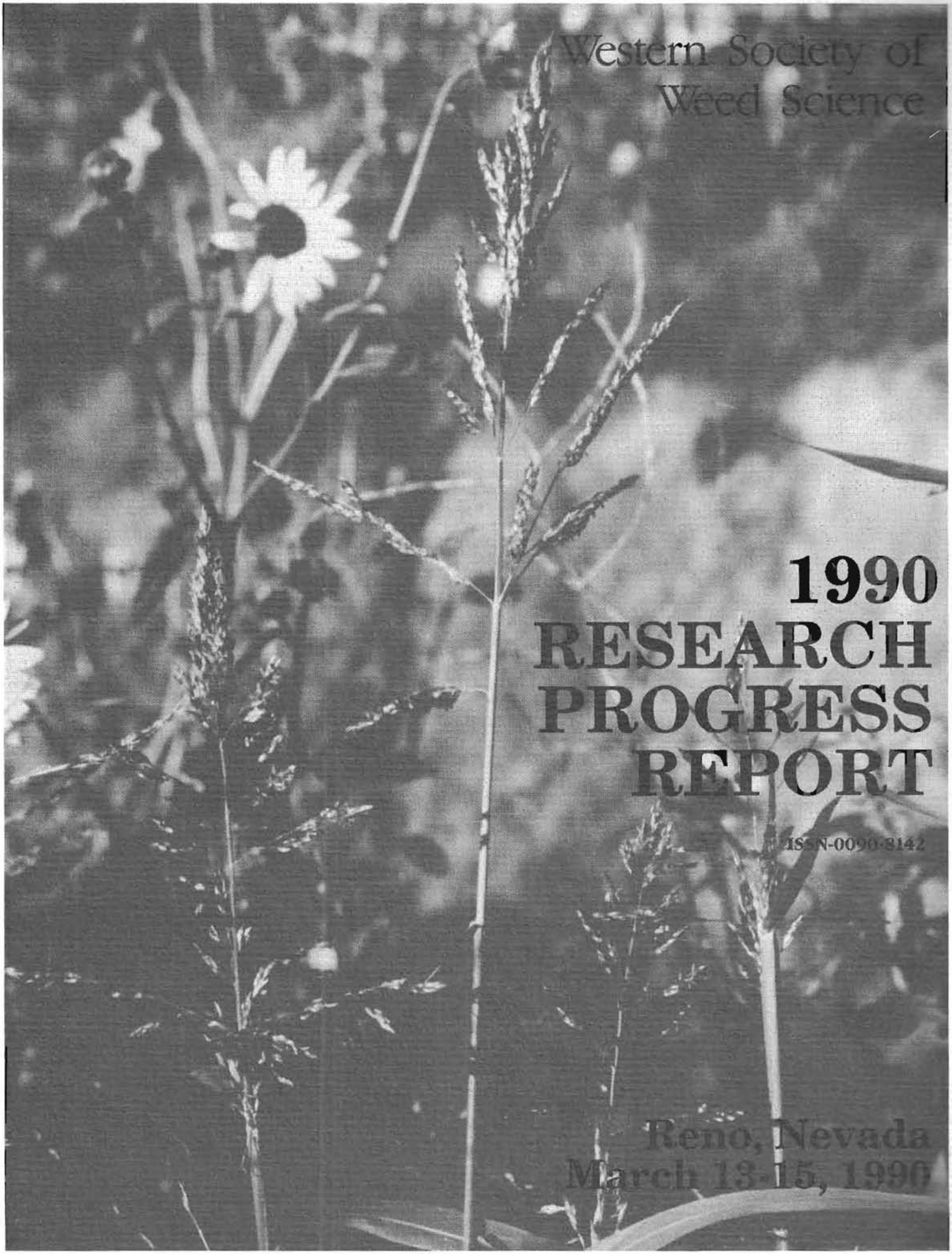

Western Society of Weed Science

1990 RESEARCH PROGRESS REPORT

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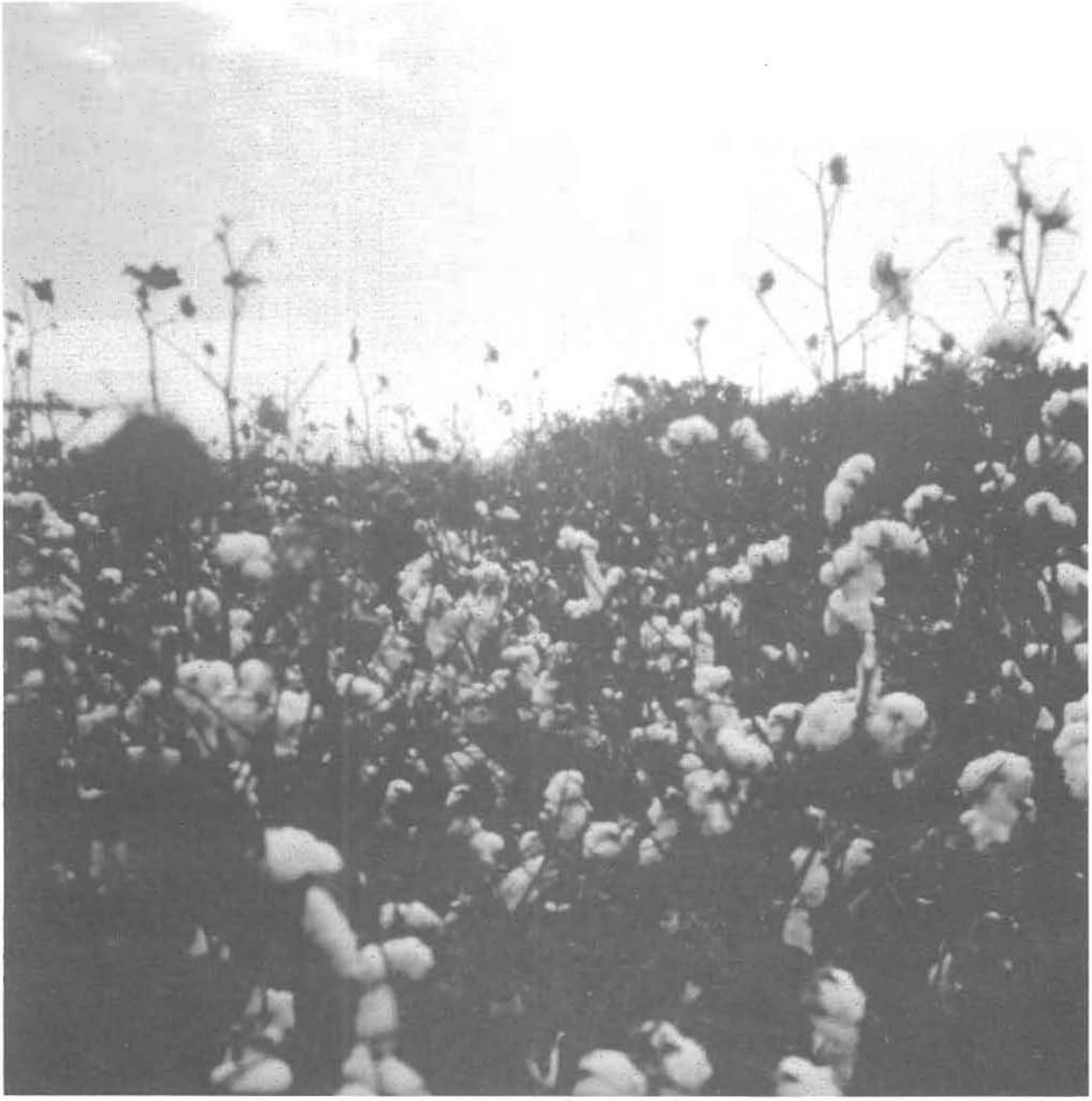

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FOREWORD

The Western Society of Weed Science (WSWS) 1990 Research Progress Report is a compilation of brief reports and recent investigations by weed scientists in the western United States. The primary function of this volume is to facilitate interchange of information within the weed science community. It is not meant to serve as a means of presenting conclusions, endorsements or recommendations to the general public or anyone else. Information contained in this report is meant to be considered in a preliminary sense, and NOT FOR PUBLICATION. This represents an effort by the WSWS to make available effective research, improve communication among scientists having common interests, minimize duplication of effort and to promote a sharing of ideas.

This 1990 Western Society of Weed Science Research Progress Report is prepared by photoreproduction of reports as submitted by the authors, without retyping or significant editorial changes. Content, format, and style of each paper or report are the sole responsibility of the author(s). In the interest of information exchange, reports were accepted for printing, except for profound deviations from WSWS editorial rules.

The accumulation of the project reports and some index work was the responsibility of the seven (7) Project Chairpersons and Chairpersons-elect. Final responsibility for compiling the report and developing the indices belongs to the Research Section Chairperson. Recognition and credit must go to the members of the Western Society of Weed Science whose efforts are reflected in the reports contained herein.

Jodie S. Holt
Chairperson, Research Section
Western Society of Weed Science
1990

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No papers were submitted for this project in 1990

PROJECT 1

PERENNIAL HERBACEOUS WEEDS

Mike Foster - Project Chairperson

Field bindweed control/suppression with fall treatments on CRP land in Colorado. Sebastian, J.R., K.G., Beck, and D.E. Hanson. A Conservation Reserve Program (CRP) experiment was established near Briggsdale, CO to evaluate field bindweed (CONAR) control with picloram, dicamba, 2,4-D, and their tank mixes. The design was a randomized complete block with four replications. All treatments were applied on October 19, 1988 with a CO2 pressurized backpack sprayer using 11003LP flat fan nozzles at 24 gal/a, 15 psi. Other application information is in Table 1. Plot size was 10 by 30 feet.

Visual evaluations were taken on May 25, August 14, and October 25, 1989 approximately 6, 9, and 12 months after treatments were applied, respectively. All picloram, dicamba, and tank mixes of picloram and dicamba provided moderate to excellent control 6 and 9 months after application (Table 2). Dicamba plus 2,4-D and 2,4-D alone provided poor to fair control. Picloram (>0.13 lb ai) and all picloram plus dicamba tank mixes maintained moderate to excellent CONAR control 1 year after treatment application.

Herbicide treatments will be evaluated again in 1989 for control longevity (Weed Research Laboratory, Colorado State University, Fort Collins, CO 80523).

Table 1. Application information and weed data for field bindweed control with fall treatments on CRP land in Colorado.

Environmental data	
Application date	October 19, 1988
Application time	11:00 am
Air temperature, C	14
Cloud cover, %	20
Relative humidity, %	60
Wind speed/direction, mph	0 to 2/SE
Soil temperature (2 in), C	11

Weed data

Application date	Species	Growth stage	Length (in)	Density (shoots/ft^2)
October 19, 1988	CONAR	vegetative	6 to 12	5 to 10

Table 2. Field bindweed control with fall treatments on Colorado CRP.

Herbicide	Rate	Field bindweed control		
	(lb ai/a)	May 25	August 14	October 25
		--------(% of check)----------		
dicamba	1.0	100	87	41
dicamba	2.0	100	95	63
2,4-D amine	1.0	41	14	0
2,4-D amine	2.0	55	5	0
picloram	0.13	100	84	48
picloram	0.25	100	99	87
picloram	0.50	100	100	100
dicamba + picloram	0.50 0.13	100	100	87
dicamba + picloram	0.50 0.25	100	100	92
dicamba + picloram	1.0 0.13	100	97	81
dicamba + picloram	1.0 0.25	100	100	97
2,4-D amine + dicamba	1.0 0.50	100	66	25
LSD (0.05)		12	11	18

Fall treatments for field bindweed control. Lym, Rodney G. Field bindweed is a problem weed in North Dakota, especially where minimum till and strip-fallow farming are common. Previous research has shown dicamba provides good field bindweed control the following growing season but may injure barley if applied just prior to freeze-up or at high rates. The purpose of this experiment was to evaluate several herbicides as single and combination treatments for late-season field bindweed control.

The experiment was established on September 8, 1988, on a dense stand of field bindweed near the Ranch Headquarters of the Dickinson (ND) Experiment Station. The herbicides were applied in 6- to 8-inch corn stubble which had been harvested 7 days prior to treatment. The field bindweed was in the vegetative growth stage with 20 to 24 inch long stems and was growing vigorously following several recent rains. However, the plants had been under severe drought stress most of the growing season. The herbicides were applied using a tractor-mounted sprayer delivering 8.5 gpa at 35 psi. All plots were 9 by 30 ft in a randomized complete block design with four replications. The weather was overcast, 45 F, 71% relative humidity with a soil temperature of 52 F at 4 inches. Field bindweed control evaluations were based on a visual estimate of percent stand and seedling establishment reduction as compared to the control on June 14, 1989. The area again was seeded to corn in 1989 and no further evaluations were made.

All herbicides except fluroxypyr provided satisfactory field bindweed control (Table). Field bindweed regrowth control with picloram at 0.13 lb/A increased from 56 to 94% when 2,4-D at 0.5 lb/A was added, but seedling control was similar. Glyphosate + 2,4-D at 0.6 + 1.1 lb/A provided 94% regrowth control but had little effect on seedling establishment. The addition of dicamba or picloram to the glyphosate + 2,4-D mixture did not increase regrowth control but did reduce seedling establishment similarly to dicamba and picloram applied alone. Dicamba + 2,4-D at 0.13 + 0.5 lb/A provided similar control to dicamba alone at 2 lb/A and averaged 85 and 97%, respectively.

Previous research at North Dakota State University has shown dicamba and picloram provide better long-term field bindweed control than glyphosate. Control generally increases with all three of these herbicides when they are applied with 2,4-D especially if picloram or dicamba are applied at low rates to reduce the potential for crop injury. Subsequent crop rotation and size of the infestation must be considered to determine which herbicide combination(s) are most cost-effective for field bindweed control in specific situations. (Published with approval of the Agric. Exp. Stn., North Dakota State Univ., Fargo).

Table. Field bindweed control with several herbicides applied in September

Treatment	Rate-1	Control	
		Regrowth	Seedling
	(lb/A)	--------(%)--------	
Picloram	0.13	56	63
Picloram	0.25	92	87
Picloram + 2,4-D	0.06 + 0.5	60	58
Picloram + 2,4-D	0.13 + 0.5	94	72
Picloram + glyphosate + 2,4-D	0.06 + 0.6 + 1.1	87	62
Picloram + glyphosate + 2,4-D	0.13 + 0.6 + 1.1	97	72
Glyphosate + 2,4-D	0.6 + 1.1	94	36
Dicamba + 2,4-D	0.13 + 0.5	85	73
Fluroxypyr	0.25	14	61
2,4-D	0.5	80	43
Picloram + fluroxypyr	0.13 + 0.13	57	76
Dicamba + glyphosate + 2,4-D	0.13 + 0.6 + 1.1	82	75
Dicamba + glyphosate + 2,4-D	1 + 1.8 + 3.3	96	77
Dicamba + X-77	2 + 0.5%	97	51
LSD (0.05)		24	36

Leafy spurge control under trees. Lym, Rodney G., and Calvin G. Messersmith. Leafy spurge is difficult to control with herbicides near trees because of potential damage to desirable vegetation. However, these areas provide a source of seed for infestation of nearby areas when leafy spurge is not controlled. The purpose of these experiments was to evaluate several herbicides both for leafy spurge control and for potential to damage desirable vegetation.

Three experiments for leafy spurge control under trees were established in a shelter belt located in a waterfowl rest area near Valley City, ND. The plots were located in a dense stand of leafy spurge growing under mature ash and elm trees that had been planted 5 ft apart in 12-ft rows. The herbicides were applied either with a hand-held single-nozzle sprayer delivering 40 gpa or with a controlled droplet applicator (CDA) which applied about 4 gpa. The hand-held sprayer treatments were applied as a premeasured amount of herbicide:water per plot to assure the correct rate and three passes were made across each plot to assure adequate coverage. The CDA treatments covered each plot only once. The experiment starting dates and leafy spurge stage at treatment were: June 26, 1986, flowering and beginning seed set; September 3, 1986, post-seed set and chlorotic leaves; and June 16, 1987, yellow bract to flowering. Plots were 12 by 24 ft arranged in a randomized complete block design with four replications. Evaluations were based on visible percent stand reduction as compared to the control.

Initial leafy spurge control was poor when glyphosate was applied alone, regardless of rate or treatment date (Table). Control improved to over 90% 12 months after treatment (MAT) following a June but not September application. Grass injury was nearly 100% with all glyphosate treatments. Leafy spurge control declined to 50% or less by June 1989 but very little grass had reestablished.

Sulfometuron alone did not control leafy spurge, but control was improved consistently when sulfometuron was applied with glyphosate regardless of rate or treatment date (Table). Leafy spurge control averaged 97% 12 MAT with sulfometuron plus glyphosate at 1 or 2 + 17 oz/A, declined rapidly to 67% the second year after treatment, but remained at 72% in June 1989. However, grass injury remained at 93% 3 yr after application. Leafy spurge control with sulfometuron plus 2,4-D declined rapidly following the 12 month evaluation. Picloram, applied with the CDA at a picloram:water concentration of 1:7 (v/v), provided over 95% leafy spurge control with no grass injury. Control averaged 76% in June 1989 following application in June 1986 but only 40% when applied in September. Several ash trees had some leaf curling after picloram application but no visible permanent damage occurred. (Published with approval of the Agric. Exp. Stn., North Dakota State Univ., Fargo 58105)

Table. Leafy spurge control under trees (Lym and Messersmith)

Application date and treatment	Rate	Aug 86	May 87		Aug 87		June 88		Aug 88		June 1989	
		Control	Control	Grass injury	Control	Grass injury	Control	Grass injury	Control	Grass injury	Control	Grass injury
	(oz/A)	(%)										
June 26, 1986												
Glyphosate	8.5	9	92	88	79	..	46	70	33	71	15	38
Glyphosate	17	41	96	98	94	..	53	89	54	91	21	38
Sulfometuron	0.5	15	0	0	29	..	4	0	26	0	3	0
Sulfometuron	1	9	0	0	19	..	0	0	14	0	0	0
Sulfometuron	2	9	28	15	19	..	4	0	12	10	0	0
Sulfometuron + glyphosate	0.5 + 8.5	13	98	98	90	..	58	63	50	68	63	58
Sulfometuron + glyphosate	1 + 8.5	13	96	99	95	..	75	96	81	95	86	78
Sulfometuron + glyphosate	2 + 8.5	24	99	96	85	..	71	70	66	94	66	58
Picloram (CDA)	1:7[a]	99	95	0	85	..	76	0	79	0	76	0
LSD (0.05)		19	8	14	23	..	28	31	27	24	30	39
September 3, 1986												
Glyphosate	17	..	65	99	54	..	22	98	10	94	5	75
Sulfometuron + glyphosate	2 + 17	..	99	99	89	..	63	99	55	75	72	93
Sulfometuron + 2,4-D	2 + 17	..	69	66	51	..	6	29	1	25	0	15
Picloram (CDA)	1:7[a]	..	86	9	66	..	67	0	57	0	40	0
LSD (0.05)			26	17	31	..	29	21	25	40	32	21
June 16, 1987												
Glyphosate	8.5	..	..	..	13	98	36	89	18	99	..	..
Glyphosate	17	..	..	..	30	98	76	94	36	100	..	..
Sulfometuron + glyphosate	0.5 + 8.5	..	..	..	9	83	21	60	9	88	..	..
Sulfometuron + glyphosate	1 + 8.5	..	..	..	12	86	51	83	31	96	..	..
Sulfometuron + glyphosate	2 + 8.5	..	..	..	36	76	24	87	11	84	..	..
Sulfometuron + 2,4-D	1 + 17	..	..	..	95	48	55	40	46	23	..	..
Sulfometuron + 2,4-D	2 + 17	..	..	..	99	63	41	14	34	51	..	..
Picloram (CDA)	1:7[a]	..	..	..	96	0	80	0	71	0	..	..
LSD (0.05)					12	25	18	20	16	23		

[a]Solution concentration picloram (Tordon 22K):water, and equals 2 lb picloram/8 gal solution.

Fluroxypyr alone and with auxin herbicides applied annually for 3 years to control leafy spurge. Lym, Rodney G., and Calvin G. Messersmith. Fluroxypyr is a pyridinecarboxylic acid herbicide similar to picloram but with less soil residual and a different weed control spectrum. The purpose of this experiment was to evaluate fluroxypyr for leafy spurge control when applied alone or with auxin herbicides and when applied in a repetitive treatment program.

The experiment was established and original herbicide treatments were applied to a dense stand of leafy spurge near Dickinson, ND, on July 14, 1986. Previous research had indicated the optimum application time for leafy spurge control with fluroxypyr was post seed-set rather than during true flower as for picloram. The herbicides were applied using a tractor-mounted sprayer delivering 8.5 gpa at 35 psi. The retreatments were applied as a split-block treatment with three replications. The original whole plots were 15 by 56 ft, and the retreatment subplots were 10 by 15 ft. Retreatments were applied in mid-July 1987 and 1988. The final evaluation was made on July 10, 1988, and was based on visible percent stand reduction as compared to the control.

		Retreatment/rate (lb/A)							
Original treatment	Rate	Fluro. 0.5	Pic. 0.25	Pic. 0.5	Fluro. + pic. 0.25+0.25	Fluro. + pic. 0.5+0.25	Pic.+ 2,4-D 0.25+1	Control	Mean
	(lb/A)	(% control July 1989)							
Fluroxypyr	0.5	40	27	56	53	61	29	3	38
Fluroxypyr	1	53	23	62	38	57	37	8	40
Fluroxypyr + picloram	0.25 + 0.25	37	17	43	42	49	32	13	33
Fluroxypyr + picloram	0.5 + 0.25	32	33	50	46	57	32	15	38
Fluroxypyr + 2,4-D	0.5 + 1	47	18	32	24	43	56	15	34
Fluroxypyr + dicamba	0.25 + 0.25	47	22	42	18	42	42	2	31
Picloram + 2,4-D	0.25 + 1	58	39	52	49	44	57	20	46
Picloram	1	58	16	58	38	51	53	7	46
Control		42	8	41	39	32	42	10	31
Mean		46	23	49	39	48	42	10	

LSD (0.05) whole plot = 10; subplots = 9; whole plot x subplot = 25

No treatment provided satisfactory leafy spurge control in July 1989, 12 months following the third retreatment (Table). Picloram at 1 lb/A and picloram plus 2,4-D at 0.25 plus 1 lb/A provided the best leafy spurge control of the original treatments (46%) when averaged over retreatments. All retreatments provided similiar control when averaged over the original treatments except picloram at 0.25 lb/A and fluroxypyr plus picloram at 0.25 plus 0.25 lb/A which tended to provide less control.

Although fluroxypyr alone or fluroxypyr plus dicamba, picloram, or 2,4-D generally provided similar or less leafy spurge control than picloram or picloram plus 2,4-D in 1987, fluroxypyr alone was much better than picloram alone under dry conditions in 1988 (data not shown). Fluroxypyr at 0.5 lb/A averaged 95% control as a retreatment compared to 50 and 70% with picloram at 0.25 or 0.5 lb/A, respectively. Fluroxypyr may be useful in a retreatment program, especially in areas where picloram cannot be used or in late-season treatments during dry conditions. But fluroxypyr does not provide long-term leafy spurge control. (Published with approval of the Agric. Exp. Stn., North Dakota State Univ., Fargo 58105).

Various additives applied with dicamba, picloram, and 2,4-D for leafy spurge control. Lym, Rodney G., and Calvin G. Messersmith. Previous research at North Dakota State University has shown only 28% of the picloram applied to leafy spurge is absorbed. Also, only 5% of the picloram applied reaches the roots and over 60% of that portion is released from the roots into the soil. Although the exact mechanism of picloram release is not known it is likely a passive process and thus cannot be inhibited. Therefore, increased picloram efficiency for leafy spurge control will probably come from increasing absorption and thereby increasing the amount of picloram translocated to the roots. The purpose of this experiment was to evaluate various additives applied with dicamba, picloram, and 2,4-D for increased leafy spurge control compared to the herbicides applied alone.

The experiments were established on a dense leafy spurge infestation near Hunter, ND, as spring- or fall-applied treatments. The spring treatments were applied on June 16, 1988, and the leafy spurge was beginning seed set. The weather was partly cloudy with 70 F, 60% relative humidity, and soil temperature of 82 and 76 F at 1 and 3 inches, respectively. The fall treatments were applied on September 1, 1988 and the leafy spurge was lush and growing vigorously after several rains following a hot and very dry summer. The weather was 72 F, 66% relative humidity, and the soil temperature was 70 and 68 F at 1 and 3 inches, respectively. The herbicides were applied using a tractor-mounted sprayer delivering 8.5 gpa at 35 psi. All plots were 10 by 25 ft in a randomized complete block design with four replications. Leafy spurge control evaluations were based on a visual estimate of percent stand reduction as compared to the control.

The additives included methylated sunflower oil, $(NH_4)_2SO_4$ (8-0-0-9 N-P-K-S) liquid fertilizer at 0.2 lb N and S/A, respectively, $(NH_4)_2SO_4$ water-soluble dry fertilizer at 2.5 lb N/A, citric acid buffer adjusted to pH 4.8, and a commercial formulation of fertilizer + surfactant equivalent to 15-3-3-2 (N-P-K-S) by weight plus 17% nonionic surfactant.

No treatment applied in June 1988 provided satisfactory leafy spurge control 3 or 12 months after treatment (MAT) (Table). The weather during the summer was very hot with much below normal precipitation. No additive provided better control than picloram + 2,4-D applied alone in these growing conditions.

Picloram + 2,4-D at 4 + 16 oz/A + methylated sunflower oil fall-applied provided better control than the herbicides applied alone at 9 but not 12 MAT (Table). Treatments that included picloram at 8 oz/A provided the best control and averaged 78% 9 MAT. Control generally was similar at similar herbicide application rates regardless of additive 12 MAT except the commercial formulation of fertilizer + surfactant and $(NH_4)_2SO_4$ dry formulation which was lower. No herbicide + additive treatment provided a long-term increase in leafy spurge control compared to the herbicides applied alone, but this may be due to the poor environmental conditions in 1988 and this experiment will be repeated. (Published with approval of the Agric. Exp. Stn., North Dakota State Univ., Fargo).

Table. Leafy spurge control with various herbicides and spray additives (Lym and Messersmith)

Treatment	Rate	Treatment date/evaluation (MAT)[a] June 88 3	June 88 12	Sept. 88 9	Sept. 88 12
	(oz/A)	------(% control)------			
Picloram + 2,4-D + methylated sunflower oil	4 + 16 + 32	4	3	63	34
Picloram + 2,4-D + methylated sunflower oil	8 + 16 + 32	20	0	81	51
Picloram + methylated sunflower oil	8 + 16	16	5	82	60
Dicamba + methylated sunflower oil	32 + 16	0	0	48	29
Picloram + 2,4-D + $(NH_4)_2SO_4$ (liquid)[a]	4 + 16 + 16	9	3	46	21
Picloram + 2,4-D + $(NH_4)_2SO_4$ (liquid)[a]	8 + 16 + 16	31	10	83	43
Picloram + 2,4-D + $(NH_4)_2SO_4$ (dry)	4 + 16 + 40	25	9	41	26
Picloram + 2,4-D + $(NH_4)_2SO_4$ (dry)	8 + 16 + 40	22	7	71	32
Picloram + 2,4-D + citric buffer	4 + 16	4	3	26	8
Picloram + 2,4-D + citric buffer	8 + 16	15	2	84	57
Picloram + 2,4-D + fertilizer + surfactant[b]	4 + 16 + 8	5	0	41	21
Picloram + fertilizer + surfactant[b]	8 + 8	21	6	68	37
Dicamba + fertilizer + surfactant[b]	32 + 8	33	6	38	14
Picloram + 2,4-D	4 + 16	18	8	33	28
LSD (0.05)		19	NS	27	20

[a]Months after treatment.
[b]Commercial formulation (Inhance) MCA Labs, Union Mills, IN 46382.

Evaluation of sulfometuron applied alone or with other herbicides in the spring or fall for leafy spurge control and grass injury. Lym, Rodney G., and Calvin G. Messersmith. Previous research at North Dakota State University has shown that sulfometuron must be applied at rates of at least 1 oz/A with an auxin herbicide to control leafy spurge. Also, sulfometuron has been more effective on leafy spurge when applied in fall compared to spring but grass injury also is higher. The purpose of this research was to evaluate leafy spurge control and grass injury with sulfometuron applied alone or with dicamba, picloram, or 2,4-D in the spring or fall followed by various retreatments the next year.

The experiment was established in a dense stand of leafy spurge near Valley City, ND, on June 2 or August 31, 1988, for the spring- or fall-applied treatments, respectively. The soil at Valley City was a loam with pH 7.1 and 9.2% organic matter. The herbicides were applied using a tractor-mounted sprayer delivering 8.5 gpa at 35 psi. The retreatments were applied as a split-block treatment with three replications. The original whole plots were 15 by 50 ft, and the retreatment subplots were 10 by 15 ft. The 1988 growing season was much warmer and drier than normal. The weather at application for the spring or fall applied treatments was 89 and 74 F, 42 and 68% relative humidity, and soil temperature of 79 and 70 F at 3 inches, respectively. Retreatments were applied on June 7 and September 13, 1989, for the spring and fall treatments, respectively. Evaluations were based on visible percent stand reductions as compared to the control.

Picloram at 16 oz/A with 92% control was the only spring-applied treatment to provide satisfactory leafy spurge control 12 months after treatment (MAT) (Table). Sulfometuron at 1.5 and 3 oz/A applied with 2,4-D at 16 oz/A provided 20 and 75% leafy spurge control, respectively, compared to 0 and 8%, respectively, with sulfometuron alone. Sulfometuron + picloram at 1.5 + 8 oz/A provided 65% leafy spurge control 12 MAT compared to only 26% with picloram at 8 oz/A applied alone. Sulfometuron applied with dicamba did not increase control compared to either herbicide applied alone. There was only slight grass injury with sulfometuron.

Sulfometuron + picloram at 1.5 + 8 oz/A and picloram alone at 16 oz/A without a retreatment provided similar leafy spurge control in September 1989 (15 MAT) and averaged 51% (Table). Leafy spurge control with all original treatments following the 1989 retreatments was similar and averaged 59% except 2,4-D alone. The best retreatments were picloram + 2,4-D at 4 + 16 oz/A, picloram at 8 oz/A, and sulfometuron + picloram at 1.5 + 8 oz/A which averaged 78, 74 and 68% control, respectively. Grass injury increased when sulfometuron at 1.5 oz/A was applied as a retreatment either with 2,4-D or picloram compared to a single application and averaged 43 and 29%, respectively, over all original treatments but 92 and 73%, respectively, when applied 12 months after sulfometuron alone at 3 oz/A.

All treatments fall-applied provided excellent leafy spurge control in June 1989 except 2,4-D at 16 oz/A and picloram at 8 oz/A (Table). However, grass injury averaged 98% with any treatment that included sulfometuron. Control declined rapidly by September 1989. The best treatments, averaging 76% leafy spurge control, were sulfometuron at 3 oz/A plus 2,4-D, sulfometuron at 1.5 oz/A plus dicamba or picloram, and picloram at 16 oz/A. Grass injury declined slightly to 88% 12 MAT averaged over all fall sulfometuron treatments.

Leafy spurge control was improved when sulfometuron was applied with 2,4-D or picloram in the spring compared to the herbicides applied alone with minimal grass injury. Grass injury increased when sulfometuron was applied 2 yr in a row. Sulfometuron fall-applied provided good initial leafy spurge control but nearly 100% grass injury. (Published with approval of the Agric. Exp. Stn., North Dakota State Univ., Fargo).

Table. Sulfometuron applied alone or with various auxin herbicides in the spring or fall for leafy spurge control (Lym and Messersmith)

				Retreatment and rate (oz/A)/ evaluation Sept. 1989											
		Evaluation June 1989		Sulf.+2,4-D 1.5 + 16		Sulf+pic 1.5 + 8		Picloram 8		Pic+2,4-D 4 + 16		Control		Mean	
Application date and treatment	Rate	Control	Grass inj.	Control	Grass inj.	Control	Grass inj.	Control	Grass inj.	Control	Grass inj.	Control	Grass inj.	Control	Grass inj.
	(oz/A)	(%)													
June 1988															
Sulfometuron	1.5	0	15	44	53	69	48	60	31	82	11	24	7	56	30
Sulfometuron	3	8	22	44	92	67	73	93	57	73	26	2	16	56	53
Sulfometuron+2,4-D	1.5+16	20	17	28	52	73	14	87	33	73	17	2	35	53	30
Sulfometuron+2,4-D	3+16	75	21	70	43	81	70	63	35	79	7	34	8	66	33
Sulfometuron+dicam.	1.5+32	6	7	54	37	80	28	64	25	90	17	0	5	56	22
Sulfometuron+pic.	1.5+8	65	8	52	77	81	35	71	2	67	0	52	0	65	23
2,4-D	16	0	0	9	13	38	10	86	3	77	0	0	0	42	5
Dicamba	32	0	0	61	45	62	3	86	3	72	3	25	0	61	11
Picloram	8	26	0	35	12	59	2	68	3	87	0	17	0	53	3
Picloram	16	92	0	50	0	75	0	63	0	77	3	50	3	63	1
Control	..	0	0	33	43	58	39	68	5	76	9	0	0	47	19
Mean				44	43	68	29	74	18	78	8	19	7		
LSD (0.05)		16	15	Whole plot = 17, 11; subplot = 12, 8; whole plot X subplot = 38,26											
August 1988															
Sulfometuron	1.5	97	97	..	..	..	..	..	..	..	..	31	88		
Sulfometuron	3	99	99	..	..	..	..	..	..	..	..	52	91		
Sulfometuron+2,4-D	1.5+16	96	98	..	..	..	..	..	..	..	..	31	83		
Sulfometuron+2,4-D	3+16	99	97	..	..	..	..	..	..	..	..	67	92		
Sulfometuron+dicam.	1.5+32	100	99	..	..	..	..	..	..	..	..	79	91		
Sulfometuron+pic.	1.5+8	100	98	..	..	..	..	..	..	..	..	88	80		
2,4-D	16	8	3	..	..	..	..	..	..	..	..	12	0		
Dicamba	32	97	3	..	..	..	..	..	..	..	..	20	0		
Picloram	8	78	17	..	..	..	..	..	..	..	..	37	0		
Picloram	16	99	7	..	..	..	..	..	..	..	..	70	1		
Control	..	0	0	..	..	..	..	..	..	..	..	0	0		
LSD (0.05)		6	7									21	17		

Canada thistle control with picloram, clopyralid, dicamba, and 2,4-D on a Colorado pasture. Sebastian, J.R., and K.G., Beck. A 3 year pasture experiment was established near Fort Collins, CO to evaluate Canada thistle (CIRAR) control with picloram, clopyralid, dicamba, 2,4-D and their tank mixes. The design was a randomized complete block with four replications. All treatments were applied on May 25, 1989 with a CO2 pressurized backpack sprayer using 11003LP flat fan nozzles at 24 gal/a, 15 psi. Other application information is provided in Table 1. Plot size was 10 by 60 feet.

Visual evaluations were taken on June 25, August 22, and October 22, 1989, approximately 1, 3, and 6 months after treatment application, respectively. All treatments provided fair to good control.

All treatments will be re-applied at same rates during spring 1990 to 2/3 of each plot and in 1991 to 1/3 of each plot to simulate 1,2 and 3 years of consecutive treatments. (Weed Research Laboratory, Colorado State University, Fort Collins, CO 80523).

Table 1. Application information for Canada thistle control with picloram, clopyralid, dicamba, and 2,4-D on a Colorado pasture.

Environmental data	
Application date	May 25, 1989
Application time	8:00 am
Air temperature, C	22
Cloud cover, %	-
Relative humidity, %	32
Wind speed/direction, mph	0 to 5/SE
Soil temperature, (2.0 in), C	20

Weed data

Application date	Species	Growth stage	Height (in)	Density (plt/ft^2)
May 25, 1989	CIRAR	bolting	4 to 12	1 to 5

Table 2. Canada thistle control with picloram, clopyralid, dicamba, and 2,4-D on a Colorado pasture.

Herbicide	Rate	Canada thistle control		
	(lb ai/a)	--------(% of check)---------		
		June 25	August 25	October 22
picloram + 2,4-D amine	0.10 0.50	61	66	53
picloram + 2,4-D amine	0.20 1.0	64	82	68
picloram + 2,4-D amine	0.38 1.0	71	84	80
clopyralid + 2,4-D amine	0.10 0.50	60	75	70
clopyralid + 2,4-D amine	0.20 1.0	64	76	73
clopyralid + 2,4-D amine	0.38 2.0	69	84	71
picloram	0.38	69	92	89
clopyralid	0.38	71	89	87
dicamba + picloram	0.50 0.25	79	86	79
dicamba + picloram	1.0 0.13	75	87	84
dicamba + 2,4-D amine	1.0 2.0	71	82	68
LSD (0.05)		6	11	13

PROJECT 2

HERBACEOUS WEEDS OF RANGE AND FOREST

K. George Beck - Project Chairperson

Control of seaside arrowgrass (*Triglochin maritima* L.) in grass hay meadows with chlorsulfuron, metsulfuron and 2,4-D. Whitson, T. D. and W. R. Tatman. Seaside arrowgrass, reported throughout the western U.S., contains hydrocyanic acid and is highly toxic to cattle when injested in small amounts. Thousands of cattle have been poisoned in the western U.S. and considerable amounts of forage have been left unused in areas infested with arrowgrass. An experiment was established on a dense stand of seaside arrowgrass in Albany Co., WY, on August 23, 1988, to compare metsulfuron, chlorsulfuron and 2,4-D for control of seaside arrowgrass during late bloom when seed stalks were 14 to 20 inches long. Plots were 10 by 27 ft. with four replications arranged in a randomized complete block design. Herbicides were applied broadcast with a CO_2 pressurized knapsack unit delivering 30 gpa at 45 psi. Temperature: air 73F, surface 74F, 1 inch 74F, 2 inches 70F, 4 inches 65F with 36% relative humidity and 1 to 2 mph west winds. Soil: sandy loam (60% sand, 13% silt and 26% clay with 6.6% organic matter and pH of 7.9. Evaluations were made July 15, 1989. Chlorsulfuron applications of 0.0126 lb ai/A and above and metsulfuron applications of 0.0315 lb ai/A and above controlled 100% of the seaside arrowgrass. 2,4-D (LVE) applications of 4.0 and 6.0 lb ai/A controlled 50 and 56% of the seaside arrowgrass, respectively. 2,4-D has been the standard recommended control for seaside arrowgrass in past years. (Department of Plant, Soil and Insect Sciences, University of Wyoming, Laramie, WY, 82071.)

Control of seaside arrowgrass in grass hay meadows.

Herbicide[1]	Rate lb ai/A	Average % control[2]
chlorsulfuron + X-77	0.0063+0.25%	95
chlorsulfuron + X-77	0.0126+0.25%	100
chlorsulfuron + X-77	0.0189+0.25%	100
chlorsulfuron + X-77	0.0252+0.25%	100
chlorsulfuron + X-77	0.0315+0.25%	100
chlorsulfuron + X-77	0.0378+0.25%	100
chlorsulfuron + X-77	0.0441+0.25%	100
chlorsulfuron + X-77	0.0504+0.25%	100
chlorsulfuron + X-77	0.0567+0.25%	100
chlorsulfuron + X-77	0.063+0.25%	100
chlorsulfuron + X-77	0.0945+0.25%	100
chlorsulfuron + X-77	0.125+0.25%	100
metsulfuron + X-77	0.0315+0.25%	100
metsulfuron + X-77	0.063+0.25%	100
metsulfuron + X-77	0.125+0.25%	100
2,4-D (LVE)	4.0	50
2,4-D (LVE)	6.0	56
Check	------------	0
(LSD 0.05)		4
(CV)		3

[1]Treatments applied August 23, 1988.
[2]Evaluations made July 15, 1989.

Wild caraway control with metsulfuron, dicamba, and 2,4-D on Colorado hay meadow. Sebastian, J.R., and K.G. Beck. A hay meadow experiment was established near Yampa, Colorado to evaluate wild caraway (CARCA) control with metsulfuron, dicamba, and 2,4-D applied when weeds were in rosette or flowering growth stages, or in fall. The design was a randomized complete block with four replications. Rosette (August 10), flowering (June 7), and fall (November 21) applications were sprayed for timing comparison. All treatments were applied with CO_2 pressurized backpack sprayer using 11003LP flat fan nozzles at 24 gal/a, 15 psi. Plot size was 10 by 30 feet. Other application data is presented in Table 1.

Visual evaluations for control were taken on June 7, July 7, and August 9, 1989 (fall applications were not evaluated). All treatments at both spring timings provided poor control 30 days after treatment application (Table 2). On the August 9 evaluation, metsulfuron alone provided good control and 2,4-D (0.5 lb ai/a) fair control when applied at flowering.

All herbicide treatments will be evaluated in 1990 for control longevity (Weed Research Laboratory, Colorado State University, Fort Collins, CO 80523).

Table 1. Application information and weed data for wild caraway control with metsulfuron, dicamba, and 2,4-D on Colorado hay meadow.

Environmental data			
Application date	May 10	June 7	November 21
Application time	11:00 am	3:30 pm	10:00 am
Air temperature, C	24	24	12
Cloud cover, %	75	50	0
Relative humidity, %	70	45	26
Wind speed/direction, mph	0 to 5/W	0 to 3/W	0 to 2/NE
Soil temperature (2 in), C	18	19	6

Weed data

Application date	Species	Growth stage	Diameter or height (in)	Density (plts/ft^2)
May 10, 1989	CARCA	rosette	5 to 9	1 to 3
June 7, 1989	CARCA	flowering	9 to 14	1 to 3
November 21, 1989	CARCA	fall rosette	1 to 3	1

Table 2. Wild caraway control with metsulfuron, dicamba, and 2,4-D on Colorado hay meadow.

Herbicide	Rate	Timing	Wild caraway control		
	(oz ai/a)		------(% of check)-------		
			June 7	July 7	August 9
2,4-D	8.0	rosette[1]	20	24	24
metsulfuron	0.14[2]	rosette	43	50	39
metsulfuron	0.3	rosette	44	78	65
dicamba	8.0	rosette	14	4	4
dicamba	16.0	rosette	18	10	15
metsulfuron + dicamba	0.06 8.0	rosette	28	15	5
metsulfuron + dicamba	0.14 8.0	rosette	39	40	34
2,4-D	8.0	flowering	0	58	68
metsulfuron	0.14	flowering	0	59	84
metsulfuron	0.3	flowering	0	61	90
dicamba	8.0	flowering	0	8	5
dicamba	16.0	flowering	0	11	18
metsulfuron + dicamba	0.06 8.0	flowering	0	28	55
metsulfuron + dicamba	0.14 8.0	flowering	0	45	61
2,4-D	8.0	fall	0	0	0
metsulfuron	0.14	fall	0	0	0
metsulfuron	0.3	fall	0	0	0
dicamba	8.0	fall	0	0	0
dicamba	16.0	fall	0	0	0
metsulfuron + dicamba	0.06 8.0	fall	0	0	0
metsulfuron + dicamba	0.14 8.0	fall	0	0	0
LSD (0.05)			4	14	16

1 rained 10 minutes after last treatment was applied.
2 X-77 added at 0.25% v/v to metsulfuron treatments.

Wild caraway control with picloram, dicamba, and 2,4-D on Colorado hay meadow. Sebastian, J.S., and K.G. Beck. A hay meadow experiment was established near Clark, Colorado to evaluate wild caraway (CARCA) control with picloram, dicamba, and 2,4-D applied when weeds were in rosette or flowering growth stages, or in fall. The design was a randomized complete block with four replications. Rosette (August 10), flowering (June 7), and fall (October 2) applications were sprayed for timing comparison. All treatments were applied with a CO_2 pressurized backpack sprayer using 11003LP flat fan nozzles at 24 gal/a, 15 psi. Plot size was 10 by 30 feet. Other application data is presented in Table 1.

Visual evaluations for control were taken on June 6, July 8, and August 9, 1988 (fall applications were not evaluated). All treatments at both spring timings provided poor control approximately 30 days (June 6) after treatment application (Table 2). Tank mixes of picloram plus 2,4-D and 2,4-D alone (0.50 lb ai/a) provided good CARCA control (August 9); and picloram, dicamba, and picloram plus dicamba tank mixes provided poor CARCA control prior to cutting hay on August 9.

All herbicide treatments will be evaluated in 1990 for control longevity (Weed Research Laboratory, Colorado State University, Fort Collins, CO 80523).

Table 1. Application information and weed data for wild caraway control with picloram, dicamba, and 2,4-D on Colorado hay meadow.

Environmental data			
Application date	May 10	June 7	October 2
Application time	6:00 am	12:30 am	9:30 am
Air temperature, C	22	24	15
Cloud cover, %	75	-	50
Relative humidity, %	78	40	54
Wind speed/direction, mph	0	0	0
Soil temperature (2 in), C	20	19	11

Weed data

Application date	Species	Growth stage	Height or diameter (in)	Density (plts/ft^2)
May 10, 1989	CARCA	rosette	4 to 7	1 to 4
June 7, 1989	CARCA	flowering	8 to 14	1 to 4
October 2, 1989	CARCA	fall rosette	5 to 6	1 to 2

Table 2. Wild caraway control with picloram, dicamba, and 2,4-D on Colorado hay meadow.

Herbicide	Rate	Timing	Wild caraway control		
	(lb ai/a)		------(% of check)-------		
			June 6	July 8	August 9
picloram	0.25	rosette	31	36	31
picloram	0.50	rosette	34	41	45
2,4-D	0.50	rosette	40	65	71
dicamba	0.50	rosette	16	9	8
picloram	0.13	rosette	46	70	80
+ 2,4-D	0.50				
picloram	0.25	rosette	54	78	83
+ 2,4-D	0.50				
picloram	0.13	rosette	45	74	76
+ 2,4-D	0.50				
+ liquid N	8.00[1]				
picloram	0.13	rosette	26	26	23
+ dicamba	0.50				
picloram	0.25	flowering	0	18	29
picloram	0.50	flowering	0	26	38
2-4-D	0.50	flowering	0	40	76
dicamba	0.50	flowering	0	18	23
picloram	0.13	flowering	0	17	78
+ 2,4-D	0.50				
picloram	0.25	flowering	0	48	85
+ 2,4-D	0.50				
picloram	0.13	flowering	0	25	30
+ dicamba	0.50				
picloram	0.25	fall	0	0	0
picloram	0.50	fall	0	0	0
2,4-D	0.50	fall	0	0	0
dicamba	0.50	fall	0	0	0
picloram	0.13	fall	0	0	0
+ 2,4-D	0.50				
picloram	0.25	fall	0	0	0
+ 2,4-D	0.50				
picloram	0.13	fall	0	0	0
+ dicamba	0.50				
LSD (0.05)			5	11	10

1 liquid nitrogen applied at qt/acre rather than lb/acre.

Comparisons of two repeated herbicide applications for control of hoary cress (*Candaria draba*). Whitson, T. D., A. Mooney, M. Griswold and K. R. Drake. Hoary cress, a perennial growing on rangeland and non-cropland sites, is a common problem on alkaline soils in Wyoming. Two experiments were established on a pasture having a densely populated hoary cress stand near Gillette, WY. Plots 10 by 27 ft. were arranged in a randomized complete block design with four replications. Herbicides were applied with a pressurized knapsack sprayer delivering 30 gpa at 45 psi. Soils were sandy loam (38% sand, 24% silt and 38% clay) with 1.3% organic matter and pH of 8.0. Spraying conditions, May 4, 1988: temperature - air 67F, soil surface 72F, 1 inch 72F, 2 inches 62F, 4 inches 60F, with a relative humidity of 62% and winds SW at 2 to 3 mph; May 17, 1989: temperature - air 67F, surface 50F, 1 inch 52F, 2 inches 46F, 4 inches 44F with a relative humidity of 60% and winds SW at 0 to 5 mph. Hoary cress was in the bud stage from 4 to 6 inches tall during the two trials. Hoary cress control averaged 84, 93 and 90% and was consistent between years with applications of metsulfuron at 0.032 and 0.063 lb ai/A and chlorsulfuron at 0.063 lb ai/A, respectively. 2,4-D LVE at 1.0 and 2.0 lb ai/A provided good control in 1989 but poor control in 1988. (Department of Plant, Soil and Insect Sciences, University of Wyoming, Laramie, WY 82071.)

Comparisons of two repeated herbicide applications for control of hoary cress.

		% Control[1]	
		Application Date	
Herbicide	Rate lb ai/A	May 4, 1988	May 17, 1989
2,4-D LVE	1.0	41	86
2,4-D LVE	2.0	14	88
fluroxypyr	0.25	13	28
fluroxypyr	0.5	5	18
fluroxypyr	1.0	10	63
triclopyr	1.0	15	41
triclopyr	2.0	21	60
chlorsulfuron+X-77	0.032+0.25%	59	73
chlorsulfuron+X-77	0.063+0.25%	89	90
metsulfuron+X-77	0.032+0.25%	80	88
metsulfuron+X-77	0.063+0.25%	89	97
Check	-----------	0	0

[1]Evaluations made July 25, 1989.

Control of hoary cress with selected herbicides. Flom, D.G. An experiment was established near Lovelock, Nevada on June 14, 1988 to test the efficacy of several herbicides on the control of hoary cress. A randomized complete block design with four replications was used. All treatments were applied with a CO_2 pressurized sprayer delivering 20 gpa at 37 psi. Air temperature was 29C, relative humidity was 33% and winds were 0 to 3 mph at the time of application. Herbicides were applied to hoary cress at the flowering to early seed set growth stage. All plots were periodically flood irrigated along with adjacent alfalfa fields. Plot size was 6 by 30 feet.

Visual evaluations were taken June 29, 1988 and May 31, 1989, approximately 2 weeks and 1 year after application. Glyphosate provided only fair control (55%) at 2 weeks after application. Only glyphosate and amitrole provided good to excellent control (70%+) of hoary cress regrowth at 1 year after application. (University of Nevada, Reno, Cooperative Extension, Yerington, NV 89447)

Percent control of hoary cress

Herbicide	Rate	Evaluation date June 29, 1988	Evaluation date May 31, 1989
	(lb ai/a)	(%)	(%)
glyphosate	3	55	93
2,4-D + dicamba	4 + 4	18	40
clopyralid/2,4-D	0.24 + 1.5	11	1
clopyralid/2,4-D + 2,4-D	0.24 + 2.75	28	12
amitrole	4	32	78
2,4-D	4	23	12
$LSD_{0.05}$		17	14

Response of yellow hawkweed to sulfonylurea and pyridine herbicides. Lass, L.W., R.H. Callihan and T.W. Miller. The purpose of this experiment was to determine the effects of six different herbicides at three rates on established meadow hawkweed (Hieracium pratense Tausch. HIECA) in a grass pasture. The experiment was initiated on a Helmer silt loam, June 19, 1986 at Fernwood, Idaho. Plots measured 10 by 25 ft, with four replicates of a split-strip block design. Treatments consisted of single applications of chlorsulfuron, sulfometuron, metsulfuron, and DPX-L5300 (each at 0.5, 1.0, 2.0 oz ai/a and check), picloram (1.6, 6.4 and 9.6 oz ai/a and check) and clopyralid (4, 8 and 16 oz ae/a and check). Treatments were applied in 23 gal/a water carrier with flat-fan 8002 nozzles at 40 psi from a CO2-pressurized backpack sprayer operated at 3 mph. The air temperature at the time of treatment was 66F, the soil temperature at 6 inches was 59F and the relative humidity was 55%. Cloud cover was 50%, and dew was present. Herbicide treatments were split with a strip-plot application of ammonium nitrate solution (check and 50 lbs N/a) on March 17, 1987 during a rain. Plots were mowed and clippings were removed September 20, 1987.

Plots were evaluated the first year by estimating percent chlorosis of treated yellow hawkweed on July 17, 1986. The second and third year's evaluations consisted of gravimetric vegetative sampling on mid-July 1987 and 1988. The fourth year's evaluation was a visual estimate of the hawkweed and grass biomass on July 31, 1989.

Results of the first year indicated (93 to 100%) chlorosis of yellow hawkweed in 6.4 and 9.6 oz/a picloram treatments and all clopyralid treatments (80 to 100%). Metsulfuron caused moderate chlorosis at 1 to 2 oz ai/a (71 to 66%). Chlorsulfuron, sulfometuron, and DPX-L5300 caused some chlorosis, but the effect was erratic and not pronounced. The vegetative analysis of the second year showed hawkweed dry weights in comparison with checks decreased 72 to 100% in the picloram plots, 89 to 100% in the clopyralid plots and 70% in the 2.0 oz/a metsulfuron treatment. Grass dry weights more than doubled in comparison with checks in plots treated with all rates of clopyralid, picloram at 6.4 and 9.6 oz/a, chlorsulfuron at 0.5 and 2.0 oz/a, and metsulfuron at 2.0 oz/a. Results of the third year indicated clopyralid at all rates and picloram at 6.4 and 9.6 oz/a were still controlling 95 to 100% of the yellow hawkweed. Picloram at 1.6 oz/a controlled 75% of the hawkweed in the fertilized plots. Grass regrowth in third year more than doubled in all plots treated with clopyralid, picloram at 6.4 and 9.6 oz/a, and metsulfuron at 2.0 oz/a as measured by dry weight and compared to the check. The application of nitrogen in the second year did not increase hawkweed or grass dry weights of the third year when compared to the check.

The results of the fourth year indicate clopyralid and picloram at 6.4 and 9.6 oz/a are still controlling 80 to 100% of the hawkweed. Grass biomass was about ten times greater in the clopyralid treatments than in the check. Grass biomass was three times greater in the picloram treatments than in the checks. Other herbicide treatments have failed to provide long-term control of hawkweed or increase grass production.

Results of this project indicate at least four years of control of yellow hawkweed with clopyralid at rates of 8 and 16 oz/a and picloram at rates of 6.4 and 9.6 lb/a. Hawkweed control by both the clopyralid and picloram treatments substantially increased the yield of grass. (University of Idaho, Dept of P.S.& E.S., Moscow 83843)

Response of pasture vegetation to sulfonylurea and pyridine herbicides 4 years after application.

Herbicide	Rate (oz ai/A)	Relative biomass (estimated)[1] Hawkweed	Grasses
		(%)	(%)
chlorsulfuron	0	100 ns	15 ns
	0.5	100	14
	1	100	23
	2	100	28
clopyralid	0	100 A	9 B
	4	20 B	93 A
	8	0 C	100 A
	16	0 C	100 A
DPX-L5300	0	100 ns	20 ns
	0.5	100	14
	1	95	30
	2	93	28
metsulfuron	0	100 ns	21 ns
	0.5	100	30
	1	100	23
	2	100	33
picloram	0	100 A	31 BC
	1.6	95 A	41 B
	6.4	6 C	100 A
	9.6	0 C	100 A
sulfometuron	0	100 ns	24 ns
	0.5	100	22
	1	100	16
	2	100	28

ns = treatment means within columns are not statistically different from the check. Means with the same letter are not significantly different at the 0.05% level of the Duncan's multiple-range test.

[1] biomass expressed as a % of check. 100% = not different from check, 0 = no plants.

Spotted knapweed control in a non-crop site. Lass, L.W. and R.H. Callihan. The objective of this experiment was to determine the effects of six different herbicides at three rates on established spotted knapweed (Centaurea maculosa Lam.) in non-crop land.

The experiment was established at Farragut State Park, west of Athol, ID. on June 9, 1986. Plots measured 10 by 40 ft with four replicates in a split block design. The treatments consisted of single applications of metsulfuron (0.5, 1.0, 2.0 oz ai/a and a check), DPX-L5300 (0.5, 1.0, 2.0 oz ai/a and a check), clopyralid (0.45, 0.9, 1.8 lb ai/a and a check), chlorsulfuron (0.5, 1.0, 2.0 oz ai/a and a check), sulfometuron (0.5, 1.0, 2.0 oz ai/a and a check), and picloram (0.5, 1.0, 2.0 lb ai/a and a check).

Treatments were applied in 23 gal/a water carrier, with TeeJet 8002 nozzles at 43 psi, from a backpack sprayer operated at 3 mph. The application date was June 9, 1986. The air temperature at the time of application was 83F, soil temperature at 3 inch depth was 70F, and relative humidity was 46%. The sky was 80% cloudy, and no dew was present. Visual estimates of biomass were recorded July 17 and October 22, 1986; April 28 and August 11, 1987; July 11, 1988; and August 1, 1989.

Results of the first year (1986) indicated that metsulfuron, DPX-L5300, chlorsulfuron, and sulfometuron slightly suppressed the biomass of spotted knapweed following application. However, clopyralid and picloram reduced the spotted knapweed biomass by 95-100% during growth of the first year after application ($p = 0.0001$). Less than 5% of the plants treated with metsulfuron, DPX-L5300, sulfometuron, clopyralid, and picloram produced seeds the first year. In the summer of the second year, the growth suppression was less than that observed in the previous year, in the plots of metsulfuron, DPX-L5300, chlorsulfuron, and sulfometuron. Successful control (95%) of spotted knapweed was maintained with clopyralid and picloram. The metsulfuron, DPX-L5300, chlorsulfuron, and sulfometuron did not reduce seed production the second year. Evaluations in the summer of the third year indicated that all clopyralid and picloram treatments continued to control over 95% of the spotted knapweed.

Results of the fourth year (1989) show spotted knapweed continues to be controlled at all rates in the clopyralid and picloram plots. Although some spotted knapweed has started to appear in those plots. This may be due in part to the existing seed bank, in addition to the seed rain from border plants and check plots. Apparently, the loss of spotted knapweed competition has allowed yellow toadflax (Linaria vulgaris Hill) to become the dominant species in the clopyralid treatments. Picloram suppression of yellow toadflax has prevented its dominance in the picloram plots.

After four years, results suggest picloram and clopyralid will control spotted knapweed growth and seed production for more than 3 years. Although both herbicides provide a method of controlling spotted knapweed, criteria for herbicide selection should include ability to control other potential invading species after the removal of spotted knapweed competition. (University of Idaho, Dept. of P.S.& E.S., Moscow 83843)

Spotted Knapweed Control in a non-crop site.

Herbicide	Rate	Spotted Knapweed Biomass Summer 7/86	Fall 10/86	Spring 4/87	Summer 8/87	Summer 7/88	Summer 8/89	Current year Seed Production Fall 10/86	Summer 8/87	Yellow Toadflax % Cover 8/87	8/89
	(ai/a)	--------------- (% of Check)	------------------					-(% of Check)-		----(%)----	
metsulfuron	0.0 oz	100 a	100 a	100 a	100 a	100 a	100 a	100 a	100 a	0 b	0 b
	0.5 oz	62 a	90 a	97 ab	100 a	100 a	100 a	1 b	100 a	0 b	0 b
	1.0 oz	72 a	100 a	100 a	100 a	100 a	100 a	3 b	100 a	0 b	0 b
	2.0 oz	70 a	77 a	97 ab	100 a	100 a	100 a	1 b	100 a	0 b	0 b
DPX-L5300	0.0 oz	100 a	100 a	100 a	100 a	100 a	100 a	100 a	100 a	0 b	0 b
	0.5 oz	67 a	93 a	82 ab	100 a	100 a	100 a	3 b	100 a	0 b	0 b
	1.0 oz	70 a	95 a	97 ab	100 a	100 a	100 a	1 b	100 a	0 b	0 b
	2.0 oz	65 a	91 a	77 b	100 a	100 a	100 a	1 b	100 a	0 b	0 b
chlorsulfuron	0.0 oz	100 a	100 a	100 a	100 a	100 a	100 a	100 a	100 a	0 b	0 b
	0.5 oz	88 a	88 a	100 a	100 a	100 a	100 a	58 a	100 a	0 b	0 b
	1.0 oz	82 a	81 a	100 a	100 a	100 a	100 a	65 a	100 a	0 b	0 b
	2.0 oz	87 a	74 a	97 a	100 a	100 a	100 a	54 a	100 a	0 b	0 b
clopyralid	0.0 lb	100 a	100 a	100 a	100 a	100 a	100 a	100 a	100 a	0 b	0 b
	0.4 lb	2 b	0 b	0 c	4 b	4 b	8 b	0 b	0 b	50 a	45 a
	0.9 lb	1 b	0 b	0 c	4 b	1 b	10 b	0 b	0 b	50 a	42 a
	1.8 lb	0 b	0 b	0 c	4 b	1 b	5 b	0 b	1 b	37 ab	42 a
sulfometuron	0.0 oz	100 a	100 a	100 a	100 a	100 a	100 a	100 a	100 a	0 b	0 b
	0.5 oz	58 a	80 a	81 ab	100 a	100 a	100 a	0 b	100 a	0 b	0 b
	1.0 oz	53 a	89 a	97 ab	100 a	100 a	100 a	1 b	100 a	0 b	0 b
	2.0 oz	50 a	74 a	77 b	100 a	100 a	100 a	0 b	100 a	0 b	0 b
picloram	0.0 lb	100 a	100 a	100 a	100 a	100 a	100 a	100 a	100 a	25 a	10 a
	0.5 lb	5 b	0.5 b	0 c	0 b	2 b	6 b	0 b	0 b	6 b	12 b
	1.0 lb	2 b	0 b	0 c	0 b	1 b	10 b	0 b	0 b	2 b	5 b
	2.0 lb	1 b	0 b	0 c	0 b	3 b	12 b	0 b	0 b	0 b	1 b

1. The 8/86 fall biomass estimation was based on new seedling growth or regrowth from perennial roots.
2. Any two means having a common letter are not significantly different at the 5% level of significance, using Protected Duncan's Test.

Russian knapweed control in rangeland. Ferrell, M.A. Russian knapweed is a serious problem on Wyoming's rangelands. This research was conducted on rangeland near Rock River, Wyoming to compare the efficacy of fluroxypyr and tank mixes of dicamba with picloram or 2,4-D LVE on Russian knapweed.

Plots were 10 by 27 ft. with four replications arranged in a randomized complete block. The herbicide treatments were applied broadcast with a CO_2 pressurized six-nozzle knapsack sprayer delivering 30 gpa at 35 psi June 15, 1987 (air temp. 78 F, soil temp. 0 inch 90 F, 2 inch 90 F, 4 inch 85 F, relative humidity 64%, wind calm, sky clear). The soil was classified as a sandy loam (70% sand, 15% silt, and 15% clay) with 1.5% organic matter and a 7.8 pH. Russian knapweed was in the bud stage and 10 to 14 inches in height. Infestations were moderate thoughout the experimental area. Visual weed control evaluations were made August 3, 1988 and August 2, 1989.

Picloram at 2.0 lb ai/A was the only treatment providing adequate leafy spurge control two years after application. (Wyoming Agric. Exp. Sta., Laramie, WY 82071 SR 1595.)

Russian knapweed control

Treatment[1]	Rate	Control[2] 1988	1989
	(lb ai/a)	-- (%) --	
dicamba	0.5	0	0
dicamba	1.0	0	0
dicamba	2.0	0	0
picloram	0.5	88	59
picloram	2.0	100	99
dicamba + picloram	0.5 + 0.125	5	0
dicamba + picloram	0.5 + 0.25	35	8
dicamba + picloram	1.0 + 0.125	18	8
dicamba + picloram	1.0 + 0.25	44	13
dicamba + picloram	2.0 + 0.125	3	0
dicamba + picloram	2.0 + 0.25	60	28
dicamba + 2,4-D LVE	1.0 + 1.0	0	0
dicamba + 2,4-D LVE	1.0 + 3.0	0	0
fluroxypyr	0.25	0	--
fluroxypyr	0.5	0	--
fluroxypyr	0.75	0	--
fluroxypyr	1.0	0	--
Check	0	0	--
(LSD 0.05)		18	14
(CV)		49	63

[1]Treatments applied June 15, 1987. Surfactant, X-77, added to all treatments at 0.5% v/v.

[2]Visual evaluations August 3, 1988 and August 2, 1989.

Russian knapweed (Centaurea repens (L.) control with various herbicides. Whitson, T.D. and J.R. Gill. Russian knapweed, designated as a noxious weed in many western states, occupies over 250,000 acres of farm and pasture land in Wyoming. This experiment was established near Worland, Wyoming on pasture land that was previously an irrigated farm. Soils were a clay loam (32% sand, 35% silt and 33% clay) with 1.6% organic matter and 7.5 pH. Plots 10 by 27 ft. were arranged in a randomized complete block design with four replications. Herbicides were applied with a pressurized knapsack sprayer delivering 30 gpa at 45 psi. May 10, 1988 (temperature: air 75F, surface 70F, 1 inch 71F, 2 inches 72F, 4 inches 71 F with 50% relative humidity and 2-3 mph south winds) to Russian knapweed in the vegetative stage 6 to 8 inches tall. Treatment applications were followed by extremely dry weather. Evaluations were made August 8, 1989. Picloram applied at 1.0 and dicamba applied at 2.0 lb ai/A provided 69 and 77% control, respectively. (Department of Plant Soil and Insect Sciences, University of Wyoming, Laramie, WY 82071.)

Russian knapweed (Centaurea repens (L.) control with various herbicides.

Herbicide[1]	Rate lb ai/A	% control[2]
Picloram	0.125	6
Picloram	0.25	25
Picloram	0.375	33
Picloram	0.5	40
Picloram	0.75	58
Picloram	1.0	69
2,4-D (Esteron 99)	2.0	9
Glyphosate	0.5	1
Dicamba	0.5	8
Dicamba	1.0	11
Dicamba	2.0	77
Dicamba + 2,4-D (Amine)	0.25 + 0.75	8
Dicamba + 2,4-D (Amine)	0.5 + 1.5	15
Triclopyr + 2,4-D (LVE)	0.33 + 0.67	13
Metsulfuron + X-77	0.031 + 0.25%	38
Metsulfuron + X-77	0.063 + 0.25%	33
Fluroxypyr	0.5	3
Chlorsulfuron + X-77	0.063 + 0.25%	40
Chlorsulfuron + X-77	0.125 + 0.25%	49
Check	-------------	0
(LSD 0.05)		24
(CV)		63

[1]Treatments applied May 10, 1988.
[2]Evaluations made August 22, 1989.

Diffuse knapweed (Centaura diffusa (Lam.)) control on rangeland with various herbicides. Whitson, T. D., G. E. Fink and J. P. Buk. Diffuse knapweed, an alleopathic biennial species, is considered extremely threatening to western U.S. rangelands. An experiment was established on a dense stand of diffuse knapweed, located on a creek bottom in Natrona County, Wyoming to evaluate the efficacy of various herbicides for control of diffuse knapweed. Plots were 10 by 27 ft. with four replications arranged in a randomized complete block design. Herbicides were applied broadcast on May 11, 1988 with a CO_2-pressurized six-nozzle knapsack sprayer delivering 30 gpa at 45 psi. Spraying conditions: temperature - air 85F, soil surface 80F, 1 inch 80F, 2 inches 75F, 4 inches 70F with 78% relative humidity and calm winds; soils: sandy loam (48.5% sand, 30.4% silt and 21.1% clay) with 2.2% organic matter and a pH of 8.1. Diffuse knapweed was in the rosette stage 3 to 5 inches in diameter. Evaluations were made July 18, 1988 and May 22, 1989. Treatments providing above 98% control one year after treatment included picloram at 0.25, 0,375, 0.5, 0.75 and 1.0 lb ai/A, 2,4-D (LVE) at 2.0 lb ai/A, dicamba at 0.5, 1.0 and 2.0 lb ai/A, dicamba + 2,4-D at 0.25 + 0.75 and 0.5 + 1.5 lb ai/A. Control of diffuse knapweed was better one year following treatment, compared to evaluations made 2 months after treatment. (Department of Plant, Soil and Insect Sciences, University of Wyoming, Laramie, WY 82071.)

Diffuse knapweed control on rangeland with various herbicides.

		% Control[2]	
		Evaluation Date	
Herbicide[1]	Rate lb ai/A	July 1988	May 1989
picloram	0.125	58	91
picloram	0.25	78	100
picloram	0.375	90	100
picloram	0.5	97	100
picloram	0.75	99	100
picloram	1.0	100	100
2,4-D LVE	2.0	100	100
glyphosate	0.5	61	60
dicamba	0.5	79	98
dicamba	1.0	99	100
dicamba	2.0	100	100
dicamba+2,4-D(A)	0.25+0.75	89	98
dicamba+2,4-D(A)	0.5+1.5	100	99
triclopyr+2,4-D(A)	0.33+0.67	88	82
metsulfuron+X-77	0.03+0.25%	3	0
metsulfuron+X-77	0.06+0.25%	9	49
fluroxypyr	0.5	46	82
chlorsulfuron+X-77	0.06+0.25%	5	0
chlorsulfuron+X-77	0.125+0.25%	8	0
Check	----------	0	0

[1]Treatments applied May 11, 1988.
[2]Evaluations made July 18, 1988 and May 22, 1989.

Control of Russian knapweed in fallow. Flom, D.G. An experiment was established near Lovelock, Nevada on June 7, 1988 to test the efficacy of several herbicides on the control of Russian knapweed in fallow. A randomized complete block design with four replications was used. All treatments were applied with a CO_2 pressurized sprayer delivering 20 gpa at 37 psi. Air temperature was 18C, relative humidity was 25% and winds were 2 to 5 mph at the time of application. Herbicides were applied to Russian knapweed at the early bud growth stage. Physical clipping and pulling were included for an evaluation of non-chemical control methods. Plot size was 6 by 30 feet.

Visual evaluations were taken June 29, 1988, September 21, 1988 and May 31, 1989, approximately 3 weeks, 4 months and 1 year after application. Only paraquat provided adequate control at 3 weeks. At 4 months no herbicide treatment provided better than good (70%) control. However, at 1 year after application, 2,4-D + dicamba, amitrole and all treatments containing clopyralid provided good to excellent (70%+) control of Russian knapweed regrowth. (University of Nevada, Reno, Cooperative Extension, Yerington, NV 89447)

Percent control of Russian knapweed

		Evaluation date		
Herbicide	Rate	June 29, 1988	Sept. 21, 1988	May 31, 1989
	(lb ai/a)	-----------------	(%)	---------------
glyphosate	3	35	48	33
2,4-D	4	15	50	16
2,4-D	8	15	34	25
2,4-D + dicamba	4 + 4	14	35	98
clopyralid/2,4-D	0.24 + 1.5	9	41	83
clopyralid/2,4-D	0.48 + 3.0	16	44	81
clopyralid/2,4-D	0.24 + 3.0	16	45	78
clopyralid/2,4-D	0.48 + 4.5	19	43	85
amitrole	4	33	53	75
paraquat	0.5	93	66	13
clipping	-	100	70	23
pulling	-	100	75	18
$LSD_{0.05}$		6	13	20

Control of tall larkspurs on mountain rangelands. Ralphs, M.H., L.V. Mickelsen, J.O. Evans and S.A. Dewey. Larkspur species kill over 1000 cattle annually on National Forests in the Intermountain Region. Similar losses occur in the Rocky Mountain Region. Poisoning occurs in dense patches where cattle can consume large quantities of larkspur in a short time. If these patches could be controlled, losses could be substantially reduced.

Three experiments are reported here. (1) The first objective was to determine the range of efficacy for picloram and clopyralid (applied at 1.1, 2.2 and 4.5 kg ae/ha), triclopyr (2.2, 4.5 and 9.0 kg ae/ha), glyphosate (0.6, 1.1 and 2.2 kg ai/ha), and metsulfuron (8.6, 13.8 and 27.4 g ai/ha). Herbicide treatments were applied by broadcast application to 1.8 by 10-m plots in a randomized complete block design with 3 replications. Treatments were repeated two consecutive years (1986 and 1987) at two sites for each of two species (duncecap and tall larkspur). Density of larkspur (plants/plot) and foliar cover of associated species were measured before, and one year after treatment. (2) The second experiment compared repeated annual applications of picloram, triclopyr and metsulfuron at the two lower rates to a single high application. The two lower rates were reapplied in 1988 to the same plots treated in the previous experiment. (3) The third experiment compared selective application techniques for application of glyphosate. Two 3- by 15-m blocks were staked for each species, and randomly allocated to a spot-spray or wiper application treatment. The spot spray consisted of a single nozzle hand held wand attached to a CO_2 backpack sprayer. Glyphosate was mixed as a 2% solution in water and applied until the plant was visibly moist. The wiper was a wand with perforated PVC pipe wrapped with foam rubber. Glyphosate was mixed as a 33% solution in water and wiped across the plant from several directions.

Results. (1) Glyphosate at 1.1 to 2.2 kg/ha was most effective in killing larkspur plants (>90% reduction of both species). However, it is non selective and killed all other perennial vegetation. Picloram at 2.2 to 4.5 kg/ha killed > 80% of larkspur plants. These higher rates were detrimental to grasses and prevented an increase in grass cover. Triclopyr and metsulfuron provided variable control (6-98% kill). They were not detrimental to grasses. Clopyralid was ineffective.

(2) Repeated application of the two lower rates of picloram, triclopyr and metsulfuron produced additional mortality following the second application. The middle rate of picloram and triclopyr applied twice did not differ from the single high application. Two applications at the low rate were not as effective as the higher rates. The low and middle rates of all three herbicides allowed grass cover to increase.

Recommendations for the selective herbicides include: single application of picloram at 2.2 to 4.5 kg/ha, or two repeated annual applications at 1.1 or 2.2 kg/ha; two repeated annual applications of triclopyr at 4.5 kg/ha; or two repeated annual applications of metsulfuron at 8.6 or 13.8 g/ha.

(3) Spot spray or wiper applications of glyphosate were equally effective. A few larkspur plants were missed in each block from applicator error. Neither method adversely affected cover of associated forbs or grasses. The spot-spray required about half the time to treat individual plants (2.0 vs 3.9 sec/plant), and was easier to apply. Selective application methods must cover the entire plant to ensure mortality. (USDA/ARS Poisonous Plant Lab., and Utah State Univ., Logan, UT 84321).

Tall larkspur (Delphinium occidentale (wats) wats) control with various herbicides. Whitson, T.D. and G.E. Fink. Tall larkspur, a poisonous perennial rangeland species, causes more losses in cattle than any other poisonous plant in Wyoming. A tall larkspur-infested site located near Barnum, Wyoming was treated with various herbicides on a silty clay loam soil (20% sand, 52% silt and 28% clay) with 7.5% organic matter and 7.0 pH. Environmental conditions on June 12, 1987 were: temperature: air 70F, soil surface 72F, 1 inch 74F, 2 inches 73F, 4 inches 69F with 70% relative humidity and wind south 1 to 2 mph. Larkspur was 10 to 14 inches high and before bloom. Environmental conditions on July 18, 1987 were: temperature: air 78F, soil surface 85F, 1 inch 80F, 2 inches 80F, 4 inches 80F with 42% relative humidity and wind south 2 to 3 mph. Larkspur was in early seed set. Treatment areas 10 by 27 ft. were arranged in a randomized complete block design with four replications. The studies were fenced to prevent grazing. Herbicides were applied broadcast with a CO_2-pressurized six-nozzle knapsack unit delivering 30 gpa at 45 psi. Evaluations were made July 20, 1988 and July 19, 1989 by counting total numbers of larkspur plants in each plot. Treatments of picloram at 1.0 and 2.0 lb ai/A and metsulfuron at 0.0625 lb ai/A applied in June controlled 78, 97 and 93% of tall larkspur, respectively, and were significantly higher than the check. Control provided by picloram treatments at 0.75, 1.0 and 2.0 lb ai/A applied in July was also significantly higher than the check. Metsulfuron provided effective control when applied to tall larkspur in the vegetative stage, but was not effective in the flowering stage, while picloram applications made in the flowering stage at 0.75 and 1.0 lb ai/A controlled 21 and 10% more of the larkspur than the same treatments applied in the vegetative stage. (Department of Plant, Soil and Insect Sciences, University of Wyoming, Laramie, WY 82071.)

Tall larkspur control two years after treatment with various herbicides.

		% Control			
	Rate	Applied 6-12-87		Applied 7-18-87	
Herbicide	lb ai/A	Eval. 1988[1]	Eval. 1989	Eval. 1988	Eval. 1989
Dicamba +	0.25 +				
2,4-D (A)	0.75	34	9	27	16
Dicamba +	0.5 +				
2,4-D (A)	1.5	47	22	26	2
Dicamba	0.5	36	19	9	4
Dicamba	1.0	42	29	14	4
Dicamba	2.0	41	36	3	3
Picloram	0.25	38	12	39	30
Picloram	0.5	60	48	29	12
Picloram	0.75	61	55	79	86
Picloram	1.0	78	78	89	88
Picloram	2.0	98	97	98	93
2,4-D (LVE)	1.0	27	0	12	14
2,4-D (LVE)	2.0	43	22	0	0
Triclopyr +	0.33 +				
2,4-D (LVE)	0.67	10	0	36	16
Triclopyr +	0.67 +				
2,4-D (LVE)	1.33	20	0	0	0
Triclopyr	1.0	27	0	11	12
Triclopyr	2.0	51	24	0	0
Clopyralid	0.25	40	43	13	0
Clopyralid	0.5	27	0	0	28
Fluroxypyr	0.25	14	0	17	37
Fluroxypyr	0.5	31	0	10	21
Fluroxypyr	1.0	25	0	18	18
Metsulfuron +	0.0625 +				
X-77	0.25%	82	93	44	37
Chlorsulfuron +	0.0625 +				
X-77	0.25%	54	38	29	33
Sulfometuron +	0.0625 +				
X-77	0.25%	44	21	39	40
Check	--------	0	0	0	0
(LSD 0.05)			58		40
(CV)			54		39

[1]Evaluations made July 20, 1988 and July 19, 1989.

Control of tall larkspur (Dephinium occidentale (wats.) wats) in late flowering with metsulfuron, picloram and 2,4-D. Whitson, T.D. and G.E. Fink. Tall larkspur, a perennial rangeland species growing in high elevation rangeland, contains toxic alkaloids that are poisonous to cattle. A study was established on a uniform population of tall larkspur on July 20, 1988 to determine the efficacy of metsulfuron, picloram and 2,4-D during the late flowering stage. Plots, 10 by 24 ft., were arranged in a randomized complete block design with four replications. Herbicides were applied with a pressurized knapsack unit delivering 30 gpa at 45 psi. Herbicide application information: temperature: air 78F, surface 85F, 1 inch 80F, 2 inches 70F, 4 inches 80F, relative humidity 42%, wind south at 2 to 3 mph. Soil was classified as a silty clay loam (20% sand, 52% silt, 28% clay) with 7.5% organic matter and 7.0 pH. Tall larkspur plants were counted in each treatment area before herbicides were applied, and during evaluation on July 19, 1989. Percent control was calculated from counts. Picloram at 1.5 and 1.75 lb ai/A controlled 99 and 97% of the tall larkspur, respectively. Metsulfuron at 0.125 lb ai/A failed to adequately control tall larkspur at the flowering stage. Other studies have shown metsulfuron to provide effective control at 0.0625 lb ai/A when applied in the vegetative growth stage. (Department of Plant, Soil and Insect Sciences, University of Wyoming, Laramie, WY 82071.)

Control of tall larkspur in late flowering with metsulfuron, picloram, and 2,4-D.

Herbicide[1]	Rate lb ai/A	% Control[2] (Average)
Metsulfuron + X-77	0.0625 + 0.25%	42
Metsulfuron + X-77	0.0913 + 0.25%	46
Metsulfuron + X-77	0.125 + 0.25%	62
Metsulfuron + 2,4-D (LVE)	0.0625 + 2.0	33
Metsulfuron + picloram + X-77	0.0625 + 0.5 + 0.25%	74
Picloram	1.5	99
Picloram	1.75	97
Check	--------------	0
(LSD 0.05)		20
(CV)		24

[1]Treatments applied July 20, 1988.
[2]Evaluations made July 19, 1989.
Tall larkspur control in Johnson County.

Tall larkspur (*Delphinium occidentale*) suppression two months following herbicide applications. T.D. Whitson, G.E. Fink and J.R. Gill. Tall larkspur, a perennial, poisonous rangeland species, is responsible for cattle losses amounting to approximately ½ million dollars annually in Wyoming. On May 23, 1989, a tall larkspur infestation near Barnum, Wyoming was treated with various herbicides on a silty clay soil (28% sand, 46% silt and 26% clay) with 7.9% organic matter and 6.3 pH. Herbicide application information: temperature: air 60F, soil surface 61F, 1 inch 62F, 2 inches 60F, 4 inches 60F, relative humidity 18% and wind NE from 1 to 5 mph. Tall larkspur was in the 4- to 6-leaf stage at 2 to 3 inches in height. Treatment areas 10 by 27 ft. were arranged in a randomized complete block design with four replications. The studies were fenced to prevent grazing. Herbicides were applied broadcast with a CO_2-pressurized six-nozzle knapsack unit delivering 30 gpa at 45 psi. Evaluations were made July 19, 1989, two months following application, to determine first season suppression of larkspur. Control percentages were determined by counting total plant numbers within plots. Those controlling greater than 78% of the larkspur were considered the same when treatments were compared statistically. Herbicide combinations of metsulfuron plus dicamba at 0.06 + 0.25, 0.125 + 0.5, metsulfuron plus picloram at 0.06 + 1.0 and 0.125 + 1.0 lb ai/A provided 79, 90, 78, and 88% suppression, respectively, while metsulfuron alone at 0.06 lb ai/A provided 81% suppression. (Department of Plant, Soil and Insect Sciences, University of Wyoming, Laramie, WY 82071.)

Tall larkspur suppression with various herbicides.

Herbicide[1]	Rate lb ai/A	% Suppression[2]
Picloram	0.75	6
Picloram	1.0	20
Picloram	1.5	21
Picloram	2.0	18
2,4-D (LVE)	1.0	35
2,4-D (LVE) + picloram	1.0 + 1.0	33
Triclopyr + 2,4-D (LVE)	0.5 + 1.0	43
Triclopyr + 2,4-D (LVE) + picloram	0.5 + 1.0 + 0.25	44
Picloram + L-77	0.75 + 0.25%	18
Triclopyr + 2,4-D (LVE) + L-77	0.5 + 1.0 + 0.25%	35
Metsulfuron + X-77	0.063 + 0.25%	81
Metsulfuron + picloram + X-77	0.063 + 0.75 + 0.25%	61
Metsulfuron + picloram + X-77	0.063 + 1.0 + 0.25%	78
Metsulfuron + picloram + X-77	0.125 + 1.0 + 0.25%	88
Metsulfuron + dicamba + X-77	0.063 + 0.5 + 0.25%	79
Metsulfuron + dicamba + X-77	0.125 + 0.5 + 0.25%	90
Check		0
(LSD 0.05)		18
(CV)		29

[1]Herbicides were applied May 22, 1989.
[2]Evaluations were made July 19, 1989.

Longevity of mat-grass seeds in a mountain meadow. Northam, F. E. and R. H. Callihan. A study was established on 24 August 1987 to monitor the longevity of mat-grass (Nardus stricta L.) seed. Florets (caryopses enclosed in lemmas and paleas) were buried at 0.2 cm, 2.0 cm, and 20.0 cm below the soil surface. The experimental site was a wet meadow in mountain forest land of northern Idaho (Latah Co.). Flat, nylon-organdy packets were constructed with 100 mat-grass florets placed into each packet. A set of three packets (one for each depth) was sewn on a nylon cord, and one set was placed in each hole with one packet at each depth. Thus when samples were retrieved, all three depths for each replication came from the same hole. Samples from six replications were retrieved at each sampling date (3.5, 8.5, 15.5, and 20.0 months after burial). Prior to burial, the initial germination of the seedlot was tested at 18C with a 14 hrs light/10 hrs dark photoperiod (Table). A gibberellic acid treatment was evaluated at the same time. These two tests gave an initial germination estimate of 67%.

Florets were removed from the packets at each sampling date, surface-sterilized by soaking in a 2.5% sodium hypochlorite solution for 1.5 min and rinsing five times with 50 ml of distilled water. The florets were placed into plastic petri dishes with one layer of Anchor brand germination pads. Plates were maintained in an 18C germinator with a 14 hrs light/10 hrs dark photoperiod. A control treatment consisting of florets from the same seedlot, but stored at room temperature during the time the buried florets were in the soil, was also tested. A floret was considered germinated when both the radicle and plumule had each emerged to a length of 1.0 mm. Germinated florets were removed when counted (every seven days).

The maximum germination of mat-grass florets buried 3.5 months averaged 32.8% at 0.2 cm, 32.0% at 2.0 cm, and 29% at 20.0 cm (Table). These averages were attained after 12-14 weeks in the germinator. The control treatment (stored at room temperature during the 3.5 months) had a total germination of 55%. Comparing the 29% to 33% germination of florets buried for 3.5 months to the initial 67% germination of the seedlot (when the experiment began), a reduction of 51% to 57% occurred during 3.5 months of burial.

The maximum germination of mat-grass florets buried for 8.5 months averaged 31.3% at 0.2 cm, 35.3% at 2.0 cm, and 31.2% at 20.0 cm (Table). These maxima were attained after five weeks in the germinator. The control treatment (stored at room temperature during the 8.5 months) had a total germination of 47.0% after 31 weeks in the germinator. Again, comparing the 31% to 35% germination of the buried florets with the initial 67%, germination was reduced by 47.3% to 53.4% during the 8.5 months of burial.

Based on the two sampling periods, it appears that germination of the buried mat-grass florets was reduced to an average of 50% of the initial viability of the seedlot. Viable florets that had been buried reached maximum germination much more rapidly than those that had been maintained in dry storage at room temperature. This suggests that conditions in the meadow

Table. The effects of 3.5, 8.5, 15.5 and 20.0 months of burial on the germination of mat-grass florets

Treatment	Weeks in germinator						
	1	2	5	12	24	31	52
	(% Germination)						
	0 mos. non-buried florets						
(a) Normal germin. test	0.0	1.0	27.5	41.3	56.5	61.3	63.0
(b) Germin. tested with Gibberellic Acid:	0.0	5.3	46.3	66.8	67.8	67.8	--
	3.5 mos. burial						
Buried 0.2 cm	6.0	11.2	30.5	32.5	32.8	32.8	32.8
Buried 2.0 cm	27.5	30.5	31.7	32.0	32.0	32.0	32.0
Buried 20.0 cm	19.7	24.7	28.5	29.0	29.0	29.0	29.0
Dry storage in lab	0.7	4.7	35.7	50.7	55.3	55.7	55.7
	8.5 mos. burial						
Buried 0.2 cm	30.5	31.3	31.3	31.3	31.3	31.3	31.3
Buried 2.0 cm	34.1	35.0	35.3	35.3	35.3	35.3	35.3
Buried 20.0 cm	29.3	31.0	31.2	31.2	31.2	31.2	31.2
Dry storage in lab	0.3	4.7	28.6	38.5	42.2	42.5	42.6
	15.5 mos. burial						
Buried 0.2 cm	0.0	0.0	0.0	0.0	0.0	0.0	--
Buried 2.0 cm	0.0	0.0	0.0	0.0	0.0	0.0	--
Buried 20.0 cm	0.0	0.0	0.0	0.0	0.0	0.0	--
Dry storage in lab	2.3	14.3	38.0	44.2	44.7	44.7	44.7
	20.0 mos. burial						
Buried 0.2 cm	0.0	0.0	0.0	0.0	0.0	0.0	--
Buried 2.0 cm	0.0	0.0	0.0	0.0	0.0	0.0	--
Buried 20.0 cm	0.0	0.0	0.0	0.0	0.0	0.0	--
Dry storage in lab	0.0	1.2	12.8	22.3	35.7	38.5	--

soils may have overcome an inhibitor or seed condition that reduces the speed of mat-grass germination.

None of the buried florets germinated in either the 15.5 or 20-month samples (Table), but the dry storage control samples tested concurrently with the 15.5 month samples averaged 45% germination after 52 weeks in the germinator. The controls tested concurrently with the 20 month samples germinated 39% after 31 weeks. This test is in progress and the 52 week counts are due in March 1990.

The 15.5 month samples were retrieved on 10 Nov. 1988. Several of the florets in the buried samples showed evidence of previous germination activity when sampled. Some florets had radicles and a few had plumules present, but were no longer alive, even though the Clorox disinfection treatment was not used. The packets buried 0.2 cm averaged 14.3 florets that showed evidence of previous germination. The packets buried 2.0 cm and 20.0 cm averaged 15 and 22 florets, respectively, showing previous germination activity. This suggests the last viable florets may have germinated during the warmer period of late summer or early fall, but were not able to survive.

The results from the 15.5 and 20 month samples indicates the florets of this mat-grass seed lot had a relatively short life span in the wet meadow soil. According to these data, within two years after seed production ceases, the soil at this site may be virtually free of viable mat-grass seeds. (Idaho Agricultural Experiment Station, Moscow, Id 83843)

Survey and removal of disjunct matgrass plants in an eradication program. R. H. Callihan and F. E. Northam. A dense infestation of mat-grass (Nardus stricta L.) is located in approximately forty acres of a wet mountain meadow habitat three miles north of Bovill, Idaho. This is the only known occurrence of this species in Idaho. Scattered, disjunct colonies of this grass have spread into wet meadow and forest habitats adjacent to the main infestation. The University of Idaho and the U.S. Forest Service are continuing a research based Integrated Pest Management plan to eradicate this invader from the Clearwater National Forest. Development of a species-specific plan is necessary for eradication of this infestation. One component of the plan is the detection and elimination of disjunct colonies.

Surveys for disjunct colonies were conducted in Oct. 1986, and 1987, Nov. 1988 and Sept. 1989. Colonies were defined as individual matgrass plants, or clumps of matgrass plants separated by no more than six feet. Colonies were considered disjunct from previously removed plants if they were no closer than six feet from either the herbicide-treated meadow area or previous removal sites. The number of disjunct colonies located during the surveys were 36 in 1986, 22 in 1987, 28 in 1988 and 41 in 1989. Removal of the colonies by hand began in 1987. Disjunct plants found in both 1986 and 1987 were dug in 1987. A total of 127 disjunct colonies have been removed since 1987. It is important to note that only two colonies were found outside a polygon encompassing previously discovered colonies. This suggests that the matgrass plants that have moved from the original infested area since 1986 are not numerous nor widely dispersed in the vicinity of the infestation.

A total of 636 acres were surveyed during 1989 compared to 567 in 1988. One hundred fifty-five of the 1989 acres were not surveyed during the 1988 survey, but approximately 87 acres surveyed in 1988 were not covered in 1989. So the 1988 survey resulted in one mat-grass colony removed for every 20.3 acres surveyed while the 1989 survey removed one mat-grass colony for every 15.5 acres surveyed.

The most significant discovery found during 1989 were the two southern-most colonies. Those two colonies extended the distribution of this species 400-500 yards farther south than was previously known. This gives a linear distance from the northern-most disjunct location to the southern-most disjunct of 1.75 miles. The linear distance from the eastern to western-most disjuncts is approximately one mile.

The four years of survey have confirmed that the main body of the matgrass infestation is north of the generally northwest-to-southeast flowing West Fork of Potlatch Creek. Only 17 colonies have been located south of this line even though the southern boundary of the main infestation borders approximately 0.5 mile of the West Fork of Potlatch Creek.

The number of new disjuncts found in 1989 indicates that surveys for disjuncts should continue for several more growing seasons. The newly found colonies at the southern end of the survey area indicate future surveys should investigate meadow areas further south of the main infestation along the Potlatch River. Meadow areas east of Highway Three need to be searched since four colonies have been found within 50 meters of Highway Three during the last two surveys.

Visual detection of matgrass is the most critical factor in the eradication program. Our ability to detect and remove matgrass has improved over the four years as indicated by the increase in numbers of colonies found each year. It is expected that more colonies will continue to be discovered in the survey area for at least three to four more years, but the number of disjunct colonies is expected to decrease substantially during the same period. Continued annual surveys will be necessary to accomplish the disjunct removal portion of the IPM eradication program. (Idaho Agricultural Experiment Station, Moscow, ID 83843).

Mesquite (Prosopis glandulosa) control following individual plant treatments with hexazione and tebuthiuron. Duncan, K. W., K. C. McDaniel and B. Sowell. A study investigating the seasonal effectiveness of hexazione and tebuthiuron for IPT of mesquite was conducted in southeastern New Mexico. Study sites were established on either sandy or sandy loam textured soils at fourteen separate locations. Plot size was variable in order that a minimum of 25 mesquite were treated by each herbicide and rate per location. Hexazione liquid was hand applied by spot gun near or within the canopy dripline at a rate of 2, 4 or 6 ml per 3 ft of canopy diameter. Tebuthiuron 250 brush bullets (0.25 gms ai/bullet) were applied at 2, 4 or 6 pellets in a similar manner. Evaluations were made in July 1989. Mesquite was initiating bud break when herbicides were applied in April 1985; in the post-flower and bean production phenology state in July, 1985; and in the no-leaf dormant stage in Jan. 1986. Mesquite growth form was variable in height and stem number by location. Hexazione and tebuthiuron were usually more effective in controlling upright and fewer stemmed mesquite compared to low-growing multistemmed shrubs. Additionally, these herbicides were generally more effective when applied in spring the year of this study compared to summer or winter. (Coop. Ext. Serv., and Department of Animal and Range Sciences, New Mexico St. Univ., Las Cruces, NM 88001).

Mesquite mortality 3-growing seasons after individual plant treatment with hexazione and tebuthiuron

Application season and date	Mesquite height	Mesquite stem/ plant unit	% Mesquite mortality: Hexazione[1] ml/3 ft. can. dia. 2	4	6	Tebuthiuron[2] B.B./3 ft. can. dia. 2	4	6
	(ft)	(no)						
Spring	3-6	<6	61	70	81	46	95	88
4/85	3-6	<6	71	90	89	68	67	75
	3-6	<6	69	80	95	6	13	38
	3-6	<6	77	88	78	17	76	61
	0-6	<6	69	95	100	0	0	87
	0-6	>6	64	100	94	19	87	86
	0-6	>6	38	76	71	22	82	68
	0-3	>6	71	67	78	0	47	45
Summer	0-3	<6	0	50	57	6	56	63
7/85	0-3	>6	5	32	13	0	27	0
	0-3	>6	0	0	40	0	0	18
	0-3	>6	0	5	0	0	18	0
Winter	0-3	>6	0	32	68	0	0	20
1/86	0-3	>6	52	74	65	6	7	6

[1] 2.0 lb ai/gal
[2] 0.25 g ai/brush bullet

Perennial pepperweed control with metsulfuron, chlorsulfuron, and 2,4-D on Colorado rangeland. Sebastian, J.S., K.G. Beck, and D.E. Hanson. A rangeland experiment was established near Greeley, CO to evaluate perennial pepperweed (LEPLA) control with metsulfuron, chlorsulfuron, and 2,4-D applied in spring and fall. The design was a randomized complete block with three replications. Spring (May 18) and fall (October 10) applications were sprayed for timing comparison. Split applications of 2,4-D were applied in spring and fall (2 lb ai/a). Chlorsulfuron and metsulfuron treatments were sprayed with X-77 surfactant (0.25% v/v). All treatments were applied with a CO_2 pressurized backpack sprayer using 11003LP flat fan nozzles at 24 gal/a and 15 psi. Plot size was 10 by 30 feet. Other application data is presented in Table 1.

Visual evaluations for control were taken on August 18, 1988 and May 2, 1989. All metsulfuron and chlorsulfuron treatments provided moderate to excellent control and 2,4-D (2.0 lb ai/a) provided poor control in 1988 (Table 2). All chlorsulfuron treatments and metsulfuron (> 0.20 oz ai/a) maintained good to excellent control one year after application. Spring plus fall applied 2,4-D (2.0 lb ai/a) provided good control in 1989. (Weed Research Laboratory, Colorado State University, Fort Collins, CO 80523).

Table 1. Application information and weed data for perennial pepperweed control with metsulfuron, chlorsulfuron, and 2,4-D on Colorado rangeland.

Environmental data		
Application date	May 18, 1988	October 10, 1988
Application time	2:30 pm	11:00 am
Air temperature, C	29	20
Cloud cover, %	65	0
Relative humidity, %	52	58
Wind speed/direction, mph	5 to 8/E	0 to 2/W
Soil temperature (2 in), C	16	12

Weed data

Application date	Species	Growth stage	Height (in)	Density (shoot/ft^2)
May 18, 1988	LEPLA	vegetative	1 to 2	15 to 20
October 10, 1988	LEPLA	vegetative	-	2 to 5

Table 2. Perennial pepperweed control with metsulfuron, chlorsulfuron, and 2,4-D on Colorado rangeland.

Treatment	Rate	Timing	Perennial pepperweed control	
	(oz ai/acre)		-------(% of check)--------	
			August 17,1988	May 2, 1989
metsulfuron[1]	0.20	spring	89	74
metsulfuron	0.35	spring	94	83
metsulfuron	0.50	spring	91	85
chlorsulfuron[1]	0.75	spring	99	95
chlorsulfuron	1.0	spring	96	92
2,4-D	32.0	spring	50	-
+ 2,4-D	32.0	fall[2]	0	85
metsulfuron	0.20	fall	0	94
metsulfuron	0.35	fall	0	93
metsulfuron	0.50	fall	0	97
chlorsulfuron	0.75	fall	0	100
chlorsulfuron	1.0	fall	0	100
LSD (0.05)			10	9

1 X-77 surfactant added at 0.25% v/v to all metsulfuron and chlorsulfuron treatments.
2 Fall applications not evaluated until 1989.

<u>Control of perennial pepperweed in pasture.</u> Flom, D.G. An experiment was established near Lovelock, Nevada on June 7, 1988 to test the efficacy of several herbicides on the control of perennial pepperweed in pasture. A randomized complete block design with four replications was used. All treatments were applied with a CO_2 pressurized sprayer delivering 20 gpa at 37 psi. Air temperature was 12C, relative humidity was 41% and winds were 2 to 5 mph at the time of application. Herbicides were applied to perennial pepperweed at the flowering growth stage. Physical clipping and pulling were included for an evaluation of non-chemical control methods. Plot size was 6 by 30 feet.

Visual evaluations were taken June 29, 1988, September 21, 1988 and May 31, 1989, approxiamtely 3 weeks, 4 months and 1 year after application. Only paraquat gave better than good (70%+) control at 3 weeks. At 4 months no herbicide treatment provided better than good (70%+) control. However, at 1 year after application 2,4-D at 8 lb/a, 2,4-D + dicamba and amitrole provided good to excellent control of perennial pepperweed regrowth.
(University of Nevada, Reno, Cooperative Extension, Yerington, NV 89447)

Percent control of perennial pepperweed

Herbicide	Rate	June 29, 1988	Evaluation date Sept. 21, 1988	May 31, 1989
	(lb ai/a)		(%)	
glyphosate	3	10	34	44
2,4-D	4	25	49	59
2,4-D	8	35	53	76
2,4-D + dicamba	4 + 4	23	35	91
clopyralid/2,4-D	0.24 + 1.5	14	45	5
clopyralid/2,4-D	0.48 + 3.0	15	41	33
clopyralid/2,4-D	0.24 + 3.0	18	30	59
clopyralid/2,4-D	0.48 + 4.5	16	23	49
amitrole	4	18	55	83
paraquat	0.5	86	34	3
clipping	-	100	58	4
pulling	-	100	71	5
$LSD_{0.05}$		15	35	27

Big sagebrush (Artemisia tridentata Nutt.) control and perennial grass yields ten years following tebuthiuron applications. Whitson, T.D. When rangeland becomes infested with big sagebrush perennial grass yields decline up to 75%, depending on rangeland sites. This study was located near Bosler, WY, on a rangeland site uniformly infested with big sagebrush. Treatments were applied with a centrifugal granular applicator May 29, 1980 and September 16, 1980 on a Boyle sandy loam soil (61% sand, 24% silt and 16% clay with 1.7% organic matter and a 6.9 pH. Plots 20 by 30 ft. were arranged in a randomized complete block design with three replications. The study was fenced to prevent grazing. Perennial grass yields were determined by clipping six 1/4 m^2 quadrats per treatment. All areas treated with 0.5 lb ai/A or greater had big sagebrush control of 87% or higher. Areas treated with tebuthiuron at 0.25 lb ai/A had an average sagebrush control of only 60% with 589 lbs of perennial grasses dry matter/A. Tebuthiuron applied at 0.5, 0.75 and 1.0 lb ai/A had 90, 92, 96% sagebrush control, while grass yields were 790, 941, and 865 lbs. dry matter/acre, respectively. Tebuthiuron rates of 0.5 and 0.75 lb ai/A provide excellent big sagebrush control with increases in grass production. (Department of Plant, Soil and Insect Sciences, University of Wyoming, Laramie, WY 82071.)

Big sagebrush control and perennial grass yields ten years following tebuthiuron applications.

		% Sagebrush[2] Control		Perennial grs yld lbs DM/Acre	
		Applied		Applied	
Herbicide[1]	Rate lb ai/A	May	Sept.	May	Sept.
Tebuthiuron 10P	0.25	72	62	571	654
	0.5	95	87	916	838
	0.75	91	95	868	886
	1.0	93	98	844	952
Tebuthiuron 20P	0.25	48	57	589	541
	0.5	90	87	696	708
	0.75	92	90	1023	690
	1.0	98	94	743	922
Check	----	0	0	363	255

[1]Herbicides were applied May 29 and Sept 16, 1980
[2]Evaluated July 26, 1989

Big sagebrush (Artemisia tridentata Nutt.) control with fluroxypyr and 2,4-D. Whitson, T.D. Big sagebrush limits grass production on 34 million acres of Wyoming rangeland. This experiment was located on a uniform big sagebrush infestation on rangeland near Saratoga, WY. Treatments were applied to 10 by 27 ft plots arranged in a randomized complete block design. Herbicides were applied with a pressurized knapsack sprayer delivering 30 gpa at 45 psi on May 26, 1988. Spraying conditions, temperature: Air 64F, Soil surface 65F, 1 inch 66F, 2 inches 70F, 4 inches 77F, with a relative humidity of 38% and calm winds, Soils, sandy loam (73% sand, 10% silt and 17% clay with 1.2% organic matter and a 7.1 pH. Evaluations made August 6, 1989. Big sagebrush control with fluroxypyr at 0.6 and 0.7 lb ai/A was equal to that of 2,4-D LVE at 2.0 lb ai/A. (Department of Plant, Soil and Insect Sciences, University of Wyoming, Laramie, WY 82071.)

Big sagebrush control with fluroxpyr and 2,4-D.

Herbicide[1]	Rate lb ai/A	% control[2]
Fluroxypyr	0.1	0
Fluroxypyr	0.2	4
Fluroxypyr	0.3	61
Fluroxypyr	0.4	70
Fluroxypyr	0.5	80
Fluroxypyr	0.6	90
Fluroxypyr	0.7	93
2,4-D (LVE)	2.0	93

[1]Applied May 26, 1988.
[2]Evaluated Aug. 6, 1989.

Big sagebrush (Artemisia tridentata Nutt.) control ten years after applying tebuthiuron. Whitson, T.D. Wyoming has 53.5 million acres of rangeland with 34 million acres infested with big sagebrush. Without big sagebrush, grass yields often double or triple, depending on control sites. This experiment was located near Kaycee, WY, on a rangeland site uniformly infested with big sagebrush. Treatments were applied June 25, 1980 and Sept. 6, 1980 to 36 by 30 ft plots arranged in a randomized complete block design with three replications. Herbicides were applied with a centrifugal granular applicator to a Moret loam soil (47% sand, 32% silt, 21% clay with 3.1% organic matter and 7.4 pH. The study area was fenced to prevent grazing. Tebuthiuron 10 and 20% formulations applied at rates of 0.5 lb ai/A and above during spring or fall provided 93% to 100% control. Perennial grasses in the understory were displaced by downy brome, therefore yields were not determined. (Department of Plant, Soil and Insect Sciences, University of Wyoming, Laramie, WY 82071.)

Big sagebrush control 10 years after applying tebuthiuron.

Herbicide[1]	Rate	Date of Application: June 24, 1980	Date of Application: Sept. 6, 1980
	lb ai/A	% Control[2]	% Control[2]
Tebuthiuron 10p	0.25	62	70
Tebuthiuron 10p	0.5	93	96
Tebuthiuron 10p	0.75	99	100
Tebuthiuron 10p	1.0	96	100
Tebuthiuron 20p	0.25	72	97
Tebuthiuron 20p	0.5	92	100
Tebuthiuron 20p	0.75	100	100
Tebuthiuron 20p	1.0	99	100
Check	----	0	0

[1]Herbicides were applied June 24 and Sept. 6, 1980.
[2]Evaluations were made Aug. 3, 1989.

Control of big sagebrush (Artemisia tridentata (Nutt.) with various herbicides and resulting forage production. Whitson, T.D., B.R. Shreve, N.R. Adam and M.A. Ferrell. Big sagebrush can be controlled with early spring applications of 2,4-D (LVE) but the time of control is usually only two to three weeks after sagebrush has started spring growth. An experiment was established to compare 2,4-D (LVE) and other herbicides with big sagebrush control potential. A study was established, then fenced, on rangeland densely infested with big sagebrush in Freemont Co., WY. Herbicide plots were 9 by 30 ft. arranged as a randomized complete block design with three replications. Environmental conditions June 10, 1982, temperature: Air 50F, soil surface 76F, 1 inch 69F, 2 inches 56F, 4 inches 55F with a relative humidity of 56% and wind 2 to 3 mph NW. Soils: sandy loam (sand 70%, wilt 22% clay 08%) with 0.8% organic matter and a 6.5 pH. Sagebrush was 8 to 16 inches in full leaf with good moisture conditions during treatments. Yields were determined by calculating dry matter yields from six 1/4 m^2 quadrants within selected treatments. Those controlling over 87% of the big sagebrush included: 2,4-D (LVE) 2.0 lb ai/A, tebuthiuron 20p 0.5, 0.75 and 1.0 lb ai/A and triclopyr at 0.5 and 1.0 lb ai/A. Forage yeilds above 800 lbs. per acre came from areas treated with tebuthiuron at 0.5 and 0.75 lb ai/A and triclopyr at 1.0 lb ai/A. All other treatments controlling over 87% had perennial grass yields approximately twice the check. (Department of Plant, Soil and Insect Sciences, University of Wyoming, Laramie, WY 82071.)

Control of big sagebrush with various herbicides and resulting forage production.

Herbicide	Rate lb ai/A	% Control[2] 1984	% Control[2] 1989	Air Dry Forage2lb/A 1984	Air Dry Forage2lb/A 1989
Metsulfuron 70% WP + X-77	0.031	33	15	310	
Metsulfuron 70% WP + X-77	0.062	67	48	406	
Metsulfuron 70% WP + X-77	0.125	68	45	348	
Metsulfuron 70% WP + X-77	0.5	100	93	368	
DPX-T 6206 70% WP + X-77	0.031	58	48	282	
DPX-T 6206 70% WP + X-77	0.062	53	37	479	
DPX-T 6206 70% WP + X-77	0.125	88	47	609	
DPX-T 6206 70% WP + X-77	0.5	95	81	865	
PPG 1259 Fl	1.0	100	100	631	
PPG 1259 Fl	2.0	100	97	404	
PPG 1259 Fl	4.0	100	98	203	
Dicamba	1.0	7	7	224	
Dicamba	2.0	30	42	276	
2,4-D ester	1.0	55	28	300	523
2,4-D ester	2.0	97	92	470	648
2,4,5-T ester	1.0	90	68	281	
2,4,5-T ester	2.0	95	85	574	
Tebuthiuron 20P	0.125	47	23	291	500
Tebuthiuron 20P	0.25	85	73	471	488
Tebuthiuron 20P	0.5	93	90	368	826
Tebuthiuron 20P	0.75	99	97	126	874
Tebuthiuron 20P	1.0	99	97	139	553
UC 77179	0.5	83	75	385	
UC 77179	1.0	100	63	107	
UC 77179	2.0	100	98	0	
UC 77179	4.0	100	100	0	
UC 77179	6.0	100	100	0	
Triclopyr	0.25	18	10	342	
Triclopyr	0.5	93	87	476	701
Triclopyr	1.0	93	87	406	892
Triclopyr+2,4-D	0.5+1.0	80	70	211	
Clopyralid	0.25	5	5	476	
Clopyralid	0.5	27	7	438	
Clopyralid	1.0	27	10	312	
Check	-------	---	---	176	351

[1]Herbicide treatments applied June 10, 1982
[2]Visual control evaluations 5/31/84 & 7/31/89. Production measurements 7/24/84 and 7/31/89 from six 1/2 m^2 diameter quadrats per treatment.

Common sagewort (Artemisia campestris (L.) control with various herbicides. Whitson, T.D. and A.E. Gade. Common sagewort, a highly competitive biennial rangeland species, is often considered an invading species in northeastern Wyoming. A common sagewort infestation near Sundance, Wyoming was treated with various herbicides June 6, 1989 on a silt loam soil (48% sand, 28% silt and 24% clay) with 2.5% organic matter and 7.4 pH. Herbicide application information is as follows: temperature: air 70F, surface 62F, 1 inch 62F, 2 inches 55F and 4 inches 60F with relative humidity of 80% and wind NW 1 to 2 mph. Green sagewort was in the vegetative stage, 6 to 10 inches in height. Treatment areas 10 by 27 ft. were arranged in a randomized complete block design with four replications. Herbicides were applied broadcast with a CO_2-pressurized six-nozzle knapsack unit delivering 30 gpa at 45 psi. Evaluations were made August 8, 1989, two months after application. Counts of green sagewort were made before treatment and during evaluation to determine percent control. Those treatments controlling greater than 76% were considered the same when treatments were compared by LSD at 0.05. Metsulfuron at 0.063, fluroxypyr at 1.0 and 2.0 and chlorsulfuron + 2,4-D at 0.063 + 2.0 lb ai/A provided 76, 78, 85, and 78% control, respectively. (Department of Plant, Soil and Insect Sciences, University of Wyoming, Laramie, WY 82071.)

Common sagewort control with various herbicides.

Herbicide[1]	Rate lb ai/A	% Control[2]
Fluroxypyr	0.5	33
Fluroxypyr	1.0	78
Fluroxypyr	2.0	85
Triclopyr	0.5	8
Triclopyr	1.0	16
Triclopyr	2.0	61
Triclopyr + 2,4-D (LVE)	0.5 + 1.0	37
Triclopyr + 2,4-D (LVE)	1.0 + 2.0	58
Metsulfuron + LI700	0.063 + 0.25%	76
Chlorsulfuron + LI700	0.0625 + 0.25%	43
2,4-D (LVE)	2.0	53
Tebuthiuron	0.5	1
Tebuthiuron	0.75	0
Clopyralid + 2,4-D (Amine)	.19 + 1.0	39
Fluroxypyr + triclopyr	0.5 + 1.0	70
Tebuthiuron + 2,4-D (LVE)	0.5 + 2.0	46
Chlorsulfuron + 2,4-D (LVE) + LI700	0.063 + 0.25% + 2.0	78
Check	------------------	0
(LSD 0.05)		23
(CV)		37

[1]Treatments applied June 6, 1989.
[2]Evaluations made August 8, 1989.

Seasonal control of broom snakeweed (Gutierrezia sarothrae) with picloram and metsulfuron. McDaniel, K. C., K. W. Duncan and W. T. Cox. Mature broom snakeweed (about six years old) growing on rangeland near Lovington, NM was sprayed with picloram at 0.125 and 0.25 lb ae/a and metsulfuron at 0.188 and 0.375 oz ai/a every six weeks throughout 1987. The higher picloram and metsulfuron dosages are commercially recommended rates. Plots were 88 by 200 ft. Herbicides were broadcast with 18 gpa water and 0.25% v/v surfactant using a trailer mounted boom (22 ft) pulled behind a pickup truck. The soil belongs to the Kimbrough series which at a 15 cm depth contained 55% sand, 26% silt and 19% clay (sandy loam), with 2.4% organic matter and a pH of 7.3. Solum thickness was shallow (about 8 to 16 in.) with a distinct accumulation of calcium carbonate below the soil. Blue grama and sand dropseed were associated species. Broom snakeweed phenology by date sprayed included on Jan. 4 - perrenating bud stage with no leaf development; Mar 3 and April 16 - early vegetative growth with leaf development on lower portions of stems; May 26 - mid vegetative with leaf development along entire stems; Jul. 15 - late vegetative; Aug. 19 - prebloom; Oct. 1 - full to post flower; and Nov. 10 - seed set. In general, spraying picloram or metsulfuron in late winter-early spring during broom snakeweed's early to mid vegetative stage or in fall at flower to post-flower provided excellent control at recommended rates. Spraying in mid-winter or summer provided poor control. Picloram applied at one-half the recommended rate provided excellent control on 4 spray dates (3/3, 4/16, 5/26 and 10/1). We have observed similar results using the 0.125 lb ae/a rate in other experiments at other locations. However, snakeweed control has been inconsistent at this rate and more research is needed to define the optimal conditions for application at the 0.125 lb ae/a rate. (Department of Animal and Range Sciences and Coop. Ext. Serv., New Mexico State Univ., Las Cruces, NM 88001).

Broom snakeweed control following application of picloram and metsulfuron at six week intervals near Lovington, NM in 1987.

Herbicide	Rate	Snakeweed mortality by date 1/14	3/3	4/16	5/26	7/15	8/19	10/1	11/10
		(%)							
Picloram	0.125 lb ae/a	8	98	98	87	8	16	99	7
Picloram	0.25 lb ae/a	29	99	99	97	19	19	99	93
Metsulfuron	0.187 oz ai/a	99	63	83	35	38	12	65	98
Metsulfuron	0.375 oz ai/a	57	92	99	80	73	42	98	97

Broom snakeweed (*Gutierrezia sarothrae* (Pursh) Britt. and Rusby) control two years following herbicide treatments. Whitson, T.D. and J.W. Freeburn. Broom snakeweed is a highly competitive perennial rangeland species which is reported to cause cattle abortions and is observed to cause grazing distribution problems. Approximately 120 million acres in the southwestern U.S. are infested with this invader. Three studies were established in 1987 to evaluate the efficacy of herbicide treatments for broom snakeweed control. Plots were 10 by 27 ft with four replications arranged in a randomized complete block design. Herbicides were applied broadcast with a CO_2-pressurized knapsack unit delivering 30 gpa at 45 psi. June 28, 1987 at M^c^fadden, Wyoming. Temperature: air 70F, surface 65F, 1 inch 70F, 2 inches 70F, 4 inches 80F with 60% relative humidity and 5 mph NW wind, to grazed and ungrazed experiments with broom snakeweed 4 to 6 inches in a vegetative stage. Herbicides were applied at Wheatland, Wyoming on July 28, 1987 when broom snakeweed was 12 to 14 inches and in early bloom. Temperature: air 96F, surface 100F, 1 inch 90F, 2 inches 93F, 4 inches 91F with 40% relative humidity and 1 to 2 mph N wind. Soils: M^c^fadden, sandy loam (75% sand, 18% silt, and 7% clay) with 2.4% organic matter and 7.8 pH; Wheatland, sandy loam (54% sand, 28% silt and 18% clay) with 1.6% organic matter and 7.6 pH. Treatments controlling greater than 95% of broom snakeweed included picloram at 0.25 and 0.5 lb ai/A, metsulfuron at 0.025, 0.038, 0.05 and 0.063 lb ai/A. The surfactant X-77 added to picloram did not increase control. Applications of metsulfuron were more effective when applied during the early growth stage rather than during flowering. Broom snakeweed control was the same during both growth stages with the picloram application rates. No grass suppression was found at either location with any treatment. (Department of Plant Soil and Insect Sciences, University of Wyoming, Laramie, WY 82071.)

Broom snakeweed control in grazed and ungrazed studies two years following herbicide treatments.

Herbicide [1]	Rate lb ai/A	McFadden grazed (% cont)	McFadden ungrazed (% cont)	Wheatland grazed (% cont)	% avg. control
Picloram	0.125	98[2]	95	83	92
Picloram + X-77	0.125 + 0.25%	99	92	70	87
Picloram	0.25	100	100	96	99
Picloram + X-77	0.25 + 0.25%	100	99	87	95
Picloram	0.5	100	99	100	100
2,4-D (LVE) Esteron 99	2.0	96	92	0	63
Triclopyr	0.125	47	0	0	16
Triclopyr	0.5	29	16	0	15
Fluroxypyr	0.25	0	34	0	11
Fluroxypyr	0.25	75	57	0	44
Fluroxypyr	0.75	76	82	0	53
Dicamba + 2,4-D (A)	0.25 + 0.75	60	75	0	45
Triclopyr + 2,4-D (LVE)	0.33 + 0.67	79	34	0	38
2,4-D Weedone 638	2.0	94	93	0	62
Metsulfuron + X-77	0.013 + 0.25%	89	92	0	60
Metsulfuron + X-77	0.025 + 0.25%	99	99	87	95
Metsulfuron + X-77	0.038 + 0.25%	100	100	87	96
Metsulfuron + X-77	0.05 + 0.25%	100	100	91	97
Metsulfuron + X-77	0.063 + 0.25%	100	100	99	100
Check	-------	0	0	0	0
(LSD 0.05)		26	33	1536	
(CV)		76	115	59	34

[1]Treatments applied at McFadden on June 28, 1987 and at Wheatland on July 28, 1987.
[2]Evaluations (% control) calculated from total snakeweed plants/plot, counted July 10 and 11, 1989.

Production changes in crested wheatgrass infested with broom snakeweed (*Gutierrezia sarothrae*) following herbicide applications. Whitson, T.D., B.R. Shreve, and N. R. Adam. Broom snakeweed infestations redice grass utilization by livestock and have been reported to reduce native grass yields to one-third their normal production. A study was established near McFadden, Wyoming on a crested wheatgrass pasture which was uniformly infested with broom snakeweed. The area was fenced to prevent grazing. Plots 10 by 27 ft were arranged in a randomized complete block design with four replications. Herbicides were broadcast with a CO_2-pressurized knapsack unit delivering 30 gpa at 45 psi, June 29, 1987, near McFadden, Wyoming. Temperature: air, 70F, surface, 65F, 1 inch, 70F, 2 inches, 70F, 4 inches, 80F with 69% relative humidity and 5 mph NW wind; growth stage was vegetative, 4 to 6 inch height. Soil was sandy loam (75% sand, 18% silt, and 7% clay) with 2.4% organic matter and a 7.8 pH. Yields of forage were calculated from sampling two 1/4 m^2 quadrants from each treatment area. Treatments yielding significantly higher than the check were 2,4-D (LVE) isooctylester at 2.0 lb ai/A, 2,4-D butoxyethylester at 2.0 lb ai/A, Metsulfuron at 0.013, 0.025 and 0.05 lb ai/A. (Department of Plant, Soil and Insect Sciences, University of Wyoming, Laramie, WY 82071.)

Production changes in crested wheatgrass infested with broom snakeweed following herbicide applications.

Herbicide[1]	Rate lb ai/A	% control[2]	lb DM/A
Picloram	0.125	95	892
Picloram + X-77	0.125 + 0.25%	92	785
Picloram	0.25	100	821
Picloram + X-77	0.25 + 0.25%	99	785
Picloram	0.5	99	660
2,4-D (LVE) isooctylester	2.0	92	999
Triclopyr	0.125	0	767
Triclopyr	0.5	16	696
Fluroxypyr	0.25	34	713
Fluroxypyr	0.5	58	642
Fluroxypyr	0.75	82	767
Dicamba + 2,4-D (A)	0.25 + 0.75	75	625
Triclopyr + 2,4-D (LVE)	0.33 + 0.67	34	874
2,4-D butoxyethylester	2.0	93	946
Metsulfuron + X-77	0.013 + 0.25%	92	1071
Metsulfuron + X-77	0.025 + 0.25%	99	963
Metsulfuron + X-77	0.038 + 0.25%	100	874
Metsulfuron + X-77	0.05 + 0.25%	100	1070
Metsulfuron + X-77	0.063 + 0.25%	100	821
Check	-------------	0	625
(LSD 0.05)		33	285
(CV)		115	24

[1]Herbicides applied June 29, 1987.
[2]Evaluations made July 10, 1989.

Leafy spurge control with reduced rates of picloram, dicamba, and 2,4-D on Colorado rangeland. Sebastian, J.R., K.G. Beck, and D.E. Hanson. A 3 year rangeland experiment was established near Pagosa Springs, CO to evaluate leafy spurge (EPHES) control with reduced rates of picloram, dicamba, and 2,4-D and their tank mixes. The design was a randomized complete block with four replications. All treatments were applied on June 1, 1989 with a CO_2 pressurized backpack sprayer using 11003LP flat fan nozzles at 24 gal/a, 15 psi. Other application information is provided in Table 1. Plot size was 10 by 60 feet.

Visual evaluations were taken on July 11, August 10, and October 17, 1989, approximately 1, 2, and 4 months after treatment application, respectively. Picloram and dicamba plus 2,4-D tank mixes provided excellent (99%) control 1 and 2 months after application. Picloram alone and picloram plus 2,4-D maintained fair to good (64-90%) control 4 months after treatment application.

All treatments will be re-applied at same rates during spring 1990 to 2/3 of each plot and in 1991 to 1/3 of each plot to simulate 1,2, and 3 years of treatment. (Weed Research Laboratory, Colorado State University, Fort Collins, CO 80523).

Table 1. Application information for leafy spurge control with picloram, dicamba, and 2,4-D on Colorado rangeland.

Environmental data	
Application date	June 1, 1989
Application time	10:00 am
Air temperature, C	26
Cloud cover, %	5
Relative humidity, %	14
Wind speed/direction, mph	3 to 8/S
Soil temperature, (2.0 in), C	17

Weed data

Application date	Species	Growth stage	Height
June 1, 1989	EPHES	flowering	-

Table 2. Leafy spurge control with picloram, dicamba, and 2,4-D on Colorado rangeland.

Herbicide	Rate	Leafy spurge control		
	(lb ai/acre)	------------% control-----------		
		July 7	August 10	October 17
picloram	0.25	23	10	73
picloram	0.5	58	65	90
picloram + 2,4-D	0.25 1.0	99	99	64
picloram + 2,4-D	0.5 1.0	99	99	84
dicamba	2.0	36	48	43
dicamba + 2,4-D	1.0 2.0	99	98	37
LSD (0.05)		10	15	19

Leafy spurge control in a non-grazed meadow. Lass, L.W., and R.H. Callihan. The purpose of this experiment was to determine the effects of three rates of six herbicides on established leafy spurge (Euphorbia esula L.) (EPHES) in pasture.

The experiment was established in dense leafy spurge in a non-grazed pasture east of Rathdrum, Idaho June 9, 1986. The soil type was Avonvulle gravely silt loam. Plots measured 10 by 20 ft with four replicates in a randomized complete block design. The treatments consisted of single applications of DPX-L5300 (0.5, 1.0, 2.0 oz ai/a and a check), clopyralid (0.25, 0.5, 1.0 lb ai/a and a check), sulfometuron (0.5, 1.0, 2.0 oz ai/a), picloram (0.5, 1.0, 2.0 lb ai/a and a check), fosamine-ammonium (0.5, 1.0, 2.0 lb ai/a and a check) and combinations of metsulfuron and chlorsulfuron (0.3 + 0.3, 0.5 + 0.5, and 1.0 + 1.0 oz ai/a and a check).

Treatments were applied in 23 gal/a water carrier, with flat fan nozzles (TeeJet 8002) at 43 psi., from a backpack sprayer operated at 3 mph. The air temperature at the time of treatment was 59 F, soil surface temperature was 42 F, and the relative humidity was 46%. The sky was 80% cloudy and no dew was present.

In this four-year study, three of the herbicides suppressed leafy spurge growth. Fosamine-ammonium at 0.5, 1.0 and 2.0 lb ai/a significantly delayed leafy spurge emergence in the spring after application. Sulfometuron at 2.0 oz ai/a appeared to suppress the first summer's growth, although statistically not verifiable. The next year's spring growth was reduced significantly (99%). The summer growth, 14 months after spraying sulfometuron at 2.0 oz ai/a, was suppressed 39% when compared to the checks.

Picloram suppressed leafy spurge more than other herbicides tested. Leafy spurge growth in the summer of 1986 was reduced significantly by all rates of picloram (77 to 92%), which was the only herbicide providing more than 50% control. Some regrowth (5 to 10 plants) occurred in picloram plots 4 months after application. In the spring, 10 months after application, picloram continued to reduce regrowth of leafy spurge 98 to 100%. Regrowth of leafy spurge 14 months after application was reduced by all rates of picloram, although lower rates were less effective. The summer control by picloram ranged from 48 to 84% for 0.5, 1.0 and 2.0 lb ai/a. In 1988, 24 months after application, picloram at 2.0 lbs/a was the only treatment significantly suppressing the leafy spurge growth (55%). Grass cover was the highest (85%) in the plots with 2.0 lb/a picloram. The leaf-rolling moth Sparganothis umbrana caused more insect damage to the leafy spurge than many of the herbicide treatments. In heavily insect-infested areas, the insects removed leaves from the upper 2/3 of 80 to 95% of the plants.

In 1989, 37 months after application, picloram at 2.0 lb ai/a was the only treatment reducing leafy spurge biomass (52%). Grass cover was 245% in plots with picloram at 2.0 lb ai/a.

Since leafy spurge is a rhizomatous perennial, long-term control may only be possible with an integrated pest management system using herbicides and biological control agents. Single applications of either long-residual or short-residual herbicides are ineffective answers for long-term control. (University of Idaho, Dept. of P.S.& E.S. Moscow 83843)

Leafy Spurge Control in a non-grazed meadow.

Biomass as % of Check

		Leafy Spurge					Grasses	Grass Cover	
Herbicide	Rate	Summer 7/17/86	Spring 4/28/87	Summer 8/8/87	Summer 7/20/88	Summer 7/26/89	Spring 4/28/87	Summer 7/20/88	Summer 7/26/89
	(ai./A)	(%)[2]	(%)	(%)	(%)	(%)	(%)	(%)3	(%)3
metsulfuron +	0.0 oz	100 a	100 a	100 a	100 a	100 a	100 a	100 bc	100 b
chlorsulfuron	0.3+0.3 oz	98 a	100 a	100 a	100 a	100 a	100 a	45 c	100 b
(Ally+Glean)	0.5+0.5 oz	98 a	100 a	100 a	90 a	100 a	100 a	135 bc	100 b
	1.0+1.0 oz	98 a	100 a	100 a	92 a	100 a	87 ab	85 bc	100 b
DPX-L5300	0.0 oz	100 a	100 a	100 a	100 ab	100 a	100 a	100 bc	100 b
(Express)	0.5 oz	100 a	100 a	100 a	115 a	100 a	100 a	94 bc	79 b
	1.0 oz	105 a	100 a	100 a	107 ab	100 a	100 a	123 bc	87 b
	2.0 oz	92 a	90 a	100 a	108 ab	100 a	100 a	116 bc	114 b
fosamine-	0.0 oz	100 a	100 a	100 a	100 a	100 a	100 a	100 bc	100 b
ammonium	0.5 oz	83 a	11 b	72 bcd	100 a	100 a	62 ab	42 bc	101 b
(Krenite)	1.0 oz	80 a	11 b	81 abc	85 a	100 a	87 ab	96 bc	65 b
	2.0 oz	95 a	5 bc	51 d	87 a	100 a	67 b	96 bc	78 b
clopyralid	0.0 lb	100 a	100 a	100 a	100 ab	100 a	100 a	100 bc	100 b
(Stinger)	0.3 lb	100 a	100 a	100 a	110 a	100 a	100 a	83 b	100 b
	0.5 lb	99 a	100 a	100 a	100 ab	100 a	90 ab	95 bc	87 b
	1.0 lb	96 a	100 a	100 a	98 ab	100 a	100 a	115 bc	68 b
sulfometuron	0.0 oz	100 a	100 a	100 a	100 a	100 a	100 a	100 bc	100 b
(Oust)	0.5 oz	91 a	100 a	87 ab	65 ab	108 a	100 a	92 bc	107 b
	1.0 oz	87 a	100 a	100 a	92 a	108 a	80 ab	175 bc	100 b
	2.0 oz	67 a	1 bc	61 cd	95 a	95 a	15 c	88 bc	92 b
picloram	0.0 lb	100 a	100 a	100 a	100 a	100 a	100 a	100 bc	100 b
(Tordon)	0.5 lb	23 b	2.5 bc	52 d	95 a	100 a	100 a	193 bc	108 b
	1.0 lb	6 b	1 c	56 d	80 ab	82.5 a	100 a	193 bc	82 b
	2.0 lb	2 b	0 c	16 e	45 b	47.5 b	100 a	607 a	242 a

1. Estimated biomass, expressed as a percent of the untreated control.
2. Any two means having a common letter are not significantly different at the 5% level of significance using Protected Duncan's Test.
3. Grass cover expressed as a percent of total plant cover by all species as a % of the check.

Dicamba combinations for leafy spurge shoot control. Ferrell, M.A. and T.D. Whitson. Leafy spurge is a major broadleaf, perennial weed problem in rangeland. This research was conducted in Crook County, Wyoming to compare the efficacy of dicamba combined with picloram or 2,4-D LVE, on leafy spurge control.

Plots were established May 14, 1986 to a dense stand of leafy spurge. The leafy spurge was in the prebud stage-of-growth. Perennial grasses 4 to 6 inches tall were present as an understory. Herbicides were applied with a CO_2 six-nozzle knapsack spray unit with a carrier volume of 40 gpa delivered at 40 psi pressure through 8004 flat fan nozzles. Weather conditions were as follows; air temperature = 45 F, relative humidity = 60%, wind southwest at 5 mph, sky cloudy, and a soil temp. - 0 in 60 F, 1 in. 54 F, 2 in. 50 F, 4 in. 50 F. Soil was a silt loam (22% sand, 58% silt, and 20% clay) with 1.8% organic matter and 6.3 pH. Plots were 9 by 30 ft and arranged in a randomized complete block design with four replications.

Visual evaluations made May 24, 1989 continued to show picloram at 2.0 lb ai/a as the only effective treatment. Combinations of dicamba with picloram and 2,4-D LVE have not been effective in long term control of leafy spurge when applied as single treatments. (Wyoming Agric. Exp. Sta., Laramie, WY 82071 SR 1598.)

Leafy spurge shoot control

Treatment[1]	Rate	Control[2] 1987	1988	1989
	(lb ai/a)	-------	(%)	-------
dicamba	0.5	0	0	0
dicamba	1.0	0	10	15
dicamba	2.0	0	10	10
dicamba	4.0	53	50	43
dicamba + picloram	0.5 + 0.125	0	0	0
dicamba + picloram	1.0 + 0.25	18	0	10
picloram	0.5	42	15	15
picloram	1.0	65	53	40
picloram	2.0	96	88	84
dicamba + 2,4-D LVE	1.0 + 1.0	47	33	39
dicamba + 2,4-D LVE	1.0 + 3.0	45	23	18
LSD (0.05)		18	28	25
CV		40	83	76

[1]Treatments applied May 14, 1986. Surfactant, X-77, added to all treatments at 0.5% v/v.
[2]Visual evaluations July 7, 1987; June 8, 1988; and May 24, 1989.

Dicamba combined with various herbicides for leafy spurge shoot control. Ferrell, M.A. and T.D. Whitson. Leafy spurge is a major broadleaf, perennial weed problem in rangeland. This research was conducted in Crook County, Wyoming to compare the efficacy of dicamba in combination with various herbicides on leafy spurge control.

Plots were established May 18, 1988 on dense stand of leafy spurge. The leafy spurge was in the prebud stage-of-growth. Perennial grasses 4 to 6 inches tall were present as an understory. Herbicides were applied with a CO_2 six-nozzle knapsack spray unit with a carrier volume of 40 gpa delivered at 40 psi pressure through 8004 flat fan nozzles. Weather conditions were as follows; air temperature = 50 F, relative humidity = 90%, wind south at 5 mph, sky cloudy, and a soil temp. - 0 in 50 F. Soil was a silt loam (22% sand, 58% silt, and 20% clay) with 1.8% organic matter and 6.3 pH. Plots were 10 by 27 ft and arranged in a randomized complete block design with four replications.

Visual evaluations made June 6, 1989 showed no treatment or treatment combination providing adequate leafy spurge control. (Wyoming Agric. Exp. Sta., Laramie, WY 82071 SR 1599.)

Leafy spurge shoot control

Treatment[1]	Rate	Control[2] 1989
	(lb ai/a)	(%)
dicamba	2.0	20
dicamba + picloram	0.5 + 0.125	23
dicamba + picloram	0.5 + 0.25	20
dicamba + picloram	1.0 + 0.125	13
dicamba + picloram	1.0 + 0.25	20
dicamba + clopyralid + 2,4-D amine	0.5 + 0.05 + 0.25	0
dicamba + clopyralid + 2,4-D amine	0.5 + 0.10 + 0.5	8
dicamba + clopyralid + 2,4-D amine	1.0 + 0.05 + 0.25	18
dicamba + clopyralid + 2,4-D amine	2.0 + 0.10 + 0.5	3
dicamba + triclopyr + 2,4-D LVE	0.5 + 0.25 + 0.5	36
dicamba + triclopyr + 2,4-D LVE	0.5 + 0.5 + 1.0	20
dicamba + triclopyr + 2,4-D LVE	1.0 + 0.25 + 0.5	23
dicamba + triclopyr + 2,4-D LVE	1.0 + 0.5 + 1.0	15
picloram	0.25	20
clopyralid + 2,4-D amine	0.1 + 0.5	5
triclopyr + 2,4-D LVE	0.5 + 1.0	15
control	---------------	0
LSD (0.05)		24
CV		109

[1]Treatments applied May 18, 1988. Surfactant, X-77, added to all treatments at 0.5% v/v.

[2]Visual evaluations June 6, 1989.

Metsulfuron evaluation for leafy spurge control. Ferrell, M.A. and T.D. Whitson. This research was conducted on pastureland near Devil's Tower, Wyoming to compare the efficacy of treatments of metsulfuron on the control of leafy spurge.

Plots were 10 by 27 ft. with four replications arranged in a randomized complete block. The herbicide treatments were applied broadcast with a CO_2 pressurized six-nozzle knapsack sprayer delivering 30 gpa at 35 psi May 28, 1987 (air temp. 60 F, soil temp. 0 inch 60 F, 1 inch 55 F, relative humidity 75%, wind west at 10 mph, sky cloudy). The soil was classified as a silt loam (22% sand, 58% silt, and 20% clay) with 1.8% organic matter and a 6.3 pH. Leafy spurge was in the full bloom stage and 8 to 12 inches high. Infestations were heavy thoughout the experimental area. Visual weed control evaluations were made June 8, 1988 and May 24, 1989.

Picloram and fosamine were the only herbicides showing activity two years after herbicide application. The metsulfuron + glyphosate treatments continue to show grass damage in 1989. (Wyoming Agric. Exp. Sta., Laramie, WY 82071 SR 1600.)

Leafy spurge control and grass damage

Treatment[1]	Rate	Control[2]		Grass damage[2]	
		1988	1989	1988	1989
	(lb ai/a)	-- (%) --		--- (%) ----	
metsulfuron + 2,4-D amine	0.05 + 1.0	0	0	0	0
metsulfuron + 2,4-D amine	0.06 + 1.0	0	0	0	0
metsulfuron + 2,4-D amine	0.09 + 1.0	0	0	0	0
metsulfuron + dicamba	0.05 + 0.5	0	0	0	0
metsulfuron + dicamba	0.09 + 0.5	0	0	0	0
metsulfuron + glyphosate	0.05 + 1.0	0	0	100	50
metsulfuron + glyphosate	0.09 + 1.0	0	0	100	30
metsulfuron + picloram	0.05 + 0.25	0	0	0	0
metsulfuron + picloram	0.06 + 0.25	0	0	0	0
metsulfuron + picloram	0.09 + 0.25	0	0	0	0
metsulfuron + fluroxypyr	0.05 + 0.5	0	0	0	0
metsulfuron + fluroxypyr	0.09 + 0.5	5	0	0	0
fosamine	6.0	54	48	0	0
fosamine	12.0	61	50	0	0
picloram	2.0	83	83	0	0
metsulfuron	0.05	0	0	0	0
metsulfuron	0.06	0	0	0	0
metsulfuron	0.09	0	0	0	0
Check	-----	0	0	0	0
(LSD 0.05)		11	12	--	13

[1]Treatments applied May 28, 1987.
[2]Visual evaluations June 8, 1988 and May 25, 1989.

Control of leafy spurge with retreatments of picloram and 2,4-D LVE. Ferrell, M.A. and T.D. Whitson. This research was conducted on pastureland near Devil's Tower, Wyoming to compare the efficacy of retreatments of picloram and 2,4-D LVE on the control of leafy spurge.

Plots were 10 by 27 ft. with four replications arranged in a randomized complete block. The original herbicide treatments were applied broadcast with a CO_2 pressurized six-nozzle knapsack sprayer delivering 30 gpa at 35 psi May 28, 1987 (air temp. 60 F, soil temp. 0 inch 60 F, 1 inch 55 F, relative humidity 75%, wind west at 10 mph, sky cloudy). Retreatments were applied July 6, 1988 in the same manner as the original treatments (air temp. 93 F, soil temp. 0 inch 110 F, 1 inch 95 F, relative humidity 38%, wind south at 3 to 5 mph, sky partly cloudy). The soil was classified as silt loam (22% sand, 58% silt, and 20% clay) with 1.8% organic matter and a 6.3 pH. Leafy spurge was in the full bloom stage and 8 to 12 inches in height, for the original treatments and in seed set and 12 to 16 inches in height, for the retreatments. Infestations were heavy thoughout the experimental area. Visual weed control evaluations were made June 8, 1988 and May 25, 1989.

Leafy spurge control in 1988 was 80% or better with picloram at rates greater than 1.0 lb ai/a. Picloram at 0.25 + 2,4-D LVE at 1.0 lb ai/a and 2,4-D LVE at 2.0 lb ai/a were the only 1988 retreatments that increased leafy spurge control in 1989. Picloram at 2.0 lb ai/a was the only original treatment maintaining 80% or better shoot control in 1989. Plots with less than 80% control were retreated again June 6, 1989. Retreatments will be applied as needed to maintain or attain 80% leafy spurge shoot control. (Wyoming Agric. Exp. Sta., Laramie, WY 82071 SR 1597.)

Leafy spurge control

Treatment[1]	Rate		Control[2]	
	Original	Retreatment	1988	1989
	------ (lb ai/a) -------		-- (%) --	
picloram	0.25	0.25	5	13
picloram	0.5	0.5	48	28
picloram	0.75	0.5	59	50
picloram	1.0	0.5	75	68
picloram	1.25	none	83	76
picloram	1.5	none	80	65
picloram	1.75	none	83	73
picloram	2.0	none	89	81
picloram + 2,4-D LVE	0.25 + 1.0	0.25 + 1.0	25	51
2,4-D LVE	1.0	1.0	0	15
2,4-D LVE	2.0	2.0	18	34
Check	0	none	0	0
(LDS 0.05)			17	21
(CV)			25	32

[1]Original treatments applied May 28, 1987. Retreatments applied July 6,1988.
[2]Visual evaluations June 8, 1988 and May 25, 1989.

Leafy spurge control with sequential treatments. Ferrell, M.A. and T.D. Whitson. This research was conducted on pastureland near Devil's Tower, Wyoming to compare the efficacy of sequential herbicide treatments on leafy spurge control.

A study area, 90 ft by 120 ft, was established with an initial application of fluroxypyr at 3/8 lb ai/a. After the initial treatment was applied, the study area was divided into plots 9 by 30 ft. with four replications, to which spring or late summer retreatments were applied. The initial treatment was applied broadcast with a CO_2 pressurized six-nozzle knapsack sprayer delivering 30 gpa at 35 psi August 12, 1986 (air temp. 96 F, soil temp. 0 inch 115 F, 1 inch 93 F, 2 inch 83 F, 4 inch 78 F, relative humidity 27%, wind south at 5 mph, sky clear). The leafy spurge was 14 inches tall and most of the seed had been shed 4 weeks earlier. The soil was a silt loam (22% sand, 58% silt, and 20% clay) with 1.8% organic matter and a 6.3 pH. Spring retreatments were applied May 28, 1987 to a dense stand of leafy spurge 8 to 12 inches tall (air temp. 65 F, soil temp. 0 inch 70 F, 1 inch 60 F, 2 inch 60 F, 4 inch 55 F, relative humidity 63%, wind calm, sky clear). Late summer treatments were applied August 27, 1987 to a dense stand of leafy spurge 10 to 14 inches tall (air temp. 57 F, soil temp. 0 inch 75 F, 1 inch 70 F, 2 inch 65 F, 4 inch 60 F, relative humidity 77%, wind calm, sky clear). Blanket retreatments of fluroxypyr (applied to the spring retreatments) and picloram (applied to the late summer retreatments) were applied July 6, 1989.

Visual weed control evaluations made May 28, 1987, prior to retreatment applications, showed the leafy spurge to be stunted with very little flowering. Visual weed control evaluations were also made June 8, 1988 to evaluate the 1987 retreatments. No 1987 treatment has provided adequate control. Blanket retreatments of fluroxypyr and picloram have not provided adequated control one year after application. (Wyoming Agric. Exp. Sta., Laramie, WY 82071 SR 1596.)

Leafy spurge shoot control

Retreatment[1]	Rate	Shoot control[2] Fluroxypyr initial treatment (3/8 lb ai/a)[3] fluroxypyr[4] 0.5 lb ai/a	picloram[4] 0.5 lb ai/a
	(lb ai/a)	------------- (%)	-------------
May 1987			
dicamba	2.0	49	---
2,4-D LVE	2.0	18	---
picloram	0.5	10	---
fluroxypyr	0.5	25	---
August 1987			
dicamba	2.0	---	45
2,4-D LVE	2.0	---	43
picloram	0.5	---	20
fluroxypyr	0.5	---	30
check	0	0	0
(LSD 0.05)		43	43
(CV)		124	124

[1]Retreatments applied May 28, 1987 and August 27, 1987
[2]Visual evaluations May 24, 1989.
[3]Initial fluroxypyr blanket treatment applied August 12, 1986.
[4]Retreatment fluroxypyr and picloram blanket treatments applied July 6, 1989.

The comparison of three 2,4-D formulations applied by airplane for control of leafy spurge. Whitson, T.D., D.A. Austin and M.A. Ferrell. Leafy spurge commonly grows on rangeland that cannot be treated by ground spray equipment; therefore, airplanes are commonly used for application. This experiment was established near Sundance, Wyoming to compare three 2,4-D formulations when applied by airplane. Treatment areas 227 by 1089 ft. were applied as single blocks with four permanently-located line transects within each block. Live canopy cover of leafy spurge was determined by making 100 point-frame counts within each line transect before treatment on May 26, 1989 and after treatment on August 8, 1989. Application information, May 26, 1989, temperature: air 41F, soil surface 90F, 1 inch 50F, 2 inches 50F, 4 inches 53F with 90% relative humidity and 2- to 3-mph west winds. Herbicides were applied by airplane equipped with a 24-nozzle airfoil 3-inch drop nozzle boom with 010 nozzles and 46 corners delivering 3 gal/A at 120 mph. Soils, silt loam (22% sand, 58% silt and 20% clay) with 1.8% organic matter and a 6.3 pH. No significant differences were found in leafy spurge control with the three 2,4-D formulations when used alone. Control ranged from 40.8 to 42%. When combined with picloram, the Dimethylamine, Diethanolamine 2,4-D and 2,4-D butoxyethyl ester formulations provided controls of 82 and 73.2%, respectively, and were significantly higher than the amine formulation, with 64% control. Perennial grasses increased from 240 to 250% when the three 2,4-D formulations were combined with picloram. Grass releases were variable when 2,4-D formulations were used alone. Bare ground changes were not correlated with either leafy spurge control or increases in perennial grasses. (Department of Plant, Soil and Insect Sciences, University of Wyoming, Laramie WY 82071 SR)

The comparison of three 2,4-D formulations applied by airplane for control of leafy spurge.

Herbicide[1]	lb ai/A	% Control[2] Leafy Spurge	% Live Canopy Increase perennial grasses	% Change bare ground
2,4-D amine	2.0	42 b	28.5 ab	-30.4
2,4-D amine+picloram	2.0+0.5	64 ab	34.5 a	-10.3
2,4-D (dimethylamine+ diethanolamine)	2.0	40.8 b	15.5 c	+14.3
2,4-D (dimethylamine+) diethanolamine)+picloram	2.0+ 0.5	82 a	36.75 a	+31
2,4-D (butoxyethyl ester)	1.4	41.5 b	20.5 bc	+ 3.1
2,4-D (butoxyethyl ester+ picloram)	1.4+ 0.5	73.2 a	30.75 ab	+30.3
(LSD 0.05)		24.8	12.01	

[1]Herbicides were applied May 26, 1989.
[2]Evaluations were made August 8, 1989.

Comparisons of sulfometuron application timing for control of leafy spurge. Whitson, T.D., A.E. Gade and M.A. Ferrell. Leafy spurge is considered one of the most persistent rangeland weeds in the U.S. These experiments were established to compare sulfometuron with other currently registered herbicides for control of leafy spurge. The experiments were established in a randomized complete block design with four replications. Application information: May 18, 1988, temperature: air 50F, soil surface 50F, 1 inch 60F, 2 inches 65F, 4 inches 65F with 90% relative humidity and a 3 to 5 mph NW wind with leafy spurge 10 to 12 inches tall in the early bloom; September 14, 1988, temperature: air 66F, soil surface 65F, 1 inch 66F, 2 inches 66F, 4 inches 68F, with 58% relative humidity and 2 to 3 mph south wind, with leafy spurge in full seed, 12 to 16 inches tall. Soils: silt loam (22% sand, 58% silt and 20% clay) with 1.8% organic matter and a 6.3 pH. Herbicides were applied with a CO_2-pressurized six-nozzle sprayer delivering 30 gpa at 45 psi. Neither leafy spurge control nor perennial grass damage was greatly changed by timing of herbicide application. When spring and fall treatment data were combined, the three treatments (sulfometuron at 0.094 lb ai/A, sulfometuron + 2,4-D amine at 0.094 + 1.0, and 0.188 + 1.0 lb ai/A) provided 89, 95 and 92% leafy spurge control, respectively, with perennial grass damage of 92, 82, and 80%, respectively. Even though leafy spurge control was good, perennial grass damage was extremely high. (Department of Plant, Soil and Insect Sciences, University of Wyoming, Laramie, WY 82071.)

Comparisons of application timing of sulfometuron combinations for control of leafy spurge.

Herbicide[1]	Rate lb ai/A	% Leafy spurge cont. Applic. time 5/18/88	9/14/88	% Peren'l grass dmg Applic. time 5/18/88	9/14/88
Sulfometuron	0.094	48	63	20	67
	0.188	86	91	90	93
Sulfometuron + 2,4-D (A)	0.094 + 1.0	47	58	20	67
	0.188 + 1.0	94	95	77	87
Sulfometuron + picloram	0.094 + 1.0	63	79	57	77
Sulfometuron + dicamba	0.094 + 2.0	87	96	72	87
2,4-D (Amine)	1.0	0	0	0	0
Picloram	0.5	35	37	13	0
Picloram	1.0	57	63	35	10
Dicamba	2.0	8	0	7	0
Check	-------	0	0	0	0
(LSD 0.05)		10	26	15	13

The control of leafy spurge (Euphorbia esula L.) by the integration of herbicides and perennial grasses. Whitson, T.D., D.W. Koch, A.E. Gade and M.E. Ferrell. Plant competition has long been recognized as an important method for control of weeds. This experiment was established near Sundance, WY, to determine the effects of establishing eleven perennial grass species on control of leafy spurge. Before seeding perennial grasses, two applications of glyphosate at 0.75 lb ai/A were broadcast with a truck-mounted sprayer delivering 15 gpa at 35 psi on June 2, 1986 (temperature: air 69F, soil surface 65F, 1 inch 64F, 2 inches 63F, 4 inches 63F with 58% relative humidity and calm winds) and on July 1, 1986 (temperature: air 85F, soil surface, 85F, 1 inch 84F, 2 inches 81F and 4 inches 80F with 40% relative humidity and 2 to 3 mph west winds). Soils were classified as a silt loam (22% sand, 58% silt and 20% clay) with 1.8% organic matter and 6.3 pH. A postemergent broadcast application of pendimethalin at 2.0 and fluroxypyr at 0.5 lb ai/A was applied May 16, 1988 (temperature: air 73F, 1 inch 68F, 2 inches 67F, 4 inches 64F with 64% relative humidity and wind 2 to 3 mph NW.) with a tractor-mounted sprayer applying 20 gpa at 35 psi. Plots (60 by 90 ft.) were arranged in a split plot design with four replications, one half the plot tilled, the other half left untilled. Tillage was performed with a rototiller on Aug. 11, 1986 and grasses were seeded with a John Deere powertill drill on Aug. 12, 1986. Evaluations were made Sept. 14, 1988 and Aug. 8, 1989. In areas established with no tillage before seeding, pubescent wheatgrass and big bluegrass provided 72 and 78% control of leafy spurge and were 71 and 83% established with yields of 1062 and 2118 lb. dry matter (D.M.) per acre, respectively, while in treatment areas with tillage before seeding, western wheatgrass, hybrid wheatgrass, crested wheatgrass, big bluegrass, intermediate wheatgrass, pubescent wheatgrass and Russian wildrye provided 88, 89, 90, 91, 91, 93, and 93% control of leafy spurge, and were 58, 85, 86, 88, 91, 90, and 90% established with yields of 1348, 2886, 1434, 2997, 3173, 2074, and 1283 lb. D.M./Acre, respectively. Yields were especially high due to considerably greater than normal rainfall at the study site in May and June. (Department of Plant, Soil and Insect Sciences, University of Wyoming, Laramie, WY 82071.)

The control of leafy spurge by the integration of herbicides and perennial grasses.

Grass Species (Variety)[1]	Grass Establishment[2]				%Leafy Spurge Control				Lb. Grass (D.M./Acre)			
	Tilled		No-tilled		Tilled		No-tilled		Tilled		No-tilled	
	1988	1989	1988	1989	1988	1989	1988	1989	1988	1989	1988	1989
Pubescent wheatgrass(Luna)	90	90	70	71	97	93	84	72	572	2074	274	1062
Crested wheatgrass(Ephraim)	83	86	55	14	95	90	79	56	474	1434	218	413
Mountain Rye	18	11	5	4	79	50	58	31	368	436	224	119
Big bluegrass(Sherman)	74	88	79	83	96	91	89	78	594	2997	336	2118
Hybrid wheatgrass(RS1)	74	85	13	10	94	89	60	33	518	2886	142	619
Smooth bromegrass(Manchar)	80	80	18	23	92	79	68	40	294	1263	152	605
Intermediate wheatgrass(Oahe)	71	91	16	53	97	91	68	51	652	3173	152	2053
Bluebunch wheatgrass(Secar)	64	64	15	2	83	76	64	35	194	968	128	169
Western wheatgrass(Rosana)	76	58	26	19	91	88	65	48	464	1348	174	387
Russian wildrye(Bozoisky)	83	90	30	10	97	93	63	44	552	1283	160	220
Thickspike wheatgrass(Critana)	81	61	29	15	94	78	70	29	484	1587	210	690

[1] Grasses seeded Aug. 12, 1986.
[2] Evaluations made Sept. 14, 1988 and Aug. 8, 1989.

Comparison of various adjuvants in combination with picloram and fluroxypyr for control of leafy spurge (Euphorbia esula). Whitson, T.D. and N.R. Adam. Leafy spurge is a deep-rooted perennial growing on rangeland sites and is extremely difficult to control. This experiment was conducted to determine whether differences in leafy spurge control could be obtained when various adjuvants were combined with sublethal rates of picloram and fluroxypyr. This experiment was established on an ungrazed rangeland area with a uniform stand of leafy spurge near Sundance, Wyoming. Plots 10 by 27 ft. were arranged in a randomized complete block design with four replications. Plots were split with the first ½ of each plot (10 by 13.5 ft.) treated May 18, 1988 (temperature: air 50F, soil surface 50F, 1 inch 60F, 2 inches 65F, 4 inches 65F with 90% relative humidity and wind NW at 3 to 5 mph). Leafy spurge was in early bract development, 10 to 12 inches tall. The second treatment was applied to the remaining ½ of the plots on July 6, 1988 (temperature: air 73F, soil surface 90F, 1 inch 85F, 2 inches 83F, 4 inches 79F with 48% relative humidity and wind west at 0-5 mph) The soil was classified as a silt loam (22% sand, 58% silt, and 20% clay) with 1.8% organic matter and 6.3 pH. When picloram at 0.5 lb ai/A was applied May 18, 1988 and combined with Surphtac at 2 qt/A, Sprayfuse 90 at 1 qt/A and Sulfac DG at 2 lbs/A and then evaluated June 8, 1989, significantly higher leafy spurge control occurred compared to picloram at 0.5 lb ai/A alone. When picloram at 0.5 lb ai/A was applied July 6, 1988, and combined with Aacess Penetrator at 1 qt/A and Sulfac DG at 2.0 lbs/A and then evaluated June 8, 1989, significant increases in leafy spurge control occurred compared to picloram at 0.5 lb ai/A used alone. No control differences were found on August 9, 1989 (Table 1). Neither the addition of surfactant nor the time of application had any effect on leafy spurge control when fluroxypyr was applied at 0.25 lb ai/A (Table 2). (Department of Plant, Soil and Insect Sciences, University of Wyoming, Laramie, WY 82071.)

Table 1. Comparison of various adjuvants combined with picloram at 0.5 lb ai/A for control of leafy spurge.

		% Control			
		Treated 6/88 Evaluated[2]		Treated 8/88 Evaluated	
Adjuvant[1]	Appl. Rate/Acre	6/89	8/89	6/89	8/89
X-77	0.5%	26	27	20	14
Surphtac	2 qt	33	26	19	6
Sprayfuse 90	1 qt	36	23	29	6
Activator 90	1 qt	18	4	11	3
Aacess Penetrator	1 qt	29	16	38	5
Sulfac DG	2 lb	31	19	30	11
Amway APSA-80	5 oz	13	1	9	1
Crop Oil Concentrate	2 qt	25	8	21	8
LI-700	2 qt	13	11	8	9
Am. Sulfate	4 lb	5	13	14	11
Picloram	0.5 lb	9	20	16	14
AquaMate II	2.8 oz	----	----	16	25
Check	-------	0	0	0	0
(LSD 0.05)		20.2	16.8	13.5	13.6

[1]Treatments were applied May 18 and July 6, 1988.
[2]Evaluations were made June 8 and Aug 9, 1989.

Table 2. Comparisons of various adjuvants combined with fluroxypyr at 0.25 lb ai/A for control of leafy spurge.

		% Control			
		Treated 6/88 Evaluated[2]		Treated 8/88 Evaluated	
Adjuvant[1]	Appl. Rate/Acre	6/89	8/89	6/89	8/89
X-77	0.25%	1	0	1	4
Surphtac	2 qt	0	19	1	18
Sprayfuse 90	1 qt	4	16	1	15
Activator 90	1 qt	0	8	1	9
Aacess Penetrator	1 qt	1	8	0	5
Sulfac DG	2 lb	8	14	1	9
Amway APSA-80	5 oz	0	9	0	9
Crop Oil Concentrate	2 qt	0	5	0	5
LI-700	2 qt	1	13	0	10
Am. Sulfate	4 lb	0	11	0	10
Fluroxypyr	0.25 lb	0	6	0	10
AquaMate II	2.8 oz	----	----	1	19
Check	--------	0	0	0	0
(LSD 0.05)		20.2	16.8	13.5	13.6

[1]Treatments were applied May 18 and July 6, 1988.
[2]Evaluations were made June 8 and Aug 9, 1989.

Evaluation of soil conservation plant materials for herbicide tolerance and revegetating semi-arid land infested with yellow starthistle. Northam, F. E. and R. H Callihan. Sixteen grass and three forb cultivars were planted in a hot, dry, well-drained site adjacent to the Snake River near Lewiston, Idaho. Species used to revegetate yellow starthistle infested land must be able to survive the typical summer drought in this region.

Site preparation began in February 1986 by tilling with a chisel plow in two directions to break up a dense downy brome (Bromus tectorum L. BROTE) sod and to kill fall germinated Scotch thistle (Onopordum acanthium L. ONRAC). The site was disked twice and packed prior to planting on 19 February 1987.

The cultivars and seeding rates in pure live seed per square foot (pls) were as follows: Alkar tall wheatgrass (40 pls), Appar Lewis flax (80 pls), Bandera Rocky Mountain penstemon (80 pls), Delar small burnet (40 pls), Durar hard fescue (120 pls), Ephraim crested wheatgrass (80 pls), Luna pubescent wheatgrass (40 pls), Magnar basin wildrye (40 pls), Nezpar Indian ricegrass (40 pls), Nordan crested wheatgrass (40 pls), Oahe intermediate wheatgrass (40 pls), Paiute orchardgrass (80 pls), P-27 Siberian wheatgrass (40 pls), Rosana western wheatgrass (40 pls), Rush wheatgrass (40 pls), Secar bluebunch wheatgrass (40 pls), Sherman big bluegrass (120 pls), Tualatin tall oatgrass (40 pls) and T2950 bluebunch wheatgrass (40 pls). The cultivar plots were drilled strips 1.4 x 30.5 m and were replicated four times in a randomized complete block experimental design.

Herbicide treatments were applied on 6 April 1987 at 90° angles to the cultivar strips. A single herbicide strip extended across all cultivar strips within a replication. The herbicide strips were 3.0 x 27.4 m resulting in experimental units 1.4 x 3.0 m. The herbicide treatments were replicated four times in a randomized complete block design. Since the cultivar strips and herbicide strips were randomized independently, the cultivar and herbicide effects were analyzed as a split (strip) block experimental design. The herbicide treatments included: atrazine at 1.12 kg ai/ha, chlorsulfuron at 0.014 kg ai/ha, clopyralid at 1.12 kg ai/ha, ethiozine at 1.78 kg ai/ha, picloram at 0.42 kg ai/ha, propham at 2.9 kg ai/ha, sulfometuron at 0.056 kg ai/ha and an unsprayed control.

Densities for each cultivar and chemical combination were sampled in June 1987 and 1988 (Table 1). A rectangular 0.74 m^2 (8 ft^2) quadrat was placed in the center of each plot and the number of plants recorded. Due to the skewed distribution of the data, each count was transformed to its natural logarithm value (1.0001 was added to all zero values prior to log transformation) for the analysis of variance (Table 1).

Cultivar densities decreased substantially between 1987 and 1988 (Table 1). The overall mean density for all cultivars and treatments was 47.9 plants/m^2 in June 1987, but by June 1988 this had decreased to 5.1 plants/m^2. Cultivars averaging less than 5.0 plants/m^2 by 1988 were considered poorly adapted to the site. These included: Paiute orchardgrass, Tualatin tall oatgrass, Magnar basin wildrye, Appar Lewis flax, T2950 bluebunch wheatgrass, Delar small burnet, Rosana western wheatgrass, Secar bluebunch wheatgrass, Sherman big bluegrass, Durar hard fescue and Bandera Rocky Mountain penstemon. Two or three of the remaining cultivars are expected to be added to this list after analysis of the 1989 growing season data.

Since Nordan crested wheatgrass is a widely planted species in western United States rangelands, it was chosen as a standard for comparing cultivar performance. By 1988 five cultivars had significantly higher mean densities than Nordan's 5.1 plants/m^2. These were Alkar tall wheatgrass (15.9 plants/m^2), Luna pubescent wheatgrass (11.4 plants/m^2), Oahe intermediate wheatgrass (11.0 plants/m^2), P-27 Siberian wheatgrass (9.5 plants/m^2), and Rush wheatgrass (9.2 plants/m^2). Densities of Alkar, Oahe and Luna were also significantly higher than densities of Rush and P-27. After two growing seasons tall wheatgrass, pubescent wheatgrass and intermediate wheatgrass were able to sustain populations with slightly more than 10.8 plants/m^2 in these semi-arid conditions in spite of strong competition from downy brome and Scotch thistle.

Table 2 compares the grass densities among chemical treatments. The average 1987 density in controls (65.7 plants/m^2) was significantly higher than in the plots of picloram (54.6 plants/m^2), chlorsulfuron (46.9 plants/m^2), ethiozine (37.7 plants/m^2), atrazine (37.4 plants/m^2), and sulfometuron (35.5 plants/m^2). Grass densities in propham and clopyralid plots in 1987 (70.4 and 65.7 plants/m^2, respectively) were not significantly different from those in the control plots. With the exception of propham and clopyralid, the herbicide treatments reduced the densities of all the cultivars two months after herbicide application.

Fourteen months after herbicide application the cultivar densities in the control plots (5.4 plants/m^2) were significantly less than the densities in the clopyralid (10.1 plants/m^2) and picloram (9.7 plants/m^2) plots(Table 2). Lower cultivar mortality (due to aridity and weed competition) in the clopyralid and picloram plots was probably due to the moisture that became available because these herbicides eliminated Scotch thistle during the 1987 and 1988 growing seasons. Even though the cultivar densities in the 1987 control plots were greater than in picloram and clopyralid plots, these two herbicide treatments provided better conditions for long-term stand survival. None of the densities in the other herbicide treatments were significantly different from densities in control plots during 1988 (Table 2), except that the chlorsulfuron plots had 33% higher densities than the control (8.1 vs 5.4 plants/m^2). The average in the chlorsulfuron plots was elevated by high densities in the tall, intermediate, pubescent and Siberian wheatgrass strips.

At this point, it is clear that broadleaf weed control by picloram and clopyralid enhanced the survival of tall, intermediate, rush, and pubescent wheatgrass for at least two growing seasons. (Univ. of Idaho Agriculture Experiment Station, Moscow, ID).

Table 1. Overall densities for all treatments of soil conservation cultivars at four and 16 months after planting

Cultivar	Density: LOGn data 1987		LOGn data 1988		Non-transformed data 1987	Non-transformed data 1988
	--(LOGn no./m^2)--				-----(no./m^2)-----	
Paiute orchardgrass	4.58	X*	0.88		133.3	4.1
Alkar tall whtgr.	4.54	X	2.43	X*	122.3	15.9
Oahe intermediate whtgr.	4.40	X	2.08	X	104.4	11.0
Rush whtgr.	4.02	X	1.75	X	75.3	9.2
Luna pubescent whtgr.	3.97	X	2.05	X	73.5	11.4
Nezpar Indian ricegrass	3.40	X	1.17		43.7	5.4
P-27 Siberian whtgr.	3.22	X	1.76	X	37.7	9.5
Ephraim crested whtgr.	3.22	X	1.50		41.6	7.0
Tualitin tall oatgrass	2.99	X	--**		35.9	1.4
Magnar basin wildrye	2.98	X	0.49		36.0	2.5
Appar Lewis flax	2.95	X	--**		47.9	<0.1
T2950 bluebunch whtgr.	2.71		0.47		35.1	2.5
Delar small burnet	2.51		--**		38.5	0.2
Rosana western whtgr.	2.37		0.90		21.1	4.0
Secar bluebunch whtgr.	2.34		0.69		19.6	2.7
Nordan crested whtgr.	2.02		0.95		19.0	5.1
Sherman big bluegrass	1.87		0.44		16.3	2.1
Durar hard fescue	1.55		--**		8.5	1.7
Bandera Rocky Mountain penstemon	--**		--**		1.4	0.2
Minimum signif. diff.	0.83		0.64		--	--

*X densities significantly different from the Nordan density (Tukey's Studentized Range, P<0.05).
** Data not included in the analysis of variance.

Table 2. Overall mean plant densities (for all cultivars) in the herbicide treatments of a screening trial for soil conservation cultivars

	Density					
	LOGn data				Non-transformed data	
Cultivar	1987		1988		1987	1988
	--LOGn (no./m^2)--				----(no./m^2)----	
Propham 2.9 kg ai/ha	3.76		1.19		70.4	6.2
CONTROL	3.70		1.05		65.7	5.4
Clopyralid 1.12 kg ai/ha	3.29		1.84	X*	56.2	10.1
Picloram 0.42 kg ai/ha	3.09	X*	1.74	X	54.6	9.7
Chlorsulfuron 0.014 kg ai/ha	2.79	X	1.41		46.9	8.1
Ethiozine 1.78 kg ai/ha	2.76	X	1.17		37.7	6.0
Atrazine 1.12 kg ai/ha	2.68	X	0.73		37.4	3.3
Sulfometuron 0.056 kg ai/ha	2.64	X	0.91		35.5	3.9
Minim. signf. diff.	0.48		0.44		--	--

* X denotes densities in herbicide plots were significantly different from control plot densities (Tukey's Studentized Range, $P<0.05$).

<u>Grass adaptation to semi-arid, yellow starthistle infested canyonland</u>. Northam, F.E., and R.H. Callihan. The establishment, survival and production of fourteen grass species were evaluated on canyonland near Culdesac, Idaho (Nez Perce Co.). During late October 1985 the plot area was disked 15 cm (6 in.) deep to bury a dense layer of yellow starthistle (<u>Centaurea</u> <u>solstitialis</u> L. CENSO) litter and to kill winter annual seedlings. The grasses were drilled into 1 x 2.1 m plots. A six-row plot drill with 17.8 cm row spacings was used to seed the grasses on 30 October 1985. Four replications were seeded for each grass treatment in a randomized completed block experimental design.

The grasses evaluated were buffalograss, Covar sheep fescue, Durar hard fescue, little bluestem, Luna pubescent wheatgrass, Manchar smooth brome, Nordan crested wheatgrass, Oahe intermediate wheatgrass, Paiute orchardgrass, Reubens Canada bluegrass, Sherman big bluegrass, and sideoats grama. Densities of the grasses were sampled by counting four rectangular 0.74 m^2 quadrats for each grass in June 1986, in July 1987, 1988, and 1989. Initial grass density estimates were made in June 1986 (eight months after seeding). The following grass stands failed during the first season: little bluestem, Reubens Canada bluegrass, Sherman big bluegrass, and sideoats grama.

Eight months after seeding, the densities of established grasses ranged from 34 plants/m^2 (sheep fescue) to 5 plants/m^2 (orchardgrass) (Table 1). Hard fescue was second with 22.5 plants/m^2 and crested wheatgrass was third with 18.5 plants/m^2. All others had less than 15 plants/m^2. The following grasses had stands of less than 0.7 plants/m^2 during the first spring and no plants by the second year: little bluestem, Canada bluegrass, big bluegrass, and sideoats grama. Buffalograss had fair initial emergence but by the time the plots were sampled, no plants were present. These five grasses were dropped from the evaluation during the first season.

Stands of smooth brome, Siberian wheatgrass, and orchardgrass declined to < 0.4 plants/m^2 by 21 months. These were dropped from subsequent sampling efforts (Table 1). Densities in established grass stands were lower at 21 months than at eight months. The range was 18.8 plants/m^2 (sheep fescue) to 1.3 plants/m^2 (tall oatgrass). Intermediate wheatgrass had 12.4 plants/m^2 and crested wheatgrass had 10.4 plants/m^2. Hard fescue dropped from 22.5 to 3.4 plants/m^2.

Thirty three months after seeding intermediate wheatgrass had the highest density with 14.5 plants/m^2 while pubescent wheatgrass increased to second with 14.1 plants/m^2. These two grasses showed a slight density increase over their eight-month stands. Sheep fescue declined to third highest with 12.4 plants/m^2. Hard fescue, crested wheatgrass and tall oatgrass populations continued to decline, with tall oatgrass averaging less than 0.4 plants/m^2. Tall oatgrass was also dropped from further evaluation.

Table 1. Densities of grasses seeded on semi-arid, yellow starthistle infested canyonland

Grass	Months After Seeding[1]							
	8		21		33		45	
Covar sheep fescue	34.3	a	18.8	a	12.4	ab	9.1	bc
Durar hard fescue	22.5	ab	3.4	bc	2.0	c	2.0	c
Nordan crested wheatgrass	18.5	bc	10.4	abc	7.7	bc	5.4	c
Oahe intermediate wheatgrass	13.8	bcd	12.4	ab	14.5	a	17.2	ab
tall oatgrass	11.1	bcd	1.3	c	0.3	....	....	
Luna pubescent wheatgrass	9.8	cd	9.1	bc	13.1	ab	17.5	a
Manchar smooth brome	6.7	cd	0.3	....	DROPPED FROM EVAL.			
P-27 Siberian wheatgrass	6.4	cd	0.0	....	DROPPED FROM EVAL.			
Paiute orchardgrass	5.3	d	0.0	....	DROPPED FROM EVAL.			
buffalograss	0.0	....	DROPPED FROM EVAL.					
LSD ($P < 0.05$)	12.4		9.7		6.4		8.2	

[1] These estimates are the means of four replicates using a 0.74 m^2 (8 sqft) rectangular quadrat.

.... Data not included in the analysis of variance.

Forty-five months after seeding, a distinct division between the grasses became evident. Intermediate and pubescent wheatgrass densities continued to increase, averaging more than 17 plants/m^2 while all others had less than 9.5 plants/m^2. Densities of crested wheatgrass, sheep and hard fescue continued to decline (Table 1).

All current-season, above-ground plant biomass production was estimated by hand clipping four rectangular 0.37 m^2 quadrats from the unseeded control, tall oatgrass, intermediate, crested and pubescent wheatgrass plots in July 1987. The same plots were harvested in July 1988 with the exception of the tall oatgrass plots. The samples were dried for 24 hours at 120 F before weighing. The dry biomass was separated into three components before weighing, including: yellow starthistle, annual grass and seeded grass. Total biomass was estimated by summing the three vegetation components for each plot. Even though this site has many ephemeral, early spring, annual broadleaf species, most forb biomass had disappeared by the time the plots were harvested. Consequently, forbs composed <1.0% of the total biomass and were not included in the biomass weights.

The sheep fescue had good stand counts, but its production was extremely low at 21 months. Sheep fescue plants averaged only 51 mm (2 in.) tall with a basal diameter of 13 mm (0.5 in.) in 1987. Sheep fescue plants at 45 months averaged 25 cm (10 in.) tall with a basal diameter of 3.8 cm (1.5 in.). The wheatgrasses were 50-100 cm tall with basal diameters of 20-30 cm (8-12 in.) at 45 months. Since sheep fescue had low biomass production, it was not harvested.

The forage estimates for the three wheatgrasses ranged from 11 to 42 g/m^2 at 21 months (not significantly different; Table 2). But at 33 months intermediate and pubescent wheatgrass biomass estimates were three to four times greater than crested wheatgrass (145, 122, and 32 g/m respectively; Table 2).

Yellow starthistle biomass at 21 months was five to fourteen times greater than biomass of any of the wheatgrasses (Table 2). By 33 months this ratio had declined. Yellow starthistle biomass in the crested wheatgrass plots was 14 times greater than the grass at 21 months but was only 7.5 times greater at 33 months. Pubescent wheatgrass plots had five times more starthistle than grass at 21 months but at 33 months starthistle biomass was 1.8 times greater than the grass. Yellow starthistle biomass in intermediate wheatgrass plots was eight times greater than grass biomass at 21 months, but at 33 months intermediate wheatgrass biomass was 1.5 times greater than yellow starthistle. (Table 2).

Only intermediate, pubescent and crested wheatgrass were able to establish stands in yellow starthistle infested grazing land that was treated only with fall tillage. Also, the three grasses did not begin to suppress yellow starthistle production until the third growing season. This indicates that some chemical control is needed to hold yellow starthistle in check while seeded grass stands mature. The grass density and biomass data indicated Oahe intermediate and Luna pubescent wheatgrass are better adapted to surviving interference from starthistle and suppressing yellow starthistle populations than any other grass tested at this site. (Univ. of Idaho Agricultural Experiment Station, Moscow, Id.)

Table 2. Biomass of seeded grasses, yellow starthistle and total plant biomass from semi-arid, yellow starthistle infested canyonland at 21 and 33 months after seeding

	Seeded Grass Biomass*		Yellow Starthistle Biomass		Total Plant Biomass	
	21 months	33 months	21 months	33 months	21 months	33 months
	(grams/meter)					
Control (not seeded)	--	--	222.5	242.4	287.6	386.5
Luna pubescent wheatgrass	41.9	122.0 a	212.9	229.4	326.1	375.8
Oahe intermediate wheatgrass	22.7	144.6 a	183.1	97.4	251.1	314.3
Nordan crested wheatgrass	11.1	31.8 b	163.8	240.2	219.6	426.2
tall oatgrass	0.8...	0.0...	242.7	--	314.7...	--
LSD (P<0.05)	NS	49.4	NS	NS	NS	NS

* Weight estimates are the means of four replications of oven-dried samples clipped from 0.37 meter rectangular quadrats.

... Data not included in the analysis of variance.

The effects of pyridine herbicides in combination with atrazine for grass establishment in yellow starthistle habitat. Callihan R.H., L.W. Lass, and F.E. Northam. Yellow starthistle (*Centraurea solstialis* L.) is becoming a dominant species along the Snake River drainage in the Pacific Northwest. Yellow starthistle easily invades range sites and co-habitates with annual weedy grasses like downy brome and mesudahead. Controlling yellow starthistle with herbicides often releases undesirable annual grasses that are poor forages. The aggressive reinvasion by yellow starthistle in annual grass sites has prevented the effective range rehabilitation with a single herbicide. Competitive grasses must be established to reduce the frequency of herbicide applications and prevent reinvasion by the weeds. The purpose of this study is to verify the tolerance of selected grasses to a herbicide for controlling annual grasses that are released when yellow starthistle is suppressed with hormone herbicides.

The grasses used in the study were:

Bluegrass, Canby, (*Poa secunda* Presl.)
Fescue, sheep, (*Festuca ovina* L. cv. Covar) (L).
Fescue, hard, (*Festuca ovina* (L.) Koch var *duriuscula* cv. Durar)
Oatgrass, tall, (*Arrhenatherum elatius* (L.) Presl. cv. Tualatin)
Wheatgrass, tall, (*Thinopyrum ponticum* (Podp.) Barkw. and D.R. Dewey (*Agropyron elongatum*) cv. Alkar)
Wheatgrass, crested, (*Agropyron cristatum* (L.) Gaertner cv. Ephraim)
Wheatgrass, crested, (*Agropyron cristatum* Gaerthn. cv. Hycrest)
Wheatgrass pubescent, (*Thinopyrum intermedium* spp *barbulatum* (Schu) Barkw. cv. Luna (*Agropyron tricophorum*))
Wheatgrass, crested (*Agropyron desertorum* (Fisher ex link) Shultes cv. Nordan)
Wheatgrass, intermediate, (*Thinopyrum intermedium* spp *intermedium* (Host) Bark. and D.R. Dewey (*Agropyron intermedium*) cv. Oahe)
Wheatgrass bluebunch, (*Pseudorogneria spicata* (Nevski) A. Love (*Agropyron spicatum*) cv. Secar)
Wheatgrass, Siberian, (*Agropyron fragile* (Roth) Candargy (*A. sibiricum*) cv. P-27)
Wheatgrass, streambank (*Elymus lanceolatus* (Scribner & J.G. Smith) Gould (*Agropyron riparium*) cv. Sodar).

The grasses were planted in randomized strips measuring 12 by 150 ft in four replications. The herbicide main effects in the strip block split-strip plot design consisted of single applications of clopyralid (2 oz ai/a), picloram (1 lb ai/a) and an untreated check. The four herbicide sub-plot treatments were single applications of atrazine (0.5, 1.0, and 1.5 lb ai/a) and a check.

The experiment was established near Lapwai, Id. on a Linville-Waha silt loam. The field was in wheat production in 1988 and was placed in the U.S.D.A Conservation Reserve Program. The soil pH was 5.89 and organic matter was 2.92%. The field slope was 20 to 35%, facing SE. The field was plowed, harrowed, and rodweeded prior to planting. The grasses were planted at a depth of 1 inch on May 12 to 15 using a drill seeder with 7 inch spacing and packer wheels . Prior to grass emergence, 0.5 lb ai /a glyphosate was applied on May 20, for control of emerged weeds. Herbicides were applied on June 21, using a tractor sprayer with a 25 ft boom. The herbicides were applied without a surfactant. The sprayer delivered 31 gal/a water and travelled 1.13 mph. The air temperature was 71 F and the sky was clear; the wind was 0 to 3 mph. Soil temperatures were 104 F at surface, 68 F at a depth of 2 inches, and 64 F at 6 inches. The relative humidity was 50% and no dew was present.

Yellow starthistle and grass stands were estimated by counting the number of plants in two 0.74 m^2 (8 sq ft) rectangular quadrants in each plot in mid-July. Visual estimate of chlorophyll loss was made on July 12.

The average number of yellow starthistle in the untreated check was 7.5 plants per 0.74 m^2 (Table 1). The number of living yellow starthistle plants in the clopyralid-and picloram- treated areas were fewer than one per 0.74 m^2. The addition of atrazine at 1.5 lb ai/a decreased living yellow starthistle plants by more than 75%.

Canby bluegrass failed to establish (Table 2). Excessive planting depth and poor surface moisture may have prevented germination and establishment.

Since the grasses were sprayed in the 2 to 3 leaf stage, some germination of new grass plants was possible after application of picloram and clopyralid. The numbers of grass plants in clopyralid and picloram treatments were not different from those in check. Atrazine at 0.5 and 1.0 lb ai/a did not reduce the number of grass plants. However, the number of grass plants in atrazine at 1.5 lb ai/a was reduced 68% in Hycrest crested wheatgrass, 58% in Luna pubescent wheatgrass treated with clopyralid and 54% in Luna pubescent wheatgrass treated with picloram (Table 2).

Atrazine increased chlorosis of some grass leaves (Table 3). In the check, atrazine above 0.5 lb ai/a increased leaf chlorosis more than 30% in Ephraim crested wheatgrass, Hycrest crested wheatgrass, Oahe intermediate wheatgrass and Siberian P27 wheatgrass. Leaf chlorosis in Durar hard fescue was increased by 50%, and Tualatin tall oatgrass increased by 31%, when treated with 1.5 lb ai/a atrazine.

In clopyralid plots, atrazine above 0.5 lb ai/a increased chlorosis of Hycrest crested wheatgrass by more than 25%, Oahe intermediate wheatgrass by more than 65% and P27 Siberian wheatgrass by more than 25% (Table 3). As the atrazine rate increased, injury symptoms increased in these grasses. Leaf chlorosis was increased in Covar sheep fescue by 67%, in Luna pubescent wheatgrass by 39%, in Nordan crested wheatgrass by 23% and in Sodar streambank wheatgrass by 43%, when treated with atrazine at 1 lb ai/a and clopyralid. Tualatin tall oatgrass expressed 35% chlorosis when treated with the 1.5 lb ai/a rate of atrazine and clopyralid.

Atrazine at all rates increased chlorosis in Ephraim crested wheatgrass by more than 30%, Hycrest crested wheatgrass by more than 23% and Siberian P-27 wheatgrass by more than 28% in picloram plots (Table 3). Chlorosis first appeared significantly in Durar hard fescue 36%, Tualatin tall oatgrass 33%, Luna pubescent wheat grass 39%, Nordan crested wheatgrass 30%, Oahe intermediate wheatgrass 58%, Secar bunch wheatgrass 93% and Sodar streambank wheatgrass 43% in plots treated with picloram and 1 lb ai/a atrazine. All grasses except Paiute orchardgrass showed more than 48% chlorosis when treated with the highest rate of atrazine (1.5 lb ai/a) in the picloram plots.

Atrazine injury was detected in 12 of 13 established grasses in the picloram main plots, in 10 of 13 established grasses in the clopyralid plots, and in 7 of 13 established grasses, where no pyridine was applied. Atrazine did not appear to interact with pyridine herbicides to the detriment of the grasses, and additive effects were not appearant. One lb ai/a atrazine added to pyridine control of yellow starthistle, an effect of substantial importance. A 1990 spring evaluation of weed competition and grass is necessary since the high chlorosis levels of the summer may indicate low final seedling survival. (Univ. of Idaho, Dept. of P.S. &E.S., Moscow, 83843)

Table 1. Effects of pyridine herbicides in combination with atrazine on yellow starthistle density.

Herbicide		Canby Blue-grass	Covar Sheep Fescue	Durar Hard Fescue	Tual. Tall Oatg.	Paiu. Orch. Grass	Alkar Tall Whtgr.	Ephr. Inter. Whtgr.	Hycr. Crest. Whtgr.	Luna Pub. Whtgr.	Nord. Crest. Whtgr.	Oahe Int. Whtgr.	Secar Blueb. Whtgr.	P-27 Sib. Whtgr.	Sodar Stream. Whtgr.
(lb ai/A)		--------	--------	--------	--------	--------	--------	(Plants per 0.74 m2)	--------	--------	--------	--------	--------	--------	--------
check +															
atrazine	0	11 A	5 A	8 A	5 A	5 A	6 A	4 BA	6 B	8 A	7 BA	7 A	10 A	9 A	8 B
atrazine	0.5	13 A	2 B	8 A	7 A	3 BAC	4 BA	5 A	8 A	4 BC	13 A	5 A	8 A	11 A	15 A
atrazine	1	7 BA	2 B	4 A	2 B	4 BA	1 BC	3 BAC	1 C	6 BA	6 B	1 B	4 B	11 A	8 B
atrazine	1.5	1 B	1 B	1 A	1 B	0 C	2 BC	1 BC	1 C	2 DC	1 B	1 B	2 B	1 B	3 C
clopyralid 0.12 +															
atrazine	0	0 B	0 B	0 A	1 B	1 BC	0 C	0 C	0 C	0 D	0 B	0 B	1 B	0 B	0 C
atrazine	0.5	1 B	0 B	0 A	0 B	1 BC	0 C	0 C	0 C	0 D	0 B	0 B	0 B	0 B	0 C
atrazine	1	1 B	0 B	0 A	0 B	0 C	0 C	0 C	0 C	0 D	0 B	0 B	0 B	0 B	0 C
atrazine	1.5	0 B	0 B	0 A	0 B	0 C	0 C	0 C	0 C	0 D	0 B	0 B	0 B	0 B	0 C
picloram 1.0 +															
atrazine	0	0 B	0 B	10 A	0 B	0 C	0 C	0 C	0 C	0 D	0 B	0 B	0 B	0 B	0 C
atrazine	0.5	0 B	0 B	0 A	0 B	0 C	0 C	0 C	0 C	0 D	0 B	0 B	0 B	0 B	0 C
atrazine	1	0 B	0 B	0 A	0 B	0 C	0 C	0 C	0 C	0 D	0 B	0 B	0 B	0 B	0 C
atrazine	1.5	0 B	0 B	0 A	0 B	0 C	0 C	0 C	0 C	0 D	0 B	0 B	0 B	0 B	0 C

1. Means having a same letter within a column are not significantly different at the 5 % level.

Table 2. Effects of pyridine herbicides in combination with atrazine density of seedling grasses.

Herbicide		Canby Blue-grass	Covar Sheep Fescue	Durar Hard Fescue	Tual. Tall Oatg.	Paiu. Orch. Grass	Alkar Tall Whtgr.	Ephr. Inter. Whtgr.	Hycr. Crest. Whtgr.	Luna Pub. Whtgr.	Nord. Crest. Whtgr.	Oahe Int. Whtgr.	Secar Blueb. Whtgr.	P-27 Sib. Whtgr.	Sodar Stream. Whtgr.
(lb ai/A)		--------	--------	--------	--------	--------	--------	(Plants per 0.74 m2)	--------	--------	--------	--------	--------	--------	--------
check +															
atrazine	0	0 B	21 BA	37 A	82 B A	79 A	65 DC	103 A	203 BAC	73 B A	49 A	114 BA	28 BA	77 A	68 BA
atrazine	0.5	0 B	30 BA	63 A	71 B C	120 A	78 BDAC	102 A	223 BA	78 B A	57 A	130 A	34 A	76 BA	42 B
atrazine	1	0 B	11 B	27 A	86 B A	117 A	62 D	99 A	208 BA	73 B A	52 A	114 BA	26 BA	63 BA	48 B
atrazine	1.5	0 B	27 BA	42 A	97 B A	111 A	75 BDAC	90 A	170 BDAC	70 B A	39 A	83 B	15 BA	49 BA	44 B
clopyralid 0.12 +															
atrazine	0	0 B	33 BA	31 A	119 A	113 A	86 BAC	98 A	240 A	71 BA	62 A	124 BA	30 BA	64 BA	83 BA
atrazine	0.5	0 B	3 B	56 A	101 B A	111 A	94 A	91 A	198 BAC	53 BC	51 A	136 A	29 BA	71 BA	56 BA
atrazine	1	0 B	36 BA	46 A	112 B A	130 A	68 BDC	69 A	202 BAC	61 BC	49 A	130 A	16 BA	72 BA	90 A
atrazine	1.5	0 B	14 BA	35 A	74 B C	99 A	83 BDAC	62 A	163 BDC	41 C	46 A	96 BA	8 B	49 BA	55 BA
picloram 1.0 +															
atrazine	0	1 A	35 BA	55 A	90 BAC	116 A	81 BDAC	92 A	174 BDAC	98 A	66 A	122 BA	34 A	72 BA	49 B
atrazine	0.5	0 B	55 A	57 A	87 BAC	114 A	80 BDAC	91 A	170 BDAC	74 BA	67 A	131 A	31 B A	77 A	68 BA
atrazine	1	0 B	20 BA	40 A	73 BC	99 A	85 BAC	101 A	132 DC	71 BA	40 A	100 BA	19 B A	57 BA	48 B
atrazine	1.5	0 B	17 BA	31 A	59 C	103 A	88 BA	74 A	120 D	53 BC	52 A	97 BA	29 B A	44 B	50 BA

1. Means having a same letter within a column are not significantly different at the 5 % level.

Table 3. Effects of pyridine herbicides in combination with atrazine on chlorosis of seedling grasses.

Herbicide		Canby Blue-grass	Covar Sheep Fescue	Durar Hard Fescue	Tual. Tall Oatg.	Paiu. Orch. Grass	Alkar Tall Whtgr.	Ephr. Inter. Whtgr.	Hycr. Crest. Whtgr.	Luna Pub. Whtgr.	Nord. Crest Whtgr.	Oahe Int. Whtgr.	Secar Blueb. Whtgr.	P-27 Sib. Whtgr.	Sodar Stream. Whtgr.
	(lb ai/A)	--------	--------	--------	--------	--------	--------	(Chlorosis (%))	--------	--------	--------	--------	--------	--------	--------
check +															
atrazine	0	100 A	50 BA	0 D	0 D	0 A	0 D	0 F	0 D	25 E	0 C	0 D	25 C	0 E	0 C
atrazine	0.5	100 A	63 BA	23 BDC	5 D	2 A	3 DC	33 ED	33 BC	50 BDEC	16 BC	33 BC	35 C	30 D	14 BC
atrazine	1	100 A	93 A	63 A	20 BDC	3 A	5 BDC	68 BAC	60 A	65 BDAC	31 BA	65 A	84 BA	84 BA	39 BA
atrazine	1.5	100 A	86 A	53 BA	31 BAC	5 A	6 BDAC	80 A	66 A	88 A	47 A	73 A	95 A	88 A	63 A
clopyralid 0.12 +															
atrazine	0	100 A	50 BA	0 D	0 D	1 A	0 D	0 F	0 D	25 E	0 C	0 D	25 C	0 E	0 C
atrazine	0.5	100 A	80 A	17 DC	4 D	1 A	3 BDC	15 EF	25 C	46 DEC	12 BC	30 C	90 A	20 D	23 BC
atrazine	1	100 A	93 A	67 A	15 D C	4 A	9 BAC	48 DC	50 BA	64 BDAC	23 BAC	60 A	97 A	53 C	43 BA
atrazine	1.5	100 A	90 A	63 A	35 B A	5 A	8 BAC	75 BA	56 A	80 BA	45 A	78 A	95 A	85 B A	65 A
picloram 1.0 +															
atrazine	0	100 A	25 B	0 D	0 D	0 A	3 DC	0 F	0 D	26 E	0 C	0 D	45 BC	0 E	0 C
atrazine	0.5	100 A	50 BA	13 DC	7 D	0 A	7 BDAC	30 ED	23 DC	34 DE	9 BC	19 DC	66 BAC	28 D	19 BC
atrazine	1	100 A	73 BA	36 BAC	33 B A	3 A	9 BA	53 BDC	72 A	65 BDAC	30 BA	58 BA	93 A	68 BC	43 BA
atrazine	1.5	100 A	88 A	59 A	45 A	3 A	12 A	65 BAC	71 A	78 BAC	48 A	64 A	88 BA	74 BA	69 A

1. Means having a same letter within a column are not significantly different at the 5 % level.

<u>Yellow starthistle population dynamics in perennial and annual communities</u> Prather, T.S. and R.H. Callihan. Two permanent 1 m^2 plots were established 2 December 1987 at each of four sites to monitor populations of yellow starthistle (<u>Centaurea solstitialis</u> L.) in annual and perennial communities. Three sites were located at Juliaetta, Idaho and one site was located at Central Grade near Lewiston, Idaho. The perennial community at Juliaetta is dominated by pubescent wheatgrass (<u>Thinopyrum intermedium</u> ssp. <u>barbulatum</u> (Schur) Barkw. & D.R. Dewey) and at Central Grade, sheep fescue (<u>Festuca ovina</u> L.) dominates. The annual communities at both sites are dominated by yellow starthistle. Seedlings of yellow starthistle were counted 15 April 1988 and 19 May 1989. Mature yellow starthistle plants were counted 6 December 1988 and 17 October 1989.

In 1988, densities of mature yellow starthistle plants in the perennial communities (6 plants/m^2 and 6 plants/m^2, Juliaetta and Central Grade sites, respectively) were dramatically less than in annual communities (508 plants/m^2 and 3325 plants/m^2, Juliaetta and Central Grade sites, respectively). In addition to large density differences, the percentage of yellow starthistle surviving to maturity was less in the perennial communities (10% and 8%) than in the annual communities (36% and 46%).

Spring yellow starthistle seedling densities were lower in 1989 than in 1988 (Table). All seedlings in the pubescent wheatgrass stands survived to produce seed. Intense grazing of the pubescent wheatgrass stands may have been responsible for the higher yellow starthistle survival rate during the 1989 growing season. In contrast, no yellow starthistle seedlings in the sheep fescue stand survived to produce seed, and there was no grazing at this site. Yellow starthistle survival in the annual communities was also lower in 1989 than 1988, with 10% and 14% surviving to produce seed in 1989, versus 46% and 36% in 1988. Precipitation was high in 1989 so some yellow starthistle plants continuing to flower through summer and fall. With high precipitation, <u>Vicia villosa</u> Roth. produced abundantly in the annual communities, shading yellow starthistle and probably contributed to reduction in 1989 yellow starthistle survival.

Yellow starthistle populations fluctuated more in the annual communities than in the perennial communities. This yearly fluctuation is characteristic of highly disturbed areas. Introducing perennial vegetation seems to reduce yellow starthistle populations as well as dampen the wide population fluctuations found in annual communities. (Idaho Agricultural Experiment Station, Moscow, Idaho 83843).

Table. Yearly changes in survival of yellow starthistle in annual and perennial communities

Growth Stage	Annual Community		Perennial Community	
	Central Grade	Juliaetta	Central Grade (*F. ovina*)	Juliaetta (*T. intermedium*)
	(plants/m^2)			
1988				
Seedling	7175	1417	75	58
Mature	3325	508	6	6
Surviving	46%	36%	8%	10%
1989				
Seedling	1000	192	14	18
Mature	100	27	0	19
Surviving	10%	14%	0%	106%

Picloram resistance in yellow starthistle. Callihan, R. H., R. O. Schirman, and F. E. Northam. Apparent yellow starthistle (Centaurea solstitialis L. CENSO) resistance to picloram was observed in 1988 in a nonarable pasture that had been frequently treated with picloram during the preceding 10 years.

Seeds from surviving apparently tolerant plants from this pasture were germinated on blotters wet with 200 ppb picloram (in comparison with seeds from plants in a comparable field that had not been treated). Seedlings from the apparently resistant plants were significantly less inhibited by picloram (Table 2). When 15 cm soil cores containing yellow starthistle plants in the small rosette stage were removed from both fields to a common location, several tests showed that plants from the field where resistance was indicated tolerated at least four times more picloram than did the control, whether picloram was applied to the root zone soil only or sprayed over the top of the plants. Final survival data a month later indicated a substantial difference between populations; i.e. no plants from the susceptible population survived shoot applications of 57 to 227 g/ha picloram, whereas many plants from the tolerant population survived (Table 3).

These results verify that resistance is present in an undetermined proportion of the yellow starthistle population in the field where it was first observed. This is the first well-documented evidence of field resistance to picloram. Resistance to other auxin herbicides (Phenoxyalkanoics) in Canada thistle, wild carrot and goatweed has been reported. No information was found on degree of resistance, mechanisms of this resistance, or cross-resistance to pyridine herbicides.

Since yellow starthistle appears to have developed resistance to picloram, alternative management strategies should be investigated without delay. Such strategies must be based upon a sound understanding of the extent and biological nature of that resistance, to enable continued use of picloram where feasible, without further loss in effectiveness. Such strategies must consider use of other herbicides or practices to avoid selection for picloram resistance. The physiology, ecology, and management of picloram resistance in yellow starthistle are being examined to determine the status, biological nature, and solution to picloram resistance in yellow starthistle. Investigations planned for FY 1990-4 will evaluate degree, frequency of occurrence, inheritance, biochemical basis, ecological significance, cross-resistance patterns , multiple resistance tests and management strategies. (University of Idaho Agriculture Experiment Station, Moscow, 83843).

Table 1. Germination[1] response of seeds from suspected resistant (R) and known susceptible (S) yellow starthistle populations to picloram in the germination media, Experiment 1

Population	Picloram concentration (ppb) 0	20	200
	-----------	(%)[1]	-----------
(R)	82	77	63
(S)	61	61	21
$S \times R^{-1}$	.74	.79	.33*

[1] Expanded cotyledons. * S < R: P = .0001

Table 2. Germination [1] of seeds from suspected picloram-resistant (R) and known susceptible (S) yellow starthistle populations to picloram in the germination media, Experiment 2

Population	Picloram concentration (ppb) 0	100	200
	-----------	(%)[1]	-----------
(R)	90	45	25
(S)	65	7	5
S x R -1	0.72	0.16*	0.20*

[1] Expanded cotyledons. * S < R: P = .0001

Table 3. Final weed control results: Phenological response of picloram R and S yellow starthistle in pots to postemegrence over-top treatment with picloram solution (Dayton plot study), Experiment 3

Populations	Picloram (g/ha) 0	28	57	114	227
	-----------		(score[1])		----------
R	10	9	10	9	4
S	10	2	0	0	0

[1] 10 = plants bolting; 5 = foliage alive but not bolting; 0 = all plants dead.
Data are averages of 4 replicates. Evaluated 6/28/89.

Common tansy control in a non-crop site. Lass, L.W. and R.H. Callihan. The effects of four herbicides were evaluated on established common tansy (Tanacetum vulgare L.) in pasture. The treatments consisted of single applications of metsulfuron (0.5, 1.0, 2.0 oz ai/a and a check), DPX-L5300 (0.5, 1.0, 2.0 oz ai/a and a check), clopyralid (0.5, 1.0 lb ai/a and 1.0 + glyphosate at 0.5 lbs ai/a and a check), and picloram (0.5, 1.0, 2.0 lbs/a and a check). Chemicals were applied in 23 gal/a water to 10 by 20 ft, using a split plot design with four replications at Farragut State Park, Kootenai Co., Idaho on June 9, 1986. The air temperature was 59 F, soil surface temperature was 55 F, and the RH 42%. The sky was 80% cloudy; no dew was present. Visual estimates of tansy biomass were recorded July 17, 1986, October 22, 1986, April 28, 1987, August 8, 1987, July 15, 1988 and August 1, 1989.

Metsulfuron significantly reduced the total biomass (88 to 92%) of common tansy one month after application (Table). New seedling growth and growth from rhizomes were significantly reduced by all metsulfuron treatments (96 to 100%) by four months after application. Picloram (2 lb/a) and clopyralid (1 lb/a) reduced fall regrowth of seedlings and rhizomes.

By spring (10 months after application), common tansy biomass in the metsulfuron plots was reduced by 90 to 98%, and biomass in the picloram plots was reduced 72 to 100%. The 1987 spring growth was suppressed in the clopyralid plots, and where applied with glyphosate, the biomass was reduced 93%, but the effect did not continue through the summer. In the summer of 1987 (14 months after application), biomass continued to be significantly reduced (90 to 100%) by metsulfuron and by the 2.0 lb ai/a rate of picloram. Results of visual evaluations in the summer of 1988 (23 months after application) indicated that all all rates of metsulfuron and the high rate of picloram (2 lb ai/a) had consistantly reduced to show reduced total biomass (88 to 97%).

Results of the fourth year (1989) show subsiding metsulfuron effects, although more than 65% control of tansy continued (Table). Picloram at 2.0 lb ai/a provided 85% control.

Reduction of common tansy by metsulfuron in the first, second, third, and fourth years was significant and striking. It is assumed the metsulfuron application effectively controlled the common tansy crowns and rhizomes; however, with short soil residual activity, seedlings regenerated the infestation in the metsulfuron-treated area. Early-season application of either metsulfuron at 0.5 to 1.0 oz./a and 2.0 lb ai/a of picloram provided adequate fourth-season control. Lower rates of 0.5 and 1.0 lb ai/a picloram provided control the third season, but not the fourth. (University of Idaho, Dept of P.S.& E.S., Moscow 83843)

Common Tansy control in a non-crop site.

Herbicide	Rate	Summer 7/86	Fall 10/86	Spring 4/87	Summer 8/87	Summer 7/88	Summer 8/89
		Live common tansy biomass					
	(ai/a)	(% of Check)					
metsulfuron	0.0 oz	100 a	100 a	100 a	100 a	100 a	100 ba
	0.5 oz	12 d	4 b	10 cd	10 d	10 cd	29 d
	1.0 oz	6 d	0 b	2 d	0 d	3 d	18 d
	2.0 oz	6 d	0 b	1 d	2 d	12 d	35 bd
DPX-L5300	0.0 oz	100 a	100 a	100 a	100 a	100 a	100 a
	0.5 oz	70 b	18 b	72 ab	81 a	100 a	75 ba
	1.0 oz	65 b	9 b	97 a	100 a	100 a	100 a
	2.0 oz	55 bc	23 b	75 ab	82 a	100 a	100 a
clopyralid	0.0 lb	100 a	100 a	100 a	100 a	100 a	100 a
	0.5 lb	60 b	30 b	70 ab	100 a	100 a	100 a
	1.0 lb	57 b	7.5 b	42 bc	90 a	100 a	88 a
clopyralid+ glyphosate	1.0 lb + 0.5 lb	60 b	1 b	7 d	66 b	75 ab	100 a
picloram	0.0 lb	100 a	100 a	100 a	100 a	100 a	100 a
	0.5 lb	60 b	20 b	27 cd	87 a	67 b	68 ba
	1.0 lb	52 bc	12 b	5 d	45 c	32 c	85 a
	2.0 lb	40 c	0 b	0 d	0 d	5 d	15 d

[1]Biomass expressed as a percentage of control.
The fall evaluation of 1986 was new growth or regrowth from perennial rhizomes.
[2]Any two means having a common letter are not significantly different at the 5% level of significance using Protected Duncan's Test.

Musk thistle control with bentazon, picloram, clopyralid + 2,4-D, and 2,4-D at different timings on a Colorado pasture. Sebastian, J.S., K.G. Beck. A pasture experiment was established near Fort Collins, CO to evaluate musk thistle (CRUNU) control with bentazon, picloram, clopyralid + 2,4-D, and 2,4-D. The design was a randomized complete block with four replications. Rosette (May 4), bolting (May 25), bud (June 5), or fall (October 10) applications were sprayed for timing comparison. Bentazon treatments were sprayed with COC (1.25% v/v). All treatments were applied with a CO_2 pressurized backpack sprayer using 11003LP flat fan nozzles at 24 gal/a and 15 psi. Plot size was 10 by 20 feet. Other application data is presented in Table 1.

Visual evaluations for control were taken on June 25, July 26, and October 10, 1989 (fall applications were not evaluated). All picloram and picloram plus 2,4-D treatments provided good to excellent control whereas, bentazon provided poor control. Clopyralid plus 2,4-D (> 0.002 + 0.009 lb ai/a) provided fair control 30 and 60 DAT and good control approximately 90 DAT.

All treatments will be evaluated in 1990 for control longevity. (Weed Research Laboratory, Colorado State University, Fort Collins, CO 80523).

Table 1. Application information for musk thistle control with bentazon, picloram, clopyralid + 2,4-D, and 2,4-D on a Colorado pasture.

Environmental data

Application date	May 4	May 25	June 5	Oct 10
Application time	7:30 am	1:30 pm	10:30 am	10:30 am
Air temperature, C	10	17	26	26
Cloud cover, %	100	40	0	0
Relative humidity, %	55	46	70	43
Wind speed/direction, mph	0-4/NW	0-6/SE	0-3/N	0-2/W
Soil temperature (2 in), C	10	18	17	18

Weed data

Application date	Species	Growth stage	Diameter or height (inches)
May 4, 1989	(CRUNU)	rosette	1 to 7
May 25, 1989	(CRUNU)	bolt	5 to 24
June 5, 1989	(CRUNU)	bud	6 to 36
October 10, 1989	(CRUNU)	fall rosette	7 to 12

Table 2. Musk thistle control with betazon, picloram, clopyralid + 2,4-D, and 2,4-D at different timings on a Colorado pasture.

Treatment	Rate (lb ai/a)	Timing	Musk thistle control (% of check) June 25	July 26	October 10
picloram	0.13	rosette	89	100	98
picloram + 2,4-D	0.13 1.0	rosette	83	100	95
clopyralid + 2,4-D	0.002 0.009	rosette	29	19	0
clopyralid + 2,4-D	0.004 0.018	rosette	43	55	84
clopyralid + 2,4-D	0.008 0.036	rosette	63	68	78
picloram	0.13	bolt	76	90	100
picloram + 2,4-D	0.13 1.0	bolt	76	95	100
clopyralid + 2,4-D	0.008 0.036	bolt	48	53	78
clopyralid + 2,4-D	0.016 0.08	bolt	51	63	89
bentazon[1]	0.5	bolt	20	13	0
bentazon	0.75	bolt	9	5	0
bentazon	1.0	bolt	21	13	0
bentazon	0.5	bud	0	26	0
bentazon	0.75	bud	0	21	0
bentazon	1.0	bud	0	48	0
picloram	0.13	fall[2]	0	0	0
picloram	0.25	fall	0	0	0
picloram + 2,4-D	0.13 1.0	fall	0	0	0
LSD (0.05)			14	21	10

1 Crop oil concentrate added at 1.25% v/v.
2 Fall applications will not be evaluated until 1990.

Plumeless thistle control on Colorado rangeland. Sebastian, J.R., K.G. Beck, and D.E. Hanson. A rangeland experiment was established near Ruedi Reservoir, CO to evaluate plumeless thistle control with several herbicides. The design was a randomized complete block with four replications. All treatments were applied on June 15, 1988 with a CO_2 pressurized backpack sprayer using 11003LP flat fan nozzles at 24 gal/a, 15 psi. Other application information is provided in Table 1. Plot size was 10 by 30 feet.

Visual evaluations were taken on July 22, September 15, 1988, and September 13, 1989, approximately 1, 3, and 15 months after treatment application, respectively. Picloram, dicamba, and clopyralid treatments applied alone and all tank mixes with dicamba, except dicamba plus chorsulfuron (0.5 lb ai/a + 0.38 or 0.75 oz ai/a), provided excellent plumeless thistle control 30 DAT (Table 2). Chlorsulfuron (0.38 oz ai/a), metsulfuron (0.14 oz ai/a), and dicamba plus picloram (1.0 + 0.13 lb ai/a) provided good to excellent control 3 and 15 MAT. Poor control was provided by 2,4-D alone (1.0 lb ai/a) 3 MAT, however, control was excellent 15 MAT.

Treatments will be evaluated in 1990 for control longevity. (Weed Research Laboratory, Colorado State University, Fort Collins, CO 80523).

Table 1. Application data for plumeless thistle control in Colorado rangeland.

Environmental data	
Date treated	June 15, 1988
Time treated	12:30 pm
Cloud cover, %	40
Air temperature, C	24
Relative humidity, %	50
Wind speed/direction, mph	5 to 9/W
Soil temperature, (2 in) C	11

Weed data

Application date	Species	Growth stage	Height or diameter (in)	Density (plt/ft^2)
June 15, 1988	CRUAC	bolting	7 to 12	0.1
	CRUAC	2nd year rosette	6 to 7	3 to 10
	CRUAC	1st year rosette	1 to 2	5 to 20

Table 2. Plumeless thistle control on Colorado rangeland.

Herbicide	Rate (lb ai/a)	Plumeless thistle control					
		CRUAC[1]	CRUAC[2]	CRUAC	CRUAC	CRUAC	CRUAC
		% of check					
		July 22, 1988		Sept 15.1988		Sept 13, 1989	
picloram	0.13	95	100	100	100	100	100
picloram	0.25	98	100	100	100	90	90
picloram	0.5	100	100	100	100	100	100
dicamba	0.5	89	96	100	100	100	93
dicamba	1.0	100	100	100	100	100	100
dicamba + picloram	0.5 0.25	100	100	100	100	100	100
dicamba + picloram	1.0 0.13	100	100	100	100	65	60
2,4-D	1.0	46	58	68	39	94	94
dicamba + 2,4-D	0.5 1.0	99	100	100	100	100	96
clopyralid	0.13	95	96	100	99	100	94
clopyralid	0.25	100	100	100	100	100	100
dicamba + clopyralid	0.5 0.25	100	100	100	100	100	100
dicamba + clopyralid	1.0 0.13	100	100	100	100	100	100
chlorsulfuron[3]	0.38	23	25	54	28	15	17
chlorsulfuron	0.75	30	34	95	81	88	88
metsulfuron[3]	0.14	29	31	71	50	34	15
metsulfuron	0.3	33	38	84	76	58	63
dicamba + chlorsulfuron	0.5 0.38	73	84	100	98	98	100
dicamba + chlorsulfuron	0.5 0.75	63	60	93	93	100	100
dicamba + chlorsulfuron	1.0 0.38	100	97	100	100	91	86
LSD (0.05)		11	11	19	16	27	24

1 second year plumeless thistle plants found in first data column at each evaluation date.
2 first year plumeless thistle rosettes found in second data column at each evaluation date.
3 X-77 added at 0.25% v/v to all chlorsulfuron and metsulfuron treatments.

Yellow toadflax control with fluroxypyr and picloram on Colorado rangeland. Sebastian, J.R., K.G. Beck. A rangeland experiment was established near Meeker, CO to evaluate yellow toadflax (LINVU) control with fluroxypyr, picloram, and tank mixes of fluroxypyr plus picloram. The design was a randomized complete block with four replications. All treatments were applied on July 2, 1987 with CO_2 pressurized backpack sprayer using 11003LP flat fan nozzles at 24 gpa, 15 psi. Other application information is presented in Table 1. Plot size was 10 by 30 feet.

Visual observations were taken on October 7, 1987, August 3, 1988, and August 9, 1989, approximately 3 months, 1 year, and 2 years after treatment application. Picloram alone (2.0 lb ai/a) and picloram (1.0 lb ai/a) plus fluroxypyr (1.0 lb ai/a) provided excellent LINVU control 3 months after application (Table 2). Picloram (2.0 lb ai/a) and picloram (> 0.25 lb ai/a) plus fluroxypyr tank mixes maintained fair to good yellow toadflax control one year after application and picloram alone (2 lb ai/a) maintained good control two years after treatment.

Herbicide treatments will be evaluated again in 1990 for control longevity. (Weed Research Laboratory, Colorado State University, Fort Collins, CO 80523).

Table 1. Application information for yellow toadflax control with fluroxypyr and picloram on Colorado rangeland.

Environmental data	
Application date	July 2, 1987
Application time	12:30 P
Air temperature, C	22
Cloud cover, %	0
Relative humidity, %	Not Taken
Wind speed/direction, mph	0 to 3/W
Soil temperature (2.0 in), C	18

Weed data

Application date	Species	Growth stage	Height (in)	Density ($shoot/ft^2$)
July 2, 1987	LINVU	vegetative	3 to 8	2 to 4

Table 2. Yellow toadflax control with fluroxypyr and picloram on Colorado rangeland.

Herbicide	Rate	Yellow toadflax control		
	(lb ai/acre)	----------(% of check)----------		
		Oct 7,1987	Aug 3, 1988	Aug 9, 1989
fluroxypyr	1.0	45	30	0
picloram	1.0	48	60	45
picloram	2.0	93	86	76
fluroxypyr	0.25			
+ picloram	0.25	44	30	6
fluroxypyr	0.25			
+ picloram	0.50	79	65	31
fluroxypyr	0.25			
+ picloram	1.0	79	63	34
fluroxypyr	0.50			
+ picloram	0.25	66	10	0
fluroxypyr	0.50			
+ picloram	0.50	88	43	17
fluroxypyr	0.50			
+ picloram	1.0	91	58	49
fluroxypyr	1.0			
+ picloram	0.25	65	55	25
fluroxypyr	1.0			
+ picloram	0.50	80	56	12
fluroxypyr	1.0			
+ picloram	1.0	70	75	50
LSD (0.05)		12	36	26

Dalmatian toadflax control with fluroxypyr and picloram on Colorado rangeland. Sebastian, J.R., K.G. Beck, and D.E. Hanson. A roadside experiment was established near Livermore, CO to evaluate Dalmatian toadflax (LINDA) control with fluroxypyr, picloram, and tank mixes of fluroxypyr plus picloram. The design was a randomized complete block with four replications. Treatments were applied when plants were in vegetative (June 7) or flowering (July 11) growth stages, or in fall (October 7) for timing comparison. All treatments were applied with a CO_2 pressurized backpack sprayer using 11003LP flat fan nozzles at 24 gal/a, 15 psi. Other application data is presented in Table 1. Plot size was 10 by 45 feet.

Visual evaluations were taken on September 6, 1988, May 24, 1989, and September 21, 1989. Picloram (>0.5 lb ai/a) provided good control 90 days after vegetative application (September 6,1988, Table 2). All picloram and picloram plus fluroxypyr treatments provided excellent LINDA control whereas, fluroxypyr alone provided poor control one year after application. LINDA seedlings started to emmerge in all picloram and picloram plus fluroxypyr treatments 18 months after application.

All treatments will be re-applied at same rates in 1990 to 2/3 of each plot and in 1991 to 1/3 of each plot to simulate 1,2, and 3 years of treatment. (Weed Research Laboratory, Colorado State University, Fort Collins, CO 80523).

Table 1. Application information for Dalmatian toadflax control with fluroxypyr and picloram on Colorado rangeland.

Environmental data			
Application date	June 7	July 11	October 7
Application time	11:00 am	12:00 am	9:00 am
Air temperature, C	34	28	9
Cloud cover, %	0	35	0
Relative humidity, %	29	35	86
Wind speed/direction, mph	5 to 7/S	5 to 6/S	0
Soil temperature (2.0 in), C	12	20	8

Weed data

Application date	Species	Growth stage	Density (plants/ft^2)
June 7, 1988	LINDA	vegetative	2 to 3
July 11, 1988	LINDA	flowering	2 to 3
October 7, 1988	LINDA	fall	2 to 3

Table 2. Dalmatian toadflax control with fluroxypyr and picloram on Colorado rangeland.

Treatment	Rate	Timing	Dalmation toadflax control		
	(lb ai/a)		--------(% of check)--------		
			Sep 6, 1988	May 24, 1989	Sep 21, 1989
picloram	0.5	vegetative	31	100	98
picloram	1.0	vegetative	74	100	97
picloram	2.0	vegetative	65	100	97
fluroxypyr	0.5	vegetative	11	0	0
fluroxypyr	1.0	vegetative	11	0	0
fluroxypyr	0.5	vegetative	50	100	99
+ picloram	1.0				
fluroxypyr	1.0	vegetative	31	100	96
+ picloram	0.5				
picloram	0.5	flowering	11	100	94
picloram	1.0	flowering	14	100	99
picloram	2.0	flowering	30	10	99
fluroxypyr	0.5	flowering	18	18	5
fluroxypyr	1.0	flowering	29	29	5
fluroxypyr	0.5	flowering	31	100	97
+ picloram	1.0				
fluroxypyr	1.0	flowering	31	100	93
+ picloram	0.5				
picloram	0.5	fall	0	100	100
picloram	1.0	fall	0	100	100
picloram	2.0	fall	0	100	97
fluroxypyr	0.5	fall	0	0	0
fluroxypyr	1.0	fall	0	0	0
fluroxypyr	0.5	fall	0	100	97
+ picloram	1.0				
fluroxypyr	1.0	fall	0	100	95
+ picloram	0.5				
LSD (0.05)			16	8	7

Picloram/fluroxypyr combinations for Dalmatian toadflax control. Ferrell, M.A. and T.D. Whitson. Dalmatian toadflax is a problem on pasturelands and right-of-ways. This research was conducted at the High Plains Research Station near Cheyenne, Wyoming on pasture to compare the efficacy of picloram/fluroxypyr combinations on the control of Dalmatian toadflax.

Plots were 10 by 20 ft with three replications. The herbicide treatments were applied broadcast with a CO_2 pressurized six-nozzle knapsack sprayer delivering 30 gpa at 35 psi June 16, 1987 (air temp. 78 F, soil temp. 0 inch 95 F, 1 inch 90 F, 2 inch 85 F, 4 inch 75 F, relative humidity 47%, wind southwest at 8 mph, sky clear). Dalmatian toadflax was in full bloom and 18 to 24 inches high. Infestations were moderate throughout the experimental area.

Visual weed control evaluations made July 27, 1989 show picloram maintaining excellent Dalmatian toadflax control two years after herbicide application. Fluroxypyr was ineffective in controlling Dalmatian toadflax and there was no increase in control when fluroxypyr was combined with picloram. (Wyoming Agric. Exp. Sta., Laramie, WY 82071 SR 1594.)

Dalmatian toadflax control

Treatment[1]	Rate	Control[2] 1988	1989
	(lb ai/a)	— (%) —	
picloram	0.5	97	97
picloram	1.0	99	98
picloram	2.0	99	98
fluroxypyr	0.5	0	0
fluroxypyr	1.0	0	0
picloram + fluroxypyr	0.5 + 0.5	99	99
picloram + fluroxypyr	0.5 + 1.0	98	99
picloram + fluroxypyr	1.0 + 0.5	99	100
picloram + fluroxypyr	1.0 + 1.0	98	98
Check	0	0	0
(LSD)		3	3
(CV)		2	2

[1]Treatments applied June 16, 1987.
[2]Visual evaluations August 3, 1988 and July 27, 1989.

New weed species and potential weed problems in Idaho. Old, R.R., F.E. Northam, and R.H. Callihan. The distributions of weed species submitted from all sources for identification by weed science diagnostic personnel, and of weed species otherwise called to our attention, were examined to determine which reports represented changes in distributions. The distributions were categorized into three groups: (I) those not previously reported in Floras or other documents to exist in the Pacific Northwest; (II) those not previously documented for Idaho, although present in the Pacific Northwest (Hitchcock and Cronquist, Flora of the Pacific Northwest, (1973); (III) those previously reported in Idaho, wherein the known range of the species has been expanded to other counties due to 1989 field observations.

Several species of plants not previously reported in Idaho were observed during 1989 and were considered to possess the potential to become problem weeds. All such species are included in this report. Some species used as ornamentals, such as indigobush and orange hawkweed are included. Extensions of the ranges of several species that have been present in Idaho for several years were also recorded. Three species new to Idaho were found to be new records for the Pacific Northwest (Idaho, Oregon and Washington) in 1989. Eight species, including the three that were new to the Pacific Northwest, were found to be new records for Idaho in 1989. Twenty-nine species, including the eight species new to Idaho, were found to be new records for individual counties in 1989. The following lists cite the scientific name, Weed Science Society of America code (if available), common name, family name and location of each new record.

Group I: Species not previously reported for Idaho, nor listed in Flora of the Pacific Northwest (new regional, as well as state and county records).

1. Lychnis chalcedonica L. (LYHCH) maltese-cross; Caryophyllaceae; escaped ornamental along irrigation ditches, Madison Co.

2. Panicum virgatum L. (PANVI) switchgrass; Gramineae; roadside near Gooding in Gooding Co, this specimen was misidentified and reported as Sorghum halepense in 1986.

3. Sporobolus vaginiflorus (Torr. ex Gray) Wood (SPZVA) poverty dropseed; Gramineae; gravelled areas near Lewiston in Nez Perce Co. and roadside near Kooskia in Idaho Co. One previous collection from near Slate Creek, Idaho Co. by E.W. Tisdale 1982.

Group II: Species not previously documented for Idaho, although currently listed in Flora of the Pacific Northwest (new state as well as county records).

1. Calystegia sepium (L.) R. Br. (CAGSE) hedge bindweed; Convolvulaceae; canal banks at Emmett, Gem Co. (= Convolvulus sepium).

2. Crepis capillaris (L.) Wallr. (CVPCA) smooth hawksbeard; Compositae; pasture near St. Maries, Benewah Co.

3. Holcus lanatus L. (HOLLA) common velvetgrass; Gramineae; river bottom near Kooskia, Idaho Co.

4. Sagina procumbens L. (SAIPR) birdseye pearlwort; Caryophyllaceae; weedy in flower beds at Boise, Ada Co. and at St. Maries, Benewah Co.

5. Sisymbrium officinale (L.) Scop. (SSYOF) hedgemustard; Cruciferae; irrigated pasture, Lapwai Canyon, Nez Perce Co.

Group III: Species not previously reported in the county listed, although previously reported in one or more other counties in Idaho (new county records).

1. Amorpha fruticosa L. (AMHFR) indigobush; Leguminosae; very dense along roads north of Bonners Ferry, Boundary Co. [1]

2. Bryonia alba L. (BYOAL) white bryony; Cucurbitaceae; reported as "gone berserk" in garden near Burley, Minidoka Co. [1,2,3]

3. Carduus acanthoides L. (CRUAC) plumeless thistle; Compositae; widespread in Fremont, Madison and Teton Cos. Apparently long known to certain local people, but unreported. [2]

4. Carduus pycnocephalus L. (CRUPY) Italian thistle; Compositae; near Nez Perce, Lewis Co. [2]

5. Centaurea pratensis Thuill. meadow knapweed; Compositae; northeastern Boundary Co., first substantial population reported in Idaho. [3]

6. Centaurea repens L. (CENRE) Russian knapweed; Compositae; cultivated land near Lewiston Orchards, Nez Perce Co., Bonners Ferry, Boundary Co. circa 1985.

7. Centaurea solstitialis L. (CENSO) yellow starthistle; Compositae; roadside near Coeur d'Alene, Kootenai Co. [4]

8. Cynosurus echinatus L. (CYXEC) hedgehog dogtailgrass; Gramineae; roadsides near Cavendish, Clearwater Co. [1,3]

9. Eragrostis orcuttiana Vasey. Orcutt's lovegrass; Gramineae; Lewiston, Nez Perce Co. [2,4]

10. Eremocarpus setigerus (Hook.) Benth. (ERMSE) turkey mullien; Euphorbiaceae; gravelled area at Boise, Ada Co. [2,4]

11. Erucastrum gallicum (Wilde.) O.E. Schulz (ERWGA) dog mustard; Cruciferae; at Bonners Ferry, Boundary Co.

12. Galeopsis tetrahit L. (GAETE) common hempnettle; Labiatae; in cropland near St. Maries, Benewah Co. [3]

13. Galium pedamontanum All.; foothills bedstraw; Rubiaceae; near Emida, Benewah Co. and along east side of Lake Coeur d'Alene, Kootenai Co. [3]

14. Hieracium aurantiacum L. (HIEAU) orange hawkweed; Compositae; in flower beds, Nampa, Canyon Co. [1,2,3]

15. Leonurus cardiaca L. (LECCA) motherwort; Labiatae; collected by F.D. Johnson near Spalding Park, Nez Perce Co. [4]

16. Panicum dichotomiflorum Michx (PANDI) fall panicum; Gramineae; roadside Highway 95 near Moscow, Latah Co. [3]

17. *Potentilla recta* L. (PTLRC) sulphur cinquefoil; Rosaceae; pastures and roadsides, Camas Co. [4]

18. *Sorghum halepense* (L.) Pers. (SORHA) johnsongrass; Gramineae; roadside near hop field, Canyon Co. [2,3]

19. *Torilis arvensis* (Huds.) Link (TOIAR) hedgeparsley; Umbelliferae; open roadcuts and heavy woods near Kooskia, Idaho Co. [1,3]

20. *Trifolium arvense* L. (TRFAR) rabbitfoot clover; Leguminosae; near Bonners Ferry, Boundary Co. Idaho. [1,2]

21. *Zygophyllum fabago* L. (ZYGEA) Syrian beancaper; Zygophyllaceae; on roadside near Aberdeen Research and Extension Center, Bingham Co.

(University of Idaho Agriculture Experiment Station, Moscow, 83843)

Weed identification for county extension and weed control programs in Idaho. Old, R.R., R.H. Callihan, and F.E. Northam. The occurrence and distribution of weed species is a dynamic phenomenon. It is their nature to disperse into new areas. Therefore one aspect of weed science encompasses ecological plant geography. Few programs devote resources to systematically surveying weed floras or documenting weed species movements. The weed identification program at the University of Idaho provides data useful in documenting changes in the Idaho weed flora, which includes: (1) identifying weed species present in Idaho, (2) determining distribution of weeds, (3) recording weed dispersal into new areas, (4) detecting new alien weeds, (5) recognizing the season(s) that particular weed identification problems arise, (6) identifying educational deficiencies and planning programs for extension and regulatory personnel on weed identification, and (7) creating an available historical data base. This report also serves the important function of advising research, extension, and regulatory personnel in other states of problems and weed status in Idaho that may be significant in their states.

Plants submitted for identification or verification in 1989 are listed below. These data are from identification requests submitted to weed identification personnel by county extension agents and county weed superintendents. Eleven additional specimens were identified only to genus, and over 500 specimens submitted from other sources are not included. Over 800 plant species have been identified for these two groups during the past five years (see also WSWS Progress Reports for 1986 - 1989). Although data from these two groups over the past five years are generally indicative of their educational needs, some samples are submitted because of unusual circumstances that call for specialist capabilities. This program continues to grow in both extension and non-extension usage; there were about five times more requests the past year than the first year of the program. (Idaho Agricultural Experiment Station, Moscow, Idaho 83843)

Identification	County	Date
Acer palmatum, Aceraceae	Ada	11/15/89
Acer platanoides, Aceraceae	Ada	05/05/89
Aegopodium podagraria, Apiaceae	Ada	09/07/89
Agastache urticifolia, Lamiaceae	Caribou	09/11/89
Agropyron cristatum, Poaceae	Canyon	05/12/89
Agropyron repens, Poaceae	Canyon	05/04/89
Agrostis palustris, Poaceae	Ada	05/01/89
Agrostis tenuis, Poaceae	Canyon	01/09/89
Agrostis tenuis, Poaceae	Ada	06/23/89
Alisma plantago-aquatica, Alismataceae	Latah	06/23/89
Allium geyeri, Liliaceae	Canyon	05/19/89
Amorpha fruticosa, Fabaceae	Ada	09/15/89
Antennaria neglecta, Asteraceae	Clearwater	05/30/89
Anthemis tinctoria, Asteraceae	Kootenai	06/23/89
Apocynum androsaemifolium, Apocynaceae	Butte	06/09/89
Apocynum cannabinum, Apocynaceae	Power	07/13/89
Apocynum cannabinum, Apocynaceae	Ada	10/06/89
Arabis hirsuta, Brassicaceae	Caribou	06/02/89
Arctium minus, Asteraceae	Canyon	06/23/89
Argemone munita, Papaveraceae	Canyon	06/30/89
Artemisia douglasiana, Asteraceae	Boundary	08/22/89
Artemisia ludoviciana, Asteraceae	Nez Perce	06/01/89
Asperugo procumbens, Boraginaceae	Ada	05/19/89
Aster campestris, Asteraceae	Minidoka	09/22/89
Aster occidentalis, Asteraceae	Ada	09/07/89
Aster occidentalis, Asteraceae	Blaine	09/20/89
Astragalus filipes, Fabaceae	Lincoln	06/14/89
Atriplex hortensis, Chenopodiaceae	Washington	10/06/89

Atriplex spinosa, Chenopodiaceae	Minidoka	06/17/89
Atriplex spinosa, Chenopodiaceae	Ada	06/23/89
Berberis aquifolium, Berberidaceae	Ada	05/30/89
Berberis repens, Berberidaceae	Caribou	05/12/89
Berteroa incana, Brassicaceae	Boise	07/13/89
Bidens cernua, Asteraceae	Latah	08/22/89
Bidens frondosa, Asteraceae	Boundary	09/21/89
Brassica campestris, Brassicaceae	Canyon	03/28/89
Bromus commutatus, Poaceae	Lewis	07/14/89
Bromus secalinus, Poaceae	Lewis	06/17/89
Bromus tectorum, Poaceae	Canyon	08/15/89
Bryonia alba, Cucurbitaceae	Minidoka	05/12/89
Bryonia alba, Cucurbitaceae	Minidoka	08/24/89
Camassia quamash, Liliaceae	Caribou	06/17/89
Campanula glomerata, Campanulaceae	Ada	06/23/89
Campanula rapunculoides, Campanulaceae	Ada	04/26/89
Campanula rapunculoides, Campanulaceae	Boundary	05/05/89
Campanula rapunculoides, Campanulaceae	Bear Lake	05/12/89
Campanula rapunculoides, Campanulaceae	Ada	09/15/89
Cardaria draba, Brassicaceae	Canyon	08/13/89
Cardaria pubescens, Brassicaceae	Power	10/27/89
Carduus acanthoides, Asteraceae	Nez Perce	07/07/89
Centaurea cyanus, Asteraceae	Kootenai	01/25/89
Centaurea maculosa, Asteraceae	Latah	08/22/89
Centaurea pratensis, Asteraceae	Boundary	08/08/89
Centaurea repens, Asteraceae	Ada	06/09/89
Centaurea solstitialis, Asteraceae	Kootenai	08/22/89
Cerastium vulgatum, Caryophyllaceae	Gem	04/28/89
Chaenactis douglasii, Asteraceae	Gem	05/30/89
Chaenactis douglasii, Asteraceae	Canyon	08/13/89
Chenopodium album, Chenopodiaceae	Ada	08/14/89
Chenopodium botrys, Chenopodiaceae	Idaho	05/19/89
Chenopodium rubrum, Chenopodiaceae	Bingham	09/11/89
Chorispora tenella, Brassicaceae	Caribou	06/17/89
Chrysopsis villosa, Asteraceae	Franklin	09/22/89
Cirsium arvense, Asteraceae	Ada	04/24/89
Cirsium brevifolium, Asteraceae	Lewis	11/27/89
Cirsium canovirens, Asteraceae	Washington	07/10/89
Cirsium magnificum, Asteraceae	Blaine	07/07/89
Cirsium scariosum, Asteraceae	Blaine	07/28/89
Cleome serrulata, Capparidaceae	Bannock	09/27/89
Comandra umbellata, Santalaceae	Gem	04/28/89
Conium maculatum, Apiaceae	Ada	03/28/89
Conium maculatum, Apiaceae	Ada	05/30/89
Convolvulus arvensis, Convolvulaceae	Bonner	05/26/89
Convolvulus sepium, Convolvulaceae	Ada	09/11/89
Conyza canadensis, Asteraceae	Idaho	10/05/89
Cornus stolonifera, Cornaceae	Ada	09/29/89
Crepis acuminata, Asteraceae	Owyhee	05/22/89
Crepis acuminata, Asteraceae	Canyon	05/30/89
Crepis acuminata, Asteraceae	Gem	05/50/89
Cynodon dactylon, Poaceae	Ada	09/05/89
Dactylis glomerata, Poaceae	Lewis	05/08/89
Dactura meteloides, Solanaceae	Ada	10/16/89
Digitaria sanguinalis, Poaceae	Clearwater	08/09/89
Elodea canadensis, Hydrocharitaceae	Idaho	03/28/89
Epilobium angustifolium, Onagraceae	Lewis	10/06/89
Eragrostis orcuttina, Poaceae	Nez Perce	07/14/89
Eremocarpus setigerus, Euphorbiaceae	Ada	08/23/89
Eriophyllum lanatum, Asteraceae	Lewis	06/21/89
Euphorbia cyparissias, Euphorbiaceae	Ada	05/15/89
Euphorbia cyparissias, Euphorbiaceae	Ada	09/15/89
Euphorbia myrsinites, Euphorbiaceae	Ada	05/15/89
Festuca arundinaceae, Poaceae	Idaho	10/30/89
Festuca rubra, Poaceae	Ada	07/14/89
Filago arvensis, Asteraceae	Boundary	07/25/89
Filago arvensis, Asteraceae	Idaho	08/02/89
Galeopsis tetrahit, Lamiaceae	Benewah	04/28/89
Galeopsis tetrahit, Lamiaceae	Kootenai	07/07/89
Galium boreale, Rubiaceae	Lewis	06/21/89
Galium boreale, Rubiaceae	Idaho	06/30/89

Galium verum, Rubiaceae	Fremont	08/02/89
Hordeum leporinum, Poaceae	Nez Perce	07/14/89
Hydrangea quercifolia, Hydrangeaceae	Ada	06/23/89
Hypericum perforatum, Hypericaceae	Bonner	09/15/89
Iva axillaris, Asteraceae	Bannock	10/20/89
Koelreuteria paniculata, Sapindaceae	Ada	04/19/89
Lamium amplexicaule, Lamiaceae	Canyon	05/04/89
Lamium purpureum, Lamiaceae	Idaho	05/02/89
Lepidium campestre, Brassicaceae	Lincoln	05/12/89
Lepidium campestre, Brassicaceae	Lewis	09/12/89
Lepidium latifolium, Brassicaceae	Ada	06/09/89
Lepidium latifolium, Brassicaceae	Canyon	06/17/89
Lepidium latifolium, Brassicaceae	Gem	06/23/89
Lepidium latifolium, Brassicaceae	Bingham	07/14/89
Lepidium virginicum, Brassicaceae	Canyon	07/17/89
Ligusticum canbyi, Apiaceae	Boundary	09/13/89
Linaria vulgaris, Scrophulariaceae	Butte	06/30/89
Linaria vulgaris, Scrophulariaceae	Boundary	08/22/89
Lithospermum ruderale, Boraginaceae	Power	05/19/89
Lolium multiflorum, Poaceae	Lewis	05/16/89
Lolium multiflorum, Poaceae	Ada	06/09/89
Lolium perenne, Poaceae	Ada	04/11/89
Lolium perenne, Poaceae	Nez Perce	04/22/89
Lolium perenne, Poaceae	Nez Perce	06/02/89
Lomatium dissectum, Apiaceae	Owyhee	05/10/89
Lomatium grayi, Apiaceae	Bannock	05/09/89
Lycium halimifolium, Solanaceae	Minidoka	05/15/89
Lycium halimifolium, Solanaceae	Ada	09/27/89
Lygodesmia spinosa, Asteraceae	Butte	08/23/89
Lychnis alba, Caryophyllaceae	Nez Perce	06/01/89
Lychnis alba, Caryophyllaceae	Kootenai	06/23/89
Machaeranthera canescens, Asteraceae	Bingham	07/11/89
Machaeranthera canescens, Asteraceae	Butte	09/07/89
Madia glomerata, Asteraceae	Kootenai	06/23/89
Madia glomerata, Asteraceae	Latah	06/23/89
Matricaria perforata, Asteraceae	Minidoka	05/01/89
Medicago lupalina, Fabaceae	Ada	04/20/89
Medicago sativa, Fabaceae	Idaho	10/03/89
Mentzelia laevicaulis, Loasaceae	Ada	04/07/89
Mentzelia laevicaulis, Loasaceae	Bingham	08/09/89
Milium vernale, Poaceae	Idaho	04/11/89
Muhlenbergia asperifolia, Poaceae	Jerome	07/21/89
Myosotis micrantha, Boraginaceae	Boundary	05/05/89
Myriophyllum spicatum, Haloragaceae	Ada	05/08/89
Navarretia intertexta, Polemoniaceae	Idaho	08/30/89
Nemophila breviflora, Hydrophyllaceae	Clearwater	05/02/89
Oenothera strigosa, Onagraceae	Ada	05/12/89
Oenothera strigosa, Onagraceae	Blaine	08/28/89
Oenothera strigosa, Onagraceae	Bonner	09/05/89
Onobrychis viciaefolia, Fabaceae	Canyon	06/14/89
Onopordum acanthium, Asteraceae	Canyon	05/24/89
Ornithogalum umbellatum, Liliaceae	Ada	04/13/89
Ornithogalum umbellatum, Liliaceae	Ada	05/11/89
Ornithogalum umbellatum, Liliaceae	Lewis	05/16/89
Ornithogalum umbellatum, Liliaceae	Latah	06/06/89
Osmorhiza occidentalis, Apiaceae	Owyhee	05/10/89
Osmorhiza occidentalis, Apiaceae	Caribou	06/09/89
Osmorhiza occidentalis, Apiaceae	Boundary	09/21/89
Pastinaca sativa, Apiaceae	Power	07/13/89
Penstemon palmeri, Scrophulariaceae	Minidoka	07/14/89
Penstemon X parishii, Scrophulariaceae	Owyhee	05/01/89
Phacelia hastata, Hydrophyllaceae	Idaho	06/14/89
Phacelia linearis, Hydrophyllaceae	Boundary	06/30/89
Phalaris arundinaceae, Poaceae	Kootenai	06/23/89
Philadelphus lewisii, Hydrangeaceae	Ada	05/30/89
Phragmites communis, Poaceae	Gem	04/13/89
Phragmites communis, Poaceae	Payette	05/09/89
Pinus wallichiana, Pinaceae	Ada	10/27/89
Polemonium micranthum, Polemonium	Nez Perce	04/24/89
Polygonum cuspidatum, Polygonaceae	Ada	06/23/89
Polygonum cuspidatum, Polygonaceae	Twin Falls	08/22/89

Polygonum cuspidatum, Polygonaceae	Oneida	09/07/89
Populus deltoides, Salicaceae	Ada	06/30/89
Portulaca oleracea, Portulacaceae	Bonner	09/15/89
Potentilla gracilis, Rosaceae	Blaine	05/12/89
Potentilla recta, Rosaceae	Camas	09/07/89
Prunus domestica, Rosaceae	Ada	07/14/89
Prunus tomentosa, Rosaceae	Ada	06/23/89
Prunus tomentosa, Rosaceae	Ada	06/30/89
Prunus virginiana, Rosaceae	Ada	05/24/89
Purshia tridentata, Rosaceae	Ada	06/23/89
Ranunculus acriformis, Ranunculaceae	Caribou	06/17/89
Ranunculus sceleratus, Ranunculaceae	Canyon	05/12/89
Ranunculus testiculatus, Ranunculaceae	Latah	08/23/89
Rorippa islandica, Brassicaceae	Minidoka	06/17/89
Sagina procumbens, Caryophyllaceae	Ada	05/30/89
Sanguisorba minor, Rosaceae	Canyon	05/19/89
Sanguisorba minor, Rosaceae	Franklin	09/28/89
Saponaria officinalis, Caryophyllaceae	Nez Perce	07/19/89
Saponaria officinalis, Caryophyllaceae	Minidoka	07/26/89
Secale cereale, Poaceae	Idaho	06/17/89
Senecio canus, Asteraceae	Ada	04/24/89
Senecio hydrophilus, Asteraceae	Bannock	06/30/89
Senecio serra, Asteraceae	Latah	06/23/89
Sidalcea oregana, Malvaceae	Lewis	07/14/89
Smilacina stellata, Liliaceae	Power	05/17/89
Solanum dulcamara, Solanaceae	Bannock	09/22/89
Solanum dulcamara, Solanaceae	Idaho	10/30/89
Solanum sarrachoides, Solanaceae	Ada	07/11/89
Solidago canadensis, Asteraceae	Caribou	06/09/89
Sonchus asper, Asteraceae	Bonner	09/18/89
Sonchus oleraceus, Asteraceae	Bannock	05/22/89
Sophora arizonica, Fabaceae	Ada	04/11/89
Sorghum halepense, Poaceae	Canyon	11/13/89
Spartina pectinata, Poaceae	Kootenai	01/25/89
Spergularia rubra, Caryophyllaceae	Lewis	08/13/89
Symphytum officinale, Boraginaceae	Ada	05/17/89
Trifolium arvense, Fabaceae	Kootenai	04/20/89
Trifolium arvense, Fabaceae	Boundary	08/07/89
Trifolium plumosum, Fabaceae	Washington	06/30/89
Vaccaria segetalis, Caryophyllaceae	Camas	09/07/89
Valeriana occidentalis, Valerianaceae	Caribou	06/09/89
Verbascum blattaria, Scrophulariaceae	Ada	06/05/89
Veronica anagallis-aquatica, Scrophul.	Bingham	07/24/89
Veronica hederaefolia, Scrophulariaceae	Ada	05/12/89
Veronica persica, Scrophulariaceae	Idaho	05/02/89
Vinca minor, Apocynaceae	Clearwater	08/09/89
Viola palustris, Violaceae	Minidoka	04/22/89

Effects of various herbicides on six grass species grown for seed production. Whitson, T.D. and J.G. Lauer. The effects of herbicides after the establishment year for grasses is important from a weed control and seed production standpoint. This study was established at the Powell, Wyoming Research and Extension Center to determine the effects of various herbicides and herbicide combinations on grass seed yields and weed control. Six grass species seeded following barley August 28, 1987 included "Hycrest" crested wheatgrass, "Rosana" western wheatgrass, "Critana" thickspike wheatgrass, PI 432403 slender wheatgrass, "Bozoisky" Russian wildrye and "Regar" meadow bromegrass. Herbicides were applied May 25, 1988, 9 months following grass seeding, with a four-nozzle knapsack sprayer delivering 40 gpa at 45 psi. Herbicide plots were 7 by 34 ft. and arranged in a randomized complete block design with four replications. Temperature: air 85F, soil surface 85F, 1 inch 85F, 2 inches 80F, 4 inches 80F; relative humidity 40% and wind west at 5 to 6 mph. Grasses were 4 to 6 inches in height with weeds in early seedling stages. Soils were classified as sandy clay loam (47% sand, 27% silt and 26% clay) with 1.6% organic matter and 7.9 pH. Herbicides providing greater than 80% broadleaf weed control with little or no perennial grass injury included clopyralid + 2,4-D + paraquat at 0.19 + 1.0 + 0.75 lb ai/A, diuron + paraquat at 0.75 + 1.0 lb ai/A, and metsulfuron + paraquat at 0.06 + 0.75 lb ai/A. Applications of paraquat + cyanazine, paraquat + dicamba and paraquat + metribuzin provided good weed control, but grass damage ranged from 21 to 34%. (Department of Plant, Soil, and Insect Sciences, University of Wyoming, Laramie, WY 82071.)

Effects of various herbicides on six grass species grown for seed production.

Herbicide[1]	Rate lb ai/A	% Broadleaf weed control[2,3]	% Suppression of perennial grasses
Alachlor + paraquat + X-77	3.0 + 0.75 + 0.25%	36	1
Paraquat + atrazine + X-77	0.75 + 0.75 + 0.25%	74	19
Clopyralid + 2,4-D + paraquat + X-77	0.19 + 1.0 + 0.75 + 0.25%	89	0
Paraquat + cyanazine + X-77	0.75 + 2.0 + 0.25%	89	34
Dicamba + paraquat + X-77	0.5 + 0.75 + 0.25%	84	21
Paraquat + diuron + X-77	0.75 + 1.0 + 0.25%	81	3
Ethalfluralin + paraquat + X-77	1.5 + 0.75 + 0.25%	26	0
Paraquat + metribuzin + X-77	0.75 + 0.5 + 0.25%	75	25
Metsulfuron + paraquat + X-77	0.006 + 0.75 + 0.25%	80	0
Paraquat + X-77	0.75 + 0.25%	51	0
Paraquat + pendimethalin + X-77	0.75 + 2.0 + 0.25%	51	0
Pronamide + paraquat + X-77	0.25 + 0.75 + 0.25%	18	18
Paraquat + terbacil + X-77	0.75 + 0.5 + 0.25%	51	34
Check	-------------	0	0

[1]Herbicides were applied May 25, 1988.
[2]Evaluations were made May 16, 1989.
[3]Broadleaf weeds included kochia (Kochia scoparia (L.) Schrad), common lambsquarters (Chenopodium album L.), wild mustard (Sinapis avensis L.) and wild buckwheat (polygonum convolvulus L.).

Herbicide tolerance of seedling grasses for CRP. Lass L.W., and R.H. Callihan. Grass establishment practices on erodible crop land in the U.S.D.A. Conservation Reserve Program (CRP) often allow weeds to dominate during and after grass establishment. Early application of certain herbicides may cause injury to some seedling grasses. The tolerance of seedlings of 19 grass taxa to picloram (0.25, 0.5, 1.0 lb ai/a and a check); clopyralid (0.125, 0.25, 0.5, 1.0 lb ai/a and a check); clopyralid plus 2,4-D amine (0.25 + 1 lb ai/a and a check); DPX-G8311 (0.016, 0.023, 0.031 lb ai/a and a check); chlorsulfuron (0.017, 0.023, 0.031 lb ai/a and a check); CGA-136872 (0.013, 0.027, 0.054 lb ai/a and a check); triasulfuron (0.013, 0.027, 0.054 lb ai/a and a check); and glyphosate (0.125, 0.25, 0.5 lb ai /a and a check) was tested in the field. Grass seedlings were: bluebunch x quackgrass (Agropyron spicatum (Pursh) Scribn. & Smith x A. repens (L.)Beauv.); Canada bluegrass (Poa compressa L. cv. Reubens); Kentucky bluegrass (Poa pratensis L. cv. Kenblue); meadow brome (Bromus biebersteinii cv. Regar); smooth brome (Bromus inermis Leys. cv. Manchar); crested wheatgrass (Agropyron cristatum Gaertn. cv. Ephraim); creeping red fescue (Festuca rubra L. cv. Logro); hard fescue (Festuca ovina L. var. duriuscula cv. Durar); sheep fescue (Festuca ovina cv. Covar), and (Festuca ovina cv. Meckelenburg); tall fescue (Festuca arundinacea Schreb. cv. Alta) and (Festuca arundinacea cv. Fawn); orchard grass (Dactylis glomerata L. cv. Paiute); redtop (Agrostis alba L. cv. Alba), (Agrostis alba cv. Exerata), and (Agrostis alba cv. Streaker), common timothy (Phleum pratense L. cv. Climax), intermediate wheatgrass (Agropyron intermedium (Host)Beauv. cv. Oahe), streambank wheatgrass (Agropyron riparium Scribn. & Smith cv. Sodar) and an unplanted check.

Plots on a Vassar-Uvi silt loam near Viola, Id. were tilled and packed on April 13, 1988. Treatments were placed in a split-plot randomized strip block design with four replications. Grass seed was planted on 8 by 300 ft plots April 28, using a 7 ft drill with drag chains, calibrated to deliver 12.98 lb/a. The row spacing was 7 inches and the depth of planting was 1/2 to 3/4 inches. Rice hulls were used to adjust seed volume to a constant seeding rate to compensate for different grass seed sizes. Plots were treated with 0.5 lb ai/a of glyphosate on May 10 prior to grass emergence to remove seedling weeds.

Herbicide treatments were applied to 8 X 160 ft plots across the grass strips in 25 gal/a water carrier, with TeeJet 8002 nozzles at a pressure of 25 psi, from a motorized plot sprayer operated at 1.9 mph. The application date was July 10, 1988. The air temperature was 73F, soil temperature was 93F at the surface, 91F 2 inches depth, and 73F 5 inches deep. The relative humidity was 38% and the sky was clear, 0 to 3 mph west wind. Grass seedling height ranged from 2 to 5 inches. Grass height, chlorosis, and seed head production were measured the first week of August. Internode length and seed head length were measured the third week of August 1988. Height, internode length, and estimated biomass were recorded in late July 1989.

1988. Grass seedlings not showing herbicide injury symptoms in 1988 were Covar sheep fescue, Meckelenburg sheep fescue, and Durar hard fescue. Seedlings of the following grasses tolerated to all herbicides except glyphosate: Kenblue Kentucky bluegrass; Reubens Canada bluegrass; Logro creeping red fescue; redtop; Exerata redtop; Streaker redtop; and Oahe intermediate wheatgrass.

In 1988, height of bluebunch X quackgrass was reduced 52% by glyphosate, 30% by chlorsulfuron, 44% by picloram, 35% by clopyralid plus

2,4-D, and 46% by CGA-136872 (data not shown). Triasulfuron reduced the height of Fawn tall fescue by 40%. Triasulfuron and the combination of clopyralid plus 2,4-D reduced the height of Paiute orchard grass by 45% and 20% respectively (data not shown).

1989. Grass stands reduced by glyphosate in 1988 tended to be lower in 1989. Estimates of grass cover in 1989 (data not shown) showed glyphosate at 0.5 lb ai/a reduced species cover of bluebunch X quackgrass by 83%, Manchar smooth brome by 37%, common timothy by 71%, Ephraim crested wheatgrass by 48%, Oahe intermediate wheatgrass by 47%, and Sodar streambank wheatgrass by 59%, when compared to the check. The low levels of grass cover were reflected in a biomass reduction of 82% in bluebunch X quackgrass and of 53% in Oahe intermediate wheatgrass when compared to the check (Table 1). Exerata redtop had six times more biomass when treated with 0.027 lb ai/a triasulfuron than the check. Redtop in all clopyralid treatments except the combination of clopyralid and 2,4-D produced three times more shoot biomass. 2,4-D alone reduced redtop by about 50%, when compared to the check. Both the combination of 2,4-D and clopyralid and 2,4-D alone increased the biomass of Alta tall fescue by 4 times; of Meckelenburg sheep fescue by 5 times; of common timothy by 3 times; and of Regar meadow brome by 1.6 times when compared to the check, but clopyralid alone did not. CGA-136872 at 0.013 lb ai/a increased Reubens Canada bluegrass biomass 10-fold, when compared to the check. The biomass of Kenblue Kentucky bluegrass treated with chlorsulfuron at 0.023 lb ai/a was 6 times greater than that in the check.

Glyphosate at 0.5 lb ai/a reduced the height of Bluebunch X quackgrass by 20%, common timothy by 8%, and Sodar streambank wheatgrass by 21% when compared to the check. Picloram at 1 lb ai/a decreased the height of Ephraim crested wheatgrass by 12 % when compared to the check (Table 2). Durar hard fescue height was increased 115% in plots treated with 0.016 lb ai/a chlorsulfuron, 108% in plots treated with 0.023 lb ai/a chlorsulfuron, and 0.031 lb ai/a chlorsulforon. Plots treated with CGA-136872 at all rates increased the height of Streaker redtop by 112 to 116% when compared to the check.

Internode length of most grasses (data not shown) was not affected by the herbicides. The internode length of Meckelenburg sheep fescue however, was decreased 20% by 0.5 lb ai/a glyphosate. Picloram at 0.25 and 0.5 lb ai/a decreased the internode length of Reubens Canada bluegrass by about 20%. CGA-136872 at 0.05 increased internode length by 139%.

The results of this study suggests seedlings of some taxa are not seriously injured for CRP purposes by effective rates of these herbicides, when used for postemergence weed control. Many of the seedlings of taxa that showed injury the first year appeared to be normal plants the second. Growth stimulation observed in some grasses during the second year was probably due to reduced competition. (University of Idaho, Dept. of P.S.&E.S., Moscow 83843)

Table 1.
Effects of herbicides on estimated plant biomass in the second year (1989).

Herbicide	Rate (lb ai/A)	Blue X Quack-grass	Kenbl. Kent. Blueg.	Reub. Canada Blueg.	Manch. Smooth Brome	Regar Mead. Brome	Common Timothy	Covar Sheep Fesc.	Durar Hard Fesc.	Meck. Sheep Fesc.	Logro Creep Fesc.	Alta Tall Fesc.	Fawn Tall Fesc.	Paiute Orchard Grass	Ephr. Crest. Whtg.	Oahe Inter. Whtg.	Sodar Strm. Whtg.	Redtop	Exer. Redtop	Streak. Redtop
										(%)										
triasulfuron	0.000	100 ns[1]	100 ns	100 ns	100 ns	100 ns	100 ns	100 ns	100 ns	100 ns	100 ns	100 ns	100 ns	100 ns	100 ns	100 ns	100 ns	100 ns	100 B	100 ns
triasulfuron	0.013	129	99	129	100	100	115	92	115	88	115	100	126	84	85	103	86	142	213 BA	114
triasulfuron	0.027	129	80	181	100	100	108	89	172	94	102	100	134	105	97	101	91	170	677 A	114
triasulfuron	0.054	93	75	160	98	100	98	64	144	84	104	100	126	102	97	108	74	250	440 BA	115
clopyralid	0.000	100 AB	100 ns	100 ns	100 ns	100 B	100 B	100 ns	100 ns	100 B	100 ns	100 B	100 ns	100 BA	100 ns	100 ns	100 ns	100 C	100 ns	100 ns
clopyralid	0.220	102 A	172	254	95	95 B	106 B	111	124	63 B	92	125 B	80	97 B	96	100	141	375 A	148	132
clopyralid	0.450	104 A	152	296	100	100 B	112 B	86	95	89 B	72	120 B	71	100 BA	121	100	130	375 A	150	132
clopyralid	0.900	70 B	172	208	95	100 B	112 B	112	80	73 B	98	125 B	84	95 B	121	108	112	371 BA	218	112
2-4,D	1.000	152 A	72	30	84	164 A	328 A	117	88	577 A	133	469 A	137	120 BA	138	93	173	53 C	408	86
clop+2-4,D	0.45+1	129 A	68	28	84	164 A	306 A	45	114	506 BA	146	466 A	165	161 A	129	115	163	59 C	548	83
DPX-G8311	0.000	100 ns	100 ns	100 ns	100 ns	100 ns	100 ns	100 ns	100 ns	100 ns	100 ns	100 ns	100 ns	100 ns	100 ns	100 ns	100 ns	100 ns	100 ns	100 ns
DPX-G8311	0.016	112	77	83	106	90	111	97	111	197	98	93	83	107	104	100	159	100	208	104
DPX-G8311	0.023	104	88	102	99	100	100	89	124	150	115	95	92	107	104	100	144	118	165	112
DPX-G8311	0.031	96	93	90	103	98	107	97	105	193	110	95	98	88	97	100	153	101	112	115
chlorsulfuron	0.000	100 ns	100 B	100 ns	100 ns	100 ns	100 ns	100 ns	100 ns	100 ns	100 ns	100 ns	100 ns	100 ns	100 ns	100 ns	100 ns	100 ns	100 ns	100 ns
chlorsulfuron	0.016	104	81 B	85	103	111	96	108	171	100	119	143	93	97	100	97	89	115	127	110
chlorsulfuron	0.023	108	692 A	115	103	111	127	105	191	170	103	148	106	94	145	113	95	131	114	101
chlorsulfuron	0.031	119	125 B	115	95	111	127	104	174	101	129	151	96	94	108	104	90	137	135	104
glyphosate	0.000	100 A	100 ns	100 ns	100 ns	100 ns	100 ns	100 ns	100 ns	100 ns	100 ns	100 ns	100 ns	100 ns	100 ns	100 A	100 ns	100 ns	100 ns	100 ns
glyphosate	0.125	98 A	142	108	90	100	86	81	110	111	121	103	93	111	99	151 A	69	126	521	77
glyphosate	0.250	88 A	148	202	97	100	86	136	126	133	117	94	93	134	210	133 A	115	213	286	98
glyphosate	0.500	18 B	56	60	74	93	46	151	164	95	79	97	87	91	63	47 B	69	156	93	77
picloram	0.000	100 ns	100 ns	100 ns	100 ns	100 ns	100 ns	100 ns	100 ns	100 ns	100 B	100 ns	100 ns	100 ns	100 ns	100 ns	100 ns	100 ns	100 ns	100 ns
picloram	0.250	100	73	69	97	95	104	91	95	109	152 B	129	108	128	84	204	102	117	177	139
picloram	0.500	100	100	163	100	100	106	121	116	86	328 A	112	104	97	93	200	88	175	253	133
picloram	1.000	88	117	154	97	100	106	102	99	79	186 B	163	114	122	61	192	77	121	245	144
CGA-136872	0.000	100 ns	100 ns	100 B	100 ns	100 ns	100 ns	100 ns	100 ns	100 ns	100 ns	100 ns	100 ns	100 ns	100 B	100 ns	100 ns	100 ns	100 ns	100 ns
CGA-136872	0.013	101	113	1092 A	100	100	131	138	112	180	162	125	108	117	337 A	82	92	121	42	222
CGA-136872	0.027	83	88	854 BA	100	100	97	107	73	230	107	130	99	108	111 B	92	78	79	246	225
CGA-136872	0.054	104	129	596 BA	98	100	124	113	74	398	169	136	105	104	78 B	107	76	129	91	254

1. ns = differences were not significant at P=0.5; means with the same letter in a column are not significantly different at p=0.05.
2. Estimated biomass is expressed as a percentage of estimated biomass in the check. 100 = equivalent to check; 0 = no plants remaining.

Table 2.
Effects of herbicides on second year (1989) plant height.

Herbicide	Rate (lb ai/A)	Blue X Quack-grass	Kenbl. Kent. Blueg.	Reub. Canada Blueg.	Manch. Smooth Brome	Regar Mead. Brome	Common Timothy	Covar Sheep Fesc.	Durar Hard Fesc.	Meck. Sheep Fesc.	Logro Creep Fesc.	Alta Tall Fesc.	Fawn Tall Fesc.	Paiute Orchard Grass	Ephr. Crest. Whtg.	Oahe Inter. Whtg.	Sodar Strm. Whtg.	Redtop	Exer. Redtop	Streak. Redtop
		(cm)																		
triasulfuron	0.000	130 ns	78 ns	58 ns	124 ns	120 ns	126 ns	61 B	80 ns	70 ns	89 ns	106 ns	106 ns	129 ns	91 ns	137 ns	86 ns	73 ns	79 ns	86 ns
triasulfuron	0.013	126	82	56	118	122	123	65 B A	83	72	93	107	107	131	89	143	88	74	79	83
triasulfuron	0.027	120	78	59	121	127	123	72 A	84	72	88	109	102	134	90	142	90	78	75	84
triasulfuron	0.054	123	80	64	121	121	123	61 B	88	70	92	104	107	128	93	135	88	72	78	85
clopyralid	0.000	125 ns	74 ns	60 ns	123 ns	121 ns	127 ns	59 ns	80 ns	74 ns	86 ns	105 B D	106 ns	128 ns	92 ns	132 ns	87 ns	71 ns	75 ns	83 ns
clopyralid	0.220	127	79	65	121	123	128	64	80	71	84	114 B A	107	136	96	134	88	76	74	87
clopyralid	0.450	125	76	60	123	123	127	65	83	69	90	108 B A	101	135	95	133	92	75	73	83
clopyralid	0.900	118	80	68	126	124	127	57	81	73	85	111 B A	100	132	94	145	94	73	77	85
2-4,D	1.000	125	83	64	125	122	129	64	82	73	86	114 B A	107	130	94	130	91	77	81	82
clop+2-4,D	0.45+1	123	87	63	120	126	127	63	86	70	89	115 A	108	129	92	134	91	75	79	83
DPX-G8311	0.000	128 ns	81 ns	59 ns	117 ns	122 ns	126 ns	65 ns	84 ns	69 ns	85 ns	108 ns	101 ns	129 ns	96 ns	139 ns	81 ns	76 ns	74 ns	79 ns
DPX-G8311	0.016	126	84	59	122	127	125	63	80	73	86	109	104	122	94	144	85	77	76	82
DPX-G8311	0.023	129	77	60	120	127	126	66	81	71	88	109	106	124	95	141	90	78	75	80
DPX-G8311	0.031	135	80	61	119	131	123	65	82	75	89	108	103	122	95	141	85	70	82	84
chlorsulfuron	0.000	123 ns	83 ns	61 ns	116 ns	122 ns	126 ns	66 ns	74 C	71 ns	84 ns	104 ns	105 ns	128 ns	94 ns	142 ns	86 ns	77 ns	69 ns	86 ns
chlorsulfuron	0.016	124	77	56	124	121	126	64	85 B A	67	85	106	112	130	89	137	81	80	69	87
chlorsulfuron	0.023	127	83	59	122	124	127	64	80 B A	68	83	107	110	132	94	148	88	78	79	86
chlorsulfuron	0.031	125	79	60	126	128	129	65	88 B A	70	88	102	105	126	97	144	92	77	74	89
glyphosate	0.000	127 B A	80 ns	59 ns	123 ns	122 ns	130 A	63 ns	82 B A	77 ns	92 ns	110 ns	108 ns	129 ns	85 ns	137 ns	87 B A	71 ns	71 ns	82 AB
glyphosate	0.125	122 B C	81	63	121	126	124 B A	67	90 A	71	96	108	111	123	91	137	80 B A	73	75	87 A
glyphosate	0.250	118 B C	81	57	119	126	131 A	64	82 B A	70	90	109	111	127	92	140	81 B A	75	68	85 A
glyphosate	0.500	101 D	82	55	112	121	118 B	62	81 B A	68	85	111	103	123	83	125	69 D C	67	68	73 B
picloram	0.000	126 ns	81 ns	62 ns	123 ns	119 ns	126 ns	67 ns	76 ns	69 ns	83 ns	97 ns	101 ns	115 ns	92 A	133 ns	72 ns	74 ns	73 ns	82 ns
picloram	0.250	122	80	58	112	122	124	63	82	70	82	97	106	125	89 AB	136	87	73	75	80
picloram	0.500	120	82	61	119	119	122	64	79	68	83	95	106	128	85 AB	132	79	78	74	82
picloram	1.000	117	81	60	116	122	123	66	80	68	85	97	108	124	81 B	135	78	69	72	80
CGA-136872	0.000	127 ns	79 ns	61 ns	119 ns	127 ns	127 ns	61 ns	83 ns	72 ns	88 ns	108 ns	106 ns	132 ns	94 ns	139 ns	90 A	75 ns	71 ns	77 B
CGA-136872	0.013	129	83	60	120	122	125	63	83	69	92	106	104	126	94	132	65 D	76	74	89 A
CGA-136872	0.027	121	82	59	121	121	125	63	81	74	88	105	109	128	92	134	85 B A	74	75	86 A
CGA-136872	0.054	120	78	59	123	123	125	60	82	74	88	101	106	126	96	136	85 B A	79	74	87 A

1. ns = differences were not significant at P=0.5; means with the same letter in a column within a herbicide are not significantly different at p=0.05.

Table 3.
Effects of herbicides on second year (1989) node length.

Herbicide	Rate (lb ai/A)	Blue X Quack-grass	Kenbl. Kent. Blueg.	Reub. Canada Blueg.	Manch. Smooth Brome	Regar Mead. Brome	Common Timothy	Covar Sheep Fesc.	Durar Hard Fesc.	Meck. Sheep Fesc.	Logro Creep Fesc.	Alta Tall Fesc.	Fawn Tall Fesc.	Paiute Orchard Grass	Ephr. Crest. Whtg.	Oahe Inter. Whtg.	Sodar Strm. Whtg.	Redtop	Exer. Redtop	Streak. Redtop
		(cm)																		
triasulfuron	0.000	59 ns	48 ns	35 ns	45 ns	55 ns	38 ns	51 ns	72 ns	59 ns	57 ns	64 ns	53 ns	44 ns	36 ns	56 A	46 ns	31 A	28 ns	33 ns
triasulfuron	0.013	53	42	34	45	54	37	48	69	61	65	54	58	44	34	46 B	42	23 B	30	32
triasulfuron	0.027	50	44	36	46	51	36	55	71	61	63	64	55	49	33	63 A	40	28 AB	27	32
triasulfuron	0.054	49	45	40	48	51	37	52	73	60	61	56	54	48	36	56 A	42	27 AB	30	34
clopyralid	0.000	53 ns	48 ns	37 ns	44 ns	55 ns	38 ns	51 ns	70 ns	63 ns	64 ns	59 ns	63 ns	51 ns	35 ns	48 ns	46 ns	29 ns	26 ns	34 ns
clopyralid	0.220	54	47	33	50	53	38	53	72	60	63	60	54	53	34	54	47	28	26	32
clopyralid	0.450	53	43	35	44	56	41	53	68	61	63	58	58	47	32	50	41	30	31	32
clopyralid	0.900	47	46	40	47	55	46	47	75	57	66	67	62	50	36	57	42	27	33	31
2-4,D	1.000	52	47	39	46	56	41	55	68	59	60	66	64	50	32	51	44	28	29	31
clop+2-4,D	0.45+1	45	50	39	50	57	38	50	69	60	64	61	60	46	34	58	42	26	28	38
DPX-G8311	0.000	49 ns	43 ns	38 ns	40 ns	51 ns	37 ns	56 ns	73 ns	57 ns	61 ns	58 ns	56 ns	45 ns	36 ns	49 ns	43 ns	29 ns	27 ns	31 ns
DPX-G8311	0.016	47	41	38	45	58	41	55	70	61	61	60	60	44	32	54	43	26	28	30
DPX-G8311	0.023	53	42	37	44	55	36	55	66	58	64	59	57	44	37	54	48	29	27	25
DPX-G8311	0.031	52	46	39	43	53	33	55	70	60	59	60	59	47	35	53	45	27	31	33
chlorsulfuron	0.000	42 B	42 ns	35 ns	47 ns	53 ns	38 ns	54 ns	64 ns	59 ns	60 ns	61 ns	58 ns	48 ns	36 ns	57 ns	45 ns	34 ns	28 ns	31 ns
chlorsulfuron	0.016	49 AB	44	33	41	52	41	54	71	60	59	59	59	47	34	59	44	31	26	33
chlorsulfuron	0.023	52 AB	47	35	45	54	37	51	68	52	64	64	62	47	35	53	44	33	27	35
chlorsulfuron	0.031	54 A	43	32	46	56	47	49	73	60	66	56	58	48	37	56	41	29	27	31
glyphosate	0.000	52 ns	44 ns	36 ns	47 ns	56 ns	41 ns	54 ns	69 ns	71 A	63 ns	61 ns	60 ns	46 ns	34 ns	52 ns	43 ns	28 ns	29 ns	35 ns
glyphosate	0.125	56	45	35	48	54	41	56	77	61 AB	66	61	62	47	36	59	44	28	27	33
glyphosate	0.250	51	44	36	50	54	43	55	74	62 AB	64	57	61	50	38	57	42	26	27	35
glyphosate	0.500	47	49	37	40	52	44	51	66	57 B	56	59	53	47	35	54	41	27	28	30
picloram	0.000	60 ns	41 ns	42 A	51 ns	58 ns	42 ns	55 ns	64 ns	60 ns	63 ns	53 ns	64 ns	42 ns	34 ns	53 ns	36 ns	28 ns	29 ns	35 ns
picloram	0.250	51	48	33 B	47	58	40	52	70	61	62	59	59	50	33	50	44	28	30	32
picloram	0.500	55	45	34 B	43	49	39	49	65	59	61	56	58	45	38	57	42	27	30	30
picloram	1.000	51	42	36 AB	47	54	40	51	65	60	65	56	59	48	34	54	37	29	27	30
CGA-136872	0.000	54 ns	42 ns	37 ns	46 ns	54 ns	41 ns	53 ns	70 ns	61 ns	64 ns	61 ns	55 ns	46 ns	34 ns	59 ns	39 ns	28 ns	23 B	29 ns
CGA-136872	0.013	51	44	33	45	57	35	49	70	59	63	55	56	48	35	55	37	28	28 B A	33
CGA-136872	0.027	52	45	34	45	54	38	49	68	64	64	56	58	51	37	55	41	31	27 B A	32
CGA-136872	0.054	53	46	36	46	57	37	49	69	64	59	54	53	43	37	60	39	33	32 A	31

1. ns = differences were not significant at P=0.5; means with the same letter in a column are not significantly different at p=0.05.

Tolerance of fescues and other fine-leaf grasses to glyphosate. Callihan R.H. and L.W. Lass. Establishing a weed-free grass stand is an important step in many management situations. This study examines the tolerance of nine turf and forage grass seedlings to glyphosate in four replicates. The nine grass taxa used for this test were: sheep fescue (Festuca ovina L. cv. Covar); hard fescue (Festuca ovina L. spp. duriuscula cv. Durar); Idaho fescue (Festuca idahoensis Elmer); creeping fescue (Festuca rubra L.); tall fescue (Festuca arundinacea Schreb. cv. Fawn and Alta); chewings fescue (Festuca rubra L. var commutata); Canada bluegrass (Poa compressa L. cv. Reubens); and redtop (Agrostis alba L. cv. Alba). Glyphosate was applied at rates of 0.25, 0.38, 0.5, 0.75, 1.0 and 1.5 lb ai/a and a check.

Each grass was planted in strips 8 by 105 ft with a seven-row gandy box drill with 7 inch row spacing on May 16, 1989. The planting depth was 3/4 inch.

The glyphosate was applied after all species (except Idaho fescue) were at least 90% emerged. Seedling sizes ranged from 1/4 to 1 inch in height at the time of application. Plant populations ranged from 5 to 10 plants per ft of row, except Idaho fescue, which produced fewer than 1 per ft of row. Glyphosate was applied June 6 in 15 by 72 ft strips across the grass taxa to form a strip-strip block design. Treatments were applied with a motorized plot sprayer using flat fan nozzles (TeeJet 8001) operated at 2.61 mph and delivering 7.9 gal/a. Application was between 09:07 and 10:52 am. The air temperature was 75F and the wind was 2 to 4 mph from the west. Soil temperatures were 102F at surface, 71F at 2 inches depth, and 64F at 6 inches depth. The relative humidity was 43%. The sky was clear and dew was not present. Grass height measurements and a visual estimate of the percentage of the leaves showing chlorotic and necrotic lesions were made June 28.

Height reduction appeared to occur in all grasses treated with 0.75 lb ai/a glyphosate. Grasses not showing height reductions at 0.5 lb ai/a were Covar sheep fescue, Durar hard fescue, Reubens Canada bluegrass and Fawn tall fescue. Creeping red fescue, and chewings fescue heights were not affected by 0.38 lb ai/a glyphosate. Alta tall fescue height was not effected by 0.25 lb ai/a. Glyphosate treatments at all rates reduced Redtop height by more than 50%.

Grasses showing less than 30% chlorosis at 0.5 lbs ai/a were Alta tall fescue, chewings fescue, Durar hard fescue, Reubens Canada bluegrass, and redtop. Creeping red fescue and Fawn tall fescue showed less than 30% chlorosis at 0.38 lb ai/a. Covar sheep fescue, Alta tall fescue, chewings fescue, creeping red fescue, and Reubens Canada bluegrass did not show chlorosis.

Some tolerance of fescue and other grass taxa to low doses of glyphosate would indicate the possible use of glyphosate in weed management of seedling grass fields such as CRP. The ability of fescues and other grasses to take advantage of reduced weed competition resulting from glyphosate treatment will be evaluated when the treated grasses are measured next spring. (University of Idaho, Dept. of P.S.& E.S., Moscow 83843)

Effects of glyphosate on seedling grasses.

Grass	Rate	Height	Chlorosis
	(lb ai/a)	(cm)	(%)
Fescue, Alta tall	0.00	10.3	0.0
	0.25	9.9	5.0
	0.38	5.3	10.0
	0.50	5.8	22.5
	0.75	4.0	67.0
	1.00	4.3	74.5
	1.50	4.0	75.0
Fescue, chewings	0.00	7.5	0.0
	0.25	3.8	0.0
	0.38	4.3	15.0
	0.50	2.3	25.0
	0.75	2.0	25.0
	1.00	1.3	27.5
	1.50	1.5	51.3
Fescue, Covar sheep	0.00	2.0	0.0
	0.25	1.9	0.0
	0.38	2.3	52.5
	0.50	1.5	92.0
	0.75	0.8	22.5
	1.00	0.8	27.5
	1.50	0.0	75.0
Fescue, creeping red	0.00	8.8	0.0
	0.25	8.5	0.0
	0.38	6.0	7.5
	0.50	4.3	47.5
	0.75	3.9	65.0
	1.00	2.8	80.0
	1.50	2.8	50.0
Fescue, Durar hard	0.00	6.0	0.0
	0.25	6.8	0.0
	0.38	3.8	30.0
	0.50	2.8	28.8
	0.75	3.5	52.5
	1.00	2.0	52.0
	1.50	0.8	75.0
Bluegrass, Reubens Canada	0.00	5.4	0.0
	0.25	3.5	0.0
	0.38	3.0	27.5
	0.50	4.5	26.3
	0.75	2.0	70.0
	1.00	2.0	55.0
	1.50	0.3	95.0
Fescue, Fawn tall	0.00	8.5	0.0
	0.25	12.5	2.5
	0.38	5.8	27.5
	0.50	6.0	40.0
	0.75	5.5	70.0
	1.00	5.0	67.5
	1.50	3.0	80.0
Fescue, Idaho	0.00	2.8	0.0
	0.25	1.0	0.0
	0.38	0.0	25.0
	0.50	0.0	25.0
	0.75	0.0	25.0
	1.00	0.0	25.0
	1.50	0.0	25.0
Redtop	0.00	9.3	0.0
	0.25	3.5	25.0
	0.38	4.0	27.5
	0.50	4.0	27.3
	0.75	0.0	50.0
	1.00	1.3	65.0
	1.50	3.3	75.0
LSD		3.4	46

Chlorosis is expressed as percent of leaf tissue that was chlorotic or necrotic.

The effects of herbicides on seedling grasses in CRP. L. W. Lass and R. H. Callihan. Weeds often establish to the detriment of conservation plantings and general field health during the process of grass establishment for stabilization of erodible crop lands in the U.S.D.A. Conservation Reserve Program. The tolerances of 20 grass taxa to picloram (4, 8, 16 oz ai/a and a check); clopyralid (3.5, 7, 14 oz ai/a and a check), clopyralid plus 2,4-D (7 + 16 oz ai/a); 2,4-D (16 oz ai/a), DPX-G8311 (0.25, 0.37, 0.5 oz ai/a and a check), chlorsulfuron (0.25, 0.37, 0.5 oz ai/a and a check); triasulfuron (0.2, 0.4, 0.8 oz ai/a and a check); CGA-136872 (primisulfuron) (0.2, 0.4, 0.8 oz ai/a and a check), and glyphosate (4, 8, 16 oz ai/a and a check) were tested in the field.

Grass seedlings were:

Bluegrass, Canada (Poa compressa L. cv. Reubens)
Bluegrass, Sherman Big (Poa secunda Presl. (P. ampla)
Brome, Smooth (Bromus inernmis Leys. cv. Manchar)
Brome, Meadow (Bromus biebersteinii cv. Regar)
Fescue, Tall (Festuca arundinaceae Schreb. cv. Alta)
Fescue, Chewings (Festuca rubra L.)
Fescue, Sheep (Festuca ovina L. cv. Covar)
Fescue, Hard (Festuca ovina (L.) Koch var. duriuscula cv. Durar)
Fescue, Tall (Festuca arundineae Schreb. cv. Fawn)
Fescue, Creeping red (Festuca rubra L. cv. Novarubra)
Orchardgrass (Dactylis glomerata L. cv. Paiute)
Redtop, Alba (Agrostis alba L. cv. Alba)
Timothy (Phleum pratense L. cv. Climax)
Wheatgrass, Crested (Agropyron cristatum Gaerthn. cv Hycrest)
Wheatgrass, Crested (Agropyron cristatum Gaerthn. cv. Ephriam)
Wheatgrass, pubescent (Thinopyrum intermedium spp barbulatum (Schu) Bakw. cv. Luna (Agropyron tricophorum))
Wheatgrass, Crested (Agropyron desertorum (Fischer ex Link) Shultes)
Wheatgrass, Intermediate (Thinopyrum intermedium spp. intermedium (Host) Bark. & D.R. Dewey (Agropyron intermedium (Host)Beauv.)cv. Oahe)
Wheatgrass, Bluebunch (Pseudoroegneria spicata (Nevski) A. Love (Agropyron spicatum (Pursh) S. & S. cv. Secar))
Wheatgrass, Streambank (Agropyron riparium Schribn. & Smith cv. Sodar)

The experiment was initiated on May 5, 1989 near Joel, Id. Replicates 1 and 2 were on a Southwick silt loam and replicate 3 and 4 were on a Larkin silt loam. Plots were tilled and rolled with a soil packer on May 25, 1989. The grasses were planted on June 15, 1989 using a 4 ft drill with press wheels, calibrated to deliver 13 lbs/a rice hulls. The row spacing was 7 inches and the depth of planting was 1/2 to 3/4 inches. Rice hulls were used to adjust seed volume to a constant seeding rate to compensate for different grass seed sizes. Plots were treated with a 2% v/v clopyralid solution using a rope wick applicator for control of Canada thistle after grass emergence.

Herbicide treatments were applied in 20 gal/a water carrier with flat-fan nozzles (TeeJet 8002), except for glyphosate treatments, which were applied at 10 gal/a with flat-fan nozzles (TeeJet 8001), from a tractor-mounted plot sprayer operated at 1.7 mph. Application started on June 27, but rain delayed completion until July 1. Grass seedling size was 1 to 3 inches at the time of treatment.

Grass height was measured the second week of September. Grasses not showing herbicide injury symptoms were Covar sheep fescue, Fawn tall fescue and Oahe intermediate wheatgrass. Tolerance to all herbicides except glyphosate was found in seedlings of: Secar bluebunch wheatgrass; Reubens Canada bluegrass, Sherman big bluegrass; Manchar smooth brome; Regar meadow brome; Alta tall fescue; Durar hard Fescue; Paiute orchardgrass; Climax Timothy; Hycrest crested wheatgrass; Ephraim crested wheatgrass; Luna pubescent wheatgrass; Nordan crested wheatgrass; and Sodar streambank wheatgrass.

Grasses surviving glyphosate postemergence treatments at all rates include Chewing fescue, Covar sheep fescue, Fawn tall fescue, and Oahe intermediate wheatgrass. A slight tolerance to glyphosate at 0.25 lb ai/a, but not at higher rates was detected in Regar brome, Alta tall fescue, Durar hard fescue, and Nordan crested wheatgrass.

Height of redtop was reduced 40 % by 0.4 oz/a chlorsulfuron and tended to be lower at other rates. Common timothy height was reduced 48% by 0.5 oz/a of chlorsulfuron. CGA-136872 at 0.4 oz ai/a reduced the height of Chewing fescue by 46%.

This study validates previously observed tolerance of Covar sheep fescue to the tested herbicides of a previous study. Grass seedlings tolerant to all herbicides except glyphosate were those of bluegrass, creeping red fescue, and Oahe intermediate wheatgrass. The results of these studies suggest that seedlings of some taxa are not injured by effective rates of these herbicides, when used for postemergence weed control. It is apparent however, that responses of any given grass taxon to these herbicides may not be accurately predicted without confirming field data. (Univ. of Idaho, Dept. of P.S.&E.S., Moscow 83843)

Effect of herbicides on height of seedling grasses.

Herbicide	Rate	Reubens Canada Blueg.	Sherman Big Blueg.	Manchar Smooth Brome	Regar Meadow Brome	Alta Tall Fescue	Chewing Fescue	Creep. Red Fescue	Covar Sheep Fescue	Durar Hard Fescue	Fawn Tall Fescue	Paiute Orchard	Redtop	Common Timothy	Secar Blueb. Wheatg.	Ephraim Crested Wheatg.	Hycrest Crested Wheatg.	Luna Pubesc. Wheatg.	Nordan Crested Wheatg.	Oahe Interm. Wheatg.	Sodar Streamb. Wheatg.
	(oz ai/A)	(cm)																			
triasulfuron	0	12 ns[1]	17 ns	24 ns	20 ns	22 ns	9 ns	12 ns	7 ns	12 ns	26 ns	22 ns	17 ns	16 ns	21 ns	24 ns	27 ns	29 ns	23 ns	26 ns	20 ns
triasulfuron	0.2	8	16	24	22	21	11	10	5	11	25	24	18	13	20	19	24	29	25	24	21
triasulfuron	0.4	10	18	22	20	19	11	12	6	9	20	23	12	13	25	27	28	31	20	19	23
triasulfuron	0.8	8	20	24	10	19	8	10	6	10	21	23	12	12	19	24	27	25	20	22	22
chlorsulfuron	0	12 ns	22 ns	24 ns	11 ns	20 ns	10 ns	12 ns	6 ns	12 ns	23 ns	24 ns	23 A	17 A	24 ns	26 ns	26 ns	27 ns	17 ns	25 ns	21 ns
chlorsulfuron	0.3	10	20	28	19	23	10	14	6	10	22	24	18 AB	15 AB	23	23	27	28	18	22	21
chlorsulfuron	0.4	7	21	28	18	22	11	13	6	13	24	24	14 B	14 AB	18	24	25	30	24	26	21
chlorsulfuron	0.5	11	24	24	21	21	10	12	5	13	20	22	17 AB	9 B	20	21	25	26	19	23	22
clopyralid	0	11 ns	16 ns	25 ns	18 ns	24 ns	13 ns	11 B	6 ns	11 ns	21 ns	23 ns	16 AB	17 ns	23 ns	20 ns	23 ns	24 ns	17 ns	20 ns	21 ns
clopyralid	3.5	8	17	27	19	20	12	12 B	6	15	20	23	24 A	14	21	25	22	25	18	22	17
clopyralid	7	10	23	27	19	24	12	16 A	7	12	27	23	22 AB	14	25	22	28	26	20	22	18
clopyralid	14	9	20	25	25	23	12	14 BA	7	11	23	20	19 AB	14	26	22	26	31	15	25	20
2,4-D	16	8	17	22	19	23	12	12 BA	6	12	22	23	14 B	19	24	24	28	27	19	26	16
clop+2,4D	7+16	8	18	23	20	22	12	12 B	6	11	28	22	21 AB	15	25	19	26	26	20	20	20
DPX-G8311	0	11 ns	24 ns	19 ns	21 ns	23 ns	12 ns	12 ns	5 ns	12 ns	25 ns	21 ns	16 AB	16 ns	25 ns	22 ns	27 ns	19 ns	20 ns	19 ns	17 ns
DPX-G8311	0.3	9	17	21	23	19	9	12	5	10	20	19	20 A	16	27	25	25	20	20	23	19
DPX-G8311	0.4	9	17	23	28	25	11	13	6	10	21	21	11 B	10	20	24	28	26	19	23	22
DPX-G8311	0.5	8	18	18	28	20	10	14	6	10	20	18	16 B	11	20	23	31	22	17	24	20
glyphosate	0	10 A	18 B A C	25 B A C	19 B A	25 A	9 ns	13 B	6 ns	11 AB	20 ns	22 A	18 AB	15 A	19 A	26 A	26 A	24 A	20 A	18 ns	22 A
glyphosate	4	4 B	7 E D	14 D E	13 B A	17 BC	6	7 C	5	13 A	18	13 B	10 C	2 C	9 B	16 B	14 B	15 B	15 A	23	16 B
glyphosate	8	1 B	5 E	11 F E	6 C	14 C	6	7 CD	5	8 B	14	11 B	8 C	3 C	3 B	6 C	8 BC	12 B	12 B	13	9 C
glyphosate	16	0 B	4 E	7 F	7 B C	13 C	7	6 D	4	7 B	13	10 B	3 C	2 C	8 B	4 C	1 C	0 C	6 C	11	0 D
picloram	0	12 ns	20 ns	23 ns	18 ns	29 ns	11 ns	14 ns	6 ns	12 ns	20 ns	21 ns	14 ns	14 ns	24 ns	21 ns	27 ns	26 ns	19 ns	25 ns	22 ns
picloram	4	11	17	21	24	23	12	15	5	13	25	23	19	18	26	20	25	24	22	27	21
picloram	8	12	21	25	18	26	12	14	7	15	27	20	19	17	17	19	30	26	20	28	23
picloram	16	13	23	23	18	25	11	14	8	14	25	23	18	17	24	18	25	30	20	24	17
CGA-136872	0	9 ns	20 ns	24 ns	20 ns	24 ns	11 A	12 ns	7 ns	11 ns	26 ns	19 ns	16 ns	15 ns	26 ns	24 ns	27 ns	28 ns	18 ns	26 ns	23 ns
CGA-136872	0.2	7	14	23	10	18	9 AB	12	7	10	23	27	16	11	25	16	22	27	17	20	18
CGA-136872	0.4	7	16	24	8	17	6 B	11	7	10	21	25	12	12	22	19	22	27	17	25	22
CGA-136872	0.8	7	15	18	22	19	7 AB	9	5	10	21	19	9	13	18	21	22	22	13	23	19

1. n.s. = differences were not significant at P=0.5; means with the same letters in a column are not significantly different at P=0.05. Means are rounded to signifincant digit.

PROJECT 3

UNDESIRABLE WOODY PLANTS

Mike Newton - Project Chairperson

Broadcast spraying of snowbrush ceanothus and greenleaf manzanita. Cole, E.C., and M. Newton. Snowbrush ceanothus and greenleaf manzanita are serious competitors for moisture and nutrients in ponderosa pine plantations. A study was initiated to determine the efficacy of broadcast spraying for control of the two species. The site, located about 12 miles east of Bend, Oregon, was part of a large wildfire in 1979, and both species originated from seed after the fire. Ceanothus varied from 0.3 to 1 m tall and manzanita 0.3 to 1.3 m tall at the time of treatment. Ponderosa pine had been planted five years prior to treatment.

Treatments, including untreated controls, were randomly assigned to plots and replicated twice. Each plot was 3.7 m by 21.9 m. Liquid herbicides were applied at 207 kPa using a nitrogen pressurized sprayer which consisted of a boom mounted with 8 nozzles (8015 teejet). Spray volume was 108 l/ha. Granular applications were applied with a whirlybird fertilizer spreader. Liquid applications were made April 15, 1988 and granular on December 8, 1988.

Plots were evaluated in late August 1989 for crown reduction and stem dieback on shrubs and pine injury. Pine injury was rated on a six-point scale--0) no injury; 1) minor injury to foliage; 2) injury to buds; 3) slight terminal dieback; 4) severe terminal dieback and loss of foliage; and 5) dead.

Snowbrush Ceanothus. Only two treatments resulted in greater than 80 percent crown reduction--imazapyr at 0.8 and 1.1 kg/ha (Table 1). Most of the fluroxypyr and glyphosate treatments were not significantly different from the untreated plots. The sulfometuron, granular hexazinone, and triclopyr ester treatments were intermediate in crown reduction. In the untreated plots, frost injury caused measurable crown reduction to the ceanothus. Resprouting was observed in all herbicide treatments. Stem dieback was generally poor among all treatments (Table 1).

Although the addition of L-77 to fluroxypyr caused a significant increase in crown reduction, the same was not true for glyphosate. Stem dieback was not improved with the addition of L-77 to fluroxypyr. With glyphosate, stem dieback was increased, but was not significantly different from the untreated plots.

Greenleaf Manzanita. As with ceanothus, most of the treatments were ineffective in reducing manzanita (Table 2). For crown reduction, fluroxypyr at 1.1 kg/ha was the best. Five treatments resulted in greater than 50 percent crown reduction--fluroxypyr at 0.8 kg/ha with and without L-77, 2,4-D at 1.1 kg/ha, and imazapyr at 0.8 and 1.1 kg/ha. Most of the remaining treatments were not significantly different from the untreated plots. Treatments that were effective in reducing crowns were also effective on stem dieback.

Addition of L-77 to fluroxypyr significantly increased both crown reduction and stem dieback. Addition of L-77 to glyphosate did not increase efficacy significantly, and glyphosate was ineffective in controlling manzanita.

Ponderosa Pine Injury. Most herbicide treatments did not significantly increase injury rating in pines when compared to the untreated plots (Table 3). The important exception was imazapyr at all rates. Imazapyr treatments resulted in frequent injury to buds as well as top dieback. Because of the growing habit of pines, injury to buds is considered severe, and all seedlings in the imazapyr at 0.8 or 1.1

kg/ha plots had at least injury to buds. Triclopyr ester at 0.8 kg/ha also caused injury to buds on 21 percent of the seedlings. The glyphosate at 1.7 kg/ha treatments caused severe injury to 17 and 12 percent of the pines. In the remaining treatments, injury was limited to minor injury to foliage. (Department of Forest Science, Oregon State University, Corvallis, OR 97331)

Table 1. Crown reduction and stem dieback for snowbrush ceanothus.

Treatment	Rate[1]	Crown Reduction	Stem Dieback
	(kg ai/ha)	--------(%)--------	
Fluroxypyr	0.6	23 h[2]	7 cd
	0.8	23 h	5 d
	1.1	25 gh	5 d
Fluroxypyr + L-77	0.6	37 defg	7 cd
	0.8	32 efgh	7 cd
Glyphosate	0.8	30 efgh	3 d
	1.7	30 efgh	4 d
Glyphosate + L-77	0.8	37 defg	8 cd
	1.7	23 h	4 d
2,4-D	1.1	25 gh	7 cd
Granular hexazinone	1.7	48 cd	7 cd
	3.4	67 b	19 ab
Imazapyr	0.6	48 cd	16 b
	0.8	83 a	26 a
	1.1	85 a	26 a
Sulfometuron	0.1	41 cdef	6 d
	0.2	38 defg	3 d
Triclopyr ester	0.6	43 cde	14 cd
	0.8	52 c	21 ab
Untreated		21 h	2 d

[1] Glyphosate is rate ae/ha.
[2] Means within the same column followed by the same letter are not significantly different at alpha=0.05 using Tukey's.

Table 2. Crown reduction and stem dieback for greenleaf manzanita.

Treatment	Rate[1]	Crown Reduction	Stem Dieback
	(kg ai/ha)	--------(%)--------	
Fluroxypyr	0.6	30 de[2]	11 def
	0.8	52 bc	34 bc
	1.1	77 a	65 a
Fluroxypyr + L-77	0.6	43 cd	20 cde
	0.8	66 ab	47 b
Glyphosate	0.8	1 g	0 f
	1.7	2 g	0 f
Glyphosate + L-77	0.8	1 g	0 f
	1.7	8 fg	4 ef
2,4-D	1.1	53 bc	31 bc
Granular hexazinone	1.7	1 g	0 f
	3.4	7 fg	1 f
Imazapyr	0.6	24 ef	7 def
	0.8	51 bc	18 cde
	1.1	51 bc	22 cd
Sulfometuron	0.1	3 g	1 f
	0.2	3 g	1 f
Triclopyr ester	0.6	2 g	1 f
	0.8	17 efg	9 def
Untreated		0 g	0 f

[1] Glyphosate is rate ae/ha.
[2] Means within the same column followed by the same letter are not significantly different at alpha=0.05 using Tukey's.

Table 3. Ponderosa pine injury.

Treatment	Rate[1]	Injury Rating	Injured	Severely Injured
	(kg ai/ha)		------(%)------	
Fluroxypyr	0.6	0 b[2]	0 c	0 b
	0.8	0 b	0 c	0 b
	1.1	0 b	0 c	0 b
Fluroxypyr + L-77	0.6	0 b	0 c	0 b
	0.8	0 b	0 c	0 b
Glyphosate	0.8	0 b	0 c	0 b
	1.7	0.4 b	33 abc	17 b
Glyphosate + L-77	0.8	0.2 b	33 abc	0 b
	1.7	0.4 b	29 bc	12 b
2,4-D	1.1	0 b	0 c	0 b
Granular hexazinone	1.7	0 b	0 c	0 b
	3.4	0 b	0 c	0 b
Imazapyr	0.6	1.9 a	92 ab	79 a
	0.8	2.3 a	100 a	100 a
	1.1	2.2 a	100 a	100 a
Sulfometuron	0.1	0 b	0 c	0 b
	0.2	0 b	0 c	0 b
Triclopyr ester	0.6	0 b	0 c	0 b
	0.8	0.7 b	21 c	21 b
Untreated		0 b	0 c	0 b

[1] Glyphosate is rate ae/ha.
[2] Means within the same column followed by the same letter are not significantly different at alpha=0.05 using Tukey's.

Directed spraying of snowbrush ceanothus and greenleaf manzanita. Cole, E.C., and M. Newton. Snowbrush ceanothus and greenleaf manzanita are serious competitors for moisture in ponderosa pine plantations. Due to the sensitivity of pine to certain herbicides, broadcast spraying can be damaging. To examine the possibilities of directed spraying for release, a series of plots was established about 12 miles east of Bend, Oregon. The site is part of a large wildfire in 1979, which resulted in snowbrush ceanothus and greenleaf manzanita regenerating by seed. Ceanothus varied from 0.3 to 1 m tall and manzanita 0.3 to 1 m tall at the time of treatment. Ponderosa pine had been planted five years prior to treatment.

Treatments, including untreated controls, were randomly assigned to plots and replicated twice. Plot size varied so that fifteen shrubs of each species were included in the plots. Shrubs were "sprayed just to wet" individually, using a backpack sprayer. During application, volume per shrub was unavoidably greater then during broadcast treatments, but all dosage was focused on target shrubs. Applications were made April 15, 1988.

Plots were evaluated in late August 1989 for crown reduction and stem dieback on shrubs and pine injury. Pine injury was rated on a six-point scale--0) no injury; 1) minor injury to foliage; 2) injury to buds; 3) slight terminal dieback; 4) severe terminal dieback and loss of foliage; and 5) dead.

Snowbrush Ceanothus. The imazapyr application was the best treatment (Table 1). Only the fluroxypyr at 0.6 percent was not significantly different from the untreated plots in terms of crown reduction. For stem dieback, both the fluroxypyr at 0.6 percent and at 1.2 percent were not significantly different from the untreated plots. All other treatments gave moderate control on ceanothus.

Greenleaf Manzanita. Several treatments resulted in 70 percent or greater crown reduction and greater than 50 percent stem dieback (Table 2). Among these, fluroxypyr at 2.4 percent and triclopyr ester plus 2,4-D at 0.5 plus 0.5 percent were the best.

Ponderosa Pine Injury. The imazapyr treatment was the only treatment that caused severe injury to pines (Table 3). Most of the seedlings in these plots had some degree of bud injury, even though seedlings were not directly sprayed. Soil uptake of the chemical must have occurred, and this caused severe injury to pines that were in the vicinity of treated shrubs. For the other herbicide treatments, soil uptake was not a factor, and no significant injury was apparent.

Directed spray treatments with fluroxypyr, triclopyr ester plus 2,4-D, and triclopyr ester offer the potential for effective shrub control with minimal injury to pines. The triclopyr ester plus 2,4-D at 0.5 % plus 0.5 % directed spray is likely the most cost-effective treatment observed. The economy of not spraying non-target areas permits not only a moderate investment in hand labor, but also a dosage that provides more control than achievable broadcast in any current release treatments, especially on snowbrush ceanothus. (Department of Forest Science, Oregon State University, Corvallis, OR 97331)

Table 1. Crown reduction and stem dieback for snowbrush ceanothus.

Treatment	Concentration	Crown Reduction	Stem Dieback
	(%)	---(%)---	
Fluroxypyr	0.6	21 cd[1]	6 e
	1.2	32 c	10 de
	2.4	52 b	24 cd
Imazapyr	1.25	99 a	69 a
Triclopyr ester	0.5	52 b	26 c
	1.0	60 b	42 b
Triclopyr ester + 2,4-D	0.5+0.5	59 b	35 bc
Untreated		10 d	4 e

[1] Means within the same column followed by the same letter are not significantly different at alpha=0.05 using Tukey's.

Table 2. Crown reduction and stem dieback for greenleaf manzanita.

Treatment	Concentration	Crown Reduction	Stem Dieback
	(%)	---(%)---	
Fluroxypyr	0.6	57 b[1]	33 bc
	1.2	75 a	52 ab
	2.4	86 a	73 a
Imazapyr	1.25	78 a	51 ab
Triclopyr ester	0.5	32 c	16 cd
	1.0	70 ab	57 ab
Triclopyr ester + 2,4-D	0.5+0.5	86 a	73 a
Untreated		1 d	0 d

[1] Means within the same column followed by the same letter are not significantly different at alpha=0.05 using Tukey's.

Table 3. Ponderosa pine injury.

Treatment	Concentration	Injury Rating	Injured	Severely Injured
	(%)		------(%)------	
Fluroxypyr	0.6	0 b[1]	0 b	0 b
	1.2	0 b	0 b	0 b
	2.4	0 b	0 b	0 b
Imazapyr	1.25	2.5 a	93 a	85 a
Triclopyr ester	0.5	0.2 b	22 ab	0 b
	1.0	0.1 b	12 b	0 b
Triclopyr ester + 2,4-D	0.5+0.5	0 b	0 b	0 b
Untreated		0.2 b	33 ab	0 b

[1] Means within the same column followed by the same letter are not significantly different at alpha=0.05 using Tukey's.

Effect of three adjuvants on herbicide activity on gorse. Burrill, L., L. Cannon, R. Duddles, and A. Poole. Gorse is a dense, spiny, evergreen legume shrub which infests more than 30,000 acres in the southern coastal counties of Oregon. Several herbicides control the foliage of gorse and in some cases good control of the crowns and roots is observed as well. Addition of a surfactant or an oil to a spray mixture is generally considered to improve herbicide entry into gorse plants, but few experiments have been reported on this subject (see Proceedings, Western Weed Science Society Vol. 42, 1989, page 156).

A field experiment was conducted north of Port Orford in Curry County, Oregon, to test the effect of three adjuvants, Surphtac, Silwet L-77, and X-77, on performance of picloram, glyphosate, dicamba, triclopyr, triclopyr plus 2,4-D, 2,4-D LVE, imazapyr, and metsulfuron. Each herbicide was applied at two rates selected to give sub-lethal activity on gorse. The herbicides were applied without additional adjuvants and with the adjuvants at 0.5% by volume of the spray mixture.

On June 7 and 8, 1989, herbicides were applied to single well-established plants that were treated as plots. Treatments were replicated three times. Herbicides were applied through four 8004 flat fan nozzles on a hand-held boom that was moved over the plants twice at right angles. Herbicides and adjuvants were added to water to make 1 gallon of spray mix at the desired concentration.

Evaluations were made on June 30, 1989,only 23 days after application, and on November 22, 1989. At the first evaluation there was little, if any, response to the adjuvants in most of the treatments. Two major exceptions were with glyphosate and with the amine form of triclopyr. With glyphosate Silwet L-77 increased activity considerably compared to the other adjuvants. The most interesting response to adjuvants occurred with triclopyr amine, which was much more active in combination with Silwet L-77 than with other adjuvants or compared to triclopyr ester.

When evaluations were made on November 22, the increased activity of glyphosate due to Silwet L-77 was still visible, but the overall control level was down from the earlier reading. For a fast acting herbicide such as glyphosate this recovery from a sub-lethal rate is not surprising. Triclopyr and triclopyr plus 2,4-D gave complete control, so no differences due to adjuvants occurred. The addition of Silwet L-77 made imazapyr a good herbicide on gorse while it did not give adequate control with X-77 or Surphtac. X-77 and Silwet L-77 increased the activity of metsulfuron to nearly complete control. Surphtac increased metsulfuron activity, but to a lesser extent. We plan to make a third evaluation in the summer of 1990. (Coos County Extension and Department of Crop Science, Oregon State University, Corvallis, OR 97331)

Gorse control with herbicides and adjuvants
Cape Blanco Properties
Curry Co., Oregon

	% Surf. Conc.	% Herb. Conc.	June 30, 1989 R1	R2	R3	Avg.	November 22, 1989 R1	R2	R3	Avg.
			-----% control-----							
2,4-D LVE	0	.5	30	20	20	23	80	100	95	92
2,4-D LVE	0	1.0	30	30	30	30	100	100	100	100
2,4-D + Surphtac	.5	.5	40	30	30	33	80	95	95	90
2,4-D + Surphtac	.5	1.0	30	20	30	27	95	95	85	92
2,4-D + Silwet L-77	.5	.5	40	30	40	37	95	95	95	95
2,4-D + Silwet L-77	.5	1.0	40	30	40	37	100	95	95	97
2,4-D + X-77	.5	.5	20	30	40	30	90	95	95	93
2,4-D + X-77	.5	1.0	30	30	30	30	100	100	100	100
Imazapyr	0	.75	10	0	10	7	25	30	20	25
Imazapyr	0	1.5	0	0	0	0	50	40	30	40
Imazapyr + Surphtac	.5	.75	0	0	0	0	25	40	40	35
Imazapyr + Surphtac	.5	1.5	10	10	10	10	80	45	45	57
Imazapyr + Silwet L-77	.5	.75	10	10	10	10	90	80	80	83
Imazapyr + Silwet L-77	.5	1.5	20	10	10	13	100	90	95	95
Imazapyr + X-77	.5	.75	10	10	10	10	50	50	20	40
Imazapyr + X-77	.5	1.5	10	10	10	10	30	75	80	62
Metsulfuron	0	.25 oz.	10	10	10	10	40	20	20	27
Metsulfuron	0	.5 oz.	10	10	10	10	30	60	40	43
Metsulfuron + Surphtac	.5	.25 oz.	10	10	10	10	50	70	60	60
Metsulfuron + Surphtac	.5	.5 oz.	10	10	10	10	70	50	70	63
Metsulfuron + Silwet L-77	.5	.25 oz.	20	10	10	13	100	100	100	100
Metsulfuron + Silwet L-77	.5	.5 oz.	30	10	20	20	95	95	100	97
Metsulfuron + X-77	.5	.25 oz.	10	10	10	10	100	100	95	98
Metsulfuron + X-77	.5	.5 oz.	10	10	10	10	95	95	95	95
Picloram	0	.25	30	20	20	23	60	60	65	62
Picloram	0	.5	30	30	30	30	85	90	90	88
Picloram + Surphtac	.5	.25	30	40	30	33	100	85	85	90
Picloram + Surphtac	.5	.5	30	30	40	33	85	100	100	95
Picloram + Silwet L-77	.5	.25	40	40	30	37	90	85	95	90
Picloram + Silwet L-77	.5	.5	40	40	40	40	85	100	85	90
Picloram + X-77	.5	.25	40	40	40	40	85	100	85	90
Picloram + X-77	.5	.5	30	20	20	23	100	95	100	98
Glyphosate	0	.5	80	90	80	83	75	90	60	75
Glyphosate	0	1.0	80	90	90	87	80	75	70	75
Glyphosate + Surphtac	.5	.5	50	80	70	67	60	80	50	63
Glyphosate + Surphtac	.5	1.0	100	100	80	93	75	100	70	82
Glyphosate + Silwet L-77	.5	.5	100	100	100	100	75	90	85	83
Glyphosate + Silwet L-77	.5	1.0	100	100	90	97	85	90	90	88
Glyphosate + X-77	.5	.5	90	70	70	77	75	50	20	48
Glyphosate + X-77	.5	1.0	100	100	90	97	85	95	85	88

	% Surf. Conc.	% Herb. Conc.	-----% control----- June 30, 1989 R1	R2	R3	Avg.	November 22, 1989 R1	R2	R3	Avg.
Dicamba	0	.5	20	20	20	20	50	50	50	50
Dicamba	0	1.0	20	20	20	20	95	80	80	85
Dicamba + Surphtac	.5	.5	20	20	30	23	50	50	50	50
Dicamba + Surphtac	.5	1.0	30	30	30	30	75	70	70	72
Dicamba + Silwet L-77	.5	.5	30	40	40	37	80	80	85	82
Dicamba + Silwet L-77	.5	1.0	30	40	40	37	70	90	85	82
Dicamba + X-77	.5	.5	30	20	20	23	40	40	40	40
Dicamba + X-77	.5	1.0	30	30	30	30	60	60	50	57
Triclopyr 4-E	0	.67	30	40	40	37	100	100	100	100
Triclopyr 4-E	0	1.3	30	30	30	30	100	100	100	100
Triclopyr 4-E + Surphtac	.5	.67	30	30	30	30	100	95	100	98
Triclopyr 4-E + Surphtac	.5	1.3	30	30	30	30	100	100	100	100
Triclopyr 4-E + Silwet L-77	.5	.67	40	40	40	40	100	90	100	97
Triclopyr 4-E + Silwet L-77	.5	1.3	100	100	100	100	100	100	100	100
Triclopyr 4-E + X-77	.5	.67	40	40	40	40	100	100	100	100
Triclopyr 4-E + X-77	.5	1.3	20	20	20	20	100	100	100	100
Triclopyr 3A	0	.67	20	30	30	27	100	100	100	100
Triclopyr 3A	0	1.3	20	20	20	20	100	100	100	100
Triclopyr 3A + Surphtac	.5	.67	30	40	30	33	100	100	100	100
Triclopyr 3A + Surphtac	.5	1.3	40	30	30	33	100	100	100	100
Triclopyr 3A + Silwet L-77	.5	.67	60	60	50	57	100	95	100	98
Triclopyr 3A + Silwet L-77	.5	1.3	100	100	100	100	100	100	100	100
Triclopyr 3A + X-77	.5	.67	40	40	40	40	100	100	100	100
Triclopyr 3A + X-77	.5	1.3	20	20	20	20	100	100	100	100
Triclopyr + 2,4-D	0	.5	40	30	40	37	100	80	90	90
Triclopyr + 2,4-D	0	1.0	40	40	40	40	100	90	100	97
Triclopyr + 2,4-D + Surphtac	.5	.5	30	40	40	37	100	100	100	100
Triclopyr + 2,4-D + Surphtac	.5	1.0	30	40	40	37	100	100	100	100
Triclopyr + 2,4-D + Silwet L-77	.5	.5	40	40	40	40	100	90	100	97
Triclopyr + 2,4-D + Silwet L-77	.5	1.0	40	40	40	40	100	100	100	100
Triclopyr + 2,4-D + X-77	.5	.5	30	30	30	30	100	100	100	100
Triclopyr + 2,4-D + X-77	.5	1.0	30	30	30	30	100	100	100	100

Triclopyr + 2,4-D was a 1:2 mix marketed as Crossbow

Efficacy of control methods on shrubs on the Kenai Peninsula, Alaska. Cole, E.C., and M. Newton. Rapid shrub growth in clearcut areas in Alaska can decrease growth and survival of naturally-regenerated Sitka spruce. A series of field plots was established on the southern Kenai Peninsula at Windy Bay, Alaska to determine the efficacy of control methods on Sitka alder, salmonberry, and devilsclub.

The site was part of an area that was clearcut over twenty years ago. Shrub vegetation consisted of a mix of salmonberry, devilsclub, and Sitka alder. At the time of treatment, alder was approximately 2 to 2.5 m tall and salmonberry and devilsclub 0.3 to 1 m tall.

All treatments were completely randomized among plots with three replications of each treatment, including an untreated control. Plot size was 17.9 m by 4.6 m (0.008 ha). Dates of application were August 30, 1988 and June 1 (granular) and 4 (liquid), 1989.

Liquid herbicides were applied by backpack sprayer using the "waving wand" technique. Total spray volume was 93.4 l/ha.

Granular applications were made using a rotary fertilizer spreader. To facilitate even dispersal of herbicide material, super-phosphate and ammonium nitrate fertilizers were added to granular imazapyr and hexazinone, respectively, to increase applied volume.

Manual treatments were done by chainsaws and removed all shrubs at approximately 15 cm above the ground. Slash was not removed from the plots.

Plots were evaluated in August, 1989 for crown reduction and stem dieback for Sitka alder, salmonberry, and devilsclub.

Results on Sitka alder ranged from highly effective to poor control (Table 1). The most effective treatments were glyphosate at 1.1 and 1.7 kg/ha and the manual treatments in August and June. In the manual treatments, alder that were not killed were resprouting. Although the liquid imazapyr treatments offered only moderate control, the alder exhibited no new growth. The sulfometuron, triclopyr ester, granular imazapyr, and granular hexazinone treatments were not significantly different from the untreated plots.

Several treatments resulted in excellent (80 percent or greater) control of salmonberry for both crown reduction and stem dieback (Table 2). These included glyphosate at 1.1 and 1.7 kg/ha, granular imazapyr at 0.8 kg/ha, granular imazapyr at 1.7 kg/ha, liquid imazapyr at 0.8 kg/ha, sulfometuron at 0.16 kg/ha, and sulfometuron plus 2,4-D at 0.16 plus 2.2 kg/ha.

Although the 2,4-D and triclopyr ester treatments resulted in 70 percent or greater stem dieback, crown reduction was 56 percent or less. In these treatments, shrubs were frequently killed to the ground, but were resprouting vigorously. This was also the case in the manual treatments; shrubs in these plots had resprouted vigorously and had recovered almost all of pretreatment leaf area.

Most of the treatments were ineffective in controlling devilsclub, resulting in less than 35 percent crown reduction and 30 percent stem dieback (Table 3). However, the glyphosate treatments were more effective. Crown reduction was 85 percent and stem dieback 77 percent for the 1.1 kg/ha rate. For the 1.7 kg/ha treatment, crown reduction was 97 percent and stem dieback 91 percent. Some mortality of devilsclub occurred in both treatments.

Overall, glyphosate at 1.1 and 1.7 kg/ha in August gave the best control on Sitka alder, salmonberry, and devilsclub. Other treatments were as effective on Sitka alder or salmonberry, but not on both species simultaneously. (Department of Forest Science, Oregon State University, Corvallis, OR 97331)

Table 1. Crown reduction and stem dieback for Sitka alder.

Treatment	Rate	Month	Crown Reduction	Stem Dieback
	(kg ai/ha)[1]		--------(%)-------	
2,4-D	2.2	Aug	62 cde[2]	15 c
		June	39 fg	0 c
	4.5	Aug	77 bcd	15 c
		June	58 def	8 c
Glyphosate	1.1	Aug	82 abc	37 b
	1.7	Aug	100 a	93 a
Granular hexazinone	1.7	June	10 hi	8 c
	3.4	June	9 hi	0 c
Granular imazapyr	0.8	June	12 hi	0 c
	1.7	June	26 gh	10 c
Liquid imazapyr	0.6	June	54 ef	12 c
	0.8	June	46 ef	6 c
Manual		Aug	94 ab	98 a
		June	94 ab	100 a
Sulfometuron	0.16	June	16 hi	0 c
Sulfometuron plus 2,4-D	0.16 + 2.2	June	40 fg	5 c
Triclopyr ester	1.1	June	21 ghi	4 c
	1.7	June	18 hi	3 c
Untreated			3 i	1 c

[1] Glyphosate rates are ae/ha.
[2] Means within the same column followed by the same letter are not significantly different at alpha=0.05 using Tukey's.

Table 2. Crown reduction and stem dieback for salmonberry.

Treatment	Rate	Month	Crown Reduction	Stem Dieback
	(kg ai/ha)[1]		---------(%)[2]--------	
2,4-D	2.2	Aug	31 efg[2]	66 bcde
		June	40 def	96 a
	4.5	Aug	38 def	79 abc
		June	37 def	73 abcd
Glyphosate	1.1	Aug	97 ab	93 ab
	1.7	Aug	98 a	90 abc
Granular hexazinone	1.7	June	15 ghi	85 abc
	3.4	June	27 fgh	44 de
Granular imazapyr	0.8	June	80 ab	80 abc
	1.7	June	89 ab	84 abc
Liquid imazapyr	0.6	June	75 bc	90 abc
	0.8	June	86 ab	93 ab
Manual		Aug	0 i	63 cde
		June	5 hi	78 abc
Sulfometuron	0.16	June	94 ab	93 ab
Sulfometuron plus 2,4-D	0.16 + 2.2	June	99 a	94 ab
Triclopyr ester	1.1	June	53 de	95 ab
	1.7	June	56 bc	70 abcd
Untreated			24 fgh	39 e

[1] Glyphosate rates are ae/ha.
[2] Means within the same column followed by the same letter are not significantly different at alpha=0.05 using Tukey's.

Table 3. Crown reduction and stem dieback for devilsclub.

Treatment	Rate	Month	Crown Reduction	Stem Dieback
	(kg ai/ha)[1]		---------(%)--------	
2,4-D	2.2	Aug	0 c[2]	0 c
		June	3 bc	1 c
	4.5	Aug	10 bc	11 bc
		June	18 bc	6 bc
Glyphosate	1.1	Aug	85 a	77 a
	1.7	Aug	97 a	91 a
Granular hexazinone	1.7	June	24 bc	22 bc
	3.4	June	15 bc	12 bc
Granular imazapyr	0.8	June	10 bc	0 c
	1.7	June	11 bc	7 bc
Liquid imazapyr	0.6	June	3 bc	0 c
	0.8	June	16 bc	15 bc
Manual		Aug	8 bc	38 b
		June	16 bc	23 bc
Sulfometuron	0.16	June	32 b	27 bc
Sulfometuron plus 2,4-D	0.16 + 2.2	June	11 bc	0 c
Triclopyr ester	1.1	June	0 c	0 c
	1.7	June	5 bc	1 c
Untreated			2 c	2 bc

[1] Glyphosate rates are ae/ha.
[2] Means within the same column followed by the same letter are not significantly different at alpha=0.05 using Tukey's.

Glyphosate and imazapyr site preparation trials. Cole, E.C., and M. Newton. Site preparation treatments should be able to control a variety of species with low rates of application. A series of field trials was established in the Oregon Coast Range approximately 5 miles from Hoskins to evaluate the efficacy of glyphosate and imazapyr for site preparation on red alder and vine maple. The site was clearcut two years prior to treatment and planted to Douglas-fir one year prior to treatment. Vine maple was primarily from sprout and residual shrub origin and ranged in size from 0.3 to 1 m tall. Red alder was primarily from seed origin and ranged from 0.3 to 2 m tall.

Two sets of plots were established on the site--one in an area dominated by vine maple, the other set a series of roadside plots dominated by red alder. For both sets, treatments were assigned to plots in a completely randomized design, with two replications and including untreated controls.

Red Alder Plots: Plot size was 3.7 m by 4.6 m. Treated plots were sprayed at 207 kPa using a nitrogen pressurized precision sprayer with eight nozzles (8015 teejet) mounted on the boom. Spray volume was 93.4 l/ha; the carrier was water. Application dates were May 19, July 1, and August 26, 1988, and plots were evaluated in June 1989.

There seemed to be different levels of canopy penetration among the red alder treatments. In some, cover was reduced to less than 5 percent for all vegetation. In others, total cover of alder would be 20 to 30 percent, even though the sample alder exhibited almost complete mortality. When shrubs were selected for sampling, only the dominant shrubs were flagged. In plots with low canopy penetration, understory alder would be virtually uninjured. Unfortunately, this difference is not directly reflected within the data. Therefore, data will also be reported with regards to canopy penetration.

The best treatments (Table 1), those with approximately 90 percent crown reduction, greater than 40 percent stem reduction, and high canopy penetration, were all in August and included imazapyr at 0.21 and 0.28 kg/ha and mixtures of glyphosate and imazapyr. In general, treatments were more effective as the growing season progressed from May to August. Canopy penetration appeared to increase as the season progressed, as well.

The additions of small rates of imazapyr increased efficacy over glyphosate alone, especially at the low rates of glyphosate. At 0.6 kg ae/ha of glyphosate, crown reduction was 32 and 39 percent for July and August, respectively. In mixtures with imazapyr, crown reduction increased from 56 to 93 percent, depending upon rate of imazapyr. Even with the addition of only 0.01 kg/ha imazapyr, crown reduction was 68 percent in July and 90 percent in August. However, canopy penetration in these plots and in most other plots with low rates (0.01 and 0.06 kg/ha) of imazapyr was low, and treatments were not as effective overall as those treatments with higher rates (0.14 kg/ha or greater) of imazapyr.

Vine Maple Plots: Plot size was 4.6 m by 8.8 m. Treated plots were sprayed with a backpack sprayer with a single adjustable hollow cone nozzle and using the "waving wand" technique. Spray volume was 93.4 l/ha, and the carrier was water. Application dates were May 19, July 5, and August 26, 1988, and plots were evaluated in June 1989.

Unlike the red alder plots, differences in canopy penetration were not apparent among the treatments. The July treatment results were lower than expected. Upon examination of the field notes, it was recorded that the foliage was wet during application. In addition, 0.1 inch rainfall occurred a few hours after application and without a period of drying.

Eight treatments (all in August) had greater than 90 percent crown reduction and at least 25 percent stem dieback. These included imazapyr at 0.21 and 0.28 kg/ha and mixtures of glyphosate and imazapyr.

The addition of the lowest rate of imazapyr to glyphosate did not increase efficacy. However, efficacy was increased with the addition of 0.06 kg/ha or more imazapyr. Crown reduction without imazapyr ranged from 58 to 73 percent, but, with at least 0.06 kg/ha imazapyr, crown reduction ranged from 85 to 99 percent.

With the 0.14 and 0.21 kg/ha rates of imazapyr, crown reduction did not vary with or without the addition of glyphosate. However, stem dieback increased significantly in most cases. Stem dieback at 0.14 kg/ha imazapyr in August was 18 percent. With 0.6 kg ae/ha glyphosate, stem dieback was 39 percent; with 0.8 kg ae/ha, stem dieback was 51 percent; and with 1.1 kg ae/ha, stem dieback was 46 percent. At the 0.21 kg/ha imazapyr rate in August, stem dieback was 42 percent. With 1.1 kg ae/ha glyphosate added, stem dieback increased to 71 percent.

Several treatments were found to be effective in controlling red alder and vine maple. For red alder, imazapyr alone and mixtures of glyphosate plus at least 0.14 kg/ha imazapyr were the best. Treatments with lower rates of imazapyr had excellent control on sample shrubs, but low canopy penetration and little control on understory alder. Efficacy increased as the season progressed. For vine maple, imazapyr alone and mixtures of glyphosate plus imazapyr gave excellent control on vine maple. The addition of at least 0.06 kg/ha imazapyr to glyphosate increased crown reduction and stem dieback over treatments with glyphosate alone. The addition of at least 0.8 kg ae/ha glyphosate to imazapyr (0.14 and 0.21 kg/ha) significantly increased stem dieback.
(Department of Forest Science, Oregon State University, Corvallis, OR 97331)

Table 1. Crown reduction and stem dieback for red alder.

Treatment	Rate[1]	Month	Crown Reduction	Stem Dieback	Canopy Penetration
	(kg/ha)		(%)		
Glyphosate	0.6	July	32 h[2]	21 ijkl[2]	Low
		Aug	39 gh	12 kl	Low
	0.8	July	85 abcd	79 abcd	Low
		Aug	68 defg	16 jkl	Med
	1.1	July	83 abcde	79 abcd	Low
		Aug	85 abcd	38 fghijk	High
Imazapyr	0.14	May	60 efgh	53 cdefghi	Low
		July	75 abcdef	55 bcdefgh	Low
		Aug	87 abcd	25 hijkl	High
	0.21	May	85 abcd	81 abc	Low
		Aug	97 ab	41 efghijk	High
	0.28	May	79 abcdef	80 abc	Low
		Aug	91 abcd	48 cdefghij	High
Glyphosate +imazapyr	0.6 + 0.01	July	68 defg	53 cdefghi	Low
		Aug	90 abcd	49 cdefghij	Med
	0.6 + 0.01	July	93 abc	93 a	Low
		Aug	81 abcde	29 hijkl	Low
	0.6 + 0.14	July	56 fghi	46 defghij	Med
		Aug	89 abcd	52 cdefghi	High
	0.8 + 0.01	July	70 cdefg	66 abcdefg	Low
		Aug	90 abcd	46 defghij	Med
	0.8 + 0.06	July	90 abcd	89 ab	Low
		Aug	75 bcdef	37 ghijk	Low
	0.8 + 0.14	July	46 ghi	30 hijkl	Low
		Aug	99 a	75 abcd	High
	1.1 + 0.01	July	86 abcd	81 abc	Low
		Aug	92 abcd	72 abcdef	Med
	1.1 + 0.06	July	93 abc	92 a	Low
		Aug	90 abcd	73 abcde	Med
	1.1 + 0.14	July	95 ab	93 a	Med
		Aug	95 ab	70 abcdefg	High
	1.1 + 0.21	Aug	94 ab	64 abcdefg	High
Untreated			1 j	1 l	

[1] Glyphosate rates are ae/ha; imazapyr ai/ha.
[2] Means within columns followed by the same letter are not significantly different at alpha=0.05 using Tukey's.

Table 2. Crown reduction and stem dieback for vine maple.

Treatment	Rate[1]	Month	Crown Reduction	Stem Dieback
	(kg/ha)		----------(%)----------	
Glyphosate	0.6	July	28 gh[2]	11 jkl[2]
		Aug	58 ef	7 jkl
	0.8	July	14 hij	0.5 kl
		Aug	73 cde	17 hijkl
	1.1	July	23 hij	8 jkl
		Aug	65 de	15 ijkl
Imazapyr	0.14	May	72 cde	62 abc
		July	7 ij	0.4 l
		Aug	84 abcd	18 ghijkl
	0.21	May	74 bcde	66 ab
		Aug	100 a	42 cdef
	0.28	May	66 de	48 bcde
		Aug	97 a	25 efghij
Glyphosate +imazapyr	0.6 + 0.01	July	10 hij	2 kl
		Aug	61 ef	8 jkl
	0.6 + 0.06	July	13 hij	3 jkl
		Aug	97 a	34 defghi
	0.6 + 0.14	July	46 fg	4 jkl
		Aug	94 ab	39 defgh
	0.8 + 0.01	July	24 hi	4 jkl
		Aug	75 bcde	12 ijkl
	0.8 + 0.06	July	9 hij	0.2 l
		Aug	85 abc	23 fghij
	0.8 + 0.14	July	8 ij	2 kl
		Aug	96 a	51 abcd
	1.1 + 0.01	July	18 hij	3 jkl
		Aug	86 abc	23 fghijk
	1.1 + 0.06	July	9 hij	1 kl
		Aug	91 abc	41 cdefg
	1.1 + 0.14	July	15 hij	3 jkl
		Aug	99 a	46 bcdef
	1.1 + 0.21	Aug	99 a	71 a
Untreated			5 j	1 kl

[1] Glyphosate rates are ae/ha; imazapyr ai/ha.
[2] Means within columns followed by the same letter are not significantly different at alpha=0.05 using Tukey's.

Weeding and fertilizing to enhance conifer growth. Cole, E.C., and M. Newton. In interior Alaska, both competition with weeds and nitrogen deficiences can reduce conifer growth and survival. To determine if nitrogen fertilization and herbicide weeding can enhance conifer survival and growth in northern latitude forests, a study was established at Bonanza Creek, about 15 miles west of Fairbanks. The study area was part of an 8500-acre burn in 1983. The site had been dominated by bluejoint grass, horsetail, and fireweed. Parts of the area were cleared with a feller-buncher, and these were planted with plug white spruce approximately three years prior to treatment.

All treatments were completely randomized, with three replications per treatment, including an untreated control. Plot size was 6 m by 16.6 m. Herbicide applications were made with a backpack sprayer equipped with a single adjustable hollow cone nozzle and using the "waving wand" technique. Volume per acre was 93.4 l/ha. Fertilizer (34-0-0 ammonium nitrate) was applied with a rotary fertilizer spreader. All nitrogen was applied at 179 kg/ha. Applications were made on May 25, 1989.

Plots were evaluated for percent grass, horsetail, forb, fireweed, rose, and other shrub cover in August, 1989. Cover was estimated in a one-meter radius around each of eight to ten spruce seedlings per plot. In addition, the seedlings were measured for total height, previous year's height, and basal diameter. Basal diameter was measured at 15 cm above ground.

Grass cover was not significantly different among the herbicide treatments and the untreated plots (Table 1). However, nitrogen resulted in a significant increase in grass cover over the untreated and herbicide only treatments.

The highest forb cover (excluding fireweed) was found in the hexazinone at 1.1 kg/ha plus nitrogen plots. In these plots, the forbs that were not removed by the herbicide benefited from the nitrogen fertilization and increased in growth, hence greater cover. Forb cover among the other treatments was not significantly different.

Fireweed showed a significant response to nitrogen. In the untreated plots, fireweed cover averaged 2 percent, while in the nitrogen only plots, cover averaged 12 percent.

Horsetail was significantly higher in the untreated plots than in the other treatments. Hexazinone decreased horsetail cover, especially at the high rate. In the nitrogen only plots, average cover was less than the untreated plots. This was due in part to the increase in fireweed and grass, which suppressed the horsetail.

Most of the treatments were not significantly different from one another in terms of prickly rose cover (Table 2). Although the rose appeared more vigorous in the plots with added fertilizer, differences were not significant.

For shrubs other than rose, cover was variable. Shrub cover was significantly greater in the nitrogen only plots. This was primarily due to a response of aspen to nitrogen. Suckers appeared more vigorous and more numerous in the nitrogen only plots.

For total cover, the untreated plots and the nitrogen plots were similar. Even though these treatments were significantly different among some vegetation types, the totals were not significantly different. This was primarily due to the decrease in horsetail and increase in grass, shrub, and fireweed in the nitrogen only plots. For the herbicide treatments, the hexazinone at 1.1 kg/ha plus nitrogen had significantly higher total cover. The 1.1 kg/ha rate of hexazinone was not totally effective in eliminating vegetation. Those plants that were not killed benefited from both the "weeding" and the fertilization.

Some herbicide injury to seedlings did occur at the 2.2 kg/ha rate of hexazinone. This appeared primarily in areas where seedlings had been planted in depressions where hexazinone could accumulate. Some mortality (5 to 10 percent) did occur in these depressions. Second flushing was common throughout the plots, especially in the fertilized plots.

For analyses of height and height growth, the covariate previous year's height was used and means were adjusted. Since the covariate was significant, comparisons among means were based upon adjusted means (Table 3).

Long-term seedling response is unknown at this time and will require several years of following. Currently, the seedlings in the nitrogen only plots are the tallest and have the best height growth. Most of the treatments were not significantly different from each other for basal diameter. Some herbicide injury occurred on the hexazinone plots. Seedlings in the hexazinone only plots were the shortest and had the least height growth. (Department of Forest Science, Oregon State University, Corvallis, OR 97331)

Table 1. Grass, forb, fireweed (EPAN), and horsetail (EQSP) cover.

Treatment	Rate	Grass	Forb	EPAN	EQSP
	(kg ai/ha)	(% Cover)			
Hexazinone	1.1	1 bc[1]	1 b	2 b	2 d
	2.2	0.3 c	1 b	2 b	0.3 d
Hexazinone	1.1	3 b	5 a	11 a	8 c
+ nitrogen	2.2	0.3 c	1 b	3 b	0.5 d
Nitrogen Only		7 a	2 b	12 a	15 b
Untreated		2 bc	2 b	2 b	31 a

[1] Means within columns followed by the same letter are not significantly different at alpha=0.05 using Tukey's.

Table 2. Rose (ROAC), other shrub, and total cover.

Treatment	Rate	ROAC	Shrub	Total
	(kg ai/ha)	(% Cover)		
Hexazinone	1.1	2 b[1]	1 bc	8 c
	2.2	2 b	0.4 c	5 c
Hexazinone	1.1	3 ab	2 bc	26 b
+ nitrogen	2.2	1 b	1 bc	6 c
Nitrogen Only		6 a	5 a	44 a
Untreated		3 ab	3 b	41 a

[1] Means within columns followed by the same letter are not significantly different at alpha=0.05 using Tukey's.

Table 3. Total height, adjusted total height, height growth, adjusted height growth, and basal diameter.

Treatment	Rate	Total Height	Adjusted Height	Height Growth	Adjusted Height Growth	Basal Diameter
	(kg ai/ha)	-------------	-----	(cm) -----	-----	(mm)
Hexazinone	1.1	34	34.6 b[1]	6.8	6.8 b	4.6 ab
	2.2	36	34.9 b	6.8	7.0 b	5.1 ab
Hexazinone + nitrogen	1.1	32	35.8 ab	8.5	7.9 ab	4.1 b
	2.2	37	35.5 ab	7.4	7.7 ab	5.2 a
Nitrogen Only		38	37.7 a	9.8	9.8 a	4.6 ab
Untreated		36	35.8 ab	7.9	8.0 ab	4.9 ab

[1] Means within columns followed by the same letter are not significantly different at alpha=0.05 using Tukey's.

Western hemlock sensitivity to various glyphosate formulations applied one week after planting. Figueroa, P.F., R.L. Crockett. Western hemlock (*Tsuga heterophylla* {Raf} Sarg) is an important commercial conifer in western Washington. The effects of competition from grasses, forbs, shrubs and hardwoods can significantly reduce western hemlock survival and growth. Glyphosate {N-(phosphonomethyl)glycine} has been a widely used and effective herbicide for control of competing vegetation. It has been shown to cause injury when applied during the initial period of active conifer growth. The primary agent causing injury has been linked primarily to the surfactant used in the Roundup[R] formulation of glyphosate and secondarily to the active ingredient glyphosate.

A herbicide screening trial was established to test several glyphosate formulations at different rates that used various rates of surfactants. A single application was timed to coincide with the time western hemlock would be sensitive to the Roundup[R] formulation.

The study site is in Washington State in Lewis county, 10 miles east of Centralia. The study site is at 450 feet elevation on a Melbourne soil series that is deep, well-drained, with fine-textured Lateritic soil, and suitable for hemlock growth. The site was tractor scarified and burned in the fall of 1987. The plots were planted with 2+0 hemlock mini-plug transplants on March 23, 1988.

Treatments were applied at 15 gallons per acre solution using a multi-tip boom sprayer. Application date was March 28, 1988. Survival assessments were made in the fall after the first growing season and survival and height were measured in fall after the end of the second growing season.

The glyphosate formulations tested in this study were as follows:

Treatment	Rate (lb ae/a)
Check - no treatment	-
Accord[R]	1.875
Accord[R] + Mon15151	1.875 + 2 lb/ai
Accord CR[R]	1.125
Accord CR[R]	1.5
Accord CR[R]	1.875

The experimental design for this study was a randomized block design with four replications. The six treatments were randomly assigned within a block. Each treatment was a planting row of 25 hemlock planted at 3 ft. intervals. The hypothesis tested was the glyphosate formulations would not affect western hemlock survival or growth. Percent survival was transformed using a square root arcsine transformation. Treatment effects were analyzed using analysis of variance procedures and hypothesis tested at the 0.05 probability level.

The partitioning of degrees of freedom appear in the following analysis of variance table:

Source of Variation	Degrees of Freedom
Block	3
Treatment	5
Error	15
Total	23

Results/Discussion

There were significant differences ($P < 0.01$) in percent survival among treatments for both first and second year survival. All treatments have significantly lower survival than the untreated check plots. The Accord[R] + Mon15151 treatment had significantly higher survival than the glyphosate formulation treatments (Figure 1).

There were no significant differences in survivor total tree height after the second growing season. Those seedlings that had survived the treatment appeared to overcome damage after the second year (Figure 2).

This herbicide trial did not show a tolerance by western hemlock to glyphosate formulations with various surfactants. It did show the high degree of sensitivity of western hemlock to any glyphosate formulation applied during an active growth period. In this study treatment was applied one week after planting which the trees would be actively growing. It is recommended that glyphosate only be applied over hemlock over dormant hemlock during the fall foliar season. (Weyerhaeuser Company, 505 North Pearl street, Centralia, Wa. 98531; Monsanto Agricultural Chemicals, 17004 NE Circle, Vancouver WA 98682)

Figure 1. Western hemlock glyphosate sensitivity test, percent survival by treatment and year.

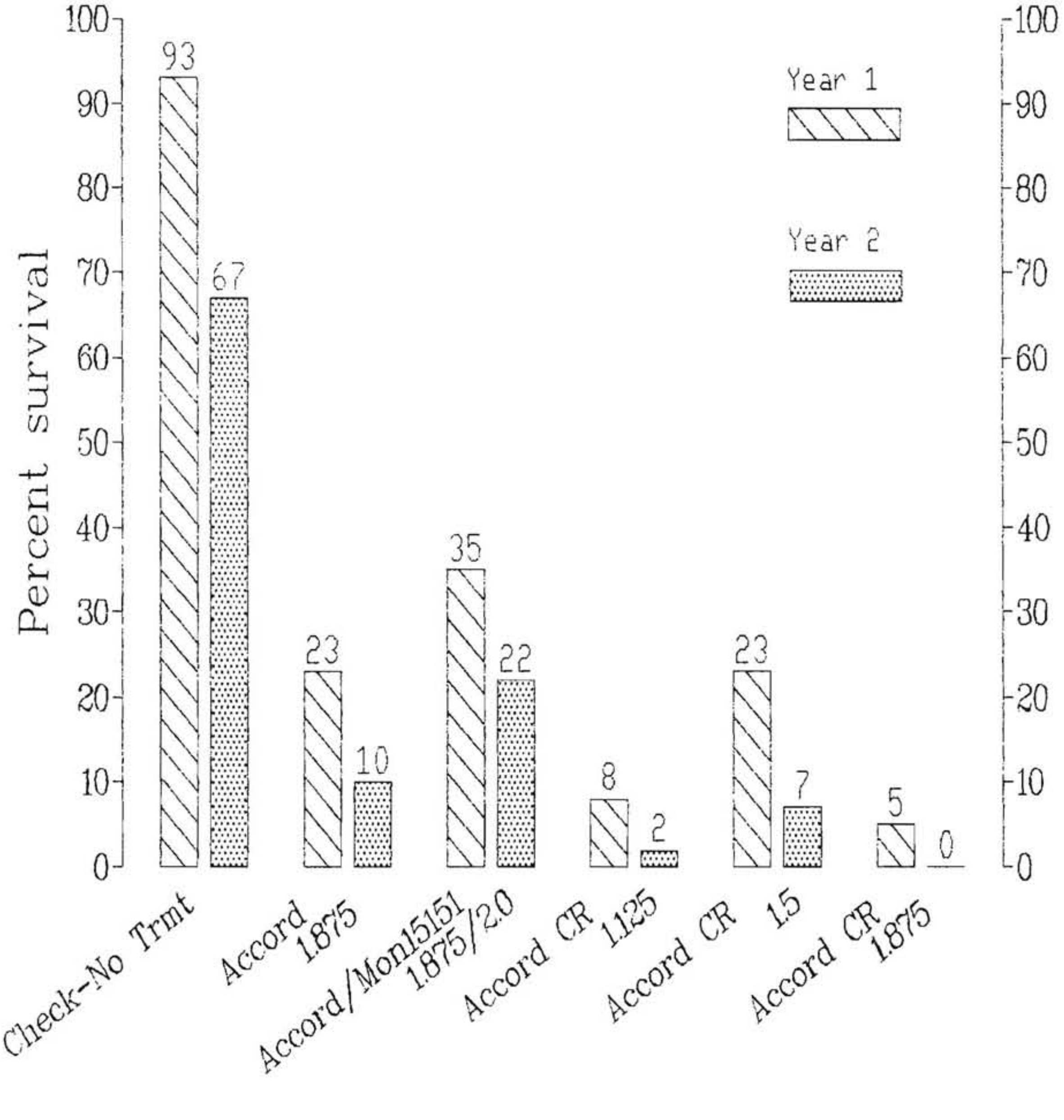
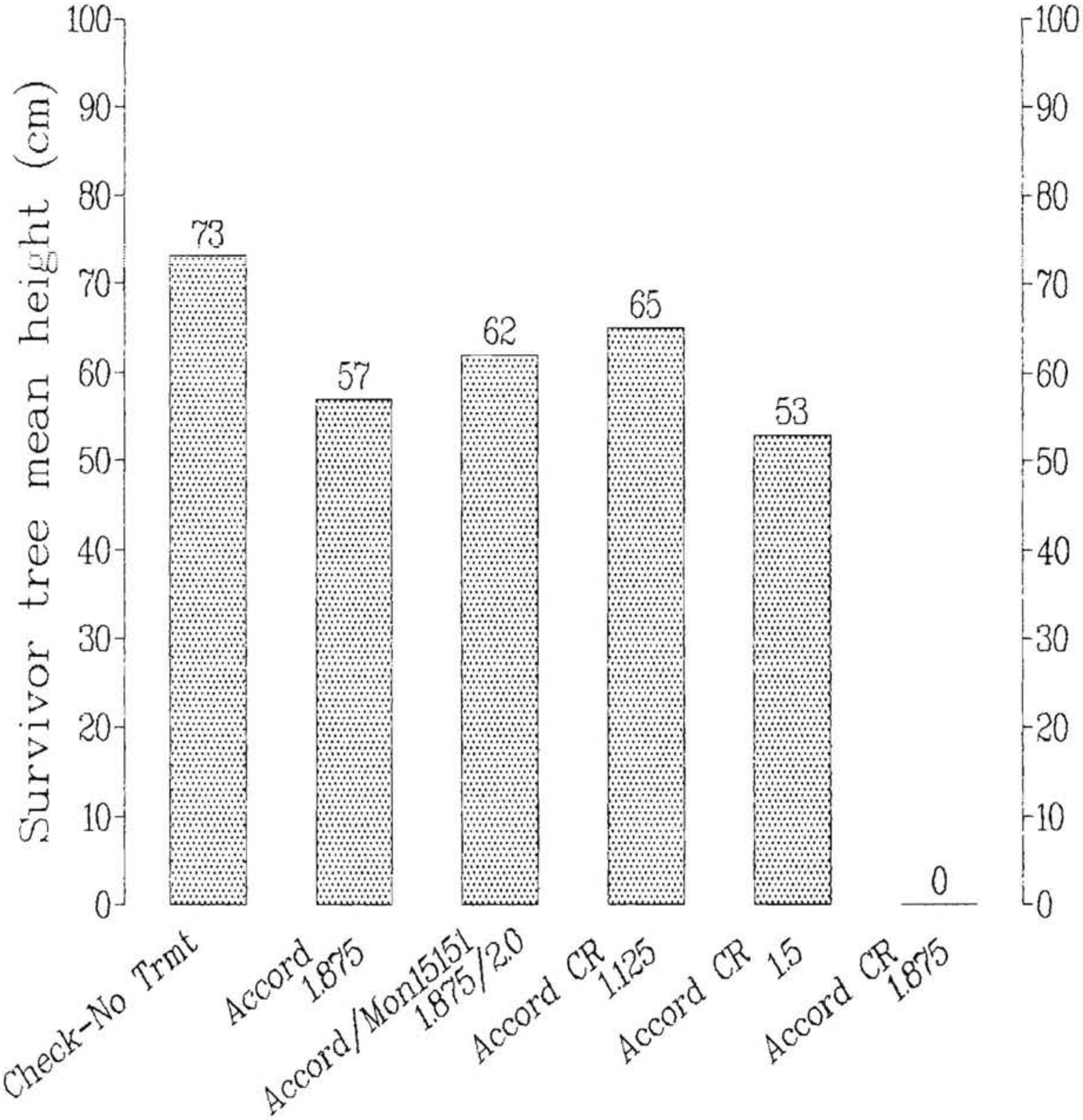


Figure 2. Western hemlock glyphosate sensitivity test, survivor total height two years after treatment.



PROJECT 4

WEEDS IN HORTICULTURAL CROPS

Steven Bowe - Project Chairperson

<u>Artichoke herbicide evaluation</u>. Cudney, D.W., W.L. Schrader, H.S. Agamalian, and K.S. Mayberry. A new method of artichoke production has been suggested by Farm Advisors Keith Mayberry and Wayne Schrader. The method involves producing artichokes as a annual crop rather than a perennial crop. Artichokes are seeded and produced as "speeding" transplants in the greenhouse and then placed into preformed drip irrigated beds. Utilizing this method in the coastal and southern desert regions of California, artichokes can be planted in the summer and fall months allowing harvest "off season" during the winter and early spring months. After harvest, the plants are removed, as would be the case of other annual crops.

In traditional artichoke production the herbicides are utilized with established perennial artichoke plants. Thus, there is a need to evaluate artichoke herbicides in the transplanted annual production scheme.

An evaluation trial was established at the South Coast Field Station in Irvine, California on a sandy loam soil on preformed 60" beds. Preemergence treatments were made on June 14 utilizing a CO_2 backpack plot sprayer and 8003 flat fan nozzles. A spray volume of 30 gallons per acre was used. Each plot was 80" wide by 40' long and all treatments were replicated four times. Preemergence treatments consisted of pronamide at 2 and 4 lb ai/a, pendimethalin at 1 lb ai/a, napropamide at 2 and 4 lb ai/a and oxyfluorfen at 1 lb ai/a. A second postemergence application was included, consisting of 1 lb ai/a of oxyfluorfen. Treatments were divided so there were two sets of preemergence treatments, one which did not receive oxyfluorfen and a second set which did receive oxyfluorfen postemergence treatment.

Among preemergence treatments evaluated July 28, only napropamide caused any phytotoxic effects, resulting in severe stunting and some stand loss. Overall weed control was best for napropamide and oxyfluorfen preemergence treatments with good results for the 4 lb pronamide application and the pendimethalin application. Pigweed and goosefoot control was similar to the overall weed control ratings.

A second evaluation was made on October 26, one month after the postemergence application. All napropamide plots were stunted with some stand loss. Postemergence treatment with oxyfluorfen resulted in some leaf burn and foliar spotting, however, except for treatments with napropamide, phytotoxicity was within the acceptable range. Artichoke plant height measurements indicated that napropamide preemergence applications severely limited height and postemergence applications of oxyfluorfen reduced height slightly. Nettleleaf goosefoot and pigweed control was increased by postemergence application of oxyfluorfen. Best results were evident in the pendimethalin plus oxyfluorfen, and oxyfluorfen plus oxyfluorfen plots with intermediate results in the pronamide plus oxyfluorfen plots.

The results of this trial indicate that napropamide should not be used as a preemergence herbicide under these production conditions. Pronamide, pendimethalin and oxyfluorfen were acceptable preemergence herbicides. The use of these herbicides plus a postemergence treatment of oxyfluorfen gave best results. (University of California, Botany & Plant Sciences Department, Riverside, CA 92521.)

Table 1. Artichoke pre[1] and postemergence[2] trial in Irvine, California

First Evaluation

Treatment	Rate lb ai/a	Phyto-toxicity ratings**	Plant diameter (inches)	Overall control ratings**	Pigweed in 10 linear ft. of row (bed top)	Nettleleaf Goosefoot in 10 linear ft. of row
		7/28/89				
pronamide	2.0	0.0	15.3	5.8	2.3	6.0
pronamide	4.0	0.5	15.3	9.0	0.8	1.3
*pronamide+	2.0	0.3	15.3	6.8	3.8	1.0
*pronamide+	4.0	0.8	14.3	9.0	1.0	1.0
pendimethalin	1.0	0.0	15.8	8.0	0.8	0.5
*pendimethalin+	1.0	0.0	15.3	8.5	0.5	0.3
napropamide	2.0	4.3	5.5	8.5	1.0	0.0
napropamide	4.0	5.3	4.3	10.0	0.0	0.0
*napropamide+	2.0	4.5	6.5	9.5	0.8	0.5
*napropamide+	4.0	5.5	4.5	9.8	0.0	0.0
oxyfluorfen	1.0	0.5	15.0	10.0	0.0	0.0
*oxyfluorfen+	1.0	0.8	14.0	9.8	0.0	0.0
Check		0.0	15.8	0.0	12.3	7.3
LSD 0.05		0.7	1.5	1.7	3.2	3.0

[1]preplant applications made on 6/14/89
[2]postemergence applications made on 7/28/89
* plus a postemergence treatment of 1 lb ai/A oxyfluorfen
** 0 = no effect; 10 = all plants dead

Table 2. Artichoke pre[1] and postemergence[2] trial at Irvine, California

Second Evaluation

		8/26/89			
Treatment	Rate lb ai/a	Phyto-toxicity ratings**	Plant Height (in.)	Nettleleaf Goosefoot Control**	Pigweed Control**
pronamide	2.0	0.0	10.5	2.3	2.3
pronamide	4.0	0.0	9.0	8.0	8.0
*pronamide+	2.0	2.0	8.8	7.5	7.5
*pronamide+	4.0	1.5	8.3	8.3	8.5
pendimethalin	1.0	0.3	9.8	9.3	9.5
*pendimethalin+	1.0	2.0	8.5	10.0	9.8
napropamide	2.0	5.5	4.3	5.8	6.0
napropamide	4.0	6.8	3.8	7.8	7.5
*napropamide+	2.0	5.3	4.0	9.3	9.5
*napropamide+	4.0	7.0	3.5	9.8	10.0
oxyfluorfen	1.0	0.3	10.0	10.0	10.0
*oxyfluorfen+	1.0	2.8	7.8	10.0	10.0
Check		0.0	10.3	0.0	0.0
*Check		2.5	8.3	5.5	5.5
LSD 0.05		1.3	1.4	2.7	2.9

[1]preplant applications made on 6/14/89
[2]postemergence applications made on 7/28/89
* plus a postemergence treatment of 1 lb ai/A oxyfluorfen
** 0 = no effect; 10 = all plants dead

Effect of tillage level on weed control in asparagus. Boydston, R.A. Asparagus grown in Washington is commonly tilled in early spring and again at the end of spear harvest in late June. Notill asparagus production may increase asparagus yield, reduce soil erosion, prevent specific weed problems, reduce the incidence of certain diseases, and conserve soil moisture. This research was conducted to determine the merits of notill asparagus production in Washington State.

The experiment was a split plot design with tillage as main plots and herbicides as subplots. Main plots were arranged in a randomized complete block with five replications. Main plots were 4.6 m wide by 21 m long. Tillage treatments were 1) notill; 2) tilled once in mid April; and 3) tilled once in mid April and again in early June. Soil was tilled with a rototiller set 6 cm deep. Herbicides were applied on April 13 and May 30, 1989, with a tractor mounted sprayer delivering 280 l/ha at 276 kPa using 8002 flat fan nozzles. Weed counts were taken on July 18, 1989, and asparagus yield was taken from April 17 to May 12, 1989.

Total marketable number of spears and total weight of spears were greater in notill plots than in tilled plots (table 1). The decrease in asparagus yield in tilled plots was mainly due to delayed spear emergence during the 2 weeks following the tillage operation. Herbicide treatments did not affect asparagus yield.

Spring tillage increased the number of volunteer asparagus (ASPOF) plants compared to notill (table 2). However, volunteer asparagus was controlled by both herbicide treatments.

Spring tillage controlled common groundsel and horseweed (table 2). Metribuzin plus norflurazon controlled common groundsel in notill plots better than diuron plus prodiamine. Both herbicide treatments controlled horseweed well in notill plots.

Hairy nightshade populations were increased by spring tillage (table 2). A second tillage at layby eliminated emerged seedlings, but another flush germinated shortly after. Both herbicide treatments controlled hairy nightshade well under all tillage levels. (USDA/ARS in affiliation with Washington State University, IAREC, Prosser, WA 99350).

Table 1. Yield of asparagus grown under three tillage levels in 1989

Tillage	Herbicide	Total rate	Total marketable yield[1]	Total marketable yield weight	Weight/ spear	Culls
		(kg ai/ha)	(no./row)	(g/row)	(g)	(%)
Spring	Diuron + prodiamine	2.9 + 2.9	50	853	16	28
	Metribuzin + norflurazon	1.8 + 4.0	42	660	14	29
			46 B	757 B	15 A	29 A
Spring and layby	Diuron + prodiamine	2.9 + 2.9	35			
	Metribuzin + norflurazon	1.8 + 4.0	32	501	17	32
			33 B	563 B	17 A	31 A
Notill	Diuron + prodiamine	2.9 + 2.9	111	2161	20	22
	Metribuzin + norflurazon	1.8 + 4.0	110	2043	19	22
			110 A	2102 A	19 A	22 B

[1]Means within a column followed by the same letter are not significantly different at the 5% level using Fisher's protected LSD.

Table 2. Weed control in asparagus grown under three levels of tillage

Tillage	Herbicide	ASPOF[1]	SOLSA	SENVU	ERICA
Spring	None	155 A	12 A	0 B	0 B
	Diuron + prodiamine	12 C	0 B	0 B	0 B
	Metribuzin + norflurazon	2 C	0 B	0 B	0 B
Spring and layby	None	62 B	15 A	0 B	0 B
	Diuron + prodiamine	0 C	0 B	0 B	0 B
	Metribuzin + norflurazon	0 C	0 B	0 B	0 B
Notill	None	17 C	1 B	8 A	10 A
	Diuron + prodiamine	5 C	0 B	1 B	0 B
	Metribuzin + norflurazon	1 C	0 B	0 B	0 B

[1]Means within a column followed by the same letter are not significantly different at the 5% level using Fisher's protected LSD.

Comparison of levels of EPTC disced in five weeks prior to carrot planting. Kempen, H.M. and M.P. Gonzalez. Our objectives were to find a control for purple (CYPRO) and yellow nutsedge (CYPES) in California to replace stoddard solvent which was withdrawn due to expensive SB950 toxicology requirements. Plots were disced 6-8 inches within 2 hours after treatment application to a dry soil surface. Trifluralin was applied preplant at 0.75 lbai/a. Linuron was applied on June 16,1989 when carrots were 3-5 fern leaf.

All EPTC treatments showed some signs of injury early in the season in comparison to the control, with the apparent injury level increasing as the rate of EPTC increased. By August 10, 1989, the injury ratings for all the treatments except the highest rate (6.0 lb ai/a) were negligible. Injury from 2 or 3 lb ai/a was probably tolerable. No weeds were present. Only EPTC at 6 lb ai/a reduced yields. No damage to carrot roots were observed. Symptoms were deformed and stunted fern leaves, often adhering to one another. These leaves seemed more injured by the linuron. (Univ. of Calif. Coop. Ext., Bakersfield, CA 93307.)

Table 1. Field and application data

CROP:	Carrots	APPLICATION DATE:	4-10-89
LOCATION:	Cuyama, CA	APPLICATION METHOD:	CO_2 backpack
PLANTING DATE:	5-20-89	VOLUME / PSI	20 gpa @ 17 psi
ROW SPACING:	40 in.	SOIL TYPE:	sandy loam
PLOT SIZE:	25 ft.by 40 ft.	O.M.:	0.5 - 1.0 %
PLOT DESIGN:	RCB, 4 reps.	IRRIGATION METHOD:	solid set sprinklers
CONDITIONS:	85°F, light NW wind, dry		
WEED SPECIES:	Russian thistle (SASKR) occasionally		

Table 2. Comparison of carrot injury resulting from EPTC

TREATMENT	RATE (lb ai/a)	CARROT PLANTS (per foot of bed) 6-Jun-89	AVERAGE CARROT INJURY† 6-Jun (1-2 lf)	30-Jun (6 lf)	25-Jul (6-22 in.)	10-Aug (12-22 in.)	YIELD (T/A)
Control	–	47.9	0.0	0.0	0.0	0.3	38.7
EPTC	2.00	46.0	0.7	3.3	0.0	0.0	36.0
EPTC	3.00	47.3	1.0	4.0	1.0	0.3	38.4
EPTC	4.50	45.8	1.7	5.3	3.0	0.7	41.3
EPTC	6.00	48.6	2.3	6.0	7.0	4.3	21.6
LSD (0.05)		NS	NS	1.9	2.0	1.4	6.9

† 0-10 Rating: 0=no injury, 10=kill.

Comparison of post-emergence herbicide treatments for control of Russian thistle in carrots. Kempen, H.M. and M.P. Gonzalez. Herbicide applications were made post-emergence to a field which received no pre-plant herbicide application. Russian thistle (SASKR) and yellow nutsedge (CYPES) were present at application of treatments. Linuron was applied to the field three weeks after treatment on March 29, 1989. An evaluation of carrot retardation and Russian thistle vigor reduction was taken prior to the linuron application. An additional evaluation of carrot retardation was taken several weeks following the linuron application.

Pendamethalin was very effective in retarding emerged 2 inch Russian thistle at 1 or 2 lb ai/a and trifluralin EC was somewhat effective. Weeding before final evaluations prevented longer-term retardation. No carrot foliage symptoms or retardation was noted. Granular materials failed to control the weed. Linuron seemed to reduce plant count at the 1 lb ai/a (2X) rate without effect on the 1 1/4 leaf carrots. A promising lead for control after emergence. (Univ. of Calif. Coop. Ext., Bakersfield, CA 93307.)

Table 1. Field and application data

CROP:	Carrots	APPLICATION DATE:	3/8/89
LOCATION:	Arvin, CA	APPLICATION METHOD:	CO2 backpack
CROP STAGE:	1 1/4 true leaf	VOLUME / PSI:	20 gpa @ 17psi
ROW SPACING:	40 in.	SOIL TYPE:	sandy loam
PLOT SIZE:	7.5 ft by 80 in	O.M.:	0.8%
PLOT DESIGN:	2KXRCB, 3 rep.	IRRIGATION METHOD:	solid set sprinklers
CONDITIONS:	80°F, no wind, dry surface, moist root zone		
WEED SPECIES:	Russian thistle (2 in., 2-26 plants/plot), yellow nutsedge (emerging)		

Table 2. Evaluation of carrot retardation and Russian thistle vigor reduction

TREATMENT	1X RATE (lb ai/a)	RUSSIAN THISTLE (3/28/89) Plants/ Foot		Vigor Reduction*		CARROT RETARDATION* 3/28/89		4/17/89	
		1X	2X†	1X	2X†	1X	2X†	1X	2X†
Control	-	17	-	0.0	0.0	0.0	0.0	0.7	-
Linuron	0.5	16	6	0.0	0.7	0.0	0.0	0.3	0.7
Pendimethalin	1.0	8	6	6.7	8.0	0.0	0.0	0.0	0.0
Trifluralin 5EC	1.0	8	11	4.7	5.7	0.0	0.0	0.3	0.3
Trifluralin TR-10	1.0	29	20	0.0	0.7	0.0	0.0	0.0	0.7
Trifluralin 10G	1.0	20	26	0.0	0.0	0.0	0.0	0.0	0.0
LSD 0.05		-		1.7		NS		NS	

* 0-10 Rating: 0= no injury, 10= kill

† All 2X treatments were double-sprayed, like an overlap (K2X)

<u>Tolerance of carrots to pendimethalin.</u> Zamora, D.L. Field trials were conducted to determine the tolerance of seed production carrots (variety 'Chanteney') to postemergence applications of pendimethalin. Pendimethalin controls field dodder and largeseed dodder in alfalfa. Dodder is a problem in carrot seed production in Washington, Oregon, and Idaho.

Two field trials were conducted at Nampa, ID and two at Warden, WA. Soils at the Nampa sites were silt loams with 1.5% organic matter. Soils at the Warden sites were silt loams with 0.8% organic matter. Applications at the four sites were made with a CO_2 pressurized backpack sprayer, calibrated to deliver 14 gpa at 40 psi and 3 mph. The experiments were randomized complete block designs with four replications. Plots were 7 by 25 ft.

The applications were made at Nampa on April 29, 1989 when the carrots had four leaves. The air temperature at application was 60 F, soil temperature was 50 F, and the relative humidity was 30%. The sky was clear and no dew was present. Both trials at Nampa received approximately 2 inches of water on May 1 by sprinkler irrigation. The treatments for both sites at Nampa were single applications of pendimethalin at 1, 2, 3, and 4 lbs ai/a, plus an untreated check. The carrots were visually evaluated for injury on May 15, 1989.

The applications were made at Warden on May 8, 1989 when the carrots were at the early bolting stage of growth. The air temperature at application was 75 F, soil temperature was 70 F, and the relative humidity was 25%. The sky was clear and no dew was present. The trials were furrow irrigated with approximately 2 inches of water on May 10. The treatments of one trial site at Warden were single applications of pendimethalin at 2, 3, 4, and 6 lbs ai/A, plus an untreated check. Treatments at the other site consisted of single applications of pendimethalin at 1, 2, 3, 4, and 6 lbs ai/A after a directed spray of linuron (0.75 lb ai/A) was applied to the entire trial area. A check treatment consisting of linuron only also was included. The carrots were visually evaluated for injury on June 2, 1989.

The carrots were not injured by pendimethalin at either trial at Nampa (data not presented). Carrots treated with pendimethalin alone at Warden were not injured compared to the untreated check (Table 1). Carrots treated with linuron and pendimethalin also were not injured compared to carrots treated with linuron only. There were no visual differences between carrots treated with linuron and untreated carrots at Warden. The carrots of some plots treated with pendimethalin were uniformly shorter on June 2 compared to carrots in plots not treated with pendimethalin; however, no height differences were apparent at harvest.

The carrots in these field trials were tolerant to the rates of pendimethalin that would be used for dodder control in the Pacific Northwest. The carrots also were tolerant to pendimethalin and linuron used together. (American Cyanamid Company, 4525 Cochees Way, Boise, ID 83709)

Table 1. Carrot tolerance to postemergence applications of pendimethalin

Treatment	Rate	Injury
	(lbs ai/A)	(% check)
check	-	0.0
pendimethalin	2.0	3.0
pendimethalin	3.0	3.8
pendimethalin	4.0	2.5
pendimethalin	6.0	1.3
LSD (0.05)		N.S.

Table 2. Carrot tolerance to postemergence applications of pendimethalin and a directed application of linuron

Treatment	Rate	Injury
	(lbs ai/A)	(% check)
linuron	0.75	0
pendimethalin + linuron	1.0 0.75	3.0
pendimethalin + linuron	2.0 0.75	3.8
pendimethalin + linuron	3.0 0.75	2.5
pendimethalin + linuron	4.0 0.75	1.3
pendimethalin + linuron	6.0 0.75	1.3
LSD (0.05)		N.S.

Annual weed control in cole crops under plastic mulch. Draper, E.A. and J.L. Anderson. Preemergent herbicides were evaluated for annual weed control and safety to cole crops grown with and without a clear plastic mulch. Trials were conducted at the Kaysville farm of the Farmington (Utah) Field Station on a Kidman fine sandy loam soil. All treatments were applied with a carbon dioxide backpack sprayer in 280 L/ha of water on April 19, 1989. Trifluralin was incorporated to a 2-inch depth with a rototiller; other herbicide treatments were not incorporated. Eight seedlings each of 'Premium Crop' broccoli, 'Early Snowball' cauliflower and 'Market Prize' cabbage were transplanted to a series of plots, with and without a clear plastic mulch cover on April 19. Plots, measuring 0.9 x 12.1 m, were replicated four times and furrow irrigated as required. The most common weeds in the plots were hairy nightshade, witchgrass, common purslane, common lambsquarters and redroot pigweed.

Only DCPA weed control was enhanced by plastic mulch. Napropamide provided poor weed control in comparison to other herbicide treatments. Broccoli and cabbage yields were increased by plastic mulch (.01 level). Broccoli yields were not significantly different, and cabbage exhibited little yield response to herbicide treatment. Cauliflower was not harvested due to high temperature induced bolting of the heads in all plots. (Plant, Soil, & Biometeorology Department, Utah State University, Logan, UT 84322-4820)

Effects of herbicides and clear plastic mulch on weed control and cole crop yield

Treatment	Rate (kg/ha)	Clear Plastic Mulch			No Mulch		
		Weed Control (%)	Broccoli (g/plant)	Cabbage (kg/plant)	Weed Control (%)	Broccoli (g/plant)	Cabbage (kg/plant)
DCPA	8.96	93 ab	374	2.65 a	73 cd	254	2.08 abc
napropamide	2.24	70 de	372	2.29 ab	55 e	319	1.63 c
oryzalin	0.84	73 cd	325	2.45 ab	75 bcd	276	1.88 bc
oxyfluorfen	1.12	98 a	438	2.54 ab	100 a	330	2.21 abc
oxyfluorfen	0.56	93 ab	401	2.40 ab	90 abc	260	2.03 abc
trifluralin	0.56	88 abcd	379	2.49 ab	95 a	301	1.97 bc
untreated	---	0 f	365	2.29 ab	0 f	348	1.86 bc
average yield			379	2.45		286	1.95

Weed control ratings and cabbage weights followed by a common are letter are not significantly different (.05)

Comparison of ground and chemigation applied fluazifop for barnyardgrass control in onions. Orloff, S.B. and D.W. Cudney. Chemigation through solid-set sprinkler irrigation systems is an important application technology in onion fields in the high desert of Los Angeles County. Nearly all fertilizers and herbicides are applied in this manner. This technique has proven more efficaceous for some agricultural chemicals, it is less costly to the grower, and provides the grower greater flexibility in application timing. With one exception, all of the herbicides used in Antelope Valley onion fields (DCPA, bromoxynil, and oxyfluorfen) are injected into sprinkler irrigation systems. The one exception occurs when a postemergence grass control herbicide is needed. Barnyardgrass is a common problem in high desert onion fields. Fluazifop is registered for this use. A trial was established to compare the effectiveness of fluazifop when applied through sprinklers and a standard ground application.

The trial was established in the Lancaster area of the Antelope Valley. The field was planted to the Fiesta variety of onions which were in the one true leaf stage at the time of application. There was a dense infestation of barnyardgrass which was in the three to four leaf stage. Fluazifop was applied at 0.38 lb ai/a with one quart of crop oil concentrate (Dash). Ground applications were made with a CO_2 backpack sprayer with Teejet flat fan nozzles at a pressure of 30 psi and a spray volume of 20 gallons per acre. The chemigation treatment was applied by injecting the herbidcide into two sprinkler lines 40 feet apart. Areas for ground application and check plots were reserved by plugging sprinkler heads at appropriate locations. Injection was accomplished by sprinkler irrigating for one half hour, injecting the herbicide for one half hour, and rinsing the irrigation system for approximately 15 minutes (until an indicator dye revealed that herbicide residue had dissipated from the last sprinkler head). Barnyardgrass control evaluations were made 8 and 19 days after treatment. Eight days after treatment, both chemigated and ground-applied fluazifop severely injured barnyardgrass. Nineteen days after treatment, barnyardgrass was dead in both treatments. Fresh weight data, taken for both evaluation dates, illustrates this well. Data from this trial indicates that chemigation was an effective alternative method for applying fluazifop. (University of California Cooperative Extension, Lancaster, CA 93535.)

Onion chemigation
at Lancaster, California

	Barnyardgrass Fresh Weights[1]		Barnyardgrass Control Ratings[2]	
	8 DAT	19 DAT	8 DAT	19 DAT
Chemigation	16.5	26.1	8.5	10.0
Ground applied	31.90	11.4	8.0	10.0
Check	85.7	205.3	0.0	0.0

[1]Fresh weight of barnyardgrass expressed in grams per foot of bed
[2]0 = Barnyardgrass control: 0 = no control; 10 = all plants dead

Antagonism of postemergence applied grass and broadleaf herbicides in peppermint. Boydston, R.A. Fluazifop-P, sethoxydim, and quizalofop were tested alone and in combination with bentazon, bromoxynil, clopyralid, and pyridate for weed control in peppermint. Herbicides were applied on June 1, 1989, with a CO_2 pressurized backpack sprayer delivering 280 l/ha at 275 kPa through 8002 flat fan nozzles. The main weeds present were green foxtail (three to five leaves) and redroot pigweed (5 to 13 cm). Weed control was visually rated at 3 weeks after herbicide application. The experiment was a randomized complete block, design with three replications.

Sethoxydim and quizalofop controlled green foxtail better than fluazifop-P when applied alone or in tank mixes with broadleaf herbicides (see table).

Bromoxynil reduced the activity of fluazifop-P on green foxtail, but did not significantly reduce the activity of sethoxydim and quizalofop. Clopyralid did not affect the activity of the grass herbicides on green foxtail.

Pyridate lowered the activity of fluazifop-P and sethoxydim on green foxtail by about 25%. Pyridate tended to reduce the activity of quizalofop also, but differences were not statistically significant. Bentazon lowered the activity of fluazifop-P on green foxtail. Bentazon tended to reduce the activity of sethoxydim also, but differences were not statistically significant.

Tank mixes containing bentazon or pyridate controlled redroot pigweed better than those containing bromoxynil or clopyralid (see table). Clopyralid did not control redroot pigweed. None of the broadleaf herbicides controlled redroot pigweed well due to the size of the pigweed at the time of herbicide application. (USDA/ARS in affiliation with Washington State University, IAREC, Prosser, WA 99350).

Green foxtail and pigweed control in peppermint with herbicide combinations applied post-emergence on June 1, 1989

Herbicide	Rate	Green foxtail control 3 WAT[1]	Pigweed control 3 WAT
	(kg ai/ha)	(%)	
sethoxydim	0.22	100 A	0 F
fluazifop-P	0.22	78 BCD	0 F
quizalofop	0.13	100 A	0 F
sethoxydim + bromoxynil	0.22 + 0.28	91 AB	47 D
fluazifop-P + bromoxynil	0.22 + 0.28	61 EFG	62 C
quizalofop + bromoxynil	0.15 + 0.28	97 A	40 E
sethoxydim + clopyralid	0.22 + 0.15	97 A	0 F
fluazifop-P + clopyralid	0.22 + 0.15	66 DEF	0 F
quizalofop + clopyralid	0.15 + 0.15	100 A	0 F
sethoxydim + pyridate	0.22 + 1.0	73 CDE	78 AB
fluazifop-P + pyridate	0.22 + 1.0	53 FG	84 A
quizalofop + pyridate	0.15 + 1.0	89 AB	83 A
sethoxydim + bentazon	0.22 + 1.1	88 ABC	81 AB
fluazifop-P + bentazon	0.22 + 1.1	47 G	82 A
quizalofop + bentazon	0.15 + 1.1	97 A	75 B
Check		0 H	0 F

[1]Means within a column followed by the same letter are not significantly different at the 5% level using Fisher's protected LSD.

Annual grass and broadleaf weed control evaluations in field pumpkins. Arnold, R.N., E.J.Gregory and D. Smeal. Research plots were established on May 29, 1989 at the Agricultural Science Center, Farmington, New Mexico to evaluate efficacy of individual and/or herbicide combinations applied preemergence surface for annual grass and broadleaf weed control in pumpkins (var. Connecticut Field). Soil type was a Wall sandy loam with a pH of 7.8 and an organic matter content of less than 1%. Individual plots were 6 by 30 ft long in size with three replications arranged in a randomized complete block design. Pumpkins were planted in each plot on 3 ft centers. Herbicides were applied with a CO_2 backpack sprayer calibrated to deliver 30 gal/A at 25 psi. All treatments were applied May 31, 1989 and immediately incorporated with 0.75 in of sprinkler applied water. Prostrate pigweed (AMABL) infestations were heavy and kochia (KCHSC), barnyardgrass (ECHCG), green foxtail (SETVI), Russian thistle (SASKR), and redroot pigweed (AMARE) were light throughout the experimental area.

Visual evaluations of crop injury and weed control were made July 6, 1989. All treatments gave good to excellent control of all weeds employed in this study. Pumpkin yields were from 28 to 38 T/A higher in all herbicide treated plots except pendimethalin applied at 2.0 lb ai/A, as compared to the check. Pendimethalin applied at 2.0 lb ai/A caused extensive damage to pumpkin seedlings, respectively. (Agricultural Science Center, New Mexico State University, Farmington, N.M. 87499)

Weed control evaluations in field pumpkins

Treatment	Rate	Crop[1]	Weed Control[1]						Yield
	lb ai/A	Injury	KCHSC	ECHCG	SETVI	SASKR	AMABL	AMARE	T/A
			%						
pendimethalin	1.0	4	100	100	100	93	100	100	46
pendimethalin	2.0	90	100	100	100	100	100	100	7
pendimethalin + metolachlor	0.5 + 1.0	0	100	100	100	100	100	100	55
pendimethalin + metolachlor	1.0 + 2.0	6	100	100	100	100	100	100	45
trifluralin	1.0	0	100	100	100	94	97	98	53
trifluralin + metolachlor	0.75 + 1.0	0	100	100	100	91	100	100	51
trifluralin + metolachlor	1.5 + 2.0	3	100	100	100	100	100	100	51
trifluralin + metolachlor + pendimethalin	0.25 + 0.5 + 0.25	0	100	100	100	86	100	100	51
trifluralin + metolachlor + pendimethalin	0.5 + 1.0 + 0.5	8	100	100	100	98	100	100	52
bensulide	5.0	0	100	97	87	85	91	92	45
ethalfluralin	0.5	0	100	100	95	97	97	100	53
ethalfluralin	1.0	0	100	100	100	98	100	100	52
ethalfluralin + metolachlor	0.5 + 1.0	0	100	100	100	100	100	100	52
ethalfluralin + metolachlor + pendimethalin	0.5 + 1.0 + 0.5	5	100	100	100	100	100	100	51
handweeded check		0	100	100	100	100	100	100	48
check		0	0	0	0	0	0	0	17
av weeds/m^2			3	5	7	4	15	5	
LSD 0.05			ns	1.6	2.6	4.0	2.3	1.6	11

1. Based on a visual scale from 0-100 where 0 = no control or crop injury and 100 = dead plants.

__Enquik for caneburning in red raspberries__. Kaufman, D., A. Sheets, and K. Olson. The removal of early primocane growth and lower foliage from fruiting canes enhances production of machine harvested raspberries. The recent loss of dinoseb has necessitated the search for alternatives. This research was conducted in three commercial fields in the Portland area to evaluate the effectiveness of *monocarbamide dihydrogensulfate* (Enquik) for caneburning on red raspberry varieties, 'Meeker' and 'Willamette'.

Each experiment was randomized in a complete block design with four replications. Plots were 3 feet wide by 30 feet long, consisting of 10 to 15 plants depending on growers' spacing within the row.

Application equipment involved a bicycle sprayer which was calibrated to deliver a total of 30 gallons spray per acre (15 gallons to each side of the row) at a pressure of 40 psi through 8002 flat fan nozzles set in a double-overlap pattern. Enquik was applied at a rate of 15 gallons per acre in 15 gallons of water with 0.5% AG 98 surfactant. Some treatments received two applications of Enquik separated by 1 or 2 weeks while others received only one. For purposes of comparison, treatments of 50 and 100 gallons diesel oil per acre also were included. Treatments were compared to an untreated control and adjacent rows treated by growers using dinoseb.

Because timing is an important factor. Enquik treatments were applied at various stages of primocane height representing approximately 0-4, 4-10, 10-14, or 10-18 inches.

Visual evaluations for control of lower fruiting laterals and suppression of primocanes were recorded in all three fields on 4/26 and data presented for 5/12 only. Fruiting laterals that interfere with mechanical fruit harvest were controlled with most Enquik timings except single treatments applied late or 50 gal/A diesel. Primocane suppression was achieved by waiting for 4 to 6 inches of growth and repeating the treatment 7 to 10 days later. Warm weather without rain for several hours were required for maximum response. Although ratings for dinoseb were slightly better than Enquik, growers confirmed that the response was adequate.

Although yield was not measured in the research plots, 100 fruits were randomly harvested and weighed from each plot in fields 1 and 3. Significant differences were lacking for fruit weight among any of the treatments.

After harvest on 8/24, all treatments in Field #1 were evaluated for number of canes per hill, cane diameter, cane height, and number of branched or twisted canes. Significant differences were lacking in cane number or diameter. Cane heights were similar among all Enquik applications and were significantly shorter than cane heights in either the control or dinoseb treatments. However, none of the treatments resulted in heights which were considered inadequate (below 72 inches), nor were differences of 10 inches considered significant in terms of production. The number of branched canes was greatest in treatments where Enquik was applied only one time after primocanes were 10 inches high or greater. (Assistant Professor, Professor, and Graduate Assistant, Extension Service, Oregon State Univeristy, Corvallis, OR 97330.)

Table 1. Visual ratings of fruiting spur control and primocane suppression recorded approximately 2 weeks after normal caneburning season, Clackamas County, Oregon, 1989.[a]

Treatments and timing[b]	Primocane height (inches)	Fruiting Cane Field: #1	#2	#3	Primocane Field: #1	#2	#3
Control	---	0	0	0	0	0	0
Enquik early+mid (1wk)	0-4 4-10	9.0	9.1	9.1	5.5	5.2	3.6
Enquik early+late (2wk)	0-4 10-14	9.6	8.0	8.4	6.6	5.6	5.2
Enquik mid	4-10	8.4	7.8	7.7	5.4	5.5	4.0
Enquik mid+late (1wk)	4-10 10-14	9.2	8.4	8.8	7.4	7.4	6.4
Enquik late	10-14	6.5	3.1	4.9	5.6	3.1	4.8
Enquik late+v.late (1wk)	10-14 10-18	7.3	5.8	6.1	8.9	7.5	8.0
Enquik very late	10-18	3.0	2.1	---	7.2	6.9	---
Diesel (25) early+mid (1wk)	0-4 4-10	6.1	3.4	3.2	2.5	1.5	1.8
Diesel (50) early+mid (1wk)	0-4 4-10	7.8	6.1	7.1	5.1	3.2	4.0

[a] Ratings averaged from 2 persons; Enquik (15 gal) diluted in 15 gal water/A; Diesel at 25 and 50 gal/A applied twice; Ratings: 0 = no control, 10 = perfect control.

[b] Dates of application and conditions:

Early	- April 10;	65F,	sunny, calm
Mid	- April 18;	65F,	sunny, calm
Late	- April 25;	55F,	cloudy + rain 4 hours
Very Late	- May 1;	55F,	cloudy, warming to 65°F

Table 2. Red raspberry growth comparisons treated with Enquik and diesel at various stages of growth in early spring, Clackamas County, Oregon. 1989[a]

Treatments and timing[b]	Primocane height (inches)	Cane			
		Number/ hill	Diameter (min)	Height (inches)[c]	No branched/ plant[c]
Control	---	14.6	8.9	96	0.03
Enquik early+mid (1wk)	0-4 4-10	12.7	8.7	86	0.12
Enquik early+late (2wk)	0-4 10-14	12.3	8.4	86	0.37
Enquik mid	4-10	13.2	8.4	87	0.18
Enquik mid+late (1wk)	4-10 10-14	12.2	8.5	87	0.31
Enquik late	10-14	11.4	8.6	86	0.59
Enquik late+v.late (1wk)	10-14 10-18	11.8	7.8	85	0.18
Enquik very late	10-18	10.8	8.6	79	0.78
Diesel (25) early+mid (1wk)	0-4 4-10	13.2	9.0	92	0.09
Diesel (50) early+mid (1wk)	0-4 4-10	11.2	9.0	89	0
LSD (P=0.05)	---	NS	NS	7	0.29

a Ratings averaged from 2 persons; Enquik (15 gal) diluted in 15 gal water/A; Diesel at 25 and 50 gal/A applied twice.

b Dates of application and conditions:

Early	- April 10;	65F,	sunny, calm
Mid	- April 18;	65F,	sunny, calm
Late	- April 25;	55F,	cloudy + rain 4 hours
Very Late	- May 1;	55F,	cloudy, warming to 65°F

c Comparisons with adjacent dinoseb treatments applied twice were 95 inch cane heights and 0.06 branches/plant.

Tolerance of selected field grown, deciduous shrubs to spring applied herbicides. Richards, W. Don and John M. Turman. As labor costs increase, the use of effective, highly selective herbicides becomes a very primary concern in horticultural crops. Herbicide programs in many nurseries have become as varied and elaborate as the number of plants produced. Companies who produce only field grown, deciduous trees, for example, may be able to rely on a single application of 1 or more herbicides to control a wide spectrum of weeds through the summer months with minimal crop growth loss due to phytotoxicity. It becomes a little more complicated when dealing with field grown, deciduous shrubs, however, due to the large number of individual cultivars that are grown on the same number of acres.

The trial initiated at Carlton Plants, Dayton, Oregon concentrated on two herbicides being developed and marketed for preemergence use on horticultural crops. The first material was a combination of benefin and oryzalin at a ratio of 1 to 1 formulated in a 2 percent ai granule. The second material was a combination of isoxaben and oryzalin at a ratio of 1 to 3 formulated in an 80 percent ai dry flowable.

Replicated trials were applied to 1-year-old shrubs at the recommended rates of 0.37 kg/ha of the benefin plus oryzalin product, (0.12 kg/banded hectare) and 0.92 kg/ha of the isoxaben and oryzalin product, (0.30 kg/banded hectare). Four replications were used in the trials and all were applied with either a 15 horsepower tractor and a 190 L sprayer or a hand held granular herbicide applicator. The preemergence applications were incroporated to a depth of approximately 1.3 cm using overhead sprinkler irrigation within 3 days of application. Oryzalin had been used on all plots the previous fall and most were weed free when the spring herbicides were applied. There were a few weed species that had already germinated, however. These were Cirsium arvense (L), Cirsium vulgare T., some Capsella bursa-pastoris (L.) and Solanum sarrachoides S. Most of the shrub varieties were in full or partial leaf, resulting in herbicide contact with the foliage even though the application was directed in a 45 cm band at the bottom of the plants. All plot locations were situated on a common soil type of Woodburn silt loam with an average cultivation depth of 1 m and a common pH 5.5 to 6.5. The application dates were March 31 and April 4, 1988 respectfully. The nozzles used were T-jet 6504E and the amount of material used was 189.25 L/ha.

The results from these trials (see table) indicated a relative safety factor on all shrub varieties except the Euonymous genus or the varieties with a high content of yellow carotene pigment. Weed control from these two herbicides was fair to good in most field locations.

Conclusions drawn from the results indicated in the table are somewhat relative to the weed species existing at the time of herbicide application. It appears that the isoxaben and oryzalin formulation is slightly more phytotoxic on the Euonymous, Ligustrum and Physocarpus genera than the benefin and oryzalin combination. However, overall the isoxaben and oryzalin formulation gave better weed control on Capsella bursa-pastoris (L.) and Solanum sarrachoides S. than the benefin and oryzalin combination. It is generally felt that the phytotoxicity problem was caused by the oryzalin in both materials and that the increased weed control was a result of the isoxaben.

The isoxaben and oryzalin formulation gave very good postemergence weed control on Capsella bursa-pastoris in the 3 to 5 leaf stage. This is a positive effect of the isoxaben in this combination since previous experience has shown poor preemergence control of this weed with oryzalin alone and no postemergence activity. (Carlton Plants, Dayton, Oregon 97114).

Efficacy and phytotoxicity data with spring-applied benefin + oryzalin and isoxaben + oryzalin herbicides.

Shrubs/'Variety'	Weed control 1/			Phytotoxicity 1/		Weed control comments
	benefin + oryzalin	isoxaben + oryzalin	control	benefin + oryzalin	isoxaben + oryzalin	(In order of greatest population) specific weeds not controlled by one or both materials.
Berberis thunbergi atropurpurea	7.5	8.0	4.0	0	0	Equisetum arvense L.
Berberis thunbergi	5.5	9.5	1.5	0	0	Cirsium arvense (L.)
Cornus sericea baileyi	9.0	10.0	4.0	0	0	Equisetum arvense L./Solanum sarrachoides S.
Euonymous alatus 'Compacta'	5.0	7.0	4.0	7.0	8.0	Trifolium pratense L.
Ligustrum x vicaryi	6.0	7.0	2.0	2.0	2.5	Equisetum arvense L./Solanum sarrachoides S.
Lonicera x xylosteoides 'Clavey's Dwarf'	7.5	8.0	4.0	0	0	Cirsium vulgare T.
Physocarpus opulus aurea	7.0	10.0	6.0	4.0	5.0	Cirsium arvense (L.)/Solanum sarrachoides S.
Potentilla fruticosa 'Gold Drop'	8.0	10.0	4.0	0	0	Cirsium arvense (L.)
Prunus x cistena	8.0	10.0	6.0	0	0	---
Ribes alpinum	8.0	9.0	4.0	0	0	Cirsium vulgare T.
Rosa 'Pink Grootendorst'	9.0	10.0	7.0	1.0	0	---
Spirea x bumalda 'Anthony' Waterer'	8.0	10.0	5.0	0	0	---
Syringa vulgaris	9.0	8.0	2.0	0	0	Cirsium vulgare T.
Viburnum trilobum 'Bailey Compact'	8.5	8.0	3.5	0	0	Trifolium pratense L./Anthemis cotula L.
Weigelia vaniceki	8.5	9.5	5.0	0	0	Solanum sarrachoides S.

1/ Average of 4 replications where 0 = no phytotoxicity symptoms and 10 = tree dead or 0 = no weed control and 10 = complete weed control.

Response of Alta tomatoes and hairy nightshade to postemergence applications of metribuzin. Orr, J. P. On June 8, 1989, in Clarksburg, California, metribuzin at rates from 0.08 to 0.25 lb ai/a followed by a second application eight days later of 0.5 lb ai/a was applied postemergence to Alta tomatoes in the 2 to 4 leaf stage and hairy nightshade in the 2 to 4 leaf stage. Tomatoes were grown in a clay loam soil and sprinkler irrigated.

Application was with a CO_2 backpack sprayer, 30 gpa water, and replicated four times.

The vigor of the nightshade was reduced 80% when metribuzin was applied at 0.25 lb ai/a followed by a second application of 0.5 lb ai/a eight days later. Tomato stand and vigor was not affected by any treatment. (University of California Cooperative Extension, Sacramento County, 4145 Branch Center Road, Sacramento, CA 95827)

Response of Alta tomatoes and hairy nightshade to postemergence applications of metribuzin

Chemical	Rate lb ai/a		Hairy Nightshade[1] Vigor	Tomatoes[1] Stand	Vigor	Phytotoxicity
	6/08	6/16	6/21	6/21	6/21	6/21
metribuzin	0.08	0.50	4.7	9.0	9.0	0.3
metribuzin	0.10	0.50	4.7	9.5	9.5	0.3
metribuzin	0.12	0.50	4.5	9.0	9.0	0.8
metribuzin	0.15	0.50	3.5	9.5	9.5	0.3
metribuzin	0.175	0.50	2.7	9.0	8.2	1.0
metribuzin	0.20	0.50	4.0	9.2	9.2	0.5
metribuzin	0.25	0.50	2.0	9.7	9.7	0.8
ethiozin	0.40	1.00	10.0	10.0	10.0	0.0
control			10.0	10.0	10.0	0.0

[1] 0 = no weed control, crop dead
10 = complete weed control, no crop damage

Postemergence hairy nightshade control in canning tomatoes. Orr, J. P. On April 14, 1989, in Clarksburg, California, metribuzin was applied at rates ranging from 0.08 to 0.25 lb ai/a to tomatoes in the 2 to 3 leaf stage and hairy nightshade in the 2 to 3 leaf stage. A second application of 0.35 lb ai/a was made on April 24, 1989. This trial was established on a clay loam soil and sprinkler irrigated. Application was with a CO_2 backpack sprayer, 30 gpa water, four replications, in a randomized complete block design.

On May 1, 1989, metribuzin at rates of 0.17 and 0.2 reduced the hairy nightshade population from 8 plants/7.5 ft^2 to 3 and 2 plants/7.5 ft^2, respectively. Tomato stand reduction was 8% and 22%. Vigor reduction was 12% and 10%. The tomatoes outgrew this initial vigor reduction. (University of California Cooperative Extension, Sacramento County, 4145 Branch Center Road, Sacramento, CA 95827)

Postemergence hairy nightshade control in canning tomatoes

Chemical	Rate lb ai/a		Weed stand count[2] Hairy Nightshade	Weed stand count[2] Lambsquarter	Tomatoes[1] Stand	Tomatoes[1] Vigor
	04/14	04/24	05/01	05/01	05/01	05/01
metribuzin	0.08	0.35	12.0	0.3	9.0	9.0
metribuzin	0.10	0.35	5.3	0.0	9.7	9.7
metribuzin	0.12	0.35	7.5	0.0	8.5	8.2
metribuzin	0.15	0.35	9.8	0.0	9.2	9.2
metribuzin	0.175	0.35	2.8	0.0	9.2	8.7
metribuzin	0.20	0.35	1.8	0.0	7.7	9.0
metribuzin	0.25	0.35	2.5	0.0	9.7	10.0
control			8.5	1.0	10.0	10.0

[1] 0 = crop dead
10 = no tomato stand or vigor reduction

[2] plants/7.5 ft^2

Effect of ethiozin as a preemergence herbicide in canning tomatoes. Orr, J. P. On August 21, 1989, at Consumnes River College, ethiozin at rates from 0.10 to 1.00 lb ai/a was applied preemergence to a clay loam soil. FM785 tomatoes were planted and sprinkler irrigated for four hours.

Application was with a CO_2 backpack sprayer, 30 gpa water, and four replications in a randomized complete block.

On August 29, 1989, and September 13, 1989, the stand and vigor of the tomatoes in all treatments were equal to the control.

Effect of ethiozin as a preemergence herbicide in canning tomatoes

		Weed Control[1]		Tomatoes[1]				
Chemical	Rate lb ai/a	Redstem filaree	Redroot pigweed	Stand		Vigor		Phyto-toxicity
		9/13	9/13	8/29	9/13	8/29	9/13	9/13
ethiozin	0.10	10.0	10.0	10.0	10.0	10.0	10.0	0.0
ethiozin	0.15	10.0	10.0	10.0	10.0	10.0	10.0	0.0
ethiozin	0.25	10.0	10.0	10.0	10.0	10.0	10.0	0.0
ethiozin	0.35	10.0	10.0	10.0	10.0	10.0	10.0	0.0
ethiozin	0.50	10.0	10.0	10.0	10.0	10.0	10.0	0.0
ethiozin	1.00	10.0	10.0	10.0	10.0	10.0	10.0	0.0
control		0.0	0.0	10.0	10.0	10.0	10.0	0.0

[1] 0 = No weed control, crop dead
10 = Complete weed control, no stand or vigor reduction

Postemergence control of hairy nightshade and jimsonweed in canning tomatoes. Orr, J. P. On April 10, 1989, in Elk Grove, California, metribuzin was applied at rates ranging from 0.08 to 0.25 lb ai/a as a single application followed by a second application of 0.5 lb ai/a eight days later. Tomatoes were in the 1 to 3 leaf stage, hairy nightshade in the 1 to 3 leaf, and jimsonweed in the 1 to 3 leaf stage.

This trial was established on a sandy loam soil and furrow irrigated. Application was with a CO_2 backpack sprayer, 30 gpa water, four replications, in a radomized complete block design.

On April 18, 1989, metribuzin at a rate of 0.175 lb ai/a reduced hairy nightshade from 52 plants/5 ft sq to 30 plants/5 ft sq. Tomato stand and vigor reduction was not affected by any rate. (University of California Cooperative Extension, Sacramento County, 4145 Branch Center Road, Sacramento, CA 95827)

Postemergence control of hairy nightshade and jimsonweed in canning tomatoes

			Weed stand count[2]			Tomatoes[1]	
Chemical	Rate lb ai/a		Hairy Nightshade	Lambs-quarters	Jimson-weed	Stand	Vigor
	4/10	4/18	4/18	4/18	4/18	4/18	4/18
metribuzin	0.08	0.50	51.8	0.3	1.8	10.0	10.0
metribuzin	0.10	0.50	40.0	0.5	1.3	10.0	10.0
metribuzin	0.12	0.50	43.3	0.0	2.3	10.0	10.0
metribuzin	0.15	0.50	34.3	0.3	1.0	10.0	10.0
metribuzin	0.175	0.50	30.8	0.3	4.0	10.0	9.7
metribuzin	0.20	0.50	42.0	0.8	0.0	10.0	10.0
metribuzin	0.25	0.50	33.5	0.3	0.5	10.0	9.5
control			45.0	2.0	4.3	10.0	10.0

[1] 0 = tomato stand reduced 100%
10 = no tomato stand or vigor reduction

Postemergence nightshade control in Murietta tomatoes. Orr, J. P. On March 3, 1989, in Winters, California, metribuzin 75DF was applied to tomatoes in the first leaf stage, hairy nightshade in the 1 to 2 leaf, and black nightshade in cotyledon to 2 leaf.

This trial was established on a clay loam soil and furrow irrigated. Application was with a CO_2 backpack sprayer, 30 gal/a water and replicated four times in a radomized complete block design. Weather at the time was 65F air temperature with scattered clouds.

Metribuzin at 0.10 lb ai/a gave excellent black and hairy nightshade control of 70% and 84%, respectively, slight tomato stand reduction and moderate vigor reduction. Nightshade control was significantly increased at the 0.5 lb ai/a rate, resulting in 94% black nightshade control and 88% hairy nightshade control, however, the tomato stand was reduced 100%. The tomatoes outgrew the initial vigor reduction at 0.1 lb ai/a. (University of California Cooperative Extension, Sacramento County, 4145 Branch Center Road, Sacramento, CA 95827)

Postemergence nightshade control in Murietta tomatoes

Chemical	Rate lb ai/a	Percent control Nightshade Black	Percent control Nightshade Hairy	Stand count[2] Nightshade Black	Stand count[2] Nightshade Hairy	Tomatoes Stand Count	Tomatoes Vigor[1]
	03/03	03/30	03/30	03/30	03/30	03/30	03/30
metribuzin	0.10	70.0	84.0	2.5	1.3	7.3	6.7
metribuzin	0.15	84.0	81.0	1.3	1.5	6.5	6.2
metribuzin	0.20	77.5	77.5	1.8	1.8	3.3	5.0
metribuzin	0.25	94.0	88.0	0.5	1.0	1.0	2.5
metribuzin	0.50	90.0	90.0	0.8	0.8	0.0	0.0
control		0.0	0.0	8.0	8.0	8.0	10.0

1 0 = Crop dead
10 = No crop damage

2 Number of plants per 10.5 square feet

Postemergence control of hairy nightshade in relation to yield. Orr, J. P. On May 4, 1989, in Elk Grove, California, on Takemori Farms, metribuzin was applied postemergence to furrow irrigated Ferrymorse 6203 canning tomatoes in the one to three true leaf stage, hairy nightshade was in the 1 to 3 leaf stage, and malva species in the 1 to 2 leaf stage. This was followed by a second additional application of 0.35 lb ai/a six days later when tomatoes were in the 3 to 5 leaf stage. This resulted in plots with one application only and plots with an additional application.

Application was by means of a CO_2 backpack sprayer, 30 gpa water, four replications, in a randomized complete block design.

In general, the second application significantly increased the hairy nightshade control. Metribuzin at 0.175 lb ai/a plus 0.35 lb ai/a resulted in 98% control of hairy nightshade, 100% control of lambsquarter, and 100% control of malva species with a yield of 22.1 tons/a compared to a 9.3 tons/a yield in the control. (University of California Cooperative Extension, Sacramento County, 4145 Branch Center Road, Sacramento, CA 95827)

Postemergence control of hairy nightshade in relation to tomato yield

			Weed control[2]						Tomatoes							
Chemical	Rate lb ai/a		Hairy Nightshade		Lambsquarters		Malva spp.		Chlorosis[3]		Stand Count[4]		Vigor[2]		Yield tons/a[1]	
	Single 5/04	Addit. 5/10	Single 5/10	Addit. 5/17	Single 5/10	Addti. 5/17	Single 5/10	Addit. 5/17	Single 5/10	Addit. 5/17	Single 5/10	Addit. 5/17	Single 5/10	Addit. 5/17	Single 5/17	Addit. 5/17
metribuzin	0.08	0.35	4.5	7.3	8.3	8.8	5.0	8.5	0.0	1.8	6.5	5.0	10.0	8.0	13.0	15.5
metribuzin	0.10	0.35	4.8	8.0	8.8	9.5	5.5	10.0	0.0	1.5	7.0	5.0	10.0	8.7	17.3	18.7
metribuzin	0.12	0.35	4.8	7.3	9.5	9.8	6.3	10.0	0.3	2.8	6.8	4.8	9.5	7.5	16.6	16.8
metribuzin	0.15	0.35	5.0	9.0	10.0	10.0	6.0	10.0	0.0	2.0	6.0	5.5	10.0	7.7	19.3	20.5
metribuzin	0.175	0.35	6.5	9.8	10.0	10.0	6.8	10.0	0.3	1.8	7.0	1.8	9.5	8.2	19.3	22.1
metribuzin	0.20	0.35	6.5	9.8	10.0	10.0	7.5	10.0	1.3	2.3	6.5	5.3	8.5	7.2	17.3	21.0
metribuzin	0.25	0.35	6.3	9.3	10.0	10.0	6.8	10.0	1.0	1.8	6.0	4.8	8.7	7.7	15.2	20.7
metribuzin	0.35	0.35	8.5	10.0	10.0	10.0	9.0	10.0	1.3	3.0	6.0	3.0	8.0	7.2	16.8	15.8
metribuzin	0.45	0.35	7.8	10.0	10.0	10.0	9.0	10.0	1.3	2.5	6.3	4.8	8.2	7.7	18.7	23.9
control			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.3	6.3	0.0	0.0	9.3	
Single Applications																
metribuzin		0.35	NA	4.3	NA	10.0	NA	NA	NA	0.5	NA	6.0	NA	0.0	NA	NA
metribuzin		0.45	NA	4.3	NA	10.0	NA	NA	NA	0.3	NA	6.3	NA	0.0	NA	NA
metribuzin		0.50	NA	5.3	NA	10.0	NA	NA	NA	1.0	NA	6.0	NA	1.5	NA	NA
ethiozin		0.25	NA	1.8	NA	10.0	NA	NA	NA	0.0	NA	6.0	NA	0.0	NA	NA
ethiozin		0.35	NA	1.0	NA	10.0	NA	NA	NA	0.0	NA	6.0	NA	0.0	NA	NA

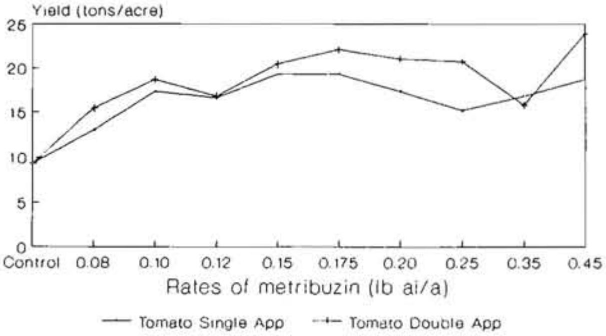
1 LSD (0.05) 9.8 single application yield 10.4 additional application yield
CV 23.3 21.7

2 0 = no weed control, crop dead
10 = complete weed control, no crop damage

3 0 = no chlorosis
10 = severe chlorosis

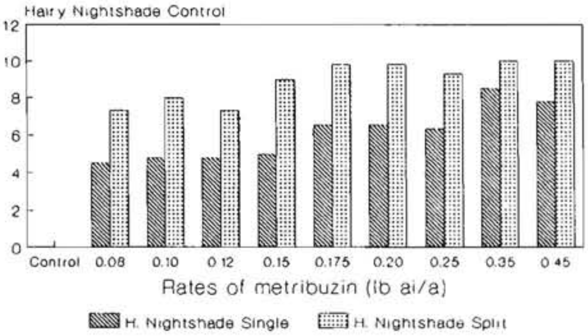
4 Number of plants per 3/72 square feet

Tomato Yield in Relation to Hairy Nightshade Control



+ Second Application 0.35 lb ai/a

Postemergence Hairy Nightshade Control Single vs Split Application



+ Second Application 0.35 lb ai/a

Control of hairy nightshade and yield response of FM785 tomatoes to postemergence application of metribuzin. Orr, J. P. On May 24, 1989, in Sacramento, California, metribuzin was applied as a single application to hairy nightshade in the 1 to 2 leaf stage and FM785 tomatoes in the cotyledon to first true-leaf stage, followed by a second additional application of 0.35 lb ai/a on June 1, 1989, to nightshade in the 2 to 3 leaf stage and tomatoes in the 2 leaf stage. This resulted in plots with one application only and plots with an additional application. Metribuzin rates as a single application ranged from 0.08 to 0.30 lb ai/a followed by an 0.35 lb ai/a application six days later. This resulted in plots with one application only and plots with an additional application.

Application was with a CO_2 backpack sprayer, 30 gpa water, with four replications, in a randomized complete block design.

Single applications rates slightly reduced the number of nightshade over the control. However, the combination split treatment with the addition of 0.30 lb ai/a very significantly reduced the number of nightshade. The vigor of the nightshade was reduced very significantly compared to the single treatment. Yields were not significantly different among single application treatments. Yields were not significantly different where 0.35 lb ai/a was added to the initial treatments. (University of California Cooperative Extension, Sacramento County, 4145 Branch Center Road, Sacramento, CA 95827)

Control of hairy nightshade and FM785 tomato yield response to postemergence applications of metribuzin

Chemcial	Rate lb ai/a		Hairy nightshade: Weed Control[2]		Hairy nightshade: Stand count[3 4]		Tomatoes: Stand[2]		Tomatoes: Vigor[2]		Tomatoes: Yield[1]	
			06/07		06/07		06/07		06/07		06/07	
	1st	2nd	Single	Double	Single	Double	Single	Double	Single	Double	Single	Double
metribuzin	0.08	0.35	0.0	7.3	36.0	25.3	10.0	10.0	10.0	8.5	11.6	11.6
metribuzin	0.10	0.35	0.0	6.0	68.3	33.3	10.0	10.0	10.0	8.5	9.9	10.0
metribuzin	0.12	0.35	0.0	7.0	45.3	27.7	10.0	10.0	10.0	8.3	13.7	12.5
metribuzin	0.15	0.35	0.0	6.5	46.0	31.8	10.0	10.0	10.0	8.5	12.9	12.3
metribuzin	0.175	0.35	0.0	8.0	42.0	23.0	10.0	10.0	10.0	7.5	12.9	13.3
metribuzin	0.20	0.35	2.8	8.3	33.3	15.3	10.0	10.0	9.3	7.0	13.8	13.0
metribuzin	0.25	0.35	2.0	8.3	32.0	18.8	10.0	10.0	8.0	7.5	11.8	11.7
metribuzin	0.30	0.35	3.3	6.3	31.5	24.5	10.0	10.0	9.2	8.7	15.2	12.3
control			0.0	0.0	47.5	45.5	10.0	10.0	10.0	10.0	13.3	
ethiozin	0.15	0.35	0.0	0.0	49.5	48.5	0.0	0.0	0.0	0.0		
ethiozin	0.25	0.35	0.0	0.0	55.0	47.8	0.0	0.0	0.0	0.0		
ethiozin	0.30	0.35	0.0	0.0	54.3	53.3	0.0	0.0	0.0	0.0		
ethiozin	0.35	0.35	0.0	0.0	48.0	51.8	0.0	0.5	0.0	0.0		
ethiozin	0.40	0.35	0.0	0.0	42.5	41.8	0.0	0.0	0.0	0.0		

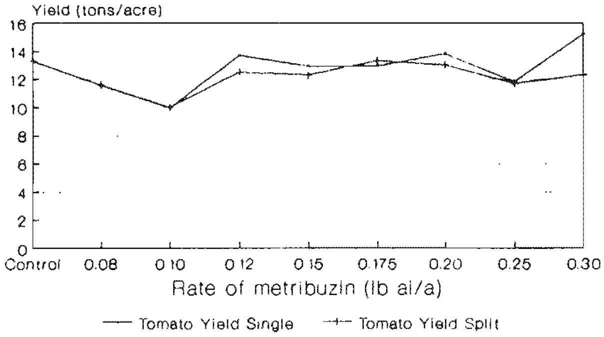
[1] LSD (0.05) 8.0 single application yield NS additional application yield
CV 13.5 15.2

[2] 0 = no weed control, crop dead
10 = complete weed control, no crop damage

[3] Vigor of Nightshade was reduced 80%

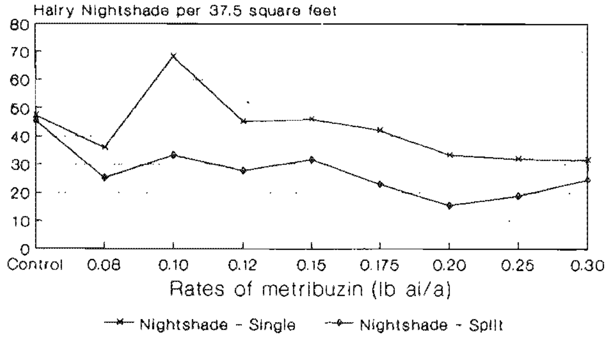
[4] Number of plants per 3.7 square feet

Tomato Yield Single vs. Split Application



+ Second Application of 0.35 lb ai/a

Hairy Nightshade Control Single vs. Split Application



+ Second Application 0.35 lb ai/a

Spotted spurge control in mixed cool season turf. Cudney, D.W., J. Van Dam, N.E. Jackson, and C.L. Elmore. Spotted spurge is a difficult to control summer annual weed in turf-producing areas of California. It germinates in April, May and June, forming a dense, unsightly mat in the summertime. It is a prolific seeder which, when established in a turf sward, becomes an annual problem. Preemergence trials done in previous years had shown poor performance by DCPA. Pendimethalin showed promise of better control than other preemergence herbicides in previous studies. Dithiopyr had shown promise of controlling spurge in one previous trial.

The following trial was established in the community of Highland in Southern California. The plot area was allowed to seed heavily with spotted spurge for one year. The plot area was seeded to perennial rye-Kentucky bluegrass mixture in the fall of 1988. On April 7, 1989, preemergence treatments consisting of 1 1/2 and 3 lb ai/a pendimethalin and 0.38, 0.5, 0.75, and 1.0 lb ai/a dithiopyr were applied. All applications were made with CO_2 constant pressure backpack sprayer using 8003 flat fan nozzles and a spray volume of 50 gallons per acre. Each treatment was 6 by 15 feet in size and was replicated four times. There was no phytoxicity to the perennial rye-Kentucky bluegrass mixture noted at any time subsequent to the spray application.

Weed control estimates were made on July 7. Pendimethalin did not control spotted spurge adequately. Dithiopyr controlled spotted spurge better with higher rates. The 0.38 rate was intermediate in spurge control. The 0.75 rate was also intermediate in control due to variability in two replications. Dithiopyr showed a promise for the control of spotted spurge in Southern California and will be included in future studies. (University of California, Botany & Plant Sciences Department, Riverside, CA 92521.)

Spotted spurge control at Highland, California

Treatment	Rate lb ai/a	Percent Spurge Control
dithiopyr	1.0	98.5
dithiopyr	0.5	94.3
dithiopyr	0.75	84.5
dithiopyr	0.38	80.0
pendimethalin	1.5	42.5
pendimethalin	3.0	46.3
check	0.0	0.0
LSD 0.05		39.9

Kikuyugrass postemergence control in mixed cool season turf. Cudney, D.W., J.A. Downer, C.L. Elmore, and V.A. Gibeault. Kikuyugrass has been a serious weed management problem in turf along the coastal and intermountain valleys of California from San Francisco to San Diego. Kikuyugrass is well adapted to these areas and invades both cool and warm season turfgrass species. This invasion is so rapid and complete that kikuyugrass has become the major weed control problem for many of the turfgrass producers in the region.

Until recently, one of the first lines of defense against kikuyugrass invasion was the use of siduron. Since siduron has been removed from the market, new methods of control are needed. The following trial was established in a mixed kikuyugrass and cool season turf sward. The cool season turf consisted of perennial ryegrass and Kentucky bluegrass.

Triclopyr, MSMA and a combination of triclopyr plus MSMA were applied in single and multiple applications to the mixed turfgrass. The first application occurred on 8/1/89, the second application was made on 9/3/89, and the third application on 11/13/89. Single application plots received treatments only on August 2. This is a continuing trial which will be utilized to measure kikuyugrass invasion and cool season reestablishment over a two-year period. Five replications of each treatment were made on plots that were 10 by 7 feet in size.

The accompanying table shows the effect of treatment on kikuyugrass control and cool season phytotoxicity when measured on August 17, October 17 and November 13. A single application of triclopyr gave some initial kikuyugrass control, but by October 17 and November 13 the kikuyugrass had recovered. A second application of triclopyr increased kikuyugrass control. MSMA applied at a single application also gave control initially. A second MSMA application increased kikuyugrass control markedly. Triclopyr plus MSMA controlled kikuyugrass similarly to MSMA alone for the single application. However, the combination, after two applications, controlled kikuyugrass best. None of the applications have thus far produced significant phytotoxicity to the cool season species. (University of California, Botany & Plant Sciences Department, Riverside, CA 92521.)

Kikuyugrass postemergence[1] trial at Ventura, California

Treatment	Rate	T.S.	K.C.	C.S.P.	K.C.	K.D.	K.C.
	lb ai/a		8/17/89		10/17/89		11/13/89
triclopyr	0.5	5.2	3.6	0.8	2.2	8.8	1.2
triclopyr[2]	0.5	4.8	3.8	0.8	5.2	7.0	5.0
MSMA	2.0	3.6	6.0	1.6	2.6	7.2	1.2
MSMA[2]	2.0	3.6	5.4	1.2	6.8	5.6	5.2
triclopyr+MSMA	0.5+2	3.2	6.2	1.6	4.4	7.4	1.8
triclopyr+MSMA[2]	0.5+2	3.2	6.2	1.4	8.6	1.8	8.8
Check		7.6	0.4	0.4	0.0	10.0	0.0
LSD 0.05		0.8	0.8	0.6	0.4	0.6	0.8

[1] 1st application 8/2/89; 2nd application 9/3/89; 3rd application 11/13/89
[2] repeated applications
T.S. = turf score. 0 is dead and 10 is perfect turf.
K.C. = kikuyugrass control. 0 is no control and 10 is dead kikuyugrass.
C.S.P. = cool season phytotoxicity. 0 = no effect; 10 = all turf dead.
K.D. = kikuyugrass density based on presence in 10, 4 $in.^2$ samplings per plot.

PROJECT 5

WEEDS IN AGRONOMIC CROPS

Charles E. Osgood - Project Chairperson

Dose-response of five sensitive crops to sulfometuron. Callihan R.H., L.W. Lass, and L.K. Hiller. This study used logarithmic dose treatments of sulfometuron in a Shano silt loam to develop dose-response curves and to characterize the injury induced. Alfalfa, lentil, pea, potato, and sugar beet plots were planted June 3 to 5, 1989. Pre-emergence applications were made June 7, 1989 with a tractor-mounted sprayer to paired 3 by 30 m plots in a randomized complete block design with 4 replications. The logarithmic sprayer was calibrated prior to application by spectrophotometric measure-ment of dye applied on a time-distance line, which allowed construction of a log-dose output curve.

The growth rate of the crops and intensity of the shoot injury described of was measured at each of seven preselected dosages in each log plot. Pea, alfalfa, and sugar beet shoot height and injury ratings were measured June 17, July 3, and July 15. Additional alfalfa height measurements were taken August 26. Potato vine length were measured July 4, July 15, August 11, and August 26.

On July 16, 10 plants from each of the seven dosages in lentil and pea plots were harvested, dried, and weighed. Alfalfa was harvested August 11 by clipping 5 plants at ground level; these were dried and weighed. Sugar beet tops and roots from three plants were harvested for fresh weight September 23. Potato tubers from five plants at each dosage were harvested for fresh weight and quality evaluations September 29.

1. Peas. Early pea shoot growth reduction June 17 ranged from 66% by 2.19 g/ha sulfometuron, to 28% by 0.07 g/ha sulfometuron. Node length was reduced in approximately the same proportion as was the reduction of shoot height. Pea growth essentially stopped in all rates above 0.55 g/ha after June 17. Pea height measured at the bloom stage July 3 was reduced more than 60% by rates above 0.27 g/ha, but height was not affected by 0.14 or 0.07 g/ha sulfometuron by July 15.

Estimated leaf chlorosis ranged from 58% by 2.19 g/ha to 14% by 0.55 g/ha. Leaf chlorosis at bloom July 3 was discernible in plants exposed to 0.27 g/ha and above. Chlorosis was still evident during pod fill, at 2.19 and 1.64 g/ha. Total shoot biomass reduction varied from 93% by 2.19 g/ha to 29% by 0.07 g/ha. Harvestable pea pods were eliminated by all doses above 0.55 g/ha.

2. Lentils. Early lentil shoot growth, measured on June 17, was reduced from 49% by 2.19 g/ha to 19% by 0.07 g/ha. Chlorosis varied from 34% at 2.19 g/ha to 12% at 1.09 g/ha. Evaluations of chlorosis after June 17 indicated no further damage to new leaves and stems. Plant shoot biomass was decreased from 95% by 2.19 g/ha to 63% by 0.27 g/ha, but was not affected by lower doses. Pods were not produced in the 1.64 and 2.19 g/ha treatments. Pod numbers were reduced by about 80% at rates ranging from 0.27 to 1.09, but were not affected at rates from 0.07 or 0.14 g/ha.

3. Alfalfa. Seedling alfalfa shoot length measured June 17, was shortened from 60% by 2.19 g/ha, to 22% by 0.07 g/ha. Unlike peas, alfalfa in treated plots continued to grow, but at a slower rate than in the check. Differences in shoot length were greater in mid-season measurements, but shoot height at seed maturity on August 26 was not affected by rates below

1.64 g/ha. Alfalfa shoots in treated plots did not show chlorotic symptoms. Reductions in shoot biomass were still detected at harvest on August 11, and ranged from 92% by 2.19 g/ha to 17% by 0.07 g/ha.

4. Sugar beets. Sulfometuron reduced the shoot height of sugar beet seedlings from 69% at 2.19 g/ha to 29% at 0.07 g/ha on June 17. By July 15, shoot height was reduced over 90% by rates from 1.09 to 2.19 g/ha, and was even reduced 60% by 0.07 g/ha. By August 26 height was still suppressed 32% by 0.14 g/ha and 0.07 g/ha. Sugar beet root biomass was decreased more than 90% at rates of sulfometuron above 0.55 g/ha, and at 0.27 g/ha the reduction was 84%. At rates less than 0.27 g/ha the reduction in root weight was not significantly different than the check. Shoot weight was reduced more than 90% at rates above 0.55 g/ha, and shoot weights were reduced 77% at 0.27 g/ha, but were not significantly affected by sulfometuron below 0.14 g/ha. Leaf-to-root ratios were greater in plants exposed to sulfometuron.

5. Potato. Potato shoot heights and stem lengths observed July 3 were reduced from 50 to 60% at rates from 2.19 g/ha to 1.09 g/ha but were not reduced at rates below 0.55 g/ha. No potato vine length differences were still observed by August 26, however. Total potato tuber yield weight was not significantly decreased by the treatments. Plants exposed to more than 1.09 g/ha rate failed to produce tubers without cracks or knobs. Plants exposed to more than 0.55 g/ha produced less than 32% of tubers free from cracks or knobs. Plants exposed to more than 1.09 g/ha produced 31 to 50% more small cracked tubers.

Statistical no-effect threshold levels of sulfometuron were found in pea shoot biomass, chlorosis, and pod weight, lentil shoot biomass and pod number, alfalfa shoot biomass, sugar beet root and shoot biomass, potato shoot height, tuber weight and tuber quality. No-effect threshold levels in pea height, inter-node length, and pod number, lentil height, alfalfa height, and sugar beet shoot height were below the lowest dose tested (0.07 g/ha).

Temporal changes in perception of apparent no-effect thresholds of sulfometuron in all of the crops were observed throughout the growing season. In the first month after application pea and lentil height were significantly reduced at the lowest tested dose (0.07 g/ha); therefore the no-effect level was not reached. The observance of a statistical no-effect threshold in data from the last height measurement of peas and lentils suggests plant recovery from effects of the 0.07 g/ha sulfometuron treatment. This may be due to degradation or less uptake because of an expanded root system outside the herbicide zone. Similar late shifts in apparent no-effect thresholds were observed in sugar beet and alfalfa shoot heights. It is clear that a series of observations during plant development is necessary to ensure detection of transient effects. Response thresholds are dependent upon evaluative criteria, temporal effects, and environment. Statistically significant no-effect levels reported here are assumed to be higher than actual differences since effects, though not consistent, were found, at low dose levels. (Univ. of Idaho, Dept. of P.S.& E.S., Moscow 83843 and Washington State University, Dept. of Hort. Pullman 99163)

Delayed weed control applications in seedling alfalfa. Orloff, S. B. and D. W. Cudney. Alfalfa in the high desert is usually planted in the fall, September - early October. Winter annual weeds are a common problem in these fields. Postemergence herbicides are usually applied at the one to five trifoliate leaf stage of the alfalfa, October to early December. Occasionally, growers miss this application window, or underestimate the weed population, and a delayed herbicide application is required to reduce competition and to improve the quality of the first cutting. However, when weed control is delayed, the weeds can get excessively large, making control difficult. Less information is available on herbicide efficacy when the preferred application window is missed.

A trial was conducted in the high desert of San Bernardino County (El Mirage) to determine the efficacy of several herbicides under delayed application conditions. Herbicides were applied on March 3, 1989 with a CO_2 backpack sprayer calibrated to deliver 20 gallons per acre at 30 psi. 2,4-DB, hexazinone, imazethpyr, sethoxydim, 2,4-DB + sethoxydim, oxyfluorfen, paraquat, and oxyfluorfen + paraquat were applied at the rates indicated in the following table. The alfalfa had greater than nine trifolate leaves and a root system deeper than six inches at the time of application. The grasses, primarily foxtail barley, were 4 to 5 inches in size. The broadleaf weeds had passed the rosette stage and averaged 3-4 inches tall. Plots were 10 by 20 feet in size. Treatments were replicated four times. Evaluations were made two and six weeks after application.

There was no significant alfalfa injury at the March 20th evaluation date. There was the typical "burn back" that occurs with paraquat and oxyfluorfen, but the alfalfa out-grew this injury. It was not possible to make another alfalfa injury rating, as drought stress masked the possible phytotoxic effects of the herbicides.

2,4-DB controlled 90 percent of the mustard weeds, less than that which is achieved in the high desert when 2,4-DB is applied to younger, smaller weeds. Hexazinone controlled both mustards and foxtail barley when applied at the .45 lb ai/A rate. Grass control diminished when hexazinone was used at the lower rate. Despite the late application date, imazethapyr controlled all of the broadleaf weeds. Foxtail barley control, however, was poor with imazethapyr. Sethoxydim did not control the mustards and provided only partial grass control (rating of 7.8). The combination of 2,4-DB plus sethoxydim at .5 and .375 lb ai/A partially controlled both mustards and grasses. Oxyfluorfen, at both rates tested, did not adequately control mustards or grasses. The higher rate of paraquat (.5 lbs/A) was needed before greater than 80 percent control of all weed species was achieved. The tank mix of oxyfluorfen plus paraquat impoved mustard control slightly.

None of the herbicide treatments used provided 100 percent control, emphasizing the importance of proper application timing to control the weeds when they are small. However, several of the herbicide treatments did control most of the weeds, thus reducing the competitive effects of the weeds and improving hay quality. (University of California Cooperative Extension, Lancaster, CA 93535.)

Delayed weed control applications in seedling alfalfa at El Mirage, California

Treatment	Rate #ai/A	Crop Injury	Weed Control[1]				
			Tansy Mustard 3/20	London Rocket 3/20	Mustard[2] 4/21	Foxtail 3/20	Foxtail 4/21
2,4-DB	0.75	0.3	6.3	6.3	9.1	1.0	1.0
hexazinone	0.30	0.5	5.5	6.1	9.4	1.8	5.8
hexazinone	0.45	0.7	6.9	6.9	9.5	2.9	8.7
imazethapyr	0.094	0.0	8.2	8.5	10.0	1.8	2.8
sethoxydim	0.375	0.0	1.3	1.0	0.0	3.3	7.8
2,4-DB+sethoxydim	0.5+0.375	0.5	3.3	4.5	7.6	2.0	4.0
oxyfluorfen	0.25	1.7	3.9	4.3	4.1	3.2	3.0
oxyfluorfen	0.35	2.5	5.5	5.3	5.3	2.8	0.8
paraquat	0.25	1.0	7.0	6.4	7.3	6.8	5.3
paraquat	0.50	2.0	8.6	8.6	8.6	8.5	8.3
oxyfluorfen+paraquat	0.25+0.25	1.9	6.5	7.0	7.3	6.8	6.8
oxyfluorfen+paraquat	0.25+0.5	2.1	8.3	8.6	9.5	8.0	8.3
Check		0.0	0.0	0.0	1.0	0.3	0.8
LSD 0.05		0.9	3.0	2.7	2.9	1.9	2.6

[1]0 = no control; 10 = all weeds dead
[2]Mustard - both Tansy and London Rocket

Evaluation of herbicides for the control of foxtail barley in seedling alfalfa Orloff, S.B. and D.W. Cudney. Postemergence grass herbicides have been used recently to control grasses in alfalfa. Pronamide is an established preemergence herbicide for winter annual grass control. The following trial was conducted to compare postemergence herbicides and pronamide. The trial was established in the high desert region of Southern California near Lancaster. Treatments were applied on 10/19 and 10/21/88 to alfalfa which was in the one to two trifoliate leaf stage. Foxtail barley had 4 to 6 leaves, 1 to 2 tillers, and was 1 to 3 inches tall at the time of treatment. The herbicides tested included pronamide, sethoxydim, fluazifop, and clethodim at two rates each as shown in the table below. The herbicides were applied with a CO_2 backpack sprayer calibrated to deliver 20 gallons per acre at 30 psi. The plots were 10 by 20 feet in size with each treatment replicated four times. The plots were evaluated three times before the first harvest (2, 7, and 18 weeks after application). Weed control was reevaluated after the first cutting (25 weeks after application). Alfalfa cover and stand density were measured after the second alfalfa harvest (7 months after treatment).

Foxtail barley control with pronamide steadily improved over the first three evaluations. In contrast, foxtail barley control with sethoxydim and fluazifop declined over the same four month time period. The most effective treatments were pronamide at both rates, and fluazifop and clethodim at the higher rate (0.2 lbs ai/A). Foxtail barley regrew after the first cutting and contaminated the second cutting as well. Pronamide, and fluazifop and clethodim at the higher rate continued to be the most effective treatments. Evaluations made after the second cutting illustrated that foxtail barley competition dramatically reduced both alfalfa stand and cover. There were only 0.4 alfalfa plants per square foot in the untreated check plots compared to over 20 in the pronamide-treated plots. There was a strong correlation between alfalfa stand density and foxtail barley control. (University of California Cooperative Extension, Lancaster, CA 93535.)

Foxtail barley control in seedling alfalfa at Lancaster, California

Treatment	Rate #ai/A	Foxtail Barley Control 11/4	12/9	4/6	5/31	Alfalfa %Cover 6/27	Alfalfa Plants/ft^2 6/27
pronamide	0.50	3.5	7.5	9.1	9.1	62	21.1
pronamide	0.75	4.0	8.6	10.0	10.0	66	21.9
sethoxydim	0.28	7.5	8.3	5.7	6.7	56	16.1
sethoxydim	0.375	7.1	8.6	6.9	7.4	56	17.5
fluazifop	0.1	6.6	7.3	2.8	5.6	41	13.5
fluazifop	0.2	7.6	10.0	9.8	9.3	58	17.5
clethodim	0.1	7.9	9.5	8.4	8.6	58	18.3
clethodim	0.2	8.4	10.0	10.0	9.8	63	19.6
Check		0.0	0.0	0.0	0.3	0	0.4
LSD 0.05		1.1	0.7	0.9	0.7	8	4.4

Seedling alfalfa weed control. Orloff S. B. and D. W. Cudney. Both broadleaf and grassy weeds typically infest seedling alfalfa fields. Broadleaf herbicides have been commonly used for weed control in alfalfa. Recently, postemergence grass control herbicides have been introduced. The purpose of the following trial was to determine if postemergence broadleaf herbicides could be combined with a postemergence grass herbicide in a single tank mix to control both classes of weeds. Each of the broadleaf herbicides (2,4-DB, bromoxynil, and imazethapyr) was tested at two rates. A combination of 2,4-DB plus bromoxynil was also included. The lower rate of each herbicide and the 2,4-DB plus bromoxynil treatment were combined with sethoxydim at .375 lb ai/A plus a crop oil concentrate at one quart per acre. The herbicides were applied with a CO_2 backpack sprayer calibrated to deliver a spray volume of 20 gallons per acre at 30 psi. Plot size was 10 by 20 feet. Treatments were replicated four times.

Significant alfalfa injury occurred with the treatments containing bromoxynil. Stand data was not collected but there appeared to be a noticeable reduction in stand with the bromoxynil treatments. This was probably due to the warm temperatures at application time, approximately 85 degrees F. Little to no alfalfa injury occurred with the other treatments.

2,4-DB and imazethapyr completely controlled London rocket, while bromoxynil provided approximately 95 percent control. No filaree was present at the time of harvest with treatments that received 2,4-DB or imazethapyr. Bromoxynil was ineffective for the control of filaree. None of the broadleaf herbicides controlled volunteer barley. London rocket control declined slightly when sethoxydim was tank mixed with 2,4-DB or bromoxynil. The reduction is not statistically significant but the trend is noteworthy, antagonism has been observed in previous trials. Complete London rocket control was still achieved when imazethapyr and sethoxydim were tank mixed. Although not statistically significant, better barley control was accomplished when sethoxydim was used alone rather than when it was combined with any of the broadleaf herbicides. These results suggest that it may be better to apply the broadleaf herbicides and sethoxydim in separate applications rather than tank mixed. (University of California Cooperative Extension, Lancaster, CA, 93535.)

Broadleaf and grass control[1] in seedling alfalfa at Apple Valley, California

Treatment	Rate #ai/A	Alfalfa Injury 11/4	Filaree 11/4	Lambs-quarters 11/4	Vol. Barley 11/4	Vol. Barley 4/25	London Rocket 11/14	London Rocket 4/25
2,4-DB	0.5	0.4	7.0	7.5	0.8	2.0	7.8	10.0
4,4-DB	0.75	1.1	8.3	8.0	0.0	1.3	8.0	10.0
bromoxynil	0.25	3.1	0.0	10.0	0.0	2.3	9.3	9.5
bromoxynil	0.375	3.0	0.5	10.0	0.0	3.0	10.0	9.5
imazethapyr	0.063	0.5	8.5	8.5	4.1	0.8	9.8	10.0
imazethapyr	0.125	1.5	9.5	8.3	5.3	3.3	9.9	10.0
2,4-DB+bromoxynil	0.5+0.25	2.5	8.0	10.0	0.0	3.0	9.6	10.0
sethoxydim	0.375	0.3	0.0	0.0	8.1	9.5	0.0	1.0
2,4-DB+sethoxydim	0.5+0.375	1.8	7.3	8.4	8.1	9.1	8.0	9.8
bromoxynil+ sethoxydim	0.25+0.375	2.6	0.5	10.0	8.4	9.3	10.0	8.5
imazethapyr+ sethoxydim	0.063+0.375	1.3	9.3	8.5	8.4	8.9	10.0	10.0
2,4-DB+bromoxynil +sethoxydim	0.5+0.25+0.375	3.3	7.3	9.3	8.0	8.9	8.3	5.1
Check		0.3	0.0	0.0	0.0	2.5	0.0	4.5
LSD 0.05		1.0	1.1	1.1	1.1	2.6	1.0	2.1

[1]Ratings: 0 = no effect; 10 = all plants dead

The effect of adjuvents on weed control in seedling alfalfa with imazethyapyr and sethoxydim. Orloff, S. B. and D. W. Cudney. A trial was conducted in Lancaster, California to determine the effect of four different adjuvents on the activity of two herbicides, imazethapyr and sethoxydim. The adjuvent treatments included a nonionic surfactant (Triton AG 98), a crop oil concentrate (Surfel), a nonionic surfactant plus liquid fertilizer (UN32), and Dash (a new crop oil concentrate developed by BASF). The sethoxydim plots received an application of 2,4-DB ester at .75 lb ai/A subsequent to the sethoxydim treatment to avoid the competitive effects of the broadleaf weeds. The herbicides were applied with a CO_2 backpack sprayer calibrated to deliver a spray volume of 20 gallons per acre at a pressure of 30 psi. The plots were 10 by 20 feet in size and the treatments were replicated four times. The application was made when the alfalfa was in the two to three trifoliate leaf stage. Filaree, tansy mustard, shepherd's purse, and foxtail barley were in their early seedling stages of development.

The adjuvent treatments did not effect the activity of imazethapyr on any of the weed species. However, the adjuvents did have a significant effect on the foxtail barley control activity of sethoxydim. Foxtail barley control was least when a nonionic surfactant was used as the adjuvent, a control rating of only 5.4. The addition of UN32 to the nonionic surfactant improved foxtail barley control. Control of foxtail barley was also better with a crop oil concentrate compared to a nonionic surfactant alone. Sethaxydim with Dash tended to be the most effective in foxtail barley control, providing approximately 90 percent control. (University of California Cooperative Extension, Lancaster, CA, 93535.)

The effect of adjuvents on seedling alfalfa weed control

					Weed Control					
	Rate		Alfalfa Injury		Filaree	Shepherd's Purse	Tansy Mustard		Foxtail Barley	
Treatment	#ai/A	Adjuvent	12/9	1/26	1/26	1/26	1/26	4/20	1/26	4/20
imazethapyr	0.063	NIS	0.5	0.0	8.1	9.4	9.3	9.5	3.8	5.8
imazethapyr	0.094	NIS	1.3	1.0	9.4	10.0	10.0	10.0	6.6	7.3
imazethapyr	0.063	COC	0.5	0.3	9.0	9.8	9.5	10.0	4.5	6.6
imazethapyr	0.094	COC	0.8	0.3	9.0	9.9	10.0	10.0	5.3	7.0
imazethapyr	0.063	NIS+Liq.Fert.	1.1	0.3	9.4	10.0	10.0	10.0	4.8	5.3
imazethapyr	0.094	NIS+Liq.Fert.	1.0	0.6	8.8	10.0	9.8	10.0	6.0	7.1
imazethapyr	0.063	Dash	0.5	0.3	8.4	9.3	9.3	10.0	4.5	6.3
sethoxydim	0.094	Dash	0.5	0.4	9.0	10.0	9.8	10.0	6.5	6.8
sethoxydim	0.28	NIS	0.1	0.4	4.5	7.0	8.5	9.8	6.5	5.4
sethoxydim	0.28	COC	0.4	0.4	5.3	6.4	7.8	10.0	8.9	7.1
sethoxydim	0.28	NIS+Fert.	0.1	0.3	5.6	7.3	8.3	10.0	9.3	8.6
sethoxydim	0.28	Dash	0.5	0.1	4.3	7.0	6.4	8.8	9.4	9.0
Check			0.0	0.0	0.0	0.5	0.0	1.5	0.5	2.0
LSD 0.05			0.5	0.6	1.2	1.3	1.4	1.3	1.8	1.9

NIS = Triton AG 98 at .25%
COC = Surfel at 1 qt/A
Dash = 1 qt/A
Liq. Fert. = UN32 1 qt/A
2,4 DB ester at .75 lbs ai/A applied on 12/01/88 to all plots treated with Poast

Timing of sethoxydim applications for winter annual grass control in seedling alfalfa. Orloff, S. B. and D. W. Cudney. Inconsistent results have been observed when sethoxydim has been used for the control of volunteer oats and winter annual grassy weeds such as foxtail barley and volunteer cereals in seedling alfalfa. The following trial was established to determine the optimum timing of sethoxydim for maximum grass control and if a reduced rate could then be used. The trial was established in the high desert region of Southern California near Lancaster. The plots were 10 by 20 feet in size and each treatment was replicated four times. The herbicide was applied with a CO_2 backpack sprayer calibrated to deliver a spray volume of 20 gallons per acre at a pressure of 30 psi. Sethoxydim was applied at .19 and .38 lbs ai/A with 2 pints per acre of a crop oil concentrate (Surfel). Applications were made at four alfalfa and oat growth stages:

Appl. Dates:	Alfalfa Growth Stage:	Oat Growth Stage:
9/27/88	Unifoliate leaf	2-3" 1 leaf (2nd starting)
10/08/88	2 trifoliate	3-6" 3-4 leaves
10/19/88	4-6 trifoliate	6-9" 6-9 leaves
10/31/88	7-9 trifoliate	10-14" 6-9 leaves

Volunteer oat control was monitored four times after the applications were made and prior to the first cutting. A foxtail barley control rating and seed head counts of foxtail barley, and volunteer oats were taken on the last evaluation, April 20.

In every case weed control was equal or superior with the higher application rate. When sethoxydim was applied at the earliest growth stage, volunteer oat control although initially good, declined by the end of the monitoring period. When sethoxydim was applied at the second growth stage, oat control remained consistent. The third application timing resulted in increasing oat control over the evaluation period. Oat control increased over time with the last application date, but the level of control never reached that of the third application. Volunteer oat seed head production data were similar to the oat control ratings, with maximum reduction being obtained with the third application date and the higher rate of sethoxydim. This same trend was observed with foxtail barley control ratings. The foxtail barley seed head counts were also lowest for the third application date and the higher rate of sethoxydim. Foxtail barley seed head numbers were equal to or slightly higher than the control plots when the low rate of sethoxydim was used and applied early. This is most likely due to reduced competition from volunteer oats in these plots.

The results of this trial indicate that the best long-term annual grass control may not occur when applications are made at the earliest growth stages (when chemical control is generally considered to be best). Other factors, such as alfalfa competition may be important. Volunteer oats in the earliest application may have recovered due to an open alfalfa canopy. Volunteer oats in the latest application were not controlled because they were too large at the time of treatment. Best

control resulted from the middle application dates when the best combination of weed size and alfalfa competitive ability occurred. (University of California Cooperative Extension, Lancaster, CA, 93535.)

Timing of sethoxydim applications for volunteer oat and foxtail barley control in seedling alfalfa at Lancaster, California

Treatment[1]	Rate #ai/A	Appl. Date	Volunteer Oat Control Rating[2]				Foxtail Barley Rating 4/20	Sead Heads/ ft^2 (4/20)	
			11/4	12/1	12/21	4/20		Vol. Oat	Foxtail Barley
sethoxydim	0.188	9/27	7.8	7.4	6.8	5.0	2.5	1.57	1.99
sethoxydim	0.375	9/27	9.6	9.1	8.1	6.6	7.5	0.69	0.38
sethoxydim	0.188	10/08	7.9	8.6	7.5	7.4	5.3	0.56	1.23
sethoxydim	0.375	10/08	7.9	8.6	8.0	8.5	8.3	0.39	0.18
sethoxydim	0.188	10/19	5.4	6.3	6.5	8.5	7.9	0.28	0.46
sethoxydim	0.375	10/19	5.9	7.5	8.1	9.0	8.8	0.21	0.17
sethoxydim	0.188	10/31	0.0	3.8	4.1	5.8	4.3	1.43	1.43
sethoxydim	0.375	10/31	0.0	4.8	4.9	7.7	8.4	1.05	0.06
Check			0.0	0.0	0.0	1.0	2.8	3.04	1.21
LSD 0.05			1.0	0.8	0.7	1.3	2.2	0.74	0.60

[1]Two pints/A Surfel added to all treatments.
[2]Weed control rating: 0 = no effect; 10 = all weeds dead.

Wild proso millet control in seedling alfalfa. Miller, S.D. and A.W. Dalrymple. A series of postemergence herbicide treatments were applied near Cassa, Wyoming to evaluate their efficacy for wild proso millet control in seedling alfalfa (var. Apollo II). The alfalfa was seeded June 14 and postemergence treatments applied July 7, 1989 (air temperature 93F, relative humidity 70%, wind calm, sky clear and soil temperature - 0 inch 122F, 2 inches 105F and 4 inches 89F) to unifoliolate leaf alfalfa and 4- to 6-inch wild proso millet. Plots were established under flood irrigation and were 9 by 30 ft with three replications arranged in a randomized complete block. The herbicides were applied broadcast with a CO_2-pressurized, six-nozzle, knapsack sprayer delivering 10 gpa at 40 psi. The soil was classified as a silt loam (52% sand, 34% silt and 14% clay) with 2.1% organic matter and pH 7.7. Visual weed control ratings were made July 27 and August 21, 1989. Alfalfa injury was not visually evaluated because stands were poor and quite variable. Wild proso millet (PANMI) densities were very uniform and averaged over 90 plants/sq ft.

Wild proso millet control was 8 to 34% greater when evaluated 7 rather than 3 weeks after application. Wild proso millet control was good (90% or greater) with sethoxydim at 0.3 lb/A, clethodim at 0.078 or 0.125 lb/A, fluazifop at 0.37 lb/A, haloxyfop at 0.1 or 0.2 lb/A and quizalofop at 0.2 lb/A. The addition of imazethapyr reduced wild proso millet control with grass herbicides 8 to 50%, while the addition of bromoxynil had little effect. (Wyoming Agric. Exp. Sta., Laramie, WY 82071 SR 1605)

Wild proso millet control in seedling alfalfa.

Treatment[1]	Rate lb ai/A	PANMI Control[2] July %	August %
Sethoxydim	0.1	60	78
Sethoxydim	0.2	77	87
Sethoxydim	0.3	90	93
Sethoxydim+imazethapyr	0.1+0.047	47	72
Sethoxydim+bromoxynil	0.1+0.25	53	81
Clethodim	0.078	63	91
Clethodim	0.125	83	91
Clethodim+imazethapyr	0.078+0.047	33	38
Clethodim+bromoxynil	0.078+0.25	63	91
Fluazifop	0.19	33	71
Fluazifop	0.37	58	92
Fluazifop+imazethapyr	0.19+0.047	20	63
Fluazifop+bromoxynil	0.19+0.25	28	68
Haloxyfop	0.1	77	90
Haloxyfop	0.2	85	93
Haloxyfop+imazethapyr	0.1+0.047	48	52
Haloxyfop+bromoxynil	0.1+0.25	58	84
Quizalofop	0.1	68	88
Quizalofop	0.2	92	93
Quizalofop+imazethapyr	0.1+0.047	30	38
Quizalofop+bromoxynil	0.1+0.25	67	78
HOE-46360	0.075	58	76
HOE-46360	0.15	78	87
HOE-46360+imazethapyr	0.075+0.047	30	44
HOE-46360+bromoxynil	0.075+0.25	62	82

[1]Treatments applied July 7, 1989; oil concentrate (AT Plus 411F) was included with all treatments at 1 qt/A.
[2]Wild proso millet control visually evaluated July 27 and August 21, 1989.

Influence of additives on weed control with imazethapyr in new seeding alfalfa. Miller, S.D. and A.W. Dalrymple. Research plots were established at the Research and Extension Center, Torrington, Wyoming to evaluate the influence of additives on weed control and alfalfa tolerance with postemergence imazethapyr applications. Plots were established under sprinkler irrigation and were 9 by 30 ft with three replications arranged in a randomized complete block. Alfalfa (var. Dekalb 1120) was planted in a sandy loam soil (77% sand, 12% silt and 11% clay) with 1.5% organic matter and pH 7.2 April 7, 1989. Herbicide treatments were applied broadcast with a CO_2-pressurized, six-nozzle, knapsack sprayer delivering 20 gpa at 40 psi May 16, 1989 (air temperature 70F, relative humidity 80%, wind calm, sky cloudy and soil temperature - 0 inch 80F, 2 inches 72F and 4 inches 64F) to 2 trifoliolate leaf alfalfa and 1- to 2-inch weeds. Visual weed control and crop damage evaluations were made June 15 and plots harvested for yield July 6, 1989. Kochia (KCHSC) and common lambsquarters (CHEAL) infestations were heavy and Russian thistle (SASKR) and volunteer corn (ZEAMA) infestations light and variable throughout the experimental area.

No treatment reduced alfalfa stand; however, several treatments injured alfalfa (3 to 18%). Greatest alfalfa injury occurred when imazethapyr was applied in combination with X-77 plus 28% N, regardless of rate. Kochia and Russian thistle control with imazethapyr was excellent, regardless of additive or rate; however, additives increased imazethapyr activity on common lambsquarters and volunteer corn. Additives generally were equally effective in enhancing imazethapyr activity on these two species. Alfalfa yields were 1393 to 1728 lb/A higher and weed yields 2021 to 2207 lb/A lower in imazethapyr-treated compared to weedy check plots. (Wyoming Agric. Exp. Sta., Laramie, WY 82071 SR 1604).

Influence of additives on weed control with imazethapyr in new seeding alfalfa.

Treatment[1]		Alfalfa[2]			Weed Control[3]				Weed[3]
Imazethapyr Rate lb ai/A	Additive Rate	Injury %	Stand Red. %	Yield lb/A	KCHSC %	CHEAL %	SASKR %	ZEAMA %	Yield lb/A
0.047	none	0	0	3993	93	77	93	20	198
0.047	X-77 0.25%	0	0	4020	98	88	98	37	114
0.047	At Plus 411F 1qt	0	0	4033	98	87	98	37	61
0.047	Dash 1pt	0	0	4080	100	87	97	40	91
0.047	Sunit 1qt	0	0	4134	100	92	100	43	76
0.047	X-77+28%N 0.25%+1g	5	0	4074	100	90	100	47	57
0.063	none	0	0	4114	100	85	98	28	114
0.063	X-77 0.25%	0	0	4214	100	97	100	53	15
0.063	At Plus 411F 1qt	7	0	4127	100	93	100	63	27
0.063	Dash 1pt	3	0	4201	100	96	100	57	30
0.063	Sunit 1qt	0	0	4087	100	93	100	60	12
0.063	X-77+28%N 0.25%+1g	10	0	4167	100	98	100	60	12
0.094	none	0	0	4114	100	86	97	50	38
0.094	X-77 0.25%	3	0	4100	100	97	100	70	15
0.094	At Plus 411F 1qt	13	0	4328	100	98	100	75	12
0.094	Dash 1pt	7	0	4342	100	93	100	73	23
0.094	Sunit 1qt	5	0	4154	100	97	100	73	12
0.094	X-77+28%N 0.25%+1g	18	0	4000	100	100	100	80	12
Weedy Check	------------------	0	0	2600	0	0	0	0	2219

[1]Treatments applied May 16, 1989.
[2]Alfalfa injury and stand reduction visually evaluated June 15 and plots harvested July 6, 1989.
[3]Weed control visually evaluated June 15 and weeds harvested July 6, 1989.

Evaluation of preplant, postemergence or complimentary preplant/ postemergence treatments in new seeding alfalfa. Miller, S.D. and A.W. Dalrymple. Research plots were established at the Research and Extension Center, Torrington, Wyoming to evaluate the efficacy of preplant, postemergence or complimentary herbicide treatments for weed control in new seeding alfalfa. Plots were established under sprinkler irrigation and were 9 by 30 ft. with three replications arranged in a randomized complete block. Herbicide treatments were applied broadcast with a CO_2-pressurized, six-nozzle, knapsack sprayer delivering 20 gpa at 40 psi. Preplant herbicides were applied April 5, 1989 (air temperature 62F, relative humidity 25%, wind W at 3 mph, sky cloudy and soil temperature - 0 inch 72F, 2 inches 60F and 4 inches 50F) and incorporated twice immediately after application with a roller harrow operating at a depth of 1.5 inch. Alfalfa (var. Dekalb 1120) was seeded April 7, 1989 in a sandy loam soil (77% sand, 12% silt and 11% clay) with 1.5% organic matter and pH 7.2. Postemergence treatments were applied May 16, 1989 (air temperature 65F, relative humidity 80%, wind SE at 5 mph, sky cloudy and soil temperature - 0 inch 75F, 2 inches 69F and 4 inches 60F) to 2 trifoliolate leaf alfalfa and 1.0- to 1.5-inch weeds. Visual weed control and crop damage evaluations were made June 15 and plots harvested for yield July 6, 1989. Kochia (KCHSC), common lambsquarters (CHEAL) and Russian thistle (SASKR) infestations were heavy, and wild buckwheat (POLCO) and volunteer corn (ZEAMA) infestations light but uniform throughout the experimental area.

No treatment reduced alfalfa stand; however, bromoxynil, alone or in combination with imazethapyr injured alfalfa 10 to 20% and pendimethalin/ imazethapyr and imazethapyr/sethoxydim combinations injured alfalfa 5 to 7%. Broadleaf weed control was good to excellent with treatments containing bromoxynil or imazethapyr, and volunteer corn control was excellent with treatments containing sethoxydim. All herbicide treatments increased alfalfa yield and reduced weed yield compared to the weedy check. Alfalfa yield related closely to weed control and/or crop injury. (Wyoming Agric. Exp. Sta., Laramie, WY 82071 SR 1603)

Evaluation of preplant, postemergence or complimentary treatments in new seeding alfalfa.

		Alfalfa[2]			Weed Control[3]					Weed[3]
Treatment[1]	Rate lb ai/A	Inj %	Stand red %	Yield lb/A	KCHSC %	CHEAL %	SASKR %	POLCO %	ZEAMA %	Yield lb/A
Preplant incorporated										
EPTC	3.0	0	0	3155	50	83	40	50	10	1140
EPTC+pendimethalin	2.0+1.0	0	0	3410	78	88	73	70	0	847
EPTC+benefin	2.0+1.5	0	0	3162	73	90	73	60	20	1037
Pendimethalin	1.0	0	0	3316	77	90	66	50	23	992
Preplant incorporated/postemergence										
EPTC/bromoxynil	3.0/0.25	10	0	3685	97	97	93	100	0	38
EPTC/imazethapyr+X-77	3.0/0.032+0.25%	0	0	4074	100	93	100	70	40	12
Pendimethalin/imazethapyr+X-77	1.0/0.032+0.25%	7	0	4000	100	97	97	80	27	31
Postemergence										
Bromoxynil	0.25	10	0	3772	97	100	93	100	0	80
Bromoxynil	0.38	17	0	3450	100	100	100	100	0	27
Bromoxynil+2,4-DB	0.25+0.5	13	0	3518	97	100	97	100	0	57
Bromoxynil+sethoxydim+Dash	0.25+0.2+1pt	10	0	3739	93	100	93	100	97	0
Imazethapyr+X-77	0.032+0.25%	0	0	3886	100	83	93	70	40	87
Imazethapyr+X-77	0.063+0.25%	0	0	4100	100	93	100	90	57	30
Imazethapyr+sethoxydim+Dash	0.063+0.2+1pt	5	0	4007	100	100	100	90	100	0
Imazethapyr+bromoxynil	0.032+0.25	18	0	3591	100	100	100	100	53	19
Imazethapyr+bromoxynil	0.063+0.25	20	0	3511	100	100	100	100	57	19
Weedy Check	--------------	0	0	2559	0	0	0	0	0	2082

[1]Treatments applied April 5 and May 16, 1989.
[2]Alfalfa injury and stand reduction visually evaluated June 15 and plots harvested July 6, 1989.
[3]Weed control visually evaluated June 15 and weeds harvested July 6, 1989.

Redroot pigweed control in seedling alfalfa in Colorado. Hanson, D.E., K.G. Beck and J.R. Sebastian. An experiment was conducted in Cargill H-1030 seedling alfalfa near Sterling, Colorado to evaluate herbicide effects on phytotoxicity, yield and redroot pigweed (AMARE) control. The experiment was a randomized complete block design with four replications. Treatments were applied on June 30, 1989 with additional bromoxynil treatments on July 6, 1989. Applications were made using a CO_2 pressurized backpack sprayer with 11002LP flat fan nozzles at 19 gal/a, 22 psi to alfalfa in the six trifoliate leaf stage. Other application information is in Table 1. Plots were 10 by 30 feet.

Visual evaluations were made 1, 2, and 4 weeks after application. Yields were determined by harvesting 1.0 m^2/plot on July 27, 1989. Bromoxynil plus 2,4-DB ester and bromoxynil at 0.13 lb ai/a plus 2,4-DB amine caused greater phytotoxicity than the check or other treatments 7 DAT (Table 2). No phytotoxicity was observed 28 DAT. Bromoxynil plus 2,4-DB ester, bromoxynil plus imazethapyr, and 2,4-DB amine plus bromoxynil at 0.25 lb ai/a gave acceptable control 7 DAT. Bromoxynil plus 2,4-DB ester, and bromoxynil plus imazethapyr provided acceptable control 14 DAT. At 28 DAT, only bromoxynil plus imazethapyr provided acceptable control. No yield differences were detected. (Weed Research Laboratory, Colorado State University, Fort Collins, CO 80523)

Table 1. Redroot pigweed control in seedling alfalfa application data, Sterling, Colorado

Environmental Data

Application date	June 30, 1989	July 6, 1989
Application time	1:00 pm	7:30 am
Air temperature, F	91	72
Wind speed, mph, direction	5, SE	0
Soil temperature (2 in), F	83	70
Cloud cover, %	0	0

Weed Data

Application Date	Species	Growth Stage	Height (in)	Density (pl/ft^2)
June 30, 1989	AMARE	Seedling	1 to 6	18
July 6, 1989	AMARE	Seedling	2 to 8	18

Table 2. Redroot pigweed control and yield in seedling alfalfa, Sterling, Colorado

Herbicide	Rate (lb ai/a)	AMARE	Phyto	AMARE	Phyto	AMARE	Yield (lb/a)
		July 6, 1989		July 13, 1989		July 27, 1989	
		(% of check)					
bromoxynil	0.25	76	8	38	4	8	159
bromoxynil	0.38	63	6	26	4	5	271
bromoxynil + 2,4-DB ester	0.25 0.50	88	15	84	6	51	183
bromoxynil + sethoxydim + COC[1]	0.25 0.20	65	5	51	2	15	84
bromoxynil + imazethapyr + surfactant[2]	0.25 0.06	87	5	94	2	89	554
bromoxynil + 2,4-DB amine	0.25 0.5	83	8	56	4	20	243
2,4-DB amine + sethoxydim + COC	0.5 0.15	30	0	44	0	34	121
2,4-DB amine + sethoxydim + COC	1.0 0.15	35	0	55	1	69	291
2,4-DB amine + bromoxynil + sethoxydim + COC	0.5 0.19 0.15	74	6	58	4	35	304
2,4-DB amine + bromoxynil + sethoxydim + COC	0.5 0.13 0.15	75	12	66	5	38	156
bromoxynil[3]	0.13	64	4	30	2	15	149
bromoxynil	0.19	66	3	25	4	5	180
check							157
LSD (0.05)		19	5	19	3	21	N/S

[1]Crop oil concentrate added at 2.5% v/v.
[2]Non-ionic surfactant (X-77) added at 0.5% v/v.
[3]Applied and evaluated 7 days later.

Predicting weed competition in alfalfa and wheat under irrigated field conditions. Pomela, E. M., J. O. Evans, and S. A. Dewey. Weed populations vary in response to soil moisture. Therefore weed competition under variable irrigation levels must also be variable. This research was conducted at Huntington and Logan, Utah to ascertain the influence of irrigation on frequency and density distributions of weeds and subsequent competition with alfalfa and wheat.

The experimental design was a randomized complete block with three replications. The six irrigation levels were provided by a line-source sprinkler irrigation system. When the system is operating at about 270 kPa, it provides a water application gradient pattern which is uniform along the length of the experimental plot, and uniformly variable across the width of the experimental plot. The irrigation water applied by the system is highest near the line and lowest away from the line.

Weed frequency and density distribution and drymatter harvests for both crops and weeds were determined on June 20, July 11, and August 10, 1989 at Logan and June 8, July 20, and September 5, 1989 at Huntington.

Wild oat, kochia, redroot pigweed, green foxtail, prickly lettuce, and common lambsquarters were the prevalent weeds. The frequency distributions of wild oat and foxtail were low at Logan and Huntington; respectively. The density distributions of wild oat, prickly lettuce, and green foxtail increased with increasing irrigation level. Contrarily, the density distribution of kochia decreased with increasing irrigation level. Redroot pigweed density distribution was high at field capacity (Irrigation level 4).

Weed competition was severe in low irrigation levels and less severe in high irrigation levels. A crop yield prediction model which is based on alfalfa and wheat water use (evapotranspiration) measurements and competitive indexes of each weed at each irrigation level was developed. (Utah Agricultural Experiment Station, Logan, UT. 84322-4820).

Table. Frequency and density distributions of six weeds in response to irrigation in alfalfa and wheat at Logan and Huntington, Utah.[a]

Irrigation		Density of weeds[b]											
Level	Amount	SETVI		KCHSC		LACSE		CHEAL		AMARE		AVEFA	
		L	H	L	H	L	H	L	H	L	H	L	H
	--mm--	Numbers/m^2											
1	540	448	0	0	912	0	0	24	0	0	48	0	4
2	1578	708	8	0	300	0	0	20	3	0	45	0	12
3	3457	1128	28	0	180	0	4	14	4	0	66	0	30
4	5905	1292	44	0	120	0	8	8	8	0	80	0	205
5	6893	1492	20	0	20	0	20	4	32	0	36	0	580
6	8142	1804	20	0	8	0	22	6	44	0	32	0	612

[a]Data are the average of three harvests per season in both crops

[b]SETVI = green foxtail, KCHSC = kochia, LACSE = prickly lettuce, CHEAL = common lambsquarters, AMARE = redroot pigweed, AVEFA = wild oat, L = Logan, H = Huntington

Green foxtail control between cuttings in established alfalfa in Colorado. Hanson, D.E., K.G. Beck, J.R. Sebastian. Green foxtail (SETVI) control with herbicides applied between cuttings was evaluated in established alfalfa near Boulder, Colorado. The experiment was designed as a randomized complete block with four replications. Treatments were applied on June 22, and July 29, 1989 using a CO_2 pressurized backpack sprayer with 11002LP flat fan nozzles at 22 gal/a, 36 psi 9 and 6 days after cutting, respectively. Other application information is in Table 1. Plots were 10 by 30 feet.

Visual evaluations were made 30 and 60 days after application. After the first cutting, clethodim at 0.09 lb ai/a 30 DAT and paraquat 30 and 60 DAT provided less control than other treatments (Table 2). Clethodim at 0.08 lbai/a and paraquat applied after the second cutting provided less control than other treatments 30 DAT. Phytotoxicity was greater with the two low rates of clethodim and high rate of sethoxydim than the check or other treatments 30 DAT following first cutting. No phytotoxicity was observed 60 days after first application or 30 days after second application. (Weed Research Laboratory, Colorado State University, Fort Collins, CO 80523)

Table 1. Application data for green foxtail control between cuttings in established alfalfa, Boulder, Colorado

Environmental Data		
Application date	June 22, 1989	July 29, 1989
Application time	10:00 am	10:30 am
Air temperature, C	19	32
Wind speed, mph, direction	3 to 5, W	0 to 2, W
Soil temperature (2 in), C	18	26
Cloud cover, %	30	15

Weed Data

Application Date	Species	Growth Stage	Density (pl/ft^2)
June 22, 1989	SETVI	vegetative to flowering	3 to 6
July 29, 1989	SETVI	flowering	3 to 6

Table 2. Green foxtail control between cuttings in established alfalfa, Boulder, Colorado

Herbicide	Rate	SETVI	Phyto	SETVI	SETVI
	(lb ai/a)	July 29, 1989[1]		August 23, 1989[2]	
		-----------(% of check)-----------			
clethodim + COC[1]	0.08	83	2	81	74
clethodim + COC	0.09	45	2	90	95
clethodim + COC	0.13	90	0	96	100
paraquat + surfactant[2]	0.28	31	1	38	75
sethoxydim + COC	0.20	79	0	69	98
sethoxydim + COC	0.30	85	1	88	93
LSD (0.05)		16	1	20	20

[1]July 29 evaluations 30 DAT for treatments applied after first cutting.
[2]August 23 evaluations 60 DAT for treatments applied after first cutting and 30 DAT for treatments applied after second cutting, respectively.
[3]Crop oil concentrate applied at 1.0 qt/a.
[4]Non-ionic surfactant (X-77) added at 0.5% v/v.

Weed control with herbicides in semidormant alfalfa. Miller, S.D. and A.W. Dalrymple. Research plots were established at the Research and Extension Center, Torrington, Wyoming to evaluate weed control and alfalfa (var. Apollo II) tolerance with semidormant herbicide applications. Plots were established under sprinkler irrigation and were 9 by 30 ft. with three replications arranged in a randomized complete block. The herbicides were applied broadcast with a CO_2-pressurized, six-nozzle, knapsack sprayer delivering 20 gpa at 40 psi March 29, 1989 (air temperature 60F, relative humidity 39%, wind NW at 5 mph, sky partly cloudy and soil temperature - 0 inch 80F, 2 inches 62F and 4 inches 49F) to emerging weeds and semidormant alfalfa. The soil was classified as a sandy loam (83% sand, 8% silt and 9% clay) with 1.1% organic matter and pH 7.6. Visual weed control and crop damage evaluations were made April 27 and plots harvested for yield June 8, 1989. Kochia (KCHSC) and Russian thistle (SASKR) infestations were heavy while downy brome (BROTE) infestations were light and variable.

No alfalfa injury or stand reduction was observed with any treatment. Broadleaf weed control was excellent with imazethapyr or C-4243, and downy brome control good with C-4243, pendimethalin or the 0.094 lb/A rate of imazethapyr. Alfalfa yields were 516 to 973 lb/A higher in herbicide-treated compared to weedy check plots. (Wyoming Agric. Exp. Sta., Laramie, WY 82071 SR 1602)

Weed control with herbicides in semidormant alfalfa.

		Alfalfa[2]			Weed Control[3]		
Treatment[1]	Rate lb ai/A	Injury %	Stand red. %	Yield lb/A	BROTE %	SASKR %	KCHSC %
Imazethapyr	0.047	0	0	3030	70	93	98
Imazethapyr	0.063	0	0	3056	80	94	99
Imazethapyr	0.078	0	0	3200	80	98	100
Imazethapyr	0.094	0	0	3102	90	99	100
C-4243	0.125	0	0	3193	90	100	100
C-4243	0.25	0	0	3213	95	100	100
C-4243	0.5	0	0	3161	95	100	100
Pyridate	0.45	0	0	3004	0	65	92
Pyridate	0.9	0	0	3082	60	83	97
Imazethapyr+bromoxynil	0.032+0.125	0	0	3252	60	99	100
Imazethapyr+bromoxynil	0.047+0.125	0	0	3167	70	100	100
Imazethapyr+bromoxynil	0.063+0.125	0	0	3265	80	100	100
Imazethapyr+2,4-DB	0.063+0.5	0	0	3232	70	99	100
Imazethapyr+2,4-DB	0.063+0.5	0	0	3076	80	98	100
Pendimethalin	1.0	0	0	2939	90	0	73
Bromoxynil	0.25	0	0	2945	0	50	70
2,4-DB	1.0	0	0	2808	0	27	70
Weedy Check	-----------	0	0	2292	0	0	0

[1]Treatments applied March 29, 1989.
[2]Alfalfa injury and stand reduction visually evaluated April 27 and plots harvested June 8, 1989.
[3]Weed control visually evaluated April 27, 1989.

Control of flixweed in dormant established alfalfa in Colorado. Hanson, D.E., K.G. Beck and J.R. Sebastian. An experiment was conducted in dormant established alfalfa at the Arkansas Valley Research Center, Rocky Ford, Colorado to evaluate phytotoxicity, yield and control of flixweed (DESSO) as influenced by herbicides. The experiment was designed as a randomized complete block with four replications. Treatments were applied on March 16, 1989 using a CO_2 pressurized backpack sprayer with 11003LP flat fan nozzles at 24 gal/a, 15 psi. Other application information is in Table 1. Plots were 10 by 30 feet.

Visual evaluations were made 30 and 60 days after application. Yields were determined by harvesting 1.0 m^2/plot on May 25, 1989. Paraquat at 0.75 lb ai/a 30 and 60 DAT and hexazinone 60 DAT provided acceptable control (Table 2). Only 2,4-DB exhibited phytotoxicity greater than the check or other treatments 30 DAT. No phytotoxicity was observed 60 DAT. No yield differences from the check were detected. (Weed Research Laboratory, Colorado State University, Fort Collins, CO 80523)

Table 1. Application data for flixweed control in dormant established alfalfa, Rocky Ford, Colorado

Environmental Data

Application date	March, 16 1989
Application time	7:30 am
Air temperature, C	22
Wind speed, mph, direction	0
Soil temperature (2 in), C	16
Cloud cover, %	0

Weed Data

Application Date	Species	Growth Stage	Diameter (cm)	Density (pl/ft^2)
March 16, 1989	DESSO	rosette	2 to 6	5 to 10

Table 2. Flixweed control and yield in dormant established alfalfa, Rocky Ford, Colorado

Herbicide	Rate (lb ai/a)	DESSO April 20, 1989	Phyto April 20, 1989	DESSO May 18, 1989	Yield (T/a)
		---------(% of check)		----------	
metribuzin	0.38	64	0	56	1.5
metribuzin	0.75	53	0	54	1.4
hexazinone	0.25	74	1	89	1.6
hexazinone	0.50	65	0	55	1.2
diuron	0.80	61	0	45	1.4
diuron	1.6	59	1	40	1.5
paraquat + surfactant[1]	0.50	68	1	61	1.5
paraquat + surfactant	0.75	90	0	91	1.3
2,4-DB + bromoxynil	0.50 0.25	79	0	70	1.4
2,4-DB	0.50	41	3	41	1.6
bromoxynil	0.50	64	1	64	1.4
2,4-DB + bromoxynil	1.0 0.25	71	0	66	1.4
2,4-DB + bromoxynil	1.0 0.50	70	0	69	1.4
check					1.5
LSD (0.05)		38	2	47	0.3

[1]Non-ionic surfactant (X-77) added at 0.5% v/v.

Downy brome control in dormant alfalfa. Arnold, R.N., E.J. Gregory and M.W. Murray. Research plots were established on November 10, 1988 at the Jackson Lake Game Refuge, La Plata, New Mexico to evaluate the response of alfalfa (var. Lahonton) and BROTE to herbicides. Soil type was a Persayo-Farb silty clay loam with a pH of 7.5 and organic matter content of less than 1%. The experimental design was a randomized complete block with four replications. Individual plots were 12 by 30 ft in size. Treatments were applied with a CO_2 backpack sprayer calibrated to deliver 30 gal/A at 25 psi.

Visual evaluations of crop injury and BROTE control were made April 27, 1989. All treatments provided over 91% control of BROTE except hexazinone applied at 0.25 lb ai/A and oxyfluorfen applied at 0.2 and 0.5 lb ai/A. None of the treatments caused any noticeable alfalfa injury. (Agricultural Science Center, New Mexico State University, Farmington, N.M. 87499)

Downy brome evaluations in dormant alfalfa

Treatment	Rate lb ai/A	Crop[1] Injury	Weed Control[1] BROTE
		%	%
prodiamine	1.0	0	100
prodiamine	2.0	0	100
norflurazon	1.5	0	100
norflurazon	2.0	0	100
norflurazon	2.5	0	100
prodiamine + norflurazon	0.75+1.5	0	100
prodiamine + norflurazon	1.0+2.0	0	100
prodiamine + norflurazon	2.0+2.0	0	100
diuron	2.5	0	100
metribuzin	0.5	0	100
hexazinone	0.5	0	100
prodiamine	0.75	0	91
hexazinone	0.25	0	89
oxyfluorfen	0.5	0	85
oxyfluorfen	0.2	0	78
check		0	0
av BROTE/M^2			31

1. Based on a visual scale from 0-100 where 0 = no control or crop injury and 100 = dead plants

Fall applied herbicides for weed control in established alfalfa. Miller, S.D. and A.W. Dalrymple. Research plots were established at the Research and Extension Center, Torrington, Wyoming, to evaluate the efficacy of fall applied herbicide treatments for weed control in established alfalfa (var. Apollo II). Plots were established under sprinkler irrigation and were 9 by 30 ft. with three replications arranged in a randomized complete block. The herbicides were applied broadcast with a CO_2-pressurized, six-nozzle, knapsack sprayer delivering 20 gpa at 40 psi October 13, 1988 (air temperature 59F, relative humidity 25%, wind calm, sky clear and soil temperature - 0 inch 70F, 2 inches 52F and 4 inches 56F). The soil was classified as a sandy loam (83% sand, 8% silt and 9% clay) with 1.1% organic matter and pH 7.6. Visual weed control and crop damage evaluations were made April 27 and plots harvested for yield June 8, 1989. Tansymustard (DESPI) and downy brome (BROTE) infestations were moderate and Russian thistle (SASKR) infestations light but uniform throughout the experimental area.

No alfalfa injury or stand reduction was observed with any treatment. Broad spectrum weed control was excellent with fall applications of imazethapyr at all rates. Alfalfa yields were 374 to 742 lb/A higher in herbicide-treated compared to weedy check plots. (Wyoming Agric. Exp. Sta., Laramie, WY 82071 SR 1601)

Fall applied herbicides for weed control in established alfalfa.

		Alfalfa[2]			Weed Control[3]		
Treatment[1]	Rate lb ai/A	Injury %	Stand red. %	Yield lb/A	BROTE %	DESPI %	SASKR %
Prodiamine	0.75	0	0	3195	95	0	0
Prodiamine	1.0	0	0	3214	98	0	0
Prodiamine	2.0	0	0	3379	100	13	0
Norflurazon	1.5	0	0	3303	80	72	27
Norflurazon	2.0	0	0	3183	88	83	33
Norflurazon	2.5	0	0	3271	100	85	47
Prodiamine+norflurazon	0.75+1.5	0	0	3316	95	73	20
Prodiamine+norflurazon	0.75+2.0	0	0	3430	97	83	37
Prodiamine+norflurazon	1.0 +1.5	0	0	3246	100	80	30
Prodiamine+norflurazon	1.0 +2.0	0	0	3265	100	85	37
Imazethapyr	0.063	0	0	3411	95	100	100
Imazethapyr	0.094	0	0	3411	98	100	100
Imazethapyr	0.125	0	0	3551	98	100	100
Weedy Check	--------	0	0	2809	0	0	0

[1]Treatments applied October 13, 1988.
[2]Alfalfa injury and stand reduction visually evaluated April 27 and plots harvested June 8, 1989.
[3]Weed control visually evaluated April 27, 1989.

Interplanting oats into the last year of an alfalfa stand. Lanini, W.T., and W.E. Bendixen. Oats and other grasses can be interplanted into the last year of an alfalfa stand to increase yields and reduce weeds. Another potential benefit of interplanting is the cultivation needed for incorporation of oats could destroy alfalfa weevils. A study conducted in 1989 at Santa Ynez, Santa Barbara County, CA, assessed the influence of oat variety and oat seeding rate on weed control, forage yields and alfalfa weevils reduction.

This site had originally been planted to alfalfa in the spring of 1986 and was scheduled for removal at the end of the 1989 season. A randomized complete block design was used with four replications. Oats was seeded and paraquat applied to the various treatment plots on January 4, 1989; alfalfa was dormant. Nitrogen fertilizer was broadcast over all plots at the rate of 33 kg/ha (ammonium nitrate 34-0-0). Oats was seeded by broadcasting the seeds and then incorporating them with a field cultivator. Carbofuran (Furadan), was applied to treatments 7 and 8 on March 24, 1989, after weevil counts indicated an economic threshold (10 per sweep) had been reached. Cover measurements were also made on March 24, 1989, by placing a 1 meter squared quadrat in 2 random locations and visually evaluating cover by species. Alfalfa was harvested at 10 percent bloom, regardless of the stage of oat growth. A flail type harvester was used, taking a 2 meter by 6 meter sample from each plot. Subsamples of harvested material were dried and data presented represents dry weight.

First harvest yields were increased by the addition of oats, regardless of seeding rate or variety. Second harvest yields on plots with Montezuma oats at the low and high rates and Cal Red oats at the high rate were higher than control plots or those treated for weevils only, but were not significantly higher than paraquat treated or cultivated plots. Oat plots yielded less than control plots in the third harvest. The fourth and last cutting of the year did not yield differently among the treatments. Alfalfa weevil counts of all plots indicated that cultivation had not significantly reduced the weevil population relative to noncultivated plots. Weed cover was not significantly different among treatments.

Correlations between yields and oat or weed cover measurements made in March indicated that oats was no longer a significant proportion of the yield by the third cutting, but that in plots without oats, weeds were significantly increasing yields. Oats that had not jointed at cutting time recovered and contributed to the yield in the following cutting. Plots which had oats interplanted as did the plots treated with paraquat were visually observed to have less weeds throughout the season.

Oats was observed to require a slightly longer period to dry (1 day), primarily to the nodes needing longer to dry. If the oats had formed seed, raking to aid forage drying caused excessive seed shatter. (Department of Botany, University of California, Davis, 95616, and Cooperative Extension, Santa Barbara County, 93455)

Table 1. Forage yields relative to treatment and date at Santa Ynez, California

Treatment	Seeding or Application Rate	Apr 26	May 31	Jul 7	Aug 9	Sept 16	Total
	(kg/ha)	(Mg/ha)					
1 Montezuma Oats	28	3.99	3.36	2.22	3.12	3.05	15.74
2 Montezuma Oats	56	5.11	3.14	2.29	2.80	2.76	16.07
3 Montezuma Oats	84	4.75	3.38	2.42	3.07	2.73	16.36
4 Cal Red Oats	28	4.26	3.18	2.22	2.85	2.89	15.40
5 Cal Red Oats	56	4.03	3.05	2.29	2.62	2.65	14.62
6 Cal Red Oats	84	4.98	3.79	2.33	2.78	2.69	16.59
7 Paraquat	0.56	2.91	2.96	2.82	3.03	2.69	14.44
8 Furadan	0.56	2.51	2.26	2.62	2.96	2.78	13.34
9 Paraquat + Furadan	0.56 + 0.56	2.71	3.30	2.82	3.18	3.03	14.84
10 Cultivated		2.31	2.85	2.85	3.09	3.12	14.21
11 Control		2.60	2.62	2.96	3.14	2.78	14.08
LSD .05		0.80	0.72	0.61	ns	ns	2.25

Table 2. Forage composition and alfalfa weevils on March 24, 1989 relative to treatment at Santa Ynez, California

Treatment	Seeding or Application Rate	Alfalfa	Oats	Weeds	Weevils
	(kg/ha)	% Cover			number per 5 sweeps
1 Montezuma Oats	28	82	4	4	84
2 Montezuma Oats	56	68	20	1	62
3 Montezuma Oats	84	70	19	0	58
4 Cal Red Oats	28	75	9	1	47
5 Cal Red Oats	56	82	11	2	53
6 Cal Red Oats	84	71	19	2	74
7 Paraquat	0.56	89	0	0	53
8 Furadan	0.56	68	0	3	46
9 Paraquat + Furadan	0.56 + 0.56	74	2	8	38
10 Cultivated		66	0	8	72
11 Control		75	2	6	69
LSD .05		ns	15	ns	ns

Evaluation of herbicide treatments for alfalfa control or suppression in barley. Krall, J.M. and S.D. Miller. Research plots were established at the Research and Extension Center, Torrington, Wyoming to evaluate the efficacy of herbicide treatments for control or suppression of established alfalfa plants in barley. Plots were established under sprinkler irrigation and were 9 by 30 ft. with four replications arranged in a randomized complete block. Barley (var. Steptoe) was seeded April 3, 1989 in a sandy loam soil (79% sand, 13% silt and 8% clay) with 1.4% organic matter and 7.2 pH. Herbicide treatments were applied broadcast with a CO_2-pressurized six-nozzle knapsack sprayer delivering 20 gpa at 40 psi May 9, 1989 (air temperature 67F, relative humidity 37%, wind SE at 8 mph, sky cloudy and soil temperature - 0 inch 64F, 2 inches 60F and 4 inches 58F) to 4-leaf barley and 5- to 6-inch alfalfa. Visual alfalfa control and crop damage evaluations were made June 16, plant height measured June 21, alfalfa density and yield measured July 18 and barley harvested July 24, 1989. Alfalfa infestation averaged over 39,000 plants/A and was uniform throughout the experimental area.

No treatment reduced barley stand; however, slight injury was observed with clopyralid at 0.125 lb/A and picloram combinations with 2,4-D. Alfalfa stands were reduced 33 to 97% and yields 60 to 96% in herbicide-treated compared to untreated plots. Barley yields related closely to alfalfa control and were 5 to 20 bu/A lower in untreated than in herbicide-treated plots. (Wyoming Agric. Exp. Sta., Laramie, WY 82071 SR 1620)

Alfalfa control or suppression in barley.

Treatment[1]	Rate lb ai/A	Barley[2] Inj %	SR %	Height inches	Yield bu/A	Alfalfa[3] Control %	Stand plants/A	Yield lb/A
Clopyralid	0.032	0	0	30	94	38	31680	576
Clopyralid	0.063	0	0	30	97	58	18480	407
Clopyralid	0.125	3	0	29	99	90	6600	69
Clopyralid+2,4-D	0.032+0.19	0	0	30	97	69	18480	407
Clopyralid+2,4-D	0.063+0.38	0	0	29	101	85	6600	92
Clopyralid+2,4-D	0.125+0.75	4	0	27	98	95	2640	77
Metsulfuron+2,4-D+X-77	0.008+0.5+0.25%	0	0	29	109	95	2640	146
Bromoxynil	0.38	0	0	30	95	5	26400	799
Bromoxynil+MCPA	0.38+0.38	0	0	29	95	50	21120	399
Picloram+2,4-D	0.012+0.38	6	0	26	98	58	18480	207
Picloram+2,4-D	0.024+0.38	4	0	27	103	88	11800	77
2,4-D	0.5	0	0	27	97	44	21120	438
MCPA	0.5	0	0	29	100	33	23760	376
Weedy check	---------------	0	0	29	89	0	39600	1974

[1]Treatments applied May 9, 1989.
[2]Barley injury (Inj) and stand reduction (SR) visually evaluated June 16, plant height measured June 21 and plots harvested July 24, 1989.
[3]Alfalfa control evaluated June 16 and alfalfa density and yield measured July 18, 1989.

Broadleaf weed control in barley with DPX-R9674. Evans, J.O. and B.M. Jenks. DPX-R9674 was tank mixed with 2,4-D, bromoxynil, or dicamba for broadleaf weed control in barley near Providence, Utah. Treatments were applied to Steptoe barley in the 5 leaf to early tillering stage. Redroot pigweed (AMARE) and black mustard (BRSNI) were in the 1 to 2 leaf stage. The plots were 10 by 30 feet arranged in a randomized complete block design, replicated three times. Treatments were applied with a compressed air bicycle sprayer delivering 16 gpa at 40 psi.

Plots were evaluated visually on July 10 and harvested on August 8. Broadleaf control was excellent in all treatments. Treatments containing dicamba reduced crop height 4 to 5 inches, but did not reduce yield.(Table 2) (Utah Agricultural Experiment Station, Logan, Utah 84322-4820)

Table 1. Application data for broadleaf control in barley

Planting date	04-19-89
Application date	05-26-89
AMARE density (yd2)	105
BRSNI density (yd2)	5
Air Temp (F)	63
Soil Temp at 2 in. (F)	65
Wind (mph)	3
RH (%)	30
Soil type	Silt loam
OM (%)	2.55
pH	7.8

Table 2. Broadleaf control with DPX-R9674 in barley

Treatment[1]	RATE	WEED CONTROL		CROP INJURY[2]	YIELD
	lb ai/A	-------%-------		0-10	bu/A
		AMARE	BRSNI		
DPX-R9674	0.0113	98	98	0	130
DPX-R9674	0.0141	100	100	0	115
DPX-R9674 + 2,4-D	0.0113 0.25	100	100	0	103
DPX-R9674 + 2,4-D	0.0141 0.25	100	100	0	105
DPX-R9674 + bromoxynil	0.0113 0.125	100	100	0	111
DPX-R9674 + bromoxynil	0.0141 0.125	100	100	0	106
DPX-R9674 + dicamba	0.0113 0.0625	100	98	6	118
DPX-R9674 + dicamba	0.0141 0.0625	100	98	6	107
Control	------	0	0	0	112
LSD (0.05)		2	3		30
CV		1	2		16

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

[2] 0 = no injury, 10 = complete kill

Broadleaf herbicide-insecticide combinations in barley. Miller, S.D., A.W. Dalrymple and J.M. Krall. Research plots were established at the Research and Extension Center, Torrington, Wyoming to evaluate barley tolerance with broadleaf herbicides alone and in combination with insecticides. Plots were established under sprinkler irrigation and were 9 by 30 ft. with three replications arranged in a randomized complete block. Barley (var. Steptoe) was seeded March 29, 1989 in a sandy loam soil (77% sand, 9% silt and 14% clay) with 1.6% organic matter and pH 7.7. Herbicide and/or insecticide treatments were applied broadcast with a CO_2-pressurized six-nozzle knapsack sprayer delivering 20 gpa at 40 psi May 8, 1989 (air temperature 66F, relative humidity 45%, wind SE at 9 mph, sky clear and soil temperature - 0 inch 72F, 2 inches 55F and 4 inches 52F) to 4-leaf barley. Common lambsquarters infestations were light and variable through the experimental area and did not influence barley response to the herbicide and/or insecticide treatments. Visual crop damage evaluations were made May 25, plant height measured June 15 and plots harvested July 17, 1989.

No herbicide and/or insecticide treatment reduced barley stand; however, all dicamba treatments injured barley slightly (2 to 4%). Barley tolerance to broadleaf herbicides was not influenced by insecticide. Barley yield in herbicide-treated plots was similar to barley yield in the untreated check. (Wyoming Agric. Exp. Sta., Laramie, WY 82071 SR 1621)

Broadleaf herbicide-insecticide combinations in barley.

Treatment[1]	Rate lb ai/A	Barley[2] Inj %	SR %	Height inches	Yield bu/A
Clopyralid+2,4-D	0.094+0.5	0	0	26	67
Clopyralid+2,4-D+disulfoton	0.094+0.5+1.5	0	0	28	65
Clopyralid+2,4-D+chlorpyrifos	0.094+0.5+0.5	0	0	25	65
Clopyralid+2,4-D+λcyhalathrin	0.094+0.5+0.03	0	0	28	69
Clopyralid+MCPA	0.094+0.5	0	0	25	66
Clopyralid+MCPA+disulfoton	0.094+0.5+1.5	0	0	25	65
Clopyralid+MCPA+chlorpyrifos	0.094+0.5+0.5	0	0	28	64
Clopyralid+MCPA+λcyhalathrin	0.094+0.5+0.03	0	0	27	65
Bromoxynil+MCPA	0.37+0.37	0	0	27	66
Bromoxynil+MCPA+disulfoton	0.37+0.37+1.5	0	0	26	64
Bromoxynil+MCPA+chlorpyrifos	0.37+0.37+0.5	0	0	26	65
Bromoxynil+MCPA+λcyhalathrin	0.37+0.37+0.03	0	0	28	64
Dicamba(SGF)+MCPA	0.094+0.37	4	0	28	63
Dicamba(SGF)+MCPA+disulfoton	0.094+0.37+1.5	3	0	27	64
Dicamba(SGF)+MCPA+chlorpyrifos	0.094+0.37+0.5	4	0	26	64
Dicamba(SGF)+MCPA+λcyhalathrin	0.094+0.37+0.03	2	0	25	63
2,4-D	0.75	0	0	27	67
2,4-D+disulfoton	0.75+1.5	0	0	26	65
2,4-D+chlorpyrifos	0.75+0.5	0	0	28	68
2,4-D+λcyhalathrin	0.75+0.03	0	0	28	67
MCPA	0.75	0	0	26	66
MCPA+disulfoton	0.75+1.5	0	0	28	67
MCPA+chlorpyrifos	0.75+0.5	0	0	29	68
MCPA+λcyhalathrin	0.75+0.03	0	0	29	68
Disulfoton	1.5	0	0	28	65
Chlorpyrifos	0.5	0	0	28	67
λcyhalathrin	0.03	0	0	28	68
Untreated check	---------------	0	0	28	66

[1]Treatments applied May 8, 1989.
[2]Barley injury (Inj) and stand reduction (SR) visually evaluated May 25, plant height measured June 15 and plots harvested July 17, 1989.

Broadleaf weed control in barley. Miller, S.D., J. Lauer and A.W. Dalrymple. Research plots were established at the Research and Extension Center, Powell, Wyoming to evaluate weed control and barley tolerance with postemergence herbicide treatments. Plots were established under furrow irrigation and were 9 by 30 ft. with three replications arranged in a randomized complete block. Barley (var. Klages) was seeded April 6, 1989 in a clay loam soil (40% sand, 25% silt and 35% clay) with 1.2% organic matter and pH 7.8. Herbicide treatments were applied broadcast with a CO_2-pressurized six-nozzle knapsack sprayer delivering 20 gpa at 40 psi May 25, 1989 (air temperature 49F, relative humidity 41%, wind NW at 6 mph, sky partly cloudy and soil temperature - 0 inch 60F, 2 inches 52F and 4 inches 54F) to 3-leaf barley and 0.5- to 1.5-inch weeds. Visual weed control, crop damage and plant height measurements were made July 28 and plots harvested August 8, 1989. Wild buckwheat (POLCO) and wild mustard (SINAR) infestations were heavy and redroot pigweed (AMARE), common lambsquarters (CHEAL) and redstem filaree (EROCI) infestations light but uniform throughout the experimental area.

No injury or stand reduction was observed with any treatment. Broad spectrum weed control was excellent (>90% control of all species) with clopyralid plus 2,4-D or MCPA, dicamba plus MCPA or DPX-R9674 and bromoxynil plus MCPA. In addition, DPX-R9674 combinations with 0.25 lb/A bromoxynil provided excellent control. Barley yields were good and related closely to weed control. Yields were 11 to 22 bu/A higher in herbicide-treated compared to weedy check plots. (Wyoming Agric. Exp. Sta., Laramie, WY SR 1618)

Broadleaf weed control in barley.

Treatment[1]	Rate lb ai/A	Barley[2] Inj %	SR %	Height inches	Yield bu/A	Weed control[3] POLCO %	SINAR %	AMARE %	CHEAL %	EROCI %
DPX-R9674+X-77	0.014+0.25%	0	0	34	128	78	90	100	100	93
DPX-R9674+dicamba+X-77	0.014+0.094+0.25%	0	0	33	128	95	95	100	100	100
DPX-R9674+dicamba(SGF)+X-77	0.014+0.094+0.25%	0	0	34	129	95	95	100	100	100
Thiameturon+X-77	0.016+0.25%	0	0	34	131	78	83	100	100	100
Clopyralid+MCPA	0.094+0.5	0	0	35	127	100	97	90	100	100
Clopyralid+2,4-D	0.094+0.5	0	0	34	129	98	99	95	98	100
Clopyralid+MCPA+dicamba	0.094+0.5+0.094	0	0	35	130	100	99	100	100	98
Clopyralid+MCPA+dicamba(SGF)	0.094+0.5+0.094	0	0	34	127	100	100	100	100	100
Dicamba+MCPA	0.094+0.37	0	0	35	125	98	97	100	100	95
Dicamba(SGF)+MCPA	0.094+0.37	0	0	34	124	95	98	100	100	92
BAS-514+BAS-090	0.063+1qt	0	0	34	120	40	37	70	80	73
BAS-514+BAS-090	0.125+1qt	0	0	33	123	57	30	70	83	73
Bromoxynil	0.25	0	0	34	131	83	67	97	97	85
Bromoxynil	0.38	0	0	34	131	95	77	95	100	93
Bromoxynil+MCPA	0.38+0.38	0	0	33	128	95	100	98	100	95
Bromoxynil+DPX-R9674+X-77	0.187+0.008+0.25%	0	0	34	131	83	97	100	100	100
Bromoxynil+DPX-R9674+X-77	0.25+0.008+0.25%	0	0	34	128	97	100	100	100	98
Bromoxynil+DPX-R9674+X-77	0.187+0.014+0.25%	0	0	33	125	82	95	97	100	100
Bromoxynil+DPX-R9674+X-77	0.25+0.014+0.25%	0	0	33	127	95	100	100	100	100
Disulfoton	1.5	0	0	35	111	0	0	0	0	0
Disulfoton+DPX-R9674+X-77	1.5+0.014+0.25%	0	0	34	125	80	93	100	100	93
Disulfoton+DPX-R9674+dicamba+X-77	1.5+0.014+0.094+0.25%	0	0	34	129	93	100	100	100	100
Weedy check	--------------------	0	0	34	109	0	0	0	0	0

[1]Treatments applied May 25, 1989.
[2]Barley injury (Inj), stand reduction (SR) and plant height measurements taken July 28 and plots harvested August 8, 1989.
[3]Weed control visually evaluated July 28, 1989.

Application time of imazamethabenz, difenzoquat, and diclofop alone and tank mixed for wild oat control in spring barley. Tapia, L.S., D.C. Thill, D.L. Barton. Imazamethabenz, difenzoquat, and diclofop usually are applied at different wild oat (AVEFA) growth stages for optimum control. The herbicides were applied alone and in combination in a study using a randomized complete block design at Moscow, Idaho. Herbicides were applied at two wild oat growth stages with a pressurized CO_2 backpack sprayer calibrated to deliver 10 or 20 gal/a at 40 psi at 3 mph (Table 1). Treatments were applied at 20 gal/a to 1 to 3 leaf wild oat plants because gusty winds prevented applications at lower solution volume. Additional surfactant should have been added to treatments containing imazamethabenz and/or difenzoquat, but was not. Wild oat control was evaluated visually August 8, and barley grain was harvested August 30, 1989. The experiment was established at a second location (Bonners Ferry), but a very competitive barley crop prevented wild oat development and subsequent competition.

Table 1. Application data

Application date	May 30	June 10
Wild oat leaf stage	1 to 3	5 to 7
Barley leaf stage	3 to 4	8 to 10
Air temperature (F)	60	68
Soil temp. at 2 in. (F)	52	63
Relative Humidity (%)	62	60
Wind (mph)/direction	3/SE	0
Delivery rate (gal/a)	20	10
Crop	spring barley var., 'Cougbar'	
Soil pH	5.38	
OM (%)	3.92	

Diclofop alone applied at the 1 to 3 leaf stage of wild oat controlled wild oat best (Table 2). Diclofop and difenzoquat controlled wild oat adequately when applied at the 5 to 7 leaf wild oat growth stage. Difenzoquat alone and imazamethabenz tank mixed with diclofop tended to control wild oat better (15 to 32%) when applied later. Other treatments applied early controlled wild oat better than the same treatments applied late (2 to 20%). All treatments, other than diclofop alone and difenzoquat alone applied late, provided only moderate to poor control regardless of application time. Spring barley injury was less when herbicide treatments were applied early except for diclofop applied alone. Herbicides applied late damaged the barley crop 3 to 35% more than the early applications. Wild oat control may have improved had surfactant been added to the imazamethabenz and difenzoquat treatments applied early.

Barley grain yield was highest when herbicides were applied early in the season. Delaying herbicide application 11 days reduced grain yield 10 to 35%. Barley grain yield was slightly higher than the untreated check when imazamethabenz, diclofop, difenzoquat, and imazamethabenz + difenzoquat were applied early. Grain yield was as much as 571 lb/a less than the untreated check when herbicide treatments were applied late, which may have been related to crop injury. (Idaho Agricultural Experiment Station, Moscow, Idaho 83843)

Table 2. Wild oat control and barley grain yield.

Treatment	Rate	AVEFA stage	AVEFA control	Crop injury	Grain yield
	(lb ai/a)	(leaves)	(%)	(%)	(lb/a)
check	--	--	-	-	1703
imazamethabenz	0.47	1 to 3	73	13	2023
difenzoquat	1.00	1 to 3	54	0	1841
diclofop	1.00	1 to 3	91	35	1841
imazamethabenz + difenzoquat	0.25 + 0.50	1 to 3	59	10	2008
imazamethabenz + difenzoquat	0.125 + 0.50	1 to 3	58	8	1852
imazamethabenz + diclofop	0.25 + 0.50	1 to 3	45	8	1689
imazamethabenz + diclofop	0.125 + 0.50	1 to 3	30	10	1624
imazamethabenz + difenzoquat	0.31 + 0.25	1 to 3	71	20	1549
imazamethabenz	0.47	5 to 7	53	18	1326
difenzoquat	1.00	5 to 7	86	35	1658
diclofop	1.00	5 to 7	83	31	1396
imazamethabenz + difenzoquat	0.25 + 0.50	5 to 7	48	13	1371
imazamethabenz + difenzoquat	0.125 + 0.50	5 to 7	56	15	1158
imazamethabenz + diclofop	0.25 + 0.50	5 to 7	61	19	1132
imazamethabenz + diclofop	0.125 + 0.50	5 to 7	45	28	1257
imazamethabenz + difenzoquat	0.31 + 0.25	5 to 7	66	23	1176
LSD (0.05)			29	23	834
Wild oat density (plants/ft^2)			12		

Imazamethabenz-insecticide combinations in barley. Miller, S.D. and A.W. Dalrymple. Research plots were established at the Research and Extension Center, Torrington, Wyoming to evaluate barley tolerance with imazamethabenz alone and in combination with insecticides. Plots were established under sprinkler irrigation and were 9 by 30 ft. with three replications arranged in a randomized complete block. Barley (var. Steptoe) was seeded March 27, 1989 in a sandy loam soil (77% sand, 9% silt and 14% clay) with 1.6% organic matter and pH 7.7. Imazamethabenz and/or insecticide treatments were applied broadcast with a CO_2-pressurized six-nozzle knapsack sprayer delivering 20 gpa at 40 psi May 16, 1989 (air temperature 67F, relative humidity 100%, wind SE at 6 mph, sky partly cloudy and soil temperature - 0 inch 70F, 2 inches 72F and 4 inches 64F) to 6-leaf barley. Common lambsquarters infestations were light and variable throughout the experimental area and did not influence barley response to imazamethabenz and/or insecticide treatments. Visual crop damage evaluations were made May 31, plant height measured June 15 and plots harvested July 17, 1989.

No imazamethabenz and/or insecticide treatment reduced barley stand; however, disulfoton combinations with 0.38 and 0.47 lb/A imazamethabenz caused 3 and 8% injury, respectively. Barley yield was reduced 7 bu/A, compared to the untreated check, with 0.47 lb/A imazamethabenz in combination with disulfoton. (Wyoming Agric. Exp. Sta., Laramie, WY 82071 SR 1623)

Imazamethabenz-insecticide combinations in barley.

		Barley[2]			
Treatment[1]	Rate lb ai/A	Inj %	SR %	Height inches	Yield bu/A
Imazamethabenz	0.47	0	0	26	57
Imazamethabenz+disulfoton	0.38+1.5	3	0	27	56
Imazemathabenz+disulfoton	0.47+1.5	8	0	24	51
Imazamethabenz+dimethoate	0.38+0.75	0	0	27	60
Imazamethabenz+dimethoate	0.47+0.75	0	0	28	58
Imazamethabenz+chlorpyrifos	0.38+0.5	0	0	28	59
Imazamethabenz+chlorpyrifos	0.47+0.5	0	0	26	58
Imazamethabenz+λcyhalathrin	0.38+0.03	0	0	28	59
Imazamethabenz+λcyhalathrin	0.47+0.03	0	0	26	57
Disulfoton	1.5	0	0	27	59
Dimethoate	0.75	0	0	28	59
Chlorpyrifos	0.5	0	0	28	57
λcyhalathrin	0.03	0	0	28	59
Untreated check	---------	0	0	27	58

[1]Treatments applied May 16, 1989. X-77 was included with all treatments at 0.25% v/v.

[2]Barley injury (Inj) and stand reduction (SR) visually evaluated May 31, plant height measured June 15 and plots harvested July 17, 1989.

Sulfonyl urea herbicide-insecticide combinations in barley. Miller, S.D., A.W. Dalrymple and J.M. Krall. Research plots were established at the Research and Extension Center, Torrington, Wyoming to evaluate barley tolerance to sulfonyl urea herbicides alone and in combination with insecticides. Plots were established under sprinkler irrigation and were 9 by 30 ft. with three replications arranged in a randomized complete block. Barley (var. Steptoe) was seeded March 29, 1989 in a sandy loam soil (77% sand, 9% silt and 14% clay) with 1.6% organic matter and pH 7.7. Herbicide and/or insecticide treatments were applied broadcast with a CO_2-pressurized six-nozzle knapsack sprayer delivering 20 gpa at 40 psi May 10 (air temperature 57F, relative humidity 65%, wind SE at 9 mph, sky clear and soil temperature - 0 inch 67F, 2 inches 70F and 4 inches 52F) to 5-leaf barley, or May 17, 1989 (air temperature 65F, relative humidity 100%, wind calm, sky cloudy and soil temperature - 0 inch 67F, 2 inches 70F and 4 inches 64F) to 6-leaf barley. Common lambsquarters infestations were light and variable throughout the experimental area and did not influence barley response to the herbicide and/or insecticide treatments. Visual crop damage evaluations were made May 25 and June 20, plant height measured June 15 and plots harvested July 17, 1989.

No herbicide and/or insecticide treatment reduced barley stand; however, barley injury ranged from 0 to 11% at the early evaluation date and from 0 to 12% at the late evaluation date with herbicide and/or insecticide treatments. Disulfoton combinations with the sulfonyl urea herbicides were the most injurious, with greatest injury occurring when disulfoton was applied 7 days prior to the herbicides. Disulfoton-chlorsulfuron combinations caused greater barley injury than CGA-131036 or DPX-R9674 combinations, regardless of whether tank mixed or applied as a split treatment. Barley yields related closely to crop injury. (Wyoming Agric. Exp. Sta., Laramie, Wy 82071 SR 1622)

Sulfonyl urea herbicide-insecticide combinations in barley.

Treatment[1]	Rate lb ai/A	Barley[2] Injury May %	Injury June %	SR %	Plant Height inches	Yield bu/A
Chlorsulfuron	0.032	0	0	0	26	60
Chlorsulfuron+disulfoton	0.032+1.5	9	8	0	24	51
Chlorsulfuron+chlorpyrifos	0.032+0.5	3	0	0	25	57
Chlorsulfuron+λcyhalathrin	0.032+0.03	3	0	0	26	58
Chlorsulfuron/disulfoton(7day)	0.032/1.5	7	2	0	25	55
Disulfoton/chlorsulfuron(7day)	1.5/0.032	11	12	0	23	48
CGA-131036	0.016	0	0	0	26	58
CGA-131036+disulfoton	0.016+1.5	7	2	0	25	55
CGA-131036+chlorpyrifos	0.016+0.5	2	0	0	25	57
CGA-131036+λcyhalathrin	0.016+0.03	2	0	0	26	59
CGA-131036/disulfoton(7day)	0.016/1.5	2	0	0	26	55
Disulfoton/CGA-131036(7day)	1.5/0.016	8	7	0	24	53
DPX-R9674	0.019	1	0	0	26	58
DPX-R9674+disulfoton	0.019+1.5	2	2	0	27	57
DPX-R9674+chlorpyrifos	0.019+0.5	1	0	0	26	58
DPX-R9674+λcyhalathrin	0.019+0.03	4	0	0	28	59
DPX-R9674/disulfoton(7day)	0.019/1.5	2	2	0	27	56
Disulfoton/DPX-R9674(7day)	1.5/0.019	11	8	0	24	52
Disulfoton	1.5	3	0	0	27	60
Chlorpyrifos	0.5	1	0	0	26	58
λcyhalathrin	0.03	0	0	0	26	58
Untreated check	----------	0	0	0	28	58

[1]Treatments applied May 10, except those after / applied May 17, 1989. X-77 was included with all treatments at 0.25% v/v.

[2]Barley injury and stand reduction (SR) visually evaluated May 25 and June 20, plant height measured June 15 and plots harvested July 17, 1989.

Canada thistle control in barley. Miller, S.D., R. Hybner and A.W. Dalrymple. Postemergence herbicide treatments were applied east of Sheridan, Wyoming June 13, 1989 (air temperature 70F, relative humidity 33%, wind NW at 5 mph, sky partly cloudy and soil temperature - 0 inch 93F, 2 inches 74F and 4 inches 65F) to 4- to 14-inch Canada thistle rosettes and 5-leaf barley (var. Steptoe) to evaluate weed control and crop tolerance. Plots were established under sprinkler irrigation and were 9 by 30 ft. with three replications arranged in a randomized complete block. Herbicide treatments were applied broadcast with a CO_2-pressurized six-nozzle knapsack sprayer delivering 20 gpa at 40 psi. The soil was classified as a clay loam (28% sand, 30% silt and 42% clay) with 1.7% organic matter and pH 7.7. Visual weed control evaluations were made June 29 and July 25, visual crop damage evaluations June 29, plant height measured July 26 and plots harvested August 11, 1989. Canada thistle (CIRAR) infestations were very heavy throughout the experimental area.

No treatment reduced barley stand; however, treatments containing dicamba injured barley 5 to 7%. Canada thistle control exceeded 80% with all clopyralid treatments and was similar when combined with 2,4-D or MCPA. Clopyralid - 2,4-D or MCPA combinations with DPX-L5300 tended to provide the greatest level of Canada thistle control. Barley yields were poor and quite variable. (Wyoming Agric. Exp. Sta., Laramie, WY 82071 SR 1619)

Canada thistle control in barley.

Treatment[1]	Rate lb ai/A	Barley[2] Inj %	SR %	Height inches	Yield bu/A	CIRAR Control[3] June %	July %
Clopyralid+2,4-D	0.094+0.5	0	0	23	33	80	87
Clopyralid+2,4-D	0.125+0.625	0	0	24	36	87	90
Clopyralid+MCPA	0.094+0.5	0	0	24	37	80	80
Clopyralid+MCPA	0.125+0.625	0	0	23	35	90	88
Clopyralid+2,4-D+dicamba	0.094+0.5+0.094	7	0	22	28	90	93
Clopyralid+2,4-D+dicamba(SGF)	0.094+0.5+0.094	5	0	22	29	93	92
Clopyralid+MCPA+dicamba	0.094+0.5+0.094	5	0	21	27	85	90
Clopyralid+MCPA+dicamba(SGF)	0.094+0.5+0.094	5	0	23	28	82	88
Clopyralid+2,4-D+picloram	0.094+0.5+0.023	5	0	24	34	87	92
Clopyralid+MCPA+picloram	0.094+0.5+0.023	5	0	24	32	85	93
Clopyralid+2,4-D+DPX-L5300+X-77	0.094+0.5+0.016+0.25%	0	0	24	35	96	96
Clopyralid+MCPA+DPX-L5300+X-77	0.094+0.5+0.016+0.25%	0	0	24	35	95	95
DPX-L5300+X-77	0.016+0.25%	0	0	23	30	65	58
Dicamba+MCPA	0.094+0.5	5	0	22	31	65	62
Dicamba(SGF)+MCPA	0.094+0.5	5	0	22	28	70	67
Dicamba+2,4-D	0.094+0.5	5	0	23	29	67	67
Dicamba(SGF)+2,4-D	0.094+0.5	5	0	22	31	75	67
Weedy check	--------------------	0	0	25	27	0	0

[1]Treatments applied June 13, 1989.
[2]Barley injury (Inj) and stand reduction (SR) visually evaluated June 29, plant height measured July 26 and plots harvested August 11, 1989.
[3]Canada thistle control visually evaluated June 29 and July 25, 1989.

Canada thistle control in barley. Westra, P. and N.E. Humburg. Canada thistle is a major perennial weed problem in barley in Colorado. This research was conducted at Fort Collins, CO, to test the efficacy of nine herbicide treatments.

The experiment was arranged in a randomized complete block with three replications. Plots were 10 feet by 30 feet long. Plots were sprayed with thirteen gallons per acre at twenty psi boom pressure using 11001 LP flat fan tips. Herbicides were applied May 16, 1989 when the barley had three to four tillers and the Canada thistle was at the rosette stage and four to six inches tall. Canada thistle control was evaluated July 25 and barley was harvested July 29.

All herbicides caused early-season Canada thistle chlorosis and provided excellent Canada thistle control with no barley damage. The three treatments which produced significantly higher barley yields than the untreated check were DPX-R9674 plus 2,4-D LVE, DPX-R9674 plus clopyralid and 2,4-D, and DPX-R9674. (Weed Research Laboratory, Colorado State University, Fort Collins, CO 80523)

Canada thistle control and barley yield
at Fort Collins, Colorado

Herbicide	Rate (lb ai/a)	Canada thistle control[2] (%)	barley yield[2] (bu/a)
check		0b	47c
DPX-R9674 + 2,4-D LVE[1]	0.45 0.25	83a	67a
DPX-R9674 + MCP ester[1]	0.45 0.25	88a	60a
dicamba + clopyralid + 2,4-D	0.094 0.44	85a	61a
dicamba + clopyralid + 2,4-D + MCPA	0.094 0.44	89a	54bc
DPX-R9674 + clopyralid + 2,4-D[1]	0.375 0.45	85a	73a
DPX-R9674 + clopyralid + 2,4-D + MCPA[1]	0.375 0.45	85a	64a
clopyralid + 2,4-D	0.60	88a	62a
clopyralid + 2,4-D	0.60	87a	64a
DPX-R9674[1]	0.375	85a	68a

[1]Surfactant activator 90 added at 0.25% v/v
[2]Means followed by the same letter do not significantly differ based on Duncan's MRT, P=0.05

Wild oat control with different imazamethabenz formulations alone and tank mixed with broadleaf herbicides. Tapia, L.S., D.C. Thill, and D.L. Barton. Two formulations of imazamethabenz at two rates, with and without nonionic surfactant (R-11), were evaluated when applied at two wild oat (AVEFA) growth stages in spring barley (var. 'Steptoe') using a fractional factorial arrangement (single treatments of diclofop and difenzoquat were included) near Bonners Ferry, Idaho. The treatments were replicated four times. In a separate study near Bonners Ferry, the same formulations with surfactant were examined alone and tank mixed with DPXR9674, clopyralid-MCPA, bromoxynil-MCPA, and pyridate in spring wheat (var. '906-R') using a factorial design and four replications. Herbicides were applied at two wild oat growth stages with a pressurized CO_2 backpack sprayer calibrated to deliver 10 gal/a at 40 psi and 3 mph (Table 1). Wild oat control was estimated visually on July 18, 1989. Grain was not harvested.

Table 1. Application data

	Location 1		Location 2
Application date	May 23	June 5	June 1
Wild oat leaf stage	1 to 3	4 to 5	1 to 3
Barley leaf stage	1 to 3	3 to 5	2 to 3
Air temperature (F)	60	70	76
Soil temp. at 2 in. (F)	52	72	72
Relative humidity (%)	62	66	60
Wind (mph)/direction	4/SE	0	0
Soil pH	7.6		8.0
OM (%)	5.5		3.5
texture	clay		loam

In the first study all treatments, regardless of time of application, controlled wild oat adequately (> 74%) (Table 2). The new imazamethabenz formulation (SC 2.5) applied without surfactant to wild oat plants at the 1 to 3 leaf stage did not control wild oat as well as the other treatments ($P > 0.05$). Both herbicide formulations applied to 3 to 5 leaf wild oat plants controlled the weed more than 86%.

Wild oat control in the second study was good with all herbicide treatments (Table 3). Wild oat control was not different among imazamethabenz formulations alone, or when combined with the broadleaf herbicides. (Idaho Agricultural Experiment Station, Moscow, Idaho 83843)

Table 2. Wild oat control in spring barley with imazamethabenz formulations

Treatment	Formulation	Rate	AVEFA stage	AVEFA control
		(lb ai/a)	(leaves)	(%)
check	--	--	--	-
imazamethabenz	SC 2.5	0.38	1 to 3	74
imazamethabenz	SC 2.5	0.47	1 to 3	79
imazamethabenz + R-11[1] (v/v)	SC 2.5	0.38 + 0.25%	1 to 3	80
imazamethabenz + R-11 (v/v)	SC 2.5	0.47 + 0.25%	1 to 3	88
imazamethabenz	LC 2.5	0.38	1 to 3	90
imazamethabenz	LC 2.5	0.47	1 to 3	88
imazamethabenz + R-11 (v/v)	LC 2.5	0.38 + 0.25%	1 to 3	94
imazamethabenz + R-11 (v/v)	LC 2.5	0.47 + 0.25%	1 to 3	94
imazamethabenz	SC 2.5	0.38	3 to 5	86
imazamethabenz	SC 2.5	0.47	3 to 5	94
imazamethabenz + R-11 (v/v)	SC 2.5	0.38 + 0.25%	3 to 5	89
imazamethabenz + R-11 (v/v)	SC 2.5	0.47 + 0.25%	3 to 5	91
imazamethabenz	LC 2.5	0.38	3 to 5	94
imazamethabenz	LC 2.5	0.47	3 to 5	94
imazamethabenz + R-11 (v/v)	LC 2.5	0.38 + 0.25%	3 to 5	95
imazamethabenz + R-11 (v/v)	LC 2.5	0.47 + 0.25%	3 to 5	95
LSD (0.05)				15
Wild oat density (plants/ft^2)				4

[1] R-11 is a nonionic surfactant, the rate is expressed as %v/v.

Table 3. Wild oat control spring wheat with imazamethabenz formulations

Treatment	Formulation	Rate	AVEFA stage	AVEFA control
		(lb ai/a)	(leaves)	(%)
check	--	--	--	-
imazamethabenz + R-11 (v/v)	SC 2.5	0.47 + 0.25%	1 to 3	95
imazamethabenz + DPXR9674 + R-11 (v/v)	SC 2.5	0.47 + 0.0141 + 0.25%	1 to 3	95
imazamethabenz + DPXR9674 + R-11 (v/v)	SC 2.5	0.38 + 0.0281 + 0.25%	1 to 3	95
imazamethabenz + bromoxynil/MCPA + R-11 (v/v)	SC 2.5	0.47 + 0.25 + 0.25%	1 to 3	95
imazamethabenz + clopyralid/MCPA + R-11 (v/v)	SC 2.5	0.47 + 0.60 + 0.25%	1 to 3	95
imazamethabenz + pyridate + R-11 (v/v)	SC 2.5	0.47 + 0.90 + 0.25%	1 to 3	94
imazamethabenz + R-11 (v/v)	LC 2.5	0.47 + 0.25%	1 to 3	95
imazamethabenz + DPXR9674 + R-11 (v/v)	LC 2.5	0.47 + 0.0141 + 0.25%	1 to 3	94
imazamethabenz + DPXR9674 + R-11 (v/v)	LC 2.5	0.47 + 0.0281 + 0.25%	1 to 3	95
imazamethabenz + bromoxynil/MCPA + R-11 (v/v)	LC 2.5	0.47 + 0.25 + 0.25%	1 to 3	95
imazamethabenz + clopyralid/MCPA + R-11 (v/v)	LC 2.5	0.47 + 0.60 + 0.25%	1 to 3	94
imazamethabenz + pyridate + R-11 (v/v)	LC 2.5	0.47 + 0.90 + 0.25%	1 to 3	91
LSD (0.05)				2
Wild oat density (plants/ft^2)				9

[1] R-11 is a nonionic surfactant, the rate is expressed as % v/v.

Wild oat control in spring barley and spring wheat with herbicide tank mixtures. Tapia, L.S., D.C. Thill, and D.L. Barton. Efficacy of several wild oat (AVEFA) herbicides applied alone and tank mixed with bromoxynil, DPXR9674, and clopyralid were evaluated in duplicate studies in spring barley (var. 'Cougbar') and spring wheat (var. '906-R') near Moscow and Bonners Ferry, Idaho, respectively. A third study near Moscow examined wild oat herbicides alone and tank mixed with CGA-131036 in spring barley (var., 'Cougbar'). The herbicides were studied using a randomized complete block design with four replications. Herbicides were applied to wild oat at different stages of growth with a pressurized CO_2 backpack sprayer calibrated to deliver 10 or 20 gal/a at 40 psi and 3 mph (Table 1). Wild oat control was estimated visually July 18 and August 5, 1989 at Bonners Ferry and Moscow, respectively. Barley grain was harvested August 30, 1989 at Moscow.

Table 1. Application data

	Moscow		Bonners Ferry	
Application date	May 23	June 5	June 13	June 28
Wild oat leaf stage	1 to 3	4 to 5	1 to 3	4 to 5
Barley leaf stage	1 to 3	3 to 5	4 to 5	Head
Air temperature (F)	60	70	76	83
Soil temp. at 2 in. (F)	52	72	76	69
Relative humidity (%)	62	66	62	54
Wind (mph)/direction	4/SE	0	7/SE	0
Delivery rate (gal/a)	20	10	20	10
Soil pH	5.1		7.4	
OM (%)	3.2		3.4	
texture	silt loam		silty clay	

In the duplicate studies, all treatments at Bonners Ferry controlled wild oat adequately except the low rate of diclofop, which was poor (Table 2). When HOE7125 was applied in combination with DPXR9674 or bromoxynil (low rate of HOE7125 only) wild oat control tended to be less than HOE7125 applied alone ($P > 0.05$). At Moscow, only the low rate of HOE7125 tank mixed with DPXR9674 and HOE7125 plus clopyralid gave poor wild oat control. All other treatments controlled at least 84% of the wild oat.

At Moscow, diclofop at 1.0 lb/a and some rates of HOE7125 combined with bromoxynil, DPXR9674, and clopyralid did not increase barley grain yield compared to the untreated check (Table 2). The other treatments increased barley grain 43 to 77% over the untreated check.

In the separate study at Moscow, crop injury was greater (12%) with herbicides applied late (Table 3). Barley grain yields for all herbicide treatments except HOE7125 alone and HOE6004-05H plus CGA-131036 were higher than the untreated check (P > 0.05). Grain yields tended to be higher (10%) when herbicides were applied early. All treatments except diclofop + CGA-131036 and HOE7125 + CGA-131036 controlled at least 65% of the wild oat (Table 3). HOE7125 and diclofop applied alone controlled 17 and 20% more wild oat, respectively, than when combined with CGA-131036. CGA-131036 tank mixed with the other herbicides did not affect wild oat control. (Idaho Agricultural Experiment Station, Moscow, Idaho 83843)

Table 2. Wild oat control and barley grain yield

Treatment	Rate	AVEFA stage	Bonners Ferry AVEFA control	Moscow AVEFA control	Moscow Grain yield
	(lb ai/a)	(leaves)	(%)	(%)	(lb/a)
check	--	--	-	-	1529
diclofop + COC[1]	0.75 1.25%	1 to 3	49	93	2417
diclofop	1.00	1 to 3	95	89	1784
diclofop + COC	1.00 1.25%	1 to 3	97	84	2186
imazamethabenz R-11[2]	0.47 0.25%	1 to 3	92	91	2740
HOE6001	0.074	1 to 3	97	94	2191
HOE6001	0.074	4 to 5	98	94	2540
HOE7125	0.66	4 to 5	86	94	2704
HOE7125	0.78	4 to 5	94	95	2281
HOE6004-05H	0.275	4 to 5	97	94	2236
HOE7125 + bromoxynil	0.66 + 0.25	4 to 5	76	89	2117
HOE7125 + bromoxynil	0.78 0.25	4 to 5	88	91	2395
HOE7125 + DPXR9674	0.66 + 0.0156	4 to 5	75	63	1933
HOE7125 + DPXR9674	0.78 + 0.0156	4 to 5	75	88	2375
HOE7125 + clopyralid	0.66 + 0.09	4 to 5	90	70	2293
HOE7125 + clopyralid	0.78 + 0.09	4 to 5	93	89	1930
difenzoquat	1.00	4 to 5	98	95	2182
LSD (0.05)			22	25	644
Wild oat density (plants/ft^2)			5	25	

[1] COC is a crop oil concentrate, the rate is expressed as % v/v.
[2] R-11 is a nonionic surfactant, the rate ia expressed as % v/v.

Table 3. Wild oat control and barley grain yield at Moscow

Treatment	Rate	AVEFA stage	AVEFA control	Crop injury	Grain yield
	(lb ai/a)	(leaves)	(%)	(%)	(lb/a)
check	--	--	-	-	1623
diclofop	1.00	1 to 3	85	5	2450
imazamethabenz	0.47	1 to 3	83	3	2389
difenzoquat	1.00	1 to 3	78	0	2866
HOE6001	0.074	1 to 3	89	0	2680
diclofop + CGA-131036	1.00 + 0.0134	1 to 3	65	0	2673
imazamethabenz + CGA-131036	0.47 + 0.0134	1 to 3	93	3	2689
HOE6001 + CGA-131036	0.57 + 0.0134	1 to 3	91	13	2465
HOE7125	0.66	3 to 5	83	15	2079
HOE6004-05H	0.90	3 to 5	90	15	2353
HOE7125 + CGA-131036	0.66 + 0.0134	3 to 5	66	10	2287
HOE6004-05H + CGA-131036	0.90 + 0.0134	3 to 5	84	23	2117
difenzoquat + CGA-131036	1.00 + 0.0134	3 to 5	78	15	2484
LSD (0.05)			17	19	499
Wild oat density (plants/ft^2)			15		

Postemergence wild oat control in spring barley and spring wheat. Tapia, L.S., J.M. Lish, and D.C. Thill. Wild oat control with postemergence herbicides in spring barley (var. 'Dutch Boy') and spring wheat (var. '906-R') was evaluated near Bonners Ferry and Idaho Falls, Idaho, respectively. Wild oat control with HOE6001 and HOE7125 alone or tank mixed with broadleaf herbicides was examined near Bonners Ferry. A second study near Idaho Falls examined the effectiveness of wild oat herbicides applied alone or combined with broadleaf herbicides. The herbicides were studied using a randomized complete block design with four replications. Herbicides were applied to wild oat at different stages of growth with a pressurized CO_2 backpack sprayer calibrated to deliver 10 or 20 gal/a at 40 psi and 3 mph (Table 1). Wild oat control was estimated visually July 18 and July 25, 1989 at Bonners Ferry and Idaho Falls, respectively. Grain was not harvested.

Table 1. Application data

	Idaho Falls		Bonners Ferry	
Application date	May 25	June 9	June 13	June 28
Wild oat leaf stage	1 to 3	4 to 5	1 to 3	4 to 5
Barley leaf stage	1 to 3	4 to 5	4 to 5	Head
Air temperature (F)	37	76	76	83
Soil temp. at 2 in. (F)	40	82	76	69
Relative Humidity (%)	66	56	62	54
Wind (mph)/direction	4/SW	0	7/SE	0
Delivery rate (gal/a)	10	10	20	10
Soil pH	7.8		7.4	
OM (%)	2.8		3.4	
texture	silt loam		silt clay loam	

Wild oat control in Bonners Ferry was poor when HOE6001 and HOE7125 were tank mixed with 2,4-DLVE + DPXL5300 (Table 2). Tank mixing DPXR9674 + bromoxynil with HOE7125 reduced wild oat control compared to the sequential application of the same treatment. Wild oat control was consistently good when the wild oat and broadleaf herbicides were applied five days apart.

Only imazamethabenz applied at the 1 to 3 leaf stage of wild oat and HOE6001 applied at the 4 to 5 leaf stage controlled wild oat more than 90% near Idaho Falls (Table 3). Diclofop applied with COC tended to control wild oat better than diclopfop alone. When HOE6001 was tank mixed with DPXL5300 + 2,4-D wild oat control was reduced greatly. Though not significantly, control was less when HOE6001 was tank mixed compared to applied alone. HOE7125 tank mixes also tended to be less than the herbicide applied alone. (Idaho Agricultural Experiment Station, Moscow, Idaho 83843)

Table 2. Wild oat control in spring barley at Bonners Ferry

Treatment	Rate	AVEFA stage	AVEFA control
	(lb ai/a)	(leaves)	(% of check)
HOE6001	0.074	4 to 5	94
HOE7125	0.66	4 to 5	81
HOE6001 + DPXL5300 + 2,4-DLVE	0.074 + 0.0094 + 0.50	4 to 5	54
HOE6001 + DPXR9674 + bromoxynil	0.074 + 0.0281 + 0.25	4 to 5	92
HOE7125 + DPXL5300 + 2,4-DLVE	0.66 + 0.0094 + 0.50	4 to 5	54
HOE7125 + DPXR9674 + bromoxynil	0.66 + 0.0281 + 0.25	4 to 5	71
HOE6001 + DPXL5300 + 2,4-DLVE	0.074 + 0.0094 + 0.50	4 to 5 5 DAT[1] 5 DAT	95
HOE6001 + DPXR9674 + bromoxynil	0.074 + 0.0281 + 0.25	4 to 5 5 DAT 5 DAT	95
HOE7125 + DPXL5300 + 2,4-DLVE	0.66 + 0.0094 + 0.50	4 to 5 5 DAT 5 DAT	94
HOE7125 + DPXR9674 + bromoxynil	0.66 + 0.0281 + 0.25	4 to 5 5 DAT 5 DAT	95
LSD (0.05)			19
Wild oat density (plants/ft^2)			15

[1] 5 DAT denotes herbicide application 5 days after wild oat herbicide application.

Table 3. Wild oat control in spring wheat at Idaho Falls

Treatment	Formulation	Rate	Time of application	Wild oat control
	(lb ai/gal)	(lb ai/a)	(leaf stage)	(% of check)
diclofop +	3.00	0.75	1 to 3	78
COC[1] (v/v)		1.25%		
diclofop	3.00	1.00	1 to 3	62
diclofop +	3.00	1.00	1 to 3	84
COC (v/v)		1.25%		
imazamethabenz +	2.5	0.47	1 to 3	94
R-11[2] (v/v)		0.25%		
imazamethabenz +	2.5	0.47	4 to 5	80
R-11 (v/v)		0.25%		
HOE6001	0.57	0.074	4 to 5	96
HOE7125	3.08	0.66	4 to 5	56
HOE6001 +	0.57	0.074	4 to 5	79
DPXR9674 +	75DF	0.0281		
bromoxynil	2.00	0.25		
HOE6004-05H	0.275	0.090	4 to 5	84
HOE7125 +	3.08	0.66	4 to 5	29
bromoxynil	2.00	0.25		
HOE6001 +	0.57	0.074	4 to 5	20
DPXL5300 +	75DF	0.0094		
2,4-DLVE	3.8	0.5		
HOE7125 +	3.08	0.66	4 to 5	38
DPXR9674	75DF	0.0156		
HOE6001 +	0.57	0.074	4 to 5	70
DPXR9674 +	75DF	0.0281		
bromoxynil	2.0	0.25		
HOE7125 +	3.08	0.66	4 to 5	49
clopyralid	3.00	0.09		
difenzoquat	2.00	1.00	4 to 5	79
LSD (0.05)				29
Wild oat density (plants/ft^2)				2

[1] COC is a crop oil concentrate, the rate is expressed as % v/v.
[2] R-11 is a nonionic surfactant, the rate is expressed as % v/v.

Wild oat control in barley with herbicide tank mixes. Evans, J.O. and B.M. Jenks. Herbicide tank mixes were evaluated for wild oat (AVEFA) control in irrigated spring barley located in North Logan, Utah. Twelve treatments were applied to 10 by 30 feet plots arranged in a randomized complete block design with four replications. Spring barley (var. Russell) was seeded April 11, 1989.

Herbicides were applied May 19 to wild oats in the 4 to 5 leaf stage. Barley had 4 to 5 leaves and 2 to 3 tillers. All treatments were applied with a compressed air bicycle sprayer delivering 16 gpa at 40 psi. Visual evaluations were made on June 9 and July 12.

DPX-R9674 and DPX-L5300 in combination with 2,4-D did not control wild oat, but control of broadleaves was excellent. HOE-7113, diclofop, and imazamethabenz provided excellent control of wild oat. However, when HOE-7113 or diclofop were tank mixed with 2,4-D, DPX-9674, or DPX-L5300, wild oat control was reduced significantly. (Table 2) No crop injury was visible in any treatment. The cooperator harvested the crop before yield data could be taken. (Utah Agricultural Experiment Station, Logan, UT 84322-4820)

Table 1. Application data for weed control in spring barley

Planting date	04-11-89
Application date	05-19-89
AVEFA density (yd2)	48-240
Air Temp (F)	60
Soil Temp at 2 in. (F)	73
Relative Humidity (%)	25
Wind (mph)	3
Soil type	Silt loam
pH	7.9
OM (%)	2.74

Table 2. Wild oat control with herbicide tank mixes

Treatment[1]	RATE	AVEFA CONTROL		CROP INJURY
	(lb ai/A)	------%------		-----%-----
		6-09	7-12	
DPX-R9674 + 2,4-D	0.0141 4.0	10	3	0
DPX-L5300 + 2,4-D	0.0078 4.0	10	2	0
DPX-R9674 + 2,4-D + diclofop	0.0141 4.0 0.75	52	48	0
DPX-L5300 + 2,4-D + diclofop	0.0078 4.0 0.75	37	48	0
DPX-R9674 + 2,4-D + HOE-7113	0.0141 4.0 0.24	65	78	0
DPX-L5300 + 2,4-D + HOE-7113	0.0078 4.0 0.24	73	84	0
diclofop	1.0	83	92	0
HOE-7113	0.24	90	98	0
imazamethabenz + Amway surf.	0.4688	62	95	0
imazamethabenz + bromoxynil	0.4688 0.375	73	83	0
imazamethabenz	0.4688	70	92	0
Control	------	0	0	0
LSD (0.05)		12	11	
CV		14	11	

[1] X-77 added at 0.25% v/v to all treatments except imazamethabenz + Amway surfactant.

Wild oat control in barley. Westra, P. and N.E. Humburg. Wild oat is a major weed problem in Colorado barley fields. Research conducted at Fort Collins, CO, tested the efficacy of six herbicide treatments for wild oat control.

The experiment was arranged in a randomized complete block with three replications. Plots were ten feet by thirty feet long. Herbicides were applied in 23 gallons per acre of water at seventeen psi boom pressure through 11002 LP flat fan tips. Herbicides were applied May 11, 1989 when the barley was tillering at the three to five leaf stage and the wild oat was at the three leaf stage. Herbicide efficacy was evaluated July 25 and barley was harvested July 29.

Wild oat control varied from 80% to 96% , when compared to the untreated check. All herbicide treated plots except those treated with AC 222,293 plus bromoxynil and MCPA produced significantly higher yields than the untreated check. None of the treatments resulted in barley damage. This study showed that tank mixes of AC 222,293 plus broadleaf herbicides did not significantly reduce wild oat control compared to AC 222,293 applied alone. (Weed Research Laboratory, Colorado State University, Fort Collins, CO)

Wild oat control and barley yield
at Fort Collins, Colorado

Herbicide	Rate (lb ai/a)	wild oat control[3] (%)	barley yield3 (bu/a)
check		0b	40b
AC 222,293[1]	0.48	92b	64a
AC 222,293 +[1] 28% N	0.48 1.0[2]	96b	68a
AC 222,293 + 28%N	0.48 1.0[2]	83b	66a
diclofop +[1]	1.0	95b	61a
bromoxynil +[1] AC 222,293	0.25 0.38	80b	63a
bromoxynil + MCPA[1] AC 222,293	 0.50 0.38	82b	55ab

[1]surfactant X-77 added at 0.25% (v/v)
[2]28%N rate is in quarts per acre
[3]Means followed by the same letter do not significantly differ based on Duncan's MRT, P=0.05

Wild oats control in barley. Miller, S.D. and J. Lauer. Research plots were established at the Research and Extension Center, Powell, Wyoming to evaluate wild oats control with postemergence herbicides applied at several stages. Plots were established under furrow irrigation and were 9 by 30 ft. with three replications arranged in a randomized complete block. Barley (var. Klages) was seeded April 6, 1989 in a clay loam soil (40% sand, 25% silt and 35% clay) with 1.2% organic matter and pH 7.8. Herbicide treatments were applied broadcast with a CO_2-pressurized six-nozzle knapsack sprayer delivering 10 gpa at 40 psi May 24 (air temperature 46F, relative humidity 35%, wind NW at 14 mph, sky partly cloudy and soil temperature - 0 inch 54F, 2 inches 64F and 4 inches 60F) to 3-leaf barley, 2- to 3-leaf wild oats and 0.5- to 1-inch broadleaf weeds, or May 31 (air temperature 64F, relative humidity 34%, wind NW at 6 mph, sky clear and soil temperature - 0 inch 70F, 2 inches 59F and 4 inches 36F) to 5-leaf barley, 4- to 5-leaf wild oats and 1- to 1.5-inch broadleaf weeds. Visual crop damage evaluations were made June 28 and July 28, visual weed control ratings July 28, barley height measured July 29 and plots harvested August 8, 1989. Wild oats (AVEFA) infestations were moderate and wild mustard (SINAR) and wild buckwheat (POLCO) infestations light but uniform throughout the experimental area.

No treatment reduced barley stand; however, barley was injured 2 to 13% and 3 to 10% by HOE-6001-02H and diclofop treatments, respectively. Barley injury with HOE-6001-02H was greater at the 3- than the 5-leaf stage; however, barley injury with diclofop was similar at both stages of application. Wild oats control was excellent with imazamethabenz, HOE-6001-02H and HOE-7125 at rates above 0.44 lb/A. Barley yields were good, and related closely to weed control and/or crop injury. (Wyoming Agric. Exp. Sta., Laramie, WY 82071 SR 1624)

Wild oats control in barley.

Treatment[1]	Rate lb ai/A	Barley[2] Injury June %	Injury July %	SR %	Plant height inches	Yield bu/A	Weed control[3] AVEFA %	SINAR %	POLCO %
2- to 3-leaf									
Imazamethabenz	0.375	0	0	0	36	128	95	100	60
Imazamethabenz+X-77	0.375+0.25%	0	0	0	36	129	97	100	62
Imazamethabenz+oc	0.375+1qt	0	0	0	35	127	100	100	65
Imazamethabenz+Sunit	0.375+1qt	0	0	0	35	129	100	100	63
Imazamethabenz+bromoxynil+MCPA	0.375+0.25+0.25	0	0	0	35	129	100	100	100
Imazamethabenz+bromoxynil	0.375+0.25	0	0	0	36	129	100	100	100
Imazamethabenz	0.47	0	0	0	35	128	98	100	72
Imazamethabenz+X-77	0.47+0.25%	0	0	0	35	129	100	100	73
HOE-6001-02H	0.08	11	13	0	33	117	100	0	0
HOE-6001-02H	0.12	12	10	0	33	99	100	0	0
Diclofop+oc	0.75+1qt	7	3	0	34	112	85	0	0
Diclofop+Sunit	0.75+1qt	6	5	0	33	111	85	0	0
Diclofop+oc	1.0+1qt	12	10	0	33	110	93	0	0
4- to 5-leaf									
Diclofop+oc	1.0+1qt	7	7	0	33	110	85	0	0
Diclofop+Sunit	1.0+1qt	7	7	0	33	111	87	0	0
Difenzoquat+X-77	0.75+0.25%	0	0	0	36	124	67	0	0
Difenzoquat+X-77	1.0+0.25%	0	0	0	36	128	85	0	0
HOE-6001-02H	0.08	2	3	0	34	127	97	0	0
HOE-6001-02H	0.12	5	3	0	34	127	100	0	0
HOE-7125	0.44	0	0	0	36	129	80	100	37
HOE-7125	0.66	0	2	0	35	127	97	100	57
HOE-7125	0.78	3	3	0	35	129	98	100	72
Imazamethabenz+X-77	0.375+0.25%	0	0	0	35	126	93	100	62
Imazamethabenz	0.47	0	0	0	35	127	98	100	68
Imazamethabenz+X-77	0.47+0.25%	0	0	0	35	129	97	100	68
Weedy check	---------------	0	0	0	36	115	0	0	0

[1]Treatments applied May 24 and 31, 1989; oc = At Plus 411f.
[2]Barley injury (Inj) visually evaluated June 28 and July 28, stand reduction (SR) visually evaluated June 28, plant height measured July 29 and plots harvested August 8, 1989.
[3]Weed control visually evaluated July 28, 1989.

Evaluation of preplant incorporated herbicide treatments in kidney beans. Mitich, L.W., N.L. Smith, and G.B. Kyser. Six herbicides, including the low-rate experimental chemical imazethapyr, applied in 12 preplant incorporated treatments, were evaluated for weed control and crop tolerance in 'California Dark Red' kidney beans. The trial was conducted at the UC Davis Farm on Yolo clay loam soil; experimental plots were 10 ft wide (four 30-inch beds) by 20 ft long, arranged in four randomized complete blocks. The field was furrow irrigated at 10 to 14 day intervals.

Treatments were applied 19 June 1989, using a CO_2 backpack sprayer delivering 20 gal/a. On the same day, treatments were incorporated to 2 to 3 inches with a Marvin Rowmaster. Beans were precision planted 20 June at a depth of 2 inches.

Evaluations for crop tolerance and weed control were made 25 July. Crop tolerance did not vary significantly between treatments. Weeds present at evaluation included barnyardgrass (ECHCG), tomatillo groundcherry (PHYIX), redroot pigweed (AMARE), common lambsquarters (CHEAL), and common purslane (POROL). Though control of all weeds varied somewhat between treatments, this variation was significant at the 5% level only for barnyardgrass and tomatillo groundcherry. Treatments producing barnyardgrass control of 90% or better included ethalfluralin (1.5 lb ai/a), pendimethalin + metolachlor (1.5 + 2.5 lb ai/a), metolachlor (in a new formulation sold as DUAL II) at 2.5 lb ai/a, and imazethapyr + pendimethalin (0.047 + 1.5 lb ai/a). Treatments producing tomatillo groundcherry control of 90% or better included DUAL II (2.5 lb ai/a), imazethapyr + pendimethalin (0.047 + 1.5 lb ai/a), and imazethapyr alone (0.063 lb ai/a).

Beans were cut 4 October and harvested 16 October. Yields tended to favor treatments which produced better control of barnyardgrass, but variations were not significant at the 5% level. Poor yields in plots treated with the high rate of imazethapyr may be attributable to interaction of crop plant injury (though not detected in the early visual evaluation) and poor control of barnyardgrass. (Department of Botany, University of California, Davis, CA 95616)

Evaluation of 12 preplant incorporated herbicide treatments in 'California Dark Red' kidney beans

Chemical	Rate (lbs ai/a)	Crop tolerance[1,2] (percent)	Percent weed control[1,3]					Yield[1,4] (lb/a)	
			ECHCG	PHYIX	AMARE	CHEAL	POROL		
metolachlor	2.5	98	80	65	83	88	95	2385	ABC
metolachlor [DUAL II]	2.5	100	90	98	100	100	90	2598	A
alachlor	2.5	100	70	60	100	100	100	2264	ABC
pendimethalin	1.5	98	85	55	100	100	100	2392	AB
imazethapyr	0.047	100	48	65	100	100	100	2608	A
imazethapyr	0.063	98	48	90	100	100	100	1711	CD
ethalfluralin	1.5	98	95	73	100	100	100	2519	A
imazethapyr + pendimethalin	0.047 + 1.5	95	90	95	100	100	100	2539	A
imazethapyr + pendimethalin	0.063 + 1.5	100	88	85	100	100	100	2661	A
pendimethalin + metolachlor	1.5 + 2.5	100	93	73	100	100	100	1712	BCD
trifluralin	0.75	100	85	45	100	100	100	2249	ABC
alachlor + trifluralin	2.5 + 0.5	100	88	63	100	100	100	2421	A
control	---	100	13	10	65	75	85	1510	D

[1] Average of four replications.
[2] 100 = complete crop tolerance, 0 = crop killed.
[3] 100 = complete weed control, 0 = no weed control.
[4] Yields followed by the same letter are not significantly different at the 10% level. Least significant difference = 681 lb/a at alpha = 0.10 (no significant differences at alpha = 0.05).

Annual grass and broadleaf weed control evaluations in pinto beans. Arnold, R.N., E.J. Gregory and D. Smeal. Research plots were established on May 18, 1989 at the Agricultural Science Center, Farmington, New Mexico to evaluate efficacy of imazethapyr and/or imazethapyr combinations applied preplant incorporated, preemergence, and postemergence in pinto beans (var. UI-126). Soil type was a Kinnear very fine sandy loam with a pH of 7.9 and an organic matter content of less than 1%. Individual plots were 12 by 30 ft in size with three replications arranged in a randomized complete block design. Herbicides were applied with a CO_2 backpack sprayer calibrated to deliver 30 gal/A at 25 psi. Preplant incorporated treatments were applied May 18, 1989 and immediately incorporated with a power driven rototiller to a depth of 2 to 4 in. Preemergence surface applied treatments were applied May 23, 1989 and incorporated with 0.75 in of sprinkler applied water. Postemergence treatments were applied June 6, 1989 when weeds were small and pinto beans were in the first trifoliolate leaf stage. Pinto beans were planted on 34 in beds at a rate of 60 lb/A on May 18, 1989. Prostrate pigweed (AMABL) and barnyardgrass (ECHCG) infestations were heavy to moderate and kochia (KCHSC), Russian thistle (SASKR), redroot pigweed (AMARE), and black nightshade (SOLNI) infestations were light throughout the experimental area.

Visual evaluations of crop injury and weed control were made July 11, 1989. All treatments provided excellent control of broadleaf weeds. Imazethapyr combinations gave excellent control of barnyardgrass, as compared to single applications. Pinto bean yields were 2153 to 3048 lb/A higher in the herbicide treated plots as compared to the check. Imazethapyr applied preplant incorporated at 0.094 lb ai/A gave the highest injury rating of 8. (Agricultural Science Center, New Mexico State University, Farmington, N.M. 87499)

Weed control evaluations in pinto beans, 1989

Treatment	Rate lb/ai/A	Crop[1] Injury	Weed Control[1] AMABL	ECHCG	KCHSC	SASKR	AMARE	SOLNI	Yield lb/A
		%	%	%	%	%	%	%	
imazethapyr + pendimethalin[2]	0.063 + 0.75	4	100	100	100	100	100	100	4817
imazethapyr + metolachlor[2]	0.063 + 1.5	5	100	100	100	100	100	100	4509
imazethapyr + trifluralin[2]	0.063 + 0.75	3	100	100	100	100	100	100	4766
imazethapyr + EPTC[2]	0.063 + 3.0	2	100	100	100	100	100	100	5022
trifluralin + EPTC[2]	1.0 + 3.0	0	100	100	100	100	100	100	5022
imazethapyr + metolachlor[3]	0.063 + 1.5	4	100	100	100	100	100	100	4407
imazethapyr + pendimethalin[3]	0.063 + 0.75	4	100	100	100	100	100	100	4458
imazethapyr[4]	0.063	0	100	76	100	100	100	100	4561
imazethapyr[4]	0.047	0	100	77	100	100	100	100	4253
imazethapyr[2]	0.094	8	99	96	100	100	100	100	4561
imazethapyr[3]	0.063	4	98	93	100	100	100	100	4100
imazethapyr[2]	0.047	2	97	85	100	100	100	100	4971
imazethapyr[2]	0.063	4	97	85	100	100	100	100	4612
imazethapyr[3]	0.047	2	96	84	100	100	100	100	4202
handweeded check			100	100	100	100	100	100	4817
check			0	0	0	0	0	0	1947
av weeds/m^2			23	10	4	4	5	3	
LSD 0.05			2.2	6.1	ns	ns	ns	ns	730

1. Based on a visual scale from 0-100 where 0 = no control or crop injury and 100 = dead plants
2. Preplant incorporated
3. Preemergence surface applied
4. Postemergence with a crop oil concentrated at 0.25% v/v

Weed control in pinto beans with preemergence, postemergence or complimentary preemergence/postemergence treatments. Miller, S.D., A. W. Dalrymple and J.M. Krall. Research plots were established at the Research and Extension Center, Torrington, Wyoming to evaluate the efficacy of preemergence, postemergence, or complimentary treatments for weed control in pinto beans. Plots were established under sprinkler irrigation and were 10 by 30 ft. with three replications arranged in a randomized complete block. Herbicide treatments were applied broadcast with a CO_2-pressurized six-nozzle knapsack sprayer delivering 20 gpa at 40 psi. Pinto beans (var. UI-114) were planted June 1, 1989 in a sandy loam soil (78% sand, 13% silt and 9% clay) with 1.3% organic matter and pH 7.6, and preemergence treatments applied (air temperature 75F, relative humidity 40%, wind NW at 5 mph, sky clear and soil temperature - 0 inch 105F, 2 inches 84F and 4 inches 68F). Postemergence treatments were applied June 22, 1989 (air temperature 56F, relative humidity 61%, wind calm, sky clear and soil temperature - 0 inch 74F, 2 inches 54F and 4 inches 54F) to 2-trifoliolate leaf beans and 0.75- to 1.5-inch weeds. Weed counts, crop stand counts and visual crop injury ratings were made June 29, visual weed control ratings August 9 and plots harvested September 5, 1989. Common lambsquarters (CHEAL) infestations were heavy, hairy nightshade (SOLSA) infestations moderate and redroot pigweed (AMARE), kochia (KCHSC) and yellow foxtail (SETLU) infestations light but uniform throughout the experimental area.

No treatment reduced pinto bean stand; however, treatments containing imazethapyr caused 0 to 30% injury. Broad-spectrum, season-long weed control was excellent ($\geq$95% control of all weed species) with preemergence combinations of imazethapyr and metolachlor. Pinto bean yields generally reflected weed control and/or crop injury and were 1276 to 2049 lb/A higher in herbicide-treated compared to weedy check plots. (Wyoming Agric. Exp. Sta., Laramie, WY 82071 SR 1607)

Weed control in pinto beans with preemergence, postemergence or complimentary treatments.

Treatment[1]	Rate lb ai/A	Pinto beans[2] Inj %	SR %	Yield lb/A	% Weed control[3] June CHEAL	AMARE	KCHSC	SOLSA	SETLU	August CHEAL	AMARE	KCHSC	SOLSA	SETLU
Preemergence														
Metolachlor	2.5	0	0	1558	94	92	62	96	100	72	82	47	83	93
Alachlor	2.5	0	0	1743	97	92	100	100	100	87	95	80	87	90
Alachlor (MT)	2.5	0	0	1814	97	92	100	100	100	87	93	83	83	90
Alachlor (WDG)	2.5	0	0	1739	96	92	100	96	100	77	90	83	83	88
Imazethapyr (imaz)	0.032	0	7	1928	98	100	100	100	92	87	100	100	100	80
Imazethapyr	0.047	0	20	1903	97	100	100	100	100	95	100	100	100	85
Imazethapyr	0.063	0	30	1718	97	100	100	100	100	100	100	100	100	85
Imazethapyr+metolachlor	0.032+2.0	0	15	2188	100	100	100	100	100	95	100	100	100	100
Imazethapyr+metolachlor	0.047+2.0	0	23	2066	99	100	100	100	100	100	100	100	100	100
Preemergence/postemergence														
Metolachlor/imaz+s	2.0/0.032	0	2	1802	93	100	100	96	100	85	100	79	100	100
Metolachlor/imaz+s	2.0/0.047	0	0	1974	97	100	100	100	100	91	100	90	100	100
Metolachlor/bentazon + acifluorfen+oc	2.0/0.92	0	0	1638	96	100	100	96	100	77	93	50	87	93
Postemergence														
Imazethapyr+s	0.032	0	0	1415	77	87	37	94	65	53	100	77	100	63
Imazethapyr+s	0.047	0	3	1474	81	100	64	94	73	68	98	90	100	67
Imazethapyr+s	0.063	0	7	1903	86	95	100	96	86	82	100	93	100	73
Imazethapyr+s+N	0.032	0	0	1495	86	100	75	94	65	63	100	83	100	67
Sethoxydim+imaz+oc	0.19+0.047	0	0	1642	90	92	100	94	100	70	100	93	100	98
Sethoxydim+imaz+oc	0.25+0.047	0	3	1579	89	92	100	94	95	70	100	94	100	98
Weedy check	----------	0	0	139	0	0	0	0	0	0	0	0	0	0
Plants/ft. row 6-inch band		-	5.2	----	7.8	0.7	0.2	1.1	0.8	---	---	---	---	---

[1]Treatments applied June 1 and June 22, 1989; s = X-77 at 0.25% v/v, oc = At Plus 411F at 1 qt/A and N = 28% w/w nitrogen at 1 gal/A.
[2]Crop stand counts (SR = stand reduction) and visual crop injury evaluated June 29 and plots harvested September 5, 1989.
[3]Weed stand counts June 27 and visual weed control ratings August 9, 1989.

Weed control in pinto beans with preplant incorporated or complimentary preplant incorporated/postemergence treatments. Miller, S.D., A.W. Dalrymple and J.M. Krall. Research plots were established at the Research and Extension Center, Torrington, Wyoming to evaluate the efficacy of preplant incorporated herbicide treatments alone or in combination with postemergence treatments for weed control in pinto beans. Plots were established under sprinkler irrigation and were 10 by 45 ft with three replications arranged in a randomized complete block. Herbicide treatments were applied broadcast with a CO_2-pressurized six-nozzle knapsack sprayer delivering 20 gpa at 40 psi. Preplant incorporated treatments were applied May 31, 1989 (air temperature 64F, relative humidity 54%, wind NW at 5 mph, sky partly cloudy and soil temperature - 0 inch 72F, 2 inches 64F and 4 inches 62F) and incorporated twice immediately after application with a roller harrow operating 2 to 3 inches. Pinto beans (var. UI-114) were planted June 1, 1989 in a sandy loam soil (78% sand, 13% silt and 9% clay) with 1.3% organic matter and pH 7.6. Postemergence treatments were applied to 2-trifoliolate leaf beans and 0.5- to 1.5-inch weeds June 22, 1989 (air temperature 56F, relative humidity 61%, wind W at 4 mph, sky clear and soil temperature - 0 inch 74F, 2 inches 54F and 4 inches 57F). Weed counts, crop stand counts and visual crop injury ratings were made June 29, visual weed control ratings, August 9 and plots harvested September 5, 1989. Common lambsquarters (CHEAL) infestations were heavy, redroot pigweed (AMARE)infestations moderate and hairy nightshade (SOLSA), kochia (KCHSC) and yellow foxtail (SETLU) infestations light but uniform throughout the experimental area.

Herbicide treatments generally had little effect on pinto bean stands; however, treatments containing imazethapyr caused 0 to 20% injury. Broad-spectrum season-long weed control was good (>85% control of all weed species) with imazethapyr alone at 0.047 lb/A or 0.032 lb/A in combination with pendimethalin. Pinto bean yields generally reflected weed control and were 985 to 1496 lb/A higher in herbicide-treated compared to weedy check plots. (Wyoming Agric. Exp. Sta., Laramie, WY 82071 SR 1606)

Weed control in pinto beans with preplant incorporated or complimentary treatments.

Treatment[1]	Rate	Pinto beans[2]			% Weed control[3]									
					June					August				
	lb ai/A	Inj %	SR %	Yield lb/A	CHEAL	SOLSA	AMARE	KCHSC	SETLU	CHEAL	SOLSA	AMARE	KCHSC	SETLU
Preplant incorporated														
Pendimethalin (pend)	1.5	0	0	1238	96	60	82	100	100	89	0	57	82	100
EPTC	3.0	0	0	1140	31	100	70	100	100	53	78	23	55	100
EPTC+pend	2.0+1.0	0	0	1376	87	100	86	100	100	85	72	74	67	97
EPTC+trifluralin	2.0+0.75	0	0	1247	92	91	79	100	100	81	50	58	87	100
Imazethapyr (imaz)	0.032	10	0	1320	41	100	95	100	80	75	87	82	89	78
Imazethapyr	0.047	15	0	1428	79	100	100	100	80	86	93	88	90	87
Imazeth pyr	0.063	20	9	1651	76	100	100	100	100	95	93	99	93	90
Imazethapyr+pend	0.032+1.0	13	0	1625	92	100	100	100	100	90	90	93	90	90
Imazethapyr+pend	0.047+1.0	18	3	1584	94	100	100	100	100	93	97	97	98	97
Alachlor (alac) + trifluralin (trif)	2.63	0	1	1264	82	91	96	80	100	57	88	53	71	93
Alac+trif+alac	2.63+0.5	0	1	1342	83	91	95	100	100	61	85	60	89	93
Alac+trif	3.0	2	0	1333	93	91	96	100	100	73	87	88	83	100
Alac+trif+alac	3.0+0.5	0	0	1312	94	94	100	100	100	78	87	77	87	92
Preplant incorporated/postemergence														
Pend/imaz+s	1.0/0.032	0	0	1509	88	100	96	100	100	87	100	93	87	100
Pend/imaz+s	1.0/0.047	3	0	1625	89	100	100	100	100	90	100	96	87	100
EPTC/bentazon (bent) + acifluorfen (acif)+oc	2.0/ 0.92	0	0	1380	82	94	88	70	100	87	97	90	60	93
EPTC/bent+acif+N	2.0/0.92	3	0	1393	86	100	100	80	100	86	97	92	63	93
EPTC/bent+acif+oc	2.0/1.15	3	0	1458	85	94	96	80	100	92	93	92	73	90
EPTC/bent+acif+N	2.0/1.15	2	0	1402	94	100	100	80	100	92	97	97	67	93
EPTC/bent+acif+oc	2.0/0.75+ 0.125	2	0	1428	89	100	100	100	87	84	92	88	63	93
EPTC/bent+acif+N	2.0/0.75+ 0.125	2	0	1385	94	94	100	80	100	90	93	93	67	90
EPTC/bent+acif+oc	2.0/0.75+ 0.25	2	0	1535	95	94	100	100	87	92	92	92	82	90
EPTC/bent+acif+N	2.0/0.75+ 0.25	2	0	1552	96	94	96	100	100	90	97	95	80	92
EPTC/bent+oc	2.0/0.75	0	0	1415	86	100	91	80	87	63	83	68	60	90
EPTC/acif+oc	2.0/0.25	0	0	1479	85	100	96	80	100	85	47	93	67	93
Weedy check	--------	0	0	155	0	0	0	0	0	0	0	0	0	0
Plants/ft. row 6-inch band		--	5.3	----	7.9	0.7	1.1	0.3	·0.5	---	---	---	---	---

[1]Treatments applied May 31 and June 22, 1989; s = X-77 at 0.25% v/v, oc = At Plus 411F at 1 qt/A and N = 28% w/w nitrogen at 1 gal/A.

[2]Crop stand counts (SR - stand reduction) and visual crop injury were evaluated June 29 and plots harvested September 5, 1989.

[3]Weed stand counts June 29 and visual weed control ratings August 9, 1989.

Annual-broadleaf weed control in crimson clover. Brewster, B.D., J.A. Leffel, A.P. Appleby, and D.L. Kloft. Pyridate and imazethapyr were applied to seedling crimson clover at two sites to evaluate broadleaf weed control. The experimental design was a randomized complete block with four replications and 2.5 by 6 m plots. Carrier volume was 160 L/ha delivered at 172 kPa through XR 8003 flat fan nozzle tips. Pyridate was applied on October 28, 1988, and imazethapyr was applied on December 1, 1988. Visual evaluations reported here were conducted on April 20, 1989.

Pyridate controlled mayweed chamomile and shepherdspurse at the Hillsboro site (Table 1), which resulted in increased clover seed yield compared to the check. The imazethapyr application was less effective on both weed species at this location, but still resulted in increased clover seed yield. Pyridate did not provide adequate hedge mustard control at the Cornelius site, but imazethapyr was quite effective and provided a substantial increase in clover seed yield, despite the crop stunting. (Department of Crop Science, Oregon State University, Corvallis, OR 97331).

Table 1. Annual broadleaf control, crimson clover injury, and crimson clover seed yield near Hillsboro, OR

Herbicide[1]	Rate	Crimson clover	Seed yield	ANTCO	CAPBP
	(kg a.i./ha)	(% injury)	(kg/ha)	(% control)	
October 28, 1988[2]					
pyridate	1.0	0	1970	100	96
October 28/December 1, 1988					
pyridate/imazethapyr	1.0/0.07	20	2940	91	100
December 1, 1988					
imazethapyr	0.07	13	1750	73	0
check	0	0	1550	0	0
		$LSD_{.05}$	178		

[1]Non-ionic surfactant added to imazethapyr at 0.25% v/v.
[2]October 28: clover 3 trifoliate, mayweed chamomile 2 to 6 leaf, shepherdspurse 1-2 leaf.
December 1: clover 6 to 8 trifoliate, mayweed chamomile 5 to 8 cm diameter, shepherdspurse 5 to 8 cm diameter.

Table 2. Hedge mustard control, crimson clover injury, and crimson clover seed yield near Cornelius, OR.

Herbicide[1]	Rate	Crimson clover	Seed yield	SSYOF
	(kg a.i./ha)	(% injury)	(kg/ha)	(% control)
October 28, 1988[2]				
pyridate	1.0	0	1080	67
October/December 1, 1988				
pyridate/imazethapyr	1.0/0.07	30	1400	100
December 1, 1988				
imazethapyr	0.07	15	1310	98
check	0	0	830	0
		$LSD_{.05}$	310	

[1]Non-ionic surfactant added to imazethapyr at 0.25% v/v.
[2]October 28: clover 1 trifoliate, hedge mustard 2 to 3 leaf
December 1: clover 6 to 10 trifoliate, hedge mustard 10 to 15 cm diameter

Annual grass and broadleaf weed control in field corn with postemergence herbicides. Arnold, R.N., E.J. Gregory and M.W. Murray. Research plots were established on May 9, 1989 at the Agricultural Science Center, Farmington, New Mexico to evaluate the response of field corn (var. Super Crost 5460) and annual grass and broadleaf weeds to herbicides. Soil type was a Wall sandy loam with a pH of 7.8 and an organic matter content of less than 1%. The experimental design was a randomized complete block with three replications. Individual plots were 4, 34 in rows 30 ft long. Field corn was planted on May 9, 1989. Treatments were applied with a CO_2 backpack sprayer calibrated to deliver 30 gal/A at 25 psi. Herbicides were all applied postemergence on May 29, 1989 when corn was in the 3 to 4 leaf stage and weeds were small. Prostrae pigweed (AMABL) and barnyardgrass (ECHCG) infestations were heavy to moderate and redroot pigweed (AMARE), kochia (KCHSC), Russian thistle (SASKR), and green foxtail (SETVI) infestations were light throughout the experimental area.

Visual evaluations of crop injury and weed control were made June 27, 1989. All treatments gave over 90% control of weeds employed in this study. No crop injury was apparent in any of the treatments. (Agricultural Science Center, New Mexico State University, Farmington, N.M. 87499)

Weed control evaluations in field corn with postemergence herbicides

Treatment	Rate lb ai/A	Crop Injury[1]	AMABL	AMARE	KCHSC	SASKR	ECHGC	SETVI
		Weed Control[1] -- %						
dicamba + atrazine[2] (pm)	0.8	0	100	100	100	100	100	100
dicamba + atrazine[2] (pm)	1.2	0	100	100	100	100	100	100
dicamba + atrazine (pm)	0.8	0	100	100	100	100	100	93
dicamba + atrazine (pm)	1.2	0	100	100	100	100	100	100
dicamba + atrazine (pm) + cyanazine	0.8 + 1.0	0	100	100	100	100	100	100
dicamba + atrazine (pm) + pendimethalin	0.8 + 1.0	0	100	100	100	100	100	100
dicamba + atrazine (pm) + DPX-V9360	0.8 + 0.047	0	100	100	100	100	100	96
dicamba + atrazine (pm) + CGA-136872	0.8 + 0.032	0	100	100	100	100	100	100
dicamba + atrazine (pm) + DPX-79406	0.8 + 0.047	0	100	100	100	100	100	100
dicamba + cyanazine	0.38 + 1.0	0	100	100	100	100	96	96
dicamba + pendimethalin	0.38 + 1.0	0	100	100	100	100	96	96
dicamba + cyanazine + pendimethalin	0.38 + 1.0 + 1.0	0	100	100	100	100	100	100
dicamba + DPX-79406	0.38 + 0.047	0	100	100	100	100	90	90
handweeded check		0	100	100	100	100	100	100
check		0	0	0	0	0	0	0
av weeds/M^2			13	5	2	2	10	6
LSD 0.05			ns	ns	ns	ns	3.2	4.4

1. Based on a visual scale from 0-100 where 0 = no control or crop injury and 100 = dead plants
2. A COC was added at 0.25 v/v
3. pm = packaged mix

Annual grass and broadleaf weed control in field corn with preemergence herbicides. Arnold, R.N., E.J. Gregory and M.W. Murray. Research plots were established on May 8, 1989 at the Agricultural Science Center, Farmington, New Mexico to evaluate the response of field corn (var. Super Crost 5460) and annual grass and broadleaf weeds to herbicides. Soil type was a Wall sandy loam with a pH of 7.8 and an organic matter content of less than 1%. The experimental design was a randomized complete block with three replications. Individual plots were 4, 34 in rows 30 ft long. Field corn was planted on May 8, 1989. Treatments were applied with a CO_2 backpack sprayer calibrated to deliver 30 gal/A at 25 psi. Treatments were all applied preemergence surface on May 11, 1989 and immediately incorporated with 0.75 in of sprinkler applied water. Prostrate pigweed (AMABL) infestations were heavy and barnyardgrass (ECHCG), redroot pigweed (AMARE), kochia (KCHSC), Russian thistle (SASKR), and green foxtail (SETVI) infestations were moderate to light throughout the experimental area.

Visual evaluations of crop injury and weed control were made June 27, 1989. All treatments gave over 80% control of AMARE, KCHSC, and SASKR. All treatments gave excellent control of AMABL, ECHCG, and SETVI except dicamba applied at 0.25 and 0.5 lb ai/A. Dicamba applied at 0.5 lb ai/A and pendimethalin applied at 1.0 lb ai/A caused the highest injury rating of 5. Agricultural Science Center, New Mexico State University, Farmington N.M. 87499)

Weed control evaluations in field corn with preemergence herbicides

Treatment	Rate lb ai/A	Crop[1] Injury	AMARE	AMABL	KCHSC	SASKR	ECHCG	SETVI
		---Weed Control[1]---						
		%						
dicamba + atrazine (pm)	0.8	0	100	100	100	100	100	100
dicamba + atrazine (pm)	1.6	0	100	100	100	100	100	100
dicamba + atrazine (pm)	2.4	0	100	100	100	100	100	100
dicamba + atrazine (pm) + cyanazine	0.8 + 2.0	0	100	100	100	100	100	100
dicamba + atrazine (pm) + alachlor	0.8 + 2.0	0	100	100	100	100	100	100
dicamba + atrazine (pm) + pendimethalin	0.8 + 1.0	0	100	100	100	100	100	100
pendimethalin + dicamba	1.0 + 0.25	3	100	96	100	100	100	100
dicamba + atrazine (pm) + metolachlor	0.8 + 2.0	0	100	100	100	100	100	100
dicamba	0.5	5	100	76	100	100	0	0
dicamba	0.25	3	100	71	96	93	0	0
metolachlor	2.0	0	100	100	80	93	100	100
pendimethalin	1.0	5	100	100	100	93	96	100
cyanazine	2.0	3	100	97	100	96	100	100
alachlor	2.0	0	100	96	96	100	100	100
handweeded check		0	100	100	100	100	100	100
check		0	0	0	0	0	0	0
av weeds/m^2			4	10	3	7	6	4

1. Based on a visual scale from 0-100 where 0 = no control or crop injury and 100 = dead plants
2. pm = packaged mix

Postemergence seedling johnsongrass control in 7680 field corn. Orr, J. P. On May 25 on Staten Island in Walnut Grove, California, postemergence applications of primisulfuron and DPX E9636 were made to Seedtech 7680 Field Corn in the 3 to 5 leaf stage and seedling johnsongrass in the 3 to 5 leaf stage. On June 2nd, a second application was made with primisulfuron treatments.

This trial was established on a Staten peaty muck soil and irrigated by means of a spud ditch. Application was with a CO_2 backpack sprayer, 30 gal/a water, with four replications.

In this trial, the johnsongrass population was predominantly seedling. Primisulfuron as a single treatment and combination split applications resulted in only fair control with slight initial Seedtech 7680 corn vigor reduction and slight phytotoxicity.

DPX E9636 at rates of 0.015 to 0.060 lb ai/a gave excellent seedling control, slight field Seedtech 7680 corn vigor reduction, and very slight phytotoxicity. (University of California Cooperative Extension, Sacramento County, 4145 Branch Center Road, Sacramento, CA 95827)

Postemergence seedling johnsongrass control in Seedtech 7680 field corn

Chemical	Rate lb ai/a[2]		Control Johnsongrass[1] Seedling	Control Johnsongrass[1] Rhizome	Seedtech 7680 Field Corn Stand[1]	Seedtech 7680 Field Corn Vigor[1]	Seedtech 7680 Field Corn Phytotoxicity[3]
	05/25	06/02	30 days	30 days	30 days	30 days	30 days
primisulfuron	0.018		3.8	1.0	10.0	9.5	0.3
primisulfuron	0.036		5.3	0.8	10.0	9.0	0.5
primisulfuron	0.018	0.018	4.5	0.8	10.0	8.2	0.0
primisulfuron	0.018	0.036	6.5	3.0	10.0	8.0	1.3
primisulfuron	0.036	0.036	6.0	3.0	10.0	8.5	0.3
primisulfuron[4]	0.036	0.036	4.5	2.3	10.0	8.7	0.0
primisulfuron[4]	0.036	0.054	7.3	2.8	10.0	9.5	0.8
DPX E9636	0.015		9.3	4.8	10.0	8.7	0.5
DPX E9636	0.030		9.8	4.0	10.0	8.7	0.0
DPX E9636	0.045		9.0	3.3	10.0	9.7	0.0
DPX E9636	0.060		8.3	3.0	10.0	9.2	0.3
Control			0.0	0.0	10.0	10.0	0.0

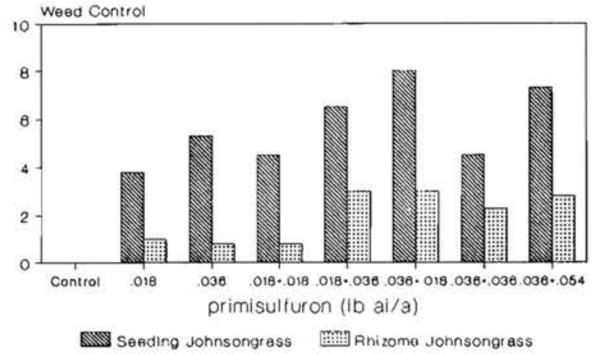
[1] 0 = no weed control, crop dead
10 = complete weed control, no crop damage

[2] X-77 1% added to each treatment

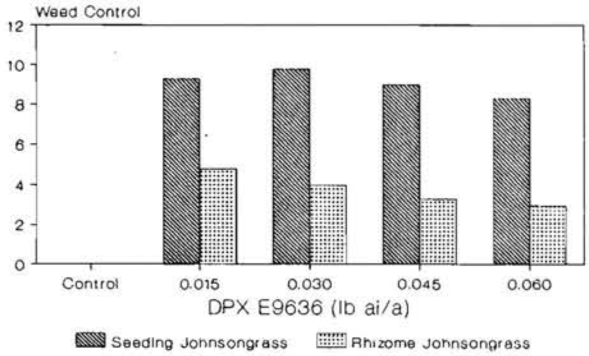
[3] 0 = no crop damage
10 = severe damage

[4] Post Directed

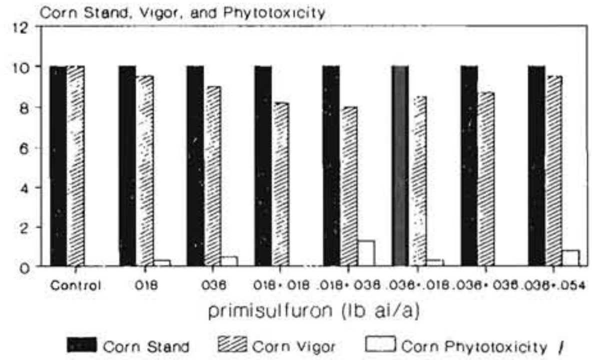
Johnsongrass Control in Seedtech 7680 Field Corn



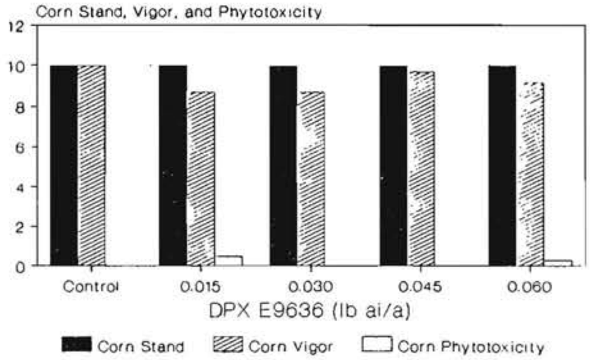
Johnsongrass Control in Seedtech 7680 Field Corn



Seedtech 7680 Field Corn Tolerance to Primisulfuron



Seedtech 7680 Field Corn Tolerance to DPX E9636



Rhizome and seedling johnsongrass control in Pioneer 3183 field corn. Orr, J. P. On May 19, 1989, on Tyler Island in Walnut Grove, California, postemergence applications of primisulfuron and DPX E9636 were made to Pioneer 3183 field corn and johnsongrass in the 3 to 5 leaf stage. On May 24, a second application of primisulfuron was made to corn in the 5 to 7 leaf stage. Treatments were directed and non-directed in the primisulfuron treatments.

The trial was established on an Egbert muck soil and irrigated by means of spud ditches. Application was with a CO_2 backpack sprayer, 30 gal/a water, with four replications. Weather was clear with an air temperature of 80F.

Primisulfuron gave better control of seedling johnsongrass than of rhizome. The 0.018 + 0.036 lb ai/a gave 80% seedling control and 48% rhizome control. Pioneer 3183 tolerance was good.

DPX E9636 at rates of 0.015 to 0.060 lb ai/a gave excellent seedling johnsongrass control. The 0.060 lb ai/a rate resulted in 98% seedling and 85% rhizome johnsongrass control with slight initial Pioneer 3183 corn vigor reduction. (University of California Cooperative Extension, Sacramento County, 4145 Branch Center Road, Sacramento, CA 95827)

Rhizome and seedling johnsongrass control in Pioneer 3183 field corn

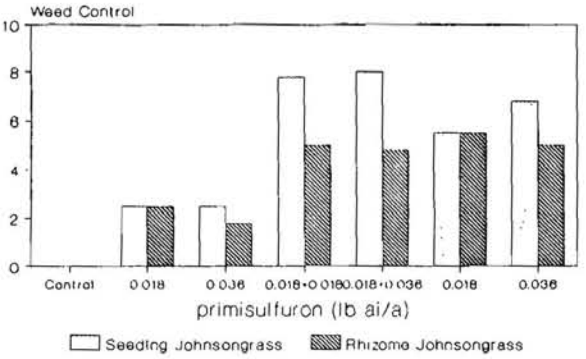
Chemical	Rate lb ai/a[2]		Control Johnsongrass[1]		Pioneer 3183[1] Field Corn	
			Seedling	Rhizome	Stand	Vigor
	05/19	05/24	30 days	30 days	30 days	30 days
primisulfuron	0.018		2.5	2.5	10.0	10.0
primisulfuron	0.036		2.5	1.8	10.0	10.0
primisulfuron	0.018	0.018	7.8	5.0	10.0	10.0
primisulfuron	0.018	0.036	8.0	4.8	10.0	10.0
primisulfuron[3]		0.018	5.5	5.5	10.0	10.0
primisulfuron[3]		0.036	6.8	5.0	10.0	10.0
DPX E9636		0.015	9.5	7.3	10.0	10.0
DPX E9636		0.030	9.5	7.0	10.0	10.0
DPX E9636		0.045	10.0	7.8	10.0	9.5
DPX E9636		0.060	9.8	8.5	10.0	9.2
control			0.0	0.0	10.0	10.0

[1] 0 = no weed control, crop dead
10 = complete weed control, no crop damage

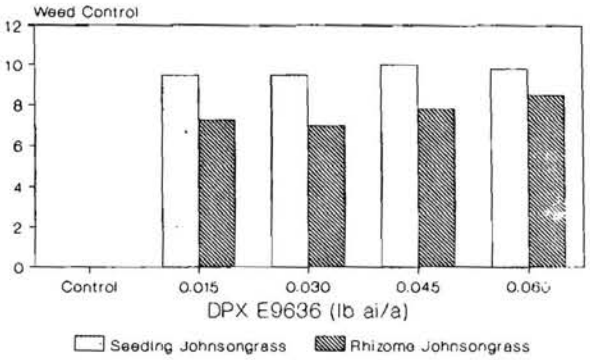
[2] X-77 1% added to each treatment

[3] Post Directed

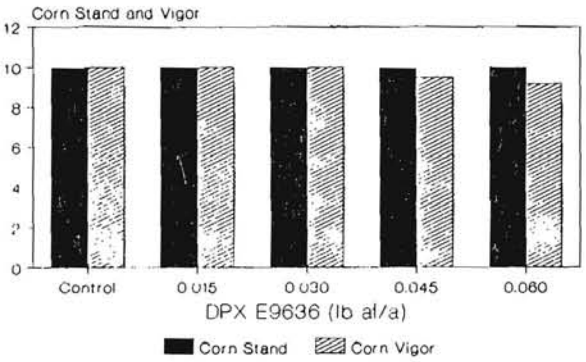
Johnsongrass Control in Pioneer 3183 Field Corn



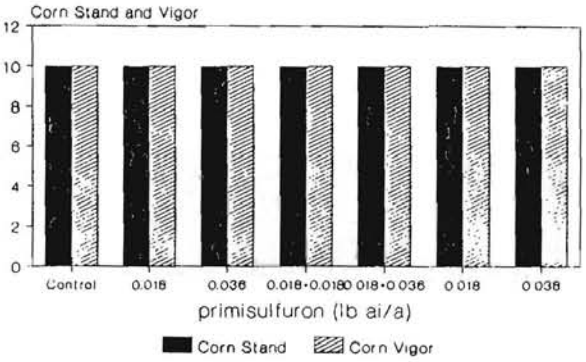
Johnsongrass Control in Pioneer 3183 Field Corn



Pioneer 3183 Field Corn Tolerance to DPX E9636



Pioneer 3183 Field Corn Tolerance to Primisulfuron



Postemergence rhizome johnsongrass control in Pioneer 3377 field corn. Orr. J. P. On August 7, 1989, on Grand Island in Walnut Grove, California, initial postemergence applications of primisulfuron and single applications of DPX E9636 were made to Pioneer 3377 field corn in the 3 to 4 leaf stage. Primisulfuron treatments in addition to the initial treatment were made August 14th to field corn in the 5 to 7 leaf stage post-directed and post-non-directed.

This trial was established on a loam soil, furrow irrigated, replicated four times in a randomized complete block design. Applications was with a CO_2 backpack sprayer in 30 gal/a water.

Primisulfuron at single rates of 0.018 and 0.036 lb ai/a and combination treatments of 0.018 + 0.018, 0.018 + 0.036, 0.036 + 0.036, and 0.036 + 0.054 lb ai/a effectivly reduced rhizome johnsongrass vigor. Pioneer 3377 corn vigor was reduced slightly. Tolerance was the same in either directed or non-directed treatments.

DPX E9636 at rates of 0.015 to 0.060 lb ai/a gave excellent control of rhizome johnsongrass. Pioneer 3377 corn vigor was reduced severely intially. Stand was not affected. (University of California Cooperative Extension, Sacramento County, 4145 Branch Center Road, Sacramento, CA 95827)

Postemergence rhizome johnsongrass control
in Pioneer 3377 field corn

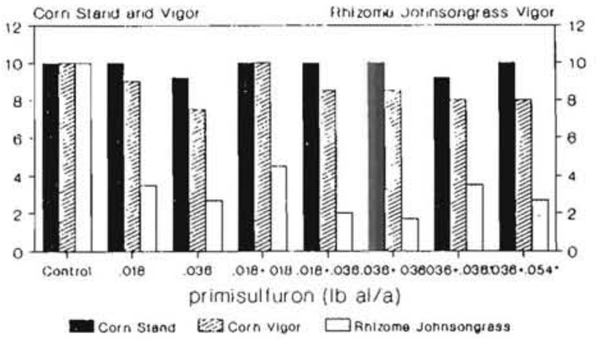
Chemical	Rate lb ai/a[2]		Rhizome Johnsongrass[1] Vigor	Pioneer 3377[1] Field Corn Stand	Pioneer 3377[1] Field Corn Vigor
	07/07	07/14	30 days	30 days	30 days
primisulfuron	0.018		3.5	10.0	9.0
primisulfuron	0.036		2.7	9.2	7.5
primisulfuron	0.018	0.018	4.5	10.0	10.0
primisulfuron	0.018	0.036	2.0	10.0	8.5
primisulfuron	0.036	0.036	1.7	10.0	8.5
primisulfuron[3]	0.036	0.036	3.5	9.2	8.0
primisulfuron[3]	0.036	0.054	2.7	10.0	8.0
DPX E9636	0.015		1.5	10.0	10.0
DPX E9636	0.030		0.7	10.0	7.0
DPX E9636	0.045		0.0	10.0	6.0
DPX E9636	0.060		0.0	10.0	5.0
control			10.0	10.0	10.0

1 0 = complete weed control, crop dead
10 = no weed control, no crop damage

2 X-77 1% added to each treatment

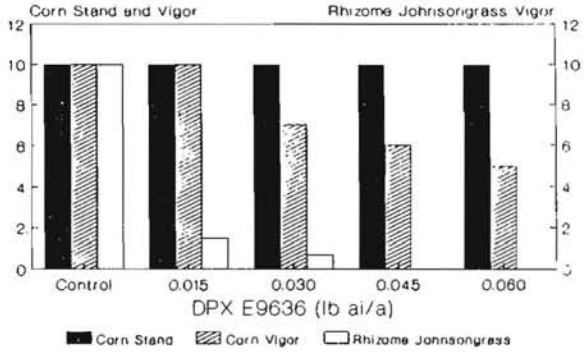
3 Post Directed

Pioneer 3377 Field Corn Tolerance and Rhizome Johnsongrass Vigor



* post directed

Pioneer 3377 Field Corn Tolerance and Rhizome Johnsongrass Vigor



Postemergence rhizome johnsongrass control in Pioneer 3377 field corn. Orr, J. P. On April 27, 1989, in Elk Grove, California, Pioneer 3377 field corn in the 5 leaf stage and rhizome johnsongrass in the 3 to 5 leaf stage was treated postemergence with primisulfuron at rates of 0.018 + 0.036 lb ai/a and DPX E9636 0.015 to 0.060 lb ai/a. On May 9, a second application was made resulting in primisulfuron treatments of 0.018 + 0.018 lb ai/a and 0.018 and 0.036 lb ai/a. A directed 0.036 lb ai/a primisulfuron treatment was made as a comparison to non-directed treatments.

The trial was established on a sandy loam soil and furrow irrigated. Application was made with a CO_2 backpack sprayer, 30 gal/a water, with four replications. Weather at the time of application consisted of a 5 mph wind, clear skys, and a temperature of 80F.

Primisulfuron gave good johnsongrass control as a single application at rates of 0.018 and 0.036 lb ai/a. The combination of 0.018 + 0.036 lb ai/a gave 93% control. Pioneer 3377 corn vigor was reduced initially.

DPX E9636 at 0.30 lb ai/a gave 93% johnsongrass control and 27% Pioneer 3377 corn vigor reduction.

In general, Pioneer 3377 field corn tolerance was better with primisulfuron than with DPX E9636. DPX E9636 caused greater inital vigor reduction and the field corn was slower in growing out of this than with primisulfuron treatments. (University of California Cooperative Extension, Sacramento County, 4145 Branch Center Road, Sacramento, CA 95827)

Postemergence rhizome johnsongrass control in Pioneer 3377 field corn

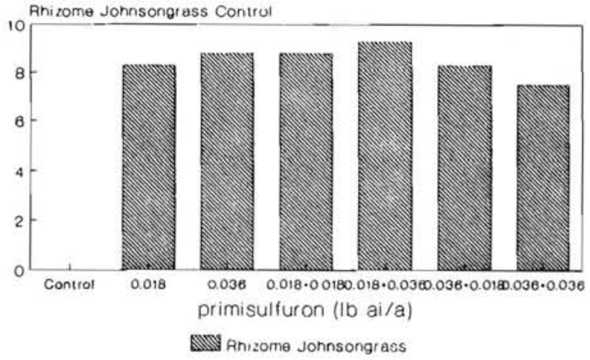
Chemcial	Rate lb ai/a[2]		Rhizome Johnsongrass[1] Vigor	Rhizome Johnsongrass[1] Control	Pioneer 3377[1] Field Corn Vigor	
	04/27	05/09	30 days	30 days	14 days	30 days
primisulfuron	0.018		7.5	8.3	8.7	10.0
primisulfuron	0.036		7.7	8.8	8.5	10.0
primisulfuron	0.018	0.018	6.2	8.8	8.7	10.0
primisulfuron	0.018	0.036	5.0	9.3	7.5	10.0
primisulfuron		0.036	5.0	8.3	8.5	10.0
primisulfuron[3]	0.036		8.5	7.5	8.5	10.0
DPX E9636		0.015	7.0	6.0	7.5	10.0
DPX E9636		0.030	4.0	9.3	7.3	9.0
DPX E9636		0.045	3.2	9.5	7.2	8.2
DPX E9636		0.060	1.7	10.0	5.7	6.7
Control			10.0	0.0	10.0	10.0

[1] 0 = complete weed control, crop dead
10 = no weed control, no crop damage

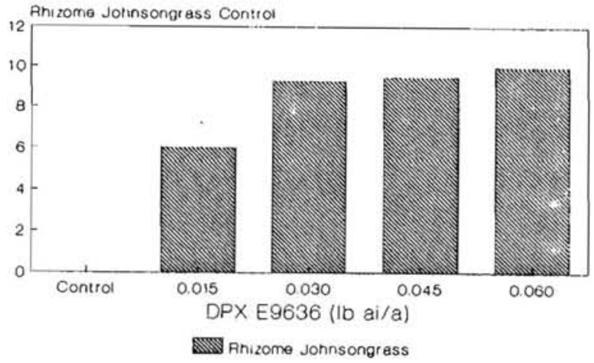
[2] X-77 1% added to each treatment

[3] Post Directed

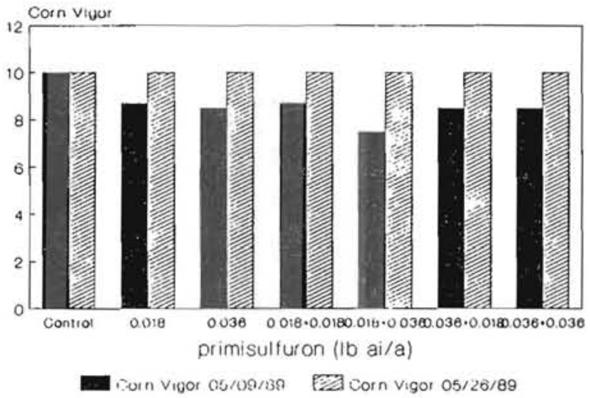
Rhizome Johnsongrass Control in Pioneer 3377 Field Corn



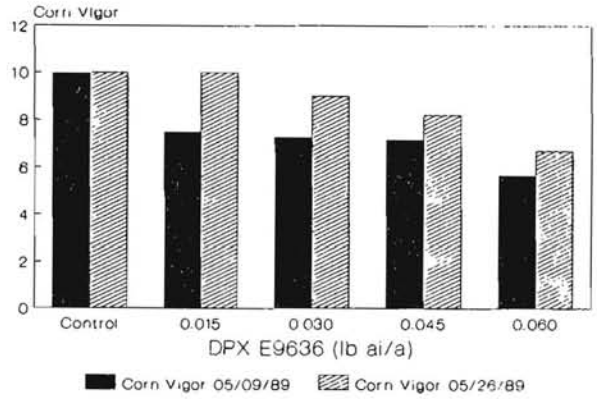
Rhizome Johnsongrass Control in Pioneer 3377 Field Corn



Pioneer 3377 Field Corn Vigor



Pioneer 3377 Field Corn Vigor



Lambsquarters and green foxtail control in field corn. Evans, J.O. and B.M. Jenks. DPX-V9360, primisulfuron, and cyanazine were applied to field corn for lambsquarters (CHEAL) and green foxtail (SETVI) control. Eight herbicide treatments were applied to "Grand Valley 134L" field corn in the 7 to 8 leaf stage. Lambsquarters and green foxtail were approximately 6 to 8 and 4 inches tall, respectively.

Plots were established under sprinkler irrigation and were 10 by 30 feet with 3 replications arranged in a randomized complete block design. Applications were made with a compressed air bicycle sprayer delivering 16 gpa at 40 psi.

DPX-V9360 was effective on green foxtail, but not on lambsquarters. Primisulfuron did not control green foxtail, but showed good control on lambsquarters. Cyanazine was ineffective on both weeds. (Utah Agricultural Experiment Station, Logan, UT 84322-4820)

Table 1. Application data for weed control in field corn

Planting date	05-18-89
Application date	06-29-89
CHEAL density (yd2)	48
SETVI density (yd2)	96
Air Temp (F)	86
Soil Temp at 2 in. (F)	87
Wind (mph)	0
Relative humidity (%)	15
Soil type	Silt loam
pH	8.1
OM (%)	2.7

Table 2. CHEAL and SETVI control in field corn

TREATMENT[1]	RATE	WEED CONTROL				YIELD
	lb ai/A	----------%----------				bu/A
		07-26		08-22		
		CHEAL	SETVI	CHEAL	SETVI	
DPX-V9360	0.0156	0	92	3	87	67
DPX-V9360	0.0313	10	93	23	94	82
DPX-V9360	0.0625	17	95	47	97	92
primisulfuron	0.018	37	13	91	0	99
primisulfuron	0.0205	18	12	84	0	86
primisulfuron	0.036	30	37	89	13	73
cyanazine	0.625	3	3	7	0	86
cyanazine	1.25	7	3	20	0	82
Control	-----	0	0	0	0	84
LSD (0.05)		17	15	19	10	31
CV		74	23	27	17	21

1 X-77 added at 0.25% v/v to DPX-V9360 and primisulfuron treatments.

Wild proso millet control in corn with preplant incorporated, preemergence, postemergence or complimentary treatments. Miller, S.D. and A.W. Dalrymple. Research plots were established near Cassa, Wyoming to evaluate the efficacy of preplant incorporated, preemergence, postemergence and complimentary preplant incorporated/postemergence herbicide treatments for wild proso millet control in corn. Plots were established under furrow irrigation and were 10 by 30 ft. with three replications arranged in a randomized complete block. Herbicide treatments were applied broadcast with a CO_2-pressurized six-nozzle knapsack sprayer delivering 20 gpa at 40 psi except postdirected treatments applied at 40 gpa. Preplant herbicides were applied April 25 (air temperature 58F, relative humidity 66%, wind calm, sky cloudy and soil temperature - 0 inch 62F, 2 inches 57F and 4 inches 52F) and incorporated twice, immediately after application, with a roller harrow operating at 2.5 to 3 inches. Corn (var. Golden Harvest 2445) was seeded May 10 in a silt loam soil (52% sand, 34% silt and 14% clay) with 2.1% organic matter and pH 7.7 and preemergence treatments applied (air temperature 64F, relative humidity 100%, wind calm, sky cloudy and soil temperature - 0 inch 68F, 2 inches 60F and 4 inches 57F). Postemergence treatments were applied to 0.5- to 1-inch wild proso millet and 2-leaf corn May 30 (air temperature 60F, relative humidity 78%, wind NW at 5 mph, sky cloudy and soil temperature - 0 inch 65F, 2 inches 64F and 4 inches 58F) to 1.5- to 2-inch wild proso millet and 5-leaf corn June 5 (air temperature 77F, relative humidity 29%, wind NW at 7 mph, sky clear and soil temperature - 0 inch 95F, 2 inches 74F and 4 inches 66F or to 3- to 4-inch wild proso millet and 8-leaf corn June 20, 1989 (air temperature 78F, relative humidity 39%, wind S at 2 mph, sky cloudy and soil temperature - 0 inch 91F, 2 inches 82F and 4 inches 78F). Weed counts, crop stand counts and visual crop injury ratings were made June 30, visual weed control ratings July 13 and August 1 and silage yield determined August 31, 1989. Wild proso millet (PANMI) infestations were heavy (>12 plants/linear ft. of row) and uniform throughout the experimental area.

Corn was injured 8 to 85% and stand reduced 0 to 70% by postdirected herbicide applications. In addition, several complimentary preplant incorporated/postemergence herbicide treatments injured corn 3 to 20%. Wild proso millet control was excellent (>90%) with EPTC combinations with cyanazine plus pendimethalin, paraquat, paraquat plus cyanazine, or sethoxydim and good (>80%) with preplant incorporated combinations of metolachlor, AC-301448 and atrazine or EPTC combinations with DPX-V9360 and DPX-E9636. Silage yields related closely to weed control and/or crop injury. (Wyoming Agric. Exp. Sta., Laramie, WY 82071 SR 1611)

Wild proso millet control in corn with preplant incorporated, preemergence, postemergence or complimentary treatments.

Treatment[1]	Rate lb ai/A	Corn[2] Inj %	SR %	Silage T/A	PANMI control[3] June %	July %	August %
Preplant incorporated							
EPTC(+)	6.0	0	0	9.2	0	0	0
Metolachlor	3.0	0	0	20.1	65	55	53
Metolachlor+AC-301448+atrazine	2.0+0.15+0.75	0	0	21.2	70	77	88
Metolachlor+AC-301448+atrazine	2.0+0.2+1.0	3	0	21.2	82	85	90
Preemergence							
Metolachlor+AC-301448	2.0+0.2	3	0	21.1	75	73	78
AC-301448+atrazine	0.2+1.0	0	0	18.3	27	27	50
Metolachlor+atrazine	3.0+1.5	0	0	20.2	68	63	67
Metolachlor+AC-301448+atrazine	2.0+0.15+0.75	0	0	20.7	70	65	70
Metolachlor+AC-301448+atrazine	2.0+0.2+1.0	0	0	20.7	72	63	65
Preplant incorporated/2-leaf							
EPTC(+)/CGA-136872+s	4.0/0.036	13	0	10.9	48	50	32
EPTC(+)/DPX-V9360+s	4.0/0.063	13	0	20.3	92	88	88
EPTC(+)/DPX-E9636+s	4.0/0.016	10	0	20.3	92	86	86
EPTC(+)/cyanazine+ pendimethalin	4.0/1.0+1.5	7	0	21.4	97	96	98
EPTC(+)/pendimethalin	4.0/1.5	0	0	20.1	79	77	70
Preplant incorporated/5-leaf							
EPTC(+)/CGA-136872+s	4.0/0.036	0	0	18.8	76	68	67
EPTC(+)/DPX-V9360+s	4.0/0.063	3	0	21.1	91	87	83
EPTC(+)/DPX-E9636+s	4.0/0.016	3	0	21.1	89	85	87
EPTC(+)/cyanazine+ pendimethalin	4.0/1.0+1.5	20	0	21.2	94	93	93
Preplant incorporated/2- and 5-leaf							
EPTC(+)/CGA-136872+s/ CGA-136872+s	4.0/0.018/0.018	8	0	10.7	67	55	47
Preplant incorporated/postdirected							
EPTC(+)/paraquat+s	4.0/0.25	8	0	21.1	65	90	93
EPTC(+)/paraquat+s	4.0/0.38	17	10	17.5	68	90	95
EPTC(+)/paraquat+s	4.0/0.5	50	25	13.7	67	96	96
EPTC(+)/paraquat+cyanazine+s	4.0/0.38+0.5	55	40	13.0	67	99	99
EPTC(+)/sethoxydim+oc	4.0/0.2	85	70	5.1	67	93	98
Weedy check	---------------	0	0	8.5	0	0	0
Plants/ft. row 6-inch band		--	1.8	----	12.3	--	--

[1]Treatments applied April 25, May 10, May 30, June 5 and June 20, 1989; s = X-77 at 0.25% v/v, oc = At Plus 411F at 1 qt/A and EPTC(+) = EPTC with safener and extender.
[2]Crop stand counts (SR = stand reduction) and visual crop injury evaluated June 30 and silage yield determined August 31, 1989.
[3]Weed stand counts June 30 and visual weed control ratings July 13 and August 1, 1989.

Wild proso millet control in corn with postemergence herbicide treatments. Miller, S.D. and A. W. Dalrymple. Research plots were established near Cassa, Wyoming to evaluate the efficacy of postemergence herbicide treatments for wild proso millet control in corn. Plots were established under furrow irrigation and were 10 by 30 ft. with three replications arranged in a randomized complete block. Corn (var. Golden Harvest 2445) was seeded May 11, 1989 in a silt loam soil (52% sand, 34% silt and 14% clay) with 2.1% organic matter and pH 7.7. Herbicide treatments were applied broadcast with a CO_2-pressurized six nozzle knapsack sprayer delivering 20 gpa at 40 psi May 30 (air temperature 58F, relative humidity 72%, wind NW at 10 mph, sky cloudy and soil temperature - 0 inch 64F, 2 inches 62F and 4 inches 58F) to 0.5- to 1.0-inch wild proso millet and 2-leaf corn, or June 5, 1989 (air temperature 77F, relative humidity 24%, wind NW at 7 mph, sky clear and soil temperature - 0 inch 95F, 2 inches 74F and 4 inches 66F) to 1.5- to 2.0-inch wild proso millet and 5-leaf corn. Weed counts, crop stand counts and visual crop injury ratings were made June 30, visual weed control ratings July 13 and August 1, and silage yield determined August 31, 1989. Wild proso millet (PANMI) infestations were heavy (>15 plants/linear ft. of row) and uniform throughout the experimental area.

No treatment reduced corn stand; however, several treatments injured corn 3 to 13%. Wild proso millet control with DPX-V9360 was slightly better at the 5-leaf than at the 2-leaf stage and was influenced by additive. DM 710 was the least effective and oil concentrate plus aqueous nitrogen the most effective additive with DPX-V9360. Wild proso millet control was not adequate with CGA-136872 at either stage of application. DPX-E9636 at 0.016 lb/A provided similar wild proso millet control to DPX-V9360 at 0.063 lb/A. Silage yields related closely to wild proso millet control and were 3.2 to 14.1 T/A higher in herbicide-treated compared to weedy check plots. (Wyoming Agric. Exp. Sta., Laramie, WY 82071 SR 1612)

Wild proso millet control in corn with postemergence herbicide treatments.

Treatment[1]	Rate lb ai/A	Corn[2] Inj %	SR %	Silage T/A	PANMI control[3] June %	July %	August %
2-leaf							
DPX-V9360+X-77	0.032	0	0	21.1	68	60	63
DPX-V9360+oc+28%N	0.032	0	0	22.6	82	72	73
DPX-V9360+DM 710	0.032	0	0	19.6	68	58	53
DPX-E9636+X-77	0.016	0	0	23.0	90	85	82
DPX-V9360+X-77	0.047	0	0	21.1	75	63	67
DPX-V9360+oc+28%N	0.047	0	0	23.1	86	78	75
DPX-V9360+X-77	0.063	0	0	22.6	85	75	77
DPX-V9360+oc+28%N	0.063	0	0	23.5	89	80	78
Cyanazine+pendimethalin+ tridiphane	1.0+1.5+ 0.75	13	0	23.5	94	85	75
CGA-136872+X-77	0.036	3	0	13.2	22	13	15
5-leaf							
DPX-V9360+X-77	0.032	0	0	23.1	79	78	80
DPX-V9360+oc+28%N	0.032	5	0	22.6	90	80	80
DPX-V9360+DM 710	0.032	0	0	18.8	72	60	58
DPX-E9636+X-77	0.016	0	0	24.1	92	90	87
DPX-V9360+X-77	0.047	0	0	22.6	87	78	73
DPX-V9360+oc+28%N	0.047	0	0	24.1	92	85	87
DPX-V9360+X-77	0.063	3	0	23.9	92	88	80
DPX-V9360+oc+28%N	0.063	3	0	23.3	93	87	83
CGA-136872+X-77	0.036	3	0	17.3	60	43	47
Weedy check	-------	0	0	10.0	0	0	0
Plants/ft. row 6-inch band		--	1.7	----	15.2	--	--

[1]Treatments applied May 30 and June 5, 1989. X-77 and DM-710 applied at 0.25% v/v, oc = At Plus 411F at 1 qt/A and 28% N = 28% w/w N at 3 gpa.
[2]Crop stand counts (SR = stand reduction) and visual crop injury (Inj) evaluated June 30 and silage yield determined August 31, 1989.
[3]Weed stand counts June 30 and visual weed control ratings July 13 and August 1, 1989.

Evaluation of DPX-V9360 and other postemergence herbicides for wild proso millet control in field corn. Jenks, B.M. and J.O. Evans. Several postemergence herbicides were evaluated for wild proso millet (PANMI) control in field corn. All treatments were applied with a compressed air bicycle sprayer delivering 23 gpa at 40 psi. Plots were 10 by 30 feet arranged in a randomized complete block design. The plots at Jensen Farms had 4 replications and Fuhriman Farms had 3 replications.

None of the treatments caused any visual crop injury. DPX-V9360 treatments provided fair to excellent control. No other treatment was effective on wild proso millet. DPX-V9360 treatments increased yields significantly at Jensen Farms. Yield increases at Fuhriman Farms were lower than at Jensen Farms. The lower yield may be due to less weed competition. (Utah Agricultural Experiment Station, Logan, UT 84322-4820)

Table 1. Application data for PANMI control in field corn

	JENSEN FARMS	FUHRIMAN FARMS
Planting date	05-10-89	05-03-89
Application date	06-10-89	06-12-89
PANMI density (yd2)	190-1300	287
PANMI stage (leaf)	3	3
Corn stage (leaf)	4	5
Air Temp (F)	75	80
Soil Temp at 2 in. (F)	75	89
Relative humidity (%)	42	30
Wind (mph)	3	3
Soil type	Silty clay loam	Silty clay loam
pH	7.7	7.8
OM (%)	2.84	2.16

Table 2. PANMI control in field corn with DPX-V9360

TREATMENT[1]	RATE	JENSEN FARMS WEED CONTROL		JENSEN FARMS YIELD INCREASE	FUHRIMAN FARMS WEED CONTROL		FUHRIMAN FARMS YIELD INCREASE
	lb ai/A	%					
		6-21	7-25		6-21	7-31	
DPX-V9360	0.0156	82	64	200	78	74	27
DPX-V9360	0.0313	88	84	200	77	77	109
DPX-V9360	0.0625	90	94	229	83	92	76
tridiphane	0.75	5	0	0	3	13	48
tridiphane + cyanazine	0.75 1.25	34	20	4	25	27	55
tridiphane[2] + atrazine	0.75 1.25	15	14	42	17	32	33
pendimethalin + cyanazine	1.0 1.25	35	20	42	--	--	--
Control	----	0	0	0	0	0	0
LSD (0.05)		6	7	6	12	16	20
CV		9	13	29	17	20	22

1 X-77 added at 0.25% v/v to all DPX-V9360 rates and tridiphane alone.

2 COC added at 0.25% v/v.

Relative competitiveness of corn and redroot pigweed under conditions of water or nitrogen deficits. Ball, D.A., M.J. Shaffer, E.E. Schweizer, and P. Westra. A field study was conducted at Ft. Collins, CO during 1989 to evaluate the changes in competitiveness between corn (*Zea mays* L.) and redroot pigweed (*Amaranthus retroflexus* L., AMARE) under conditions of reduced irrigation or nitrogen fertilization inputs. An addition series competition study was employed to determine the relative contribution of intraspecies and interspecies competitive effects on community biomass distribution and grain yield of corn.

The addition series design consisted of three corn densities (0, 70,000 and 100,000 plants/ha) and three redroot pigweed densities (0, 450,000 and 850,000 plants/ha) grown in all possible plant density combinations with four replications. The addition series arrangement was repeated as three sub-treatments consisting of 1) a fully irrigated and N fertilized sub-treatment, 2) a sub-treatment with reduced irrigation but with N fertilization and 3) a sub-treatment which received full irrigation but no N fertilization. The fully irrigated plots (sub-treatments 1 and 3) were irrigated when the high density plant community (high consumptive water use plots) reached 50% moisture depletion in the root zone as monitored by a neutron moisture meter. The reduced irrigation plots (sub-treatment 2) received irrigation after the low density plots (low consumptive water use plots) reached 70% moisture depletion with the intention of inducing moisture stress. Plots receiving fertilization (sub-treatments 1 and 2) were supplied with 80 kg/ha of N fertilizer as urea (46-0-0) in the fall before to planting. Sub-treatment 3 received no N fertilizer before planting in order to produce an N nutrient deficit.

A comparison between fully irrigated and reduced irrigation plots (sub-treatments 1 and 2) indicated that total community biomass was lower in low irrigation plots except the CL/PL (see table) population combination. The distribution of total aboveground biomass tended to shift in favor of redroot pigweed only at the low population mixture density indicating that this species may gain a competitive advantage under reduced irrigation conditions at certain densities. A comparison between N fertilized and non-fertilized plots indicated that biomass tended to shift in favor of corn at both low and high densities making this species more competitive when N is deficient. Further statistical analysis is needed to fully separate the influence of population density, irrigation and N fertilization on biomass distribution. (USDA-ARS, Ft. Collins, CO 80526).

Distribution of mid-season aboveground biomass of corn and redroot pigweed as influenced by irrigation and nitrogen fertilization

Total aboveground dry weight (kg/ha)

Population*	N Fertilized						No N Fertilization		
	Low irrigation			Full irrigation			Full irrigation		
	Corn	AMARE	Total	Corn	AMARE	Total	Corn	AMARE	Total
CO/PO	0	0	0	0	0	0	0	0	0
CL/PO	15220	0	15220	17630	0	17630	15770	0	15770
CH/PO	15360	0	15360	19010	0	19010	20730	0	20730
CO/PL	0	9020	9020	0	13000	13000	0	10730	10730
CL/PL	11920	5680	17600	13500	3770	17270	14470	3050	17520
CH/PL	13910	1850	15760	16260	1920	18180	17290	2060	19350
CO/PH	0	7250	7250	0	10443	10440	0	8380	8380
CL/PH	8400	3690	12100	13780	6820	20600	11300	6250	17550
CH/PH	13230	3620	16850	14130	4400	18530	15980	3410	19390

Percent of total aboveground dry matter (%)

Population*	Fertilized						No N Fertilization		
	Low Irrigation			Full Irrigation			Full Irrigation		
	Corn	AMARE	Total	Corn	AMARE	Total	Corn	AMARE	Total
CO/PO	0	0	0	0	0	0	0	0	0
CL/PO	100	0	100	100	0	100	100	0	100
CH/PO	100	0	100	100	0	100	100	0	100
CO/PL	0	100	100	0	100	100	0	100	100
CL/PL	68	32	100	78	22	100	83	17	100
CH/PL	88	12	100	89	11	100	89	11	100
mean	78	22	100	84	16	100	86	14	100
CO/PH	0	100	100	0	100	100	0	100	100
CL/PH	69	31	100	67	33	100	64	36	100
CH/PH	78	22	100	76	24	100	82	18	100
mean	73	27	100	71	29	100	73	27	100

* CO - 0 plant/ha corn population density, CL - 70,000/ha corn population density, CH - 100,000/ha corn population density PO - 0/ha AMARE density, PL - 450,000/ha AMARE density, PH - 850,000/ha AMARE density.

Shattercane control in corn with several new corn herbicides. Westra, P., and T. D'Amato. Shattercane is spreading as a problem for Colorado corn growers. This research was conducted at Crook in silage corn to compare efficacy of a number of herbicide treatments.

The experiment was a randomized complete block design with three replications. Plots were 10 ft wide by 30 ft long. Carrier volume was 13 gal/a delivered at 20 psi through 11001LP flat fan nozzles. Herbicide applications were made at various growth stages ranging from preplant treatments applied in late April to postemergent treatments applied in mid-June.

DPX-V9360, DPX-79406 and KIH-2665 provided excellent post-applied control of shattercane with no visible injury to the corn (see table). A split application of CGA-136872 and dichlormid showed excellent shattercane control, while dichlormid alone was ineffective. Split applications using atrazine or cyanazine applied postemergent showed unacceptable damage to the corn.

(Weed Research Laboratory, Colorado State University, Ft. Collins, CO 80523)

Shattercane control in corn

Herbicide	Stage	Rate	Corn injury	Shattercane
	(shattercane leaf number)	(lb ai/a)	(% height reduction)	(% control)
Check			0	0
DPX-V9360[1]	2-6	0.03	5	100
DPX-79406[1]	2-6	0.03	2	100
KIH-2665[1]	2-6	0.05	0	100
EPTC + dichlormid	preplant	4.0	3	48
EPTC + dichlormid	preplant	4.0	2	98
CGA- 136872[1]	2-6	0.03		
EPTC + dietholate	preplant	4.0	20	97
tridiphane	1-2	0.75		
cyanazine	1-2	1.50		
tridiphane	1-2	0.75	60	97
cyanazine	1-2	1.50		
atrazine[2]	2-6	1.00		

1Surfactant activator 90 added at 0.25% v/v

2Crop oil concentrate added at 0.25% v/v

Weed control in field corn with complimentary preemergence/postemergence herbicides. Arnold, R.N., E.J. Gregory and M.W. Murray. Research plots were established at the Agricultural Science Center, Farmington, New Mexico to evaluate the efficacy of complementary preemergence/postemergence herbicide treatments for weed control in field corn (var. Super Crost 5460). Soil type was a Wall sandy loam with a pH of 7.8 and an organic matter content of less than 1%. Individual plots were 4, 34 in rows 30 ft long. Treatments were applied with a CO_2 backpack sprayer calibrated to deliver 30 gal/A at 25 psi. Field corn was planted on May 11, 1989. Preemergence surface treatments were applied May 16, 1989 and immediately incorporated with 0.75 in of sprinkler applied water. Postemergence treatments were applied June 5, 1989 when corn was in the 3 to 4 leaf stage and weeds were small. Redroot pigweed (AMARE), prostrate pigweed (AMABL), green foxtail (SETVI), and barnyardgrass (ECHCG) infestations were heavy to moderate and Russian thistle (SASKR) and field sandbur (CCHIN) infestations were light throughout the experimental area.

Visual evaluations of crop injury and weed control were made July 20, 1989. All treatments gave excellent control of annual grass and broadleaf weeds employed in this study. No crop injury was apparent in any of the treatments. (Agricultural Science Center, New Mexico State University, Farmington, N.M. 87499)

Weed control in field corn with complimentary preemergence/postemergence herbicides

Treatment[1]	Rate	Crop[2]	Weed Control[2]					
	lb ai/A	Injury	AMABL	AMARE	ECHCG	CCHIN	SASKR	SETVI
		%						
Preemergence/Postemergence								
cyanazine/atrazine + tridiphane	1.0/1.5 + 0.75	0	100	100	100	100	100	100
atrazine/atrazine + tridiphane	1.0/1.5 + 0.75	0	100	100	100	100	100	100
atrazine + tridiphane[3]	1.5 + 0.75	0	100	100	100	100	100	100
cyanazine/atrazine	1.0/1.5	0	100	100	100	100	100	100
atrazine/atrazine	1.0/1.5	0	100	100	100	100	100	100
atrazine[3]	1.5	0	100	100	100	100	100	87
atrazine/cyanazine + tridiphane	1.0/1.0 + 0.75	0	100	100	100	100	100	100
cyanazine + tridiphane[3]	1.0 + 0.75	0	100	100	100	100	100	100
hand weeded check		0	100	100	100	100	100	100
check		0	0	0	0	0	0	0
av weeds/m^2			9	20	8	4	3	10
LSD 0.05			ns	ns	ns	ns	ns	4.3

1. All postemergence treatments were applied with a COC at 0.25 v/v
2. Based on a visual scale from 0-100 where 0 = no control or crop injury and 100 = dead plants
3. Treatments were applied postemergence only

Evaluation of preemergence and complimentary preemergence/postemergence treatments in corn. Miller, S.D., A.W. Dalrymple and J.M. Krall. Plots were established at the Research and Extension Center, Torrington, Wyoming to evaluate the efficacy of preemergence or complimentary preemergence/postemergence treatments for weed control in corn. Plots were established under sprinkler irrigation and were 10 by 45 ft. with three replications arranged in a randomized complete block. Herbicide treatments were applied broadcast with a CO_2-pressurized six-nozzle knapsack sprayer delivering 20 gpa at 40 psi, except postdirected treatments applied at 40 gpa. Corn (var. Pioneer 3902) was seeded in a sandy loam soil (71% sand, 19% silt and 10% clay) with 1.4% organic matter and pH 7.6 April 26, 1989 and preemergence treatments applied (air temperature 65F, relative humidity 30%, wind SW at 5 mph, sky partly cloudy and soil temperature - 0 inch 89F, 2 inches 70F and 4 inches 60F). Postemergence treatments were applied to 1- to 2-inch weeds and 5-leaf corn May 31 (air temperature 65F, relative humidity 90%, wind calm, sky cloudy and soil temperature - 0 inch 66F, 2 inches 62F and 4 inches 60F), or to 4- to 6-inch weeds and 10-leaf corn June 16, 1989 (air temperature 63F, relative humidity 60%, wind NW at 3 mph, sky cloudy and soil temperature 0 inch 64F, 2 inches 61F and 4 inches 60F). Weed counts, crop stand counts and visual crop injury ratings were made June 30 and grain yield determined October 12, 1989. Redroot pigweed (AMARE) and common lambsquarters (CHEAL) infestations were moderate and common sunflower (HELAN), Russian thistle (SASKR), yellow foxtail (SETLU) and witchgrass (PANCA) infestations light but uniform throughout the experimental area.

No treatment reduced corn stand; however, corn was injured 4 to 20% by postdirected applications of paraquat. Broad-spectrum weed control was excellent ($\geq$90% control of all weed species) with preemergence or complimentary preemergence/postemergence herbicide combinations. Corn yields reflected weed control and were 48 to 79 bu/A higher in herbicide-treated compared to weedy check plots. (Wyoming Agric. Exp. Sta., Laramie, WY 82071 SR 1610)

Evaluation of preemergence and complimentary preemergence/postemergence treatments in corn.

Treatment[1]	Rate lb ai/A	Corn[2] Inj %	SR %	Yield bu/A	Weed control[3] AMARE %	CHEAL %	HELAN %	SASKR %	SETLU %	PANCA %
Preemergence										
Alachlor	2.5	0	0	140	90	73	0	78	98	97
Alachlor (WDG)	2.5	0	0	143	92	73	0	77	99	98
Alachlor (MT)	2.5	0	0	146	93	75	0	73	100	100
Cyanazine	2.0	0	0	157	77	95	90	97	98	97
Metolachlor	2.5	0	0	148	90	72	0	63	100	100
Alachlor+cyanazine	2.0+2.0	0	0	160	100	100	100	100	100	100
Metolachlor+cyanazine	2.0+2.0	0	0	165	100	100	100	97	100	100
Alachlor+atrazine	3.0	0	0	162	100	100	100	100	100	100
ICIA-5676+cyanazine	1.25+2.0	0	0	171	100	100	100	100	100	100
ICIA-5676+cyanazine	1.5+2.0	2	0	168	100	100	100	100	100	100
ICIA-5676+cyanazine	1.75+2.0	3	0	163	100	100	100	100	100	100
Preemergence/postemergence										
Metolachlor/bentazon+atrazine+oc	2.0/1.04	0	0	162	100	100	100	100	100	100
Metolachlor/bentazon+atrazine+Dash	2.0/1.04	0	0	160	100	100	100	100	100	100
Metolachlor/bentazon+atrazine+oc	2.0/1.45	3	0	162	100	97	100	98	100	100
Metolachlor/bentazon+atrazine+Dash	2.0/1.45	0	0	160	100	100	100	100	100	100
Metolachlor/bentazon+atrazine+dicamba+Dash	2.0/1.04+0.25	0	0	168	100	100	100	100	100	100
Alachlor/bromoxynil	2.0/0.25	0	0	168	100	100	100	100	100	100
Alachlor/bromoxynil	2.0/0.38	0	0	160	100	100	100	100	100	100
Alachlor/bromoxynil+dicamba	2.0/0.25+0.125	0	0	160	100	98	100	100	100	100
Alachlor/pyridate	2.0/0.45	0	0	165	97	90	93	100	100	100
Alachlor/pyridate	2.0/0.9	0	0	162	100	98	100	97	100	100
Preemergence/postdirected										
Metolachlor/paraquat+X-77 (3 in.)	2.0/0.25	4	0	162	100	90	93	97	100	100
Metolachlor/paraquat+X-77 (3 in.)	2.0/0.5	10	0	165	100	100	100	100	100	100
Metolachlor/paraquat+X-77 (1/3 plant)	2.0/0.25	6	0	168	100	95	100	100	100	100
Metolachlor/paraquat+X-77 (1/3 plant)	2.0/0.5	20	0	154	100	100	100	100	100	100
Weedy check	--------------	0	0	92	0	0	0	0	0	0
Plants/ft. row 6-inch band		--	1.4	---	1.2	1.0	0.4	0.4	0.6	0.4

[1]Treatments applied April 26, May 31 and June 16, 1989; oc (At Plus 411F) applied at 1 qt/A and Dash at 1 pt/A.
[2]Crop stand counts (SR = stand reduction) and visual crop injury evaluated June 30 and plots harvested October 12, 1989.
[3]Weed stand counts evaluated June 30, 1989.

Postemergence weed control in irrigated seed corn. Wright, S. D., and W. J. Steele. Several herbicides were evaluated for grass and broadleaf weed control when applied postemergence to corn.

The experiment was a randomized complete block design with four replications. Plots were 6.6 feet wide by 30 feet long. Carrier volume was 20 gpa delivered at 27 psi through 8002 flat fan nozzles. Herbicides were applied on August 18, 1988, to seed corn that was 4 to 10 inches tall. Barnyardgrass up to 4 inches in diameter and 4 inches tall had 4 to 8 leaves. Annual morningglory was 2 to 5 inches tall and 3 to 5 inches in diameter. There was also a moderate population of purple nutsedge.

Visual observations were conducted on September 1, 23, and October 10, 1988. Primisulfuron gave good control of barnyardgrass for several weeks. At 8 weeks after application a new flush of seedling barnyardgrass emerged. Primisulfuron also gave good control of annual morningglory and purple nutsedge. The combination of cyanazine plus primisulfuron gave slightly less control of barnyardgrass and purple nutsedge. Cyanazine and dicamba combination gave good control of annual morningglory. Control of weeds with bromoxynil was inferior. None of the treatments caused visible injury to the corn. (University of California Cooperative Extension, Visalia, CA 93291; E. I. Dupont de Nemours, Fresno, CA 93704)

Weed control in corn at Tipton, California

		% Control								
Treatment	Rate ai/A	Barnyardgrass			Purple Nutsedge			Tall Morningglory		
		9/1	9/23	10/10	9/1	9/23	10/10	9/1	9/23	10/10
primisulfuron	0.5 oz.	80	90	80	53	78	85	78	80	77
primisulfuron	1.0 oz.	88	93	78	55	80	90	88	88	83
cyanazine + dicamba	1.6 + .25	0	13	15	8	0	18	58	73	87
bromoxynil	.25	5	0	0	0	0	0	18	38	33
cyanazine + primisulfuron	1.6 + 1.0	70	63	50	55	60	53	95	93	85
dicamba	.25	0	0	18	23	0	0	75	75	58
check	--	0	0	0	0	0	0	0	0	0

Evaluation of postemergence herbicide treatments in corn. Miller, S.D. and A.W. Dalrymple. Herbicide treatments were applied postemergence at the Research and Extension Center, Torrington, Wyoming to evaluate weed control and corn tolerance. Plots were established under sprinkler irrigation and were 10 by 45 ft. with three replications arranged in a randomized complete block. Corn (var. Pioneer 3902) was seeded in a sandy loam soil (71% sand, 19% silt and 10% clay) with 1.4% organic matter and pH 7.6 April 26, 1989. Herbicide treatments were applied broadcast with a CO_2-pressurized six-nozzle knapsack sprayer delivering 20 gpa at 40 psi May 31 (air temperature 67F, relative humidity 90%, wind calm, sky cloudy, soil temperature - 0 inch 70F, 2 inches 64F and 4 inches 62F) to 4-leaf corn and 0.5- to 1.5-inch weeds, or June 6, 1989 (air temperature 80F, relative humidity 35%, wind N at 3 mph, sky partly cloudy and soil temperature - 0 inch 114F, 2 inches 76F and 4 inches 70F) to 6-leaf corn and 2- to 3-inch weeds. Weed counts, crop stand counts and visual crop injury ratings were made June 21 and silage yield determined August 24, 1989. Redroot pigweed (AMARE) and common lambsquarters (CHEAL) infestations were moderate and Russian thistle (SASKR), yellow foxtail (SETLU) and witchgrass (PANCA) infestations light but uniform throughout the experimental area.

No treatment reduced corn stand; however, treatments containing cyanazine injured corn 5 to 10% and 4-leaf CGA-136872 treatments at 0.036 lb/A injured corn 3 to 8%. Broad spectrum weed control was good (>90% control of all weed species) with cyanazine plus pendimethalin, bromoxynil combinations with cyanazine or DPX-V9360, dicamba-atrazine combinations with pendimethalin, cyanazine or DPX-V9360 and dicamba combinations with DPX-V9360. Grass control was better with DPX-E9636 or DPX-V9360 than with CGA-136872 at both application times. Silage yields were 6.5 to 9.2 T/A higher in herbicide-treated compared to weedy check plots. (Wyoming Agric. Exp. Sta., Laramie, WY SR 1609)

Weed control in corn with postemergence herbicide treatments.

Treatment[1]	Rate lb ai/A	Corn[2] Inj %	SR %	Silage T/A	Weed control[3] AMARE %	CHEAL %	SASKR %	SETLU %	PANCA %
4-leaf									
DPX-E9636+s	0.016	0	0	20.8	98	82	35	98	100
DPX-V9360+s	0.047	0	0	19.9	97	57	17	98	98
DPX-V9360+s	0.063	0	0	20.9	97	65	10	99	100
CGA-136872+s	0.018	0	0	20.1	97	78	40	70	85
CGA-136872+s	0.036	7	0	19.7	100	78	45	85	92
Cyanazine (cyan) + pendimethalin (pend)	1.0+1.5	10	0	21.9	99	100	100	100	100
Bromoxynil+atrazine (atra)	0.75	0	0	20.8	100	100	100	67	27
Bromoxynil+cyan	0.25+1.0	5	0	21.5	100	100	100	100	100
Bromoxynil+ DPX-V9360+s	0.25+0.047	0	0	21.3	100	100	100	96	100
Bromoxynil+ CGA-136872+s	0.25+0.036	0	0	20.4	100	100	100	40	70
Dicamba+atra	1.0	0	0	21.7	100	100	100	63	23
Dicamba+atra+pend	1.0+1.0	0	0	20.1	100	100	99	98	100
Dicamba+atra+cyan	1.0+1.0	5	0	22.1	100	100	99	97	100
Dicamba+atra+ DPX-V9360+s	1.0+0.047	0	0	21.4	100	100	100	100	100
Dicamba+atra+ CGA-136872+s	1.0+0.036	3	0	21.6	100	100	100	88	94
Dicamba+DPX-V9360+s	0.375+0.047	0	0	22.7	100	100	100	93	98
Dicamba+CGA-136872+s	0.375+0.036	8	0	21.2	100	100	100	83	97
6-leaf									
DPX-E9636+s	0.016	0	0	22.4	97	72	27	87	93
DPX-V9360+s	0.047	0	0	21.0	88	40	0	80	92
DPX-V9360+s	0.063	0	0	20.3	93	43	17	85	93
CGA-136872+s	0.018	0	0	20.7	95	67	40	60	78
CGA-136872+s	0.036	0	0	20.8	98	75	53	67	87
Weedy check	-----------	0	0	13.2	0	0	0	0	0
Plants/ft row 6-inch band		--	1.7	----	1.2	1.0	0.4	0.6	0.4

[1]Treatments applied May 31 and June 6, 1989; s = X-77 at 0.25% v/v.
[2]Corn stand counts (SR = stand reduction) and visual injury evaluated June 21 and silage yield determined August 24, 1989.
[3]Weed stand counts June 21, 1989.

Reduced tillage planting of silage corn into an established alfalfa stand. Kempen, H.M., D. Munier and M.P. Gonzalez. After removing two alfalfa cuttings on third year alfalfa, the irrigation 5 days after the second cutting was followed by herbicide applications to the regrowth. Treatments on May 31, 1989 included glyphosate at different rates, glyphosate plus metolachlor or dicamba. Planting on June 1, 1989 was done behind a 20 inch flat sweep which cut off alfalfa crowns in the drill row. After corn emerged, cultivation with flat sweeps in the middles removed alfalfa before recovery from these sprays. Weeds present were crabgrass (DIGSA), purple nutsedge (CYPRO), and bermudagrass (CYNDA).

Results showed glyphosate at 0.75 lb ai/a plus surfactant was effective in stopping alfalfa. Also application immediately after irrigation was as good as delaying to just before corn emergence on June 5,1989. Adding a residual herbicide, metolachlor, did not seem necessary, since a dust mulch developed by planting. (No rains occur at this time in the San Joaquin Valley). Dicamba was very effective on alfalfa, but failure to control crabgrass and bermudagrass caused moderate moisture competition and the corn was retarded. No herbicides caused symptoms in the corn. (Univ. of Calif. Coop. Ext., Bakersfield, CA 93307.)

Table 1. Field and application data

CROP:	Corn, silage	APPLICATION DATE:	5-31-89
LOCATION:	Bakersfield, CA	APPLICATION METHOD:	CO_2 backpack
PLANTING DATE:	6-1-89	VOLUME / PSI:	20 gpa @ 15 psi
ROW SPACING:	38 in.	SOIL TYPE:	silt loam
PLOT SIZE:	8.3 ft. by 15 ft.	O.M.:	0.5%
PLOT DESIGN:	K2XRCB, 3 reps	IRRIGATION METHOD:	Border
CONDITIONS:	75°F, light NW wind, dry surface, moist root zone		

Table 2. Alfalfa control and percent grassy weeds[1] in no-till corn plantings

TREATMENT	1X RATE (lb ai/a)	ALFALFA CONTROL (0=NO INJURY TO 10=KILL) JUNE 14, 1988 1X RATE	2X RATE[2]	PERCENT GRASS JUNE 23, 1989 1X RATE	2X RATE[2]
Control	- -	0.0	0.0	56.7%	40.0%
Glyphosate [3]	0.75	8.0	8.0	3.7%	3.0%
Glyphosate [3]	3.00	8.3	8.3	1.7%	0.3%
Glyphosate (applied 6-5-89) [3]	0.75	6.3	7.0	1.0%	0.0%
Glyphosate + metolachlor [3]	0.75 +2.00	7.3	7.5	0.7%	2.7%
Dicamba [3]	0.25	8.2	9.0	63.3%	50.0%
LSD 0.05		1.2		15.9%	

[1] Grassy weeds include bermudagrass and crabgrass.
[2] All 2X treatments were double-sprayed, like an overlap [K2X].
[3] All herbicides were mixed with non-ionic surfactant at 0.25%.

Weed control in no-till corn. Miller, S.D. and J.M. Krall. Several soil-persistent herbicide treatments were applied at the Research and Extension Center, Torrington, Wyoming 25 and 0 days prior to corn planting to assess weed control and crop tolerance. Plots were established under sprinkler irrigation and were 10 by 45 ft. with three replications arranged in a randomized complete block. Herbicide treatments were applied broadcast with a CO_2-pressurized six-nozzle knapsack sprayer delivering 20 gpa at 40 psi April 5 (air temperature 64F, relative humidity 35%, wind calm, sky cloudy and soil temperature - 0 inch 76F, 2 inches 49F and 4 inches 42F) and May 1, 1989 (air temperature 65F, relative humidity 30%, wind SW at 10 mph, sky partly cloudy and soil temperature - 0 inch 88F, 2 inches 70F and 4 inches 60F). Corn (var. Pioneer 3902) was seeded on May 1, immediately prior to herbicide applications at planting, in a sandy loam soil (71% sand, 19% silt and 10% clay) with 1.4% organic matter and pH 7.6. Weed counts, crop stand counts and visual crop injury ratings were made June 7 and silage yield determined August 24, 1989. Russian thistle (SASKR) and yellow foxtail (SETLU) infestations were moderate and kochia (KCHSC), redroot pigweed (AMARE), hairy nightshade (SOLSA) and common lambsquarters (CHEAL) infestations light but uniform throughout the experimental area.

No corn injury or stand reduction was observed with any treatment. Treatments applied 25 days prior to corn planting were equally as effective as those applied at planting. Kochia control was not adequate with any treatment. Silage yields were 5.9 to 8.5 T/A higher in herbicide-treated compared to weedy check plots. (Wyoming Agric. Exp. Sta., Laramie, WY 82071 SR 1608)

Weed control in no-till corn with herbicide treatments applied early preplant or at planting.

Treatment[1]	Rate lb ai/A	Corn[2] Inj %	SR %	Silage T/A	Weed control[3] KCHSC %	AMARE %	SOLSA %	SASKR %	CHEAL %	SETLU %
Early preplant										
Metolachlor+atrazine	1.5+1.2	0	0	18.4	50	100	100	100	100	100
Cyanazine+atrazine	2.0+1.0	0	0	17.4	0	100	89	100	100	78
Pendimethalin+atrazine	1.5+1.5	0	0	17.3	0	100	100	100	100	100
Alachlor+atrazine	2.5+1.5	0	0	17.3	40	100	100	100	84	86
Alachlor+cyanazine	2.0+2.0	0	0	17.1	0	54	89	92	100	91
Metolachlor+cyanazine	2.0+2.0	0	0	17.4	40	100	100	88	100	86
Cyanazine	3.0	0	0	16.7	40	54	72	92	100	55
At planting										
Paraquat+metolachlor+atrazine	0.75+1.2+1.0	0		18.3	65	100	100	100	100	100
Paraquat+cyanazine+atrazine	0.75+1.4+0.7	0	0	19.3	50	100	89	100	100	86
Paraquat+pendimethalin+atrazine	0.75+1.0+1.0	0	0	17.7	65	100	100	100	100	86
Paraquat+alachlor+atrazine	0.75+2.0+1.0	0	0	17.0	65	100	89	100	100	100
Paraquat+alachlor+cyanazine	0.75+1.5+1.5	0	0	16.9	65	67	100	100	84	100
Paraquat+metolachlor+cyanazine	0.75+1.5+1.5	0	0	16.7	35	100	89	100	84	91
Paraquat+cyanazine	0.75+2.0	0	0	16.7	60	53	100	100	84	78
Weedy check	------------	-	0	10.8	0	0	0	0	0	0
Plants/ft row 6-inch band		-	1.7	----	0.4	0.3	0.4	1.2	0.3	1.2

[1]Treatments applied April 5 and May 1, 1989; X-77 included with all paraquat treatments at 0.25% v/v.
[2]Corn stand counts (SR = stand reduction) and visual injury evaluated June 7 and silage yield determined August 24, 1989.
[3]Weed stand counts June 7, 1989.

Evaluation of herbicide treatments in field corn. Mitich, L.W., and N.L. Smith. Nine herbicides were applied in 16 treatments in field corn, variety "Payco SX900", for evaluation of weed control and crop tolerance. Applications included both preplant incorporated treatments and early postemergence treatments. The experimental herbicide DPX-E9636 was evaluated, and the experimental grass herbicide primisulfuron was evaluated extensively in early postemergence, late postemergence, split, and uncultivated treatments.

Treatments were applied in 10 ft (four 30-inch rows) by 20 ft plots in four randomized complete blocks; treatments were made with a CO_2 backpack sprayer delivering 20 gal/a. Preplant incorporated treatments were applied 8 May 1989 and incorporated 9 May with a Marvin Row Master set to 2 inches. Corn was planted 15 May.

Early postemergence treatments were applied 12 June, when corn had 3 to 4 leaves and weeds were 1 to 3 inches tall. Three primisulfuron treatments were applied late postemergence - 19 June - when corn had 5 to 7 leaves. Two of these treatments were part of an early/late split. Weeds present included barnyardgrass (ECHCG), purslane (POROL), redroot pigweed (AMARE), and nightshade and groundcherry species (SOLsp).

Corn was cultivated 14 June and then fertilized with 200 lb nitrogen (in urea).

Visual evaluations for crop tolerance and weed control were made 11 July. Early applications of primisulfuron and cyanazine significantly reduced crop vigor. Primisulfuron effectively controlled broadleaf weeds when applied early postemergence. DPX-E9636 controlled barnyardgrass and redroot pigweed. Other crop tolerance and weed control data are included in the following table.

Corn was harvested 30 October. High winds during the preceding week caused many of the stalks to lodge, making some of the yields imprecise; no significant differences were found among the yields. (Department of Botany, University of California, Davis, CA 95616)

Evaluation of herbicide treatments in field corn

Treatment	Rate (lb ai/a)	Cultivated 14 June	Crop vigor[1] (percent)	Percent weed control[1] ECHCG	POROL	AMARE	SOLsp	Yield (lb/plot)
Preplant incorporated								
metolachlor	2.5	yes	100	95	50	78	53	8.84
metolachlor (DUAL II)	2.5	yes	100	80	35	48	38	7.04
alachlor	2.5	yes	100	75	78	93	30	7.84
metolachlor + cyanazine	2.0 + 1.5	yes	100	100	100	95	100	7.99
Early postemergence (3 to 4 leaf stage of crop)								
primisulfuron + 0.25% X-77	0.018	yes	78	13	88	88	83	6.23
primisulfuron + 0.25% X-77	0.036	yes	78	30	98	100	100	6.27
primisulfuron + 0.25% X-77	0.036	no	78	30	75	80	100	7.70
DPX-E9636 + 0.25% X-77	0.031	yes	93	93	38	85	38	6.08
DPX-E9636 + 0.25% X-77	0.047	yes	90	100	53	98	40	7.53
tridiphane + cyanazine	0.75 + 1.0	yes	93	25	100	100	90	8.02
2,4-D amine	1.0	yes	98	40	88	100	100	8.07
dicamba	0.25	yes	80	5	100	100	100	6.01
cyanazine + oil	1.0 + 1.0 qt	yes	75	33	83	48	83	6.43
Late postemergence (5 to 7 leaf stage of crop) and split treatment								
primisulfuron + 0.25% X-77	0.036	no	80	13	30	60	55	7.22
primisulfuron + 0.25% X-77 (split early and late, both treatments broadcast)	0.018 + 0.018	no	98	48	98	100	98	6.95
primisulfuron + 0.25% X-77 (split early and late, early treatment broadcast, late treatment directed)	0.018 + 0.018	no	80	30	68	100	85	6.70
control	---	yes	98	23	10	23	13	8.19

All values based on average of four replications.

[1]Visual evaluations made 11 July 1989.

Least significant differences (alpha 0.05)

Crop vigor: 18.48%
ECHCG control: 35.20%
POROL control: 43.42%
AMARE control: 35.11%
SOLsp control: 43.65%
Yield: no significant differences

Evaluation of preemergence and postemergence herbicides for use in cowpea. Cudney, D.W., A.N. Eckard, C.A. Frate, and H.M. Kempen. Weed management in cowpea is made difficult by such problem weeds as black nightshade and nutsedge spp. A new herbicide, imazethapyr, has shown activity on these weeds in previous tests when used at elevated rates. These elevated rates may pose a problem to susceptible crops which would follow cowpea in the crop rotation. The following trials were established to investigate the weed control potential and cowpea phytotoxicity of imazethapyr under lower use rates where potential residual activity to following crops would be reduced. The addition of pendimethalin and trifularlin to imazethapyr was also explored to broaden the weed contgrol spectrum. Two trials were established at the University of California, Riverside Experiment Station: a trial to compare the efficacy of incorporation methods (mechanical incorporation prior to planting vs preemergence application followed by heavy furrow irrigation) and a trial to compare preplant and postemergence applications. Two trials were established in Tulare County: a preplant and a postemergence evaluation of black nightshade control. One test was conducted in Kern County to evaluate imazethapyr for its potential in controlling yellow nutsedge as a postemergence application. All treatments were applied with a constant pressure CO^2 backpack plot sprayer. Each treatment was replicated four times.

Table 1 shows the results of the comparison of furrow irrigation and mechanical incorporation as preemergence and preplant treatments. None of the treatments of trifularlin, pendimethalin, imazethapyr, and combinations of trifluralin or pendimethalin plus imazethapyr injured the cowpeas. Furrow irrigation incorporation was superior to mechanical incorporation when pendimethalin was included. There was little difference in control for incorporation methods with imazethapyr. Imazethapyr at the rate tested (0.048 lbs ai/A) did not control pigweed or lambsquarter.

Table 2 shows the results of the comparison between preplant and postemergence applications at Riverside. No weeds were present in the trial area to offer a chance for weed control evaluations. All combinations containing either trifluralin or pendimethalin as a preplant application caused initial stunting of the cowpeas; however, the intial stunting could not be observed at the second evaluation one month later. Postemergence applications of imazethapyr or imazethapyr plus pendimethalin did not cause significant cowpea pytotoxicity. There was a slight delay in maturation and a lower test weight for the highest rates of imazethapyr and imazethapyr plus pendimethalin applied as postemergence applications.

The results of a preemergence trial in Tulare County in table 3 showed a slight reduction in vigor for the initial ratings for the highest rate of imazethapyr; however, the cowpeas soon recovered and three weeks later no difference in vigor was evident for any of the treatments. None of the treatments controlled crabgrass, yellow nutsedge, or the selection of broadleaved weeds present (mainly chickweed) in the plot area.

Table 4 shows the results of the postemergence applications in Tulare County. None of the treatments caused observable pytotoxicity to the cowpeas. Control of black nightshade was variable with a trend toward control at the highest rate of application in early evaluations and a reduction in black nightshade height particularly at the highest rate of application.

The results of the postemergence trial in Kern County are recorded in Table 5. There was some initial pytotoxicity to cowpea which the plants soon outgrew. The yellow nutsedge was temporarily stunted but it also recovered.

The overall results of these trials were disappointing for weed control. It is evident that when used at the lower rates to avoid soil residual activity in sensitive rotational crops, weed control efficacy may be compromised. Black nightshade was found in only one of the trials and some stunting and initial control was noted; further study may be justified with this problem weed. It is evident that yellow nutsedge will not be controlled by imazethapyr at the rates tested. There was some initial cowpea pytotoxicity in most cases from the use of imazethapyr, but the cowpeas recovered quickly and yield was unaffected. (University of California, Botany & Plant Sciences Department, Riverside CA 92521.)

Table 1. Herbicide Incorporation[1] Trial at Riverside, California

Treatment	Incorporation Method[2]	Rate #ai/A	Control[3] pigweed 9/5/89	Control[3] lambsquarters 9/5/89
Hand Weeded			3.50	2.50
trifluralin	W	0.75	4.75	2.25
imazethapyr	W	0.48	4.00	3.00
pendimethalin	W	0.75	8.75	9.50
trifluralin	M	0.75	7.50	6.50
imazethapyr	M	0.048	5.25	3.75
pendimethalin	M	0.75	5.50	5.00
trifluralin+ imazethapyr	W	0.75+0.048	5.25	5.50
pendimethalin+ imazethapyr	W	0.75+0.048	9.00	8.25
trifluralin+ imazethapyr	M	0.75+0.048	9.00	9.00
pendimethalin+ imazethapyr	M	0.75+0.048	7.75	8.25
Check			2.00	3.25
LSD 0.05			1.45***	1.94***

[1]herbicide applications made 7/19/89
[2]W = incorporation by furrow irrigation
M = mechanical incorporation by Lilliston prior to irrigation
[3]0 = no control; 10 = 100% control

Table 2. Preplant[1] and postemergence[2] at Riverside, California

Treatment		Rate #ai/A	Phytoxicity[3] 6/27/89	Phytoxicity[3] 7/27/89	Delayed[4] Maturation 9/5/89	Yield[5] 10/4/89	Test[6] Wt.
Hand Weeded			0.50	0.00	6.50	1910	26.6
trifluralin	preplant	0.75	3.00	0.00	7.00	1951	25.1
imazethapyr	preplant	0.125	2.50	0.00	6.50	1718	25.2
imazethapyr	preplant	0.063	3.50	0.00	7.00	1800	25.7
imazethapyr	preplant	0.048	3.25	0.00	6.50	2058	25.7
trifluralin+ imazethapyr	postemergent	0.75+0.125	3.00	1.75	4.25	1639	24.5
trifluralin+ imazethapyr	postemergent	0.75+0.063	3.75	1.50	6.00	1799	24.4
trifluralin+ imazethapyr	postemergent	0.75+0.048	2.25	1.00	5.75	1897	25.1
imazethapyr	postemergent	0.125	0.25	0.75	5.25	1860	24.7
imazethapyr	postemergent	0.063	0.00	1.50	6.25	1835	25.3
imazethapyr	postemergent	0.048	0.25	0.50	6.75	1856	25.8
imazethapyr	postemergent	0.125	0.75	2.00	3.75	1462	23.4
imazethapyr	postemergent	0.063	0.75	0.50	5.50	1969	25.5
imazethapyr	postemergent	0.048	0.00	1.25	5.75	1710	24.8
Check			0.75	0.50	7.00	1767	25.5
LSD 0.05			0.812***	0.881***	0.772**	N.S.	1.4

[1]Preplant treatments made 6/23/89
[2]Postemergence treatments made 7/24/89
[3]0 = no effect; 10 = total necrosis; greater than 3 = not acceptable
[4]0 = green pods; 10 = all pods mature
[5]Kg/Ha at 10% moisture content
[6]weight in grams of 100 seeds at 10% moisture

Table 3. Cowpea preplant incorporated[1] trial at Farmersville, California

Treatment	Rate lbs ai/A	Cowpea Vigor 8/2/89	Cowpea Vigor 8/25/89	Crab-grass Control 9/6/89	Nut-Sedge 9/6/89	Chick-weed 9/6/89
imazethapyr	0.032	9.0	9.25	8.38	9.0	5.75
imazethapyr	0.047	8.75	9.0	6.62	8.0	6.0
imazethapyr	0.067	8.00	8.8	8.25	8.5	6.25
pendimethalin	0.75	7.75	8.0	9.38	7.5	6.25
imazethapyr + pendimethalin	(0.047)+0.75	9.00	9.0	8.75	8.0	7.25
Check		9.50	9.0	6.88	8.5	6.25
LSD 0.05		1.14	N.S.	N.S.	N.S.	N.S.

[1]all treatments incorporated 4" with a Tandom disk on 6/28/89 preplant.

Table 4. Cowpea postemergence[1] trial at Porterville, California

Treatment	Rate #ai/A	#Night-shade Seedlings per ft of row 7/14/89	#Night-shade Seedlings per ft of row 7/21/89	#Night-shade Seedlings per ft of row 8/4/89	#Night shade Seedlings per ft of row 8/24/89	Avg. Ht. (in.) of 5 Night Shades 9/4/89
imazethapyr	0.032	2.5	1.4	1.1	0.8	3.58
imazethapyr	0.047	1.8	1.3	1.0	0.9	3.30
imazethapyr	0.067	2.3	0.7	1.2	0.3	1.62
imazethapyr + pendimuralin	0.032	2.9	0.7	1.3	0.6	3.02
imazethapyr + pendimuralin	0.047	1.4	0.7	0.6	0.4	1.8
imazethapyr + pendimuralin	0.067	1.25	0.3	0.5	0.2	1.8
Check	--	4.3	2.5	1.4	0.6	5.5
LSD 0.05		N.S.	1.4	N.S.	N.S.	1.8

[1]postemergence treatments applied 6/28/89.

Table 5. Cowpea postemergence[1] herbicide trial Kern County, California

Treatment	Rate #ai/A	Phytoxicity[2]	Yellow Nutsedge Control[2] 5/30/89
imazethapyr	0.032	1.75	1.00
imazethapyr	0.064	2.50	2.00
imazethapyr	0.047	2.75	2.00
imazethapyr	0.084	2.75	3.00
pendimethalin	0.67	0.50	0.25
pendimethalin	1.34	0.25	0.25
imazethapyr	0.047 + 0.67	1.75	1.25
imazethapyr	0.094 + 1.34	1.75	2.75
imazethapyr + X-77 @ 1/4	0.047 + 0.67	2.50	2.50
imazethapyr + X-77 @ 1/4	0.094 + 1.34	2.50	3.00
Check		0.00	0.00
LSD 0.05		0.81	0.92

[1]postemergence application made 6/28/89.
[2]0 = no effect; 10 = all plants dead.

Post-emergence control of ivyleaf morningglory in cotton with two herbicide applications. Kempen, H.M. and M.P. Gonzalez. We attempted to use MSMA applied over-the-top (OT) to retard morningglory (IPOHE) until cotton growth would permit a directed spray of more MSMA as well as MSMA mixtures with other registered herbicides. The field had been treated with prometryn, but control was not achieved.

MSMA alone at 1.5 or 3.0 lb ai/a OT , followed by a second directed spray was safe enough but inadequate. When these rates were followed by directed sprays, control was improved but with considerable cotton injury. Better precision than these hand-applied directed sprays would reduce injury, but might not be acceptable to most growers. Control must be 100%. (Univ. of Calif. Coop. Ext., Bakersfield, CA 93307.)

Table 1. Field and application data

CROP:	Cotton	APPLICATION DATE:	5-24-89 (OT)
LOCATION:	Maricopa, CA		6- 8-89 (Directed)
CROP STAGE:	(OT) 3 in., 2nd true leaf,	(Directed)2-8 in., 8 nodes	
VOLUME / PSI:	35 gpa @ 26 psi	APPLICATION METHOD:	CO_2 backpack
ROW SPACING:	38 in.	SOIL TYPE:	heavy silt loam
PLOT SIZE:	15 ft. by 38 in.	O.M.:	1.0%
PLOT DESIGN:	K2XRCB, 3 reps	IRRIGATION METHOD:	solid set sprinklers
CONDITIONS:	75-80°F, dry surface, moist root zone		
WEED SPECIES:	ivyleaf morningglory - seedlings to early bloom		

Table 2. Cotton injury and morningglory control on June 23,1989 (0=no injury, 10=kill)

TREATMENT OVER-THE-TOP 5/24/89	1X RATE (lb ai/a)	DIRECTED 6/8/89	1X RATE (lb ai/a)	COTTON INJURY 1X	2X†	MORNINGGLORY CONTROL 1X	2X†
Control, weedy				0.0	-	0.0	-
Control, weeded				0.0	-	10.0	-
MSMA	1.5	MSMA	1.5	2.2	2.8	5.8	6.5
MSMA + fluazifop-P	3.0 + 0.12	MSMA	3.0	2.8	2.2	5.0	6.8
MSMA + clethodim	4.0 + 0.25	MSMA + oxyfluorfen	4.0 + 0.25	6.5	7.0	9.8	10.0
MSMA + sethoxydim	4.0 + 0.75	MSMA + prometryn	4.0 + 0.75	4.5	5.5	8.8	9.8
Fluometuron + surfactant @1/4	4.0	No further treatment		1.0	3.2	0.7	4.5
		LSD 0.05		1.95		1.78	

† All 2X treatments were double-sprayed, like an overlap (K2X).

Evaluating directed sprays for control of ivyleaf morningglory (IPOHE) in 2 to 8 inch cotton. Kempen, H.M. and M.P. Gonzalez. Doubling label rates of MSMA alone or with mixtures were tested in hand-held spray plots. Cotton size was 2 to 8 inches, due to cultural or other reasons. The field had been treated with prometryn, but control was not obtained.

Table 2 shows that injury to the cotton was severe in some treatments. Treatments with MSMA or MSMA plus fluometuron showed adequate cotton tolerance. While control of morningglory with MSMA alone was not adequate, MSMA plus fluometuron was acceptable. Other mixtures with higher rates of MSMA were too injurious to cotton. (Univ. of Calif. Coop. Ext., Bakersfield, CA 93307.)

Table 1. Field and application data

CROP:	Cotton	APPLICATION DATE:	6-8-89
LOCATION:	Maricopa, CA	APPLICATION METHOD:	CO_2 backpack
CROP STAGE:	2-8 in., 8 nodes	VOLUME / PSI:	35 gpa @ 26 psi
ROW SPACING:	38 in.	SOIL TYPE:	heavy silt loam
PLOT SIZE:	15 ft. by 38 in.	O.M.:	1.0%
PLOT DESIGN:	K2XRCB, 3 reps	IRRIGATION METHOD:	solid set sprinklers
CONDITIONS:	80°F, no wind, dry surface, moist root zone		
WEED SPECIES:	ivyleaf morningglory - seedlings to early bloom		

Table 2. Cotton injury and morningglory control on June 23,1989 (0=no injury, 10=kill).

TREATMENT	1X RATE (lb ai/a)	COTTON INJURY 1X	2X†	MORNINGGLORY CONTROL 1X	2X†
Control, weedy	-	0.0	--	0.0	-
Control, weeded	-	0.0	--	10.0	-
MSMA	1.50	0.3	1.0	1.7	2.7
MSMA	3.00	3.7	3.3	3.3	4.7
MSMA + oxyfluorfen	4.00 + 0.25	4.3	6.3	8.3	9.3
MSMA + prometryn	4.00 + 0.75	5.0	5.7	8.3	9.3
MSMA + fluometuron	4.00 + 2.00	2.3	2.3	7.5	8.5
MSMA + oxyfluorfen + prometryn	2.00 + 0.25 + 0.75	3.5	4.8	4.0	5.8
Lactofen + surfactant @0.25%	0.25	3.3	4.8	4.0	5.8
LSD 0.05		3.2		1.3	

† All 2X treatments were double-sprayed, like an overlap (K2X).

Evaluation of surfactant performance in hard water situations. Kempen, H.M. and M.P. Gonzalez. Research plots were established to evaluate the performance of three surfactants when excessively hard water ($CaCO_3$=586 mg/L) was used as a carrier for fluazifop-P application.

No injury symptoms or reduction in growth were noted on June 1, 1989 when cotton was 2 to 4 inches. At all four rating dates, there were no differences in control of bermudagrass (CYNDA) between surfactants at both 1X and 2X (double-sprayed) plots. Control at 1/4 lb ai/a at 45 or 90 gpa were not different except on the late rating on regrowth of bermudagrass. Here 45 gpa seemed superior. Fluazifop-P at 1/2 lb ai/a gave increased control of regrowth. (Univ. of Calif. Coop. Ext., Bakersfield, CA 93307.)

Table 1. Field and application data

CROP:	Cotton	APPLICATION DATE:	5-19-89
LOCATION:	Bakersfield, CA	APPLICATION METHOD:	CO_2 backpack
CROP STAGE:	2 to 4 true leaves	VOLUME / PSI:	45 gpa @ 35 psi
ROW SPACING:	40 in.	SOIL TYPE:	sand
PLOT SIZE:	10 ft. by 40 in.	O.M.:	0.3%
PLOT DESIGN:	K2XRCB, 4 reps	IRRIGATION METHOD:	Furrow
CONDITIONS:	90°F, light NW wind, dry surface, moist root zone		
WEED SPECIES:	Bermudagrass		
CULTIVATION:	5-20-89, periodically		

Table 2. Average bermudagrass control ratings in cotton (0=no injury, 10=kill)

TREATMENT	1X RATE (lb ai/a)	BERMUDAGRASS CONTROL 1-JUN-89 1X	1-JUN-89 2X†	16-JUN-89 1X	16-JUN-89 2X†	10-JUL-89 1X	10-JUL-89 2X†	3-AUG-89 1X	3-AUG-89 2X†
Control - SURpHTAC @ 1/2%	--	0.0	0.0	0.0	0.0	1.5	1.5	0.0	0.0
Fluazifop-P + SURpHTAC @ 1/2%	1/8	4.5	5.3	6.7	8.2	7.0	9.4	2.8	3.8
Fluazifop-P + SURpHTAC @ 1/2%	1/2	6.3	6.5	8.8	9.5	9.5	10.0	6.5	7.3
Fluazifop-P + X-77 (non-ionic)@ 1/2%	1/8	5.3	5.3	6.8	8.0	8.8	9.6	5.5	5.8
Fluazifop-P + X-77 (non-ionic)@ 1/2%	1/2	5.5	5.8	8.2	9.0	9.8	10.0	8.0	8.8
Fluazifop-P + COC @ 1/2%	1/8	5.8	6.3	6.5	8.0	7.8	9.4	4.5	5.3
Fluazifop-P + COC @ 1/2%	1/2	5.8	6.3	8.4	6.9	9.8	9.7	7.8	8.8
LSD 0.05		1.1		1.1		2.0		1.7	

† All 2X treatment were double-sprayed, as if overlapped (K2X).
Note: Proprietary names: SURpHTAC (Brea); non-ionic X-77 (Valent); COC (CWR).

Evaluation of broadcast versus band treatments for control of bermudagrass in cotton. Kempen, H.M. and M.P. Gonzalez. To evaluate the difference in bermudagrass (CYNDA) control between broadcast and band treatments, herbicide applications were made with a single-nozzle boom covering 12 inches applied to the top of the bed and compared to a five-nozzle boom covering 80 inches, centered at the top of the bed. A rain occurred a day before treatment. Crop Oil Concentrate was added at 1 qt/a.

Cotton injury was seen in areas of heavy bermudagrass infestation due to water competition only. Bermudagrass control was different between treatments, with the broadcast treatment at the rate of 0.50 lb ai/a averaging the best control at the test site. Broadcast control was slightly better in the drill row a month after treatment, control in furrows was much better than in the band treatment. Later bermudagrass stolons grew into all furrows. Repeat treatments are needed for eradication. (Univ. of Calif. Coop. Ext., Bakersfield, CA 93307.)

Table 1. Field and application data

CROP:	Cotton	APPLICATION DATE:	5-11-89
LOCATION:	Bakersfield, CA	APPLICATION METHOD:	CO2 backpack
CROP STAGE:	2 true leaves	VOLUME / PSI:	54 gpa @ 40 psi (1X)
ROW SPACING:	40 in	SOIL TYPE:	sand
PLOT SIZE:	10 ft length	O.M.:	0.5%
PLOT DESIGN:	K2XRCB, 6 reps	IRRIGATION METHOD:	Furrow
CONDITIONS:	70°F, no wind, dry surface, moist root zone		
WEED SPECIES:	Bermudagrass		
CULTIVATION:	5-10-89, 6-17-89, periodically until 7-21-89		

Table 2a. Rating of bermudagrass control in drill row

TREATMENT	1X RATE† (lb ai/a)	June-16-89* (2-10 inches)		July-10-89* (16-22 inches)		Aug-10-89* (young/green boll)		Sep-14-89* (pre-harvest)	
		1X	2X	1X	2X	1X	2X	1X	2X
Control	--	0.0	-	0.0	-	0.0	-	0.0	-
Fluazifop-P + COC Broadcast	0.25	7.8	9.3	9.1	9.6	8.7	9.8	7.2	8.8
Fluazifop-P + COC Band	0.25	7.8	9.2	8.7	9.4	8.0	8.8	6.2	6.2
LSD 0.05		0.8		0.6		0.9		1.8	

† All 2X treatments were double-sprayed, like an overlap (K2X)
* (0=No injury, 10=Kill)

Table 2b. Rating of bermudagrass control in furrows

TREATMENT	1X RATE† (lb ai/a)	Percent Ground Cover June-16-89		Aug-10-89* (young/green boll)		Sep-14-89* (pre-harvest)	
		1X	2X	1X	2X	1X	2X
Control	--	23.0%	21.7%	3.8	3.7	0.3	0.2
Fluazifop-P + COC Broadcast	0.25	1.0%	0.3%	8.0	9.8	7.3	8.8
Fluazifop-P + COC Band	0.25	12.0%	12.0%	6.4	8.4	6.0	6.4
LSD 0.05		5.6%		1.6		1.6	

† All 2X treatments were double-sprayed, like an overlap (K2X)
* (0=No injury, 10=Kill)

Canada thistle control on set-aside acres. Miller, S.D., A.W. Dalrymple and D.A. Ball. A series of postemergence herbicide treatments were applied near Ethete, Wyoming to evaluate their efficacy for Canada thistle control. Plots were established under dryland conditions and were 9 by 30 ft. with three replications arranged in a randomized complete block. Herbicide treatments were applied broadcast with a CO_2-pressurized six-nozzle knapsack sprayer delivering 20 gpa at 40 psi May 27, 1987 (air temperature 74F, relative humidity 43%, wind SE at 5 mph, sky partly cloudy and soil temperature - 0 inch 98F, 2 inches 77F and 4 inches 67F) to Canada thistle in the rosette stage (4 to 7 inches tall). The soil was classified as a sandy clay loam (59% sand, 19% silt and 22% clay) with 1.8% organic matter and pH 7.6. Visual weed control evaluations were made July 16, 1987, August 23, 1988 and May 22, 1989. Canada thistle infestations were moderate throughout the experimental area.

Canada thistle control two months after application was 90% or greater with dicamba at 2.0 lb/A, picloram at 0.5 lb/A, glyphosate at 1.5 lb/A and clopyralid at 0.25 and 0.5 lb/A; however, 24 months after application, only picloram at 0.5 lb/A and clopyralid at 0.125 lb/A or higher maintained satisfactory control. (Wyoming Agric. Exp. Sta., Laramie, WY 82071 SR 1628)

Canada thistle control on set-aside land.

Treatment[1]	Rate lb ai/A	Canada thistle control[2] 1987 %	1988 %	1989 %
Dicamba	2.0	96	73	53
Picloram	0.5	96	100	99
Glyphosate	1.5	98	57	33
Amitrole+ammonium thiocyanate	4.0	85	32	13
Chlorsulfuron+s	0.032	70	67	53
Chlorsulfuron+s	0.063	75	73	63
DPX-R9674+s	0.032	55	13	8
DPX-R9674+s	0.063	62	15	10
Clopyralid	0.063	75	73	63
Clopyralid	0.125	87	100	90
Clopyralid	0.25	94	100	100
Clopyralid	0.5	99	100	100
Clopyralid+2,4-D	0.063+0.375	70	50	60
Clopyralid+2,4-D	0.125+0.75	82	100	87

[1]Treatments applied May 27, 1987; s = X-77 at 0.25% v/v.
[2]Canada thistle control visually evaluated July 16, 1987, August 23, 1988 and May 22, 1989.

Evaluation of early spring herbicide treatments in fallow. Dalrymple, A.W. and S.D. Miller. Research plots were established at the Archer Research and Extension Center, Archer, Wyoming to evaluate the efficacy of individual and/or herbicide combinations for weed control in fallow when applied in the early spring. Plots were 9 by 30 ft. with three replications arranged in a randomized complete block. Herbicide treatments were applied broadcast with a CO_2-pressurized six-nozzle knapsack sprayer delivering 20 gpa at 40 psi. Treatments were applied April 17, 1989 (air temperature 55F, relative humidity 40%, wind NW at 12 mph, sky partly cloudy and soil temperature - 0 inch 65F, 2 inches 48F and 4 inches 45F) to 4-inch tansymustard and emerging kochia and wild buckwheat. The soil was classified as a loam (54% sand, 23% silt and 23% clay) with 1.4% organic matter and pH 7.2. Visual weed control evaluations were made June 14, 1989. Kochia (KCHSC) infestations were heavy, downy brome (BROTE) infestations moderate and wild buckwheat (POLCO) and prostrate knotweed (POLAV) infestations light but uniform throughout the experimental area.

Combination treatments provided more effective weed control than individual treatments. Broad spectrum weed control was good to excellent (>90% control of all weed species) with clomazone plus atrazine, cyanazine plus metribuzin and paraquat and paraquat-diuron combinations with atrazine or cyanazine. (Wyoming Agric. Exp. Sta., Laramie, WY 82071 SR 1627)

Weed control in fallow with early spring herbicide treatments.

Treatment[1]	Rate lb ai/A	Weed control[2] KCHSC %	POLCO %	POLAV %	BROTE %
Clomazone+atrazine	0.5+0.5	100	100	100	100
CGA-131036+s	0.018	73	93	33	27
CGA-136872+s	0.036	73	93	63	37
CGA-131036+CGA-136872+s	0.018+0.036	85	100	92	78
CGA-131036+atrazine+s	0.009+0.5	97	100	100	55
CGA-136872+atrazine+s	0.036+0.5	95	100	100	82
CGA-131036+dicamba+s	0.018+0.25	97	97	97	33
CGA-136872+dicamba+s	0.036+0.25	90	92	93	73
C-4243	0.062	0	57	67	43
C-4243	0.125	20	70	77	57
C-4243+atrazine	0.062+0.5	98	97	100	65
Paraquat+cyanazine+s	0.5+2.0	97	100	100	100
Paraquat+atrazine+s	0.5+0.5	98	100	100	100
Paraquat+diuron+cyanazine+s	0.5+0.02+2.0	98	100	100	100
Paraquat+diuron+atrazine+s	0.5+0.02+0.5	98	100	100	100
Dicamba+atrazine	0.28+0.52	100	100	100	50
Cyanazine+metribuzin	2.0+0.625	100	100	100	92
Atrazine	0.5	88	93	93	60

[1]Treatments applied April 17, 1989; s = X-77 at 0.25% v/v.
[2]Plots visually evaluated June 14, 1989.

Kochia and Russian thistle control in fallow. Westra, P. and T. D'Amato. Kochia and Russian thistle are very common in the wheat-fallow fields of eastern Colorado. This research was conducted at Proctor to compare the efficacy of a number of herbicide treatments. A non-ionic surfactant at 0.5% v/v was added to all treatments containing glyphosate.

The experiment was a randomized complete block design with three replications. Plots were 10 ft wide by 30 ft long. Carrier volume was 13 gal/a delivered at 20 psi through 11001LP flat fan nozzles. Herbicides were applied June 15, 1989 when the kochia and Russian thistle plants were 2-4 inches tall. Visual evaluations were made on July 13, 1989.

Treatments containing glyphosate showed 100% control of both weed species. Clopyralid and 2,4-D were both rated fair for controlling Russian thistle and poor for kochia control. Dicamba was slightly more effective for kochia control, and picloram was rated poor for both weed species. (Weed Research Laboratory, Colorado State University, Ft. Collins, CO 80523)

Kochia and Russian thistle control

Herbicide	Rate	kochia	Russian thistle
	(lb ai/a)	% control	
Check		0	0
2,4-D	.50	43	85
dicamba	.25	75	60
clopyralid + 2,4-D	.60	42	83
picloram	.125	37	55
glyphosate	.50	100	100
Fallowmaster	.65	100	100
Landmaster II	.67	100	100

Herbicide control of annual bromes, broadleaf weeds, and volunteer wheat in chemical fallow in no-till and conventional tillage. Dial, M.J. and D.C. Thill. Brome control with paraquat applied alone and in tank mix combination was evaluated on a no-till site south of Lewiston, Idaho. At a second location, glyphosate, glyphosate/2,4-D and glyphosate/dicamba treatments also were evaluated. Glyphosate and glyphosate tank mixed with DPXR9674 or CGA131036 treatments were evaluated for volunteer winter wheat (TRIAX), purple mustard (COBTE), flixweed (DESSO), and downy brome (BROTE) control as an aid to tillage in conventionally cultivated fallow south of Lewiston, Idaho. Herbicide treatments were applied at both locations with a CO_2 pressurized backpack sprayer calibrated to deliver 10 gal/a at 40 psi and 3 mph (Table 1). Treatments at each location were arranged in a randomized complete block design, replicated four times. The brome growth stage was five leaves at the no-till site. At the conventionally cultivated site, the volunteer winter wheat was 8 in. tall and tillered, purple mustard was in the prebolt stage and approximately 5 in. in diameter, flixweed was 5 in. in diameter, and downy brome was in the two to three leaves growth stage when the herbicide treatments were applied. Herbicide efficacy was estimated visually for brome control on April 24 and May 14 at the no-till site. At the conventionally cultivated site herbicide efficacy was estimated visually for volunteer winter wheat and weed species on May 14.

Table 1. Application data

Location	no-till	conventional
Application date	April 7	April 11
Air temperature (F)	60	60
Soil temperature @ 2 in. (F)	59	62
Relative humidity (%)	48	52
Wind speed-direction	5-W	3-N
Soil pH	5.12	5.6
OM (%)	4.6	4.4
Texture	silt loam	silt loam
CEC (meq/100g soil)	23.3	22.2

All treatments initially controlled the brome 80 to 90% (Table 2). By 34 days after treatment, the brome had recovered in the paraquat and paraquat/diuron tank mix treatments except those containing atrazine (Table 2). No plant regrowth occurred in the glyphosate treatments (Table 2).

All treatments containing glyphosate controlled volunteer winter wheat, purple mustard, flixweed, and downy brome 89% or greater in conventionally cultivated fallow (Table 3). Dicamba/atrazine controlled purple mustard and flixweed 95%, however, did not adequately control volunteer winter wheat or downy brome (Table 3). (Idaho Experiment Station, Moscow, Idaho 83843)

Table 2. Brome control 17 and 34 days after treatment (DAT) in no-till chemical fallow

Treatment[1]	Rate	Control[2] 17 DAT	Control[2] 34 DAT
	(lb ai/a)	--(% of check)--	
check	---	---	---
paraquat	0.39	89	18
paraquat	0.52	90	35
paraquat/diuron	0.39	90	40
paraquat/diuron	0.52	92	54
glyphosate/2,4-D[3]	0.53	87	100
glyphosate/dicamba	0.40	85	90
paraquat/diuron + dicamba	0.52 0.125	89	50
paraquat/diuron + atrazine	0.52 0.25	98	76
paraquat/diuron + cyanazin	0.52 0.66	91	69
paraquat/diuron + 2,4-D LVE	0.52 0.25	91	40
paraquat/diuron + diuron	0.52 0.60	93	55
paraquat + dicamba	0.52 0.125	91	53
paraquat + atrazine	0.52 0.25	96	81
paraquat + cyanazin	0.52 0.66	96	75
paraquat + 2,4-D LVE	0.52 0.25	93	43
paraquat +	0.52	96	53
glyphosate	0.28	89	100
glyphosate	0.38	80	100
glyphosate + CGA131036	0.38 0.0179	80	100
LSD (0.05)		7	24
plant density (no./ft^2)		85	

[1]All treatments were applied with R-11; a nonionic surfactant. All paraquat treatments contained 0.25 % v/v, and glyphosate treatments contained 0.5% v/v nonionic surfactant.
[2]Visual estimate of percent reduction in population density compared to the check.
[3]Glyphosate/2,4-D, glyphosate/dicamba, and glyphosate rates based on acid equivalent.

Table 3. Volunteer winter wheat, broadleaf weed, and downy brome control in fallow.

Treatment	Rate	Control[1]			
		TRIAX	COBTE	DESSO	BROTE
	(lb ae/a)	---------(% of check)--------			
Check	----	---	---	---	---
glyphosate +	0.28	95	95	95	89
surfactant[2]	0.50%				
glyphosate +	0.38	95	95	95	95
surfactant	0.50%				
dicamba/atrazine[3] +	1.00	45	95	95	78
surfactant	0.50%				
glyphosate +	0.28	93	93	93	93
CGA131036[3] +	0.0179				
surfactant	0.25%				
glyphosate +	0.28	95	95	95	95
CGA131036 +	0.0268				
surfactant	0.25%				
glyphosate +	0.28	95	95	95	95
DPXR9674[3] +	0.0141				
surfactant	0.25%				
glyphosate	0.28	95	95	95	95
DPXR9674 +	0.0281				
surfactant	0.25%				
LSD (0.05)		4	2	2	11
plant density (no./ft^2)		6	4	3	12

[1] Visual estimate of percent reduction in population density compared to the check.

[2] Surfactant was R-11; rate is expressed as % v/v.

[3] Rate is in lb ai/a.

Weed control in fallow with fall herbicide treatments. Dalrymple, A.W. and S.D. Miller. Research plots were established near Chugwater, Wyoming to evaluate the efficacy of individual and/or herbicide combinations for weed control in fallow when applied in the fall. Plots were 9 by 30 ft. with three replications arranged in a randomized complete block. Herbicide treatments were applied broadcast with a CO_2-pressurized six-nozzle knapsack sprayer delivering 20 gpa at 40 psi. Treatments were applied September 15, 1988 (air temperature 56F, relative humidity 50%, wind NW at 5 mph, sky clear and soil temperature - 0 inch 64F, 2 inches 46F and 4 inches 52F). The soil was classified as a sandy loam (69% sand, 18% silt and 13% clay) with 1.4% organic matter and pH 7.8. Visual weed control evaluations were made June 21, 1989. Downy brome (BROTE), volunteer wheat (TRAZX) and tansymustard (DESPI) infestations were moderate and Russian thistle (SASKR), cutleaf nightshade (SOLTR) and kochia (KCHSC) infestations light but uniform throughout the experimental area.

Clomazone-atrazine and dicamba-atrazine combinations provided good to excellent broad spectrum weed control (>90% control of all weed species). The package mix (pm2) containing 1.5 plus 1.5 lb/gal of clomazone and atrazine was considerably less effective for weed control than the tank mix or 2 plus 2 lb/gal (pml) package mix. A-1237 and C-4243 did not provide adequate broad spectrum weed control when applied alone. Volunteer wheat control was not adequate with CGA-136872 and cutleaf nightshade control not adequate with CGA-131036. (Wyoming Agric. Exp. Sta., Laramie, WY 82071 SR 1626)

Weed control in fallow with fall herbicide treatments.

Treatment[1]	Rate lb ai/A	Weed control[2] SASKR %	SOLTR %	KCHSC %	DESPI %	BROTE %	TRAZX %
Clomazone	1.0	8	93	73	100	100	100
Clomazone+atrazine	0.5+0.5	92	96	98	100	100	100
Clomazone+atrazine(pm1)	0.5+0.5	95	100	100	100	100	99
Clomazone+atrazine(pm2)	0.5+0.5	28	97	98	100	100	85
CGA-136872+CGA-131036	0.009+0.009	95	20	100	100	63	63
CGA-136872+CGA-131036	0.009+0.018	98	17	100	100	86	67
CGA-136872+CGA-131036	0.018+0.009	95	17	100	100	90	60
CGA-136872+CGA-131036	0.018+0.018	99	32	100	100	95	70
Clomazone+CGA-131036	0.5+0.009	92	82	100	100	95	92
Atrazine+CGA-131036	0.5+0.009	95	100	100	100	100	99
Dicamba+atrazine(pm)	0.28+0.52	90	100	100	100	100	97
Dicamba+atrazine(pm)+paraquat+s	0.28+0.52+0.5	90	100	100	100	100	99
Dicamba+atrazine(pm)+clomazone	0.28+0.52+0.5	97	100	100	100	100	100
Dicamba+atrazine(pm)+norflurazon	0.28+0.52+0.5	93	99	100	100	100	98
A-1237	0.032	57	60	83	100	75	23
C-4243	0.063	28	45	42	98	33	0
A-1237+atrazine	0.032+0.5	90	93	100	100	97	90
C-4243+atrazine	0.063+0.5	78	93	97	100	97	90
Cyanazine+atrazine	2.0+0.5	58	97	99	100	99	90
Metribuzin+atrazine	0.5+0.5	82	98	100	100	100	97
Atrazine	0.75	87	100	97	100	100	93

[1]Treatments applied September 15, 1988; pm = package mix and s = X-77 at 0.25% v/v.
[2]Weed control visually evaluated June 21, 1989.

Evaluation of selected herbicides for use in lentils. Miller, T.W., B.B. Barstow, and R.H. Callihan. The purpose of this experiment was to determine the effectiveness of several herbicides for use in lentils as alternatives to the herbicide dinoseb. Weeds included common lambsquarters (Chenopodium album L.)(CHEAL), field pennycress (Thlaspi arvense L.)(THLAR) and wild oat (Avena fatua L.)(AVEFA).

The experiment included 2 sites; near Troy and near Grangeville. In both cases, 10 x 30 ft plots were placed on farmer-seeded fields in a randomized complete block design. Plots were replicated 4 times at each site. Post-plant incorporated (PoPI) and pre-emergent (pre) treatments were applied on the same dates, with PoPI treatments shallowly incorporated into the top 2 inches of soil either with a rake or by rainfall. Post-emergent (post) treatments were applied after the crop was beyond the 4-node stage. Field evaluation included visual estimation of weed control (both sites) and yield (Troy site). However, populations of AVEFA and THLAR at Grangeville and CHEAL at Troy were dense and well-distributed.

At Grangeville, only the sethoxydim treatment gave adequate control of AVEFA (Table 1). Addition of metribuzin to this treatment reduced AVEFA control by nearly 20% indicating strong antagonism between the herbicides. Imazethapyr and imazethapyr + metribuzin did show some activity on wild oat, while also giving complete control of THLAR. The split application of metribuzin also provided good control of THLAR.

Metribuzin applied either as a split application or post-emergent to the crop showed excellent activity on CHEAL at Troy while imazethapyr and sethoxydim + metribuzin provided good control (Table 2).

Yields at Troy were generally increased by the use of herbicides (Table 2). Notable exceptions were imazethapyr and paraquat. The paraquat application may have been timed too close to lentil emergence, resulting in crop damage. Imazethapyr apparently caused toxicity symptoms in lentils at Grangeville, but at Troy, lentils were not apparently injured by the herbicide. Further screening of imazethapyr in lentils at various rates and times of application is warranted based on these findings.
(University of Idaho Cooperative Extension System, Moscow, Idaho 83843)

Table 1. Control of *Avena fatua* and *Thlaspi arvense* in lentils (Grangeville).

Treatment No.	Herbicide	Rate	Time[2]	AVEFA	THLAR
		lb/a		- (% control) -	
1	Sethoxydim[1]	0.125	POST	99	0
2	Sethoxydim[1] +	0.125	POST		
	Metribuzin	+0.2	POST	80	44
3	Imazethapyr	0.047	PRE	69	100
4	Imazethapyr +	+0.047	PRE		
	Metribuzin	+0.2	PRE	58	100
5	Metribuzin	0.2	POST	19	63
6	Glyphosate	0.25	PRE	18	1
7	Paraquat +	0.5	PRE		
	Metribuzin	+0.2	PRE	15	21
8	Trifluralin +	0.375	PoPI		
	Metribuzin	0.2	PoPI	5	36
9	Ethalfluralin +	0.375	PoPI		
	Metribuzin	+0.2	PoPI	3	49
10	Paraquat	0.25	PRE	3	3
11	Metribuzin +	0.25	PRE	1	91
	Metribuzin	+0.2	POST		
12	Metribuzin	0.25	PRE	0	40
13	Glyphosate +	0.25	PRE		
	Metribuzin	+0.2	PRE	0	18
lsd (0.05)				17	27
r^2				0.92	0.84
c.v.				0.46	0.46

[1]Sethoxydim treatments include 2 pints of crop oil per acre.

[2]PoPI = post-plant incorporated, PRE = pre-emergent (crop), POST = post-emergent (crop).

Table 2. Control of <u>Chenopodum album</u> and yield of lentils (Troy).

Treat-ment No.	Herbicide[1]	Rate	Time[3]	CHEAL Control	Yield
		lb/a		(%)	(lbs/a)
1	Metribuzin +	0.25	PRE	100	1640
	Metribuzin	+0.2	POST		
2	Metribuzin	0.25	POST	97	1493
3	Imazethapyr	0.047	PRE	88	1197
4	Sethoxydim[2] +	0.125	POST		
	Metribuzin	+0.2	POST	85	1521
5	Metribuzin	0.25	PRE	84	1526
6	Imazethapyr +	0.047	PRE		
	Metribuzin	+0.2	PRE	64	1651
7	Paraquat	0.5	PRE	63	1213
8	Glyphosate +	0.25	PRE		
	Metribuzin	+0.2	PRE	60	1358
9	Ethalfluralin +	0.375	PoPI		
	Metribuzin	+0.2	PoPI	46	1550
10	Paraquat +	0.25	PRE		
	Metribuzin	+0.2	PRE	44	1549
11	Trifluralin +	0.375	PoPI		
	Metribuzin	+0.2	PoPI	38	1459
12	Glyphosate	0.25	PRE	28	1373
13	Sethoxydim[2]	0.125	POST	0	1515
14	Check	-		0	1230
	lsd (0.05)			32	327
	r^2			0.75	0.40
	c.v.			0.39	0.16

[1]Pre-plant incorporated application of 1.25 lb/a triallate was used on all plots.

[2]Sethoxydim treatments include 2 pints of crop oil per acre.

[3]PoPI = post-plant incorporated, PRE = pre-emergent (crop), POST = post-emergent (crop).

Evaluation of herbicide treatments for phytotoxicity and weed control in grain lupine at UC Davis. Mitich, L.W., N.L. Smith, and T.E. Kearney. In order to evaluate unregistered and experimental herbicides for use in weed management in grain lupine, a trial was conducted with fifteen treatments on 10 ft by 40 ft plots in four replications at the UC Davis Farm. Seed of "Minnesota Ultra Blue" variety grain lupine was coated with Rhizobium inoculum and planted 27 October 1988. Preemergence herbicides and nitrogen (16-20-0) were applied 7 November; plots were sprinkle irrigated the next day. Postemergence herbicides were applied 9 January 1989. All herbicides were applied in a spray volume of 15 gal/a, using a CO_2 backpack sprayer. Visual evaluations for phytotoxicity and weed control were made 13 March; weeds present at evaluation included common groundsel [Senecio vulgaris (SENVU)], annual bluegrass [Poa annua (POAAN)], and shepherdspurse [Capsella bursa-pastoris (CAPBP)]. Lupine seed was harvested 23 June.

No treatment caused visually detectible crop damage. Yield differences covaried significantly with control of each of the three weed species. Yield losses are therefore attributable to weed competition. Yields and weed control were poorest in control plots, plots treated with postemergence herbicides, and plots treated with nitrogen; yields and weed control were highest in plots treated with the high rate of linuron (2.0 lb ai/a), plots treated with linuron + metolachlor or pendimethalin, and plots treated with experimental compound imazethapyr. (Department of Botany, University of California, Davis, CA 95616)

Herbicide treatments evaluated in grain lupine, Davis

Treatment	Rate (lb ai/a)	Vigor[1] (%)	Weed control (%)[2] CAPBP	SENVU	POAAN	Yield[3] (lb/a)	
pendimethalin	2.0	100	95	0	75	2111	BCD
metolachlor	2.5	100	55	58	95	1836	D
linuron	1.0	100	98	20	43	2299	BCD
linuron	2.0	100	98	63	35	3060	A
imazethapyr	0.047	100	83	0	28	1926	CD
imazethapyr	0.063	100	88	30	45	2563	ABC
imazethapyr	0.094	98	88	55	70	2532	ABCD
pendimethalin + metolachlor	1.0 + 2.0	100	85	45	100	2265	BCD
pendimethalin + linuron	1.0 + 1.0	100	98	38	95	2398	ABCD
metolachlor + linuron	2.0 + 1.0	100	98	65	98	2655	AB
nitrogen	25.0	100	0	0	0	695	E
nitrogen	50.0	100	0	0	0	340	E
metolachlor + linuron	2.0 + 2.0	100	98	75	85	2685	AB
sethoxydim	0.5	100	0	0	0	495	E
fluazifop	0.6	100	0	0	0	601	E
control	---	100	0	0	0	506	E

All values averaged over 4 replications.

[1]100% indicates excellent crop vigor, no phytotoxicity.
[2]100% indicates excellent weed control.
[3]Yield values followed by the same letter are not significantly different at the 5% level.

Least significant differences (alpha 0.05)

Crop vigor:	1.78%
CAPBP control:	8.18%
SENVU control:	30.63%
POAAN control:	24.99%
Yield:	711.65 lb/a

Avena sativa L. (Poaceae) bioassay to determine imazamethabenz antagonism with broadleaf herbicides -- second year. Lish, J.M. and D.C. Thill. *Avena fatua* L. control is reduced occasionally when some broadleaf herbicides are tank mixed with imazamethabenz. This antagonism was investigated near Moscow, Idaho in 1988 and 1989. Data for 1989 are presented here (See 1989 WSWS Progress Report, p 317 for 1988 results). *A. sativa* L. response to wild oat herbicide is similar to *A. fatua* thus *A. sativa* was selected as the bioassay species to ensure a uniform plant stand and to avoid spreading *A. fatua*. 'Otana' *A. sativa* was planted May 4, and herbicides were applied June 1 with a CO_2 pressurized backpack sprayer delivering 94 L/ha at 290 kPa (Table 1). The experimental design was a randomized complete block with four replications and plots were 3.3 by 9.8 m. Herbage (1 m^2) was collected July 7 and was dried 48 h at 60 C.

Table 1. Environmental conditions at time of application

A. sativa growth stage	2 to 5 leaves
Air temperature (C)	24
Soil temperature at 5 cm (C)	28
Relative humidity (%)	59
Soil moisture	high
Wind (kmph)/direction	3/east
Soil pH	5.7
CEC (meq/100 g)	18.2
OM (%)	2.8
texture	silt loam

A. sativa biomass was higher in the untreated check compared to all treatments except imazamethabenz + bromoxynil/MCPA (0.263 + 0.28 kg ai/ha) according to LSD mean separation at P = 0.05 (Table 2). More biomass was produced when bromoxynil and/or MCPA were tank mixed with imazamethabenz compared to imazamethabenz alone at 0.526 (kg ai/ha). However, only bromoxynil/MCPA reduced effectiveness of imazamethabenz compared to imazamethabenz alone at 0.263 (kg ai/ha). Imazamethabenz + difenzoquat (0.263 + 0.56 kg ai/ha) was as effective as imazamethabenz at 0.526 kg ai/ha, but was not as effective as difenzoquat at 1.12 kg ai/ha.

Bromoxynil and MCPA were antagonistic to imazamethabenz, but this antagonism was avoided by tank mixing half the highest recommended rate of difenzoquat and imazamethabenz. This procedure may prove beneficial in situations where potential crop injury could result from application of difenzoquat at 1.12 kg ai/ha. (Idaho Agricultural Experiment Station, Moscow, Idaho 83843)

Table 2. *A. sativa* biomass affected by herbicide treatment

Treatment	Rate (kg ai/ha)	Biomass (g/m^2)
check	--	738
imazamethabenz	0.263	480
imazamethabenz	0.526	280
difenzoquat	0.56	406
difenzoquat	1.12	150
imazamethabenz + bromoxynil	0.263 0.28	506
imazamethabenz + bromoxynil	0.526 0.28	495
imazamethabenz + bromoxynil/MCPA	0.263 0.28	625
imazamethabenz + bromoxynil/MCPA	0.526 0.28	473
imazamethabenz + MCPA LVE	0.263 0.28	504
imazamethabenz + MCPA LVE	0.526 0.28	416
imazamethabenz + difenzoquat	0.263 0.56	287
imazamethabenz + difenzoquat + bromoxynil	0.263 0.56 0.25	234
imazamethabenz + difenzoquat + MCPA LVE	0.263 0.56 0.28	158
imazamethabenz + difenzoquat + bromoxynil/MCPA	0.263 0.56 0.28	230
$LSD_{0.05}$		122

California brome control with pronamide in orchardgrass seed fields. Reynolds, J.D., G. Mueller-Warrant, M. Mellbye, and D. Walters. California or Mountain brome, (BROCA), a short-lived perennial, is causing much concern to grass-seed producers in Western Oregon, particularly when it occurs in orchardgrass and tall fescue. The main reason California brome is common in established seed fields is that the standard soil-residual herbicide program (diuron and triazines) has failed to control it in the seedling stage. Therefore, control of seedling bromes is crucial. Loss of propham and chlorpropham and reduced open field burning may contribute further to the spread of this weed. A field trial was conducted to evaluate the effect of timing and location of pronamide applications on control of established California brome plants.

Plots, 8 by 10 ft., were arranged in a randomized block design with four replications. The herbicide was applied on November 20, 1988, December 20, 1988, and January 20, 1989, using a CO2 backpack handsprayer delivering 20 gpa at 30 psi. Established brome plants were counted prior to treatment and again at heading, April, 1989, to determine percent control.

Pronamide controlled established brome at all but one of the locations, Site 1, when applied in December at 0.5 to 0.6 lb ai/a. The low soil temperature and reliable rainfall at this time enabled pronamide to be more effective than the November or January treatments. The split November plus January treatment did no better than the November treatment alone. Pronamide persists longer if soil temperatures stay low, and requires ample rain to move it into the root zone.

The variation in effectiveness of pronamide among locations appeared to be due in part to the buildup of charcoal from open field burning. The poorest results occurred on older stands, Site 1, that were burned the summer or fall prior to treatment. After many years of field burning, a heavy ash accumulation was present in the surface layer of soil. Site 3 had some visible carbon but no heavy accumulation. Percent control was somewhat improved compared to Site 1. Pronamide provided excellent control on Site 2, where residue was baled and hauled away rather than burned, resulting in low organic matter buildup. (Crop Science Department, Oregon State University, Corvallis, OR 97331)

Control of Established California Brome with Pronamide in Orchardgrass Seed Fields: The Effect of Timing and Location

Pronamide Rate	Soil Temp.[a]	Site 1 Burned[b]	Site 2 Baled	Site 3 Baled[c]
(lb a.i./A)	F		(% control)	
Nov. 20, 1988	43			
0.4		0	91	0
0.5		11	96	34
0.6		0	89	29
Dec. 20, 1988	42			
0.4		0	80	8
0.5		4	90	60
0.6		0	96	68
0.8		15	96	85
1.0		33	100	87
Jan. 20, 1989	36			
0.6		0	99	51
Nov./Jan. split				
0.6		6	94	9
Check				
0		0	0	0

[a]31-day average, post treatment soil temperature.
[b]Heavy ash accumulation from open field burning.
[c]Some visible carbon residue from previous burn, but not heavy.

Pea tolerance to imazethapyr and pendimethalin. Miller, T.W. and R.H. Callihan. The purpose of this experiment was to determine the tolerance of freezer pea varieties to imazethapyr and pendimethalin and to evaluate their suitability as alternatives to the herbicide dinoseb. The primary weed of concern was mayweed chamomile (*Anthemis cotula* L.)(ANTCO), a late-season competitor.

The experiment was established in May 1989 at Moscow and Genesee. In both cases, 10 x 30 ft plots were placed on farmer- seeded fields in a randomized complete block design. Plots were replicated 4 times at each site. Post-plant incorporated (PoPI) and pre-emergent (pre) treatments were applied on the same dates, with PoPI treatments incorporated into the top 2 inches of soil with a rake. A pre-emergence application of metribuzin (0.44 lb ai/a) was included as a local standard for comparison purposes. A post-emergent (post) treatment of sethoxydim (0.167 lb ai/a + 2 pts crop oil/a) was applied after wild oats were in the 4-5 leaf stage. Field evaluations included visual estimation of herbicide injury, weed control and dry pea yield.

No herbicide injury was detected at either site at 2, 4, or 6 weeks after treatment. Flowering was not delayed by any treatment. Weed control was not evaluated due to low weed populations at both sites.

Plots without herbicide treatments were among the top yielders at Moscow but were among the poorest yielders at Genesee. Peas treated with pendimethalin (1.5 lb/a) + imazethapyr (0.063 lb/a) yielded significantly less than imazethapyr alone (0.047 lb/a) at Moscow. Peas treated with pendimethalin + imazethapyr (0.047 lb/a) resulted in highest yields at Genesee although differences there were not statistically significant. Yield data indicate that other herbicide treatments had little effect on these pea varieties. (University of Idaho Cooperative Extension System, Moscow, ID 83843)

Yield of freezer peas treated with three herbicides at two sites in northern Idaho.

Treatment[1]	Rate	Timing[2]	Location		
			Moscow	Genesee	Average
	(lbs ai/a)		- - - -	-(lbs/a)-	- - - - -
Pendimethalin + Imazethapyr	1.5 0.047	PoPI	1953	2009	1981
Check	-	-	2307	1569	1938
Imazethapyr	0.063	PRE	2024	1834	1929
Imazethapyr	0.047	PRE	2062	1657	1860
Imazethapyr	0.032	PRE	2022	1653	1837
Metribuzin	0.44	PRE	1780	1686	1733
Pendimethalin + Imazethapyr	1.5 0.063	PoPI	1664	1593	1629
lsd (5%)			391	426	-
r^2			0.48	0.37	-
c.v.			0.13	0.17	-

[1]All plots received a post-emergent application of sethoxydim + crop oil (0.167 lb ai + 2 pts/ac) to control wild oats.

[2]PRE = pre-emergent (crop), PoPI = post-plant incorporated.

Evaluation of selected herbicides for use in dry peas. Miller, T.W., B.B. Barstow, and R.H. Callihan. The purpose of this experiment was to determine the effectiveness of several herbicides for use in dry peas as alternatives to the herbicide dinoseb. The primary weed of concern was mayweed chamomile (Anthemis cotula L.)(ANTCO), a late-season competitor. Other important weeds included common lambsquarters (Chenopodium album L.)(CHEAL), wild oat (Avena fatua L.)(AVEFA) and flixweed (Descurainia sophia (L.) Webb)(DESSO).

The experiment began in 1988 with one dry pea site near Moscow. In 1989, the number of sites was increased to 5 (Potlatch, Moscow, Genesee, Nezperce, and Ferdinand). In all cases, 10 x 30 ft plots were marked on farmer-seeded fields in a randomized complete block design. Plots were replicated 4 times at each site. Post-plant incorporated (PoPI) and pre-emergent (pre) treatments were applied on the same dates, with PoPI treatments incorporated into the top 2 inches of soil either with a rake or by rainfall. Postemergent (post) treatments were applied after the crop was beyond the 4-node stage. Evaluations included visual estimation of weed control (all sites) and dry pea yield (selected sites).

Bentazon provided excellent control of ANTCO in 1988 data not shown and 1989 (Table 1), but did a poor job on CHEAL in 1989 (Table 4). Although only evaluated at one site, bentazon tankmixes (with MCPA or sethoxydim) also showed excellent activity on ANTCO, and warrant further study. In 1988, metribuzin (pre) was the only other herbicide to acceptably control ANTCO. In 1989, the metolachlor + metribuzin treatment showed excellent activity on ANTCO at 4 of 5 sites and excellent control of CHEAL at Moscow. Also showing good to excellent activity on ANTCO at 4 of 5 sites were imazethapyr + metribuzin and metribuzin (pre + post). CHEAL was also controlled effectively by pendimethalin, MCPA + metribuzin, metribuzin (post), and MCPA. Several herbicides provided excellent control of DESSO, of particular note were metolachlor + metribuzin, MCPA, imazethapyr, and imazethapyr + metribuzin (Table 2). The AVEFA population at Nezperce was not distributed evenly enough to evaluate herbicide efficacy on this weed species.

Plots at the Potlatch, Moscow, and Nez Perce, sites were harvested. Most treatments did not affect yield (Table 3). Yields in the check plots were also not reduced, indicating that ANTCO does not dramatically reduce yield. The weed's primary influence in legume crops is mechanical hinderance of harvest equipment. The 1988 trial and the 1989 trial at Genesee were so highly infested with ANTCO that harvest would have been impossible without swathing. (University of Idaho Cooperative Extension System, Moscow, Idaho 83843)

Table 1. Anthemis cotula control in dry peas at five sites in northern Idaho (1989).

Herbicide Treatment[1]	Dose	Time[3]	Location					Average
			Ne	Fe	Ge	Mo	Po	
	(lb/a)		---------(% control)--------					
Treatments Tested at All Five Locations								
Bentazon	0.75	POST	100	96	96	100	100	99
Metolachlor	+1.64	PRE						
Metribuzin	+0.36	PRE	100	100	11	100	99	82
Imazethapyr	+0.047	PRE						
Metribuzin	+0.2	PRE	100	99	15	83	95	78
Metrib.	0.25+	PRE	91	95	44	98	95	78
Metribuzin	+0.2	POST						
Metrib.	0.2	PRE	75	99	15	93	90	74
Clomazone	0.25+	PoPI						
Metribuzin	0.2	PoPI	83	98	15	78	88	72
Glyphosate	+0.25	PRE						
Metribuzin	+0.2	PRE	73	89	31	70	83	69
Paraquat	0.5+	PRE						
Metribuzin	0.2	PRE	75	86	10	76	71	64
Clomazone	0.375	PoPI	51	91	34	51	75	61
Imazethapyr	0.047	PRE	56	98	34	38	36	52
Clomazone	0.25	PoPI	74	51	10	56	70	52
MCPA +	0.375	POST						
Metribuzin	+0.2	POST	23	48	38	44	21	42
Metrib.	0.2	POST	49	8	44	55	30	37
MCPA	0.375	POST	40	28	45	44	10	33
Glyphosate	0.25	PRE	0	14	4	8	64	18
Sethoxydim[2] +	+0.125	POST						
Metribuzin	+0.25	POST	6	3	15	25	18	13
Paraquat	0.5	PRE	3	0	10	6	26	9
Sethoxydim[2]	0.125	POST	33	0	9	0	0	8
Treatments Tested at Less Than Five Locations								
Bentazon +	0.75	POST	-	99	-	-	-	99
MCPA	+0.375	POST						
Bentazon	+0.75	POST						
Sethoxydim[2]	+0.125	POST	95	-	-	-	-	95
Trifluralin	0.375	PoPI						
Metribuzin	+0.2	PoPI	-	-	-	68	89	78
Ethalfluralin	0.75	PoPI						
Metribuzin	+0.2	PoPI	93	99	26	-	89	77
Pendimethalin	1.5	PoPI	-	-	-	39	-	39
Trifluralin	0.375	PoPI	-	-	35	-	-	35
lsd (0.05)			27	15	30	31	30	-
r^2			0.79	0.95	0.61	0.77	0.82	-
c.v.			0.37	0.18	0.89	0.40	0.34	-

[1]Pre-plant incorporated applications of 1.25 lb triallate per acre were used at all plots in Ferdinand (Fe), Genesee (Ge), Moscow (Mo), and Potlatch (Po) but not at Nez Perce (Ne); 0.375 lb ethalfluralin per acre was also used at Moscow.

[2]Sethoxydim treatments include 2 pints of crop oil per acre.

[3]PoPI = post-plant incorporated, PRE = pre-emergent (crop), POST = post-emergent (crop).

Table 2. Control of <u>Chenopodium album</u> at Moscow and <u>Descurainia sophia</u> at Ferdinand in dry peas (1989).

Treatment No.	Herbicide[1]	Dose	Time[3]	CHEAL	DESSO
		(lb/a)		- -(% control)- -	
1	Metribuzin	0.25	PRE	100	84
	+Metribuzin	+0.2	POST		
2	Pendimethalin	1.5	PoPI	100	-
3	MCPA	0.375	POST	98	96
	+Metribuzin	+0.2	POST		
4	Metribuzin (post)	+0.2	POST	98	24
5	Metolachlor	1.64	PRE	98	100
	+Metribuzin	+0.2	PRE		
6	MCPA	0.375	POST	96	100
7	Clomazone	0.25	PoPI	87	95
	+ Metribuzin	+0.2	PoPI		
8	Sethoxydim[2]	0.125	POST	83	5
	+Metribuzin	+0.2	POST		
9	Clomazone	0.375	PoPI	75	83
10	Imazethapyr	0.047	PRE	69	100
	+Metribuzin	+0.2	PRE		
11	Imazethapyr	0.047	PRE	68	100
12	Clomazone	0.25	PoPI	65	59
13	Metribuzin	0.25	PRE	63	86
14	Glyphosate	0.25	PRE	39	68
	+Metribuzin	+0.2	PRE		
15	Trifluralin	0.375	PoPI	31	-
	+Metribuzin	+0.2	PoPI		
16	Bentazon	0.75	POST	30	60
17	Paraquat	0.5	PRE	10	23
18	Paraquat	0.5	PRE	8	65
	+Metribuzin	+0.2	PRE		
19	Bentazon	0.75	POST	-	99
	+Metribuzin	+0.2	POST		
20	Glyphosate	0.25	PRE	0	19
21	Ethalfluralin	0.75	PoPI	-	91
	+Metribuzin	+0.2	PoPI		
22	Sethoxydim[2]	0.12	PRE	0	0
	lsd (0.05)			25	24
	r^2			0.85	0.87
	c.v.			0.32	0.26

[1]Pre-plant incorporated applications of1.25 lb triallate per acre were used on all plots; 0.375 lb ethalfluralin per acre was also used at Moscow.

[2]Sethoxydim treatments include 2 pints of crop oil per acre.

[3]PoPI = post-plant incorporated, PRE = pre-emergent (crop), POST = post-emergent (crop).

Table 3. Dry pea yield after treatment with various herbicides at three sites in northern Idaho (1989).

Herbicide[1]	Rate	Time[3]	Location: Nezperce	Moscow	Potlatch	Average
	(lb/a)		- - - - - - - - (lb/a)	- - - - - - - -		
Treatments Tested at All Three Locations						
Paraquat	0.5	PRE	1810	1432	1668	1637
Paraquat +	0.5	PRE	2026	1248	1591	1622
Metribuzin	+0.2	PRE				
MCPA	0.375	POST	1858	1356	1587	1600
Check	-	-	1906	1353	1501	1587
Clomazone	0.25	PoPI	1816	1268	1650	1578
Glyphosate	0.25	PRE	1923	1476	1325	1575
Sethoxydim[2]	0.125	POST	1762	1389	1552	1567
Clomazone	0.375	PoPI	1723	1302	1595	1540
Glyphosate +	0.25	PRE				
Metrizbuzin	+0.2	PRE	1903	1055	1561	1506
Metribuzin	0.25	PRE	2051	1157	1287	1498
Bentazon	0.75	POST	1738	1340	1383	1487
Clomazone +	0.25	PoPI				
Metribuzin	+0.2	PoPI	2001	1065	1384	1484
MCPA +	0.375	POST	1746	1156	1538	1480
Metribuzin	+0.2	POST				
Metolachlor +	1.64	PRE				
Metribuzin	+0.2	PRE	1605	1299	1515	1473
Imazethapyr +	0.047	PRE				
Metribuzin	+0.2	PRE	1785	1146	1665	1429
Imazethapyr	0.047	PRE	1837	1104	1282	1408
Sethoxydim[2] +	0.25	POST				
Metribuzin	+0.2	POST	1785	830	1249	1288
Metribuzin +	0.25	PRE	1323	790	1450	1188
Metribuzin	+0.2	POST				
Metribuzin	0.25	POST	1344	874	1299	1172
Treatments Tested at Less Than Three Locations						
Ethalfluralin +	0.75	PoPI				
Metribuzin	+0.2	PoPI	1894	-	1415	1654
Bentazon +	0.75	PoPI				
Sethoxydim[2]	+0.125	PoPI	1525	-	-	1525
Trifluralin +	0.375	PoPI				
Metribuzin	+0.2	PoPI	-	1249	1684	1467
Pendimethalin	1.5	PoPI	-	1448	-	1448
lsd (0.05)			473	319	382	-
r^2			0.66	0.55	0.38	-
c.v.			0.19	0.19	0.18	-

[1]Pre-plant incorporated applications of 1.25 lb triallate per acre were used at all plots in Moscow and Potlatch; 0.375 lb ethalfluralin per acre was also used at Moscow.

[2]Sethoxydim treatments include 2 pints of crop oil per acre.

[3]PoPI = post-plant incorporated, PRE = pre-emergent (crop), POST = post-emergent (crop).

Clomozone carryover to winter wheat and spring barley. Lish, J.M. and D.C. Thill. Clomozone may be registered for grass and broadleaf weed control in pea in Idaho. The soils in the pea production areas of northern Idaho have a silt loam texture and pH can range from 4.8 to 6. These conditions are conducive to clomozone persistence in the soil. An experiment was established to determine potential injury to winter wheat and spring barley from carryover of clomozone applied in spring pea. Herbicides were applied with a CO_2 pressurized backpack sprayer (Table 1). Clomozone was applied preplant and was incorporated with two passes of a tine tooth harrow. Metribuzin was applied preemergence and postemergence, and bentazon was applied postemergence. Small sieve 'Alaska' pea was seeded on May 3, 1989 and the field was rolled May 4. The experimental design was a randomized complete block and plots were 20 by 25 ft. Pea injury was evaluated visually on June 7, and pea seed was harvested July 27. Winter wheat was planted October 2 and spring barley will be planted in 1990 in an adjacent study.

Table 1. Environmental data

	Preplant incorporated	Preemergence	Postemergence
Date of application	May 2, 1989	May 12, 1989	June 1, 1989
Pea growth stage	--	germinated	4 node
Air temperature (F)	55	48	65
Soil temperature (F)[1]	65	56	68
Relative humidity (%)	63	67	67
Wind speed (mph)/direction	5/west	0	5/east
Spray volume (gal/a)	10	10	20
Pressure (psi)	42	42	38
Soil pH		5.7	
OM (%)		2.8	
CEC (meq/100 g)		18	
texture		silt loam	

[1]Soil temperature at 2 in.

Chlorosis was the primary symptom visible on pea and the plants recovered within 1 month in all treatments containing clomozone (Table 2). The split application of metribuzin stunted plant growth 50% compared to the untreated check. Differences in seed yield were not statistically significant, but yield tended to be low with the split application of metribuzin. Weed control was not evaluated because few weeds were present. (Idaho Agricultural Experiment Station, Moscow, Idaho 83843)

Table 2. Pea injury and seed yield

Treatment	Rate	Type of application	Pea injury	Seed yield
	(lb ai/a)		(% of check)	(lb/a)
check	--	--	--	1887
clomazone	0.25	PPI	2	1670
clomazone	0.5	PPI	15	1886
clomazone	1.0	PPI	26	1751
clomazone + metribuzin	0.38 0.25	PPI Pre	11	1739
clomazone + bentazon	0.38 0.75	PPI Post	33	1684
metribuzin + metribuzin	0.25 0.15	Pre Post	51	1513
$LSD_{0.05}$			10	ns

CGA-131036 pea and potato plant back in southeastern Idaho. Dial, M.J., J.M. Lish and D.C. Thill. Pea and potato herbage and tubers were evaluated for herbicide injury from CGA-131036 carry over at separate locations near Ashton, Idaho. Herbicides were applied in 1988 to spring barley (Table 1). In May 1989, pea seed and potato tubers were planted in their respective plot areas. Potato foliage was evaluated visually July 25 for herbicide injury symptoms. A 10.8 ft^2 area of pea herbage was harvested July 25 from each plot, dried and weighed for biomass determination. Soil samples were taken July 25 from the pea experiment and the potato experiment was sampled September 26 to determine pH. Soil cores, 6 inches deep, were removed from each plot and were bulked by replication. The pH ranged from 6.6 to 7.4 at the pea experiment and 5.4 to 5.8 at the potato site. September 26, potato tubers were lifted using a single row level bed potato digger. Two nonadjacent 20 ft rows in each plot were lifted and all tubers regardless of shape or size were collected and were weighed. Tubers from each plot were subsampled sorted and graded according to rules adopted from the United States Standards for Grade of Seed Potatoes. The grades are divided into three categories (A, B, and C) based on weight and subjective measures of tuber uniformity, blemishes, and external damage. A subsample from each tuber seed class will be placed in storage at 45 to 49 F until dormancy is broken. Tubers will be planted at the Plant Science Research Farm east of Moscow to evaluate plant foliage for visual symptoms of herbicide injury.

Table 1. Herbicide application data

Crop	Pea	Potato
Date of application	June 8, 1988	June 24, 1988
Air temperature (F)	90	90
Soil temperature at 2 in. (F)	84	88
Relative humidity (%)	32	33
Wind speed-direction (mph)	3-W	4-W
Soil		
OM (%)	2.4	1.8
Texture	silt loam	silt loam
CEC (meq/100 g soil)	13.2	16.0

CGA-131036 applied at 0.0268 and 0.0536 lb ai/a reduced pea biomass compared to bromoxynil/MCPA and DPXL5300 (Table 2). The pH was highest in the first replication near the field edge, and decreased toward the center of the field. Pea biomass was negatively correlated with pH ($r = -0.87$, $p = 0.13$).

No visual symptoms of herbicide injury were observed on the potato foliage during the growing season (data not shown). No differences among treatments were measured for tuber yield (Table 1). No differences were observed among treatments for A and C grade tubers. More B grade tubers were produced when CGA-131036 was applied at 0.0268 and 0.0536 lb ai/a than any other treatment. Soil pH did not vary among replications in the potato experiment as much as the soil pHin the pea experiment. (Idaho Experiment Station, Moscow Idaho 83843)

Table 1. Pea herbage biomass and potato tuber yield and grade for plants grown in soil treated with CGA-131036 the previous growing season.

Treatment[1]	Rate	Pea biomass	Tuber yield	Potato tuber grade A	B	C
	(lb ai/a)	(lb ai/a)	(cwt/a)[2]	(% by weight)		
bromoxynil/MCPA	0.375	4669	218	74	7	19
CGA-131036	0.0134	2929	207	81	8	11
CGA-131036	0.0268	1413	225	71	16	13
CGA-131036	0.0536	1315	228	76	12	12
DPXL5300	0.0234	3980	207	77	8	15
chlorsulfuron	0.0268	2548	197	71	6	23
LSD (0.05)		2174	ns	ns	3	ns

[1]Herbicide treatments were applied in spring of 1988. Pea and potato were planted in spring 1989.
[2]Cwt/a based on total weight divided by 100 pounds.

Imazamethabenz plant back to pea and lentil. Lish, J.M. and D.C. Thill. Some imidazolinone and sulfonylurea herbicides persist in the soil long enough to cause injury to sensitive rotational crops. An experiment was initiated in 1988 to determine potential injury to pea and lentil following spring barley treated with imazamethabenz and CGA 131036. 'Vangard' spring barley was planted May 11, 1988 and herbicides were applied June 3, 1988 with a CO_2 pressurized backpack sprayer calibrated to deliver 20 gal/a at 40 psi (Table 1). Barley grain was harvested August 18, 1988. 'Brewer' pea and 'Chilean' lentil were planted May 3, 1989. Herbage (1 m^2) was sampled July 10 and seed was harvested July 27.

Table 1. Environmental conditions at application

Barley growth stage	1 to 2 tiller
Air temperature (F)	65
Soil temperature at 2 in. (F)	73
Wind speed (mph)/direction	0
Soil pH	5.7
OM (%)	2.5
CEC (meq/100 g)	18.1
texture	silt loam

Pea was not affected by imazamethabenz or CGA 131036 (Table 2). Lentil biomass was low in response to imazamethabenz applied at twice the use rate (0.94 lb ai/a). Lentil yield was also low with this treatment, but it was not statistically different from any other treatments. It appears that pea and lentil may safely follow applications of imazamethabenz and CGA 131036 applied at recommended use rates in northern Idaho. Imazamethabenz applied at rates above 0.47 lb ai/a may persist and injure lentils. (Idaho Agricultural Experiment Station, Moscow, Idaho 83843)

Table 2. Barley, pea, and lentil yield

Treatment	Rate	Barley grain	Pea		Lentil	
			Biomass	Seed	Biomass	Seed
	(lb ai/a)	(lb/a)	(g/m^2)	(lb/a)	(g/m^2)	(lb/a)
diclofop[1]	1	1344	396	1582	390	2077
imazamethabenz	0.12	1351	419	1949	396	2100
imazamethabenz	0.24	1253	418	1408	428	2261
imazamethabenz	0.47	1119	416	1565	369	2164
imazamethabenz	0.94	1240	413	1562	344	1800
CGA 131036	0.013	1260	425	1703	378	2278
CGA 131036	0.027	1359	420	1914	353	2123
CGA 131036	0.054	1298	436	1792	360	2159
$LSD_{0.05}$		ns	ns	ns	48	ns

[1]All treatments except diclofop applied with nonionic surfactant at a rate of 0.05% v/v

Quackgrass control in peppermint near Jefferson, Oregon. Brewster, B.D., G. Gingrich, A.P. Appleby, and D.L. Kloft. Three herbicides were applied as repeated treatments for quackgrass control in peppermint. The quackgrass stand was very dense and had not been tilled for several years. The experimental design was a randomized complete block with four replications and 2.5 by 6 m plots. Carrier volume was 160 L/ha delivered at 172 kPa through XR 8003 flat fan nozzle tips. The first application was made on March 20, 1989, and the second on April 5. The quackgrass was about 10 cm tall and the peppermint about 5 cm tall when treated. A crop oil concentrate was added to each treatment at 2.3 L/ha. The treatments were evaluated three times.

None of the treatments caused visible injury to the peppermint. Quizalofop-ethyl was the most effective herbicide on the quackgrass with over 90% control 7 weeks after treatment. Clethodim was initially fairly good, but was much less effective than fluazifop-P-butyl in the final evaluation. (Department of Crop Science, Oregon State University, Corvallis, OR 97331)

Peppermint injury and quackgrass control with herbicides applied as repeated treatments[1]

		Evaluation[2]					
		1	2	3	1	2	3
Herbicide	Rate	Peppermint			Quackgrass		
	(kg a.i./ha)	---(% injury)--			--(% control)--		
fluazifop-P-butyl	0.21/0.21	0	0	0	86	96	81
clethodim	0.21/0.21	0	0	0	80	80	63
quizalofop-ethyl	0.21/0.21	0	0	0	89	95	94
check	0	0	0	0	0	0	0

[1]Applied on March 30 and April 5, 1989
[2]Evaluation 1 = April 12, 1989
2 = May 2, 1989
3 = May 23, 1989

Annual grass and broadleaf weed control evaluations in field potatoes. Arnold, R.N., E.J. Gregory and D. Smeal. Research plots were established on April 26, 1989 at the Agricultural Science Center, Farmington, New Mexico to evaluate the response of Centennial potatoes and annual grass and broadleaf weeds to herbicides. 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 CO_2 backpack sprayer calibrated to deliver 30 gal/A at 25 psi. Centennial potatoes were planted at 3000 lb/A on April 26, 1989. All treatments were applied preemergence surface on May 12, 1989 after drag-off and immediately incorporated with 0.75 in of sprinkler applied water. Prostrate pigweed (AMABL) and barnyardgrass (ECHCG) infestations were heavy to moderate and kochia (KCHSC), Russian thistle (SASKR), redroot pigweed (AMARE), and green foxtail (SETVI) infestations were light throughout the experimental area.

Visual evaluations of crop injury and weed control were made June 26, 1989. All treatments gave good to excellent control of SETVI, ECHCG, AMABL, and AMARE. Metolachlor and trifluralin applied at 1.5 and 0.75 lb ai/A were the only treatments that gave poor control of SASKR. KCHSC control was good to excellent with all treatments except metolachlor applied at 1.5 lb ai/A. Potato yields were 54 to 220 cwt/A higher in the herbicide treated plots as compared to the check. Fluorochloridone applied alone or in combination caused injury ratings of 30, 45, and 65, respectively. (Agricultural Science Center, New Mexcio State University, Farmington, N.M. 87499)

Weed control evaluations in field potatoes, 1989

Treatment	Rate lb ai/A	Crop Injury[1]	SETVI	ECHCG	AMABL	AMARE	SASKR	KCHSC	Yield cwt/A
		Weed Control[1] ---%							
trifluralin + metribuzin (pm)	0.75	0	100	100	100	100	100	100	473
trifluralin + metribuzin (pm)	1.5	3	100	100	100	100	100	100	423
metolachlor + metribuzin (pm)	1.5	0	100	100	100	100	100	100	510
metolachlor + metribuzin (pm)	3.0	5	100	100	100	100	100	100	468
pendimethalin + metribuzin	1.0 + 0.25	0	100	100	100	100	100	100	515
pendimethalin + metribuzin	2.0 + 0.5	2	100	100	100	100	100	100	473
metribuzin + fluorochloridone	0.25 + 0.25	30	100	100	100	100	100	100	406
metribuzin + fluorochloridone	0.5 + 0.5	65	100	100	100	100	100	100	349
metribuzin	0.38	0	100	100	100	100	100	100	493
metolachlor	1.5	0	100	100	92	100	63	73	475
pendimethalin	1.0	0	100	87	97	100	82	100	447
fluorochloridone	0.38	45	100	90	100	100	100	100	422
metribuzin	0.75	10	100	100	100	100	100	100	472
trifluralin	0.75	0	97	84	87	86	68	81	413
handweeded check		0	100	100	100	100	100	100	492
check		0	0	0	0	0	0	0	295
av weeds/m^2			4	10	23	7	4	4	
LSD 0.05			1.9	3.8	1.7	1.2	2.9	1.7	83

1. Based on a visual scale from 0-100 where 0 = no control or crop injury and 100 = dead plants
2. pm = packaged mix

Bentazon plus additives for hairy nightshade control in potatoes. Eberlein, C.V. and W.C. Schaffers. The objective of this study was to evaluate bentazon applied alone or with various additives for hairy nightshade control and crop phytotoxicity. Experiments were conducted under both weedy and weed-free conditions. In the weed control study, 'Russet Burbank' potatoes were seeded at 10-inch intervals in 36-inch wide rows on April 28, 1989 in a Declo loamy sand with 1.4% organic matter and pH 8.1 near Aberdeen, ID. The experimental area received a broadcast application of 180 lb/a N and 26 lb/a P prior to seeding, and an additional 60 lb/a N by injection through the sprinkler system during the growing season. The experimental design was a split-split plot with nightshade growth stages as main plots, bentazon rates as subplots, and additives as sub-subplots, with three replications. Sub-subplot size was 12 by 35 feet. The experimental area received trifluralin at 0.375 lb/a preplant incorporated and metribuzin at 0.125 lb/a early postemergence to control weeds other than nightshade. In the tolerance trial, 'Russet Burbank' potatoes were seeded as described previously on April 26, 1989 in a Declo silt loam with 1.3% organic matter and pH 8.2 near Aberdeen, ID. The experimental area received a broadcast application of 180 lb/a N and 86 lb/a P prior to seeding and 60 lb/a N by injection through the sprinkler system during the growing season. The experimental design was split-split plot with potato growth stages as main plots, bentazon rates as subplots, and additives as sub-subplots, with four replications. Sub-subplot size was 12 by 40 feet. Plots were maintained weed free with a preemergence application of pendimethalin + metribuzin at 1.0 + 0.25 lb/a and hand weeding as needed.

Bentazon at 0, 0.5, 0.75, and 1.0 lb/a with or without X-77, crop oil concentrate (COC), modified sunflower oil (MSO), Dash, or urea ammonium nitrate (UAN) was applied in the weed control studies. Bentazon at 0 or 1.0 lb/a with or without the same additives was applied in the tolerance trial. All herbicides were applied with a tractor-mounted plot sprayer which delivered 17.5 gpa at 30 psi. In the weed control trials, bentazon was applied on June 19 and June 26, 1989 when hairy nightshade was in the 2 to 3 leaf and 4 to 6 leaf stage, respectively. Hairy nightshade infestations averaged $14/ft^2$ on July 5, 1989. In the tolerance experiment, bentazon was applied on June 5 and June 12, 1989 when potatoes were 3 and 7 inches tall, respectively.

In the hairy nightshade control experiment, potato injury (7 DAT) increased as bentazon rates increased, regardless of the additive used (Table 1). Typical injury symptoms included leaf chlorosis, some leaf necrosis, and stunting of plant growth. In the potato tolerance trial, bentazon injury was greater with late than with early postemergence treatment (Table 2). With early postemergence application, bentazon plus additives did not cause more injury than bentazon applied alone, but with late postemergence application bentazon plus any of the additives tested caused 5 to 10% more injury than bentazon alone (Table 2).

Hairy nightshade control with bentazon at 0.5 lb/a was often better when bentazon was applied with an additive than when applied alone, and was best when bentazon was applied with MSO, Dash, or UAN (Table 3). In fact, bentazon at 0.5 lb/a plus MSO, Dash, or UAN gave better hairy nightshade control than bentazon alone at 1.0 lb/a. Therefore, it may be possible to reduce bentazon use rates and maintain good hairy nightshade control by using certain additives. Lowering the use rate could reduce the potential for bentazon injury to potatoes.

Yield of US #1 potatoes was not affected by additives, but was affected by bentazon rate in the weed control trial. Total yield of US #1 potatoes was lower than the weedy check when bentazon at 1.0 lb/a was used (Table 4). In contrast, bentazon at 1.0 lb/a did not reduce total yield of US #1 potatoes in the weed-free trial (Table 5). The difference in potato response to bentazon at 1.0 lb/a may have occurred because potatoes in the weed control trial were moderately damaged by a June frost (hairy nightshade was unaffected) while potatoes in the weed-free trial suffered no frost damage. These results suggest that there may be an interaction between environmental conditions and potato tolerance to bentazon. Therefore, additional studies on environmental influences on potato tolerance to bentazon should be conducted. (Aberdeen Research and Extension Center, University of Idaho, Aberdeen, ID 83210)

Table 1. Potato injury from bentazon plus additives in a hairy nightshade control experiment

Treatment	Rate	7 DAT	21 DAT
	(lb/a)	--------(%)-------	
Bentazon	0.0	0	0
Bentazon	0.5	14	8
Bentazon	0.75	22	10
Bentazon	1.0	32	17
LSD (0.05)		4	4

Table 2. Injury from bentazon plus additives applied at various rates to potatoes at two growth stages in a weed-free experiment

		Potato injury					
		7 DAT		14 DAT		28 DAT	
Treatment	Rate	3-in.	7-in.	3-in.	7-in.	3-in.	7-in.
	(lb/a)	----------------(%)------------------					
Bentazon	0	0	0	0	0	0	0
Bentazon + X-77	0 + 0.25%	0	0	0	0	0	0
Bentazon + COC[a]	0 + 1 qt/A	0	0	0	0	0	0
Bentazon + MSO[b]	0 + 1 qt/A	0	0	0	0	0	0
Bentazon + DASH	0 + 1 qt/A	0	0	0	0	0	0
Bentazon + UAN[c]	0 + 1 gal/A	0	0	0	0	0	0
Bentazon	1.0	15	24	11	24	7	21
Bentazon + X-77	1.0 + 0.25%	14	31	9	26	6	24
Bentazon + COC	1.0 + 1 qt/A	15	31	13	28	7	23
Bentazon + MSO	1.0 + 1 qt/A	17	29	11	24	8	23
Bentazon + DASH	1.0 + 1 qt/A	15	30	12	26	9	24
Bentazon + UAN	1.0 + 1 gal/A	16	34	11	28	9	25
LSD(0.05)		4		5		5	

[a]COC = crop oil concentrate
[b]MSO = modified sunflower oil (AGSCO SUN-IT)
[c]UAN = urea ammonium nitrate (32% N)

Table 3. Hairy nightshade control with bentazon plus additives

Treatment	Rate	Time of Evaluation	Hairy nightshade control: Additive					
			None	X-77	COC[a]	MSO[b]	DASH	UAN[c]
	(lb/a)		(%)					
Bentazon	0	7 DAT	0	0	0	0	0	0
Bentazon	0.5	7 DAT	79	84	93	98	98	98
Bentazon	0.75	7 DAT	89	92	98	99	99	99
Bentazon	1.0	7 DAT	92	97	99	99	99	98
LSD (0.05)						4		
Bentazon	0	21 DAT	0	0	0	0	0	0
Bentazon	0.5	21 DAT	78	85	89	96	98	98
Bentazon	0.75	21 DAT	89	96	98	98	99	99
Bentazon	1.0	21 DAT	90	97	99	99	98	97
LSD (0.05)						4		
Bentazon	0	77 DAT	0	0	0	0	0	0
Bentazon	0.5	77 DAT	72	73	82	89	89	91
Bentazon	0.75	77 DAT	77	77	89	92	91	90
Bentazon	1.0	77 DAT	80	92	93	94	93	89
LSD (0.05)						6		

[a]COC = crop oil concentrate at 1 qt/a
[b]MSO = modified sunflower oil at 1 qt/a
[c]UAN = urea ammonium nitrate (32% N)

Table 4. Yield of potatoes treated with bentazon plus additives in a hairy nightshade control experiment

Treatment	Rate	Potato yield: Total	<4oz	4 to 6 oz	6 to 12 oz	>12oz	Total US#1	US#2	Culls
	(lb/a)	(cwt/a)							
Bentazon	0.0	281	65	55	65	15	135	50	31
Bentazon	0.5	283	58	51	69	19	139	51	35
Bentazon	0.75	291	50	47	75	23	145	58	38
Bentazon	1.0	254	53	43	55	16	114	52	35
LSD(0.05)		14	10	NS	11	6	19	NS	NS

Table 5. Effect of bentazon plus additives on potato yield in a weed-free experiment

Treatment	Rate	Potato yield: Total	<4oz	4 to 6 oz	6 to 12 oz	>12oz	US#1	US#2	Culls
		(cwt/a)							
Bentazon	0	422	65	65	112	44	221	85	51
Bentazon	1.0	386	69	70	118	34	222	55	40
LSD(0.05)		NS	NS	NS	NS	6	NS	16	10

<u>Tolerance of Italian Ryegrass to Fenoxaprop.</u> Hassan, G. and George W. Mueller-Warrant. After the registration of Horizon 1EC (fenoxaprop) for the control of grasses in Italian ryegrass (LOLMU; <u>Lolium</u> <u>multiflorum</u> Lam.), severe injury was observed to 'Tetrone' variety of Italian ryegrass with the use of this herbicide. This suggested the possibility of differential response of various cultivars. Therefore, studies were undertaken under a greenhouse environment to evaluate the tolerance of 22 certified cultivars of Italian ryegrass to fenoxaprop during spring, 1988. Five rates of fenoxaprop were employed ranging from 0.05 to 0.25 lb a.i/acre at a 7- leaf, 2-tiller stage of the crop growth. The response of cultivars was evaluated as the proportionate fresh weight as compared to the check treatment. Growth reduction 50% (GR 50%) rates were evaluated from a regression analysis.

A wide array of genetic tolerance was found among the germplasm under reference (Table 1). A perusal of Table 1 reveals that the varieties 'Marshall' and 'Gulf' proved to be among the most tolerant and the varieties 'Minamewase' and 'Futahara' to be the most susceptible, respectively. Two samples of variety 'Sakurawase' from different seed lots showed variable results. But the findings of the subsequent greenhouse test confirmed its tolerance to fenoxaprop. The variety 'Tetrone' which had shown susceptibility to fenoxaprop in the field, fell in the middle of the rankings of varieties for tolerance with a GR50% of 0.15 lb a.i/acre. This rate is lower than the recommended application rate of 0.25 lb/acre in 1988. However, in the light of our findings and reported field injury, the label was subsequently modified in 1989 by reducing the recommended rate to 0.15 lb a.i/acre on the most tolerant varieties, and prohibiting its use on the more susceptible ones. (Crop Science Department, Oregon State University, Corvallis, OR 97331.)

Table 1. Tolerance of Italian ryegrass varieties to Fenoxaprop.

Variety	Fenoxaprop Rate causing GR50% (lb a.i /A)	Label use recommendation
Sakurawase	0.35	No
Marshall (common)	0.32	Yes
Promenade	0.29	Yes
Gulf	0.26	Yes
Barspectra	0.26	Yes
Torerro	0.25	No
Lemtal RVP	0.23	No
Florida 80	0.23	No
Florida Rust Resistant	0.20	No
Ellire	0.20	No
Hitachiaoba	0.18	No
Aubade	0.17	No
Biliken	0.16	No
Tetrone	0.15	No
TT80	0.14	No
Barmultra	0.13	No
Waseyutaka	0.12	No
Bartolini	0.10	No
Yamaaoba	0.08	No
Ace	0.07	No
Futahara	0.07	No
Minamewase	0.05	No

Comparison of formulations of phenmedipham plus desmedipham for weed control in sugarbeets. Norris, R.F. and R.A. Lardelli. Three new formulations of phenmedipham plus desmedipham were compared with the current commercial formulation for safety to sugarbeets and for control of redroot pigweed and common purslane on the Experimental Station at the University of California, Davis.

Sugarbeets were drill seeded June 9, 1989, and a mixture of redroot pigweed and common purslane seed was broadcast over the top of the bed and covered by raking. Postemergence treatments were applied with a CO_2 backpack hand sprayer using 8002LP nozzles delivering 30 gal/A of water. Treatments were applied on June 27 (18-day) when the sugarbeets were in the 2- and 4-leaf growth stage, and the redroot pigweed and common purslane were in the 2- to 4-leaf and 2- to 4-inch diameter rosette stages. A second set of plants, with only a slight difference in growth to the previous treatment, was treated on June 30 (21-day). A third set of plants was treated on July 5 (26-day) when the growth stages for the sugarbeet plants were in the 3- to 6-leaf and the same weeds were in the 3- to 8-leaf, respectively. High and low temperatures for the three treatment dates were 30 and 12 C, 23 and 13 C, and 32 and 12 C, respectively. Plot size was 2 beds (30 inch centers) by 8 ft.; all treatments were replicated four times in a randomized complete block design. Visual estimates of treatment effects were made on July 10 and July 24.

Sugarbeets showed 10 to 20% vigor reductions on July 10 with minor variations between treatments. Factorial analysis of variance showed no significant differences between formulations, with highly significant ($p = 0.001$ level or higher) injury reductions due to herbicide rate and sugarbeet stage of growth at treating. There were no significant differences in sugarbeet vigor in relation to treatments by the July 24 (data not presented) assessment date.

Weed control decreased between the two assessment dates, but significance in relation to the treatments did not change; only data for the July 24 assessment date are presented. Minor variations in weed control occurred within a rate but factorial analysis of variance showed no consistent difference (below $p = 0.1$ level) overall between formulations in relation to application rate or stages of growth. Control was not complete with any treatment; redroot pigweed was controlled to a slightly greater degree than purslane. (Botany Department, University of California, Davis, CA 95616.)

Table 1. Comparison of performance of four formulations of a mixture of phenmedipham plus desmedipham.

Plant	Age at treating	Rate	Weed control by formulation				
			1.3 EC	17.5% SC	70% WP	80% WG	Mean
	(days)	(lb a.i./A)	(%)				
Sugarbeet vigor[1/] (July 10)	18	0.65	86	79	75	89	82
	21		82	79	76	76	78
	26		89	86	86	85	87
	Mean						82
	18	1.00	84	82	74	82	81
	21		76	64	71	71	71
	26		84	79	81	84	82
	Mean						78
	18	1.30	81	80	80	71	78
	21		74	76	74	72	74
	26		70	80	81	74	76
	Mean						76
	Overall mean		81	78	78	78	
Redroot pigweed[2/] control (July 24)	18	0.65	52	30	62	30	44
	21		40	32	42	40	39
	26		22	45	38	10	29
	Mean						37
	18	1.00	49	69	68	55	60
	21		40	55	45	56	49
	26		32	28	18	42	30
	Mean						46
	18	1.30	72	70	54	50	62
	21		45	52	52	64	53
	26		50	35	32	45	41
	Mean						52
	Overall mean		45	46	46	44	
Common purslane[2/] control (July 24)	18	0.65	38	30	35	38	35
	21		32	15	48	25	30
	26		32	35	12	8	22
	Mean						29
	18	1.00	32	50	28	35	36
	21		58	58	48	65	57
	26		45	25	20	35	31
	Mean						41
	18	1.30	58	55	62	35	52
	21		50	48	52	55	51
	26		35	28	35	20	21
	Mean						44
	Overall mean		42	38	38	35	

1/ Vigor: 0 = dead; 100 = normal.
2/ Control: 0 = no control; 100 = complete control.

Herbicide evaluations for control of velvetleaf in sugarbeets. Norris, R.F. and R.A. Lardelli. Velvetleaf is becoming an increasingly severe problem in California sugarbeet production. This research was conducted at Davis CA, to evaluate the efficacy of preplant incorporated, postemergence or combined preplant incorporated/postemergence herbicide treatments for control of this weed.

The experiment was a randomized complete block design with three replications. Velvetleaf and sugarbeets were planted at a depth of 0.75 inches on May 24, 1989. Plots were 2 beds, 30 inches wide by 15 feet long. Carrier volume was 30 gal/A delivered at 30 psi pressure through 8002E flat fan nozzles. The preplant treatments were incorporated with a 2-row bed shaper to a depth of 2 to 3 inches. The postemergence treatments were initiated when the velvet-leaf was 2 to 3 inches tall and the sugarbeets were at the 2 to 4 true leaf growth stage.

Postemergence treatments of phenmedipham plus desmedipham, pyrazon plus dash adjuvant, and ethofumesate were applied as two split treatments 9 days apart starting on June 13, 1989. Plots were cultivated 2 times during the experiment. On June 6, 1989 the bed tops of all plots were treated with 0.40 lb ai/A of sethoxydim plus oil for grass control. On August 3, 1989, 1.5 meters (3 meters total) at each selected 2 row plots were harvested and fresh weight obtained. Visual weed control and sugarbeet damage evaluations were made on June 8, 18 and 29, 1989.

Competition from velvetleaf reduced sugarbeet vigor in all treatments that did not control the weed. Injury to sugarbeets resulting from herbicide application was small and could not be reliably determined in relation to suppression caused by weeds.

Barnyardgrass was present throughout the experimental area. The herbicides applied for the experiment varied in ability to control this weed (Table 1). The grass was killed in all plots following the June 8 assessment by overall application of sethoxydim. Common purslane likewise occurred throughout most the experimental area. Chemical control varied from none to complete; visual control estimations are provided in Table 1, and biomass yields for specific treatments are provided in Table 2. Variations in control of this weed modified the growth of sugarbeets and velvetleaf.

No herbicide provided complete control of velvetleaf. Preplant incorporated, or preplant followed by postemergence, treatments overall resulted in higher levels of control than only postemergence treatments. Cycloate was the most effective herbicide; combinations with pyrazon preplant incorporated were almost as effective. Preplant treatments of ethofumesate or diethatyl did not provide control of velvetleaf. Postemergence treatments of phenmedipham plus desmedipham, or endothall, showed no activity against the weed. Postemergence treatment of ethofumesate caused distortion of velvetleaf growth for about two weeks following treatment; this was reflected in the control ratings made June 29 (Table 1). Sample harvest of biomass made August 3, however, showed that velvetleaf treated with ethofumesate postemergence were larger than the plants in the untreated check (Table 2). (Botany Department, University of California at Davis, Davis, CA 95616)

Table 1. Herbicide evaluation of velvetleaf and common purslane control in sugarbeets.

Treatment[1]	PPI		Postemergence 0 Day	Postemergence 9 Day	Visual Evaluation[2,3] Sugarbeets 6/29	ABUTH 6/18	ABUTH 6/29	POROL 6/29	ECHCG 6/8
	Rate lb ai/a				(Vigor)	% Control			
Preplant-incorporated									
Cycloate	4.00				78	80	70	20	77
Ethofumesate	2.00				67	30	7	100	77
Pyrazon FL	3.15				78	40	40	57	0
Pyrazon FL	3.68				92	53	68	73	23
Diethatyl	3.00				63	37	23	0	90
Preplant-incorporated/postemergence									
Cycloate	4.00	Pyrazon + DASH	3.15 + 1.25%		75	85	80	80	77
Cycloate	4.00	Endothall + X-77	1.00 + 0.5%		70	70	67	43	63
Cycloate	4.00	Ethofumesate	1.00		87	70	83	87	87
Cycloate	4.00	Phenm/Desm	0.65	0.65	77	73	57	63	43
Ethofumesate	2.00	Pyrazon + DASH	3.15 + 1.25%		67	40	27	67	50
Ethofumesate	2.00	Endothall + X-77	1.00 + 0.5%		70	27	30	93	47
Ethofumesate	2.00	Ethofumesate	1.00		90	13	53	87	57
Ethofumesate	2.00	Phenm/Desm	0.65	0.65	67	13	0	67	57
Pyrazon FL	3.68	Pyrazon + DASH	3.15 + 1.25%		78	70	75	98	17
Pyrazon FL	3.68	Endothall + X-77	1.00 + 0.5%		77	50	60	77	0
Pyrazon FL	3.68	Ethofumesate	1.00		87	65	77	100	20
Pyrazon FL	3.68	Phenm/Desm	0.65	0.65	77	50	40	33	53
Diethatyl	3.00	Pyrazon + DASH	3.15 + 1.25%		70	30	43	43	97
Diethatyl	3.00	Endothall + X-77	1.00 + 0.5%		67	20	17	53	80
Diethatyl	3.00	Ethofumesate	1.00		80	40	65	100	97
Diethatyl	3.00	Phenm/Desm	0.65	0.65	63	23	0	43	87
Pyrazon Fl	3.15	Pyrazon + DASH	2.10 + 1.25%		75	55	57	80	50

[1]Treatments applied; PPI (May 24, 1989); Postemergence, 0 day, June 13,1989, 9 day, June 22, 1989.
[2]Abbreviations are WSSA code numbers from composite list of weeds, Weed Science 32, Suppl. 2.
[3]ABUTH = Velvetleaf
POROL = Purslane, common
ECHCG = Barnyardgrass

Table 1 continued

Treatment[1]	PPI		Postemergence 0 Day	Postemergence 9 Day	Visual Evaluation[2,3] Sugarbeets 6/29	ABUTH 6/18	ABUTH 6/29	POROL 6/29	ECHCG 6/8
	-----	-----	Rate lb ai/a	-----	(Vigor)	-----	% Control	-----	-----
Postemergence (9 day)									
		Phenm/Desm	0.65	0.65	67	0	0	0	0
		Pyrazon + DASH	1.85 + 1.25%		67	0	10	0	0
		Pyrazon + DASH	0.925 + 1.25%	0.925 + 1.25%	73	0	40	23	0
		Pyrazon + DASH	3.70 + 1.25%		57	13	17	0	0
		Pyrazon + DASH	1.85 + 1.25%	1.85 + 1.25%	70	7	47	17	0
		Ethofumesate	1.00		63	0	47	80	0
		Ethofumesate	1.50		73	0	47	72	0
		Ethofumesate	0.50	0.50	73	0	43	75	0
		Ethofumesate	0.75		75	0	50	80	0
		Endothall + X-77	1.00 + 0.5%		60	0	3	17	0
		Endothall + X-77	1.50 + 0.5%		63	0	3	33	0
		Pyrazon + DASH + Endothall	1.85 + 1.25% + 1.00		63	0	7	33	0
		Pyrazon + DASH + Endothall	3.70 + 1.25% + 1.00		70	0	17	0	0
		Ethofumesate + Endothall + X-77	1.00 + 1.00 + 0.5%		60	7	33	87	0
		Ethofumesate + Endothall + X-77	1.00 + 1.00 + 0.5%		60	10	27	93	0
Untreated check		Untreated check			63	13	0	0	0

[1]Treatments applied; PPI (May 24, 1989); Postemergence, 0 day, June 13,1989, 9 day, June 22, 1989.
[2]Abbreviations are WSSA code numbers from composite list of weeds, Weed Science 32, Suppl. 2.
[3]ABUTH = Velvetleaf
POROL = Purslane, common
ECHCG = Barnyardgras

Table 2. Herbicide impacts on sugarbeet and weed sample dry matters yields[1]

Treatment	Rate	Sugar beet tops		ABUTH	POROL
	--(lb ai/a)--	(kg)	(no)	(kg)	(kg)
<u>preplant incorporated</u>					
Cycloate	4.0	2.4 CDE	27	0.4 G	3.3 A
Pyrazon FL	3.68	5.3 A	20	0.7 FG	0 C
<u>preplant incorporated/postemergence[2]</u>					
Cycloate/pyrazon & DASH	4.00/3.15	3.0 BCD	19	0.4 G	0 C
Cycloate/Ethofumesate	4.00/1.00	4.6 A	23	0.5 G	0 C
PyrazonFL/pyrazonFL & DASH	3.68/3.15	3.9 ABC	16	0.6 F	0 C
PyrazonFL/Ethofumesate	3.68/1.00	3.9 ABC	28	0.9 EFG	0 C
<u>post emergence</u>					
Pyrazon & DASH	1.85	1.4 DEF	49	1.6 CD	1.8 B
Pyrazon & DASH	0.925/0.925	1.4 DEF	46	1.5 CDE	1.1 BC
Pyrazon & DASH	3.70	1.0 EF	41	1.4 CDE	1.3 B
Pyrazon & DASH	1.85/1.85	1.2 EF	46	1.1 DEF	1.7 B
Ethofumesate	1.00	1.3 EF	60	2.7 A	0.1 C
Ethofumesate	1.50	1.5 DEF	50	2.3 AB	0 C
Untreated check		0.6 F	49	1.8 BC	1.6 B

[1]sample size: 2 rows x 1.5 meter in center of plot, August 3, 1989.
[2]DASH = no foam herbicide activator; 1.25% of total spray volume.

Data, within a column, not followed by the same letter differs significantly at p = 0.05 level.

Postemergence Canada thistle control in sugarbeets. Miller, S.D. and K.J. Fornstrom. Research plots were established at the Research and Extension Center, Powell, Wyoming to evaluate Canada thistle control in sugarbeets with clopyralid and desmedipham plus phenmedipham, alone or in combination. Plots were established under furrow irrigation and were 9 by 20 ft. with three replications arranged in a randomized complete block design. Ethofumesate plus diethatyl (2+2 lb/A) was applied and incorporated over the entire experimental area prior to seeding sugarbeets (var. MonoHyD2) April 19, 1989. The soil in the experimental area was classified as a clay loam (40% sand, 29% silt and 31% clay) with 1.3% organic matter and pH 7.7. Postemergence treatments were applied with a CO_2-pressurized six-nozzle knapsack sprayer delivering 10 gpa at 40 psi May 24 (air temperature 46F, relative humidity 45%, wind NW at 14 mph, sky cloudy and soil temperature - 0 inch 56F, 2 inches 64F and 4 inches 60F) to 2-leaf sugarbeets and 2- to 3-inch Canada thistle rosettes, or May 31, 1989 (air temperature 66F, relative humidity 29%, wind NE at 8 mph, sky clear and soil temperature - 0 inch 88F, 2 inches 68F and 4 inches 60F) to 4- to 6-leaf sugarbeets and 3-to 6-inch Canada thistle rosettes. All weeds but Canada thistle were removed several times throughout the growing season. Sugarbeet stand and Canada thistle populations were determined June 28, Canada thistle control visually evaluated July 26 and plots harvested September 21, 1989. Canada thistle densities averaged 1.1 plant/ft. row in a 3-inch band in the untreated check.

No sugarbeet injury or stand reduction was observed with any treatment. Canada thistle control with the various clopyralid treatments ranged from 70 to 95%. Sugarbeet yields related closely to Canada thistle control and were 7.7 to 10.3 T/A higher in plots treated with clopyralid than in the untreated check. Based on regression analysis, sugarbeet yields were reduced 0.4 T/A (R^2 = 0.99) and percent sucrose 0.044% (R^2 = 0.87) for each 1000 Canada thistle plants/A. (Wyoming Agric. Exp. Sta., Laramie, WY 82071 SR 1613)

Sugarbeet response and Canada thistle control with postemergence herbicide treatments.

Treatment[1]	Rate	Sugarbeets[2]					Canada thistle[3] % control	
	lb ai/A	Inj %	Init SR %	Harvest Std 1000 pl/A	Sucrose %	Yield T/A	June	July
Desm+phen/desm+phen	0.38/0.38	0	0	24.5	14.8	9.5	0	0
Desm+phen/desm+phen	0.5/0.5	0	0	25.3	14.9	10.2	23	0
Desm+phen/desm+phen+clop	0.38/0.38/0.094	0	0	34.0	16.1	17.4	70	78
Desm+phen/desm+phen+clop	0.5/0.5+0.094	0	0	33.3	16.0	17.4	75	80
Desm+phen/desm+phen+clop	0.38/0.38+0.19	0	0	33.3	15.7	19.7	90	95
Desm+phen/desm+phen+clop	0.5/0.5+0.19	0	0	28.6	15.8	19.2	88	90
Desm+phen	0.75	0	0	23.8	15.0	9.5	0	0
Desm+phen	1.0	0	0	25.3	15.0	10.0	20	0
Desm+phen+clop	0.75+0.094	0	0	24.5	15.9	17.1	72	72
Desm+phen+clop	1.0+0.094	0	0	31.6	15.8	17.2	72	70
Desm+phen+clop	0.75+0.19	0	0	26.9	15.8	19.5	87	85
Desm+phen+clop	1.0+0.19	0	0	32.4	16.0	19.0	90	85
Clopyralid (clop)	0.094	0	0	31.6	15.9	17.8	77	73
Clopyralid	0.19	0	0	26.2	15.8	19.1	88	85
Weedy check	---------------	0	0	26.2	15.1	9.4	0	0
Plants/ft. row 3-inch band		--	1.2	1.1	----	----	1.1	--

[1]Treatments before/applied May 24, all other treatments applied May 31, 1989.
[2]Crop stand counts (SR = stand reduction) and visual injury evaluated June 28 and plots harvested September 21, 1989.
[3]Weed counts determined June 28 and visual evaluations July 26, 1989.

Tolerance of four triticale varieties to seven wild oat herbicides. Mallory-Smith, C.A., M.J. Dial, and D.C. Thill. Triticale tolerance to seven wild oat herbicides was evaluated. Four varieties of triticale, Juan, Nutrical, Grace, and Whitman, were planted April 28, 1989 at the University of Idaho Plant Science Farm near Moscow, Idaho. The plot area was wild oat free. Experimental design was a split block with four replications. Plots were 10 by 20 ft. Treatments were applied with a CO_2 pressurized backpack sprayer calibrated to deliver 10 gal/a at 40 psi and 3 mph. Triallate was applied 24 hr after seeding and was incorporated once with a harrow immediately after application. Other wild oat herbicides were applied May 26, when the triticale was in the 4-lf to 1-tiller stage. June 6, clopyralid/2,4-D (0.6 lb ai/a) was applied for broadleaf weed control. Application and edaphic data are presented in Table 1. June 8, crop injury, which included shortening and thinning of the crop, was evaluated visually (Table 2). Triticale was harvested September 8.

Table 1. Application and edaphic data

	Triallate	Other herbicides
Treatment date	4/29/89	5/26/89
Air temperature (F)	68	40
Soil temperature at 2 in. (F)	68	49
Relative humidity (%)	39	88
Soil texture	silt loam	
organic matter (%)	2.9	
pH	5.	
CEC (meq/100 g)	18.2	

Nutrical was injured more by barban but less by HOE7113 than were the three other varieties (Table 2). Grace was injured less by HOE7125 than were the other varieties. Averaged over varieties, barban, HOE7113, and HOE7125 injured the crop 28, 39, and 82%, respectively. However, this injury was not reflected by a similar reduction in grain yield (Table 3). There was no variety by herbicide interaction effect on yield. Environmental conditions may have allowed the crop to outgrow the injury. August was unusually cool and wet. HOE7125 had the greatest effect on grain yield, producing 68 bu/a compared to 80 bu/a in the untreated check. Grain yield was different among the varieties (Table 4). In 1988, crop injury was similar to the 1989 study but there was a greater reduction in grain yield (See 1988 WSWS Progress Reports pp 68-69). (Idaho Agricultural Experiment Station, Moscow, Idaho 83843)

Table 2. Crop injury for the variety by herbicide interaction

Herbicide	Grace	Whitman	Juan	Nutrical	Mean[a]
	--------------Variety------------				
	---------------(% of control)---------------				
triallate	0[b]	0	0	0	0
barban	18	23	20	50	28
imazamethabenz	0	0	0	0	0
difenzoquat	3	10	8	3	6
diclofop	0	0	5	0	1
HOE7125	65	90	90	83	82
HOE7113	33	65	43	15	39
Mean[c]	17	27	24	22	

[a]LSD (0.05) = 5 for herbicide
[b]LSD (0.05) = 10 for variety by herbicide
[c]LSD (0.05) = 4 for variety

Table 3. Grain yield averaged across triticale varieties

Herbicide	Rate	Grain yield
	(lb ai/a)	(bu/a)
check	--	80
triallate	1.25	76
barban	0.38	73
imazamethabenz	0.47	81
difenzoquat	1.00	75
diclofop	1.00	75
HOE7125	0.66	68
HOE7113	0.20	77
LSD (0.05)		5

Table 4. Grain yield averaged across herbicide treatments

Variety	Grain yield (bu/a)
Juan	86
Grace	77
Whitman	76
Nutrical	64
LSD (0.05)	4

Broadleaf weed control in dryland wheat. Wright, S. D., and W. J. Steele. Thiameturon and DPX-9674 were evaluated for weed control when tank-mixed with very low rates of commercially used herbicides.

The experiment was a randomized complete block design with four replications. Plots were 6.33 ft wide by 25 ft long. Water volume was 20 gpa delivered at 27 psi through 8002 flat fan nozzles. Air temperature was 62^{O}F. Herbicides were applied on February 27, 1989, to Yecora Rojo wheat in late tillering (6 to 8 inches tall). Coastal fiddleneck was 1 to 8 inches tall with some flowering. Burning nettle and shepherd's purse were 1 to 4 inches tall.

Visual evaluations were conducted on March 23, 1989, when wheat was 12 to 18 inches tall and was in the boot stage. Both wheat and weeds were drought stressed. By April 4, 1989, all weeds were dead regardless of treatments including the check.

The addition of bromoxynil at 1.0 oz and 2.0 oz ai to thiameturon or DPX-9674 slightly increased control of fiddleneck and shepherd's purse. DPX-9674 plus MCPA or 2,4-D at 4.0 and 6.0 oz ai enhanced control of shepherd's purse, and burning nettle. Thiameturon + MCPA or 2,4-D at 4.0 and 6.0 oz ai increased control of burning nettle and shepherd's purse. Bromoxynil alone at .37 lb ai gave the most complete control of fiddleneck and shepherd's purse. 2,4-D at .75 lb ai gave the greatest control of burning nettle. Because of lack of rainfall weeds were not competitive enough to reduce yields in this test. Subsequently there were no significant differences in grain yield or bushel weights. (University of California Cooperative Extension, Visalia, CA 93291 and E. I. DU PONT De Nemours, Fresno, CA 93704).

Table 1. WEED CONTROL AT DUCOR, CALIFORNIA

Treatment	oz. ai/A	% CONTROL Fiddleneck X	Burning Nettle X	Shepherd's Purse X
1. DPX-9674 75DF	.075	80	42	77
2. DPX-9674	.15	78	50	85
3. DPX-9674	.225	83	50	87
4. DPX-9674 + bromoxynil	.225 + 1.0	98	49	95
5. DPX-9674 + bromoxynil	.225 + 2.0	100	60	94
6. DPX-9674 + MCPA	.225 + 4.0	85	70	97
7. DPX-9674 + MCPA	.225 + 4.0	85	80	93
8. DPX-9674 + 2,4-D	.225 + 6.0	90	60	95
9. DPX-9674 + 2,4-D	.225 + 4.0	90	90	95
10. thiameturon 75DF	.125	88	57	83
11. thiameturon	.25	90	38	75
12. thiameturon + bromoxynil	.25 + 1.0	93	53	85
13. thiameturon + bromoxynil	.25 + 2.0	100	55	90
14. thiameturon + MCPA	.25 + 4.0	88	65	90
15. thiameturon + MCPA	.25 + 6.0	85	80	90
16. thiameturon + 2,4-D	.25 + 4.0	88	60	97
17. thiameturon + 2,4-D	.25 + 6.0	95	90	95
18. bromoxynil	.37 lb.	100	53	100
19. MCPA	.75 lb.	43	75	88
20. 2,4-D (amine)	.75 lb.	60	95	90
21. check	.00	0	5	0

X-77 @.25% v/v mixed with thiameturon and thiameturon DPX-9674 treatments.

Table 2. WHEAT YIELD AND BUSHEL WEIGHTS AT DUCOR, CALIFORNIA

Treatment	Yield Lbs/A	Bu.Wt. Lbs/A
1. DPX-9674 75DF	526	60.0
2. DPX-9674	544	56.9
3. DPX-9674	587	58.4
4. DPX-9674 + bromoxynil	446	58.2
5. DPX-9674 + bromoxynil	569	56.6
6. DPX-9674 + MCPA	381	56.1
7. DPX-9674 + MCPA	545	58.8
8. DPX-9674 + 2,4-D	433	58.2
9. DPX-9674 + 2,4-D	539	56.7
10. thiameturon 75D	435	58.4
11. thiameturon	438	56.3
12. thiameturon + bromoxynil	496	58.4
13. thiameturon + bromoxynil	497	56.3
14. thiameturon + MCPA	528	54.7
15. thiameturon + MCPA	548	58.0
16. thiameturon + 2,4-D	384	57.4
17. thiameturon + 2,4-D	477	58.6
18. bromoxynil	525	59.6
19. MCPA	691	59.8
20. 2,4-D (amine)	585	58.4
21. check	503	56.7
$LSD_{.05}$	NS	NS

Broadleaf weed control in spring wheat. Arnold, R.N., E.J. Gregory and D. Smeal. Research plots were established on April 3, 1989 at the Agricultural Science Center to evaluate the response of Quantum 906R and annual broadleaf weeds to selected postemergence herbicides. The experimental design was a randomized complete block with four replications. Individual plots were 20 by 30 ft in size. Treatments were applied with a CO_2 backpack sprayer calibrated to deliver 30 gal/A at 25 psi. Treatments were applied with a COC at 0.25% v/v on May 4, 1989. Prostrate and redroot pigweed infestations were heavy with Russian thistle and kochia infestations moderate throughout the experimental area.

Visual evaluations of crop injury and weed control were made June 26, 1989. Broadleaf weed control was excellent with all treatments. Spring wheat yields were 20 to 26 bu/A higher in herbicide treated plots than in the check. (Agricultural Science Center, New Mexico State University, Farmington, N.M. 87499)

Herbicide evaluations for broadleaf weed control in spring wheat

Treatment	Rate oz ai/A	Crop[1] Injury	---------Weed Control[1]---------				Yield bu/A
			AMABL	AMARE	KCHSC	SASKR	
DPX-R9674	0.225	0	100	100	100	100	96
DPX-T6376	0.06	0	100	100	100	100	90
DPX-R9674	1.35	0	100	100	100	100	92
DPX-R9674	0.90	0	100	100	100	100	92
DPX-R9674	0.45	0	100	100	100	100	94
check		0	0	0	0	0	70
LSD 0.05			ns	ns	ns	ns	9

1. Based on a visual scale from 0-100, where 0 = no control or crop injury and 100 = dead plants.

Broadleaf weed control in spring wheat. Arnold, R.N., E.J. Gregory and M.W. Murray. Research plots were established on April 3, 1989 at the Agricultural Science Center, Farmington, New Mexico to evaluate the efficacy of sulfonyl urea herbicides for control of annual broadleaf weeds in spring wheat (var. Quantum 906R). Soil type was a Wall sandy loam with a pH of 7.8 and an organic matter content of less than 1%. Individual plots were 10 by 30 ft in size with four replications arranged in a randomized complete block design. Treatments were applied with a CO_2 backpack sprayer calibrated to deliver 30 gal/A at 25 psi. Treatments were applied on May 4, 1989 when weeds were small and wheat was 3-4 in height. Plots were harvested for yield August 9, 1989 with a self-propelled plot combine. Weed infestations were moderate throughout the experimental area.

Visual evaluations of crop injury and weed control were made June 26, 1989. All treatments provided excellent control of broadleaf weeds. DPX-R9674 at 0.3 oz ai/A plus Uran 32 at 5 gal/A plus COC was the only treatment to significantly reduce yield. Spring wheat yields were 20 to 36 bu/A higher in herbicide treated plots than in the check. (Agricultural Science Center, New Mexico State University, Farmington, N.M. 87499)

Broadleaf weed control in spring wheat

Treatment[1]	Rate oz ai/A	Crop[2] Injury	Weed Control[2] KCHSC	AMARE	AMABL	SASKR	Yield bu/A
		%					
DPX-R9674	0.15	0	100	100	100	100	110
DPX-R9674	0.3	0	100	100	100	98	103
DPX-R9674	0.45	0	100	100	100	100	102
DPX-L5300 + Uran 32[4]	0.187 + 5[3]	0	100	100	100	100	102
DPX-L5300	0.25	0	100	100	100	98	101
DPX-R9674 + Uran 32[4]	0.3 + 5[3]	0	100	100	100	100	100
DPX-L5300	0.125	0	100	100	97	100	100
DPX-L5300 + Uran 32	0.187 + 5[3]	0	100	100	100	100	100
DPX-T6376	0.06	0	100	100	100	100	99
DPX-R9674 + Uran 32	0.3 + 5[3]	5	100	100	100	100	94
Handweeded check			100	100	100	100	100
check			0	0	0	0	74
LDS 0.05			ns	ns	ns	ns	5

1. Surfel a COC was applied at 0.25% v/v
2. Based on a visual scale from 0 to 100 where 0 = no control or crop injury and 100 = dead plants
3. Uran 32 a nitrogen solution was applied at 5 gal/A
4. A COC was not added

Wild oats control in spring wheat. Miller, S.D. and R. Hybner. Research plots were established at the Research and Extension Center, Sheridan, Wyoming to evaluate wild oats control with postemergence herbicides applied at several growth stages. Plots were established on nonirrigated land and were 9 by 30 ft. with three replications arranged in a randomized complete block. Spring wheat (var. Newana) was seeded May 2, 1989 in a loam soil (49% sand, 27% silt and 24% clay) with 1.6% organic matter and pH 6.3. Herbicide treatments were applied broadcast with a CO_2-pressurized six-nozzle knapsack sprayer delivering 10 gpa at 40 psi May 16 (air temperature 66F, relative humidity 54%, wind S at 5 mph, sky clear and soil temperature - 0 inch 80F, 2 inches 60F and 4 inches 56F) to 2-leaf spring wheat and 1- to 2-leaf wild oats, or May 30, 1989 (air temperature 55F, relative humidity 65%, wind NW at 4 mph, sky clear and soil temperature - 0 inch 60F, 2 inches 60F and 4 inches 57F) to 4-leaf wheat and wild oats. Visual weed control, crop damage and plant height measurements were made July 25 and plots harvested August 10, 1989. Wild oats (AVEFA) infestations were light but uniform throughout the experimental area.

No treatment reduced crop stand; however, slight (3 to 7%) injury was observed with several treatments. Wild oats control exceeded 90% with all herbicide treatments except diclofop and difenzoquat. Formulation did not influence wild oats control with imazamethabenz. Wheat yield in herbicide-treated plots was not different from wheat yield in the weedy check. (Wyoming Agric. Exp. Sta., Laramie, WY 82071 SR 1625)

Wild oats control in spring wheat.

Treatment[1]	Rate lb ai/A	Spring wheat[2] Inj %	SR %	Height inches	Yield bu/A	Control[3] AVEFA %
1- to 2-leaf						
Imazamethabenz(LC)	0.375	0	0	24	26	93
Imazamethabenz+X-77	0.375+0.25%	0	0	23	23	99
Imazamethabenz+oc	0.375+1qt	0	0	23	25	100
Imazamethabenz+Sunit	0.375+1qt	0	0	24	27	100
Imazamethabenz	0.47	0	0	24	24	97
Imazamethabenz+X-77	0.47+0.25%	0	0	24	24	100
Imazamethabenz(SC)	0.375	0	0	23	24	92
Imazamethabenz+X-77	0.375+0.25%	0	0	24	27	100
Imazamethabenz+oc	0.375+1qt	0	0	24	24	100
Imazamethabenz+Sunit	0.375+1qt	0	0	24	28	100
Imazamethabenz	0.47	0	0	23	25	95
Imazamethabenz+X-77	0.47+0.25%	0	0	24	26	100
HOE-6001-02H	0.08	0	0	24	25	92
HOE-6001-02H	0.12	0	0	24	24	98
Diclofop+oc	0.75+1qt	0	0	23	25	75
Diclofop+Sunit	0.75+1qt	0	0	23	25	78
Diclofop+oc	1.0+1qt	7	0	24	24	85
4-leaf						
Difenzoquat+X-77	0.75+0.25%	3	0	24	26	57
Difenzoquat+X-77	1.0+0.25%	3	0	23	23	67
HOE-6001-02H	0.08	0	0	24	29	98
HOE-6001-02H	0.12	3	0	24	24	100
HOE-7125	0.66	3	0	24	26	97
HOE-7125	0.78	3	0	24	25	100
Imazamethabenz+X-77	0.375+0.25%	0	0	23	27	93
Imazamethabenz	0.47	0	0	24	25	93
Imazamethabenz+X-77	0.47+0.25%	0	0	23	25	98
Weedy check	------------	0	0	24	24	0

[1]Treatments applied May 16 and 30, 1989; oc = At Plus 411F.
[2]Wheat injury (Inj), stand reduction (SR) and plant height measurements July 25, and plots harvested August 10, 1989.
[3]Wild oats control visually evaluated July 25, 1989.

Kochia control in spring wheat. Rydrych, D.J. Kochia (*Kochia scoparia* L. Schrad) is a serious weed competitor in grain fields in eastern Oregon. It is able to grow in saline soils and can germinate repeatedly throughout the growing season. Kochia is difficult to control when non-residual herbicides are used and can germinate several weeks later when rainfall or supplemental irrigation is available. Research was conducted in Union County on silt loam soils that exceeded pH 7.5. Spring wheat (Owens) was tested for tolerance to several herbicides and was planted in a split-plot experimental design with three replications. Herbicides were applied post-emergence on May 5, 1988, when spring wheat had two to three tillers with six to eight leaves. Kochia had 8 to 10 leaves and was .5 to 1 in. diameter. Weed control was evaluated in June and the results are recorded in the table. Since other crops are used in the rotation such as potatoes and legumes, the analogs of Harmony such as chlorsulfuron cannot be commercially used in the area. The treatments controlled Kochia for the entire season. Harmony and bromoxynil mixtures were the most effective compounds based on total yield, Kochia control, and spring wheat safety. Some injury was observed in the Harmony mixtures and Harmony Extra. Metribuzin was also effective when combined with bromoxynil. The metribuzin-Harmony mixture was overly active on spring wheat in this series. Metribuzin gave excellent residual control which is essential for late season Kochia germination. (Oregon State University, CBARC, Pendleton, OR 97801.)

Kochia control in spring wheat - LaGrande, OR 9788

Treatment[1]	Rate	Kochia control	Crop Injury	Avg. wheat yield
	oz (or) lb/A	%	%	lb/A
Harmony	.50 oz	99	0	5160
Harmony + dicamba	.33 oz + 2 oz	98	4	4690
Harmony Plus	.50 oz	97	4	4990
Metribuzin + Harmony	.25 lb + .25 oz	99	0	4560
Metribuzin + Bromoxynil	.25 lb + .25 lb	98	0	5310
Bromoxynil + MCPA	.38 lb + .38 lb	80	0	5290
Weedy check	----	0	0	3440

[1]Treated post - May 5, 1988, Spring wheat (Owens) 6 to 8 leaf, 2 to 3 tiller
Kochia - 21 plants/ft^2, 8 to 10 leaf, .50 to 1 in. diameter

Jointed goatgrass cultural and chemical control in winter wheat. Rydrych, D.J. Jointed goatgrass is a serious problem in the wheat producing areas of the Pacific Northwest and eastern Oregon. Cultural and chemical methods have been tested that can make our crops more competitive with jointed goatgrass. A series of experiments were established on the Pendleton Station in 1985 to test the effectiveness of cultural and chemical treatments on jointed goatgrass. A split-plot experimental design was used with four replications on a Walla Walla silt loam soil (pH 6.2, OM 1.9%). The most effective cultural control is spring planted crops. Double fallow followed by winter wheat has proved to be over 94% effective on jointed goatgrass competition. No-till can be up to 97% effective if assisted by selective herbicides. Annual crop cereal rotations provide poor jointed goatgrass competition even when herbicides are used. The most effective selective herbicide for jointed goatgrass control in winter wheat is ethiozin. A portion of this research is recorded in the table. Several of the management systems when combined with a chemical control gave good jointed goatgrass competition. Total eradication would not be possible unless a long term spring crop system was practiced. (Oregon State University, CBARC, Pendleton, OR 97801.)

Goatgrass cultural and chemical control in winter wheat using ethiozin

Treatment*	Goatgrass control	Crop injury	Grain yield
	%	%	lb/A
Conventional (fallow)	85	0	5030
Conventional (annual crop)	65	1	3290
Double fallow	94	0	6690
No-till (fallow)	97	0	4820
Spring crop	100	0	2370

*All systems except spring crop received ethiozin @ 1.50 lb/A. Treatments applied PPS (October 10, 1988) and planted immediately.

Weed control in winter wheat with preplant incorporated and postplant, preemergence, surface applied herbicides. Dial, M.J. and D.C. Thill. Triallate was applied preplant incorporated (PPI) alone and in tank mix combination with MON-11611 or chlorsulfuron during the fall, 1988. Treatments were incorporated once immediately after the herbicide application, with a rod weeder and spring tine harrow. DPXM6316 + bromoxynil treatments were applied as early spring (ESPRI) sequential treatments. Another herbicide experiment was established immediately adjacent to the triallate experiment to determine broadleaf weed control with UBI-C4243 applied postplant preemergence (PES) in fall 1988. In both experiments the winter wheat variety was Stephens. All treatments were applied with a CO_2 pressurized backpack sprayer calibrated to deliver 10 gal/a at 40 psi and 3 mph (Table 1). Treatments were arranged in a randomized complete block design replicated four times. Experiments were located near Potlatch, Idaho. Treatments were evaluated for percent weed control June 6, 1989. The plots were not harvested for grain yield because of a high infestation of field brome (BROAV).

Table 1. Application data

Application type	(PPI)	(ESPRI)	(PES)	(ESPRI)
Application date	Sep. 29, 1988	May 4, 1989	Oct. 3, 1988	May 4, 1989
Air temperature (F)	75	75	70	75
Soil temperature (F)	66	65	76	65
Relative humidity (%)	40	42	48	42
Wind speed-direction	3-W	3-W	3-E	3-W
Soil pH		5.3		
OM (%)		3.2		
Texture		silt loam		
CEC(meq/100g soil)		17.1		

DPXM6316 + bromoxynil controlled mayweed chamomile (ANTCO) 86 to 95 percent (Table 2). MON11611 and chlorsulfuron controlled 43 to 80 percent of the mayweed chamomile. Triallate applied alone did not control mayweed chamomile. All treatments except triallate alone controlled field pennycress (THLAR). Triallate + chlorsulfuron applied at 1.25 + 0.008 lb ai/a, respectively, and triallate alone controlled common lambsquarters (CHEAL) less than DPXM6316 + bromoxynil (Table 2). None of the herbicide treatments controlled field brome (data not shown).

All UBI-C4243 and DPXM6316 + bromoxynil treatments controlled broadleaf weeds equally (Table 3). No visible crop injury symptoms were observed (data not shown). None of the herbicide treatments controlled field brome (data not shown). (Idaho Experiment Station, Moscow, Idaho 83843)

Table 2. Broadleaf weed control with triallate tank mix combinations in winter wheat

Treatment	Rate	Time[1] of application	Control[2] ANTCO	THLAR	CHEAL
	(lb ai/a)		------(% of check)------		
check	----	---	---	---	---
triallate +	1.25	PPI	76	89	89
MON11611	0.008				
triallate +	1.25	PPI	80	88	76
MON11611	0.012				
triallate +	1.25	PPI	66	76	85
MON11611	0.016				
triallate +	1.25	PPI	76	83	73
chlorsulfuron	0.008				
triallate +	1.25	PPI	43	84	80
chlorsulfuron	0.012				
triallate +	1.25	PPI	65	85	84
chlorsulfuron	0.016				
triallate +	1.25	PPI	86	94	91
DPXM6316 +	0.0234	ESPRI			
bromoxynil +	0.25				
surfactant[3]	0.25%				
triallate	1.25	PPI	56	63	70
DPXM6316 +	0.0234	ESPRI	95	95	95
bromoxynil +	0.25				
surfactant	0.25%				
LSD (0.05)			23	17	17
Weed density (no./ft^2)			6	10	7

[1]Application time refers to; (PPI) preplant incorporated and (ESPRI) early spring.
[2]Visual estimate of percent reduction in plant density compared to the check.
[3]Surfactant is R-11; rate is expressed as % v/v.

Table 3. Preemergence broadleaf weed control with UBI-C4243

Treatment	Rate	Time[1] of application	control[2] ANTCO	THLAR	CHEAL
	(lb ai/a)		-------(% of check)		------
check	---	----	---	---	---
UBI-C4243	0.063	PES	98	97	97
UBI-C4243	0.111	PES	93	94	94
UBI-C4243	0.125	PES	95	95	95
DPXM6316 +	0.0234	ESPRI	94	94	94
bromoxynil +	0.25				
surfactant[3]	0.25%				
LSD (0.05)			ns	ns	ns
Weed density (no./ft^2)			5	10	6

[1]Time of application; (PES) preemergence surface, (ESPRI) early spring.
[2]Visual estimate of percent reduction in plant density compared to the check.
[3]Surfactant was R-11; rate is expressed as % v/v.

Broadleaf weed control in winter wheat with CGA-131036 and DPXR9674 tank mixtures. Dial, M.J. and D.C. Thill. CGA-131036 was evaluated for broadleaf weed control, applied alone and in tank mix combinations, to winter wheat on a conventually cultivated site near Nezperce, Idaho. DPXR9674 applied alone and in combination was evaluated for control of *Lepyrodiclis holosteoides* in winter wheat seeded on a conventionally cultivated site north of Uniontown, Washington. At both locations the Stephens winter wheat was fully tillered and had developed 2 inch adventitious roots prior to application of the herbicide treatments. The predominant broadleaf weeds at Nezperce were flixweed (DESSO), corn gromwell (LITAR), and catchweed bedstraw (GALAP). The flixweed was 4 inches in diameter, corn gromwell had four leaves and was 5 inches tall, and the catchweed bedstraw was emerging to 5 inches tall and branching. The *L. holosteoides* was just emerging to 5 inches tall and three leaves. Herbicide treatments were applied with a CO_2 pressurized backpack sprayer calibrated to deliver 10 gal/a at 41 psi and 3 mph (Table 1). Treatments were arranged in a randomized complete block design, replicated four times. Herbicide efficacy was estimated visually May 17 at Nezperce and May 26 at Uniontown. Grain yield was not measured.

Table 1. Application data

Location	Nezperce	Uniontown
Date of application	April 16	April 30
Air temperature (F)	59	60
Soil temperature at 2 in. (F)	58	62
Relative humidity (%)	62	48
Wind speed-direction	4-W	4-N
Soil pH	5.9	5.7
OM (%)	7.0	3.2
Texture	silt loam	silt loam
CEC(meq/100 g soil)	30.0	21.4

Bromoxynil applied alone was not as effective controlling flixweed as the other herbicide treatments (Table 2). All herbicide treatments controlled corn gromwell 89% or greater. Catchweed bedstraw was controlled 91% or greater with DPXR9674 and CGA-131036 + diuron.

All herbicide treatments controlled *L. holostoides* 93% or greater (Table 3). (Idaho Experiment Station, Moscow, Idaho 83843)

Table 2. Broadleaf weed control with CGA-131036 in winter wheat

Treatment[1]	Rate	Control[2] DESSO	LITAR	GALAP
	(lb ai/a)	(-----% of check-----)		
check	------	---	---	---
CGA-131036	0.0089	95	92	83
CGA-131036	0.0134	89	94	88
bromoxynil/MCPA	0.375	94	95	70
bromoxynil	0.375	80	95	74
DPXR9674	0.0156	89	95	91
CGA-131036 + bromoxynil/MCPA	0.0089 0.25	95	95	80
CGA-131036 + bromoxynil	0.0089 0.25	95	90	88
CGA-131036 + diuron	0.0089 0.6	95	95	93
CGA-131036 + MCPA Na^+ salt	0.0089 0.5	95	93	70
CGA-131036 + MCPA ester	0.0089 0.5	93	90	76
CGA-131036 + dicamba	0.0089 0.125	95	90	76
CGA-131036 + clopyralid/2,4-D	0.0089 0.4	95	89	74
CGA-131036 + clopyralid/MCPA	0.0089 0.4	94	94	74
CGA-131036 + pyridate	0.0089 0.9	88	94	83
CGA-131036 + metribuzin	0.0089 0.25	89	94	81
LSD (0.05)		8	ns	10
weed density (no./ft^2)		8	12	4

[1]Surfactant was R-11; a nonionic surfactant, added to all treatments, rate was 0.25 % v/v.
[2]Visual estimate of percent reduction in plant density compared to the check.

Table 3. Herbicide control of *Lepyrodiclis holosteoides* in winter wheat

Treatment[1]	Rate	Control[2]
	(lb ai/a)	(% of check)
check	------	---
DPXR9674	0.0141	95
DPXR9674	0.0281	98
metsulfuron	0.0039	98
bromoxynil/MCPA	0.375	97
DPXR9674 + bromoxynil	0.0141 0.1875	98
DPXR9674 + bromoxynil	0.0141 0.1875	98
DPXR9674 + pyridate	0.0141 0.9	98
DPXR9674 + clopyralid/MCPA	0.0141 0.4	96
DPXR9674 + clopyralid/2,4-D	0.0141 0.4	93
DPXR9674 + diuron	0.0141 0.6	98
DPXR9674 + metribuzin	0.0141 0.25	95
DPXR9674 + 2,4-D	0.0141 0.25	96
metsulfuron + 2,4-D	0.0039 0.75	98
metsulfuron + DPXR9674 + 2,4-D	0.0039 0.0141 0.75	96
LSD (0.05)		ns
weed density (no./ft^2)		10

[1]Surfactant was R-11; a nonionic surfactant, added to DPXR9674 and metsulfuron treatments, rate was 0.25 % v/v. 2,4-D formulation was LVE ester.

[2]Visual estimate of percent reduction in plant density compared to the check.

Broadleaf weed control with V-23121 applied at two growth stages on winter wheat. Dial, M.J. and D.C. Thill. V-23121 was applied on Stephens winter wheat in two seperate experiments. One was applied to winter wheat with two to three leaves and the other to tillered wheat. Experiments were adjacent to each other and were located near Potlatch, Idaho. The predominant broadleaf weeds were mayweed chamomile (ANTCO) and coast fiddleneck (AMSIN). Mayweed chamomile was 2 inches in diameter when the early treatments were applied and 4 inches in diameter at the tiller application. The coast fiddleneck was just emerging to three leaves at the initial application, by the tiller application the coast fiddleneck had six leaves and was 5 inches tall. Treatments were applied with a CO_2 backpack sprayer calibrated to deliver 15 gal/a at 42 psi and 3 mph (Table 1). Treatments were arranged in a randomized complete block design with four replications. Herbicide efficacy was evaluated visually for percent broadleaf weed control and crop injury May 26. Square root of arc sin transformation of the percent control data was used to normalize the data for analysis. Weed control interpretation was made using the untransformed data. An area 4.6 feet by 27 feet was harvested for grain yield on August 8 with a small plot combine.

Table 1. Application data

Wheat growth stage	two to three leaves	fully tillered
Application date	April 20	May 4
Air temperature (F)	72	65
Soil temperature at 2 in. (F)	77	58
Relative humidity (%)	41	49
Wind speed-direction (mph)	5-W	3-W
Soil pH	4.9	5.4
OM (%)	2.5	2.2
Texture	silt loam	silt loam
CEC(meq/100 g soil)	14.0	12.7

V-23121 applied alone or in tank mix combination with MCPA or 2,4-D controlled mayweed chamomile and coast fiddleneck as well as MCPA or 2,4-D alone (Table 2 and 3). DPXR9674 and metribuzin tank mixed with bromoxynil controlled mayweed chamomile and coast fiddleneck 90% or greater. Herbicide treatments did not injure the crop (data not shown). Grain yield was not different among treatments. Grain yield tended to be less, however, when V-23121 was applied with a surfactant or in tank mix combination. (Idaho Experiment Station, Moscow, Idaho 83843)

Table 2. Broadleaf weed control with V-23121 applied at the two to three leaves growth stage of winter wheat

Treatment[1]	Rate	Square root arc sin ANTCO	Square root arc sin AMSIN	Control[2] ANTCO	Control[2] AMSIN	Grain yield
	(lb ai/a)			(- % of check-)		(bu/a)
check	------	-----	-----	----	----	---
V-23121	0.0088	0.837	0.782	57	50	67
V-23121	0.0132	0.973	1.013	66	70	73
V-23121	0.0176	1.054	1.178	74	85	76
V-23121	0.0220	1.132	1.070	79	69	77
V-23121 +	0.0088	0.836	0.958	55	66	65
surfactant	0.0625%					
V-23121 +	0.0132	1.176	1.176	85	78	58
surfactant	0.0625%					
V-23121 +	0.0044	0.963	1.075	66	76	60
MCPA	0.25					
V-23121 +	0.0088	0.994	1.071	69	76	64
MCPA	0.25					
V-23121 +	0.0132	1.097	1.054	76	74	60
MCPA	0.25					
V-23121 +	0.0088	0.907	1.013	61	70	60
MCPA +	0.25					
surfactant	0.0625%					
MCPA	0.25	0.945	0.907	65	61	68
bromoxynil	0.25	1.132	1.238	80	89	66
DPXR9674 +	0.0156	1.342	1.342	95	95	80
bromoxynil +	0.25					
surfactant	0.25%					
LSD (0.05)		0.244	0.286			ns
weed density (no./ft^2)				7	10	

[1]Surfactant was R-11; a nonionic surfactant. Rate expressed as % v/v. MCPA was the amine formulation.
[2]Visual estimate of percent reduction in population density compared to the check.

Table 3. Broadleaf weed control with V-23121 applied at fully tillered winter wheat

Treatment[1]	Rate	Square root Arc sin ANTCO	Square root Arc sin AMSIN	Control[2] ANTCO	Control[2] AMISN	Grain yield
	(lb ai/a)			(-% of check-)		(bu/a)
check	------	------	------	---	---	54
V-23121	0.0088	0.8357	0.8357	60	55	60
V-23121	0.0132	0.8357	0.8357	70	55	71
V-23121	0.0176	0.8106	0.8106	59	53	70
V-23121	0.0220	0.8357	0.8357	58	55	70
V-23121 +	0.0088	0.8357	0.8357	65	55	59
surfactant	0.0625 %					
V-23121 +	0.0132	0.8357	0.8357	68	55	54
surfactant	0.0625 %					
V-23121 +	0.0044	0.8357	0.8357	70	55	63
2,4-D	0.25					
V-23121 +	0.0088	0.8357	0.8357	68	55	62
2,4-D	0.25					
V-23121 +	0.0132	0.8357	0.8357	66	55	67
2,4-D +	0.25					
V-23121 +	0.088	0.8357	0.8357	71	55	62
2,4-D +	0.25					
surfactant	0.0625 %					
2,4-D	0.25	0.8357	0.8357	63	55	70
bromoxynil	0.25	0.8620	0.8620	65	58	72
metribuzin +	0.25	1.2541	1.2541	90	90	74
bromoxynil	0.25					
LSD (0.05)		0.0712	0.0712			ns
weed density (no./ft^2)				8	10	

[1]Surfactant is R-11; a nonionic surfactant. Rate is expressed as % v/v. Amine formulation of 2,4-D.

[2]Visual estimate of percent reduction of plant density compared to the check.

Broadleaf weed control with pyridate tank mixtures. Dial, M.J. and D.C. Thill. Pyridate was applied alone and in combination to no-till seeded winter wheat var. Hawk south of Lewiston, Idaho for ivyleaf speedwell (VERHE) control. The growth stage of the winter wheat at the first application date was three to five leaves, the ivy leaf speedwell was in full bloom. At the second application date the winter wheat had three to five tillers and had developed 2 inch adventitious roots (2 ADV) and the ivyleaf speedwell had developed seed pods. Pyridate also was evaluated for broadleaf weed control applied alone and in tank mix combination in conventionally seeded winter wheat var. Stephens west of Nezperce, Idaho. The treatments were applied when the winter wheat was fully tillered and 2 ADV roots were present. The broadleaf weeds at the Nezperce location were: catchweed bedstraw (GALAP), mayweed chamomile (ANTCO), volunteer winter rape (BRSNA), and field pennycress (THLAR). The growth stage of the catchweed bedstraw was just emerging to 5 inches tall, mayweed chamomile was 2 to 3 inches in diameter, the volunteer winter rape was 5 to 6 inches tall, and field pennycress ranged from four leaves to full bloom. At both locations the treatments were arranged in a randomized complete block design replicated four times. Herbicide treatments were applied with a CO_2 pressurized backpack sprayer calibrated to deliver 10 gal/a at 42 psi and 3 mph (Table 1). Grain yield was not determined at either location because of lodging or variability in crop density.

Table 1. Application data

Location	Lewiston		Nezperce
Date of application	Apr. 11	Apr. 25	Apr. 15
Air temperature (F)	64	55	60
Soil temperature (F)	51	70	58
Relative humidity (%)	45	52	75
Wind speed-direction	N-2	N-4	N-3
Soil pH	5.9		5.4
OM (%)	3.8		6.5
Texture	silt loam		clay loam
CEC(meq/100 g soil)	24.5		28.2

Ivyleaf speedwell control was variable and no differences among herbicide treatments were observed (Table 2). DPXL5300, DPXR9674 tank mixed with metribuzin, pyridate tank mixed with 2,4-D or diuron, and diuron applied alone controlled ivyleaf speedwell 80% or greater.

All treatments except bromoxynil/MCPA, metribuzin, and clopyralid/2,4-D controlled catchweed bedstraw 90% or greater (Table 3). Adding pyridate to bromoxynil/MCPA, metribuzin, and clopyralid/2,4-D improved control of catchweed bedstraw to 95%. No differences were observed among herbicide treatments for control of mayweed chamomile. All treatments controlled mayweed chamomile 88% or greater. Pyridate alone and pyridate tank mixed with dicamba controlled less than 90% of the volunteer winter rape. No differences among herbicide treatments were observed for control of field pennycress. All treatments controlled field pennycress 90% or greater. (Idaho Experiment Station, Moscow, Idaho 83843)

Table 2. Ivyleaf speedwell control in no-till winter wheat

Treatment[1]	Rate[2]	Time of application[3]	Control[4]
	(lb ai/a)		(% of check)
check	---	----	---
pyridate	0.9	ESPRI	51
DPXR9674 +	0.0234	ESPRI	64
surfactant	0.25%		
DPXL5300 +	0.0094	ESPRI	81
surfactant	0.25%		
pyridate +	0.9	ESPRI	58
DPXR9674 +	0.0234		
surfactant	0.25%		
pyridate +	0.9	ESPRI	78
DPXL5300 +	0.0039		
surfactant	0.25%		
metsulfuron +	0.0039	ESPRI	46
surfactant	0.25%		
pyridate +	0.9	ESPRI	73
metsulfuron +	0.0039		
surfactant	0.25%		
DPXR9674 +	0.0234	ESPRI	51
dicamba +	0.125		
surfactant	0.25%		
diuron	0.8	2 ADV	81
pryidate +	0.9	2 ADV	80
diuron	0.8		
DPXR9674 +	0.0234	2 ADV	85
metribuzin +	0.25		
surfactant	0.25%		
2,4-D	0.75	2 ADV	66
pyridate +	0.9	2 ADV	85
2,4-D	0.75		
LSD (0.05)			ns
weed density (no./ft^2)			25

[1]Surfactant was R-11; a nonionic surfactant. Rate is expresed as % v/v.

[2]2,4-D rate is calculated on acid equivalent.

[3]ESPRI refers to early spring, 2 ADV is 2 inch adventitious roots on crop.

[4]Visual estimate of percent reduction in population density compared to the check.

Table 3. Broadleaf weed control at Nezperce

Treatment[1]	Rate	Control[2] GALAP	ANTCO	BRSNA	THLAR
	(lb ai/a)	(-----------% of check----------)			
check	---	---	---	---	---
pryidate	0.9	95	95	85	93
bromoxynil	0.375	95	93	90	92
bromoxynil/MCPA	0.375	83	91	95	92
metribuzin	0.375	79	94	94	96
clopyralid/2,4-D	0.6	83	88	94	92
clopyralid/MCPA	0.6	91	95	95	91
DPXR9674 +	0.0281	94	91	95	96
surfactant	0.25%				
pyridate +	0.9	93	95	91	95
bromoxynil	0.25				
pyridate +	0.9	95	95	95	94
bromoxynil/MCPA	0.25				
pyridate +	0.9	95	95	94	96
metribuzin	0.25				
pyridate +	0.9	95	95	94	91
copyralid/2,4-D	0.4				
pyridate +	0.9	94	94	95	96
clopyralid/MCPA	0.4				
pyridate +	0.9	95	95	95	96
DPXR9674 +	0.0141				
surfactant	0.25%				
pyridate +	0.9	95	93	80	96
dicamba	0.125				
LSD (0.05)		8	ns	6	ns
Weed density (no./ft^2)		10	6	3	6

[1]Surfactant was R-11; a nonionic surfactant. Rate is expressed as % v/v.
[2]Visual estimate of percent reduction in population density compared to the check.

Interrupted windgrass, broadleaf weed, and wild oat control in winter wheat. Dial, M.J. and D.C. Thill. Herbicide control of mayweed chamomile (ANTCO), tumble mustard (SSYAL), interrupted windgrass (APEIN), and wild oat (AVEFA) was evaluated in winter wheat on a conventionally cultivated site east of Plummer, Idaho. Herbicide treatments were applied when Hill-81 winter wheat had four tillers, the mayweed chamomile was 3 to 5 inches in diameter, tumble mustard was 4 inches in diameter, interrupted windgrass ranged from emerging to five leaves and the wild oat had two leaves. All treatments were applied May 5, 1989 with a CO_2 pressurized backpack sprayer calibrated to deliver 10 gal/a at 42 psi and 3 mph (Table 1). Treatments were arranged in a randomized complete block design replicated four times. Treatments were evaluated visually for percent weed control July 25, 1989. Grain was harvested August 8 with a plot combine.

Table 1. Application data

Air temperature (F)		75
Soil temperature at 2 in. (F)		73
Relative humidity (%)		44
Wind speed (mph) - direction		4-W
Soil	pH	5.4
	OM (%)	3.6
	Texture	silt loam
	CEC (meq/100 g soil)	13.3

DPXR9674 and metribuzin applied alone or in tank mix combination controlled mayweed chamomile 90 to 95% (Table 2). Imazamethabenz or ethiozin applied alone did not control mayweed chamomile. Ethiozin applied alone at either 1.00 or 0.75 lb ai/a controlled tumble mustard 86 to 88%. Other treatments controlled tumble mustard 91% or greater. Adding bromoxynil to HOE 7125 tended to reduce control of interrupted windgrass. Diclofop applied alone or in tank mix with DPXR9674 did not control interrupted windgrass. DPXR9674 applied alone, ethiozin applied alone or in combination with metribuzin, and metribuzin applied alone or in tank mix combination with bromoxynil did not control wild oat. Grain yield usually reflected the level of weed control. However, when ethiozin and metribuzin were applied in tank mix combination, grain yield was reduced due to crop injury (data not shown). (Idaho Experiment Station, Moscow Idaho 83843)

Table 2. Weed control and grain yield in winter wheat

Treatment[1]	Rate	ANTCO	SSYAL	APEIN	AVEFA	Grain yield
		Control[2]				
	(lb ai/a)	(-----------	% of check	---------	)	(bu/a)
check	----	---	---	---	---	50
imazamethabenz	0.47	18	95	93	94	58
imazamethabenz + DPXR9674	0.47 0.0156	93	95	80	90	68
imazamethabenz + bromoxynil	0.47 0.25	66	91	90	90	68
DPXR9674	0.0281	95	95	89	39	67
ethiozin	1.00	51	86	81	35	62
ethiozin	0.75	38	88	81	38	65
ethiozin + DPXR9674	0.75 0.0156	93	95	75	47	70
ethiozin + metribuzin	1.00 0.125	24	95	93	43	58
diclofop	1.00	80	93	13	90	71
diclofop + DPXR9674	1.00 0.0156	94	95	19	94	67
HOE 7125	0.66	39	95	71	95	73
HOE 7125	0.78	39	95	93	95	65
HOE 7125 + bromoxynil	0.66 0.25	59	95	50	91	62
HOE 7125 + bromoxynil	0.78 0.25	66	95	79	94	64
metribuzin	0.38	90	95	94	43	67
metribuzin + bromoxynil	0.38 0.38	93	95	95	64	70
metribuzin + DPXR9674	0.25 0.0156	93	95	86	53	65
LSD (0.05)		36	5	24	38	7
plant density (plant no./ft^2)		15	8	8	3	

[1]All treatments containing imazamethabenz or DPXR9674 were applied with 0.25% v/v R-11; nonionic surfactant.
[2]Visual estimate of percent reduction in population density compared to the check.

Brome control with atrazine in no-till winter wheat. Dial, M.J. and D.C. Thill. Atrazine, 90% dry flowable formulation, applied preplant surface (PPES); triallate, 10% granular formulation and triallate/trifluralin, 13% granular formulation, applied preplant incorporated (PPI); diclofop applied post plant preemergence surface (PES); and ethiozin applied post emergence in the spring (ESPRI) were evaluated for annual Bromus species control in a no-till winter wheat site south of Lewiston, Idaho. The atrazine treatments were applied as a broadcast spray before a Yielder no-till drill, equipped with stubble composters, seeded the experiment area. The stubble composters were mounted ahead of each double disk opener to move harvest residue away from the front of the openers and create an area clear of harvest residue and atrazine. The triallate and triallate/trifluralin treatments were applied through a spreader box attached to the drill calibrated to deliver 15 or 12.5 pounds of product, respectively, per acre. The stirring action of the stubble composters and double disk openers incorporated the granular product into the soil surface. Diclofop was broadcast sprayed following seeding and prior to crop and weed emergence. Ethiozin was broadcast sprayed in the spring 1989. The broadcast spray treatments were applied with a self-propelled sprayer calibrated to deliver 21 gal/a at 38 psi and 3 mph (Table 1). Treatments were arranged in a randomized complete block design replicated four times. Plots were 20 by 100 ft. Treatments were evaluated visually June 26 for Bromus species control. Grain yield was harvested from a 4.6 by 50 ft. area in the center of each plot with a small plot combine August 1.

Table 1. Application data

		PPES	PPI	PES	ESPRI
Type of application		PPES	PPI	PES	ESPRI
Date of application		Oct. 18	Oct. 22	Oct. 24	Apr. 14
Air temperature (F)		70	71	54	60
Soil temperature at 2 in. (F)		48	50	49	58
Relative humidity (%)		82	71	71	30
Wind speed-direction (mph)		5-S	3-E	1-E	2-E
Soil	pH		5.5		
	OM (%)		3.5		
	Texture		silt loam		
	CEC(meq/100 g soil)		21.2		

Atrazine controlled the annual brome better than triallate (Table 2). Grain yield was not different among herbicide treatments. When the brome was controlled, wild oat (AVEFA) dominated the plot area. This most likely affected grain yield (data not shown). (Idaho Experiment Station, Moscow, Idaho 83843)

Table 2. Bromus species control and winter wheat grain yield

Treatment	Rate	Time of application	Bromus species control[1]	Grain yield
	(lb ai/a)		(% of check)	(bu/a)
check	----	-----	---	37
atrazine	0.5	PPES	91	36
triallate	1.5	PPI	75	36
triallate/trifluralin	1.6	PPI	78	39
diclofop	1.0	PES	80	40
ethiozin	1.5	ESPRI	78	39
LSD (0.05)			15	ns
Bromus species density (no./ft^2)			50	

[1]Visual estimate of percent reduction in population density compared to the check.

Herbicide control of spring milletgrass in winter wheat. Dial, M.J. and D.C. Thill. Herbicide control of spring milletgrass (*Milium vernale* M. Biede.) was evaluated in winter wheat near Grangeville, Idaho. The herbicide treatments were applied with a CO_2 pressurized backpack sprayer calibrated to deliver 10 gal/a at 40 psi and 3 mph (Table 1). The winter wheat growth stage ranged from five leaves to four tillers, and the spring milletgrass growth stage ranged from emerging to five fully expanded leaves. Herbicide treatments were arranged in a randomized complete block design and replicated three times. The spring milletgrass control and crop injury were evaluated visually June 21,1989. The plots were not harvested for grain yield to prevent possible transporting and contaminating other cooperator's fields with spring milletgrass seed.

Table 1. Application data

Application date	April 13, 1989
Air temperature (F)	80
Soil temperature @ 2 in. (F)	72
Relative Humidity (%)	30
Wind speed (mph) direction	4-N
Soil pH	5.2
OM (%)	6.5
Texture	clay loam
CEC (meq/100g soil)	29.5

Diclofop + DPXM6316 or chlorsulfuron, ethiozin + metribuzin, and diclofop alone controlled spring milletgrass 93% or greater (Table 2). Ethiozin alone and imazamethabenz controlled spring milletgrass 85% (Table 2). Difenzoquat, DPXM6316 and chlorsulfuron applied alone did not control spring milletgrass effectively. Ethiozin + metribuzin shortened and reduced the stand of winter wheat compared to the other treatments and the check (data not shown). (Idaho Agricultural Experiment Station, Moscow Idaho 83843)

Table 2. Spring milletgrass control in winter wheat

Treatment[1]	Rate	Control[2]
	(lb ai/a)	(% of check)
check	---	--
diclofop +	1.00	95
DPXM6313 +	0.0313	
surfactant	0.25%	
ethiozin +	1.5	95
metribuzin	0.1875	
diclofop	1.00	95
diclofop +	1.00	93
chlorsulfuron +	0.0156	
surfactant	0.25%	
imazamethabenz +	0.47	85
surfactant	0.25%	
ethiozin	1.5	85
difenzoquat +	1.00	78
surfactant	0.25%	
DPXM6316 +	0.0313	67
surfactant	0.25%	
chlorsulfuron +	0.0156	63
surfactant	0.25%	
LSD (0.05)		11
spring milletgrass density in check (no./ft^2)		4

[1]Surfactant was R-11; concentration is expressed as % v/v.
[2]Visual estimate of percent reduction in population density compared to the check.

Wild oat control in winter wheat. Dial, M.J., J.M. Lish and D.C. Thill. Several herbicides were evaluated for wild oat control at two locations in Latah County: north of Genesee, Idaho (Hill-81 winter wheat); and the Plant Science Research Farm east of Moscow, Idaho (Stephens winter wheat). The herbicides were applied at the two to three and four to five leaves stage of the wild oat. The winter wheat was tillered at each location when the first application was applied. Herbicides were applied with a CO_2 pressurized backpack sprayer calibrated to deliver 10 gal/a at 40 psi and 3 mph (Table 1). Treatments were arranged in a randomized complete block design replicated four times. Wild oat control was evaluated visually at Genesee July 25 and grain yield was harvested August 16. Due to a sparse population of wild oat, only grain yield was measured at Moscow.

Table 1. Application data

Location	---------Genesee--------			------Moscow------	
Wild oat growth stage	2 to 3 lf		4 to 5 lf	2 to 3 lf	4 to 5 lf
Date of application	May 11 and 12		May 22	May 12	May 31
Air temperature (F)	43	42	66	42	61
Soil temperature at 2 in. (F)	54	44	68	44	66
Relative humidity (%)	85	78	50	59	74
Wind speed-direction (mph)	2-W	3-E	3-E	4-W	2-W
Soil pH	5.2			4.8	
OM (%)	2.7			5.3	
Texture	silt loam			loam	
CEC (meq/100 g soil)	22.2			27.6	

No differences among treatments were measured for wild oat control (Table 2). All treatments controlled wild oat 89% or greater at Genesee. Grain yield was greater when HOE6001 and imazamethabenz were applied at the two to three leaves stage and when HOE7125, HOE6004-05H, and difenzoquat were applied at the four to five leaves stage. Other treatments did not appear to injure the crop. Grain yield among treatments was not different at Moscow where wild oat densities were low. Treatments did not injure the crop. (Idaho Experiment Station, Moscow, Idaho 83843)

Table 2. Wild oat control in winter wheat

Treatment[1]	Rate	Wild oat growth stage	(---Genesee---) Wild oat control[2]	Grain yield	(-Moscow-) Grain yield
	(lb ai/a)	(leaves)	(% of check)	(bu/a)	(bu/a)
check	----		----	52	77
diclofop	1.00	2 to 3	94	59	88
HOE6001	0.074	2 to 3	94	67	76
imazamethabenz +	0.47	2 to 3	90	67	84
surfactant	0.25%				
HOE7125	0.66	2 to 3	94	60	89
HOE6004-05H	0.090	2 to 3	95	59	88
HOE6001	0.074	4 to 5	89	58	90
HOE7125	0.66	4 to 5	94	72	88
HOE6004-05H	0.090	4 to 5	94	71	80
difenzoquat	1.00	4 to 5	94	71	80
LSD (0.05)			ns	13	ns
weed density (no./ft^2)			15		

[1]Surfactant was R-11; rate is expressed as % v/v.
[2]Visual estimate of percent reduction in plant density compared to the check.

Downy brome control in winter wheat with clomazone. Rydrych, D.J. Research plots were established at the Columbia Basin Agricultural Research Center (CBARC), in Pendleton, OR, to evaluate selective downy brome control in winter wheat with clomazone. Since clomazone is non-selective in cereals, the "Inversion" system was used to provide crop safety. Inversion is a preplant treatment on the soil surface that is planted with a hoe-drill opener which greatly improves crop safety. The system was developed at Pendleton, and a private commercial label registration was established for atrazine (Cheat-stop) in 1988. Tests have been conducted for several years and the 1989 results are recorded in the table. Plots were established on a Walla Walla silt loam soil (pH 6.2, om 1.9%) using a split-plot design, and three replications. Winter wheat (Stephens) was seeded after a preplant application of clomazone at .12 and .25 lb/A using a hoe drill. Clomazone provided excellent downy brome control with good crop safety on this soil type. Atrazine (Cheat-stop) and metribuzin gave good crop safety but were not as effective on downy brome. Tests are being conducted on alternate soil types and on new winter wheat cultivars. This system has been very successful using other soil active herbicides where additional crop tolerance is required. Clomazone is not selective in winter wheat when applied preemergence or postemergence and will only work when using the PPS (Inversion) system. (Oregon State University, CBARC, Pendleton, OR 97801.)

Downy brome control in winter wheat with clomazone
Pendleton, OR 1989

Treatment[1]	Time	Rate	Downy brome	Crop injury	Crop yield
		lb/A	%	%	lb/A
Atrazine (Cheat-stop)	PPS	.50	50	0	4070
Atrazine (Cheat-stop)	PPS	1.00	73	0	5920
Metribuzin	PPS	.50	68	0	5020
Clomazone	PPS	.12	70	0	5070
Clomazone	PPS	.25	90	0	5920
Clomazone + atrazine	PPS	.12 + .50	88	0	5360
weeded control	---	---	100	0	5580
control	---	---	0	0	4110

[1]Treated - PPS (Inversion) - September 28, 1988
Downy brome - 15 plants/ft^2

Broadleaf weed control in winter wheat with V-23121. Miller, S.D., A.W. Dalrymple and J.M. Krall. Research plots were established at the Research and Extension Center, Torrington, Wyoming to evaluate broadleaf weed control with V-23121 alone or in combination with 2,4-D or MCPA. Plots were established under sprinkler irrigation and were 9 by 30 ft. with three replications arranged in a randomized complete block. Winter wheat (var. Archer) was seeded in a sandy loam soil (77% sand, 11% silt and 12% clay) with 1.5% organic matter and pH 7.7 September 8, 1988. Herbicide treatments were applied broadcast with a CO_2-pressurized six-nozzle knapsack sprayer delivering 15 gpa at 30 psi March 29 (air temperature 49F, relative humidity 48%, wind NE at 8 mph, sky mostly cloudy and soil temperature - 0 inch 54F, 2 inches 60F and 4 inches 56F) to 4-tiller wheat and 2-inch tansymustard, or April 14, 1989 (air temperature 50F, relative humidity 40%, wind calm, sky clear and soil temperature - 0 inch 55F, 2 inches 40F and 4 inches 42F) to 8-tiller wheat, 3-inch tansymustard and emerging common lambsquarters and kochia. Visual weed control and crop damage evaluations were made May 3, plant height measured June 15 and plots harvested July 10, 1989. Tansymustard (DESPI), shepherdspurse (CAPBP), kochia (KCHSC) and common lambsquarters (CHEAL) infestations were light and variable throughout the experimental area.

No crop injury or stand reduction was observed with any treatment. V-23121 did not provide acceptable weed control at rates up to 0.022 lb/A at either stage of application. 2,4-D or MCPA combinations with V-23121 increased weed control; however, in no situation did it approach the level of weed control obtained with metsulfuron plus 2,4-D. Wheat yield in herbicide-treated plots was similar to wheat yield in the weedy check. (Wyoming Agric. Exp. Sta., Laramie, WY 82071 SR 1616)

Broadleaf weed control in winter wheat with V-23121.

Treatment[1]	Rate lb ai/A	Winter wheat[2] Inj %	SR %	Height inches	Yield bu/A	Weed control[3] DESPI %	CAPBP %	CHEAL %	KCHSC %
4-tiller									
V-23121	0.009	0	0	18	43	0	0	20	13
V-23121	0.013	0	0	18	41	0	0	33	20
V-23121	0.018	0	0	18	41	13	10	40	27
V-23121	0.022	0	0	17	40	73	77	73	33
V-23121+X-77	0.009+0.062%	0	0	16	40	0	0	37	20
V-23121+X-77	0.013+0.062%	0	0	16	41	33	40	43	40
V-23121+MCPA	0.0045+0.25	0	0	17	43	77	82	73	70
V-23121+MCPA	0.009+0.25	0	0	18	43	75	80	75	75
V-23121+MCPA	0.013+0.25	0	0	16	42	78	85	73	77
V-23121+MCPA+X-77	0.009+0.25+0.062%	0	0	17	41	80	83	75	73
MCPA	0.25	0	0	16	41	68	75	67	70
Bromoxynil	0.25	0	0	16	42	20	33	90	90
Metsulfuron+2,4-D+X-77	0.008+0.25+0.25%	0	0	16	45	92	95	98	98
8-tiller									
V-23121	0.009	0	0	18	43	0	0	20	20
V-23121	0.013	0	0	18	43	20	20	33	27
V-23121	0.018	0	0	18	41	33	30	33	33
V-23121	0.022	0	0	16	41	40	43	60	43
V-23121+X-77	0.009+0.062%	0	0	19	43	23	27	20	13
V-23121+X-77	0.013+0.062%	0	0	18	42	40	43	20	13
V-23121+2,4-D	0.0045+0.25	0	0	18	43	67	72	83	77
V-23121+2,4-D	0.009+0.25	0	0	16	41	70	73	87	83
V-23121+2,4-D	0.013+0.25	0	0	16	41	75	75	87	80
V-23121+2,4-D+X-77	0.009+0.25+0.062%	0	0	16	41	72	77	87	80
2,4-D	0.25	0	0	16	40	67	72	77	83
Bromoxynil	0.25	0	0	16	41	23	33	90	80
Metsulfuron+2,4-D+X-77	0.008+0.25+0.25%	0	0	16	44	93	95	97	97
Weedy check	------------------	0	0	17	42	0	0	0	0

[1]Treatments applied March 29 and April 14, 1989.
[2]Wheat injury (Inj) and stand reduction (SR) visually evaluated May 3, plant height measured June 15 and plots harvested July 10, 1989.
[3]Weed control visually evaluated May 3, 1989.

Downy brome control in winter wheat. Miller, S.D., A. W. Dalrymple and J.M. Krall. Plots were established at the Research and Extension Center, Torrington, Wyoming to evaluate the efficacy of SMY-1500 for downy brome control in winter wheat when applied at several stages. Plots were established on nonirrigated land and were 9 by 30 ft. with three replications arranged in a randomized complete block. Herbicide treatments were applied broadcast with a CO_2-pressurized six-nozzle knapsack sprayer delivering 20 gpa at 40 psi. Winter wheat (var. Buckskin) was seeded in a sandy loam soil (75% sand, 10% silt and 15% clay) with 1.4% organic matter and pH 8.0 September 14, 1988 and preemergence treatments applied (air temperature 57F, relative humidity 95%, wind calm, sky cloudy and soil temperature - 0 inch 60F, 2 inches 64F and 4 inches 66F). Postemergence treatments were applied to 2-leaf wheat and 1- to 2-leaf downy brome September 27 (air temperature 65F, relative humidity 30%, wind SE at 10 mph, sky cloudy and soil temperature - 0 inch 66F, 2 inches 62F and 4 inches 60F), or 3- to 4-leaf wheat and 3-leaf downy brome October 5, 1988 (air temperature 50F, relative humidity 61%, wind SE at 7 mph, sky partly cloudy and soil temperature - 0 inch 79F, 2 inches 50F and 4 inches 48F). Visual weed control and crop damage evaluations were made May 2, plant height measured June 20 and plots harvested July 10, 1989. Downy brome (BROTE) infestations were moderate but uniform throughout the experimental area.

Slight winter wheat injury (2 to 3%) was observed when SMY-1500 and metribuzin were applied in combination at the 3-leaf stage. Downy brome control was 90% or greater with all SMY-1500 treatments except the 0.75 lb/A rate applied preemergence. Winter wheat yields were 3 to 6 bu/A higher in herbicide-treated compared to weedy check plots. (Wyoming Agric. Exp. Sta., Laramie, WY 82071 SR 1615)

Downy brome control in winter wheat.

Treatment[1]	Rate lb ai/A	Winter wheat[2] Inj %	SR %	Height inches	Yield bu/A	Control[3] BROTE %
Preemergence						
SMY-1500	0.75	0	0	21	20	80
SMY-1500	1.0	0	0	20	21	93
SMY-1500	1.25	0	0	21	23	99
1- to 2-leaf						
SMY-1500	0.75	0	0	21	21	90
SMY-1500	1.0	0	0	22	22	97
SMY-1500	1.25	0	0	21	21	98
SMY-1500	1.5	0	0	21	21	99
3-leaf						
SMY-1500+metribuzin	0.75+0.063	0	0	22	22	90
SMY-1500+metribuzin	0.75+0.125	2	0	22	23	90
SMY-1500+metribuzin	1.0+0.063	3	0	21	23	90
SMY-1500+metribuzin	1.0+0.125	3	3	21	21	90
Weedy check	----------	0	0	19	17	0

[1]Treatments applied September 14, September 27 and October 5, 1988.
[2]Wheat injury (Inj) and stand reduction (SR) visually evaluated May 2, plant height measured June 20 and plots harvested July 10, 1989.
[3]Downy brome control visually evaluated May 2, 1989.

Evaluation of herbicide treatments for broadleaf weed control in winter wheat. Miller, S.D., A.W. Dalrymple and J.M. Krall. Research plots were established at the Research and Extension Center, Archer, Wyoming to evaluate weed control and winter wheat tolerance with several postemergence herbicide treatments. Plots were established under dryland conditions and were 9 by 30 ft. with three replications arranged in a randomized complete block. Winter wheat (var. Buckskin) was seeded in a loam soil (55% sand, 23% silt and 22% clay) with 1.7% organic matter and pH 7.3 September 1, 1988. Herbicide treatments were applied broadcast with a CO_2-pressurized six-nozzle knapsack sprayer delivering 20 gpa at 40 psi April 14 (air temperature 62F, relative humidity 25%, wind NW at 3 mph, sky partly cloudy and soil temperature - 0 inch 80F, 2 inches 52F and 4 inches 44F) to 6-tiller wheat, 2-inch tansymustard and emerging kochia, common lambsquarters and Russian thistle. Visual weed control and crop damage evaluations were made May 4, plant height measured June 19 and plots harvested July 19, 1989. Tansymustard (DESPI), common lambsquarters (CHEAL), Russian thistle (SASKR) and kochia (KCHSC) infestations were light and variable throughout the experimental area.

Winter wheat stands were reduced slightly (1 to 2%) by several treatments. Wheat injury was less than 5% with all treatments except C-4243, which caused greater than 5% injury at all rates. Broad-spectrum weed control was excellent with bromoxynil plus MCPA or dicamba combinations with MCPA, CGA-131036, DPX-R9674 and metsulfuron. Winter wheat yield in herbicide-treated plots was similar to yield in the weedy check, except C-4243 at 0.19 lb/A reduced yield 7 bu/A. (Wyoming Agric. Exp. Sta., Laramie, WY 82071 SR 1617)

Broadleaf weed control in winter wheat.

Treatment[1]	Rate lb ai/A	Winter wheat[2] Inj %	SR %	Height inches	Yield bu/A	Weed control[3] DESPI %	CHEAL %	SASKR %	KCHSC %
Bromoxynil	0.25	0	0	26	30	33	89	100	89
Bromoxynil	0.38	0	0	26	32	58	95	100	93
Bromoxynil+MCPA	0.38+0.38	0	0	25	30	100	99	96	99
CGA-131036+X-77	0.004+0.25%	0	0	27	34	98	60	96	99
CGA-131036+X-77	0.008+0.25%	0	0	26	34	100	70	100	100
CGA-131036+X-77	0.016+0.25%	0	1	25	33	100	77	100	100
CGA-131036+dicamba+X-77	0.008+0.094+0.25%	3	1	25	33	98	100	100	100
CGA-131036+dicamba(SGF)+X-77	0.008+0.094+0.25%	1	0	25	32	98	99	99	100
CGA-131036+dicamba+disulfoton+X-77	0.008+0.094+1.5+0.25%	4	0	26	30	99	99	99	100
CGA-131036+dicamba(SGF)+disulfoton+X-77	0.008+0.094+1.5+0.25%	3	0	23	29	99	98	99	99
Dicamba	0.094	1	0	25	33	57	99	99	99
Dicamba(SGF)	0.094	1	0	24	31	63	99	99	100
Dicamba+DPX-R9674+X-77	0.094+0.016+0.25%	1	0	25	29	99	99	97	99
Dicamba(SGF)+DPX-R9674+X-77	0.094+0.016+0.25%	1	0	26	32	99	100	99	100
Dicamba+metsulfuron+X-77	0.094+0.004+0.25%	3	1	23	29	100	99	99	100
Dicamba(SGF)+metsulfuron+X-77	0.094+0.004+0.25%	1	0	24	29	100	100	95	100
Dicamba+metsulfuron+disulfoton+X-77	0.094+0.004+1.5+0.25%	3	0	25	32	100	99	100	100
Dicamba(SGF)+metsulfuron+disulfoton+X-77	0.094+0.004+1.5+0.25%	1	0	25	33	99	99	99	100
Dicamba+MCPA	0.094+0.38	0	0	26	30	100	99	98	100
Dicamba(SGF)+MCPA	0.094+0.38	0	0	24	32	96	98	95	99
BAS-514+BAS-090	0.063+1qt	0	0	25	31	33	17	18	13
BAS-514+BAS-090	0.125+1qt	2	0	24	28	30	23	78	70
C-4243	0.063	6	0	25	31	70	100	88	79
C-4243	0.125	7	2	25	30	87	100	100	100
C-4243	0.19	15	1	21	22	86	100	100	100
MCPA	0.5	0	0	26	32	70	57	33	60
2,4-D	0.38	0	0	26	30	96	91	80	87
Weedy check	--------------------	0	0	25	29	0	0	0	0

[1]Treatments applied April 14, 1989.
[2]Wheat injury (Inj) and stand reduction (SR) visually evaluated May 4, plant height measured June 19 and plots harvested July 19, 1989.
[3]Weed control visually evaluated May 4, 1989.

Jointed goatgrass phenological development within a winter wheat canopy. Anderson, R. L. Jointed goatgrass has a similar genetic makeup as winter wheat, which limits the herbicide options for control of jointed goatgrass within a wheat crop. Producers may destroy winter wheat infested with jointed goatgrass to prevent jointed goatgrass seed production, if destruction occurs before plant development results in viable seed. A knowledge of the phenological development of jointed goatgrass within a winter wheat canopy is needed so timely weed management practices can be implemented. The objectives of this study were to characterize the phenological development of jointed goatgrass within a 'Vona' winter wheat canopy, and to compare its rate of development with Vona and 'Carson' winter wheat.

Vona winter wheat was planted at 50 kg/ha in 30 cm rows on Sep. 19, 1988. Jointed goatgrass was germinated in peat pellets on Sep. 19, Oct. 3, Oct. 17, Oct. 31, and March 16, then planted between the Vona rows at 18 plants/m^2 1 week later. Plant spacing within the jointed goatgrass row was 15 cm. The experimental design was a randomized complete block with four replications. Plot size was 2m by 2m. Four jointed goatgrass plants were selected from each planting date within each replication, and the developmental stage (based on the Zadoks-Chang-Konzak scale) for these sixteen plants was recorded on a weekly basis until the hard dough stage. Sixteen random wheat plants within the Vona stand were marked and evaluated weekly for development. Carson was planted at 50 kg/ha adjacent to the Vona-jointed goatgrass site and 16 random Carson plants were also evaluated weekly for development. The jointed goatgrass was harvested before maturity on July 1, 1989, to avoid spikelet shattering. Tillers/plant and spikelets/plant were recorded.

The number of days until stem elongation, anthesis, and soft dough for each planting date is shown in the table. Jointed goatgrass planted on March 16 did not develop past the tillering stage, thus, this data was not included. Jointed goatgrass planted on the same date as both winter wheat varieties reached anthesis on May 31, one day before Vona and five days before Carson. By the soft dough stage, jointed goatgrass was five days ahead of Vona and 11 days ahead of Carson. Jointed goatgrass planted later required less days to reach each development stage, and by the soft dough stage, all jointed goatgrass plantings were ahead of Carson development and ahead of or similar to Vona. Jointed goatgrass productivity was influenced by its planting date. The number of tillers/plant and spikelets/plant declined with later planting dates, but jointed goatgrass germinating on Oct. 31 produced over 21 spikelets/plant, indicating that plants emerging six weeks after winter wheat will increase the resultant weed seed population in the soil by 20 fold. Grass species will begin to produce viable seed soon after anthesis, so if producers choose to destroy or cut winter wheat infested with jointed goatgrass, the operation should occur before late May. (USDA-ARS, Akron, CO 80720)

Phenological development of jointed goatgrass and two winter wheat varieties and jointed goatgrass tiller and spikelet production

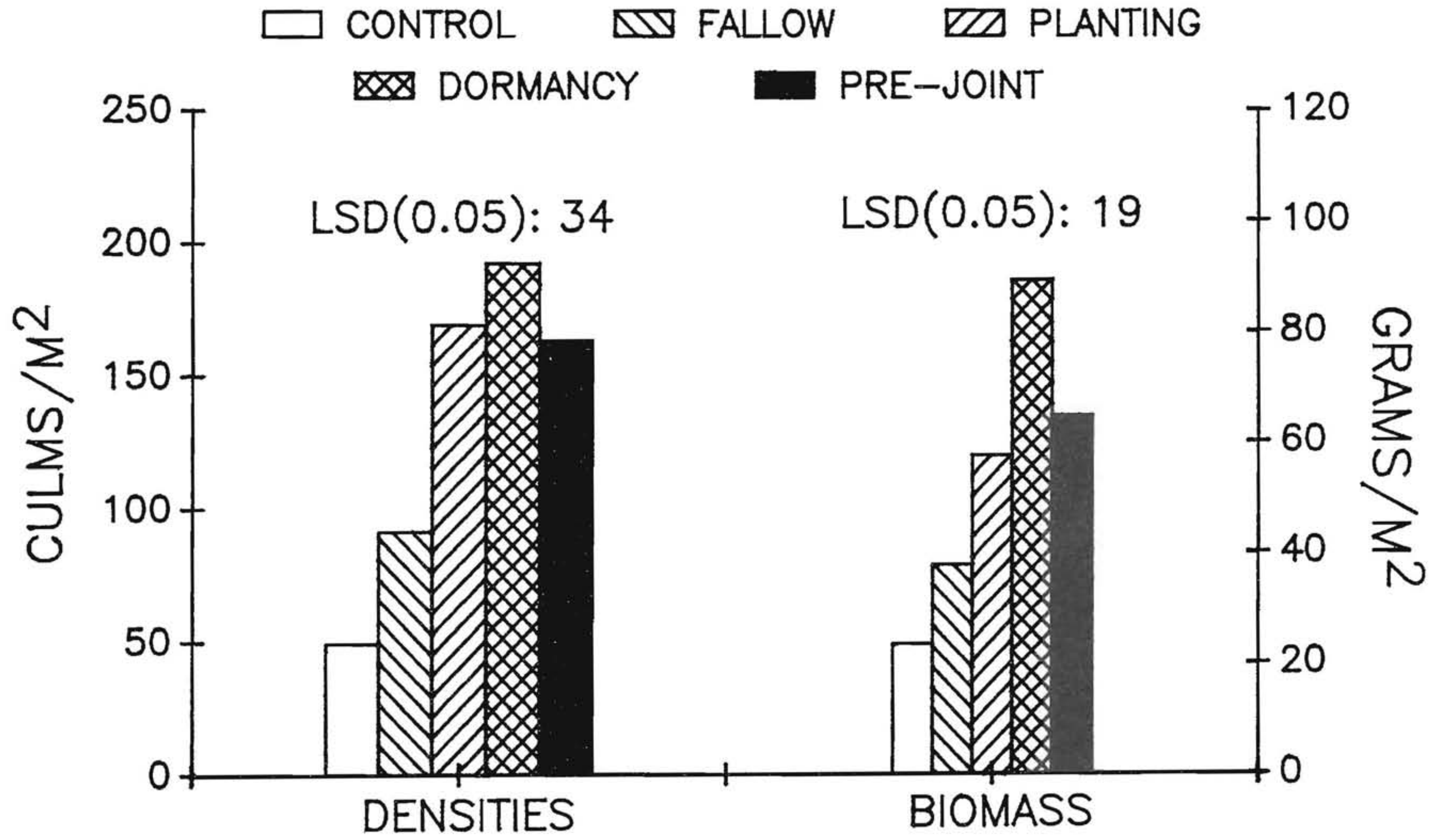
		Days from planting until:			Harvest yields	
Species	Planting date	Stem elongation	Anthesis	Soft dough	Tillers/plant	Spikelet/plant
		(days)			(no.)	
'Vona' wheat	Sept. 19	218 (Apr. 26)	254 (June 1)	286 (June 13)	-[a]	-
'Carson' wheat	Sept. 19	219 (Apr. 27)	258 (June 5)	292 (June 19)	-	-
Jointed goatgrass	Sept. 19	213 (Apr. 21)	253 (May 31)	281 (June 8)	18.7	142.9
Jointed goatgrass	Oct. 3	203 (Apr. 25)	241 (June 2)	269 (June 10)	10.2	74.0
Jointed goatgrass	Oct. 17	198 (May 4)	230 (June 5)	257 (June 12)	7.2	34.8
Jointed goatgrass	Oct. 31	190 (May 9)	220 (June 9)	244 (June 13)	4.1	21.3
LSD (0.05)		6	2	3	4.6	45.1

[a] The Vona and Carson harvest yields were not included because of different planting geometry.

Time of nitrogen application effect on downy brome growth within a winter wheat canopy. Anderson, R. L. Producers in the Great Plains are searching for cultural practices which enhance winter wheat's competitiveness with downy brome. Applying N has increased winter wheat grain yields and the timing of the N application has not affected this response if applied before jointing (usually mid-April). The objectives of this study were to determine: 1) the response of downy brome to N applied at various times during the crop season, and 2) if altering the timing of N application would increase winter wheat tolerance to downy brome interference.

Ammonium nitrate was applied broadcast at 50 kg N/ha at four different times during the fallow or cropping season: 1) four months before wheat planting (May); 2) at planting (September); 3) during plant dormancy (December); and 4) before jointing (March). The control had no N applied. The study site was located in a reduced-till winter wheat-fallow rotation. Tillage operations for weed control during the fallow period were begun in June, three months before planting. 'Sandy' winter wheat, a standard height variety, was planted at 50 kg/ha on September 22, 1988. Downy brome culms were counted in designated m^2 subplots on May 23, 1989, and these subplots were harvested on July 11 to determine biomass of both species and grain yield of winter wheat. Precipitation for the crop season (September through July) was 73% of the long-term average (297 mm).

Nitrogen increased the number of downy brome culms/m^2, with the greatest response occurring with the later applications (see Figure). Downy brome biomass production was highest when N was applied during plant dormancy. Downy brome was more responsive to N than winter wheat, as the downy brome component of the community biomass increased from 5% in the control to 9, 13, 20, 14% for the May, September, December, and March timings, respectively. Winter wheat grain yield for the control was 138 g/m^2, while the four N treatments significantly reduced grain yield 20, 12, 28, and 20% for the May, September, December, and March applications, respectively. This winter wheat grain yield loss due to N application may be attributed to increased downy brome growth utilizing more soil water, thus reducing the soil water supply available for winter wheat. This N effect of increasing downy brome growth without a concomitant response by winter wheat was similar to results in a previous year and indicate that altering the timing of N application does not increase winter wheat's tolerance to downy brome, and does not appear to be a useful cultural practice for producers in the Great Plains to reduce downy brome-induced yield loss in winter wheat. (USDA-ARS, Akron, CO 80720).



DOWNY BROME RESPONSE TO N APPLIED AT FOUR DIFFERENT TIMES

Efficacy of preemergence herbicides in winter wheat. Brewster, B.D., A.P. Appleby, and D.L. Kloft. Preemergence treatments of two experimental herbicides were compared to diuron for control of broadleaf and grass weeds. Two rows of each weed species were planted in front of the wheat in each plot. In addition, annual bluegrass and common chickweed infested the trial site, and were the only weeds to compete with the crop. The herbicides were applied on October 18, 1988, the same day the wheat and weeds were seeded. The trial was a randomized complete block design with three replications and 2.5 by 13.7 m plots. Carrier volume was 234 L/ha delivered at 138 kPa through 8002 flat fan nozzle tips set in a double-overlap spray pattern. Visual evaluations reported here were conducted on March 15, 1989.

Control of annual bluegrass and common chickweed resulted in higher grain yields in some treatments than in the untreated control, but the highest rates, especially of S 53482, caused crop injury that tended to reduce yields compared to the lower rates. The control of several brome species by UBI C4243 was particularly encouraging because these weeds are not adequately controlled by registered herbicide treatments. (Department of Crop Science, Oregon State University, Corvallis, OR 97331).

Wheat injury, grain yield, and weed control with preemergence herbicide tratments on winter wheat

Herbicide	Rate	Wheat		VLPMY	DAUCA	ANTCO	RUMAC	BROSE	BROTE	BROCN	BRODI	LOLMU	VICSA	BRSNA[1]	AVESA	POANN	SENVU	STEME
	(kg a.i./ha)	(% injury)	(kg/ha)	(% control)														
diuron	1.8	3	10,620	99	77	97	99	22	10	33	28	97	37	48	2	99	93	98
S 53482	0.012	0	10,080	33	87	96	96	20	27	50	13	30	27	67	8	13	93	97
S 53482	0.025	3	10,750	67	48	48	93	37	38	70	47	47	37	98	10	38	98	97
S 53482	0.05	8	10,210	93	96	98	100	78	45	67	43	85	52	100	30	93	100	100
S 53482	0.1	32	9,610	100	100	100	100	88	72	78	88	97	90	100	94	98	100	100
S 53482	0.2	70	5,380	100	100	100	100	100	100	98	100	100	99	100	99	100	100	100
UBI C4243	0.035	2	10,620	67	33	70	92	70	42	63	68	70	93	93	45	85	95	100
UBI C4243	0.07	7	10,620	90	60	69	92	76	62	82	92	95	97	99	97	97	99	100
UBI C4243	0.14	13	10,210	94	73	88	95	93	90	96	98	99	100	100	100	99	100	100
UBI C4243	0.21	20	10,150	96	93	93	100	97	98	98	98	99	100	100	100	98	100	100
UBI C4243	0.28	35	10,080	98	98	99	100	99	98	99	100	100	100	100	100	100	100	100
Check	0	0	9,000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		$LSD_{.05}$	1,450															

[1]BRSNA = Brassica napus

Catchweed bedstraw control in winter wheat. Brewster, B.D., M. Mellbye, A.P. Appleby, and D.L. Kloft. Catchweed bedstraw in fall-seeded wheat was treated with herbicides in fall and spring applications. The experimental design was a randomized complete block with four replications and 2.5 by 8 m plots. Carrier volume was 234 L/ha delivered at 138 kPa through 8002 flat fan nozzle tips set in a double-overlap spray pattern. The fall treatments were applied on December 8, 1988, when the wheat had two leaves and the bedstraw was in the cotyledon stage. The wheat had four to five leaves and two to four tillers on February 24, 1989, when the spring treatments were applied; the bedstraw had up to four whorls of leaves.

All treatments provided fair to good control of bedstraw and (except for pyridate applied alone or treatments that contained dicamba) increased wheat yields. The wheat was at a susceptible stage when the dicamba was applied. Chlorsulfuron-metsulfuron and pyridate plus SMY 1500 stunted the wheat, but the crop largely recovered by harvest. (Department of Crop Science, Oregon State University, Corvallis, OR 97331).

Catchweed bedstraw control, wheat injury, and grain yield with herbicide treatments near Coffin Butte, OR

Herbicide	Rate	Catchweed bedstraw	Wheat	Grain yield
	(kg a.i./ha)	(% control)	(% injury)	(kg/ha)
Applied December 8, 1988				
chlorsulfuron-metsulfuron	0.026	94	16	3700
CGA 131036	0.026	83	0	3960
Applied February 24, 1989				
DPX M6316 + dicamba	0.026 + 0.14	96	0	3230
DPX M6316 + bromoxynil	0.026 + 0.42	89	3	3630
DPX M6316 + pyridate	0.026 + 1.0	97	3	3830
DPX R9674 + dicamba	0.026 + 0.14	97	0	3160
DPX R9674 + bromoxynil	0.026 + 0.42	95	0	3490
DPX R9674 + pyridate	0.026 + 1.0	98	5	3700
pyridate + bromoxynil	1.0 + 0.42	100	4	3630
pyridate + dicamba	1.0 + 0.14	100	3	3160
pyridate + SMY 1500	1.0 + 1.1	98	21	3630
pyridate	1.0	90	3	3290
check	0	0	0	3230
			$LSD_{.05}$	360

Ivyleaf speedwell control in winter wheat. Brewster, B.D., J.A. Leffel, G. Gingrich, A.P. Appleby, and D.L. Kloft. Herbicide treatments on fall-seeded wheat were compared for efficacy on ivyleaf speedwell at three sites in western Oregon. The trial design was a randomized complete block with four replications and 2.5 by 8 m plots. Carrier volume was 234 L/ha delivered at 138 kPa through 8002 flat fan nozzle tips set in a double-overlap spray pattern. The herbicides were applied in November or December, 1988, when the wheat had two leaves and the ivyleaf speedwell was in the cotyledon stage. Visual evaluations of crop injury and ivyleaf speedwell control were conducted in April, 1989.

Chlorsulfuron-metsulfuron was more effective on ivyleaf speedwell at one location than was CGA-131036, but CGA-131036 caused less injury and resulted in higher average grain yields. The addition of diuron to either sulfonylurea herbicide tended to increase crop injury ratings and reduce grain yields. (Department of Crop Science, Oregon State University, Corvallis, OR 97331).

Ivyleaf speedwell control, wheat injury, and grain yield with fall-applied herbicide treatments at three sites in western Oregon

Herbicide	Rate	Wheat Site 1	Wheat Site 2	Wheat Site 3	Grain Yield Site 1	Grain Yield Site 2	Grain Yield Site 3	Ivyleaf speedwell control Site 1	Ivyleaf speedwell control Site 2	Ivyleaf speedwell control Site 3
	(kg a.i./ha)	(% injury)			--- (kg/ha) ----			---- (%) ----		
CGA-131036	0.026	5	0	0	3960	7930	9000	98	100	89
chlorsulfuron-metsulfuron	0.026	15	14	15	3290	7460	8130	98	100	100
CGA-131036 + diuron	0.026 + 0.9	21	13	13	2960	8130	8200	100	100	88
chlorsulfuron-metsulfuron + diuron	0.026 + 0.9	28	19	28	2820	7530	7260	99	100	98
check	0	0	0	0	3960	5110	7800	0	0	0
		LSD.05			710	830	670			

[1]site 1 = Klopfenstein farm, Marion County
site 2 = Schmidt farm, Marion County
site 3 = Schaff farm, Washington County

In vitro selection for sethoxydim tolerance in wheat (*Triticum aestivum*): preliminary research. Westra, P., M. Hunt, and M. Callan. Yield losses due to winter annual grass weeds in winter wheat (*Triticum aestivum*) total up to $20 million a year in the state of Colorado alone. The ability to use a broad spectrum postemergence grass herbicide to which wheat is tolerant would be a great advantage for wheat weed control. Preliminary research was conducted to determine, 1) cultivars suitable for in vitro selection for sethoxydim tolerance, and 2) an LD50 (lethal dose of sethoxydim to cause 50% death loss in vitro) for tissue culture selection.

Three cultivars of winter wheat were tested in tissue culture: TAM 107, Vona, and Hawk. TAM 107 and Vona exhibited low culturability, so Hawk was chosen for subsequent experimentation. Mature embryos were excised and cultured on 10 ml of Linsmaier and Skoog's (LS) basal medium with a 1.5 ppmw 2,4-D addendum. Resulting embryogenic callus was cultured on media containing the following sethoxydim micromolar concentrations: 0, 0.5, 1.0, 2.5, 3.5, 5.0, and 10.0. Cultures were retained on selection media for a total of five passages, being subcultured every two weeks.

Approximately 53% callus loss resulted at a 2.5 micromolar concentration of sethoxydim. This concentration was chosen as an LD50, and is now being used as the initial concentration in a stepwise in vitro selection program for sethoxydim tolerance. (Weed Research Laboratory, Colorado State University, Fort Collins, CO 80523)

Winter wheat callus growth and death loss during in vitro selection of sethoxydim tolerance: preliminary determination of an LD50

Micromolar sethoxydim concentration	Percent weight increase of surviving callus	Percent death loss
0	29.2	40
0.5	57.4	48
1.0	10.0	57
2.5	35.0	53
3.5	35.0	89
5.0	0	100
10.0	0	100

Simulated clomazone drift injury. Westra, P. , W. Stump and T. D'Amato. Clomazone, a soybean herbicide, shows good promise for weed control in fallow cropland in Colorado dryland wheat production. Clomazone controls several problem weed species including volunteer wheat, jointed goatgrass and downy brome but also has the potential to injure non-target wheat. This study was set up to simulate drift by the application of low rates of clomazone to wheat.

The experiment was a randomized complete block design with three replications. Plots were 10 feet by 30 feet long. Carrier volume was 11.7 gallons per acre delivered at 20 psi boom pressure using 11001 flat fan nozzles. Clomazone was applied November 7, 1988 to wheat with 1-2 tillers at rates ranging from 0.008 to 0.125 lbs ai/A. Normal clomazone rates for chemical fallow are 0.5 to 1.0 lbs ai/A.

Two weeks after application all treatments caused typical clomazone wheat injury with chlorosis and bleaching of plant tissue (see table). Up to 46% wheat injury occured at the high rate. Six months later however, none of the treatments exhibited any injury, and yields were not statistically different from the untreated check.

In preliminary data from fall 1989 experiments, wheat exhibited injury ranging between 10 and 40% at 4 weeks. Another study set up to measure actual drift injury to wheat under winds above 10 mph show injury symptoms up to 50 feet downwind from the application point 4 weeks after treatment. Experiments will be monitored to see if the wheat recovers. (Weed Research Laboratory, Colorado State University, Fort Collins, CO 80523)

Simulated clomazone drift injury to winter wheat
at Fort Collins, Colorado

Treatment name	Rate lbs ai/A	Wheat injury 10/20/88	Wheat injury 11/22/88 %	Wheat injury 5/25/89 %	Wheat bu/A 7/27/89 %
Check		0.0d	0.0d	0.0a	36a
clomazone	0.008	0.0d	11.7c	0.0a	36a
clomazone	0.015	1.7d	16.7c	0.0a	34a
clomazone	0.031	13.3c	18.3c	0.0a	31a
clomazone	0.063	21.7b	35.0b	0.0a	34a
clomazone	0.125	36.7a	46.7a	0.0a	36a

Means followed by the same letter do not significantly differ based on Duncan's MRT, P=.05

Downy brome control in no-till winter wheat. Miller, S.D. and J.M. Krall. Plots were established at the Research and Extension Center, Archer, Wyoming to evaluate the efficacy of several soil-applied herbicide treatments for downy brome control in no-till winter wheat. Plots were established on a nonirrigated, chemically fallowed area and were 9 by 30 ft. with three replications arranged in a randomized complete block. Herbicide treatments were applied broadcast with a CO_2-pressurized six-nozzle knapsack sprayer delivering 20 gpa at 40 psi immediately prior to (preplant), or after (preemergence), seeding winter wheat (var. Buckskin) September 1, 1988 (air temperature 75F, relative humidity 25%, wind SE at 5 mph, sky partly cloudy and soil temperature - 0 inch 100F, 2 inches 80F and 4 inches 78F). The soil in the experimental area was a loam (54% sand, 24% silt and 22% clay) with 1.7% organic matter and pH 7.3. Visual weed control and crop damage evaluations were made April 24, plant height measured June 19 and plots harvested July 20, 1989. Downy brome (BROTE) infestations were heavy and uniform throughout the experimental area.

Wheat injury and stand loss increased as clomazone rate increased from 0.125 to 0.5 lb/A, regardless of application method. Wheat stands were reduced 10 to 62% and 20 to 67% while surviving plants were stunted 12 to 47% and 20 to 67% by preplant and preemergence applications of clomazone, respectively. In addition, preplant or preemergence applications of triallate at 1.5 lb/A and preemergence SMY-1500 applications at 1.25 lb/A caused slight winter wheat stand loss (5 to 7%). Downy brome control exceeded 85% with preplant or preemergence applications of clomazone at 0.25 and 0.5 lb/A, preplant applications of triallate at 1.0 and 1.5 lb/A or preemergence applications of SMY-1500 at 0.75 to 1.25 lb/A. Wheat yields related closely to downy brome control and/or crop injury. (Wyoming Agric. Exp. Sta., Laramie, WY 82071 SR 1614)

Downy brome control in no-till winter wheat.

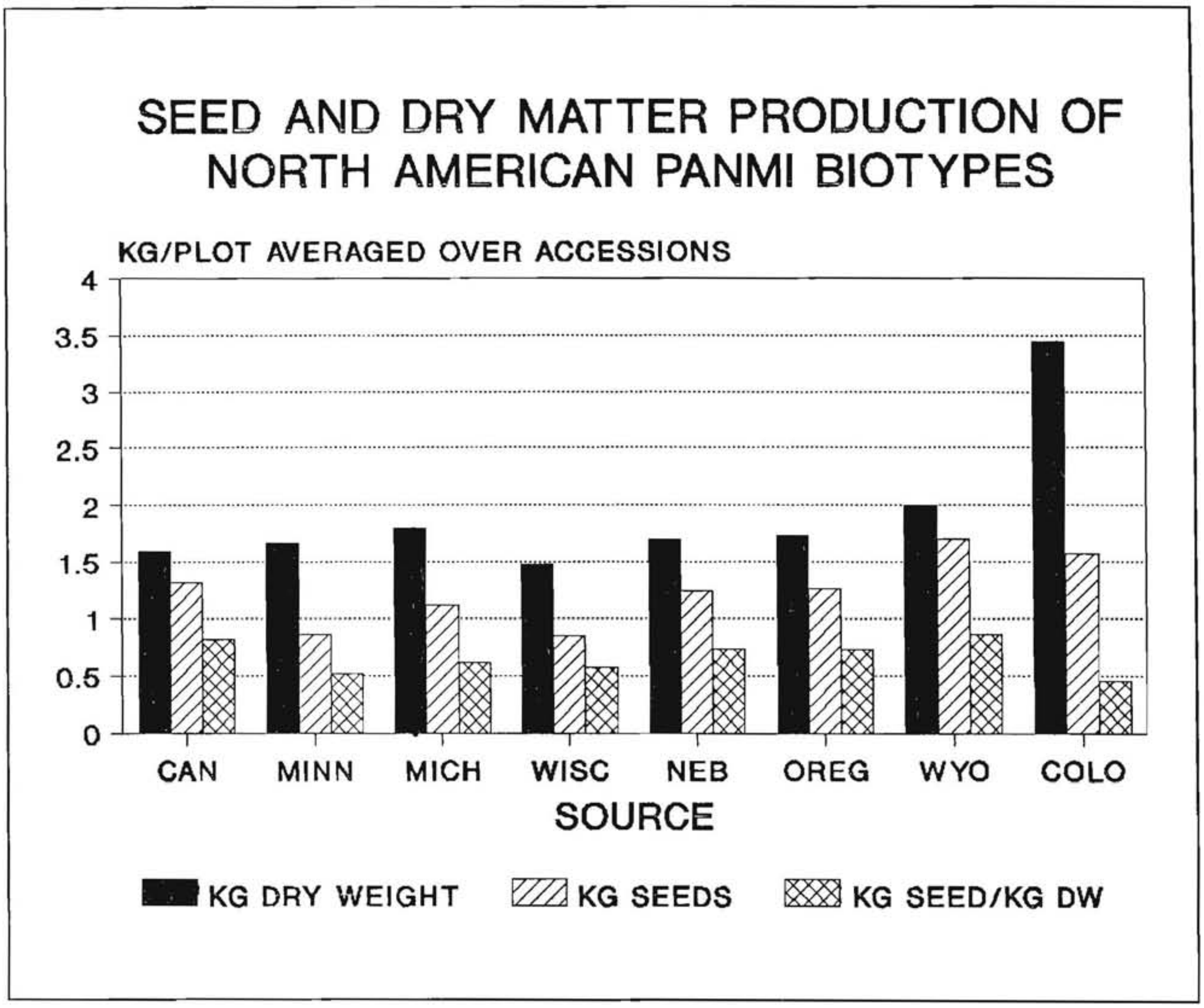
Treatment[1]	Rate lb ai/A	Winter wheat[2] Inj %	SR %	Height inches	Yield bu/A	Control[3] BROTE %
Preplant						
Clomazone	0.125	12	10	27	29	82
Clomazone	0.25	17	27	27	23	93
Clomazone	0.5	47	62	24	12	99
A-1237	0.031	0	0	26	27	65
C-4243	0.063	0	0	27	28	67
Triallate	1.0	0	0	27	33	90
Triallate	1.5	0	5	27	29	92
Preemergence						
Clomazone	0.125	20	20	28	25	80
Clomazone	0.25	45	28	27	19	87
Clomazone	0.5	67	66	24	8	92
A-1237	0.031	0	0	26	25	62
C-4243	0.063	0	0	26	25	60
Triallate	1.0	0	0	27	33	73
Triallate	1.5	0	5	27	31	78
SMY-1500	0.75	0	0	26	31	87
SMY-1500	1.0	0	0	28	32	90
SMY-1500	1.25	0	7	28	30	93
Weedy check	-----	0	0	25	22	0

[1]Treatments applied September 1, 1988.
[2]Wheat injury (Inj) and stand reduction (SR) visually evaluated April 24, plant height measured June 19 and plots harvested July 20, 1989.
[3]Downy brome control visually evaluated April 24, 1989.

<u>Weed control in crops in the Soviet Union</u>. Rydrych, D.J. The weed science delegation which visited the Soviet Union (USSR) in the summer of 1989 was sponsored by "SNIO". This is the USSR Scientific and Engineering Society in Moscow. There are over 1500 troublesome weed species in the USSR. Of this group there are about 150 that are most common in field crops and 50 which are almost always present in grain and cereal regions. Losses by weeds in the USSR are estimated at 10 to 12% annually. This corresponds to .8 to .9 T/ha yield loss in field crops and winter cereals. Thirty percent of the crop acres are treated with herbicides in the Moscow region and 50% of crops such as cereals, vegetables and fruit are treated for weeds in Kichinev, USSR. The most troublesome broadleaf weed in cereals is ragweed (AMBAR). Grass weeds such as downy brome (BROTE) and jointed goatgrass (AEGCY) are found in the USSR but are not a problem. Problem grass weeds in the USSR include wild oat (AVEFA), and blackgrass (ALOMY). Weed scientists in the USSR report that ragweed can extract 45 kg/ha of phosphorus, 137 kg/ha of nitrogen, and 117 kg/ha of potash in a season. Agricultural research in the USSR has shown that crop production can be improved by using alternate methods such as (1) plant breeding to develop better weed competition in cereals, (2) developing herbicide and disease resistance in cereals, (3) adapting soil bacteria to suppress weed growth in crops, (4) using intensive crop rotations, (5) using biotechnology to improve weed control, and (6) releasing predators for the suppression of weeds and plants. Despite all these methods, the USSR averages about 50% of American crop output per acre. (Oregon State University, CBARC, Pendleton, OR 97801).

Morphological and reproductive characteristics of fifteen wild proso millet (Panicum miliaceum) accessions from the United States and Canada. Westra, P., and M. Callan. Wild proso millet is a rapidly spreading weed that has become a major problem in row crop production. In order to evaluate and compare characteristics of the numerous North American weedy biotypes reported in the literature, fifteen seed accessions were obtained from researchers across the United States and Canada. This research was conducted at the Colorado State University Bay Farm in Fort Collins, Colorado.

Each accession was grown out in a separate 5 by 10 foot block, which was prepared by covering tilled ground with a piece of landscape fabric (also known as Weed-Mat). Six inch holes were cut in the fabric with one foot equidistant spacing between holes. Approximately twenty seeds were planted one-half inch deep in each hole. After emergence seedlings were thinned to five plants per hole. Throughout the summer, observations and measurements were taken on plant height, culm length, number of tillers, flag leaf width and length, heading dates, and general growth characteristics. After maturity, plants were harvested by cutting two inches above ground level, and retained seed was threshed by shaking panicles in a bucket. Whole-block dry weights were taken. Shattered seed was collected by vacuuming the landscape fabric in each block, and this was combined with threshed seed to obtain whole-block seed weights. The Colorado, Wyoming, and Nebraska accessions appeared to be best suited to growth in the Colorado environment compared to some accessions from more northern regions of North America. (Weed Research Laboratory, Colorado State University, Fort Collins, CO 80523)


SEED AND DRY MATTER PRODUCTION OF
NORTH AMERICAN PANMI BIOTYPES
KG/PLOT AVERAGED OVER ACCESSIONS
4
3.5
3
2.5
2
1.5
1
0.5
0
CAN
MINN
MICH
WISC
NEB
OREG
WYO
COLO
SOURCE
KG DRY WEIGHT
KG SEEDS
KG SEED/KG DW

Characteristics of North American wild proso millet accessions at maturity grown in Fort Collins, Colorado

Place of origin and accession	Plant Height (cm)	Culm diameter (mm)	Flag leaf length (cm)	Panicle type	Shattered versus Non-Shattered (S vs. NS)
Minnesota					
Cambridge type	83	7.0	22.0	Open	S
Crown type	73	4.3	19.0	Open	NS
LeSeur type	65	5.0	22.5	Open	S
Canada					
Rosemount	75	4.7	18.0	Open	S
Huron	75	5.0	17.5	Open	S
Michigan Kent County	67	5.7	18.2	Open	S
Wisconsin	73	5.0	18.8	Open	S
Oregon					
Stayton	42	7.0	22.0	Slightly drooping	S
Grnd. Island	80	5.7	20.5	Open	S
Nebraska					
U.N.L. Center	76	6.3	21.1	Open	S
Western	71	5.7	19.4	Dense, drooping	S
Wyoming	72	6.0	24.4	Dense, drooping	S
Colorado					
Black type	102	8.7	17.2	Dense, drooping	NS
Olive type	79	4.3	20.7	Open	S
Tan type	85	5.3	19.2	Open	S

PROJECT 6

AQUATIC, DITCHBANK AND NON-CROP WEEDS

Shafeek Ali - Project Chairperson

(No papers were submitted for this project in 1990)

PROJECT 7

CHEMICAL AND PHYSIOLOGICAL STUDIES

Jill Schroeder - Project Chairperson

Control of the bunchy top virus of bananas using herbicides applied by nonconventional means. Isherwood, M.O. The banana bunchy top disease (BBTD) is the most serious virus disease affecting bananas (Musa spp.) in tropical and semitropical areas of the world. It is the only known banana disease not present in the Western Hemisphere. The banana aphid, Pentalonia nigronervosa, is the only known vector of the disease worldwide. This aphid has been present in Hawaii since 1924 and occurs on all islands. Although banana is the primary host plant, the banana aphid has also been found on alternate host plants in Hawaii, such as gingers (Zingiberaceae fam.), taro (Colocasia spp.) and heleconia (Heleconia spp.) No banana varieties are known to be resistant to BBTD although some varieties may be tolerant.

BBTD was discovered in Hawaii at Punaluu, Oahu during July, 1989. Subsequent surveys of other areas of Oahu indicate that BBTD may be widespread over most of Oahu, including Windward Oahu, Honolulu, and Aiea-Pearl City.

The Hawaii Department of Agriculture has embarked on a high priority eradication program and is working closely with the University of Hawaii's College of Tropical Agriculture and Human Resources, the Oahu Banana Growers Association, and the Hawaii Farm Bureau Federation. The department has imposed an interim quarantine rule on the inter-island movement of banana plants and plant parts (except fruits) to prevent the spread of BBTD to the neighbor islands. The department has declared a crisis exemption under Section 18 of the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) to the U.S. Environmental Protection Agency (EPA) to eradicate the BBTD and subsequently submitted a request for quarantine exemption to continue the use of the pesticides diazinon, picloram and glyphosate.

The department is implementing a program where State work crews systematically survey Oahu's farms, residential areas, and waste areas in close proximity to major banana farms for infected plants. These crews spray, rogue, and otherwise destroy infected plants at residences and waste areas, and assist farmers in identifying and/or sampling of plants suspected to be diseased.

However, it is impractical to maintain a manual eradication program over the island of Oahu for an indefinite period. Based on a published report from Guam, the department investigated the use of toothpicks soaked in picloram for 24 hours, air dried until an equilibrium in toothpick weight was realized, and inserted into stems of infected banana plants. Although complete kill of banana plants and their undeveloped corms was achieved with treatments of three or more picloram-laced toothpicks per plant stem, problems were encountered with picloram leachates exuding from splits occuring in the treated stems. In addition, the picloram dosage rate could not be accurately determined. Approval to use of Hodokaya Keipins, small wooden toothpicks impregnated with 6 mg of picloram manufactured in Japan, was not granted by the department's pesticide regulatory staff because this product is not registered with EPA.

The department is evaluating concentrations of triclopyr amine, glyphosate, dicamba, picloram, and 2,4-D amine applied with microsyringes at 1 cc per banana stem. Application of these herbicides at 50% v/v in water have given almost 80% kill of treated banana plants at 30 DAT; however, 30 DAT before kill of treated banana plants may provide enough time for banana aphids to continue feeding on infected plants and transmit the virus disease to adjacent healthy plants. We intend to investigate higher concentrations of herbicide to determine if faster knockdown and kill of treated plants can be realized. If this objective is realized, a request with supporting data for an amendment to the quarantine exemption under Section 18 of FIFRA to

EPA will be submitted. (Plant Pest Control Branch, Hawaii Department of Agriculture, Honolulu, HI 96822).

Effects of daylength on grass inflorescence initiation and sensitivity to sethoxydim. Draper, E.A. and J.L. Anderson. Previous studies have shown that flowering of barnyardgrass is induced by short daylength conditions. Our working hypothesis for this study was that flowering of selected annual grasses would be induced by short daylength conditions and that following flowering induction, seedlings would become more tolerant to sethoxydim treatment. Barnyardgrass, foxtail millet, green foxtail and field sandbur were grown in 10 cm square pots in a greenhouse under short daylength (8 hr day/16 hr night) and long daylength (16 hr day/8 hr night) conditions. Natural daylight was supplemented by high intensity (high pressure 1000 W sodium) lights. When inflorescences were first observed in each grass species, the respective grasses were treated with one of five rates of sethoxydim (4 replications per treatment) and evaluated for herbicide tolerance (see table).

All grass seedlings flowered uniformly under short daylength conditions. No barnyard and only occasional foxtail millet, green foxtail or field sandbur seedlings under long daylength conditions flowered within the time limits (6 weeks) of this experiment. The growth habit of field sandbur responded to daylength; under short-day conditions sandbur seedlings exhibited a prostrate growth habit while the long-day plants grew typically upright. Response of all four grasses to sethoxydim treatment was similar. No difference to sethoxydim due to daylength effect was observed at any treatment rate. (Plant, Soil, & Biometeorology Department, Utah State University, Logan, UT 84322-4820)

Effect of daylength and sethoxydim on annual grass control (%)

Sethoxydim Rate (kg ai/ha)	Barnyardgrass		Foxtail Millet		Green Foxtail		Field Sandbur	
	LD[1]	SD[1]	LD	SD	LD	SD	LD	SD
0.70	100	100	100	100	100	100	100	100
0.56	100	100	100	100	100	100	100	100
0.42	100	100	100	100	100	100	100	100
0.28	92	83	92	100	92	100	92	92
0.14	0	0	0	0	0	0	0	0

[1]LD = 16 hr daylength/8 hr night; SD = 8 hr daylength/16 hr night

Effect of two adjuvants on performance of five herbicides. Burrill, L., B.Brewster, and W. Donaldson. Activity of five herbicides representing different herbicide families was compared on 10 crop and weed species to evaluate the effectiveness of two adjuvants, X-77 Spreader and Surphtac. The trial was conducted at Corvallis, Oregon. The trial design was a randomized complete block with three replications. The herbicides used were glyphosate + 2,4-D as the Landmaster formulation, glyphosate as Roundup, 2,4-D amine salt, bentazon, and DPX R9674. Three rates of each herbicide were selected in hopes of producing a sub-lethal response on each of the species.

On June 6, 1989 the test species were planted except Powell amaranth which was a volunteer weed. The herbicides were applied on July 13 in a carrier volume of 160 L/ha delivered at 172 kPa through XR8003 flat fan tips. Adjuvants were added at the rate of 0.5% by volume of the spray mix.

Visual evaluations of herbicide symptoms were made on July 19 and again on July 26. Activity of each of the herbicides tested markedly increased on one or more species when either of the adjuvants was added. In most cases, there was little or no difference between response to the two adjuvants. When differences could be seen, treatments with X-77 caused more intense herbicide symptoms. (Department of Crop Science, Oregon State University, Corvallis, OR 97331)

Effect of two adjuvants on performance of herbicides
Hyslop Research
Corvallis, Oregon

	Herb. rate lb ai/a	Wheat		Corn		Red clover		Red sorrel		Sugar-beets		Proso millet		Rape-seed		Maple peas		Powell amaranth	
		7/19	7/26	7/19	7/26	7/19	7/26	7/19	7/26	7/19	7/26	7/19	7/26	7/19	7/26	7/19	7/26	7/19	7/26
Glyphosate + 2,4-D	0.1	8	13	13	30	22	27	5	7	18	37	28	73	18	87	25	23	8	43
Glyphosate + 2,4-D + Surphtac	0.1	25	37	33	83	27	50	7	7	22	30	50	80	45	80	30	47	25	78
Glyphosate + 2,4-D + X-77	0.1	15	33	25	70	28	53	7	7	35	43	35	80	30	80	38	72	30	77
Glyphosate + 2,4-D	0.2	37	47	62	89	43	67	20	23	25	50	60	87	52	93	40	73	68	90
Glyphosate + 2,4-D + Surphtac	0.2	37	48	43	93	43	63	18	33	47	67	70	92	53	93	35	70	83	97
Glyphosate + 2,4-D + X-77	0.2	37	53	60	94	37	60	17	40	63	57	60	83	67	96	37	78	77	97
Glyphosate + 2,4-D	0.4	50	60	58	95	63	84	30	40	63	70	77	99	80	100	38	68	96	100
Glyphosate + 2,4-D + Surphtac	0.4	57	63	67	97	67	80	22	37	65	72	80	100	85	99	40	77	100	100
Glyphosate + 2,4-D + X-77	0.4	57	58	67	98	63	82	32	40	82	87	82	100	96	100	47	68	100	100
Glyphosate	0.5	15	43	30	65	23	30	5	10	7	10	32	72	5	13	10	30	13	60
Glyphosate + Surphtac	0.5	25	80	38	93	33	60	7	13	25	47	43	80	33	77	8	27	25	90
Glyphosate + X-77	0.5	22	75	35	83	40	51	15	20	43	57	42	78	32	75	15	47	28	75
Glyphosate	0.1	43	88	50	96	47	60	30	33	40	40	60	88	53	78	15	47	80	93
Glyphosate + Surphtac	0.1	53	93	57	97	48	70	15	20	63	73	75	96	53	80	18	57	92	98
Glyphosate + X-77	0.1	53	93	57	98	60	77	30	40	82	87	67	92	83	95	22	47	87	98
Glyphosate	0.2	67	96	77	99	70	80	35	50	77	75	82	100	73	97	35	82	95	100
Glyphosate + Surphtac	0.2	70	100	77	100	70	88	35	40	83	94	83	100	90	100	47	82	100	100
Glyphosate + X-77	0.2	63	99	75	100	67	77	35	50	90	97	83	99	88	100	43	80	98	100
2,4-D	0.1	0	0	0	0	15	7	5	0	15	0	0	0	7	27	8	0	7	7
2,4-D + Surphtac	0.1	3	0	3	0	17	23	3	0	25	30	0	0	18	53	33	60	13	43
2,4-D + X-77	0.1	2	0	3	0	12	20	3	0	18	20	0	0	17	60	25	73	15	37
2,4-D	0.2	3	0	3	0	13	15	8	0	25	23	0	0	10	23	15	13	8	57
2,4-D + Surphtac	0.2	3	0	3	0	22	33	10	0	35	43	2	0	27	53	42	68	23	70
2,4-D + X-77	0.2	3	0	5	10	23	40	8	0	33	37	0	0	22	62	43	82	27	73

	Herb. rate lb ai/a	Wheat 7/19	Wheat 7/26	Corn 7/19	Corn 7/26	Red clover 7/19	Red clover 7/26	Red sorrel 7/19	Red sorrel 7/26	Sugar-beets 7/19	Sugar-beets 7/26	Proso millet 7/19	Proso millet 7/26	Rape-seed 7/19	Rape-seed 7/26	Maple peas 7/19	Maple peas 7/26	Powell amaranth 7/19	Powell amaranth 7/26
2,4-D	0.4	3	0	3	0	18	27	10	7	47	53	0	0	28	65	37	55	30	75
2,4-D + Surphtac	0.4	3	0	7	0	32	57	15	7	40	57	0	0	32	73	40	73	38	77
2,4-D + X-77	0.4	8	0	8	0	42	60	15	0	47	60	0	0	43	85	47	75	43	78
Bentazon	0.25	0	0	0	0	3	0	3	0	5	10	0	0	8	7	3	0	12	7
Bentazon + Surphtac	0.25	0	0	0	0	10	0	3	0	10	17	0	0	68	63	8	7	15	13
Bentazon + X-77	0.25	0	0	0	0	12	7	3	0	8	13	0	0	58	59	8	23	18	7
Bentazon	0.5	0	0	2	0	8	0	5	0	12	20	0	0	20	33	7	25	17	17
Bentazon + Surphtac	0.5	0	0	2	0	10	0	7	0	10	17	0	0	68	63	8	7	15	13
Bentazon + X-77	0.5	0	0	0	0	13	0	7	0	13	23	0	0	83	97	7	0	18	0
Bentazon	1.0	0	0	0	0	8	0	10	0	20	33	0	0	63	73	10	17	22	17
Bentazon + Surphtac	1.0	0	0	0	0	22	0	12	0	17	27	0	0	85	67	13	0	32	20
Bentazon + X-77	1.0	0	0	0	0	43	13	17	0	35	53	0	0	90	100	15	17	32	20
DPX R9674	0.005	0	0	0	10	15	37	23	50	30	70	0	0	17	30	23	57	13	82
DPX R9674 + Surphtac	0.005	0	0	0	10	43	77	27	53	43	80	2	0	33	73	23	57	25	93
DPX R9674 + X-77	0.005	0	0	5	27	47	73	37	53	40	80	0	0	47	83	33	67	37	90
DPX R9674	0.01	0	0	8	17	33	50	25	53	30	80	8	0	33	59	25	53	28	94
DPX R9674 + Surphtac	0.01	0	0	5	17	47	75	37	67	47	80	5	0	50	88	33	77	32	97
DPX R9674 + X-77	0.01	2	0	10	33	50	80	37	63	47	80	5	0	43	83	27	72	28	94
DPX R9674	0.02	2	0	15	23	27	57	33	63	33	80	10	0	40	75	27	70	32	94
DPX R9674 + Surphtac	0.02	0	0	8	50	53	73	33	60	40	80	7	0	47	83	20	62	30	94
DPX R9674 + X-77	0.02	3	0	12	65	50	80	33	63	53	80	8	0	67	94	47	75	35	96

Numbers represent the average percent control of these replications.

Inhibition of acetyl-CoA carboxylase from tall fescue chloroplast extracts by haloxyfop applied alone and in combination with bentazon. Aguero, R., D.J. Armstrong, and A.P. Appleby. Haloxyfop and all related compounds tested to date appear to share a common mechanism of action, i.e, inhibiting acetyl-CoA carboxylase in grasses but not in broadleaf species.

Bentazon antagonizes the activity of this group of herbicides. Several explanations have been proposed to account for such phenomena, but the mechanism(s) remain largely unexplained. The present studies were conducted to test if such antagonism occurred at the site of action. Acetyl-CoA carboxylase was extracted from 18- to 20-day-old tall fescue shoots by macerating 15 g of fresh tissue in a pre-chilled mortar to which 50 ml of the following buffer was added: 100 mM tricine-KOH, pH 8.3; 10% v/v glycerol; 10 mM β-mercaptoethanol; 1 mM Na_2 EDTA; and 1 mM phenylmethyl sulfonyl fluoride. All extract manipulations were conducted at 4 C. The crude extract was purified through a series of centrifugation steps followed by protein precipitation with the addition of solid polyethylene glycol (M.W. = 8000) up to 14% v/v.

Acetyl-CoA carboxylase activity was assayed in reaction volumes of 250 μl containing: 50.8 mM tricine-KOH, pH 8.3; 2 mM DTT; 2 mM ATP; 10 mM NaH $^{14}CO_3$ (0.26 μCi/μmol); approximately 0.2 μg protein/μl; 0.32 mM acetyl-CoA; and appropriate concentrations of the acid form of haloxyfop and the sodium salt of bentazon.

No effect of bentazon on the haloxyfop-induced inhibition of acetyl-CoA-carboxylase occurred. A 18-20 μM concentration of haloxyfop inhibited the enzyme activity by 50%, an observation consistent with general susceptibility of whole tall fescue plants to this herbicide. Bentazon concentrations above 1000 μM inhibited ACCase activity, thus a rather synergistic effect between the two herbicides is observed when higher concentrations of bentazon were tested. From these studies and previous work with dicamba, we conclude that neither of these herbicides antagonize the activity of haloxyfop in tall fescue shoots by a mechanism directly involving the site of action. (Department of Crop Science, Oregon State University, Corvallis, OR 97331).

Structural damage induced by haloxyfop-methyl on tall fescue applied alone or in combination with dicamba. Aguero, R., and A.P. Appleby. Previous experiments showed that dicamba significantly reduces translocation of haloxyfop-methyl to the growing point of tall fescue plants. Experiments were conducted to examine possible structural changes in leaf sheaths of tall fescue that could account for the above effect. Plants were grown as described elsewhere in this Research Progress Report.

Plants selected for uniformity at the 3-leaf stage were dipped in either 18 μM haloxyfop-methyl or 18 μM haloxyfop-methyl + 1 mM dicamba. A non-treated check and a 1-mM dicamba treatment also were included. Seventy-two hours after dipping, plants were stripped of leaf blades and roots. Pseudostems (leaf sheaths + meristem) were saved and used to examine structural features. Pseudostems were fixed in glutaraldehyde 2.5% for 2h; then the specimens were buffer-washed overnight. Following the buffer wash, samples were placed in a 1% osmium solution for 1 h. Pseudostems then were dehydrated, starting with a 50% acetone solution for 15 min, then moved to a 70% acetone solution that had been saturated with uranyl acetate for 20 min, and ending with three changes in absolute acetone for 15 min each. Pseudostems were then infiltrated beginning with a 1/1 solution of acetone and Spurr's plastic for 4 to 5 h. Enough Spurr's was then added to the samples to make a 2:1 Spurr's:acetone mixture, and were left overnight. Samples were then flat embedded in 100% Spurr's and placed in a 70-C oven overnight.

Sectioning was done on a Sorvall Porter-Blum, model MT2, ultramicrotome to a thickness of 800-1100 Å. Reynolds' lead citrate was used as a post-stain. Outside cuticle layer, phloem end-walls, mitochondria, and proplastids were examined.

No distinctive structural features were observed in cuticles, phloem end-walls, or mitochondria among the different treatments. Proplastids from segments treated with haloxyfop-methyl alone looked small, dense, and osmophilic and lacked nearly all internal membrane development. Proplastids from dicamba treatment resembled those of non-treated checks, whereas proplastids from haloxyfop-methyl + dicamba treatment were closer in appearance to those of checks but yet showed somewhat less internal membrane development. Our results confirm previous experiments where we found less haloxyfop-methyl reaching this region when mixed with dicamba. Furthermore, these results are consistent with the view that haloxyfop-methyl and other related grass killers act by reducing fatty acid synthesis through inhibition of acetyl-CoA carboxylase activity. Lack of thylakoid membrane development explains why chlorosis symptoms are first observed in developing leaves. Death of mature leaves could be an indirect result of death of the growing point and surrounding tissues, whereby nutrient and water uptake are halted. The above view agrees with our observation of a lack of haloxyfop-methyl-induced symptoms in the whole plant when mixed with dicamba above 1 mM. Mature tissue, which intercepts most of the herbicides during dipping, likewise lacked symptoms. Lack of haloxyfop-methyl activity also was observed in mature-leaf segment experiments conducted at our laboratory. (Department of Crop Science, Oregon State University, Corvallis, OR 97331).

Tolerance of tall fescue shoots to haloxyfop applied alone or in combination with dicamba. Aguero, R. and A.P. Appleby. Bentazon and phenoxy-type herbicides such as 2,4-D and MCPA antagonize haloxyfop activity in some grass species. Present studies were conducted to test if dicamba (a benzoic acid derivative) also antagonizes haloxyfop activity in shoots of tall fescue.

Plants were grown in a growth chamber set at 25/15 C day/night temperature, 15-h photoperiod, and an average of 350 $\mu E \cdot m^{-2} \cdot S^{-1}$.

Uniform plants in the 3-leaf stage were used in all experiments. In a series of experiments, plant foliage was dipped in several concentrations of haloxyfop alone or mixed with several concentrations of dicamba. Additional experiments were conducted to test the effect of separating the exposure to herbicides in time (up to 12 h) and physically (i.e. providing haloxyfop through roots and dicamba through foliage). The effect of applying both herbicides through the roots also was studied. Additionally, the effect of using different forms of the herbicides was evaluated.

The concentration of haloxyfop-methyl alone required to reduce tall fescue shoot fresh weight by 50% varied between 11 to 18 μM in the different experiments, whereas 30 to 40 μM were required when mixed with dicamba at 1 mM. The magnitude of the antagonism decreased with increasing time between dipping in haloxyfop-methyl followed by dipping in dicamba. Dipping plants in dicamba first, followed by dipping in haloxyfop-methyl did not affect magnitude of antagonism. When haloxyfop was provided through the roots and dicamba through the foliage or when both herbicides were provided through the roots, the antagonism did not occur.

Technical grade acid forms of haloxyfop and dicamba, as well as commercial ester of haloxyfop-methyl and commercial dimethylamine salt of dicamba, all gave an antagonistic response when applied together to the foliage (see Table). (Department of Crop Science, Oregon State University, Corvallis, OR 97331).

Shoot fresh weight 10 days after dipping

Treatment	Fresh weight	% of non-treated* check
	(mg)	
1. Non-treated check	680	100
2. 18 μM H-m	420	62 a
3. 18 μM H-m + 2 mM D	637	94 b
4. 2 mM D	673	99 b
5. 70 μM H	470	69 a
6. 70 μM H + 1 mM D-s	593	87 b
7. 70 μM H + 2 mM D	637	94 b
8. 1 mM D-s	663	98 b

*Means with same letter are statistically similar according to $LSD_{(0.05)}$ test

H = haloxyfop acid (technical grade, 99% purity)
H-m = haloxyfop-methyl (Verdict)
D = dicamba acid (technical grade, 88% purity)
D-s = dicamba dimethylamine salt (Banvel)

Uptake and translocation of ^{14}C-haloxyfop-methyl in shoots of tall fescue previously treated with haloxyfop-methyl alone or in combination with dicamba. Aguero, R. and A.P. Appleby. Experiments were conducted to determine if uptake and/or translocation differences would account for previously observed dicamba antagonism on haloxyfop-methyl activity in tall fescue shoots.

Plants were grown in a growth chamber set at 25/15 C day/night temperature with a 15-h photoperiod and an average light intensity of 350 $\mu E \cdot m^{-2} \cdot S^{-1}$. Seeds were pregerminated in wet paper rolls; after about 8 days, rolls were opened and seedling (selected for uniformity) were transferred to individual plastic cones (2.5 cm diameter by 16 cm depth) filled with "greenhouse soil".

In all experiments, plant shoots were dipped in either 18 μm haloxyfop-methyl or 18 μM haloxyfop-methyl + 1 mM dicamba. The concentration of haloxyfop-methyl was found to reduce tall fescue shoot fresh weight by nearly 50% in previous experiments, and concentration of dicamba was found to antagonize such reduction in weight by nearly 50%. Following treatment, plants were allowed to dry for about 10 min and then 3-5 μl/plant (depending on experiment) of ^{14}C-haloxyfop-methyl in 75% v/v HPLC-grade methanol (15000 to 25000 dpm/μl, depending on experiment) were placed on top of the middle region of the 2nd fully expanded leaf as several droplets. Methanol quickly evaporated and did not produce visible damage to the treated zone.

Differences in uptake did not account for the antagonism. Data, however, was highly variable. To confirm the above result, the experiment was repeated, this time including a 1-min chloroform wash of the treated leaf aimed at removing epicuticular wax (in addition to the two methanol washes that are part of methodology in the previous experiments). Results, again, confirmed no differences in uptake. In all experiments performed (10), about half of the ^{14}C-haloxyfop-methyl was detected in the pseudostem region (including growing point) when plants were pretreated with the mixture of haloxyfop-methyl + dicamba as compared to pre-treatment with haloxyfop-methyl alone. Thus, translocation seems to account for the antagonism. Our data suggests that reduction in translocation is due to an internal effect induced by dicamba rather than a physical phenomena during herbicide uptake. However, in additional experiments where ^{14}C-haloxyfop-methyl and dicamba were placed in separate leaves, the effect of dicamba in reducing translocation was not observed. Dicamba might be inducing plugging of phloem elements, competing with haloxyfop during phloem loading, altering metabolism of haloxyfop-methyl inside the plant, or forming a chemical complex with haloxyfop. Some of these possibilities are presently been explored. Whatever the mechanism, it appears that both herbicides must be present together (at least in the same plant region) in order for the antagonism to occur. (Department of Crop Science, Oregon State University, Corvallis, OR 97331).

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This table was compiled from approved nomenclature adopted by the Weed Science Society of America (Weed Science 35(5):1986) and the herbicide handbook of the WSSA (5th edition). "Page" refers to the page where a report about the herbicide begins; actual mention may be on a following page.

ABBREVIATIONS USED IN THIS REPORT

A°	angstrom
A, a, or ac	acre(s)
ACCase	acetyl-CoA-carboxylase
ae	acid equivalent
Agric.	Agricultural
ai or a.i.	active ingredient
ai/a	active ingredient per acre
applic	application
ARS	Agricultural Research Service
ASPOF	Asparagus officinalis
Aug	August
avg	average
bb	brush bullet
BBTD	banana bunchy top virus disease
blueb	bluebunch
blueg	bluegrass
bu/a	bushel per acre
C	degree(s) Celsius
cc	cubic centimeter
can	canopy
CDA	controlled droplet applicator
CIRAR	Canada thistle (Cirsium arvense)
cm	centimeter
Co	county
CO_2 or CO2	carbon dioxide
COC	crop oil concentrate
CONAR	field bindweed (Convolvulus arvensis)
cont	control
Coop.	Cooperative
CRP	Conservation Reserve Program
creep	creeping
crest	crested
C.S.P.	cool season phytotoxicity
CV or cv	coefficient of variation
cwt/A	hundred weight per acre
DAT	days after treatment
°	degree
dia	diameter
dg	dispersable granule
dm	dry matter
dmg	damage
dpm	disintegrations per minute
DTT	dithiothreitol

E	east
EPA	Environmental Protection Agency
Ephr	Ephraim
eval	evaluation
Exer	Exerata
Exp	Experiment
Ext	Extension
F	degrees Fahrenheit
fam	family
FC	fruiting cane lower lateral control
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
fesc	fescue
ft	foot or feet
ft^2 or sq ft	square feet
FY	fiscal year
g	gram
g/ha	grams per hectare
g/m^2	grams per square meter
gal	gallon(s)
gal/A, gal/a, G/A, GPA or gap	gallon(s) per acre
gpa	gallons per acre
>	greater than
h	hour
ha	hectare
hr(s)	hour(s)
Hycr	Hycrest
in or "	inch(es)
inter	intermediate
interm	intermediate
IPT	individual plant treatment
Jan	January
Jul	July
K.D.	kikuyugrass density
Kenbl	Kenblue
Kent	Kentucky
kg	kilogram
kg ai/ha	kilograms active ingredient per hectare
kg/ha	kilogram(s) per hectare
kPa	kilopascal
K.S.	kikuyugrass control

L	liter
l/ha	liter(s) per hectare
lab	laboratory
lb	pound(s)
lb/a	pound(s) per acre
lb ai/A, lb a.i./A, or lb ai/a	pound(s) active ingredient per acre
LP	low pressure
LSD	least significant difference
LVE	low volatile ester
m	meter
m^2	square meter
μM	micromolar
Manch	Manchar
Mar	March
MAT	months after treatment
mCi	microcurie
mE	microeinsteins
mead	meadow
Meck	Mecklenburg
mg	miligram
mg/L	miligrams per liter
Mg	megagrams per hectare
min	minute
ml	mililiter, microliter
mm	milimeter
mM	milimolar
mmol	micromol
mos	months
mph	miles per hour
M.W	molecular weight
N	nitrogen, north
NE	northeast
NS	nonsignificant
No. or no.	number
Nord	Nordan
Nov	November
NW	northwest
oatg	oatgrass
Oct	October
OM	organic matter
OR	Oregon
orch	orchardgrass
oz/A	ounce(s) per acre

p or %	percent
P	probability
Paiu	Paiute
peren'l	perennial
pH	-log hydrogen ion concentration
pl or plt	plant(s)
pls	pure live seed
pm	package mix
PPI or ppi	preplant incorporated
ppmw	parts per million by weight
PS	primocane suppression
P.S.&E.S.	Plant, Soil, & Entomological Sciences
psi	pounds per square inch
pub	pubescent
pubesc	pubescent
pvc	polyvinylchloride
qt	quart(s)
qt/A	quart(s) per acre
s	second/seconds
S	south, susceptible
SE	Southeast
Sep	September
Sept.	September
Serv.	Service
SETVI	green foxtail
Sib	Siberian
spp	species
sq	square
sqft	square foot
St	state
Sta.	Station
Streak	Streaker
Stream	Streambank
Streamb	Streambank
Strm	Streambank
SW	southwest
T/A	ton(s) per acre
T.S.	turf score
Tual	Tualatin
univ	university
Uran 32	Ammonium nitrate + urea + water
U.S.	United States
USDA	United States Department of Agriculture

v/v	volume per volume
var.	variety
W	west
w/v	weight to volume
wheatg	wheatgrass
whtgr	wheatgrass
10P	10% active ingredient pellet
20P	20% active ingredient pellet