrat was placed within each plot July 30, and pea plants in the quadrat were counted, and yield components determined. Due to extensive crop injury, fomesafen-treated plots were not harvested. The experimental design was a randomized complete block with three replicates. A general linear models procedure was used to analyze the data. Means were separated using Fisher's Protected LSD.

Table 2. Application data, POST study.

Date:	6:00 a.m., June 12, 1998
Type:	Broadcast, postemergence
Crop stage:	4 to 5 nodes; 4 leaves
Weed stage:	1 to 3 in.
Cloud cover:	70%
Winds:	0 to 1 mph from W
Air temp.:	17 C
Soil temp (6"):	8 C
Relative humidity:	76%
Comments:	Dew present; soil surface damp

Plant back study. PPI and PRE treatments were applied May 22 and 23, respectively; plots measured 10 by 20-ft and were seeded May 22. POST herbicides were applied June 16, when peas were at the 4-leaf stage. All herbicide treatments were applied using a tractor-mounted sprayer delivering 29.7 gpa at 15 psi (Table 3). Crop injury and general weed control was visually estimated June 24. A 1-m^2 quadrat was placed within each plot August 4, 1998, and pea plants in the quadrat were counted, and yield components determined. Rotational crops will be seeded during fall 1998 and spring 1999 in these plots and will be monitored for herbicide carryover symptoms. The experimental design was a split-plot, randomized complete block with four replicates. A general linear models procedure was used to analyze the data. Means were separated using Fisher's Protected LSD.

Table 3. Application data, green pea plant back study.

Date:	6:00 a.m., May 22, 1998	5:10 a.m., May 23, 1998	2:00 p.m., June 16, 1998
Type:	Broadcast, preplant incorporated	Broadcast, preemergence	Broadcast, postemergence
Crop stage:	---	---	5 nodes, 4 leaves
Weed stage:	---	---	1 to 3 in.
Cloud cover:	100%, overcast	100%, overcast	10%
Winds:	2 to 5 mph from S	0 to 1 mph from S	5 to 7 mph from SE
Air temp.:	10 C	11 C	14 C
Soil temp (4"):	7 C	9 C	13 C
Relative humidity:	85%	95%	71%
Comments:	No dew; soil surface damp	No dew; soil surface damp	No dew; soil surface damp

PPI/PRE study. All herbicides except trifluralin at 0.5 lb/A provided greater than 90% weed control on June 12 (22 and 20 days after treatment (DAT) for PPI and PRE, respectively)(Table 4). Crop injury exceeded 50% from the three *S*-metolachlor treatments at 20 DAT, however, and was 26% from 0.75 lb/A trifluralin at 22 DAT. There was no significant difference in pea plant density, the number of pods per plant, or yield due to herbicide treatment at the time of harvest.

POST study. The greatest weed control at 12 DAT resulted from the following treatments: metribuzin alone at either rate, bentazon, bentazon + MCPB, and metribuzin + bentazon at either rate (Table 5). Fomesafen at 0.3125 or 0.378 also provided 85% weed control, but all rates caused significant crop injury, ranging from 65 to 75% at 12 DAT. There was no significant difference in pea plant density, the number of pods per plant, or yield due to herbicide treatment at the time of harvest.

Plant back study. Clomazone and pendimethalin + imazamox gave 99 and 93% weed control, respectively, at 8 DAT (Table 6). All treatments containing imazamox caused greater than 20% crop injury at 12 DAT, however, and fomesafen injury was 94%. Peas treated with sulfentrazone, clomazone, and trifluralin yielded significantly better than untreated plants. Compared to the highest yielding treatment, yields were reduced by imazamox, pendimethalin + imazamox, and fomesafen. Green pea density, pods per plant, and yield was significantly reduced by fomesafen compared to the untreated check.

Table 4. Crop injury, weed control, and yield parameters of green peas treated with several preplant incorporated and preemergence herbicides and herbicide combinations.

Treatment	Rate	Timing[a]	Crop Injury	Weed Control	Plant pop.[b]	Pods/ plant	Yield
	lbs/A		%	%			tons/A
Clomazone	0.25	PPI	1	98	3.71	3.1	0.99
Clomazone	0.5	PPI	13	100	3.61	4.0	1.53
Metribuzin	0.25	PRE	5	95	4.07	3.6	1.96
Metribuzin	0.38	PRE	4	97	4.01	3.0	1.38
S-metolachlor	1.43	PRE	53	100	3.61	3.6	1.26
S-metolachlor	2.86	PRE	74	100	3.55	3.8	1.73
Pendimethalin	0.5	PRE	3	96	4.02	3.8	1.50
Pendimethalin	1.0	PRE	9	96	3.72	4.5	1.95
Pendimethalin	1.5	PRE	19	95	3.23	4.6	1.80
Trifluralin	0.5	PPI	8	88	3.53	3.8	1.45
Trifluralin	0.75	PPI	26	100	3.34	5.1	2.12
Clomazone + metribuzin	0.25 + 0.25	PPI + PRE	8	100	3.68	4.1	1.98
S-metolachlor + metribuzin	1.43 + 0.25	PRE	61	100	3.97	4.1	1.98
Pendimethalin + metribuzin	0.5 + 0.25	PRE	5	100	3.80	4.1	2.10
Trifluralin + metribuzin	0.5 + 0.25	PPI + PRE	6	100	3.75	3.7	1.63
Untreated control	---	---	0	0	3.70	3.4	1.32
$LSD_{0.05}$	---	---	6	5	ns	ns	ns

[a]PPI = preplant incorporated; PRE = preemergence.

[b]Pea plants per acre (x 100,000).

Table 5. Crop injury, weed control, and yield parameters of green peas treated with several postemergence herbicides and herbicide combinations.

Treatment[a]	Rate	Crop Injury	Weed Control	Plant pop.[b]	Pods/ plant	Yield
	lbs/A	%	%			tons/A
Fomesafen + NIS	0.25	65	78	---	---	---
Fomesafen + NIS	0.3125	75	85	---	---	---
Fomesafen + NIS	0.378	73	85	---	---	---
Metribuzin	0.125	2	91	4.14	4.7	3.34
Metribuzin	0.25	3	98	3.99	4.1	3.24
MCPA	0.38	5	43	3.38	4.4	2.78
MCPB	1.5	2	48	4.07	5.0	4.18
Bentazon	0.75	0	88	4.01	4.4	3.02
Bentazon + MCPA	0.5 + 0.25	2	67	4.11	4.4	4.04
Bentazon + MCPB	0.5 + 0.5	2	83	3.72	4.9	3.21
Bentazon + metribuzin	0.25 + 0.125	0	96	4.18	4.2	3.05
Bentazon + MCPA	0.25 + 0.38	5	72	3.79	4.3	3.08
Bentazon + MCPB	0.25 + 0.75	2	62	3.21	4.1	2.49
Bentazon + metribuzin	0.125 + 0.25	5	99	3.60	4.0	2.97
Untreated control	---	0	0	3.95	4.2	2.80
$LSD_{0.05}$	---	6	18	ns	ns	ns

[a] NIS = nonionic surfactant at 0.25% v/v (X-77).
[b] Pea plants per acre (x 100,000).

Table 6. Crop injury, weed control, and yield parameters of green peas treated with several herbicides and herbicide combinations (plant back study).

Treatment[a]	Rate	Timing[b]	Crop Injury	Weed Control	Plant pop.[c]	Pods/ plant	Yield
	lbs/A		%	%			tons/A
Imazamox	0.032	POST	21	83	4.56	3.6	2.67
+ 32-0-0 + NIS	+ 1.25% v/v + 0.25% v/v						
Imazamox	0.04	POST	28	85	3.70	3.9	2.45
+ 32-0-0 + NIS	+ 1.25% v/v + 0.25% v/v						
Pendimethalin	1.0	PRE	13	79	3.66	4.2	2.31
Pendimethalin	1.0	PRE	26	93	3.62	4.0	2.66
+ imazamox + NIS	+ 0.032 + 0.24% v/v	POST					
Trifluralin	0.75	PPI	18	76	3.43	4.8	3.24
Clomazone	0.5	PPI	19	99	4.07	4.5	3.26
Sulfentrazone	0.25	PRE	15	81	3.69	5.1	3.42
Fomesafen + NIS	0.375 + 0.25% v/v	POST	94	89	1.57	3.1	0.67
Untreated control	---	---	0	0	2.90	4.4	2.14
$LSD_{0.05}$	---	---	6	18	0.53	0.8	0.88

[a] NIS = nonionic surfactant (X-77).
[b] PPI = preplant incorporated; PRE = preemergence; POST = postemergence.
[c] Pea plants per acre (x 100,000).

Applications of herbicides on dormant peppermint for control of summer-annual broadleaf weeds. Bill D. Brewster, Paul E. Hendrickson, and Carol A. Mallory-Smith. (Department of Crop and Soil Science, Oregon State University, Corvallis, OR 97331-3002) Research has shown that sulfentrazone and clomazone applied on dormant peppermint as a tank-mix at 0.25 plus 0.5 lb/A can provide effective season-long control of many cool-season and warm-season annual broadleaf and grass weeds. These herbicides can persist in the soils of central Oregon at rates high enough to injure certain rotation crops over a year after application. A trial was conducted near Powell Butte in Crook County to compare the efficacy of several herbicide combinations with reduced application rates. The experimental design was a randomized complete block with four replications and 8 ft by 20 ft plots. The herbicide treatments were applied on February 24, 1998, with a single-wheel, compressed-air, plot sprayer which delivered 20 gpa through XR8003 flat fan spray tips at 19 psi. The soil was an Ayres gravelly sandy loam with an organic matter content of 3.4% and a pH of 5.4.

Visual evaluations on May 14 revealed very little crop stunting from any treatment, and in July no injury was present (Table). Redroot pigweed control was good to excellent in all treatments that included sulfentrazone. Those treatments that failed to control redroot pigweed through the season also failed to provide season-long control of common lambsquarters. All of the sulfentrazone treatments provided complete control of lambsquarters into July.

Table. Visual ratings of peppermint injury and weed control.

				Control			
		Peppermint injury		Redroot pigweed		Common lambsquarters	
Treatment	Rate	May 14	July 8	May 14	July 8	May 14	July 8
	lb/A	%					
Sulfentrazone + oxyfluorfen	0.188 + 0.25	0	0	100	95	100	100
Clomazone + oxyfluorfen	0.375 + 0.25	0	0	78	0	100	62
Sulfentrazone + clomazone + oxyfluorfen	0.125 + 0.25 + 0.25	0	0	100	88	100	100
Sulfentrazone + pendimethalin	0.188 + 1.0	0	0	99	95	100	100
Clomazone + pendimethalin	0.375 + 1.0	3	0	80	28	100	50
Sulfentrazone + clomazone + pendimethalin	0.125 + 0.25 + 1.0	0	0	93	80	100	100
Sulfentrazone + clomazone	0.25 + 0.5	4	0	100	96	100	100
Check	0	0	0	0	0	0	0

Italian ryegrass interference in peppermint. Bill D. Brewster, Paul E. Hendrickson, and Carol A. Mallory-Smith. (Department of Crop and Soil Science, Oregon State University, Corvallis, OR 97331-3002) Italian ryegrass was established in a new planting of 'Murray' peppermint to evaluate its effect on peppermint growth and oil production. The trial site was fumigated with methyl bromide plus chloropicrin prior to planting the peppermint and ryegrass in October 1997. Italian ryegrass was planted at five rates plus a ryegrass-free treatment. The peppermint was planted in 2-ft rows. The experimental design was a randomized complete block with six replications and 8 ft by 24 ft plots. Peppermint was harvested from 3 sq yd in each plot, the foliage was air-dried, and the oil was extracted in a small-scale still.

Even the lowest density of Italian ryegrass reduced peppermint fresh weight and oil yield (Table). Because peppermint provides very little competition to weeds for the first 6 months after planting, the Italian ryegrass plants were able to attain a large size before the mint began to make substantial growth.

Table. Italian ryegrass stand density and peppermint fresh weight and oil yield.

		Peppermint	
	Italian ryegrass stand	Fresh weight	Oil
	plants/100 sq ft	lb/sq yd	lb/A
	0	4.7	34.5
	1.5	3.2	21.7
	3.0	2.0	13.6
	6.0	0.9	6.6
	12.0	0.1	1.3
	24.0	0.0	0.3
$LSD_{0.05}$	0.8	0.8	6.7

Potato vine desiccation. Richard K. Zollinger and Scott A. Fitterer. (Department of Plant Sciences, North Dakota State University, Fargo, ND 58105) An experiment was conducted, in McLeod, ND, to evaluate potato vine desiccation from labeled and experimental desiccants. 'Red Pontiac' potato was planted May 22, 1998, and one cultivation was performed on June 6. Vine kill chemicals were applied at beginning of natural senescence (BNS), September 9 at 10:30 am with 73 F, 25% RH, 70% clouds, 5 to 12 mph SE wind, and no dew present. An additional diquat treatment was applied only on September 16 which was 7 days after the initial treatments, at 6:00 pm with 83 F, 41% RH, 60% clouds, 5 to 8 mph NE wind, and no dew present. Treatments were applied to the 12 by 25 foot plots with a back-pack sprayer delivering 26 gpa at 40 psi through 8003 flat fan nozzles. The experiment had a randomized complete block design with three replicates per treatment. Tubers were evaluated four times for skin set, prior to application, at 7 and 14 days after treatment (DAT), and one day following harvest. Skin set values are ounces per inch at 17 lb of pressure. Stem end discoloration was measured after harvest by comparing untreated and treated tubers.

Initially, ammonium sulfate improved speed of potato desiccation but no longer enhanced effectiveness by 14 days after application. Most treatments gave greater potato desiccation than diquat until 14 days after application. ET-751 gave equal potato desiccation to glufosinate but greater than diquat at 14 days after application. Potato senescence was initially lower with diquat applied 7 days after beginning of natural potato senescence than treatments applied at beginning of natural senescence but speed of desiccation surpassed earlier applied treatments by 5 days after treatment. With the exception of greater potato yield with glufosinate at 0.28 lb/A, there were no differences in potato yield. Skin set of potatoes from treated plants did not differ from tubers of potatoes from untreated plots. No significant stem end discoloration was found after harvest.

Table. Potato vine desiccation.

		Vine desiccation (DAT)							Yield	Skin set		
Treatment [a]	Rate	2	5	7	10	14	16	21	Oct 13	Sept 16	Sept 23	Oct 14
BNS	lb/A	(%)							(cwt/A)	(oz/in)		
Glufosinate	0.28	13	43	50	61	81	91	97	419	40	45	52
Glufosinate	0.38	21	48	64	76	92	92	97	348	42	45	51
Glufosinate+AMS	0.28+3.0	21	53	64	73	86	94	97	367	43	45	53
Glufosinate+AMS	0.38+3.0	26	54	65	76	90	94	98	386	43	44	51
Diquat+NIS	0.25+0.25%	23	31	40	54	74	85	97	383	42	47	52
ET-751+Agri-Dex	0.009+1%	19	39	53	63	85	93	97	368	43	45	53
ET-751+Agri-Dex	0.018+1%	24	40	54	65	88	94	97	382	42	46	52
ET-751+Agri-Dex	0.027+1%	25	48	55	68	90	95	98	359	43	43	52
7 days after BNS												
Diquat+NIS	0.25+0.25%	10	63	97	99	-	-	-	394	45	45	52
Untreated		0	0	0	0	0	0	0	380	44	43	52
LSD (0.05)		8	12	14	14	9	6	1	47	NS	NS	NS

[a]AMS = ammonium sulfate, NIS = nonionic surfactant (Preference), Agri-Dex = petroleum oil concentrate.

Potato vine desiccation with endothall. Richard K. Zollinger and Scott A. Fitterer. (Department of Plant Sciences, North Dakota State University, Fargo, ND 58102). An experiment was conducted, in McLeod, ND, to evaluate potato vine desiccation. 'Russet Burbank' potato was seeded May 22, 1998, and one cultivation was performed on June 6. The first treatments of vine kill desiccants were applied at beginning of natural senescence (BNS), September 9 at 10:30 am with 73 F, 25% RH, 70% clouds, 5 to 12 mph SE wind, and no dew present. The sequential treatments were applied 7 days following the first application on September 16 at 6:00 pm with 83 F, 41% RH, 60% clouds, 5 to 8 mph NE wind, and no dew present. Treatments were applied to the center 8 feet of 12 by 25 foot plots with a back-pack sprayer delivering 26 gpa at 40 psi through 8003 flat fan nozzles. The experiment had a randomized complete block design with three replicates per treatment.

Two days after first treatment date, only diquat gave greater than 50% potato leaf and greater than 20% stem desiccation. Generally, ammonium sulfate enhanced potato leaf and stem desiccation from endothall more than LI-700 until 7 days after the sequential treatment. Potato stems were slower to desiccate than leaves. Effective stem desiccation did not match leaf desiccation until 14 DAT. Endothall applied as a split treatment was slow to desiccate potato leaves and stems. Diquat was needed as a second treatment to effectively dessicate potato leaves and stems. Evaluations were taken 9 and 14 days after the second treatment (data not shown), and potato leaves and stems were completely desiccated by 9 days after second application for all treatments.

Table. Vine desiccation in potato.

		First treatment date						Second treatment date			
		2 DAT		5 DAT		7 DAT		2 DAT		7 DAT	
Treatment[a]	Rate	leaf	stem	leaf	stem	leaf	stem	leaf	stem	leaf	stem
	lb/A	(% desiccation)									
Endothall+LI 700/ diquat	0.75+0.125%/ 0.25	20	7	50	33	60	40	68	53	92	85
Endothall+AMS/ diquat+NIS	0.75+5/ 0.25+0.25%	28	12	82	53	92	75	95	82	98	94
Endothall+LI 700/ diquat+NIS	0.75+0.125%/ 0.25+0.25%	17	7	47	30	57	45	67	53	85	75
Endothall+LI 700+AMS/	0.75+0.125%+5/ 0.25+0.25%	33	15	75	53	83	70	88	78	93	87
Endothall/ diquat+NIS	0.75/ 0.5+0.25%	13	3	60	43	82	70	86	77	93	85
Endothall+LI 700/ endothall+LI 700	0.5+0.125%/ 0.5+0.125%	8	3	30	30	42	37	57	48	88	78
Diquat+NIS/ diquat+NIS	0.25+0.25%/ 0.25+0.25%	52	23	82	53	87	68	93	77	98	96
Untreated		0	0	0	0	0	0	0	0	0	0
LSD (0.05)		11	6	14	10	9	18	10	9	10	15

[a] LI-700 = surfactant, AMS = ammonium sulfate, NIS = Preference (nonionic surfactant).

Evaluation of preemeregence and postemergence herbicides on seed radish, 1997. Marvin D. Butler. (Central Oregon Agricultural Research Center, Oregon State University, Madras, OR 97741) Herbicides propachlor and alachlor were applied postplant, preemergence, and pendimethalin was applied both postplant, preemergence and postemergence for weed control in seed radish in central Oregon. Treatments were applied with a CO_2 pressurized, hand-held boom sprayer at 40 psi and 20 gal/A water. Plots 10 ft by 20 ft were replicated three times in a randomized complete block design. Preemergence herbicides were incorporated by sprinkler irrigation shortly after application. Treatments were evaluated June 2 for control of redroot pigweed, hairy nightshade, and Jim Hill mustard. Reduction in stand and crop injury was rated visually.

Propachlor provided the best results with 100% control of redroot pigweed and Jim Hill mustard, and 75% control of hairy nightshade. Alachlor controlled 100% of redroot pigweed, but provided inadequate control of Jim Hill mustard. Pendimethalin applied postplant, preemergence provided better control of redroot pigweed, but less control of hairy nightshade and Jim Hill mustard than when applied postemergence. However, the postemergence application caused 57% crop stunting.

Table. Effect of herbicides applied postplant, preemergence April 23 and postemergence May 9, 1997, on commercial seed radish near Madras, OR.

Treatments[b]	Rate Pre	Rate Post	Weed control[a] Redroot pigweed		Hairy nightshade		Jim Hill mustard		Stunting	
	(lb/A)		(%)							
Propachlor	1		100	a[c]	75	a	100	a	0	b
Alachlor	1.25		100	a	12	ab	67	a	0	b
Pendimethalin	1		93	a	63	a	83	a	0	b
Pendimethalin		1	33	ab	70	a	100	a	57	a
Untreated	---	---	0	b	0	b	0	b	0	b

[a]Visual evaluation was conducted June 2, 1997.
[b]Treatments applied preemergence April 23 and postemergence May 9, 1997.
[c]Mean separation with Student-Newman-Keuls $P \leq 0.05$.

A processing tomato postemergence weed control trial. Robert J. Mullen, Ted Viss, Dawn Brunmeier, Jasmine Noriega and Michelle Rego. A postemergence weed control trial in processing tomatoes was established at Nunn Farms near Brentwood, California on April 22, 1998. All treatments were applied over the late first true leaf tomatoes and cotyledon to three true leaf black nightshade (SOLNI), cotyledon stage to three inch tall stinging nettle (URTDI) and first true leaf to three inch tall redroot pigweed (AMARE) using a handheld CO_2 backpack sprayer. There were four replications of each treatment in a randomized complete block design. The spray volume was 30 gal/a water using 8002 nozzles at 40 psi. The soil type at the trial site was a Brentwood clay and individual plots were single 60-inch beds measuring 25 feet in length. Single rates of rimsulfuron, halosulfuron, and metribuzin were evaluated, along with sequential sprays of rimsulfuron and metribuzin five days after initial application; a combination treatment of rimsulfuron plus metribuzin was also in the trial.

Weed control efficacy and crop injury evaluations were made on April 27, 1998 and again on May 4, 1998. Control of all three weed species present was excellent with rimsulfuron, either as a single higher rate treatment or as two lower rate treatments applied sequentially. Some temporary slowdown in crop growth did occur with rimsulfuron. Halosulfuron alone and metribuzin alone were a bit weak on black nightshade, but controlled stinging nettle and redroot pigweed very well. Metribuzin was quite safe to the tomato crop but halosulfuron caused considerable crop injury and growth delay. The combination treatment of rimsulfuron plus metribuzin gave good weed control and crop safety. The trial was harvested on August 17, 1998, and the yield for the halosulfuron treatment was considerably less than that of other herbicides evaluated in the trial, primarily due to the delay in crop maturity caused by the earlier crop injury.

Table. A postemergence weed control trial in processing tomatoes.

		Weed Control[1]						Tomato Injury		Tomato Yield
	Rate	SOLNI		URTDI		AMARE				
Herbicide[2]	oz or lb/a	4/27	5/4	4/27	5/4	4/27	5/4	4/27	5/4	
		---%							---	T/A
Rimsulfuron + COC	0.50 oz	80	90	70	97	86	99	26	20	46.5
Rimsulfuron[3] + COC	0.25 oz. + 0.25 oz.	73	89	69	97	84	100	21	17	49.3
Halosulfuron + X77	1.00 oz.	66	70	65	96	78	94	54	45	30.0
Metribuzin[3]	0.15 lb. + 0.30 lb.	45	63	70	97	80	98	15	16	41.7
Rimsulfuron + Metribuzin + COC	0.25 oz. + 0.125 lb.	75	76	80	88	90	95	14	12	44.8
Untreated Control	--------------	5	0	10	0	15	0	5	4	46.4

[1]0 = no weed control, no crop injury.
100 = complete weed control, crop dead.
[2]Treatments of Rimsulfuron and Halosulfuron had COC (crop oil concentrate) and X77, respectively, applied at 0.25% (V/V).
[3]Rimsulfuron and Metribuzin applied as sequential sprays 5 days apart.

Evaluation of carfentrazone-ethyl and perlargonic acid for primocane suppression in red raspberry and Marion blackberry. Diane Kaufman and Ray D. William. (Department of Horticulture, Oregon State University, Corvallis, OR 97331) The removal of early primocane growth and lower foliage from fruiting canes enhances production of machine harvested red raspberries and Marion blackberries. Oxyfluorfen has provided inadequate suppression of primocanes in Marion blackberry, and there is concern among growers that repeated use has reduced plant vigor in red raspberry. Unlike oxyfluorfen, which can remain active in the soil for several weeks, carfentrazone-ethyl and pelargonic acid are herbicides with no soil activity. This research was conducted in tow commercial fields in the Portland area and at the North Willamette Research & Extension Center to evaluate the effectiveness of carfentrazone-ethyl and pelargonic acid for primocane suppression in two varieties of red raspberry ('Meeker' and 'Willamette') and Marion blackberry. This is the second year of evaluation with carfentrazone and the first year of evaluation with pelargonic acid.

With the exception of this year's observations of pelargonic acid on Marion blackberry and boysenberry, each experiment was randomized in a complete block design with four replications. Treatments were applied with a CO2 pressured backpack sprayer, mounted with a single 8004 nozzle set at 40 psi. Herbicides were applied at the equivalent of 50 gal of water per acre with carfentrazone and 75 gal of water with pelargonic acid and each included the addition of 0.25% surfactant on a volume basis. Red raspberries were treated one time in late April, 1998. Marion blackberries were treated multiple times between mid-April and early June.

Marion Blackberry: Carfentrazone-ethyl applied 2, 3, or 4 times at rates of 0.05, 0.1, or 0.2 lb/A was compared to oxyfluorfen applied twice at a rate of 0.4 lb/A. At all rates and timings, carfentrazone provided more uniform and thorough suppression of primocanes than oxyfluorfen, with no apparent damage to fruiting canes or plant vigor. There was no difference in yield among treatments or in the number of primocanes produced in 1997 or 98. There was no difference in yield among treatments or in the number of primocanes produced in 1997 or 98. There were significantly fewer kinked and damaged primocanes at the end of the season in any carfentrazone treatment that in oxyfluorfen plots. Four applications of carfentrazone appears to hold promocane regrowth back too late in the season. Both carfentrazone and oxyfluorfen performed better last year with WA-100 as the surfactant than this year with R-11.

Pelargonic acid, applied twice at a concentration of 5.33% to unreplicated plots of Marion blackberry and boysenberry, did not adequately burn back primocanes of either variety.

Red raspberry: Carfentrazone applied at rates of 0.025, 0.05, 0.1 and 0.2 lb/A was compared to oxyfluorfen applied at 0.1 9 ('Meeker') and 0.067 ('Willamette') lb/A, pelargonic acid applied at a concentration of 5.33%, hand removal of primocanes, and an untreated control. At all rates, carfentrazone provided more uniform and thorough suppression of primocanes than oxyfluorfen on the variety 'Meeker'. There was not difference among treatments in the number of canes produced in 1997 or 98 in either variety. Yield In 'Meeker has been similar both years, with a trend toward larger fruit size in the carfentrazone 0.1 treatment. Both carfentrazone and oxyfluorfen performed better last year with WA-100 as the surfactant than this year with R-11.

Control of field bindweed in walnuts with sulfosate and glyphosate. W. Thomas Lanini, Ernie J. Roncoroni, and Martina Dokladalova. (Department of Vegetable Crops, University of California, Davis, CA 95616) Sulfosate and glyphosate were examined for their influence on field bindweed (Convolvulus arvensis). Each herbicide was applied at three rates (2 lb/a, 3lb/a, and 4 lb/a) in addition to each herbicide at the 2 lb/a rate plus dicamba at 0.25 lb/a. Another treatment combined ammonium sulfate at 13.2 lbs/100 gal with 2 lb/a of sulfosate or glyphosate, with an identical treatment applied with a double flat fan nozzle. The double flat fan nozzle is said to improve spray coverage by angling half the spray solution 30° forward of vertical and the other half 30° back. These treatments were all compared to an untreated check plot. Treatments were applied on August 7, 1998, approximately one week after the area had been mowed. Three days prior to treatment, the area had been irrigated. Field bindweed was 6 to 24 inches in length at the time of treatment. The experiment was arranged in a randomized complete block with four replications.

At one week after treatment, the treatments which contained dicamba had the best control (Table 1). This treatment with dicamba was approximately 18% better control than the comparable treatment of glyphosate or sulfosate, alone. At two weeks after treatment, glyphosate or sulfosate plus dicamba was still providing better field bindweed control than glyphosate or sulfosate applied alone. At four weeks after treatment, the higher rates of sulfosate or glyphosate were providing equivalent control of field bindweed compared to either plus dicamba.

The higher rates of sulfosate gave better control of field bindweed at one, two and four weeks after treatment, than did the 2 lb/a rate, but differences were not evident at later evaluations. Some slight differences in activity were noted at the last evaluation with sulfosate seeming to provide better control, however, sulfosate and glyphosate generally did not differ significantly in their control of field bindweed.

Adding ammonium sulfate generally increased field bindweed control, with glyphosate benefiting the most from this addition. It appeared that adding ammonium sulfate increased the burndown rate, but did not influence control at the last evaluation. Quicker burndown is often beneficial, as long as long-term control is not sacrificed. The double flat fan nozzles did not significantly increase control. The vegetation was relatively low at the time of treatment, which meant the regular flat fan nozzles gave good coverage; difference may occur in denser vegetation.

Table. Field bindweed control at 7, 14, 28, 49 and 65 days after treatment.

Treatment and rate	Days after treatment 7	14	28	49	65
	(% control)				
Glyphosate					
@ 2 lb/a	64	72	71	46	35
@ 3 lb/a	65	84	87	62	50
@ 4 lb/a	71	82	85	60	38
@ 2lb/a					
+ Dicamba @ 0.25 lb/a	81	94	92	65	35
+ Amm. Sulf.[a] @ 13.2 lb/100gal	70	81	85	65	35
+ Amm. Sulf. @ 13.2 lb/100gal (dbl FF[a]) 68	84	82	65	45	
Sulfosate[1]					
@ 2 lb/a	62	76	76	62	48
@ 3 lb/a	79	88	92	62	50
@ 4 lb/a	74	88	91	54	45
@ 2lb/a					
+ Dicamba @ 0.25 lb/a	81	88	86	72	50
+ Amm. Sulf. @ 13.2 lb/100gal	65	76	81	55	52
+ Amm. Sulf. @ 13.2 lb/100gal (dbl FF)	70	81	86	56	52
Untreated	0	0	0	0	0
$LSD_{.05}$	9	10	12	18	18

[1] A nonionic surfactant was added to all sulfosate treatments at 0.5% v/v.

[a] Amm. Sulf. = ammonium sulfate, dbl ff = double flat fan

PROJECT 3

WEEDS OF AGRONOMIC CROPS

Donn Thill, Chair

Annual grass control in spring-seeded alfalfa. Richard N. Arnold and Daniel Smeal. (New Mexico State University Agricultural Science Center Farmington, NM 87499) Research plots were established on May 14, 1998 at the Agricultural Science Center, Farmington, New Mexico to evaluate the response of spring-seeded alfalfa (var. Evergreen) and annual grass to postemergence applications of AC 299-263 and imazethapyr alone or in combination. Soil type was a Wall sandy loam with a pH of 7.8 and an organic matter content of less than 1%. The experimental design was a randomized complete block with three replications. Individual plots were 10 by 30 ft in size. Treatments were applied with a compressed air backpack sprayer calibrated to deliver 30 gal/A at 30 psi. Treatments were applied on June 10, when alfalfa was in the second trifoliolate leaf stage and weeds were small. Barnyardgrass and green foxtail infestations were moderate throughout the experimental area. Crop injury, height and weed control evaluations were made on July 9. Alfalfa was harvested August 11, using a self-propelled Almaco plot harvester.

AC 299-263 applied at 0.048 had the highest injury level of 6 All treatments gave good to excellent control of annual grasses except the check. Redroot and prostrate pigweed and black nightshade control were good to excellent with all treatments except sethoxydim plus bromoxynil applied at 0.19 plus 0.25 lb/A and the check (data not shown). The weedy check had significantly higher yields as compared to the herbicide treatments. This is possibly attributed to the heavy weed pressure during harvest.

Table. Annual grass control in spring-seeded alfalfa.

Treatments	Rate	Crop injury	Plant height	Weed Control ECHCG	SETVI	Yield	Protein
	lb/A	---%--	in	------%-----		T/A	---%---
AC 299-263 + 2,4-DB[a]	0.024+0.5	0	8	100	99	1.4	21.7
Sethoxydim + bromoxynil[b]	0.19+0.25	0	8	100	100	1.6	17.1
Sethoxydim + 2,4-DB[b]	0.19+0.5	0	10	100	100	1.7	18.4
AC-299-263 + sethoxydim[b]	0.024+0.19	0	9	100	100	1.8	23.1
AC 299-263 + 2,4-DB[a]	0.032+0.5	0	8	99	98	1.5	20.8
AC 299-263 + 2,4-DB[a]	0.04+0.5	0	8	99	98	1.7	20.2
AC 299-263[a]	0.04	2	8	99	98	1.3	22.2
AC 299-263[a]	0.048	6	6	99	98	1.4	23.0
Imazethapyr[a]	0.063	0	9	98	97	1.5	20.7
AC 299-263 + bromoxynil[a]	0.032+0.25	0	7	98	98	1.6	23.1
AC 299-263 + bromoxynil[a]	0.04+0.25	0	8	97	97	1.6	20.8
AC 299-263 + bromoxynil[a]	0.024+0.25	2	8	96	96	1.5	20.1
AC 299-263[a]	0.032	1	8	95	96	1.6	21.1
Imazethapyr[a]	0.047	0	9	95	96	1.7	19.6
Ac 299-263[a]	0.024	0	9	94	95	1.4	20.2
Check		0	10	0	0	2.2	16.2
LSD 0.05		1	1	2	2	0.4	

[a]Treatments applied with a surfactant and 32% nitrogen solution at 0.25 and 1.0% v/v.
[b]Treatments applied with a COC and 32% nitrogen solution at 1% v/v.

Imazamox compared to imazethapyr for weed control in seedling alfalfa. Carl E. Bell and Brent Boutwell (Cooperative Extension, University of California, Holtville, CA 92250). A field trial was conducted near Holtville, CA to compare imazamox and a tank mixture of imazamox plus 2,4-DB amine to imazethapyr for postemergence weed control in seedling alfalfa. Experimental design was a randomized complete block with four replications. Plot size was 5 feet by 25 feet. Herbicide applications were made on December 18, 1997. The crop was in the 2 to 4 trifoliolate stage of growth and weeds had 4 to 6 leaves. Application was made with a CO_2 pressured sprayer at 30 psi, using 3003 nozzles for a spray volume of 21 gpa. All treatments included nonionic surfactant at 0.25% v/v and liquid fertilizer (UAN 32) at 1 qt/A. Soil type was a clay loam. Weather on the day of application was sunny, calm, and 50°F.

Data collected were visual evaluations of weed control by species on January 5, February 2, and March 3, 1998, crop phytotoxicity on January 5 and February 2, and yield on March 3, 1998. Results are shown in the Tables below. Weed control was very good with all treatments, including littleseed canarygrass and annual sowthistle (Tables 1 & 2). The effect of these treatments on sand spurry (*Spergularia Bocconii*) was initially slow (Table 1), but was very good by the March 3 evaluation. Yields were nearly equal between herbicide treatments (Table 2). The untreated control yield was higher (P = 0.05) than the other treatments because of the large biomass of weeds in those plots. Single degree of freedom orthogonal comparisons of imazamox treatments to imazethapyr and between imazamox treatments with and without 2,4-DB were both insignificant (P = 0.05).

Table 1. Visual evaluations in the spring, 1998 of weed control in a field trial comparing Imazamox with and without 2,4-DB to imazethapyr in seedling alfalfa near Holtville, CA.

Treatments	Rate	CHEMU[a]			SPURRY		SSYIR		PHAMI	
		Jan. 5	Feb. 2	Mar. 3	Jan. 5	Mar. 3	Feb. 2	Mar. 3	Feb. 2	Mar. 3
	lb/A	%								

Imazamox	0.024	85	100	100	4	100	100	100	100	99
Imazamox + 2,4-DB	0.024 + 0.75	88	100	100	42	100	100	100	100	100
Imazamox	0.032	88	100	100	17	100	100	100	100	100
Imazamox + 2,4-DB	0.032 + 0.75	91	100	100	54	100	100	100	100	100
Imazamox	0.04	93	100	100	46	100	100	100	100	100
Imazamox + 2,4-DB	0.04 + 0.75	93	100	100	58	100	100	100	100	100
Imazamox	0.048	95	100	100	46	100	100	100	100	100
Imazethapyr	0.063	98	100	100	62	100	100	100	88	98
Untreated control		0	0	0	0	0	0	0	0	0

[a] CHEMU = nettleaf goosefoot, SPURRY = Boccone's sand spurry, SSYIR = London rocket, PHAMI = littleseed canarygrass

Table 2. Visual evaluations of weed control and phytotoxicity and yield data collected in the spring, 1998 in a field trial comparing Imazamox with and without 2,4-DB to imazethapyr in seedling alfalfa near Holtville, CA.

Treatments	Rate	SONOL[a]	Phytotoxicity		Yield
		Mar. 3	Jan. 5	Feb. 2	Mar. 3
	lb/A	%			gms m^{-2}
Imazamox	0.024	99	5	4	189.0
Imazamox + 2,4-DB	0.024 + 0.75	100	10	1	190.0
Imazamox	0.032	100	3	10	186.0
Imazamox + 2,4-DB	0.032 + 0.75	100	15	7	182.1
Imazamox	0.04	100	7	10	196.8
Imazamox + 2,4-DB	0.04 + 0.75	100	18	10	185.9
Imazamox	0.048	99	5	5	178.7
Imazethapyr	0.063	96	15	24	180.0
Untreated control		0	0	0	380.0
LSD (0.05)					59.1

[a] SONOL = annual sowthistle

Imazamox compared to imazethapyr for weed control in seedling alfalfa. Carl E. Bell and Brent Boutwell (Cooperative Extension, University of California, Holtville, CA 92250). A field trial was conducted near Holtville, CA to compare imazamox and a tank mixture of imazamox plus 2,4-DB amine to imazethapyr for postemergence weed control in seedling alfalfa. Experimental design was a randomized complete block with four replications. Plot size was 5 feet by 25 feet. Herbicide applications were made on December 18, 1997. The crop was in the 2 to 4 trifoliolate stage of growth and weeds had 4 to 6 leaves. Application was made with a CO_2 pressured sprayer at 30 psi, using 3003 nozzles for a spray volume of 21 gpa. All treatments included nonionic surfactant at 0.25% v/v and liquid fertilizer (UAN 32) at 1 qt/A. Soil type was a clay loam. Weather on the day of application was sunny, calm, and 50°F.

Data collected were visual evaluations of weed control by species on January 5, February 2, and March 3, 1998, crop phytotoxicity on January 5 and February 2, and yield on March 3, 1998. Results are shown in the Tables below. Weed control was very good with all treatments, including littleseed canarygrass and annual sowthistle (Tables 1 & 2). The effect of these treatments on sand spurry (*Spergularia Bocconii*) was initially slow (Table 1), but was very good by the March 3 evaluation. Yields were nearly equal between herbicide treatments (Table 2). The untreated control yield was higher (P = 0.05) than the other treatments because of the large biomass of weeds in those plots. Single degree of freedom orthogonal comparisons of imazamox treatments to imazethapyr and between imazamox treatments with and without 2,4-DB were both insignificant (P = 0.05).

Table 1. Visual evaluations in the spring, 1998 of weed control in a field trial comparing Imazamox with and without 2,4-DB to imazethapyr in seedling alfalfa near Holtville, CA.

Treatments	Rate	CHEMU[a] Jan. 5	CHEMU Feb. 2	CHEMU Mar. 3	SPURRY Jan. 5	SPURRY Mar. 3	SSYIR Feb. 2	SSYIR Mar. 3	PHAMI Feb. 2	PHAMI Mar. 3
	lb/A	%								

Imazamox	0.024	85	100	100	4	100	100	100	100	99
Imazamox + 2,4-DB	0.024 + 0.75	88	100	100	42	100	100	100	100	100
Imazamox	0.032	88	100	100	17	100	100	100	100	100
Imazamox + 2,4-DB	0.032 + 0.75	91	100	100	54	100	100	100	100	100
Imazamox	0.04	93	100	100	46	100	100	100	100	100
Imazamox + 2,4-DB	0.04 + 0.75	93	100	100	58	100	100	100	100	100
Imazamox	0.048	95	100	100	46	100	100	100	100	100
Imazethapyr	0.063	98	100	100	62	100	100	100	88	98
Untreated control		0	0	0	0	0	0	0	0	0

[a] CHEMU = nettleaf goosefoot, SPURRY = Boccone's sand spurry, SSYIR = London rocket, PHAMI = littleseed canarygrass

Table 2. Visual evaluations of weed control and phytotoxicity and yield data collected in the spring, 1998 in a field trial comparing Imazamox with and without 2,4-DB to imazethapyr in seedling alfalfa near Holtville, CA.

Treatments	Rate	SONOL[a] Mar. 3	Phytotoxicity Jan. 5	Phytotoxicity Feb. 2	Yield Mar. 3
	lb/A	%			gms m^{-2}
Imazamox	0.024	99	5	4	189.0
Imazamox + 2,4-DB	0.024 + 0.75	100	10	1	190.0
Imazamox	0.032	100	3	10	186.0
Imazamox + 2,4-DB	0.032 + 0.75	100	15	7	182.1
Imazamox	0.04	100	7	10	196.8
Imazamox + 2,4-DB	0.04 + 0.75	100	18	10	185.9
Imazamox	0.048	99	5	5	178.7
Imazethapyr	0.063	96	15	24	180.0
Untreated control		0	0	0	380.0
LSD (0.05)					59.1

[a] SONOL = annual sowthistle

Developing new remote sensing technology for more economical weed control. Lawrence Lass and Donn Thill. (Department of Plant, Soil, and Entomological Sciences, University of Idaho, Moscow Idaho, 83844-2339) Advances in selective chemical weed control and application technology provide more opportunity for "smart" precision management with herbicides during crop rotations. To take full advantage of new application systems, accurate digital mapping of weed positions will be necessary. Digital maps generated from images using multispectral and hyperspectral remote sensors offer a rapid method of surveying the weeds in the field. The objective of this project is to develop modern remote sensing procedures to identify, define, and record the locations and spatial distribution of weed infestations in wheat and pea fields with management level accuracy. The Probe 1 hyperspectral sensor, from Earth Search Sciences Inc., McCall, ID recorded images of four farms near Moscow, ID on July 19, 1998. The hyperspectral sensor has 128 bands and a spatial resolution of about 5 m. Images were georectified using both flight line correction and quadratic rectification algorithms.

Weed infestations and field conditions were monitored and positioned with a differentially corrected global positioning system (DGPS) in 1997 and 1998. Crops of the Redman farm were alfalfa, lentil, pea, chickpea, and winter wheat. Crops of the Kopf fram were winter and spring wheat and pea. Crops on the Esser farm were winter and spring wheat, pea, lentil, barley, and chickpea. Crops at the University of Idaho research farm were pea, lentil, winter and spring canola, winter and spring wheat, and barley. The spectral radiance was measured in the field for all weed species near the time of the hyperspectral imaging. Additional spectral radiance data between 1100 and 2500 nm were gathered using a benchtop NIRSystems spectrometer. Yield data were gathered at Redman's and Kopf's farms with yield monitors mounted on combine harvesters. Some yield data also were taken from the University of Idaho research farm.

Images are currently being processed to develop spectral signatures for the training sites. Preliminary classification of the interrupted windgrass spectral signature indicates hyperspectral signature analysis enhanced the detection when compared to a multispectral image. The multispectral image showed a few interrupted windgrass infestations with a cover class 70 to 100%, but mistakenly classified most of the pea fields as interrupted windgrass. Hyperspectral signature analysis of interrupted windgrass generated an image with an omissional error of 29% and a commissional error of 1%. Hyperspectral signature analysis allowed us to refine the images and increase detection accuracy.

Comparison of fluroxypyr premixed with MCPA, 2,4-D, and bromoxynil to other herbicides for broadleaf weed control in spring barley. Michael J. Wille and Don W. Morishita. (Twin Falls Research and Extension Center, University of Idaho, Twin Falls 83303-1827). A study was established at the University of Idaho Research and Extension Center near Kimberly, ID, to compare premixtures of fluroxypyr plus MCPA, 2,4-D, or bromoxynil with other herbicide combinations for postemergence control of broadleaf weeds in 'Crystal' spring barley. The experimental design was a randomized complete block with four replications. Individual plots were 8 by 25 ft. Spring barley was seeded April 18, 1998, in a Portneuf silt loam (14% sand, 54% silt, 32% clay, pH 8.3, 1.7% organic matter, 20-meq/100 g soil CEC). Kochia and common lambsquarters were the major weed species present at plant densities of 137 and 24 plants/ft^2, respectively. Herbicides were broadcast-applied with a CO_2-pressurized bicycle-wheel sprayer calibrated to deliver 10 gpa at 40 psi. Additional application information is presented in Table 1. Crop injury and weed control was evaluated visually on May 26, and July 2. Grain was harvested with a small-plot combine September 3.

Table 1. Application information and weed species densities.

Application timing (HORVU)	4 leaf, 2 tiller	5 leaf, 3 tiller	6 leaf, 3 tiller	7 leaf, 4 tiller
Application date	5/23	5/30	6/2	6/5
Air temperature (F)	56	68	63	62
Soil temperature (F)	60	69	59	50
Relative humidity (%)	72	29	63	62
Wind velocity (mph)	0	6	8	6

No crop injury was evident from combinations of fluroxypyr on either evaluation date (Table 2). Dicamba combinations injured barley 14 to 18% on both evaluation dates. It is recommended that dicamba be applied before barley exceeds the four-leaf stage, but because of weather conditions, the barley had 4 main stem leaves and two tillers. Crop injury with dicamba combinations was therefore likely due to late applications of dicamba. Kochia control ranged from 78 to 99% on May 26, and from 92 to 100% on July 2. Common lambsquarters control ranged from 71 to 100% on May 26, and from 98 to 100% on July 2. Herbicide treatments did not differ significantly from each other with respect to either kochia or common lambsquarters control. Barley grain yield ranged from 69 to 97 bu/A, and grain test weights ranged from 48 to 54 lb/bu. Grain yields and test weights did not differ among treatments.

Table 2. Crop injury, weed control, and barley grain yield with fluroxypyr premixed with MCPA, 2,4-D, and bromoxynil.

					Weed control[1]				
		Application	Crop injury		KCHSC		CHEAL		
Treatment	Rate	timing[2]	6/26	7/2	6/26	7/2	6/26	7/2	Yield
	lb/A		%						bu/A
Check			0	0	0	0	0	0	48
Dicamba +	0.094 +	May 23	18	19	99	100	99	100	48
bromoxynil	0.375				99				
Dicamba +	0.094 +	May 23	14	18	99	100	100	100	49
thifenuron & tribenuron[3]	0.016								
Fluroxypyr & 2,4-D	0.625	May 30	5	0	89	100	98	100	49
Fluroxypyr & MCPA	0.625	May 30	0	0	90	95	96	100	49
Fluroxypyr & bromoxynil	0.5	May 30	3	3	99	100	99	100	48
Fluroxypyr & 2,4-D	0.625	June 2	5	3	85	100	98	100	53
Fluroxypyr & MCPA	0.625	June 2	0	0	88	95	97	100	49
Fluroxypyr & bromoxynil	0.5	June 2	1	1	99	100	99	100	54
Fluroxypyr & 2,4-D	0.625	June 5	3	2	81	93	71	100	49
Fluroxypyr & MCPA	0.625	June 5	1	3	90	98	99	100	49
Fluroxypyr & bromoxynil	0.5	June 5	0	0	91	99	95	100	41
Fluroxypyr & 2,4-D +	0.625 +	May 30	5	1	78	92	98	98	48
thifenuron & tribenuron	0.016								
Fluroxypyr & 2,4-D +	0.625 +	June 2	3	3	84	98	95	100	52
thifenuron & tribenuron	0.016								
Fluroxypyr & 2,4-D +	0.625 +	June 5	3	3	95	98	98	100	51
thifenuron & tribenuron	0.016								
Fluroxypyr & MCPA +	0.625 +	May 30	3	0	91	99	98	100	51
thifenuron & tribenuron	0.25								
Fluroxypyr & MCPA +	0.625 +	June 2	0	0	88	97	98	100	49
thifenuron & tribenuron	0.25								
Fluroxypyr & MCPA +	0.625 +	June 5	3	3	89	98	96	100	49
thifenuron & tribenuron	0.25								
LSD (0.05)			6	5	15	6	17	2	10

[1]Weed species evaluated for control were kochia (KCHSC), and common lambsquarters (CHEAL).

[2]Crop growth stage correspnds to the following dates: May 23 = 4-leaf, 2-tiller; May 30 = 5-leaf, 3-tiller; June 2 = 6-leaf, 3-tiller; and June 5 = 7-leaf, 4-tiller.

[3]Thifensulfuron & tribenuron was applied as a commercial formulation. Nonionic surfactant added at the rate of 0.25% v/v.

Evaluation of carfentrazone combinations for weed control in spring barley. Michael J. Wille and Don W. Morishita. (Twin Falls Research and Extension Center, University of Idaho, Twin Falls 83303-1827). A study was established at the University of Idaho Research and Extension Center near Kimberly, to compare postemergence weed control with carfentrazone combined with MCPA, dicamba, and 2,4-D in 'Crystal' spring barley. The experimental design was a randomized complete block with four replications. Individual plots were 8 by 25 ft. Spring barley was seeded April 18, 1998, in a Portneuf silt loam (14% sand, 54% silt, 32% clay, pH 8.3, 1.7% organic matter, 20-meq/100 g soil CEC). Kochia and common lambsquarters were the major weed species present at densities of 137 and 24 plants/ft^2, respectively. Herbicides were broadcast-applied May 23 with a CO_2-pressurized bicycle-wheel sprayer calibrated to deliver 10 gpa at 40 psi. Barley had 4 leaves and 2 tillers and weeds were 2 to 4-inches high. Environmental conditions were as follows: soil temperature 60 F, air temperature 56 F, relative humidity 72%, no wind, and 80% cloud cover. Crop injury was evaluated May 27, June 9, and June 23. Weed control was evaluated visually June 9 and June 23. Grain was harvested with a small-plot combine September 3.

Crop injury ranged from 9 to 39%, 1 to 22%, and 0 to 19% on May 27, June 9, and June 23, respectively. All herbicide treatments controlled kochia and common lambsquarters ≥90% (Table). Low populations of redroot pigweed, hairy nightshade, and common mallow were controlled 100% by all herbicide treatments (data not shown). Barley grain yields ranged from 66 to 92 bu/A. Yields from herbicide treated plots were similar to the untreated check except carfentrazone + dicamba at 0.125 lb/A which yielded 66 bu/A compared to 92 bu/A for the check. This yield difference is likely due to the fact carfentrazone + dicamba caused the greatest crop injury and the injury persisted longer than other herbicide treatments. Although total weed populations were initially more than 160 plants/ft^2, favorable growing conditions enabled the untreated check to out compete the weeds.

Table. Crop injury, weed control, and grain yield response to carfentrazone combined with MCPA, 2,4-D, dicamba, thifensulfuron & tribenuron, and fenoxaprop & phenylpyrazolin in spring barley.

		Crop injury			Weed control[1]				
					KCHSC		CHEAL		
Treatment	Rate	5/27	6/9	6/23	6/9	6/23	6/9	6/23	Yield
	lb/A	%							bu/A
Check		-	-	-	-	-	-	-	92
Carfentrazone[2]	0.008	14	0	1	91	94	95	98	88
Carfentrazone +	0.008 +	16	0	0	91	94	94	98	85
ammonium sulfate	0.5% v/v								
Carfentrazone +	0.008 +	24	8	4	96	97	100	100	75
MCPA LVE	0.375								
Carfentrazone	0.008	39	15	9	97	96	100	100	83
2,4-D LVE	0.375								
Carfentrazone +	0.008 +	9	19	19	100	100	100	100	66
dicamba	0.125								
Carfentrazone +	0.008 +	35	22	14	100	99	100	100	75
dicamba	0.094								
MCPA LVE	0.375								
Carfentrazone +	0.008 +	10	1	1	90	96	100	100	85
thifenuron &tribenuron[3]	0.016								
Carfentrazone +	0.008 +	23	14	4	90	95	99	99	77
fenoxaprop & phenylpyrazolin[4]	0.1								
LSD (0.05)		6	4	5	5	4	4	3	17

[1]Weed species evaluated for control were: kochia (KCHSC), and common lambsquarters (CHEAL).

[2]Nonionic surfactant added at the rate of 0.25% v/v.

[3]Thifensulfron & tribenuron applied as a commercial formulation.

[4]Fenoxaprop & phenylpyrazolin is a commericial formulation of fenoxaprop and safener.

Evaluation of clodinafop for postemergence wild oat control in spring barley. Michael J. Wille and Don Morishita. (Twin Falls Research and Extension Center, University of Idaho, Twin Falls 83303-1827). A study was established in Cassia County, Idaho to evaluate postemergence wild oat control in 'Galena' spring barley with clodinafop alone and combined with broadleaf herbicides. The experimental design was a randomized complete block with four replications. Individual plots were 8 by 25 ft. Soil texture was a clay loam (30% sand, 42% silt, 28% clay, pH 8.5, 1.8% organic matter, 14-meq/100 g soil CEC). Clodinafop was applied alone or combined with dicamba, bromoxynil & MCPA, or thifensulfuron & tribenuron. Tralkoxydim, fenoxaprop & phenylpyrazolin, and an untreated control were included for comparison. All herbicide treatments were broadcast-applied postemergence with a CO_2-pressurized bicycle-wheel sprayer calibrated to deliver 10 gpa at 40 psi on May 27, 1998. Barley had 3 to 4 leaves and two tillers and wild oat had 3 leaves and two tillers. Wild oat density at herbicide application was 34 plants/ft^2. Environmental conditions were as follows: soil temperature 60 F, air temperature 64 F, relative humidity 54%, wind velocity 5 mph, and 20% cloud cover. Crop injury was evaluated 14 and 28 days after treatment (DAT) on June 11 and June 24. Wild oat control was evaluated visually at wild oat maturity July 27. Grain was harvested at maturity with a small plot combine on August 19.

Clodinafop injured barley (chlorosis and stunting) 33 to 47% 14-DAT, and 30% to 40% 28 DAT. Tralkoxydim or fenoxaprop & phenylpyrazolin combinations injury ranged from 0 to 3% 14 DAT, and averaged 0% 28 DAT. Clodinafop or fenoxaprop & phenylpyrazolin combinations controlled wild oat 88 to 100% except when clodinafop was combined with bromoxynil & MCPA which controlled wild oat 63%. Tralkoxydim alone, and tralkoxydim + bromoxynil & MCPA controlled wild oat 35 and 28%, respectively, and both were significantly less effective than all other herbicide combinations. Barley grain yields ranged from 72 to 100 bu/A and did not differ from each other or from the untreated check. Grain test weights ranged from 47 to 51 lb/bu and did not differ from the untreated check except plots treated with clodinafop alone (data not shown). Grain test weight from plots treated with clodinafop alone averaged 47 lb/bu compared to 49 lb/bu for the untreated check.

Table. Crop injury, wild oat control, and grain yield response to cladinafop, fenoxaprop & phenylpyrazolin, and tralkoxydim combined with broadleaf herbicides in spring barley.

Treatment[1]	Rate	Crop injury 6/11	Crop injury 6/24	AVEFA control	Yield
	lb/A	%			bu/A
Untreated check		-	-	-	72
Clodinafop +	0.05 +	37	40	100	99
Score	0.80% v/v				
Clodinafop +	0.05 +	33	37	63	77
bromoxynil & MCPA	0.5				
Score	0.80% v/v				
Clodinafop +	0.05 +	47	40	90	72
dicamba +	0.94 +				
Score	0.80% v/v				
Clodinafop +	0.05 +	43	30	98	98
thifensulfuron & tribenuron +	0.014 +				
Score	0.80% v/v				
Clodinafop +	0.05 +	40	33	92	86
thifensulfuron & tribenuron +	0.014 +				
dicamba +	0.063 +				
Score	0.80% v/v				
Fenoxaprop	0.084	3	0	98	98
Fenoxaprop +	0.084 +	3	0	88	100
thifensulfuron & tribenuron	0.014				
Tralkoxydim +	0.18 +	3	0	35	94
Supercharge	0.5% v/v				
Tralkoxydim +	0.18 +	0	0	28	73
bromoxynil & MCPA +	0.5 +				
Supercharge	0.5% v/v				
LSD (0.05)		8	12	20	37

[1]Bromoxynil & MCPA, and thifensulfuron & tribenuron applied as commercial premixes. Score and supercharge are commercial nonionic surfactant formulations.

Wild oat control in barley with fenoxaprop. John O. Evans, and R. William Mace. (Department of Plants, Soils, and Biometeorology, Utah State University, Logan, Utah 84322-4820). Fenoxaprop was compared to tralkoxydim, imazamethabenz, difenzoquat, CGA84927, and diclofop for wild oat (AVEFA) control and crop injury to barley. Individual treatments were applied to 10 by 30 foot plots with a CO_2 backpack sprayer using flatfan 80015 nozzles providing a 7 foot spray width calibrated to deliver 14 gpa at 39 psi. The soil was a Millville silt loam with 7.5 pH and OM content of less than 2%. Treatments were applied in a randomized block design with three replications June 3, 1998. Visual evaluations for wild oat control and crop injury were completed June 19 and July 21. Plots were harvested August 18.

Initial evaluations in June indicated some treatment injury to the barley which was no longer evident in July for any herbicide. Wild oat control also improved with later evaluations and was generally excellent for all treatments except fenoxaprop. Yields were not significantly different among treatments but a large yield variation exsisted within replications probably due to crop lodging near harvest. (Utah Agricultural Experiment Station, Logan, UT. 84322-4820)

Table. Wild oat control with fenoxaprop.

		Barley			Wild oat control	
		Injury		Yield		
Treatments	Rate	6/19	7/21		6/19	7/21
	lb ai/A	---------%--------		Bu/A	----------------%	--------------
Check		0	0	79	0	0
Fenoxaprop	0.1	15	0	76	85	77
Fenoxaprop+ Thifensulfuron/tribenuron[a]	0.1+ 0.019	17	0	76	87	88
Fenoxaprop+ Bromoxynil/MCPA	0.1+ 0.5	10	0	58	57	95
Fenoxaprop/2,4-D/MCPA+ Bromoxynil	0.58+ 0.25	7	0	99	87	96
Imazamethabenz+ Bromoxynil/MCPA+ Scoil	0.37+ 0.5+ 0.5	3	0	69	68	85
Tralkoxydim+ Bromoxynil/MCPA[b]	0.18+ 0.5	12	0	95	73	85
CGA184927	0.045	0	0	89	40	82
Difenzoquat[a]	0.75	0	0	87	37	70
Diclofop	0.93	3	0	75	63	88
$LSD_{(0.5)}$		9	-	36	29	16

[a]Nonionic surfactant added at .25% v/v
[b]Nonionic surfactant added at .5% v/v

Glyphosate drift with and without Placement adjuvant. Joan Campbell and Donn Thill. (Plant Science Division, University of Idaho, Moscow ID 83844-2339) Pressure and boom height can affect off-target spray drift. This experiment, south of Moscow, Idaho, was designed to determine if Placement adjuvant might help reduce off-target glyphosate drift. Glyphosate was applied at 12 oz/A plus ammonium sulfate at 5% v/v to a uniform, 12 in. tall, tillered barley stand with a CO_2 pressurized backpack sprayer on June 1, 1998. The treatments were 20, 30, and 40 psi at 16 in. boom height and 30 psi at 32 in. boom height. Ground speed was adjusted to keep the spray volume at 10 gal/A. Each treatment was applied with and without Placement adjuvant. Plots were 6 by 30 ft and were laid out perpendicular to wind direction. Plots were spaced 20 ft apart within a replication and each of the four replications were separated by 75 ft. Wind speed was recorded after each plot was sprayed. Environmental conditions were 78 F air temperature, 49% relative humidity, clear sky, and moist soil surface. The distance from the downwind edge of the spray swath to the edge of the dead plants (primary drift) and the edge of stunted plants (secondary drift) was measured on June 30.

Data were analyzed with wind speed as a covariate. Wind speed, which ranged between 6 and 8 mph, was not a significant factor in the model. However, there was a lull in wind speed (4 mph) when the 20 psi, no adjuvant treatment was applied. This likely accounts for the corresponding low amount of drift for that treatment (Table 1). Primary and secondary drift was greater with a 32 in. than 16 in. boom height. Over all treatments, Placement did not have a consistent effect on drift.

Table 1. Primary and secondary glyphosate drift.

Drift adjuvant	Pressure	Boom height	Primary drift	Secondary drift
	psi	in	ft	ft
None	30	16	2.6 cd[a]	4.0 ef[a]
Placement	30	16	3.2 cd	5.5 cd
None	30	32	8.1 a	12.2 a
Placement	30	32	7.0 ab	10.2 b
None	20	16	1.6 d	2.8 f
Placement	20	16	4.9 bc	4.9 ed
None	40	16	4.1 c	6.7 c
Placement	40	16	2.9 cd	5.8 cd

[a]Numbers followed by the same letter within a column are not significantly different (P=0.05).

Green foxtail control with imazamox in dry beans. Brian M. Jenks and Tammy L. Ellefson. (North Central Research Extension Center, Minot, ND 58701). The objective of the study was to evaluate weed control in dry beans with imazamox compared to standard treatments. Maverick dry beans were planted May 19 in Washburn, ND. Seedbed preparation was conventional with 30-inch row spacing and 60 lb/A seeding rate. Herbicide treatments consisted of preplant incorporated and postemergence applications. Individual plots were 10 by 30 feet and were arranged in a RCBD design and replicated four times. PPI treatments were applied with 80015 flat fan nozzles delivering 20 gpa at 30 PSI. All postemergence treatments were applied with 8001 flat fan nozzles delivering 10 gpa at 40 PSI. Postemergence applications were made on June 25 with the exception of one split treatment applied on July 1. On June 25 dry beans were 1-2 trifoliate, while green foxtail was approximately 1-inch tall and 175 plants/ft^2.

Green foxtail populations were very high as indicated by the extremely low dry bean yield in the untreated plot. Ethalfluralin, pendimethalin, and dimethenamid applied PPI did not control green foxtail. Dimethenamid looked good initially, but control was poor later in the season. We collected green foxtail from the ethalfluralin-treated area and sent it to a laboratory for testing. It was determined that the green foxtail was completely tolerant to dinitroaniline herbicides. Green foxtail control with imazamox, sethoxydim, or quizalofop was good to excellent in all treatments. Even though much of the green foxtail was resistant to DNA herbicides, control was slightly better with a soil-applied herbicide followed by imazamox postemergence. Control with imazamox + NIS was 5-10% lower compared to other adjuvants. Some antagonism may have occurred with imazamox + quizalofop as green foxtail control was also 5-10% lower than imazamox applied alone.

Table. Green foxtail control with imazamox in dry beans.

Treatment	Rate	7-8 Grft	8-26 Grft	9-2 Yield
	lb/A	---% Control---		lb/A
ethalfluralin	0.94	26	15	308
ethalfluralin / imazamox + MSO + 28% N	0.56 / 0.016 + 1.5% + 1 qt/A	92	98	1428
pendimethalin	1.25	0	3	158
pendimethalin / imazamox + MSO + 28% N	1.0 / 0.016 + 1.5% + 1 qt/A	87	93	1053
dimethenamid	0.94	66	48	802
dimethenamid / imazamox + MSO + 28% N	0.75 / 0.016 + 1.5% + 1 qt/A	95	97	1385
imazamox + MSO + 28% N	0.016 + 1.5% + 1 qt/A	88	94	1302
imazamox + MSO + 28% N	0.024 + 1.5% + 1 qt/A	88	98	1201
bentazon + COC / sethoxydim + COC (Post II)	0.75 + 2 pt/A / 0.055 + 2 pt/A	94	90	1375
bentazon + sethoxydim + COC / bentazon + COC (Post II)	0.375 + 1.5 pt/A + 2 pt/A / 0.375 + 2 pt/A	95	91	1631
bentazon + quizalofop + COC	0.75 + 0.055 + 2 pt/A	97	88	1314
imazamox + Quad 7 + 28% N	0.016 + 1% + 2 pt/A	83	92	1334
imazamox + NIS + 28% N	0.016 + 0.25% + 1 qt/A	80	86	1164
imazamox + quizalofop + COC + 28% N	0.016 + 0.055 + 2 pt/A + 1 qt/A	82	85	1101
untreated		0	0	124
CV		12	7	25
LSD (0.05)		13	8	372

COC= Herbimax by Loveland
MSO= Scoil by AGSCO
NIS= Activator 90 by Loveland
Quad 7= Surfactant blend by AGSCO

Broadleaf weed control in pinto beans with postemergence applications of AC 299-263 alone or in combination Richard N. Arnold and Daniel Smeal. (New Mexico State University Agricultural Science Center Farmington, NM 87499) Research plots were established on May 18, 1998 at the Agricultural Science Center, Farmington, New Mexico to evaluate the response of pinto beans (var. Flint), and broadleaf weeds to postemergence applications of AC 299-263 alone or in combination. Soil type was a Wall sandy loam with pH of 7.8 and an organic matter content less than 1%. The experimental design was a randomized complete block with three replications. Individual treatments were applied with a compressed air backpack sprayer calibrated to deliver 30 gal/A at 30 psi. Postemergence treatments were applied June 23 when bean plants were in the fourth trifoliolate leaf stage and weeds were two to three inch in height. Dimethenamid was applied preemergence to all plots on May 19 at 1.0 lb/A and was immediately incorporated with 0.75 in of sprinkler applied water. Black nightshade infestations were heavy and redroot and prostrate pigweed infestations were moderate throughout the experimental area. Treatments were evaluated for crop injury on July 23 and weed control on August 24. The two center rows of each plot were thrashed on September 8. Results obtained were subjected to analysis of variance at P=0.05.

No crop injury was observed in any of the treatments. All treatments gave good to excellent control of broadleaf weeds. Yields were 1383 to 3064 lb/A higher in the herbicide treated plots as compared to the check. (Published with the approval of the New Mexico State University Agricultural Experiment Station.)

Table. Control of broadleaf weeds in pinto beans with AC 299-263 applied postemergence alone or in combination.

		Weed Control			
Treatments	Rate	AMABL	AMARE	SOLNI	Yield
	lb/A	-----------%--------			lb/A
AC 299-263[a]	0.024	100	100	95	2613
AC 299-263[a]	0.032	100	100	99	2767
AC-299-263[b]	0.024	100	98	98	3074
AC-299-263[b]	0.032	100	99	100	3228
AC 299-263[c]	0.024	100	97	100	3228
AC 299-263 + bentazon[b]	0.032+0.5	100	99	100	3535
Imazethapyr[b]	0.032	100	97	100	3074
Imazethapyr + bentazon[b]	0.032+0.5	100	99	100	3381
AC 299-263 + bentazon[d]	0.032+0.38	99	98	100	3535
AC 299-263[a]	0.016	98	95	92	1844
AC 299-263[b]	0.016	98	94	97	2152
Check		0	0	0	461
LSD 0.05		1	2	2	277

[a]A surfactant was added at 0.25% v/v.
[b]A surfactant and 32% nitrogen solution was added at 0.25 and 1% v/v.
[c]Sunit-II was added at 1% v/v.
[d]A COC and 32% nitrogen solution was added at 1% v/v.

Broadleaf weed control in pinto beans with preemergence, cultivation and postemergence herbicides. Richard N. Arnold and Daniel Smeal. (New Mexico State University Agricultural Science Center Farmington, NM 87499) Research plots were established on May 18, 1998 at the Agricultural Science Center, Farmington, New Mexico to evaluate the response of pinto beans (var. Flint) to preemergence, cultivation and postemergence herbicides. Soil type was a Wall sandy loam with pH of 7.8 and an organic matter content less than 1%. The experimental design was a randomized complete block with three replications. Treatments were applied with a compressed air backpack sprayer calibrated to deliver 30 gal/A at 30 psi. Preemergence treatments were applied on May 19 and immediately incorporated with 0.75 in of sprinkler applied water. Treatments were cultivated and postemergence treatments were applied on June 23 when pinto beans were in the fourth trifoliolate leaf stage. Treatments were evaluated visually for crop injury on July 23 and weed control on August 24. The two center rows of each plot were thrashed on September 4. Results obtained were subjected to analysis of variance at P=0.05.

Dimethenamid applied preemergence at 2.0 lb/A caused the highest injury rating of 9. BAS 656, dimethenamid and metolachlor II Mag all applied preemergence followed by cultivation gave poor control of broadleaf weeds. Yields were 922 to 3105 lb/A higher in the herbicide treated plots as compared to the check. (Published with the approval of the New Mexico State University Agricultural Experiment Station.)

Table. Broadleaf weed control in pinto beans with preemergence, cultivation and postemergence herbicides.

Treatments[a]	Rate	Crop Injury	Weed Control AMARE	AMABL	SOLNI	Yield
	lb/A	----------------	-------%	------------		lb/A
Dimethenamid/AC 299-263 + bentazon[b]	0.75/0.032+0.5	0	100	100	97	3381
Dimethenamid/dimethenamid + AC 299-263 + bentazon[b]	0.75/0.5+0.032+0.5	0	100	99	99	3535
Metolachlor II Mag/ metolachlor II Mag + AC 299-263 + bentazon[b]	0.83/0.5+0.032+0.5	5	100	99	99	3381
BAS 656/AC 299-263 + bentazon[b]	0.41/0.032+0.5	0	99	100	86	3381
BAS 656/BAS 656 + AC 299-263 + bentazon[b]	0.41/0.27+0.032+0.5	0	99	100	97	3535
Metolachlor II Mag/ metolachlor II Mag	0.83/0.5	0	99	99	79	2152
Dimethenamid/dimethenamid	0.75/0.5	0	99	99	84	1998
Metolachlor II Mag/ AC 299-263 + bentazon[b]	0.83/0.032+0.5	0	99	100	90	3381
BAS 656/BAS 656	0.41/0.27	0	99	100	90	3381
BAS 656[c]	0.55	0	85	72	58	1383
Dimethenamid[c]	2.0	9	85	77	74	1844
Dimethenamid[c]	1.0	0	83	70	58	1537
BAS 656[c]	1.1	6	83	75	68	1844
Metolachlor II Mag[c]	2.2	3	82	78	64	1844
Metolachlor II Mag[c]	1.1	0	82	60	53	1537
Check		0	0	0	0	461
LSD 0.05		1	1	1	5	430

[a]First treatment applied preemergence followed by a postemergence treatment and evaluated for crop injury on July 23 and weed control on August 24.
[b]A surfactant and 32 % nitrogen solution was added at 0.25% v/v and 1% v/v.
[c]Treatments applied preemergence and evaluated for crop injury on July 23 and weed control on August 24.

Annual grass and broadleaf weed control in pinto beans with early preemergence, preemergence and preemergence band applications of dimethenamid, BAS 656 and metolachlor II Mag followed by cultivation and postemergence applications of AC 299-263 and imazethapyr in combination with bentazon. Richard N. Arnold and Daniel Smeal. (New Mexico State University Agricultural Science Center Farmington, NM 87499) Research plots were established on May 19, 1998 at the Agricultural Science Center, Farmington, New Mexico to evaluate the response of pinto beans (var. Flint), and annual grass and broadleaf weeds to early preemergence, preemergence and preemergence band applications of dimethenamid, BAS 656 and metolachlor II Mag followed by cultivation and postemergence applications of AC 299-263 and imazethapyr alone or in combination. Soil type was a Wall sandy loam with pH of 7.8 and an organic matter content less than 1%. The experimental design was a randomized complete block with three replications. Individual treatments were applied with a compressed air backpack sprayer calibrated to deliver 30 gal/A at 30 psi. Early preemergence, preemergence and preemergence band treatments were applied on May 14, 19 and 20. Postemergence treatments were applied after cultivation on June 24 when pinto beans were in the fourth trifoliolate leaf stage. Treatments were evaluated for crop injury on July 23 and weed control on August 24. The two center rows of each plot were thrashed on September 8. Results obtained were subjected to analysis of variance at P=0.05.

No crop injury was observed in any of the treatments. All treatments gave good to excellent control of annual grass and broadleaf weeds. Yields were 2460 to 3074 lb/A higher in the herbicide treated plots as compared to the check. (Published with the approval of the New Mexico State University Agricultural Experiment Station.)

Table. Control of annual grass and broadleaf weeds in pinto beans with early preemergence, preemergence and preemergence band applications of dimethenamid, BAS 656 and metolachlor II Mag followed by cultivation and postemergence application of AC 299-263 and imazethapyr in combination with bentazon.

Treatments[a]	Rate	AMABL	AMARE	SOLNI	ECHCG	SETVI	Yield
		Weed Control					
	lb/A	%					lb/A
BAS 656/AC 299-263 + bentazon[b]	0.55/0.032+0.5	100	99	97	98	98	2920
Dimethenamid/AC 299-263 + bentazon[c]	1.0/0.032+0.5	100	100	98	97	98	3228
BAS 656/AC 299-263 + bentazon[c]	0.55/0.032+0.5	100	98	99	97	98	3228
Metolachlor II Mag/ AC 299-263 + bentazon[c]	1.1/0.032+0.5	100	98	98	98	100	3074
Dimethenamid/AC 299-263 + bentazon[d]	1.0/0.032+0.5	100	98	100	96	94	2920
BAS 656/AC 299-263 + bentazon[d]	0.55/0.032+0.5	100	100	100	95	93	2920
Dimethenamid/imazethapyr + bentazon[c]	1.0/0.032+0.5	99	100	97	98	100	3074
Metolachlor II Mag/ imazethapyr + bentazon[c]	1.1/0.032+0.5	99	98	99	98	98	3381
Metolachlor II Mag/ AC 299-263 + bentazon[d]	1.1/0.032+0.5	99	100	98	97	95	3381
Dimethenamid/imazethapyr + bentazon[d]	1.0/0.032+0.5	99	100	98	94	97	2920
BAS 656/imazethapyr + bentazon[d]	0.55/0.032+0.5	99	99	97	95	96	2920
Metolachlor II Mag/ imazethapyr + bentazon[d]	1.1/0.032+0.5	99	100	99	96	95	3074
Dimethenamid/AC 299-263 + bentazon[b]	1.0/0.032+0.5	98	98	98	98	99	2920
BAS 656/imazethapyr + bentazon[c]	0.55/0.032+0.5	98	99	99	96	98	3228
Metolachlor II Mag/ AC 299-263 + bentazon[b]	1.1/0.032+0.5	97	99	95	98	99	2767
Check		0	0	0	0	0	307
LSD 0.05		1	1	2	3	2	769

[a]Postemergence treatments were applied with a surfactant and 32% nitrogen solution at 0.25 and 1.0% v/v.
[b]First treatment applied early preemergence followed by a postemergence treatment.
[c]First treatment applied preemergence followed by a postemergence treatment.
[d]First treatment applied preemergence band followed by a postemergence treatment.

Evaluation of CGA-77102 for weed control in sugar beet applied preplant-incorporated, preemergence, and postemergence. Michael J. Wille and Don W. Morishita. (Twin Falls Research and Extension Center, University of Idaho, Twin Falls 83303-1827). A study was established at the University of Idaho Research and Extension Center near Kimberly to evaluate the weed control efficacy of CGA-77102 at different rates and application timings in sugarbeet ('WSMP9'). The experimental design was a randomized complete block with four replications. Individual plots were four rows by 30 ft. Soil type was a Portneuf silt loam (14% sand, 54% silt, 32% clay, pH 8.3, 1.6% organic matter, 20-meq/100 g soil CEC). Sugar beet was planted in rows 22-inches apart on April 22, 1998. Treatments consisted of either one or two sequential applications of CGA-77102. Plots treated with a single application received 1.42 or 1.72 lb/A CGA-77102 preplant-incorporated (PPI), preemergence (PRE), or postemergence (POST) when sugar beet was at the cotyledon stage of growth. These plots received additional applications of ethofumesate & desmedipham & phenmedipham (efs&dmp&pmp) when sugar beet had 1 to 2 leaves, and again 7 days later. Plots treated with two applications of CGA-77102 received an initial application of 1.42 or 1.72 lb/A of CGA-77102 PPI or PRE, and a second application of CGA-77102 at 2.77 lb/A when sugarbeet had 1 to 2 leaves followed by an application of efs&dmp&pmp 7 days later. Additional treatments included cycloate (PPI), ethofumesate (PRE), or efs&dmp&pmp (POST) for comparison in place of the initial CGA-77102 application. All herbicide treatments were applied in a 10-inch band with a CO_2-pressurized bicycle-wheel sprayer calibrated to deliver 20 gpa at 40 psi. Kochia, redroot pigweed, and common lambsquarters were the major weed species present. Additional application information and weed species densities are given in Table 1. Crop injury and weed control in plots receiving a single preplant-incorporated or preemergence application of CGA-77102 were evaluated May 22, when sugarbeet had 1 to 2 leaves. All plots were evaluated for crop injury and weed control June 8 and 30. Sugar beet was harvested from the middle two rows of each plot October 8.

Table 1. Application information and weed species densities.

Application timing (BEAVU)	PPI	PRE	Cotyledon	1 to 2 leaf	+7 days
Application date	4/20	4/27	5/8	5/22	5/20
Air temperature (F)	56	45	71	50	65
Soil temperature (F)	48	46	68	51	66
Relative humidity (%)	58	64	38	78	46
Wind velocity (mph)	2	0	7	6	7
Weed Species			plants/ft^2		
Redroot pigweed (AMARE)	-	-	9	10	14
Common lambsquarters (CHEAL)	-	-	1	1	2
Kochia (KCHSC)	-	-	<1	<1	<1
Hairy nightshade (SOLSA)	-	-	<1	<1	1
Annual sowthistle (SONOL)	-	-	<1	<1	<1

Crop injury in plots receiving a single PPI or PRE herbicide application ranged from 13 to 34% when evaluated May 22 (Table 2). Herbicides injured sugar beet 3 to 18% when evaluated June 8, and 5 to 36% when evaluated June 30. Kochia control ranged 74 to 99% on all three evaluation dates and did not differ among herbicide treatments. Redroot pigweed and common lambsquarters control was ≥83% on all three evaluation dates, and did not differ among herbicide treatments. Sugar beet root yield ranged from 22 to 30 ton/A in herbicide-treated plots compared to 9 ton/A in the untreated check. Yields from herbicide-treated plots were greater than the untreated check but did not differ from each other.

Table 2. Effect of CGA-77102 application rate and timing on crop injury, weed control, and sugarbeet root yield at Kimberly, Idaho.

						Weed control[1]										
		Appl.	Crop injury			AMARE			CHEAL			KCHSC				
Treatment	Rate	timing[2]	5/22	6/8	6/30	5/22	6/8	6/30	5/22	6/8	6/30	5/22	6/8	6/30	Yield
	lb/A		%												tons/A
Check			-	-	-	-	-	-	-	-	-	-	-	-	9
CGA-77102/	1.42/	PPI	16	7	15	91	100	100	90	100	99	76	91	80	24
efs&dmp&pmp[3]/	0.33/	1-2 lf													
efs&dmp&pmp	0.33	+7 d													
CGA-77102/	1.78/	PPI	16	6	11	88	98	100	95	99	100	85	91	86	29
efs&dmp&pmp/	0.33/	1-2 lf													
efs&dmp&pmp	0.33	+7 d													
Cycloate/	3/	PPI	13	3	5	83	99	95	94	98	100	81	86	80	24
efs&dmp&pmp/	0.33/	1-2 lf													
efs&dmp&pmp	0.33	+7 d													
CGA-77102/	1.42/	PRE	28	6	25	98	100	100	98	100	98	85	91	76	24
efs&dmp&pmp/	0.33	1-2 lf/													
efs&dmp&pmp	0.33	+7 d													
CGA-77102/	1.78	PRE	34	10	36	100	100	100	95	100	99	91	93	90	28
efs&dmp&pmp/	0.33/	1-2 lf													
efs&dmp&pmp	0.33/	+7 d													
Ethofumesate/	1.12/	PRE	19	10	10	99	100	100	99	100	100	86	97	99	29
efs&dmp&pmp/	0.33/	1-2 lf													
efs&dmp&pmp	0.33	+7 d													
CGA-77102/	2.14/	Cotyl		16	23		100	100		100	100		97	89	29
efs&dmp&pmp/	0.33/	1-2 lf													
efs&dmp&pmp	0.33	+7 d													
CGA-77102/	2.78/	Cotyl		18	35		100	100		100	100	90	83		24
efs&dmp&pmp/	0.33/	1-2 lf													
efs&dmp&pmp/	0.33	+7 d													
Efs&dmp&pmp/	0.25/	Cotyl	15	8	11	90	100	98	100	100	98	86	97	93	31
efs&dmp&pmp/	0.33	1-2 lf													
efs&dmp&pmp/	0.33/	+7 d													
CGA-77102/	1.07/	PPI		8	18		100	100		96	96		91	86	32
CGA-77102/	2.78/	1-2 lf													
efs&dmp&pmp	0.33	+7 d													
CGA-77102/	1.42/	PPI		8	16		98	100		96	93		83	74	24
CGA-77102/	2.78/	1-2 lf													
efs&dmp&pmp	0.33	+7 d													
CGA-77102/	1.07/	PRE		13	29		100	100		99	98		94	86	28
CGA-77102/	2.78/	1-2 lf													
efs&dmp&pmp	0.33	+7 d													
CGA-77102/	1.42/	PRE		10	11		92	94		93	88		88	83	25
CGA-77102/	2.78/	1-2 lf													
efs&dmp&pmp	0.33	+7 d													
LSD (0.05)			13	6	16	NS	NS	NS	5	NS	NS	NS	NS	NS	8

[1]Weed species evaluated for control were redroot pigweed (AMARE), common lambsquarters (CHEAL), and kochia (KCHSC).

[2] Crop growth stages correspond to the following application dates: 5/8 = cotyledon, 5/22 = 1 to 2 leaf, 5/30 = + 7d after 1 to 2 leaf.

[3]Efs&dmp&pmp is a commercial formulation of ethofumesate + desmedipham + phenmedipham.

Evaluation of preemergence and postemergence herbicide applications on sugar beets, 1997. Marvin D. Butler. (Central Oregon Agricultural Research Center, Oregon State University, Madras, OR 97741) Evaluation of preemergence and postemergence herbicide applications on sugar beets was conducted in two commercial fields near Prineville and Culver, Oregon. Preemergence treatments were ethofumesate and pyrazon, and a combination of the two. Postemergence applications were phenmedipham and desmedipham plus triflusulfuron, and phenmedipham and desmedipham at half the normal rate plus triflusulfuron with crop oil concentrate at 1.5 % v/v. Treatments applied preemergence were made April 18 at Culver and April 17 at Prineville. This was followed by paraquat treatments to appropriate plots on April 29 at Prineville, while the crop at Culver emerged unexpectedly early so no application was made. The entire field at Prineville was replanted due to freeze damage May 3. Treatments applied postemergence were made at the cotyledon stage May 8 at Culver and May 16 in Prineville. The second postemergence treatments were made at the two-leaf stage May 14 at Culver and at the four-leaf stage May 27 at Prineville.

Treatments were applied with a CO_2-pressurized, hand-held boom sprayer at 40 psi and 20-gal/A water. Plots 10 ft by 22 ft were replicated four times in a randomized complete block design. Treatments at the Culver location were evaluated for crop injury and percent control of common groundsel, common lambsquarters, redstem filaree, redroot pigweed, and kochia May 23 and August 1. Evaluation of treatments at the Prineville location were made June 10 and August 1 for redroot pigweed, prostrate knotweed, hairy nightshade, and common lambsquarters.

At the Culver location (Table 1) all treatments provided excellent weed control, except the preemergence only applications with an average of 74% control. Crop stunting was the highest, with 16% when crop oil was added to the phenmedipham and desmedipham plus triflusulfuron treatments. Ethofumesate at 1.5 lb/A and pyrazon at 3.1 lb/A produced 13% crop stunting, while other treatments with both preemergence and postemergence applications produced 9 to 11% stunting. Since yields in hand-weeded plots were no different that those where herbicides were applied, there was no indication of reduced yields associated with herbicide treatments in these trials.

Results for the Prineville location are provided in Table 2. Preemergence application of ethofumesate at 1 lb/A or 1.5 lb/A, pyrazon at 2 lb/A or 3.1 lb/A, or the combination of ethofumesate at 0.75 lb/A plus pyrazon at 0.84 lb/A followed by phenmedipham and desmedipham plus triflusulfuron provided excellent weed control. Preemergence only application of ethofumesate plus pyrazon provided only 89% control.

Redroot pigweed was the most difficult weed to control for treatments not including ethofumesate or pyrazon applied preemergence. At the Culver location, the weed spectrum was 45% common lambsquarters, 37% common groundsel, 10% redroot pigweed, 4% kochia, and 4% redstem filaree. At the Prineville location, the weed spectrum included 38% redroot pigweed, 22% prostrate knotweed, 20% common lambsquarters, and 20% hairy nightshade.

Table 1. Effect of herbicide applications on sugar beets near Culver, OR, evaluated May 23, 1997.

Treatments[b]	Application timing: Pre	Post 1	Post 2	Weed control[a]: Common groundsel	Common lambsquarters	Redstem filaree	Redroot pigweed	Kochia	Average
	(lb/A)			(%)					
Ethofumesate+	0.75			95 b	72 b	33 b	80 b	92 a	74 b
pyrazon	0.84								
Ethofumesate+	0.75			100 a	100 a	100 a	100 a	100 a	100 a
pyrazon	0.84								
phen & desm[c] +		0.24	0.33						
triflusulfuron		0.016	0.5						
Ethofumesate	1			100 a	100 a	100 a	100 a	100 a	100 a
phen & desm +		0.24	0.33						
triflusulfuron		0.5	0.016						
Ethofumesate	1.5			100 a	100 a	100 a	100 a	100 a	100 a
phen & desm +		0.24	0.33						
triflusulfuron		0.016	0.016						
Pyrazon	2			100 a	100 a	100 a	100 a	100 a	100 a
phen & desm +		0.24	0.33						
triflusulfuron		0.016	0.016						
Pyrazon	3.1			100 a	100 a	100 a	100 a	100 a	100 a
phen & desm +		0.24	0.33						
triflusulfuron		0.016	0.016						
Phen & desm +		0.24	0.33	100 a	100 a	100 a	100 a	100 a	100 a
triflusulfuron		0.016	0.016						
Phen & desm +		0.24	0.33	100 a	100 a	99 a	100 a	100 a	100 a
triflusulfuron		0.016	0.016						
Phen & desm +		0.75	0.165	100 a	99 a	100 a	99 a	98 a	99 a
triflusulfuron[d]		0.016	0.016						
Untreated		----	----	0 c	0 c	0 b	0 c	0 b	0 c
Hand weeded		----	----	100 a	100 a	100 a	100 a	100 a	100 a

[a]Visual evaluation was conducted May 23, 1997.
[b]Treatments were applied April 18, May 8, and May 14, 1997.
[c]Phen& desm= phenmedipham & desmedipham commerical formulation.
[d]Crop oil concentrate added at 1.5% v/v.

Table 2. Effect of herbicide application on sugar beets near Prineville, OR, evaluated June 9, 1997.

Treatments[b]	Application timing: Pre	Post 1	Post 2	Weed control[a]: Redroot pigweed		Prostrate knotweed		Hairy nightshade		Common lambsquarters		Average
	(lb/A)			(%)								
Ethofumesate+	0.75			92	a	98	a	73	b	92	a	89
pyrazon	0.84											
Ethofumesate+	0.75			100	a	98	a	100	a	100	a	100
pyrazon	0.84											
phen & desm[c] +		0.24	0.33									
triflusulfuron		0.016	0.016									
Ethofumesate	1			100	a	99	a	100	a	100	a	100
phen & desm +		0.24	0.33									
triflusulfuron		0.016	0.016									
Ethofumesate	1.5			100	a	98	a	100	a	100	a	100
phen & desm +		0.24	0.33									
triflusulfuron		0.016	0.016									
Pyrazon	2			100	a	100	a	100	a	100	a	100
phen & desm +		0.24	0.33									
triflusulfuron		0.016	0.016									
Pyrazon	3.1			100	a	98	a	100	a	100	a	100
phen & desm +		0.24	0.33									
triflusulfuron		0.016	0.016									
Paraquat	0.47			100	a	88	a	100	a	98	a	97
phen & desm +		0.24	0.33									
triflusulfuron		0.016	0.016									
Phen & desm +		0.24	0.33	93	a	43	b	94	a	93	a	81
triflusulfuron		0.016	0.016									
Phen & desm +		0.75	1	93	a	88	a	93	a	92	a	92
triflusulfuron[d]		0.016	0.016									
Untreated		----	----	0	b	0	c	0	c	0	b	0

[a]Visual evaluation was conducted May 23, 1997.
[b]Treatments were applied April 17, May 16, and May 27, 1997.
[c]Phen & desm = phenmedipham & desmedipham commerical formulation.
[d]Crop oil concentrate added at 1.5% v/v.

Micro-rate postemergence herbicide applications for weed control in sugar beet. Michael J. Wille and Don W. Morishita. (Twin Falls Research and Extension Center, University of Idaho, Twin Falls 83303-1827). Previous research in the Red River valley of Minnesota and North Dakota has shown that sugarbeet herbicides applied at rates lower than the full-labeled rates can be effective in controlling broadleaf and grass weeds. A study was established under sprinkler irrigation at the University of Idaho Research and Extension Center near Kimberly to determine the effectiveness of reduced herbicide rates compared to standard rates in the drier climate of southern Idaho. Typically, postemergence sugarbeet herbicides are applied in a 7-inch band. In this experiment, the reduced herbicide rate treatments ('micro-rates') were calculated as the amount of active ingredient per acre in a 7-inch band broadcast over the entire row width.

The experimental design was a randomized complete block with four replications. Individual plots were four rows by 25 ft. The soil type was a Portneuf silt loam (14% sand, 54% silt, 32% clay, pH 8.3, 1.6% organic matter, 20-meq/100 g soil CEC). Sugar beet ('WSPM9') was seeded at a density of 47,520 seed/A in rows 22-inches apart on April 22, 1998. Kochia, redroot pigweed, common lambsquarters, and hairy nightshade were the major weed species present. Herbicides were applied at a standard rate or at a reduced rate ('micro-rate'). Standard and micro-rates were either broadcast applied at 10 gpa with 11001 flat fan nozzles, or band-applied at 20 gpa with either 8001 even fan or 8002 twinjet nozzles using a CO_2-pressurized bicycle-wheel sprayer. All herbicide treatments were applied to sugar beet at the cotyledon stage of growth on May 8, and at 7 to 10 d intervals May 19, June 1, and 8. Additional application information and weed species densities are given in Table 1. Crop injury and weed control were evaluated 7 and 28 days after treatment (DAT) June 15 and July 8, respectively. Sugar beet was harvested from the middle two rows of each plot October 9.

Table 1. Application information and weed species densities.

Application timing	Cotyledon	+ 7 days	+ 13 days	+ 7 days
Application date	5/8	5/19	6/1	6/8
Air temperature (F)	71	80	72	64
Soil temperature (F)	68	65	62	62
Relative humidity (%)	38	31	25	52
Wind velocity (mph)	8	6	6	7
Weed species density	plants/ft^2			
Redroot pigweed (AMARE)	6	8	8	<1
Common lambsquarters (CHEAL)	<1	<1	<1	<1
Kochia (KCHSC)	<1	<1	<1	<1
Hairy nightshade (SOLSA)	2	2	3	10

Sugar beet injury ranged from 0 to 18% 7 DAT but no injury was evident with any herbicide treatment by 28 DAT (Table 2). Kochia control with the micro-rate band-applied or applied with twinjet nozzles was 99 and 97%, respectively, and was similar to the band-applied, standard rate on 7 DAT. Kochia control using the standard herbicide rate with twinjet nozzles, or the micro-rate, broadcast application, was significantly less effective than the band-applied standard rate treatment. Kochia control 28 DAT ranged from 45 to 96%. All herbicide treatments were similar to the band-applied standard rate treatment. Redroot pigweed control ranged from 80 to 100% 7 DAT and from 50 to 90% 28 DAT. Redroot pigweed control was similar among herbicide treatments at both evaluation dates except the broadcast-applied micro-rate treatment, which was significantly lower than all other treatments. Common lambsquarters control ranged from 95 to 100% 7 DAT, and from 90 to 100% on 28 DAT. Herbicide treatments did not differ from the standard treatment on either evaluation date. Hairy nightshade was controlled 100% by all herbicide treatments. These data indicate that broadcast or twinjet micro-rates effectively control redroot pigweed, common lambsquarters, and hairy nightshade, but do not control kochia. Sugar beet root yield ranged from 11 to 32 ton/A. All herbicide treated plots yielded more than the untreated check plots but did not differ from each other.

Table 2. Crop injury, weed control and sugar beet root yield

							Weed control[1]								
		Nozzle	Appl.	Appl.	Crop injury		AMARE		CHEAL		KCHSC		SOLSA		
Treatment[2]	Rate	type[3]	vol.	date	6/15	7/8	6/15	7/8	6/15	7/8	6/15	7/8	6/16	7/8	Yield
	lb/A		gpa		%										ton/A
Check					-	-	-	-	-	-	-	-	-	-	11
Efs&dmp&pmp + triflusulfuron + clopyralid	0.084 + 0.005 + 0.031	Flat fan	10	5/8	0	0	80	50	95	90	55	45	100	100	23
Efs&dmp&pmp + triflusulfuron + clopyralid	0.084 + 0.005 + 0.031	Flat fan	10	5/19											
Efs&dmp&pmp + triflusulfuron + clopyralid	0.084 + 0.005 + 0.031	Flat fan	10	6/1											
Efs&dmp&pmp + triflusulfuron + clopyralid	0.084 + 0.005 + 0.031	Flat fan	10	6/8											
Efs&dmp&pmp + triflusulfuron	0.25 + 0.016	Even fan	20	5/8	14	0	100	99	100	98	98	86	100	100	32
Efs&dmp&pmp + triflusulfuron + clopyralid	0.25 + 0.016 + 0.016	Even fan	20	5/19											
Efs&dmp&pmp + triflusulfuron + clopyralid	0.25 + 0.016 + 0.016	Even fan	20	6/1											
Efs&dmp&pmp + triflusulfuron	0.127 + 0.016	Even fan	20	5/8	18	0	99	99	100	99	99	96	100	100	27
Efs&dmp&pmp + triflusulfuron	0.127 + 0.016	Even fan	20	5/19											
Efs&dmp&pmp + triflusulfuron	0.127 + 0.016	Even fan	20	6/1											
Efs&dmp&pmp + triflusulfuron	0.25 + 0.016	Twin jet	20	5/8	10	0	95	95	100	100	70	75	100	100	27
Efs&dmp&pmp + triflusulfuron + clopyralid	0.25 + 0.016 + 0.094	Twin jet	20	5/19											
Efs&dmp&pmp + triflusulfuron + clopyralid	0.25 + 0.016 + 0.094	Twin jet	20	6/1											
Efs&dmp&pmp + triflusulfuron + clopyralid	0.084 + 0.005 + 0.031	Twin jet	20	5/8	7	0	93	93	97	93	97	67	100	100	24
Efs&dmp&pmp + triflusulfuron + clopyralid	0.084 + 0.005 + 0.031	Twin jet	20	5/19											
Efs&dmp&pmp + triflusulfuron + clopyralid	0.084 + 0.005 + 0.031	Twin jet	20	6/1											
Efs&dmp&pmp + triflusulfuron + clopyralid	0.084 + 0.005 + 0.031	Twin jet	20	6/8											
LSD (0.05)					NS	NS	7	25	NS	NS	10	NS	NS	NS	9

[1]Weed species evaluated: redroot pigweed (AMARE), common lambsquarters (CHEAL), kochia (KCHSC), and annual sowthistle (SOLSA).

[2]Efs&dmp&pmp is a commercial formulation of ethofumesate & desmedipham & phenmedipham. Methylated seed oil added at the rate of 1. v/v to treatments containing triflusulfuron.

[3]Flat fan nozzles were used for broadcast herbicide applications, and Even fan or Twin jet nozzles were used for banded applications.

Weed control in sugar beet with BAS 656 07 H. Michael J. Wille and Don W. Morishita. (Twin Falls Research and Extension Center, University of Idaho, Twin Falls 83303-1827). A study was established under sprinkler irrigation at the University of Idaho Research and Extension Center near Kimberly to evaluate the efficacy of BAS 656 07 H combinations for postemergence weed control in sugar beet. The experimental design was a randomized complete block with four replications. Individual plots were four rows by 30 ft. Soil type was a Portneuf silt loam (14% sand, 54% silt, 32% clay, pH 8.3, 1.6% organic matter, 20-meq/100 g soil CEC). Sugar beet ("WSPM9') was seeded at a density of 47,520 seed/A in rows 22-inches apart April 22, 1998. Kochia, redroot pigweed, and common lambsquarters, were the major weed species present. All herbicide treatments were applied in a 10-inch band, with a CO_2-pressurized bicycle-wheel sprayer calibrated to deliver 20 gpa at 40 psi. Application information and weed species densities are given in Table 1. A different formulation of BAS 656 07 H was inadvertently used for the first herbicide application in place of BAS 656 07 H on May 8. An additional BAS 656 07 H application was made June 5 to adjust the total amount of active ingredient applied to conform to the original protocol. Crop injury and weed control were evaluated June 17 and July 2. Sugar beets were harvested from the middle two rows of each plot October 9.

Table 1. Application information and weed species densities.

Application timing	Cotyledon	2 leaf	+ 12 days	+ 7 days
Application date	5/8	5/18	5/30	6/5
Air temperature (F)	71	66	65	62
Soil temperature (F)	68	66	66	50
Relative humidity (%)	38	34	46	64
Wind velocity (mph)	7	3	6	6
Weed species density	plants/ft^2			
Redroot pigweed (AMARE)	5	5	8	8
Common lambsqsuarters (CHEAL)	1	1	2	<1
Kochia (KCHSC)	<1	<1	<1	<1

Crop injury from herbicide treatments ranged from 8 to 45% when evaluated June 9 (Table 2). No crop injury from herbicide treatments was >5% June 17 or July 2 except desmedipham & phenmedipham + triflusulfuron applied three times. Three applications of desmedipham & phenmedipham + triflusulfuron caused significantly more injury than other herbicide combinations on all three evaluation dates. All herbicide treatments controlled common lambsquarters ≥92% at all evaluation dates and did not differ from each other. The same was observed for redroot pigweed control which ranged from 92 to 100% on June 9 and 17 and from 85 to 99% on July 17. All herbicide treatments controlled kochia 95 to 100% on June 9, 88 to 100% on June 17, and 60 to 90% on July 27. Kochia control was similar among herbicide treatments at all three evaluation dates. Sugar beet root yield from the herbicide-treated plots ranged from 31 to 36 ton/A compared to 16 ton/A in the untreated check. Yields from all herbicide-treated plots were greater than the untreated check but did not differ from each other.

Effect of sugar beet populations and herbicides on weed control. Steve L. Young, Don W. Morishita, and Michael J. Wille. A study was established to determine how sugar beet populations and herbicide treatment combination affect weed control. The trial was conducted under sprinkler irrigation at the University of Idaho Research and Extension Center near Kimberly, Idaho. Sugar beet ('WS-PM 9') was planted at a rate of 142,560 seed/A on 22-inch rows April 22, 1998, and emerged May 6. Experimental design was a split plot randomized complete block with six replications. Main plots were the following sugar beet populations: 100 to 105 plants/100 ft, 125 to 130 plants/100 ft, 150 to 155 plants/100 ft, and 175 to 180 plants/100 ft. Sub-plots were herbicide treatment and were 4 rows by 30 ft. Soil type was a silt loam with a pH of 8.3, CEC of 20 meq/100 g of soil, and 1.65% organic matter. Herbicides were applied in a 10-inch band with a CO_2-pressurized bicycle-wheel sprayer calibrated to deliver 20 gpa at 38 psi using 8001 even fan nozzles. Additional application information is shown in Table 1. Crop injury and weed control evaluations were taken June 11 and July 1. Sugar beet yields were determined by harvesting roots from the two center rows of each plot October 8 with a mechanical harvester.

Table 1. Application information and weed densities.

Application timing	Preemergence	1 to 2 leaf	7 days later
Application date	4/27	5/22	5/30
Air temperature (F)	45	50	68
Soil temperature (F)	46	51	74
Relative humidity (%)	64	78	28
Wind speed (mph)	0	6	6
Weed species density		Plants/ft^2	
Redroot pigweed	-	102	122
Common lambsquarters	-	7	15
Hairy nightshade	-	10	11
Annual sowthistle	-	3	8
Kochia	-	2	2

Sugar beet population did not affect control of the weed species (data not shown). Sugar beet was not injured by any herbicide treatment (data not shown). Herbicide treatment alone however, did affect weed control (Table 2). Ethofumesate applied preemergence (PRE) with no sequential herbicides effectively controlled redroot pigweed, hairy nightshade, and annual sowthistle at all evaluation dates. Ethofumesate applied PRE followed by either a single postemergence (POST) application or two sequential POST applications of ethofuesate & desmedipham & phenmedipham + triflusulfuron controlled redroot pigweed, common lambsquarters, kochia, hairy nightshade, and annual sowthistle ≥95%. The level of weed control in sugar beet appears to be more dependent on herbicide combination and number of applications rather than competition from higher sugar beet populations. In terms of sugar beet yield, ethofumesate applied PRE yielded 23 ton/A compared to 31 and 30 ton/A with ethofumesate applied PRE followed by a single POST application or two POST applications, respectively.

Table 2. Weed control and yield response to herbicide treatments averaged across sugar beet populations.

			Weed control[1]														
		Application	AMARE			CHEAL			KCHSC			SOLSA			SONOL		
Treatment	Rate	timing	6/8	6/24	7/27	6/8	6/24	7/27	6/8	6/24	7/27	6/8	6/24	7/27	6/24	7/27	Yield
	lb/A		%														ton/A
Hand weeded check			100	100	100	100	100	100	100	100	100	100	100	100	100	100	32
Ethofumesate	1.12	PRE	89	97	82	81	89	62	90	80	75	96	100	100	100	80	23
Ethofumesate /	1.12 /	PRE	100	100	97	99	100	95	100	99	98	100	100	100	99	100	31
efs&dmp&pmp +	0.25 +	1-2 leaf															
triflusulfuron	0.016																
Ethofumesate /	1.12 /	PRE	100	99	100	100	98	99	96	99	98	100	100	100	100	100	30
efs&dmp&pmp +	0.25 +	1-2 leaf															
triflusulfuron	0.016 /																
efs&dmp&pmp +	0.25 +	7 d later															
triflusulfuron	0.016																
			6	2	5	3	3	9	6	12	11	2	NS	NS	NS	5	4

[1]Weed species evaluated for control were redroot pigweed (AMARE), common lambsquarters (CHEAL), kochia (KCHSC), hairy nightshade (SOLSA), and annual sowthistle (SONOL).
[2]Efs&dmp&pmp is a commercial formulation of ethofumesate & desmedipham & phenmedipham.

Postemergence herbicide application timing for broadleaf weed control in sugar beet. Don W. Morishita and Michael J. Wille. (Twin Falls Research and Extension Center, University of Idaho, Twin Falls, ID 83303-1827). Timely application of postemergence herbicides for weed control in sugar beet is critical especially for growers who choose not to apply a preplant or preemergence herbicide. The objective of this study was to determine the effect of desmedipham & phenmedipham & ethofumesate (dmp&pmp&efs) plus triflusulfuron rate and application timing for the control of weeds at different growth stages. Sugar beets (' WS-PM9') were planted April 22, 1998, at a rate of 47,520 seed/A on 22-inch rows, 0.75-inch deep, and grown under sprinkler irrigation. Individual plots were 4-rows by 30-feet and treatments were arranged in a randomized complete block design with four replications. All herbicides were applied in a 10-inch band with a CO_2-pressurized bicycle-wheel sprayer calibrated to deliver 20 gpa at 38 psi using 8001 even fan nozzles. Three sequential herbicide application treatments beginning at the cotyledon (application timing A), 1 to 2-leaf (application timing B), and 3 to 4-leaf (application timing C) growth stage were compared. Additional application information is shown in Table 1. Soil type at this site was a silt loam with a pH of 8.3, CEC of 20 meq/100 g of soil, and 1.65% organic matter. Visual evaluations for crop injury and weed control were taken 4, 14, and 28 days after the last treatment was applied (DAT). Weed species evaluated were redroot pigweed, common lambsquarters, and kochia. The two center rows of each plot were harvested October 9 with a mechanical harvester.

Table 1. Application information and weed species densities.

Application date	5/8	5/18	5/30	6/5	6/8	6/11	6/22
Application timing A	Cotyledon	+ 10 days	+22 days	-	-	-	-
Application timing B			1 to 2 leaf		+ 9 days		+ 23 days
Application timing C				3 to 4 leaf		+ 6 days	+ 11 days
Air temperature (F)	71	66	68	62	70	70	
Soil temperature (F)	68	66	74	50	68	80	
Relative humidity (%)	38	34	28	64	64	58	
Wind velocity (mph)	7	3	6	6	4	3	
Weed species density				plants/ft^2			
Redroot pigweed (AMARE)	15	15	18	-	21	-	19
Common lambsqsuarters (CHEAL)	1	2	3	-	4	-	3
Kochia (KCHSC)	1	1	1	-	<1	-	<1

The first herbicide treatment listed on Table 2, efs&dmp&pmp + triflusulfuron at 0.25 + 0.016 lb/A, is a typical herbicide rate and application regime for sequential postemergence herbicide applications. None of the herbicide treatments injured the crop including the higher herbicide application rates. Redroot pigweed control with either rates of efs&dmp&pmp + triflusulfuron ranged from 98 to 100% when application began at the cotyledon growth stage. Equal control was not achieved until efs&dmp&pmp + triflusulfuron was applied at 0.42 or 0.5 + 0.022 or 0.026 lb/A when applications began at either the 3 to 4-leaf or 4 to 5-leaf growth stage. Because of inconsistent common lambsquarters and kochia densities, control of these weeds was not significantly different among herbicide treatments. However, average weed control values for efs&dmp&pmp + triflusulfuron at 0.33 + 0.019 lb/A improved common lambsquarters and kochia control over the lower triflusulfuron rate of 0.016 lb/acre. Herbicide treatment yields ranged from 23 to 32 ton/A and were all greater than the untreated check, which yielded only 6 ton/A. Among the herbicide treatments, only efs&dmp&pmp + triflusulfuron at 0.33 + 0.019 lb/A beginning at the 1 to 2-leaf stage was significantly lower than the highest yielding treatment, efs&dmp&pmp + triflusulfuron at 0.42 + 0.023 lb/A beginning at the 1 to 2-leaf stage.

Table 2. Crop injury, broadleaf weed control, and sugar beet yield with different timings of application.

						Weed control[1]										
		Application	Crop injury			AMARE			CHEAL			KCHSC				
Treatment[2]	Rate	date[3]	6/26	7/9	7/20	6/26	7/9	7/20	6/26	7/9	7/20	6/26	7/9	7/20	Yield
	lb/A		%												ton/A
Check			-	-	-	-	-	-	-	-	-	-	-	-	6
Efs&dmp&pmp +	0.25 +	5/8	0	0	0	98	85	83	93	88	79	73	65	64	26
triflusulfuron /	0.016 /														
efs&dmp&pmp +	0.25 +	5/18													
triflusulfuron /	0.016 /														
efs&dmp&pmp	0.25 +	5/30													
triflusulfuron	0.016														
Efs&dmp&pmp +	0.33 +	5/8	0	0	0	100	96	94	100	95	91	78	73	75	26
triflusulfuron /	0.019 /														
efs&dmp&pmp +	0.25 +	5/18													
triflusulfuron /	0.016 /														
efs&dmp&pmp +	0.25 +	5/30													
triflusulfuron	0.016														
Efs&dmp&pmp +	0.33 +	5/8	0	0	0	99	98	95	98	98	93	94	90	80	31
triflusulfuron /	0.019 /														
efs&dmp&pmp +	0.33 +	5/18													
triflusulfuron /	0.019 /														
efs&dmp&pmp +	0.33 +	5/30													
triflusulfuron	0.019														
Efs&dmp&pmp +	0.33 +	5/18	0	0	0	80	53	48	95	94	94	73	58	68	23
triflusulfuron /	0.019 /														
efs&dmp&pmp +	0.33 +	5/30													
triflusulfuron /	0.019 /														
efs&dmp&pm +	0.33 +	6/5													
triflusulfuron	0.019														
Efs&dmp&pmp +	0.42 +	5/18	0	0	0	88	82	66	94	95	94	91	80	78	28
triflusulfuron /	0.023 /														
efs&dmp&pmp +	0.33 +	5/30													
triflusulfuron /	0.019 /														
efs&dmp&pmp +	0.33 +	6/5													
triflusulfuron	0.019														
Efs&dmp&pmp +	0.42 +	5/18	0	0	0	86	83	60	93	94	88	84	65	70	27
triflusulfuron /	0.023 /														
efs&dmp&pmp +	0.42 +	5/30													
triflusulfuron /	0.023 /														
efs&dmp&pmp +	0.42 +	6/5													
triflusulfuron	0.023														
Efs&dmp&pmp +	0.42 +	5/30	0	0	0	93	75	65	95	93	91	66	55	53	32
triflusulfuron /	0.023 /														
efs&dmp&pmp +	0.42 +	6/5													
triflusulfuron /	0.023 /														
efs&dmp&pmp +	0.42 +	6/8													
triflusulfuron	0.023														
Efs&dmp&pmp +	0.5 +	6/5	0	0	0	95	90	83	96	99	93	86	70	68	28
triflusulfuron /	0.026 /														
efs&dmp&pmp +	0.42 +	6/8													
triflusulfuron /	0.023 /														
efs&dmp&pmp +	0.42 +	6/11													
triflusulfuron	0.023														
Efs&dmp&pmp +	0.5 +	6/5	0	0	0	90	85	70	91	95	88	79	60	63	24
triflusulfuron /	0.026 /														
efs&dmp&pmp +	0.5 +	6/8													
triflusulfuron /	0.026 /														
efs&dmp&pmp +	0.5 +	6/11													
triflusulfuron	0.026														
LSD (0.05)			NS	NS	NS	9	16	24	NS	NS	NS	NS	NS	NS	6

[1]Weed species evaluated were redroot pigweed (AMARE), common lambsquarters (CHEAL), and kochia (KCHSC).
[2]Efs&dmp&pmp is a commercial formulation of ethofumesate & desmedipham & phenmedipham.
[3]Application date corresponds to the following application stage of crop: 5/8 = cotyledon, 5/18 = 1 to 2 leaf, 5/30 = 2 to 3 leaf, 6/5 = 3 to 4 leaf, 6/8 3 to 4 leaf, 6/11 = 4 to 5 leaf.

Sugar beet tolerance to postemergence dimethenamid applications. Don W. Morishita and Michael J. Wille. (Twin Falls Research and Extension Center, University of Idaho, Twin Falls, ID 83303-1827). Dimethenamid has shown promise in previous research to effectively control a broad range of grass and broadleaf weeds in sugar beet. With the introduction of the single isomer of dimethenamid (BAS 656 07 H), a study was initiated to evaluate the tolerance of sugar beet ('WS PM9') to this herbicide. The study was conducted at the University of Idaho Research and Extension Center near Kimberly, Idaho under sprinkler irrigation. Soil type at this site was a silt loam with 1.65% organic matter, pH 8.3, and CEC of 20 meq/100 g soil. Sugar beets were planted April 22, 1998, at a rate of 47,529 seed/A, 0.75-inch deep on 22-inch row spacing. Experimental design was a randomized complete block with four replications and each plot was 4-rows by 30-feet. Herbicides were applied with a CO_2-pressurized bicycle-wheel sprayer calibrated to deliver 20 gpa in a 10-inch band using 8002 even fan nozzles. Due to an error in the original calculation of BAS 656 07 H application rate, a sequential application of BAS 656 07 H was made 17 days after the original application. Additional application information and weed species density is presented in Table 1. Crop injury and weed control was evaluated visually June 17 and July 2. Sugar beets were harvested October 9 with a mechanical harvester.

Table 1. Application information and weed species densities.

Application timing (crop growth stage)	Cotyledon	1 to 2 leaf	3 to 4 leaf
Application date	5/8	5/18	6/5
Air temperature (F)	71	6	62
Soil temperature (F)	68	66	50
Relative humidity (%)	38	34	64
Wind velocity (mph)	7	3	6
Weed species density		plants/ft^2	
Redroot pigweed	7	5	8
Common lambsqsuarters	<1	<1	2
Kochia	<1	<1	<1

Dimethenamid at 2.34 lb/A minimally injured the sugar beets 3%. Conversely, BAS 656 07 H at rates from 1.28 to 2.56 lb/A injured the crop 23 to 30% at the first evaluation (Table 2). By the second evaluation, crop injury from these same treatments had decreased and ranged from 10 to 23%. Overall weed control was best when BAS 656 07 H was applied in combination with desmedipham & phenmedipham with or without triflusulfuron. Redroot pigweed, common lambsquarters, and kochia control averaged 96 to 99% at the first evaluation date. Sugar beet yields of treatments with BAS 656 07 H applied at 1.28 lb/A or higher were not affected adversely by the injury observed at either evaluation date. Yields of the lowest applied rate of BAS 656 07 H and dimethenamid were greater than the handweeded check. The handweeded check however, was not weeded until after the second visual evaluation (July 2).

Table 2. Sugar beet tolerance to dimethenamid applied postemergence.

Treatment[3]	Rate	Applic.[2] date	Crop injury 6/17	Crop injury 7/2	Weed control[1] AMARE 6/17	AMARE 7/2	CHEAL 6/17	CHEAL 7/2	KCHSC 6/17	KCHSC 7/2	Yield
	lb/A		%								ton/A
Handweeded check			-	-	-	-	-	-	-	-	30
Dmp&pmp / dimethenamid	0.25 / 2.34	5/8 5/18	3	3	93	95	93	85	90	75	39
Dmp&pmp / BAS 656 07 H	0.25 / 0.64	5/8 5/18 & 6/5	5	10	93	93	93	70	89	63	42
Dmp&pmp / BAS 656 07 H	0.25 / 1.28	5/8 5/18 & 6/5	30	18	43	13	46	13	44	13	39
Dmp&pmp / BAS 656 07 H	0.25 / 2.56	5/8 5/18 & 6/5	23	18	93	75	91	65	83	55	36
Dmp&pmp / dmp&pmp + BAS 656 07 H	0.25 / 0.25 + 2.56	5/8 5/18 5/18 & 6/5	25	10	100	98	100	96	100	83	35
Dmp&pmp / dmp&pmp + triflusulfuron + BAS 656 07 H	0.25 / 0.25 + 0.25 + 2.56	5/8 5/18 5/18 & 6/5	25	23	99	99	96	95	99	88	32
LSD (0.05)			18	NS	30	35	33	40	33	34	7

[1]Weed species evaluated were redroot pigweed (AMARE), common lambsquarters (CHEAL) and kochia (KCHSC).
[2]Application date corresponds to the following application stage of crop: 5/8 = cotyledon, 5/18 = 1 to 2 leaf, 6/5 = 3 to 4 leaf.
[3]Dmp&pmp is a commercial formulation of desmedipham and phenmedipham.

Effect of glufosinate application rate, method, and spray volume on weed control in sugar beet. Don W. Morishita and Michael J. Wille. (Twin Falls Research and Extension Center, University of Idaho, Twin Falls, ID 83303-1827). Glufosinate was evaluated for weed control in Liberty-Linked® sugar beet at the University of Idaho Research and Extension Center near Kimberly, Idaho. Sugar beets ('8455 LL') were planted 0.75 inch deep April 22, 1998, at a rate of 142,560 seed/A on 22-inch row spacing and grown under sprinkler irrigation. Soil type was a silt loam with 1.65% organic matter, pH 8.3, and CEC of 20 meq/100 g soil. Herbicides were applied with a CO_2-pressurized bicycle-wheel sprayer. Application methods compared were broadcast, even band, and twinjet band. Broadcast applications were applied with flat fan nozzles at 10 and 20 gpa and both band applications were applied at 20 gpa. All band applications were 10-inches wide. Additional application information and weed densities are in Table 1. Experimental design was a randomized complete block with four replications. Individual plots were 4-rows by 30-feet. Sugar beets were thinned by hand to a 4-inch spacing June 11. Crop injury and weed control evaluations were taken 7 and 28 days after treatment (DAT). The two center rows of each plot were harvested with a mechanical harvester October 8.

Table 1. Application information and weed species densities.

Application timing	<1 inch weeds	+ 7 days	+ 7 days	+ 7 days
Application date	5/8	5/19	6/1	6/8
Air temperature (F)	71	80	72	64
Soil temperature (F)	68	65	62	62
Relative humidity (%)	38	31	20	52
Wind velocity (mph)	8	6	5	6
Weed species density		plants/ft^2		
Redroot pigweed	11	18	29	21
Common lambsquarters	1	2	3	2
Kochia	<1	2	1	1
Hairy nightshade	4	7	8	6
Annual sowthistle	10	20	29	25
Common mallow	<1	1	3	2
Barnyardgrass	7	0	21	15

None of the glufosinate treatments injured the crop more than 4% (Table 2). All broadcast applications controlled the weeds 94 to 100% 7 DAT. At 28 DAT, broadcast applications controlled all weeds 91 to 100% with the exception of glufosinate applied at 20 gpa and 0.268 lb/A. This treatment controlled common lambsquarters and kochia 80 and 77%, respectively. With the even band nozzles all weeds except common mallow were controlled 96 to 100% 7 DAT and 92 to 100% 28 DAT. Common mallow control with the even band nozzles averaged 90 to 92% at 0.268 lb/A. Overall, weed control with the twinjet nozzles was lowest. However, the control ranged from 87 to 100% 7 DAT, and decreased to as low as 74% control of common lambsquarters 28 DAT. Weed control with ethofumesate & phenmedipham & desmedipham + triflusulfuron applied three times ranged from 90 to 100% for all weeds at both evaluation dates. Sugar beet yields among all herbicide treatments ranged from 31 to 37 ton/A and were all significantly higher than the untreated check, which yielded 13 ton/A. Results from this study show no difference in weed control between broadcast and even band applications. This is in contrast to our 1997 study which showed that weed control with even band applications was not as good as broadcast applications.

Table 2. Glufosinate rate, application method, and spray volume effect on crop injury, weed control, and yield in sugar beet.

					Weed control[1]														
		Applic.	Crop injury		AMARE		CHEAL		SOLSA		SONOL		KCHSC		ECHCG		MALNE		
Treatment[2]	Rate	date[3]	6/15	7/8	6/15	7/8	6/15	7/8	6/15	7/8	6/15	7/8	6/15	7/8	6/15	7/8	6/15	7/8	Yield
	lb/A		%																ton/A
Check			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	13
Glufosinate broadcast @ 10 gpa /	0.268/	5/19	1	0	100	100	99	97	100	100	100	100	96	91	100	100	100	100	
glufosinate /	0.268/	6/1																	
glufosinate	0.268	6/8																	
Glufosinate broadcast @ 10 gpa /	0.357/	5/19	0	0	100	100	99	96	100	100	100	100	99	99	100	100	100	100	37
glufosinate /	0.357/	6/1																	
glufosinate	0.357	6/8																	
Glufosinate broadcast @ 20 gpa /	0.268/	5/19	3	0	98	94	95	80	99	100	100	100	94	77	100	100	98	98	36
glufosinate /	0.268/	6/1																	
glufosinate	0.268	6/8																	
Glufosinate broadcast @ 20 gpa /	0.357/	5/19	0	3	100	100	100	98	100	100	100	100	100	100	100	100	100	100	34
glufosinate /	0.357/	6/1																	
glufosinate	0.357	6/8																	
Glufosinate even band /	0.268/	5/19	0	0	99	96	97	98	100	96	100	98	100	97	98	96	92	90	37
glufosinate /	0.268/	6/1																	
glufosinate	0.268	6/8																	
Glufosinate even band /	0.357/	5/19	4	1	100	96	99	92	100	100	100	99	100	100	100	100	100	100	35
glufosinate /	0.357/	6/1																	
glufosinate	0.357	6/8																	
Glufosinate twinjet band /	0.268/	5/19	1	0	88	85	87	74	93	100	99	96	90	81	98	100	93	96	34
glufosinate /	0.268/	6/1																	
glufosinate	0.268	6/8																	
Glufosinate twinjet band /	0.357/	5/19	1	0	94	93	88	81	98	96	100	99	91	89	100	99	89	87	31
glufosinate /	0.357/	6/1																	
glufosinate	0.357	6/8																	
Efs&dmp&pmp +	0.33 +	5/8	8	1	100	95	100	98	100	100	100	100	95	98	100	100	95	90	32
triflusulfuron even band /	0.25/																		
efs&dmp&pmp +	0.33 +	5/19																	
triflusulfuron /	0.25/																		
efs&dmp&pmp +	0.33 +	6/1																	
triflusulfuron	0.25																		
LSD (0.05)			4	3	7	11	11	21	7	4	1	4	10	22	3	4	13	13	6

[1]Weed species evaluated were redroot pigweed (AMARE), common lambsquarters (CHEAL), hairy nightshade (SOLSA), annual sowthistle (SONOL), kochia (KCHSG), barnyard grass (ECHCG), and common mallow (MALNE).

[2]Efs&dmp&pmp is a commercial formulation of ethofumesate, desmedipham and phenmedipham.

[3]Application date corresponds to the following application stage of weeds: 5/8 = Cotyledon, 5/9 = <1-inch tall weeds, 5/19 = 7 days later, 6/1 = 14 days after <1-inch application.

Effect of glufosinate application rate and timing on weed control in sugar beet. Michael J. Wille and Don W. Morishita. (Twin Falls Research and Extension Center, University of Idaho, Twin Falls, ID 83303-1827). A study was established at the University of Idaho Research and Extension Center near Kimberly to evaluate postemergence weed control in glufosinate-resistant sugar beets with glufosinate applied at two different rates and application timings. The experimental design was a randomized complete block with four replications. Individual plots were four rows by 30 ft. The soil type was a Portneuf silt loam (14% sand, 54% silt, 23% clay, pH 8.3, 1.6% organic matter, 20-meq/100 g soil CEC). Sugar beet ('8455 LL') was seeded at a density of 142,560 seed/A in rows 22-inches apart April 22, 1998. Seedlings were thinned to a spacing of four inches. Kochia, redroot pigweed, common lambsquarters, hairy nightshade, and annual sowthistle were the major weed species present. Glufosinate was applied at either 0.268 or 0.357 lb/A, with and without 3 lb ammonium sulfate (AMS)/A, beginning when weeds were either 1-nch (early timing) or 3-inches (late timing) high and at 7 to 14-day intervals, thereafter. Ethofumesate & desmedipham & phenmedipham was included as a standard herbicide treatment. All herbicide treatments were broadcast-applied, except ethofumesate & desmedipham & phenmedipham which was applied in a 10-inch band, with a CO_2-pressurized bicycle-wheel sprayer calibrated to deliver 20 gpa at 40 psi. Application information and weed species densities are given in Table 1. Crop injury and weed control were evaluated 1 and 4 weeks after the last herbicide application on June 26 and July 17. Sugar beets were harvested from the middle two rows of each plot October 8.

No herbicide treatment injured the crop (Table 2). All herbicide treatments controlled kochia >90% at both evaluation dates except glufosinate at 0.375 lb/A + AMS (late timing) which controlled kochia 80 to 88%. Common lambsquarters was controlled ≥89% with all herbicide treatments except glufosinate at 0.375 lb/A + AMS (late timing) which controlled kochia 86 and 68% on June 26 and July 17, respectively; and glufosinate alone at 0.268 lb/A (late timing) which controlled common lambsquarters 75% on July 17. Redroot pigweed control was ≥95% with all herbicides except glufosinate at 0.375 lb/A + AMS (late timing) which was slightly lower (91%) at the first evaluation only. Hairy nightshade, and annual sowthistle was controlled 100% by all herbicide treatments. Sugar beet yield with glufosinate at 0.357 lb/A + AMS (early timing) was significantly greater than the standard herbicide treatment or the untreated check. Sugar beet yields with all other herbicide treatments were similar to each other and greater than the untreated check.

Table 1. Application information and weed species densities.

Application timing (BEAVU)	cotyledon	1 to 2 leaf	2 to 3 leaf	3 to 4 leaf	4 to 5 leaf
Application date	5/8	5/19	6/1	6/8	6/18
Air temperature (F)	72	80	72	64	67
Soil temperature (F)	68	65	62	62	60
Relative humidity (%)	38	31	26	52	62
Wind velocity (mph)	8	6	6	6	2
Weed species density			plants/ft2		
Redroot pigweed (AMARE)	5	7	8	10	9
Common lambsquarters (CHEAL)	<1	1	<1	<1	<1
Kochia (KCHSC)	3	1	<1	<1	<1
Hairy nightshade (SOLSA)	2	8	8	8	7
Annual sowthistle (SONOL)	2	5	9	9	5

Table 2. Effect of gluphosinate application rate and timing on sugar beet injury, weed control, and root yield near Kimberly, ID.

					Weed control[1]										
		Appl.	Crop injury		KCHSC		AMARE		CHEAL		SOLSA		SONOL		
Treatment	Rate	date[2]	6/26	7/17	6/26	7/17	6/26	7/17	6/26	7/17	6/26	7/17	6/26	7/17	Yield
	lb/A		%												ton/A
Check			-	-	-	-	-	-	-	-	-	-	-	-	13
Glufosinate/	0.268/	5/19	0	0	100	100	100	100	99	100	100	100	100	100	34
glufosinate/	0.268/	6/1													
glufosinate	0.268	6/8													
Glufosinate/	0.357/	5/19	0	0	100	100	100	100	100	100	100	100	100	100	35
glufosinate/	0.357/	6/1													
glufosinate	0.357	6/8													
Glufosinate + AMS[3]/	0.268/	5/19	0	0	100	100	100	100	98	99	100	100	100	100	28
glufosinate + AMS/	0.268/	6/1			b										
glufosinate + AMS	0.268	6/8													
Glufosinate + AMS/	0.357/	5/19	0	0	100	100	100	100	100	100	100	100	100	100	37
glufosinate + AMS/	0.357/	6/1													
glufosinate + AMS	0.357	6/8													
Glufosinate/	0.268/	6/1	0	0	99	93	100	98	100	75	100	100	100	100	33
glufosinate/	0.268/	6/8													
glufosinate	0.268	6/18													
Glufosinate/	0.357/	6/1	0	0	99	93	100	100	98	89	100	100	100	100	29
glufosinate/	0.357/	6/8													
glufosinate	0.357	6/18													
Glufosinate + AMS/	0.268/	6/1	0	0	98	96	100	98	100	91	100	100	100	100	36
glufosinate + AMS/	0.268/	6/8													
glufosinate + AMS	0.268	6/18													
Glufosinate + AMS/	0.357/	6/1	0	0	88	80	91	95	86	68	100	100	100	100	32
glufosinate + AMS/	0.357/	6/8													
glufosinate + AMS	0.357	6/18													
Efs&dmp&pmp[4]/	0.33/	5/8	0	0	100	93	100	99	100	98	100	100	100	100	23
efs&dmp&pmp/	0.33/	5/19													
efs&dmp&pmp	0.33	6/1													
LSD (0.05)			NS	NS	6	10	1	NS	3	11	NS	NS	NS	NS	11

[1]Weeds evaluated for control were kochia (KCHSC), redroot pigweed (AMARE), common lambsquarters (CHEAL), hairy nightshade (SOLSA), and annual sowthistle (SONOL).

[2]Application dates correspond to the following weed growth stages: 5/8 = cotyledon, 5/19 = 1 to 2 leaf, 6/1 = 3 to 4 leaf, 6/18 = 4 to 5 leaf.

[3]AMS = ammonium sulfate added at the rate of 3 lb/A.

[4]Efs&dmp&pmp is a commercial formualtion of ethofumesate & desmedipham & phenmedipham.

Broadleaf weed control in glyphosate-resistant sugar beet. Don W. Morishita and Michael J. Wille. (Twin Falls Research and Extension Center, University of Idaho, Twin Falls, ID 83303-1827). A study was established to evaluate weed control in Roundup-Ready® sugar beet with sequential glyphosate applications and glyphosate applied in combination with other herbicides. Sugar beet ('RR Pillar') was planted May 7, 1998, at the University of Idaho Research and Extension Center near Kimberly, Idaho and grown under sprinkler irrigation. Seeding rate and depth was 95,040 seed/acre and 0.75-inch, respectively. Sugar beet was hand-thinned at approximately the 6-leaf stage. The experiment was established as a randomized complete block design with four replications and individual plots were 4-rows by 30-feet. Herbicides were applied with a CO_2-pressurized bicycle-wheel sprayer calibrated to deliver 20 gpa in a 10-inch band using 8001 even fan nozzles. Soil type was a silt loam with 1.65% organic matter, pH 8.3 and CEC of 20 meq/100 g soil. Additional application information and weed species composition is given in Table 1. Crop injury and weed control were evaluated visually August 4 and 24. The two center rows from each plot were harvested with a mechanical harvester October 8.

Table 1. Application information and weed species densities.

Application timing	Cotyledon	1 to 2 leaf	2 to 3 leaf	3 to 4 leaf	4 to 5 leaf	16 leaf	22 leaf	>25 leaf
Application date	5/8	5/18	6/1	6/8	6/20	7/8	7/18	7/27
Air temperature (F)	71	66	72	70	78	70	94	76
Soil temperature (F)	68	66	62	68	68	60	80	70
Relative humidity (%)	38	66	26	64	26	48	31	66
Wind velocity (mph)	7	3	6	4	3	3	4	<1
Weed species density	plants/ft^2							
Redroot pigweed (AMARE)	3	8	6	6	-	-	-	-
Common lambsqsuarters (CHEAL)	<1	<1	<1	<1	-	-	-	-
Kochia (KCHSC)	<1	<1	<1	<1	-	-	-	-
Hairy nightshade (SOLSA)	3	5	3	2	-	-	-	-
Annual sowthistle (SONOL)	<1	<1	<1	<1	-	-	-	-

None of the herbicide treatments injured the sugar beets (Table 2). All herbicide treatments consistently controlled redroot pigweed, common lambsquarters, kochia, hairy nightshade, and annual sowthistle 95 to 100% at both evaluation dates. Sugar beet yield of the herbicide treatments ranged from 30 to 35 ton/A. These were all significantly greater than the untreated check, which yielded 12 ton/A. Based on these data, it appears that a single application of glyphosate plus CGA-77102, BAS 656 07 H, or ethofumesate applied at the sugar beet 4 to 5-leaf stage shows promise for allowing growers to control weeds with a single herbicide application.

Table 2. Crop injury, weed control, and root yield in glyphosate resistant sugar beets, near Kimberly, Idaho.

					Weed control[1]											
		Application	Crop injury		AMARE		CHEAL		KCHSC		SOLSA		SONOL			
Treatment	Rate	date[2]	8/4	8/24	8/4	8/24	8/4	8/24	8/4	8/24	8/4	8/24	8/4	8/24	Yield
	lb/A		---%												ton/A
Check			-	-	-	-	-	-	-	-	-	-	-	-	12
Glyphosate /	0.75 /	5/18	0	0	99	100	99	100	100	96	100	100	100	100	34
glyphosate /	0.75 /	6/1													
glyphosate	0.75	6/8													
Glyphosate /	0.75 /	5/18	0	0	100	100	100	100	100	100	100	100	100	100	35
glyphosate /	0.75 /	6/8													
glyphosate	0.75	6/20													
Glyphosate /	0.75 /	5/18	0	0	99	100	100	100	100	100	100	100	100	100	30
glyphosate	0.75	7/8													
Glyphosate /	0.75 /	6/20	0	0	100	100	100	100	100	100	100	100	100	100	31
glyphosate /	0.75 /	7/8													
glyphosate	0.75	7/18													
Glyphosate /	0.75 /	6/20	0	0	100	100	100	100	100	100	100	100	100	100	31
glyphosate	0.75	7/27													
Glyphosate +	0.75 +	6/20	0	0	99	100	99	100	100	100	100	100	100	100	35
CGA-77102	2.47														
Glyphosate +	0.75 +	6/20	0	0	96	95	98	99	100	100	100	100	100	100	32
BAS 656 07 H	0.64														
Glyphosate +	0.75 +	6/8	0	0	100	100	100	100	100	100	100	100	100	100	33
ethofumesate	1.12														
Ethofumesate /	1.12 /	5/8	0	0	100	99	100	100	100	100	100	100	100	100	32
glyphosate +	0.75 +	6/8													
glyphosate	0.75	6/20													
Ethofumesate /	1.12 /	5/8	0	0	95	98	100	100	100	99	100	100	100	100	31
efs&dmp&pmp[3] +	0.25 +	6/1													
triflusulfuron /	0.25 /														
efs&dmp&pmp +	0.25 +	6/1													
triflusulfuron	0.25														
LSD (0.05)			NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	5

[1]Weed species evaluated were redroot pigweed (AMARE), common lambsquarters (CHEAL), kochia (KCHSC), hairy nightshade (SOLSA), and annual sowthistle (SONOL).

[2]Application date corresponds to the following application stage of crop: 5/8 = preemergence, 5/18 = cotyledon, 6/1 = 2 to 3 leaf, 6/8 = 3 to 4 leaf, 6/20 =4 to 5 leaf, 7/8 = 16 leaf, 7/18 = 22 leaf, and 7/27 = >25 leaf.

[3]Efs&dmp&pmp is a commercial formulation of ethofumesate, desmedipham and phenmedipham.

Seedling Kentucky bluegrass variety tolerance to primisulfuron. Traci A. Rauch and Donald C. Thill. (Plant Science Division, University of Idaho, Moscow, ID 83844-2339) A study was established at the Plant Science Farm near Moscow, ID to evaluate seedling tolerance of different Kentucky bluegrass varieties to rates of primisulfuron. The experimental design was a split-plot with four replications. Main plots were eight bluegrass varieties (16 by 16 ft) and subplots were three rates of primisulfuron (4 by 16 ft). An untreated check was included for comparison with each variety. Bluegrass varieties were seeded on May 8, 1997 using a cone seeder with five rows on seven inch spacing. Herbicide treatments were applied on June 10, 1997 with a CO_2 pressurized backpack sprayer delivering 10 gpa at 30 psi (Table 1). Bluegrass injury was evaluated visually on June 25, 1997. Bluegrass panicle number was counted in a 0.7ft^2 area and bluegrass seed was harvested by hand from a 2.7 ft^2 area at variety maturity during summer 1998 (first seed crop).

Table 1. Application and soil data.

Bluegrass stage	1 to 3 leaves
Air temp (F)	60
Relative humidity (%)	61
Wind	Calm
Cloud cover (%)	80
Soil temp at 2 inches (F)	64
Soil texture	silt loam
pH	6.3
OM%	4.0

All herbicide rates applied to all bluegrass varieties injured seedling bluegrass 2 to 20% (Table 2). Bluegrass injury averaged over variety increased from 6 to 13% with primisulfuron rate. The main effect, variety, was not significant for injury. Primisulfuron, averaged over rate, injured Blue Chip and Palouse varieties 12%, while Award was injured only 5%. Bluegrass panicle number and yield were affected by variety but not herbicide rate (Table 3 and 4). Award, Caliber, and Odyssey had a greater number of panicles than Blue Chip and NuBlue, when averaged over herbicide rate. Seed yield for Caliber was greater than all other varieties, when averaged over herbicide rate.

Table 2. The effect of Kentucky bluegrass variety and primisulfuron rate on seedling bluegrass injury in 1997.

Variety[a]	Primisulfuron rate 0.0145 lb/A	0.029 lb/A	0.058 lb/A	*Mean*
	% injury			
Award	2	5	9	*5*
Blue Chip	8	9	20	*12*
Caliber	7	6	9	*7*
Classic	5	12	15	*11*
NuBlue	5	10	18	*11*
Odyssey	8	5	12	*8*
Palouse	8	12	18	*12*
South Dakota	6	6	11	*8*
Mean[b]	*6a*	*7a*	*13b*	

[a]The rate by variety interaction was not significant.
[b]Treatment means with different letters are significant at the P<0.05.

Table 3. The effect of Kentucky bluegrass variety and primisulfuron rate on bluegrass panicle number in 1998.

Variety[a]	0	Primisulfuron rate 0.0145 lb/A	0.029 lb/A	0.058 lb/A	*Mean*[b]
	panicle no./ ft^2				
Award	240	262	296	368	*311a*
Blue Chip	167	175	181	152	*169c*
Caliber	355	266	320	303	*311a*
Classic	190	222	214	263	*222bc*
NuBlue	189	191	154	214	*187c*
Odyssey	334	247	277	316	*294a*
Palouse	230	360	282	216	*272ab*
South Dakota	190	242	243	185	*215bc*
Mean	*237*	*255*	*246*	*252*	

[a]The rate by variety interaction was not significant.
[b]Treatment means with different letters are significant at the P<0.05.

Table 4. The effect of Kentucky bluegrass variety and primisulfuron rate on bluegrass seed yield in 1998.

Variety[a]	0	Primisulfuron rate 0.0145 lb/A	0.029 lb/A	0.058 lb/A	*Mean*[b]
	yield lb/A				
Award	666	849	819	650	*746b*
Blue Chip	682	795	468	626	*643b*
Caliber	1307	1170	1219	1231	*1232a*
Classic	794	823	790	992	*850b*
NuBlue	613	808	925	863	*802b*
Odyssey	1060	923	829	724	*884b*
Palouse	650	750	612	678	*673b*
South Dakota	614	738	813	766	*733b*
Mean	*798*	*857*	*810*	*816*	

[a]The rate by variety interaction was not significant.
[b]Treatment means with different letters are significant at the P<0.05.

Downy brome control with pendimethalin, metolachlor, and primisulfuron in Kentucky bluegrass. Traci A. Rauch and Donald C. Thill. (Plant Science Division, University of Idaho, Moscow, ID 83844-2339) A study was established near Nezperce, Idaho in 3 year old 'Palouse' Kentucky bluegrass to evaluate downy brome control and Kentucky bluegrass yield with pendimethalin, metolachlor, and primisulfuron. Plots were 8 by 20 ft arranged in a randomized complete block with four replications. All herbicide treatments were applied with a CO_2 pressurized backpack sprayer calibrated to deliver 10 gpa at 30 psi and 3 mph (Table 1). Kentucky bluegrass injury was evaluated visually on October 13, 1997 and April 9, 1998. Downy brome control was evaluated on October 13,1997, and May 6 and 29, 1998. Bluegrass seed was harvested by hand from a 2.7 ft^2 area in each plot on July 13, 1998.

Table 1. Application data.

Application date	September 22, 1997	April 2, 1998
Bluegrass growth stage	vegetative, 1 to 2 inches tall	vegetative, 3 to 4 inches tall
Downy brome growth stage	1 leaf	2 to 4 leaf
Air temp (F)	80	45
Relative humidity (%)	60	70
Wind (mph, direction)	4, NW	3, NW
Cloud cover (%)	0	100
Soil temperature at 2 in (F)	60	44
pH	5.4	
OM (%)	5.4	
CEC (meq/100g)	30.9	
Texture	silt loam	

No treatment injured Kentucky bluegrass (data not shown). Metolachlor + primisulfuron (1.25 + 0.018 lb/A) and primisulfuron alone (both rates) controlled downy brome 69 to 80%. All other treatments suppressed downy brome 38 to 62%. Plots treated with metolachlor + primisulfuron (1.25 + 0.036 lb/A) had the highest yield at 874 lb/A, while plots treated with pendimethalin at 2.0 lb/A had the lowest yield (424 lb/A). Seed yield for all treatments did not differ from the untreated check.

Table 2. Downy brome control and Kentucky bluegrass yield with pendimethalin, metolachlor and primisulfuron.

Treatment[a]	Rate	Application timing	Downy brome control	Kentucky bluegrass yield
	lb/A		%	lb/A
Pendimethalin	1.65	1 leaf	50	662
Pendimethalin	2.0	1 leaf	38	424
Metolachlor	0.95	1 leaf	56	602
Metolachlor	1.25	1 leaf	48	570
Pendimethalin + metolachlor	1.65 + 0.95	1 leaf + 1 leaf	54	658
Pendimethalin + metolachlor	1.65 + 1.25	1 leaf + 1 leaf	50	779
Pendimethalin + metolachlor	2.0 + 0.95	1 leaf + 1 leaf	52	694
Pendimethalin + metolachlor	2.0 + 1.25	1 leaf + 1 leaf	45	589
Metolachlor + primisulfuron	0.95 + 0.018	1 leaf + 2 to 4 leaf	62	673
Metolachlor + primisulfuron	1.25 + 0.018	1 leaf + 2 to 4 leaf	79	492
Metolachlor + primisulfuron	0.95 + 0.036	1 leaf + 2 to 4 leaf	62	568
Metolachlor + primisulfuron	1.25 + 0.036	1 leaf + 2 to 4 leaf	58	874
Primisulfuron	0.018	2 to 4 leaf	80	637
Primisulfuron	0.036	2 to 4 leaf	69	733
Untreated check	--	--	--	625
LSD (0.05)			22	NS
plants/ft^2			46	

[a]All primisulfuron treatments applied with crop oil concentrate at 2 pint/A.

Chemical renovation of Kentucky bluegrass with glyphosate. Janice M. Reed, Jerry B. Swensen, Donald C. Thill, and Glen A. Murray. (Plant Science Division, University of Idaho, Moscow, ID 83844-2339) Two experiments were established in a five year-old stand of Kentucky bluegrass near Moscow, Idaho to evaluate chemical renovation of Kentucky bluegrass varieties with different rates of glyphosate. Kentucky bluegrass seed yield declines with age and high stand density may be partially responsible, especially when post-harvest residue is removed mechanically instead of by burning. Stand suppression and thinning with spring applied herbicides may renovate Kentucky bluegrass stands, and no-till planting of an annual crop in the suppressed Kentucky bluegrass may allow economic return during renovation. In 1997, the effect of glyphosate rate and Kentucky bluegrass variety on lentil seed yield was evaluated. In 1998, the effect of renovation with glyphosate on the re-establishment and subsequent seed yield of the Kentucky bluegrass varieties was evaluated. Both experiments were arranged as strip plot designs with four replications. The main plots for the first experiment were five rates of glyphosate (0.5, 0.75, 1, 1.25, and 1.5 lb/A), and five Kentucky bluegrass varieties (Adelphi, Glade, Liberty, South Dakota, Suffolk) were the sub-plots. Each sub-plot was 4 by 8 ft. The main plots for the second experiment were two rates of glyphosate (1 and 1.5 lb/A), and sixteen Kentucky bluegrass varieties were the sub-plots. Each sub-plot was 8 by 10 ft. Glyphosate treatments were applied April 8, 1997 with a CO_2 pressurized backpack sprayer calibrated to deliver 10 gpa at 40 psi (Table 1). 'Pardina' lentil was seeded at a rate of 52 lb/A using a no-till drill on May 14, 1997. Lentil seed was harvested from each sub-plot at maturity with a small plot combine on August 22 (experiment 2) and August 23, 1997 (experiment 1). Following lentil harvest, post-harvest residues were spread evenly over the plots. Typical fertilizer and weed control practices were used in the fall of 1997 and the spring of 1998. Kentucky bluegrass ground cover was evaluated visually on March 31, 1998, and heading date was evaluated from May to June, 1998. Panicle counts were taken from each plot at maturity. Each variety was swathed as it matured from June 25 to July 14, 1998. Plot samples were placed in cloth bags and hung to dry for 10 days, threshed and cleaned.

Table 1. Application data.

Bluegrass growth stage	Vegetative, 1 inch tall
Air temp (F)	53
Relative humidity (%)	59
Wind (mph)	3
Cloud cover (%)	80
Soil temp at 2 in. (F)	38

In experiment 1, 1997 lentil seed yield was highest with the two highest glyphosate rates and lowest with the two lowest glyphosate rates regardless of Kentucky bluegrass variety (Table 2). In experiment 2, yield tended to be higher from lentil seeded into earlier maturing Kentucky bluegrass varieties, while later maturing varieties had lower lentil yield (Table 3). Early maturing varieties were suppressed more by glyphosate due to greater vegetative growth, and thus were less competitive with the lentil crop. There was no variety by rate interaction in either experiment in 1997 and 1998.

In experiment 1, there was a tendency for Kentucky bluegrass percent ground cover to decrease as glyphosate rates increased from 0.5 to 1.5 lb/A (Table 2). Kentucky bluegrass panicle density was lowest with the 0.5 lb/A rate of glyphosate and highest with the 1.5 lb/A rate. Kentucky bluegrass seed yield ranged from 391 to 447 lb/A and was not affected by glyphosate rate.

The sixteen varieties in experiment 2 represent a range of Kentucky bluegrass maturity types (Table 3). However, actual maturity within a given growing season can be influenced by environmental and cultural factors. The effect of glyphosate on Kentucky bluegrass ground cover, panicle density, and seed yield was not different between glyphosate rates of 1 and 1.5 lb/A (data not shown). Kentucky bluegrass panicle density and percent ground cover were not related to seed yield. Kentucky bluegrass seed yield ranged from nearly 800 lb/A in Hunstsville and Suffolk (early maturing types) to less than 300 lb/A in Adelphi and Ram I (intermediate maturing types).

Table 2. The effect of glyphosate rate on lentil yield and Kentucky bluegrass ground cover, panicle density, and seed yield (experiment 1).

Glyphosate rate	Lentil yield [a]	Kentucky bluegrass [a] Ground cover [b]	Panicle density	Seed yield
lb/A	lb/A	%	no./ft^2	lb/A
0.5	590	76	213	409
0.75	570	71	237	403
1	757	59	232	438
1.25	818	60	222	391
1.5	816	63	255	447
LSD (0.05)	212	8	39	NS

[a] Values are means of five bluegrass varieties and four replications.
[b] Rated March 31, 1998

Table 3. The effect of Kentucky bluegrass variety on lentil yield and Kentucky bluegrass ground cover, panicle density, and seed yield (experiment 2).

Bluegrass variety	Lentil yield	Kentucky bluegrass [a] Maturity	Heading date	Ground [b] cover	Panicle density	Seed yield
	lb/A	type	Julian day	%	no/ft^2	lb/A
Argyle	1015	Early	125	63	190	761
Kenblue	1025	Early	125	64	180	644
South Dakota	957	Early	125	59	188	500
Huntsville	1064	Early	131	60	188	798
Newport	940	Early	131	69	234	671
Julia	893	Intermed	138	66	184	536
Wabash	877	Intermed	138	78	114	328
Cheri	743	Intermed	147	58	271	413
Liberty	569	Intermed	147	70	285	698
Ram I	662	Intermed	147	73	104	284
Baron	1024	Intermed	147	39	229	430
Adelphi	857	Intermed	147	68	226	291
Eclispse	791	Late	147	76	294	554
Suffolk	660	Late	147	81	369	784
Glade	768	Late	153	69	213	334
Midnight	754	Late	153	65	230	437
LSD (0.05)	267		—	14	79	144

[a] Values are means of two glyphosate rates (1 and 1.5 lb/A) and 4 replications.
[b] Rated May 12, 1998.

Optimum rate and application timing in glyphosate-tolerant canola. Brian M. Jenks and Tammy L. Ellefson. (North Central Research Extension Center, Minot, ND 58701). The objective was to evaluate the effect of different rates and application timings on crop tolerance and weed control. Canola was seeded May 15 into 7.5-inch rows at 700,000 pls/A in a conventional tillage system. Herbicide treatments consisted of early-post (June 6), mid-post (June 15), and late-post (June 22) applications. Individual plots were 10 by 30 ft and were arranged in a RCBD with three replications. All postemergence treatments were applied with 8001 flat fan nozzles delivering 10 gpa at 40 PSI. Canola was harvested with a small plot combine on August 18.

Soil conditions were very dry for the first 30 days after seeding (0.5 inch precip). We received 8 inches of rainfall the remainder of the growing season. Flea beetle population was high in surrounding fields, but there was little or no damage to the glyphosate-tolerant canola which had been treated with Gaucho. Wild oat control was excellent with all herbicide treatments. Any treatments receiving the late-post application caused lower leaves to turn a purplish color and also delayed flowering. Delayed flowering was not observed with the early- or mid-post applications. Yield decreased with later applications when glyphosate was applied at 16 or 32 fl oz alone. Weed competition and/or crop injury may have contributed to the yield decrease. A decreasing yield trend was not observed in the split applications of glyphosate.

Application date	June 6	June 15	June 22
Application timing	POST I	POST II	POST III
Temperature (°F)			
Air	56	58	65
Soil	58	65	61
Relative humidity (%)	42	38	66
Canola stage	2 to 3-leaf	4-leaf	6-leaf
Wild oat stage	3-leaf	4-leaf	6-leaf

Table. Optimum rate and application timing in glyphosate-tolerant canola.

Treatment	Rate	Timing	7-4 Wioa	8-11 Wioa	8-18 Yield
	lb/A		-----% Control-----		lb/A
untreated			0	0	1020
glyphosate + AMS	0.38 + 1%	Early	93	96	1655
glyphosate + AMS	0.38 +1%	Mid	96	98	1587
glyphosate + AMS	0.38 +1%	Late	97	99	1396
glyphosate + AMS	0.75 + 1%	Early	96	96	1761
glyphosate + AMS	0.75 + 1%	Mid	96	97	1618
glyphosate + AMS	0.75 + 1%	Late	98	99	1556
glyphosate + AMS / glyphosate + AMS	0.38 + 1% / 0.38 + 1%	Early / Mid	95	97	1605
glyphosate + AMS / glyphosate + AMS	0.38 + 1% / 0.38 + 1%	Early / Late	99	99	1585
glyphosate + AMS / glyphosate + AMS	0.38 + 1% / 0.38 + 1%	Mid / Late	98	99	1617
sethoxydim + clopyralid + MSO	0.2 + 0.188 + 2.5%	Mid	97	99	1719
quizalofop + NIS	0.055 + 0.25%	Early	91	93	1832
quizalofop + NIS	0.055 + 0.25%	Mid	94	96	1681
CV			2	1	22
LSD (0.05)			3	1	347

MSO = DASH from BASF
NIS = Class Preference from Cenex

Wild oat control in glufosinate-tolerant canola. Brian M. Jenks and Tammy L. Ellefson. (North Central Research Extension Center, Minot, ND 58701). The objective was to evaluate weed control in glufosinate-tolerant canola. Canola was seeded May 12 into 6-inch rows at 700,000 pls/A in a conventional tillage system. Herbicide treatments consisted of preplant incorporated, early-post (June 6), and late-post (June 15) applications. Individual plots were 10 by 30 ft and were arranged in a RCBD with three replications. PPI treatments were applied with 80015 flat fan nozzles delivering 20 gpa at 30 PSI. All postemergence treatments were applied with 8001 flat fan nozzles delivering 10 gpa at 40 PSI. Canola was harvested with a small plot combine on August 17.

Soil conditions were very dry for the first 30 days after seeding (0.5 inch precip). We received 8 inches of rainfall the remainder of the growing season. Flea beetle population was high during the dry period and damage was significant. No crop injury or maturity differences were observed with any herbicide treatment. All PPI or early-post treatments provided good wild oat control. However, control and yields were much higher when glufosinate was applied to 3-lf wild oat compared to 5-lf wild oat. Wild oat control was slightly higher with the split application of glufosinate compared to single applications. Canola yields were much higher by reducing early-season wild oat competition with either trifluralin, trifluralin + glufosinate, or glufosinate applied early-post. The addition of sethoxydim did increase wild oat control and canola yield. Kochia was present in the experimental area, but populations were not uniform and therefore not rated; however, kochia was controlled in glufosinate-treated plots.

Application date	May 5	June 6	June 15
Application timing	PPI	POST I	POST II
Temperature (°F)			
Air	61	59	72
Soil	64	62	70
Soil moisture	Dry	Dry	Moderate
Relative humidity (%)	33	38	34
Canola stage		2 to 3-leaf	4-leaf
Wild oat stage		3-leaf	5-leaf

Table. Wild oat control in glufosinate-tolerant canola.

Treatment	Rate	7-4 Wioa	8-11 Wioa	8-17 Yield
	lb/A	--------% Control	----------	lb/A
trifluralin	0.75	94	93	1380
trifluralin / endothall	0.75 / 0.56	89	90	1467
trifluralin / glufosinate	0.75 / 0.27	96	97	1801
trifluralin / glufosinate (Post II)	0.75 / 0.27	91	97	1754
glufosinate	0.27	79	87	1386
glufosinate + AMS	0.27 + 3	82	90	1381
glufosinate + sethoxydim + MSO	0.27 + 0.2 + 1.25%	94	93	1657
glufosinate	0.36	79	86	1474
glufosinate + AMS	0.36 + 3	88	83	1377
glufosinate	0.45	94	94	1720
glufosinate	0.89	94	94	1720
glufosinate / glufosinate (Post II)	0.27 / 0.27	96	95	1618
glufosinate (Post II)	0.27	68	67	842
glufosinate + MSO (Post II)	0.27 + 1.25%	77	70	1068
glufosinate (Post II)	0.36	65	55	999
glufosinate + AMS (Post II)	0.36 + 3	82	74	1306
glufosinate (Post II)	0.45	78	69	1059
glufosinate (Post II)	0.89	86	78	1400
hand-weeded + /		98	99	1710
trifluralin + /	0.75			
glufosinate	0.27			
weedy check		0	0	452
CV		9	8	28
LSD (0.05)		12	11	599

MSO = Class Destiny from Cenex

Wild oat control in imidazolinone-tolerant canola. Brian M. Jenks and Tammy L. Ellefson. (North Central Research Extension Center, Minot, ND 58701). The objective was to evaluate weed control in imidazolinone-tolerant canola. Canola was seeded May 15 into 6-inch rows at 700,000 pls/A in a conventional tillage system. Herbicide treatments consisted of preplant incorporated, early-post (June 8), and late-post (June 22) applications. Individual plots were 10 by 30 ft and were arranged in a RCBD with three replications. PPI treatments were applied with 80015 flat fan nozzles delivering 20 gpa at 30 PSI. All postemergence treatments were applied with 8001 flat fan nozzles delivering 10 gpa at 40 PSI. At planting, soil temperature was 56°F and soil was dry. Canola was harvested with a small plot combine on August 19.

Soil conditions were very dry for the first 30 days after seeding (0.5 inch precip). We received 8 inches of rainfall the remainder of the growing season. Flea beetle population was high during the dry period and damage was significant. Postemergence treatments were delayed due to cold temperatures and high winds. No crop injury or maturity differences were observed. All imazamox treatments provided good wild oat control. However, yields were much higher when imazamox was applied to smaller wild oat compared to larger wild oat. Canola yields were much higher when early-season wild oat competition was reduced with trifluralin, trifluralin + imazamox, or imazamox applied early-post. Although they appeared less competitive, a light population of ALS-resistant kochia was present in the plots and were standing above the crop at the end of the season.

Application date	May 12	June 8	June 22
Application timing	PPI	POST I	POST II
Temperature (°F)			
Air	65	60	67
Soil	62	57	65
Soil moisture	dry	dry	moderate
Relative humidity (%)	35	40	57
Canola stage		2 to 3-leaf	4 to 5-leaf
Wild oat stage		4-leaf	6-leaf

Table. Wild oat control in imidazolinone-tolerant canola.

Treatment	Rate	7-5 Wioa	8-12 Wioa	8-19 Yield
	lb/A	--% Control--		lb/A
trifluralin	0.75	75	68	1025
trifluralin / endothall	0.75 / 0.56	80	68	1182
trifluralin / imazamox + COC + 28% N	0.75 / 0.016 + 1.25% +1.25%	99	96	1553
trifluralin / imazamox + COC + 28% N	0.75 / 0.032 + 1.25% + 1.25%	98	99	1472
trifluralin / thifensulfuron + COC	0.75 / 0.023 + 1.25%	72	73	1068
imazamox + COC + 28% N	0.016 + 1.25% + 1.25%	95	98	1509
imazamox + NIS + 28% N	0.016 + 0.25% + 1.25%	89	88	1264
imazamox + COC + 28% N	0.032 + 1.25% + 1.25%	94	96	1299
imazamox + NIS + 28% N	0.032 + 0.25% + 1.25%	95	95	1441
imazamox + COC + 28% N	0.04 + 1.25% + 1.25%	96	99	1359
imazamox + NIS + 28% N	0.04 + 0.25% + 1.25%	97	98	1524
sethoxydim + imazamox + COC + 28% N	0.2 + 0.016 + 1.25% + 1.25%	95	98	1376
sethoxydim + imazamox + COC + 28% N	0.2 + 0.032 + 1.25% + 1.25%	96	99	1180
sethoxydim + clopyralid + COC + 28% N	0.2 + 0.125 + 1.25% + 1.25%	95	97	1471
quizalofop + thifensulfuron + NIS	0.055 + 0.023 + 0.25%	89	88	1182
imazamox + COC + 28% N (Post II)	0.032 + 1.25% + 1.25%	88	99	1164
imazamox + NIS + 28% N (Post II)	0.032 + 0.25% + 1.25%	85	98	1005
imazamox + COC + 28% N (Post II)	0.04 + 1.25% + 1.25%	90	99	1151
imazamox + NIS + 28% N (Post II)	0.04 + 0.25% + 1.25%	89	99	1042
hand-weeded + /		98	98	1649
trifluralin + /	0.75 + /			
imazamox + NIS + 28% N	0.032 + 0.25% + 1.25%			
weedy check		0	0	596
weedy check		0	0	585
CV		6	6	17
LSD (0.05)		8	8	333

COC= Class 17% Concentrate by Cenex
NIS= Class Preference by Cenex

Screening imidazolinone-resistant canola for sulfonylurea herbicide cross resistance. Curtis R. Rainbolt and Donald C. Thill. (Plant Science Division, University of Idaho, Moscow, ID 83844-2339) A study was established near Moscow, Idaho to evaluate sulfonylurea herbicide cross resistance in imidazolinone-resistant spring canola. Imi-Smart canola was seeded on April 30, 1998 at a rate of 10 lb/A into a silt loam soil (Table 1). The experimental design was a randomized complete block with four replications, and individual plot size was 8 by 20 ft. Herbicide treatments were applied post emergence on June 2, 1998 with a CO_2 pressurized backpack sprayer delivering 10 gpa at 32 psi (Table 1). Crop injury was evaluated visually on June 18 and June 29, 1998; and redroot pigweed (AMARE) control was evaluated on June 29, 1998. Canola was harvested at maturity with a small plot combine from a 4.1 by 17 ft area on August 20, 1998.

Table 1. Application and soil data.

Crop growth stage	2 to 3 leaf
Pigweed growth stage	1 to 2 inch diameter
Air temperature (F)	62
Relative humidity (%)	65
Wind (mph)	2
Cloud Cover (%)	5
Soil temperature at 2 in (F)	50
Soil texture	Silt loam
Sand (%)	18.4
Silt (%)	57.6
Clay (%)	24
Organic matter (%)	2.4
pH	5.7
CEC (meq/100g)	14.22

Quizalofop + thifensulfuron/tribenuron at the middle and high rates stunted the canola 3% 16 DAT, however the crop showed no signs of stunting by 27 DAT (Table 2). Control of redroot pigweed (AMARE) was excellent with all treatments and ranged from 97 to 98%. Canola yield ranged from 1470 to 1910 lb/A and no treatment differed statistically from the untreated check.

Table 2. Pigweed control, and canola yield data.

Treatment[a]	Rate	Canola injury 16 DAT	Canola injury 27 DAT	AMARE control	Canola yield
	lb/A	%	%	%	lb/A
Quizalofop + thifensulfuron	0.05 + 0.016	0	0	98	1700
Quizalofop + thifensulfuron	0.05 + 0.023	0	0	98	1700
Quizalofop + thifensulfuron	0.05 + 0.031	0	0	98	1640
Quizalofop + thifen/triben	0.05 + 0.013	0	0	98	1640
Quizalofop + thifen/triben	0.05 + 0.016	3	0	98	1580
Quizalofop + thifen/triben	0.05 + 0.019	3	0	98	1530
Nicosulfuron	0.023	0	0	97	1470
Nicosulfuron	0.031	0	0	98	1650
Nicosulfuron	0.046	0	0	98	1910
Untreated check	–	–	–	–	1660
LSD (0.05)				NS	310

[a] All treatments were applied with 90% NIS at 0.25% v/v.

Thifen/triben is the commercial formulation of thifensulfuron/tribenuron.

Broadleaf weed control and crop tolerance in imidazolinone-resistant canola. Traci A. Rauch and Donald C. Thill. (Plant Science Division, University of Idaho, Moscow, ID 83844-2339) Two studies in imidazolinone-resistant canola were established on the University of Idaho Plant Science Farm near Moscow, Idaho. Experiment one evaluated broadleaf weed control and canola response to imazamox. Plots were 8 by 21 ft arranged in a randomized complete block with four replications. Experiment two evaluated crop response of imidazolinone-resistant canola compared to 'Legend' canola at low rates of imazethapyr. The experimental design was a strip plot. Main plots were two canola varieties, 'Legend' and imidazolinone-resistant, (10.5 by 48 ft) and five herbicide treatments plus an untreated check (8 by 10.5 ft) were the sub-plots. All herbicide treatments were applied with a CO_2 pressurized backpack sprayer calibrated to deliver 10 gpa at 30 psi and 3 mph (Table 1). Canola injury for both experiments and weed control for experiment one were evaluated visually on June 18, 1998. Canola seed was harvested with a small plot combine from a 4 by 18 ft area (experiment one) and 4 by 7.5 ft area (experiment two) in each plot on August 20, 1998.

Table 1. Application data.

	Experiment one	Experiment two
Application date	June 2, 1998	April 29, 1998
Application timing	Postemergence	Preplant incorporated
Canola growth stage	2 to 4 leaf	--
Redroot pigweed growth stage	1 to 2 inches in diameter	--
Wild oat growth stage	2 to 4 leaf	
Interrupted windgrass growth stage	2 to 4 leaf	
Volunteer wheat growth stage	1 to 3 tiller	--
Air temp (F)	51	74
Relative humidity (%)	79	38
Wind (mph, direction)	0	1, SW
Cloud cover (%)	40	0
Soil temperature at 2 in (F)	55	62
pH	5.4	
OM (%)	3.2	
CEC (meq/100g)	20	
Texture	silt loam	

In experiment one, no treatment injured canola (data not shown). All rates of imazamox controlled redroot pigweed (AMARE), wild oat (AVEFA), and interrupted windgrass (APEIN) 99% (Table 2). Volunteer wheat (TRZAX) control ranged from 93 to 98% with imazamox. Canola seed yield did not differ from the untreated check for any herbicide treatment.

In experiment two, the interaction (herbicide treatment by canola variety) and the main effects (herbicide treatment and canola variety) were not significant for canola stand counts and seed yield, but all factors were significant for stand reduction (percent of the untreated check) (Table 3). Stand reduction was greater in 'Legend' canola than imidazolinone-resistant canola (15 vs. 0%) and generally increased with increasing imazethapyr rate in 'Legend' canola.

In both experiments, canola seed yield was low and variable. Cold, wet soil after planting and hot, dry weather during flowering adversely affected growth and yield.

Table 2. Weed control and canola seed yield in experiment one.

		Weed control				Canola
Treatment[a]	Rate	AMARE	AVEFA	APEIN	TRZAX	Yield
	lb/A	%				lb/A
Imazamox	0.024	99	99	99	93	950
Imazamox	0.032	99	99	99	93	987
Imazamox	0.040	99	99	99	98	949
Imazamox	0.048	99	99	99	94	1098
Imazamox	0.080	99	99	99	94	995
Untreated check	--	--	--	--	--	943
LSD (0.05)		NS	NS	NS	NS	NS
Plants/ft^2		15	2	1	1	

[a]All treatments were mixed with 32% UAN (urea ammonium nitrate) at 1 quart/A and 90% NIS (nonionic surfactant) at the 0.25% v/v.

Table 3. Canola stand counts, stand reduction as percent of the control and seed yield in experiment two.

Treatment	Rate	Canola			
		variety[a]	stand counts	stand reduction	yield
	lb/A		plants/ft^2	% of untreated check	lb/A
Imazethapyr	0.0007	Imi	10	0	1450
Imazethapyr	0.0015	Imi	9	0	1307
Imazethapyr	0.0029	Imi	10	0	1571
Imazethapyr	0.0059	Imi	8	0	1545
Imazethapyr	0.0118	Imi	11	0	1362
Untreated check	--	Imi	8	0	1585
Imazethapyr	0.0007	Legend	7	0	1109
Imazethapyr	0.0015	Legend	7	2	932
Imazethapyr	0.0029	Legend	7	10	1110
Imazethapyr	0.0059	Legend	6	45	958
Imazethapyr	0.0118	Legend	6	32	955
Untreated check	--	Legend	7	0	1224
LSD (0.05)			NS	11	NS

[a]Imi = imidazolinone-resistant canola

Efficacy and crop tolerance to quizalofop/ethametsulfuron combinations in canola. Brian M. Jenks and Tammy L. Ellefson. (North Central Research Extension Center, Minot, ND 58701). The objective was to evaluate weed control in imidazolinone-tolerant canola. Canola was seeded May 15 into 6-inch rows at 700,000 pls/A in a conventional tillage system. Herbicide treatments consisted of a single application timing for grass control in canola. Individual plots were 10 by 30 ft and were arranged in a RCBD with three replications. Postemergence treatments were applied with 8001 flat fan nozzles delivering 10 gpa at 40 PSI. Canola was harvested with a small plot combine on August 18.

Soil conditions were very dry for the first 30 days after seeding (0.5 inch precip). We received 8 inches of rainfall the remainder of the growing season. Flea beetle population was high during the dry period and damage was significant. No crop injury or maturity differences due to herbicide treatments were observed. Wild oat control with quizalofop alone was excellent (>96%) at both evaluations. Wild oat control was reduced slightly (5-10%) when quizalofop was tankmixed with ethametsulfuron. Increasing the quizalofop rate to overcome antagonism did not significantly raise percent weed control or canola yields in this study.

Application date	June 8
Application timing	POST
Temperature (°F)	
Air	60
Soil	57
Soil moisture	dry
Relative humidity (%)	60
Canola stage	3-leaf
Wild oat stage	4-leaf

Table. Efficacy and crop tolerance to quizalofop/ethametsulfuron combinations in canola.

Treatment	Rate	July 7 Wioa	August 10 Wioa	Aug 18 Yield
	lb/A	------------ % Control	-----------	lb/A
quizalofop + COC	0.055 + 1%	96	99	1381
quizalofop + COC	0.07 + 1%	97	99	1364
ethametsulfuron + COC	0.014 + 1%	66	73	1284
quizalofop + ethametsulfuron + COC	0.055 + 0.014 + 1%	86	95	1345
quizalofop + ethametsulfuron + COC	0.07 + 0.014 + 1%	89	92	1413
untreated		0	0	488
CV		11	8	14
LSD (0.05)		14	12	305

COC = Herbimax by Loveland

Evaluation of thiafluamide for annual weed control in corn. John O. Evans and R.William Mace. (Department of Plants, Soils and Biometeorology, Utah State University, Logan, Utah 84322-4820) Preplant incorporated treatments of thiafluamide and USA 1000, alone or in combination with other herbicides were applied to Heritage 2588 field corn for broadleaf and grass weed control. Plots were established near Smithfield, Utah on the Cleon Chambers farm. The soil type was Nibley silty clay loam with 7.6 pH and an OM content of less than 2%. Preplant treatments were established and corn planted May 20. Treatments were applied in a randomized block design, with three replications. The weeds evaluated were redroot pigweed (AMARE) and green foxtail (SETVI). Individual treatments were applied to 10 by 30 foot plots with a CO_2 backpack sprayer using flatfan 8002 nozzles providing a 10 foot spray width calibrated to deliver 25 gpa at 39 psi. Visual weed control evaluations were recorded June 19 and July 22. Plots were harvested September 28.

Corn injury was not observed in any treatment and excellent control of both redroot pigweed and green foxtail was recorded with all treatments. Yields were not significantly different among treatments. (Utah Agricultural Experiment Station, Logan, UT. 84322-4820)

Table. Evaluation of thiafluamide for pre-plant incorporated annual weed control in corn. Smithfield, UT. 1998.

		Corn		Weed Control			
		injury	Yield	AMARE		SETVI	
Treatment	Rate	6/19	9/28	6/19	7/22	6/19	7/22
	lb/A	--%--	T/A	%			
Check		0	34	0	0	0	0
Thiafluamide/ metribuzin	0.54	0	41	87	90	99	97
Thiafluamide/ metribuzin/ atrazine	1.5	0	33	100	100	99	98
Thiafluamide/ metribuzin/ atrazine + Isoxaflutole	1.5+ 0.035	0	42	99	99	100	100
Thiafluamide/ metribuzin/ atrazine	1.88	0	40	100	100	99	98
USA 1000	0.40	0	35	100	100	98	99
USA 1000	0.55	0	41	100	100	100	100
USA 1000+ atrazine	0.40+ 0.75	0	35	100	100	100	99
Thiafluamide/metribuzin+ isoxaflutole	0.54+ 0.058	0	39	100	99	99	99
Thiafluamide/metribuzin+ isoxaflutole	0.54+ 0.035	0	41	100	97	99	98
LSD(0.05)			9	2	5	2	4

Wild proso millet control in silage corn with selected PPI treatments. John O. Evans, Kevin Kelly, and R.William Mace. (Department of Plants, Soils, and Biometeorology, Utah State University, Logan, Utah 84322-4820) Wild proso millet (PANMI) is a very difficult weed to control in silage corn and expresses itself by significant yield reductions in this crop in Northern Utah. Several new herbicide formulations including isoxaflutole and new combinations of rimsulfuron, thifensulfuron, nicosulfuron, and atrazine were tested for wild proso millet control. Three different formulations of metolachlor were also evaluated for proso millet activity. All treatments were applied preplant incorporated.

Silage corn was planted May 29, 1998 on the Jensen farm near Nibley UT. The soil type was Nibley silty loam with 7.6 pH and O.M. content less than 2%. Treatments were applied and incorporated May 28, in three replications using a randomized block design. Individual treatments were applied to 10 by 30 foot plots with a CO_2 backpack sprayer using flatfan 8002 nozzles providing a 10 foot spray width calibrated to deliver 25 gpa at 39 psi. Visual evaluations for weed control and corn injury were completed July 27. The plots were harvested by collecting and weighing plants within 1.5 m^2 from the center of each plot on September 29.

There was slight injury to corn with isoxaflutole treatments and also with the metolachlor combinations but no evidence of injury existed with any treatment at harvest (Table) . Excellent control of wild proso millet was achieved with all treatments except for 2 pt/A rate of metolachlor. Yields were not significantly different among treatments. (Utah Agricultural Experiment Station, Logan, UT. 84322-4820)

Table. Wild proso millet control in silage corn with selected preplant incorporated treatments.

		Corn		Weed Control
		Injury	Yield	PANMI
Treatment	Rate	7/27	9/25	7/27
	oz ai/A	–%–	T/A	– % –
Rimsulfuron/ thifensulfuron	0.25	0	24	95
Isoxaflutole	1.125	8	25	98
Isoxaflutole + acetochlor	1.125+ 16.0	10	25	99
Isoxaflutole + dimethenamid	1.125+ 18.0	0	28	99
Metolachlor[a]	1.67 pt/A	5	25	89
Metolachlor[b]	1.67 pt/A	3	21	90
Metolachlor[c]	2 pt/A	15	22	33
Nicosulfuron/rimsulfuron/ atrazine	12.6	0	20	97
Check		0	22	0
LSD(0.05)		19	13	9

[a]Dual Magnum [b]Dual Magnum II [c]Dual II Magnum SI

Broadleaf weed control in field corn with preemergence herbicides. Richard N. Arnold and Daniel Smeal. (New Mexico State University Agricultural Science Center, Farmington, NM 87499) Research plots were established on May 4, 1998 at the Agricultural Science Center, Farmington, New Mexico to evaluate the response of field corn (var. Pioneer 3525), and broadleaf weeds to preemergence herbicides. Soil type was a Wall sandy loam with a pH of 7.8 and an organic matter content of less than 1%. The experimental design was a randomized complete block with three replications. Individual plots were 4, 34 in rows 30 ft long. Treatments were applied with a compressed air backpack sprayer calibrated to deliver 30 gal/A at 30 psi. Preemergence treatments were applied on May 5 and immediately incorporated with 0.75 in of sprinkler applied water. Black nightshade infestations were heavy and redroot and prostrate pigweed infestations were moderate throughout the experimental area. Preemergence were evaluated visually for crop injury and weed control on June 8. Results obtained were subjected to analysis of variance at P=0.05.

Metribuzin + fluthiamide (pm = packaged mix) applied at 0.55 lb/A caused the highest injury level of 14. Redroot and prostrate pigweed control were excellent with all treatments except the check. Black nightshade control was poor with metribuzin plus fluthiamide (pm) applied at 0.2975 lb/A. (Published with the approval of the New Mexico State University Agricultural Experiment Station.)

Table. Broadleaf weed control in field corn with preemergence herbicides.

Treatments[a]	Rate	Crop Injury	Weed Control AMABL	AMARE	SOLNI
	lb/A	-----	-----%	-----	-----
Metribuzin + fluthiamide (pm)	0.55	14	100	100	92
Metribuzin + fluthiamide (pm)	0.425	8	100	100	92
Metribuzin + fluthiamide (pm)	0.02975	0	100	100	50
Metribuzin + fluthiamide (pm) + atrazine	0.17+0.8	0	100	100	100
Metribuzin + fluthiamide (pm) + atrazine	0.25+0.8	0	100	100	100
Metribuzin + fluthiamide (pm) + isoxaflutole	0.17+0.03	1	100	100	100
Metribuzin + fluthiamide (pm) + isoxaflutole	0.25+0.03	4	100	100	100
Isoxaflutole	0.03	0	100	100	100
Isoxaflutole	0.05	3	100	100	100
Isoxaflutole	0.07	11	100	100	100
Isoxaflutole + dimethenamid	0.05+0.66	1	100	100	100
Isoxaflutole + atrazine	0.05+0.8	3	100	100	100
Check		0	0	0	0
LSD 0.05		1	1	1	5

[a]pm = packaged mix

Broadleaf weed control in field corn with preemergence herbicides. Richard N. Arnold and Daniel Smeal. (New Mexico State University Agricultural Science Center Farmington, NM 87499) Research plots were established on May 4, 1998 at the Agricultural Science Center, Farmington, New Mexico to evaluate the response of field corn (var. Pioneer 3525) and broadleaf weeds to preemergence herbicides. Soil type was a Wall sandy loam with a pH of 7.8 and an organic matter content of less than 1%. The experimental design was a randomized complete block with three replications. Individual plots were 4, 34 in rows 30 ft long. Treatments were applied with a compressed air backpack sprayer calibrated to deliver 30 gal/A at 30 psi. Treatments were applied on May 5 and immediately incorporated with 0.75 in of sprinkler applied water. Black nightshade infestations were heavy and redroot and prostrate pigweed infestations were moderate throughout the experimental area. Treatments were evaluated visually for crop injury on June 9 and weed control on July 9. Results obtained were subjected to analysis of variance at P=0.05.

No injury was observed in any of the treatments. Redroot and prostrate pigweed control were excellent with all treatments except the check. Black nightshade control were good to excellent with all treatments except metolachlor II and metolachlor II Mag applied at 1.5, 1.0 lb/A. (Published with the approval of the New Mexico State University Agricultural Experiment Station.)

Table. Broadleaf weed control in field corn with preemergence herbicides.

Treatments[a]	Rate	Weed Control AMABL	AMARE	SOLNI
	lb/A	------------%-----------		
Acetochlor + atrazine (pm)	2.7	100	100	97
BAS 656	0.66	100	99	92
Dimethenamid	1.0	100	99	89
Metolachlor II Mag	1.0	100	99	84
Acetochlor	1.6	100	100	85
Dimethenamid + atrazine (pm)	2.0	100	100	98
BAS 656 + atrazine	0.47+0.75	100	99	97
Dimethenamid	1.2	100	100	97
Atrazine	1.5	100	97	97
BAS 656	0.55	99	98	91
Acetochlor + atrazine (pm)	2.5	99	99	97
Metolachlor II	1.5	99	98	81
Acetochlor	2.2	99	99	94
Acetochlor + atrazine (pm)	2.0	98	98	96
Acetochlor	1.2	98	99	85
Check		0	0	0
LSD 0.05		1	2	2

[a]pm = packaged mix

Control of annual broadleaf and grass weeds in field corn. Bill D. Brewster, Paul E. Hendrickson, and Carol A. Mallory-Smith. (Department of Crop and Soil Science, Oregon State University, Corvallis, OR 97331-3002) Preemergence and postemergence herbicide applications were compared for control of annual weeds in field corn. The trial was conducted at the Hyslop Research Farm near Corvallis. In addition to the natural weed population, proso millet and barnyardgrass were seeded over the trial area. The trial design was a randomized complete block with four replications and 10 ft by 35 ft plots. The corn ('N4640') was seeded in four rows, spaced 30 inches apart, per plot on May 5, 1998. Herbicides were applied with a single-wheel, compressed-air sprayer which delivered 20 gpa through XR8003 flat fan nozzle tips at 19 psi. Herbicide application information is presented in Table 1. The primary ears were harvested on September 22, 1998, from 12 ft of each of the middle two rows in each plot.

Barnyardgrass was more easily controlled than was proso millet (Table 2); several treatments provided complete control of barnyardgrass. Acetochlor and rimsulfuron/thifensulfuron plus atrazine, and flufenacet/metribuzin provided nearly total control of the broadleaf weeds. All treatments increased corn ear yields dramatically compared to the weedy check. The early postemergence application of rimsulfuron/thifensulfuron provided a lower yield than did some of the other treatments, and was the only treatment that provided poor control of hairy nightshade.

Table 1. Herbicide application data for preemergence and postemergence treatments at Hyslop Farm, 1998.

Application date	May 8	June 2	June 8
Timing	PES	EPOE	POE
Growth stage: corn	preemergence	3 leaf	4 leaf, 6-7 inches
barnyardgrass	preemergence	1-2 leaf	2 leaf, 2 inches tall
proso millet	preemergence	1-2 leaf	2 leaf, 2 inches tall
Italian ryegrass	preemergence	1 leaf - 2 tillers	up to 6 inches
common groundsel	preemergence	1-2 inch diameter	1-3 inch diameter
Powell amaranth	preemergence	cotyledon to 2 leaf	2-4 leaf
hairy nightshade	preemergence	cotyledon to 2 leaf	2-4 leaf
Air temperature (F)	52	59	57
Soil temperature (F)	56	56	55
Soil moisture	dry surface	dry surface	dry 1 inch
Relative humidity (%)	82	64	77

Table 2. Visual evaluations of weed control and crop injury and corn ear yield.

			Weed control						Corn	
Treatment[a]	Timing	Rate	Italian ryegrass	Barn-yardgrass	Proso millet	Common groundsel	Powell amaranth	Hairy nightshade	Injury	Ears
		lb/A	%							Ton/A
Acetochlor	PES	1.6	92	100	84	98	100	100	0	10.2
Dimethenamid	PES	1.17	99	100	79	86	95	91	3	9.2
Metolachlor	PES	1.95	98	100	78	64	72	89	5	9.4
s-Metolachlor	PES	1.0	93	99	60	66	73	80	0	9.1
Flufenacet/ metribuzin	PES	0.68	91	100	85	97	96	93	3	10.2
Rims/thifen + atrazine	PES	0.23 + 0.75	84	93	86	100	100	100	9	10.2
Rims/thifen	EPOE	0.016	89	98	96	100	100	20	3	8.1
Nicosulfuron	EPOE	0.03	100	100	98	55	91	95	0	9.3
Nicos + dimeth	EPOE	0.03 + 1.17	98	100	98	63	100	100	0	8.8
Nicos/rims/ atrazine	POE	0.78	85	91	85	91	99	81	8	9.4
Check		0	0	0	0	0	0	0	0	1.7
									$LSD_{0.05}$	1.6

[a]Acetochlor contained diclormid, metolachlor and s-metolachlor contained benoxacor, rims = rimsulfuron, thifen = thifensulfuron, nicos = nicosulfuron, dimeth = dimethenamid, crop oil concentrate at 1% v/v and Solution 32 fertilizer at 2 qt/A added to early postemergence and postemergence treatments.

Broadleaf weed control in field corn with preemergence followed by postemergence herbicides. Richard N. Arnold and Daniel Smeal. (New Mexico State University Agricultural Science Center Farmington, NM 87499) Research plots were established on May 4, 1998 at the Agricultural Science Center, Farmington, New Mexico to evaluate the response of field corn (var. Pioneer 3525) and broadleaf weeds to preemergence followed by postemergence herbicides. Soil type was a Wall sandy loam with a pH of 7.8 and an organic matter content of less than 1%. The experimental design was a randomized complete block with three replications. Individual plots were 4, 34 in rows 30 ft long. Treatments were applied with a compressed air backpack sprayer calibrated to deliver 30 gal/A at 30 psi. Preemergence treatments were applied May 5 and immediately incorporated with 0.75 in of sprinkler applied water. Postemergence treatments were applied on May 28, when corn was in the fifth leaf stage and weeds were small. Black nightshade infestations were heavy, prostrate and redroot pigweed infestations were moderate throughout the experimental area. Visual evaluations of crop injury and weed control were made July 29. Results obtained were subjected to analysis of variance at P=0.05.

Metolachlor II Mag applied preemergence at 1.19 lb/A followed by a postemergence treatment of prosulfuron plus primisulfuron (pm = packaged mix and registered under Norvartis Crop Protection as Spirit) at 0.036 lb/A had the highest injury rating of 5. All treatments gave good to excellent control of broadleaf weeds except the check. (Published with the approval of the New Mexico State University Agricultural Experiment Station.)

Table. Broadleaf weed control in field corn with preemergence followed by postemergence herbicides.

Treatments[a]	Rate	Crop Injury	Weed Control AMARE	Weed Control AMABL	Weed Control SOLNI
	lb/A	%			
Metolachlor II Mag/ prosulfuron + primisulfuron (pm)	1.19/0.036	0	100	99	97
Metolachlor II Mag/ prosulfuron + primisulfuron (pm) + dicamba	1.19/0.036+0.125	3	100	100	100
Metolachlor II Mag/ prosulfuron + primisulfuron (pm) + dicamba[b]	1.19/0.036+0.125	3	100	100	100
Metolachlor II Mag/ prosulfuron + primisulfuron (pm) + metolachlor II Mag	0.83/0.036+0.5	0	100	100	99
Metolachlor II Mag/ prosulfuron + primisulfuron (pm) + metolachlor II Mag[b]	0.83/0.036+0.5	4	100	100	100
Metolachlor II Mag/ prosulfuron + primisulfuron (pm)[b]	1.19/0.036	5	99	97	96
LSD 0.05		1	1	1	1

[a]First treatment applied preemergence followed by a postemergence treatment and evaluated on July 29. Packaged mix = pm

[b]Packaged mix is registered with Norvartis Crop Protection under the name of Spirit.

Broadleaf weed control in field corn with postemergence and preemergence/postemergence herbicides. Richard N. Arnold and Daniel Smeal. (New Mexico State University Agricultural Science Center, Farmington, NM 87499) Research plots were established on May 4, 1998 at the Agricultural Science Center, Farmington, New Mexico to evaluate the response of field corn (var. Pioneer 3525) and broadleaf weeds to postemergence and preemergence/postemergence herbicides. Soil type was a Wall sandy loam with a pH of 7.8 and an organic matter content of less than 1%. The experimental design was a randomized complete block with three replications.
Individual plots were 4, 34 in rows 30 ft long. Treatments were applied with a compressed air backpack sprayer calibrated to deliver 30 gal/A at 30 psi. The preemergence treatment was applied May 5 and immediately incorporated with 0.75 in of sprinkler applied water. Postemergence treatments were applied May 28 when corn was in the three to four leaf stage and weeds were small. Black nightshade infestations were heavy, redroot and prostrate pigweed infestations were moderate throughout the experimental area. The preemergence treatmemt was rated visually for crop injury on June 9 and weed control on July 9. Preemergence/postemergence and postemergence treatments were rated visually for crop injury on June 29 and weed control July 29. Results obtained were subjected to analysis of variance at P=0.05.

Atrazine plus nicosulfuron plus rimsulfuron (pm = packaged mix) plus prosulfuron plus primisulfuron (pm) applied at 0.79 plus 0.009 lb/A gave the highest injury rating of 11. All treatments gave good to excellent control of broadleaf weeds except the check. (Published with the approval of the New Mexico State University Agricultural Experiment Station.)

Table. Broadleaf weed control in field corn with postermergence and preemergence/postemergence herbicides.

Treatments	Rate	Crop Injury	Weed Control AMARE	AMABL	SOLNI
	lb/A	----------------	--------%--------	----------------	----------------
Dimethenamid + atrazine (pm)/ atrazine + nicosulfuron + rimsulfuron (pm)[b]	1.6/0.79	0	100	100	100
Dimethenamid + atrazine (pm)/ rimsulfuron + nicosulfuron (pm) + flumetsulam + clopyralid (pm)[b]	1.6/0.023+0.125	2	100	100	100
Atrazine + nicosulfuron + rimsulfuron (pm) + atrazine[c]	0.79+0.25	0	100	100	100
Atrazine + nicosulfuron + rimsulfuron (pm) + atrazine[c]	0.79+0.5	0	100	100	100
Atrazine + nicosulfuron + rimsulfuron (pm) + prosulfuron + primisulfuron (pm)[c]	0.79+0.009	11	100	99	99
Nicosulfuron + atrazine[c]	0.031+1.0	0	100	100	97
Atrazine + nicosulfuron + rimsulfuron (pm) + dicamba[d]	0.79+0.125	3	100	100	99
Atrazine + nicosulfuron + rimsulfuron (pm) + BAS 662[d]	0.79+0.175	4	100	100	100
Nicosulfuron + BAS 662[d]	0.031+0.263	4	100	100	100
Nicosulfuron + BAS 662[d]	0.016+0.263	4	100	100	99
Nicosulfuron + BAS 662[d]	0.031+0.175	4	100	100	100
Atrazine + dimethenamid (pm)[a]	1.6	0	99	99	99
Flumetsulam + clopyralid (pm) + rimsulfuron + nicosulfuron (pm)[c]	0.125+0.023	0	98	99	98
Nicosulfuron + dicamba[d]	0.031+0.262	3	98	99	98
Atrazine + nicosulfuron + rimsulfuron (pm)[c]	0.79	0	98	99	98
Check		0	0	0	0
LSD 0.05		1	1	1	2

[a]Treatment applied preemergence with crop injury and weed control evaluated on June 9 and July 9.

[b]First treatment applied preemergence followed by a postemergence treatment with crop injury and weed control evaluated on June 29 and July 29.

[c]Treatments applied postemergence with COC at 1% v/v with crop injury and weed control evaluated on June 29 and July 29.

[d]Treatments applied postemergence with a surfactant and 32% nitrogen solution at 0.25% and 1% v/v with crop injury and weed control evaluated on June 29 and July 29.

Broadleaf weed control in roundup ready field corn with preemergence, preemergence/postemergence and postemergence herbicides. Richard N. Arnold and Daniel Smeal. (New Mexico State University Agricultural Science Center, Farmington, NM 87499) Research plots were established on May 4, 1998 at the Agricultural Science Center, Farmington, New Mexico to evaluate the response of field corn (var. Dekalb 512RR) and broadleaf weeds to preemergence, preemergence/postemergence and postemergence herbicides. Soil type was a Wall sandy loam with a pH of 7.8 and an organic matter content of less than 1%. The experimental design was a randomized complete block with three replications. Individual plots were 4, 34 in rows 30 ft long. Treatments were applied with a compressed air backpack sprayer calibrated to deliver 30 gal/A at 30 psi. The preemergence treatment was applied on May 6 and immediately incorporated with 0.75 in of sprinkler applied water. Postemergence treatments were applied to corn 12 in tall on June 2 and to corn 24 in tall on June 23. Black nightshade infestations were heavy and prostrate and redroot pigweed infestations were moderate throughout the experimental area. The preemergence treatment was evaluated visually for crop injury and weed control on June 8. Postemergence treatments applied to corn 12 and 24 in tall were evaluated for crop injury and weed control on July 2 and 23. Results obtained were subjected to analysis of variance at P=0.05.

Roundup applied at 1.0 lb/A to corn 12 in tall, followed by a sequential treatment at 0.75 lb/A to corn 24 in tall had the highest injury rating of 4. All treatments gave good to excellent control of bradleaf weeds except the check. (Published with the approval of the New Mexico State University Agricultural Experiment Station.)

Table. Broadleaf weed control in roundup ready field corn with preemergence, preemergence/postemergence and postemergence herbicides.

Treatments	Rate	Crop Injury	Weed Control AMABL	AMARE	SOLNI
	lb/A	-----------------%---------------			
Acetochlor + atrazine (pm)/ glyphosate[c]	1.3/1.0	0	100	98	100
Acetochlor + atrazine (pm)/ glyphosate[c]	2.0/1.0	0	100	97	100
Acetochlor + atrazine (pm)/ glyphosate[c]	2.7/1.0	0	100	100	100
Atrazine/glyphosate[c]	1.5/1.0	0	100	97	100
Metolachlor II Mag/ nicosulfuron[c]	1.19/0.031	1	100	100	100
Dimethenamid + atrazine (pm)/ nicosulfuron[c]	1.6/0.031	1	100	100	100
Atrazine + metolachlor II Mag (pm)[a]	1.37	0	100	100	100
Atrazine + metolachlor II Mag (pm)/ glyphosate[c]	1.37/1.0	0	100	100	100
Atrazine + metolachlor II Mag (pm) + glyphosate[b,e]	1.37+1.0	3	100	100	100
Glyphosate/glyphosate[d]	1.0/0.75	4	100	100	97
Acetochlor + atrazine (pm) + glyphosate[b,e]	1.3+1.0	3	100	100	100
Acetochlor + atrazine (pm) + glyphosate[b,e]	2.0+1.0	2	100	100	100
Mon 8411 + glyphosate + atrazine[b,e]	1.75+1.0+1.0	2	100	100	100
Dimethenamid + atrazine (pm)/ glyphosate[c]	1.6/1.0	0	100	99	100
Glyphosate[b]	1.0	2	100	100	100
Check		0	0	0	0
LSD 0.05		1	1	1	1

[a]Treatment applied preemergence and evaluated on June 8 and pm = packaged mix.
[b]Treatments applied postemergence to corn 12 in tall and evaluated on July 2.
[c]First treatment applied preemergence followed by a postemergence treatment applied to corn 24 in tall and evaluated on July 23.
[d]First treatment applied postemergence to corn 12 in tall followed by a postemergence treatment to corn 24 in tall and evaluated on July 23.
[e]Treatments applied with sprayable ammonium sulfate at 2% v/v.

Wild proso millet and broadleaf weed control in transgenic corn. John O. Evans, R. William Mace and Kevin B. Kelley. (Department of Plants, Soils and Biometeorology, Utah State University, Logan, UT 84322-4820) Weed control studies were conducted at two sites in corn, hybrid DeKalb 626 planted on the T. Jenson farm west of Logan, UT (1st site) on May 10, 1998 and transgenic corn hybrid DeKalb 363RR planted on the J. Jenson farm near Nibley, UT (2nd site) on May 28. Corn was planted in 30 inch rows at both locations. Several herbicides commonly used in corn were compared at both sites and glyphosate and sulfosate were also used at the 2nd site to control wild proso millet, common lambsquarters, and redroot pigweed. The soil type at the 1st site was Provo loam with a 7.8 pH and OM content of 14%. The soil type at the 2nd site was Nibley silt loam with a 7.6 pH and OM content less than 2%. Treatments were applied to both sites June 25 using randomized complete block designs with three replications. Individual plots measured 30 feet by 4 rows. Crop height at the 1st and 2nd sites at time of application was 12 inches and 8 inches, respectively. Control and injury were measured June 17 and yield at the 2nd site was determined August 29.

No crop injury was evident at either location. Glyphosate, sulphosate, nicosulfuron, nicosulfuron + dicamba, and nicosulfuron + rimsulfuron + atrazine provided good control of wild proso millet. All treatments but Mon 12000, Mon 12000 + Mon 13900 and nicosulfuron were effective at controlling common lambsquarters. Control of redroot pigweed was good to excellent with all treatments except Mon 12000 + Mon 13900 at the 1st site (Table 1). Management practices of the grower at the second site add doubt as to the reliability of the control data, however. Yield was not significantly different at the 2nd site (Table 2) and was not able to be measured at the 1st. High yield variability at the second site may be due to inconsistent soil type, fertility or other factors.

Table 1. Effect of herbicide treatments on crop injury and weed control. Logan, UT.

Treatment	Rate	Corn Injury	Weed Control: Wild proso millet	Weed Control: Common Lambsquarters	Weed Control: Redroot pigweed
		7/17	7/17	7/17	7/17
	oz/A	----%----	%		
Mon 12000[a]	1	0	3	53	70
Mon 12000 + mon 13900[a]	0.077 0.23	0	8	18	37
Nicosulfuron[b d]	1	0	78	50	67
Nicosulfuron + dicamba[b d]	1 8	0	75	98	97
Nicosulfuron + rimsulfuron + atrazine[b d]	0.19 0.19 12	0	68	98	98
Atrazine[c]	16	0	0	100	100
Check		0	0	0	0
LSD (0.05)			12.8	22.1	34.1

[a] Non-ionic surfactant added at 0.5% v/v. [b] Crop oil added at 1% v/v. [c] Crop oil added at 1qt/A. [d] Ammonium sulphate added at 3 lb/A

Table 2. Effect of herbicide treatments on crop injury, yield and weed control. Nibley, UT.

Treatment	Rate	Corn Injury	Corn Yield	Weed Control: Wild proso millet	Weed Control: Common Lambsquarters	Weed Control: Redroot pigweed
		7/17	9/29	7/17	7/17	7/17
	oz/A	----%----	T/A	%	%	%
Glyphosate	16	0	22.0	87	100	99
Glyphosate	8	0	22.4	97	88	93
Glyphosate [f]	16	0	21.1	99	100	100
Sulfosate [b]	24	0	22.4	90	100	100
Sulfosate [b]	12	0	21.0	87	100	100
Sulfosate [b f]	24	0	18.9	95	100	100
Mon 12000 [a]	1	0	21.7	3	53	68
Mon 12000 + mon 13900 [a]	0.077 0.23	0	21.6	17	40	70
Nicosulfuron [c e]	1	0	21.1	83	77	80
Nicosulfuron + dicamba [c e]	1 8	0	18.3	78	95	97
Nicosulfuron + rimsulfuron + atrazine [c e]	0.19 0.19 12	0	17.7	90	98	97
Atrazine [d]	16	0	19.5	25	93	93
Ammonium sulfate	64	0	19.3	3	0	3
Check		0	16.4	0	0	0
LSD (0.05)			7.42	25.7	16.0	16.2

[a] Non-ionic surfactant added at 0.5% v/v. [b] Non-ionic surfactant added at 0.75 oz/gal. [c] Crop oil added at 1% v/v. [d] Crop oil added at 1qt/A. [e] Ammonium sulphate added at 3 lb/A. [f] Ammonium sulphate added at 4 lb/A.

Annual morningglory control in Roundup Ready cotton. Ron Vargas and Mark Keeley. (University of California Cooperative Extension, Madera, CA 93637) DP6100 RR, Roundup Ready, cotton was planted on April 29, 1998 in a heavy, uniformly infested field of annual morningglory. The crop was grown with standard cultural practices for cotton grown on the sandy soils of the Shafter, California area. Roundup Ultra was applied over the top of 2 to 4 true leaf cotton at 1.0 lb ai/A on May 27, with annual morningglory seedlings being 2 to 4 inches tall. As a comparison, pyrithiobac sodium was also applied over the top at 1.0 oz ai/A at the same time. The initial glyphosate treatments were followed with a post directed treatment of glyphosate at 1.0 lb ai/A at various stages of morningglory growth ranging from 2 to 4 inches tall to 10 to 15 inch stolons. In one treatment glyphosate was applied tank mixed with oxyfluorfen and applied post directed to annual morningglory at 10-15 inch stolons. A combination of pyrithiobac sodium and MSMA at 1.0 oz plus 1.88 lb ai/A followed the first pyrithiobac sodium application. Cyanazine was applied at 1.0 lb ai/A, at layby, to all plots except the single over the top treatment of glyphosate.

Evaluations of cotton phytotoxicity indicated little if any effect to cotton growth and development with either Roundup or pyrithiobac sodium was applied over the top or post directed. A slight yellowing of the cotton terminal occurred, but was non existent at 28 days after treatment (DAT). At 7 DAT morningglory control ranged from 27 to 62 percent, with poorest control being exhibited when glyphosate was applied to annual morningglory at the 10 to 15 stolon stage. Control increased with all treatments at 50 DAT, except the single 1.0 lb ai/A rate of glyphosate at the 2 to 4 inch stage. At 50 DAT control, due to the glyphosate treatments ranged from 72 to 90 percent. Control was not increased when oxyfluorfen was tank mixed with glyphosate. The pyrithiobac sodium treatment was providing 70 percent control 50 DAT.

Table. Glyphosate for annual morningglory control in Roundup Ready cotton.

Treatment	Rate	Timing/Stage		Percent Morningglory Control				
	lb ai/A	Cotton	Morningglory	7DAT	14DAT	21DAT	28DAT	50DAT
1. Glyphosate	1.0	OT 2-4 TL	2-4"	53	68	86	73	48
2. Glyphosate B. Glyphosate C. Cyanazine	1.0 1.0 1.0	OT 2-4 TL PD LAYBY	2-4" 2-4"	63	68	88	83	89
3. Glyphosate B. Glyphosate C. Cyanazine	1.0 1.0 1.0	OT 2-4 TL PD LAYBY	2-4" 10-15" runner	63	76	85	81	73
4. Glyphosate B. Glyphosate + oxyfluorfen C. Cyanazine	1.0 1.0 + 0.125 1.0	OT 2-4 TL PD LAYBY	2-4" 10-15" runner	60	75	90	73	75
5. Glyphosate B. Glyphosate C. Cyanazine	1.0 1.0 1.0	PD PD @ 10 DAPD LAYBY	10-15" runner 10-15" runner	28	53	53	69	90
6. Pyrithiobac sodium B. Pyrithiobac sodium + MSMA C. Cyanazine	1 oz 1 oz + 1.88 lb 1.0 lb	OT 2-4 TL PD @ 10 DAPD LAYBY	2-4"	43	55	83	88	70

Hairy Nightshade Control in Cotton. Ron Vargas and Tomé Martin-Duvall (University of California Cooperative Extension, Madera, CA 93637) A uniform stand of Acala GTO Maxxa cotton, infested with hairy nightshade, was divided into plots of 4, 40 inch rows by 30 feet long and replicated four times in a randomized complete block design. Pyrithiobac sodium and MSMA were applied, alone and in tank mix combinations over the top of cotyledon to 2 leaf stage cotton with nightshade in the cotyledon to 4 leaf stage. Sequential applications of pyrithiobac sodium following the initial treatments were applied over the top of cotton at the 6 leaf stage. All treatments were applied with a CO_2 backpack sprayer with 8002 vs nozzles at 30 psi delivering 20 gallons of spray solution per acre. All treatments contains non-ionic surfactant at 0.25% V/V.

Evaluations of cotton phytotoxicity indicated considerable injury with all treatments containing MSMA at 7 days after treatment (DAT) but injury symptoms were gone at 28 DAT. Pyrithiobac sodium injury was slight with symptoms being gone at 28 DAT. Evaluations of nightshade control indicated reduced control when MSMA was tank mixed with pyrithiobac sodium at 7 DAT, but there were no differences in control at 28 DAT, except for the low 0.50 and 0.75 oz ai/A rate of pyrithiobac sodium. At 74 DAT, 99 to 100 percent control was being exhibited by the sequential 0.50, 0.75 and 1.0 oz ai/A rate of pyrithiobac sodium. Control was reduced when MSMA was tank mixed with pyrithiobac sodium with poor control being exhibited with the single treatment of MSMA at 2.0 lb ai/A.

Table. Hairy Nightshade Control in Cotton

	Rate	Percent Control			
Treatment	ai/A	14 DAT	21 DAT	28 DAT	74 DAT
1. Pyrithiobac sodium	0.50 oz	76 a	86 b	31 c	40 de
2. Pyrithiobac sodium	0.75 oz	79 a	93 a	61 b	47 de
3. Pyrithiobac sodium	1.00 oz	78 a	92 ab	86 a	64 cd
4. Pyrithiobac sodium	1.50 oz	80 a	91 ab	94 a	97 ab
5. Pyrithiobac sodium B. Pyrithobac sodium	0.50 oz 0.50 oz	78 a	90 ab	85 a	100 a
6. Pyrithiobac sodium B. Pyrithiobac sodium	0.75 oz 0.75 oz	80 a	93 a	89 a	99 a
7. Pyrithiobac sodium B. Pyrithiobac sodium	1.00 oz 1.00 oz	79 a	92 ab	92 a	100 a
8. Pyrithiobac sodium + MSMA	0.75 oz 2.00 lb	79 a	88 ab	87 a	79 bc
9. Pyrithiobac sodium + MSMA	1.00 oz 2.00 lb	76 a	89 ab	87 a	93 ab
10. Pyrithiobac sodium + MSMA	1.50 oz 2.00 lb	80 a	91 ab	89 a	92 ab
11. MSMA	2.00 lb	0 b	0 c	0 d	21 e
12. UTC		0 e	0 c	0 d	0 f
LSD @ .05		11.07	5.6	10.28	18.36
Percent CV		4.02	6.49	13.18	21.52

Weed control in Roundup Ready cotton. Ron Vargas and Tomé Martin-Duvall (University of California Cooperative Extension, Madera, CA 93637) A uniform stand of DP6100RR (Roundup Ready) cotton, infested with black nightshade and yellow nutsedge was divided into plots of 4, 30 inch rows by 30 feet long and replicated five times in a randomized complete block design. Glyphosate and pyrithiobac sodium were applied over the top alone and in a tank mix at various rates. At the time of application the cotton was in the 2 to 3 true leaf stage with nightshade being in the 2 true leaf stage and up to 3 inches tall and yellow nutsedge 4 leaf stage and 3 inches tall. Two treatments received a second application; one pyrithiobac sodium alone and the other pyrithiobac sodium and glyphosate. All treatments contained a 0.25 percent surfactant and were applied with a CO_2 backpack sprayer at 30 psi delivering 20 gallons of spray solution per acre.

Evaluations of cotton phytotoxicity showed the typical crinkled, yellowed leaves of pyrithiobac sodium injury in all treatments that contained pyrithiobac sodium either alone or in combination with glyphosate. Symptoms were non existent 21 days after treatment (DAT). Glyphosate applied alone exhibited no visual injury symptoms to the cotton. Black nightshade control at 7 DAT ranged from 26 to 57 percent, with the poorest control being the 0.50 oz ai/A rate of pyrithiobac sodium. Control increased with all treatment and at 21 DAT all treatments were providing acceptable control (90 - 100%) except the 0.50 oz ai/A rate of pyrithiobac sodium (58%). Yellow nutsedge control at 14 and 21 DAT was poor, ranging from 4 to 38 percent. At 64 DAT all treatments were exhibiting acceptable control.

Table 1. Black Nightshade Control in Roundup Ready Cotton

Treatment	Rate ai/A	Percent Nightshade Control		
		7 DAT	14 DAT	21 DAT
1. Pyrithiobac sodium + glyphosate	0.50 oz 0.50 lb	57 a	93 a	100 a
2. Pyrithiobac sodium + glyphosate	0.50 oz 0.75 lb	55 a	98 a	100 a
3. Pyrithiobac sodium + glyphosate	0.75 oz 0.50 lb	55 a	98 a	98 ab
4. Pyrithiobac sodium + glyphosate	0.75 oz 0.75 lb	59 a	96 a	100 a
5. Pyrithiobac sodium + glyphosate B. Pyrithiobac sodium + glyphosate	0.50 oz 0.75 lb 0.50 oz 0.50 lb	56 a	91 a	100 a
6. Pyrithiobac sodium + glyphosate B. Staple	0.50 oz 0.50 lb 1.00 oz	55 a	95 a	98 ab
7. Pyrithiobac sodium	0.50 oz	26 b	46 c	58 c
8. Pyrithiobac sodium	0.75 oz	30 b	58 b	90 b
9. Glyphosate	0.50 lb	54 a	89 a	100 a
10. Glyphosate	0.75 lb	49 a	96 a	100 a
11. Glyphosate	1.00 lb	56 a	95 a	100 a
12. UTC		0 c	2 d	0 d
LSD @ .05		17.24	9.78	9.72
Percent CV		10.11	9.62	8.78

Table 2. Yellow Nutsedge Control in Roundup Ready Cotton

Treatment	Rate ai/A	Percent Yellow Nutsedge Control		
		14 DAT	21 DAT	64 DAT
1. Pyrithiobac sodium + glyphosate	0.50 oz 0.50 lb	23 abc	26 bc	93 abc
2. Pyrithiobac sodium + glyphosate	0.50 oz 0.75 lb	29 abc	30 abc	100 a
3. Pyrithiobac sodium + glyphosate	0.75 oz 0.50 lb	21 c	28 abc	78 d
4. Pyrithiobac sodium + glyphosate B. Pyrithiobac sodium + glyphosate	0.75 oz 0.75 lb	23 abc	32 abc	91 abc
5. Pyrithiobac sodium + glyphosate B. Pyrithiobac sodium + glyphosate	0.50 oz 0.75 lb 0.50 oz 0.50 lb	31 ab	35 ab	100 a
6. Pyrithiobac sodium + glyphosate B. Pyrithiobac sodium	0.50 oz 0.50 lb 1.00 oz	24 abc	27 bc	97 ab
7. Pyrithiobac sodium	0.50 oz	4 d	6 d	85 cd
8. Pyrithiobac sodium	0.75 oz	6 d	10 d	86 cd
9. Glyphosate	0.50 lb	20 c	24 c	90 bc
10. Glyphosate	0.75 lb	22 bc	27 bc	93 abc
11. Glyphosate	1.00 lb	32 a	38 a	98 ab
12. UTC		0 d	0 d	0 e
LSD @ .05		9.88	10.029	9.57
Percent CV		39.59	33.24	8.90

Quackgrass control with quizalofop and glyphosate. Katheryn M. Christianson and Rodney G. Lym. (Plant Sciences Department, North Dakota State University, Fargo, ND 58105). Quackgrass is an aggressive, rapidly spreading weed that competes with crops. It grows in a wide range of temperate environments from cultivated fields to pastures and is difficult to control once established. The purpose of this experiment was to evaluate quizalofop and glyphosate alone and in combination for quackgrass control

The experiment was established in a dense stand of quackgrass at the North Dakota State University experiment station at Fargo, ND. The soil was a Fargo silty clay with 3.5% organic matter and a 8.0 pH. The quackgrass was 8 to10 inches tall and had 4 to 6 leaves. Herbicides were applied using a hand-held sprayer delivering 8.5 gpa at 35 psi. Quackgrass control was visually evaluated on June 17, 1998, 21 DAT (days after treatment) and July 10, 1998, 45 DAT. Control was based on percent stand reduction as compared to the untreated check.

Table. Quackgrass control with quizalofop and glyphosate[a].

Treatment	Rate	Control 21 DAT	Control 45 DAT
	oz/A	%	%
Quizalofop + glyphosate + AMS	1.1 + 8 + 40	87	93
Quizalofop + glyphosate + AMS	1.1 + 12 + 40	83	94
Quizalofop + glyphosate + AMS + COC	1.1 + 8 + 40 + 1%	86	93
Quizalofop + AMS + COC	1.1 + 40 + 1%	53	52
Glyphosate + AMS	8 + 40	81	90
Glyphosate + AMS	12 + 40	88	97
Untreated check		0	0
LSD (0.05)		10	4

[a]AMS, ammonium sulfate; COC, crop oil concentrate - Herbimax; DAT, days after treatment; glyphosate, commercial formulation Roundup Ultra.

Quackgrass control 21 DAT was greater than 80% with all glyphosate treatments regardless of application rate or if tank mixed with quizalofop. Quackgrass control 45 DAT increased to greater than 90% for all treatments applied with glyphosate. Glyphosate at 12 oz/A applied alone provided almost complete quackgrass control (97%) 45 DAT. Quizalofop at 1.1 oz/A applied alone provided approximately 52% control of quackgrass regardless of evaluation date. The addition of quizalofop did not increase quackgrass control compared to glyphosate alone.

Annual bluegrass interference in meadowfoam. Bill D. Brewster, Paul E. Hendrickson, and Carol A. Mallory-Smith. (Department of Crop and Soil Science, Oregon State University, Corvallis, OR 97331-3002) Meadowfoam is grown in rotation with grass seed crops in Oregon's Willamette Valley. The primary weed in central Willamette Valley grass seed fields is annual bluegrass. Research was conducted to evaluate the impact of this weed on meadowfoam at the Hyslop Research Farm near Corvallis. The trial area was fumigated with methyl bromide plus chloropicrin prior to planting to eliminate interference from other weed species. Annual bluegrass seed was broadcast over the plots at seven rates; a weed-free control was included. Meadowfoam seed was drilled in 6-inch rows at a rate of 30 lb/A on September 30, 1997. No fertilizer was applied at planting. Urea was applied at a rate of 55 lb/A on February 17 and March 16, 1998. The trial design was a randomized complete block with 4 replications and 8 ft by 30 ft plots. Annual bluegrass impacted the percent of the soil surface that was covered by meadowfoam early in the season, but the meadowfoam seed yield was not affected even at very high densities of annual bluegrass.

Table. Annual bluegrass stand density and percent ground cover and meadowfoam percent ground cover and seed yield.

	Annual bluegrass		Meadowfoam	
	Stand[a]	Ground cover[b]	Ground cover[b]	Seed[c]
	plants/sq ft	%	%	lb/A
	0	0	84	703
	21	9	84	829
	47	17	71	771
	81	19	73	806
	135	32	64	852
	225	41	57	809
	389	46	51	856
	826	48	42	772
$LSD_{0.05}$	50	7	10	ns

[a]Mean of five 1-sq-ft quadrats on October 21, 1997.
[b]Line transect December 10, 1997.
[c]Harvested July 2, 1998.

Tolerance of meadowfoam to herbicides and control of annual bluegrass. Bill D. Brewster, Paul E. Hendrickson, and Carol A. Mallory-Smith. (Department of Crop and Soil Science, Oregon State University, Corvallis, OR 97331-3002) A trial was conducted at the Hyslop Research Farm near Corvallis to evaluate the tolerance of four herbicides on meadowfoam. The trial site was infested with a sparse stand of annual bluegrass. 'Floral' meadowfoam was seeded at 30 lb/A in 6-in-wide rows on September 30, 1997. Metolachlor, propachlor, and sulfentrazone were applied preemergence to the meadowfoam and annual bluegrass on October 2, 1997. Ethofumesate was applied to 1- to 3-leaf meadowfoam and 1- to 4-leaf annual bluegrass on October 24, 1997. Herbicides were applied with a single-wheel, compressed-air, plot sprayer that delivered 20 gpa at 19 psi through XR8003 flat fan nozzle tips. The trial design was a randomized complete block with 4 replications and 8 ft by 30 ft plots.

All herbicide treatments controlled annual bluegrass (Table). The highest rate of the three preemergence-applied herbicides produced greater meadowfoam seed yields than the lowest rate. Since other research has shown that even extremely dense populations of annual bluegrass have little affect on meadowfoam yield, the increase in yield was probably a response to herbicide injury. The unusually mild winter in western Oregon (a low of 26 F) probably allowed the meadowfoam to survive the severe injury.

Table. Annual bluegrass control and meadowfoam injury.

			Meadowfoam	
Treatment	Rate	Annual bluegrass control	Injury[a]	Yield
	lb/A	%	%	lb/A
Metolachlor	1	99	40	1126
Metolachlor	2	100	60	1329
Metolachlor	4	100	73	1354
Propachlor	2	93	23	1012
Propachlor	4	100	40	1070
Propachlor	8	100	58	1237
Sulfentrazone	0.062	92	8	917
Sulfentrazone	0.125	98	35	972
Sulfentrazone	0.25	100	60	1132
Ethofumesate	1.5	100	3	845
Ethofumesate	3	100	5	910
Ethofumesate	6	100	10	943
Control	0	0	0	778
			$LSD_{0.05}$	154

Effects of fomesafen on spring pea and lentil. Bradley D. Hanson and Donald C. Thill. (Plant Science Division, University of Idaho, Moscow, Idaho 83844-2339) Studies were established near Viola, ID in spring pea and near Uniontown, WA in lentil to determine the effects of three POST rates of fomesafen on crop tolerance and weed control. Also included in the studies were an untreated control and a PPI treatment of imazethapyr plus triallate as a standard for the area. Plots were 8 by 30 ft arranged in a randomized complete block with four replications. All treatments were applied with a CO_2 pressurized backpack sprayer calibrated to deliver 10 gpa at 32 psi and 3 mph (Table 1). PPI treatments were applied on April 1 and April 21, 1998 at Uniontown and Viola, respectively, and were incorporated with two passes of a field cultivator. 'Pardina' lentil was seeded at Uniontown on April 3, 1998 and 'Rex' pea was seeded at Viola on April 25, 1998. Fomesafen treatments were applied on May 5 at Uniontown and on May 18 at Viola when the crop was 2-3 in. tall. After an initial weed control rating, both experiments were oversprayed with quizalofop at 0.069 lb/A plus NIS at 0.25% v/v to control wild oat and quackgrass. At Uniontown, visual injury and weed control were rated on May 15, 1998. Pea injury was rated on May 28, 1998 at Viola. Lentil and pea seed were harvested from a 4.1 by 27 ft area on August 10 at Uniontown and August 13, 1998 at Viola with a small plot combine.

Table 1. Application data and soil analysis

Site		Uniontown	Viola
PPI application		April 1, 1998	April 21, 1998
POST application		May 5, 1998	May 18, 1998
	Air temp (F)	85	58
	Relative humidity (%)	35	62
	Wind speed (mph)	2	2
	Cloud cover (%)	10	100
	Soil temp at 2 in (F)	70	59
Soil	pH	5.8	5.4
	OM (%)	3.4	4.6
	CEC (cmol/Kg)	28.9	24.2
	Texture	silt loam	silt loam

Fomesafen treatments injured lentil 18 to 51% (chlorosis) and 4 to 25% (stunting) 6 weeks after treatment (Table 2). Suppression of wild oat in lentil ranged from 1 to 25% with fomesafen. Control of field pennycress with all fomesafen treatments was similar to the standard. Control of mayweed chamomile and henbit was similar to the standard at the 0.375 lb/A rate, but decreased with lower doses. Fomesafen treatments did not reduce lentil yield compared to the untreated control or the standard. The lentil experiment was flooded after the initial rating causing poor crop competitiveness and multiple flushes of mayweed and field pennycress. Because these weeds overran all treatments in the study, further weed control ratings are not included. Weed control was not rated at the pea location due to a low infestation of broadleaf and grass weeds. Fomesafen injured pea 98 to 100% ten days after treatment. Although the pea crop exhibited some regrowth, fomesafen reduced pea yield 72 to 84%.

Table 2. Effects of fomesafen on spring pea and lentil

		Uniontown							Viola	
		control				Lentil	Lentil	Lentil	Pea	Pea
Treatment	Rate	Wild oat	Field pennycress	Mayweed	Henbit	chlorosis	stunting	yield	injury [c]	yield
	lb/A	% [b]						lb/A	%	lb/A
Untreated	--	--	--	--	--	--	--	1211	--	3544
fomesafen [a]	0.25	13	88	45	40	18	4	1392	98	1001
fomesafen	0.3125	1	84	49	65	36	10	918	100	604
fomesafen	0.375	25	98	80	74	51	25	1040	100	574
imazethapyr + triallate	0.047 + 1.25	88	98	95	98	8	8	1538	6	3632
LSD (0.05)		42	12	39	25	22	13	686	5	610
CV, %		108	11	47	30	63	93	37	6	21

[a] R-11, a nonionic surfactant, was added at 0.25% v/v to all fomesafen treatments.
[b] May 15, 1998 rating.
[c] May 28, 1998 rating.

Pre- and post-emergence herbicide treatments applied to spring pea with various tillage regimes. Joan Campbell and Donn Thill. (Plant Science Division, University of Idaho, Moscow, Idaho 83844-2339) Imazethapyr and imazethapyr/pendimethalin (applied pre-emergence) and imazamox (applied post emergence) were evaluated for pea injury and pea seed yield effects at Nezperce and Genesee, Idaho. The experiment was a split block design with four replications. The main plot tillage regimes were fall moldboard plow/spring cultivate, fall disc, spring burn, and direct seed at Nezperce, and fall moldboard plow, fall chisel, fall paratill, and direct seed at Genesee. 'Karita' semi-leafless pea was seeded with a Flexicoil 5000 no-till hoe airseeder at Nezperce. 'Columbia' pea was seeded with a Haybuster 1000 offset disc opener drill at Genesee. Subplots were herbicide treatments applied at 10 gpa with a tractor mounted sprayer. The herbicide plots were 15 ft wide by the width of the tillage strip which varied from 20 to 46 ft depending on the tillage operation. Winter wheat was planted in September 1998 to determine carry-over effects on wheat injury and grain yield.

Table 1. Herbicide application data.

	Nezperce		Genesee	
Treatments	Pre-emergence	Postemergence	Pre-emergence	Postemergence
Date of application	March 31, 1998	June 11, 1998	April 1, 1998	June 2, 1998
Stage of growth	Pre-emergence	4 nodes	Pre-emergence	4 nodes
Air temperature (F)	52	63	62	73
Soil temperature (F)	44 @ 4 inch	57 @ 3 inch	52 @ 3 inch	70 @ 3 inch
Relative humidity (%)	55	70	54	60

UAN (urea ammonium nitrate) was not added to the imazamox treatments at Nezperce because of injury observed at Genesee. However, visual injury from imazamox treatments was similar at both locations. Pea plants were chlorotic 5 to 7 days after imazamox application. Also, flowering was delayed and reduced, and plants were shortened about 5 in. with imazamox treatments. Seed yield reduction was greater at Genesee, 43% and 60%, than Nezperce, 8% and 25%, for imazamox at 0.032 and 0.064 lb/A, respectively, compared to the highest yielding treatment (Table 2).

There was no herbicide treatment by tillage regime interaction. Pea seed yield averaged over herbicide treatment was lowest from the plow treatment at both locations (Table 3).

Table 2. Pea seed yield averaged over tillage.

		Pea seed yield	
Herbicide treatment	Rate	Nezperce	Genesee
	lb/A	lb/A	
control	0	1844 ab[b]	1658 a
imazamox[a]	0.032	1782 b	1006 b
imazamox[a]	0.064	1446 c	720 c
imazethapyr	0.047	1871 ab	1772 a
imazethapyr	0.094	1914 a	1777 a
imazethapyr/pendimethalin	0.68	1929 a	1677 a
imazethapyr/pendimethalin	1.35	1880 ab	1761 a

[a] Applied with R-11 nonionic surfactant (0.25% v/v) at Nezperce and R-11 nonionic surfactant (0.25%v/v) + UAN 32-0-0 (1qt/A) at Genesee
[b] Means within a column followed by the same letter are not significantly different from one another (P=0.05)

Table 3. Pea seed yield averaged over herbicide treatment.

Nezperce		Genesee	
Tillage	Pea seed yield	Tillage	Pea seed yield
	lb/A		lb/A
Disc	1916 a[a]	Paratill	1592 a[a]
Direct seed	1876 a	Chisel	1546 a
Burn	1854 a	Direct seed	1537 a
Moldboard plow	1591 b	Moldboard plow	1251 b

[a] Means within a column followed by the same letter are not significantly different from one another (P=0.05)

Broadleaf weed control in field potato. Richard N. Arnold and Daniel Smeal. (New Mexico State University Agricultural Science Center, Farmington, NM 87499) Research plots were established in April 23, 1998 at the Agricultural Science Center, Farmington, New Mexico to evaluate the response of potato (var. Russet Norkotah) and annual broadleaf weeds to herbicides. Soil type was a Wall sandy loam with a pH of 7.8 and an organic matter content of less than 1%. The experimental design was a randomized complete block with three replications. Individual plots were 4, 34 in rows 30 ft long. Treatments were applied with a compressed air backpack sprayer calibrated to deliver 30 gal/A at 30 psi. Preemergence treatments were applied after drag-off on May 18 and were immediately incorporated with 0.75 in of sprinkler applied water. Three preemergence treatments were applied on May 18 followed by a postemergence treatment applied on June 2 when potato were four to six inch in height and weeds were small. Black nightshade infestations were heavy, prostrate and redroot pigweed infestations were moderate throughout the experimental area. Preemergence, preemergence/postemergence treatments and crop injury were evaluated visually on June 18 and July 2. The postemergence treatment was evaluated on July 2. Results obtained were subjected to analysis of variance at P=0.05.

None of the treatments showed any noticeable crop injury. Broadleaf weed control was good to excellent with all treatments except the check. (Published with the approval of the New Mexico State University Agricultural Experiment Station.)

Table. Broadleaf weed control in field potato.

Treatments	Rate	Crop Injury	Weed Control AMARE	AMABL	SOLNI
	lb/A	%			
Metribuzin[a]	0.3	0	100	100	100
Metribuzin + dimethenamid[a]	0.3+1.17	0	100	100	100
Metribuzin + BASF 656[a]	0.3+0.64	0	100	100	100
Metribuzin + rimsulfuron[a]	0.3+0.0156	0	100	100	100
BAS 656 + rimsulfuron[a]	0.64+0.0156	0	100	100	100
Rimsulfuron[a]	0.0156	0	100	100	94
Metribuzin/rimsulfuron[b]	0.3/0.0156	0	100	100	100
Dimethenamid/rimsulfuron[b]	1.17/0.0156	0	100	100	100
BAS 656/rimsulfuron[b]	0.64/0.0156	0	100	100	100
Rimsulfuron[c]	0.0156	0	100	100	100
Dimethenamid[a]	2.34	0	100	100	97
BAS 656[a]	1.28	0	100	100	97
Dimethenamid + rimsulfuron[a]	1.17+0.0156	0	99	99	99
Dimethenamid[a]	1.17	0	97	96	96
BAS 656[a]	0.64	0	96	94	95
Check		0	0	0	0
LSD 0.05		ns	1	1	1

[a]Treatments were applied preemergence and evaluated on June 18.
[b]First treatment was applied preemergence and second treatment was applied postemergence with a surfactant at 0.25% v/v and evaluated on July 2.
[c]Treatment was applied postemergence with a surfactant at 0.25% and evaluated on July 2.

Weed control in no-tillage safflower. Joseph P. Yenish and Nichole A. Eaton. Washington State University, Pullman, WA 99164-6420. A field trial was conducted to determine safflower crop safety and weed control efficacy in a grower's field near Ritzville, WA. The experimental design was a randomized complete block with four replications and an individual plot size of 10 by 35 feet. Granular trifluralin was applied by hand to the full 10 foot width of the respective plots during the fall of 1997. Herbicide granules were blended with sand to ensure even distribution. Other herbicides treatments were applied either spring preemergence or postemergence to the center 6 feet of respective plots with a CO_2 backpack sprayer calibrated to deliver 10 gpa at 33 psi. Application data is shown in Table 1. Safflower was directly seeded into small grain stubble in 7.5 inch rows on April 6, 1998. Crop injury and Russian thistle control was visually rated on June 27 and July 9, 1998. Safflower was harvested on September 3, 1998.

Slight crop injury was observed at both rating dates for sulfentrazone and fomesafen (Table 2). More severe injury was seen with tribenuron. Control of Russian thistle was greatest with pendimethalin, sulfentrazone, thifensulfuron, and tribenuron. Safflower yields were greatest in trifluralin and quizalofop treatments. Grass weed infestation was light in the experiment. Therefore, yield was more related to crop injury than weed control. The lowest yielding treatments was tribenuron due to severe crop injury. Slight yield reduction relative to the weedy check was observed in the fomesafen treatment. The amount of injury observed in sulfentrazone plots did not appear to reduce safflower yields.

Table 1. Application data

	Fall preplant	Preemerge	Postemergence
Date	Dec. 17, 1997	Apr. 8, 1998	June 9, 1998
Safflower stage	NA	NA	10" height 11 nodes
R. thistle stage	NA	NA	2-5" height
Air temp.	34 F	56 F	78 F
Rel. hum.	60%	100%	50%
Wind	3 mph	3 mph	3 mph
Soil temp.	33 F	55 F	80 F
Cloud cover	50%	90%	10%

Table 2. Safflower injury and yield and weed control.

		Crop injury		Russian thistle control		
Treatment	Rate	June 27	July 9	June 27	July 9	Safflower yield
	lb/A	%				lb/A
Weedy check		0	0	0	0	724
Trifluralin[a]	1	3	0	52	64	861
Pendimethalin	1	0	4	69	81	753
Sulfentrazone	0.25	4	11	75	77	752
Sulfentrazone	0.38	8	9	87	83	776
Imazamethabenz[b]	0.25	0	0	40	58	745
Thifensulfuron[b]	0.38	0	0	73	81	721
Tribenuron[b]	0.33	40	71	86	88	135
Fomesafen	0.25	11	15	48	61	663
Quizalofop[b]	0.4	2	0	0	0	828
LSD (P=0.05)		7	11	15	22	158

[a] 10% granular formulation.
[b] Applied with nonionic surfactant at 0.25% v/v.

Grass weed control in timothy for hay. Joseph P. Yenish and Nichole A. Eaton. Washington State University, Pullman, WA 99164-6420. Timothy hay is a valuable export commodity for the state of Washington. The export market demands that the timothy hay be of high quality and free of other plant species. Thus, hay growers must control grasses that are normally considered forage species in timothy fields to receive a premium price on the export market. The purpose of this research was to evaluate herbicides for control of volunteer oats and *Lolium* sp. and injury to timothy.

Herbicide treatments to compare grass weed control in timothy for hay were established in the spring of 1998 in Kittitas County, WA. Timothy had been planted in the field the previous fall following harvest of a tame oat crop. The experimental design was a randomized complete block with four replications. Individual plot size was 10 by 25 feet with only the center 6 feet of each plot receiving the herbicide treatment. Treatments were applied postemergence to crop and weeds on April 22, 1998 with a CO_2 backpack sprayer calibrated to deliver 10 gpa at 31 psi to 6 to 8 in. tall timothy with a developed corm, 0.5 to 3 in. tall 1-leaf to fully tillered mixture of perennial and Italian ryegrass (*Lolium* sp.), and 0.5 in. tall one to 3-leaf volunteer oats. Environmental conditions at application were as follows: air temperature 48 F, relative humidity 90%, wind less than 1 mph, cloud cover 30%, and soil temperature 51 F at 2 in. Rill irrigation was begun approximately 1 wk following herbicide application. Timothy injury was visually evaluated on May 1, May 17, and June 16. Volunteer oat and *Lolium* sp. control was visually evaluated on June 16. Hay was cut and harvested between June 20 and June 25. Hay yields and percentage composition were not evaluated. On July 10, following harvest regrowth of *Lolium* sp. was visually evaluated for control.

The tralkoxydim treatment was the only treatment with little to no timothy hay injury at all rating dates. Treatments of diclofop, MON 37500, and imazamethabenz had timothy injury ratings of 4, 31, and 22%, respectively, on May 1 with injury increasing to 34, 64, and 29%, respectively, by May 17 before recovering to more acceptable levels by June 16. Tralkoxydim provided good to excellent control of both volunteer oats and *Lolium* sp. Volunteer oat and *Lolium* sp. control with diclofop were good to excellent. *Lolium* sp. control with MON 37500 varied between rating dates while volunteer oat control was excellent. Imazamethabenz gave excellent control of volunteer oats, but poor control of *Lolium* sp. All other herbicides provided excellent control of volunteer oats. Control of *Lolium* sp. was variable between rating dates within a herbicide treatment. In the treatments with the most extreme differences severe timothy injury allowed the lesser injured *Lolium* sp. an opportunity to recover in the absence of crop competition following hay harvest prior to the July 10 rating.

Table. Timothy response and weed control from herbicide treatments.

					Weed control		
		Timothy injury			Volunteer oats	*Lolium sp.*	
Treatment	Rate	May 1	May 17	June 16	June 16	June 16	July 10
	lb/A	%					
Clethodim[a]	0.1	41	99	99	99	99	93
Imazamethabenz[b]	0.47	22	29	9	99	30	11
Tralkoxydim[c]	0.18	1	0	1	91	95	86
Sethoxydim[a]	0.2	37	98	99	99	99	74
Fenoxaprop /safener	0.1	18	83	65	94	16	0
Fluazifop + fenoxaprop[a]	0.05 + 0.016	42	92	90	99	80	19
Diclofop	1	4	34	19	96	88	76
MON 37500[b]	0.031	31	64	18	93	87	50
Imazamox[b]	0.031	34	90	83	96	65	41
Quizalofop[b]	0.06	30	94	94	98	81	0
LSD (P=0.05)		8	11	9	21	22	5

[a] Applied with crop oil concentrate at 1 pt./a.
[b] Applied with nonionic surfactant at 0.25% v/v.
[c] Applied with TF8035 surfactant at 0.5% v/v.

Preharvest small grain dry down. Richard K. Zollinger, Scott A. Fitterer, and Frank A. Manthey. (Department of Plant Sciences and Cereal Science, North Dakota State University, Fargo, ND 58105). An experiment was conducted at Fargo, ND, to evaluate herbicides applied preharvest in wheat. 'Ben' durum wheat was planted April 28, 1998. Plots were kept weed free by applying tralkoxydim + Scoil at 0.18 lb/A + 1.5% v/v + bromoxynil & MCPA ester at 0.25 + 0.25 lb/A to small weeds. The 50% grain moisture treatments were applied on July 23, 1998, at 8:30 am with 64 F air, 61 F soil surface, 70% RH, 0 to 2 mph NW wind, no clouds, dry soil surface, moist subsoil, good crop vigor, no dew present, and at the soft dough crop wheat stage. The 30% grain moisture treatments were applied on July 29, 1998, at 7:30 am with 72 F air, 72 F soil surface, 61% RH, 0 to 3 mph NW wind, 100% clouds, dry soil surface, moist subsoil, good crop vigor, no dew present, and at the hard dough wheat stage. The 9 days before harvest treatments were applied on July 9, 1998, at 8:00 am with 72 F air, 72 F soil surface, 61% RH, 0 to 3 mph NW wind, 100% clouds, dry soil surface, moist subsoil, good crop vigor, no dew present, and hard dough crop stage. The 3 days before harvest treatments were applied on August 4, 1998, at 8:00 am with 68 F air, 68 F soil surface, 78% RH, 3 to 5 mph SW wind, 50% clouds, dry soil surface, moist subsoil, good crop vigor, no dew present, and at the harvest ripe wheat kernel stage. The treatments were applied to the center 8 feet of the 10 by 40 foot plots with a CO_2 pressurized backpack 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. Plots were harvested August 9, 1998.

Treatments applied at 50% grain moisture wheat stage reduced test weight, 1000 kernel weight, percent large kernels, percent normal seedlings, but increased percent injured seedlings, micro-sedimentation, relative yellow color, gluten content, and protein. Treatments applied 9 days before harvest or 30% grain moisture or later generally did not have different measurements than grain from untreated plots. Measurements and their range that were not significantly different from grain of untreated plots (data not shown) were: vitreous kernels (82 to 93%); protein of whole kernel (12.3 to 13.4% dry basis); falling number, value indicates no sprout damage (390 to 428 seconds); yield (10.5 to 14.7 bu/A); total germination, sum of normal and injured seedlings (71.7 to 82.5%); semolina extracted from grain (66.6 to 68.6%); brightness of semolina, the higher the value the more bright (83.6 to 84.7); green to red reading of semolina, negative number is green reading a positive number is red (-1.6 to +2.0); yellow reading of semolina, the higher the number the more yellow (21.5 to 23.0); wet gluten content, a measure of desirable protein in semolina (26.5 to 29.9%); ash content (0.87 to 0.91% dry basis); medium kernels (7 to 12%); and small kernels (3 to 6%).

Table. Preharvest small grain dry down.

Treatment[c]	Rate	Kernel[a] Twt	1000	L/K	Seedling[b] Norm	Inj	Mst[d]	Yel[e]	Gluten index[f]	Protein[g]
	lb/A	lb/bu	g	%	—— % ——		mm		%	%
50% grain moisture										
Gylphosate-ipa salt	0.75	60.7	34.2	44	60	23	29	22.5	86	11.9
Glyphosate-tms salt	0.68+0.25%	60.8	33.4	45	62	19	30	22.8	81	11.9
Glyphosate-ipa salt&2,4-D-ipa	0.59&0.9	61.2	33.9	50	52	20	31	23.0	80	12.1
Glyphosate-ipa salt+dicamba-dma salt	0.75+0.25	60.8	33.2	44	56	22	30	23.0	77	12.2
9 days before harvest										
Paraquat+NIS	0.25+0.25%	61.6	38.1	63	73	2	27	21.9	69	11.6
Paraquat+NIS	0.37+0.25%	61.7	36.0	62	73	4	29	22.1	61	11.6
Paraquat+NIS	0.5+0.25%	61.8	36.8	64	72	5	27	21.8	63	11.9
30% grain moisture										
Gylphosate-ipa salt	0.75	62.0	36.3	64	66	5	28	22.1	63	11.6
Glyphosate-tms salt	0.68+0.25%	62.1	36.4	63	75	4	29	22.0	67	11.4
Glyphosate-ipa salt&2,4-D-ipa	0.59&0.9	62.1	36.2	62	75	2	28	22.1	56	11.5
Glyphosate-ipa salt+dicamba-dma salt	0.75+0.25	61.8	36.1	63	72	5	28	21.9	52	11.5
3 days before harvest										
Paraquat+NIS	0.25+0.25%	61.5	35.7	64	69	3	28	21.7	66	11.8
Paraquat+NIS	0.37+0.25%	60.8	35.6	62	72	2	29	21.5	69	11.2
Paraquat+NIS	0.5+0.25%	61.2	36.6	64	75	3	27	21.5	47	11.6
Untreated		61.1	35.6	65	78	0	28	22.1	63	11.7
LSD (0.05)		0.7	1.9	7	9	5	2	0.7	14	0.4

[a] Twt = kernel test weight, 1000 = 1000 kernel weight, L/K = large kernels.
[b] norm = normal germinating seedlings, inj = injured seedlings (roots thick and stunted).
[c] Glyphosate-ipm = isopropylamine salt, glyphosate-tms = trimethyl sulfonium salt, & = premix formulation.
[d] Mst = micro-sedimentation test (higher the value, the better the protein quality).
[e] Yel = yellow reading (higher the number, the more yellow).
[f] Gluten index = measure of gluten quality.
[g] Protein= protein content of semolina on dry basis.

Evaluation of fluroxypyr and other broadleaf herbicides for ALS-resistant kochia control in HRSW. Brian M. Jenks and Tammy L. Ellefson. (North Central Research Extension Center, Minot, ND 58701). A series of herbicide combinations were evaluated for broadleaf weed control, but with particular emphasis on possible low populations of ALS-resistant kochia. Amidon hard red spring wheat was seeded May 5 in Minot, ND. Seedbed preparation was conventional with 6-inch row spacing and wheat seeded at 1 million pls/A. All treatments were applied with a CO_2 pressurized bicycle sprayer traveling 3 mph with 8001 flat fan nozzles delivering 10 gpa at 40 psi. Plot dimensions were 10 feet by 30 feet. The treatments were arranged in a RCBD and replicated three times. Weeds present included kochia, Russian thistle, common lambsquarters, and prostrate pigweed. Wheat was harvested with a small plot combine on August 24.

The 1X or 2X rate of tribenuron did not control kochia more than 78%. Visual evaluations of treated kochia plants indicate that the field has about 20% ALS-resistant kochia present. When we combined tribenuron with bromoxynil + MCPA ester, fluroxypyr, or 2,4-D + dicamba, kochia control was greater than 90%. Tribenuron did provide good control of the other weeds present. Kochia control was excellent with any treatment that included fluroxypyr or bromoxynil + MCPA ester. Unfortunately, fluroxypyr by itself at 0.5 pt/A or 0.67 pt/A controlled only kochia and did not control the other broadleaf weeds. Whereas, bromoxynil + MCPA ester provided good control of all weeds present. Combinations that included propanil or thifensulfuron + tribenuron did not control kochia unless bromoxynil was present in the mixture. General broadleaf control with 2,4-D ester was better than with MCPA ester.

Application date	June 12
Air / Soil Temperature (°F)	72 / 62
Relative humidity (%)	41
Wheat stage	5-leaf
Weed size / density	
Kochia	5" / 32 per sq ft
Russian thistle	2" / 3 per sq ft
Common lambsquarters	2" / 3 per sq ft
Prostrate pigweed	2" / 3 per sq ft

Table. Evaluation of fluroxypyr and other broadleaf herbicides for ALS-resistant kochia control in HRSW.

Treatment	Rate	July 3 Kocz	July 3 Ruth	July 3 Colq	July 3 Prpw	August 10 Kocz	August 10 Ruth	August 10 Colq	August 10 Prpw	Aug 24 Yield
	lb/A	% Control								bu/A
untreated		0	0	0	0	0	0	0	0	37
tribenuron + NIS	0.0078 + 0.25%	80	100	99	85	78	100	100	92	38
tribenuron + NIS	0.016 + 0.25%	77	100	100	87	73	100	100	96	41
tribenuron +	0.0078 +	92	99	99	90	95	100	100	98	44
2,4-D ester +	0.25 +									
dicamba +	0.125 +									
NIS	0.125%									
tribenuron +	0.0078 +	93	97	99	92	92	100	100	95	42
bromoxynil-MCPA ester[a] +	0.375 +									
NIS	0.25%									
bromoxynil-MCPA ester	0.5	96	98	98	92	97	100	100	95	33
fluroxypyr +	0.083 +	99	98	100	91	100	98	100	97	44
bromoxynil-MCPA ester	0.375									
fluroxypyr	0.0625	93	20	20	17	98	33	23	30	39
fluroxypyr	0.083	95	37	23	17	99	35	23	33	42
fluroxypyr +	0.083 +	94	84	92	90	100	99	100	92	42
2,4-D ester	0.25									
fluroxypyr +	0.083 +	94	53	60	50	96	82	91	85	38
MCPA ester	0.25									
tribenuron +	0.0078 +	96	95	97	87	98	98	100	95	42
fluroxypyr +	0.083 +									
2,4-D ester +	0.25 +									
NIS	0.25%									
fluroxypyr +	0.083 +	92	84	90	82	97	96	96	94	42
dicamba +	0.063 +									
2,4-D ester +	0.25 +									
NIS	0.25%									
tribenuron +	0.0078 +	97	98	99	91	99	100	100	97	42
fluroxypyr +	0.0625 +									
2,4-D ester +	0.25 +									
NIS	0.25%									
fluroxypyr +	0.0625 +	90	86	93	83	100	100	100	96	39
dicamba +	0.063 +									
2,4-D ester +	0.25 +									
NIS	0.25%									
propanil +	1.4 +	28	17	72	71	41	52	100	77	31
MCPA ester +	0.25 +									
COC	1%									
propanil +	1.4 +	96	96	100	93	95	97	100	96	35
MCPA ester +	0.25 +									
COC +	1% +									
bromoxynil	0.187									
propanil +	1.4 +	65	96	98	95	59	98	100	100	25
thifensulfuron-tribenuron[b] +	0.011 +									
NIS	0.25%									
dicamba	0.125	82	75	72	73	92	100	100	92	40
CV		6	16	23	23	7	16	13	13	16
LSD (0.05)		8	20	30	28	9	23	18	20	10

[a] bromoxynil-MCPA ester was applied as a commercial premix
[b] thifensulfuron-tribenuron was applied as a commercial premix
COC = Class 17% Concentrate by Cenex
NIS = Class Preference by Cenex

Tralkoxydim tank mix compatibility and efficacy. Brian M. Jenks and Tammy L. Ellefson. (North Central Research Extension Center, Minot, ND 58701). Tralkoxydim was evaluated for wild oat control compared to other products. Amidon hard red spring wheat was seeded April 23. Seedbed preparation was conventional with 6-inch row spacing and wheat seeded at 1 million pls/A. All treatments were applied with a CO_2 pressurized bicycle sprayer traveling 3 mph with 8001 flat fan nozzles delivering 10 gpa at 40 psi. Plot dimensions were 10 feet by 30 feet. The treatments were arranged in a RCBD and replicated three times. Wheat was harvested with a small plot combine on August 11.

Soil conditions were very dry from mid-April through mid-June. We received only one inch of rainfall from planting to the first herbicide application and one additional inch through the first month after the herbicide application. Wild oat control with tralkoxydim was better (20-30%) when tankmixed with certain broadleaf herbicides compared to tralkoxydim applied alone. Severe antagonism was observed when tralkoxydim was tankmixed with prosulfuron. Weed control was generally as good or better when AMS was included in the tankmix.

Application date	May 19
Temperature (°F)	
Air	71
Soil	68
Soil moisture	dry
Relative humidity (%)	25
Wheat stage	3-leaf
Wild oat size / density	3-leaf / 17 per sq ft
Common lambsquarters size / density	<1" tall / 20 per sq ft

Table. Tralkoxydim tank mix compatibility and efficacy

		June 9		July 24		Aug 11
Treatment	Rate	Wioa	Colq	Wioa	Colq	Yield
	lb/A	------------% Control-----------				bu/A
tralkoxydim + TF8035[a]	0.18 + 0.5%	63	0	53	0	16
tralkoxydim + TF8035 + AMS	0.18 + 0.5% + 1.5	75	0	60	0	18
tralkoxydim + TF8035 + bromoxynil-MCPA ester[b]	0.18 + 0.5% + 0.75	85	95	83	100	30
tralkoxydim + TF8035 + bromoxynil-MCPA ester + AMS	0.18 + 0.5% + 0.75 + 1.5	85	95	91	97	35
tralkoxydim + TF8035 + fluroxypyr + 2,4-D ester	0.18 + 0.5% + 0.167 + 0.5	87	95	88	99	32
tralkoxydim + TF8035 + fluroxypyr + 2,4-D ester + AMS	0.18 + 0.5% + 0.167 + 0.5 + 1.5	85	95	82	100	26
tralkoxydim + TF8035 + 2,4-D ester	0.18 + 0.5% + 0.5	83	95	68	100	18
tralkoxydim + TF8035 + 2,4-D ester + AMS	0.18 + 0.5% + 0.5 + 1.5	88	94	88	99	34
tralkoxydim + TF8035 + clopyralid-MCPA ester[c]	0.18 + 0.5% + 0.346	85	94	84	100	29
tralkoxydim + TF8035 + clopyralid-MCPA ester + AMS	0.18 + 0.5% + 0.346 + 1.5	90	93	80	99	25
tralkoxydim + TF8035 + prosulfuron	0.18 + 0.5% + 0.018	77	82	50	100	22
tralkoxydim + TF8035 + prosulfuron + AMS	0.18 + 0.5% + 0.018 + 1.5	48	77	38	90	15
tralkoxydim + TF8035 + MCPA ester	0.18 + 0.5% + 0.5	87	93	77	99	23
tralkoxydim + TF8035 + MCPA ester + AMS	0.18 + 0.5% + 0.25 + 1.5	89	85	75	100	24
Untreated		0	0	0	0	11
CV		13	8	18	5	32
LSD (0.05)		16	10	26	8	13

[a] TF8035 = Spray additive by Zeneca
[b] bromoxynil-MCPA ester applied as commercial premix
[c] clopyralid-MCPA ester applied as commercial premix

Green foxtail control with clodinafop in HRSW. Brian M. Jenks and Tammy L. Ellefson. (North Central Research Extension Center, Minot, ND 58701). Clodinafop was evaluated for green foxtail control compared to other products. Amidon hard red spring wheat was seeded May 5. Seedbed preparation was conventional with 6-inch row spacing and wheat seeded at 1 million pls/A. All treatments were applied with a CO_2 pressurized bicycle sprayer traveling 3 mph with 8001 flat fan nozzles delivering 10 gpa at 40 psi. Plot dimensions were 10 feet by 30 feet. The treatments were arranged in a RCBD and replicated three times. Wheat was harvested with a small plot combine on August 13.

Clodinafop and fenoxaprop provided good to excellent green foxtail control. Some antagonism was observed (10% lower weed control) in the 3-way mix of clodinafop, thifensulfuron + tribenuron, and dicamba. Little or no antagonism was observed when clodinafop was tankmixed with dicamba alone, thifensulfuron + tribenuron alone, or bromoxynil + MCPA ester alone. Tralkoxydim was inadvertently mixed and applied at one-half the normal use rate.

Application date	June 6
Application timing	POST
Temperature (°F)	
Air	56
Soil	56
Relative humidity (%)	43
Wheat stage	4 to 5-leaf
Green foxtail	1-2" tall / 125 per sq ft
Common lambsquarters	< 1" tall / 2 per sq ft

Table. Green foxtail control with clodinafop in HRSW.

		July 3		August 7		Aug 13
Treatment	Rate	Grft	Colq	Grft	Colq	Yield
	lb/A	-----------------%	Control-----------------			bu/A
untreated		0	0	0	0	23
clodinafop + Score[a]	0.063 + 1%	95	0	97	0	25
clodinafop + bromoxynil-MCPA ester + Score[b]	0.063 + 0.5 + 1%	88	100	92	100	30
clodinafop + dicamba + Score	0.063 + 0.094 + 1%	95	100	94	100	32
clodinafop + thifensulfuron-tribenuron + Score[c]	0.063 + 0.014 + 1%	90	100	94	100	31
clodinafop + thifensulfuron-tribenuron + dicamba + Score	0.063 + 0.014 + 0.063 + 1%	86	100	83	100	31
fenoxaprop	0.05	92	0	92	0	30
fenoxaprop + thifensulfuron-tribenuron	0.05 + 0.014	96	100	95	100	31
tralkoxydim + Supercharge[d]	0.09 + 0.5%	85	0	73	0	26
tralkoxydim + bromoxynil-MCPA ester + Supercharge[e]	0.09 + 0.5 + 0.5%	72	100	63	100	33
CV		13	0	13	0	10
LSD (0.05)		17	0	17	0	5

[a] Score = spray additive by Novartis
[b] bromoxynil-MCPA ester applied as commercial premix
[c] thifensulfuron-tribenuron applied as commercial premix
[d] tralkoxydim inadvertently mixed at ½ rate
[e] Supercharge = spray additive by Zeneca

Wild oat control with clodinafop in HRSW. Brian M. Jenks and Tammy L. Ellefson. (North Central Research Extension Center, Minot, ND 58701). Clodinafop was evaluated for wild oat control compared to other products. Amidon hard red spring wheat was seeded April 23. Seedbed preparation was conventional with 6-inch row spacing and wheat seeded at 1 million pls/A. All treatments were applied with a CO_2 pressurized bicycle sprayer traveling 3 mph with 8001 flat fan nozzles delivering 10 gpa at 40 psi. Plot dimensions were 10 feet by 30 feet. The treatments were arranged in a RCBD and replicated three times. Wheat was harvested with a small plot combine on August 10.

Soil conditions were very dry from mid-April through mid-June. We received only one inch of rainfall from planting to the first herbicide application and one additional inch through the first month after the herbicide application. Clodinafop alone or in combination with thifensulfuron-tribenuron provided good to excellent wild oat control. Wild oat control was reduced 10-20% when clodinafop was tankmixed with dicamba in a two-way or three-way mix. Wild oat control with clodinafop alone was 10-20% better than fenoxaprop or tralkoxydim applied alone.

Application date	May 19
Application timing	POST
Temperature (°F)	
Air	69
Soil	70
Relative humidity (%)	29
Soil moisture	dry
Wheat stage	4-leaf
Wild oat	3-leaf / 19 per sq ft
Common lambsquarters	< 1" tall / 2 per sq ft

Table. Wild Oat control with clodinafop in HRSW.

Treatment Name	Rate	June 9 Wioa	June 9 Colq	July 24 Wioa	July 24 Colq	Aug 10 Yield
	lb/A	-------------% Control			--------------	bu/A
untreated		0	0	0	0	19
clodinafop + Score[a]	0.05 + 0.8%	87	0	89	0	28
clodinafop + dicamba + Score	0.05 + 0.094 + 0.8%	82	91	66	99	26
clodinafop + thifensulfuron-tribenuron + Score[b]	0.05 + 0.014 + 0.8%	88	91	93	97	34
clodinafop + thifensulfuron-tribenuron + dicamba + Score	0.05 + 0.014 + 0.063 + 0.8%	78	98	78	99	26
fenoxaprop	0.08	73	0	77	0	24
fenoxaprop + thifensulfuron-tribenuron	0.08 + 0.014	73	98	70	100	22
tralkoxydim + Supercharge[c]	0.18 + 0.5%	70	0	55	0	17
tralkoxydim + bromoxynil-MCPA ester + Supercharge[d]	0.18 + 0.5 + 0.5%	75	93	66	93	20
CV		9	10	10	5	22
LSD (0.05)		11	8	16	6	9

[a] Score = spray additive by Novartis
[b] thifensulfuron-tribenuron applied as commercial premix
[c] Supercharge = spray additive by Zeneca
[d] bromoxynil-MCPA ester applied as commercial premix

Broadleaf weed control in spring wheat with carfentrazone in combination with other herbicides. Traci A. Rauch and Donald C. Thill. (Plant Science Division, University of Idaho, Moscow, ID 83844-2339) A study was established near Palouse, WA in 'Wawahi' spring wheat to evaluate broadleaf weed control and wheat response to carfentrazone in combination with other herbicides. Plots were 8 by 30 ft arranged in a randomized complete block with four replications. All herbicide treatments were applied with a CO_2 pressurized backpack sprayer calibrated to deliver 10 gpa at 30 psi and 3 mph (Table 1). Wheat injury was evaluated visually on June 1 and June 18, 1998, and weed control was evaluated on June 18 and July 15, 1998. Wheat seed was harvested with a small plot combine from a 4 by 27 ft area in each plot on September 1, 1998.

Table 1. Application data.

Application date	May 29, 1998
Wheat growth stage	1 to 2 tiller
Broadleaf growth stage	2 to 4 in tall
Air temp (F)	58
Relative humidity (%)	76
Wind (mph, direction)	3, SW
Cloud cover (%)	80
Soil temperature at 2 in (F)	50
pH	5.3
OM (%)	3.9
CEC (meq/100g)	28.4
Texture	silt loam

Carfentrazone + 2,4-D amine injured wheat 10% at 3 DAT (Table 2). No injury was visible by 21 DAT. Carfentrazone alone and with 32% UAN suppressed common lambsquarters (CHEAL) 64 and 81% and hairy nightshade (SOLSA) 56 and 61%. Carfentrazone + thifensulfuron/tribenuron suppressed hairy nightshade 76%, while all other treatments controlled hairy nightshade 82% or better and common lambsquarters 96% or greater. Grain yield from all herbicide treatments was not different from the untreated check.

Table 2. Weed control and winter wheat response with carfentrazone in combination with other herbicides.

		Wheat		Weed control	
Treatment[a]	Rate	Injury[b]	Yield	CHEAL	SOLSA
	lb/A	%	lb/A	---------------%---------------	
Carfentrazone	0.008	0	3307	64	56
Carfentrazone + 32% UAN	0.008 + 4.0	0	3424	81	61
Carfentrazone + MCPA amine	0.008 + 0.375	2.5	2549	97	85
Carfentrazone + 2,4-D amine	0.008 + 0.375	10	2778	97	89
Carfentrazone + dicamba	0.008 + 0.125	0	3336	98	96
Carfentrazone + dicamba + MCPA amine	0.008 + 0.094 + 0.375	0	3488	96	94
Carfentrazone + thifensulfuron/tribenuron	0.008 + 0.014	0	3247	96	76
Carfentrazone + fenoxaprop/safener + thifensulfuron/tribenuron	0.008 + 0.105 + 0.014	0	3530	96	82
Untreated check	--	--	2767	--	--
LSD (0.05)		3	NS	14	24
Plants/ft^2				16	16

[a]32% UAN applied at a v/v rate. All treatments applied with NIS (90% nonionic surfactant) at the 0.25% v/v rate.
[b]June 1, 1998 evaluation date.

Field bindweed control and persistence of BAS 589 03H in rotational crops. Traci A. Rauch and Donald C. Thill. (Plant Science Division, University of Idaho, Moscow, ID 83844-2339) A study was established in 1996 near Moscow, Idaho to evaluate field bindweed control and persistence of BAS 589 03H in spring wheat and pea. The experimental design was a randomized split-block with four replications. Main plots were five herbicide treatments (applied sequentially to the same plots in 1996, 1997, and 1998) and an untreated check (16 by 30 ft), and subplots were two rotational crops (15 by 96 ft). Treatments were applied with a CO_2 pressurized backpack sprayer (Table 1). Fertilizer (40-0-0-6) was applied at 200 lb/A and incorporated with a field cultivator on March 31, 1998. Rotational crops, 'Columbia' spring pea and 'Penawawa' spring wheat, were seeded at 120 lb/A perpendicular to the herbicide treatments on half of each plot on April 13, 1998. Metribuzin was applied to spring pea at 0.25 lb ai/A post-plant preemergence on April 17 and at 0.1875 lb ai/A postemergence on May 11, 1998. The spring pea was treated with esfenvalerate at 0.05 lb ai/A on May 1, 1998 to control pea leaf weevil. Bromoxynil (0.25 lb ai/A) and MCPA amine (0.25 lb ai/A) were applied on May 8, 1998 to spring wheat to control broadleaf weeds. Spring pea and spring wheat were harvested on August 6 and 14, 1998, respectively. Field bindweed control was evaluated visually on September 30, 1997, and October 9, 1998. Field bindweed control and application data for 1996 were published in 1998 Western Society of Weed Science Research Progress Report, pg. 155.

Table 1. Application data and soil analysis.

Application date	September 19, 1997	September 21, 1998
Growth stage of field bindweed	6 to 10 in. runners/ blooming	8 to 11 in runners/ blooming
Gpa	20	20
Psi	40	40
Air temperature (F)	68	73
Relative humidity (%)	50	50
Wind (mph)	1	1
Cloud cover (%)	40	10
Soil temperature at 2 in. (F)	60	66
pH	6.3	
OM (%)	4.0	
Texture	silt loam	

No treatment visually injured the spring pea or wheat (data not shown). Dicamba + 2,4-D and glyphosate/2,4-D + AMS controlled field bindweed 90 and 94% in 1997 and 91 and 94% in 1998 (Table 2). In 1997, no other treatment adequately controlled field bindweed. BAS 589 03H treatments controlled field bindweed 75 and 80% in 1998. The treatment by crop interaction and the treatment main effect were not significant for seed yield of spring pea or wheat.

Table 2. Field bindweed control and spring wheat and spring pea yield with BAS 589 03H and other herbicide combinations

			Field bindweed control		Yield	
Treatment[a]	Rate	Timing	1997	1998	Spring pea	Spring wheat
	lb/A		---------%---------		----------lb/A----------	
BAS 589 03H	1.25	Summer 1996				
BAS 589 03H	0.62	Postharvest 1997	62		1726	4771
BAS 589 03H	0.62	Postharvest 1998		80		
BAS 589 03H	1.25	Summer 1996				
BAS 589 03H	1.25	Postharvest 1997	37		1521	4900
BAS 589 03H	0.62	Postharvest 1998		75		
Glyphosate/2,4-D + AMS	1+1.7	Summer 1996				
Glyphosate/2,4-D + AMS	1 +1.7	Postharvest 1997	94		1760	5172
Glyphosate/2,4-D + AMS	1+1.7	Postharvest 1998		94		
2,4-D	0.95	Summer 1996				
2,4-D	0.95	Postharvest 1997	63		1609	4902
2,4-D	0.95	Postharvest 1998		60		
Dicamba + 2,4-D	0.5 + 0.95	Summer 1996				
Dicamba + 2,4-D	0.5 + 0.95	Postharvest 1997	90		1881	5156
Dicamba + 2,4-D	0.5 + 0.95	Postharvest 1998		91		
Untreated check	--	--	--		1596	4620
LSD (0.05)			40	19	NS	NS
Density (shoots/ft^2)			0.3	3		

[a] All BAS 589 03H treatments were applied with 0.94% v/v sunflower oil. Glyphosate/2,4-D is a commercial premix formulation. AMS = liquid ammonium sulfate.

Weed control with V-10029 in wheat. Richard K. Zollinger and Scott A. Fitterer. (Department of Plant Sciences, North Dakota State University, Fargo, ND 58105). An experiment was conducted in Fargo, ND, to evaluate weed control from herbicides applied to wheat in the 3- to 6-leaf stage. 'Oxen' hard red spring wheat was planted April, 23, 1998. Early postemergence treatments were applied to 3- to 4-leaf wheat on May 20, 1998, at 4:00 to 6:00 pm with 77 F air, 69 F soil surface, 65% RH, 20% clouds, and no wind to 3- to 5-leaf wild oat at 1 to 5 plants/ft^2; and 0.5 to 1 inch, 1 leaf green and yellow foxtail at 5 to 10 plants/ft^2. Mid postemergence treatments were applied to 6-leaf wheat on June 2, 1998, at 9:30 to 10:00 am with 50 F air, 54 F soil surface, 55% RH, 95% clouds, and 2 to 5 mph NW wind; to 6 to 10 inch, 5- to 6-leaf wild at 1 to 5 plants/ft^2; 1 to 2 inch, 1- to 3-leaf green and yellow foxtail at 15 to 30 plants/ft^2; 4 to 6 inch, 4- to 6-leaf, rosette wild mustard at 2 to 5 plants/ft^2; and 2- to 4- inch, 2 to 4 leaf wild buckwheat at 4 plants/ft^2. Treatments were applied to the center 8 feet of the 10 by 40 foot plots with a bicycle-wheel-type plot sprayer equipped with a wind shield 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.

Wheat injury from treatments applied at the 3- to 4-leaf stage was highest from tralkoxydim on May 2 and June 8. Wheat injury from tralkoxydim was less than 30% when applied during the 3-leaf stage of wheat but was less than 15% when applied during the 6-leaf stage of wheat. V-10029 did not cause wheat injury greater than 25% at any evaluation. Small differences in wheat injury were observed from V-10029 applied at 0.19 to 0.75 lb/A to 3- or 6-leaf wheat. However, V-10029 at 0.94 or 1.1 lb/A and applied at the 6-leaf stage caused 25 to 45% injury, which was more than when applied during the 3- to 4-leaf stage. Wheat by July 2 had recovered from all treatments applied at the 3-leaf stage by July 2. However, wheat injury from V-10029 applied during the 6-leaf ranged from 2 to 20%. Wheat injury from fenoxaprop-p was minimal. V-10029 gave less than 60% foxtail and less than 63% wild oat control at any rate or application timings. V-10029 gave complete wild mustard control and less than 20% wild buckwheat control. Tralkoxydim and fenoxaprop did affect broadleaf weeds.

Table. Weed control with V-10029 in wheat.

		Wheat injury				14 DAT		28 DAT	
Treatment [a]	Rate	May 2	June 8	June 22	July 2	Fxtl	Wioa	Fxtl	Wioa
	lb/A	%				% control			
3 to 4 leaf wheat stage									
V-10029+Kinetic	0.19+0.125%	7	3	0	0	20	10	15	20
V-10029+Kinetic	0.38+0.125%	11	7	3	0	18	8	30	23
V-10029+Kinetic	0.56+0.125%	15	13	3	3	27	15	35	13
V-10029+Kinetic	0.75+0.125%	14	20	8	5	32	23	33	43
V-10029+Kinetic	0.94+0.125%	15	22	10	2	32	23	37	37
V-10029+Kinetic	1.1+0.125%	17	18	13	3	43	28	32	43
Tralkoxydim+Supercharge+AMS	0.24+1qt+15lb/100gal	28	27	3	0	85	92	77	97
Fenoxaprop-P	0.08	2	3	0	0	94	91	65	95
6 leaf wheat stage									
V-10029+Kinetic	0.19+0.125%		5	8	2	37	27	47	53
V-10029+Kinetic	0.38+0.125%		8	10	4	20	28	40	63
V-10029+Kinetic	0.56+0.125%		17	10	7	18	40	33	48
V-10029+Kinetic	0.75+0.125%		25	13	7	15	30	23	32
V-10029+Kinetic	0.94+0.125%		35	25	13	37	47	50	55
V-10029+Kinetic	1.13+0.125%		45	32	20	32	35	57	60
Tralkoxydim+Supercharge+AMS	0.24+1qt+15lb/100gal		7	12	6	72	88	90	80
Fenoxaprop-P	0.08		5	2	6	92	97	96	95
Untreated		0	0	0	0	0	0	0	0
LSD (0.05)		5	10	9	7	13	15	14	16

[a] Fxtl = green and yellow foxtail, Wioa = wild oat, Kinetic = surfactant with silicone, Supercharge = methylated seed oil, AMS = ammonium sulfate.

Weed control with BAS 635 in wheat. Richard K. Zollinger and Scott A. Fitterer. (Department of Plant Sciences, North Dakota State University, Fargo, ND 58105). An experiment was conducted in Fargo, ND, to evaluate weed control from herbicides applied postemergence. 'Oxen' hard red spring wheat was seeded April 23, 1998. POST treatments were applied to 4 leaf wheat on May 20, 1998, at 4:00 to 6:00 pm with 77 F air, 69 F soil surface, 65% RH, 20% clouds, and 0 mph wind; 0.5 to 1 inch, 1 to 2 leaf, green and yellow foxtail at 10 to 30 plants/ft^2;1 inch, cotyledon to 4 leaf, rosette wild mustard at 1 to 5 plants/ft^2; 1 inch, cotyledon redroot pigweed at 2 to 3 plants/ft^2; 3 to 5 leaf wild oat at 1 to 5 plants/ft^2; 2 to 4 inch diameter rosette Canada thistle at 1 to 7 shoots/yd^2; and 1 inch, 2 leaf wild buckwheat at 1 plant $yd/^2$. Treatments were applied to the center 8 feet of the 10 by 30 foot plots with a bicycle-wheel-type plot sprayer equipped with a wind shield 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.

All treatments gave complete redroot pigweed and common lambsquarters control, complete control of wild mustard at the June 13 and 26 ratings, and less than 10% foxtail and wild oat control. No wheat injury was observed on May 29. Dicamba-Na & diflufenzopyr-Na at 0.063 and 0.094 lb/A showed 30 and 50% wheat injury on June 13 and 13 and 14% wheat injury on June 26, respectively. A treatment containing bromoxynil, dicamba at 0.094 lb/A, or dicamba-Na&diflufenzopyr was required to give above 80% wild buckwheat control. Three-way combinations of either BAS 635 or thifensulfuron&tribenuron with 2,4-D and dicamba gave greater than 80% Canada thistle control. A reduction in wild buckwheat control at the June 26 evaluation may be due to seedlings that emerged after treatment.

Table. Weed control with BAS 635 in wheat.

		May 29			June 13		June 26	
Treatment [a]	Rate	Wimu	Wibw	Cath	Wibw	Cath	Wibw	Cath
	lb/A	% control						
BAS 635+NIS	0.027+0.25%	97	36	29	53	40	48	53
BAS 635+NIS	0.045+0.25%	99	38	30	50	35	65	55
BAS 635+dicamba-Na+NIS	0.027+0.094+0.25%	99	71	33	75	63	78	84
BAS 635+dicamba-Na+NIS	0.045+0.062+0.25%	98	71	30	65	40	60	61
BAS 635+dicamba-Na+NIS	0.045+0.094+0.25%	99	80	35	75	65	86	73
BAS 635+2,4-D amine+dicamba-Na+NIS	0.045+0.25+0.094+0.25%	97	85	58	85	73	92	83
BAS 635+2,4-D amine+NIS	0.045+0.25+0.25%	99	70	38	73	40	63	71
BAS 635+bromoxynil+NIS	0.027+0.25+0.25%	99	65	35	70	33	78	75
Dicamba-Na+2,4-D amine+NIS	0.094+0.25+0.25%	92	80	31	58	15	41	45
Thifensulfuron&tribenuron+dicamba-Na+NIS	0.026+0.094+0.25%	94	76	28	81	55	75	68
Thif&trib+2,4-D amine+dicamba-Na+NIS	0.026+0.25+0.094+0.25%	94	81	48	75	55	90	88
Thif&trib+bromoxynil+NIS	0.026+0.25+0.25%	97	88	30	78	20	80	61
Thif&trib+2,4-D amine+NIS	0.026+0.25+0.25%	97	85	30	65	30	59	69
Thif&trib+NIS	0.013+0.25%	97	88	33	35	28	48	55
Thif&trib+NIS	0.026+0.25%	97	79	25	68	15	53	55
Dicamba-dga	0.094	97	86	28	75	30	74	53
Dicamba-dga+MCPA amine	0.094+0.25	97	79	25	75	14	83	60
Dicamba-dga+bromoxynil&MCPA ester	0.094+0.25&0.25	97	89	28	86	23	87	75
Thif&trib+dicamba-dga+NIS	0.25+0.094+0.25%	97	90	30	73	50	70	70
Dicamba-Na&diflufenzopyr-Na+NIS	0.063&0.025+0.25%	97	86	40	80	58	86	65
Dicamba-Na&diflufenzopyr-Na+NIS	0.094&0.038+0.25%	97	89	53	90	65	90	73
Untreated		0	0	0	0	0	0	0
LSD (0.05)		5	15	13	13	14	14	14

[a]Wimu = wild mustard, Wibw = wild buckwheat, Cath = Canada thistle, dicamba-Na = sodium salt formulation, dicamba-dga = diglycolamine salt formulation, &=formulated premix, NIS = nonionic surfactant (Preference).

Wild oat control in spring wheat with fenoxaprop/safener in combination with broadleaf herbicides. Curtis R. Rainbolt and Donald C. Thill. (Plant Science Division, University of Idaho, Moscow, ID 83844-2339) A study was established in spring 1998, near Moscow, Idaho to evaluate wild oat control in spring wheat with fenoxaprop alone and in combination with broadleaf herbicides. 'Penawawa' spring wheat was seeded on May 1, 1998 into a loam soil (28.0% sand, 57.6% silt, 14.4% clay, pH 5.6, and 4.1% organic matter). The experimental design was a randomized complete block with four replications, and individual plot size was 8 by 30 ft. Herbicide treatments were applied on June 1, 1998 with a CO_2 pressurized backpack sprayer calibrated to deliver 10 gpa at 32 psi and 3 mph (Table 1). Wheat injury was evaluated visually on June 15 and July 10, 1998. Weed control evaluations were taken on July 10, 1998. Wheat was harvested at maturity with a small plot combine on August 31, 1998 from a 4.1 by 27 ft area of each plot.

Table 1. Application data.

Wheat growth stage	5 to 7 leaf
Wild oat growth stage	1 to 4 leaf
Air temperature (F)	59
Relative humidity (%)	80
Wind (mph)	1 to 2
Cloud cover (%)	20
Soil temperature at 2 in. (F)	64

Fenoxaprop + bromoxynil/MCPA stunted wheat 2% (data not shown) on June 15, however no injury was visible on July 10, 1998. All fenoxaprop/safener treatments controlled wild oat (AVEFA) 93% or better (Table 2), and combinations with broadleaf herbicides showed no antagonistic effects. The other wild oat herbicides controlled wild oat 93% with the exception of imazamethabenz (28%). All treatments with the exception of fenoxaprop/safener + MCPA ester and fenoxaprop/safener alone controlled mayweed chamomile (ANTCO) 93% or better. Grain yield in all treatments except imazamethabenz was significantly better than the untreated check.

Table 2. Weed control and spring wheat yield.

		Weed Control		Spring wheat
Treatment[a]	Rate	AVEFA	ANTCO	yield
	lb/A	---%	---	lb/A
Fenoxaprop/safener	0.104	95	23	760
Fenoxaprop/safener + thifen/triben	0.104 + 0.014	95	93	680
Fenoxaprop/safener + bromoxynil/MCPA	0.104 + 0.5	93	100	850
Fenoxaprop/safener + bromoxynil	0.104 + 0.25	95	95	680
Fenoxaprop/safener + MCPA ester	0.104 + .0375	95	75	700
Fenoxaprop/2,4-D/MCPA + bromoxynil	0.58 + 0.25	93	100	660
Imazamethabenz + bromoxynil/MCPA[b]	0.375 + 0.5	28	100	480
Tralkoxydim + bromoxynil/MCPA[c]	0.18 + 0.5	93	100	880
Diclofop + thifen/triben[b]	1.0 +0.014	93	100	1040
Untreated check	--	--	--	280
LSD(0.05)		4	17	350

[a] Thifen/triben is the commercial formulation of thifensulfuron/tribenuron, fenoxaprop/2,4-D/MCPA and bromoxynil/MCPA were applied as the commercial formulations.

[b] Applied with 90% NIS at 0.25% v/v.

[c] Applied with 0.5 % v/v TF8305 (Supercharge) a nonionic, crop oil concentrate blend.

<u>The effect of broadleaf herbicides tank-mixed with tralkoxydim on wild oat control</u>. David S. Belles and Donald C. Thill. (Plant, Soil and Entomological Sciences Department, University of Idaho, Moscow ID 83844-2339) A study was established in Latah County, ID to evaluate the efficacy of tralkoxydim for wild oat control in combination with broadleaf herbicides. Spring wheat (var. Penewawa) was seeded May 1, 1998 in a loam soil (40% sand, 12% clay, 48% silt, pH 4.9, and 6% organic matter). The experimental design was a randomized complete block with four replications and individual plots were 8 by 30 ft. Herbicide treatments were applied postemergence on June 2, 1998 with a CO_2 pressurized backpack sprayer calibrated to deliver 10 gpa at 32 psi. Growth stages were as follows; wheat 4 leaf stage, wild oat (AVEFA) 1 to 7 leaf and mayweed chamomile (ANTCO) 0.5 to 2 in. diameter. Environmental conditions at application were as follows; air temperature 57° F, relative humidity 69%, wind 0 to 3 mph, sky clear, and soil temperature 56° F at 4 inches. Spring wheat injury was evaluated June 8 and June 18, 1998. Wild oat control was evaluated on June 8, June 18, July 1, and July 20, 1998. Mayweed chamomile control was evaluated on July 1 and July 20, 1998. Spring wheat was harvested at maturity with a small plot combine from a 4.1 by 27 ft area of each plot on August 20, 1997.

Some treatments injured wheat slightly; chlorosis and/or stunting was evident when evaluated on June 8, 5 DAT (Table). Inadequate spray solution agitation resulted in injury with the tralkoxydim + bromoxynil + AMS treatment in the first block. This injury was not evident by July 1. On July 20, all treatments with a broadleaf herbicide controlled mayweed chamomile 91% or greater. On July 20, wild oat control was greater than 90% with tralkoxydim + clopyralid/MCPA ester with ammonium sulfate and tralkoxydim + fluroxypyr-methyl + MCPA ester with ammonium sulfate. Treatments with greater than 90% mayweed and wild oat control produced the highest grain yield. Tralkoxydim alone suppressed wild oat only 23% but controlled wild oat 85% when AMS was added to the spray solution. 2,4-D ester treatments antagonized wild oat control with tralkoxydim. Other broadleaf herbicides mixed with tralkoxydim did not affect wild oat control except bromoxynil alone without AMS. Treatments with AMS controlled wild oat significantly better than treatments without AMS ($p = 0.005$).

Spring wheat yield was poor due to heavy rain and standing water in late May and early June. All herbicide treated plots, except tralkoxydim alone (without AMS) produced significantly more grain than the untreated control. Grain yield in treatments with and without AMS was the same.

Table. Spring wheat response and weed control from herbicide treatments, Latah County, Idaho.

Treatment[a]	Rate	Spring wheat Injury[b]	Spring wheat Yield	Weed control[c] ANTCO	Weed control[c] AVEFA
	lb/A	%	lb/A	--%--	
Tralkoxydim + TF8035	0.18	1	783	0	23
Tralkoxydim + TF8035 + AMS	0.18	0	1108	0	85
Tralkoxydim + TF8035 + bromoxynil/MCPA	0.18 + 0.75	0	1068	100	75
Tralkoxydim + TF8035 + AMS + bromoxynil/MCPA	0.18 + 0.75	2	1172	100	86
Tralkoxydim + TF8035 + bromoxynil	0.18 + 0.5		1289	100	68
Tralkoxydim + TF8035 + bromoxynil + AMS	0.18 + 0.5	0	1252	100	83
Tralkoxydim + TF8035 + fluroxypyr-methyl + 2,4-D ester	0.18 + 0.125 + 0.5	6	797	100	30
Tralkoxydim + TF8035 + fluroxypyr-methyl + 2,4-D ester + AMS	0.18 + 0.125 + 0.5	0	963	100	55
Tralkoxydim + TF8035 + fluroxypyr-methyl + MCPA ester	0.18 + 0.125 + 0.5	0	1317	98	85
Tralkoxydim + TF8035 + fluroxypyr-methyl + MCPA ester + AMS	0.18 + 0.125 + 0.5	0	1639	94	96
Tralkoxydim + TF8035 + 2,4-D ester	0.18 + 0.5	0	963	91	45
Tralkoxydim + TF8035 + 2,4-D ester + AMS	0.18 + 0.5	1	1022	100	50
Tralkoxydim + TF8035 + clopyralid/MCPA ester	0.18 + 0.3463	0	1323	100	88
Tralkoxydim + TF8035 + clopyralid/MCPA ester + AMS	0.18 + 0.3463	0	1415	98	97
Tralkoxydim + TF8035 + prosulfuron + AMS	0.18 + 0.0178	0	1120	100	73
Tralkoxydim + TF8035 + prosulfuron + AMS	0.25 + 0.0178	0	1244	100	84
Tralkoxydim + TF8035 + thifensulfuron + AMS	0.18 + 0.0234	0	1353	100	85
Tralkoxydim + TF8035 + thifensulfuron + AMS	0.25 + 0.0234	1	1241	99	86
Untreated check	-------	0	452	---	---
	LSD (0.05)	0	378	5	15
	Density (plants/ft^2)			1	70

[a]TF8035 = a commercial nonionic, crop oil concentrate blend (Supercharge), added at 0.5% v/v.
AMS = ammonium sulfate applied at 1.5 lb product/A.
[b]June 8, 1998 evaluation. Injury = chlorosis and/or stunting.
[c]July 20, 1998 evaluation.

Comparison of postemergence wild oat herbicides in hard red spring wheat. Michael J. Wille and Don W. Morishita. (Twin Falls Research and Extension Center, University of Idaho, Twin Falls 83303-1827). A study was established in Minidoka County, Idaho to compare postemergence wild oat herbicides in spring wheat. The experimental design was a randomized complete block with four replications. Individual plots were 8 by 25 ft. 'Westbred 936' hard red spring wheat was seeded April 3, 1998, in a Portneuf sandy clay loam (48% sand, 28% silt, 24% clay, pH 7.7, 2.3% organic matter, 15-meq/100 g soil CEC). Wild oat herbicides were broadcast-applied postemergence with a CO_2-pressurized bicycle-wheel sprayer calibrated to deliver 20 gpa at 40 psi on May 27, when wheat had begun jointing and had 5 leaves and 4 to 5 tillers. Wild oat density was 19 plants/ft^2 and had three leaves and two tillers. Environmental conditions were as follows: soil temperature 62 F, air temperature 57 F, relative humidity 56%, wind velocity 3 mph, and 10% cloud cover. Crop injury was evaluated 14 days after treatment on June 11. Wild oat control was evaluated visually at wild oat maturity on July 27. Grain was harvested at maturity with a small-plot combine on September 19.

Imazamethabenz, tralkoxydim, clodinafop, and imazamethabenz + difenzoquat did not injure spring wheat, while diclofop, difenzoquat alone, and fenoxaprop & phenylpyrazolin caused 10 to 15% injury (Table). Avenge alone, clodinafop, and fenoxaprop & phenylpyrazolin controlled wild oat 90 to 100%. Tralkoxydim, imazamethabenz + difenzoquat, imazamethabenz alone, and diclofop controlled wild oat 53, 43, 25 and 18%, respectively. Spring wheat grain yield ranged from 66 to 98 bu/A in herbicide-treated plots compared to 43 bu/A in the untreated check. Grain yield from all herbicide-treated plots was greater than the untreated check. Fenoxaprop & phenylpyrazolin, difenzoquat, tralkoxydim, and clodinafop all had yields greater than diclofop. Grain test weights from herbicide-treated plots ranged from 46 to 59 lb/bu and did not differ from each other (data not shown).

Table. Crop injury, wild oat control, and grain yield response in spring wheat to wild oat herbicides.

Treatment	Rate	Crop injury	AVEFA control	Yield
	lb/A	%	%	bu/A
Untreated check		-	-	43
Diclofop	1.0	10	18	66
Fenoxaprop & phenylpyrazolin[1]	0.1	15	100	95
Imazamethabenz +	0.47 +	0	25	79
nonionic surfactant	0.25% v/v			
Difenzoquat +	1.0 +	15	90	90
nonionic surfactant	0.25% v/v			
Imazamethabenz +	0.23 +	5	42	79
difenzoquat +	0.5 +			
nonionic surfactant	0.25% v/v			
Tralkoxydim +	0.178 +	0	53	96
Supercharge[2]	0.5% v/v			
Clodinafop +	0.05 +	0	100	98
Score[2]	0.8% v/v			
LSD (0.05)		7	18	22

[1]Fenoxaprop & phenylpyrazolin is a commericial formulation of fenoxaprop and the safener, phenylpyrazolin.

[2]Score and Supercharge are commercial adjuvant formulations.

Comparison of wild oat control in spring wheat between imazamethabenz and difenzoquat versus tralkoxydim in combination with broadleaf herbicides. Michael J. Wille and Don W. Morishita. (Twin Falls Research and Extension Center, University of Idaho, Twin Falls 83303-1827). A study was established in Minidoka County, Idaho to compare postemergence wild oat control with imazamethabenz, difenzoquat, and tralkoxydim combined with broadleaf herbicides in spring wheat ('Penewawa'). The experimental design was a randomized complete block with four replications. Individual plots were 8 by 25 ft. Spring wheat was seeded April 21, 1998, in a Portneuf silt loam (19% sand, 71% silt, 10% clay, pH 7.8, 1.5% organic matter, 15-meq/100 g soil CEC). Wild oat herbicides were broadcast-applied with a CO_2-pressurized bicycle-wheel sprayer calibrated to deliver 10 gpa at 40 psi on May 19 when wheat had 4 leaves and 5 tillers. Wild oat density was 41 plants/ft^2 and averaged three leaves and two tillers. Environmental conditions were as follows: soil temperature 58 F, air temperature 60 F, relative humidity 74%, wind velocity 3 mph, and 80% cloud cover. Crop injury was evaluated 14 and 28 days after treatment June 3 and 19, respectively. Wild oat control was evaluated visually at wild oat maturity July 28, 1998. Grain was harvested with a small-plot combine August 26, 1998.

Crop injury on June 3 and 19 ranged from 0 to 8%. Herbicide treatments did not injure the crop except tralkoxydim + bromoxynil which injured the crop 8% at both evaluation dates. Wild oat control among herbicide treatments ranged from 35 to 97%. Imazamethabenz + difenzoquat tank-mixed with either thifensulfuron & tribenuron or clopyralid & 2,4-D did not control wild oat (35 and 65%) as well as imazamethabenz + difenzoquat without broadleaf herbicides (89%). Grain yield of all treatments ranged from 48 to 80 bu/A. Grain yields in herbicide-treated plots did not differ from each other. Grain test weight ranged from 52 to 62 lb/bu and did not differ from the untreated check (data not shown).

Table. Crop injury, wild oat control, and wheat grain yield response to imazamethabenz, difenzoquat, and tralkoxydim combined with broadleaf herbicides in spring wheat.

Treatment	Rate	Crop injury 6/3	Crop injury 6/19	AVEFA control	Yield
	lb/A	%	%	%	bu/A
Untreated check		-	-	-	48
Imazamethabenz[1]	0.469	0	0	95	78
Imazamethabenz +	0.234 +	0	0	89	76
difenzoquat	0.5				
Imazamethabenz +	0.469 +	0	0	91	75
bromoxynil & MCPA[2]	0.5				
Imazamethabenz +	0.234 +	0	0	79	62
difenzoquat +	0.5 +				
bromoxynil & MCPA	0.5				
Imazamethabenz +	0.469 +	0	0	92	70
thifenuron & tribenuron[2]	0.014				
Imazamethabenz +	0.234 +	0	0	65	69
difenzoquat +	0.5 +				
thifenuron & tribenuron	0.014				
Imazamethabenz +	0.469 +	0	0	70	64
clopyralid & 2,4-D[2]	0.606				
Imazamethabenz +	0.234 +	3	3	35	70
difenzoquat +	0.5 +				
clopyralid & 2,4-D	0.606				
Imazamethabenz +	0.469 +	5	6	94	71
metsulfuron	0.004				
Imazamethabenz +	0.234 +	3	3	71	60
difenzoquat +	0.5 +				
metsulfuron	0.004				
Tralkoxydim +	0.18 +	0	3	78	65
Supercharge[3]	0.5% v/v				
Tralkoxydim +	0.24 +	0	0	86	79
Supercharge	0.5% v/v				
Tralkoxydim +	0.18 +	5	5	95	70
bromoxynil & MCPA +	0.5 +				
Supercharge	0.5% v/v				
Tralkoxydim +	0.18 +	8	8	97	74
bromoxynil +	0.375 +				
Supercharge	0.5% v/v				
Tralkoxydim +	0.18 +	5	5	95	63
MCPA isooctyl ester +	0.463 +				
Supercharge	0.5% v/v				
LSD (0.05)		5	5	20	19

[1]Nonionic surfactant added at the rate of 0.25% v/v.

[2]Thifensulfuron & tribenuron, bromoxynil & MCPA, and clopyralid & 2,4-D were applied as commercial formulations.

[3]Supercharge is a commercial adjuvant formulation.

Wild oat control with fenoxaprop & phenylpyrazolin in combination with broadleaf herbicides in spring wheat. Michael J. Wille and Don Morishita. (Twin Falls Research and Extension Center, University of Idaho, Twin Falls 83303-1827). A study was established in Minidoka County, Idaho to compare postemergence wild oat control with fenoxaprop & phenylpyrazolin combined with broadleaf herbicides in spring wheat ('Penewawa'). The experimental design was a randomized complete block with four replications. Individual plots were 8 by 25 ft. Spring wheat was seeded April 21, 1998, in a Portneuf silt loam (19% sand, 71% silt, 10% clay, pH 7.8, 1.5% organic matter, 15-meq/100 g soil CEC). Wild oat herbicides were broadcast-applied postemergence with a CO_2-pressurized bicycle-wheel sprayer calibrated to deliver 10 gpa at 40 psi on May 19 when wheat had 4 leaves and 3 tillers. Wild oat density was 41 plants/ft^2 and averaged three leaves and two tillers. Environmental conditions were as follows: soil temperature 58 F, air temperature 60 F, relative humidity 74%, wind velocity 3 mph, and 80% cloud cover. Crop injury was evaluated 14 days after treatment on June 2. Wild oat control was evaluated visually at wild oat maturity on July 27. Grain was harvested on August 26, 1998 with a small plot combine.

No crop injury was evident with any herbicide treatment 14 days after treatment (Table). All herbicide treatments controlled wild oat 97 to 100% except imazamethabenz + difenzoquat + bromoxynil & MCPA which controlled wild oat 90%. Grain yields in herbicide treated plots ranged from 67 to 91 bu/A, and all were greater than the untreated check which averaged 47 bu/A. Grain test weight ranged from 57 to 62 lb/bu (data not shown). Test weights of all herbicide-treated plots were greater than the untreated check except fenoxaprop & phenylpyrazolin at 0.209 lb/A + bromoxynil & MCPA and fenoxaprop & phenylpyrazolin + thifensulfuron & tribenuron which did not differ from the untreated check.

Table. Crop injury, wild oat control, and yield with fenoxaprop & phenylpyrazolin and broadleaf weed herbicides in spring wheat.

Treatment	Rate	Crop injury	AVEFA control	Yield
	lb/A	%		bu/A
Untreated check		-	-	47
Fenoxaprop & phenylpyrazolin	0.119	0	99	88
Fenoxaprop & phenylpyrazolin	0.209	0	100	90
Fenoxaprop & phenylpyrazolin +	0.104 +	0	98	71
thifenuron &tribenuron[1]	0.014			
Fenoxaprop & phenylpyrazolin +	0.104 +	0	99	79
bromoxynil & MCPA[1]	0.5			
Fenoxaprop & phenylpyrazolin +	0.119 +	0	98	72
bromoxynil & MCPA	0.5			
Fenoxaprop & phenylpyrazolin +	0.209 +	0	98	90
bromoxynil & MCPA	0.5			
Fenoxaprop & phenylpyrazolin +	0.607 +	0	99	82
bromoxynil & MCPA	0.5			
Fenoxaprop & phenylpyrazolin +	0.104 +	0	99	70
bromoxynil	0.25			
Fenoxaprop & phenylpyrazolin +	0.104 +	0	99	81
MCPA isooctyl ester	0.375			
Imazamethabenz +	0.23 +	0	90	67
difenzoquat +	0.5 +			
bromoxynil & MCPA +	0.5 +			
Scoil[3]	0.25% v/v			
Tralkoxydim +	0.178 +	0	96	75
bromoxynil & MCPA +	0.5 +			
Supercharge[3]	0.5% v/v			
LSD (0.05)		0	4	19

[1]Thifensulfuron & tribenuron, bromoxynil & MCPA were applied as commercial formulations.

[2]Fenoxaprop & phenylpyrazolin is a commericial formulation of fenoxaprop and the safener, phenylpyrazolin.

[3]Scoil and Supercharge are commercial adjuvant formulations.

<u>Wild oat control in spring wheat with clodinafop and other wild oat herbicides.</u> Suzy M. Sanders and Donald C. Thill. (Department of Plant, Soil, and Entomological Sciences, University of Idaho, Moscow, ID 83844) A study was established during spring, 1998 near Moscow, Idaho to evaluate wild oat control in spring wheat with clodinafop alone and in combination with other herbicides. 'Penawawa' spring wheat was seeded May 1, 1998 in a loam soil (28.0% sand, 57.6% silt, 14.4% clay, pH 5.6, and 4% organic matter). The experimental design was a randomized compete block with four replications and individual plots were 8 by 30 ft. Herbicide treatments were applied postemergence on June 2, 1998 with a CO_2 pressurized backpack sprayer calibrated to deliver 10 gpa at 30 psi (Table 1). Crop injury was evaluated visually June 11, June 19, and July 1, 1998. Wild oat (AVEFA) control was evaluated visually at heading on July 23, 1998. Spring wheat was harvested with a small plot combine from a 4.3 by 27 ft area on August 31, 1998.

Table 1. Application data.

Crop stage	4 leaf/1 tiller
Wild oat stage	3 to 4 leaf
Air temperature (F)	59
Wind (mph)	Calm
Cloud cover	30%
Relative humidity (%)	80
Soil temperature at 2 in (F)	62

Wheat was not injured by any herbicide treatments. All treatments controlled wild oat 81% or greater, except fenoxaprop/safener (76%) (Table 2). Wild oat control was greatest with clodinafop + thifensulfuron/tribenuron and clodinafop + thifensulfuron/tribenuron + dicamba diglycolamine salt (99%). Crop stand was poor due to standing water and possible anaerobic conditions caused by above normal rainfall in late May and early June. Grain yield ranged from 528 to 718 lb/A and was similar in all treatments and the untreated control.

Table 2. Spring wheat yield and wild oat control with clodinafop and other wild oat herbicides.

Treatment	Rate	AVEFA control	Wheat yield
	lb/A	%	lb/A
Clodinafop + COC[a]	0.05	81	662
Clodinafop + bromoxynil/MCPA + COC	0.05 + 0.5	87	693
Clodinafop + dicamba diglyco salt + COC	0.05 + 0.0938	96	616
Clodinafop + thifensulfuron/tribenuron + COC	0.05 + 0.0141	99	718
Clodinafop + dicamba diglyco salt + thifensulfuron/tribenuron + COC	0.05 + 0.0625 + 0.0141	99	601
Fenoxaprop/safener + NIS[b]	0.105	76	678
Fenoxaprop/safener + thifensulfuron/tribenuron + NIS	0.105 + 0.0141	95	541
Tralkoxydim + TF8035[c]	0.18	88	676
Tralkoxydim + bromoxynil/MCPA + TF8035	0.18 + 0.5	85	687
Untreated check	-	-	528
LSD $_{(0.05)}$	-	20	268
Density (plants/ft^2)	-	9	-

[a]COC = crop oil concentrate added at 0.8% v/v.
[b]NIS = 90% nonionic surfactant added at 0.5% v/v.
[c]TF8035 = mineral oil/nonionic surfactant blend added at 0.5% v/v.

Wild oat control in spring wheat with sulfosulfuron and other wild oat herbicides. Suzy M. Sanders and Donald C. Thill. (Department of Plant, Soil, and Entomological Sciences, University of Idaho, Moscow, ID 83844) A study was established during spring, 1998 near Moscow, Idaho to evaluate wild oat control in spring wheat with sulfosulfuron alone and in combination with other wild oat herbicides. 'Penawawa' spring wheat was seeded May 1, 1998 in a loam soil (28.0% sand, 57.6% silt, 14.4% clay, pH 5.6, and 4% organic matter). The experimental design was a randomized compete block with four replications and individual plots were 8 by 30 ft. Herbicide treatments were applied post-emergence on June 2, 1998 with a CO_2 pressurized backpack sprayer calibrated to deliver 10 gpa at 30 psi (Table 1). Crop injury was evaluated June 11 and July 1, 1998. Wild oat (AVEFA) control was evaluated visually at heading on July 23, 1998. Spring wheat was harvested with a small plot combine from a 4.3 by 27 ft area on August, 1998.

Table 1. Application data.

Crop stage	4 leaf/1 tiller
Wild oat stage	3 to 4 leaf
Air temperature (F)	59
Wind (mph)	Calm
Cloud cover	30%
Relative humidity (%)	80
Soil temperature at 2 in (F)	62

Wheat was not injured by any herbicide treatment (data not shown). Wild oat control at heading ranged from 64 to 99% (Table 2). Greatest control was with fenoxaprop/safener and was similar to all treatments except tralkoxydim (70%) and imazamethabenz (64%). For each wild oat herbicide, control was not different between treatments of the herbicide alone and treatments applied at the half rate + the full rate of sulfosulfuron. Crop stand was poor due to standing water and possible anaerobic conditions caused by above normal rainfall in late May and early June. Grain yield ranged from 251 to 466 lb/A and was greatest with imazamethabenz alone and sulfosulfuron + fenoxaprop/safener treatments. Grain yield of all other treatments was similar to the untreated control.

Table 2. Spring wheat yield and wild oat control with sulfosulfuron and other wild oat herbicides.

Treatment	Rate	AVEFA control	Wheat yield
	lb/A	%	lb/A
Sulfosulfuron + NIS[a]	0.032	85	402
Tralkoxydim + TF8035[b]	0.18	70	346
Fenoxaprop/safener + NIS	0.105	99	289
Imazamethabenz + NIS	0.47	64	452
Sulfosulfuron + tralkoxydim + TF8035	0.032 + 0.09	74	363
Sulfosulfuron + fenoxaprop/safener + NIS	0.032 + 0.0525	83	466
Sulfosulfuron + imazamethabenz + NIS	0.032 + 0.235	81	315
Untreated check	–	–	251
$LSD_{(0.05)}$	–	25	201
Density (plants/ft^2)	–	14	–

[a]NIS = 90% nonionic surfactant (R-11) added at 0.5% v/v.
[b]TF8035 is a mineral oil/nonionic surfactant blend added at 0.5% v/v.

Paraquat as a harvest aid in spring wheat. Traci A. Rauch and Donald C. Thill. (Plant Science Division, University of Idaho, Moscow, ID 83844-2339) A study was established near Genesee, Idaho in 'Penawawa' spring wheat to evaluate the effects of paraquat and other harvest aid herbicides on grain moisture, test weight, and yield. Plots were 8 by 30 ft arranged in a randomized complete block with four replications. All herbicide treatments were applied with a CO_2 pressurized backpack sprayer calibrated to deliver 10 gpa at 30 psi and 3 mph (Table 1). Wheat seed was harvested with a small plot combine from a 4 by 27 ft area in each plot on August 25, 1998. Moisture was measured with a grain moister tester within one hour of harvest.

Table 1. Application data.

Application date	August 13, 1998		August 18, 1998
Air temp (F)	73		55
Relative humidity (%)	45		49
Wind (mph, direction)	0		3, W
Cloud cover (%)	0		0
Soil temperature at 2 in (F)	59		57
pH		5.6	
OM (%)		4.2	
CEC (meq/100g)		23.6	
Texture		silt loam	

Grain moisture for all treatments was not different among treatments (Table 2). Paraquat at the lowest rate 7 to 10 days before harvest and glyphosate and paraquat (0.375 lb/A) at 3 to 5 days before harvest reduced grain test weight compared to the untreated check. Grain yield was 17% lower than the untreated check for plots treated with the high rate of paraquat 7 to 10 days before harvest and paraquat at the 0.375 lb/A rate 3 to 5 days prior to harvest.

Table 2. Spring wheat moisture, test weight and yield with paraquat and other harvest aids.

		Application	Wheat		
Treatment[a]	Rate	timing	Moisture	Test weight	Yield
	lb/A	days before harvest	%	lb/bu	lb/A
Paraquat	0.25	7 to 10	17.6	57	2144
Paraquat	0.375	7 to10	17.7	58	1978
Paraquat	0.50	7 to10	18.0	59	1790
Glyphosate	1.0	7 to10	17.6	58	1836
Sulfosate	1.0	7 to10	17.2	58	1986
Paraquat	0.25	3 to 5	17.5	58	1867
Paraquat	0.375	3 to 5	17.5	57	1790
Paraquat	0.50	3 to 5	17.3	58	1926
Glyphosate	1.0	3 to 5	17.4	57	2036
Sulfosate	1.0	3 to 5	17.3	58	1929
Untreated check	--	--	17.5	59	2150
LSD (0.05)			NS	1	336

[a]All treatments, except glyphosate, applied with NIS (90% nonionic surfactant) at the 0.25% v/v rate.

Downy brome control and winter wheat yield with sulfosulfuron at different spray solution pH. Traci A. Rauch and Donald C. Thill. (Plant Science Division, University of Idaho, Moscow, ID 83844-2339) A study was established near Tammany, ID in no-till 'Rhode' winter wheat to evaluate the effects of application timing and spray solution pH of sulfosulfuron on downy brome (BROTE) control and crop response. Plots were 8 by 30 ft arranged in a randomized complete block with four replications. All herbicide treatments were applied with a CO_2 pressurized backpack sprayer calibrated to deliver 10 gpa at 30 psi and 3 mph (Table 1). Wheat injury was evaluated visually on March 19 and 31, 1998. Downy brome control was evaluated on April 22 and May 19, 1998. Wheat seed was harvested with a small plot combine from a 4 by 27 ft area in each plot on August 4, 1998.

Table 1. Application data.

Application date	February 25, 1998	March 19, 1998
Wheat growth stage	1 tiller	1 to 2 tiller
Downy brome growth stage	3 to 4 leaf	4 to 5 leaf
Air temp (F)	40	42
Relative humidity (%)	62	55
Wind (mph, direction)	0	2, NW
Cloud cover (%)	15	0
Soil temperature at 2 in (F)	31	38
pH	5.6	
OM (%)	4.0	
CEC (meq/100g)	27.0	
Texture	silt loam	

No treatment at any application timing or spray solution pH injured wheat (data not shown) or adequately controlled downy brome (Table 2). Application timing and spray solution pH affected downy brome control. The 1 to 2 leaf application timing, on average, controlled downy brome better than the 3 to 5 timing (43 vs. 31%). Sulfosulfuron at a spray solution of pH 6 controlled downy brome best overall (48%), while control was least (15%) at a spray solution of pH 4. Herbicide treatment did not affect grain yield.

Table 2. Downy brome control and wheat yield with sulfosulfuron as affected by spray solution pH .

Treatment[a]	Rate	Application timing	pH water	pH spray solution[b]	Weed control BROTE	Wheat[c] yield
	lb/A				%	lb/A
Sulfosulfuron	0.023	1 to 2 leaf	4	5	17	2215
Sulfosulfuron	0.031	1 to 2 leaf	4	5	48	2424
Sulfosulfuron	0.023	1 to 2 leaf	7	6	56	2416
Sulfosulfuron	0.031	1 to 2 leaf	7	6	30	2502
Sulfosulfuron	0.023	1 to 2 leaf	10	6	51	2329
Sulfosulfuron	0.031	1 to 2 leaf	10	6	53	2233
Sulfosulfuron	0.023	3 to 5 leaf	4	4	19	2142
Sulfosulfuron	0.031	3 to 5 leaf	4	4	11	2163
Sulfosulfuron	0.023	3 to 5 leaf	7	7	59	2615
Sulfosulfuron	0.031	3 to 5 leaf	7	7	32	2348
Sulfosulfuron	0.023	3 to 5 leaf	10	8	25	2306
Sulfosulfuron	0.031	3 to 5 leaf	10	8	39	2375
Untreated check	--	--	--	--	--	1905
LSD (0.05)					26	NS
plants/ft^2					79	

[a]NIS (90% nonionic surfactant) applied at 0.5% v/v with all treatments.
[b]Procedures, water source (U of I greenhouse) and the chemical batch lot was the same for both application timimgs. The only difference was that a different bottle of NIS was used. This may account for the difference in spray solution pH.
[c]Grain weight of uncleaned samples.

Mayweed chamomile and interrupted windgrass control with metsulfuron plus thifensulfuron/tribenuron in winter wheat. David S. Belles and Donald C. Thill. (Plant, Soil and Entomological Sciences Department, University of Idaho, Moscow ID 83844-2339) A study was established in Latah County, ID to evaluate weed control with metsulfuron + thifensulfuron/tribenuron in wheat. Winter wheat (var. Cashup) was seeded in a silt loam soil (33% sand, 12% clay, 55% silt, pH 5.2, and 4% organic matter). The experimental design was a randomized complete block with four replications and individual plots were 8 by 30 ft. Herbicide treatments were applied postemergence on April 20, 1998 with a CO_2 pressurized backpack sprayer delivering 10 gpa at 33 psi. The wheat had three tillers and the weed stages were; mayweed chamomile (ANTCO) 1.5 in. diameter, field pennycress (THLAR) nine leaves, shepherd's-purse (CAPBA) nine leaves, henbit (LAMAM) eight leaves, and interrupted windgrass (APEIN) two tillers. Environmental conditions at application were as follows; air temperature 70° F, relative humidity 52%, wind 0 to 2 mph, clear sky, and soil temperature 60° F at four inches. Wheat injury was evaluated May 6, May 15, and June 15, 1998 and weed control was evaluated May 7, May 15, and June 15, 1998. Winter wheat was harvested at maturity with a small plot combine from 4.1 by 27 ft area of each plot on August 7, 1997.

Slight wheat injury was evident in the dicamba treatments on May 6 characterized by prostrate plant growth (Table). By May 15 no injury was visible (data not shown). On June 15, all treatments controlled mayweed chamomile, shepherd's-purse, and field pennycress 100% (data not shown). All herbicide treatments controlled henbit 85% or better except the low rate of metsulfuron + thifensulfuron/tribenuron (77%). Windgrass was partially controlled (50 to 80%) with all treatments containing thifensulfuron/tribenuronexcept when mixed with 0.125 lb/A dicamba (38%). All other treatments controlled windgrass less than 50%. Grain yield was not different from the control with any herbicide treatment.

Table. Winter wheat response and weed control from herbicide treatments, Latah County, Idaho.

		Winter wheat		Weed control[c]	
Treatment[a]	Rate	Injury[b]	Yield	LAMAM	APEIN
	lb/A	%	lb/A	%	
Metsulfuron + thifen/triben + NIS	0.0019 + 0.0071	0	6201	77	50
Metsulfuron + thifen/triben + NIS	0.0029 + 0.011	0	6346	90	68
Metsulfuron + thifen/triben + NIS	0.0038 + 0.0141	0	6284	98	80
Metsulfuron + thifen/triben + MCPA amine + NIS	0.0019 + 0.0071 + 0.25	0	6391	95	73
Metsulfuron + thifen/triben + MCPA amine + NIS	0.0029 + 0.011 + 0.25	0	6494	85	70
Metsulfuron + thifen/triben + MCPA amine + NIS	0.0038 + 0.0141 + 0.25	0	6404	100	79
Prosulfuron + MCPA amine + NIS	0.0089 + 0.25	0	6379	98	28
Prosulfuron + MCPA amine + NIS	0.0134 + 0.25	0	6256	97	48
Prosulfuron + MCPA amine + NIS	0.0178 + 0.25	0	6201	96	43
Thifen/triben + MCPA amine + NIS	0.0234 + 0.25	0	6261	85	75
Thifen/triben + dicamba + NIS	0.0234 + 0.095	5	6017	94	53
Thifen/triben + dicamba + NIS	0.0234 + 0.125	5	6186	93	38
Bromoxynil/MCPA + dicamba	0.5 + 0.095	5	5905	100	18
Untreated check	--------	0	6167	-	-
	LSD (0.05)	0	395	18	17
	Density (plants/ft^2)			3	7

[a]Thifen/triben is the commercial formulation of thifensulfuron/tribenuron. NIS = nonionic surfactant (R-11) added at 0.25% v/v with all treatments except those containing MCPA amine, which had 0.125% v/v.
[b]May 6, 1998 evaluation.
[c] June 15, 1998 evaluation.

Rattail fescue control in winter wheat. Joseph P. Yenish and Nichole A. Eaton. Washington State University, Pullman, WA 99164-6420. A trial to determine herbicide control of rattail fescue was established in a grower's field near Walla Walla, WA in October of 1997. The field has a history of continuous winter wheat with fall burning to manage crop residue prior to no-tillage planting. The experimental design was a randomized complete block with four replications and an individual plot size of 10 by 35 feet of which only the center 6 feet received the herbicide treatment. The soil type was a Palouse silt loam with pH of 4.8 containing 3.5% organic matter, 31% sand, 60% silt, and 10% clay, An imidazolinone resistant selection of "Fidel" winter wheat was seeded on October 14, 1997 at 84 lbs/a at 3 inch seeding depth in seven inch rows with a double disk drill. Herbicides were applied either fall, early spring, or late spring postemergence with a CO_2 backpack sprayer calibrated to deliver 10 gpa at 33 psi. Application data is shown in Table 1. Crop injury was visually rated on April 28 and rattail fescue control evaluated on April 28 and August 15. Wheat was harvested on August 25.

April 28 ratings indicated that no treatments injured winter wheat (data not shown). Fall applied MON 37500 provided greatest control of rattail fescue on both rating dates and had the greatest wheat yield (Table 2). Only fall applied imazamox controlled rattail fescue greater than 50% at both rating dates. Fall application provided better rattail fescue control than early spring applications for MON 37500 and imazamox. No late spring treatments were effective. Early spring imazamox had the lowest yielding wheat because the spring application provided better control of non-imidazolinone resistant volunteer wheat which emerged between late fall and early spring, thus lessening the total wheat stand in this treatment. Volunteer wheat contributed greatly to grain yield in other treatments.

Table 1. Application data

	Fall post	Early spring post	Late spring post
Date	Nov. 11, 1997	March 18, 1998	April 10, 1998
Wheat stage	1-3 leaf	4 tillers	4 tillers
Rattail fescue stage	1-3 leaf	4 tillers	4 tillers
Air temperature	43 F	44 F	59 F
Relative humidity	91%	62%	54%
Wind	1 mph	9 mph	12 mph
Soil temperature	43 F	40 F	54 F
Cloud cover	90%	80%	60%

Table 2. Rattail fescue control and winter wheat yield.

			Rattail fescue control		
Treatment	Rate	Application timing	April 28	August 15	Wheat yield
	lb/A		——%——		bu/a
Weedy check			0	0	40.1
MON 37500	0.031	Fall post	91	94	45.3
Imazamox[a]	0.031	Fall post	76	70	43.6
Metribuzin	0.25	Fall post	23	62	44.4
MON 37500	0.031	Early spring post	39	51	37.5
Imazamox[a]	0.031	Early spring post	38	45	35.7
Diclofop	1	Late spring post	9	12	39.6
Fenoxaprop /safener	0.1	Late spring post	11	18	41.7
Tralkoxydim[b]	0.18	Late spring post	1	0	44.4
Difenzoquat	1	Late spring post	8	0	42.4
Imazamethabenz[a]	0.41	Late spring post	1	0	42.7
LSD (P=0.05 for rattail fescue control; P=0.10 for wheat yield)			19	20	5.2

[a] Applied with nonionic surfactant at 0.25% v/v.
[b] Applied with TF8035 surfactant at 0.5% v/v.

Effects of spring crop rotations, and planting date, and tillage on the control of jointed goatgrass in winter wheat in the intermountain west. Caleb D. Dalley, John O. Evans, and William S.Rigby. (Department of Plant, Soils, and Biometeorology, Utah State University, Logan, UT 84322-4820) Jointed goatgrass is a serious weed problem for wheat growers in the West. To improve the management of jointed goatgrass on traditional winter wheat cropland, better understandings are needed of the effects spring crop rotations, tillage and winter wheat planting date have on jointed goatgrass populations and wheat yield. A study to find the effects spring crops, tillage intensity and wheat planting date (normal versus late) have on yield, weed seed contamination of harvested crop, jointed goatgrass population density, and soil seedbank concentration over a five year period was initiated. Two identical experiments were initiated at the same location in northern Utah, the first beginning in 1996: the second in 1997. Jointed goatgrass spikelets were scattered evenly to establish a base population just before initiating each experimental location. Initial plant counts taken in the spring of 1997 showed nearly identical jointed goatgrass populations in all treatments. After planting safflower in the spring of 1997 and 1998, jointed goatgrass plants were recounted in the crop. Jointed goatgrass reductions of 97% were observed for both years (Table 1). Winter wheat yields were 25% and 35% higher in September than in October planted wheat, in 1997 in experiment one, and 1998 in experiment two, respectively (Table 2). Crop contamination with jointed goatgrass propagules was four times higher in late versus early planted wheat in 1997 and increased 36% in the late planted wheat in 1998 (Table 2).

1998 fallow season plant counts in experiment one showed 55 and 75% less jointed goatgrass in fallow following safflower than in fallow following September or October planted wheat, respectively (Table 1). Soil seedbank concentrations were highest in the 0-5 cm depth in all treatments. However, September and October planted wheat had nearly a thirty-fold higher concentration of jointed goatgrass seedlings compared to safflower.

This study showed the use of safflower to be a very useful management tool for reducing jointed goatgrass populations. September planted wheat, with similar jointed goatgrass populations, had higher yields, and less jointed goatgrass contamination. Much of this is attributed to the increased number of fall growing degree days (GDD) following planting of wheat in September compared to October. Wheat yield has been shown to be optimal when receiving 400 GDD (4.4° C base temperature) prior to December 31. September planted wheat received 322 and 438 GDD while October planted wheat received only 103 and 160 GDD in 1996, and 1997, respectively. The increased number of GDD is most likely responsible for the increased yield observed in September planted wheat.

Table 1. Number of Jointed Goatgrass Seedlings in Safflower, September Planted Wheat, and October Planted Wheat in Experiment One in 1997 and 1998, and Experiment Two in 1998.

Treatment	Seedling populations 1[a]-1997	1-1998	2-1998
	plants m^{-2}		
Safflower (postplant)	0.34a[b]	-NA-	0.33a(a)
Safflower (preplant)	9.8b	3.7a	11.3c(b)
September Wheat	11.1b	8.1b	6.8bc
October Wheat	11.7b	14.9c	4.4b
LSD 0.05	5.2[c]	3.71	2.9(4.13)[d]

[a] 1 is experiment one, 2 is experiment two. [b]Within columns, treatments followed by the same letter are not significantly different. [c]LSD for plants m^{-2} in 1997 is for safflower plots only, other comparisons were not significant. [d]The LSD in parenthesis is for the comparison of the letters in parenthesis (safflower pre and postplant).

Table 2. Wheat and Safflower yield, and Crop Contamination for 1997, and 1998.

Treatment	Yield 1[a]-1997	Yield 2-1998	Dockage 1-1997	Dockage 2-1998
	bu/A		g/kg	
Safflower	20.0[c]	6.9	0.64a	0[b]
September Wheat	51.3a	76.7a	0.54a	24.5a
October Wheat	40.2b	50.2b	2.37b	38.5b
LSD 0.05	3.74	13.7	0.63	5.4

[a]1 is experiment one, 2 is experiment two. [c] g jointed goatgrass per kg wheat or safflower. [b]No safflower data was collected, so no analysis was made.

The effect of tralkoxydim rate, fertilizer enhancers, and other herbicides on wild oat control in winter wheat. David S. Belles and Donald C. Thill. (Plant, Soil and Entomological Sciences Department, University of Idaho, Moscow ID 83844-2339) A study was established in Lewis County, ID to evaluate the efficacy of tralkoxydim for wild oat control with or without ammonium sulfate and compare it to other wild oat herbicides. Winter wheat (var. Madsen) was seeded in a silt loam soil (31% sand, 14% clay, 55% silt, 5.8 pH, and 5.4% organic matter). The experimental design was a randomized complete block with four replications and individual plots were 8 by 30 ft. Broadleaf weeds were sprayed on April 23 with bromoxynil and MCPA. Wild oat herbicide treatments were applied postemergence on April 28, 1998 with a CO_2 pressurized backpack sprayer delivering 10 gpa at 36 psi when the wild oat (AVEFA) was in the 1 to 3 leaf stage. Environmental conditions at application were as follows; air temperature 69° F, relative humidity 60%, wind 3 to 5 mph from the NW, clear sky, and soil temperature 44° F at four inches. Winter wheat injury was evaluated visually May 7, and June 6, 1998. Wild oat control was evaluated on June 6 and July 30, 1998. Winter wheat was harvested at maturity with a small plot combine from a 4.1 by 27 ft area of each plot on August 11, 1998.

No treatment injured wheat one and six weeks after treatment (data not shown). All treatments controlled wild oat greater than 84% on June 6 and greater than 92% at heading on July 28 (Table). A good winter wheat crop competed aggressively with wild oat contributing to wild oat control. Tralkoxydim + TF8035 + AMS at 0.25 lb/A, imazamethabenz + difenzoquat, fenoxaprop/safener at 0.105 lb/A, and clodinafop at 0.05 lb/A yielded significantly better than the control. All other treatments yielded the same as the control.

Table. Winter wheat response and weed control from herbicide treatments, Latah County, Idaho.

Treatment[a]	Rate	AVEFA control June 6	AVEFA control July 28	Winter wheat yield
	lb/A	%	%	lb/A
Tralkoxydim + TF8035	0.125	86	95	6515
Tralkoxydim + TF8035 +AMS	0.125	90	96	6559
Tralkoxydim + TF8035	0.18	89	98	6328
Tralkoxydim + TF8035 + AMS	0.18	90	98	6707
Tralkoxydim + TF8035	0.25	95	100	6562
Tralkoxydim + TF8035+ AMS	0.25	93	96	7084
Tralkoxydim + TF8035 + AMS (lq)	0.18	93	99	6647
Tralkoxydim + TF8035 + 32% UAN	0.18	91	93	6712
Diclofop	1.0	86	98	6505
Imazamethabenz + NIS	0.47	85	94	6510
Imazamethabenz + difenzoquat + NIS	0.23	91	93	6849
Fenoxaprop/2,4-D/MCPA	0.575	94	100	6509
Fenoxaprop/MCPA	0.46	94	100	6278
Fenoxaprop/safener	0.094	94	99	6563
Fenoxaprop/safener	0.105	95	100	6927
Clodinafop + COC	0.05	93	100	6826
Clodinafop + COC	0.06	94	100	6306
Untreated check	——	-	-	6039
	LSD (0.05)	6	6	728
	Density (plants/ft^2)	20	20	

[a]Fenoxaprop/2,4-D/MCPA applied as the commercial formulation.
AMS= ammonium sulfate. Dry AMS applied at 1.5 lb product/A, liquid AMS (lq) at 2% v/v.
NIS = nonionic surfactant (R-11), added at 0.25% v/v.
COC = crop oil concentrate (Score), added at 1% v/v.
TF8035 = a commercial nonionic, crop oil concentrate blend (Supercharge), added at 0.5% v/v.

Wild oat and catchweed bedstraw control in winter wheat with wild oat and sulfonylurea herbicide combinations. Suzy M. Sanders and Donald C.Thill. (Department of Plant, Soil, and Entomological Sciences, University of Idaho, Moscow, ID 83844-2339) Experiments were established during spring, 1998 near Porthill, Idaho to evaluate catchweed bedstraw control and possible antagonism of wild oat control in winter wheat when wild oat herbicides were combined with thifensulfuron/tribenuron and metsulfuron. Difenzoquat, imazamethabenz, and diclofop-methyl were tested in experiments 1 and 1a, and fenoxaprop/2,4-D/MCPA, fenoxaprop/safener, and tralkoxydim were tested in experiment 2. 'Stevens' winter wheat was seeded in October, 1997 in a loam soil (44% sand, 34% silt, 22% clay) with a pH of 5.7 and 23% organic matter. The experimental design for all experiments was a randomized complete block with four replications and individual plots were 8 by 30 ft. Herbicide treatments were applied to experiment 1a on April 23, 1998 but a light rain began falling 1 hour after completion of spraying and developed into a hard rain for 2+ hours. This experiment was reestablished (experiment 1) adjacent to experiment 1a and initial herbicide treatments (wild oat herbicides alone or tank mixed with sulfonylureas) were applied in both experiments 1 and 2 and the second timing (sequential application of sulfonylureas to plots treated previously with wild oat herbicides) for experiment 1a postemergence on April 28, 1998 with a CO_2 backpack sprayer delivering 10 gpa at 30 psi. Sequential treatments (sulfonylureas) were applied to experiments 1 and 2 on May 4, 1998 (second timing) (Table 1). Crop injury was evaluated on May 4 and May 19, 1998. Wild oat control was evaluated on May 19 and at crop and wild oat heading stage on July 21, 1998. Catchweed bedstraw control was evaluated on June 4, 1998. Winter wheat was harvested with a small plot combine from a 4.3 by 27 ft area on August 14, 1998.

Table 1. Application data.

	April 23, 1998	April 28, 1998	May 4, 1998
Crop stage	3 tiller	3 tiller	3 tiller
Wild oat stage	2 leaf	2 to 3 leaf	3 leaf
Catchweed bedstraw stage	4 inch	6 inch	6 to 8 inch
Air temperature (F)	72	59	85
Relative humidity (%)	48	62	42
Wind (mph)	0 to 2	0 to 2	0 to 2
Cloud cover	90%	Clear	Mostly clear
Soil temperature at 2 in. (F)	62	50	–

The study area for all experiments contained a variable infestation of catchweed bedstraw, which was 6 in. tall on April 28, 1998. In experiment 1 (no rain), greatest bedstraw control 38 DAT was 88% (Table 2) and was similar for all treatments except diclofop-methyl plus thifensulfuron/tribenuron at 0.0071 lb/A + metsulfuron at 0.0019 lb/A applied six days after diclofop-methyl, diclofop-methyl alone, and difenzoquat alone. These latter treatments did not control bedstraw, had the lowest grain yield in experiment 1, and did not differ from the check. Bedstraw control in experiment 1a usually was less than in experiment 1. Average bedstraw control in experiment 1a was 39% and was 65% in experiment 1. Rain likely reduced control in experiment 1a. Grain yield ranged from 3,219 lb/A to 3,825 lb/A in experiment 1a. Difenzoquat, diclofop, and imazamethabenz alone were the lowest yielding treatments. In experiment 2, neither fenoxaprop/safener nor tralkoxydim alone controlled bedstraw (Table 3). Average bedstraw control was 60% in experiment 2 which was similar to experiment 1.

In experiment 1, two treatments with difenzoquat at 1 lb/A caused slight injury (3 and 5%, data not shown) 21 DAT. There was no injury with any other treatment at any timing. All treatments with difenzoquat controlled wild oat at heading stage 91 to 97% except difenzoquat plus thifensulfuron/tribenuron at 0.0141 lb/A + metsulfuron at 0.0038 lb/A applied six days later (54%). No other treatments controlled wild oat greater than 43% by heading stage of wild oat (Table 2). Grain yield ranged from 2,948 to 4,050 lb/A and was highest with thifensulfuron at 0.0234 lb/A + difenzoquat at 1 lb/A. This was similar to all treatments with difenzoquat except difenzoquat alone, and to all treatments with imazamethabenz, except imazamethabenz alone, and to thifensulfuron/tribenuron at 0.0071 lb/A + metsulfuron at 0.0019 lb/A + diclofop-methyl at 1 lb/A. Grain yield in these treatments was higher than the untreated check.

In experiment 1a, wild oat control was lower than that of experiment 1 (Table 2), especially in difenzoquat treatments. Average wild oat control in experiment 1a and 1 was 4 and 87%, respectively. Rain very likely caused this difference. No other treatment suppressed wild oat greater than 28%.

In experiment 2, there was no injury with any treatment. No treatments adequately controlled wild oat (35% or less) (Table 3). Grain yield ranged from 3,182 to 4,267 lb/A and varied greatly among treatments.

It was difficult to assess antagonism because wild oat control tended to be poor with most treatments (except difenzoquat, no rain). Wild oat control with diclofop tank mixed with thifensulfuron/tribenuron at 0.0141 lb/A + metsulfuron at 0.0038 lb/A was less than diclofop alone (Table 2). Wild oat control with difenzoquat applied sequentially with thifensulfuron/tribenuron at 0.0141 lb/A + metsulfuron at 0.0038 lb/A was less than difenzoquat alone (no rain).

Table 2. Wild oat (AVEFA) and catchweed bedstraw (GALAP) control and winter wheat yield with difenzoquat, imazamethabenz, and diclofop-methyl.

		Weed control					
		Rain		No rain		Wheat yield[d]	
Treatment[a]	Rate	GALAP	AVEFA	GALAP	AVEFA	Rain	No rain
	lb/A	%				lb/A	
Thifensulfuron	0.0234	50	0	73	0	3683	3,253
Thifensulf/triben[b] + metsulfuron	0.0141 + 0.0038	25	0	63	0	3,439	3,367
Thifensulf/triben + metsulfuron	0.0071 + 0.0019	25	0	73	0	3,736	3,277
Thifensulfuron + difenzoquat	0.0234 + 1.0	68	5	73	94	3,488	4,050
Thifensulf/triben + metsulfuron + difenzoquat	0.0141 + 0.0038 + 1.0	0	5	85	96	3,697	3,841
Thifensulf/triben + metsulfuron + difenzoquat	0.0071 + 0.0019 + 1.0	25	5	60	91	3,466	3,746
Thifensulf/triben + metsulfuron + difenzoquat[c]	0.0141 + 0.0038 + 1.0	53	8	68	54	3,646	3,567
Thifensulf/triben + metsulfuron + difenzoquat[c]	0.0071 + 0.0019 + 1.0	58	3	75	97	3,668	3,818
Difenzoquat	1.0	0	0	0	91	3,219	3,216
Thifensulfuron + imazamethabenz	0.0234 + 0.47	25	0	75	28	3,631	3,769
Thifensulf/triben + metsulfuron + imazamethabenz	0.0141 + 0.0038 + 0.47	38	5	78	30	3,822	3,769
Thifensulf/triben + metsulfuron + imazamethabenz	0.0071 + 0.0019 + 0.47	50	10	75	30	3,596	3,905
Thifensulf/triben + metsulfuron + imazamethabenz[c]	0.0141 + 0.0038 + 0.47	90	5	88	20	3,526	3,524
Thifensulf/triben + metsulfuron + imazamethabenz[c]	0.0071 + 0.0019 + 0.47	53	0	88	38	3,644	3,755
Imazamethabenz	0.47	25	15	63	40	3,310	3,425
Thifensulfuron + diclofop-methyl	0.0234 + 1.0	25	28	88	30	3,540	3,752
Thifensulf/triben + metsulfuron + diclofop-methyl	0.0141 + 0.0038 + 1.0	38	9	73	13	3,686	3,441
Thifensulf/triben + metsulfuron + diclofop-methyl	0.0071 + 0.0019 + 1.0	25	10	60	20	3,825	3,526
Thifensulf/triben + metsulfuron + diclofop-methyl[c]	0.0141 + 0.0038 + 1.0	90	15	75	43	3,719	3,340
Thifensulf/triben + metsulfuron + diclofop-methyl[c]	0.0071 + 0.0019 + 1.0	53	10	28	30	3,712	3,158
Diclofop-methyl	1.0	0	0	0	40	3,420	2,948
Untreated check	–	–	–	–	–	3,319	2,990
LSD $_{(0.05)}$	–	49	19	44	24	388	537
Density (plants/ft^2)	–	–[e]	17	–[e]	15	–	–

[a]All treatments were applied with a 90% nonionic surfactant at 0.25% v/v.
[b]Thifensulf/triben = thifensulfuron/tribenuron applied as the packaged formulation.
[c]Thifensulfuron/tribenuron + metsulfuron applied 6 days after initial treatment of wild oat herbicide (5 days after in experiment with rain).
[d]Yield includes wild oat seed contamination.
[e]Initial density of GALAP was not recorded due to variable population.

Table 3. Wild oat (AVEFA) and catchweed bedstraw (GALAP) control and winter wheat yield with fenoxaprop/2,4-D/MCPA, fenoxaprop/safener, and tralkoxydim.

Treatment[a]	Rate	Weed control AVEFA	Weed control GALAP	Wheat yield
	lb/A	%	%	lb/A
Thifensulfuron	0.0234	0	68	3,708
Thifensulf/triben[b] + metsulfuron	0.0141 + 0.0038	0	53	3,182
Thifensulf/triben + metsulfuron	0.0071 + 0.0019	0	74	3,480
Thifensulfuron + fenox/2,4-D/MCPA	0.0234 + 0.575	13	53	4,056
Thifensulf/triben + metsulfuron + fenox/2,4-D/MCPA	0.0141 + 0.0038 + 0.575	25	51	3,541
Thifensulf/triben + metsulfuron + fenox/2,4-D/MCPA	0.0071 + 0.0019 + 0.575	5	53	3,788
Thifensulf/triben + metsulfuron + fenox/2,4-D/MCPA[c]	0.0141 + 0.0038 + 0.575	30	85	3,835
Thifensulf/triben + metsulfuron + fenox/2,4-D/MCPA[c]	0.0071 + 0.0019 + 0.575	10	68	4,267
Fenox/2,4-D/MCPA	0.575	30	18	4,165
Thifensulfuron + fenoxaprop/safener[d]	0.0234 + 0.105	5	81	4,203
Thifensulf/triben + metsulfuron + fenoxaprop/safener	0.0141 + 0.0038 + 0.105	20	86	3,575
Thifensulf/triben + metsulfuron + fenoxaprop/safener	0.0071 + 0.0019 + 0.105	10	75	3,896
Thifensulf/triben + metsulfuron + fenoxaprop/safener[c]	0.0141 + 0.0038 + 0.105	23	69	3,695
Thifensulf/triben + metsulfuron + fenoxaprop/safener[c]	0.0071 + 0.0019 + 0.105	23	43	3,951
Fenoxaprop/safener	0.105	35	0	3,991
Thifensulfuron + tralkoxydim[e]	0.0234 + 0.18	25	78	3,989
Thifensulf/triben + metsulfuron + Tralkoxydim[e]	0.0141 + 0.0038 + 0.18	5	94	3,619
Thifensulf/triben + metsulfuron + tralkoxydim[e]	0.0071 + 0.0019 + 0.18	35	78	3,647
Thifensulf/triben + metsulfuron + tralkoxydim[ce]	0.0141 + 0.0038 + 0.18	30	48	3,742
Thifensulf/triben + metsulfuron + tralkoxydim[ce]	0.0071 + 0.0019 + 0.18	13	88	3,744
Tralkoxydim[e]	0.18	3	0	3,780
Untreated check	–	–	–	3,450
LSD $_{(0.05)}$	–	30	37	478
Density (plants/ft^2)	–	16	–[f]	–

[a]All treatments were applied with a 90% nonionic surfactant at 0.25% v/v unless otherwise noted.
[b]Thifensulf/triben = thifensulfuron/tribenuron applied as the packaged formulation.
[c]Thifensulfuron/tribenuron + metsulfuron applied 6 days after initial treatment of wild oat herbicide.
[d]Fenoxaprop/safener applied as the packaged formulation.
[e]Treatments applied with TF8035 mineral oil/nonionic surfactant blend added at 0.5% v/v.
[f]Initial density of GALAP was not recorded due to variable population.

Italian ryegrass control and winter wheat response with fluthiamide/metribuzin. Traci A. Rauch and Donald C. Thill. (Plant Science Division, University of Idaho, Moscow, ID 83844-2339) A study was established near Moscow, Idaho in 'Madsen' winter wheat to evaluate Italian ryegrass control and wheat response with fluthiamide/metribuzin. Plots were 8 by 30 ft arranged in a randomized complete block with four replications. All herbicide treatments were applied with a CO_2 pressurized backpack sprayer calibrated to deliver 10 gpa at 30 psi and 3 mph (Table 1). Wheat injury was evaluated visually on April 13 and June 18, 1998, and weed control was evaluated on May 6, June 18, and July 27, 1998. Wheat seed was harvested with a small plot combine from a 4 by 27 ft area in each plot on August 5, 1998.

Table 1. Application data.

Application date	September 30, 1997	April 3, 1998	May 4, 1998
Application timing	Preemergence	Postemergence	Postemergence
Wheat growth stage	--	1 to 2 tillers	4 to 5 tillers
Italian ryegrass growth stage	--	3 leaf	6 to 8 leaf
Air temp (F)	80	68	72
Relative humidity (%)	35	47	68
Wind (mph, direction)	2, SE	0	2, NW
Cloud cover (%)	99	75	5
Soil temperature at 2 in (F)	65	54	60
pH	5.4		
OM (%)	3.0		
CEC (meq/100g)	18.9		
Texture	silt loam		

All fluthiamide/metribuzin treatments visually injured winter wheat 2 to 10% on April 13, 1998 (Table 1). By June 18, the fluthiamide/metribuzin injury was not visible, but flucarbazone (BAY MKH 6562) at the 6 to 8 leaf timing injured winter wheat 20%. Fluthiamide/metribuzin alone at 0.40 lb/A and in combination with flucarbazone or triasulfuron controlled Italian ryegrass (LOLMU) 88% or greater. Chlorsulfuron controlled Italian ryegrass 96%. All treatments, except flucarbazone at the 2 to 3 leaf timing, controlled mayweed chamomile (ANTCO) 86% or better. Sulfosulfuron and flucarbazone alone at the 6 to 8 leaf timing reduced grain test weight compared to the untreated check. Winter wheat yield in the chlorsulfuron, triasulfuron, and fluthiamide/metribuzin treatments was greater than the untreated check.

Table 2. Weed control and winter wheat response with fluthiamide/metribuzin.

			Wheat				Weed control[b]	
Treatment[a]	Rate	Application timing	Injury (4/13/98)	Injury (6/18/98)	Test weight	Yield	LOLMU	ANTCO[c]
	lb/A		%		lb/bu	lb/A	%	
Triasulfuron	0.016	pre	0	0	59	4579	69	95
Triasulfuron	0.026	pre	0	0	59	4878	81	98
Chlorsulfuron	0.016	pre	0	0	59	5137	96	99
Fluthiamide/metribuzin	0.27	pre	0	0	59	4864	79	97
Fluthiamide/metribuzin	0.40	pre	2	0	59	5329	89	99
Fluthiamide/metribuzin + triasulfuron	0.27 + 0.016	pre	5	1	59	5220	94	99
Flucarbazone + NIS	0.027	2 - 3 lf	0	0	59	4085	66	78
Flucarbazone + NIS	0.027	6 - 8 lf	0	20	57	3239	52	88
Fluthiamide/metribuzin + flucarbazone+NIS	0.27 + 0.027	pre + 2 - 3 lf	6	0	59	5305	88	86
Fluthiamide/metribuzin + flucarbazone+NIS	0.27 + 0.027	pre + 6 - 8 lf	10	20	58	4514	96	90
Sulfosulfuron +NIS	0.031	2 - 3 lf	0	0	58	4029	45	99
Sulfosulfuron +NIS	0.031	6 - 8 lf	0	0	57	3612	65	99
Untreated check			--	--	59	3645	--	--
LSD (0.05)			2	1	1	773	18	12
Plants/ft^2							18	

[a]Fluthiamide/metribuzin is a commercial premix at 4:1 ratio. NIS = 90% nonionic surfactant applied at the 0.25% v/v rate.
[b]July 27, 1998 evaluation date.
[c]Light to moderate infestation.

Wild oat control and crop response with imazamox in imidazolinone-resistant winter wheat. Traci A. Rauch and Donald C. Thill. (Plant Science Division, University of Idaho, Moscow, ID 83844-2339) A study was established near Moscow, Idaho in 'Fidel' winter wheat to evaluate wild oat control, winter wheat response, and soil persistence of imazamox. Plots were 16 by 30 ft arranged in a randomized complete block with four replications. All herbicide treatments were applied with a CO_2 pressurized backpack sprayer calibrated to deliver 10 gpa at 30 psi and 3 mph (Table 1). Wheat injury was evaluated visually on April 27 and May 15, 1998 and wild oat (AVEFA) control was evaluated on June 28, 1998. Wheat seed was harvested with a small plot combine from a 4 by 27 ft area in each plot on August 11, 1998.

Table 1. Application data.

Application date	April 17, 1998		May 12, 1998
Wheat growth stage	4 to 5 leaf		jointing
Wild oat growth stage	1 to 2 leaf		4 to 5 leaf
Air temp (F)	42		70
Relative humidity (%)	68		57
Wind (mph, direction)	2, SW		3, SW
Cloud cover (%)	40		50
Soil temperature at 2 in (F)	40		58
pH		4.5	
OM (%)		5.7	
CEC (meq/100g)		33	
Texture		loam	

No treatment visually injured winter wheat (data not shown). All imazamox treatments, except the 0.024 lb/A rate at the 1 to 2 leaf stage, controlled wild oat 88 to 98%. The standard treatments (diclofop + thifensulfuron/tribenuron and imazamethabenz + thifensulfuron/tribenuron) only controlled wild oat 85 and 70%, respectively. Imazamox at the 0.04, 0.048, and 0.08 lb/A rates at the 4 to 5 leaf timing significantly reduced wheat yield compared to the untreated check. Seed yield for wheat treated with diclofop + thifensulfuron/tribenuron was greater than the untreated check. Wheat seed yield from the imazamox treatments at the 4 to 5 leaf timing were lower statistically than imazamox treatments at the 1 to 2 leaf timing.

Table 2. Wild oat control and winter wheat yield with imazamox.

Treatment[a]	Rate	Application timing	AVEFA control	Winter wheat yield[b]
	lb/A		%	lb/A
Imazamox	0.024	1 to 2 leaf	79	3839
Imazamox	0.032	1 to 2 leaf	88	4283
Imazamox	0.040	1 to 2 leaf	95	3843
Imazamox	0.048	1 to 2 leaf	98	4179
Imazamox	0.080	1 to 2 leaf	98	4174
Diclofop + thifen/triben	1.0 + 0.014	1 to 2 leaf	85	4378
Imazamox + imazamox	0.024 + 0.024	1 to 2 leaf + 4 to 5 leaf	99	4137
Imazamox	0.024	4 to 5 leaf	93	3504
Imazamox	0.032	4 to 5 leaf	96	3588
Imazamox	0.040	4 to 5 leaf	96	3371
Imazamox	0.048	4 to 5 leaf	96	3342
Imazamox	0.080	4 to 5 leaf	96	3080
Imazamethabenz + thifen/triben	0.47 + 0.014	4 to 5 leaf	70	4112
Untreated check			--	3872
LSD (0.05)			12	441
Plants/ft^2			46	

[a]All treatments were applied with a 90% nonionic surfactant at 0.25% v/v and 32% UAN (urea ammonium nitrate) also was mixed with the imazamox treatments at 2.5% v/v. Thifen/triben is the commercial formulation of thifensulfuron/tribenuron.
[b]Grain weight includes wild oat contamination.

Wild oat control with selected herbicides in IMI wheat. John O. Evans, and R. William Mace. (Department of Plants, Soils and Biometeorology, Utah State University, Logan, Utah 84322-4820). IMI wheat, an imidazolinone resistant crop, was planted April 4, 1998 at the Greenville farm in North Logan, UT to evaluate the effectiveness of controlling wild oat (AVEFA) with imazamox. Individual treatments were applied to 10 by 30 foot plots with a CO_2 backpack sprayer using flatfan 80015 nozzles providing a 7 foot spray width calibrated to deliver 14 gpa at 39 psi. The soil was a Millville silt loam with 7.5 pH and O.M. content of less than 2%. Treatments were applied in a randomized block design, with four replications on May 1 and 12, when wild oat plants were 3 and 7 inches tall respectively. Visual evaluations for wild oat control and crop injury were completed July 7. Plots were harvested September 14.

There was no injury to the IMI wheat using imazamox with early post treatments. Rimsulfuron and nicosulfuron caused severe wheat injury. Later post treatments of imazamox caused some injury that increased with treatment rate applied. Wild oat control was excellent for the early and late post emergence applications of imazamox but there was a significant decrease in wild oat control when imazamox was combined with 2,4-D amine. Fenoxaprop provided excellent control of wild oat at both timings. Yields were not significantly different for any herbicide application other than rimsulfuron and nicosulfuron. (Utah Agricultural Experiment Station, Logan, UT. 84322-4820)

Table. Wild oat response to selected post emergent herbicides in IMI wheat.

			--------WHEAT------		AVEFA
Treatment[a]	Rate	Growth stage	Injury	Yield	6/6
	lb ai/A		%	Bu/A	% Control
check			0	21	0
Imazamox	0.024	1-3lf	0	23	100
Imazamox	0.032	1-3lf	0	22	100
Imazamox	0.04	1-3lf	0	23	100
Imazamox+2,4-D Amine	0.024	1-3lf	0	23	30
Imazamox+2,4-D Amine	0.032	1-3lf	0	24	70
Imazamox+2,4-D Amine	0.04	1-3lf	0	24	75
Imazamox+ bromoxynil/MCPA	0.024+ 0.24	1-3lf	0	24	100
Imazamox+ bromoxynil/MCPA	0.032+ 0.32	1-3lf	0	23	100
Fenoxaprop	0.1	1-3lf	0	24	96
Imazamox	0.024	3-6lf	0	23	100
Imazamox	0.032	3-6lf	13	23	99
Imazamox	0.04	3-6lf	10	24	100
Imazamox+2,4-D Amine	0.024	3-6lf	0	25	75
Imazamox+2,4-D Amine	0.032	3-6lf	0	24	87
Imazamox+2,4-D Amine	0.04	3-6lf	0	25	80
Imazamox+ bromoxynil/MCPA	0.024+ 0.24	3-6lf	5	23	100
Imazamox+ bromoxynil/MCPA	0.032+ 0.32	3-6lf	0	25	100
Fenoxaprop	0.1	3-6lf	0	27	95
Rimsulfuron	0.024	1-3lf	99	2	100
Nicosulfuron	0.031	1-3lf	58	17	100
$LSD_{(0.05)}$			9	4	18

[a] Nonionic surfactant applied at 0.25% v/v and N at 1qt/A with all postemergent treatments.

Ventenata control with imazamox in imidazolinone resistant winter wheat. Joseph P. Yenish and Nichole A. Eaton. Washington State University, Pullman, WA 99164-6420. A trial was established near Spangle, WA in the fall of 1997 to evaluate the control of ventenata with imazamox. The experimental design was a randomized complete block with four replications and an individual plot size of 7 by 35 feet. An imidazolinone resistant selection of "Fidel" winter wheat was seeded on October 15, 1997 at 84 lbs/a at 2 inch seeding depth in seven inch rows with a double disk drill. Herbicides were applied fall or spring postemergence with a CO_2 backpack sprayer calibrated to deliver 10 gpa at 33 psi. All herbicide applications included nonionic surfactant at 0.25% v/v. Application data is shown in Table 1. Crop injury was visually rated on April 29 and ventenata control evaluated on April 29 and June 17. Wheat was harvested on August 25.

No crop injury was observed to any treatment on April 29 (data not shown). Greatest control of ventenata was with fall-only or split fall plus spring applications (Table 2). Greatest control within spring only-applications was with the highest imazomox application rate. Greatest wheat yield was with 0.032 lbs. a.i./A applied in the fall. Grain yield from fall and split applications of imazamox was not significantly different than the highest yielding treatment. Of the spring-only applications, only the highest rate applied in the spring did not yield significantly less than the highest yielding treatment and neither the split nor any spring-only application yielded significantly greater than the weedy check.

Table 1. Application data

	Fall	Spring
Date	Nov. 21, 1997	Apr. 3, 1998
Wheat stage	2lf	4 tiller
Ventenata stage	1lf	1lf - 2 tiller
Air temp.	37 F	58 F
Rel. hum.	95%	63%
Wind	2 mph	6 mph
Soil temp.	41 F	55 F
Cloud cover	35%	65%

Table 2. Winter wheat yield and ventenata control with imazamox.

Treatment	Rate	Application timing	Ventenata control April 29	Ventenata control June 17	Wheat yield
	lb/A		%	%	bu/A
Weedy check			0	0	18.7
Imazamox	0.024	Fall	67	83	27.6
Imazamox	0.032	Fall	86	90	30.1
Imazamox	0.04	Fall	82	95	26.3
Imazamox	0.048	Fall	89	99	29.2
Imazamox	0.024	Spring	66	79	18.5
Imazamox	0.032	Spring	62	80	19.6
Imazamox	0.04	Spring	79	89	19.4
Imazamox	0.048	Spring	80	94	24.6
Imazamox + Imazamox	0.024 + 0.024	Fall Spring	87	95	24.8
LSD (P=0.05)			12	8	8

PROJECT 4

TEACHING AND TECHNOLOGY TRANSFER

Bob Klein, Chair

Newly reported weed species; potential weed problems in Idaho. Wayne S. Belles, Donald C. Thill, and Don W. Morishita. (Idaho Agricultural Experiment Station, University of Idaho, Moscow, Idaho, 83844-2339) The occurrence and distribution of weed species are dynamic phenomena. Weed science works within a framework of ecological plant geography. Few programs devote resources to systematically surveying weed floras or documenting changes in weed species distributions. The distribution of weed species in Idaho submitted from all sources for identification by weed science diagnostic personnel, and of weed species in Idaho otherwise called to the attention of the University of Idaho Lambert C. Erickson Weed Diagnostic Laboratory since 1984, were examined to discover recent changes in distributions. The distribution was categorized into three groups. Two species were found to be new to the Pacific Northwest (Idaho, Oregon and Washington) in 1998. One species was found to be a new record for Idaho in 1998. Extensions of the ranges of several species that have been present in Idaho for several years also were recorded. Thirty four species were found to be new records for individual counties in 1998. As this diagnostic service continues to build the data base, as extension weed identification programs increase, and as county staff and consultants gain in diagnostic ability, fewer questions are submitted, and fewer unrecorded species are reported. This is considered to be a measure of successful state and county extension programs. These new records document the reporting and verification of the presence of these species, not necessarily their time of entry into the state or county. Not all are recognized weeds; some are native to the continent, region, state, or district; others are simply escaped ornamentals or crops; none are native to the location reported. The reporting period for these data was November 1, 1997 to October 31, 1998. The following lists cite the scientific name, Bayer code (when extant), Weed Science Society of America common name (or common name from other references when WSSA common name is not available), family name, and location(s) of each new record. Additional data are maintained on permanent file.

GROUP I: New regional records: species not previously documented for the Pacific Northwest by the Weed Diagnostic Laboratory, nor currently listed in Flora of the Pacific Northwest (new regional as well as state and county records).

1. *Cycloloma atriplicifolium* (Spreng.) Coult. (CYMAT), pigweed, winged, Chenopodiaceae. County: Minidoka.
2. *Helenium hoopesii,* Gray (HENHO) , sneezeweed, orange, Asteraceae. County: Caribou.

GROUP II: New state records: species not previously documented for Idaho by the Weed Diagostic Laboratory, although currently listed Flora of the Pacific Northwest (new state as well as county records).

1. *Secale montanum,* Guss.(*) (common name not available) Poaceae. County: Twin Falls.

GROUP III: New county records: species not previously submitted and/or reported to the Weed Diagnostic Laboratory in the county listed, although previously reported in one or more counties in Idaho.

1. *Asperugo procumbens* L. (ASGPR) catchweed; Boraginaceae. County: Twin Falls.
2. *Brassica rapa* L. (BRSRA) mustard, birdsrape; Brassicaceae. County: Bingham.
3. *Bryonia alba* L. (BYOAL) bryony, white; Cucurbitaceae. County: Canyon.
4. *Conringia orientalis* L. (Dumort) (CNHOR) mustard, haresear; Brassicaceae. Counties: Minidoka & Oneida.
5. *Digitaria ischaemum* Schreb. ex Schweig (DIGIS) crabgrass, smooth; Poaceae. County: Caribou.
6. *Eragrostis pectinacea* (Michx.) Nees (ERAPE) lovegrass, tufted; Poaceae. County: Jerome.
7. *Erica carea,* L. (*) heath, spring; Ericaceae. County: Oneida.
8. *Erysimum asperum* (nutt.) DC. (ERYAS) wallflower, western; Brassicaceae. County: Franklin.
9. *Euphorbia myrsinites* L. (*) spurge, myrtle; Euphorbiaceae. County: Idaho.
10. *Euphorbia peplus* L. (EPHPE) spurge, petty; Euphorbiaceae. County: Caribou.
11. *Glechoma hederaceae* L. (GLEHE) ivy, ground; Lamiaceae. County: Idaho.
12. *Helianthus salicifolius* A. Dietr. (*), sunflower, willow-leaved; Asteraceae. County: Payette.
13. *Hesperis matronalis* L. (HEVMA) damesrocket; Brassicaceae. County: Bonneville.
14. *Lepidium latifolium* L. (LEPLA) pepperweed, perennial; Brassicaceae. County: Nez Perce.
15. *Lupinus, sericeus* Pursh. (LUPSE) lupine, silky: Fabaceae. County: Latah.
16. *Lythrum salicaria* L. (LYTSA) loosestrife, purple; Lythraceae. County: Fremont.
17. *Medicago lupulina* L. (MEDLU) medic, black; Fabaceae. County: Oneida.

18. *Microseris cuspidata* (Pursh) Schultz-Bip. (*) microseris, toothed; Asteraceae. County: Kootenai.
19. *Mimulus guttatus* DC. (*) monkey-flower, yellow; Scrophulariaceae. County: Nez Perce.
20. *Muhlenbergia asperifolia* (Nees & Mey.) Parodi (MUHAS) muhly, alkali; Poaceae. County: Kootenai.
21. *Oenothera pallida* Munz. (*) eveningprimrose, pale; Onagraceae. County: Oneida.
22. *Oenothera elata* Kunh. (*) eveningprimrose, Hooker's; Onagraceae. County: Washington.
23. *Polygonum nuttalli* Small (*) knotweed, Nuttall's; Polygonaceae. County: Blaine.
24. *Ranunculus glaberrimus* Hook (*) buttercup, sagebrush; Ranunculaceae. County: Twin Falls.
25. *Ranunculus acriformis* Gray (*) buttercup, sharp; Ranunculaceae. County: Butte.
26. *Salvia aethiopis* L. (SALAE) sage, Mediterranean; Lamiaceae. County: Lincoln.
27. *Scleranthus annus* L. (SCRAN) knawel; Caryophyllaceae. County: Lewis.
28. *Sclerochloa dura* (L.) Beauv. (SCMDU) hardgrass; Poaceae. County: Oneida.
29. *Setaria glauca* (L.) Beauv. (SETLU) foxtail, yellow; Poaceae. Counties: Kootenai & Nez Perce.
30. *Silene alba* (Mill.) E.H.L. Krause (MELAL) campion, white; Caryophyllaceae. County: Gooding.
31. *Sisymbrium officinale* (L.) Scop.(SSYOF) mustard, hedge; Brassicaceae. County: Kootenai.
32. *Solanum rostratum* Dun. (SOLCU) buffalobur; Solanaceae. Counties: Bingham & Latah.
33. *Spergularia diandra* (Guss.) Bois. (*) sandspurry, alkali; Carophyllaceae. County: Kootenai.
34. *Verbena bracteata* Lag. & Rodr. (VEBBR) vervain, prostrate; Verbenaceae. County: Caribou.

(*) no Bayer code listed in WSSA Composite List of Weeds

PROJECT 5

WEEDS OF WETLANDS & WILDLANDS

Joe DiTomaso, Chair

Biological control of purple loosestrife in North Dakota. Jeffrey A. Nelson, Rodney G. Lym, and Katheryn M. Christianson. (Department of Plant Sciences, North Dakota State University, Fargo, ND 58105). Purple loosestrife was added to the North Dakota Noxious Weed List in 1996. Purple loosestrife is found in 11 North Dakota counties with the largest infestations in urban areas. Biological control of purple loosestrife fits well in urban areas considering public apprehension of herbicides sprayed in close proximity to residential areas. Three species of purple loosestrife biological agents were introduced in North Dakota in 1997 and 1998. The objective of this research was to evaluate purple loosestrife control with biological agents.

Experiments were established along a water way at Sertoma Park (park site) and along a walking trial (channel site) in Grand Forks, North Dakota. Approximately 5,000 leaf beetle adults, *Galerucella calmariensis* and *G. pusilla*, were released at a single release point at both locations in June 1997. *Galerucella* spp. overwinter as adults and begin to lay eggs soon after emergence. The number of *Galerucella* spp. adults and egg masses, and purple loosestrife stems, plant height, and spike length were recorded at 15 meter increments from and including the release point. A second experiment was established at Sertoma Park to evaluate the effect of *Hylobius transversevittatus* on purple loosestrife in July 1997. Approximately 1,000 *H. transversevittatus* eggs were placed into cut purple loosestrife stems or on the roots. This biological agent is nocturnal so evaluations of population density were not conducted. However, the effect of *H. transversevittatus* on purple loosestrife was evaluated by estimating stem density, plant height, and spike length in four square meter quadrats within the experiment.

Galerucella spp. successfully established at both the channel and park sites (*Table 1*). Adults and egg masses were observed on purple loosestrife plants at both sites on June 11, 1998. Egg masses were removed and introduced into an artificial enclosure with purple loosestrife plants to evaluate egg viability. Eggs hatched, larvae increased in size, pupated, and emerged as adults within the enclosure confirming *Galerucella* spp. life cycle could be completed in North Dakota. Few adult *Galerucella* spp. were observed in the field at either the channel or park locations. The reason few adults were observed in the field is unknown; however, adults will drop from foliage when disturbed and readily disperse from the experiment location so the population density may have been underestimated. Changes in purple loosestrife stem density and percent cover between 1997 and 1998 were likely due to natural fluctuations in plant population. To date, the density of *Galerucella* spp. is not high enough to significantly impact purple loosestrife.

Purple loosestrife stems that had been infested with *H. transversevittatus* eggs were harvested in September 1997 and dissected to determine egg viability and larval feeding. Over 50% of the harvested stems contained *H. transversevittatus* larvae. Larvae were allowed to feed but failed to develop into adults under artificial conditions. There was little reduction in stem density, stem height, and spike length from the *H. transversevittatus* release site the first year following release (*Table 2*). However, numerous purple loosestrife plants appeared stunted and flowered later than plants outside the release area. Delayed flowering maybe an indication of *H. transversevittatus* larval feeding.

North Dakota State University initiated an outreach program for biological control of purple loosestrife in 1998. An implementation grant from the National Biological Control Institute provided funds to release *G. calmariensis* and *G. pusilla* at locations in Minot and Valley City, North Dakota. These locations will be used for demonstration and field tours in the summer of 1999.

Table 1. Purple loosestrife control with *Galerucella* spp. released in 1997 at two locations in Grand Forks, ND.

	Purple loosestrife							
	Stem		Stem height		Cover		*Galerucella* spp.	
Treatment[1]	1997	1998	1997	1998	1997	1998	Adult	Egg masses
Channel site	No./m²		m		%		No./m²	
Release	25	60	1.3	1.7	100	75	0	12
15 m	10	8	1.3	1.7	33	18	0	2
30 m	15	26	1.2	1.8	38	34	0	1
45 m	12	0	1.2	0	10	0	0	0
Park site								
Release	19	10	1.5	1.1	60	25	2	21
15 m	27	19	1.3	1.1	45	19	0	3
30 m	20	13	1.3	1.1	33	28	0	0
45 m	17	16	1.3	1.3	55	15	0	1

[1]Estimates of purple loosestrife control and *Galerucella* spp. population were made on July 17, 1997 and July 16, 1998.

Table 2. Purple loosestrife control with *Hylobius transversovittatus* introduced as eggs in 1997 in Grand Forks, ND.

Stem		Flower stem		Stem height		Spike length	
1997	1998	1997	1998	1997	1998	1997	1998
No./m²				m			
85	24	25	24	1.9	1.5	0.6	0.4

PROJECT 6

BASIC SCIENCES

Peter Dotray, Chair

Computerized analysis of seed viability for weed seed burial studies. David W. Wilson, Stephen D. Miller and Patrick S. Mees. (Department of Plant Sciences, University of Wyoming, Laramie, WY 82071) Due to the inherently long chronologic scale required for seed burial study analysis, a tool to standardize viability analysis over several years is required. Computerized analysis removes the human subjectivity and error associated with previously accepted visual measurement systems. Common human errors in viability assessment include miscounts, recounts and variable individual color interpretation. Software for the Windows 3.X and 95 platforms was written with a C++ compiler and scanner interface toolkit. Using an edge detection program code, software was developed to use any flatbed color scanner connected to an IBM compatible computer to count and determine viability of seed embryos. A twenty-four hour tetrazolium chloride soak in petri dishes with Whatman 4, 90mm diameter filter paper was used for the seeds to be tested. The embryos of three different seed studies were analyzed including corn/bean, a selection of stored weed seeds and a weed seed burial study. After the twenty-four hour soak, seeds were analyzed by an experienced seed test technician using visual analysis through a stereomicroscope. The seeds and filter paper were then immediately placed on a clear acetate sheet and scanned using a single pass, 24-bit color, flatbed scanner connected to a 486DX80 computer running Windows 3.11. Analysis using the computer viability software was done and compared with human analyzed samples. Samples with differences in human versus computer analysis were re-analyzed for error comparison of lot size and viability. Comparisons demonstrated the greater accuracy of the computerized system, associating errors to the human analysis procedure.

Table. Visual versus scanned live tissue analysis of *Phaseolus vulgaris*.

	Percent Viability						
Visual Viability Estimate	0	5	10	25	50	75	100
Scanned Live Tissue Calculation	3	8	12	27	47	72	96
TZScan Error	3	3	2	2	3	3	4

Note: The maximum computer scan error factor of 4% is comparable to a possible human error of 100% on an individual embryo or seed for a misread sample.

Seed longevity of ten weed species six years after burial at two depths. David W. Wilson, Stephen D. Miller and Stephen M. VanVleet. (Department of Plant Sciences, University of Wyoming, Laramie, WY 82071) The longevity of weed seeds is a primary factor in determining potential weed population problems. The ability to anticipate successive weed generation effects enables the formulation of control strategies before populations reach a yield impact level. A burial study plot was established in the last week of October of 1990 at four different dryland locations in Wyoming. Ten weed species were buried at two depths in replicates of four at each of the sites. Packets made from 100 micron mesh screen, containing 100 seeds of each species were buried at one and six inch depths in four inch diameter holes, spaced twelve inches apart. Soil was firmly tamped after packet placement and a grass cover was allowed to develop over each study site. Seed packets were carefully removed from each of the four sites in October of 1991, 1992, 1994 and 1996. Holes were refilled and the packets were transported to the laboratory for comparison with stored samples using the tetrazolium chloride viability test.

Average seed viability declined over 2 and 4 % between the first and second year of the study and 6 and 7% between the second and fourth years of the study at the one and six inch depths, respectively. Of the four monocot species tested only jointed goatgrass retained over one percent viability after six years. Cutleaf nightshade, field bindweed and spotted knapweed retained the highest viability of the weed species tested with viability remaining greater than 20%, 34% and 3% respectively.

Table. Seed viability at two soil depths six years after burial at four locations in Wyoming, 1997.

		Location				
Weed Species (Lab Viability)[a]		Cheyenne	Laramie	Sheridan % viable seed[b]	Torrington	Mean
				(1 inch depth)		
Field bindweed	(85)	13	1	6	29	12
Cutleaf nightshade	(55)	31	35	46	19	33
Spotted knapweed	(64)	0	3	2	0	1
Jointed goatgrass	(74)	0	1	0	0	0
Leafy spurge	(44)	0	0	0	0	0
Canada thistle	(0)	0	0	0	0	0
Wild oat	(17)	0	0	0	0	0
Green foxtail	(1)	0	0	0	0	0
Kochia	(42)	0	0	0	0	0
Downy brome	(8)	0	0	0	0	0
Mean	(39)	4	4	5	5	5
				(6 inch depth)		
Field bindweed		73	46	25	78	56
Cutleaf nightshade		10	14	2	0	7
Spotted knapweed		6	10	2	2	5
Jointed goatgrass		0	1	3	2	5
Leafy spurge		15	0	10	1	7
Canada thistle		0	0	0	0	0
Wild oats		0	1	5	0	2
Green foxtail		0	0	0	0	0
Kochia		0	0	0	0	0
Downy brome		0	0	0	0	0
Mean		10	7	5	8	8

[a] ( ) = viability of seed stored in nylon packets in sealed glass jars at 70 - 75F for six years in Weed Science Lab.
[b] All seed viability based on tetrazolium chloride test of 400 seeds.

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HERBICIDE CHEMICAL NAMES

Common Name or Code Designation (Trade Name): Chemical Name

2,4-D (Several): (2,4-dichlorophenoxy)acetic acid
2,4-DB (Butoxone, Butyrac): 4-(2,4-dichlorophenoxy)butanoic acid
2,4,5-T (Weedone): 2-(2,4,5-trichlorophenoxy) propionic acid
AC 263,222 [Imazapic] proposed name (Plateau): (±)-2-[4,5-dihydro-4-methyl-4-(1-methylethyl)-5-oxo-1*H*-imidazol-2-yl]-5-methyl-3-pyridinecarboxylic acid
AC 299,263 [Imazamox] proposed (Raptor): 2-(4-isopropyl-4-methyl-5-oxo-2-imidazolin-2-yl)-5-(methoxymethyl)nicotinic acid (IUPAC)
ASC-66746 (Not available)
ASC-65258 (Not available)
acetochlor (Harness): 2-chloro-*N*-(ethoxymethyl)-*N*-(2-ethyl-6-methylphenyl)acetamide
alachlor (Lasso): 2-chloro-N-(2,6-diethylphenyl)-N-(methoxymethyl)acetamide
atrazine (Aatrex, others): 6-chloro-N-ethyl-N'-(1-methylethyl)-1,3,5-triazine-2,4-diamine
BAS 514 (Facet): 3,7-dichloro-8-quinoline carboxylic acid
BAS 589 03H (Not available)
BAS 654H (proposed name diflufenzopyr): 2-[1-[[[[3,5-difluorophenyl]amino]-carbonyl]hydrazono]ethyl]-3-pyridinecarboxylic acid
BAS 662H (BAS 654H (proposed name diflufenzopyr) + dicamba)
BASF-1269
BAY FOE 5043 (None): *N*-(4-fluorphenyl)-N-(1-methylethyl)-2-[5-trifluoromethyl-(1,3,4-thiadiazol-2-yl)oxy]acetamide
BAY SMY 1500 (Tycor, Siege): 4-amino-t-(1,1-dimethylethyl)-3-(ethylthio)-1,2,4-triazin-5(4H)-one
benefin (Balan): N-butyl-N-ethyl-2,6,dinitro-4-(trifluoromethyl)benzenamine
benoxacor (proposed): 4-(dichloroacetyl-3,4-dihydro-3-methyl-2*H*-1,4-benzoxazine
bensulfuron (Londax): -[[[[[(4,6-dimethoxy-2-pyrimidinyl)amino]carbonyl]amino]sulfonyl] methyl]benzoate
bensulide (Prefar): *0,0*-bis(1-methylethyl) S-[2-[(phenylsulfonyl)amino]ethyl] phosphorodithioate
bentazon (Basagran): 3-(1-methylethyl)-(1H)-2,1,3-benzothiadiazin-4(3H)-one 2,2-dioxide
bromoxynil (Buctril, others): 3,5-dibromo-4-hydroxybenzonitrile
butifos (Def): s,s,s,-tributylphosphorotrithioate
cacodylic acid (Various): dimethyl arsinic acid
calcium cyanamide (Perlka): CaCN2
CGA-131036 (Amber): N-(6-methoxy-4-methyl-1,3,5-triiazin-2-yl-aminocarbonyl -2-(2-chloroethoxy)- benzenesulfonamide
CGA-136872 (Beacon):2-[[[[[4,6-bis(difluoromethoxy)-2-pyrimidinyl)amino)carbonyl) amino)sulfonyl)benzoic acid methyl ester
CGA-152005 See prosulfuron
CGA-248757 [fluthiacet] proposed (Action): methyl [[2-chloro-4-fluoro-5-[(tetrahydro-3-oxo-1*H*, 3*H*-[1,3,4]thiadiazolo[3,4-a]pyridazin-1-ylidene)amino]phenyl]thio]acetate
chlorimuron (Classic): 2-[[[[(4-chloro-6-methoxy-2-pyrimidinyl)amino]carbonyl]amino]

sulfonyl]benzoic acid
chlorsulfuron (Glean): 2-chloro-N-[[(4-methoxy-6-methyl-1,3,5-triazin-2-yl)amino] carbonyl]benzenesulfonamide
cinmethylin (Cinch): exo-1-methyl-4-(1-methylethyl)-2-[(2-methylphenyl)methoxy] -7-oxabicyclo[2.2.1]heptane
cinosulfuron
clethodim (Select, Prism): *(E,E)*-(±)-2-[1-[[3-chloro-2-propenyl)oxy]imino]propyl]-5-[2-(ethylthio)propyl]-3-hydroxy-2-cyclohexene-1-one
clomazone (Command): 2-[(2-chlorophenyl)methyl]-4,4-dimethyl-3-isoxazolidinone
clopyralid (Lontrel): 3,6-dichloro-2-pyridinecarboxylic acid
cyanazine (Bladex): 2-[[4-chloro-6-(ethylamino)-1,3,5-trizain-2-yl]amino]-2-methylpropanenitrile
cycloate (Ro-Neet): S-ethyl cyclohexylethylcarbamothioate
DCPA (Dacthal): dimethyl 2,3,5,6-tetrachloro-1,4-benzenedicarboxylate
desmedipham (Betanex): ethyl[3-[[(phenylamino)carbonyl]oxy]phenyl]carbamate
dicamba (Banvel, Clarity): 3,6-dichloro-2-methoxybenzoic acid
dichlobenil (Casoron): 2,6-dichlorobenzonitrile
diclofop (Hoelon): (±)-2-[4-(2,4-dichlorophenoxy)phenoxy]propanoic acid
dichlorprop (several): (+)-2-(2,4-dichlorophenoxy) propanoic acid
diethatyl (Antor): N-(chloroacetyl)-N-(2,6-diethylphenyl)glycine
difenzoquat (Avenge): 1,2-dimethyl-3,5-diphenyl-1H-pyrazolium
diflufenzopyr: 2-(1-((((3,5-difluoro phenyl)amino)carbonyl)hydrazono)ethyl)-3-pyridine carboxyic acid
[dimethenamid] proposed (Frontier): (1RS,aRS)-2-chloro-*N*-(2,4-dimethyl-3-thienyl)-*N*-(2-methoxy-1-methylethyl)-acetamide
diquat (Various): 6,7,-dihydrodipyrido[1,2-α:2′1′*c*]pyrazinediium ion
dithiopyr (Dimension, MON-15100): S,S-dimethyl 2-(difluromethyl)-4-(2-methylpropyl) -6-(trifluromethyl)-3,5-pyridinedicarbothioate
diuron (Karmex, others): N'-(3,4-dichlorophenyl)-N,N-dimethylurea
DPX-PE350 (not available)
DPX-R9674 (Harmony Extra) (Thifensulfuron:DPX-L5300 2:1): {3-[[[[(4-methoxy-6-methyl-1,3,5-triazine-2-yl)amino]carbonyl]amino]sulfonyl]-2-thiophenecarboxylic acid + methyl 2-[[[[N, (4-methoxy-6-methyl-1,3,5-triazin-2-yl)-methylamino]carbonyl]amino] sulfonyl] benzoate}
DPX-V9360 (Accent): 2-([[[[4,6-dimethoxypyrimidin-2-yl] aminocarbonyl]]aminosulfonyl]) -N-N-dimethyl-3-pyridinecarboxamide monohydrate
DPX-66037 (not available): {methyl 2-[4-dimethylamino-6-(2,2,2-trifluroethoxy)-1,3,5-triazin-2-yl-carbomyl-sulfamoyl]-M-toluate}
EPTC (Eptam): S-ethyl dipropyl carbamothioate
ethalfluralin (Sonalan): *N*-ethyl-*N*-(2-methyl-2-propenyl)-2,6-dinitro-4-(trifluoromethyl) benzenamine
Exp 31130A (None) AG30: 5-cyclopropyl-4-(2-methylsulphonyl-4-trifluoromethylbenzoyl)isoxazole
ethofumesate (Nortron): (±)-2-ethoxy-2,3-dihydro-3,3-dimethyl-5-benzofuranyl methanesulfonate

F-8426 [carfentrazone-ethyl] (proposed) (Affinity): (ethyl-2-chloro-3[2-chloro-4-fluoro-5-(4-difluoromethyl)-4,5-dihydro-3-methyl-5-oxo-1*H*-1,2,4-triazol-1-yl)phenly-propanoate
fenoxaprop (Option or Acclaim): (±)-2-[4-[(6-chloro-2-benzoxazolyl)oxy] phenoxy] propanoic acid
flamprop (Mataven): *N*-benzoyl-*N*-(3-chloro-4-fluorophenyl)DL-alanine
fluazifop-p (Fusilade DX): (*R*)-2-[4-[[5-trifluoromethyl)-2-pyridinyl] oxy]phenoxy]propanoic acid
flumetsulam (Broadstrike): *N*-(2,6-difluorophenyl)-5-methyl[1,2,4]triazolo[1,5-*a*]pyrimidine-2-sulfonamide
flumiclorac (Resource): [2-chloro-4-fluoro-5-(1,3,4,5,6,7-hexahydro-1,3-dioxo-2*H*-isoindol-2-yl)phenoxy]acetic acid
fluometuron (Cotoran, Meturon): N,N'-dimethyl-N'-[3-(trifluoromethyl)phenyl]urea
fluroxypyr (Starane): 4-amino-3,5-dichloro-6-fluoro-2-pyridyloxyacetic acid
glufosinate (Finale, Liberty): 2-amino-4-(hydroxymethylphosphinyl) butanoic acid
glyphosate (Roundup, others): N-(phosphonomethyl) glycine
halosulfuron (formerly MON 12000) (Permit): methyl-5-[[(4,6-dimethoxy-2-pyrimidinyl) amino]carbonylaminosulfonyl]-3-chloro-1-methyl-1-*H*-pyrazole-4-carboxylate
haloxyfop (Verdict): 2-[4-[[3-chloro-5-(trifluromethyl)-2-pyridinyl]oxy] phenoxy]propanoic acid
hexazinone (Velpar): 3-cyclohexyl-6-(dimethylamino)-1-methyl-1,3,5-triazine -2,4(1H,3H)-dione
HOE-6001 premix of fexoxaprop-p-ethyl plus safener
imazameth (Plateau): (±)-2-[4,5-dihydro-4-methyl-4-(1-methylethyl)-5-oxo-1*H*-imidazol-2-yl]-5-methyl-3-pyridinecarboxylic acid
imazamethabenz (Assert): (±)-2-[4,5-dihydro-4-methyl-4-(1-methylethyl)-5-oxo-1H-imidazol-2-yl]-4 (and 5)-methylbenzoic acid (3:2)
imazapyr (Arsenal): (±)-2-[4,5-dihydro-4-methyl-4-(1-methylethyl)-5-oxo-1H-imidazol-2-yl]-3-pyridinecarboxylic acid
imazaquin (Scepter): 2-[4,5-dihydro-4-methyl-4-(1-methylethyl)-5-oxo-1H-imidazol-2-y1]-3-quinolinecarboxylic acid
imazethapyr (Pursuit): 2-[4,5-dihydro-4-methyl-4-(1-methylethyl)-5-oxo-1H-imidazol-2-yl]-5-ethyl-3-pyridine-carboxylic acid
imazosulfuron
imazamox (Raptor) See AC 299,263
isoxaben (Gallery, Snapshot): *N*-[3-(1-ethyl-1-methylpropyl)-5-isoxazolyl]-2,6-dimethoxybenzamide
[isoxaflutole] proposed
lactofen (Cobra): (±)-2-ethoxy-1-methyl-2-oxoethyl 5-[2-chloro-4-(trifluoromethyl)phenoxy]-2-nitrobenzoate
linuron (Lorox, Linex): N-(3,4-dichlorophyenyl)-N-methoxy-N-methylurea
MCPA (several): (4-chloro-2-methylphenoxy) acetic acid
MCPB (This-trol): 4-(4-chloro-2-methylphenoxy)butanoic acid
mecoprop (several): (+)-2-(4,chloro-2-methylphenoxy) propanoic acid
metha (Vapam): methylcarbamodithioic acid
metham (Vapam): methylcarbamodithioic acid

metolachlor (Dual II): 2-chloro-N-(2-ethyl-6-methylphenyl)-N-(2-methoxy-1-methylethyl) acetamide
metribuzin (Lexone, Sencor): 4-amino-6-(1,1-dimethylethyl)-3-(methylthio)-1,2,4-triazin -5(4H)-one
metsulfuron (Ally, Escort): methyl 2-[[[[(4-methoxy-6-methyl- 1,3,5-triazin-2-yl)amino] carbonyl]amino]sulfonyl]benzoate
molinate (Ordram): S-ethyl hexahydro-1H-azepine-1-carbothioate
MON-13200 (not available): methyl 2-difluromethyl-4-isobutyl-5-(4,5-dihydro-2-thiazolyl)-6-trifluromethyl-3-pyridinecarboxylate
MON-13288 (not available)
MON 37500 [sulfosulfuron] (proposed): {1-[2-ethylsulfonylimidazo(1,2-a)pyridin-3-yl-sulfonyl]-3-(4,6-dimethoxypyrimidin-2-yl)urea}
MON-37503
MON-37536
monocarbamide dihydrogensulfate (Enquik)
MSMA (several): monosodium methanearsonate
napropamide (Devrinol): N,N-diethyl-2-(1-naphthalenyloxy)propanamide
naptalam (Alanap): 2-[(1-naphthalenylamino)carbonyl] benzoic acid
nicosulfuron (Accent): 2-[[[[(4,6-dimethoxy-2-pyrimidinyl)amino]carbonyl]amino]sulfonyl]-N,N-dimethyl-3-pyridinecarboxamide
norflurazon (Zorial): 4-chloro-5-(methylamino)-2-(3-(trifluoromethyl)phenyl)-3(2H)-pyridazinone
oryzalin (Surflan): 4-(dipropylamino)-3,5-dinitrobenzenesulfonamide
oxadiazon (Chipco Ronstar): 3-[2,4-dichloro-5-(1-methylethoxy)phenyl]-5-(1,1-dimethylethyl)-1,3,4-oxadiazol-2-(3*H*)-one
oxyfluorfen (Goal): 2-chloro-1-(3-ethoxy-4-nitrophenoxy)-4-(trifluoromethyl)benzene
paraquat (Gramoxone Extra): 1,1′-dimethyl-4,4′ bipyridinium ion
pendimethalin (Prowl, others): N-(1-ethylpropyl)-3,4-dimethyl-2,6-dinitrobenzenamine
phenmedipham (Spin-Aid, Betanal): 3-[(methoxycarbonyl)amino]phenyl (3-methylphenyl)carbamate
picloram (Tordon): 4-amino-3,5,6-trichloro-2-pyridinecarboxylic acid
primisulfuron (Beacon): 2-[[[[[4,6-bis(difluoromethoxy)-2-pyrimidinyl]amino]carbonyl] amino]sulfonyl]benzoic acid methyl ester
prodiamine (Rydex): 2,4-dinitro-N3,N3-dipropyl-6-(trifluoromethyl)-1,3-benzenediamine
prometryn (Caparol): N,N'-bis(1-methylethyl)-6-(methylthio)-1,3,5-triazine-2,4-diamine
pronamide (Kerb): 3,5-dichloro(N-1,1-dimethyl-2-propynyl)benzamide
propachlor (Ramrod): 2-chloro-*N*-(1-methylethyl)-*N*-phenylacetamide
propanil (Stampede, Vertac): N-(3,4-dichlorophenyl) propanamide
propazine (Milogard): 6-chloro-*N*,*N*'-bis(1-methylethyl)-1,3,5-triazine-2,4-diamine
propham (Chem Hoe): 1-methylethyl phenylcarbamate
[prosulfuron] proposed (CGA-152005) [Peak]: 1-(4-methoxy-6-methyl-triazin-2-yl)-3-[2-(3,3,3-trifluoropropyl)-phenylsulfonyl]-urea
pyrazosulfuron
pyrazon (Pyramin): 5-amino-4-chloro-2-phenyl-3(2H)-pyridazinone
pyridate (Tough or Lentagran): O-(6-chloro-3-phenyl-4-pyridazinyl)S-octyl carbonothioate

pyrithiobac-sodium (Staple): 2-chloro-6-[(4,6-dimethoxy-2-pyrimidinyl)thio]benzoic acid
quinclorac (Facet): 3,7-dichloro-8-quinolinecarboxylic acid
quizalafop (Assure II): (*R*)-2-[4-[(6-chloro-2-quinoxalinyl)oxy]phenoxy]propanoic acid
RH-123652 (none): Not available
rimsulfuron (Matrix): *N*-[[4,6-dimethoxy-2-pyrimidinyl)amino]carbonyl]-3-(ethylsulfonyl)-2-pyridinesulfonamide
SAN 582H See dimethenamid
SAN 835H
SAN 1269H
sethoxydim (Poast, Ultima 160): 2-[1-(ethoxyimino)butyl]-5-[2-(ethylthio)propyl]-3-hydroxy-2-cyclohexen -1-one
simazine (Various): 6-chloro-N,N′-diethyl-1,3,5-triazine-2,4-diamine
sodium chlorate (Various): NaClO3
sulfometuron (Oust): methyl 2-[[[[(4,6-dimethyl-2-pyrimidinyl) amino]carbonyl]amino] sulfonyl] benzoate
sulfosate (Touchdown): N-phosphonamethylglycine trimethyl suflonium salt
SMY-1500 (Tycor): (4-amino-6-(1,1-dimethyl-ethyl)-3-(ethylithio)-1,2,4-triazine-5(4H)-one
sulfentrazone (Authority): *N*-[2,4-dichloro-5-[4-(difluoromethyl)-4,5-dihydro-3-methyl-5-oxo-1 *H*-1,2,4-triazol-1-yl] phenyl]methanesulfonamide
tebuthiuron (Spike): N-[5-(1,1-dimethylethyl)-1,3,4-thiadiazol-2-yl]-N,N'-dimethylurea
terbacil (Sinbar): 5-chloro-3-(1,1-dimethylethyl)-6-methyl-2,4(1H, 3H)-pyrimidinedione
Thiafluamide [proposed] See FOE 5043
thiazopyr (Visor): methyl 2-(difluoromethyl)-5-(4,5-dihydro-2-thiazolyl)-4-(2-methylpropyl)-6-(trifluoromethyl)-3-pyridinecarboxylate
thifensulfuron (Pinnacle): 3-[[[[(4-methoxy-6-methyl-1,3,5-triazin-2-yl)amino]carbonyl] amino]sulfonyl]-2-thiophene carboxylic acid
tralkoxydim (Achieve): 2-[1-ethoxyimino)propyl]-3-hydroxy-5-mesitylcyclohex-2-enone
triallate (Far-Go): S-(2,3,3-trichloro-2-propenyl) bis(1-methylethyl)carbamothioate
triasulfuron (Amber): 2-(2-chloroethoxy)-*N*-[[4-methoxy-6-methyl-1,3,5-triazin-2-yl)amino] carbonyl] benzenesulfonamide
tribenuron (Express): 2-[[[[(4-methoxy-6-methyl-1,3,5-triazin-2-yl)-methylamino]carbonyl] amino]sulfonyl]benzoic acid
tribuphos (Folex): s,s,s-tributylphosphorotrithioate
triclopyr (Garlon): [(3,5,6-trichloro-2-pyridinyl)oxy]acetic acid
tridiphane (Tandem): 2-(3,5-dichlorophenyl)-2-(2,2,2-trichloroethyl)oxirane
trifluralin (Treflan, others): 2,6-dinitro-N,N-dipropyl-4-(trifluoromethyl)benzeneamine
triflusulfuron (Upbeet): methyl-2-[[[[4-dimethylamino)-6-(2,2,2-trifluoroethoxy)-1,3,5-triazin-2-yl]amino]carbonyl]amino]sulfonyl]-3-methylbenzoate
UBI-C4243 (not available)
UI96101 (none): Not available
UCC-C4243 (not available): 1,methylethy 2-chloro-5-(3,6-dihydro-3-methyl-4-trifluoremethyl-2,6-dioxo-1(2H)-pyrimidinyl) -benzoate