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FORWARD

The 2002 Research Progress Report of the Western Society of Weed Science (WSWS) is a compilation of research investigations contributed by weed scientists in the western United States. The objective 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 the members of WSWS.

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PROJECT 1: WEEDS OF RANGE AND FOREST

George Beck, Chair

Control of dormant Russian knapweed with various herbicides. Tom Whitson and Mark Ferrell (Department of Plant Sciences, University of Wyoming, Laramie, WY 92071-3354). In previous studies control of Russian knapweed dramatically increased after a killing frost when the knapweed appeared to be completely dormant. This study was initiated to determine if newly introduced herbicides would provide similar control at that growth stage. Applications of 30 gpa were made to 10 by 108 ft. plots with single replications. Russian knapweed had a very dense canopy with no perennial grasses present. Air temperature was 50°F while soil temperatures ranged from 60°F on the surface to 55°F at a 4 inch depth. Soils were sandy loam. Redeem at 1 and 2 qt/A and Tordon 22K at 1 pt/A each provided 100% control. Transline at 9 fl. oz/A and Redeem at 1 pt/A provided 95 and 85% control. Other treatments had no activity on Russian knapweed at this growth stage (Published with the approval of the Wyoming Agricultural Experiment Station).

Table. Control of dormant Russian knapweed with various herbicides

Treatment[1]	Rate (lb ai/A)	% Control[2]
Fluroxypyr + NIS	0 .16	0
Fluroxypyr + Salvo (2,4-D)(LVE) + NIS	0.19 + 0.83	0
Fluroxypyr + 2, 4-D (LVE) + L1136	0.19 + 0.83	0
Clopyralid + Triclopyr (Redeem)	0.13 + 0.5	100
Picloram (Tordon 22K)	0.25	100
Clopyralid (Transline)	0.21	95
Clopyralid + Triclopyr	0.25 + .1.0	100
Clopyralid + Triclopyr	0.63 + 0.25	85
Check		0

1. Treatments were applied Oct. 10, 2000
2. Evaluations were made Aug. 1, 2001

Control of Russian knapweed on southern Colorado rangeland. R.N. Arnold, Michael K. O'Neill, and Dan Smeal. (New Mexico State University Agricultural Science Center, Farmington, NM 87499) Research plots were established on September 13, 2000 in southern Colorado to evaluate the response of Russian knapweed to postemergence herbicides. Soil type was a Ramper loam with a pH of 7.8 and an organic matter content less than 1%. The experimental design was a randomized complete block with three replications. Individual plots were 12 by 25 feet. Treatments were applied with a compressed air backpack sprayer calibrated to deliver 30 gal/A at 30 psi. Treatments were applied on September 13 with 1% crop oil concentrate. Treatments were evaluated approximately one year after treatment on September 19, 2001.

Triclopyr plus 2,4-D and Clopyralid plus 2,4-D applied at 1.5, 3.0 and 1.2 lb/A did not control Russian knapweed satisfactorily when evaluated one year after treatment.

Table. Control of Russian knapweed on southern Colorado rangeland.

Treatments[a,b]	Rate	Weed Control[c] CENRE
	lb/A	——%——
Picloram + 2,4-D (pm)	1.27	86
Picloram + 2,4-D (pm)	2.54	99
Clopyralid	0.25	91
Clopyralid	0.5	99
Triclopyr + 2,4-D (pm)	1.5	10
Triclopyr + 2,4-D (pm)	3.0	22
Clopyralid + 2,4-D (pm)	1.2	52
Clopyralid + 2,4-D (pm)	2.4	89
Dicamba	2.0	65
Weedy check	0	0

[a] Treatments were applied with a COC at 1.0% v/v.
[b] pm equal packaged mix.
[c] Evaluated approximately one year after treatment on September 19, 2001.

Spotted knapweed, diffuse knapweed, and Russian knapweed control with herbicide mixtures. Rodney G. Lym and Katheryn M. Christianson. (Department of Plant Sciences, North Dakota State University, Fargo, ND 58105). Members of the knapweed genus are increasing in acreage in North Dakota and the region. Chemical control of the annual species such as spotted and diffuse knapweed has been effective and is relatively inexpensive. However, control of the perennial Russian knapweed has been difficult and can be costly because of the high herbicide rates required. Previous research at North Dakota State University has found that mixtures of herbicides can provide more cost-effective weed control than a single chemical used alone. The purpose of this research was to evaluate control of various knapweed species using herbicide mixtures.

The first experiment was established on July 8, 1999, near Hawley, MN when spotted knapweed was in the rosette growth stage and beginning to bolt. Herbicides were applied during warm, humid conditions with an air temperature of 70 F and a dew point of 67 F. The soil was sandy gravel with an organic matter of 2.2% and a pH of 8.5. The experiment was a randomized complete block design with four replicates. Treatments were applied with a hand-held sprayer delivering 8.5 gpa at 35 psi. The plots were 7 by 30 feet. Treatments were visually evaluated in late-May and late August 2000 and 2001 with control based on percent stand reduction as compared to the control.

Spotted knapweed control 2 months after treatment (MAT) was similar regardless of herbicide mixture, but long-term control was better with 2,4-D plus sulfentrazone (except the NB30027 formulation), carfentrazone, or triclopyr than with 2,4-D alone or with imazapic (Table 1). For instance, spotted knapweed control with 2,4-D plus sulfentrazone formulated as NB30021 or NB30408 averaged 78 and 86% control 25 MAT compared to 48% with 2,4-D alone. Control 25 MAT only averaged 55% with 2,4-D plus sulfentrazone in the NB30027 mixture. When imazapic was included in the mixture (NB30409 or NB30410), control only averaged 15% or less 25 MAT. 2,4-D plus triclopyr provided 83% control 2 MAT, which slowly declined to 67% by 25 MAT.

The second experiment evaluated control of diffuse knapweed which had established in a rocky pasture previously used as a gravel pit near Pingree, ND. Herbicides were applied on June 23, 2000, when the diffuse knapweed was in the rosette to bolting growth stage, up to 18 inches tall and beginning to form flower buds. The air temperature was 62 F with a dew point of 61 F with light dew on the plants and an overcast sky. Plots were 9 by 30 feet with four replications in a randomized complete block design, and herbicides were applied as previously described.

All herbicide treatments evaluated provided excellent diffuse knapweed control by 11 MAT except fluroxypyr applied either alone or with metsulfuron (Table 2). Control 15 MAT averaged 97% or better with mixtures of metsulfuron plus dicamba plus either 2,4-D or MCPA, picloram plus 2,4-D, dicamba plus diflufenzopyr, quinclorac plus diflufenzopyr, and clopyralid plus 2,4-D. Control 15 MAT with fluroxypyr applied alone or with metsulfuron only averaged 41 and 20%, respectively.

The third experiment evaluated Russian knapweed control with various herbicide mixtures. The experiment was established in the Theodore Roosevelt National Park near Medora, ND, on September 12, 2000, when the Russian knapweed was in the bolt to flowering growth stage and 18 to 36 inches tall. The infestation had been sprayed the previous year with picloram by park personnel to prevent spread of the infestation in the park. The temperature was 65 F with a dew point of 53 F and the soil temperature of 55 F at the 2 inch depth. The plots were 8 by 40 feet with three replications, and herbicides were applied as previously described.

Russian knapweed control was quite variable regardless of treatment (Table 3). The variability in control from plot to plot could be due to picloram applied the previous year. Treatments that tended to look better visually, but did not separate out statistically included quinclorac plus diflufenzopyr and imazapic applied with MSO and 28% N. However, no treatment consistently provided satisfactory Russian knapweed control.

In general, herbicide mixtures provided better knapweed control than single herbicides. Both diffuse and spotted knapweed were relatively easy to control, but no treatment evaluated provided satisfactory Russian knapweed control.

Table 1. Spotted knapweed control with 2,4-D applied with various plant growth regulators.

Treatment[b]	Rate	Control/MAT[a] 2	11	13	22	25
	—— lb/A ——			%		
2,4-D + sulfentrazone (NB30021)	1.97 + 0.03	84	97	89	80	78
2,4-D + sulfentrazone (NB30027)	1.97 + 0.03	86	92	86	68	55
2,4-D + sulfentrazone + 5-ALA (NB30408)	1.96 + 0.03 + 0.01	85	97	91	87	86
2,4-D + sulfentrazone+imazapic (NB30409)	0.86 + 0.03 + 0.11	88	63	47	31	15
2,4-D+imazapic+sulfentrazone+mefluidide (NB30410)	0.7+0.088+0.025+0.19	83	46	52	26	9
2,4-D + carfentrazone (NB30411)	1.98 + 0.02	83	96	88	73	61
2,4-D + carfentrazone + 5-ALA (NB30412)	1.98 + 0.02 + 0.01	86	96	90	88	69
2,4-D mixed amine[c]	1.92	86	87	82	66	48
2,4-D + triclopyr[d]	1 + 0.5	83	91	80	70	67
LSD (0.05)		NS	8	10	18	25

[a]Months after treatment.
[b]All treatments were applied with X-77 at 0.25%.
[c]Commercial formulation - Hi-Dep.
[d]Commercial formulation - Crossbow.

Table 2. Diffuse knapweed control with various herbicide mixtures.

Treatment	Rate	Control/MAT[a] 2	11	15
	—— oz/A ——		%	
Metsulfuron + 2,4-D + dicamba + X-77	0.3 + 16 + 8 + 0.25%	90	98	99
Metsulfuron + MCPA + dicamba + X-77	0.3 + 8 + 8 + 0.25%	97	99	97
2,4-D + dicamba + X-77	16 + 8 + 0.25%	93	97	99
MCPA + dicamba + X-77	8 + 8 + 0.25%	93	98	99
Metsulfuron + 2,4-D + dicamba + X-77	0.6 + 16 + 8 + 0.25%	100	99	100
Metsulfuron + fluroxypyr + X-77	0.3 + 1 + 0.25%	28	52	20
Fluroxypyr + X-77	1 + 0.25%	11	50	41
Picloram + 2,4-D	4 + 16	100	98	99
Dicamba + diflufenzopyr[b] + X-77	11.2 + 0.25%	96	99	99
Quinclorac + MSO[c]	12 + 0.25%	56	88	97
Quinclorac + diflufenzopyr + MSO[c]	12 + 1.2 + 0.25%	70	97	98
Clopyralid + triclopyr[d] + X-77	3 + 9 + 0.25%	97	97	99
LSD (0.05)		18	19	21

[a]Months after treatment.
[b]Commercial formulation - Distinct.
[c]Methylated seed oil was Scoil by AGSCO, Grand Forks, ND.
[d]Commercial formulation - Redeem.

Table 3. Russian knapweed control with various herbicide mixtures applied in September.

Treatment	Rate	Control/MAT[a] 10	12
	—— oz/A ——	%	
Metsulfuron + 2,4-D + dicamba[b] + X-77	0.3 + 16 + 8 + 0.25%	45	40
Metsulfuron + MCPA + dicamba[b] + X-77	0.3 + 8 + 8 + 0.25%	37	35
Metsulfuron + fluroxypyr + X-77	0.3 + 1 + 0.25%	22	47
Picloram + 2,4-D	8 + 16	33	43
Quinclorac + diflufenzopyr + MSO[c]	12 + 1.2 + 0.25%	33	70
Clopyralid + triclopyr[d] + X-77	6 + 18 + 0.25%	37	52
Imazapic + 2,4-D[e] + MSO[b]	3 + 6 + 1 qt	47	44
Imazapic + MSO[c] + 28%N	3 + 1 qt + 1 qt	67	58
LSD (0.05)		NS	NS

[a]Months after treatment.
[b]Commercial formulation - Clarity.
[c]Methylated seed oil was Scoil by AGSCO, Grand Forks, ND.
[d]Commercial formulation - Redeem.
[e]Commercial formulation - Oasis.

Yellow starthistle control in unimproved pasture near Lewiston, Idaho. Joan Campbell, Donn Thill, and Sandra Shinn. (Plant Science Division, University of Idaho, Moscow, ID 83844-2339) Two experiments were established on unimproved pasture land near Lewiston, Idaho to evaluate yellow starthistle control. The first experiment was established on November 16, 1999 to evaluate yellow starthistle control with several PBI Gordon experimental herbicides. A second experiment was established on April 7, 2000 to evaluate yellow starthistle control with quinclorac and diflufenzopyr/dicamba. Experiment details were reported previously (2001 WSWS Research Progress Report, page 2 and page 5). Yellow starthistle control was evaluated visually on July 30, 2001 in the first experiment and April 13, June 18, and July 30, 2001 in the second experiment.

In the first experiment, yellow starthistle control was 100% on July 19, 2000 with NB30027, NB30408, and 2,4-D dimethylamine/2,4-D diethanolamine applied at the rosette growth stage (2001 WSWS Research Progress Report, page 5), but control was 75% or less with all treatments on July 30, 2001 (Table 1).

In the second experiment, on August 15, 2000, yellow starthistle control was 100% for all treatments (2001 WSWS Research Progress Report, page 2). Yellow starthistle control ranged from 72 to 94% on April 13, 2001 and by June 18, 2001, yellow starthistle control was less than adequate (Table 2).

Table 1. Yellow starthistle control with experimental herbicides near Lewiston, Idaho in 2001.

Treatment[a]	Rate	Growth stage	Yellow starthistle control[b]
	lb/A		%
NB30027	1.96	rosette	44
NB30408	2	rosette	36
NB30409	0.92	rosette	28
NB30410	1	rosette	55
2,4-D dimethylamine/2,4-D diethanolamine[c]	1.9	rosette	72
NB30027	1.96	bud	69
NB30408	2	bud	66
NB30409	0.92	bud	75
NB30410	1	bud	45
2,4-D dimethylamine/2,4-D diethanolamine[c]	1.9	bud	62
LSD (0.05)			35

[a] All treatments were applied with nonionic surfactant at 0.25% v/v.
[b] Evaluated July 30, 2001.
[c] 2,4-D dimethylamine salt (1.2 lb/gal) plus 2,4-D diethanolamine salt (2.5 lb/gal).

Table 2. Yellow starthistle control with quinclorac and diflufenzopyr/dicamba near Lewiston, Idaho in 2001.

		Yellow starthistle control		
Treatment[a]	Rate	April 13	June 18	July 30
	lb/A		%	
Quinclorac	0.375	86	66	65
Quinclorac +	0.375			
BAS 654 UB H	0.038	78	12	49
Diflufenzopyr/dicamba	0.263	79	18	26
Diflufenzopyr/dicamba	0.35	72	38	31
Quinclorac +	0.375			
diflufenzopyr/dicamba	0.175	94	62	54
Quinclorac +	0.375			
diflufenzopyr/dicamba	0.263	88	61	41
Quinclorac +	0.375			
diflufenzopyr/dicamba	0.35	81	24	22
LSD (0.05)		18	47	43

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

Control of Dalmatian toadflax with spring applied herbicides. Tom D. Whitson (Department of Plant Sciences, University of Wyoming, Laramie, WY 82071-3354). Dalmatian toadflax is often controlled with lower herbicide rates with spring applications. This study was established on June 15, 1998 to compare spring applications of various herbicides. Dalmatian toadflax was in early bud in active growth at the time of application. Applications of 30 gpa were made to 10 by 27 ft. plots with four replications. Air temperatures were 60°F while soil temperatures ranged from 48°F on the surface to 52°F at a 4 inch depth. Soils were sandy loam with a pH of 6.8 and organic matter of 2%. Visual evaluations were made June 21, 2001. Areas receiving Plateau applications at 10 fl. oz/acre were clipped by species because of the dramatic increase of Western wheatgrass in those treatments. The treatment of Imazapic at .156 lb controlled 87% of the Dalmatian toadflax while changing the species composition from predominantly Dalmatian toadflax and downy brome to the desirable cool-season grasses (western wheatgrass and needleandthread). Published with the approval of the Wyoming Agricultural Experiment Station).

Table. Control of Dalmatian Toadflax 3 years after treatment

Treatment	Rate (ai/A)	% Control
Metsulfuron + NIS	0.3	0
Metsulfuron + NIS	0.6	0
Metsulfuron + NIS	0.9	15
Metsulfuron + NIS	1.2	40
Imazapic + NIS	0.094	46
Imazapic + NIS	0.125	68
Imazapic + NIS	0.156	87
Triasulfuron + NIS	0.21	0
Triasulfuron + NIS	0.42	0
Triasulfuron + Dicamba	0.003 + 0.125	0
Check		0

1. Treatments were applied June 15, 1998.
2. Evaluations made June 21, 2001.

Management of Dalmatian toadflax with various herbicides applied in late season. Tom D. Whitson (Department of Plant Sciences, University of Wyoming, Laramie, WY 82071-3354). Dalmatian toadflax is a highly competitive noxious weed in several western states on rangeland and non-cropland. Paramount and Distinct were compared alone and in various combinations in this study which was established Sept. 14, 2000. Dalmatian toadflax was in the full seed stage and starting senescence at the time of application. Applications of 30 gpa were made to 10 by 27 ft. plots with four replications. Air temperatures were 80°F while soil temperatures ranged from 85°F on the surface to 80° at 4 inches. Soils were sandy loam with a pH of 6.8 and organic matter of 2.0%. Evaluations were made July 12, 2001. Control with Paramount and Distinct at rates of 0.75 lb ai/A and 0.35 lb ai/A used separately provided poor control. The combinations of Paramount at 0.75 lb ai/A and Distinct at 0.18 and Distinct at 0.35 lb ai/A provided 91 and 94% control, respectively one year following treatment. (Published with the approval of the Wyoming Agricultural Experiment Station).

Table. Management of Dalmation toadflax with various herbicides applied in late season

Treatment[1]	Rate (lb ai/A)	% Control[2]
Untreated check		0
Quinclorac + MSO	0.75 + 1%	17
Diflufenzopyr + Dicamba (Distinct) + MSO	0.35 + 0.88 + 1%	3
Quinclorac + Diflufenzopyr + Dicamba + MSO	0.75 + 0.18 + 1%	91
Quinclorac + Diflufenzopyr + Dicamba + MSO	0.75 + 0.26 + 1%	68
Quinclorac + Diflufenzopyr + Dicamba + MSO	0.75 + 0.35 + 1%	94

1. Treatments were applied Sept. 14, 2000.
2. Evaluations were made June 21, 2001.

Yellow toadflax control on Colorado rangeland. James R. Sebastian and K. George Beck. (Department of Bioagricultural Sciences and Pest Management, Colorado State University, Fort Collins, CO 80523) An experiment was established near Camp Hale, CO to evaluate yellow toadflax (LINVU) control with picloram, picloram plus 2,4-D, chlorflurenol, fluroxypyr, and their combinations. The experiment was designed as a randomized complete block with four replications.

Herbicides were applied on July 20, 1998 when yellow toadflax was at vegetative to flower growth stage. 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. Plot size was 10 by 30 feet.

Visual evaluations for percent control were collected approximately 1, 2, and 3 years after treatment (YAT). It took at least 1.0 lb/A of picloram to control more than 74% of yellow toadflax about 1 YAT or 2 YAT (Table 2). The addition of 2,4-D or chlorflurenol to picloram did not increase control of yellow toadflax when compared to picloram applied alone at the same rates. Picloram at 2.0 lb/A almost eliminated yellow toadflax 1 YAT (99% control), but yellow toadflax recovered slightly 2 YAT (94% control) and 3 YAT (92% control). Grass injury increased as the rate of picloram increased 1 YAT (from 9 to 35%), but grasses recovered 2 YAT. Yellow toadflax was controlled poorly by chlorflurenol or fluroxypyr alone or in combination (0 to 8).

Table 1. Yellow toadflax control on Colorado rangeland.

Environmental data	
Application date	July 20, 1998
Application time	12:00 PM
Air temperature, F	65
Relative humidity, %	52
Wind speed, mph	0

Application date	Species	Growth stage	Height (in.)
August 3, 1996	LINVU	vegetative	4 to 7
	LINVU	flower	7 to 17
	AGRSM	vegetative	8 to 12
	BROMA	veg to late flwr	7 to 16
	POASP	veg to late flwr	3 to 7
	CHRNA	vegetative	12 to 18

Table 2. Yellow toadflax control on Colorado rangeland.

Herbicide	Rate	Yellow toadflax control			Grass Injury		
	lb/A	1999	2000	2001	1999	2000	2001
		(%)					
Picloram	0.5	68	68	55	16	0	0
	1.0	89	83	70	29	0	0
	2.0	99	94	92	35	0	0
Picloram + chlorflurenol	0.5 + 0.13	54	35	16	9	0	0
	0.5 + 0.25	39	38	20	13	0	0
	1.0 + 0.25	74	80	68	19	0	0
	1.0 + 0.5	88	84	73	25	0	0
Picloram[a] + 2,4-D	0.5 + 2.0	64	63	29	20	0	0
Picloram[a] + 2,4-D + Chlorflurenol	0.5 +2.0 +0.25	61	55	38	16	0	0
Fluroxypyr	0.25	8	5	0	0	0	0
	0.5	8	3	0	0	0	0
Fluroxypyr + Chlorflurenol	0.25 + 0.07	0	0	0	0	0	0
Fluroxypyr + Chlorflurenol	0.25 + 0.13	0	0	0	0	0	0
Chlorflurenol	0.07	9	9	0	0	0	0
	0.13	0	0	0	0	0	0
	0.25	0	0	0	0	0	0
	0.5	0	0	0	0	0	0
Control		0	0	0	0	0	0
LSD (0.05)		14	15	16	7	0	0

[a] Premixed formulation of the triisopropanolamine salt of picloram + triisopropanolamine salt of 2,4-D is Grazon P&D.

Control of leafy spurge following early frost with various herbicides. Tom D. Whitson (Department of Plant Sciences, University of Wyoming, Laramie, WY 82071-3354). Leafy spurge control is often improved following a killing frost. These treatments were applied near Cheyenne Wyoming one week after a killing frost to mature leafy spurge. Applications of 30 gpa were made to 10 by 27 ft. plots with four replications. Air temperatures were 65°F while soil temperatures ranged from 80°F on the surface to 62°f at a 4-inch depth. Soils were sandy loam. Picloram at 1.0 lb/A provided 93% while MSO at 1/2% V/V provided 91% control. PCC 1133 + L1 136 at 4.8 pt each controlled 36% of leafy spurge. The growth regulators PCC 1133 + L1 136 herbicides may possibly be used as additives to increase the activity of other herbicides. (Published with the approval of the Wyoming Agricultural Experiment Station).

Table. Control of leafy spurge following early frost with various herbicides

Treatment[1]	Rate/A	% Control[2]
Fluroxypyr + NIS	0.12 lb + 0.5%	18
Fluroxypyr + NIS	0.19 lb + 0.5%	8
PCC 1133 + LI 136	4.8 pt + 4.8 pt/A	36
2, 4-D (Salvo) + NIS	1.14 lb + 0.5%	18
2, 4-D (Salvo) + LI 136	1.14 lb + 2.4 pt	5
Fluroxypyr + 2, 4-D (Salvo) + NIS	0.23 lb + 0.57 lb + 0.5%	8
Fluroxypyr + 2, 4-D (Salvo)	023 lb + 0.59 lb	4
Picloram	1.0 lb	93
Imazapic + MSO	0.13 lb + 0.5%	91
Check		0

1. Treatments were applied Sept. 29, 2000.
2. Evaluations were made June 4, 2001.

Control of leafy spurge with quinclorac and BA5662 herbicides. Tom D. Whitson (Department of Plant Sciences University of Wyoming, Laramie, WY, 82071-3354). Leafy spurge, a very persistent noxious weed, grows in many riparian zones where long-term persistent herbicides cannot be used. Herbicides such as Paramount and Distinct are non-restricted and have activity on leafy spurge. Herbicides were applied with a hand-held sprayer at 30 gpa to 10 by 36 ft. plots with three replications. Air temperature was 80°F and soil temperatures ranged from 86°F on the surface to 80°F at four-inch depth. Soils were sandy loam. Leafy spurge was two to three feet tall and had a dense canopy with green leaves at the seed stage. Combinations of Quinclorac + BAS662 at 0.5 + 0.35 and 0.75 + 0.35 lb ai/A combined with 12% (NIS) non-ionic surfactant, 2.5% (UAN) Urea Ammonium Nitrate and 1% (MSO) methylated seed soil resulted in 85 and 92% control, respectively. (Published with the approval of the Wyoming Agricultural Experiment Station).

Table. Control of leafy spurge with quinclorac and BA5662 herbicides

Treatment[1]	Rate ai/A	% Control[2]
Check		0
Quinclorac	0.38 lb/A	5
Quinclorac + MSO	0.38 lb/A + 0.5%	27
Quinclorac + MSO	0.75 lb/A + 0.5%	53
BAS662 + MSO	0.38 lb/A + 0.5%	8
BAS662 + MSO	0.75 lb/A + 0.5%	13
Quinclorac + BA5662 + NIS + UAN + MSO	0.5 + 0.35 + 12% + 2.5% + 1%	85
Quinclorac + BA5662 + NIS + UAN + MSO	0.75 + 0.35 + 12% + 2.5% + 1%	92

1. Treatments were applied Sept. 14, 2000
2. Evaluations were made June 26, 2001

Leafy spurge control with imazapic combined or alternated with picloram plus 2,4-D or quinclorac and dicamba. Rodney G. Lym. (Department of Plant Sciences, North Dakota State University, Fargo, ND 58105). Research at North Dakota State University has shown that imazapic provides good leafy spurge control when fall-applied but can injure grass, especially cool-season species. Thus, picloram plus 2,4-D may need to be applied in years alternating with imazapic to reduce grass injury from imazapic in a long-term management program. The purpose of this research was to evaluate imazapic applied alone, in rotation with picloram plus 2,4-D, or the three herbicides applied together for long-term leafy spurge control.

The first experiment was established at Jamestown and Valley City, North Dakota, in a dense stand of leafy spurge. Initial herbicide treatments were applied in early June 1998 during the true-flower growth stage or in mid-September when leafy spurge was in the fall regrowth stage. Initial treatments of imazapic were followed by picloram plus 2,4-D. Conversely, initial treatments of picloram plus 2,4-D were followed by imazapic. Imazapic was applied at 1 oz/A in the spring or 2 oz/A in the fall. Picloram plus 2,4-D was applied at the common use rate of 4 + 16 oz/A in the spring or 8 + 16 oz/A in the fall. The three-way mixture of picloram plus 2,4-D plus imazapic was applied once in the spring or fall with no follow-up treatment. Any treatment that included imazapic also contained methylated seed oil plus 28% N liquid fertilizer.

Treatments were applied with a hand-held sprayer delivering 8.5 gpa at 35 psi. The experiment was a randomized complete block design with four replications at both locations, and plots were 10 by 30 feet. Control was based on a visual estimate of percent stand reduction as compared to the untreated check.

The three-herbicide mixture of picloram plus 2,4-D plus imazapic applied once in the spring provided the best long-term leafy spurge control (Table 1). Control averaged across locations was 99% in June 2000, 24 MAT (months after treatment). This high level of control was unexpected and is better than the long-term average of picloram at 32 oz/A applied alone, which generally provides the best long-term control in the region. The same three-herbicide treatment applied in the fall only averaged 61 and 15% control 12 and 24 MAT, respectively.

During the summer of 2000, *Aphthona* spp. biological control agents were found in the research plots at both Valley City and Jamestown. The insect population rapidly increased at the Valley City location so that by June 2001, very few leafy spurge stems remained and the experiment could not be reevaluated. At Jamestown, the three-way mixture spring-applied provided 53% control in June 2001, (36 MAT) compared to 6 and 10% when picloram plus 2,4-D or imazapic were applied alone (Table 1).

The best split treatments for long-term leafy spurge control were picloram plus 2,4-D applied in the spring followed by imazapic in the fall and imazapic fall-applied followed by picloram plus 2,4-D in the spring. These treatments averaged 85 and 61% control in August 1999 and 2000, respectively. No grass injury was observed following any of the rotational treatments.

The high long-term control from the spring-applied three-way mixture exceeded that from any previous herbicide treatments evaluated by North Dakota State University. To maintain such long-term control usually requires two or three annual applications of either imazapic or picloram plus 2,4-D. To further evaluate leafy spurge control from herbicide mixtures experiments were established at Valley City and Jamestown in 2000 and on the Albert Ekre Experiment Station near Walcott and the Sheyenne National Grasslands (SNG) near Lisbon and at Fargo in 2001. The herbicides were applied in mid-June at each location. The herbicide mixtures were only applied in the spring since fall-applied treatments had given poor leafy spurge control in the first experiment. Herbicides were applied as previously described and there were four replications at all locations except Fargo, which had three replications.

The three-way mixture of picloram plus 2,4-D plus imazapic did not provide as much long-term leafy spurge control in the second study compared to the first study (Tables 1 and 2). However, the three-way mixture did provide better control 3 MAT than picloram plus 2,4-D alone in all evaluations except at Jamestown (Table 2). For instance, leafy spurge control 3 MAT averaged 74% with picloram plus 2,4-D and 92% with picloram plus 2,4-D plus imazapic. The addition of diflufenzopyr to the three-way mixture tended to increase control compared to the herbicides applied alone.

Leafy spurge control dramatically increased when quinclorac was applied with picloram plus 2,4-D compared to picloram plus 2,4-D applied alone (Table 2). For instance, control averaged 74% 3 MAT with picloram plus 2,4-D compared to 91% when quinclorac was included in the mixture. In general, the addition of diflufenzopyr to picloram plus 2,4-D plus quinclorac did not increase control compared to the herbicides applied alone. The combination treatment of quinclorac plus dicamba plus diflufenzopyr provided similar control to picloram plus 2,4-D plus imazapic 3 and 12 MAT. Control was not improved with the addition of imazapic to the quinclorac plus dicamba plus diflufenzopyr mixture. The *Aphthona* spp. biocontrol agent established in the research plots at the Jamestown location so the site could not be further evaluated.

All herbicide mixtures that contained imazapic or quinclorac provided better leafy spurge control 3 MAT in 2001 than picloram plus 2,4-D or imazapic applied alone (Table 3). The three-way mixture of picloram plus 2,4-D plus imazapic provided 98% control compared to only 75% with picloram plus 2,4-D alone, averaged over both locations. Leafy spurge control 3 MAT averaged 100% when diflufenzopyr was applied with picloram plus 2,4-D plus imazapic. As in the previous study, quinclorac plus dicamba plus diflufenzopyr provided similar control to picloram plus 2,4-D plus imazapic 3 MAT. Imazapic at 1 oz/A averaged 93% control 3 MAT at SNG which is much higher than normal with this herbicide applied in the spring.

Picloram plus 2,4-D plus imazapic was applied at normal field rates including adjuvants, in the first experiment, but full rates may not be needed. The purpose of the fourth experiment was to determine if 28% N was needed in the combination treatment for leafy spurge control and if the imazapic rate could be reduced. The experiment was established at Fargo and the SNG in June 2001. Leafy spurge control was similar when picloram plus 2,4-D were applied with imazapic rates reduced from 1 to 0.25 oz/A at both locations (Table 4). There was a tendency for leafy spurge control to be improved when 28% N was applied with the herbicides, compared to without, at SNG but not at Fargo. In general, leafy spurge control tended to be higher at SNG than at Fargo especially with imazapic at 1 oz/A applied alone.

In summary, the three-way mixture of picloram plus 2,4-D plus imazapic and most mixtures that contained quinclorac provided better long-term leafy spurge control than picloram plus 2,4-D applied alone. Imazapic at 1 oz plus MSO at 1qt/A would increase treatment cost by approximately $13/A over picloram plus 2,4-D alone to a total of $26/A, but the three-way mixture would be cost-effective if long-term control was improved one or more seasons. Treatments that included quinclorac plus dicamba would cost approximately $32/A.

Table 1. Leafy spurge control with imazapic combined or alternated with picloram and 2,4-D applied in the spring or fall at Jamestown (JMS) and Valley City (VC) beginning in June 1998.

				1998			1999						2000						2001
				August			June			August			June			August			June
Treatment	Rate	Treatment	Rate	JMS	VC	Mean	JMS	VC	Mean	JMS	VC	Mean	JMS	VC	Mean	JMS	VC	Mean	JMS
	— oz/A —		— oz/A —	% control															
Spring 1998		Fall 1998																	
Picloram+2,4-D	4+16	Imazapic+MSO[a]+28% N	2+1qt+1qt	85	88	86	99	99	99	70	95	82	64	82	73	42	75	58	6
Imazapic+MSO[a]+28% N	1+1qt+1qt	Picloram+2,4-D	8+16	28	58	43	99	99	99	53	82	67	43	76	59	18	69	43	10
Picloram+2,4-D+imazapic +MSO[a]+28% N	4+16+1+ 1qt+1qt	None		99	95	97	95	99	99	97	99	98	98	99	99	75	91	83	53
LSD (0.05)				11	16	7[b]													
Fall 1998		Spring 1999																	
Picloram+2,4-D	8+16	Imazapic+MSO[a]+28% N	1+1qt+1qt				98	94	96	82	91	87	98	95	96	47	82	64	20
Imazapic+MSO[a]+28% N	2+1qt+1qt	Picloram + 2,4-D	8+16				99	99	99	96	98	97	77	81	79	25	62	43	13
Picloram+2,4-D+ imazapic+MSO[a]+28% N	8+16+2+ 1qt+1qt	None					99	99	99	59	64	61	26	50	38	3	28	15	6
LSD (0.05)							NS	2	NS	11	16	9[c]	11	16	10[c]	29	14	15[c]	15

[a]Methylated seed oil was Scoil by AGSCO, Grand Forks, ND.
[b]Significant interaction between locations. Control with imazapic at Valley City was higher than at Jamestown.
[c]Control at Valley City was higher than at Jamestown.

Table 2. Leafy spurge control from various herbicide mixtures applied at two locations in North Dakota in June 2000.

		Control			
		3 MAT[a]			12 MAT[a]
Treatment	Rate	Valley City	Jamestown	Mean	Valley City
	oz/A	%			
Picloram + 2,4-D	4 + 16	68	79	74	31
Imazapic + MSO[b] + 28%N	1 + 1 qt + 1 qt	71	66	69	67
Picloram + 2,4-D + imazapic + MSO[b] + 28%N	4 + 16 + 1 + 1 qt + 1 qt	96	89	92	85
Picloram + 2,4-D + imazapic + diflufenzopyr + MSO[b] + 28%N	4 + 16 + 1+2 + 1 qt + 1 qt	99	100	99	94
Picloram + 2,4-D + quinclorac + MSO[b]	4 + 16 + 8 + 1 qt	91	92	91	59
Picloram + 2,4-D + quinclorac + diflufenzopyr + MSO[b]	4 + 16 + 6 + 2.5 + 1 qt	96	97	97	97
Quinclorac + diflufenzopyr + MSO[b]	6 + 1.2 + 1 qt	84	89	86	93
Quinclorac + dicamba + MSO[b]	6 + 3 + 1 qt	76	89	83	93
Quinclorac + dicamba + diflufenzopyr[c] + MSO[b]	6 + 3 + 1.2 + 1 qt	93	88	91	95
Quinclorac + dicamba + diflufenzopyr[c] + imazapic + MSO[b]	6 + 3 + 1.2 + 1 + 1 qt	87	84	86	96
LSD (0.05)		9	20	11	19[d]

[a]Months after treatment.
[b]Methylated seed oil was Scoil by AGSCO, Grand Forks, ND.
[c]Commercial formulation - Distinct.
[d]Only two replications were evaluated.

Table 3. Leafy spurge control 3 months after treatment from various herbicide mixtures applied in June 2001 at two locations in North Dakota.

		Control	
Treatment	Rate	Walcott	Sheyenne National Grassland
	oz/A	%	
Picloram + 2,4-D	4 + 16	68	82
Imazapic + MSO[a] + 28%N	1 + 1 qt + 1 qt	45	93
Picloram + 2,4-D + imazapic + MSO[a] + 28%N	4 + 16 + 1 + 1 qt + 1 qt	96	99
Picloram + 2,4-D + imazapic + diflufenzopyr + MSO[a] + 28%N	4 + 16 + 1 + 2 + 1 qt + 1 qt	100	100
Picloram + 2,4-D + quinclorac + MSO[a]	4 + 16 + 8 + 1 qt	96	99
Picloram + 2,4-D + quinclorac + diflufenzopyr + MSO[a]	4 + 16 + 6 + 2.5 + 1 qt	97	95
Quinclorac + diflufenzopyr + MSO[a]	6 + 1.2 + 1 qt	93	96
Quinclorac + dicamba + MSO[a]	6 + 3 + 1 qt	90	92
Quinclorac + dicamba + diflufenzopyr[b] + MSO[a]	6 + 3 + 1.2 + 1 qt	97	97
Quinclorac + dicamba + diflufenzopyr[b] + imazapic + MSO[a]	6 + 3 + 1.2 + 1 + 1 qt	97	96
LSD (0.05)		16	7

[a]MSO is methylated seed oil by AGSCO, Grand Forks, ND.
[b]Commercial formulation - Distinct.

Table 4. Leafy spurge control 3 months after treatment with various combinations of picloram plus 2,4-D plus imazapic applied in June 2001 at two locations in North Dakota.

		Control	
Treatment	Rate	Fargo	Sheyenne National Grasland
	oz/A	%	
Picloram + 2,4-D	4 + 16	65	90
Imazapic + MSO[a] + 28% N	1 + 1 qt + 1 qt	3	82
Picloram + 2,4-D + imazapic + MSO[a] + 28% N	4 + 16 + 1 + 1 qt + 1 qt	84	98
Picloram + 2,4-D + imazapic + MSO[a] + 28% N	4 + 16 + 0.5 + 1 qt + 1 qt	84	95
Picloram + 2,4-D + imazapic + MSO[a] + 28% N	4 + 16 + 0.25 + 1 qt + 1 qt	77	95
Picloram + 2,4-D + imazapic + MSO[a]	4 + 16 + 1 + 1 qt	88	96
Picloram + 2,4-D + imazapic + MSO[a]	4 + 16 + 0.5 + 1 qt	87	99
Picloram + 2,4-D + imazapic + MSO[a]	4 + 16 + 0.25 + 1 qt	79	99
Picloram + imazapic + MSO[a]	4 + 1 + 1 qt	84	89
Picloram + imazapic + MSO[a]	4 + 0.5 + 1 qt	86	88
Picloram + imazapic + MSO[a]	4 + 0.25 + 1 qt	73	95
LSD (0.05)		22	8

[a]MSO is methylated seed oil by AGSCO, Grand Forks, ND.

Canada thistle, bull thistle, Flodman thistle, and goldenrod control with herbicide mixtures. Rodney G. Lym. (Department of Plant Sciences, North Dakota State University, Fargo, ND 58105). Canada thistle has increased rapidly in North Dakota during the last decade and currently is estimated to infest over 1.7 million acres, compared to 822,000 acres in 1992. The increase has occurred in cropland, pasture and rangeland, as well as wild land. The increase is due in part to the much above average precipitation received in the state since 1993. Other thistle species, such as the biennial bull thistle and the perennial native Flodman thistle, have also increased in acreage. The purpose of this research was to compare various herbicide mixtures, especially those that contain clopyralid, for thistle control.

The first two experiments were established in dense Canada thistle patches located within the Theodore Roosevelt National Park near Medora, ND. Separate spring and fall studies were established on June 22 and September 11, 2000, respectively. The spring treatments were applied to Canada thistle in the rosette to early bolt growth stage, 8 to 16 inches tall. The experiment was a randomized complete block design with four replicates and plots were 9 by 25 feet. The fall treatments were applied to Canada thistle in the post-bloom growth stage with numerous fall rosettes beginning growth within the canopy. The plots were 8 by 30 feet with three replicates. Herbicides were applied with a hand-held sprayer delivering 8.5 gpa at 35 psi. Treatments were visually evaluated with control based on percent stand reduction compared to the untreated control.

Clopyralid alone generally provided better Canada thistle control at comparable rates than when applied with triclopyr or 2,4-D (Table 1). For instance, Canada thistle control was 90% 3 months after treatment (MAT) when clopyralid at 4 oz/A was applied alone, compared to 75 and 76% when clopyralid at 4.5 oz/A was applied with triclopyr or at 4 oz/A with 2,4-D, respectively. Long-term Canada thistle control (15 MAT) was also better with clopyralid alone and averaged 70% control compared to 34% when clopyralid at a similar rates was applied with triclopyr or 2,4-D. Canada thistle control with dicamba plus diflufenzopyr averaged 91% 3 MAT but declined to 56% by 15 MAT.

Clopyralid or picloram fall-applied alone at 8 oz/A provided excellent Canada thistle control which averaged 98% 12 MAT (Table 2). Although not directly comparable, clopyralid alone at 8 oz/A provided better Canada thistle control than clopyralid at 6 oz/A plus triclopyr. Unlike the spring treatment, dicamba plus diflufenzopyr fall-applied provided very poor control, and averaged only 9% 9 MAT.

The third experiment was established in a weedy pasture on the Albert Ekre Research Center near Walcott, ND, on May 31, 2000. Although many common perennial pasture weeds were present, only goldenrod, bull thistle, and Flodman thistle were uniformly distributed enough for evaluation of herbicide treatments. Treatments were applied as previously described, and the plots were 10 by 30 feet and replicated four times.

In general, goldenrod control averaged 80% or better 1 MAT with all treatments evaluated, except when clopyralid was applied alone at 4 oz/A or triclopyr at 9 oz/A (Table 3). All treatments provided near 100% goldenrod control 3 MAT (data not shown). All treatments evaluated provided excellent bull thistle and Flodman thistle control which averaged 98% 16 MAT.

Table 1. Canada thistle control with various formulations of clopyralid applied to Canada thistle in June 2000 in Theodore Roosevelt National Park near Medora, ND.

Treatment	Rate	Control/MAT[a] 3	11	12	15
	oz/A	%			
Clopyralid + triclopyr[b] + X-77	2.25 + 6.75 + 0.25%	63	28	39	19
Clopyralid + triclopyr[b] + X-77	3 + 9 + 0.25%	76	40	49	29
Clopyralid + triclopyr[b] + X-77	3.75 + 11.25 + 0.25%	70	41	50	43
Clopyralid + triclopyr[b] + X-77	4.5 + 13.5 + 0.25%	75	50	36	36
Clopyralid + 2,4-D[c] + X-77	3 + 16 + 0.25%	74	51	40	37
Clopyralid + 2,4-D[c] + X-77	4 + 24 + 0.25%	76	56	63	47
Clopyralid + X-77	2 + 0.25%	95	93	90	72
Clopyralid + X-77	4 + 0.25%	90	81	87	68
2,4-D + X-77	32 + 0.25%	22	11	13	8
Dicamba + diflufenzopyr[d] + X-77	3 + 1.2 + 0.25%	91	68	54	56
LSD (0.05)		24[e]	34	36	34

[a]Months after treatment.
[b]Commercial formulation - Redeem.
[c]Commercial formulation - Curtail.
[d]Commercial formulation - Distinct.
[e]LSD (0.10).

Table 2. Canada thistle control with various formulations of clopyralid applied to Canada thistle in September 2000 in Theodore Roosevelt National Park near Medora, ND.

Treatment	Rate	Control/MAT[a] 8	9	12
	oz/A	%		
Clopyralid + triclopyr[b] + X-77	3.75 + 11.25 + 0.25%	98	83	38
Clopyralid + triclopyr[b] + X-77	4.5 + 13.5 + 0.25%	94	91	58
Clopyralid + triclopyr[b] + X-77	5.25 + 15.75 + 0.25%	93	73	38
Clopyralid + triclopyr[b] + X-77	6 + 18 + 0.25%	99	80	64
Clopyralid + X-77	8 + 0.25%	99	92	97
Picloram	8	99	73	100
Dicamba + diflufenzopyr[c] + X-77	3 + 1.2 + 0.25%	37	9	0
LSD (0.05)		31	15	47[d]

[a]Months after treatment.
[b]Commercial formulation - Redeem.
[c]Commercial formulation - Distinct.
[d]Only two of the three replicates could be evaluated.

Table 3. Goldenrod, bull thistle and Flodman thistle control with various formulations of clopyralid applied in June 2000.

Treatment	Rate	Control/MAT[a] 1 Golden rod	1 Thistle[b]	3 Thistle[b]	11 Thistle[b]	16 Thistle[b]
	oz/A	%				
Clopyralid + triclopyr[c] + X-77	3 + 9 + 0.25%	81	91	100	98	98
Clopyralid + triclopyr[c] + X-77	4.5 + 13.5 + 0.25%	85	96	100	98	99
Clopyralid + triclopyr[c] + X-77	6 + 18 + 0.25%	95	97	100	98	100
Clopyralid + 2,4-D[d] + X-77	3 + 16 +0.25%	83	96	100	98	99
Clopyralid + 2,4-D[d] + X-77	4 + 24 + 0.25%	86	96	100	99	99
Clopyralid + X-77	4 + 0.25%	63	98	100	97	99
Dicamba + diflufenzopyr[e] + quinclorac + MSO[f]	3 + 1.2 + 6 + 0.25%	79	86	100	97	99
Dicamba + diflufenzopyr[e] + X-77	3 + 1.2 + 0.25%	89	94	100	98	99
Triclopyr + X-77	9 + 0.25%	59	76	94	93	92
Triclopyr + X-77	18 + 0.25%	90	85	100	84	91
LSD (0.05)		18	9	3	9	5

[a]Months after treatment.
[b]Mixture of bull thistle and Flodman thistle.
[c]Commercial formulation - Redeem.
[d]Commercial formulation - Curtail.
[e]Commercial formulation - Distinct.
[f]Methylated seed oil was Scoil by AGSCO, Grand Forks, ND.

Comparison of various herbicides at two musk thistle growth stages. Tom D. Whitson (Department of Plant Sciences, University of Wyoming, Laramie, WY, 92071-3354). Musk thistle, a noxious weed in many Western U.S. States, is often difficult to control because of differences in herbicide tolerance at various growth stages. These experiments were initiated to help determine the best time of applications for various herbicides. Herbicides were applied near Riverside and Bosler, Wyoming during the rosette and bloom stages, respectively. Musk thistle was uniform at both sites but conditions were dry and plants were not in ideal growing condition. Both trials were applied with a hand-held boom sprayer at 30 gpa to plots 10 by 27 ft. with four replications. Air temperature: Riverside and Bosler 70°F, soil temperatures ranged from 70°F on the surface to 65°F at a 4 inch depth at Bosler. Soils at both locations were sandy loam. All treatments provided excellent control when applied in the rosette stage. The following four treatments provided from 86 to 94% control at the bloom stage: Clopyralid + triclopyr at 1.5 and 2 pints/acre, Clopyralid + Triclopyr + 2 4-D at 1 pt. + 1 pt/acre and 1 ½ pt. + 1 pt. acre. (Published with the approval of the Wyoming Agricultural Experiment Station).

Table. Comparison of various herbicides at two musk thistle growth stages

		Average % Control[3]	
Treatment	**Rate ai/A**	**Rosette[1]**	**Bloom[2]**
Clopyralid + Triclopyr (Redeem)	0.06 + 0.25	100	49
Clopyralid + Triclopyr	0.09 + 0.38	100	89
Clopyralid + Triclopyr	0.12 + 0.5	100	94
Clopyralid + Triclopyr + 2,4-D(A)	0.62 + 0.25 + 0.5	100	86
Clopyralid + Triclopyr + Metsulfuron	0.62 + 0.25 + 0.06 oz	100	64
Clopyralid + Triclopyr + 2,4-D(A)	0.09 + .38 + 0.5	100	87
2,4-D(A)	1.9	100	3
Metsulfuron	0.06	100	3
Metsulfuron	0.12	100	20
Metsulfuron	0.3	97	39
Metsulfuron + 2,4-D(A)	0.12 + 0.5	100	39
Check		0	0

1. Rosette treatments were applied May 16, 2000
2. Bloom treatments were applied July, 18, 2000
3. Evaluations made Aug. 20 and 21, 2001

Long-term control of prickly pear cactus with picloram at various rates and growth stages. Bill Taylor and Tom Whitson. (Cooperative Extension Service and Plant Sciences Dept., University of Wyoming, Laramie, WY 82071-3354). Prickly pear cactus causes a loss of forage utilization on western rangelands. These studies compare six rates of picloram applied at three growth stages of prickly pear to determine the best time for treatment.
Picloram was applied when prickly pear cactus was in one-thrid, full and late bloom in 1994. Applications of 30 gpa were made to 10 by 27 ft. plots with PH of 8.0. Plants were in active growth during spray application.
All plants were counted within treatments and percent control was calculated from plant counts. Control was adequate (94%) when picloram was applied at 8 fl. Oz per acre or greater during full to late bloom. When picloram was applied at one-third bloom 16 fl. oz./acre was required to control 95% of the cactus. The cost of $5.00/acre for 8 fl. oz. Of picloram would double if cactus were sprayed earlier than full bloom. (Published with approval of the Wyoming Agricultural Experiment Station).

Table. Long-term control of prickly pear cactus with picloram at various rates and growth stages

	Picloram[1] Rate (lb ai/A)	% Control[2]
1/3 Bloom	.031	47.6
	.062	59.5
	.093	77.5
	.125	80.8
	.25	95.3
	.5	95.3
	Check	36.6
Full Bloom	.031	53.0
	.062	81.9
	.093	89.9
	.125	94.1
	.25	98.2
	.5	94.1
	Check	38.1
End of Bloom	.031	60.1
	.062	67.8
	.093	68.5
	.125	94.8
	.25	92.1
	.5	88.2
	Check	40.7

1. Applications were made in 1994.
2. Evaluations were made in June, 2001.

A comparison of various herbicides for control of prickly pear cactus. Bill Taylor and Tom Whitson (Cooperative Extension Service and Plant Sciences Dept., University of Wyoming, Laramie, WY, 82071-3354). Prickly pear cactus is common on rangeland throughout the Western U.S. It is not competitive with perennial grass production but causes pastures to be improperly grazed. Applications were made at the prickly pear cactus bud stage on June 14, 2000. Applications of 30 gpa were made to 10 by 27 ft. plots with four replications. Soils were clay loam with a pH of 8.0. Moisture levels of the surface were dry with moist subsoil during application. All plants within each treatment area were counted one year following treatment and percent control was calculated from counts. Adequate control (85% or higher) was obtained with Plenumn of 3,4 and 5 pt./A and with Picloram at .25 lb/A at 1 pt/A. (Published with approval of the University of Wyoming Agricultural Experiment Station).

Table. A comparison of various herbicides for control of prickly pear cactus

Treatment[1]	Rate (lb ai/A)	Average % Control[2]
Triclopyr (A) + Fluroxypyr	0.5 + 0.18	40
	0.63 + 0.22	48
	0.75 + 0.26	58
Triclopyr (E) + Fluroxypyr	0.5 + 0.17	35
	0.62 + 0.21	36
	0.75 + 0.25	44
Picloram + Fluroxypyr (Plenum)	0.25 + 0.25	88
	0.33 + 0.33	86
	0.41 + 0.41	91
Triclopyr (E)	0.07 + 0.25	
Picloram + 2, 4-D (A)	0.14 + 0.5	41
Picloram	0.13	78
	0.25	89
Check		23

1. Treatments were made June 14, 2000.
2. Evaluations were made Aug. 10, 2001.

A comparison of various herbicides for control of geyer larkspur. Tom Whitson and Phil Rosenlund. (Dept. Of Plant Sciences, University of Wyoming, Laramie, WY 82071-3354). Geyer larkspur is commonly found on rangelands of Wyoming at elevations of 6000 to 7000 ft. The alkaloid containing plant is one of the earliest to produce forage, therefore cattle are often poisoned at that time by geyer larkspur. Metsulfuron, imazapic were applied near Cheyenne, WY on May 9, 2001 to control geyer larkspur. Geyer larkspur was two to three inches tall and was actively growing at the time of application. Applications of 30 gpa were made to 10 X 27 ft. plots with four replications. Revlative humidity was 65% and air temperatures were 70°F while soil temperatures ranged from 70°F on the surface to 60° at a 4-inch depth. Soils were sandy loam containing good moisture levels.

Individual plants were counted and compared to untreated controls to determine % control. Metsulfuron applications of .6 ai/A and above provided 93 to 98% control 48 days after treatment while Picloram and Imazapic controlled 61 and 59% of the geyer larkspur during this first season. A single season of control will not provide economic benefits great enough to pay the cost of the treatments so long-term control percentages will be taken for the next four years. (Published with the approval of the Wyoming Agricultural Experiment Station).

Table. A comparison of various herbicides for control of geyer larkspur

Treatment[1]	Rate (ai/A)	% Control[2]
Metsulfuron	0.6 oz + 0.5%	93
Metsulfuron	0.9 oz + 0.5%	98
Metsulfuron	1.2 oz + 0.5%	96
Metsulfuron	1.8 oz + 0.5%	96
Picloram	0.38 lb	61
Imazapic + MSO	0.16 lb + 1%	59
Check		0

1. Treatments were applied May 9, 2001
2. Evaluations were made June 26, 2001

Control of babysbreath with various herbicides. Tom D. Whitson (Department of Plant Sciences, University of Wyoming, Laramie, WY, 82071-3354). Babysbreath was introduced to Wyoming as a perennial ornamental but has spread to nearby rangeland becoming a troublesome weed species. This experiment was established to babysbreath in the bloom stage on June 23, 2000. Applications of 30 gpa were made to 10 by 36 ft. plots with three replications. Air temperature was 80°F and soil temperatures ranged from 82°F on the surface to 86°F at the 4-inch depth. Soils were sandy loam. Individual plants were counted in each plot to calculate percent control. Only the combined treatment of Metsulfuron + 2, 4-D (A) + Dicamba at .6 oz + .5 lb + .25 lb + .25% NIS per acre provided 90% control. (Published with the approval of the Wyoming Agricultural Experiment Station).

Table. Control of babysbreath with various herbicides

Treatment	Rate ai/A	% Control
Metsulfuron	0.3 oz	
2,4-D (A)	0.5 lb	
Dicamba	0.25 lb	
NIS	0.25%	30
Metsulfuron	0.3 oz	
MCPA (A)	0.25 lb	
Dicamba	0.25 lb	
NIS	0.25%	27
2,4-D (A)	0.5 lb	
Dicamba	0.25 lb	
NIS	0.25%	0
MCPA (A)	0.25 lb	
Dicamba	0.25 lb	
NIS	0.25%	0
Metsulfuron	0.6 oz	
2,4-D (A)	0.5 lb	
Dicamba	0.25 lb	
NIS	0.25%	90
Metsulfuron	0.3 oz	
Fluroxypyr	0.19 lb	
NIS	0.25%	30
Fluroxypyr	0.19 lb	
NIS	0.25%	30
Clopyralid	0.23 lb	
NIS	0.25%	0

1. Treatments applied June 23, 2000.
2. Evaluations made July 10, 2001.

Control of hoary cress with various herbicides. Tom D. Whitson, Mark Ferrell and Scott Votaw (Department of Plant Sciences, University of Wyoming, Laramie, WY, 82071-3354). Hoary cress, a cool-season noxious weed, is commonly found throughout the western U.S. growing on wetland areas with high pH soils. Plateau, Oasis and Escort herbicides were applied to hoary cress in full seed on June 22, 2000. Applications of 30 gpa were made to 10 by 36 ft. plots with three replications. Air temperatures were 80°F while soil temperatures ranged from 70°F on the surface to 68°F at a 4 inch depth. Moisture levels were good at the time of application. Five treatments provided above 80% control but all treatments had inconsistent control within replications. In past trials application timing before the bloom stage resulted in better, more consistent control. (Published with the approval of the Wyoming Agricultural Experiment Station).

Table. Control of hoary cress with various herbicides

Treatment	Rate lbs ai/A	% Control
Imazapic + MSO	0.63 + 0.5%	87
Imazapic + MSO	0.09 + 0.5%	63
Imazapic + MSO	0.13+ 0.5%	79
Imazapic + MSO	0.16 + 0.5%	86
Imazapic + MSO	0.19 + 0.5%	81
Imazapic + 2, 4-D (LVE) + MSO	0.05 + 0.09 + 0.5%	53
Imazapic + 2, 4-D (LVE) + MSO	0.07 + 0.14 + 0.5%	65
Imazapic + 2, 4-D (LVE) + MSO	0.09 + 0.19 + 0.5%	80
Imazapic + 2, 4-D (LVE) + MSO	0.12 + 0.23 + 0.5%	77
Imazapic + 2, 4-D (LVE) + MSO	0.14 + 0.28 + 0.5%	82
Metsulfuron + NIS	0.6 oz + 0.3%	57
Check		0

Control of wild iris with various herbicides. Tom D. Whitson (Department of Plant Sciences, University of Wyoming, Laramie, WY. 82071-3354). In mountain meadows in Southern Wyoming and Northern Colorado wild iris has become highly competitive in hay meadows and along riparian zones. Treatments were applied to wild iris in full seed with a hand-held sprayer at 30 gpa to 10 by 36 ft. plots with three replications. Air temperatures were 75°F while soil temperatures ranged from 74° f on the surface to 71°F at a 4-inch depth. Soils were clayloam with 4% organic matter. Metsulfuron applied at 0.5, 0.6 and 0.9 oz/A and Imazapic applied at 0.38 lb/A provided excellent control. Imazapic caused associated perennial grass to be severely reduced at the 0.25 oz. Rate. (Published with the approval of the Wyoming Agricultural Experiment Station).

Table. Control of wild iris with various herbicides

Treatment[1]	Rate ai/A	% Control[2]
Metsulfuron + NIS	0.3 oz + 0.25%	70
Metsulfuron + NIS	0.5 oz + 0.25%	93
Metsulfuron + NIS	0.6 oz + 0.25%	97
Metsulfuron + NIS	0.9 oz + 0.25%	100
Picloram	0.13 lb + 0.5%	7
Imazapic + MSO	0.13 lb + 0.5%	12
Imazapic + MSO	0.25 lb + 0.5%	73
Imazapic + MSO	0.38 lb + 0.5%	92
Check		0

1. Treatments applied June 23, 2000
2. Evaluations made July 9, 2001

Mediterranean sage control in Colorado pastures. James R. Sebastian and K.George Beck. (Department of Bioagricultural Sciences and Pest Management, Colorado State University, Fort Collins, CO 80523) Mediterranean sage (SALAE) is an escaped ornamental that recently has become a problem in pastures and along roadsides in Boulder County, Colorado.

An experiment was established near Longmont, CO to evaluate Mediterranean sage control. The experiment was designed as a randomized complete block with four replications. Herbicides were applied on May 15, 2000 when Mediterranean sage was in the rosette to early bolt growth stage. 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. Plot size was 10 by 30 feet.

Visual evaluations for percent control compared to non-treated plots were collected on October 19, 2000 and May 7, 2001, 120 and 357 days after treatment (DAT), respectively.

Combination treatments with metsulfuron controlled 68 to 84% and 66 to 100% of Mediterranean sage 120 and 357 DAT, respectively (Table 2). Picloram and imazapic plus 2,4-D controlled 71 to 83% of Mediterranean sage. Treatments combined with MCPA did not control Mediterranean sage as well as those combined with 2,4-D amine. MCPA plus dicamba and fluroxypyr did not control Mediterranean sage adequately and it may take higher rates to get sufficient control.

Table 1. Application data for Mediterranean sage control on Colorado rangeland.

Environmental data	
Application date	May 15, 2000
Application time	10:30 AM
Air temperature, F	68
Relative humidity, %	47
Wind speed, mph	0 to 8

Application date	Species	Growth stage	Height (in.)
May 15, 2000	SALAE	Rosette to early bolt	5-8"

Oriental clematis control on Colorado rangeland. James R. Sebastian and K.George Beck. (Department of Bioagricultural Sciences and Pest Management, Colorado State University, Fort Collins, CO 80523) *Clematis orientalis* (CLEOR) was established locally in the Clear Creek Valley of Colorado dating back to the mining times. Oriental clematis has extensive climbing vines that cover and shade grass, trees, and shrubs. In recent times, Oriental clematis has rapidly expanded its range on the steep slopes and canyons along the Front Range of Colorado. Due to its growth pattern and location, Oriental clematis is difficult to control. It often grows on trees and along ditches where many herbicides cannot be used. Herbicide coverage under a dense, viney canopy and rough terrain makes application difficult as well.

Two experiments were established near Georgetown, CO to evaluate Oriental clematis control. Both studies were sprayed on July 25, 2001at adjacent sites. The experiments were designed as randomized complete blocks with four replications.

Herbicides were applied when Oriental clematis was in the early flower growth stage in both studies. All treatments were applied with a CO_2-pressurized backpack sprayer using 11002LP flat fan nozzles at 20 gal/A, 30 psi. Plot size was 10 by 30 feet. Application information for both studies is presented in Table 1.

Visual evaluations for percent control compared to non-treated plots were collected on October 3, 2001. Two tables (Tables 2 and 3) reflect data for each study and will be discussed separately. Metsulfuron controlled 50 to 70% of Oriental clematis approximately 70 days after treatment (DAT; Table 2). Clopyralid did not control Oriental clematis effectively 70 DAT, however, 2,4-D controlled 89% of Oriental clematis.

In the second study, imazapic, imazapic plus 2,4-D amine, and quinclorac controlled 20 to 55% of Oriental clematis 70 DAT (Table 3). Diflufenzopyr at 6 and 8 oz/A controlled 84 and 90% of Oriental clematis, respectively, and picloram controlled 100% of Oriental clematis.

Evaluations will continue through the 2002 growing season and will provide an indication of long term Oriental clematis control. All treatments prevented seed set 70 DAT. Picloram was the only treatment that caused grass injury (leaf curling). Brush injury was apparent with some treatments however, Oriental clematis was growing over the tops of much of this brush and likely would have killed them over time.

Table 1. Application data for clematis control on Colorado rangeland.

Environmental data	
Application date	July 25, 2001
Application time	10:30 AM
Air temperature, F	80
Relative humidity, %	31
Wind speed, mph	0 to 2

Application date	Species	Growth stage	Height
July 25, 2001	CLEOR	Early flower	3 to 6'
	AGRSM	Flower	12 to 18"
	BROIN	Flower	18 to 26"

Oxeye daisy control on Colorado rangeland. James R. Sebastian and K. George Beck. (Department of Bioagricultural Sciences and Pest Management, Colorado State University, Fort Collins, CO 80523) An experiment was established near Durango, CO to evaluate oxeye daisy (CHRLE) control. The experiment was designed as a randomized complete block with four replications.

Herbicides were applied on July 27, 1999 when oxeye daisy was in the full bloom growth stage. 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. Plot size was 10 by 30 feet.

Visual evaluations for percent control compared to non-treated plots were collected in fall of 1999, 2000, and 2001 approximately 60 days after treatment (DAT), 1 year after treatment (YAT), and 2 (YAT), respectively. Metsulfuron treatments controlled oxeye daisy faster than other treatments. For example, oxeye daisy control from metsulfuron 60 DAT was 73 to 84% whereas picloram controlled 53% of oxeye daisy at the same evaluation (Table 2). Metsulfuron treatments controlled 97 to 100% of oxeye daisy 1 and 2 YAT. Picloram at 4 oz/A controlled 74 and 73% of oxeye daisy 1 and 2 YAT, respectively. Clopyralid plus 2,4-D and 2,4-D amine applied alone did not control oxeye daisy adequately and it may take higher rates to get sufficient control. Imazapic did not control oxeye daisy adequately and injured grass 36 and 34% 1 and 2 YAT, respectively.

Table 1. Application data for oxeye daisy control on Colorado rangeland.

Environmental data	
Application date	July 27, 1999
Application time	1:00 PM
Air temperature, F	78
Relative humidity, %	69
Wind speed, mph	0 to 5

Application date	Species	Growth stage	Height (in.)
July 27, 1999	CHRLE	Full Bloom	12 to 27

Puncturevine control on roadside right-of-way with azafenidin and diuron. Traci A. Rauch and Donald C. Thill. (Plant Science Division, University of Idaho, Moscow, ID 83844-2339) A study was established near Lenore, Idaho in roadside vegetation to evaluate percent bare ground and puncturevine control with azafenidin and diuron. Plots were 6 by 20 ft arranged in a randomized complete block design with four replications and included an untreated check. All herbicide treatments were applied with a CO_2 pressurized backpack sprayer calibrated to deliver 25 gpa at 38 psi and 3 mph (Table 1). Bare ground percentage was evaluated visually on May 9, June 22, and September 18, 2001. Puncturevine control was evaluated visually on June 22, July 19, and September 18, 2001.

Table 1. Application data.

Application date	October 2, 2000
Pucturevine growth stage	preemergence
Air temperature (F)	54
Relative humidity (%)	85
Wind (mph, direction)	1, W
Cloud cover (%)	99
Soil temperature at 2 in (F)	49

On June 22 (263 DAT) and September 18, 2001 (351 DAT), percent bare ground was higher with sulfometuron + diuron and imazapyr/diuron than all other treatments (Table 2). Puncturevine control on July 19 was greater with sulfometuron + diuron (91%) and imazapyr/diuron (98%) compared to diuron alone or in combination with azafenidin (20 to 40%). By September 18, imazapyr/diuron only suppressed puncturevine (51%), but was better than azafenidin at 0.5 lb/A, diuron alone or in combination with azafenidin at 0.2, 0.3, and 0.5 lb/A (0 to 12%). At 351 DAT, puncturevine control had decreased for all treatments.

Table 2. Percent bare ground and puncturevine control in roadside right-of-way near Lenore, ID in 2001.

		Bare ground		Puncturevine control	
Treatment	Rate	June 22	September 18	July 19	September 18
	lb/A	%			
Azafenidin	0.2	0	0	48	25
Azafenidin	0.3	0	0	44	26
Azafenidin	0.4	5	2	60	32
Azafenidin	0.5	21	8	64	11
Diuron	6.4	2	0	21	4
Azafenidin + diuron	0.2 + 6.4	0	0	38	0
Azafenidin + diuron	0.3 + 6.4	0	0	20	6
Azafenidin + diuron	0.4 + 6.4	15	11	40	25
Azafenidin + diuron	0.5 + 6.4	20	12	29	12
Sulfometuron + diuron	0.14 + 6.4	87	51	91	36
Imazapyr/diuron	7	88	55	98	51
LSD (0.05)		27	20	48	28
Density (plants/ft^2)				1	

Imazapic and imazapic/2,4-D affect forage quality. Joan Campbell, Donn Thill, and Sandra Shinn (Plant Science Division, University of Idaho, Moscow, ID 83844-2339) An experiment was established in a pasture near Genesee, Idaho on September 26, 2000. The objective was to evaluate tolerance of forage grass species to imazapic, imazapic/2,4-D, and picloram. Herbicide treatments were applied with a CO_2 pressurized backpack sprayer calibrated to deliver 10 gpa at 32 psi and 3 mph (Table 1). Bulbous bluegrass, medusahead rye, and downy brome were senesced, and smooth brome had some green leaves on undergrowth at application. Plants were sampled from a 5.4 ft^2 area on July 8, 2001 and sorted into yellow starthistle, grasses, and other broadleaf plants. Grass tillers were counted, biomass of all three components were dried and weighed, and forage quality was analyzed.

Table 1. Environmental and edaphic data.

Application date	September 26, 2000
Air temperature (F)	62
Soil temperature (F)	65
Relative humidity (%)	50
Cloud cover (%)	0
Wind speed (mph, direction)	1 to 2, SE
Soil	
pH	6.4
Organic matter (%)	4.8
Texture	Silt loam

Yellow starthistle was 100% controlled in 2001 with picloram and imazapic/2,4-D at 0.546 lb/A, and yellow starthistle stand was reduced with all treatments except imazapic/2,4-D at 0.188 lb/A (Table 2). Yellow starthistle biomass, grass tiller count, and grass biomass did not differ among treatments.

Grass crude protein (Crude P) was higher with imazapic at 0.125 lb/A compared to the untreated control. Grass acid detergent fiber (ADF) and neutral detergent fiber (NDF) were lower and total digestible nutrients (TDN) and relative feed value (RFV) were higher with imazapic at 0.125 and 0.188 lb/A compared to the untreated control. Also, grass RFV was higher with imazapic/2,4-D at 0.564 lb/A and NDF was lower compared to the untreated control.

Broadleaf plant biomass was higher with imazapic at 0.063 lb/A compared to the untreated control, and broadleaf crude protein was not different among treatments. Broadleaf ADF and NDF were lower and TDN and RFV were higher with all treatments compared to the untreated control.

Table 2. The effect of herbicide treatment on yellow starthistle and forage quality in pasture near Genesee, Idaho in 2001.

		Yellow starthistle		Grass plants[a]							Broadleaf plants[b]					
Treatment	Rate	Plants	Biomass	Tillers	Biomass	Crude P	ADF	NDF	TDN	RFV	Biomass	Crude P	ADF	NDF	TDN	RFV
	lb/A	no/5.4 ft^2	g/5.4 ft^2	no/5.4 ft^2	g/5.4 ft^2	%					g/5.4 ft^2	%				
Imazapic[c]	0.063	1.0	0.3	220	74	5.4	37.7	59.6	54.8	93	27.8	9.3	34.4	47.2	57	122
Imazapic[c]	0.125	0.5	0.2	182	60	9.3	36	57.2	56	99	13	11.4	34	47.3	57.2	123
Imazapic[c]	0.188	0.3	0.01	76	84	7.3	36	57.2	56	99	10.2	10.2	35.3	47.8	56.4	120
Imazapic/2,4-D[c]	0.188	3.5	4.1	248	65	6.9	37.6	61.2	54.9	91	16.9	13.2	33.6	47.2	57.5	124
Imazapic/2,4-D[c]	0.375	0.3	0.1	136	65	7.6	36.8	58.6	55.4	96	11.4	12.8	33.9	46.3	57.3	126
Imazapic/2,4-D[c]	0.564	0	0	118	71	5.2	37.1	57.0	55.2	99	15.8	12.2	35.8	46.6	56.1	122
Picloram	0.375	0	0	286	82	5.8	38.2	60.9	54.5	90	7.5	14.3	32.3	45.2	58.3	131
Untreated	--	7.0	1.2	320	71	5.9	38.3	60.6	54.5	91	14.5	9	39.1	54.2	54	100
LSD (0.05)		3.8	NS	NS	NS	2.4	1.5	3	1	7	11.3	NS	2.7	2.3	1.7	9

[a] Downy brome, bulbous bluegrass, medusahead rye, and smooth brome.
[b] Meadow salsify, field bindweed, wild carrot were the principal plants.
[c] Applied with crop oil concentrate (Sunit II) at 1 pt/A.

Total vegetative control with imazapyr/diuron. Pamela J. S. Hutchinson and Felix E. Fletcher. (Aberdeen Research and Extension Center, University of Idaho, Aberdeen, ID 83210). The objective of this trial was to compare total vegetative control effectiveness of imazapyr/diuron at four rates, and bromacil/diuron applied at four different times from early spring to summer. Herbicide treatments consisted of imazapyr/diuron at 5.6, 7, 8.4, or 10.5 lb/A, or bromacil/diuron at 8 lb/A. Applications were made with a CO_2-pressurized backpack sprayer that delivered 17.5 gpa at 30 psi. The experimental design was a randomized complete block with three replications. Plot size was 12 by 35 feet.

The same five herbicides treatments were applied at four different application times to four separate areas within the trial site on March 1, March 31, May 1, and June 1, 2000. Only scattered common mallow, flixweed, and shepherdspurse were present at the first two application times. At the May 1, 2000 application time, common lambsquarters (1 in, 4 to 6/ft^2), kochia (2 in, 4 to 6/ft^2), and redroot pigweed (2 in, 1/m^2) were present along with the aforementioned weeds. At the June 01, 2000 application time, the following weeds were present: common lambsquarters (18 in, 3-5/ft^2), common mallow (1/m^2), flixweed (10 in, 3/ft^2), hairy nightshade (2 in, 1/m^2), kochia (9 in, 5-10 ft^2), prickly lettuce (2/m^2), prostrate knotweed (1/m^2), redroot pigweed (3 in, 3-5/ft^2), and shepherdspurse (15 in, 1/m^2). By the end of the season, common lambsquarters, kochia, and redroot pigweed were the dominant weeds in the untreated control plots with 100% ground cover and heights up to five feet.

Treatments were visually rated for total vegetative and individual weed control beginning one month after the last application date. At approximately 1 and 2 months after the last application time, all herbicide treatments applied at the three earliest timings provided 95 to 100% of all weeds present (Table). Treatments applied at the last application time were providing 47 to 67% total vegetative control (TVC) 1 month after treatment (MAT), with kochia being the dominant weed present with the least control. At 2 MAT, only the high rate of imazapyr/diuron applied at the last date was providing TVC comparable to the herbicide treatments applied at the earlier times. In general, at 4 MAT, TVC was less for most treatments compared to the other rating times due to the appearance of prickly lettuce in some plots. Kochia control remained at 100% for all herbicide treatments applied at the three earliest times, and was 98% in the imazapyr/diuron 10.5 lb/A treated plots.

Table. Total vegetative control with bromacil/diuron[a] or imazapyr/diuron[b] at four different application timings

			Weed control						
			July 5		August 5		October 5		
Treatment	Rate	Date	TVC[c]	KCHSC	TVC	KCHSC	TVC	KCHSC	LACSE
	lb/A		%						
Bromacil/diuron	8.0	3/1/00	98	100	100	100	93	100	96
Imazapyr/diuron	5.6	3/1/00	100	100	100	100	96	100	99
Imazapyr/diuron	7.0	3/1/00	100	100	98	100	96	100	98
Imazapyr/diuron	8.4	3/1/00	100	100	100	100	100	100	100
Imazapyr/diuron	10.5	3/1/00	100	100	100	100	93	100	98
Bromacil/diuron	8.0	3/31/00	90	100	90	100	47	100	46
Imazapyr/diuron	5.6	3/31/00	97	100	98	100	87	100	88
Imazapyr/diuron	7.0	3/31/00	96	100	99	100	91	100	94
Imazapyr/diuron	8.4	3/31/00	98	100	98	100	93	100	96
Imazapyr/diuron	10.5	3/31/00	100	100	99	100	93	100	98
Bromacil/diuron	8.0	5/1/00	100	100	100	100	90	100	90
Imazapyr/diuron	5.6	5/1/00	100	100	100	100	70	100	61
Imazapyr/diuron	7.0	5/1/00	100	100	100	100	98	100	99
Imazapyr/diuron	8.4	5/1/00	100	100	100	100	97	100	97
Imazapyr/diuron	10.5	5/1/00	100	100	100	100	96	100	98
Bromacil/diuron	8.0	6/1/00	47	40	88	88	67	77	90
Imazapyr/diuron	5.6	6/1/00	53	53	80	80	80	83	88
Imazapyr/diuron	7.0	6/1/00	53	63	85	85	85	87	96
Imazapyr/diuron	8.4	6/1/00	53	53	82	82	87	90	91
Imazapyr/diuron	10.5	6/1/00	67	70	92	92	96	98	98
LSD(0.05)			10.3	6.4	9.2	8	17.7	15.6	25.3

a Sahara DG
b Krovar I DF
c TVC = total vegetative control

PROJECT 2: WEEDS OF HORTICULTURAL CROPS

Steve Fennimore, Chair

Weed control with developmental preemergence herbicides in potatoes. Pamela J.S. Hutchinson, Dennis J. Tonks, and Felix E. Fletcher. (Aberdeen Research and Extension Center, University of Idaho, Aberdeen, ID 83210). The objective of this trial was to evaluate preemergence (PRE) weed control with various rates of sulfentrazone, flumioxazin, and dimethenamid-p, applied alone or with standard tank-mix partners in a field trial at the Aberdeen Research and Extension Center. These herbicides were compared to a standard treatment of rimsulfuron +metribuzin in an area infested with 30 plants/m^2 hairy nightshade, 35 plants/m^2 common lambsquarters, 28 plants/m^2 redroot pigweed, and 4 plants/m^2 volunteer oat.

The experimental area was fertilized with 100 lb N, 50 lb P_2O_5, 20 lb SO_4, 3 lb Zn, 1 lb Cu, and 2 lb Mn/A before planting 'Russet Burbank' potatoes on April 27, 2000. Potatoes were planted 5 inches deep at 11-inch intervals in rows spaced 36 inches apart in a Declo loam soil with 1.4% organic matter and pH 8. The experimental design was a randomized complete block with three replications. Plot size was 12 by 30 feet.

Potatoes were hilled on May 15, 2000, just prior to potato emergence. Herbicides treatments were applied on May 18, 2000, with a CO_2-pressurized backpack sprayer that delivered 17.5 gpa at 30 psi. Herbicides were incorporated by 0.84 inch sprinkler irrigation immediately after application. No potato or weed plants were exposed at time of application.

Potatoes were sprinkler irrigated as needed throughout the growing season and received additional N and P_2O_5 through the irrigation system based on petiole test results. Chlorothalonil (1.125 lb/A) was applied through the irrigation system July 7, 2000. Pymetrozine (0.086 lb/A) was applied by air August 5, 2000 for aphid control. Potato vines were desiccated with 0.375 lb/A diquat August 25, 2000. Tubers were harvested from 25 feet of each of the two center rows in each plot using a single-row mechanical harvester on Sept 12, 2000, and graded according to United States Department of Agriculture (USDA) standards.

The standard treatment of PRE rimsulfuron + metribuzin (0.023+ 0.5 lb/A) provided at least 95% control of all weeds present (Table 1). Sulfentrazone alone (0.063, 0.094, 0.125 lb ai/A) or 0.094 lb ai/A in combination with s-metolachlor, pendimethalin, EPTC, dimethenamid-p, metribuzin, or pendimethalin + EPTC provided excellent hairy nightshade, common lambsquarters, and redroot pigweed control (95-99%). Sulfentrazone alone, regardless of rate, did not provide acceptable volunteer oat control. Tank-mixtures of sulfentrazone (0.094 lb ai/A) and s-metolachlor, pendimethalin, or EPTC, provided fair volunteer oat control (83-87%), while sulfentrazone plus dimethenamid-p, metribuzin, or pendimethalin + EPTC resulted in >90% volunteer oat control.

Flumioxazin applied alone at 0.047 or 0.063 lb ai/A did not result in acceptable control of any weed present in the trial area (Table). Flumioxazin at 0.094 or 0.125 lb/A provided 82 or 95% hairy nightshade control, respectively, and did not result in acceptable control of common lambsquarters, redroot pigweed, or volunteer oat. Flumioxazin (0.047 lb/A) + s-metolachlor, resulted in 85% redroot pigweed control compared to greater than 90% control provided by flumioxazin + pendimethalin, metribuzin, or dimethenamid-p. Only the flumioxazin + metribuzin or dimethenamid-p treatments resulted in greater than 90% common lambsquarters control.

Dimethenamid-p applied alone (0.64 lb/A) resulted in 93 and 98% hairy nightshade and redroot pigweed control, respectively, and 82% common lambsquarters control (Table). This compound applied alone did not provide acceptable volunteer oat control. The tank-mixtures of dimethenamid-p and metribuzin or rimsulfuron provided 93 to 99% control of all weeds present.

Total and U.S. No. 1 tuber yields in the rimsulfuron + metribuzin, dimethenamid-p tank-mixture, and all sulfentrazone treated plots, were greater than yields in any flumioxazin alone or tank mixture treated plot with the exception of flumioxazin + metribuzin or dimethenamid-p (Table).

Table. Season-long performance of developmental preemergence herbicides in potatoes.

Treatment	Rate	Weed control				Tuber yields	
		SOLSA	CHEAL	AMARE	V.Oats	U.S. No. 1	Total
	lb/A	——%				—(cwt/A)—	
Sulfentrazone	0.063	95	98	98	57	259	360
Sulfentrazone	0.094	98	99	99	78	285	373
Sulfentrazone	0.125	99	99	99	75	296	394
Sulfentrazone +s-metolachlor	0.094 +1.34	99	99	99	87	230	327
Sulfentrazone +pendimethalin	0.094 +1	99	99	99	83	261	364
Sulfentrazone +EPTC	0.094 +3	98	99	99	87	287	379
Sulfentrazone +dimethenamid-p	0.094 +0.64	99	99	99	93	274	362
Sulfentrazone +metribuzin	0.094 +0.5	99	99	99	99	237	336
Sulfentrazone +pendimethalin +EPTC	0.094 +1 +3	99	99	99	95	302	412
Flumioxazin	0.047	70	50	40	0	148	254
Flumioxazin	0.063	60	47	53	10	110	208
Flumioxazin	0.094	82	40	47	10	94	203
Flumioxazin	0.125	95	72	62	20	152	263
Flumioxazin +s-metolachlor	0.047 +1.34	93	81	85	70	167	269
Flumioxazin +pendimethalin	0.047 +1	76	73	91	72	97	221
Flumioxazin +metribuzin	0.047 +0.5	99	99	99	98	243	346
Flumioxazin +dimethenamid-p	0.047 +0.64	96	93	98	77	228	322
Dimethenamid-p	0.64	93	82	98	63	183	294
Dimethenamid-p +metribuzin	0.64 +0.5	99	99	99	98	242	349
Dimethenamid-p +rimsulfuron	0.64 +0.023	93	99	99	96	252	360
Rimsulfuron +metribuzin	0.023 +0.5	96	99	99	99	252	367
Weedy control	-	-	-	-	-	46	155
LSD 0.05		13.7	17.4	8.4	18.1	58.4	63.6

Weed control with preemergence herbicides in potatoes at three Idaho locations. Pamela J.S. Hutchinson, D. J. Tonks, F.E. Fletcher, B.M. Waters, and G.W. Harding. (Aberdeen Research and Extension Center, University of Idaho, Aberdeen, ID 83210). The objective of this trial was to evaluate weed control with preemergence (PRE) applications of sulfentrazone, dimethenamid-p, flufenacet/metribuzin (Axiom) applied alone or with standard tank-mix partners compared to rimsulfuron + metribuzin, and standard three-way tank mixtures in trials located near Aberdeen, Parma, and Rexburg, Idaho.

'Russet Burbank' potatoes were hilled just prior to emergence at all locations and herbicides were applied PRE. Treatments were sprinkler or mechanically incorporated immediately after application. Applications were made May 18 and 24, 2000 in Aberdeen and Parma, respectively, and June 5, 2000 at the Rexburg location. Hairy nightshade was present at Rexburg at low populations ($2/ft^2$), at Aberdeen at moderate populations (10 to $12/ft^2$), and at high populations (20 to $40/ft^2$) at the Parma location. Redroot pigweed was present at Rexburg and Parma at $2/ft^2$, and at Aberdeen at $10/ft^2$. Common lambsquarters were present at Aberdeen and Parma at 10 to $20/ft^2$. Barnyardgrass was present at Parma at high populations of 20 to $40/ft^2$ and volunteer oats were present at Aberdeen at 1 to $2/ft^2$.

Dimethenamid-p + metribuzin, and flufenacet/metribuzin + sulfentrazone weed control performance was comparable to standard treatments of rimsulfuron + metribuzin, and the three-way tank mixtures of pendimethalin or s-metolachlor with EPTC + metribuzin, or with rimsulfuron + metribuzin (Table 1). All treatments at all locations, with the exception of flufenacet/metribuzin or sulfentrazone alone, resulted in greater than 90% hairy nightshade control. Flufenacet/metribuzin alone did not provide acceptable control of hairy nightshade at any location. Sulfentrazone alone provided 87% hairy nightshade control at Parma, and 92 and 98% control at Rexburg and Aberdeen, respectively. All treatments provided at least 90% redroot pigweed control regardless of location. Common lambsquarters present only at Parma and Aberdeen, was controlled 95 to 100% by all treatments. Sulfentrazone alone did not provide acceptable barnyardgrass control (present only at Parma), or volunteer oat control (present only at Aberdeen). Sulfentrazone + pendimethalin provided 50 and 83% barnyardgrass and volunteer oat control, respectively, and dimethenamid-p provided 63 and 100% volunteer oat and barnyardgrass control, respectively. All other treatments resulted in greater than 95% barnyardgrass or volunteer oat control.

Table 1. Multi-location trial: Control of hairy nightshade and redroot pigweed with preemergence herbicides in potatoes.

Treatment	Rate	Weed control					
		Parma		Rexburg		Aberdeen	
		SOLSA	AMARE	SOLSA	AMARE	SOLSA	AMARE
	lb/A	%					
Rimsulfuron +metribuzin	0.023 +0.5	100	100	94	93	99	99
Pendimethalin +EPTC+metribuzin	1 +3+0.5	100	100	92	92	90	99
S-metolachlor +EPTC+metribuzin	1.34 +3+0.5	100	100	98	97	95	99
Pendimethalin +rimsulfuron+metribuzin	1 +0.023+0.5	90	100	92	93	98	99
S-metolachlor +rimsulfuron+metribuzin	1.34 +0.023+0.5	98	100	96	93	99	96
Flufenacet/metribuzin	1.5	63	100	70	93	60	99
Flufenacet/metribuzin[a] +sulfentrazone	1.5 +0.64	95	100	92	92	99	98
Sulfentrazone	0.094	87	100	92	94	98	99
Pendimethalin +sulfentrazone	1.0 +0.094	93	100	94	92	99	99
Dimethenamid-p	0.64	91	95	97	95	93	98
Dimethenamid-p +metribuzin	0.64 +0.5	99	100	98	98	99	99

[a]Flufenacet/metribuzin = Axiom®

Table 2. Multi-location trial: Control of common lambsquarters, barnyardgrass, and volunteer oat with preemergence herbicides in potatoes.

Treatment	Rate	Weed control			
		Parma		Aberdeen	
		CHEAL	ECHCG	CHEAL	V. oats
	lb/A	%			
Rimsulfuron +metribuzin	0.023+0.5	99	99	99	98
Pendimethalin +EPTC+metribuzin	1.0 +3+0.5	100	100	99	97
S-metolachlor +EPTC+metribuzin	1.34 +3+0.5	100	100	99	99
Pendimethalin +rimsulfuron+metribuzin	1 +0.023+0.5	100	100	99	99
S-metolachlor +rimsulfuron+metribuzin	1.34 +0.023+0.5	100	100	99	99
Flufenacet/metribuzin[a]	1.5	100	100	99	98
Flufenacet/metribuzin +sulfentrazone	1.5 +0.64	100	100	99	99
Sulfentrazone	0.094	100	0	99	78
Pendimethalin +sulfentrazone	1 +0.094	100	50	99	83
Dimethenamid-p	0.64	95	100	82	63
Dimethenamid-p +metribuzin	0.64 +0.5	100	100	99	97

[a]Flufenacet/metribuzin = Axiom®

Tolerance of 'Russet Burbank' potato to preemergence chloroacetamide herbicides. Pamela J.S. Hutchinson, Dennis J. Tonks, Charlotte V. Eberlein, and Felix E. Fletcher. (Aberdeen Research and Extension Center, University of Idaho, Aberdeen, ID 83210). The objective of this experiment was to evaluate the tolerance of 'Russet Burbank' potato to preemergence (PRE) applications of chloroacetamide herbicides. The experimental area was fertilized with 100 lb N, 150 lb P_2O_5, 100 K2O, 100 lb SO_4, 4 lb Zn, 1 lb Cu, and 2 lb Mn/A before planting 'Russet Burbank' potatoes on May 3, 2000. Potatoes were planted 5 inches deep at 11-inch intervals in rows spaced 36 inches apart in a Declo loam soil with 1.3% organic matter and pH 7.9 near Aberdeen, Idaho. The experimental design was a randomized complete block with four replications. Plot size was 12 by 30 feet. A similar trial had been conducted in 1999.

Potatoes were hilled prior to potato emergence. Treatments consisting of the 1x and 2x rates of dimethenamid, the proposed 1x and 2x rates of dimethenamid-p, and the 1x, 2x, and 4x rates of s-metolachlor were applied on May 27, 2000 with a CO_2-pressurized backpack sprayer that delivered 17.5 gpa at 30 psi. There were no potato or weed plants exposed at the time of application. Herbicides were incorporated by 0.84 inch sprinkler irrigation immediately after application. The trial area, including a weed-free control treatment, was maintained weed-free by hand-weeding throughout the growing season.

Potatoes were sprinkler irrigated as needed throughout the growing season, and received additional N and P_2O_5 through the irrigation system based on petiole test results. Chlorothalonil (1.125 lb/A) was applied through the irrigation system July 5, 2000. Pymetrozine (0.086 lb/A) was applied by air August 5, 2000 for aphid control. Potato vines were desiccated with 0.375 lb/A diquat September 5, 2000. Tubers were harvested from 25 feet of each of the two center rows in each plot using a single-row mechanical harvester on Sept 21, 2000, and graded according to United States Department of Agriculture (USDA) standards.

Potatoes were visibly rated for crop injury 13, 24, 34, and 52 days after treatment (DAT). Herbicide treatments resulted in initial 13 and 24 DAT crop injury consisting of plant height reduction and leaf malformations (leaf crinkling and puckering) ranging from 8.8 to 23.8% (Table). As with treatments in 1999, the degree of initial injury resulting from the 2x dimethenamid and dimethenamid-p herbicide rates was similar to the injury caused by the 1x s-metolachlor rate. By row closure, there were no visual injury symptoms except some leaf malformation still evident in the 4x s-metolachlor treated plots. There was no significant yield reduction of U.S. No. 1 or total tubers by any of the herbicide treatments unlike 1999 results, when total yield was reduced by the 2x dimethenamid treatment.

Table. Potato crop response to preemergence chloroacetamide herbicides in a weed-free study.

		Crop injury				Tuber yield	
Treatment	Rate	6/9/00	6/20/00	6/30/00	7/18/00	U.S. No. 1	Total
	lb/A	%				cwt/A	
Dimethenamid	1.17	8.8	10.0	0	0	174	280
Dimethenamid	2.34	15.0	17.5	0	0	180	302
Dimethenamid-p	0.64	8.8	12.5	0	0	181	289
Dimethenamid-p	1.29	16.3	13.8	0	0	198	327
S-metolachlor	1.34	16.3	13.8	0	0	154	253
S-metolachlor	2.6	13.8	20.0	0	0	190	289
S-metolachlor	5.2	23.8	21.3	3.8	0	179	287
Weed-free	-	0	0	0	0	142	246
LSD 0.05	-	7	5	1.2	nsd	50.6	59.9

Tolerance of 'Russet Burbank' potato to preemergence flumioxazin. Pamela J.S. Hutchinson, Dennis J. Tonks, and Felix E. Fletcher. (Aberdeen Research and Extension Center, University of Idaho, Aberdeen, ID 83210). The objective of this experiment was to evaluate the tolerance of 'Russet Burbank' potato to preemergence (PRE) applications of flumioxazin. The experimental area was fertilized with 100 lb N, 150 lb P_2O_5, 100 K2O, 100 lb SO_4, 4 lb Zn, 1 lb Cu, and 2 lb Mn/A before planting 'Russet Burbank' potatoes on May 3, 2000. Potatoes were planted 5 inches deep at 11-inch intervals in rows spaced 36 inches apart in a Declo loam soil with 1.3% organic matter and pH 7.9 near Aberdeen, Idaho. The experimental design was a randomized complete block with four replications. Plot size was 12 by 30 feet.

Potatoes were hilled just prior to potato emergence. Treatments consisting of 0.047, 0.094, and 0.125 lb/A flumioxazin were applied on May 27, 2000 with a CO_2-pressurized backpack sprayer that delivered 17.5 gpa at 30 psi. There were no potato or weed plants exposed at the time of application. Herbicides were incorporated by sprinkler irrigation with 0.84 inch of water immediately after application. The trial area, including a weed-free control treatment, was maintained weed-free by hand-weeding throughout the growing season.

Potatoes were sprinkler irrigated as needed throughout the growing season, and received additional N and P_2O_5 through the irrigation system based on petiole test results. Chlorothalonil (1.125 lb/A) was applied through the irrigation system July 5, 2000. Pymetrozine (0.086 lb/A) was applied by air August 5, 2000 for aphid control. Potato vines were desiccated with 0.375 lb/A diquat September 5, 2000. Tubers were harvested from 25 feet of each of the two center rows in each plot using a single-row mechanical harvester on Sept 21, 2000 and graded according to United States Department of Agriculture (USDA) standards.

Potatoes were visibly rated for crop injury 13, 24, 34, and 52 days after treatment (DAT). All flumioxazin treatments resulted in initial 13 and 24 DAT crop injury consisting of plant height reduction and some leaf malformations (leaf crinkling and puckering) ranging from 5 to 20% (Table). The two lower rates resulted in similar injury levels that were less than injury resulting from the highest rate. Injury was still evident in the 0.094 and 0.125 lb/A treated plots two weeks after row closure. There was no significant yield reduction of total tubers by any of the herbicide treatments compared to the weed-free control. U.S. No. 1 tuber yields were reduced by 0.125 lb/A flumioxazin compared to all other treatments.

Table. Potato crop response to preemergence flumioxazin in a weed-free study.

Treatment	Rate	Crop injury				Tuber yield	
		6/9/00	6/20/00	6/30/00	7/18/00	U.S. No. 1	Total
	lb/A	%				cwt/A	
Flumioxazin	0.047	10.0	5.0	1.0	0	166.4	288.3
Flumioxazin	0.094	12.5	6.3	5.0	1.5	147.4	310.3
Flumioxazin	0.125	18.8	20.0	9.0	5.0	116.6	274.8
Weed-free	-	0	0	0	0	163.5	290.3
LSD 0.05	-	3.3	6.3	1.1	0.8	27.7	36.4

Sulfentrazone tolerance in selected potato cultivars. Timothy W. Miller and Carl R. Libbey. Washington State University, Mount Vernon, WA 98273. A field study was conducted during 2001 at WSU Mount Vernon to evaluate sulfentrazone for crop safety to potato cultivars commonly grown in the Skagit Valley of northwestern Washington. Single rows of white ('White Rose' and 'Cascade'), red ('Red La Soda' and 'Chieftain'), yellow ('Yukon Gold'), and purple ('All Blue') potato cultivars were planted into each plot June 8 at a 38 in. rowspacing and 9-in. spacing between seed pieces (approximately 2870 lbs/A planting rate). Plots measured 38 by 120 in. Hills were re-shaped July 3, when the first potato leaves began to emerge. Sulfentrazone at 0.19 and 0.38 lb/A was applied across all cultivar rows immediately following re-hilling (PRE) using a CO_2-pressurized backpack sprayer delivering 32.4 gpa at 30 psi. An industry standard treatment consisting of metribuzin + rimsulfuron (0.5 + 0.02 lb/A, PRE) was applied to separate plots. Major weed species were common lambsquarters, pale smartweed, and ladysthumb. Initial weed control and foliar injury was evaluated July 18 on a 0 to 10 scale (0 = no weed control or no potato injury, 10 = no weeds or all potato plants killed). Plants were desiccated with diquat at 0.25 lb/A September 7. Tubers were dug from three randomly-selected plants for each cultivar September 28 and total weight was recorded.

The most recent soil test for this location was completed October 27, 2000. At that measurement, organic matter was 3.3%, pH was 5.9, and C.E.C. was 9.3 meq/100g. The soil texture for the site is a Field silt loam, with a particle size distribution of 16% sand, 68% silt, and 16% clay. 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, potato emergence and tuber yield by cultivar in Table 2, and weed control, potato emergence, foliar injury, and tuber yield as affected by herbicide treatment in Table 3.

Table 1. Herbicide application data.

9:00 a.m., July 3, 2001
Broadcast, after re-hilling
No cloud cover, sunny
winds 5 to 7 mph, from NW
air temp. = 80 F; soil temp (4") = 65 F
relative humidity = 40%
soil surface was damp
weeds were up to 5" at time of re-hilling

Potato cultivars emerged differently regardless of herbicide treatment. 'Red La Soda,' 'Yukon Gold,' and 'White Rose' showed excellent emergence, while 'Cascade' emergence was significantly poorer than 'Red Lasota' (Table 2). Emergence of 'All Blue' and 'Chieftain' was poorer than all other cultivars. Given the late date of planting and wet soil conditions due to 3.04" of rainfall during the three weeks after planting, this spotty emergence was not surprising. Potato tuber yield corresponded to potato emergence ratings (e.g., the better the emergence, the higher the yield), probably for the same reason (Table 2). There were no obvious differences in shape or quality of harvested tubers.

Table 2. Plant emergence and tuber yield by potato cultivar.

Cultivar	Potato plant emergence[a]	Tuber yield[b]
	plants/row	kg/3 plants
1. Red La Soda	9.0	4.1
2. Yukon Gold	8.0	3.6
3. White Rose	7.7	3.8
4. Cascade	6.8	3.3
5. All Blue	3.7	2.5
6. Chieftain	2.3	2.5
$LSD_{0.05}$	1.7	1.3

[a]Potato emergence evaluated 7/18/01.
[b]Tuber yield measured 9/28/01.

Early-season weed control was not significantly affected by the interaction of cultivar and herbicide, but was affected by herbicide treatment (Table 3). Weed control with sulfentrazone at 0.38 lb/A or metribuzin + rimsulfuron was similar (8.0 and 8.4, respectively). Weed control with sulfentrazone at 0.19 lb/A (7.4) was statistically similar to that from the higher rate of sulfentrazone, but significantly lower than the metribuzin + rimsulfuron tank mixture.

Herbicide treatment affected potato emergence, but not potato injury or potato yield (Table 3). The low rate of sulfentrazone resulted in poorest emergence (4.8 plants per row), compared to statistically similar 7.4 and 6.5 plants/row resulting from metribuzin + rimsulfuron and high rate of sulfentrazone, respectively. This response probably represents statistical noise, since it is doubtful that potatoes treated with the low rate of sulfentrazone applied PRE would show poorer emergence than those treated with the high rate. This is especially true since little rain occurred during the time after herbicide application (July 3) until emergence evaluation (July 18), so the bulk of herbicide was probably nearer to the surface of the hills than to the seed pieces/potato roots.

The interaction between cultivar and herbicide was not statistically significant for potato emergence, potato injury, or potato yield (data not shown). This indicates that these potato cultivars were not differentially sensitive to sulfentrazone in this test.

Table 3. Weed control, potato emergence, foliar injury, and tuber yield as affected by herbicide treatment.

Treatment	Timing[a]	Rate	Weed control[b]	Potato plant emergence	Potato plant injury[b]	Tuber yield[c]
		lb/A		plants/row		kg/3 plants
1. sulfentrazone	PRE	0.19	7.4	4.8	0.2	3.0
2. sulfentrazone	PRE	0.38	8.0	6.5	0.2	3.6
3. rimsulfuron	PRE	0.02	8.4	7.4	0.2	3.6
+ metribuzin	PRE	0.5				
$LSD_{0.05}$	—	—	0.7	1.2	ns	ns

[a]PRE = immediately after re-hilling, applied 7/3/01.
[b]Evaluation scale 0 to 10 (0 = no weed control or no potato injury, 10 = no weeds or all potato plants killed); weed control and potato emergence and injury evaluated 7/18/01.
[c]Tuber yield measured 9/28/01.

Evaluation of flumioxazin and fluroxypyr in green bunching and bulb onions. Steven A. Fennimore and Jose A. Valdez. (Department of Vegetable Crops and Weed Science, University of California at Davis, Salinas, CA 93905) Crop tolerance and weed control efficacy of flumioxazin and fluroxypyr were evaluated in green bunching onion and bulb onion. For comparison, the commercial standards oxyfluorfen and DCPA were applied. The green bunching onion and bulb onion evaluations were conducted on the Hartnell and Spence USDA facilities, respectively, at Salinas, CA. Randomized complete block designs with 4 replicates were utilized in both studies, and the plots were one 40-inch bed wide by 20 to 25 feet long. The bulb onion 'Rio Lobo' was seeded April 11, 2001 at Spence, and the green bunching onion 'Emerald Isle' on June 28, 2001 at Hartnell. Both studies used identical herbicide treatments that were applied in a spray volume of 40 GPA. DCPA at 5.25 lb/A was applied preemergence immediately after seeding. Flumioxazin was applied post-emergence at rates of 0.063 and 0.094 lb/A at the onion 2-leaf stage. Flumioxazin was also applied as a sequential treatment at 0.063 followed by (fb) 0.063 and 0.094 fb 0.094 lb/A applied at both the 2- and 6-leaf stages of onion. Fluroxypyr was applied at 0.024 and 0.047 lb/A to 2-leaf onions. Oxyfluorfen was applied as a single application at 0.125 lb/A at the 2-leaf stage and as sequential applications at 0.125 fb 0.125 lb/A at the 2- and 6-leaf stages. Crop injury evaluations were conducted periodically. Mid- to late-season weed biomass samples were collected from a 2.69 ft^2 area in each plot and sorted by species in both studies. Onions were harvested from a 50 ft^2 area and weighed at maturity.

Common weeds at the Spence site were hairy nightshade, prostrate knotweed, and common purslane (Table 1). Flumioxazin in a single application at 0.094 lb/A or as a sequential application provided control of hairy nightshade. The single application of oxyfluorfen provided fair control of hairy nightshade and the sequential application provided excellent control. None of the flumioxazin treatments provided control of prostrate knotweed, but the sequential application of oxyfluorfen did provide effective control. All flumioxazin and oxyfluorfen treatments provided control of common purslane. Fluroxypyr treatment did not provide control of any weed, except that the high rate controlled common purslane. DCPA preemergence provided good control of prostrate knotweed and common purslane, but fair control of hairy nightshade. Flumioxazin resulted in moderate injury to onions. DCPA, fluroxypyr and oxyfluorfen were safe on onions. The sequential application of oxyfluorfen at the 2- and 6-leaf stages resulted in the highest yield. Flumioxazin yields were not significantly different from oxyfluorfen yields, with the exception of the 0.094 lb/A sequential treatment, which had lower yields. The fluroxypyr treatments resulted in lower yield due to poor weed control.

Predominate weeds at the Hartnell site were little mallow, burning nettle, and nettleleaf goosefoot (Table 2). Flumioxazin and oxyfluorfen provided control of all three-weed species with either single or sequential applications. Fluroxypyr did not provide control of any weeds at tested rates. DCPA preemergence provided control of burning nettle and nettleleaf goosefoot, but not little mallow. Flumioxazin and oxyfluorfen resulted in moderate injury to onions. DCPA and fluroxypyr were safe on onions. Flumioxazin applied at the 2-leaf stage resulted in yields that did not differ from those of oxyfluorfen applied at the 2-leaf stage. The sequential applications of flumioxazin at the 2- and 6-leaf stage resulted in significant yield loss in green bunching onion compared to either oxyfluorfen treatment. DCPA yields were lower due to poor weed control. In summary, flumioxazin rates at 0.063 and 0.094 applied at the 2-leaf stage provided weed control and did not cause significant yield loss. No further work with fluroxypyr is recommended at 0.024 and 0.047 lb/A, since it was not an effective herbicide at these rates.

Table 1. Mean weed biomass, (lb/A) crop injury, and yield (lb/A) in a bulb onion study at Spence.

Treatment	Rate (Lb/A)	Time of Application	Weed biomass [a b] SOLSA	POLAV	POROL	Crop injury [c] Jun. 16	Jun. 23	Jul. 7	Yield Sep 5
			Lb/A			0-10			Lb/A
Flumioxazin	0.063	2nd leaf	1,461	1,053	0	0.8	0.0	0.0	33344
Flumioxazin	0.094	2nd leaf	0	1,493	0	0.0	0.5	0.0	31664
Flumioxazin	2x 0.063	2nd + 6th leaf	173	1,430	0	2.3	2.8	0.8	31965
Flumioxazin	2x 0.094	2nd + 6th leaf	0	2,765	0	4.3	2.9	0.0	25936
Fluroxypyr	0.024	2nd leaf	7,714	974	738	0.0	0.0	0.0	16272
Fluroxypyr	0.047	2nd leaf	4,713	236	86	0.0	0.0	0.0	22717
Oxyfluorfen	0.125	2nd leaf	605	1,901	0	0.0	0.3	0.3	37901
Oxyfluorfen	2x 0.125	2nd + 6th leaf	16	251	0	0.0	0.0	0.3	40830
DCPA	5.25	Preemergence	896	0	0	0.0	0.3	0.3	31566
Untreated	--	--	6,520	2,875	1,273	0.0	0.0	0.0	14178
LSD 0.05	--	--	3,065	2,543	774	1.21	0.51	0.44	11759

[a] Estimated based on the average of four 2.69 square ft. samples
[b] SOLSA = hairy nightshade, POLAV = prostrate knotweed, POROL = common purslane
[c] Crop injury estimates: 0 = no injury, 10 = plant death

Table 2. Weed biomass, (lb/A) crop injury, and yield (lb/A) in a green bunching onion study at Hartnell.

Treatment	Rate (Lb/A)	Time of Application	Weed biomass [a b] MALPA	URTUR	CHEMU	Crop injury [c] Jul 21	Aug 11	Aug 28	Yield Sep 7
			Lb/A			0-10			Lb/A
Flumioxazin	0.063	2nd leaf	1,225	11	31	3.6	0.0	0.0	25,430
Flumioxazin	0.094	2nd leaf	0	2	0	3.8	0.3	0.0	24,245
Flumioxazin	2x 0.063	2nd + 6th leaf	0	0	47	3.8	0.0	4.8	16,879
Flumioxazin	2x 0.094	2nd + 6th leaf	0	0	0	3.8	0.3	4.8	13,310
Fluroxypyr	0.024	2nd leaf	73,495	8,397	4,682	0.0	0.0	0.0	2,472
Fluroxypyr	0.047	2nd leaf	32,851	10,196	3,315	0.0	0.0	0.0	2,974
Oxyfluorfen	0.125	2nd leaf	0	0	0	3.3	0.0	0.0	27,647
Oxyfluorfen	2x 0.125	2nd + 6th leaf	0	4	0	3.5	0.0	1.3	33,991
DCPA	5.25	Preemergence	74,767	0	0	0.0	0.0	0.0	4,971
Untreated	--	--	93,824	2,152	1,194	0.0	0.0	0.0	767
LSD 0.05	--	--	28,861	5,184	2,451	0.50	0.31	0.37	7,593

[a] Estimated based on the average of four 2.69 square ft. samples
[b] MALPA = little mallow, URTUR = burning nettle, CHEMU= nettleleaf goosefoot
[c] Crop injury estimates: 0 = no injury, 10 = plant death

Evaluation of new preemergence and postemergence herbicides for weed control in dry bulb onions. Kai Umeda. (University of Arizona Cooperative Extension, Maricopa County, 4341 E. Broadway Road, Phoenix, AZ 85040) Two small plot field studies were conducted at the University of Arizona Maricopa Agricultural Center, Maricopa, AZ. Dry bulb onions were direct seeded in two seedlines per 40-in raised bed on 16 October 2000. Each treatment replicate consisted of two beds measuring 35 ft in length and the tests used a randomized complete block design with three replicates. The onions were furrow irrigated as necessary throughout the growing season. The herbicide treatments were applied using a CO_2 backpack sprayer that was equipped with a hand-held boom with four flat fan 8002 nozzle tips spaced 20-in apart. The sprayer delivered the herbicides in 20 gpa water at a pressure of 30 psi. The preemergence herbicides were applied immediately after planting on 16 October 2000. The soil was dry and then the onions were furrow irrigated within one day of application to activate the herbicides by completely wetting across the beds. The postemergence herbicides were applied on 21 February 2001 when the onions were at the 4 true leaf stage of growth and measured 6-10 inches in height.

In the preemergence test, flumioxazin at 0.1 to 0.3 lb/A severely reduced the onion crop stand. Flumioxazin applied postemergence caused onion injury of 23 to 37% at 2 weeks after treatment (WAT) at rates of 0.04 to 0.1 lb/A. Fluroxypyr and carfentrazone applied postemergence did not cause any onion injury at 5 WAT. Fluroxypyr and carfentrazone did not provide acceptable control of annual yellow sweetclover at any rate. Carfentrazone at 0.063 lb/A demonstrated activity on lambsquarters and control nearly approached acceptable levels at 83% at 5 WAT. Fluroxypyr did not provide acceptable control of lambsquarters.

Table. Evaluation of new preemergence and postemergence herbicides for weed control in dry bulb onions

Treatment	Rate	Timing	Onion			Weed Control			
	(lb/A)		Crop Stand	Injury		yellow sweetclover		common lambsquarters	
				2 WAT	5 WAT	2 WAT	5 WAT	2 WAT	5 WAT
			# /10 ft	%		%			
Untreated check				0	0	0	0	0	0
Handweeded check			131	0	0	99	99	99	99
Flumioxazin	0.1	PREE	25						
Flumioxazin	0.2	PREE	1.3						
Flumioxazin	0.3	PREE	0						
Flumioxazin	0.04	POST		23	12	33	65	0	17
Flumioxazin	0.08	POST		35	23	57	75	25	57
Flumioxazin	0.1	POST		37	32	73	78	40	75
Fluroxypyr	0.1	POST		0	0	7	7	0	0
Fluroxypyr	0.188	POST		0	0	47	50	0	33
Fluroxypyr	0.25	POST		0	0	67	53	0	63
Carfentrazone	0.032	POST		0	0	3	33	33	67
Carfentrazone	0.063	POST		7	0	43	53	63	83
LSD (p=0.05)			15.6	8.1	8.3	23.6	19.3	26.5	26.8

Sweet corn tolerance to BAS 662 01H and dimethenamid-p. Timothy W. Miller and Carl R. Libbey. Washington State University, Mount Vernon, WA 98273. A field study was conducted at WSU Mount Vernon during 2001 to determine crop safety and weed control of BAS 662 01H (formerly SAN 1269; contains 20% ae diflufenzopyr: 2-(1-[([3, 5-difluorophenylamino] carbonyl)-hydrazono] ethyl)-3-pyridinecarboxylic acid (formerly SAN 836) plus 50% ae dicamba) and dimethenamid-p used alone or in combination with atrazine, pendimethalin, or bentazon. Two rows of 'Golden Jubilee' were seeded into each plot May 20 at a rate of approximately 19,000 seeds per acre. Plot size was 8 ft wide by 20 ft long. Preemergence herbicides were applied May 24 and postemergence herbicides June 19, using a tractor-mounted sprayer delivering 39.7 gpa at 30 psi. Weed control was visually estimated June 15, June 27, and August 6, and crop injury June 27 and August 6. Major weed species present were common lambsquarters, pale smartweed, and ladysthumb. Ears were picked when ripe for fresh market (October 12), counted, and weighed (unhusked). Stand counts were recorded the day of harvest. 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, stand establishment, and yield is listed in Table 2.

Table 1. Herbicide application data.

Preemergence	Postemergence
6:00 a.m., May 24, 2001	5:00 a.m., June 19, 2001
—	Weeds 2 to 4 in. tall
—	Crop 3-leaf (2 to 4 in. tall)
100% cloud cover	10% cloud cover
winds calm	winds calm
air temp. = 50 F; soil temp (4") = 63 F	air temp. = 59 F; soil temp (4") = 60 F
87% relative humidity	77% relative humidity
dew present	dew present
soil surface was damp with small clods	soil surface was damp with small clods

Weed pressure in the check plots was extremely high, completely overwhelming the sweet corn by the end of the season and eliminating yield from those plots. Similarly, no harvestable ears were produced on corn treated with dimethenamid-p alone, apparently due to weed control failure.

Dimethenamid-p alone gave only 73% control by June 15, indicating that a higher rate or combination treatment would have been necessary for adequate weed control. Pendimethalin alone or applied with dimethenamid-p resulted in excellent weed control through June 27, but by August 6, weed control had dropped to 70 and 81%, respectively. Postemergence treatments were probably applied when weeds were too large (up to 4" tall) for optimal control with BAS 662 or bentazon. Atrazine alone (with crop oil concentrate), however, provided 92% control by August 6. BAS 662 + atrazine (all rates), dimethenamid-p + pendimethalin + BAS 662 + bentazon, BAS 662 + bentazon (high rate), and dimethenamid-p + pendimethalin provided similar levels of weed control, statistically. Weed control with all other treatments was significantly less than these and inadequate by the August rating.

Visible sweet corn injury was evident shortly after treatment with BAS 662 at the high rate, whether used alone or in combination with bentazon or atrazine. Pendimethalin alone and dimethenamid-p + pendimethalin + BAS 662 + bentazon also significantly injured sweet corn, although in all cases, injury was 10% or less.

Number and weight of ears differed based on herbicide treatment. Ear weight was reduced by BAS 662 alone (high rate), BAS 662 + bentazon (all rates), dimethenamid-p alone, and by dimethenamid-p + pendimethalin + BAS 662 + bentazon. Ear number was reduced by dimethenamid-p alone, BAS 662 + bentazon (high rate), and by dimethenamid-p + pendimethalin + BAS 662 + bentazon. While a portion of the reduced yield from BAS 662 + bentazon treatments may have resulted from inadequate weed control, yield tended to decrease with increased BAS 662 rate while weed control generally increased. Interestingly, there was a similar trend with BAS 662 applied alone (better weed control but lower yield with increased BAS 662 rate), but not with BAS 662 + atrazine. Sweet corn injury clearly resulted from the dimethenamid-p + pendimethalin + BAS 662 + bentazon treatment, given the the loss in yield accompanying 91% weed control. Herbicide treatment did not significantly affect stand count or weight per ear (data not shown).

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

Treatment[a]	Rate	Timing[b]	Crop injury 6/27	Crop injury 8/6	Weed control[c] 6/15	Weed control[c] 6/27	Weed control[c] 8/6	Plants per row	Yield ears	Yield weight
	lb/A		----- % ----		--------- % ---------				no/plot	kg/plot
1. BAS 662	0.09	POST	0	0	—	73	26	19.1	35.8	12.5
2. BAS 662	0.13	POST	0	0	—	80	50	24.5	34.3	11.9
3. BAS 662	0.175	POST	6	1	—	91	74	23.0	31.8	11.0
4. BAS 662 + bentazon	0.09 + 1.0	POST	0	0	—	70	30	23.4	31.3	10.4
5. BAS 662 + bentazon	0.13 + 1.0	POST	0	0	—	86	61	23.8	30.8	10.8
6. BAS 662 + bentazon	0.175 + 1.0	POST	6	1	—	95	83	20.0	25.5	9.2
7. BAS 662 + atrazine	0.09 + 1.0	POST	0	0	—	99	98	23.5	41.3	14.6
8. BAS 662 + atrazine	0.13 + 1.0	POST	0	0	—	100	100	21.9	39.5	14.5
9. BAS 662 + atrazine	0.175 + 1.0	POST	8	3	—	100	98	20.9	40.8	14.9
10. bentazon	1.0	POST	0	1	—	83	48	24.9	45.3	15.5
11. atrazine	1.0	POST	0	0	—	99	92	28.3	39.8	14.4
12. dimethenamid-p	0.64	PRE	0	0	73	68	0	21.0	0	0
13. dimethenamid-p + pendimethalin	0.64 + 1.0	PRE	0	1	99	95	81	22.9	39.8	15.1
14. pendimethalin	1.0	PRE	9	4	97	93	70	22.1	32.5	12.1
15. dimethenamid-p + pendimethalin + BAS 662 + bentazon	0.64 + 1.0 + 0.13 + 1.0	PRE + PRE + POST + POST	10	5	97	99	91	18.6	17.8	6.3
16. Untreated check	—	—	0	0	0	0	0	19.9	0	0
$LSD_{0.05}$	—	—	2	2	4	8	25	ns	11.2	4.4
r^2	—	—	0.92	0.61	0.99	0.97	0.83	0.40	0.81	0.78
C.V.	—	—	54.0	148	11.2	6.5	28.3	21.2	25.9	28.2

[a]Treatments 1-9 and postemergence portion of treatment 15 mixed with nonionic surfactant (0.25%, v/v); treatments 10 and 11 mixed with crop oil concentrate (1%, v/v).
[b]PRE = preemergence (applied 5/24/01); POST = postemergence (applied 6/19/01).
[c]On 6/15/01, POST treatments not yet applied.

Comparison of new postemergence herbicides for weed control in cantaloupes. Kai Umeda and Nell Lund. (University of Arizona Cooperative Extension, Maricopa County, 4341 E. Broadway Road, Phoenix, AZ 85040) A small plot field experiment was conducted at the University of Arizona Maricopa Agricultural Center, Maricopa, AZ. Cantaloupe cv. Topmark was planted in a single row into every third 40-inch raised bed on 10 April 2001. Individual plots consisted of one row measuring 30 ft long with each herbicide treatment replicated four times and plots arranged in a randomized complete block design. The treatments were applied using a CO_2 backpack sprayer equipped with a hand-held boom consisting of four 8004 flat fan nozzle tips spaced 20 inches apart. The herbicides were applied in 25 gpa of water at a pressure of 40 psi and all treatments included Latron CS-7 at 0.25% v/v. The postemergence applications were made on 23 May when the cantaloupe plants ranged in size from 4 to 7 true leaves. The weeds present were common purslane at 6 to 12 inch stem length, common lambsquarters at 4 inch height, prostrate pigweed at 4 to 6 inch stem length, Palmer amaranth at 4 to 6 inch height, and sprangletop at a height of 4 to 8 inches. The weather during applications was clear with minimal winds of 5 mph and an air temperature of 92F°. Visual observations for weed control efficacy and crop safety were made at various intervals after application.

Halosulfuron applied alone gave marginal to good control of common lambsquarters and common purslane, respectively, but did not provide control of the pigweeds or sprangletop. Acceptable control of 85% of the limited population of purple nutsedge was observed. Rimsulfuron applied alone gave good control of the pigweeds, lambsquarters, purslane, and marginal control of nutsedge. Weed control was effective until the late season evaluation at 9 weeks after treatment on 24 July. The combination of halosulfuron and rimsulfuron was similar to rimsulfuron applied alone, however, nutsedge control was not evaluated due to insufficient populations. Melons treated with halosulfuron alone showed the least injury among all of the herbicide treatments. Rimsulfuron caused marginally unacceptable injury at 18% compared to flumetsulam, thifensulfuron, MKH-6561, and flufenacet which caused unacceptable injury ranging from 20 to 68%.

Table. Weed control with new postemergence herbicides in cantaloupes.

Treatment	Rate (lb AI/A)	Melon Injury 27 DAT	Weed Control sprangletop	prostrate pigweed 27 DAT	prostrate pigweed 62 DAT	tumble pigweed 27 DAT	tumble pigweed 62 DAT	common lambsquarters 27 DAT	common lambsquarters 62 DAT	common purslane 27 DAT	common purslane 62 DAT	purple nutsedge 62 DAT
		%	%									
Untreated check		0	0	0	0	0	0	0	0	0	0	0
Halosulfuron	0.047	5	20	50	77	45	77	84	80	88	93	85
Rimsulfuron	0.02	18	82	95	95	95	95	82	85	80	90	83
Flumetsulam	0.01	36	39	73	85	83	85	75	82	89	90	0
Thifensulfuron	0.002	47	42	95	95	95	95	93	88	93	96	0
Halosulfuron + Rimsulfuron	0.047 + 0.02	11	84	91	93	94	93	89	85	91	95	-
Halosulfuron + Flufenacet	0.047 + 0.01	33	60	76	85	86	88	89	59	89	95	83
Halosulfuron + Thifensulfuron	0.047 + 0.002	47	82	95	98	95	98	95	95	95	98	-
MKH-6561	0.008	68	80	95	93	95	93	87	88	77	73	73
Flufenacet	0.5	20	80	69	77	88	85	73	83	85	90	0
		17.1	38.3	18.5	8.2	17.1	14.3	16.4	31.1	11.4	7.1	5.8

Treatments applied 23 May 2001. Rated 27 days after treatment (DAT) on 19 June and 62 DAT on 24 July.
All treatments included Latron CS-7 at 0.25% v/v.

Effects of planting depth, irrigation level, and halosulfuron rate on cucurbit growth and yield. R. Edward Peachey and Robert McReynolds (Department of Horticulture and NWREC, Oregon State University, Corvallis OR 97330) Halosulfuron was recently registered for broadleaf weed control in several cucurbit crops. This experiment evaluated the effect of planting depth and irrigation level on cucumbers, zucchini and winter processing squash tolerance to soil applied halosulfuron. The soil at this site was a silt loam soil with pH of 6.6, CEC of 24.9 meq/100g of soil, and % OM of 6.56. The experimental design was a RCB split-split plot with main effects of cucurbit type, irrigation level, planting depth, and herbicide rate. Two rows of cucumbers (var. Elite), zucchini (var. Sunex 9723 F_1), and winter processing squash (*Cucurbita maxima* var. Golden Delicious) were planted in each plot. Halosulfuron was applied after planting with a backpack sprayer at 0.03125 and 0.0625 lbs. ai/A in 20 GPA water. Hand hoeing and cultivation kept plots nearly weed-free. The entire plot was irrigated with approximately 0.5 inches of water on June 8. The high irrigation main plots received an additional 0.8 inches on June 9, for a total of 1.3 inches. Rainfall on June 11 added an additional 0.4 inches of rain to bring the total in the low and high irrigation main plots to 0.8 and 1.7 inches of water, respectively. Beginning 2 weeks after planting (WAP), plots were irrigated with 1 inch of irrigation per week. Emerged seedlings were counted on June 20 in 5 m of row for squash and zucchini and 2.5 m of row in cucumbers. A crop cut was taken on July 12 (5 WAP) and biomass dried. Cucumbers were dried for 1 week at 110 F; squash and zucchini plants were air dried for four weeks, then dried for 7 days at 110 F. Zucchini was harvested three times, cucumbers only once. Winter processing squash was harvested October 26.

Irrigation level effect. Increasing the amount of irrigation after soil application of halosulfuron had little effect on crop emergence, but generally reduced growth of all cucurbits 3 WAP regardless of planting depth. Increasing the irrigation level reduced average plant drymatter at 5 WAP for all crops, even without halosulfuron applied (Fig. 1). The higher irrigation level caused bacterial leaf spot to develop on the winter processing squash, which was the likely cause of reduced growth in processing squash at 5 WAP. Zucchini growth was significantly reduced under the high irrigation regime with both rates of halosulfuron. Cucumber growth followed similar but less severe trends. Squash growth was not reduced by halosulfuron at the high irrigation level, probably because of bacterial leaf spot. Increasing the irrigation level had little effect on cucumber and processing squash yield across the halosulfuron treatments. Zucchini yield at the high irrigation level was less than the low irrigation level, particularly when the zucchini was shallow planted and halosulfuron was applied.

Planting depth effect. Emergence for all crops was generally less in shallow planted rows and may have been due to surface drying, as shallow planting also reduced growth in the check plots. Increased planting depth reduced the effect of halosulfuron on plant growth 5 WAP for all three crops at the low irrigation level (Fig. 1). At the high irrigation level, deeper planting reduced the effect of halosulfuron on cucumber and zucchini growth 5 WAP, but not winter processing squash. Deeper planting increased yield of cucumbers for all treatments, increased zucchini yield (particularly at the high irrigation level), but had little or no effect on processing squash yield.

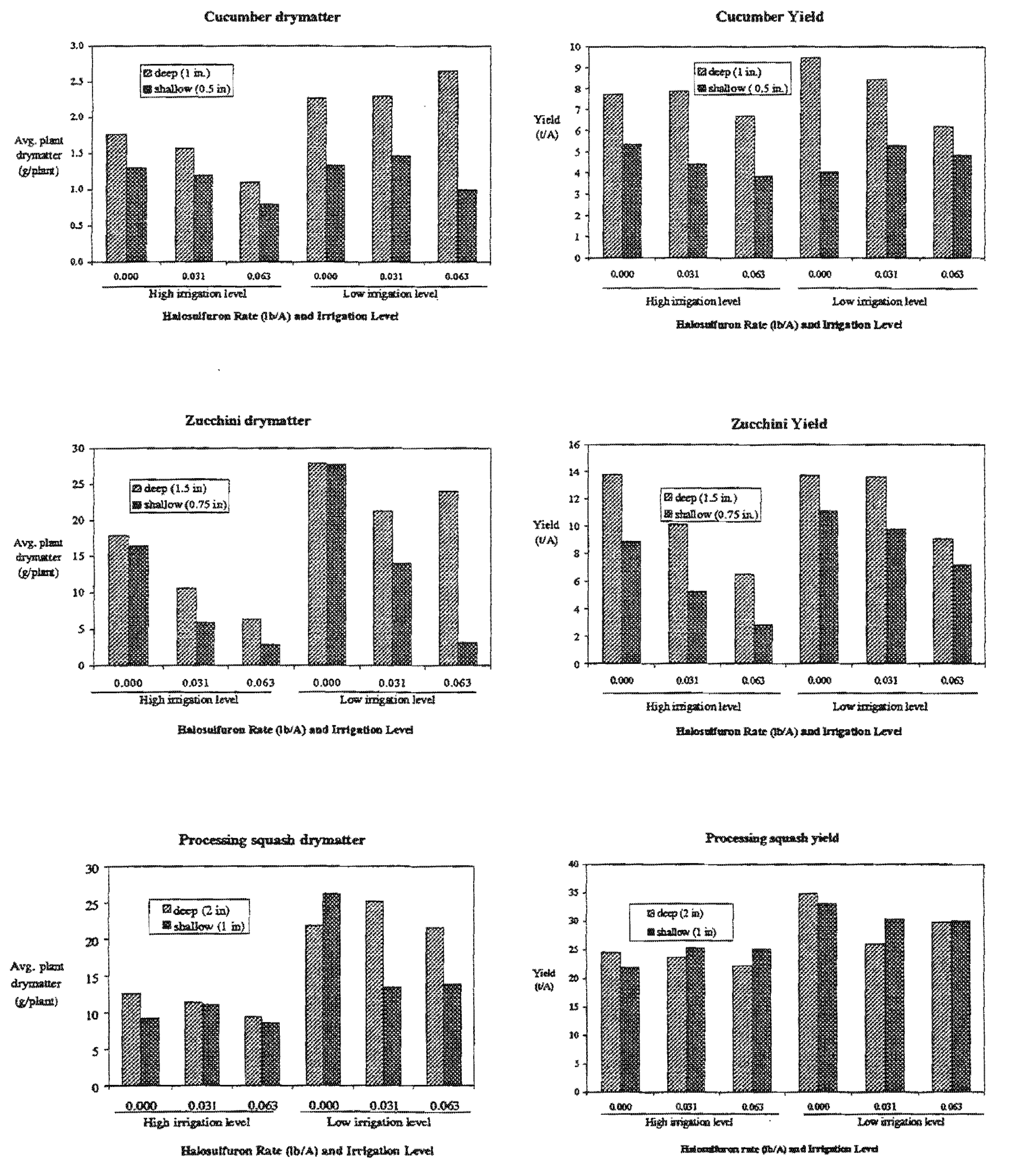

Figure 1. Effect of irrigation, planting depth, and halosulfuron rate on cucumber, zucchini and winter processing squash drymatter yield (5 WAP) and crop yield.

Effect of halosulfuron application timing and rate on cucurbit growth and yield. R. Edward Peachey and Robert McReynolds. (Department of Horticulture and NWREC, Oregon State University, Corvallis OR 97330) The objective of this experiment was to determine the effect of herbicide application timing on cucumber, zucchini, and winter processing squash tolerance to halosulfuron. The soil type was a silt loam soil with pH of 6.7, CEC of 21.3, and % OM of 4.95. The experimental design was a RCB split plot with main effects of cucurbit type, halosulfuron application timing, and halosulfuron rate. Two rows of cucumbers (var. Elite), zucchini (var. Sunex 9723 F_1), and winter processing squash (*Cucurbita maxima* var. Golden Delicious) were planted in each plot on June 14. Halosulfuron was applied at all timings with a CO_2 backpack sprayer at 0.031 and 0.063 lbs. ai/A in 20 GPA water. Preplant incorporated (PPI) herbicides were applied on June 13 and incorporated with a vertical tine tiller to 2-3 inches. Preemergence (PES) halosulfuron treatments were applied after planting on June 14; postemergence (POST) treatments were applied to one (1-LEAF) and three leaf (3-LEAF) cucurbits on June 30 and July 6, respectively, with non-ionic surfactant at 0.25% v/v. Hand-hoeing and cultivation kept plots nearly weed-free. Emerged seedlings were counted on June 29 from 5 m of row for squash and 2.5 m of row in cucumbers. Crop injury was visually estimated on July 11. A crop cut was taken from one of the two rows in each plot at 5 WAP. Crop biomass was air-dried first then dried at 110 F for 7 days to determine drymatter production. Cucumbers were harvested once, zucchini three times, and winter processing squash once in October.

Cucumber growth 4 weeks after planting was reduced by all treatments except halosulfuron applied PPI at 0.031 lb/A (Table 1). Halosulfuron reduced cucumber yield at both rates when applied PPI or POST, but not when applied PES at 0.031 lb/A (Table 2). Even though halosulfuron reduced yield in some treatments, an analysis of the sequential yield data indicated that a 2-3 day delay in harvest would compensate for lost yield in all treatments except the 1-LEAF application. Zucchini yield was reduced by halosulfuron for all except the 3-LEAF application at 0.031 lb/A (Table 3). Halosulfuron applied PES and 1-LEAF at 0.063 lb/A reduced zucchini yield by as much as 80 percent. Winter processing squash was least affected by halosulfuron (Table 4). Lowest squash yields were recorded with halosulfuron applied PES.

Table 1. Effect of halosulfuron rate and timing on cucurbit growth 4 WAP.

Timing	Rate	Obs.	Cucumbers		Zucchini		Winter processing squash	
			Emergence	Growth reduction	Emergence	Growth reduction	Emergence	Growth reduction
	lbs ai/A		No./8.2 ft	%	No./8.2 ft	%	No./8.2 ft.	%
Check	0	6	29	0	19	0	10	0
PPI	0.031	6	30	0	17	38	10	7
PPI	0.063	6	32	27	17	67	11	20
PES	0.031	6	30	18	13	57	12	5
PES	0.063	6	29	50	16	80	10	27
1 LEAF	0.031	6	-	47	-	58	-	28
1 LEAF	0.063	6	-	52	-	83	-	48
3 LEAF	0.031	6	-	33	-	28	-	15
3 LEAF	0.063	6	-	37	-	30	-	23
LSD $_{(0.05)}$			ns	11	ns	14	ns	14

Table 2. Effects of halosulfuron rate and timing on cucumber yield.

Timing	Rate	Obs.	Yield	Grade (dia. inches)					
				<1"	1-1.5"	1.5-2"	>2"	Crooks	% > 1.5 "
	lb ai/A		T/A	% of total					
Check	0	3	6.0	5	40	32	23	1	55
PPI	0.031	3	4.6	7	46	23	22	2	46
PPI	0.063	3	4.1	5	43	23	20	9	48
PES	0.031	3	5.5	6	45	22	26	1	48
PES	0.063	3	3.6	4	34	29	30	4	61
1 LEAF	0.031	3	1.7	23	56	19	0	2	19
1 LEAF	0.061	3	1.7	17	69	8	2	3	11
3 LEAF	0.031	3	4.2	6	43	33	17	1	50
3 LEAF	0.063	3	3.2	12	53	30	2	3	33
LSD $_{0.05}$			1.9	6	18	15	14	ns	19

Table 3. Effects of halosulfuron on total zucchini yield for three harvests.

Timing	Rate	N	No fruit harvested	Yield (3 harvests)	Grade			Avg. fruit Wt.
	lb ai/A		No./plot	t/A	% 6-8 in.	% 8-10 in.	% > 10 in.	lbs.
Check	0	3	57	9.3	56	39	5	0.61
PPI	0.031	3	37	6.4	54	34	12	0.65
PPI	0.063	3	32	5.0	65	33	2	0.59
PES	0.031	3	26	4.6	58	35	7	0.69
PES	0.063	3	10	1.7	55	29	16	0.63
1 LEAF	0.031	3	27	3.7	85	15	0	0.52
1 LEAF	0.063	3	14	1.9	48	52	0	0.57
3 LEAF	0.031	3	48	8.1	69	30	1	0.63
3 LEAF	0.063	3	37	5.6	72	27	1	0.56
LSD $_{0.05}$			15	2.2	ns	ns	10	ns

Table 4. Effects of halosulfuron rate and timing on winter processing squash yield.

Timing	Rate	Obs.	Count	Yield	Avg. fruit wt
	lb ai/A		No./plot	t/A	lbs.
Check	0	3	26.7	28.0	14.3
PPI	0.031	3	25.3	27.4	15.2
PPI	0.063	3	21.0	26.4	17.2
PES	0.031	3	23.7	23.3	13.2
PES	0.063	3	24.3	25.8	14.7
1 LEAF	0.031	3	23.3	26.3	15.6
1 LEAF	0.063	3	23.7	25.2	15.2
3 LEAF	0.031	3	28.3	29.6	14.3
3 LEAF	0.063	3	25.3	25.6	13.2
LSD (0.05)			ns	ns	ns

Nature of performance of pyridate on broccoli, cabbage and cauliflower. Bob McReynolds and Gina Koskela. (North Willamette Research & Extension Center, Oregon State University, Aurora, OR 97002) This trial was conducted to collect performance and crop safety data to support registration for Pyridate 5EC on broccoli, cabbage and cauliflower. The field was seeded with 'Pirate' broccoli, 'Charmant' cabbage and 'Snow Crown' cauliflower on June 28, 2001. Soil at the site is a Latourell/Quatama loam, pH 6.7. Plots consisted of three rows (one row of each vegetable) that were 20' long by 5.5' wide and arranged in a randomized complete block design with four replications. Treatments were applied using a CO_2 backpack sprayer equipped with a three-nozzle (TeeJet 8002 flat fan) boom. Pressure was set at 40 psi delivering the equivalent of 40 gallons of water per acre. No spreader sticker was added to any treatment. Both untreated and weeded control plots were included for comparison. Plots were fertilized and irrigated as per standard horticultural practices. The grower standard pre-emerge treatment (napropamide), was applied one day after planting on June 29 then irrigated for incorporation. Post-emergent treatments were applied when crop was at the two-leaf stage on July 18. Treatments were re-applied July 19 because crops were irrigated shortly after herbicide application.

Efficacy and phytotoxicity evaluations were made July 30, (11 DAT) and August 7 (19 DAT). Efficacy evaluations were rated: 0 = no weed control; 10 = excellent weed control. Phytotoxicity evaluations were rated separately for each vegetable. Phytotoxicity was rated: 0 = no injury to crop; 10 = all plants dead. Weed counts were taken August 6 by counting all weeds present in a 5' by 5' area from the middle of each plot. Plant density was determined by counting the total number of plants for each vegetable in a 10' length of row. Total above ground plant weight of all plants in a 10' length of row was recorded on August 14. Average plant weight was determined by dividing total above ground plant weight by plant density.

All treatments had significantly fewer weeds than the napropamide treated and untreated control plots. Weeds present included mostly pigweed, groundsel and some purslane. The phytotoxic effects of pyridate applied at the 0.94 and 1.88 lb/A reduced growth of broccoli, cabbage and cauliflower.

Broccoli: Pyridate applied at 1.88 lb/A reduced average plant weight compared to all other treatments. Pyridate applied at 0.47 and 0.94 lb/A reduced average plant weight compared to the napropamide check treatment.
Cabbage: Although there were no significant differences in average plant weight, the 0.94 and 1.88 lb/A rate of pyridate resulted in lower total plant weight than the pyridate + clopyralid treated, napropamide treated, and weeded control plots. The combination of pyridate + clopyralid resulted in significantly greater total plant weight than the 0.94 and 1.88 rate of pyridate.
Cauliflower: The 0.94 and 1.88 lb/A rate of pyridate resulted in significantly lower average plant weight than all other treatments. The weeded control resulted in significantly greater total plant weight than all other plots.

Table. Performance data for pyridate on broccoli, cabbage and cauliflower.

Treatments	Rate	Efficacy	Weed Count[a]	Phytotoxicty Broc[b]	Cab[b]	Cauli[b]	Total plant weight Broc	Cab	Cauli	Average plant weight Broc	Cab	Cauli
	Lb/A						kg	kg	kg	g	g	g
UTC		0.00	73.00	0.00	0.00	0.00	2.06	3.41	2.39	131.49	142.88	85.47
Pyridate	0.47	8.75	4.00	4.75	1.25	2.75	0.95	4.92	2.26	85.02	193.62	77.77
Pyridate	0.94	9.50	0.50	7.25	4.50	7.00	0.88	3.31	0.84	81.46	153.50	37.58
Pyridate	1.88	9.50	0.75	8.75	6.75	8.00	0.27	2.10	0.98	23.38	02.54	39.86
Pyridate + Clopyralid	0.47 + 0.009	8.75	0.75	2.75	1.00	2.75	1.98	5.03	2.76	128.92	180.07	100.50
Napropamide	2.00	5.25	38.25	0.75	0.25	1.00	2.05	4.10	2.91	141.48	159.50	100.96
Weeded Control		10.00	0.00	0.00	0.00	0.00	2.02	4.37	3.37	109.51	176.32	131.93
LSD $P \leq 0.05$			22.43				1.02	1.63	1.41	51.78	NS	30.73

[a]Data were analyzed using analysis of variance and means compared using Fisher's LSD.

[b]Broc = broccoli; cab = cabbage; cauli = cauliflower

Nature of performance of clopyralid on bok choy, napa cabbage, collard and kohlrabi. (Bob McReynolds and Gina Koskela. (North Willamette Research & Extension Center, Oregon State University, Aurora, OR 97002) This trial was conducted at the North Willamette Research & Extension Center near Aurora, OR to collect performance and crop safety data for clopyralid on bok choy, napa cabbage, collard and kohlrabi. The field was seeded with bok choy variety 'Joi Choi' (SeedWay Lot #208482-00-03), chinese cabbage 'Michihli' (Rispens Seeds Lot #10840), collard 'Vates' (SeedWay Lot #30345) and kohlrabi 'Early Purple Vienna' (SeedWay Lot #5035004) on June 28, 2001. Soil at the site is a Latourell/Quatama loam, pH 6.7. Plots consisted of four rows (one row of each vegetable) that were 20' long by 5.5' wide and arranged in a complete randomized block design with four replications. Treatments were applied using a CO_2 backpack sprayer equipped with a 3-nozzle (TeeJet 8002 flat fan) boom. Pressure was set at 40 psi delivering the equivalent of 40 gallons of water per acre. No spreader sticker was added to any treatment. Both untreated and weeded control plots were included for comparison. Plots were fertilized and irrigated as per standard horticultural practices. The grower standard pre-emerge treatment, napropamide, was applied one day after planting on June 29 and irrigated for incorporation. Post-emerge treatments were applied when crop was at the 2-leaf stage on July 18. Treatments were re-applied July 19 because of an irrigation event immediately after application.

Efficacy and phytotoxicity evaluations were made July 30, (11 DAT) and August 7 (19 DAT). Efficacy evaluations were rated: 0 = no weed control; 10 = excellent weed control. Phytotoxicity evaluations were rated separately for each vegetable. Phytotoxicity was rated: 0 = no injury to crop; 10 = all plants dead. Weed counts were taken August 2 by counting all weeds present in a 5' by 5' area from middle of plot. Plant density was determined by counting the total number of plants for each vegetable in a 10' length of row. Total above ground plant weight was collected on August 14. Average plant weight was determined by dividing total plant weight by plant density.

All treatments had significantly fewer weeds than the untreated control plots. Although the half rate of clopyralid had fewer weeds than the untreated control plots, it was not effective at controlling emerged weeds. Weeds present included mostly pigweed, groundsel and purslane. Clopyralid treatments resulted in little phytotoxicity to any of the brassica crops. The combination of clopyralid + pyridate was phytotoxic to all vegetables, especially the bok choy, whose leaves were severely bronzed.
Bok choy: The combination of clopyralid + pyridate resulted in significantly lower total plant weight and lower average plant weight than all other treatments.
Napa: Although there was significance in total plant weight, with the clopyralid + pyridate treatment resulting in higher total plant weight, there was no significance among any of the treatments when looking at average plant weight.
Collard: The clopyralid + pyridate treated plots resulted in significantly less total plant weight than the half rate of clopyralid treated plots. There were no significant differences among any of the treatments for average plant weight.
Kohlrabi: There were no significant differences among any treatments as regards to total plant weight or average plant weight.

Table. Performance data for clopyralid on bok choy, napa cabbage, collard and kohlrabi.

Treatments	Rate	Eff[a]	Weed Count[b]	Phytotoxcity				Total plant weight				Average plant weight			
				Bok choy	Napa	Coll[c]	Kohl	Bok choy	Napa	Coll	Kohl	Bok choy	Napa	Coll	Kohl
	Lb/A							kg	kg	kg	kg	g	g	g	g
UTC		0.00	60.50	0.00	0.00	0.00	0.00	10.29	1.41	5.94	2.38	367.16	44.19	180.94	65.42
Clopyralid	0.094	5.75	13.00	2.00	1.50	1.50	1.25	8.38	1.85	6.31	2.44	301.89	82.65	198.68	95.91
Clopyralid	0.188	8.25	7.75	0.25	0.50	0.25	0.50	10.65	1.56	6.01	2.79	337.21	72.16	210.73	106.20
Clopyralid	0.375	8.50	3.75	0.50	1.00	0.25	0.25	9.91	2.07	5.75	2.97	393.65	85.29	263.21	104.70
Clopyralid +pyridate	0.094 +0.47	8.25	1.00	6.75	5.75	5.75	6.00	3.67	3.10	3.26	2.23	95.92	87.10	137.67	70.94
Napropamide	2.00	7.00	14.75	0.00	0.00	0.25	0.00	8.99	1.76	4.33	2.17	286.74	109.03	244.81	82.41
Weeded		10.00	0.00	0.00	0.00	0.00	0.00	10.30	2.38	5.36	3.05	435.26	96.02	245.26	92.31
LSD $P \leq 0.05$			31.82					3.97	0.67	2.98	NS	145.89	NS	NS	NS

[a] Eff = Efficacy. [b] Data were analyzed using analysis of variance and means compared using Fisher's LSD. [c]coll = collard, kohl = kohlrabi.

Nature of performance of dimethenamid on garden beet. Bob McReynolds and Gina Koskela. (North Willamette Research & Extension Center, Oregon State University, Aurora, OR 97002) This trial was conducted to determine if the new formulation of dimethenamid (dimethenamid-p) had similar efficacy and phototoxicity as the formulation that was recently approved for registration (dimenthenamid-s). The field was seeded with 'Detroit Dark Red' beets on July 19, 2001. Plots consisted of four rows that were 20' long by 5.5' wide and arranged in a complete randomized block design with four replications. Soil at the site is a Latourell/Quatama loam, pH 6.7. Treatments were applied using a CO_2 backpack sprayer equipped with a three-nozzle (TeeJet 8002 flat fan) boom. Pressure was set at 40 psi delivering the equivalent of 40 gallons of water per acre. No spreader sticker was added to any treatment. The chemical standard, cycloate, an untreated control and weeded control plots were included for comparison. Plots were fertilized and irrigated per standard horticultural practices. Pre-emerge treatments were applied one day after planting on July 20 and irrigated to incorporate. Post-emerge treatments were applied when beets were at the two-leaf stage on August 9.

Efficacy and phytotoxicity evaluations were made July 27 and August 16. Efficacy evaluations were rated: 0 = no weed control; 10 = excellent weed control. Phytotoxicity evaluations were rated: 0 = no injury to crop; 10 = all plants dead. Weed counts were taken August 16 by counting all weeds present in a 5' by 5' area from the middle of plot. Plant density counts were also taken August 16 by counting the total number of plants in a 10' length of the center two rows. Whole plant weight of the plants in a 10' length of the center two rows was recorded when beets reached a marketable size on September 19.

The pre-emerge applications of dimethenamid effectively controlled weeds present (mainly pigweed, groundsel, purslane), but were phytotoxic to the beet crop. Dimethenamid applied pre-emergence at 1.32 lb/A delayed emergence and reduced stand count and yield. Post-emerge applications did not effectively control weeds present. Although post-emerge treatments were not phytotoxic, weed competition resulted in unacceptable yield reduction.

Table. Performance data for dimethenamid on garden beet.

Treatments	Rate	Efficacy	Phyto-toxicity	Weed count	Plant density	Whole plant wt
	Lb/A					kg
UTC		0.00	0.00	135.25	22.00	0.48
Dimethenamid-p pre	0.33	9.58	6.25	6.50	23.00	0.99
Dimethenamid-p pre	0.66	9.75	8.50	0.25	18.25	0.77
Dimethenamid-p pre	1.32	9.98	9.58	1.50	7.75	0.13
Dimethenamid-p pos	0.66	4.25	0.00	126.00	27.00	0.78
Dimethenamid-p pos	1.32	5.00	0.25	185.75	27.75	0.84
Cycloate pre	3.70	7.00	1.25	35.75	32.75	1.51
Weeded control		10.00	0.00	94.50	31.00	1.03
LSD $P \leq 0.05$[a]				79.20	9.15	0.59

[a] Data were analyzed using analysis of variance and means compared using Fisher's LSD

Evaluation of new herbicides for use in second year strawberries (renovation through second year harvest). Diane Kaufman, Joe DeFrancesco, Gina Koskela, Ed Peachey. (North Willamette Research and Extension Center, Oregon State University, 15210 NEMiley Rd., Aurora, OR 97002). Two field trials were established at the North Willamette Research and Extension Center (NWREC) on a Quatama loam soil with 4.5% organic matter. Herbicides were applied using a CO2 backpack sprayer equipped with a 4-nozzle boom (TeeJet 8002, flat fan) at 40 psi and a rate of 20 gallons of water per acre.

1. Renovation and Winter Timing Trial. 'Totem' strawberries were planted on raised beds on May 13, 1999. Plots four rows wide and 30 feet long were arranged in a randomized complete block design with four replications. During the first year of this trial, herbicides were applied May 15, 1999 and January 29, 2000. First year yield data was recorded during June, 2000 and there were no differences among treatments in total marketable yield or fruit size (see report in WSWS Proceedings, 2001). Because strawberry plantings in Oregon are usually harvested for 2 or 3 years, it was necessary to continue the trial to 1. observe how well the various herbicides would control weeds in the second year when there is a shift from annual to perennial weeds and 2. learn if any of the herbicides evaluated would damage mother or daughter plants during renovation or damage plants or delay spring growth when applied in winter. All plots were renovated (eg. rows mowed, narrowed, fertilized) in early July. Herbicides were applied on July 10, 2000 and followed immediately with one inch of irrigation. Flumioxazin was the only herbicide to cause a reddening of strawberry plant leaves and a burn on small runner plants.

Table 1. Herbicides applied at renovation and quality of weed control 70DAT (9/26/00).

Treatment	Rate lbai/A	Broadleaf annual weeds[a]	Crabgrass[a]	Overall annual weed control[a]	Number of dandelions/plot
Azafenidin	0.2	100	100	100	1.25
Dimethenamid	1.0	90	100	95	2.25
Fluamide+Sulfent-razone	0.25+0.125	99.2	100	98.8	1.25
Fluamide+Isoxa-ben	0.25+0.75	95.8	97.5	94.8	1.5
Flumioxazin	0.0625	93.3	77.5	91	1.5
Oxyfluorfen	0.2	97.5	100	99.5	1.0
Sulfentrazone	0.125	99.2	65	90	2.0
Thiazopyr	0.5	97.1	100	98.5	1.5
Significance		0.0275	0.0581	0.0159	0.0226
LSD 0.05		5.7		6.2	0.68

[a] percent weed control based on visual estimates compared to weedy check.

Redroot pigweed, annual sowthistle, common groundsel, crabgrass, false and common dandelion and clover were the main weeds present on 9/26. All herbicides provided excellent (90% or greater) control of broadleaf weeds, however, dimethenamid was not as impressive as the other herbicides against annual broadleaf weeds. Although only significant at P= 0.06, there was a trend for poorer crabgrass control with flumioxazin and sulfentrazone. All herbicides provided 90% or greater overall weed control on 9/26, however flumioxazin and sulfentrazone were not as impressive as other treatments due to crabgrass pressure. There were more dandelion plants in plots treated with dimethenamid and sulfentrazone than in plots treated with azafenidin, oxyfluorfen, or fluamide+sulfentrazone..

Weed pressure continued to be very low during the fall of 2000 and winter-spring of 2001 due to abnormally low amounts of rainfall. The winter herbicide applications were made on January 29, 2001.

Table 2. Herbicides applied in winter and quality of weed control 76 DAT (4/16/01).

Treatment	Rate lb ai/A	Percent overall weed control-annuals and perennials	Number of dandelions
Azafenidin	0.2	100	0
Dimethenamid	1.25	77.5	7.75
Fluamide+Sulfentrazone	0.25 + 0.1875	93.5	2.75
Fluamide+Isoxaben	0.25 + 1.0	93.2	1.75
Flumioxazin	0.0625	93.8	2.25
Oxyfluorfen	0.2	99.8	0
Sulfentrazone	0.25	85	4
Thiazopyr	0.25	92.8	2
Significance		0.0002	0.0000
LSD 0.05		8.1	2.39

With the exception of dimethenamid and sulfentrazone, all herbicides provided excellent overall weed control through harvest. The predominant weeds in plots treated with dimethenamid and sulfentrazone were common and false dandelion. In an attempt to discover how many new dandelion plants would emerge from seed, established plants were killed with clopyralid immediately following the evaluations on 4/16/01. There were no differences among treatments in the number of seedling dandelions recorded in late May (data not shown).

Fruit was harvested two times between June 6 and June 20, 2001. There were no differences among treatments in second year total marketable yield or adjusted berry size. Mean total marketable yield for five feet of row was 5.14 lbs and mean berry size was 8.97 grams.

2. Fall Timing Trial. This planting was also established on raised beds at NWREC on May 13, 1999; however, it was used to evaluate herbicide treatments made in fall. As in Trial 1, there were no differences among treatments in first-year yields or berry size. All plots were renovated in early July. Weeds were controlled by hand until September 29, 2000 when treatments were applied. The purpose of this trial was to simulate the traditional fall herbicide application program designed for use of simazine. In this program, growers control weeds and strawberry runner plants with cultivation from renovation until late fall when simazine is applied. Percent overall weed control was evaluated on 3/15, 4/16, and 5/21/01.

Table 3. Percent overall weed control (annuals and perennials) and number of dandelion plants on 3 dates, spring, 2001.

Treatment	Weed control 3/15/01	Weed control 4/16/01	Weed control 5/21/01	Number of dandelions 3/15	Number of dandelions 4/16	Number of dandelions 5/21[a]
Azafenidin	99.8	99.2	98.2	0.25	0.5	1.25
Dimethenamid	91.2	67.5	83.8	6.75	7.75	1.25
Fluamide+Isox	97.8	91.2	81.8	2.0	1.75	1.75
Fluamide+Sulfen	97	91.2	87.8	2.25	2.5	1.25
Isoxaben	94	79.2	75	2.75	3.5	2.5
Simazine	97.8	93.2	93	1.25	2.25	1
Sulfentrazone	94	84.2	81.2	4.5	5.25	4.25
Thiazopyr	96.8	87.5	92	2.5	3.25	0.25
Hand weeded						3
Weedy						2.46
Significance	0.0017	0.0002	ns	0.0005	0.0024	ns
LSD 0.05	3.5	10.5		2.68	2.98	

[a] Number of dandelion plants present after established dandelions were killed on 4/17/01 with clopyralid.

Despite abnormally dry conditions fall, 2000 to spring, 2001, weed pressure was moderate by March. Primary weeds present were annual bluegrass, pineappleweed, and common and false dandelion. Azafenidin provided the most consistent weed control during the spring of 2001. Azafenidin, Simazine and the mixtures of fluamide+isoxaben and fluamide+sulfentrazone were the only treatments providing excellent overall weed control through mid-April. Plots treated with dimethenamid had the greatest number of dandelions in March and April, followed by sulfentrazone. There were no differences in number of new dandelion plants present one month after killing existing dandelions with clopyralid.

Fruit was harvested two times between June 6 and June 20, 2001. There were no differences among treatments in second year yields or fruit size. Mean marketable yield was 4.28 lbs per five feet of row and mean berry size was 9.5 grams.

Based on these results, all herbicides evaluated in the second year of this trial would have potential for use in second year strawberries in Oregon. However, control of dandelions may be poorer with sulfentrazone and dimethenamid than with previous chemical standards of oxyfluorfen (establishment/renovation/winter timings) and simazine (fall timing).

PROJECT 3: WEEDS OF AGRONOMIC CROPS

Brian Jenks, Chair

Grass and broadleaf weed control with imazamox in seedling alfalfa. John O. Evans, J. Earl Creech, and R. William Mace. (Department of Plants, Soils and Biometeorology, Utah State University, Logan, Utah 84322-4820) A planting of seedling alfalfa in North Logan, UT, was treated with two rates of imazamox mixed with three different types of surfactants. These were applied alone and in combination with sethoxydim to evaluate their efficacy for controlling green foxtail (SETVI) and common lambsquarters (CHEAL). Clethodim was applied with crop oil alone. Individual treatments were applied to 10 by 30 foot plots with a CO_2 backpack sprayer using flatfan Tjet 015 nozzles providing a 10 foot spray width calibrated to deliver 25 gpa at 39 psi. The soil was a millville loam with 7.9 pH and O.M. content of less than 3%. Treatments were applied postemergence April 21,2001 in a randomized block design, using three replications. Alfalfa was 2 to 6 inches in height at application time with at least three trifoliate leaves. Green foxtail and common lambsquarters were 1 to 4 inches high at the time of application.

Imazamox (0.048 lb ai/A) showed some injury to alfalfa when combined with MSO. When combined with COC and sethoxydim imazamox injured seedling alfalfa at 0.032lb ai/A. Both treatments exhibited excellent control of common lambsquarters and green foxtail. Imazamox was ineffective in controlling common lambsquarters when mixed with crop oil concentrate but gave adequate control of green foxtail. Clethodim stopped green foxtail competition but had no effect on broadleaf weeds. Sethoxydim did not enhance imazamox efficacy for common lambsquarters or green foxtail. Imazamox at 0.048 lb ai/A with NIS surfactant was the best treatment for controlling both common lambsquarters and green foxtail but resulted in a slightly lower alfalfa yield. Yields were not significantly different among treatments except for the control.

Table 1. Grass and broadleaf weed control in seedling alfalfa North Logan, UT.

		Alfalfa			Weed control			
		Injury		Yield	CHEAL		SETVI	
Treatment[a]	Rate	5/5	6/29	7/5	5/5	6/29	5/5	6/29
	lb ai/A	%		T/A	%			
Imazamox[a]	0.032	0	0	2.7	68.3	98.3	80	83.3
Imazamox[b]	0.032	0	0	2.5	33.3	0	78.3	78.3
Imazamox[c]	0.032	0	0	2.5	76.7	98.3	90	90
Imazamox[a]	0.048	0	0	2.4	68.3	100	81.7	86.7
Imazamox[b]	0.048	0	0	2.7	66.7	0	90	86.7
Imazamox[c]	0.048	6.7	6.7	2.6	81.7	100	90	93.3
Imazamox[b] + sethoxydim	0.032+0.281	0	0	2.5	83.3	98.3	90	83.3
Imazamox[c] + sethoxydim	0.032+0.281	6.7	0	2.6	81.7	100	88.3	85
Clethodim	0.25	0	0	2.7	0	0	81.7	86.7
check		0	0	1.7	0	0	0	0
$LSD_{(0.05)}$		2.3	1.6	0.6	22.5	2.7	10.6	8.3

[a] Nonionic surfactant applied at 0.25% v/v and N at 1qt/A.

[b] Crop oil concentrate applied at 1% v/v and N at 1qt/A.

[c] Methylated seed oil applied at 1% v/v and N at 1qt/A.

Broadleaf weed control in spring-seeded alfalfa. Richard N. Arnold, Michael K. O'Neill and Dan Smeal. (New Mexico State University Agricultural Science Center, Farmington, NM 87499) Research plots were established on May 16, 2001 at the Agricultural Science Center, Farmington, New Mexico to evaluate the response of spring-seeded alfalfa (var. Legend) and annual broadleaf weeds to postemergence application of imazamox and imazethapyr applied 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 12 when alfalfa was in the second trifoliolate leaf stage and weeds were small. Black nightshade, redroot and prostrate pigweed, and common lambsquarters infestations were heavy and Russian thistle infestations were light throughout the experimental area. Plots were evaluated on July 12. Alfalfa was harvested on August 20, using a self-propelled Almaco plot harvester.

No crop injury was observed in any of the treatments. Bromoxynil plus clethodim applied at 0.25 plus 0.094 lb/A gave poor control of redroot and prostrate pigweed and black nightshade. Russian thistle and common lambsquarters control were good to excellent with all treatments except the check. The weedy check and bromoxynil plus clethodim applied at 0.25 plus 0.094 lb/A had significantly higher yields as compared to other treatments. This is possibly attributed to the high weed content when harvested.

Table. Broadleaf weed control in spring-seeded alfalfa.

Treatments[a]	Rate	Weed control					Alfalfa
		AMABL	AMARE	SOLNI	SASKR	CHEAL	yield
	lb/A	%					t/A
Imazamox	0.032	100	100	100	100	100	2.1
Imazamox	0.047	100	100	100	100	100	2.1
Imazamox + bromoxynil	0.032+0.25	100	98	98	100	100	2.2
Imazamox + bromoxynil	0.04+0.25	100	98	100	100	100	2.0
Imazamox + bromoxynil	0.047+0.25	100	97	100	100	100	2.2
Imazamox + 2,4-DB	0.032+0.5	100	100	100	100	100	2.2
Imazamox + 2,4-DB	0.04+0.5	100	100	100	100	100	2.0
Imazamox + 2,4-DB	0.047+0.5	100	100	100	97	100	2.2
Imazethapyr + bromoxynil	0.064+0.25	100	97	100	100	100	2.1
Imazethapyr + 2,4-DB	0.064+0.05	100	98	100	100	100	2.2
Imazethapyr	0.064	100	100	100	100	98	2.1
Imazamox + clethodim	0.032+0.094	100	100	100	100	100	2.1
Imazamox + clethodim	0.04+0.094	100	100	100	100	100	2.3
Imazethapyr + clethodim	0.064+0.094	100	98	100	100	98	2.1
Bromoxynil + clethodim	0.25+0.094	10	10	10	100	100	3.1
Weedy check		0	0	0	0	0	3.5
LSD 0.05		1	3	1	2	1	0.7

[a] Treatments were applied with a COC and AMS at 1.0% and 2.5% v/v.

The effect of fenoxaprop in combination with adjuvants and broadleaf herbicides on spring barley. Lori J. Crumley and Donn C. Thill (Plant Science Division, University of Idaho, Moscow, ID 83843-2239) A study was established east of Moscow to determine the effect of fenoxaprop/mefenpyr diethyl (safener) combined with broadleaf herbicides and adjuvants on 'Baronesse' spring barley. The experimental design was a randomized complete block with four replications. Individual plots were 8 by 30 ft. Herbicide treatments were applied with a CO_2 pressurized backpack sprayer calibrated to deliver 10 gpa at 30 psi (Table 1). Injury was evaluated visually on June 6, 15, and 21, 2001. Barley was harvested with a small plot combine from a 4.1 by 28 ft. area in each plot on August 15, 2001.

Table 1. Soil and application data.

Location	Moscow
Application date	May 31, 2001
Application timing	4 to 5 leaf
Air temp (F)	68
Relative humidity (%)	62
Wind (mph)	2 to 5
Soil temperature at 2 in (F)	55
pH	4.8
OM (%)	4.2
CEC (meq/100g)	24
Texture	Silt loam

Barley injury ranged from 8 to 13% on June 6 and 0 to 5% on June 15. On June 21, injury was not observed in any treatment. Grain yield in treated plots did not differ from the untreated control.

Table 2. The effect of herbicide treatments on barley injury and grain yield near Moscow, ID in 2001.

Treatment[a]	Rate	Injury June 6	Injury June 15	Yield
	lb/A	%		lb/A
Fenoxaprop[b]	0.083	10	5	4980
Fenoxaprop + Herbimax	0.083 + 5% v/v	10	5	4930
Fenoxaprop + Herbimax	0.083 + 1% v/v	10	5	5040
Fenoxaprop + Herbimax	0.083 + 1.5% v/v	10	4	4670
Fenoxaprop +Score	0.083 + 1% v/v	13	4	4900
Fenoxaprop + brom/MCPA[c]	0.083 + 0.5	10	5	5190
Fenoxaprop + brom/MCPA	0.083 + 0.5	10	5	5030
Fenoxaprop + brom/MCPA + Herbimax	0.083 + 0.5 + 5% v/v	8	3	5140
Fenoxaprop + brom/MCPA + Herbimax	0.083 + 0.5 + 1% v/v	8	3	4720
Fenoxaprop + brom/MCPA + Herbimax	0.083 + 0.51 + 5% v/v	10	4	4530
Fenoxaprop + brom/MCPA + Score	0.083 + 0.5 + 1% v/v	8	4	5020
Fenoxaprop + thifensulf/triben[d] + MCPA[e] + R-11	0.083 + 0.0188 + 0.0266 + 0.25% v/v	10	4	5280
Tralkoxydim + Supercharge	0.18 + 0.5% v/v	13	1	5040
Tralkoxydim + bromoxynil + Supercharge	0.18 + 0.5 + 0.5% v/v	10	0	5200
Untreated control	—	--	--	4980
LSD (0.05)		4	3	NS

[a] Herbimax and Score are crop oil concentrates (COC). R-11 is a nonionic surfactant (NIS). Supercharge is a COC/NIS blend.
[b] Fenoxaprop/mefenpyr diethyl (safener).
[c] Brom/MCPA is the commercial formualtion of bromoxynil/MCPA and is formulated as a 5 EC in this treatment, otherwise as a 4 EC.
[d] Thifen/triben is the commercial formulation of thifensulfuron + tribenuron.
[e] MCPA ester formulation, rate in lb ae/A.

Barley variety tolerance to fenoxaprop. Lori J. Crumley and Donald C. Thill. (Plant Science Division, University of Idaho, Moscow, ID 83844-2239) Two studies were established to evaluate susceptibility of 20 barley varieties to fenoxaprop plus mefenpyr diethyl (safener) applied at two rates, 0.093 and 0.186 kg/ha. The studies were located near Moscow and Nezperce, Idaho. The experimental design was a randomized split-plot factorial with barley varieties as main plots and herbicide rates as subplots with four replications. Main plots were 1.5 by 18.3 m and subplots were 2 by 6.1 m. Fenoxaprop was applied with a CO_2 pressurized backpack sprayer calibrated to deliver 94 L/ha at 276 kPa (Table 1). Injury was evaluated visually on June 25 and 29, 2001 at Moscow and June 8 and 14, 2001 at Nezperce. Barley was harvested with a small plot combine on August 23, 2001 at Moscow and September 26, 2001 at Nezperce.

Table 1. Soil and application data.

Location	Moscow	Nezperce
Application date	June 18	May 31
Application timing	4 to 5 leaf	4 to 5 leaf
Air temp (C)	21	22
Relative humidity (%)	40	58
Wind (kph)	2 to 3	3
Soil temperature at 5 cm (C)	13	12
pH	4.7	5
OM (%)	4.8	5.4
CEC (meq/100g)	36	31
Texture	loam	Silt loam

There was no variety by herbicide rate interaction (data not shown). Barley injury did not differ between herbicide rates (data not shown). The most sensitive variety at Moscow on both evaluation dates was Gallatin with 10 and 15% injury (Table). At Nezperce the most sensitive varieties were Galena, Gallatin, Baronesse, and Tango, with an average injury of 14% over the two evaluation dates. Stander was the most tolerant variety at Moscow with 0% injury on June 25 and 1% on June 29. The most tolerant variety at Nezperce was Colter with 6% injury on June 8 and 3% on June 14. Barley yield ranged from 2460 to 4180 kg/ha at Moscow and 2710 to 4350 kg/ha at Nezperce. The lowest yielding variety at Moscow was Bear (2460 kg/ha), and Tango (2710 kg/ha) was lowest at Nezperce. Xena was the highest yielding barley variety at both locations (4180 kg/ha at Moscow and 4350 kg/ha at Nezperce). Barley yield did not differ among herbicide rates (data not shown).

Table 2. Barley injury and grain yield of 20 barley varieties pooled over herbicide treatments in 2001.

			Moscow			Nezperce		
			Injury			Injury		
Variety	Market Class	Head Type	June 25	June 29	Yield	June 8	June 14	Yield
		row	——%——		kg/ha	——%——		kg/ha
B-1202	Malt	2	4	6	3130	10	4	3620
Chinook	Malt	2	9	8	3210	14	6	3360
Crystal	Malt	2	8	11	3190	14	4	3620
Galena	Malt	2	9	9	3150	19	9	3320
Harington	Malt	2	6	8	3590	13	6	3890
Klages	Malt	2	9	13	3100	14	6	3410
Bancroft	Feed	2	5	2	3500	16	3	3800
Baronesse	Feed	2	6	5	3830	19	6	3400
Camas	Feed	2	8	9	3600	15	4	3580
Gallatin	Feed	2	10	15	3250	19	9	3850
Orca	Feed	2	8	10	3160	14	7	2920
Xena	Feed	2	5	6	4180	15	6	4350
Bear	Hulless Feed	2	7	11	2460	14	1	2990
B-2601	Malt	6	3	3	3030	9	6	2940
Morex	Malt	6	3	2	3550	12	6	3670
Stander	Malt	6	0	1	3430	15	6	3400
Colter	Feed	6	4	1	3410	6	3	3380
Maranna	Feed	6	1	4	3540	9	6	3460
Steptoe	Feed	6	6	14	3540	16	6	3550
Tango	Feed	6	7	14	3060	20	8	2710
LSD (0.05)			4	6	316	7	7	620

Wild oat control in spring barley with imazamethabenz and fenoxaprop. Traci A. Rauch and Donald C. Thill. (Plant Science Division, University of Idaho, Moscow, ID 83844-2339) Two studies were established in 'Harrington' spring barley near Porthill, ID to examine wild oat control with sequential applications of imazamethabenz and fenoxaprop combined with different bromoxynil/MCPA formulations. In both experiments, plots were 8 by 30 ft arranged in a randomized complete block design with four replications and included an untreated check. All 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 27, 2001 in both experiments. In both studies, wild oat control was evaluated on June 12 and 27, 2001. Wheat seed was not harvested due to poor wild oat control in both studies.

Table 1. Application and soil data.

Experiment	Fenoxaprop study	Imazamethabenz study		
Application date	May 30, 2001	May 11, 2001	May 23, 2001	May 30, 2001
Spring barley growth stage	2 to 3 tiller	1 leaf	1 to 2 tiller	2 to 3 tiller
Wild oat growth stage	4 to 5 leaf	1 leaf	2 to 4 leaf	4 to 5 leaf
Air temperature (F)	61	56	88	61
Relative humidity (%)	49	60	35	49
Wind (mph, direction)	3, S	2, SW	2, S	3, S
Cloud cover (%)	90	90	40	90
Soil temperature at 2 in (F)	50	50	65	50
pH	5.3			
OM (%)	20			
CEC (meq/100g)	49			
Texture	loam			

In the imazamethabenz study, all treatments injured spring barley 0 to 2% (Table 2). Wild oat control ranged from 11 to 24% on June 12. On June 27, both rates of sequential applications of imazamethabenz controlled wild oat better than a single application of imazamethabenz at 0.41 lb/A. No treatment adequately controlled wild oat at either evaluation date (11 to 41%).

In the fenoxaprop study, spring barley injury ranged from 0 to 2% (Table 3). Bromoxynil/MCPA formulation did not affect wild oat control with fenoxaprop; however, no treatment adequately controlled wild oat at either evaluation date (25 to 42%).

Table 2. Spring barley injury and wild oat control with sequential applications of imazamethabenz near Porthill, Idaho in 2001.

Treatment[a]	Rate	Application timing[b]	Barley injury	Wild oat control June 12	Wild oat control June 27
	lb/A		---%---		
Imazamethabenz + imazamethabenz	0.103 + 0.103	1 leaf + 4 to 5 leaf	2	11	41
Imazamethabenz + imazamethabenz	0.205 + 0.205	1 leaf + 4 to 5 leaf	1	15	39
Imazamethabenz	0.205	2 to 4 leaf	0	20	26
Imazamethabenz	0.41	2 to 4 leaf	0	24	18
LSD (0.05)			NS	NS	16
plants/ft^2				91	

[a]A petroleum based crop oil concentrate (Moract) was applied at 1.5 pt/A with all treatments.
[b]Application timing based on wild oat growth stage.

Table 3. Spring barley injury and wild oat control with fenoxaprop plus bromoxynil/MCPA formulations near Porthill, Idaho in 2001.

Treatment	Bromoxynil/MCPA formulation[a]	Rate	Barley injury	Wild oat control June 12	Wild oat control June 27
	lb/gal	lb/A	---%---		
Fenoxaprop	--	0.083	0	34	38
Fenoxaprop + bromoxynil/MCPA	4	0.083 + 0.5	1	29	35
Fenoxaprop + bromoxynil/MCPA	5	0.083 + 0.5	1	26	42
Fenoxaprop + bromoxynil/MCPA	4	0.083 + 0.75	0	28	33
Fenoxaprop + bromoxynil/MCPA	5	0.083 + 0.75	0	28	41
Fenoxaprop + bromoxynil/MCPA + thifensulfuron	4	0.083 + 0.5 + 0.014	0	25	36
Fenoxaprop + bromoxynil/MCPA + thifensulfuron	5	0.083 + 0.5 + 0.014	2	25	38
LSD (0.05)			NS	NS	NS
plants/ft^2				91	

[a]All formulations were emulsifiable concentrates.

Spring barley response to soil persistence of imazamox and other grass herbicides. Traci A. Rauch and Donald C. Thill. (Plant Science Division, University of Idaho, Moscow, ID 83844-2339) Three studies were established to examine spring barley response to soil persistence of imazamox, sulfosulfuron, flucarbazone-sodium, and procarbazone-sodium. In all experiments, plots were 16 by 30 ft arranged in a randomized complete block design with four replications. All herbicide treatments were applied in 1999 and 2000 using a CO_2 pressurized backpack sprayer calibrated to deliver 10 gpa at 30 psi and 3 mph (Table 1). Experiments one and two were seeded to 'Camas' spring barley on April 24, 2001 and experiment three to 'Harrington' spring barley on April 25, 2001. Experiments one, two, and three were oversprayed with thifensulfuron/tribenuron at 0.016 lb/A on May 30, 2001, tralkoxydim at 0.24 lb/A and fluroxypyr at 0.281 lb ae/A on May 30, 2001, and fenoxaprop at 0.083 lb/A on May 24, 2001, respectively. Barley injury for experiment one was evaluated visually on June 14 and 26, and July 10 2001; experiment two on June 6 and 20, 2001; and experiment three on June 12 and 27 and July 12, 2001. Barley seed was harvested with a small plot combine on August 7 (experiment one), 13 (experiment two), and 16 (experiment three), 2001. Barley test weights will be determined after hand cleaning subsamples from experiments two and three due to wild oat seed contamination.

Table 1. Application and soil data for experiment one, two, and three.

	Experiment one		Experiment two	Experiment three
Location	Moscow, Idaho		Tammany, Idaho	Bonners Ferry, Idaho
Application date	November 18, 1999	April 18, 2000	April 5, 2000	May 16, 2000
Wheat growth stage	1 to 2 leaf	3 to 5 tiller	1 to 2 tiller	3 to 4 leaf
Air temperature (F)	39	61	50	72
Relative humidity (%)	79	58	49	45
Wind (mph, direction)	4, E	2, W	1, SE	4, NE
Cloud cover (%)	0	5	75	30
Soil temperature at 2 in (F)	36	52	44	64
pH	5.2		5.4	7.3
OM (%)	2.7		3.3	10.0
CEC (meq/100g)	20		23	25
Texture	silt loam		silt loam	loam
Primary tillage	moldboard plow		none (no-till)	field cultivator

In experiment one, no treatment visibly injured barley at any evaluation date (data not shown). Barley seed yield and test weight did not differ among treatments or from the untreated check (Table 2).

In experiment two, visual injury ranged from 0 to 8% on June 6, 2001, but did not differ among treatments (Table 3). By June 20, sulfosulfuron at 0.031 lb/A visibly injured barley 15%. Barley seed yield of the untreated check (1524 lb/A), imazamox treatments (1567 and 1579 lb/A), and flucarbazone-sodium at 0.054 lb/A (1509 lb/A) was greater than both sulfosulfuron treatments (808 and 402 lb/A).

In experiment three, no treatment injured barley at any evaluation date (data not shown). Barley seed yield ranged from 1557 to 2187 lb/A and did not different among treatments or from the untreated check (Table 3).

Table 2. The effect of imazamox on barley grain yield and test weight in experiment one near Moscow, Idaho in 2001.

Treatment[a]	Rate	Application timing	Barley Yield	Barley test weight
	lb/A		lb/A	lb/bu
Imazamox	0.04	fall	6346	50
Imazamox	0.08	fall	6108	50
Imazamox	0.04	spring	6346	51
Imazamox	0.08	spring	6216	50
Untreated check	--	--	6369	50
LSD (0.05)			NS	NS

[a]90% nonionic surfactant (R-11) at 0.25% v/v and 32% urea ammonium nitrate at 1.25% v/v were applied with all treatments.

Table 3. The effect of herbicide carryover on barley injury and grain yield near Tammany (experiments two) and Bonners Ferry (experiment three), Idaho in 2001.

		Experiment two[b]			
		Barley injury			Experiment three
Treatment[a]	Rate	June 6	June 20	Barley yield[c]	
	lb/A	--------%--------		----------lb/A----------	
Imazamox	0.04	0	0	1567	2187
Imazamox	0.08	0	0	1579	1835
Sulfosulfuron	0.031	5	15	808	1557
Sulfosulfuron	0.062	3	7	402	1557
Flucarbazone-sodium	0.027	0	2	1269	1970
Flucarbazone-sodium	0.054	2	3	1509	1684
Procarbazone-sodium	0.04	2	5	1276	2111
Procarbazone-sodium	0.08	8	5	1151	2065
Untreated check	--	--	--	1524	1608
LSD (0.05)		NS	7	474	NS

[a]90% nonionic surfactant (R-11) was applied at 0.5% v/v with sulfosulfuron and 0.25% v/v with all other treatments. 32% urea ammonium nitrate was applied at 1 qt/A with all imazamox treatments.
[b]Only three replications were included due to nonuniform wild oat infestation.
[c]Weights include wild oat contamination.

Effect of fenoxaprop application timing on barley injury. Lori J. Crumley and Donald C. Thill (Plant Science Division. University of Idaho, Moscow, ID 83844-2339) A study was established east of Moscow, Idaho to evaluate 'Baronesse' spring barley response to fenoxaprop plus mefenpyr diethyl (safener) applied at six timings. This study was repeated over two years, 2000 and 2001. Data from last year are published in the Western Society of Weed Science 2001 Research Progress Report, page 116. The experimental design was a two by six complete block factorial design plus a control with four replications. Plots were 2.4 by 7.3 m. Fenoxaprop was applied at two rates with a CO_2 pressurized backpack sprayer calibrated to deliver 94 L/ha at 207 kPa (Table 1). Injury was evaluated visually 5 and 15 days after treatment (DAT). Barley height was measured at heading on July 12, 2001. Barley grain was harvested from a 1 by 6 m area in each plot with a small plot combine on August 21, 2001.

Table 1. Soil and application data.

Application date		5/18	5/24	5/29	6/6	6/13	6/18
Application timing		1 leaf	3 leaf	1 to 2 tiller	3 to 4 tiller	4 to 5 tiller	6 tiller
Air temp (C)		17	18	4	13	11	18
Relative humidity (%)		59	57	74	76	77	50
Wind (kph)		2	0	0	0	2	4
Cloud cover (%)		30	30	0	80	99	10
Soil temperature at 5 cm (C)		17	24	9	10	7	13
Dew presence (Y/N)		N	N	N	N	Y	N
pH	4.8						
OM (%)	4.2						
CEC (meq/100 g)	24						
Texture	Silt loam						

Five DAT, both rates of fenoxaprop visibly injured (chlorisis and stunting) one leaf barley plants 31 to 35% and three leaf barley plants 15 to 18% (Table 2). By 22 DAT barley plants treated with either rate of fenoxaprop at the one and three leaf stages had completely recovered (data not shown). Fenoxaprop applied at 0.093 and 0.186 kg/ha to 3 to 4 tiller barley plants caused the most injury (45%) 15 DAT. Barley plants treated at the 3 to 4 and 4 to 5 tiller stage were 9 to 17 % shorter than the untreated control. Barley yield did not differ among treatments or from the untreated check.

Table 2. Effect of fenoxaprop rate and timing on barley injury, height, and yield near Moscow, ID in 2001.

Treatment	Rate	Application timing	Barley injury 5 DAT	Barley injury 15 DAT	Height	Yield
	kg/ha		%	%	cm	kg/ha
Fenoxaprop + safener	0.093	1 leaf	35	13	104	5790
Fenoxaprop + safener	0.186	1 leaf	31	15	97	5405
Fenoxaprop + safener	0.093	3 leaf	18	10	103	5826
Fenoxaprop + safener	0.186	3 leaf	15	10	103	5793
Fenoxaprop + safener	0.093	1 to 2 tiller	10	24	102	6016
Fenoxaprop + safener	0.186	1 to 2 tiller	10	28	100	5844
Fenoxaprop + safener	0.093	3 to 4 tiller	8	45	91	5611
Fenoxaprop + safener	0.186	3 to 4 tiller	6	45	87	5698
Fenoxaprop + safener	0.093	4 to 5 tiller	1	23	83	5406
Fenoxaprop + safener	0.186	4 to 5 tiller	1	36	84	5449
Fenoxaprop + safener	0.093	6 tiller	0	8	93	5602
Fenoxaprop + safener	0.186	6 tiller	0	8	88	5748
Untreated control			--	--	100	5681
LSD (0.05)			6	11	8	NS

Cold temperatures after application may have interacted with barley growth stage at application time and increased barley injury (Table 3). A 4 C decrease in the average minimum temperature occurred after application on June 13 (4 to 5 tiller stage) compared to the previous 6 days (Table 3). The minimum temperature recorded during the experiment (May 18 to July 1, 2001) was -2 C on May 29, 2001.

Table 3. Temperature data.

Application date	Avg Min Temp for 1-6 DAT	Avg Max Temp for 1-6 DAT
	---------------- C	----------------
5/18	7	24
5/24	7	26
3/29	5	19
6/6	7	18
6/13	3	21
6/18	6	25

The effect of fenoxaprop combined with broadleaf herbicides on four barley varieties. Lori J. Crumley and Donald C. Thill. (Plant Science Division, University of Idaho, Moscow, ID 83844-2239) A study was established east of Moscow, Idaho to determine the effect of fenoxaprop combined with broadleaf herbicides on injury to four barley varieties. The experimental design was a randomized complete block split-plot with barley variety as main plots and herbicide treatments as subplots. Main plots were 7.3 by 19.5 m and subplots were 2.4 by 7.3 m. Herbicide treatments were applied using a CO_2 pressurized backpack sprayer calibrated to deliver 94 kg/ha at 207 kPa (Table 1). Injury was evaluated visually on June 6, 15, and 21, 2001. Barley was harvested with a small plot combine from a 1.2 by 6.4 m area of each plot on August 21, 2001.

Table 1. Application and soil data.

Application date	May 31
Barley growth stage	4 to 5 leaf
Air temp (C)	17
Relative humidity (%)	51
Wind (kph)	4
Soil temperature at 5 cm (C)	13
pH	4.8
OM (%)	3.1
CEC (meq/100 g)	27
Texture	Silt loam

There was no variety by treatment interaction (data not shown). Treatments including fenoxaprop injured barley significantly more (13 to 18%) than treatments without (1 to 8%) on June 6 (Table 2). The highest injury on June 15 was with fenoxaprop applied alone at 9%. MCPA injured barley the least on both evaluation dates (1%). Barley yield was lowest with fenoxaprop alone (2787 kg/ha) and highest with fenoxaprop plus bromoxynil (3280 kg/ha) or bromoxynil alone (3169 kg/ha). However, treatments did not differ significantly from the control.

Table 2. The effect of herbicide treatments on barley injury and grain yield pooled over barley varieties near Moscow, ID in 2001.

Treatment	Rate	Injury June 6	Injury June 15	Barley yield
	kg/ha	----------%----------		kg/ha
Fenoxaprop[a]	0.093	18	9	2787
Bromoxynil	0.28	8	2	3169
MCPA	0.28	1	1	2803
Fenoxaprop + bromoxynil	0.093 + 0.28	18	7	3280
Fenoxaprop + MCPA	0.093 + 0.28	13	6	3024
Bromoxynil + MCPA	0.28 + 0.28	5	1	2956
Fenoxaprop + bromoxynil + MCPA	0.093 + 0.28 + 0.28	14	5	2950
Untreated control	--	--	--	2991
LSD (0.05)		4	2	327

[a] Fenoxaprop is the commercial formulation of fenoxaprop/mefenpyr diethyl (safener).

Spring barley varieties Harrington and Camas were injured 16 and 14%, respectively, on June 6 (Table 3). Baronesse had the lowest injury (4%) on June 6. On June 15, Harrington was injured the most (5%). Grain yield was not significantly different among varieties.

Table 3. Herbicide injury and grain yield of four barley varieties pooled over herbicide treatment near Moscow, ID in 2001.

Variety	Injury June 6	Injury June 15	Yield
	----------%----------		kg/ha
Baronesse	4	4	2735
Camas	14	4	3103
Harrington	16	5	3283
Morex	9	4	2861
LSD (0.05)	3	1	NS

Evaluation of herbicides for control of downy brome, perennial ryegrass and rough bluegrass in central Oregon grass seed production. Marvin D. Butler. (Central Oregon Agricultural Research Center, Oregon State University, Madras, OR 97741) Downy brome control is a major concern to the grass seed industry in central Oregon. The objective of this project was to evaluate herbicide treatments on a commercial Kentucky bluegrass field, a perennial ryegrass field and two rough bluegrass fields. The new product, flufenacet-metribuzin, was of particular interest in combination with current products being used. Plots were replicated four times in a randomized complete block design in a commercial Kentucky bluegrass (cultivar 'Geronimo') seed field, a commercial perennial ryegrass (cultivar 'SH-2') field, and two rough bluegrass (cultivars 'Laser' and 'Saber') fields near Madras, Oregon. Herbicide treatments were applied twice to the Kentucky bluegrass on September 25 and November 16, to the perennial ryegrass and 'Saber' rough bluegrass on September 26 and November 16, and to the 'Laser' rough bluegrass on October 18 and November 16, 2000. A non-ionic surfactant was applied in combination with all treatments at 1 qt/100 gal. Treatments were made to 10 by 20 ft plots with a CO_2 pressurized, hand-held boom sprayer at 40 psi with XR8002 flat fan nozzles and 20 gal/acre water. Plots were evaluated March 9, 2001 for control of downy brome, volunteer perennial ryegrass and established rough bluegrass, as appropriate for each location.

There was no observable injury to either established Kentucky bluegrass or established perennial ryegrass. However, treatments that included flufenacet-metribuzin provided 100 percent control of volunteer rough bluegrass (*poa trivialis*), between 90 and 100 percent control of established rough bluegrass and 97 to 98 percent control of volunteer perennial ryegrass. The follow-up treatments applied November 16 that included oxyfluorfen plus terbacil generally provided better control than oxyfluorfen plus diuron. Treatments that included flufenacet-metribuzin in the first application did not improve efficacy by adding pendimethalin to the follow-up application.

Table 1. Downy brome control in 'Sabre II' rough bluegrass and control of volunteers in established perennial ryegrass near Madras, Oregon.

Treatments		Application date		Control			
9/26	11/16	9/26	11/16	Downy brome		Vol. per. ryegrass	
		------------lb/A------------		----------------%----------------			
Flufenacet-met[a] + oxyfluorfen	Oxyfluorfen + diuron	0.5 0.1	0.2 0.8	70	ab[b]	98	a
Flufenacet-met + oxyfluorfen	Oxyfluorfen + terbacil	0.5 0.1	0.2 0.24	70	ab	97	a
Flufenacet-met + oxyfluorfen	Oxyfluorfen + diuron + terbacil	0.5 0.1	0.2 0.8 0.24	70	ab	98	a
Flufenacet-met + oxyfluorfen + pendimethalin	Oxyfluorfen + diuron	0.5 0.1 2	0.2 0.8	60	ab	98	a
Flufenacet-met + oxyfluorfen + pendimethalin	Oxyfluorfen + terbacil	0.5 0.1 2	0.2 0.24	76	a	98	a
Flufenacet-met + oxyfluorfen + pendimethalin	Oxyfluorfen + diuron + terbacil	0.5 0.1 2	0.2 0.8 0.24	70	ab	97	a
Oxyfluorfen + pendimethalin	Oxyfluorfen + diuron	0.1 2	0.2 0.8	40	c	73	c
Oxyfluorfen + pendimethalin	Oxyfluorfen + terbacil	0.1 2	0.2 0.24	53	b	85	b
Oxyfluorfen + pendimethalin	Oxyfluorfen + diuron + terbacil	0.1 2	0.2 0.8 0.24	56	b	88	ab
Primisulfuron	Oxyfluorfen + diuron	0.36	0.2 0.8	60	ab	53	d
Primisulfuron	Oxyfluorfen + terbacil	0.36	0.2 0.24	66	ab	53	d
Primisulfuron	Oxyfluorfen + diuron + terbacil	0.36	0.2 0.8 0.24	66	ab	78	c
Untreated	----	----	----	0	d	0	e

[a]Flufenacet-met is a commercial formulation of flufenacet and metribuzin.
[b]Mean separation with Student-Newman-Kuels Test at $P \leq 0.05$

Table 2. Control of established 'Laser' rough bluegrass near Madras, Oregon 2000-2001.

Treatments		Application date		Control of established rough bluegrass	
10/18	11/16	10/18	11/16		
		--------------lbA--------------		---%---	
Flufenacet-met[a]	Oxyfluorfen	0.5	0.2	90	a[b]
+ oxyfluorfen	+ diuron	0.05	1.6		
Flufenacet-met	Oxyfluorfen	0.5	0.2	97	a
+ oxyfluorfen	+ terbacil	0.05	0.6		
Flufenacet-met	Oxyfluorfen	0.5	0.2	99	a
+ oxyfluorfen	+ diuron	0.05	1.6		
	+ terbacil		0.6		
Flufenacet-met	Oxyfluorfen	0.5	0.2	93	a
+ oxyfluorfen	+ diuron	0.05	1.6		
+ pendimethalin		2			
Flufenacet-met	Oxyfluorfen	0.5	0.2	100	a
+ oxyfluorfen	+ terbacil	0.05	0.6		
+ pendimethalin		2			
Flufenacet-met	Oxyfluorfen	0.5	0.2	98	a
+ oxyfluorfen	+ diuron	0.05	1.6		
+ pendimethalin	+ terbacil	2	0.6		
Oxyfluorfen	Oxyfluorfen	0.05	0.2	60	b
+ pendimethalin	+ diuron	2	1.6		
Oxyfluorfen	Oxyfluorfen	0.05	0.2	86	a
+ pendimethalin	+ terbacil	2	0.6		
Oxyfluorfen	Oxyfluorfen	0.05	0.2		
+ pendimethalin	+ diuron	2	1.6	96	a
	+ terbacil		0.6		
Primisulfuron	Oxyfluorfen	0.36	0.2	91	a
	+ diuron		1.6		
Primisulfuron	Oxyfluorfen	0.36	0.2	93	a
	+ terbacil		0.6		
Primisulfuron	Oxyfluorfen	0.36	0.2	91	a
	+ diuron		1.6		
	+ terbacil		0.6		
Untreated	----	---	----	0	c

[a]Flufenacet-met is a commercial formulation of flufenacet and metribuzin.
[b]Mean separation with Student-Newman-Kuels Test at $P \leq 0.05$

Chemical suppression of Kentucky bluegrass. Janice Reed and Donn Thill. (Plant Science Division, University of Idaho, Moscow, ID 83844-2339) Two studies were established in Northern Idaho to determine the optimum herbicide and herbicide application timing to predict growth suppression of Kentucky bluegrass stands and to determine variety influence on bluegrass suppression and subsequent seed yield.

Glyphosate study: In March 2001, plots were established at the Jacklin Seed Division demonstration site near Nezperce, Idaho. Three Kentucky bluegrass cultivars were used; 'Palouse', 'Newport', and 'Nublue', which are early, intermediate, and late maturing cultivars, respectively. Plots were 10 by 30 ft arranged in a randomized complete block design with four replications. Glyphosate (Roundup Ultra) at 1 lb/A + liquid AMS (Bronc) at 8.5 lb/100 gal mix was applied to all cultivars at one-week intervals on March 20 and 27, and April 5, 12 and 19, 2001 (Table 1). Sod cores (4 in diameter) were collected from each plot prior to glyphosate application and 5 weeks after each herbicide application date. Sod cores were dissected to determine tiller density. In June 2001, panicles were collected from a 7 by 14 inch area in each unsprayed control plot and counted to determine panicle density. Grass in control plots was swathed and harvested at maturity and was burned in August 2001. Bluegrass cover (regrowth) after glyphosate application was rated visually in September 2001.

Imazapic study: An experiment was initiated during spring 2001 on established stands of eight Kentucky bluegrass cultivars at the University of Idaho Parker Research Farm in Moscow, ID. Each bluegrass cultivar plot was 16 by 16 ft and replicated four times. Imazapic at 0.125 lb/A + COC (Sun-It II) at 1.25 % v/v was applied to one-half of each plot on April 12, 2001 after active plant growth had resumed. Bluegrass cover (regrowth) was visually estimated in June and July 2001. Panicles were collected from a 7 by 14 inch area of the non-treated half of all plots to determine panicle density. Plots were mowed to a uniform height and residue was removed in July 2001.

Table 1. Application data for glyphosate and imazapic studies.

Experiment	Glyphosate					Imazapic
Application date	3/20/01	3/27/01	4/5/01	4/12/01	4/19/01	4/12/01
Air temp (F)	47	42	37	54	49	38
Soil temp at 2 in (F)	49	42	40	42	47	40
RH (%)	68	81	70	83	72	74
Wind (mph, direc)	0-4, NE	2-5, SE	2-4, SE	2-4, SW	0	0-3, NW
Cloud cover (%)	5	10	0	90	90	95

Glyphosate study: Averaged over time, pre-herbicide application tiller counts for all bluegrass varieties ranged from 1,206 to 1,425 tillers/ft^2 (Table 2). In herbicide treated plots, pre-application tiller counts were the same for all application timings in 'Palouse' and 'Newport', but were 39% greater at application timing T4 than T1 and T3 in 'Nublue'. The percentage tiller reduction 5 wk after herbicide treatment was the same among all glyphosate application timings for 'Nublue', but was reduced an average of 21% more when glyphosate was applied at T1 through T4 compared to T5 for 'Newport', and was reduced most in 'Palouse' when glyphosate was applied at T1 and T3 (93 to 99%) compared to T5 (85%). Regardless of variety, percentage bluegrass ground cover in September 2001 always was greatest in plots sprayed with glyphosate at timings T1 and T2 (65 to 81%) and least in plots sprayed at T5 (8 to 19%). Percent bluegrass ground cover in plots sprayed at timings T3 and T4 was variable and ranged from 20 to 75%. Bluegrass seed yield in the control plots of 'Palouse', 'Newport', and 'Nublue' was 149, 212, and 365 lb/A, respectively (data not shown). 'Palouse' seed yield was very low due to a poor stand and a severe wild oat infestation in two out of four replications. According to Jacklin Seed Division personnel, bluegrass seed yield for 2001 on the Camas Prairie is anticipated to be about 30% lower than 2000.

Imazapic study: Bluegrass cover (regrowth) 2 months after imazapic application ranged from 2 to 9% and was greatest in 'South Dakota' and 'Blue Chip', and least in 'Classic' (Table 3). By 3 months after treatment, recovery ranged from 12 to 54% and was greatest in 'Blue Chip' and least in 'Nublue'. 'Caliber' had the highest number of panicles in the unsprayed control plots (110/ft^2) and 'Nublue' and 'Blue Chip' had the lowest (27 and 31/ft^2).

Table 2. The effect of glyphosate timing on tiller number and percentage ground cover of three Kentucky bluegrass cultivars at Nezperce, ID in 2001.

		Palouse					Newport					Nublue				
		Tillers[a]					Tillers[a]					Tillers[a]				
		Control	Treated		Tiller[b]	KBG[c]	Control	Treated		Tiller[b]	KBG[c]	Control	Treated		Tiller[b]	KBG[c]
Applic. timing	Date	Pre	Pre	Post	reduc	cover	Pre	Pre	Post	reduc	cover	Pre	Pre	Post	reduc	cover
		--------------no/ft^2--------------			--------%--------		--------------no/ft^2--------------			--------%--------		--------------no/ft^2--------------			--------%--------	
T1	3/20	1289	1180	74	93	58	859	1352	143	88	76	1146	1226	92	93	81
T2	3/27	1782	1324	112	91	65	1020	1306	109	91	76	1043	1381	223	85	81
T3	4/5	1404	1536	6	99	20	1306	1209	34	97	40	1192	1060	97	91	24
T4	4/12	1355	957	95	89	45	1644	1300	210	84	75	1295	1868	198	88	58
T5	4/19	1295	1386	195	85	8	1203	1134	321	69	19	1352	1404	92	92	10
LSD (0.05)		---	NS	83	7	26	---	NS	138	14	13	---	533	121	NS	17

[a] Pre-treatment tillers counted prior to treatment, post-treatment tillers counted 5 weeks after each application date.
[b] Tiller reduc. is percent reduction in tiller number in treated plots from pre-treatment to 5 wk after treatment.
[c] KBG cover is Kentucky bluegrass cover rated Sept. 14, 2001.

Table 3. Regrowth after treatment with imazapic and panicle number in untreated plots of Kentucky bluegrass at Moscow, ID in 2001.

Cultivar	Bluegrass cover[a] 6/11/01	Bluegrass cover[a] 7/19/01	Panicles[b]
	----------%----------		no/ft^2
Classic	2	24	82
Nublue	3	12	27
Palouse	4	28	72
Odyssey	6	38	64
S.Dakota	9	45	37
Award	3	26	47
Caliber	4	39	110
Blue Chip	8	54	31
LSD (0.05)	5	30	47

[a] Imazapic applied on 4/12/01.
[b] Untreated plots.

Integrated management system for sustained seed yield of Kentucky bluegrass without burning. Janice M. Reed and Donald C. Thill. (Plant Science Division, University of Idaho, Moscow, ID 83844-2339) Trials were conducted in Northern Idaho and Eastern Washington to determine variety and location influence on glyphosate suppression of bluegrass, seed yield of three no-till crops and subsequent bluegrass seed yield for two years. Following harvest in 1998, trials were established in Kentucky bluegrass fields of 'Rhonde' in Farifield, WA, and 'Nublue' and 'Palouse' in Nezperce, ID. Each trial had an intercrop experiment and a herbicide experiment with high and low post-harvest residue treatments. This report will present data from the herbicide experiment only. The low residue treatments were mowed, raked, and baled at the Washington site and were burned at the Idaho sites, while all fields were re-swathed and baled without raking for the high residue treatments. The herbicide experiment was a split-plot design with residue treatments as main plots (75 by 60 ft) and herbicide treatments as sub-plots (15 by 20 ft) and included non-suppressed bluegrass control plots. Glyphosate was applied at 1 lb/A 6, 5, 4, 3, or 2 weeks prior to planting lentil, 1.5 lb/A applied 2 weeks pre-plant, and split applications of 1.0 + 1.0 lb/A and 0.75 + 0.75 lb/A applied 6 and 2 weeks pre-plant (Table 1). In July 1999, non-suppressed bluegrass plots were swathed. Grass windrows and standing intercrops were harvested to determine seed yield. Following harvest in 1999 and 2000, post harvest residue was removed from the bluegrass plots using the same methods as in fall 1998. In 1999, oat straw was raked from the intercrop plots but pea and lentil straw was allowed to remain. In the spring of 1999, 2000, and 2001 panicles derived from C and F tillers were determined by growing 4-inch sod cores in the greenhouse. In June 2000 and 2001, panicles were collected from a 7 by 14 inch area of each plot and counted to determine panicle density. Bluegrass was swathed and harvested at maturity in 2000 and 2001. The 2001 grass seed yield samples are being processed

'Rhonde' seed yield in glyphosate-treated plots was equal to or greater than non-suppressed plots in 2000 (Table 2). Panicle number at harvest of 'Rhonde' was 81% greater in plots treated with glyphosate at 1.5 lb/A compared to the untreated bluegrass control plots in 2001. Seed yield of 'Rhonde' in 2000 and panicles at harvest in 2001 did not differ between residue removal treatments. 'Nublue' seed yield in 2000 was 1.9 to 2.6 times greater in glyphosate-suppressed plots than in non-suppressed plots. In 2001, 'Nublue' panicle number at harvest was 58% greater in plots treated with glyphosate at 1.5 to 2.0 lb/A compared to the continuous bluegrass control. 'Nublue' seed yield in 2000 and panicle number in 2001 were 66 and 50% greater, respectively, in burned than in non-burned treatments. Except for the earliest application timings (6 and 5 weeks before seeding the lentil intercrop), stands of 'Palouse' did not recover from the 1999 glyphosate treatments. Seed yield of 'Palouse' in 2000 was 38% greater in plots sprayed with glyphosate 6 weeks before seeding a lentil intercrop than in the continuous bluegrass control. In 2001, panicle number at harvest of 'Palouse' was not different among glyphosate treatments, but was 36% greater in burned versus non-burned treatments.

Table 1. Application data for glyphosate applied at eight application timings to three Kentucky bluegrass varieties.

Rhonde (Fairfield, WA)					
Timing[a]	1	2, 7, 8	3	4	5, 6, 7, 8
Date	3/4/99	3/11/99	3/15/99	3/24/99	4/1/99
Air temp (F)	32	35	41	49	43
Relative humidity (%)	85	79	83	70	50
Wind (mph, direc)	4-7, SE	2-4.5, E	2-4.5, SE	3-4.5, S	3-6, NE
Cloud cover (%)	100	0	90	30	0
Soil temp at 2 in (F)	32	32	38	38	40
Nublue (Nezperce, ID)					
Timing[a]	1	2, 7, 8	3	4	5, 6, 7, 8
Date	3/17/99	3/22/99	4/2/99	4/7/99	4/15/99
Air temp (F)	58	48	40	50	45
Relative humidity (%)	48	80	70	68	50
Wind (mph, direc)	3-6, SE	3-6, SE	2-4, SE	0-5, SE	0-4, SE
Cloud cover (%)	80	95	0	0	--
Soil temp at 2 in (F)	40	41	35	40	38
Palouse (Nezperce, ID)					
Timing	1, 7, 8	2	3	4	5, 6, 7, 8
Date	3/22/99	4/2/99	4/7/99	4/15/99	4/23/99
Air temp (F)	48	40	50	45	54
Relative humidity (%)	80	64	68	50	63
Wind (mph, direc)	3-6, SE	3-5, SE	0-5, SE	0-4, SE	2-5, NW
Cloud cover (%)	90	0	0	--	0
Soil temp at 2 in (F)	40	35	40	38	42

[a] Application timings 7 and 8 were applied with timing 2 instead of timing 1 due to poor weather.

Table 2. The effects of glyphosate application time (applied in spring 1999) and rate, and residue removal methods on Kentucky bluegrass seed yield in 2000 and panicle density in 2001. Values for herbicide treatments are pooled over residue levels. Values for residue levels are pooled over glyphosate rates.

Application timing		Glyphosate rate[b]	Rhonde 2000 seed yield	Rhonde 2001 panicles at harvest	Nublue 2000 seed yield	Nublue 2001 panicles at harvest	Palouse 2000 seed yield	Palouse 2001 panicles at harvest
	weeks[a]	lb/A	lb/A	no/ft^2	lb/A	no/ft^2	lb/A	no/ft^2
0	--	--	114	68	184	114	159	76
1	6	1	152	70	347	127	219	92
2	5	1	198	99	423	140	143	101
3	4	1	138	88	366	120	--	--
4	3	1	172	77	459	161	--	--
5	2	1	195	101	460	134	--	--
6	2	1.5	136	132	436	181	--	--
7	6, 2	1, 1	156	94	478	176	--	--
8	6, 2	0.75, 0.75	191	114	442	183	--	--
		LSD (0.05)	65	42	66	54	52	NS
		Low residue	164	91	477	178	144	103
		High residue	149	95	288	119	146	76
		LSD (0.05)	NS	NS	56	26	NS	27

[a] Application time is weeks prior to planting the lentil intercrop.
[b] All treatments applied with liquid ammonium sulfate solution (Bronc)at 17 lb/100gal mix.

Control of volunteer herbicide resistant wheat and canola. Curtis R. Rainbolt and Donald C. Thill. (Plant Science Division, University of Idaho, Moscow, ID 83844-2339) Studies were conducted in spring 2000 and 2001 near Moscow, ID at the University of Idaho Parker Research Farm and near Ralston, WA at the USDA Ralston Direct Seed Project site to evaluate alternatives to traditional glyphosate treatments for control of volunteer herbicide resistant crops. Glyphosate resistant spring wheat, glyphosate resistant canola, imidazolinone resistant wheat, imidazolinone resistant canola, and glufosinate resistant canola were seeded with a no-till drill to simulate volunteer HRC. All herbicide treatments were applied with a CO_2 pressurized backpack sprayer (Table 1). Control was evaluated visually at 14 and 21 days after treatment (DAT). Above ground biomass was collected from a 2.7 ft^2 area in each plot 28 DAT. Canola biomass was not collected at Ralston in 2000 due to inconsistent emergence and poor stand. Studies were terminated immediately after biomass collection to prevent seed production.

Table 1. Application data.

Location	Ralston, WA	Ralston, WA[a]	Moscow, ID	Moscow, ID
Application date	May 15, 2000	May 31, 2001	June 11, 2000	June 6, 2001
Wheat growth stage	5 to 6 leaf	5 to 7 leaf	3 to 4 leaf	4 to 6 leaf
Canola growth stage	2 to 4 inch	3 to 4 inch	2 to 3 inch	3 to 4 inch
Air temperature (F)	55	81	40	60
Relative humidity (%)	64	45	85	75
Wind (mph)	2 to 4	2 to 4	1 to 5	0 to 4
Soil temp at 2 in (F)	65	75	50	51
pH	7.3	7.0	5.4	5.3
OM (%)	2.1	2.2	3.2	3.2
CEC (meq/100g)	17	18	22	21
Texture	silt loam	Silt loam	silt loam	silt loam

[a]At Ralston in 2001 canola was sprayed on June 13 due to replanting.

At 14 DAT, paraquat + diuron controlled glyphosate resistant wheat (RRW) 93% (Table 2). By 21 DAT control was 90 to 95% with paraquat + diuron and all treatments containing quizalofop or clethodim. These treatments reduced biomass an average of 95% compared to the untreated control. As expected, treatments containing glyphosate did not control volunteer glyphosate resistant wheat. Paraquat or glufosinate, alone or mixed with glyphosate, also did not control volunteer glyphosate resistant wheat.

Control of imidazolinone resistant wheat (CFW) 14 DAT ranged from 89 to 97% with glyphosate alone, paraquat + diuron, glyphosate/2,4-D, glyphosate/dicamba, quizalofop + glyphosate, and sethoxydim + glyphosate. By 21 DAT quizalofop, clethodim, and the previously listed treatments controlled volunteer imidazolinone resistant wheat 93 to 97%. Biomass was reduced on average 96% by glyphosate alone, quizalofop, quizalofop + glyphosate, clethodim, clethodim + glyphosate, paraquat + diuron, glyphosate/2,4-D, and glyphosate/dicamba. Gramoxone or glufosinate did not control volunteer imidazolinone resistant wheat.

At 14 DAT, glyphosate resistant canola (RRC) was controlled 92% by paraquat and 97% by paraquat + diuron (Table 3). By 21 DAT, control with paraquat alone had dropped slightly due to re-growth, but control with paraquat + diuron was consistent at 98%. Biomass was reduced most by paraquat + diuron, but due to a large degree of variation it was not significantly different than glyphosate + paraquat, paraquat, and glyphosate/2,4,-D. All other treatments did not control volunteer glyphosate resistant canola.

All treatments except glufosinate, glyphosate + glufosinate, quizalofop, and clethodim controlled imidazolinone resistant canola (CFC) 91% or more 14 DAT. At 21 DAT, control was best with glyphosate (Roundup Ultra RT) (96%), glyphosate/2,4-D (98%), glyphosate/dicamba (98%), glyphosate (Touchdown IQ) (94%), paraquat + diuron (97%), quizalofop + glyphosate (96%), and clethodim + glyphosate (95%). These treatments reduced biomass 96% on average. All other treatments did not control volunteer imidazolinone resistant canola.

At 14 DAT, all treatments except glufosinate, quizalofop, and clethodim controlled glufosinate resistant canola (LLC) 92% or more. By 21 DAT, control was best with glyphosate (95%), glyphosate/2,4-D (98%), glyphosate/dicamba (98%), glyphosate + glufosinate (93%), paraquat + diuron (95%), quizalofop + glyphosate (97%), and clethodim + glyphosate (96%). All treatments except glufosinate, quizalofop, clethodim, and paraquat alone reduced biomass 87% or more.

Table 2. Volunteer herbicide resistant wheat control and biomass with various herbicides at Moscow, ID and Ralston, WA in 2000 and 2001. Data are averaged over locations and years.

		Control				Biomass	
		14 DAT		21 DAT		28 DAT	
Treatment[a]	Rate	RRW[b]	CFW	RRW	CFW	RRW	CFW
	lb/A	--%	--			--------% of control[e]--------	
Glyphosate[c] + AMS	0.38 + 5% v/v	0	89	0	95	95	5
Glyphosate/2,4-D + AMS	1.01 + 5% v/v	0	92	0	96	81	5
Glyphosate/dicamba + AMS	0.5 + 5% v/v	0	92	0	94	84	4
Paraquat + NIS	0.5 + 0.25% v/v	83	79	57	63	24	12
Glufosinate	0.44	60	46	50	46	39	29
Glyphosate[d] + AMS	0.38 + 5% v/v	0	89	0	94	72	4
Glyphosate[c] + glufosinate + AMS	0.38 + 0.44 + 5% v/v	63	67	45	79	43	14
Glyphosate[c] + paraquat + AMS + NIS	0.38 + 0.5 + 5% v/v + 0.25% v/v	78	57	62	66	23	13
Paraquat + diuron + NIS	0.5 + 0.25 + 0.25% v/v	93	97	90	93	7	5
Quizalofop + NIS	0.055 + 0.25% v/v	72	70	93	93	5	5
Glyphosate[c] + quizalofop + AMS + NIS	0.38 + 0.055 + 5% v/v + 0.25% v/v	73	92	94	97	4	2
Clethodim + COC	0.093 + 1% v/v	72	71	94	95	6	3
Glyphosate[c] + clethodim + AMS+ COC	0.38 + 0.093 + 5% v/v + 1% v/v	79	93	95	96	3	2
LSD (0.05)		5	4	5	3	17	7

[a] AMS is liquid ammonium sulfate (Bronc), NIS is 90% non-ionic surfactant (R-11), and COC is crop oil concentrate (Score).

[b] RRW is glyphosate-resistant spring wheat and CFW is imidazolinone-resistant wheat.

[c] Roundup Ultra RT formulation of glyphosate.

[d] Touchdown IQ formulation of glyphosate (diammonium salt).

[e] Percentage of total biomass weight in the untreated control.

Table 3. Volunteer herbicide resistant canola control and biomass with various herbicides at Moscow, ID and Ralston, WA in 2000 and 2001. Data are averaged over locations and years.

		Control						Biomass[b]		
		14 DAT			21 DAT			28 DAT		
Treatment[a]	Rate	RRC[c]	CFC	LLC	RRC	CFC	LLC	RRC	CFC	LLC
	lb/A	--------------------	--------------------	--------------------	%--------------------	--------------------	--------------------	----------% of control[f]	----------	----------
Glyphosate[d] + AMS	0.38 + 5% v/v	0	95	94	0	96	95	88	4	5
Glyphosate/2,4-D + AMS	1.01 + 5% v/v	78	96	95	81	98	98	9	2	4
Glyphosate/dicamba + AMS	0.5 + 5% v/v	33	96	97	37	98	98	70	3	2
Paraquat + NIS	0.5 + 0.25% v/v	92	93	95	76	69	73	14	22	23
Glufosinate	0.44	51	46	0	54	48	0	29	36	100
Glyphosate[e] + AMS	0.38 + 5% v/v	0	92	92	0	94	95	79	5	8
Glyphosate[d] + glufosinate + AMS	0.38 + 0.44 + 5% v/v	53	84	92	48	88	93	33	11	8
Glyphosate[d] + paraquat + AMS + NIS	0.38 + 0.5 + 5% v/v + 0.25% v/v	88	92	96	72	67	85	15	24	13
Paraquat + diuron + NIS	0.5 + 0.25 + 0.25% v/v	97	98	98	98	97	98	2	3	2
Quizalofop + NIS	0.055 + 0.25% v/v	0	0	0	0	0	0	97	89	90
Glyphosate[d] + quizalofop + AMS + NIS	0.38 + 0.055 + 5% v/v + 0.25% v/v	0	91	93	0	96	97	97	4	5
Clethodim + COC	0.093 + 1% v/v	0	0	0	0	0	0	94	103	80
Glyphosate[d] + clethodim + AMS+ COC	0.38 + 0.093 + 5% v/v + 1% v/v	0	93	95	0	95	96	106	5	8
LSD (0.05)		3	3	2	4	3	2	16	3	20

[a] AMS is liquid ammonium sulfate (Bronc), NIS is 90% non-ionic surfactant (R-11), and COC is crop oil concentrate (Score).

[b] Does not inlcude 2000 Ralston data.

[b] RRC is glyphosate-resistant spring canola, CFC is imidazolinone-resistant canola, and LLC is glufosinate-resistant canola.

[d] Roundup Ultra RT formulation of glyphosate.

[e] Touchdown IQ formulation of glyphosate (diammonium salt).

[f] Percentage of total biomass weight in the untreated control.

Glyphosate application strategies in glyphosate-resistant canola. Gregory J. Endres, Robert A. Henson, and Stephen A. Valenti. (Carrington Research Extension Center, North Dakota State University, Carrington, ND 58421 and Monsanto, Fargo, ND 58104) Weed control and canola response to selected glyphosate treatments were evaluated in a randomized complete block design with three replicates. The experiment was conducted on a loam soil with 7.2 pH and 2.9% organic matter at Carrington, ND in 2001. 'Hyola 357RR' canola was seeded on May 3 in 7-inch rows at the rate of 15 pure live seeds/ft^2 in a conventional tillage system. Guard plots were present between treated plots. Herbicide treatments were applied to 5 by 25 ft plots with a CO_2 pressurized hand-held plot sprayer at 14 gal/A and 30 psi through 8001 flat fan nozzles. Early postemergence (POST1) treatments were applied on May 25 with 63 F, 51% RH, 95% clear sky, and light wind to 2-leaf canola, 1- to 2-leaf yellow foxtail, 0.5-inch tall redroot and prostrate pigweed, 0.5-inch tall common lambsquarters, and 1-inch tall wild buckwheat. Mid postemergence (POST2) treatments were applied on June 1 with 49 F, 85% RH, 10% clear sky, and light wind to 4-leaf canola, 3- to 4-leaf yellow foxtail, 0.5- to 1-inch tall redroot and prostrate pigweed, 0.5- to 4-inch tall common lambsquarters, and 2-inch tall wild buckwheat. Late postemergence (POST3) treatments were applied on June 7 with 52 F, 100% RH, clear sky, and 7 mph wind to 5- to 6-leaf canola, 3- to 5-leaf yellow foxtail, 0.5- to 2-inch tall redroot and prostrate pigweed, 3- to 4-inch tall common lambsquarters, and 3-inch tall wild buckwheat. Average canola density was 6 plants/ft^2, yellow foxtail density was 3 plants/ft^2, pigweed density was 3 plants/ft^2, common lambsquarters density was 2 plants/ft^2, and wild buckwheat density was 1 plant/ft^2. The trial was swathed on August 7 and harvested on August 14 with a plot combine.

Table. Weed control and crop response in glyphosate-resistant canola.

Herbicide			Weed control: 30 days after treatment				Weed control: 8/2				Canola seed
Treatment[a]	Rate	Timing[b]	SETLU	AMASS[c]	CHEAL	POLCO	SETLU	AMASS	CHEAL	POLCO	yield
	lb/A[d]		%								lb/A
Glyphosate	0.38	POST2	94	98	94	91	80	98	87	78	2048
Glyphosate	0.56	POST2	95	99	97	91	79	95	87	70	2103
Glyphosate	1.12	POST2	95	98	98	91	85	95	93	79	1961
Glyphosate+clopyralid	0.38+0.089	POST2	96	98	98	99	90	98	88	91	2234
Clopyralid+ quizalofop+MSO	0.094+ 0.07+1% v/v	POST3	93	76	58	75	79	69	70	79	1763
Glyphosate	0.38	POST3	87	80	86	84	92	73	79	67	2302
Glyphosate	0.56	POST3	96	86	98	86	94	78	91	70	2230
Glyphosate	1.12	POST3	91	90	99	79	85	83	99	60	2194
Glyphosate/glyphosate	0.38/0.38	POST1/3	93	98	99	94	87	94	99	82	2122
untreated			0	0	0	0	0	0	0	0	2293
LSD (0.05)			7	11	14	22	15	9	14	20	NS

[a]Glyphosate=Roundup UltraMax except fourth glyphosate treatment=Glyphomax Plus. Glyphosate treatments include AMS at 2% w/w. MSO=Destiny, a methylated seed oil from Agriliance, St. Paul, MN.
[b]POST1=May 25; POST2=June 1; POST3=June 7.
[c]AMASS=Redroot and prostrate pigweed.
[d]Glyphosate rates=acid equivalent.

Glyphosate at 0.38 lb/A generally provided similar yellow foxtail, pigweed, common lambsquarters, and wild buckwheat control as glyphosate at 0.56 or 1.12 lb/A (Table). Glyphosate at 0.38 lb/A applied at the 4-leaf stage of canola provided 91 to 99% control of all weed species when evaluated 30 days after treatment application. Glyphosate at 0.38 lb/A applied at the 4-leaf stage or sequential application generally provided greater control of pigweed compared to all glyphosate rates applied at the 5- to 6-leaf stage of canola. Glyphosate+clopyralid provided 88 to 98% control of all weed species at crop maturity (late evaluation date). Wild buckwheat control was 60 to 82% with all glyphosate treatments at crop maturity. Very low crop chlorosis ($\leq 4\%$) was observed 3 days after treatment application and no growth reduction was observed on August 2 (data not shown). Canola seed yield was similar among treatments, likely due to low weed densities.

Broadleaf weed control in silage corn. John O. Evans, J. Earl Creech, and R. William Mace. (Department of Plants, Soils, and Biometeorology, Utah State University, Logan, Utah 84322-4820) Silage corn (DK662RR) was planted May 1 0, 2001 at the Utah State University Animal Science farm Wellsville, UT to compare the efficacy of several new postemergence herbicides for redroot pigweed (AMARE) and common lambsquarters (CHEAL) control. Individual treatments were applied to 10 by 30 foot plots with a CO_2 backpack sprayer using flatfan Tjet 015 nozzles providing a 10 foot spray width calibrated to deliver 24 gpa at 40 psi. The soil was a Nibley silty clay loam with 7.5 pH and O.M. content of less than 2%. Treatments were applied in a randomized block design, with three replications. Treatments were applied June 19, when the corn was in the 6 to 7 leaf stage. Pigweed and lambsquarters were 2 to 3 inches tall. Visual evaluations for weed control and crop injury were completed June 29 and July 10, 2001. Plots were harvested September 9.

There was no evidence of corn injury for any treatment. Initial evaluations indicated a lower efficacy for lambsquarters as compared to redroot pigweed control, but by the second evaluation date all treatments improved considerably and all provided good to excellent control of both broadleaf weed species. Corn yields were not significantly different.

Table. Broadleaf weed control in silage corn, Wellsville, UT.

		Weed Control				
		AMARE		CHEAL		
Treatment	Rate	6/29/01	7/10/01	6/29/01	7/10/01	Corn yield
	lb/A	%				T/A
Untreated		0.0	0.0	0.0	0.0	60.2
AEF130360[ab]	0.066	73.3	90.0	36.7	83.3	63.6
AEF130360/008[ab]	0.067	80.0	93.3	40.0	86.7	68.7
AEF130360+Diflufenzopyr[ab]	0.066+0.175	73.3	96.7	66.7	96.7	60.4
AEF130360+Mesotrione[ab]	0.066+0.094	80.0	100.0	56.7	96.7	67.3
AEF130360+Dimethenamid[ab]	0.066+1.125	70.0	100.0	23.3	80.0	65.8
Diflufenzopyr[ac]	0.263	63.3	96.7	60.0	100.0	64.9
LSD (0.05)		16.2	13.1	31.3	11.0	13.1

[a] Ammonium nitrate added at 2 qt/A

[b] Methylated seed oil added at 1% v/v

[c] Nonionic surfactant added at 0.25% v/v

Performance of postemergence wild proso millet herbicides in field corn with and without preemergence mesotrione treatment. John O. Evans, J. Earl Creech, and R. William Mace (Department of Plants, Soils and Biometeorology, Utah State University, Logan, Utah 84322-4820) A study was conducted at the Jensen Farm in Logan, UT to determine the influence of a preemergence mesotrione application of 0.094 lb ai/A on several postemergence wild proso millet (PANMI) herbicides. Glyphosate-resistant variety DK662 was planted at 35,000 seeds/A on May 10, 2001, and preemergence mesotrione treatment was made to one-half of the plots as part of planting to provide side-by-side comparisons with and without preemergence mesotrione. Postemergence treatments were applied June 1, in a randomized block design, using three replications. Treatments were applied to 10 by 20 ft plots with a CO_2 backpack sprayer using flatfan Tjet 015 nozzles providing a 10 ft spray width calibrated to deliver 25 gpa at 39 psi. The soil was a Winn silt loam with 7.6 pH and O.M. content of 4%. Corn was 6 to 8 inches tall at application time and was in the 6-leaf stage. Wild proso millet was in the 3-leaf stage at a density of 25 plants per ft^2.

No crop injury occurred with any herbicide treatment. Glyphosate, sulphosate, and ETK2303 showed excellent control of wild proso millet. Nicosulfuron+rimsulfuron+atrazine and rimsulfuron+thifensulfuron methyl provided adequate to good weed control. Wild proso millet was not controlled by postemergence mesotrione treatments. Preemergence applications of mesotrione had no effect on wild proso millet control, postemergence herbicide performance, or yield.

Table. Broadleaf weed control in silage corn, Wellsville, UT.

		Without Mesotrione			With Mesotrione [a]		
		Control	Crop		Control	Crop	
		PANMI	Injury		PANMI	Injury	
Treatment	Rate	6/29/01	6/29/01	Yield	6/29/01	6/29/01	Yield
		——%——		T/A	——%——		T/A
Untreated		0.0	0	29.8	0.0	0	34.0
Mesotrione	0.125	7.3	0	40.9	7.3	0	37.8
Mesotrione	0.187	10.0	0	35.9	10.0	0	42.2
Nicosulfuron+	0.01+	89.7	0	39.9	89.7	0	38.5
rimsulfuron+	0.01+						
atrazine [bc]	0.72						
Rimsulfuron+	0.04+	76.7	0	39.0	76.7	0	31.4
thifensulfuron methyl [bc]	0.02						
Glyphosate	0.75	92.7	0	35.6	92.7	0	42.8
Sulphosate	0.75	94.0	0	38.8	94.0	0	35.9
ETK2303	0.75	96.7	0	31.9	96.7	0	43.0
LSD (0.05)		9.8	0	10.8	9.8	0	10.8

[a] 0.094 lb ai/A mesotrione applied to one-half of experimental area as a preemergence treatment May 10, 2001

[b] Ammonium nitrate added at 2 qt/A

[c] Crop oil concentrate added at 1% v/v

Broadleaf weed control in field corn with postemergence herbicides. Richard N. Arnold, Michael K. O'Neill and Dan Smeal. (New Mexico State University Agricultural Science Center, Farmington, NM 87499) Research plots were established on May 7, 2001 at the Agricultural Science Center, Farmington, New Mexico to evaluate the response of field corn (var. Pioneer 34K77) and annual broadleaf weeds to 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. Field corn was planted with flexi-planters equipped with disk openers on May 7. Postemergence treatments were applied on June 5 when corn was in the 4th leaf stage and weeds were small. Black nightshade, prostrate and redroot pigweed, and common lambsquarters infestations were heavy and Russian thistle infestations were light throughout the experimental area. Treatments were evaluated on July 10.

No crop injury was observed in any of the treatments. All treatments gave excellent control of common lambsquarters except the check. Clopyralid plus flumetsulam (pm) and carfentrazone applied at 0.171 and 0.008 lb/A gave poor control of black nightshade, redroot and prostrate pigweed, and Russian thistle. Mesotrione applied at 0.094 lb/A gave poor control of redroot and prostrate pigweed.

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

Treatments[a,b]	Rate	Crop injury	Weed control				
			CHEAL	SOLNI	AMARE	AMABL	SASKR
	lb/A	——%——	%				
MON 12075	0.168	0	100	94	86	78	88
Clopyralid + flumetsulam (pm)	0.171	0	100	40	13	23	47
Carfentrazone	0.008	0	100	43	13	27	57
Diflufenzopyr + dicamba (pm)	0.26	0	100	100	99	100	100
Dicamba + primisulfuron + prosulfuron (pm)	0.161	0	100	100	100	100	99
Dicamba + atrazine (pm)	1.4	0	100	100	100	100	99
Halosufluron + dicamba	0.031+0.125	0	100	100	83	96	100
Mesotrione	0.094	0	100	98	43	53	90
Weedy check		0	0	0	0	0	0

[a] pm equal packaged mix.

[b] All treatments had NIS and AMS added at 0.25% and 2.0% v/v.

Broadleaf weed control in field corn with postemergence herbicides. Richard N. Arnold, Michael K. O'Neill and Dan Smeal. (New Mexico State University Agricultural Science Center, Farmington, NM 87499) Research plots were established on May 8, 2001 at the Agricultural Science Center, Farmington, New Mexico to evaluate the response of field corn (var. Pioneer 34K77) and annual broadleaf weeds to 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. Field corn was planted with flexi-planters equipped with disk openers on May 8. Postemergence treatments were applied on June 5 when corn was in the 4[th] leaf stage and weeds were small. Black nightshade, prostrate and redroot pigweed, and common lambsquarters infestations were heavy and Russian thistle infestations were light throughout the experimental area. Treatments were evaluated on July 10.

No crop injury was observed in any of the treatments. All treatments gave excellent control of redroot and prostrate pigweed except the check. Nicosulfuron plus rimsulfuron and DPX 79406 (pm) in combination with pyridate applied at 0.035 and 0.023 plus 0.47 lb/A gave poor control of black nightshade. DPX 79406 applied at 0.023 lb/A gave poor control of common lambsquarters. Nicosulfuron plus rimsulfuron applied at 0.035 lb/A gave poor control of Russian thistle.

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

Treatments[a,b]	Rate	Crop injury	Weed control				
			AMARE	AMABL	SOLNI	CHEAL	SASKR
	lb/A	%	%				
Nicosulfuron + rimsulfuron (pm)	0.035	0	100	100	100	72	57
Nicosulfuron + rimsulfuron (pm) + dicamba	0.035+0.13	0	100	100	96	100	100
Nicosulfuron + rimsulfuron (pm) + atrazine	0.035+0.45	0	100	100	100	100	80
Nicosulfuron + rimsulfuron (pm) + pyridate	0.035+0.47	0	100	100	47	100	100
DPX 79406 (pm)	0.023	0	100	100	97	28	99
DPX 79406 (pm) + dicamba	0.023+0.13	0	100	100	96	100	100
DPX 79406 (pm) + atrazine	0.023+0.45	0	100	100	99	100	73
DPX 79406 (pm) + pyridate	0.023+0.47	0	100	100	43	72	99
Weedy check		0	0	0	0	0	0

[a] pm equal packaged mix.
[b] All treatments had MSO and 32-0-0 added at 1.0% v/v and 2.5% v/v.

Broadleaf weed control in field corn with preemergence herbicides. Richard N. Arnold, Michael K. O'Neill and Dan Smeal. (New Mexico State University Agricultural Science Center, Farmington, NM 87499) Research plots were established on May 7, 2000 at the Agricultural Science Center, Farmington, New Mexico to evaluate the response of field corn (Pioneer 34K77) and annual 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. Field corn was planted with flexi-planters equipped with disk openers on May 7. Treatments were applied on May 8 and immediately incorporated with 0.75 in of sprinkler applied water. Black nightshade, common lambsquarters, redroot and prostrate pigweed infestation were heavy and Russian thistle infestation were light throughout the experimental area. Crop injury evaluations were made on June 6 and weed control evaluations were made on July 7.

Flufenacet plus metribuzin applied at 0.425 lb/A caused the highest injury of 63. All treatments except the check gave good to excellent control of common lambsquarters, Russian thistle, redroot and prostrate pigweed. Black nightshade control was good to excellent with all treatments except flufenacet plus metribuzin applied at 0.425 lb/A and the check.

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

Treatments[a]	Rate	Crop injury	Weed control				
			CHEAL	SASKR	AMARE	AMABL	SOLNI
	lb/A	—%—	%				
USA-2001	0.29	0	100	98	98	99	99
USA-2001 + atrazine	0.29+0.66	0	100	100	100	100	100
USA-2001	0.36	0	100	100	100	100	100
USA-2001 + atrazine	0.36+0.66	0	100	100	100	100	100
USA-2001	0.45	0	100	100	100	100	100
USA-2001 + atrazine	0.45+0.66	0	100	100	100	100	100
Flufenacet + metribuzin (pm)	0.425	63	100	100	100	100	45
Flufenacet + metribuzin (pm) + atrazine	0.17+0.66	0	100	100	100	100	100
Flufenacet + metribuzin (pm) + atrazine	0.26+0.66	9	100	100	100	100	100
Dimethenamid + atrazine (pm)	2.3	6	100	100	100	100	100
Weedy check		0	0	0	0	0	0

[a] pm equal packaged mix.

Control of volunteer wheat with graminicides. Curtis R. Rainbolt and Donald C. Thill. (Plant Science Division, University of Idaho, Moscow, ID 83844-2339) A field trial was established near Moscow, ID at the University of Idaho Parker Research Farm to evaluate graminicide combinations for control of volunteer wheat. The site was located where winter wheat had been grown the previous year. Experimental design was a randomized complete block with split plots. Main plots were herbicide treatment (8 by 45 ft) and split plots were application timing (8 by 15 ft). Application timings were fall, spring, and fall/spring sequential treatment. All herbicide treatments were applied with a CO_2 pressurized backpack sprayer calibrated to deliver 10 gpa at 32 psi and 3 mph (Table 1). Control was evaluated visually on April 22, May 23, and June 7, 2001.

Table 1. Application and soil data.

Application		
timing	Fall	Spring
growth stage	3-4 leaf	7-8 leaf
date	November 30, 2000	May 7, 2001
Air temperature (F)	42	68
Soil temperature at 2 in (F)	31	62
Relative humidity (%)	67	68
Wind (mph)	4	1
Soil		
pH	5	
OM%	3.5	
CEC (meq/100g)	20	
Texture	Silt loam	

Snow fell less than 14 days after treatment in the fall and there was a significant amount of winterkill, consequently, evaluations were not taken until spring when the volunteer wheat began to regrow. On April 22, control averaged 92% with quizalofop, quizalofop + imazamox, and fluazifop + imazamox (Table 2). Mixing imazamox with clethodim reduced control by 39% compared to clethodim alone. On May 23, all fall/spring combination treatments controlled volunteer wheat 56 to 85% better than their respective fall treatment. On June 7, all fall/spring combination treatments controlled volunteer wheat 88% or better. Fall/spring treatments tended to provide slightly higher control than spring only treatments, but were not statistically different due to a large degree of variation.

Table 2. Control of volunteer wheat near Moscow, ID in 2001.

Treatment[a]	Rate[b]	Application	Control April 22	May 23	June 7
	lb/A	timing		%	
Glyphosate	0.5	Fall	83	35	35
Glyphosate	1	Fall/Spring	85	93	91
Glyphosate	0.5	Spring	--	96	81
Quizalofop	0.88	Fall	93	23	35
Quizalofop	1.76	Fall/Spring	90	97	95
Quizalofop	0.88	Spring	--	79	79
Clethodim	0.1094	Fall	85	18	26
Clethodim	0.2188	Fall/Spring	85	83	90
Clethodim	0.1094	Spring	--	58	73
Fluazifop	0.125	Fall	73	28	33
Fluazifop	0.25	Fall/Spring	74	89	93
Fluazifop	0.125	Spring	--	60	75
Sethoxydim	0.375	Fall	45	3	17
Sethoxydim	0.75	Fall/Spring	46	71	88
Sethoxydim	0.375	Spring	--	58	63
Quizalofop + metribuzin	0.88 + 0.25	Fall	81	35	38
Quizalofop + metribuzin	1.76 + 0.5	Fall/Spring	84	91	94
Quizalofop + metribuzin	0.88 + 0.25	Spring	--	48	63
Clethodim + metribuzin	0.1094 + 0.25	Fall	58	18	20
Clethodim + metribuzin	0.2188 + 0.5	Fall/Spring	54	80	90
Clethodim + metribuzin	0.1094 + 0.25	Spring	--	55	76
Fluazifop + metribuzin	0.125 + 0.25	Fall	80	13	23
Fluazifop + metribuzin	0.25 + 0.5	Fall/Spring	79	98	97
Fluazifop + metribuzin	0.125 + 0.25	Spring	--	60	78
Sethoxydim + metribuzin	0.375 + 0.25	Fall	56	26	33
Sethoxydim + metribuzin	0.75 + 0.5	Fall/Spring	58	83	88
Sethoxydim + metribuzin	0.375 + 0.25	Spring	--	72	78
Quizalofop + imazamox	0.88 + 0.04	Fall	90	30	38
Quizalofop + imazamox	1.76 + 0.08	Fall/Spring	93	97	95
Quizalofop + imazamox	0.88 + 0.04	Spring	--	76	79
Clethodim + imazamox	0.1094 + 0.04	Fall	46	13	18
Clethodim + imazamox	0.2188 + 0.08	Fall/Spring	45	71	92
Clethodim + imazamox	0.1094 + 0.04	Spring	--	60	69
Fluazifop + imazamox	0.125 + 0.04	Fall	93	20	35
Fluazifop + imazamox	0.25 + 0.08	Fall/Spring	93	93	91
Fluazifop + imazamox	0.125 + 0.04	Spring	--	70	87
Sethoxydim + imazamox	0.375 + 0.04	Fall	78	25	34
Sethoxydim + imazamox	0.75 + 0.08	Fall/Spring	78	94	97
Sethoxydim + imazamox	0.375 + 0.04	Spring	--	68	82
LSD (0.05)			37	26	28

[a]All glyphosate treatments contained AMS (Bronc) at 5% v/v; all quizalofop treatments contained 90% NIS (R-11) at 0.25% v/v; all clethodim, fluazifop, and sethoxydim treatments contained crop oil concentrate at 1% v/v; and all treatments containing metribuzin contained 32% UAN at 1.25% v/v.

[b]Fall/Spring application rates are the total amount applied over both split applications.

Control of annual grasses with glyphosate-containing herbicides plus ammonium sulfate or Class Act NG. Thomas M. Ireland and Donald C. Thill. (Plant Science Division, University of Idaho, Moscow, ID 83844-2339) Two studies were established to evaluate control of annual grass weeds with glyphosate-containing herbicides plus ammonium sulfate (AMS) at 8.5 lb/100 gal or Class Act NG at 2.5% v/v. The field experiment, which had four rates of glyphosate-containing herbicides, was located near Clyde, Washington. Plots were 8 by 30 ft arranged in a split-split block with a factorial arrangement of treatments and four replications. All herbicide treatments were applied using a CO_2 pressurized backpack sprayer calibrated to deliver 10 gpa at 30 and 3 mph (Table 1). Control was evaluated visually 13, 23, and 28 days after treatment (DAT). A greenhouse experiment was conducted to evaluate control of wheat with the same glyphosate-containing herbicides at six rates with AMS and Class Act NG. Wheat seeds were planted into potting soil in 4 by 4 by 6-inch pots with four plants per pot. The experimental design was a split-split block with a factorial arrangement of treatments. Herbicide treatments were applied with a moving nozzle cabinet sprayer calibrated to deliver 10 gpa at 47 psi at the 3 to 4 leaf wheat growth stage. Biomass was collect from each pot 28 DAT.

Table 1. Application data and soil information.

Application date	March 21, 2001
Jointed goatgrass growth stage	3 to 4 leaf
Downy brome growth stage	3 to 4 leaf
Air temperature (F)	51
Relative humidity (%)	59
Wind (mph)	3
Cloud cover (%)	50
Soil temperature at 2 in (F)	40
pH	5.9
OM (%)	2.7
CEC (meq/100g)	19
Texture	silt loam

Near Clyde, WA, at 13 DAT control of annual grasses ranged from 90 to 96% (Table 2). At 28 DAT, control was 100% with all treatments except for Roundup Original (99%), Roundup Ultra (99%), and Touchdown IQ (98%) at 0.0937 lb/A with AMS.

In the greenhouse there were no interactions observed and only main effects will be reported. Wheat dry weight was reduced 53% with Roundup Ultra, and only 24 to 28% with Cornerstone and Touchdown IQ (Table. 3). Dry weight was reduced 14% with the 0.0011 lb/A rate and 60% at 0.141 lb/A (Table 4). Treatments containing Class Act NG had 26% better control than treatments with AMS ($P > 0.0001$, data not shown).

Table 2. Visual control of annual grass weeds with four glyphosate-containing herbicides applied at four rates with additives AMS or Class Act NG near Clyde, WA in 2001.

Herbicide	Rate	Additive	Annual grass control[a] 13 DAT	23 DAT	28 DAT
	lb ae/ A		%[b]		
Cornerstone	0.0937	AMS	94 bc	99 a	100 a
Cornerstone	0.1875	AMS	95 ab	99 a	100 a
Cornerstone	0.2812	AMS	95 ab	99 a	100 a
Cornerstone	0.375	AMS	95 ab	99 a	100 a
Cornerstone	0.0937	Class Act NG	95 ab	99 a	100 a
Cornerstone	0.1875	Class Act NG	95 ab	99 a	100 a
Cornerstone	0.2812	Class Act NG	95 ab	99 a	100 a
Cornerstone	0.375	Class Act NG	94 bc	99 a	100 a
Roundup Original	0.0937	AMS	94 bc	99 a	99 b
Roundup Original	0.1875	AMS	95 ab	99 a	100 a
Roundup Original	0.2812	AMS	95 ab	99 a	100 a
Roundup Original	0.375	AMS	95 ab	99 a	100 a
Roundup Original	0.0937	Class Act NG	94 bc	99 a	100 a
Roundup Original	0.1875	Class Act NG	95 ab	99 a	100 a
Roundup Original	0.2812	Class Act NG	95 ab	99 a	100 a
Roundup Original	0.375	Class Act NG	95 ab	99 a	100 a
Roundup Ultra	0.0937	AMS	91 c	98 b	99 b
Roundup Ultra	0.1875	AMS	95 ab	99 a	100 a
Roundup Ultra	0.2812	AMS	95 ab	99 a	100 a
Roundup Ultra	0.375	AMS	95 ab	99 a	100 a
Roundup Ultra	0.0937	Class Act NG	93 c	99 a	100 a
Roundup Ultra	0.1875	Class Act NG	95 ab	99 a	100 a
Roundup Ultra	0.2812	Class Act NG	95 ab	99 a	100 a
Roundup Ultra	0.375	Class Act NG	95 ab	99 a	100 a
Touchdown IQ	0.0937	AMS	90 c	98 b	98 c
Touchdown IQ	0.1875	AMS	95 ab	99 a	100 a
Touchdown IQ	0.2812	AMS	96 a	99 a	100 a
Touchdown IQ	0.375	AMS	95 ab	99 a	100 a
Touchdown IQ	0.0937	Class Act NG	94 c	99 a	100 a
Touchdown IQ	0.1875	Class Act NG	93 c	99 a	100 a
Touchdown IQ	0.2812	Class Act NG	95 ab	99 a	100 a
Touchdown IQ	0.375	Class Act NG	95 ab	99 a	100 a

[a] Weeds evaluated for control were downy brome (40% density) and jointed goat grass (60% density).

[b] Values within the same column that are followed by the same letters are not significantly different at P > 0.05.

Table 3. Dry weight of wheat treated with glyphosate-containing herbicides in a greenhouse study. Data are averaged over herbicides rates and additives.

Herbicide[a]	28 DAT
	%[b]
Cornerstone	72 a
Roundup Original	60 b
Roundup Ultra	47 c
Touchdown IQ	76 a

[a] Cornerstone, Roundup Original, and Touchdown IQ applied with non-ionic surfactant (Preference) at 0.5% v/v.

[b] Biomass expressed as a percentage of the untreated control.

Table 4. Dry weight of wheat treated with glyphosate-containing herbicides by rate from the greenhouse study. Data are averaged over herbicides and additives.

Rate	28 DAT
lb/A	%[a]
0.0011	86 a
0.023	73 b
0.035	70 b
0.047	68 b
0.094	50 c
0.141	40 c

[a] Biomass expressed as a percentage of the untreated control.

Vegetation management with herbicides during fallow periods in direct seed, dry land winter wheat cropping systems in the Pacific Northwest. Thomas M. Ireland and Donald C. Thill. (Plant Science Division, University of Idaho, Moscow, ID 83844-2339) Studies were established near Davenport and Ritzville, Washington; Moro and Pendleton, Oregon; and Lewiston and Moscow, Idaho to evaluate control of grass weeds with glyphosate-containing herbicides with and without ammonium sulfate (AMS) at 8.5 lb /100 gal of spray solution during fallow periods. All plots were 9 by 30 ft except for Lewiston and Moscow where plots were 8 by 30 ft. The experiment at each location was designed as spilt block with a factorial arrangement of treatments with four replications, except Lewiston, which was a split-split block with a factorial arrangement of treatments with four replications. All herbicide treatments were applied using a CO_2 pressurized backpack sprayer calibrated to deliver 10 gpa at 30 to 35 psi and 3 mph (Table 1). Control was evaluated visually 7, 14, 21, and 28 days after treatment (DAT). Above ground biomass was collected from a 2.7 ft^2 area in each plot 28 DAT.

Table 1. Application data.

	Davenport	Ritzville	Moro	Pendleton	Moscow	Lewiston
Application date	May 21, 2001	May 7, 2001	April 4, 2001	April 16, 2001	June 13 , 2001	May 12, 2001
Wheat growth stage	NA	-	5 to 6 leaf	5 leaf	4 leaf	5 to 6 leaf
Barlley growth stage	-	4 to 6 leaf	-	-	-	-
Downy brome growth stage	-	2 to 3 leaf	4 to 6 leaf	4 leaf	-	-
Air temperature (F)	75	70	49	67	61	42
Relative humidity (%)	32	51	62	16	60	90
Wind (mph)	7	5	3	1	3	1
Cloud cover (%)	10	95	80	0	99	50
Soil temperature at 2 in (F)	73	63	58	52	50	40

Near Moro, OR and Moscow, ID there were no differences among treatments. Control of annual grasses ranged from 83 to 86% at Moro and was 100% at Moscow (data not shown).

Near Davenport, all rates of Engame and Roundup Ultra and the high rate of Roundup Original and Touchdown IQ controlled annual grass weeds 94% or greater 14 DAT (Table 2). Biomass 28 DAT was reduced 96 to 100% by all rates of Engame and Roundup Ultra, and the high rate of Roundup Original and Touchdown IQ. The low and medium rates of Roundup Original controlled grass weeds 78 and 88% 14 DAT, respectively, and reduced biomass 28 DAT 65 to 67 percent. The low and medium rates of Touchdown IQ controlled weeds 83 to 90% 14 DAT and reduced biomass 59 and 84%, respectively. Engame and Roundup Ultra applied with and without AMS controlled annual grass weeds 96 to 98% 14 DAT (Table 3). Roundup Original and Touchdown IQ applied with AMS controlled annual grass weeds 90 to 92%, and 86% when applied without AMS.

Near Pendleton, Engame with and without AMS and Roundup Ultra, Roundup Original and Touchdown IQ with AMS controlled annual grass weeds 97 to 99% 14 DAT (Table 3). All treatments, except Touchdown IQ without AMS reduced weed biomass 99% or more 28 DAT. The ammonium sulfate by herbicide rate interaction was significant for visual control 14 DAT and weed biomass 28 DAT (Table 4). Visual control 14 DAT was 99% at the medium and high herbicide rates when mixed with AMS. Control was least (89 to 94%) when the low and medium herbicide rates were applied without AMS. Biomass 28 DAT was reduced most at the medium herbicide rate with AMS (100%) and least at the low rate without AMS (97%).

Near Ritzville, low, medium, and high herbicide rates controlled grass weeds 88, 91 and 93%, respectively, 14 DAT (data not shown). The ammonium sulfate by herbicide rate interaction was significant for dry weight 28 DAT (Table 4). The low herbicide rate without AMS reduced biomass 94%, while all other treatments reduced biomass 99% or more.

Near Lewiston, herbicides applied at medium and high rates controlled annual grass weeds 94 and 98%, respectively, 14 DAT. Visual control 14 DAT was 99% with Engame and biomass was reduced 100% at 28 DAT (data not shown). Roundup Ultra, Roundup Original, and Touchdown IQ controlled annual grass weeds 93 to 94% and reduced biomass 97 to 100% 28 DAT. All treatments with AMS controlled grass weeds 96%, while treatments without AMS controlled weeds 93% (data not shown).

Table 2. Visual control and dry weight of annual grass weeds with four glyphosate-containing herbicides at low, medium, and high application rates near Davenport, WA in 2001. Data are averaged over ammonium sulfate rates.

Herbicide[a]	Rate	14 DAT control	28 DAT biomass[b]
	lb ae/A	%[c]	
Engame	0.281	96 ab	0.6 c
Engame	0.375	98 ab	0 c
Engame	0.562	98 a	0 c
Roundup Ultra	0.281	95 b	2.0 c
Roundup Ultra	0.375	96 ab	3.0 c
Roundup Ultra	0.562	98 a	0 c
Roundup Original	0.281	78 e	33.0 a
Roundup Original	0.375	88 c	35.0 a
Roundup Original	0.562	98 ab	0 c
Touchdown IQ	0.281	83 d	41.0 a
Touchdown IQ	0.375	90 c	16.0 b
Touchdown IQ	0.562	94 b	4.0 c

[a] Engame, Roundup Original, and Touchdown applied with a 90% non-ionic surfactant (R-11) at 0.5 % v/v.

[b] Percent of the untreated control.

[c] Values within the same column that are followed by the same letters are not significantly different at P > 0.05.

Table 3. Visual control of grass weeds near Davenport, WA and Pendleton, OR in 2001 with four glyphosate-containing herbicides with and without ammonium sulfate (AMS). Data are averaged over herbicide rates.

		Davenport	Pendleton	
Herbicide[a]	AMS[b]	14 DAT control	14 DAT control	28 DAT biomass[c]
		%[d]		
Engame	W	98 a	98 ab	0.5 b
Engame	WO	97 a	99 a	0.0 b
Roundup Ultra	W	97 a	99 a	0.5 b
Roundup Ultra	WO	96 a	93 b	2.0 b
Roundup Original	W	90 b	99 a	0.2 b
Roundup Original	WO	86 c	95 b	1.0 b
Touchdown IQ	W	92 b	97 ab	0.3 b
Touchdown IQ	WO	86 c	85 c	3.0 a

[a] Engame, Roundup Original, and Touchdown applied with a 90% non-ionic surfactant (R-11) at 0.5% v/v.

[b] Ammonium sulfate (Bronc); W = AMS added to treatments at 8.5 lb/100 gal spray solution, WO = without AMS.

[c] Percent of untreated control.

[d] Values within the same column that are followed by the same letters are not significantly different at P > 0.05.

Table 4. Visual control and dry weight of annual grass weeds with glyphosate with and without ammonium sulfate (AMS) at three herbicide rates near Ritzville, WA and Pendleton, OR in 2001. Data are averaged over glyphosate containing herbicides.

		Ritzville	Pendleton	
		28 DAT	14 DAT	28 DAT
AMS[a]	Rate	dry weight[b]	control	dry weight
	lb ae/A		%[c]	
W	0.281	0.3 b	97 b	0.6 ab
W	0.375	0.4 b	99 a	0.0 c
W	0.562	0.5 b	99 a	0.5 ab
WO	0.281	6.0 a	89 d	3.0 a
WO	0.375	1.0 b	94 c	0.8 b
WO	0.562	0.2 b	97 b	0.3 ab

[a] Ammonium sulfate (Bronc); W = AMS added to treatments at 8.5 lb/100 gal spray solution, WO = without AMS.

[b] Percent of untreated control.

[c] Values within the same column that are followed by the same letters are not significantly different at $P > 0.05$.

Weed control in fallow with herbicides applied in the fall and spring. Joan Campbell and Donn Thill. (Department of Plant, Soil, and Entomological Sciences, University of Idaho, Moscow, ID 83844-2339) Two experiments, glyphoste timing and glyphosate alternatives, were established to evaluate weed control in fallow near Moscow, Idaho. The objective of the glyphosate timing experiment was to determine the best time for glyphosate application to control volunteer wheat. The objective of the glyphosate alternative experiment was to evaluate graminicides for volunteer wheat control for use with resistant wheat varieties. Herbicide treatments were applied with a CO_2 pressurized backpack sprayer calibrated to deliver 10 gpa at 32 psi and 3 mph (Table 1). The soil texture, pH, organic matter, and cation exchange capacity were silt loam, 5.3, 2.8%, and 18 cmol/kg, respectively. The experimental design was randomized complete block with four replications and plots were 8 by 30 ft. Weed control was evaluated visually on June 11, 2001.

Table 1. Application data.

Experiment	Glyphosate timing			Glyphosate alternative	
Timing	Fall	Early spring	Spring	Fall	Spring
Application date	October 26, 2000	April 20, 2001	May 21, 2001	October 26, 2000	May 21, 2001
Soil temperature (F)	47	44	80	47	80
Air temperature (F)	51	45	65	51	65
Relative humidity (%)	80	70	52	80	52
Wheat growth stage	2 to 4 leaf	2 to 3 leaf	4 leaf to 2 tiller	2 to 4 leaf	4 leaf to 2 tiller

Snow mold and rodent depredation killed 90 to 95% of the volunteer wheat (TRZAX) over the winter which resulted in a variable wheat stand and little difference between fall applied treatments. In the glyphosate timing experiment, volunteer wheat control was 89% or better with all treatments except glyphosate applied at 0.375 lb/A in the fall and consecutively in the spring (Table 2). Intermediate windgrass (APEIN), downy brome (BROTE), and catchweed bedstraw (GALAP) control was good to excellent and did not differ among treatments. Prickly lettuce (LACSE) control was variable and ranged from 37 to 98%. In the glyphosate alternative experiment, volunteer wheat control was poor with all fall applied treatments (28 to 71%) (Table 3). Volunteer wheat control volunteer wheat control was 100% with spring applied glyphosate and was lowest with spring applied imazapyr at 0.004 and 0.006 lb/A and paraquat/diuron (51% to 71%).

Table 2. Weed control in fallow with glyphosate applied in the fall and spring near Moscow, Idaho.

			Weed control				
Treatment[a]	Rate	Timing	TRZAX	APEIN	BROTE	GALAP	LACSE
	lb/A		%				
Glyphosate +	0.1875	Fall					
glyphosate	0.375	Spring	94	95	100	95	78
Glyphosate +	0.375	Fall					
glyphosate	0.1875	Spring	96	100	100	95	55
Glyphosate	0.563	Early Spring	90	100	100	83	77
Glyphosate +	0.375	Fall					
glyphosate	0.375	Spring	72	95	80	95	65
Glyphosate +	0.1875	Early Spring					
glyphosate	0.375	Spring	89	100	100	100	72
Glyphosate +	0.375	Early Spring					
glyphosate	0.1875	Spring	92	100	100	100	95
Glyphosate +	0.375	Early Spring					
glyphosate	0.375	Spring	91	100	100	100	93
Glyphosate	0.563	Spring	90	100	100	100	73
Paraquat/diuron	0.75	Fall					
glyphosate	0.375	Spring	91	100	100	100	37
Paraquat/diuron +	0.75	Fall					
glyphosate	0.1875	Spring	94	100	100	100	68
Paraquat/diuron +	0.75	Early Spring					
glyphosate	0.375	Spring	96	100	100	100	83
Paraquat/diuron +	0.75	Early Spring					
glyphosate	0.1875	Spring	94	95	100	100	98
LSD (0.05)			11	NS	NS	NS	44

[a]Treatments containing glyphosate included AMS (Bronc) at 17 lb/100 gal. All treatments included nonionic surfactant (R11) at 0.25% v/v. The glyphosate formulation was Roundup Original.

Table 3. Volunteer wheat control with graminicides in fallow near Moscow, Idaho in 2001.

Treatment	Rate	Time of application	Volunteer wheat control[a]
	lb/A		%
Quizalafop[b,c]	0.069	Fall	64
	0.069	Spring	88
Quizalafop[b,c]	0.086	Fall	69
	0.086	Spring	88
Imazapyr[d,e]	0.004	Fall	30
	0.004	Spring	72
Imazapyr[d,e]	0.006	Fall	28
	0.006	Spring	51
Imazapyr[d,e]	0.008	Fall	35
	0.008	Spring	78
Clethodim[b,f]	0.125	Fall	71
	0.125	Spring	94
Sethoxydim[b,f]	0.375	Fall	60
	0.375	Spring	81
Glyphosate[b]	0.563	Fall	51
	0.563	Spring	100
Paraquat/diuron[e]	0.375	Fall	39
	0.375	Spring	71
LSD (0.05)			26

[a] Evaluated June 11, 2001
[b] AMS (Bronc) added at 17 lb/100 gal
[c] COC (Moract) added at 1% v/v
[d] Nitrogen solution (32%) added at 1% v/v
[e] NIS (R11) added at 0.25 % v/v
[f] COC (Sunit II) added at 1% v/v

Weed control in fallow with spring applied herbicides in northern Idaho. Joan Campbell and Donn Thill. (Department of Plant, Soil, and Entomological Sciences, University of Idaho, Moscow, ID 83844-2339) Two experiments were established to evaluate weed control in fallow in northern Idaho. Volunteer wheat control with four formulations of glyphosate was evaluated at Lewiston. Three herbicides applied at the 2 to 4 leaf and early joint wheat growth stage were evaluated at Moscow. Herbicide treatments were applied with a CO_2 pressurized backpack sprayer calibrated to deliver 10 gpa at 32 psi and 3 mph (Table 1).

Table 1. Environmental and edaphic data.

Location	Lewiston	Moscow	
Application date	April 12, 2001	April 20, 2001	May 31, 2001
Wheat growth stage	0 to 2 tiller, 6 to 8 inches	2 to 4 leaf	Early joint
Air temperature (F)	50	45	67
Soil temperature (F)	40	44	49
Relative humidity (%)	79	72	42
Cloud cover (%)	80 to 100	75	0
Wind speed (mph, direction)	0 to 3, NW	0 to 2, NW	0
Soil			
pH	5.6	5.3	
Organic matter (%)	1.7	2.8	
Cation exchange capacity (cmol/kg)	18	18	
Texture	Silt loam	Silt loam	

Volunteer wheat contol at Lewiston was 93% or greater with all treatments, but control was best with Engame applied at 0.56 and 0.75 lb/A (Table 2). Volunteer wheat control was 2 to 4% better with 0.75 lb/A than 0.375 lb/A within each formulation, but volunteer wheat control was equal to or better with Engame than other formulations within all three rates. Volunteer wheat, interrupted windgrass, and downy brome control at Moscow was 100% with RT Master and Roundup Ultra applied at the early joint stage (Table 3). Control of these three species with UI 2001A applied at the 2 to 4 leaf stage ranged from 88 to 99%, but control was inadequate when UI 2001A was applied at the early joint growth stage.

Table 2. Volunteer wheat control in fallow with glyphosate formulations at Lewiston, Idaho in 2001.

Treatment	Rate	Volunteer wheat control
	lb/A	%
Roundup Ultra[a]	0.375	93
Roundup Ultra[a]	0.56	96
Roundup Ultra[a]	0.75	97
Roundup Original[a,b]	0.375	96
Roundup Original[a,b]	0.56	97
Roundup Original[a,b]	0.75	98
RT Master[a,b]	0.375	95
RT Master[a,b]	0.56	94
RT Master[a,b]	0.75	98
Engame[b]	0.375	96
Engame[b]	0.56	99
Engame[b]	0.75	100
LSD (0.05)		2

[a] Applied with AMS (Bronc) at 8.5 lb/100 gal
[b] Applied with NIS (R-11) at 0.5% v/v

Table 3. Volunteer wheat, interrupted windgrass, and downy brome control in fallow near Moscow, Idaho in 2001.

Treatment	Rate	Growth stage	Weed control Volunteer wheat	Weed control Interrupted windgrass	Weed control Downy brome
	lb/A		%		
UI 2001A[a]	0.0134	2 to 4 leaf	92	94	88
UI 2001A[a]	0.0134	early joint	51	61	32
UI 2001A[a]	0.0268	2 to 4 leaf	94	99	89
UI 2001A[a]	0.0268	early joint	44	52	16
RT Master[b]	0.56	2 to 4 leaf	94	90	78
RT Master[b]	0.56	early joint	100	100	100
Roundup Ultra[c]	0.56	2 to 4 leaf	89	91	88
Roundup Ultra[c]	0.56	early joint	100	100	100
LSD (0.05)			18	21	29

[a] Applied with COC (Sunit II) at 1.9% v/v + UAN at 2.5% v/v
[b] Applied with NIS (R-11) at 0.5% v/v + AMS (Bronc) 8.5 lb/100 gal
[c] Applied with AMS (Bronc) at 8.5 lb/100 gal

A first year comparison of various herbicides for Canada thistle control. Tom Whitson and Alex Ogg. (Department of Plant Sciences, University of Wyoming, Laramie, WY, 82071-3354). Canada Thistle is one of the most common noxious weeds in the Western U.S. It is highly invasive in rangeland riparian zones and irrigated cropland. This trial was established to compare the new herbicide Redeem to some of the more commonly used herbicides. Applications were made May 24, 2001 to Canada thistle in the rosette stage. Applications of 30 gpa were made to 10 by 27 ft. plots with four replications. Air temperatures were 60°F while soil temperatures ranged from 82°F on the surface to 70°F at a 4 inch depth. Soils were sandy loam. Evaluations made two months following application show early first season control but final evaluations will be made in 2002. Clopyralid + triclopyr (Redeem) at rates of 2.5, 3, 3,5 and 4 pt. product/acre had average controls of 75 to 79% while Clopyralid + 2, 4-D had an 87% control the first season. (Published with the approval of the Wyoming Agricultural Experiment Station).

Table. A first year comparison of various herbicides for Canada thistle control

Treatment	Rate (ai/A)	% Control
Clopyralid + Triclopyr (Redeem) + Act. 90	0.16 + 0.62	75
Clopyralid + Triclopyr + NIS	0.19+ 0.75	77
Clopyralid + Triclopyr + NIS	0.22 + 0.87	79
Clopyralid + Triclopyr + NIS	0.25 + 1.0	75
2,4-D(A) + NIS	2.0	37
Dicamba + NIS	1.5	46
Metsulfuron + NIS	0.18	54
Clopyralid + 2,4-D (A) + NIS	0.28 + 1.5	87
Picloram + NIS	0.38	54
Check (number thistle per plot=143)		0

Tolerance of three grass species to preplant applications of quinclorac. Bill D. Brewster, Chuck Cole, and Carol A. Mallory-Smith. (Department of Crop and Soil Science, Oregon State University, Corvallis, OR 97331-3002) 'Shademaster' red fescue, 'Pennlate' orchardgrass, and 'Buccaneer' perennial ryegrass were seeded in separate trials at the OSU. Hyslop research farm near Corvallis, to evaluate tolerance to preplant applications of quinclorac. The experimental design was a randomized complete block with four replications and 8 ft by 30 ft plots. The grasses were seeded in 12-inch rows with activated charcoal on September 27, 2000. Diuron was applied at 1.6 lb/A prior to crop emergence to help control annual grass weeds. The soil was a Woodburn silt loam with a pH of 6.0 and an organic matter content of 2.4%. The quinclorac treatments were applied with a single-wheel, compressed-air plot sprayer which delivered 20 gpa through XR8003 flat fan nozzle tips at 20 psi. Quinclorac was applied at two rates on three dates prior to seeding the grasses. Herbicide application information is presented in Table 1. Seed yields were obtained by swathing the grasses, threshing with a plot combine, and cleaning the seed with an M-2B Clipper cleaner.

Grass seed yields are presented in Table 2. No visible injury symptoms occurred on the grasses in the vegetative stage of growth, and seed yield of orchardgrass and perennial ryegrass were not affected by the quinclorac applications. However, red fescue seed yields were reduced, especially in plots treated with quinclorac on the same day that the grasses were seeded.

Table 1. Herbicide application information.

Application date	August 30, 2001	September 13, 2001	September 27, 2001
Air temperature (F)	66	71	50
Soil temperature (F)	64	73	52
Relative humidity (%)	59	52	57
Wind velocity (mph)	2 to 4	4 to 6	0

Table 2. Grass seed yields following preplant applications of quinclorac, near Corvallis, OR.

		Seed yield		
Quinclorac rate	Application date	Perennial ryegrass	Orchardgrass	Red fescue
lb/A			lb/A	
0.38	August 30, 2000	1343	698	672
0.75	August 30, 2000	1308	648	621
0.38	September 13, 2000	1331	675	814
0.75	September 13, 2000	1328	605	678
0.38	September 27, 2000	1216	614	654
0.75	September 27, 2000	1324	573	540
0	---	1354	578	809
$LSD_{0.05}$	---	n.s.	n.s.	151

Weed control in seedling grasses with carfentrazone combinations. Bill D. Brewster, Chuck Cole, and Carol A. Mallory-Smith. (Department of Crop and Soil Science, Oregon State University, Corvallis, OR 97331-3002) Several cool-season grass species are grown for seed in Oregon. Carfentrazone is effective on many broadleaf weeds that infest grass fields, including ivyleaf speedwell and catchweed bedstraw, but must be applied when the weeds are small and when newly-seeded grasses are still in the seedling stage. A trial was conducted at the OSU Hyslop Research Farm near Corvallis to evaluate carfentrazone applied alone and in combination with other herbicides for crop safety on five seedling grass species. Shepherdspurse, common lambsquarters, and sharppoint fluvellin were the primary weeds that infested the site. Six rows each of 'Highland' dryland bentgrass, 'Pennlate' orchardgrass, 'Gator II' perennial ryegrass, 'Shademaster' red fescue, and 'Velocity' tall fescue were seeded across each plot on April 16, 2001. The experimental design was a randomized complete block with four replications. Individual plots were 8 ft by 35 ft. Herbicides were applied with a single-wheel, compressed-air sprayer which delivered 20 gpa through XR8003 flat fan nozzle tips at 20 psi. Herbicide application information is presented in Table 1.

Visual evaluations of crop injury and weed control 3 weeks after application of the herbicides are presented in Table 2. The standard treatment of oxyfluorfen was more injurious to dryland bentgrass than was carfentrazone either applied alone or in combination with other herbicides. Orchardgrass was injured when 2,4-D or 2,4-D plus clopyralid was added to carfentrazone but was not greatly affected by the other treatments. Perennial ryegrass was most sensitive to the treatments that contained tribenuron. Tall fescue and red fescue adequately tolerated all of the treatments. Oxyfluorfen did not control shepherdspurse and was less effective than carfentrazone on common lambsquarters, but was much better than carfentrazone on sharppoint fluvellin. The addition of tribenuron to carfentrazone greatly improved the control of sharppoint fluvellin.

Table 1. Application information.

Application date	May 16, 2001
Air temperature (F)	55
Soil temperature (F)	57
Relative humidity (%)	74
Wind velocity (MPH)	4
Stage of growth	
Perennial ryegrass	4 to 5 leaf, 1 to 2 tillers
Tall fescue	3 leaf
Red fescue	3 leaf
Orchardgrass	3 leaf
Dryland bentgrass	3 leaf
Shepherdspurse	4 to 6 leaf
Common lambsquarters	2 to 4 leaf
Sharppoint fluvellin	2 leaf

Table 2. Crop injury and weed control following herbicide application on seedling grasses grown for seed, near Corvallis, Oregon.

Treatment	Rate	Crop injury: Dryland bentgrass	Crop injury: Orchard-grass	Crop injury: Red fescue	Crop injury: Tall fescue	Crop injury: Perennial ryegrass	Weed control: Shepherdspurse	Weed control: Common lambsquarters	Weed control: Sharppoint fluvellin
	lb/A	%							
Carfentrazone	0.017	0	5	5	3	3	95	99	0
Carfentrazone	0.025	3	5	3	3	3	99	99	28
Oxyfluorfen	0.038	28	18	8	8	5	60	90	99
Carfentrazone + 2,4-D	0.017 + 0.25	9	20	9	6	3	95	99	76
Carfentrazone + 2,4-D	0.025 + 0.25	6	23	9	9	3	98	99	78
Carfentrazone + MCPA	0.017 + 0.38	8	10	10	4	5	99	100	73
Carfentrazone + MCPA	0.025 + 0.38	4	8	3	5	0	100	100	74
Carfentrazone + dicamba	0.017 + 0.25	4	10	9	9	11	93	100	81
Carfentrazone + dicamba	0.025 + 0.25	3	13	6	3	3	98	99	73
Carfentrazone + clopyralid & 2,4-D[a]	0.017 + 0.048 + 0.25	9	23	15	15	8	96	100	82
Carfentrazone + clopyralid & 2,4-D[a]	0.025 + 0.048 + 0.25	9	38	18	15	9	100	99	85
Carfentrazone + tribenuron	0.017 + 0.016	3	13	5	11	24	99	99	99
Carfentrazone + tribenuron	0.025 + 0.016	10	18	10	18	35	100	99	99
Check	0	0	0	0	0	0	0	0	0
$LSD_{0.05}$	—	10	14	n.s.	n.s.	10	4	4	21

[a]A commercial formulation.

<u>Flax response to application timing of postemergence herbicides.</u> Gregory J. Endres and Blaine G. Schatz. (Carrington Research Extension Center, North Dakota State University, Carrington, ND 58421) The trial was conducted to evaluate flax response to three application timings of selected POST herbicides. The experimental design was a randomized complete block design with a split-plot arrangement (main plots=herbicide application timing and subplots=herbicide treatments) and three replicates. The trial was conducted on a conventional-tilled, loam soil with 7.6 pH and 2.4% organic matter at Carrington, ND in 2001. 'Pembina' flax was seeded on May 11 at the rate of 42 lb/A. Herbicide treatments were applied to the center 6.7 ft of 10- by 25-ft plots with a CO_2 pressurized hand-held plot sprayer at 17 gal/A and 35 psi through 80015 flat fan nozzles. Early POST (POST A) treatments were applied on June 2 with 62 F, 64% RH, 70% clear sky, and 7 mph wind to 1.5-inch tall flax. Mid POST (POST B) treatments were applied on June 17 with 53 F, 95% RH, 30% clear sky, and 7 mph wind to 5- to 6-inch tall flax, 2- to 4-leaf yellow and green foxtail, 2- to 3-inch tall redroot and prostrate pigweed, 3- to 5-inch tall common lambsquarters, and 3- to 6-inch tall wild mustard. Late POST (POST C) treatments were applied on June 28 with 77 F, 86% RH, 10% clear sky, and 5 mph wind to 12- to 14-inch tall (initial flowering stage) flax. The trial was harvested on August 23 with a plot combine.

Full-season weed control was achieved with bromoxynil&MCPA or clopyralid&MCPA and sethoxydim tank mixtures, or the three-way tank mixture (Table 1). Averaged across herbicide treatments, flax growth reduction was higher with the first two herbicide application times but PM (physiological maturity) was delayed and seed yield was reduced with the late application (Table 2). Herbicide treatments that included clopyralid&MCPA generally had significant flax growth reduction (Table 3). All herbicide treatments and application timings extended PM four to nine days compared to the untreated check. All herbicide treatments applied early improved yield compared to the untreated check (Table 4). The mid- and late-applied herbicide treatments generally had similar yield as the untreated check and less yield compared to the early-applied treatments. The highest test weight with all herbicide application timings was with bromoxynil&MCPA or clopyralid&MCPA and sethoxydim tank mixtures, or the three-way tank mixture. Based on these data, bromoxynil&MCPA or clopyralid&MCPA and sethoxydim tank mixtures, or the three-way tank mixture applied early provided the highest yield and test weight.

Table 1. Weed control in flax with three application timings of POST herbicides.

Herbicide		POST A[a]		POST B[a]		POST C[a]	
		Weed control[b]					
		6/29		7/17		7/25	
Treatment[c]	Rate	Grass	Broadleaf	Grass	Broadleaf	Grass	Broadleaf
	lb/A	%					
Bromoxynil&MCPA	0.23&0.23	0	95	0	94	0	94
Clopyralid&MCPA	0.07&0.39	0	93	0	90	0	88
Bromoxynil&MCPA+clopyralid&MCPA	0.23&0.23+0.07&0.39	0	98	0	96	0	96
Bromoxynil&MCPA+sethoxydim+MSO	0.23&0.23+0.2+2pt	92	96	81	81	87	94
Clopyralid&MCPA+sethoxydim+MSO	0.07&0.39+0.2+2pt	92	95	94	86	91	95
Bromoxynil&MCPA+clopyralid+MCPA +sethoxydim+MSO	.23&0.23+0.07&0.39+0.2+2pt	92	97	91	96	87	96
Bentazon&sethoxydim+MSO	1&0.2+2pt	93	94	95	50	87	55
Untreated check		0	0	0	0	0	0
LSD (0.05)		4	9	4	9	4	9

[a]POST A=June 2; POST B=June 17; POST C=June 28.

[b]Grass=Yellow and green foxtail; Broadleaf=Common lambsquarters, redroot and prostrate pigweed, wild buckwheat, and wild mustard.
[c]Bromoxynil&MCPA=Bronate; Clopyralid&MCPA=Curtail M; Bentazon+sethoxydim=Rezult; MSO=Destiny, a methylated seed oil from Agriliance, St. Paul, MN.

Table 2. Flax response across herbicide treatments with three application timings of POST herbicides.

Herbicide application timings[a]	Flax Injury[b]	PM[c]	Seed yield	Test weight
	%	days	bu/A	lb/bu
POST A	13	88	18.7	52.9
POST B	17	88	17.1	52.6
POST C	7	91	14.2	53.1
LSD (0.05)	6	1	3	NS

[a]POST A=June 2; POST B=June 17; POST C=June 28.

[b]Injury=% growth reduction by visual evaluation 7 days after treatment.

[c]PM=Physiological maturity from seeding date.

Table 3. Flax injury and days to physiological maturity with three application timings of POST herbicides.

Herbicide		POSTA[a]		POSTB[a]		POSTC[a]	
		Flax					
Treatment[b]	Rate	Injury[c]	PM[d]	Injury	PM	Injury	PM
	lb/A	%	days	%	days	%	days
Bromoxynil&MCPA	0.23&0.23	0	88	8	88	0	90
Clopyralid&MCPA	0.07&0.39	3	89	23	88	12	91
Bromoxynil&MCPA+clopyralid&MCPA	0.23&0.23+0.07&0.39	23	90	40	90	13	93
Bromoxynil&MCPA+sethoxydim+MSO	0.23&0.23+0.2+2pt	18	88	3	88	3	92
Clopyralid&MCPA+sethoxydim+MSO	0.07&0.39+0.2+2pt	11	88	23	90	15	92
Bromoxynil&MCPA+clopyralid+MCPA	.23&0.23+0.07&0.39+0.2+2p	37	90	32	90	15	93
Bentazon&sethoxydim+MSO	1&0.2+2pt	13	88	3	88	0	88
Untreated check		0	84	0	84	0	84
LSD (0.05)		9	2	9	2	9	2

[a]POSTA=June 2; POSTB=June 17; POSTC=June 28.

[b]Bromoxynil&MCPA=Bronate; Clopyralid&MCPA=Curtail M; Bentazon+sethoxydim=Rezult; MSO=Destiny, a methylated seed oil from

[c]Injury=% growth reduction by visual evaluation 7 days after treatment.

[d]PM=Physiological maturity from seeding date.

Table 4. Flax seed yield and test weight with three application timings of POST herbicides.

Herbicide		POSTA[a]		POSTB[a]		POSTC[a]	
		Seed	Test	Seed	Test	Seed	Test
Treatment[b]	Rate	yield	weight	yield	weight	yield	weight
	lb/A	bu/A	lb/A	bu/A	lb/bu	bu/A	lb/bu
Bromoxynil&MCPA	0.23&0.23	17.3	52.6	17.8	53.0	15.9	52.6
Clopyralid&MCPA	0.07&0.39	19.9	52.9	17.9	52.9	12.5	53.2
Bromoxynil&MCPA+clopyralid&MCPA	0.23&0.23+0.07&0.39	19.0	52.9	18.8	52.8	13.4	53.1
Bromoxynil&MCPA+sethoxydim+MSO	0.23&0.23+0.2+2pt	20.4	53.9	17.6	53.5	15.2	53.9
Clopyralid&MCPA+sethoxydim+MSO	0.07&0.39+0.2+2pt	19.3	53.8	17.1	53.9	13.5	54.3
Bromoxynil&MCPA+clopyralid+MCPA +sethoxydim+MSO	.23&0.23+0.07&0.39+0.2+2p	19.9	53.7	16.6	53.9	13.7	53.9
Bentazon&sethoxydim+MSO	1&0.2+2pt	19.1	53.8	15.7	51.0	13.8	53.3
Untreated check		14.5	50.0	15.1	50.0	15.4	50.2
LSD (0.05)		2.8	0.9	2.8	0.9	2.8	0.9

[a]POSTA=June 2; POSTB=June 17; POSTC=June 28.

[b]Bromoxynil&MCPA=Bronate; Clopyralid&MCPA=Curtail M; Bentazon+sethoxydim=Rezult; MSO=Destiny, a methylated seed oil from Agriliance, St. Paul, MN

Weed control in Austrian winter pea in northern Idaho. Joan Campbell and Donn Thill. (Department of Plant, Soil, and Entomological Sciences, University of Idaho, Moscow, ID 83844-2339) An experiment was established to evaluate weed control in Austrian winter pea near Genesee, Idaho. Herbicide treatments were applied with a CO_2 pressurized backpack sprayer calibrated to deliver 10 gpa at 32 psi and 3 mph (Table 1). The experimental design was randomized complete block with four replications and plots were 8 by 30 ft. Broadleaf weed control and pea injury were evaluated visually.

Table 1. Environmental and edaphic data.

Application date	April 25, 2001
Austrian winter pea growth stage	2 node, 6 inch
Downy brome growth stage, density	2 leaf to 3 tiller, 1 to 3/ft^2
Prickly lettuce growth stage, density	3 inch, 1 to 2/yd^2
Mayweed chamomile growth stage, density	2 to 4 inch, 1 to 5/ft^2
Air temperature (F)	58
Soil temperature (F)	42
Relative humidity (%)	74
Cloud cover (%)	0
Wind speed (mph, direction)	5, East
Soil	
pH	7.3
Organic matter (%)	4.5
Cation exchange capacity (cmol/kg)	23
Texture	

Imazamox at 0.04 lb/A injured pea 10%. Prickly lettuce control was not adequate with any treatments and mayweed chamomile was controlled only with bentazon (91%) (Table 2). Downy brome control was 92% or better with imazamox and quizalofop treatments.

Table 2. Weed control in Austrian winter pea near Genesee, Idaho in 2001.

		Weed control		
Treatment	Rate	Mayweed chamomile	Prickly lettuce	Downy brome
	lb/A		%	
Metribuzin	0.25	62	61	10
Bentazon + COC[a]	0.75 + 1% v/v	91	45	0
Imazethapyr + R-11[b] + AMS[c]	0.047 + 0.25% v/v + 2.5% v/v	66	26	0
Imazethapyr + COC[a] + AMS[c]	0.047 + 2.5% v/v+ 2.5% v/v	56	46	0
Imazamox + COC[a] + UAN[d]	0.032 + 1.25% v/v + 1.25% v/v	41	60	92
Imazamox + COC[a] + UAN[d]	0.04 + 1.25% v/v + 1.25% v/v	28	27	94
Quizalofop + R-11[b]	0.055 + 0.25% v/v	0	0	94
Imazethapyr + Quizalofop + R-11 + AMS[c]	0.047 + 0.055 + 0.25% v/v + 2.5% v/v	32	56	94
LSD (0.05)		33	46	6

[a] Crop oil concentrate (Sunit II)
[b] Nonionic surfactant (R-11)
[c] Ammonium sulfate (Bronc)
[d] Urea ammonium nitrate liquid fertilizer

Common groundsel control in peppermint with herbicide combinations. Bill D. Brewster, Carol A. Mallory-Smith, and Chuck Cole. (Department of Crop and Soil Science, Oregon State University, Corvallis, OR 97331-3002) Common groundsel is a ubiquitous weed in peppermint production. Repeated applications of bromoxynil has led to resistance in some fields. Two trials were conducted in Willamette Valley peppermint fields to evaluate the efficacy of herbicide combinations on dense stands of common groundsel. The site near Coburg had a history of bromoxynil failure on common groundsel. The soil at the Coburg site was a Newberg loam with a pH of 6.7 and an organic matter content of 4.0%. The Stayton site had a Clackamas gravelly loam soil with a pH of 5.2 and an organic matter content of 8.4%. The experimental design was a randomized complete block with four replications. Individual plots were 8 ft by 25 ft. Herbicides were applied with a single-wheel, compressed-air plot sprayer which delivered 20 gpa at 20 psi through XR8003 flat fan nozzle tips. A non-ionic surfactant was added to all treatments at a rate of 0.25% v/v. Herbicide application information is presented in Table 1.

Treatments that did not contain clopyralid failed to control common groundsel at Coburg (Table 2), but all treatments provided greater than 90% control at Stayton. The combination of pyridate, terbacil, and bromoxynil caused the greatest amount of crop injury at both sites; the injury was probably unacceptable at Coburg.

Table 1. Herbicide application information for trial sites near Coburg and Stayton, OR.

	Coburg	Stayton
Application date	May 16, 2001	April 26, 2001
Air temperature (F)	66	59
Soil temperature (F)	69	60
Relative humidity (%)	60	81
Wind velocity (mph)	0	2 to 3
Growth stage		
Peppermint	2 to 6 inch	2 to 4 inch
Common groundsel	cotyledon to 8 inches tall and flowering	cotyledon to 8 inches tall and seed set

Table 2. Peppermint injury and common groundsel control following applications of herbicide combinations at two sites in western Oregon.

		Peppermint injury		Common groundsel control	
Treatment	Rate	Coburg[a]	Stayton[b]	Coburg[a]	Stayton[b]
	lb/A				
Bromoxynil + terbacil	0.12 + 0.8	4	0	28	96
Pyridate + terbacil	0.95 + 0.8	8	0	71	97
Pyridate + terbacil + clopyralid	0.95 + 0.8 + 0.12	8	0	98	99
Pyridate + terbacil + bromoxynil	0.95 + 0.8 + 0.12	23	15	59	94
Bromoxynil + terbacil + clopyralid	0.12 + 0.8 + 0.12	8	0	96	98
Pyridate + clopyralid	0.95 + 0.12	6	0	98	97
Bromoxynil + clopyralid	0.25 + 0.12	11	0	100	100
Check	0	0	0	0	0
$LSD_{0.05}$	---	10	2	29	5

[a]Evaluated June 19, 2001.
[b]Evaluated June 12, 2001.

Tolerance of peppermint to flumioxazin. Bill D. Brewster, Carol A. Mallory-Smith, Chuck Cole, and Richard P. Affeldt. (Department of Crop and Soil Science, Oregon State University, Corvallis, OR 97331-3002) Trials were conducted in western and central Oregon to evaluate the tolerance of dormant peppermint to applications of flumioxazin. Central Oregon has a drier, colder winter climate than does western Oregon. The soil at Site 1 near Monroe in western Oregon was a Chehalis silty clay loam with a pH of 5.6 and an organic matter content of 3.6%. The soil at Site 2 near Jefferson in western Oregon was a Newberg fine sandy loam with a pH of 5.0 and an organic matter content of 2.0%. Site 3 near Terrebonne in central Oregon had a Deschutes sandy loam soil with a pH of 4.6 and an organic matter content of 3.6%, while Site 4 in central Oregon had a Crooked sandy loam soil with a pH of 5.3 and an organic matter content of 2.8%. The plots were hand-weeded in the spring to eliminate weed interference with mint growth. The experimental design was a randomized complete block with four replications. Individual plots were 8 ft by 20 ft or 8 ft by 25 ft. Herbicides were applied with a single-wheel, compressed air plot sprayer which delivered 20 gpa through XR8003 flat fan nozzle tips at 20 psi. Herbicide application information is presented in Table 1. A non-ionic surfactant was added to the herbicide treatments at a rate of 0.25% v/v. There were two application timings at the western Oregon sites and one at the central Oregon sites. Peppermint oil yields were obtained by hand-harvesting the plants from 3 sq yd in each plot and distilling the oil from a 10-lb subsample.

The higher rate of flumioxazin at Sites 1 and 2 caused more visible peppermint injury than the lower rate or the standard treatment of oxyfluorfen plus paraquat (Table 2). The addition of paraquat did not increase crop injury. Fresh weights were reduced by the higher rate at the December application timing at Site 1 and at Site 3 in central Oregon (Table 3). Fresh weights from flumioxazin treatments were not significantly different than those from the standard treatment at any of the locations, and there were no significant differences among peppermint oil yields at any location.

Table 1. Herbicide application information for two sites in western Oregon and two sites in central Oregon.

	Site 1		Site 2		Site 3	Site 4
Application date	December 6, 2000	January 16, 2001	December 5, 2000	January 12, 2001	March 6, 2001	March 26, 2001
Growth stage	2 to 5 inch	3 to 5 inch	4 to 6 inch	4 to 6 inch	dormant	dormant
Air temperature (F)	48	52	41	45	48	46
Soil temperature	49	53	39	44	49	48
Relative humidity (%)	32	68	72	84	74	74
Wind velocity (mph)	0	2 to 4	0	2	3	0

Table 2. Peppermint injury, foliage weight, and oil yield following applications of flumioxazin in western Oregon.

			Peppermint					
			Injury		Foliage fresh weight		Oil yield	
Treatment	Rate	Timing	Site 1	Site 2	Site 1	Site 2	Site 1	Site 2
	lb/A		%		lb/yd^2		lb/a	
Flumioxazin	0.062	12/5/00	14	10	8.7	4.7	71	51
Flumioxazin	0.125	12/5/00	23	25	7.3	4.3	56	57
Flumioxazin + paraquat	0.125 + 0.25	12/5/00	25	20	7.8	5.0	73	55
Oxyfluorfen + paraquat	0.25 + 0.25	12/5/00	0	5	8.5	5.6	72	54
Flumioxazin + paraquat	0.125 + 0.25	1/12/01	25	38	9.4	4.0	73	54
Check	0		0	0	10.3	5.5	84	65
$LSD_{0.05}$	—		23	13	1.9	n.s.	n.s.	n.s.

Table 3. Peppermint injury, foliage weight, and oil yield following application of flumioxazin in central Oregon.

		Peppermint					
		Injury		Foliage fresh weight		Oil yield	
Treatment	Rate	Site 3	Site 4	Site 3	Site 4	Site 3	Site 4
	lb/A	%		lb/yd^2		lb/A	
Flumioxazin	0.125	45	13	4.2	7.3	61	69
Oxyfluorfen	0.5	0	0	4.7	6.7	62	52
Check	0	0	0	5.4	6.0	66	52
$LSD_{0.05}$	---	10	n.s.	0.6	n.s.	n.s.	n.s.

Control of western mannagrass in Italian ryegrass. Bill D. Brewster, Chuck Cole, and Carol A. Mallory-Smith. (Department of Crop and Soil Science, Oregon State University, Corvallis, OR 97331-3002) Western mannagrass infests poorly drained soils in the Willamette Valley that are used to produce Italian ryegrass seed. Trials were conducted to evaluate pyrithiobac and difenzoquat for postemergence control of western mannagrass in a field of 'Ribeye' Italian ryegrass near Lebanon, OR. The soil was a Holcomb silt loam with a pH of 5.1 and an organic matter content of 4.8%. The experimental design was a randomized complete block with four replications. Individual plots were 8 ft by 25 ft. Herbicides were applied with a single-wheel, compressed-air sprayer which delivered 20 gpa through XR8003 flat fan nozzle tips at 20 psi. The first trial was established on January 4, and the second on February 6, 2000. A nonionic surfactant was added to the herbicide treatments at a rate of 0.25% v/v. Herbicide application information for both trials is presented in Table 1.

Pyrithiobac provided complete control of western mannagrass at both rates of application in Trial 1 (Table 2). Italian ryegrass injury was moderate at the lower rate but was probably too injurious at the higher rate. Difenzoquat caused no crop injury but provided less than 50% control of western mannagrass. In the subsequent trial, lower rates of pyrithiobac provided excellent control of western mannagrass and caused less crop injury than in the previous trial (Table 3). The addition of a reduced rate of difenzoquat to pyrithiobac was not more injurious than pyrithiobac alone.

Table 1. Herbicide application information for two trials near Lebanon, OR.

	Trial 1	Trial 2
Application date	January 4, 2001	February 6, 2001
Western mannagrass growth stage	3-4 leaf, 0-1 tiller	4 leaf, 0-3 tillers
Italian ryegrass growth stage	2-3 tillers	4-12 inches tall
Air temperature (F)	43	46
Soil temperature (F)	43	47
Relative humidity (%)	87	64
Wind velocity	calm	calm

Table 2. Control of western mannagrass and injury to Italian ryegrass with pyrithiobac and difenzoquat, near Lebanon, OR (Trial 1).

Treatment	Rate	Italian ryegrass injury[a]	Western mannagrass control[a]
	lb/A	%	
Pyrithiobac	0.11	21	100
Pyrithiobac	0.16	34	100
Difenzoquat	2.0	0	43
Check	0	0	0
$LSD_{0.05}$	—	9	6

[a]Evaluated March 13, 2001.

Table 3. Control of western mannagrass and injury to Italian ryegrass with pyrithiobac and difenzoquat, near Lebanon, OR (Trial 2).

Treatment	Rate	Italian ryegrass injury[a]	Western mannagrass control[a]
	lb/A	%	
Pyrithiobac	0.027	10	97
Pyrithiobac	0.053	19	100
Difenzoquat + pyrithiobac	0.05 + 0.027	13	96
Difenzoquat + pyrithiobac	0.05 + 0.053	13	99
Check	0	0	0
$LSD_{0.05}$	---	7	4

[a]Evaluated April 17, 2001.

Evaluation of wild oat control herbicides in spring wheat. John O. Evans, Brent Beutler, and R. William Mace. (Department of Plants, Soils, and Biometeorology, Utah State University, Logan, Utah 84322-4820) Clearfield spring wheat was planted April 20, 2001 on the Wallace Beutler farm in North Logan. Herbicide treatments including fenoxaprop, clodinafop, tralkoxydim, flucarbazone and MKH 6561 were applied to evaluate wild oat (AVEFA) control. Individual treatments were applied to 10 by 30 foot plots with an CO_2 sprayer using flatfan 8002 nozzles providing a 10 foot spray width calibrated to deliver 25 gpa at 40 psi. The soil was a millville loam with 7.9 pH and O.M. content of less than 3%. Treatments were applied postemergence May 9, 2001 in a randomized block design, with three replications. Wheat ranged in size from 5 to 8 inches tall. Wild oats were 2 to 3 inches tall with 2 to 3 leaves. Visual evaluations for crop injury and weed control were completed May 28, and July 18. Plots were harvested August 15, 2001.

There was no injury to wheat with any treatment. Wild oat control was excellent for all treatments except fenoxaprop alone and fenoxyprop + bromoxynil&MCPA 5E. Excellent wild oat control was maintained through July by tralkoxydim, flucarbazone + 2,4-D, and MKH 6561 + 2,4-D. Common lambsquarters (CHEAL) was held in check when wild oat herbicides were tank mixed with bromoxynil&MCPA, 2,4-D, and thifensulfuron methyl. Yields were highest for clodinafop, MKH 6561 + 2,4-D, and fenoxaprop + bromoxynil&MCPA 5E.

Table. Evaluation of wild oat control in wheat.

		Wheat			Weed control		
		Injury		Yield	AVEFA		CHEAL
Treatment	Rate	5/28	7/18	8/15	5/28	7/18	7/18
	lb /A	——%——		Bu/A	——%——		
Untreated		0	0	14.1	0	0	0
Fenoxaprop	0.0825	0	0	23	0	54.8	61.7
Fenoxaprop + bromoxynil&MCPA[a] 4E	0.0825+0.2+0.2	0	0	34.1	90	73.3	100
Fenoxaprop + bromoxynil&MCPA 4E	0.0825 +0.25+0.25	0	0	39.1	100	63.3	96.7
Fenoxaprop + bromoxynil&MCPA 5E	0.0825+0.25+0.25	0	0	53.6	31.7	56.7	96.7
Fenoxaprop + thifensulfuron methyl +MCPA	0.0825+0.0188+0.375	0	0	35.9	100	76.7	100
Clodinafop [b]	0.05	0	0	46.4	100	43.3	0
Clodinafop [b]	0.064	0	0	57.4	100	86.7	0
Tralkoxydim [c]	0.18	0	0	43.8	100	99.8	46.7
Flucarbazone[d] +2,4-D amine	0.027+0.5	0	0	44.7	96.7	100	83.3
MKH 6561[d] +2,4-D amine	0.04+0.5	0	0	62.5	96.7	100	93.3
$LSD_{(0.05)}$				33.9	54	26.7	30.2

[a] Bromoxynil&MCPA was a commercial premix Bronate 4 or 5 EC.
[b] Score added at 0.8% v/v.
[c] Supercharge 0.5% v/v added.
[d] Activator 90 0.5% v/v added.

Control of volunteer spring, winter, and imidazolinone resistant wheat. Curtis R. Rainbolt and Donald C. Thill. (Plant Science Division, University of Idaho, Moscow, ID 83844-2339) A field trial was established near Washtucna, WA at the Ralston Direct Seed Research Site to evaluate several herbicides for control of volunteer spring, winter, and imidazolinone resistant wheat. 'Wawawai' spring wheat, 'Madsen' winter wheat, and 'Fidel' imidazolinone resistant wheat were seeded at a 20% of normal seeding rate with a no-till drill on September 26, 2000. Experimental design was a randomized complete block with split blocks. Main plots were herbicide treatment (8 by 15 ft) and split blocks were wheat variety (40 by 30 ft). All herbicide treatments were applied with a CO_2 pressurized backpack sprayer calibrated to deliver 10 gpa at 32 psi and 3 mph (Table 1). Control was evaluated visually on May 25 and June 11, 2001. Biomass was collected from a 2.7 ft^2 area on June 11, 2001.

Table 1. Application and soil data.

Application		
timing	Fall	Spring
date	October 18, 2001	May 7, 2001
growth stage	2-3 leaf	5-6 leaf
Air temperature (F)	58	60
Soil temperature at 2 in (F)	49	55
Relative humidity (%)	40	52
Wind (mph)	3	2
Soil		
pH	7.0	
OM %	2.2	
CEC (meq/100g)	18	
Texture	Silt loam	

There was no significant treatment by wheat variety interaction therefore, data were combined over variety (Table 2). On May 25, control was best with the split application of glyphosate (96%). All spring applied treatments averaged 90%. Control had dropped slightly with all spring applied treatments by June 11, but was consistent with the split application of glyphosate (97%). Control was lowest with fall herbicide application, especially paraquat/diuron. Biomass was reduced 98% with the split application of glyphosate.

Table 2. Control of volunteer wheat near Ralston, WA in 2001.

			Volunteer wheat control		
Treatment[a]	Rate	Application	May 25	June 11	Biomass
	lb/A	timing	%		% of untreated control
Quizalofop	0.055	fall	75	67	30
Paraquat/diuron	2.4	fall	50	30	66
Clethodim	0.109	fall	78	72	31
Glyphosate	0.5	fall	75	74	27
Glyphosate	0.37	fall/spring	96	97	2
Quizalofop	0.055	spring	90	83	15
Paraquat/diuron	2.4	spring	89	82	16
Clethodim	0.109	spring	91	86	13
Glyphosate	0.5	spring	90	86	12
LSD (0.05)			4	5	7

[a]Quizalofop and paraquat/diuron were applied with a 90% non-ionic surfactant (R-11) at 0.25% v/v, glyphosate was applied with ammonium sulfate (Bronc) at 5% v/v, and clethodim was applied with a crop oil concentrate at 1% v/v.

Control of over-wintered volunteer glyphosate-resistant spring wheat. Curtis R. Rainbolt and Donald C. Thill (Plant Science Division, University of Idaho, Moscow, ID 83844-2339). A field trial was established near Genessee, ID at the University of Idaho Kambitsch Research Farm to evaluate UI-2001A and quizalofop/glyphosate combinations for control of over-wintered glyphosate-resistant spring wheat. Volunteer wheat was located on a site where glyphosate-resistant wheat trials were conducted the previous year. Experimental design was a randomized complete block with split plots. Main plots were herbicide treatment (8 by 30 ft) and split plots were application timing (8 by 15 ft). Herbicide treatments were applied when the wheat was in the 2-4 leaf stage and early boot (e. boot). All herbicide treatments were applied with a CO_2 pressurized backpack sprayer calibrated to deliver 10 gpa at 32 psi and 3 mph (Table 1). Volunteer wheat control was evaluated visually and studies were terminated prior to heading to prevent seed production.

Table 1. Application and soil data.

Application		
timing	2-4 leaf	Early boot
date	April 23, 2001	May 25, 2001
Air temperature (F)	50	53
Soil temperature at 2 in (F)	48	45
Relative humidity (%)	75	85
Wind (mph)	3	0-1
Soil		
pH	5.1	
OM%	2.4	
CEC (meq/100g)	21	
Texture	Silt loam	

Fourteen days after treatment at the 2-4 leaf stage (14 DAT-1) UI-2001A at 0.027 lb/A controlled glyphosate resistant wheat 7% better than UI-2001A at 0.013 lb/A (Table 2). Control was greater with treatments containing quizalofop at 0.048 lb/A (83 and 84%) than treatments containing quizalofop at 0.021 lb/A (63 and 74%) 14 DAT-1. By 24 days after treatment at the 2-4 leaf stage (24 DAT-1) control was best with UI-2001A at 0.027 lb/A (96%), quizalofop at 0.034 + glyphosate + MSO + AMS (96%), quizalofop at 0.048 + glyphosate + MSO (96%), and quizalofop at 0.048 + glyphosate + MSO + AMS (97%). Fourteen days after application at the early boot stage (14 DAT-2) control averaged 92% for applications made at the 2-4 leaf stage and 36% for treatments applied at early boot. By 28 days after treatment at the early boot stage control improved to 54% on average. Overall control of volunteer glyphosate resistant spring wheat was much lower with treatments applied at early boot compared to those applied at the 2-4 leaf stage.

Table 2. Control of over-wintered volunteer glyphoate resistant wheat near Genessee, ID in 2001.

			Volunteer glyphosate resistant wheat control[b]			
			14 DAT-1	24 DAT-1	14 DAT-2	28 DAT-2
Treatment[a]	Rate	Timing	5/8/01	5/17/01	6/8/01	6/21/01
			%			
UI-2001A + MSO + 32 % UAN	0.013 lb/A + 1.9% v/v + 2.5% v/v	2-4 leaf	74	89	91	90
UI-2001A + MSO + 32 % UAN	0.013 lb/A + 1.9% v/v + 2.5% v/v	e. boot	--	--	31	58
UI-2001A + MSO + 32 % UAN	0.027 lb/A + 1.9% v/v + 2.5% v/v	2-4 leaf	81	96	94	93
UI-2001A + MSO + 32 % UAN	0.027 lb/A + 1.9% v/v + 2.5% v/v	e. boot	--	--	41	65
Quizalofop + Glyphosate + AMS	0.021 lb/A + 0.75 lb/A + 2.5% v/v	2-4 leaf	63	84	85	89
Quizalofop + Glyphosate + AMS	0.021 lb/A + 0.75 lb/A + 2.5% v/v	e. boot	--	--	33	48
Quizalofop + Glyphosate + MSO + AMS	0.021 lb/A + 0.75 lb/A + 1.9% v/v + 2.5% v/v	2-4 leaf	74	85	90	91
Quizalofop + Glyphosate + MSO + AMS	0.021 lb/A + 0.75 lb/A + 1.9% v/v + 2.5% v/v	e. boot	--	--	34	48
Quizalofop + Glyphosate + AMS	0.034 lb/A + 0.75 lb/A + 2.5% v/v	2-4 leaf	75	92	91	90
Quizalofop + Glyphosate + AMS	0.034 lb/A + 0.75 lb/A + 2.5% v/v	e. boot	--	--	36	51
Quizalofop + Glyphosate + MSO + AMS	0.034 lb/A + 0.75 lb/A + 1.9% v/v + 2.5% v/v	2-4 leaf	79	96	94	94
Quizalofop + Glyphosate + MSO + AMS	0.034 lb/A + 0.75 lb/A + 1.9% v/v + 2.5% v/v	e. boot	--	--	35	53
Quizalofop + Glyphosate + AMS	0.048 lb/A + 0.75 lb/A + 2.5% v/v	2-4 leaf	84	96	94	94
Quizalofop + Glyphosate + AMS	0.048 lb/A + 0.75 lb/A + 2.5% v/v	e. boot	--	--	38	55
Quizalofop + Glyphosate + MSO + AMS	0.048 lb/A + 0.75 lb/A + 1.9% v/v + 2.5% v/v	2-4 leaf	83	97	93	96
Quizalofop + Glyphosate + MSO + AMS	0.048 lb/A + 0.75 lb/A + 1.9% v/v + 2.5% v/v	e. boot	--	--	39	56
LSD (0.05)			6	4	5	6

[a]MSO is methylated seed oil (Sun-it II) and AMS is ammonium sulfate (Bronc).

[b]14 DAT-1 and 24 DAT-1 are 14 and 24 days after 2-4 leaf application timing; 14 DAT-2 and 28 DAT-2 are 14 and 28 days after e. boot application timing.

Control of volunteer glyphosate resistant wheat with graminicides. Curtis R. Rainbolt and Donald C. Thill. (Plant Science Division, University of Idaho, Moscow, ID 83844-2339) Field trials were established near Genessee, ID at the University of Idaho Kambitsch Research Farm in spring 2000 and 2001 to evaluate several graminicides for control of volunteer glyphosate resistant wheat. Glyphosate resistant spring wheat was seeded with a double disk drill at 20% of normal seeding rate to simulate volunteers. Plots were 8 by 30 ft arranged in a randomized complete block design with four replications. All herbicide treatments were applied with a CO_2 pressurized backpack sprayer calibrated to deliver 10 gpa at 32 psi and 3 mph. Control was evaluated visually 14 and 28 days after treatment (DAT). Studies were terminated prior to heading to prevent wheat seed production.

Control with all treatments applied at the 5-6 leaf stage, except glyphosate alone (0% control), averaged 36% in 2000 compared to 72% in 2001 at 14 DAT (Table). This difference in control is likely due to climatic and growing conditions at the time of application. In 2001 applications were made during a period of light daily showers when the wheat was actively growing, possibly increasing the rate of herbicide absorption. Conditions were drier in 2000. By 28 DAT, control with all treatments, except glyphosate alone, was 90% or greater both years.

Table. Control of volunteer glyphosate resistant wheat near Genessee, ID in 2000 and 2001.

			Glyphosate resistant wheat control[b]			
			14 DAT		28 DAT	
Treatment[a]	Rate	Application	2000	2001	2000	2001
	lb/A	timing	%			
Glyphosate (control)	0.75	3-4 leaf	0	0	0	0
Quizalofop	0.034	3-4 leaf	83	95	90	98
Quizalofop	0.048	3-4 leaf	85	96	97	99
Quizalofop	0.062	3-4 leaf	88	96	95	99
Glyphosate + quizalofop	0.75 + 0.034	3-4 leaf	86	97	94	97
Glyphosate + quizalofop	0.75 + 0.048	3-4 leaf	88	94	95	99
Glyphosate + quizalofop	0.75 + 0.062	3-4 leaf	86	95	94	98
Clethodim	0.109	3-4 leaf	94	91	97	99
Sethoxydim	0.375	3-4 leaf	97	90	97	99
Glyphosate (control)	0.75	5-6 leaf	0	0	0	0
Quizalofop	0.034	5-6 leaf	34	70	94	99
Quizalofop	0.048	5-6 leaf	31	73	94	99
Quizalofop	0.062	5-6 leaf	33	73	96	98
Glyphosate + quizalofop	0.75 + 0.034	5-6 leaf	33	74	93	98
Glyphosate + quizalofop	0.75 + 0.048	5-6 leaf	30	71	94	99
Glyphosate + quizalofop	0.75 + 0.062	5-6 leaf	36	74	95	99
Clethodim	0.109	5-6 leaf	43	70	99	99
Sethoxydim	0.375	5-6 leaf	44	73	97	99
LSD (0.05)			4	3	3	5

[a]All treatments contained ammonium sulfate (Bronc) at 5% v/v or 17 lb AMS/100 gal spray solution ; all treatments (except glyphosate alone) were applied with a methylated seed oil (Sun-it II) at 1% v/v. The glyphosate formulation used was Roundup Ultra RT.

[b]14 DAT and 21 DAT are 14 and 21 days after treatment at the 5-6 leaf stage.

Time of wild oat and common lambsquarters removal in glyphosate resistant spring wheat. Curtis R. Rainbolt and Donald C. Thill (Plant Science Division, University of Idaho, Moscow, ID 83844-2339). A field trial was established near Genessee, ID at the University of Idaho Kambitsch Research Farm to evaluate the effect of glyphosate application timing on control of wild oat (AVEFA) and common lambsquarters (CHEAL) and on spring wheat yield. Glyphosate resistant spring wheat was seeded on May 11, 2001 into a silt loam soil with pH 5.2 and 2.4% OM. Plots were 8 by 22 ft arranged in a randomized complete block design with four replications. All herbicide treatments were applied with a CO_2 pressurized backpack sprayer calibrated to deliver 10 gpa at 32 psi and 3 mph (Table 1). Weed control and crop injury were evaluated visually on June 29 and July 6, 2001. The study was harvested with a small plot combine on September 11, 2001.

Table 1. Application data

Application				
timing	A	B	C	D
date	May 31, 2001	June 6, 2001	June 11, 2001	June 15, 2001
Growth stage				
wheat	2 tiller	3 tiller	3-4 tiller	4 tiller
wild oat	1-2 leaf	2-3 leaf	3-4 leaf	4-5 leaf
common lambsquarters	1 in diameter	2-3 in diameter	3-4 in diameter	4-5 in diameter
Air temperature (F)	70	58	55	52
Soil temperature (F)	60	43	52	48
Relative humidity (%)	39	65	57	65
Wind (mph)	2	1	0	2

No treatment visibly injured spring wheat. On June 29, control of wild oat was not different between treatments, and control of common lambsquarters was 93% or higher with all treatments except glyphosate applied only at timing D (Table 2). On July 6, control of wild oat averaged 96%, and control of common lambsquarters was 93% or higher in all treatments receiving an application at timing D, ABC, and BC. Yield was better than the control (43 bu/A) in all treatments except glyphosate applied only at timing D (46 bu/A).

Table 2. Wild oat and common lambsquarters control and glyphosate resistant spring wheat yield near Genessee, ID in 2001.

			Weed control				
		Application	6/29/01		7/6/01		Spring wheat
Treatment	Rate	timing	AVEFA	CHEAL	AVEFA	CHEAL	yield
	lb ae/A		%				bu/A
Glyphosate	0.56	A	97	95	96	83	60
Glyphosate	0.56	B	97	95	95	85	57
Glyphosate	0.56	C	97	95	97	85	53
Glyphosate	0.56	D	94	89	95	95	46
Glyphosate	0.56	AB	97	95	96	81	56
Glyphosate	0.56	ABC	97	95	95	93	57
Glyphosate	0.56	ABCD	98	94	96	95	55
Glyphosate	0.56	BC	97	95	96	95	56
Glyphosate	0.56	BCD	97	96	98	95	55
Glyphosate	0.56	CD	96	93	95	95	54
Untreated control	--	--	--	--	--	--	43
LSD (0.05)			ns	4	2	8	8
Density (plants/ft^2)			1.8	6.5			

Wild oat and common lambsquarters control in glyphosate resistant spring wheat. Curtis R. Rainbolt and Donald C. Thill (Plant Science Division, University of Idaho, Moscow, ID 83844-2339) A field trial was established near Genessee, ID at the University of Idaho Kambitrch Research Farm to compare glyphosate to traditional treatments for wild oat (AVEFA) and common lambsquarters (CHEAL) control in glyphosate resistant spring wheat. Glyphosate resistant spring wheat was seeded on May 11, 2001 into a silt loam with pH 5.2 and 2.4 % OM. Plots were 8 by 22 ft arranged in a randomized complete block design with four replications. All herbicide treatments were applied with a CO_2 pressurized backpack sprayer calibrated to deliver 10 gpa at 32 psi and 3 mph (Table 1). Weed control was evaluated visually on June 25 and July 9, 2001. Crop injury was evaluated visually on June 19, 2001. The study was harvested with a small plot combine on September 11, 2001.

Table 1. Application data

Application		
timing	A	B
date	June 6, 2001	June 11, 2001
Growth stage		
wheat	3 tiller	3-4 tiller
wild oat	2-3 leaf	3-4 leaf
common lambsquarters	2-3 inches diameter	3-4 inches diameter
Air temperature (F)	58	55
Soil temperature (F)	43	52
Relative humidity (%)	65	57
Wind (mph)	1	0

Glyphosate + clopyralid/2,4-D visibly injured (stunting) spring wheat 10% on June 19 (Table 2). On June 25, wild oat control was lowest with fenoxaprop + bromoxynil/MCPA (86%) and flucarbazone-sodium + bromoxynil/MCPA + NIS (90%) and common lambsquarters control was not different between treatments. On July 9, wild oat control averaged 97% with all treatments except fenoxaprop + bromoxynil/MCPA (84%) and flucarbazone-sodium + bromoxynil/MCPA + NIS (86%). Common lambsquarters control was best with glyphosate applied at 1 lb/A at timing B (93%), glyphosate + bromoxynil/MCPA (93%), glyphosate + MCPA (97%), and glyphosate + clopyralid/2,4-D (97%). All treatments yielded 13 to 26 bu/A higher than the untreated control. Yield with glyphosate + clopyralid/2,4-D was significantly lower than all treatments except glyphosate applied at 0.75 lb/A at timing B, tralkoxydim + bromoxynil/MCPA + TF8035 + AMS, and flucarbazone-sodium + bromoyxnil/MCPA + NIS.

Table 2. Wild oat and common lambsquarters control, and glyphosate resistant spring wheat injury and yield near Genessee, ID in 2001.

			Weed control				Spring wheat	
			6/25/01		7/9/01			
Treatment[a]	Rate	Timing	AVEFA	CHEAL	AVEFA	CHEAL	Injury	Yield
	lb/A		%					bu/A
Glyphosate	0.5	A	97	96	97	71	0	56
Glyphosate	0.75	A	98	97	98	73	0	56
Glyphosate	1	A	96	97	97	69	0	59
Glyphosate	0.5	B	97	96	98	69	0	53
Glyphosate	0.75	B	97	97	98	78	0	51
Glyphosate	1	B	97	97	98	93	0	55
Glyphosate	0.5 + 0.5	A + B	97	97	98	81	0	59
Clodinafop + bromoxynil/MCPA + COC	0.06 + 0.38 + 0.32 qt/A	A	98	97	98	79	0	54
Fenoxaprop + bromoxynil/MCPA	0.083 + 0.38	A	86	97	84	71	0	55
Flucarbazone-sodium + bromoxynil/MCPA + NIS	0.027 + 0.38 + 0.25% v/v	A	90	97	86	75	0	52
Tralkoxydim + bromoxynil/MCPA + TF8035 + AMS	0.24 + 0.38 + 0.5% v/v + 5% v/v	A	94	97	96	65	0	50
Glyphosate + MCPA	0.5 + 0.25	B	97	97	97	97	0	55
Glyphosate + dicamba	0.5 + 0.063	A	97	97	97	78	0	57
Glyphosate + bromoxynil/MCPA	0.5 + 0.38	B	97	97	97	93	0	53
Glyphosate + thifensulfuron + NIS	0.5 + 0.023 + 0.25% v/v	A	97	97	97	75	0	55
Glyphosate + clopyralid/2,4-D	0.5 + 0.69	B	96	95	97	97	10	46
Untreated control	--	--	--	--	--	--	--	33
LSD (0.05)			3	ns	5	11	6	6
Density (plants/ft^2)			1.8	6.5				

[a]COC is crop oil concentrate (Score), TF8035 is a crop oil concentrate/non-ionic surfactant blend (Supercharge), NIS is 90% non-ionic surfactant (R-11), and AMS is liquid ammonium sulfate (Bronc). Bromoxynil/MCPA and clopyralid/2,4-D were applied as the commercial formulations.

Wild oat control in spring wheat with herbicide combinations. Branden L. Schiess and Donald C. Thill. (Plant Science Division, University of Idaho, Moscow, ID 83844-2339) A study was conducted near Cavendish, ID in 'Westbred 926' hard red spring wheat to determine the effect of two tralkoxydim formulations in combination with 2,4-D or bromoxynil/MCPA on wild oat control and crop injury. Plots were 8 by 30 feet, arranged in randomized complete block design with four replications. All herbicide treatments were applied with a CO_2 pressurized backpack sprayer calibrated to deliver 10 gpa at 33 psi and 3 mph (Table 1). Wheat injury and wild oat control were evaluated visually on June 14, July 11, and Aug 27, 2001. Wheat was harvested August 27, 2001 with a small plot combine.

Table 1. Soil and application data.

Application date	June 6, 2001
Wheat growth stage	3 to 5 leaf
Wild oat growth stage	2 to 5 leaf
Wild oat plants/ft^2	16
Air temperature (F)	61
Soil temperature at 2 in (F)	58
Relative humidity (%)	74
Wind (mph)	2 to 4
Cloud cover (%)	60
pH	4.5
OM (%)	3.8
Texture	silt loam

On June 21, imazamethabenz plus difenzoquat injured wheat 28%, all other treatments injured wheat 8 to 15% (Table 2). On July 11, only the imazamethabenz plus difenzoquat treatment injured wheat (14%), although symptoms were no longer apparent by August 27 (data not shown). On August 27, both formulations of tralkoxydim applied alone controlled wild oat 98 to 100%. When either formulation of tralkoxydim was combined with 2,4-D ester or bromoxynil/MCPA, wild oat control was reduced 12 to 17% or 2 to 17%, respectively. Wheat yield in treated plots ranged from 50 or 62 bu/A and was significantly greater than the control, which yielded 27 bu/A.

Table 2. Wild oat control in spring wheat with herbicide combinations near Cavendish, Idaho in 2001.

Treatment[a]	Rate	Crop injury		Wild oat control			Wheat yield
		June 21	July 11	June 21	July 11	Aug 27	
	lb/A	%					bu/A
YF11425	0.18	15	0	73	91	98	52
YF11425	0.25	13	0	68	89	100	55
Tralkoxydim	0.18	10	0	60	94	98	62
Tralkoxydim	0.25	13	0	60	90	100	55
YF11425 + 2,4-D ester	0.18 + 0.5	8	0	50	76	81	50
YF11425 + 2,4-D ester	0.25 + 0.5	11	0	53	76	84	52
Tralkoxydim + 2,4-D ester	0.18 + 0.5	10	0	50	81	86	51
Tralkoxydim + 2,4-D ester	0.25 + 0.5	11	0	50	81	84	52
YF11425 + bromoxynil / MCPA	0.18 + 0.5	14	0	50	86	81	56
YF11425 + bromoxynil / MCPA	0.25 + 0.5	13	0	58	96	93	59
Tralkoxydim + bromoxynil / MCPA	0.18 + 0.5	9	0	58	85	85	60
Tralkoxydim + bromoxynil / MCPA	0.25 + 0.5	14	0	58	96	91	60
Fenoxaprop-P-ethyl + MCPA	0.083 + 0.5	10	0	60	86	98	60
Clodinafop + bromoxynil / MCPA + COC	0.05 + 0.5	10	0	58	95	98	58
Imazamethabenz + difenzoquat + R-11	0.23 + 0.5	28	14	68	70	74	52
Control		--	--	--	--	--	27
LSD (0.05)		7	4	10	6	4	9

[a]YF11425 is a soluble concentrate tralkoxydim formulation. TF8035 (Supercharge) at 0.5% v/v and AMS (17 lb/gal ammonium sulfate) at 5% v/v were added to all treatments containing tralkoxydim formulations. Bromoxynil/MCPA was applied as the commercial formulation. COC = crop oil concentrate (Score) applied with clodinafop at 0.8% v/v. R-11 = non-ionic surfactant applied at 0.25 % v/v.

Wild oat control in spring wheat. Lori J. Crumley and Donn C. Thill (Plant Science Division, University of Idaho, Moscow, ID 83843-2239) A study was established west of Potlatch, ID in 'Wawawai' spring wheat to evaluate wild oat control and crop injury with wild oat herbicides alone and in combination with broadleaf herbicides. The experimental design was a randomized complete block with four replications. Individual plots were 8 by 30 ft. Herbicide treatments were applied with a CO_2 pressurized backpack sprayer calibrated to deliver 10 gpa at 30 psi (Table 1). Injury was visually evaluated on June 6, and June 15, 2001. Wheat was harvested on August 30, 2001.

Table 1. Soil and application data.

Application date	May 31, 2001
Wheat growth stage	4-5 leaf
Wild oat growth stage	2-5 leaf
Air temp (F)	72
Relative humidity (%)	54
Wind (mph)	0
Soil temperature at 2 in (F)	55
pH	5.2
OM (%)	3.5
CEC (meq/100g)	22
Texture	Silt loam

Wheat was injured 3 to 28% by all treatments on June 6 (Table 2). Wheat injury was lowest with fenoxaprop and highest when treated with carfentrazone + imazamethabenz + MCPA. No injury was visible on wheat plants by June 25 (data not shown). Carfentrazone + clodinafop + MCPA controlled wild oat the best at 70% on June 15. Clodinafop and imazamethabenz controlled wild oat only 50% on June 15. Wild oat was controlled 96 to 100% by all treatments on July 20. Grain yield was 27 to 35% higher than the control in all treated plots, however there were no differences among treatments.

Table 2. The effect of herbicide treatments on wheat injury, wild oat control, and grain yield near Potlatch, ID in 2001.

Treatment	Rate	Wheat injury June 6	Wild oat control June 15	Wild oat control July 20	Wheat yield
	lb/A	%	%	%	lb/A
Carfentrazone + fenoxaprop[a] + MCPA[b]	0.008 + 0.083 + 0.25	20	58	96	2532
Carfentrazone + fenoxaprop + MCPA + thifen/triben[c]	0.008 + 0.083 + 0.25 + 0.0188	23	65	96	2590
Fenoxaprop	0.083	3	63	97	2580
Carfentrazone + clodinafop + MCPA + COC[d]	0.008 + 0.05 + 0.25	23	70	97	2501
Carfentrazone + clodinafop + MCPA + thifen/triben + COC	0.008 + 0.05 + 0.25 + 0.0188	20	65	96	2414
Clodinafop + COC	0.05	10	50	96	2564
Carfentrazone + flucarbazone + MCPA + NIS[e]	0.008 + 0.027 + 0.25	25	53	100	2563
Clodinafop + flucarbazone + MCPA + thifen/triben + NIS	0.008 + 0.027 + 0.25 + 0.188	20	60	99	2440
Flucarbazone + NIS	0.027	10	53	99	2315
Carfentrazone + imazamethabenz + MCPA + NIS	0.008 + 0.41 + 0.25	28	65	97	2383
Carfentrazone + imazamethabenz + MCPA + thifen/triben + NIS	0.008 + 0.41 + 0.25 + 0.0188	23	65	96	2294
Imazamethabenz + NIS	0.41	5	50	97	2434
Untreated control	--	--	--	--	1678
LSD (0.05)		7	13	2	390

[a] Fenoxaprop is the commercial formulation of fenoxaprop/mefenpyr diethyl (safener).
[b] MCPA ester formulation.
[c] Thifen/triben is the commercial formulation of thifensulfuron/tribenuron trade name Harmony GT.
[d] COC= crop oil concentrate (Score) added at 0.32 qt/A.
[e] NIS= nonionic surfactant (R-11) applied at 0.25% v/v.

Wild oat control in spring wheat with combinations of clodinafop plus thifensulfuron and other broadleaf herbicides. Bradley D. Hanson and Donald C. Thill. (Plant Science Division, University of Idaho, Moscow, ID 83844-2239) A trial was conducted near Potlatch, Idaho to evaluate efficacy and antagonism of clodinafop tank mixed with thifensulfuron and other broadleaf herbicides. The experimental design was a randomized complete block with four replications and 8 by 30 ft plots. Herbicide treatments were applied with a CO_2 pressurized backpack sprayer calibrated to deliver 10 gpa at 40 psi on May 31, 2001 (Table 1). Wild oat control was visually evaluated on June 15, June 30, and July 20, 2001 and wheat grain was harvested on August 16, 2001 with a small plot combine.

Table 1. Herbicide application and soil data.

Growth stage	
'Wawawai' spring wheat	2-3 tiller
Wild oat	2-6 leaf
Air temperature (F)	74
Relative humidity (%)	54
Soil temperature (F)	55
pH	5.2
OM (%)	3.5
CEC (meq/100 g)	22
Texture	Silt loam

Wild oat control on July 20, 2001 was greater than 90% with treatments of clodinafop plus either rate of thifensulfuron plus fluroxypyr and for imazamethabenz plus difenzoquat (Table 2). Adding thifensulfuron to clodinafop did not have an effect on wild oat control at any rate combination. Compared to clodinafop applied alone, adding 2,4-D amine to the treatment reduced wild oat control 23 to 32%. Adding MCPA ester to clodinafop plus 0.0188 lb/A thifensulfuron reduced wild oat control 39% compared to a similar treatment without MCPA ester. Wheat grain yield was better than the untreated control for all treatment combinations and tended to be reduced in treatments with less effective wild oat control.

Table 2. The effect of broadleaf herbicides tank mixed with clodinafop on wild oat control and spring wheat yield near Potlatch, ID in 2001.

Treatment[a]	Rate	Wild oat control June 15	Wild oat control June 30	Wild oat control July 20	Spring wheat yield
	lb/A	%	%	%	lb/A
Untreated control	--	--	--	--	1751
Clodinafop	0.05	59	97	88	2566
Clodinafop + thifensulfuron	0.05 + 0.0188	69	94	88	2583
Clodinafop + thifensulfuron	0.05 + 0.0234	65	94	84	2748
Clodinafop	0.0625	67	94	82	2659
Clodinafop + thifensulfuron	0.0625 + 0.0188 +	73	96	89	2783
Clodinafop + thifensulfuron + MCPA ester	0.0625 + 0.0188 + 0.375	62	73	50	2141
Clodinafop + thifensulfuron + MCPA amine	0.0625 + 0.0188 + 0.375	60	89	68	2495
Clodinafop + thifensulfuron + dicamba	0.0625 + 0.0188 + 0.0938	60	84	79	2385
Clodinafop + thifensulfuron + fluroxypyr	0.0625 + 0.0188 + 0.125	61	98	91	2732
Clodinafop + thifensulfuron + fluroxypyr/MCPA ester	0.0625 + 0.0188 + 0.666	61	85	67	2602
Clodinafop + thifensulfuron + 2,4-D amine	0.0625 + 0.0188 + 0.375	50	66	50	2147
Clodinafop + thifensulfuron	0.0625 + 0.0234 +	68	94	85	2605
Clodinafop + thifensulfuron + MCPA ester	0.0625 + 0.0234 + 0.375	60	95	87	2624
Clodinafop + thifensulfuron + MCPA amine	0.0625 + 0.0234 + 0.375	64	94	78	2605
Clodinafop + thifensulfuron + dicamba	0.0625 + 0.0234 + 0.0938	55	93	67	2577
Clodinafop + thifensulfuron + fluroxypyr	0.0625 + 0.0234 + 0.125	73	98	91	2775
Clodinafop + thifensulfuron + fluroxypyr/MCPA ester	0.0625 + 0.0234 + 0.666	64	91	72	2348
Clodinafop + thifensulfuron + 2,4-D amine	0.0625 + 0.0234 + 0.375	66	80	59	2214
Imazamethabenz + difenzoquat	0.23 + 0.5	56	82	92	2557
$LSD_{(0.05)}$		NS	12	16	286

[a]A proprietary adjuvant (Score) at 0.4 qt/A was added to all clodinafop treatments and a nonionic surfactant (R-11) at 0.25% v/v was added to the imazamethabenz + difenzoquat treatment.

Weed control and crop response in imidazolinone-resistant spring wheat with imazamox and BAS 63500 H. Traci A. Rauch and Donald C. Thill. (Plant Science Division, University of Idaho, Moscow, ID 83844-2339) Two studies were established on the University of Idaho Plant Science Farm near Moscow, ID in 'Triangle' imidazolinone-resistant spring wheat to examine crop response and weed control with BAS 63500 H and imazamox. Plots (16 by 48 ft in the BAS 63500 H experiment and 16 by 32 ft in the imazamox experiment) were arranged in a randomized complete block design 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 14 and 26, 2001 in the BAS 63500 H experiment and June 14 and 26 and July 10, 2001 in the imazamox experiment. In both experiments, weed control was evaluated visually on June 14 and 26, 2001, and wheat seed was harvested with a small plot combine on August 21, 2001. Soil persistence of imazamox will be evaluated in 2002. The BAS 63500 H experiment was terminated after grain harvest at hte company's request. In each plot in the imazamox experiment, 'Granger' winter pea and 'Athena' winter canola were seeded on September 28, 2001 and spring canola and pea will be seeded in spring 2002.

Table 1. Application and soil data for experiments one and two.

	BAS 63500 H experiment		Imazamox experiment
Application date	June 6, 2001		May 31, 2001
Spring wheat growth stage	4 to 5 tiller		3 to 4 tiller
Redroot pigweed growth stage	3 inches		--
Field pennycress growth stage	bud		4 inches to bud
Common lambsquarters growth stage	3 to 4 inches		2 inches
Air temperature (F)	55		74
Relative humidity (%)	70		60
Wind (mph, direction)	2, SE		0
Cloud cover (%)	80		5
Soil temperature at 2 in (F)	50		70
pH		4.6	
OM (%)		4.3	
CEC (meq/100g)		19	
Texture		loam	

In the BAS 63500 H experiment, sulfosulfuron at 0.062 lb/A visibly injured wheat 14% (Table 2). The low rate of sulfosulfuron and BAS 63500 H + dicamba injured wheat more (9 and 6%, respectively) than BAS 63500 H alone at 0.045 and 0.18 lb/A or BAS 63500 H (0.09 lb/A) + dicamba (0.18 lb/A). All treatments controlled redroot pigweed and field pennycress 98% or more except BAS 63500 H at 0.045 lb/A (76%). Common lambsquarters control was better with BAS 63500 H (98 to 100%) than sulfosulfuron treatments (42 to 86%). Wheat grain yield and test weights did not differ among treatments or from the untreated control.

In the imazamox experiment, wheat injury increased with imazamox rate and was 40 to 31% at the highest rate of imazamox on June 26 and July 10, 2001, respectively (Table 3). Wheat injury decreased with time at all rates. All treatments controlled field pennycress and common lambsquarters 96 to 100%. Wheat grain yield was reduced 13 to 26% by imazamox at 0.04 to 0.08 lb/A compared to the untreated check. The highest rate of imazamox had a lower test weight (62 lb/bu) than the lowest imazamox rate and the untreated check (64 lb/bu).

Table 2. Weed control, wheat injury and yield in spring wheat with BAS 63500 H near Moscow, Idaho in 2001.

Treatment[b]	Rate	Wheat injury[a]	Weed control[a] redroot pigweed	Weed control[a] field pennycress	Weed control[a] common lambsquarters	Wheat yield	Wheat test weight
	lb/A	%	%	%	%	bu/A	lb/bu
BAS 63500 H	0.045	1	76	99	99	81	63
BAS 63500 H	0.09	2	99	99	99	84	63
BAS 63500 H	0.18	1	100	100	99	86	63
BAS 63500 H + dicamba	0.045 + 0.09	6	99	99	100	81	62
BAS 63500 H + dicamba	0.09 + 0.18	1	100	99	98	78	63
Sulfosulfuron	0.031	9	99	98	42	84	62
Sulfosulfuron	0.062	14	99	99	86	79	63
Untreated check		--	--	--	--	80	63
LSD (0.05)		4	NS	NS	5	NS	NS
Density (plants/ft^2)			1	1	1		

[a]June 26, 2001 evaluation date.
[b]All treatments were applied with a 90% nonionic surfactant (R-11) at 0.25% v/v, except sulfosulfuron, which was applied at 0.5% v/v.

Table 3. Weed control, wheat injury and yield in imidazolinone-resistant spring wheat with imazamox near Moscow, Idaho in 2001.

Treatment[b]	Rate	Wheat injury June 26	Wheat injury July 10	Weed control[a] field pennycress	Weed control[a] common lambsquarters	Wheat yield	Wheat test weight
	lb/A					bu/A	lb/bu
Imazamox	0.032	3	0	99	98	74	64
Imazamox	0.04	13	6	99	96	68	63
Imazamox	0.064	24	20	100	98	64	63
Imazamox	0.08	40	31	99	98	58	62
Untreated check		--	--	--	--	78	64
LSD (0.05)		14	3	NS	NS	5	1
Density (plants/ft^2)				1	1		

[a]June 26, 2001 evaluation date.
[b]All treatments were applied with a 90% nonionic surfactant (R-11) at 0.25% v/v and 32% urea ammonium nitrate at 1 qt/A.

The effect of application timing on wild oat control with different grass herbicides in winter wheat. Traci A. Rauch and Donald C. Thill. (Plant Science Division, University of Idaho, Moscow, ID 83844-2339) A study was established in 'Fidel' imidazolinone-resistant winter wheat near Bonners Ferry, ID to examine wild oat control and wheat yield with different application timings of grass herbicides. The experimental design was an incomplete split-plot design with four replications and one untreated check. Main plots were herbicide treatments (16 by 30 ft) and the subplots were application timing (8 by 30 ft). 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 27 and July 12, 2001, and weed control was evaluated visually on July 12, 2001. Wheat seed was harvested with a small plot combine on August 16, 2001. Grain weights contains wild oat seed contamination. Test weights are being determined by hand cleaning subsamples.

Table 1. Application and soil data.

Application date	May 10, 2001		May 23, 2001
Wheat growth stage	3 to 5 tiller		jointing
Wild oat growth stage	2 leaf		5 leaf
Air temperature (F)	66		85
Relative humidity (%)	42		36
Wind (mph, direction)	3, SW		2, S
Cloud cover (%)	40		35
Soil temperature at 2 in (F)	60		65
pH		5.3	
OM (%)		20	
CEC (meq/100g)		49	
Texture		loam	

Imazamox and flucarbazone-sodium applied at the wild oat 5 leaf timing (wheat jointing) injured wheat 11 to 21% more than the 2 leaf timing (Table 2). All other treatments did not injure wheat. Wild oat control averaged over herbicides was 23% better at the 2 leaf timing than the 5 leaf timing. Wild oat control decreased as growth stage increased for flucarbazone-sodium (31%), fenoxaprop (48%), and tralkoxydim (65%), while control increased 27% with growth stage for imazamethabenz + difenzoquat treatments. Wild oat control was best with either timing of imazamox and the 2 leaf timing of flucarbazone-sodium (89 to 98%) but did not differ from the 5 leaf timing of imazamethabenz + difenzoquat and the 2 leaf timing of tralkoxydim, clodinafop, and fenoxaprop (76 to 82%). Treatments applied at the 2 leaf timing yielded more grain than treatments applied at the 5 leaf timing (4333 vs. 3475 lb/A). Grain yield was higher with the 2 leaf timing of clodinafop (4578 lb/A) than the 2 leaf timing of fenoxaprop and the 5 leaf timing of imazamox, fenoxaprop, and flucarbazone-sodium (4001 to 1774 lb/A). Grain yield was reduced 43 and 56% by the 5 leaf timing of flucarbazone-sodium and imazamox, respectively, compared to the untreated check.

Table 2. Wild oat control and wheat yield with two application timings of grass herbicides near Bonners Ferry, Idaho in 2001.

Treatment[a]	Rate	Application timing (wild oat growth stage)	Wheat injury June 27	Wheat injury July 12	Wild oat control[c]	Wheat yield[b]
	lb/A		%	%	%	lb/A
Imazamox	0.04	2 leaf	2	1	98	4520
Imazamox	0.04	5 leaf	15	12	98	1774
Flucarbazone-sodium	0.027	2 leaf	1	1	89	4450
Flucarbazone-sodium	0.027	5 leaf	22	12	58	2315
Clodinafop	0.05	2 leaf	0	0	77	4578
Clodinafop	0.05	5 leaf	0	0	56	4252
Fenoxaprop	0.083	2 leaf	0	0	76	3814
Fenoxaprop	0.083	5 leaf	0	0	28	4001
Tralkoxydim	0.24	2 leaf	0	0	81	4423
Tralkoxydim	0.24	5 leaf	0	0	16	4242
Imazamethabenz + difenzoquat	0.235 + 0.5	2 leaf	0	0	55	4215
Imazamethabenz + difenzoquat	0.235 + 0.5	5 leaf	2	0	82	4269
Untreated check	--	--	--	--	--	4065
LSD (0.05)			5	3	25	569
Density (plants/ft^2)					46	

[a]90% nonionic surfactant (R-11) at 0.25% v/v was applied with imazamox, flucarbazone-sodium and imazamethabenz + difenzoquat. 32% urea ammonium nitrate at 1qt/A was applied with imazamox. Crop oil concentrate (Score) was applied at 0.32 qt/A with clodinafop. Ammonium sulfate at 17 lb/100 gal and a crop oil concentrate/non-ionic surfactant blend (Supercharge) at 0.5% v/v was applied with tralkoxydim.
[b]Weighs include wild oat seed contamination.

Rotational crop injury following flucarbazone and sulfosulfuron application to winter wheat. John O. Evans, Brent Beutler, and R. William Mace. (Department of Plants, Soils, and Biometeorology, Utah State University, Logan, Utah 84322-4820) Clearfield winter wheat (CV9804) was planted in the fall of 2000 on the Utah State University research farm in North Logan. Herbicide treatments of flucarbazone and sulfosulfuron were applied to winter wheat in the 3 to 5 leaf stage with an objective of measuring the effects of these herbicides on various follow-up crops in the event of a winter wheat crop loss. Individual treatments were applied to 12 by 200 foot plots with an ATV sprayer using flatfan Tjet 015 nozzles providing a 12 foot spray width calibrated to deliver 12 gpa. The soil was a millville loam with 7.9 pH and O.M. content of less than 3%. Treatments were applied postemergence November 4, 2000, in a randomized block design, with three replications. Wheat ranged in size from 2 - 3 inches tall. Visual evaluations for crop injury and weed control were completed June 18, and August 2, 2001. Plots were harvested August 20.

Clearfield winter wheat, spring wheat and potatoes were not injured by any herbicide treatment and yields were not different from control. Barley showed visual injury for all treatments and injury increased with increasing flucarbazone rate. Conversely barley yields were higher for treated plots, even the highest dosage when compared to the control. Safflower was sensitive to sulfosulfuron but not to flucarbazone, yields were not significantly different. Sugar beet yield was reduced by all herbicide treatments, especially sulfosulfuron. Alfalfa was significantly injured by flucarbazone and sulfosulfuron. Canola and oil mustard did not survive past the first evaluation due to insect attack and poor emergence.

Table 1. Plant back crop injury evaluation.

		Percent Crop Injury June 18, 2001									
Treat ment	Rate	Clearfield winter wheat	Clearfield spring wheat	Rick spring wheat	Rollo Barley	Safflower	Sugar beets	Alfalfa	Potatoes	Canola	Oil Mustard
	lb ai/A	%									
Flucarbazone[a]	0.027	0	0	6.7	53.3	0	10	80	0	10	93.3
Flucarbazone[a]	0.04	0	0	20	76.7	0	23.3	90	0	16.7	96.7
Sulfosulfuron[b]	0.031	0	0	0	46.7	30	100	100	0	100	100
Untreated		0	0	0	0	0	0	0	0	0	0
LSD(0.05)				5.7	9.4	0	5.7	0		5.7	7.5

Table 2. Plant back crop injury evaluation.

		Percent Crop Injury Aug 2, 2001							
Treatment	Rate	Clearfield winter wheat	Clearfield spring wheat	Rick spring wheat	Rollo Barley	Safflower	Sugar beets	Alfalfa	Potatoes
	lb ai/A	%							
Flucarbazone[a]	0.027	0	0	3.3	45	0	33.3	46.7	0
Flucarbazone[a]	0.04	0	0	13.3	56.7	1.7	26.7	76.7	0
Sulfosulfuron[b]	0.031	0	0	3.3	35	6.7	100	93.3	0
Untreated		0	0	0	0	0	0	0	0
LSD(0.05)				8.6	8.6	3.3	34	34	

Table 3. Plant back crop yield.

		Crop yield Aug. 13, 2001							
Treatment	Rate	Clearfield winter wheat	Clearfield spring wheat	Rick spring wheat	Rollo Barley	Safflower	Sugar beets	Alfalfa	Potatoes
	lb ai/A	bu/A	bu/A	bu/A	bu/A	100wt/A	T/A	T/A	T/A
Flucarbazone[a]	0.027	28.7	47.4	35.6	88.9	37.4	20.1	.6	2.63
Flucarbazone[a]	0.04	34.1	61.4	29.5	94.6	36.3	15.5	.46	2.92
Sulfosulfuron[b]	0.031	31.6	76.8	28.6	88	38.5	3.45	.24	3.04
Untreated		41.2	58.5	1.9	73.4	41.8	32.1	2.65	3.15
LSD(0.05)		24.6	34.8	16.3	42.2	6.65	9.3	.76	.91

[a] Activator 90 0.25% v/v
[b] NIS 0.25% v/v

Italian ryegrass control in imidazolinone-resistant winter wheat. Traci A. Rauch and Donald C. Thill (Plant Science Division, University of Idaho, Moscow, ID 83844-2339) Two studies were established near Moscow, Idaho in 'Fidel' imidazolinone-resistant winter wheat to evaluate Italian ryegrass control and wheat yield with various grass herbicides in experiment one and with different application timings of imazamox in experiment two. All plots were 8 by 30 ft arranged in a randomized complete block design with four replications. All herbicide treatments were applied using a CO_2 pressurized backpack sprayer calibrated to deliver 10 gpa at 32 psi and 3 mph (Tables 1 and 2). Rodent damage and winterkill reduced wheat stand in both studies. Wheat injury from herbicide treatments was evaluated visually on April 22, May 3, and 17, 2001 in experiment one; and on May 3, 17, and 30, 2001 in experiment two. In both studies, weed control was evaluated visually on May 30, June 14, and July 10, 2001. Wheat seed in both experiments was harvested August 15, 2001.

Table 1. Application and soil data for experiment one.

Application date	September 27, 2001		May 3, 2001
Wheat growth stage	preemergence		2 to 4 tiller
Italian ryegrass growth stage	preemergence		3 to 5 leaf
Air temperature (F)	80		63
Relative humidity (%)	31		40
Wind (mph, direction)	3, E		1, S
Cloud cover (%)	0		10
Soil temperature at 2 in (F)	62		60
pH		5.2	
OM (%)		3.3	
CEC (meq/100g)		22	
Texture		silt loam	

Table 2. Application and soil data for experiment two.

Application date	April 22, 2001	May 3, 2001	May 17, 2001
Wheat growth stage	1 to 3 tiller	2 to 4 tiller	3 to 4 tiller
Italian ryegrass growth stage	2 to 3 leaf	3 to 5 leaf	5 to 6 leaf
Air temperature (F)	46	63	56
Relative humidity (%)	73	40	61
Wind (mph, direction)	0	2, S	2, W
Cloud cover (%)	75	30	99
Soil temperature at 2 in (F)	40	59	52
pH		5.2	
OM (%)		3.3	
CEC (meq/100g)		22	
Texture		silt loam	

In experiment one, no treatment visibly injured wheat (data not shown). Imazamox at 0.048 lb/A controlled Italian ryegrass 96% and was not different from triasulfuron with or without flufenacet/metribuzin, flucarbazone-sodium or imazamox at 0.032 and 0.04 lb/A (84 to 94%) (Table 3). No other treatments adequately controlled Italian ryegrass (51 to 71%). Wheat grain yield was greatest with flufenacet/metribuzin + triasulfuron but did not differ from triasulfuron alone or flufenacet/metribuzin at 0.425 lb/A. All treatments yielded more than the untreated check, except diclofop and flucarbazone-sodium. Reduced wheat stand from rodent damage and winterkill likely caused the poor correlation between wheat yield and Italian ryegrass control. Wheat test weight did not differ among treatments or from the untreated check.

In experiment two, no injury was observed for any treatment (data not shown). Based on orthogonal contrasts, all rates of imazamox at the 3 to 5 and 5 to 6 leaf timing controlled Italian ryegrass better (92 and 97%) than imazamox treatments at the 2 to 3 leaf timing (71%) (Table 4). Diclofop controlled Italian ryegrass 58 (5 to 6 leaf timing) to 70% (3 to 5 leaf timing). Wheat yield of imazamox treatments at 2 to 3 and 3 to 5 leaf timing was greater than wheat yield of imazamox treatments at the 5 to 6 leaf timing (72 and 67% vs. 61%). Imazamox at 0.04 and 0.048 lb/A at the 2 to 3 leaf timing and 0.048 lb/A at the 3 to 5 leaf timing yielded more than the untreated check. Wheat test weight did not differ among treatments or from the untreated check.

Table 3. Italian ryegrass control and wheat yield and test weight in experiment one near Moscow, Idaho in 2001.

Treatment[a]	Rate	Application timing[b]	Italian ryegrass control[c]	Wheat yield	Wheat test weight
	lb/A		%	bu/A	lb/bu
Flufenacet/metribuzin	0.34	preemergence	70	73	63
Flufenacet/metribuzin	0.425	preemergence	71	75	63
Triasulfuron	0.026	preemergence	84	77	63
Flufenacet/metribuzin + triasulfuron	0.34 + 0.026	preemergence	91	79	64
Diclofop	1.0	3 to 5 leaf	66	59	63
Tralkoxydim	0.24	3 to 5 leaf	51	68	64
Clodinafop	0.0563	3 to 5 leaf	69	65	63
Sulfosulfuron	0.031	3 to 5 leaf	66	68	63
Flucarbazone-sodium	0.027	3 to 5 leaf	86	61	63
Imazamox	0.032	3 to 5 leaf	85	68	64
Imazamox	0.04	3 to 5 leaf	94	67	64
Imazamox	0.048	3 to 5 leaf	96	68	64
Untreated check	–	–	–	59	63
LSD (0.05)			13	6	NS
Density (plants/ft^2)			52		

[a]90% nonionic surfactant (R-11) was applied at 0.5% v/v with sulfosulfuron and 0.25% v/v with flucarbazone-sodium and imazamox. Ammonium sulfate (Bronc) at 17 lb/100 gal and a crop oil concentrate/non-ionic surfactant blend (Supercharge) at 0.5% v/v were applied with tralkoxydim. Crop oil concentrate (Score) was applied at 0.4 qt/A with clodinafop. 32% urea ammonium nitrate was applied at 1 qt/A with all imazamox treatments.
[b]Application timing was based on Italian ryegrass growth stage.
[c]July 10, 2001 evaluation date.

Table 4. Italian ryegrass control and wheat yield and test weight in experiment two near Moscow, Idaho in 2001.

Treatment[a]	Rate	Application timing[b]	Italian ryegrass control[c]	Wheat yield	Wheat test weight
	lb/A		%	bu/A	lb/bu
Imazamox	0.032	2 to 3 leaf	61	67	63
Imazamox	0.04	2 to 3 leaf	72	78	64
Imazamox	0.048	2 to 3 leaf	79	72	64
Diclofop	1.0	2 to 3 leaf	76	69	64
Imazamox	0.032	3 to 5 leaf	88	68	64
Imazamox	0.04	3 to 5 leaf	89	62	63
Imazamox	0.048	3 to 5 leaf	98	70	64
Diclofop	1.0	3 to 5 leaf	70	64	63
Imazamox	0.032	5 to 6 leaf	94	56	63
Imazamox	0.04	5 to 6 leaf	98	67	64
Imazamox	0.048	5 to 6 leaf	99	61	63
Diclofop	1.0	5 to 6 leaf	58	58	63
Untreated check	--	--	--	59	63
LSD (0.05)			14	10	NS
Density (plants/ft^2)			52		

[a]90% nonionic surfactant (R-11) at 0.25% v/v and 32% urea ammonium nitrate at 1 qt/A were applied with imazamox treatments.
[b]Application timing was based on Italian ryegrass growth stage.
[c]July 10, 2001 evaluation date.

Control of field horesetail in winter wheat. Branden L. Schiess and Donald C. Thill. (Plant Science Division, University of Idaho, Moscow, ID 83844-2339) A study was conducted near Moscow, ID in 'Coda' winter wheat to determine the effect of chlorsulfuron, triasulfuron, and MCPA on control of field horsetail. Plots were 8 by 30 feet, arranged in randomized complete block design with four replications. All herbicide treatments were applied with a CO_2 pressurized backpack sprayer calibrated to deliver 10 gpa at 33 psi and 3 mph (Table 1). Wheat injury and field horsetail control were evaluated visually on May 23, May 30, and July 11. Wheat was harvested August 16, 2001 with a small plot combine.

Table 1. Soil and application data.

Application date		11/15/00	5/03/01	5/18/01
Wheat growth stage		6 leaf	1-2 tiller	3-4 tiller
Field horsetail growth stage		pre-emergence	emergence	15 inches
Field horsetail shoots/ft^2		0-3	5	11
Air temperature (F)		31	68	68
Soil temperature at 2 in (F)		40	48	54
Relative humidity (%)		90	60	50
Wind (mph)		0-3	2	1-4
Cloud cover (%)		50	25	90
pH	6			
OM (%)	3.3			
Texture	silt loam			

On May 23, the low and high rates of chlorsulfuron applied November 15 controlled field horsetail 83 and 95%, respectively (Table 2). On May 30 and July 11, the high rate of chlorsulfuron applied November 15 and MCPA applied May 18 controlled field horsetail 97 and 91%, respectively. Wheat yields ranged from 38 to 57 bu/A and did not differ among treatments.

Table 2. Control of field horsetail in winter wheat near Moscow, ID in 2001.

Treatment[a]	Rate	Application timing	Field horsetail control May 23	May 30	July 11	Yield
		lb/A		%		bu/A
Chlorsulfuron	0.0313	11/15/00	83	74	75	57
Chlorsulfuron	0.0625	11/15/00	95	97	91	52
Chlorsulfuron + NIS	0.0313	5/03/01	21	40	41	42
Chlorsulfuron + NIS	0.0625	5/03/01	31	45	45	53
Chlorsulfuron + MCPA	0.0313 + 1	11/15/00 + 5/18/01	75	80	78	56
MCPA	2	5/18/01	--	91	88	51
Triasulfuron	0.0313	11/15/00	13	5	10	41
Triasulfuron	0.0625	11/15/00	18	10	13	38
Control			--	--	--	42
LSD (0.05)			6	18	17	NS

[a]NIS = non-ionic surfactant (R-11) was applied at 0.25 % v/v to spring treatments of chlorsulfuron. MCPA was applied as the ester formulation.

Weed control in imidazolinone-resistant winter wheat with imazamox. Traci A. Rauch and Donald C. Thill. (Plant Science Division, University of Idaho, Moscow, ID 83844-2339) A study was established in 'Fidel' imidazolinone-resistant winter wheat to examine weed control in 2001 and herbicide soil persistence in 2002 with imazamox. Wheat was seeded on October 3, 2000. Plots were 16 by 32 ft arranged in a randomized complete block design with four replications. All herbicide treatments were applied using a CO_2 pressurized backpack sprayer calibrated to deliver 10 gpa at 30 psi and 3 mph (Table 1). The entire plot area was oversprayed with thifensulfuron/tribenuron at 0.016 lb/A and bromoxynil /MCPA at 0.75 lb ae/A on May 12, 2001. Wheat injury and weed control were evaluated visually on June 7, 2001. Wheat seed was harvested with a small plot combine on August 7, 2001. In spring 2002, each plot will be planted to spring barley and yellow mustard to evaluate soil persistence of imazamox.

Table 1. Application and soil data.

Location	Moscow, Idaho	
Application date	November 2, 2000	April 24, 2001
Wheat growth stage	1 leaf	3 to 5 tiller
Volunteer barley growth stage	2 leaf	2 to 3 tiller
Air temperature (F)	50	50
Relative humidity (%)	73	86
Wind (mph, direction)	2, E	4, E
Cloud cover (%)	30	10
Soil temperature at 2 in (F)	44	40
pH	4.7	
OM (%)	2.8	
CEC (meq/100g)	16	
Texture	loam	

No treatment visibly injured wheat on June 7, 2001 (data not shown). All treatments controlled volunteer barley 98% or better (Table 2). Wheat grain yield (89 to 99 bu/A) and test weight (56 to 60 lb/bu) did not differ among treatments or from the untreated check.

Table 2. Weed control, wheat yield and test weight with imazamox near Moscow, Idaho in 2001.

Treatment[a]	Rate	Application timing	Volunteer barley control	Wheat Yield	Wheat Test weight
	lb/A		%	bu/A	lb/bu
Imazamox	0.04	fall	99	93	60
Imazamox	0.08	fall	98	90	60
Imazamox	0.04	spring	99	99	59
Imazamox	0.08	spring	99	92	56
Untreated check	--	--	--	89	59
LSD (0.05)			NS	NS	NS
Density (plants/ft^2)			1		

[a]90% nonionic surfactant (R-11) at 0.25 % v/v and 32% urea ammonium nitrate at 1qt/A were applied with all treatments.

Weed control in imidazolinone-resistant winter wheat with imazamox and other grass herbicides. Traci A. Rauch and Donald C. Thill. (Plant Science Division, University of Idaho, Moscow, ID 83844-2339) Three studies were established in 'Fidel' imidazolinone-resistant winter wheat to examine weed control in 2001 and herbicide soil persistence in 2002 with flucarbazone-sodium, imazamox, procarbazone-sodium, and sulfosulfuron. Wheat was seeded on September 28, October 3 and 18, 2000 near Bonners Ferry, Moscow, and Tammany, Idaho, respectively. In all experiments, plots were 16 by 30 ft arranged in a randomized complete block design with four replications and included an untreated check. All herbicide treatments were applied using a CO_2 pressurized backpack sprayer calibrated to deliver 10 gpa at 30 psi and 3 mph (Table 1). The Bonners Ferry site was oversprayed with thifensulfuron/tribenuron at 0.016 lb/A and fluroxypyr 0.125 lb ae/A on May 3, 2001, and the Moscow location was oversprayed with thifensulfuron/tribenuron at 0.016 lb/A and bromoxynil /MCPA at 0.75 lb ae/A on May 12, 2001. Wheat injury and weed control were evaluated visually during the growing season. Wheat seed was harvested with a small plot combine on August 7, 13, and 16, 2001 at the Moscow, Tammany, and Bonners Ferry locations, respectively. In spring 2002, each plot in all experiments will be planted to spring barley and yellow mustard to evaluate soil persistence of all herbicides treatments.

Table 1. Application and soil data for Moscow, Tammany, and Bonners Ferry, Idaho locations.

Location	Moscow, Idaho	Tammany, Idaho	Bonners Ferry, Idaho
Application date	May 8, 2001	April 26, 2001	May 17, 2001
Growth stage			
Wheat	4 tiller	3 to 4 tiller	4 to 6 tiller
Wild oat (AVEFA)	--	--	2 to 4 leaf
Downy brome (BROTE)	--	3 to 4 leaf	--
Volunteer barley (HORVX)	3 to 4 tiller	--	--
Air temperature (F)	62	65	62
Relative humidity (%)	45	51	58
Wind (mph, direction)	2, W	1, W	3, SW
Cloud cover (%)	25	60	90
Soil temperature at 2 in (F)	60	50	50
pH	4.7	5.0	5.3
OM (%)	2.8	4.0	20
CEC (meq/100g)	16	25	49
Texture	loam	silt loam	loam

At all locations at any evaluation date, imazamox at 0.08 lb/A visibly injured wheat 9 to 40% (Table 2). In Moscow, imazamox at 0.04 lb/A visually injured wheat 8% on June 7. Wheat injury at Bonners Ferry was 11% for flucarbazone-sodium at the high rate on June 27 and 10% for imazamox at the low rate on July 12.

At Moscow, volunteer barley control was greatest with imazamox (99%) and lowest with flucarbazone-sodium at 0.027 lb/A (59%) (Table 2). Imazamox treatments controlled downy brome 97 to 99% at Tammany. Both rates of procarbazone-sodium treatments controlled downy brome 82% on May 24 and 86% at the highest rate on June 15. No other treatment adequately controlled downy brome at either evaluation date (42 to 75%). At the Bonners Ferry site, wild oat control was 96 to 99% in imazamox treatments. On June 27, flucarbazone-sodium controlled wild oat 91 to 93% but decreased to 78 to 81% by July 12. Both sulfosulfuron treatments did not adequately control wild oat at any evaluation date (29 to 55%).

At Moscow and Tammany, wheat yield and test weight did not differ among treatments or from the untreated check (Table 3). At Bonners Ferry, wheat yield of imazamox at 0.08 lb/A was less than all other treatments including the untreated check due to herbicide injury.

Table 2. Wheat injury and weed control near Moscow, Tammany, and Bonners Ferry, Idaho in 2001.

		Wheat injury						Weed control				
		Moscow		Tammany		Bonners Ferry		Moscow HORVX	Tammany BROTE		Bonners Ferry AVEFA	
Treatment[a]	Rate	June 7	July 10	May 24	June 15	June 27	July 12	June 7	May 24	June 15	June 27	July 12
	lb/A	--------	--------	--------	--------	--------	--------	%	--------	--------	--------	--------
Imazamox	0.04	8	2	0	0	6	10	99	99	99	98	96
Imazamox	0.08	24	16	16	9	40	39	99	99	97	99	99
Sulfosulfuron	0.031	0	0	0	0	0	0	74	70	60	46	30
Sulfosulfuron	0.062	0	0	0	0	1	0	85	74	75	55	29
Flucarbazone-sodium	0.027	0	0	0	0	9	8	58	42	55	91	78
Flucarbazone-sodium	0.054	2	0	0	0	11	8	76	59	58	93	81
Procarbazone-sodium	0.04	0	0	0	0	2	0	97	82	68	72	58
Procarbazone-sodium	0.08	0	0	0	0	6	4	89	82	86	80	62
LSD (0.05)		7	7	1	2	10	9	23	13	14	13	25
Density (plants/ft^2)								1	11		46	

[a]90% nonionic surfactant (R-11) was applied at 0.5% v/v with sulfosulfuron and 0.25% v/v with all other treatments. 32% urea ammonium nitrate was applied at 1 qt/A with all imazamox treatments.

Table 3. Wheat yield and test weight near Moscow, Tammany, and Bonners Ferry, Idaho, in 2001.

		Wheat yield			Wheat test weight[a]	
Treatment[b]	Rate	Moscow	Tammany	Bonners Ferry[c]	Moscow	Tammany
	lb/A	--------	lb/A	--------	lb/bu	--------
Imazamox	0.04	4969	3406	2678	60	62
Imazamox	0.08	5240	3411	1468	59	62
Sulfosulfuron	0.031	6178	3441	3663	59	62
Sulfosulfuron	0.062	5887	3277	3119	60	62
Flucarbazone-sodium	0.027	7970	3271	3096	61	62
Flucarbazone-sodium	0.054	6267	2927	3113	59	62
Procarbazone-sodium	0.04	6641	3461	3570	60	62
Procarbazone-sodium	0.08	7271	3459	2881	61	62
Untreated check	--	6446	3074	3326	58	62
LSD (0.05)		NS	NS	1133	NS	NS

[a]Test weights at Bonners Ferry will be determined after hand cleaning subsamples contaminated with wild oat seed.
[b]90% nonionic surfactant (R-11) was applied at 0.5% v/v with sulfosulfuron and 0.25% v/v with all other treatments. 32% urea ammonium nitrate was applied at 1 qt/A with all imazamox treatments.
[c]Weight included wild oat seed contamination.

Grass weed control in winter wheat. Bradley D. Hanson and Donald C. Thill. (Plant Science Division, University of Idaho, Moscow, ID 83844-2239) A trial was conducted near Porthill, Idaho to evaluate control of wild oat and quackgrass in winter wheat with several wild oat herbicides. The experimental design was a randomized complete block with four replications and 8 by 30 ft plots. Herbicide treatments were applied with a CO_2 pressurized backpack sprayer calibrated to deliver 10 gpa at 30 psi on May 7, 2001 (Table 1). Crop injury was evaluated on May 23, 2001 and weed control was evaluated visually on July 12 and August 8, 2001. The trial was terminated prior to grain harvest.

Table 1. Herbicide application and soil data.

Growth stage	
'Symphony' winter wheat	6-8 tiller
Wild oat	2-3 leaf
Quackgrass	2-6 leaf
Air temperature (F)	53
Relative humidity (%)	49
Soil temperature (F)	50
pH	7.2
OM (%)	12
CEC (meq/100 g)	37
Texture	Loam

Applications of flucarbazone-sodium and procarbazone caused 8 to 11% stunting of winter wheat 16 DAT, however injury was not apparent at later evaluations (Table 2). Wild oat control was 95% or more with all treatments on July 12 and August 8 except for sulfosulfuron, which only controlled wild oat 85% by August 8, 2001. Quackgrass was controlled 86 to 99% by sulfosulfuron, flucarbazone-sodium, and procarbazone on July 12. By August 8, only sulfosulfuron and procarbazone controlled quackgrass 92% or greater.

Table 2. Winter wheat injury and grass weed control with selected wild oat herbicides near Porthill, ID in 2001.

Treatment[a]	Rate	Wheat injury May 23	Wild oat control July 12	Wild oat control Aug. 8	Quackgrass control July 12	Quackgrass control Aug. 8
	lb ai/A	%				
Sulfosulfuron	0.031	3	89	85	99	92
Flucarbazone-sodium	0.027	8	98	98	86	30
Procarbazone	0.04	11	98	99	99	99
Clodinafop	0.06	1	95	96	20	0
$LSD_{(0.05)}$	--	7	6	9	28	26

[a] A nonionic surfactant (R-11) was applied at 0.5% v/v with sulfosulfuron and procarbazone and at 0.25 % v/v with flucarbazone-sodium. A proprietary adjuvant (Score) was applied at 0.32 qt/A with clodinafop.

Effect of dicamba formulation on wild oat herbicide efficacy in winter wheat. Bradley D. Hanson and Donald C. Thill. (Plant Science Division, University of Idaho, Moscow, ID 83844-2239) A trial was conducted near Porthill, Idaho to evaluate control of wild oat in winter wheat with several wild oat herbicides tank mixed with two formulations of dicamba; 4 lb/gal (Clarity) and 70% DG (BAS18311H). The experimental design was a randomized complete block with four replications and 8 by 30 ft plots. Herbicide treatments were applied with a CO_2 pressurized backpack sprayer calibrated to deliver 10 gpa at 30 psi on May 10, 2001 (Table 1). Weed control was visually evaluated on June 12 and June 26, 2001. Wheat grain was harvested at maturity on August 16, 2001 with a small plot combine.

Table 1. Herbicide application and soil data.

Growth stage	
'Fidel' winter wheat	6-8 tiller
Wild oat	2-3 leaf, 46 plt/ft^2
Air temperature (F)	66
Relative humidity (%)	46
Soil temperature (F)	60
pH	5.3
OM (%)	20
CEC (meq/100 g)	49
Texture	Loam

Wild oat control on June 26, 2001 ranged from 50 to 82% with imazamethabenz treatments generally providing the least control (Table 2). Dicamba formulations did not affect wild oat control with clodinafop and imazamethabenz. However, the dicamba formulated as the 4 lb/gal diglycolamine salt slightly reduced wild oat control on June 26, 2001. Wheat yield averaged 4824 lb/A and did not differ among herbicide treatments or the untreated control.

Table 2. The effect of dicamba formulation on wild oat control in winter wheat near Porthill, ID in 2001.

Treatment[a]	Rate	Wild oat control June 12	Wild oat control June 26	Wheat yield
	lb/A	%	%	lb/A
Untreated control	--	--	--	4408
Fenoxaprop/safener	0.083	58	82	4985
Fenoxaprop/safener + dicamba	0.083 + 0.125	34	59	4825
Fenoxaprop/safener + BAS18311H	0.083 + 0.125	59	73	4749
Clodinafop	0.05	31	79	4974
Clodinafop + dicamba	0.05 + 0.125	32	80	4993
Clodinafop + BAS18311H	0.05 + 0.125	50	78	4921
Imazamethabenz	0.41	46	55	5162
Imazamethabenz + dicamba	0.41 + 0.125	29	43	4387
Imazamethabenz + BAS18311H	0.41 + 0.125	18	50	4831
LSD $_{(0.05)}$	--	21	23	NS

[a]A nonionic surfactant (R-11) at 0.25% v/v was included in all imazamethabenz treatments and a proprietary adjuvant (Score) at 0.32 qt/A was included in all clodinafop treatments.

Control of henbit and mayweed chamomile in winter wheat. Branden L. Schiess and Donald C. Thill. (Plant Science Division, University of Idaho, Moscow, ID 83844-2339) A study was conducted near Cavendish, ID in 'Cashup' soft white winter wheat to determine the effect of chlorsulfuron/metsulfuron and combinations of metsulfuron with triasulfuron/dicamba, triasulfuron, and prosulfuron on henbit and mayweed chamomile control and crop injury. Plots were 8 by 30 feet, arranged in randomized complete block design with four replications. All herbicide treatments were applied with a CO_2 pressurized backpack sprayer calibrated to deliver 10 gpa at 33 psi and 3 mph (Table 1). Wheat injury, and henbit and mayweed chamomile control were evaluated visually on June 1 and July 11, 2001. Wheat grain was harvested August 16, 2001 with a small plot combine.

Table 1. Application data.

Application date	May 18, 2001
Wheat growth stage	2-4 tiller
Henbit growth stage	bud
Henbit plants/ft^2	1
Mayweed chamomile growth stage (inches)	9.8
Mayweed chamomile plants/ft^2	2
Air temperature (F)	58
Soil temperature at 2 in (F)	51
Relative humidity (%)	62
Wind (mph)	1-6
Cloud cover (%)	90
pH	4.8
OM (%)	4.3
Texture	Silt loam

On June 1, all treatments suppressed henbit 55 to 80%, and mayweed chamomile 33 to 70% (Table 2). On July 11, all treatments controlled henbit and mayweed chamomile 99 to 100%, except the triasulfuron/dicamba treatments, which only suppressed mayweed chamomile 58 to 65%. Triasulfuron/dicamba and triasulfuron/dicamba + metsulfuron injured wheat (stunting) 5 to 10% on July 11. Wheat yields ranged from 89 to 98 bu/A and were not affected by herbicide treatment.

Table 2. Henbit and mayweed chamomile control in winter wheat near Cavendish, Idaho in 2001.

Treatment[a]	Rate	Crop injury	Henbit control		Mayweed chamomile control		Wheat
		July 11	June 1	July 11	June 1	July 11	yield
	lb/A	%					bu/A
Triasulfuron/dicamba	0.1106	10	55	99	33	58	91
Triasulfuron/dicamba	0.1475	10	60	99	40	65	89
Chlorsulfuron/metsulfuron	0.0141	0	80	100	70	100	92
Chlorsulfuron/metsulfuron	0.0188	0	80	100	70	100	96
Triasulfuron/dicamba + metsulfuron	0.0731 + 0.0013	5	68	100	60	100	94
Triasulfuron/dicamba + metsulfuron	0.0731 + 0.0019	10	68	100	58	100	90
Triasulfuron/dicamba + metsulfuron	0.0731 + 0.0025	10	70	100	65	100	95
Triasulfuron/dicamba + metsulfuron	0.1106 + 0.0013	10	80	100	65	99	91
Triasulfuron/dicamba + metsulfuron	0.1106 + 0.0019	11	78	100	60	99	90
Triasulfuron/dicamba + metsulfuron	0.1106 + 0.0025	10	80	100	58	99	90
Triasulfuron + metsulfuron	0.0134 + 0.0013	0	68	100	50	99	98
Triasulfuron + metsulfuron	0.0134 + 0.0019	0	70	100	68	99	94
Prosulfuron + metsulfuron	0.0089 + 0.0013	0	60	100	60	100	95
Prosulfuron + metsulfuron	0.0089 + 0.0019	0	78	100	65	100	97
Prosulfuron + metsulfuron	0.0134 + 0.0013	0	78	100	63	100	96
Control		--	--	--	--	--	90
LSD (0.05)		2	7	NS	7	6	NS

[a]Triasulfuron/dicamba = Rave, chlorsulfuron/metsulfuron = Finesse, trisulfuron/dicamba + metsulfuron = Rave + Ally, triasulfuron + metsulfuron = Amber + Ally, prosulfuron + metsulfuron = Peak + Ally. A non-ionic surfactant (R-11) was added at 0.25% v/v to all treatments.

Downy brome control in winter wheat. Traci A. Rauch and Donald C. Thill. (Plant Science Division, University of Idaho, Moscow, ID 83844-2339) Two studies were established in 'Fidel' imidazolinone-resistant winter wheat near Tammany, ID to determine downy brome control and winter wheat yield with different application timings of imazamox and other grass herbicides, and different application timings and water volume with sulfosulfuron. In the imazamox experiment, plots were 8 by 30 ft arranged in a randomized complete block design with four replications. In sulfosulfuron experiment, the experimental design was an incomplete split split-plot with four replications and one untreated check. Main plots were application timing (48 by 30 ft), subplots were water volume (16 by 30 ft), and sub-subplots were herbicide treatments (8 by 30 ft). All treatments were applied with a CO_2 pressurized backpack sprayer (Tables 1 and 2). Wheat injury was evaluated visually on May 18 and 24, 2001 in the imazamox experiment and April 26 and May 18, 2001 in the sulfosulfuron experiment. In both experiments, downy brome (BROTE) control was evaluated on June 15, 2001 and wheat seed was harvested with a small plot combine on August 13, 2001.

Table 1. Application and soil data in the imazamox experiment.

Application date	April 19, 2001	May 23, 2001
Wheat growth stage	2 tiller	3 to 4 tiller
Downy brome growth stage	2 to 4 leaf	4 to 6 leaf
Gpa	10	10
Psi	32	32
Mph	3	3
Air temperature (F)	42	42
Relative humidity (%)	85	65
Wind (mph, direction)	0	3, NW
Cloud cover (%)	30	50
Soil temperature at 2 in (F)	40	40
pH	5.0	
OM (%)	4.0	
CEC (meq/100g)	25	
Texture	silt loam	

Table 2. Application and soil data in the sulfosulfuron experiment.

Application date	April 9, 2001	April 9, 2001	April 26, 2001	April 26, 2001
Wheat growth stage	1 tiller	1 tiller	3 to 4 tiller	3 to 4 tiller
Downy brome growth stage	1 to 3 leaf	1 to 3 leaf	4 to 5 leaf	4 to 5 leaf
Gpa	5	20	5	20
Psi	38	40	38	40
Mph	4.2	3.0	4.2	3.0
Nozzle size	11001XR	11003XR	11001XR	11003XR
Air temperature (F)	54		74	
Relative humidity (%)	58		45	
Wind (mph, direction)	1, N		3, NW	
Cloud cover (%)	70		60	
Soil temperature at 2 in (F)	48		55	
pH		5.0		
OM (%)		4.0		
CEC (meq/100g)		25		
Texture		silt loam		

No treatment visibly injured wheat in the imazamox experiment (data not shown). Imazamox at 0.04 lb/A applied at the 4 to 6 leaf timing controlled downy brome 99% and was similar to 2 to 4 leaf timing of imazamox at 0.04 lb/A and procarbazone-sodium + metribuzin and the 4 to 6 leaf timing of imazamox at 0.032 lb/A and procarbazone-sodium (87 to 95%) (Table 3). All other treatments controlled downy brome 80% or less. Based on orthogonal contrasts, wheat yield was 15% higher in treatments applied at the 2 to 4 leaf timing than at the 4 to 6 leaf timing (53 vs. 46 bu/A). Grain yield of all treatments did not differ from the untreated check, except imazamox at 0.04 lb/A applied at the 2 to 4 leaf stage. Imazamox at 0.04 lb/A applied at the 2 to 4 leaf stage yielded more grain (58 bu/A) than the 2 to 4 leaf timing of procarbazone-sodium, the 4 to 6 leaf timing of imazamox at 0.032 lb/A and procarbazone-sodium + metribuzin, and the untreated check. Wheat test weight did not differ among treatments or from the untreated check.

No treatment visibly injured wheat in the sulfosulfuron experiment (data not shown). Downy brome control was not affected by application timing, water volume, or herbicide treatment. Downy brome control averaged over herbicide treatment was greater for the 1 to 3 leaf timing (83%) than the 4 to 5 leaf timing (68%) at 20 gpa (Table 4). Wheat yield ranged from 3336 to 3969 lb/A and did not differ among application timing, water volume or herbicide treatment.

Table 3. Downy brome control and wheat yield with two timings of imazamox and other grass herbicides near Tammany, Idaho in 2001.

Treatment[a]	Rate	Application timing[b]	Downy brome control	Wheat yield	Wheat test weight
	lb/A		%	bu/A	lb/bu
Imazamox	0.032	2 to 4 leaf	76	56	62
Imazamox	0.04	2 to 4 leaf	87	58	62
Sulfosulfuron	0.031	2 to 4 leaf	69	52	62
Procarbazone-sodium	0.04	2 to 4 leaf	72	44	61
Procarbazone-sodium + metribuzin	0.04 + 0.188	2 to 4 leaf	88	56	62
Imazamox	0.032	4 to 6 leaf	88	42	62
Imazamox	0.04	4 to 6 leaf	99	52	62
Sulfosulfuron	0.031	4 to 6 leaf	62	48	62
Procarbazone-sodium	0.04	4 to 6 leaf	95	50	62
Procarbazone-sodium + metribuzin	0.04 + 0.188	4 to 6 leaf	80	39	62
Untreated check	--	--	--	45	62
LSD (0.05)			18	12	NS
Density (plants/ft^2)			16		

[a]90% nonionic surfactant (R-11) was applied at 0.5% v/v with sulfosulfuron and 0.25% v/v with all other treatments. 32% urea ammonium nitrate was applied at 1 qt/A with all imazamox treatments.
[b]Application timing based on downy brome growth stage.

Table 4. The effect of sulfosulfuron application timing and water volume on downy brome control and wheat yield near Tammany, Idaho in 2001.

Treatment[a]	Rate	Application timing[b]	Water volume	Downy brome control	Wheat yield
	lb/A		gpa	%	lb/A
Sulfosulfuron	0.031	1 to 3 leaf	5	81	3728
Sulfosulfuron	0.031	1 to 3 leaf	20	82	3791
Sulfosulfuron + NIS	0.031 + 0.5% v/v	1 to 3 leaf	5	78	3822
Sulfosulfuron + NIS	0.031 + 0.5% v/v	1 to 3 leaf	20	91	3791
Sulfosulfuron + NIS + aqua ammonia	0.031 + 0.5% v/v + 0.125% v/v	1 to 3 leaf	5	66	3969
Sulfosulfuron + NIS + aqua ammonia	0.031 + 0.5% v/v + 0.125% v/v	1 to 3 leaf	20	75	3860
Sulfosulfuron	0.031	4 to 5 leaf	5	65	3593
Sulfosulfuron	0.031	4 to 5 leaf	20	62	3638
Sulfosulfuron + NIS	0.031 + 0.5% v/v	4 to 5 leaf	5	78	3790
Sulfosulfuron + NIS	0.031 + 0.5% v/v	4 to 5 leaf	20	76	3770
Sulfosulfuron + NIS + aqua ammonia	0.031 + 0.5% v/v + 0.125% v/v	4 to 5 leaf	5	81	3814
Sulfosulfuron + NIS + aqua ammonia	0.031 + 0.5% v/v + 0.125% v/v	4 to 5 leaf	20	64	3336
Untreated check	--	--	--	--	3364
LSD (0.05)				NS	NS
Density (plants/ft^2)				19	

[a]NIS = 90% nonionic surfactant (R-11).
[b]Application timing based on downy brome growth stage.

<u>Wild oat herbicide antagonism in winter wheat</u>. Bradley D. Hanson and Donald C. Thill. (Plant Science Division, University of Idaho, Moscow, ID 83844-2239) A trial was conducted near Porthill, Idaho to evaluate antagonism of wild oat herbicides with several broadleaf herbicides. The experimental design was a randomized complete block with four replications and 8 by 30 ft plots. Herbicide treatments were applied with a CO_2 pressurized backpack sprayer calibrated to deliver 10 gpa at 40 psi on May 11, 2001 (Table 1). Wild oat control was evaluated visually on June 12 and June 26, 2001 and wheat grain was harvested on August 16, 2001 with a small plot combine.

Table 1. Herbicide application and soil data.

Growth stage	
'Fidel' winter wheat	3-5 tiller
Wild oat	2 leaf, 46 plt/ft^2
Air temperature (F)	50
Relative humidity (%)	66
Soil temperature (F)	50
pH	5.3
OM (%)	20
CEC (meq/100 g)	49
Texture	Loam

On June 26, 2001, flucarbazone-sodium treatments controlled wild oat 81 to 85%, while all other treatments provided 3 to 65% control (Table 2). Fenoxaprop/safener applied alone tended to control wild oat better than fenoxaprop/safener plus broadleaf herbicides although differences were not always significant. Single degree of freedom contrasts were used to compare fenoxaprop/safener alone to fenoxaprop/safener combined with broadleaf herbicides (Table 3). The contrasts showed that wild oat control with fenoxaprop/safener was less when mixed with thifensulfuron/tribenuron, bromoxynil, or MCPA. Wheat grain yield, which averaged 4316 lb/A, did not differ among herbicide treatments.

Table 2. The effect of broadleaf herbicides mixed with wild oat herbicides on wild oat control and winter wheat yield near Porthill, ID in 2001.

Treatment	Rate	Wild oat control June 12	Wild oat control June 26	Wheat yield
	lb/A	%	%	lb/A
Untreated	–	–	–	4288
Fenoxaprop/safener	0.083	69	64	4437
Fenoxaprop/safener + bromoxynil	0.083 +0.75	22	58	4391
Fenoxaprop/safener + bromoxynil/MCPA	0.083 + 0.75	37	53	4667
Fenoxaprop/safener + bromoxynil + thifensulfuron/tribenuron	0.083 + 0.5 + 0.0188	40	38	4004
Fenoxaprop/safener + bromoxynil/MCPA + thifensulfuron/tribenuron	0.083 + 0.5 + 0.0188	31	21	3653
Fenoxaprop/safener + bromoxynil + tribenuron	0.083 + 0.5 + 0.012	35	52	4510
Fenoxaprop/safener + bromoxynil/MCPA + tribenuron	0.083 + 0.5 + 0.012	37	31	3615
Fenoxaprop/safener + bromoxynil + thfensulfuron/tribenuron + metsulfuron	0.083 + 0.5 + 0.0188 + 0.006	31	19	3797
Fenoxaprop/safener + bromoxynil/MCPA + thfensulfuron/tribenuron + metsulfuron	0.083 + 0.5 + 0.0188 + 0.006	18	3	4024
Fenoxaprop/safener + bromoxynil + prosulfuron	0.083 + 0.5 + 0.0178	41	59	4628
Fenoxaprop/safener + bromoxynil/MCPA + prosulfuron	0.083 + 0.5 + 0.0178	44	58	4237
Fenoxaprop/safener + clopyralid/MCPA + thifensulfuron	0.083 + 0.61 + 0.0234	51	63	4554
Fenoxaprop/safener + clopyralid/MCPA + thifensulfuron/tribenuron	0.083 + 0.61 + 0.0188	30	31	3888
Flucarbazone-sodium + 2,4-D ester[a]	0.027 + 0.5	68	81	4487
Flucarbazone sodium + bromoxynil/MCPA[a]	0.027 + 0.75	77	81	4242
Flucarbazone sodium + bromoxynil/MCPA + 2,4-D ester[a]	0.027 + 0.75 + 0.5	82	85	4769
Clodinafop + thifensulfuron/tribenuron[b]	0.05 + 0.0188	46	41	4419
Tralkoxydim + thifensulfuron/tribenuron[c]	0.24 + 0.0188	42	35	4497
Imazamethabenz + difenzoquat + thifensulfuron/tribenuron[a]	0.23 + 0.5 + 0.0188	58	65	5021
$LSD_{(0.05)}$		23	28	NS

[a]Treatments contained a nonionic surfactant (R-11) at 0.25% v/v.
[b]Treatment contained a proprietary adjuvant (Score) at 0.32 qt/A.
[c]Treatment contained a proprietary adjuvant (Supercharge) at 0.5% v/v and ammonium sulfate solution at 17 lb/100 gal.

Table 3. Orthogonal contrasts for wild oat control on June 26, 2001 with fenoxaprop/safener alone compared to fenoxaprop/safener tank mixed with broadleaf herbicides.

Contrast	P-value
Fenoxaprop/safener alone vs. tank mixed with thifensulfuron/tribenuron	0.0002
Fenoxaprop/safener alone vs. tank mixed with bromoxynil	0.0187
Fenoxaprop/safener alone vs. tank mixed with MCPA	0.0134

Downy brome control in reduced tillage winter wheat. Joan Campbell and Donn Thill. (Department of Plant, Soil, and Entomological Sciences, University of Idaho, Moscow, ID 83844-2339) An experiment was established to evaluate downy brome control in reduced tillage winter wheat near Lewiston, Idaho. Clearfield® 'Fidel' winter wheat, an imidazolinone tolerant variety, was planted with a Yielder no till drill October 18, 2000. Herbicide treatments were applied with a CO_2 pressurized backpack sprayer calibrated to deliver 10 gpa at 32 psi and 3 mph (Table 1). The experimental design was randomized complete block with four replications and plots were 8 by 30 ft. Wheat injury and downy brome control were evaluated visually and wheat grain was harvested with a small plot combine at maturity.

Table 1. Environmental and edaphic data.

Application date	April 19, 2001
Wheat growth stage	3 tiller, 8 inches tall
Downy brome growth stage, density	2 to 4 leaf, 1 to 8 per ft^2
Air temperature (F)	42
Soil temperature (F)	40
Relative humidity (%)	85
Cloud cover (%)	25
Wind speed (mph, direction)	0 to 3, NW
Soil	
pH	5
Organic matter (%)	4
Cation exchange capacity (cmol/kg)	25
Texture	Silt loam

Wheat had 3 to 10% necrosis on April 26, but injury was no longer visible by May 24. Downy brome control on May 24 was generally higher than on June 28 although the relative treatment ranking was similar. On June 28, downy brome control was 94% with imazamox (Table 2). Downy brome control was 83 and 81% with sulfosulfuron + nonionic surfactant with and without UAN as the carrier, respectively, but control was poor (42%) without nonionic surfactant. The addition of metribuzin to sulfosulfuron did not improve downy brome control (60 to 69%) compared to sulfosulfuron + NIS (81%). Downy brome control ranged from 69 to 88% control with procarbazone treatments. Wheat grain yield and test weight did not correlate with downy brome control due to inconsistent downy brome and wheat stand.

Table 2. Downy brome control in winter wheat south of Lewiston, Idaho in 2001.

		Downy brome control		Winter wheat	
Treatment	Rate	May 24	June 28	Grain yield	Test weight
	lb/A	%	%	lb/a	lb/bu
Untreated control		--	--	3118	62.6
Sulfosulfuron + NIS	0.031 + 0.5% v/v	82	81	3407	62.0
Sulfosulfuron + UAN[b]	0.031	44	42	3261	61.8
Sulfosulfuron + NIS + UAN[b]	0.031 + 0.5% v/v	88	83	3614	61.6
MON 37525 + NIS	0.031 + 0.5% v/v	76	52	3135	61.8
MON 37525 + UAN[b]	0.031	64	42	3626	61.6
MON 37525 + NIS + UAN[b]	0.031 + 0.25% v/v	88	75	3920	62.0
Imazamox + NIS + UAN	0.04 + 0.25% v/v + 1qt/A	97	94	3602	62.0
Procarbazone + NIS	0.04 + 0.5% v/v	86	81	3690	61.9
Procarbazone + metribuzin + NIS	0.04 + 0.09 + 0.5% v/v	83	69	3493	62.0
Procarbazone + metribuzin + NIS	0.04 + 0.141 + 0.5% v/v	82	80	3467	61.9
Procarbazone + metribuzin + NIS	0.04 + 0.188 + 0.5% v/v	91	88	3221	62.3
Procarbazone + MKH3586 + NIS	0.04 + 0.0656 + 0.5% v/v	90	82	3097	62.2
Sulfosulfuron + metribuzin + NIS	0.031 + 0.09 + 0.5% v/v	74	60	3568	62.2
Sulfosulfuron + metribuzin + NIS	0.031 + 0.141 + 0.5% v/v	75	69	3335	62.2
Sulfosulfuron + metribuzin + NIS	0.031 + 0.188 + 0.5% v/v	71	60	2937	62.2
LSD (0.05)		18	27	509	0.6

[a]UAN was the carrier. Water was the carrier in all other treatments.
[b]Nonionic surfactant (R-11)

Herbicide timing in winter wheat. Chuck Cole, Bill D. Brewster, and Carol A. Mallory-Smith. (Department of Crop and Soil Science, Oregon State University, Corvallis, OR 97331-3002) A trial was conducted to evaluate the efficacy of five herbicides for the control of Italian ryegrass and oats in wheat at the OSU Hyslop Research Farm near Corvallis, OR. Soil at Hyslop was a Woodburn silt loam with a pH of 6.1 and an organic matter content of 2.5%. Imidazolinone-tolerant wheat was seeded at 120 lb/A on two dates to provide two growth stages on each application date. Italian ryegrass and oats were each seeded in 7.5-ft-wide strips in front of a 15-ft-wide strip of wheat in each plot. The herbicides were applied on five dates during the fall and winter using a single-wheel compressed-air sprayer, which delivered 20 gpa at 20 psi through XR 8003 flat fan nozzle tips. Herbicide application information is presented in Table 1. A non-ionic surfactant was added to all treatments at 0.5% v/v. Bromoxynil was applied on December 4 to control broadleaf weeds.

The wheat was harvested with a small-plot combine on July 23, 2001. Bird predation, competition from annual bluegrass, and lodging increased grain yield variability (Tables 2 and 3). Grain yields were greater in the earlier planting date. Plots treated with imazamox averaged greater yields than those treated with sulfosulfuron, procarbazone or flucarbazone. Yield comparisons between imazamox and AE F130060 across planting and application dates were not significant. Herbicide treatments applied on November 13, 2000, resulted in greater yields than the February 12, 2001, applications. There were no significant statistical interactions in grain yields.

A significant three-way interaction among planting date, herbicide treatment and application date contributed to statistical differences in both Italian ryegrass and oat control (Figures 1-4). AE F130060 and imazamox provided the best Italian ryegrass and oat control. Sulfosulfuron and flucarbazone were most effective when applied on 2- to 3-leaf Italian ryegrass in mid-November. All herbicides were more effective in the first planting than in the second on the first application date because more Italian ryegrass emerged in the second planting after the herbicides were applied. All herbicides were affected by cold weather and were least effective when applied in December. Most of the herbicides were about equally as effective on Italian ryegrass as on oats, but imazamox was consistently more effective on oats.

Table 1. Application information.

Application date	November 13, 2000	November 30, 2000	December 18, 2000	January 16, 2001	February 12, 2001
Growth stage[a]					
P_1 wheat	2 to 3 leaf	3 to 4 leaf	2 to 8 inches, 2 tillers	3 to 4 inches, 3 to 4 tillers	5 to 8 inches
P_2 wheat	1 leaf	2 leaf	3 inches, 3 leaf	3 to 4 inches, 2 to 3 tillers	5 inches, 2 to 4 tillers
P_1 Italian ryegrass	2 to 3 leaf	4 to 5 leaf	4 to 6 inches, 3 to 4 tillers	6 to 8 inches	11 to 13 inches, tillered
P_2 Italian ryegrass	1 leaf	1 to 2 leaf	3 to 4 inches, 2 to 3 leaf	4 to 5 inches, 2 to 3 tillers	4 to 7 inches, 3 to 4 tillers
P_1 oats	2 to 3 leaf	3 to 4 leaf	2 to 3 inches, 1 to 2 tillers	3 to 4 inches, 3 to 4 tillers	3 to 8 inches, tillered
P_2 oats	1 leaf	1 leaf	3 to 4 inches, 2 leaf	3 to 4 inches, 2 to 3 tillers	4 to 6 inches, 3 to 5 tillers
Air temperature (F)	37	50	34	36	35
Soil temperature (F)	37	50	35	36	36
Relative humidity (%)	75	69	82	81	82
Wind velocity (mph)	3 to 5	0	0	0	0

[a]P_1 = Planting 1; P_2 = Planting 2.

Table 2. Wheat grain yields following herbicide applications, near Corvallis, OR.

		Application date									
		Planting 1[a]					Planting 2[b]				
Treatment	Rate	11/13/00	11/30/00	12/18/00	01/16/01	02/12/01	11/13/00	11/30/00	12/18/00	01/16/01	02/12/01
	lb/A	bu/A									
Imazamox	0.04	121.5	118.7	121.0	116.8	113.1	117.4	115.6	107.3	117.2	107.8
Sulfosulfuron	0.031	112.4	121.9	123.3	111.5	108.0	109.4	104.5	109.8	101.0	98.9
Procarbazone	0.027	116.1	109.6	108.5	117.8	112.8	104.3	104.0	106.6	102.2	105.0
Flucarbazone	0.027	114.5	112.6	118.4	112.2	116.4	110.3	108.5	112.8	108.4	102.2
AE F130060 + AE F107892	0.0134 + 0.0268	122.3	115.9	116.1	118.0	118.0	111.5	107.7	112.6	102.9	101.0

[a]Seeded October 12, 2000; untreated control = 119.9 bu/A.
[b]Seeded October 28, 2000; untreated control = 110.3 bu/A

Table 3. Means separation for wheat grain yield.

	Wheat grain yield
	bu/A
Planting date	
October 12, 2000	115.9
October 28, 2000	107.6
$LSD_{0.05}$	7.7
Herbicide	
Imazamox	115.6
Sulfosulfuron	110.1
Procarbazone	108.7
Flucarbazone	111.6
AE F130060	112.6
$LSD_{0.05}$	4.5
Application date	
November 13, 2000	114.0
November 30, 2000	111.9
December 18, 2000	113.7
January 16, 2001	110.8
February 12, 2001	108.3
$LSD_{0.10}$	3.8

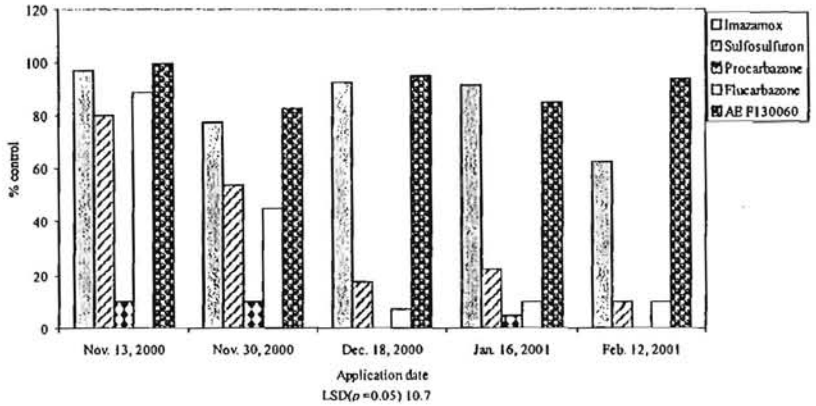

Figure 1. Percent Italian ryegrass control by application date for five herbicides in wheat seeded October 12, 2000, near Corvallis, OR.

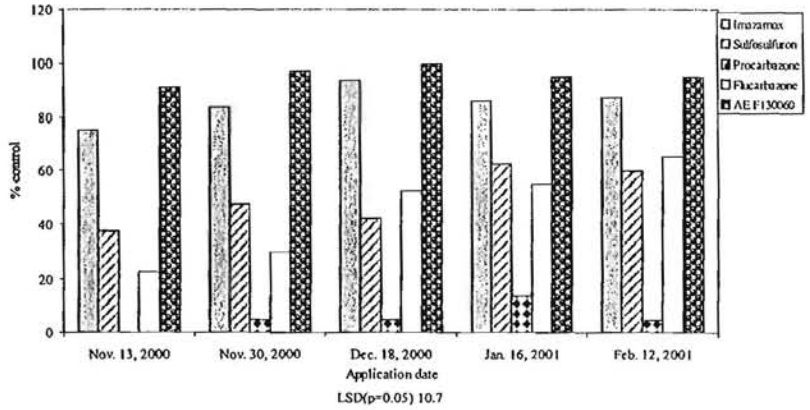

Figure 2. Percent Italian ryegrass control by application date for five herbicides in wheat seeded October 28, 2000, near Corvallis, OR.

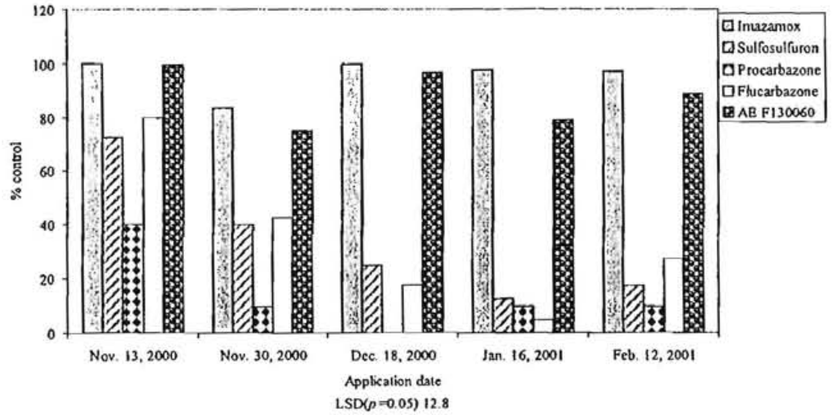

Figure 3. Percent oat control by application date for five herbicides in wheat seeded October 12, 2000, near Corvallis, OR.

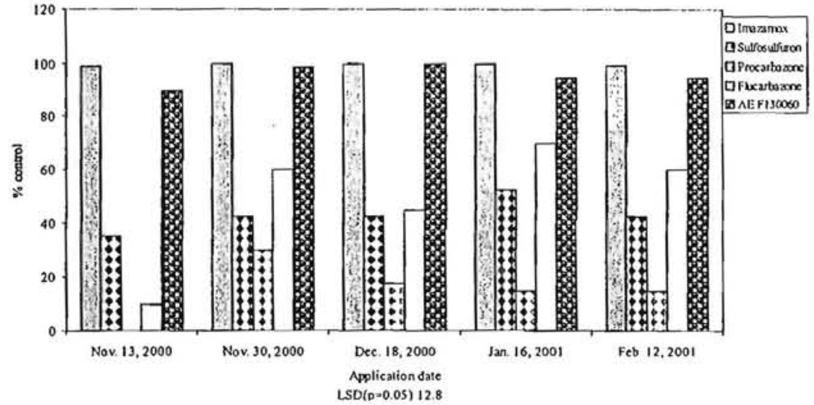

Figure 4. Percent oat control by application date for five herbicides in wheat seeded October 28, 2000, near Corvallis, OR.

Italian ryegrass control in winter wheat. Bill D. Brewster, Carol A. Mallory-Smith, and Chuck Cole. (Department of Crop and Soil Science, Oregon State University, Corvallis, OR 97331-3002) Italian ryegrass is the most significant weed problem in Willamette Valley wheat fields. Two trials were conducted to evaluate herbicide combinations for Italian ryegrass control in fall-seeded wheat. One trial site was at the OSU Hyslop research farm near Corvallis where wheat was over-seeded with Italian ryegrass. The second site was near Ballston in a field infested with diclofop-resistant Italian ryegrass. Soil at Hyslop was a Woodburn silt loam with a pH of 6.3 and an organic matter content of 3.1%. The Ballston soil was a Waldo silty clay loam with a pH of 4.9 and an organic matter content of 5.2%. Herbicides were applied with a single-wheel compressed air plot sprayer which delivered 20 gpa at 20 psi through XR 8003 flat fan nozzle tips. Herbicide application information is presented in Table 1. A non-ionic surfactant was added to the flucarbazone treatment and the chlorsulfuron-metsulfuron plus metribuzin treatment at a rate of 0.25% v/v, and to the sulfosulfuron treatment at 0.5% v/v. The wheat was harvested with a small-plot combine on July 27 at Hyslop and on August 8 at Ballston.

The treatments that contained flufenacet-metribuzin provided more than 90% control of Italian ryegrass at both locations (Table 2). AE F130060 plus AE F107892 was somewhat less effective on the Italian ryegrass than were the preemergence combination treatments, and resulted in lower wheat yields–probably partly because of early competition from the Italian ryegrass. Diclofop-methyl was ineffective on the Italian ryegrass at the Ballston site.

Table 1. Herbicide application information for two winter wheat trials in western Oregon.

	Hyslop	Ballston
Application date		
PES	October 30, 2000	October 30, 2000
POE	January 3, 2001	January 26, 2001
LPOE	January 22, 2001	February 26, 2001
Air temperature (F)		
PES	46	41
POE	48	43
LPOE	43	36
Soil temperature (F)		
PES	48	43
POE	38	44
LPOE	44	37
Relative humidity (%)		
PES	76	71
POE	81	83
LPOE	84	83
Wind velocity (mph)		
PES	2 to 3	0
POE	2	2 to 3
LPOE	3 to 4	1 to 2
Growth stage		
Wheat		
PES	preemergence	preemergence
POE	3 to 4 leaf, 1 tiller	4 leaf, 1 tiller
LPOE	4 to 5 leaf, 1-2 tillers	4 to 5 leaf, 1 to 2 tillers
Italian ryegrass		
PES	preemergence	preemergence
POE	3 to 4 leaf, 0 to 2 tillers	2 to 4 leaf, 0 to 1 tiller
LPOE	5 leaf, 2 tillers	3 to 6 leaf, 0 to 3 tillers

Table 2. Italian ryegrass control, wheat injury, and wheat grain yield following herbicide applications in western Oregon.

Treatment	Rate	Applic. timing	Italian ryegrass control: Hyslop[a]	Italian ryegrass control: Ballston[b]	Wheat Injury: Hyslop[a]	Wheat Injury: Ballston[b]	Wheat Yield: Hyslop[a]	Wheat Yield: Ballston[b]
	lb/A		%				bu/A	
Flufenacet-metribuzin[c]	0.42	PES						
chlorsulfuron-metsulfuron[c]	0.018 + 0.14	POE	100	100	5	0	100	90
Flufenacet-metribuzin	0.42	PES						
flucarbazone	0.027	POE	100	93	0	0	93	96
Flufenacet-metribuzin[c]	0.42	PES						
sulfosulfuron	0.027	POE	100	94	0	0	101	86
Flufenacet-metribuzin[c]	0.42	PES						
AE F130060 + AE F107892	0.013 + 0.027	POE	100	97	3	0	105	88
AE F130060 + AE F107892	0.013 + 0.027	POE	94	86	0	0	90	81
Diclofop-methyl	0.75	POE	99	0	0	0	88	26
AE F130060 + AE F107892	0.013 + 0.027	LPOE	83	91	0	0	80	82
AE F130060 + AE F107892	0.016 + 0.032	LPOE	86	95	0	0	81	76
Check	0		0	0	0	0	49	44
$LSD_{0.05}$	—		3	7	3	n.s.	11	11

[a]Evaluated April 12, 2001.
[b]Evaluated May 9, 2001.
[c]Commercial formulations.

Grass weed control in winter wheat with triallate and various sulfosulfuron timings. Traci A. Rauch and Donald C. Thill. (Plant Science Division, University of Idaho, Moscow, ID 83844-2339) A study was established in grain stubble prior to seeding 'Symphony' hard red winter wheat near Tammany, ID to examine grass weed control with triallate combined with various sulfosulfuron timings. Plots were 12 by 30 ft arranged in a randomized complete block design with four replications. Sulfosulfuron treatments were applied with a CO_2 pressurized backpack sprayer calibrated to deliver 10 gpa at 30 psi and 3 mph (Table 1). Granular triallate was applied with a screw-type drop spreader and incorporated the same day with a no-till drill. Wheat injury was evaluated visually on April 19, May 2, and 24, 2001. Downy brome (BROTE) control was evaluated on May 24 and June 15, 2001. Wheat seed was harvested with a small plot combine from a 4.1 by 27 ft area in each plot on August 13, 2001.

Table 1. Application and soil data.

Application date	October 15, 2000	October 16, 2000	April 19, 2001	May 2, 2001
Application equipment	hand-held boom	drop spreader	hand-held boom	hand-held boom
Wheat growth stage	preplant	preplant	2 to 3 tiller	3 to 4 tiller
Downy growth stage	preemergence	preemergence	3 to 4 leaf	4 to 6 leaf
Air temperature (F)	65	62	44	47
Relative humidity (%)	60	85	75	61
Wind (mph, direction)	3, NW	2, NW	0	2, NW
Cloud cover (%)	80	99	40	90
Soil temperature at 2 in (F)	50	50	40	40
pH	5.0			
OM (%)	4.0			
CEC (meq/100g)	25			
Texture	silt loam			

No treatment visibly injured wheat (data not shown). Downy brome control was similar (78 to 92%) for all treatments except triallate alone (35%) (Table 2). Wheat seed yield ranged from 3251 to 3854 lb/A and did not differ among treatments or from the untreated check.

Table 2. Grass weed control and wheat yield with triallate and sulfosulfuron.

Treatment[a]	Rate	Application timing[b]	BROTE contol[c]	Wheat yield
	lb/A		%	lb/A
Triallate	1.5	preplant	35	3626
Triallate + sulfosulfuron	1.5 + 0.031	preplant + preplant	91	3251
Triallate + sulfosulfuron	1.5 + 0.031	preplant + 3 to 4 leaf	92	3708
Sulfosulfuron	0.031	3 to 4 leaf	84	3623
Triallate + sulfosulfuron	1.5 + 0.031	preplant + 1 to 2 tiller	84	3483
Sulfosulfuron	0.031	1 to 2 tiller	78	3854
Untreated check	--	--	--	3538
LSD (0.05)			30	NS
plants/ft^2			4	

[a]A 90% nonionic surfactant (R-11) was applied at 0.5 % v/v with all postemergence sulfosulfuron applications.
[b]Application timing based on wheat growth stage.
[c]May 24, 2001 evaluation.

Broadleaf weed control in winter wheat near Genesee, Idaho. Joan Campbell and Donn Thill. (Department of Plant, Soil, and Entomological Sciences, University of Idaho, Moscow, ID 83844-2339) Three experiments were established in a direct seeded 'Madsen' winter wheat field near Genesee, Idaho. The objectives of these experiments were to evaluate broadleaf weed control with (1) 2,4-D plus other broadleaf herbicides to compare two adjuvants, (2) growth regulator plus sulfonylurea herbicides, and (3) carfentrazone plus other broadleaf herbicides. The growth regulator plus sulfonylurea herbicides experiment and the carfentrazone experiment were both in a portion of the field that had been in alfalfa and lentil in 1999 and 2000, respectively. The adjuvant comparison experiment was adjacent to the other two experiments, but that part of the field had been in wheat and lentil in 1999 and 2000, respectively. Herbicide treatments were applied with a CO_2 pressurized backpack sprayer calibrated to deliver 10 gpa at 32 psi and 3 mph (Table 1). The experimental design of all experiments was a randomized complete block with four replications and plots were 8 by 30 ft. The soil texture, pH, organic matter, and cation exchange capacity were silt loam, 5.7, 5.2%, and 19 cmol/kg, respectively. Broadleaf weed control was evaluated visually and wheat grain was harvested with a small plot combine at maturity.

Table 1. Application data for adjuvant comparison, growth regulator/sulfonylurea, and carfentrazone experiments.

Experiment	Adjuvant comparison	Growth regulator/sulfonylurea	Carfentrazone
Application date	April 17, 2001	April 17, 2001	April 23, 2001
Wheat growth stage	3 to 4 leaf	3 to 4 leaf	1 tiller, 6 to 7 inch
Sticky chickweed growth stage, density	--	Bud, 1/ft^2	Flowering, 6/ft^2
Field pennycress growth stage, density	--	1 to 3 leaf, 1/ft^2	2 to 3 inch, 10/ft^2
Henbit growth stage, density	--	1 inch, 4/ft^2	1 lf to flower, 1/ft^2
Alfalfa growth stage, density	--	1 inch, 1/ft^2	1 to 4 inch, 1/ft^2
Catchweed bedstraw growth stage, density	--	1 to 3 inch, 3/ft^2	4 inch, 5/ft^2
Mayweed chamomile growth stage, density	1 inch diamter, 5/ft^2	--	--
Air temperature (F)	61	61	49
Soil temperature (F)	49	49	40
Relative humidity (%)	55	55	70
Cloud cover (%)	100	100	100
Wind speed (mph, direction)	3, NW	3, NW	2 to 4, E

On April 21, wheat in the adjuvant comparison experiment was chlorotic, had necrotic spots, and tips of leaves were dead with all treatments containing carfentrazone except metsulfuon + 2,4-D + carfentrazone + NIS. Injury ranged from 10 to 15%, and was no longer visible by June 1. Wheat was not injured in the other two experiments.

Wheat competed well with the weeds in the adjuvant comparison experiment, and mayweed chamomile control was 88% or better with all treatments (Table 2). Wheat yield was highest with metsulfuron + 2,4-D + NIS + fluroxypyr and least with thifensulfuron/tribenuron + 2,4-D + carfentrazone + Quad 7, although yield from treated plots was not different from the untreated control. Mean wheat yield was 7988 lb/A with treatments applied with NIS and 7724 lb/A with the same treatments applied with Quad 7. Wheat test weight from treated plots was not different from the untreated control.

In the growth regulator/sulfonylurea herbicides experiment, sticky chickweed control was 94% or greater with thifensulfuron/tribenuron treatments (Table 3). Field pennycress was controlled with all treatments except dicamba + bromoxynil. Henbit and alfalfa control was not adequate with any treatment. Catchweed bedstraw control was 85% or better with all treatments except thifensulfuron/tribenuron + bromoxynil, procarbazone applied alone, and procarbazone + 2,4-D. Wheat grain yield was higher with procarbazone + MCPA, procarbazone + bromoxynil/MCPA, and treatments containing dicamba, except procarbazone + dicamba, compared to the untreated control. Test weight was not affected by any treatments compared to the untreated check.

In the carfentrazone experiment, sticky chickweed control was 99 to 100% with treatments containing thifensulfuron/tribenuron or metsulfuron (Table 4). Field pennycress control was 97 to 100% with all treatments. Henbit was controlled 100% with treatments containing metsulfuron. Alfalfa was not controlled with any treatments, and catchweed bedstraw control was 94% or better with treatments containing dicamba or fluroxypyr/2,4-D. Wheat grain yield generally was better in all treatments compared to the untreated control. Wheat test weight was lower from plots treated with thifensulfuron/tribenuron (59.5 lb/bu) compared to the untreated control (60.6 lb/bu).

Table 2. Mayweed chamomile control with broadleaf herbicides applied with two adjuvants in winter wheat near Genesee, Idaho in 2001.

Treatment	Rate	Mayweed chamomile control	Wheat yield	Wheat test weight
	lb/A	%	lb/A	lb/bu
Thifensulfuron/tribenuron +	0.014			
2,4-D[a] +	0.25			
NIS (R-11)	0.25[b]	93	8180	63.3
Thifensulfuron/tribenuron +	0. 014			
2,4-D[a] +	0.25			
NIS (R-11)+	0.25[b]			
fluroxypyr	1	93	8054	63.6
Thifensulfuron/tribenuron +	0. 014			
2,4-D[a] +	0.25			
carfentrazone +	0.016			
NIS (R-11)	0.25[b]	97	8204	63.6
Metsulfuron +	0.004			
2,4-D[a] +	0.25			
NIS (R-11)	0.25[b]	95	6947	63.0
Metsulfuron +	0. 004			
2,4-D[a] +	0.25			
NIS (R-11)+	0.25[b]			
fluroxypyr	1	95	8334	63.0
Metsulfuron +	0. 004			
2,4-D[a] +	0.25			
carfentrazone +	0.016			
NIS (R-11)	0.25	91	8208	62.9
Thifensulfuron/tribenuron +	0. 014			
2,4-D[a] +	0.25			
Quad 7	1[c]	93	7792	63.0
Thifensulfuron/tribenuron +	0. 014			
2,4-D[a] +	0.25			
Quad 7 +	1[c]			
fluroxypyr	1	94	8051	63.3
Thifensulfuron/tribenuron +	0. 014			
2,4-D[a] +	0.25			
carfentrazone +	0.016			
Quad 7	1[c]	95	6858	63.5
Metsulfuron +	0. 004			
2,4-D[a] +	0.25			
Quad 7	1[c]	95	7895	63.3
Metsulfuron +	0. 004			
2,4-D[a] +	0.25			
Quad 7 +	1[c]			
fluroxypyr	1	93	7929	63.3
Metsulfuron +	0. 004			
2,4-D[a] +	0.25			
carfentrazone +	0.016			
Quad 7	1[c]	95	7821	63.2
Fluroxypyr +	0.125			
2,4-D[a]	0.25	88	7638	63.5
Carfentrazone +	0.016			
2,4-D[a] +	0.25			
NIS (R-11)	0.25[b]	92	8021	63.5
Untreated control		--	7950	63.5
LSD (0.05)		8	1431	0.6

[a] Solventless formulation
[b] Rate is 0.25% v/v.
[c] Rate is 1% v/v.

Table 3. Broadleaf weed control with growth regulator and sulfonylurea herbicides in winter wheat near Genesee, Idaho in 2001.

		Weed control					Wheat	
Treatment	Rate	Sticky chickweed	Field pennycress	Henbit	Alfalfa	Catchweed bedstraw	Grain yield	Test weight
	lb/A	%					lb/A	lb/bu
Untreated control		--	--	--	--	--	4458	60.3
Dicamba/2,4-D	0.484	18	100	42	28	90	5203	60.2
Dicamba/2,4-D +	0.484							
Bromoxynil	0.25	75	100	40	32	87	5158	60.2
Dicamba/2,4-D +	0.484							
thifensulfuron/tribenuron[a]	0.0188	100	100	70	44	90	5359	60.9
Dicamba +	0.125							
Bromoxynil	0.25	58	60	51	28	92	5340	59.6
Dicamba +	0.125							
thifensulfuron/tribenuron[a]	0.0188	100	100	60	28	93	5192	59.9
Thifensulfuron/tribenuron +	0.0188							
bromoxynil[a]	0.25	96	100	68	21	75	4885	59.8
Procarbazone[b]	0.04	22	100	52	10	74	4670	60.3
Procarbazone +	0.04							
bromoxynil/MCPA[b]	0.5	55	100	55	28	90	5186	59.5
Procarbazone +	0.04							
MCPA ester[b]	0.46	79	100	71	29	90	5197	60.2
Procarbazone +	0.04							
2,4-D solventless[b]	0.48	80	100	60	24	55	4899	61.1
Procarbazone +	0.04							
thifensulfuron/tribenuron[b]	0.0188	94	100	68	19	85	4915	60.1
Procarbazone +	0.04							
thifensulfuron[b]	0.023	66	100	58	24	88	4833	59.4
Procarbazone +	0.04							
dicamba[b]	0.125	42	100	55	41	85	4878	59.9
LSD (0.05)		34	18	24	26	24	517	1.3

[a]Applied with 0.25% v/v NIS (R-11)
[b]Applied with 0.5% v/v NIS (R-11)

Table 4. Broadleaf weed control with carfentrazone in winter wheat near Genesee, Idaho in 2001.

		Weed control					Wheat	
Treatment[a]	Rate	Sticky chickweed	Field pennycress	Henbit	Alfalfa	Catchweed bedstraw	Grain yield	Test weight
	lb/A	%					lb/A	lb/bu
Carfentrazone +	0.008							
2,4-D ester	0.25	40	100	64	28	75	4979	60.5
Carfentrazone +	0.012							
2,4-D ester	0.25	49	100	81	36	78	5213	59.9
Carfentrazone +	0.016							
2,4-D ester	0.25	70	97	72	22	79	4925	60.1
Carfentrazone +	0.008							
2,4-D ester +	0.25							
dicamba	0.093	56	98	76	35	95	4840	59.8
Carfentrazone +	0.012							
2,4-D ester +	0.25							
dicamba	0.093	75	98	71	39	99	5211	60.2
Carfentrazone +	0.016							
2,4-D ester +	0.25							
dicamba	0.093	65	100	86	44	94	5195	60.1
Carfentrazone +	0.008							
2,4-D ester +	0.25							
thifensulfuron/tribenuron	0.014	100	100	81	31	74	5089	59.5
Carfentrazone +	0.012							
2,4-D ester +	0.25							
thifensulfuron/tribenuron	0.014	100	100	71	22	74	4971	59.5
Carfentrazone +	0.016							
2,4-D ester +	0.25							
thifensulfuron/tribenuron	0.014	99	100	79	32	79	5161	59.5
Carfentrazone +	0.008							
2,4-D ester +	0.25							
metsulfuron	0.004	100	100	100	24	59	5402	60.2
Carfentrazone +	0.012							
2,4-D ester +	0.25							
metsulfuron	0.004	100	100	100	46	85	5295	60.2
Carfentrazone +	0.016							
2,4-D ester +	0.25							
metsulfuron	0.004	100	100	100	51	75	5356	60.1
Carfentrazone +	0.008							
fluroxypyr/2,4-D	0.47	62	98	90	39	99	5319	60.1
Untreated control		--	--	--	--	--	4508	60.6
LSD (0.05)		26	4	19	22	18	492	0.8

[a] Nonionic surfactant (R-11) was added at 0.25% v/v.

Tolerance of imidazolinone-resistant wheat to imazapyr and imazapic in a fallow-winter wheat rotation. Traci A. Rauch and Donald C. Thill. (Plant Science Division, University of Idaho, Moscow, ID 83844-2339) Two studies were established near Tammany, ID to examine imidazolinone-resistant wheat tolerance to imazapyr and imazapic. Imazapyr and imazapic treatments were applied to chemical fallow in 1999 and 2000 and evaluated for field bindweed control (2001 WSWS Research Progress Report, p. 101). In both experiments, plots were 12 by 20 ft arranged in a randomized complete block design with four replications. Herbicide treatments were applied with a CO_2 pressurized backpack sprayer at 3 mph (Table 1). The entire plot areas were treated with glyphosate at 0.38 lb ae/A on April 10, flail mowed on April 28, and treated with glyphosate/2,4-D at 1 lb ae/A on May 22 and September 20, 2000. 'Fidel' imidazolinone-resistant winter wheat was seeded at 100 lb/A into flailed stubble on October 5, 2000. The studies were oversprayed with dicamba 0.125 lb/A and metsulfuron 0.00375 lb/A on March 30, 2001 to control broadleaf weeds. Wheat injury was evaluated visually on April 9, May 24, and June 15, 2001. Wheat seed was harvested with a small plot combine from a 4 by 17 ft area in each plot on July 19, 2001.

Table 1. Application and soil data for experiment one and two.

	Experiment one				Experiment two
Application date	September 22, 1999	March 8, 2000	July 13, 2000		July 13, 2000
Field bindweed growth stage	bloom (post-harvest)	preemergence	12 in. runners		12 in. runners
Gpa	20	20	10		10
Psi	40	40	30		30
Air temperature (F)	82	48	80		80
Relative humidity (%)	40	80	39		39
Wind (mph, direction)	1, NW	1, SW	1, NW		1, NW
Cloud cover (%)	0	80	20		20
Soil temperature at 2 in (F)	60	38	68		68
pH				5.9	
OM (%)				2.5	
CEC (meq/100g)				22	
Texture				silt loam	

No treatment visually injured winter wheat in experiment one or two (data not shown). Wheat test weight ranged from 49 (glyphosate/2,4-D treatment) to 58 and 56 to 57 lb/bu for experiments one and two, respectively (Tables 2 and 3). Wheat seed yield in experiments one and two ranged from 99 to 130 and 95 to 109 bu/A, respectively. Wheat test weight and yield did not differ among treatments or from the untreated check in both experiments.

Table 2. Winter wheat test weight and yield in 2001 following imazapyr and imazapic applications in 1999 and 2000 in experiment one.

Treatment[a]	Rate[b]	Application timing	Wheat test weight	Wheat yield
	lb/A		lb/bu	bu/A
Untreated check	--	--	55	101
Imazapyr	0.25	bloom	56	99
Imazapyr	0.50	bloom	56	108
Imazapic	0.128	bloom	58	114
Imazapic	0.192	bloom	57	108
Imazapyr	0.25	preemergence	56	102
Imazapyr	0.50	preemergence	57	101
Imazapic	0.128	preemergence	57	104
Imazapic	0.192	preemergence	58	112
Glyphosate/2,4-D	1.0	12 in. runners	49	130
LSD (0.05)			NS	NS

[a]A 90% nonionic surfactant (R-11) was applied at 0.25 % v/v with all postemergence imazapyr and imazapic applications.
[b]Rate is in lb ae/A.

Table 3. Winter wheat test weight and yield in 2001 following imazapyr and imazapic applications in 1999 and 2000 in experiment two.

Treatment[a]	Rate[b]	Wheat	
		test weight	yield
	lb/A	lb/bu	bu/A
Untreated check	--	57	105
Imazapyr	0.125	56	95
Imazapyr	0.25	57	107
Imazapic	0.128	56	98
Imazapic	0.192	57	109
Glyphosate/2,4-D	1.0	57	98
LSD (0.05)		NS	NS

[a]A 90% nonionic surfactant (R-11) was applied at 0.25 % v/v with all imazapyr and imazapic treatments.
[b]Rate is in lb ae/A.

PROJECT 4: TEACHING AND TECHNOLOGY TRANSFER

Rick Boydston, Chair

PROJECT 5: WEEDS OF WETLANDS AND WILDLANDS

Eric Lane, Chair

Evaluation of imazapic and quinclorac applied under trees and other woody species. Rodney G. Lym and Katheryn M. Christianson. (Department of Plant Sciences, North Dakota State University, Fargo, ND 58105). Most herbicides used for leafy spurge control are broad spectrum and cannot be used near trees and other woody species such as in shelter belts and wind breaks. Control using biological agents such as *Aphthona* spp. flea beetles also has been poor because the insects tend to avoid shaded areas. The leafy spurge gall midge *Spurgia esula* will establish under trees, but only prevents leafy spurge seed-set and does not reduce the root system. Imazapic and quinclorac provide excellent leafy spurge control and may be useful under and near woody species because both herbicides have a narrow weed control spectrum. The purpose of this research was to evaluate the effect of imazapic and quinclorac on various woody species when applied at rates that will control leafy spruge.

The experiment was established at three locations in well established wind breaks. The first location was on the North Dakota State University campus and included mature arborvitae (*Thuja occidentalis*), aka Northern White cedar. The plots were 15 by 50 feet with three replicates. The second location was an experimental tree planting on the NDSU research station at Casselton, and included black walnut (*Juglans nigra*), Siberian elm (*Ulmus pumila*), and white oak (*Quercus alba*) planted in 1990. The plots were 10 by 38 feet with two replicates. The third site was a mature shelter belt near Valley City, North Dakota, which included two rows each of juniper (*Juniperus scopulorum*), Black Hills spruce (*Picea glauca* var. *densata*), Siberian elm, and one row of common lilac (*Syringa vulgaris*). The plots at Valley City were 20 by 55 feet with two replicates.

Herbicides were applied with a single nozzle back-pack sprayer delivering 60 gpa at 25 psi. Application was made to the surface area walking back and forth within the plot in each shelter belt. A dye was added to the treatment solution to ensure uniform application. No attempt was made to prevent occasional spray from hitting the lower branches of the trees and shrubs. Spring- and fall-applied treatments were made the third week of May or mid-September 2000, respectively. Injury was based on visual observation of plants in the treated plots compared to the untreated control.

There was no visible injury 1, 3, 9, or 12 months after treatment (MAT) to arborvitae, black walnut, Siberian elm or white oak regardless of treatment or application date (data not shown). However, injury was observed on juniper, Black Hills spruce, and lilac at the Valley City location (Table). Imazapic spring-applied at 2 or 3 oz/A injured the new growth (candles) of both juniper and Black Hills spruce 1 and 3 MAT. The candles were yellow and injury increased as imazapic rate increased. Injury generally was less when imazapic was applied with 2,4-D compared to imazapic applied alone. Quinclorac applied alone or with diflufenzopyr caused some yellowing on new growth in spruce when evaluated 1 MAT but not 3 MAT. Fall-applied imazapic or quinclorac did not injure either juniper or spruce. The yellowing of new growth observed in 2000 was absent in 2001 and plant growth was similar to the untreated control.

Lilac was severely injured by imazapic and slightly injured by quinclorac, regardless whether the herbicides were spring- or fall-applied (Table). Imazapic applied to lilac resulted in severely stunted or no leaf growth, while quinclorac caused twisted leaf growth typical of auxin herbicides. Injury from imazapic alone or applied with 2,4-D was much greater when fall-applied compared to spring-applied. For instance, imazapic at 2 oz/A spring-applied caused 20 and 10% lilac injury 1 and 3 MAT, respectively, and the plants recovered. The same treatment fall-applied resulted in 90% injury the following spring (9 MAT) and most injured branches were dead by September 2001 (12 MAT) (data not shown). Lilac injury from quinclorac did not exceed 10%, was short-lived, and no plants were killed (Table). Grass injury averaged 10% with imazapic or imazapic plus 2,4-D applied in the fall, but not the spring.

Both quinclorac and imazapic can be used to control leafy spurge under certain tree and brush species. Neither herbicide injured elm, oak, walnut or cedar species. Both juniper and Black Hills spruce were injured by imazapic, which caused yellowing of the new growth (candles), but had no long-term effect on growth. However, imazapic at 2 or 3 oz/A fall-applied alone or with 2,4-D resulted in severe lilac injury or death, respectively. Lilac injury from quinclorac was minor and the plants soon recovered.

Table. Effect on several woody species from spring or fall application of imazapic or quinclorac.

Treatment	Rate	Injury 1 MAT[a]				Injury 3 MAT[a]				Injury 12/9/12 MAT[a]				
		Juniper	Spruce	Lilac	Elm	Juniper	Spruce	Lilac	Elm	Juniper	Spruce	Lilac	Elm	GI[b]
	——oz/A——	%												
Spring-applied treatments														
Imazapic + MSO[c]	2 + 1 qt	6	40	20	0	4	1	10	0	0	0	0	0	0
Imazapic + MSO[c]	3 + 1 qt	8	49	13	0	18	18	0	0	0	0	0	0	0
Imazapic + 2,4-D[d] + MSO[c]	2 + 4 + 1 qt	4	3	15	0	1	0	15	0	0	0	0	0	0
Imazapic + 2,4-D[d] + MSO[c]	3 + 6 + 1qt	3	31	55	0	2	0	35	0	0	0	10	0	0
Quinclorac + MSO[c]	12 + 1 qt	1	8	8	0	1	0	5	0	0	0	0	0	0
Quinclorac + diflufenzopyr + MSO[c]	12 + 1.2 + 1 qt	0	10	10	0	0	0	5	0	0	0	0	0	0
Untreated		0	0	0	0	0	0	0	0	0	0	0	0	0
LSD (0.05)		4	32[e]	30[e]	NS	6	11[e]	18[e]	NS					
Fall-applied treatments														
Imazapic + MSO[c]	2 + 1 qt									0	0	90/70[f]	0	18
Imazapic + MSO[c]	3 + 1 qt									0	0	100/90	0	9
Imazapic + 2,4-D[d] + MSO[c]	2 + 4 + 1 qt									0	0	65/70	0	5
Imazapic + 2,4-D[d] + MSO[c]	3 + 6 + 1qt									0	0	95/90	0	9
Quinclorac + MSO[c]	12 + 1 qt									0	0	0	0	0
Quinclorac + diflufenzopyr + MSO[c]	12 + 1.2 + 1 qt									0	0	5	0	0
LSD (0.05)												24/25		8

[a]Months after treatment, evaluated 12 MAT for spring-applied treatments and 9 MAT for fall-applied treatments. Evaluated for visible injury, i.e., yellow new growth (imazapic) or auxin injury (imazapic plus 2,4-D or quinclorac).
[b]Grass injury.
[c]Methylated seed oil was Scoil by AGSCO, Grand Forks, ND.
[d]Commercial formulation - Oasis.
[e]LSD = 0.10.
[f]9 MAT/12 MAT.

Biological control of purple loosestrife in North Dakota. Rodney G. Lym and Katheryn M. Christianson. (Department of Plant Sciences, North Dakota State University, Fargo, ND 58105). 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 about herbicides sprayed in close proximity to residential areas. Three species of purple loosestrife biological control agents were introduced in North Dakota in 1997 and 1998. The biological control agents included two leaf beetles, *Galerucella calmariensis* and *G. pusilla*, released in Grand Forks and Valley City, ND, and *Hylobius transversevittatus*, a root feeding weevil, in Grand Forks. The objective of this research was to evaluate purple loosestrife control with *Galerucella* spp. along a river in an urban area.

The experiment was established in Chautauqua Park along the Sheyenne River in Valley City, North Dakota. A mixed population of about 4000 *Galerucella calmariensis* and 10,000 *G. pusilla* were released at a single point in June 1998 and 1999, respectively. The number of *Galerucella* spp. adults and egg masses, as well as purple loosestrife stems, plant height, and spike length were recorded at the release point and at 25 foot increments both up and down stream from the release point. In a 1-m^2 area, measurements included the number of eggs, larvae, and adults estimated by counting for 60 seconds, height of the five tallest stems, length of the five longest flower spikes, and the total number of stems.

Galerucella spp. established the first year after release because both adults and egg masses were found in 1999 and the population increased through 2001 (Tables 1 and 2). *Gallerucella* spp. began to decrease the loosestrife stem height and flower spike length 2 yr after release (2000). For instance, stem height was reduced at the release pole from 1.4 m in 1999 to 0.4 m in 2000. Stem height in 2001 was similar to that measured in 2000. The average flower spike length was reduced to zero at the release pole and 25 feet from the pole in 2000, 2 yr after release, and at 50 feet in 2001. The number of stems increased 2 yr following the *Galerucella* spp. release even though the number of flowering plants and stem length decreased. In general, the plants were short and remained in the vegetative growth stage 2 and 3 yr after the first biological control agent was released.

The number of eggs observed increased from an average of 1/m^2 in 1998 to 27/m^2 in 2000, while larvae began to increase in 2001 and averaged 46/m^2 in 2001 (Table 2). The largest number of eggs, larvae, and adults were usually found near the original release pole and decreased as the distance from the release pole increased even 3 yr after release. However, adults and evidence of larvae feeding were observed well away from the experiment which indicated the *Galerucella* spp. were moving out of the research location as the insect population increased.

In this study, *Galerucella* spp. established and began to reduce the purple loosestrife infestation 2 yr following release. Biological control of purple loosestrife can be an alternative to chemical control in urban areas as long as insecticides sprayed for mosquito control are restricted from the release area.

Table 1. Purple loosestrife control with *Galerucella* spp. released in 1998 in Valley City, ND[a].

Distance from	Flowering stems			Stems				Stem height			Spike length		
release	1998	2000	2001	1998	1999	2000	2001	1999	2000	2001	1999	2000	2001
	no./m^2			no./m^2				m			cm		
0 (release)	0	0	0	10	15	58	30	1.4	0.4	0.8	0	0	0
25 feet	6	0	0	14	19	22	10	1.2	0.5	0.5	10	0	0
50 feet	2	0	0	35	14	50	31	0.9	0.8	0.7	6	10	0

[a] Estimates of purple loosestrife control were made in mid-July each year.

Table 2. Population change over time of *Galerucella* spp. on purple loosestrife at Valley City, ND[a].

Distance from	1998			1999			2000			2001		
release[a]	Eggs	Larvae	Adults	Eggs	Larvae	Adults	Eggs	Larvae	Adults	Eggs	Larvae	Adults
	no./m^2											
0 (release)	0	2	1	0	0	0	40	0	4	23	94	0
25 feet	2	1	0	2	0	2	11	0	1	0	34	4
50 feet	0	1	0	6	0	2	30	0	2	13	10	8

[a] Estimates of *Galerucella* spp. adults and egg masses were made in June of each year.

Roadside vegetation control in North Coast California with natural-based products. Steve L. Young. (Hopland Research and Extension Center, University of California, Hopland, CA 95449). Two studies were established at Jug Handle State Reserve on the northern coast of California near Mendocino, CA to compare the efficacy of natural-based products and synthetic herbicides for control of roadside vegetation. Gorse, a woody perennial, was the dominant vegetation at both sites with blackberry, another woody perennial, velvet grass and sweet vernalgrass growing in the open spaces. The most abundant forb was common catsear. Total vegetation control was evaluated with pine oil, plant essential oils and glyphosate at site one and with acetic acid, citrus distillate and glufosinate at site two. The reserve was mowed Fall 2000, prior to site establishment May 4, 2001. All plots were 10 by 30 feet with treatments replicated four times in a randomized complete block design. The herbicides were broadcast-applied with a CO_2 pressurized backpack sprayer delivering 100 gpa at 36 psi using three XR 8002 flat-fan nozzles evenly spaced across a five foot boom. Re-treatment applications were made at site one May 25 and June 29 and at site 2 June 8. Visual evaluations for weed control were made prior to re-treatments May 18 and June 22 at site 1 and June 1 and July 6 at site 2. After visual evaluations July 6 at site two, abundant vegetative growth prohibited re-treatment of the natural-based products. A final evaluation for vegetation control was made for both sites September 4.

Table 1. Herbicide application data.

	Site 1			Site 2	
Application date	5/4	5/25	6/29	5/18	6/8
Growth stage[a]					
Gorse	1-4" vines			1-8" vines	
Blackberry	1-6" vines			2-8" vines	
Velvet grass	2" to 4 leaves			4" to 6 leaves	
Sweet vernalgrass	2" to 5 leaves/inflor			12" to inflor	
Common catsear	2-3" rosette			2-5" rosette/bolt	
Application timing[b]	POST	21 d	56 d	POST	21 d
Air temperature (F)	64	59	64	61	60
Relative humidity (%)	70	88	75	74	78
Wind speed (m/h)	3	0	0	6	7
Cloud cover (%)	0	100	0	0	100

[a]Growth stage was evaluated prior to initial application. Additional applications were made based on percent control from previous applications. For initial application, gorse was the re-sprouts from Fall 2000 mowing, sweet vernalgrass was starting to show inflorescence (inflor) at site 1 and complete inflorescence (inflor) at site 2 and common catsear was beginning to bolt at site 2.
[b]Treatments were applied postemergence (POST) and POST 21 (d) days later at both sites and POST 56 (d) days later at site 1.

All natural-based products showed phytotoxicity on vegetation after at least one application (Tables 2 and 3). Plant essential oils provided 80% or greater control of all vegetation September 4 at site one. Pine oil was 88 to 90% effective for control of common catsear. Control of blackberry, the two grasses and common catsear with glyphosate was 94, 100 and 100%, respectively, September 4. At site two, acetic acid and citrus distillate were ineffective at controlling vegetation. Control of all species with glufosinate ranged from 84 to 100% June 1. On September 4, control with glufosinate of the two grasses and common catsear was 91 and 96%, respectively. Plant essential oils, glyphosate, and glufosinate were the most effective treatments for controlling velvet grass, sweet vernalgrass and common catsear (>86%). No treatment maintained effective control of the woody perennials, except for glyphosate on blackberry (94%).

Table 2. Weed control with natural-based products and synthetic herbicides in roadside vegetation at site 1.

			Weed control[c]											
			Gorse			Berries			Grasses			Catsear		
Treatment[a]	Rate	Timing[b]	5/18	6/22	9/4	5/18	6/22	9/4	5/18	6/22	9/4	5/18	6/22	9/4
	gal/A		%											
Plant essentials	20	POST												
	15	21 d												
	15	56 d	86	51	80	83	53	84	83	86	86	88	93	94
Pine oil	20	POST												
	20	21 d												
	20	56 d	51	33	61	59	44	79	51	43	60	59	90	88
Glyphosate	2	POST	50	90	76	32	89	94	94	100	100	30	100	100
LSD (0.05)			7	9	10	13	11	9	16	17	13	13	12	10

[a]All treatments were applied in a 100 gal/A total spray volume. Pine oil @ 71% solution (5.67lbs ai/gal), Plant essentials @ 33.1% solution, Glyphosate 41% (3lbs ae/gal).
[b]Timing of application was postemergence (POST) and POST 21 days later (d) and POST 56 (d).
[c]Weed species evaluated for control were gorse (*Ulex europaeus*) (Gorse), Himalaya blackberry (*Rubus procerus*) and California blackberry (*Rubus ursinus*) (Berries), velvet grass (*Holcus lanatus*) and sweet vernalgrass (*Anthoxanthum odoratum*) (Grasses) and common catsear (*Hypochoeris radicata*) (Catsear).

Table 3. Weed control with natural-based products and synthetic herbicides in roadside vegetation at site 2.

			Weed control[c]											
			Gorse			Berries			Grasses			Catsear		
Treatment[a]	Rate	Timing[b]	6/1	7/6	9/4	6/1	7/6	9/4	6/1	7/6	9/4	6/1	7/6	9/4
	gal/A		%											
Acetic acid	20	POST												
	33	21 d	26	25	0	28	54	0	48	64	33	44	81	19
Citrus distillate	20	POST												
	40	21 d	12	19	0	14	35	0	16	15	0	5	38	0
Glufosinate	2	POST	84	73	40	96	85	13	91	95	91	100	99	96
LSD (0.05)			8	8	9	14	20	11	8	11	18	13	13	19

[a]All treatments were applied in a 100 gal/A total spray volume. Acetic acid @ 23% solution, Citrus distillate @ 100% solution, Glufosinate 5.78% (0.5lbs ai/gal).
[b]Timing of application was postemergence (POST) and POST 21 days later.
[c]Weed species evaluated for control were gorse (*Ulex europaeus*) (Gorse), Himalaya blackberry (*Rubus procerus*) and California blackberry (*Rubus ursinus*) (Berries), velvet grass (*Holcus lanatus*) and sweet vernalgrass (*Anthoxanthum odoratum*) (Grasses) and common catsear (*Hypochoeris radicata*) (Catsear).

Natural-based products for control of annual vegetation in roadside or rangeland settings. Steve L. Young. (Hopland Research and Extension Center, University of California, Hopland, CA 95449). A study was conducted at the University of California, Hopland Research and Extension Center near Hopland, CA with natural-based products (Table 2) in comparison to glyphosate for control of annual vegetation in roadsides or rangelands. Plots were established April 11, 2001 along a roadside right-of-way in formerly grazed rangeland dominated by a variety of annual grass weed species including foxtail fescue, hare barley, medusahead, ripgut brome, soft chess and slender oat. There was a limited amount of broadleaf filaree. Soil type was a Pleasanton sandy loam (47% sand, 41% silt, 12% clay, pH 5.3, 2.5% organic matter and CEC of 18 meq/100 g soil). The plots were 10 by 30 feet with treatments replicated four times in a randomized complete block design. The treatments were broadcast-applied with a CO_2 pressurized backpack sprayer delivering 115 gpa at 36 psi using three XR 8002 flat-fan nozzles evenly spaced across a five foot boom. Weed control was evaluated visually April 23. Natural-based products, except for fatty acid soap, were applied a second time April 25. Due to weather related early senescence of all other species prior to the second application, only control of slender oat (AVEBA), medusahead (ELYCM) and hare barley (HORLE) was evaluated May 17.

Table 1. Herbicide application data.

Application date	4/11	4/25
Growth stage[a]		
Foxtail fescue	5" to 4 leaves	
Hare barley	8" to 4 leaves	
Medusa head	4" to 4 leaves	
Ripgut brome	8" to 6 leaves	
Soft chess	7" to 4 leaves	
Slender oat	8" to 6 leaves	
Broadleaf filaree	6", flowering	
Application timing[b]	POST	14 d
Air temperature (F)	70	80
Relative humidity (%)	47	78
Wind speed (m/h)	8	10
Cloud cover (%)	0	0

[a]Growth stage was evaluated prior to initial application. Additional applications were made based on percent control from previous applications. For initial application, the inflorescence for hare barley, ripgut brome and soft chess was either beginning to or had emerged.
[b]Treatments were applied postemergence (POST) and POST 14 (d) days later.

The natural-based products showed phytotoxicity on all vegetation. Due to the warm, dry spring, soft chess, ripgut brome, foxtail fescue and broadleaf filaree had senesced prior to the second application of the natural-based products and could not be included in this evaluation. Acetic acid and glyphosate controlled all weed species at least 79 and 99 percent, respectively, after one application. Slender oat and hare barley control declined to 58 and 35 percent, respectively for acetic acid even after a second application April 25. Control with all of the natural-based products was less than 73% after the second application and significantly less (LSD 0.05) than control with the standard treatment of glyphosate.

Table 2. Weed control with natural-based products and glyphosate in annual vegetation.

			Weed control[c]					
			AVEBA		ELYCM		HORLE	
Treatment[a]	Rate	Timing[b]	4/23	5/17	4/23	5/17	4/23	5/17
	gal/A		%					
Acetic acid	46	POST						
	6	14 d	79	58	95	73	89	35
Citrus distillate	23	POST						
	34.5	14 d	33	55	30	61	18	26
Pine oil	9.2	POST						
	11.5	14 d	19	31	40	63	15	24
Fatty acid soap	9.2	POST	20	14	38	28	23	9
Glyphosate	2.4	POST	99	100	100	100	100	100
LSD (0.05)			12	26	12	27	10	15

[a]All treatments were applied in a 115 gal/A total spray volume. Acetic acid @ 23% solution, Citrus distillate @ 100% solution, Pine oil @ 71% solution (5.67lbs ai/gal), Fatty acid soap @ 22% solution, Glyphosate 41% (3lbs ae/gal).
[b]Timing of application was postemergence (POST) and POST 14 (d) days later.
[c]Weed species evaluated for control were slender oat (AVEBA), medusahead (ELYCM) and hare barley (HORLE).

PROJECT 6: BASIC SCIENCES

Paul Isakson, Chair

AUTHOR INDEX 2002

WEED INDEX 2002

CROP INDEX 2002

HERBICIDE INDEX 2002

HERBICIDE PREMIXES

Product (Manufacturer)	Ingredients
Accent Gold (DuPont)	6.5% nicosulfuron (Accent), 6.5% rimsulfuron, 19.1% flumetsulam (Python), and 51.7% clopyralid (Stinger)
Axiom (Bayer)	54.4% flufenacet and 13.6% metribuzin (Sencor)
Axiom AT (Bayer)	19.6% flufenacet, 4.9% metribuzin (Sencor) and 50.5% atrazine
Backdraft (BASF)	0.25 lb imazaquin (Scepter) and 1.25 lb glyphosate (Roundup) per gal.
Basis (DuPont)	50% rimsulfuron and 25% thifensulfuron (Pinnacle)
Basis Gold (DuPont)	1.34% rimsulfuron, 1.34% nicosulfuron (Accent), and 87% atrazine
Bicep II MAGNUM (Syngenta)	3.1 lb atrazine and 2.4 lb *S*-metolachlor (Dual II MAGNUM) per gal.
Bicep MAGNUM TR (Syngenta)	2.0 lb atrazine, 2.5 lb *S*-metolachlor (Dual MAGNUM) and 0.09 lb flumetsulam (Python) per gal.
Bicep Lite II MAGNUM (Syngenta)	2.67 lb atrazine and 3.33 lb *S*-metolachlor (Dual II MAGNUM) per gal.
Bison (Agriliance)	2 lb bromoxynil (Moxy) and 2 lb MCPA per gal.
Boundary (Syngenta)	6.3 lb *S*-metolachlor (Dual MAGNUM) and 1.52 lb metribuzin (Sencor) per gal.
Broadstrike + Treflan (Dow)	0.25 lb flumetsulam (Broadstrike, Python) and 3.4 lb trifluralin per gal.
Bronate (Aventis)	2 lb bromoxynil (Buctril) and 2 lb MCPA per gal.
Brozine (Platte Chemical)	1 lb bromoxynil (Broclean) and 2 lb atrazine per gal.
Buctril + Atrazine (Aventis)	1 lb bromoxynil (Buctril) and 2 lb atrazine per gal.
Bullet (Monsanto)	2.5 lb microencapsulated alachlor (Micro-Tech) and 1.5 lb atrazine per gal.
Confront (Dow AgroSciences)	33% triclopyr (Garlon) and 12.1% clopyralid (Stinger)
Canopy 75DF (DuPont)	64% metribuzin (Lexone) and 11% chlorimuron (Classic)
Canopy XL (DuPont)	46.9% sulfentrazone (Authority) and 9.4% chlorimuron (Classic)
Canvas (DuPont)	37.5% thifensulfuron & 18.8% tribenuron (Harmony Extra) and 15% metsulfuron (Ally)
Celebrity Plus (BASF)	10.6 % nicosulfuron (Accent), 46.6 % sodium salt of dicamba (Banvel SGF) and 18.1% diflufenzopyr (ingredient of Distinct)
Command Xtra (FMC)	4 lb sulfentrazone (Authority) per gal. and 3 lb clomazone (Command) per gal. co-pack
Commence EC (Dow, FMC)	3 lb trifluralin (Treflan) and 2.25 lb clomazone (Command) per gal.
Conclude B & G (BASF)	2.7 lb bentazon plus 1.3 lb acifluorfen (Storm) per gal. and 1.5 lb sethoxydim (Poast) per gal. co-pack
Crossbow (Dow AgroSciences)	2 lb 2,4-D and 1 lb triclopyr (Remedy) per gal.
Curtail (Dow AgroSciences)	2 lb 2,4-D and 0.38 lb clopyralid (Stinger) per gal.
Degree Xtra (Monsanto)	2.7 lb microencapsulated acetolchlor (Degree) and 1.34 lb atrazine per gal.
Distinct (BASF)	20% diflufenzopyr and 50% dicamba (Banvel SGF)
Domain (Bayer)	24% flufenacet and 36% metribuzin (Sencor);
DoublePlay (Syngenta)	1.4 lb acetochlor (Surpass) and 5.6 lb EPTC (Eradicane) per gal.
Epic (Bayer)	48% flufenacet (Axiom) and 10% isoxaflutole (Balance)
Exceed (Syngenta)	28.5% primisulfuron (Beacon) and 28.5% prosulfuron (Peak)
Extreme (BASF)	0.17 lb imazethapyr (Pursuit) and 2 lb glyphosate (Roundup) per gal.
Fallow Master BS (Monsanto)	2.2 lb glyphosate (Roundup) and 0.4 lb dicamba (Clarity) per gal.
Field Master (Monsanto)	0.75 lb glyphosate (Roundup), 2 lb acetochlor (Harness), and 1.5 lb atrazine per gal.
Finesse (DuPont)	62.5% chlorsulfuron (Glean) and 12.5% metsulfuron (Ally)
Freedom (Monsanto)	2.67 lb alachlor (Lasso EC) and 0.33 lb trifluralin per gal.

FulTime (Dow AgroSciences)	2.4 lb microencapsulated acetochlor (TopNotch) and 1.6 lb atrazine per gal.
Fusion (Syngenta)	2 lb fluazifop (Fusilade) and 0.66 lb fenoxaprop (Option II) per gal.
Galaxy (BASF)	3 lb bentazon (Basagran) and 0.67 lb acifluorfen (Blazer) per gal.
Gauntlet (FMC)	75 % sulfentrazone (Authority) and 84% cloransulam (FirstRate) co-pack
Grazon P&D (Dow AgroSciences)	2 lb 2,4-D and 0.54 lb picloram (Tordon) per gal.
Guardsman (BASF)	2.3 lb dimethenamid (Frontier) and 2.7 lb atrazine per gal.
Harmony Extra (DuPont)	50% thifensulfuron (Harmony) and 25% tribenuron (Express)
Harness Xtra (Monsanto)	4.3 lb acetochlor (Harness) and 1.7 lb atrazine per gal.
Harness Xtra 5.6L (Monsanto)	3.1 lb acetochlor (Harness) and 2.5 lb atrazine per gal.
Hornet 85.6 (Dow AgroSciences)	23.1 % flumetsulam (Python) and 62.5 % clopyralid (Stinger)
Hornet 78.5 WDG (Dow AgroSci)	18.5 % flumetsulam (Python) and 60.0 % clopyralid (Stinger)
Laddok S-12	2.5 lb bentazon (Basagran) and 2.5 lb atrazine per gal.
Landmaster BW (Monsanto)	1.2 lb glyphosate (Roundup) and 1.5 lb ae 2,4-D amine per gal.
Lariat (Monsanto)	2.5 lb alachlor (Lasso) and 1.5 lb atrazine per gal.
Leadoff (DuPont)	2.3 lb dimethaenamid (Frontier) and 2.7 lb atrazine per gal.
Liberty ATZ (Aventis)	3.34 lb atrazine and 1.0 lb glufosinate (Liberty) per gal.
Lightning (BASF)	52.5% imazethapyr (Pursuit) and 17.5% imazapyr (Contain)
Marksman (BASF)	1.1 lb potassium salt of dicamba and 2.1 lb atrazine per gal.
Moxy + Atrazine (Agriliance)	1 lb bromoxynil (Moxy) and 2 lb atrazine per gal.
NorthStar (Syngenta)	7.5% primisulfuron (Beacon) and 36.3% dicamba(Banvel)
Pursuit Plus (BASF)	2.7 lb pendimethalin (Prowl) and 0.2 lb imazethapyr (Pursuit) per gal.
Ramrod/Atrazine F (Monsanto)	3 lb propachlor (Ramrod) and 1 lb atrazine per gal.
Rave (Syngenta)	8.8% triasulfuron (Amber) and 50% dicamba (Banvel)
Redeem (Dow AgroSciences)	33% triclopyr (Garlon) and 12.1% clopyralid (Stinger)
ReadyMaster ATZ (Monsanto)	2.0 lb glyphosate and 2.0 lb atrazine per gal.
Rezult B&G (BASF)	4 lb bentazon (Basagran) per gal. and 1 lb sethoxydim (Poast Plus) per gal. co-pack1 delivery system
Sahara (BASF)	7.8% imazapyr(Arsenal) and 62.2% diuron (Karmex)
Scepter OT (BASF)	0.5 lb imazaquin (Scepter) and 2.0 lb acifluorfen (Blazer) per gal.
Shotgun (United Agri Products)	2.25 lb atrazine and 1 lb iso-octyl ester of 2,4-D per gal.
Spirit (Syngenta)	42.8% primisulfuron (Beacon) and 14.2% prosulfuron (Peak)
Squadron (BASF)	2 lb pendimethalin (Prowl) and 0.33 lb imazaquin (Scepter) per gal.
Steadfast (DuPont)	50% nicosulfuron (Accent) and 25% rimsulfuron (ingredient of Basis and Basis Gold)
Starane Plus Salvo (UAP)	0.75 lb fluroxypyr (Starane) and 3 lb 2,4-D (Salvo) per gal.
Starane Plus Sword (UAP)	0.71 lb fluroxypyr (Starane) and 2.84 lb MCPA (Sword) per gal.
Stellar (Valent)	2.4 lb lactofen (Cobra) and 0.7 lb flumiclorac (Resource) per gal.
Steel (BASF)	0.17 lb imazaquin (Scepter), 0.17 lb imazethapyr (Pursuit), and 2.25 lb pendimethalin (Prowl) per gal.
Storm (BASF)	2.67 lb bentazon (Basagran) and 1.33 lb acifluorfen (Blazer) per gal.
Synchrony STS (DuPont)	32% chlorimuron (Classic) and 10% thifensulfuron (Pinnacle)
Tordon RTU (Dow AgroSciences)	3% acid equivalent picloram (Tordon) and 11.2%, 2,4-D ae per gal.
Tri-Scept (BASF)	2.57 lb trifluralin (Treflan) and 0.43 lb imazaquin (Scepter) per gal.
Weedmaster (BASF)	1.0 lb ae dicamba and 2.87 lb ae 2,4-D amine